

Relation Between Loneliness and Depression: A Structural Equation Analysis

David G. Weeks

Washington University School of Medicine

John L. Michela and Letitia Anne Peplau

University of California, Los Angeles

Martin E. Bragg

University of Illinois, Champaign-Urbana

Research on loneliness has been hampered by its strong association with depression. The two states frequently co-occur, and measures of the two states are substantially correlated. Inability to manipulate experimentally loneliness or depression makes it difficult to untangle the causal influence of one on the other. The combination of longitudinal design and structural equation methodology is proposed as a solution to this general problem. Measures of loneliness and depression were administered to undergraduates at two points 5 weeks apart. Data from 333 subjects were correlated and analyzed under a succession of structural equation models. Results indicated that loneliness and depression were correlated but clearly different constructs; neither was a direct cause of the other, though both probably share some common origins; both were highly stable over the 5-week period.

Correlation between variables that purport to measure distinct constructs is a common occurrence in personality research and all of psychology. Such correlation must in general be considered part and parcel of the phenomena under consideration, rather than a by-product of some defect in design or instrumentation. The constructs that populate a given domain often overlap (leading to correlated measures of these constructs) due to the variety of causal relations among them.

Loneliness is an important area for research that has been seriously hindered by such problems. Although loneliness is a com-

mon and distressing problem for many Americans, relatively little empirical research on loneliness has been conducted (Peplau & Perlman, 1979; Weiss, 1973). A barrier to research has been the problem of distinguishing loneliness from depression. There is empirical evidence that loneliness and depression often co-occur. Correlations between measures of these two constructs range from .4 to .6 (Russell, Peplau, & Cutrona, 1980; Russell, Peplau, & Ferguson, 1978) in college samples. In fact, the study of loneliness has often been subsumed under the more established field of research on depression. Yet theorists (Leiderman, 1969; Ortega, 1969; Peplau & Perlman, 1979; Weiss, 1973) argue that there are important distinctions between loneliness and depression. For example, according to Weiss (1973), "In loneliness there is a drive to rid oneself of one's distress by integrating a new relationship; in depression there is instead a surrender to it" (p. 15). If research on loneliness is to develop in its own right, it will be necessary to go beyond the-

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Requests for reprints should be sent to David G. Weeks, Child Development Research Center, Washington University School of Medicine, 369 North Taylor, St. Louis, Missouri 63108.

orizing to demonstrate empirically that loneliness and depression are distinct.

Distinguishing loneliness and depression requires a demonstration that the two constructs are measurably different. If this first requirement can be met, it is then possible to begin to specify the causal relations between loneliness and depression. At least three causal relationships seem plausible. First, prolonged loneliness may be a common cause of depression. Second, depression may cause people to reduce their social activities and become lonely. Finally, other factors such as the breakup of a close relationship may simultaneously produce both loneliness and depression.

Identification of the causal relations between loneliness and depression is complicated by the fact that neither variable is readily subject to experimental manipulation. Thus, attempts to analyze the causal links between loneliness and depression must be based on correlational data. Although it is true that correlation does not imply causation, it is also true that causation does imply correlation. Use of a longitudinal design is particularly desirable in the present context. One advantage is that the temporal direction of all causal links is given, that is, from earlier to later in time. However, the identification of causal paths and the determination of their magnitude remains to be determined. Current structural equation methodology (cf. Jöreskog & Sörbom, 1977; Weeks, 1980) provides a means of testing causal hypotheses on non-experimental data. (Structural equations are described in more detail below.) A second advantage of a longitudinal design is the opportunity to assess the stability of loneliness and depression. Both loneliness and depression occur as transient mood states, but it is the more stable form of each condition, enduring over some time, that is usually considered a psychological problem. Assessing the stability of these experiences is also important because it is unlikely that a particularly unstable state can be identified as a cause of anything.

Method

Subjects

Subjects were introductory psychology students at the University of California, Los Angeles (UCLA), who received course credit for attending two testing sessions. All subjects were new students, attending UCLA for their first quarter. Of an initial group of 354 who attended a first testing session, 333 returned to participate in a second testing session and comprised the sample for this research.

Procedure

Measures were administered to groups of 10–32 students. There were two measurement periods, during the 2nd and 7th weeks of the fall quarter, 1977. Each testing session lasted about 45 minutes. At each session, students completed the 20-item UCLA Loneliness Scale (ULS; Russell et al., 1978), the 20-item Beck Depression Inventory (BDI; Beck, 1967), the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971), and several other paper-and-pencil instruments not considered in the present article. (More details of data collection are given in Bragg, 1979.) To illustrate the ULS, two of the items were "I have nobody to talk to" and "I feel left out;" each item was followed by a 4-point scale indicating how frequently the respondent feels this way. Each of the BDI items required a forced choice among four or five alternate statements, for example, "(a) I don't get any more tired than usual, (b) I get tired more easily than usual, (c) I get tired from doing anything, (d) I get too tired to do anything." The POMS Depression subscale consists of 15 mood adjectives (e.g., sad, gloomy) for which responses were given on a 5-point scale to indicate the degree to which these feelings were experienced during the past week. All three scales are highly reliable (ULS .96, BDI .86, and POMS .95).

For the present analyses several variables were created from each scale. Four measures of loneliness were formed as sums of five items each on the ULS. Three measures of depression were used: the Depression subscale score on the POMS, and two sums of 10 items each on the BDI. Scores on the 14 variables (7 at each session) were correlated, and these correlations were used as input for subsequent analyses.

Structural Equations

A structural equation model is a set of equations that embodies the causal assumptions about a given set of data. A given set of causal assumptions implies a specific set of equations. The numerical solution to these equations provides estimates of the magnitudes of the various causal linkages by optimizing the goodness of fit of the model to the data. That is, a given causal model implies (or predicts)

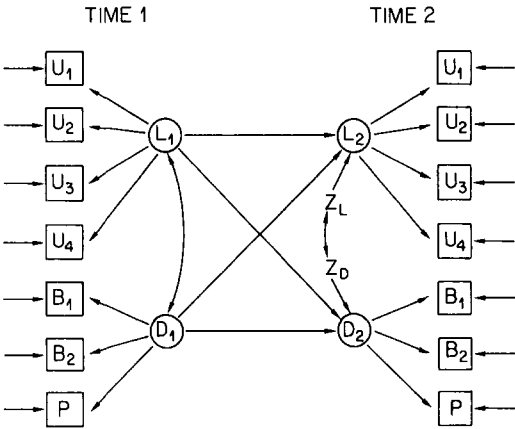


Figure 1. Diagram of the structural model.

a particular correlation matrix among the observed variables. A primary objective is to develop a plausible model for the data. One important aspect of plausibility is statistical acceptability: A particular model may be considered a null hypothesis, and if that hypothesis cannot be rejected it may be accepted as an appropriate representation of the data. An approximate χ^2 test is available to test whether the difference between the predicted and observed correlation matrices is statistically significant (if the χ^2 is significant, the model may be rejected). For two competing models, where one is a subset of the other, the differences between the two may be tested with a χ^2 difference test.

A distinction must be made at this point between observed and latent variables. Observed variables are scores of subjects on particular measures. Latent variables correspond to theoretical constructs and are not directly measured. Latent variables may be seen as causes of observed variables; observed variables are indicators of latent variables. In this study, loneliness at Time 1 is a latent variable; the four measures U_1 – U_4 taken at Time 1 are observed and are indicators of loneliness at Time 1 (see Figure 1). Although it is possible, and has been common, to specify causal models in terms of observed variables, it is generally preferable to specify causal models in terms of latent variables. Since a theory is phrased in terms of constructs, not measures, a latent variable model bears a closer resemblance to the theoretical model than does a model phrased in terms of observed variables. Furthermore, observed variables contain measurement error, and latent variables do not. Thus, estimates of the magnitude of causal paths will be more reliable in a latent variable model. In the models to be considered here, each observed variable is composed of two components, one due to the influence of the corresponding latent variable, the other due to a combination of measurement error and any other factors irrelevant to the latent variable. In this type of model, each latent variable must have at least three observed variables

as indicators. This requirement determined the derivation of the observed variables from the scales.

Results

The data were analyzed under a succession of four structural equation models. Each succeeding model was developed on the basis of the results of the previous analysis. The object of this sequence was to arrive at an acceptable model and to test specific hypotheses about the causal relations among loneliness and depression.

Model 1

Description of the model. Since it is plausible that both loneliness and depression are causes of each other, the first model was developed to test that hypothesis. Specifically, causal links were specified from loneliness at Time 1 (L_1) to loneliness and depression at Time 2 (L_2 , D_2), and from depression at Time 1 (D_1) to L_2 and D_2 . Model 1 is diagrammed in Figure 1. In Figure 1, the observed variables (U_1 – U_4 , B_1 , B_2 , P) are enclosed in squares, and the latent variables are enclosed in circles. There are two arrows pointing to each observed variable, paths from the latent variables and unconnected paths on the outside. This represents the specification that each observed variable is a linear combination of a latent variable and a component specific to that variable. The curved arrow between L_1 and D_1 indicates that these two latent variables are correlated, but no causal relation is specified. The terms Z_L and Z_D represent all causes of L_2 and D_2 other than L_1 and D_1 ; they are commonly referred to as disturbances. The disturbance terms reflect our inability to perfectly predict loneliness and depression at Time 2. In the time between the two measurement periods, the loneliness and/or depression of some of the subjects would have changed. Some of that change would be due to factors outside the scope of the present study. The curved arrow between Z_L and Z_D represents the possibility that these disturbance factors are correlated.

Findings. Values of the path coefficients for Model 1 are given in Table 1. These val-

ues may be interpreted as standardized regression coefficients. It can be seen that the two same-factor paths (L_1-L_2 , D_1-D_2) are large, and the two cross-factor paths (L_1-D_2 , D_1-L_2) are small. An approximate statistical test is available for the hypothesis that a particular parameter (in this case, a path coefficient) is zero. The parameter estimate divided by its standard error gives the critical ratio (CR), which is distributed approximately as z , so a CR greater than ± 1.96 suggests a significant path. The CR s for each of the path coefficients are also given in Table 1. The CR tests demonstrate that the two cross-factor paths are nonsignificant, whereas the two same-factor paths are significant. The overall fit of the model to the data is indicated by the χ^2 test, $\chi^2(64) = 129.1587$, $p < .00005$. Since this χ^2 is statistically significant, Model 1 must be rejected on a purely statistical criterion. But since this χ^2 test is particularly restrictive, other measures of the quality of fit are often used. For example, the ratio of χ^2 to df is approximately 2:1, which suggests that Model 1 accounts for the data reasonably well.

Model 2

Model 2 was developed from Model 1 by eliminating the two cross-factor paths. Values of the path coefficients, critical ratios, and overall χ^2 are given in Table 1. The values of the same-factor paths are close to their values in Model 1, and their CR s are again high. The χ^2 is still statistically significant ($p < .0005$), indicating that Model 2 can also be rejected. Model 2 provides a more exact test of the hypothesis that neither loneliness nor depression is the cause of the other. Model 2 is a subset of Model 1: They are identical except for two additional restrictions in Model 2 (that the paths L_1-D_2 and D_1-L_2 are zero). The difference in χ^2 values for Models 1 and 2 is itself a χ^2 , with degrees of freedom equal to the differences in degrees of freedom for the model. This χ^2 was nonsignificant, $\chi^2(2) = 1.3951$, $p > .40$. Specifically, the hypothesis that the cross-factor paths are zero cannot be rejected.

Table 1

Path Coefficients, Critical Ratios (CR), and χ^2 for the Three Models

Path	Coefficient	CR
Model 1 ^a		
L_1-L_2	.744	11.067
D_1-D_2	.749	9.645
L_1-D_2	-.076	-1.106
D_1-L_2	.046	.755
Model 2 ^b		
L_1-L_2	.782	15.641
D_1-D_2	.688	12.764
Model 3 ^c		
L_1-L_2	.784	16.104
D_1-D_2	.687	12.827

^a $\chi^2(64) = 129.1587$, $p < .00005$.

^b $\chi^2(66) = 130.5538$, $p < .0005$.

^c $\chi^2(54) = 64.5265$, $p = .1546$.

Model 3

Model 3 was generated by allowing 12 correlations between specific components (the components of measurement error and other factors irrelevant to the latent variables). Such correlations usually have no substantive interpretation and are used to compensate for the fact that the specification of the model is restrictive and that the χ^2 test is sensitive to departures from multivariate normality. When these correlations are allowed, the data are represented more accurately by the model while the conceptually meaningful links are left intact. The path coefficients, CR s, and χ^2 for Model 3 are presented in Table 1. The values of the path coefficients are nearly identical to those in Model 2, which is further indication that the added correlations do not affect the substantive interpretation of the model. The χ^2 is nonsignificant by conventional standards ($p = .1546$), indicating that Model 3 cannot be rejected; that is, it is a statistically acceptable model. Furthermore, a χ^2 difference test between Models 2 and 3 shows that the 12 added correlations make a significant contribution, $\chi^2(12) = 66.0723$, $p < .001$. It should be stressed that Models 2 and 3 are substantively equivalent. Model 3 is statistically acceptable, but Model 2 is

cleaner, containing no irrelevant parameters. There may be differences in opinion over which of the two models is best, but the theoretical implications are the same in either case.

The correlations between latent variables within each time period were substantial (.701 for L_1 - D_1 and .613 for L_2 - D_2), but with correlations in this range, loneliness and depression must be considered separate and distinct factors. The correlation between the disturbance terms Z_L and Z_D was .522. Since the disturbance terms represent all factors affecting loneliness and depression at Time 2 exclusive of the Time 1 factors, the magnitude of this correlation suggests that some of these intervening factors influence both loneliness and depression.

Model 4

That the correlation between loneliness and depression is much lower than unity may not be sufficiently convincing evidence to support the claim that these two latent variables are, in fact, distinct factors. The hypothesis that the seven observed variables at each time were all measures of a single factor was tested formally with a fourth structural equation model. The details of Model 4 were the same as for Model 3 except that loneliness and depression were combined in a single factor at each time period. This model, representing the one-factor hypothesis, could be clearly rejected, $\chi^2(57) = 592.4845$, $p < .00005$. Model 4 is the equivalent of Model 3 under the restriction that the correlations between loneliness and depression are equal to unity, so the χ^2 difference test is appropriate. Results of this test, $\chi^2(3) = 527.9580$, $p < .0005$, again indicated that the data are best described by two underlying factors.

Discussion

Our first objective in this study was to determine whether or not loneliness and depression could be empirically distinguished. Had our measures of loneliness and depression in fact measured a single latent variable, the correlation between loneliness and depression would have approached unity. This was

hardly the case: The highest correlation, which was in the first time period, was only .701. Although this may appear large, it is important to realize that this correlation is not biased downward by measurement error. It is a correlation between latent variables, and latent variables are free of measurement error. It should also be noted that over half of the variance in loneliness was not accounted for by depression, and vice versa. Also, had there been but one latent variable, the χ^2 difference between Models 3 and 4 would have been nonsignificant, or at least not nearly so massive.

The second objective was to determine the causal relations between loneliness and depression. Results from Models 1 and 2 clearly indicated that no cross-factor paths were present. Loneliness did not cause depression, nor did depression cause loneliness. The absence of cross-factor paths also served to underscore the distinctiveness of loneliness and depression. If two latent variables are really equivalent, the same-factor paths can be replaced by the cross-factor paths, but our results ruled out this possibility. It may be that such causal relations exist but that the lag time for the effect is longer than 5 weeks. There may also be a causal link between loneliness and depression of a more transient nature. For example, feeling lonely one day may increase feelings of depression for that day but have no influence on depression the day after. These types of causal relation could not be tested in the present design.

The relatively large magnitude of the same-factor paths is evidence that both loneliness and depression were stable over time. It was critical for the purpose of this study that the measures we selected tap relatively stable psychological states rather than transient moods. If, for example, loneliness had proved unstable, the absence of a path from depression to loneliness would have been much less convincing evidence for the hypothesis that depression does not cause loneliness. In that case it could be argued that depression at Time 1 may have caused loneliness the next day, but that the distribution of loneliness in the sample had changed widely during the 5-week interval between testing. Thus, the

observed stability of loneliness and depression strengthens the claim that neither was a cause of the other.

A further point should be noted about the depression construct. It is virtually certain that we did not tap severe depression to any great extent, since we sampled from a non-psychiatric population. Our results might incidentally relate to loneliness and clinical depression. However, our findings are most pertinent to questions about how the social psychological construct of loneliness (Peplau & Perlman, 1979) is distinguished from a depressed mood state.

The analyses also provided information about unidentified determinants of loneliness and depression. The correlation between loneliness and depression at both measurement periods indicates an appreciable overlap between the two constructs. Although these correlations were not high enough to suggest one construct instead of two, they were not nearly low enough to suggest that loneliness and depression are independent of one another. Since loneliness and depression are correlated, and since neither was the cause of the other, the most likely hypothesis is that loneliness and depression shared some common causes. This hypothesis is supported in particular by the correlation between the disturbance terms (.522) in Model 3. Recall that the disturbances represent all causes of loneliness and depression at Time 2 that could not be specified in the model. Since the disturbance terms were correlated, some of these unspecified causes were the same for both loneliness and depression. For example, suppose that amount of social contact is a component of Z_L and that the salience of personal problems is a component of Z_D . Then some stressful life event could affect both of these factors, which would in turn affect both loneliness and depression. Since the disturbances are by definition not identifiable in terms of the variables, for the present study it is impossible to do more than speculate on the common origin of loneliness and depression. Identification of these common origins would certainly be of importance, although it would be a difficult and time-consuming endeavor.

The primary goal of this study has been

to acquire specific information about the relationship between loneliness and depression. Analyses of longitudinal data under four relatively simple structural equation models have provided several particularly significant findings: Loneliness and depression were distinct, though correlated; neither was the cause of the other; both were stable over time; and they apparently shared some common causal origins.

A secondary but more general aim of this study was to demonstrate the use of structural equation models for the analysis of nonexperimental data. A pervasive problem in psychological research, which was encountered in this study of loneliness and depression, concerns the inability or undesirability of using experimental manipulations to determine the causal relations among certain psychological variables. Our approach to this problem has its origins primarily in sociology and econometrics (cf. Bielby & Hauser, 1977; Jöreskog & Sörbom, 1977; Wheaton, Muthen, Alwin, & Summers, 1977), in which naturalistic assessment is often necessary. This study measured persons' states of loneliness and depression on two occasions in a longitudinal design, and then structural equation methods were applied to the intercorrelations of the measures.

Future application of the method could well involve many of the issues of current interest in personality and social psychology. One example is the controversy over causality between attitudes and behaviors, which may most reasonably be studied by naturalistic assessment (cf. Kahle & Berman, 1979). Interrelations among cognitive and affective states, and the effect of these states on behavior, also may profitably be addressed by structural equation methods. We view as an ideal the prospect of basic theoretical questions being studied by a combination of carefully controlled experiments and naturalistic assessment analyzed in part by structural equation methods.

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