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Alternative Models of the Stress Buffering Hypothesis[1]

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The interactive effects of life events and social support on a DSM-III diagnosis of major depressive episode and on number of depressive symptoms were examined. Data are from a stratified random sample of 3,732 community-dwelling adults. The paper focuses on differences between linear probability models and logistic regression models with regard to the definition, detection, and interpretation of interaction effects. Results indicate that conclusions about the interaction of life events and social support are model dependent. Using a linear probability model, significant event by support interactions were observed for both depressive symptoms and major depression. Using logistic regression, which estimates interactions in terms of odds ratios, no significant event by support interactions were observed. Discussion addresses the interpretive implications of modeling interaction in terms of probability differences versus odds ratios.

For the past decade, a major emphasis of research on the relationships among stress, social support, and psychiatric symptoms has been whether life events and social support exert independent effects on psychiatric symptoms or whether the relationship between life events and psychiatric symptoms is con-

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ditional upon level of social support. These alternative hypotheses are generally referred to as the main effect and stress buffering models. The main effect model suggests that high levels of support promote mental health regardless of level of stress; the stress buffering model posits that stress has a more negative effect on mental health under conditions of low support than under conditions of high support. Statistically, support for one model over the other requires testing the interaction between social support and life events; absence of interactions favors the main effect model and presence of interaction supports the stress buffering hypothesis.

Theoretical rationales have been developed for both models. The main effect model assumes that social support has a generalized positive impact on mental health (e.g., House, 1981; Thoits, 1983). Consequently, the effect of social support on mental health is expected to be consistent across levels of stress. Advocates of the stress buffering hypothesis focus on the functions that social support can provide during times of stress (e.g., minimizing stress appraisal, maximizing perceptions of coping capacity) and suggest that the effects of stress are stronger under conditions of low support (e.g., S. Cohen & Wills, 1985; Thoits, 1982; Turner, 1981).

Empirical evidence concerning main effect versus stress buffering models has been mixed. Indeed, Wheaton (1985) observed that the results of previous research have been so inconsistent that different reviewers have used the same studies to reach different conclusions. Recent reviews emphasize the methodological weaknesses of many previous studies, the fact that some dimensions of social support may affect mental health via main effects and others via stress buffering, and the possibility that social support may affect mental health via main effects for some psychiatric disorders and via stress buffering for other disorders (Alloway & Bebbington, 1987; S. Cohen & Wills, 1985; Kessler & McLeod, 1985). Any or all of these factors may account for inconsistencies across previous studies.

The statistical technique used also may affect conclusions about the presence of stress buffering effects. Ordinary least squares (OLS) regression estimates interactions as probability differences whereas logistic regression and log-linear models estimate interactions as odds ratios (Cleary & Kessler, 1982; Kessler, 1983). This issue is especially relevant to research testing the stress buffering hypothesis because some investigators use mental health outcome measures based on symptom scales (continuous metric) and others use instruments designed to measure the presence or absence of psychiatric disorders (dichotomous metric). Given a continuous measure of psychiatric symptoms, investigators appropriately test for stress–support interactions using linear regression techniques. When dichotomous outcome measures are used, logistic regression or log-linear models typically are more appropriate.

In their classic study of the social antecedents of depression, Brown and Harris reported an interaction between early maternal loss (i.e., before age 11) and life events experienced during adulthood. The form of the interaction, presented in a series of 2 × 2 tables, suggested that life events are significantly more likely to lead to depression among persons who experienced early maternal loss (Brown, Bhrolchain, & Harris, 1975; Brown & Harris, 1978a). Tennant and Bebbington (1978) refuted this conclusion by reanalyzing the Brown and Harris data using log-linear models. Neither Brown and Harris (1978b) nor Tennant and Bebbington (1978) recognized that resolution of this issue depended upon how interaction is conceptualized (i.e., as differences in probabilities or odds ratios). Kessler (1983), however, noted that both sets of results were defensible, depending upon how interaction is conceptualized. He also noted the potential importance of this issue to tests of the stress buffering hypothesis. Nonetheless, subsequent investigators have ignored the potential implications of how interaction is conceptualized and estimated in debates about the stress buffering hypothesis.

In this paper, implications of the statistical technique used to test the stress buffering hypothesis are examined. Using data from a stratified random sample of community-dwelling adults, we examined the main and interactive effects of recent life events and subjective perceptions of social support on depressive symptoms (a continuous measure) and on a dichotomous diagnostic measure of major depression using both linear probability (i.e., OLS) and logistic regression. Discussion focuses on the implications of how interactions are conceptualized and estimated for conclusions about stress buffering.

METHOD

Data

This report presents results from the Piedmont Health Survey (PHS), one of five sites of the NIMH Epidemiologic Catchment Area (ECA) Program (Regier et al., 1984). The sampling frame for the PHS was a five-country area of north central North Carolina consisting of one urban county and four continguous rural counties. Sampling procedures were designed to generate a stratified random sample of approximately 3,000 adults age 18 and older and an oversample of approximately 900 older (age 60+) adults representative of the five-county area. First-stage sampling consisted of selection of segments in the five counties; second-stage sampling consisted of selection of households within the segments. Selected households were rostered for all residents age 18 and older. Predetermined selection grids were used to randomly select one respondent from each household, based on number of eligible persons in the household (Kish, 1965). The response rate was 79%, producing 3,798 usable interviews. Further details on the PHS sampling procedures are available in Blazer et al. (1985).

Analyses reported here are based on data weighted to represent the 1980 Census demographic profile of adults in the five counties. The weights adjust for household probability selection, nonresponse, and the elderly oversample. Though variable distributions are affected by weighting, the sample size is unaffected. Unlike patient or other special samples that may lack sufficient numbers of respondents reporting low levels of stress, this representative sample is well suited to testing the stress buffering hypothesis.

Respondents who met the DSM-III criteria for dysthymia but not major depressive episode (the dependent variable) were dropped prior to analysis, leaving a sample of 3,732. Dysthymia is a milder but more chronic form of depressed affect than major depressive episode (American Psychiatric Association, 1980). Because the risk factors for dysthymia may be similar to those for major depression, leaving dysthymics in the nondepressed category might attenuate the effects of those risk factors.[3]

Measures

Mental Health Outcomes

Mental health measures in the PHS were obtained through use of the Diagnostic Interview Schedule (DIS; Robins, Helzer, Croughan, & Ratcliff, 1981), a highly structured interview designed for use by trained lay interviewers and capable of generating computer-based diagnoses for selected DSM-III disorders. The DIS elicits the elements required for diagnosis (symptoms, their severity, frequency, and distribution over time) and standardized probes are used to identify probable causes of the symptoms. Only symptoms that cannot be attributed to physical illness, injury, or drug use are counted toward the diagnosis of major depression. The diagnostic measure used here is based on a recency period of 6 months (that is, major depression is considered present if the respondent experienced symptoms sufficient to meet DSM-III criteria at any time in life and experienced a 2-week spell of depressive symptoms during the 6 months prior to interview).

[3]Two anonymous reviewers felt strongly that dysthymics should not have been excluded from analysis. Reanalysis of the data showed the findings to be nearly identical when dysthymics were included. Given this, and given that the focus of this paper is methodological rather than substantive, the original results (with dysthymics excluded) are presented.

The depressive symptoms measure is a count of the DIS depression symptoms reported for the 6 months prior to interview that are not attributable to physical illness, injury, or drug use (range = 1–4). Only 2% of the sample reported more than four depressive symptoms. To reduce skewness, the highest value of this measure was collapsed to represent four or more symptoms. The symptom count exhibited excellent internal consistency (alpha = .81).

It should be noted that persons with a DIS-III diagnosis of major depression also may have met the criteria for other DSM-III disorders. Due in part to such comorbidity, we cannot determine whether the results are specific to major depression or also are present for other psychiatric disorders and symptoms.

Stressful Life Events

Respondents were asked about the occurrence of potentially stressful life events during the year prior to interview. (See Appendix A.) Twenty event items focused on changes in respondents' health, family and living situations, work, and finances (Hughes, George, & Blazer, 1988). Respondents also were asked whether each event had a positive, negative, or neutral effect on their lives. The negative life event measure used here is a sum of the number of events that respondents reported as having negative effects on their lives. One could argue that life events perceived as negative are likely to have artifactual high associations with depression measures because of potential confounding between subjective evaluations of recent experiences and current mood states. Previous theory, however, suggests that negative experiences are more stressful and, hence, more likely to generate distress. In line with previous research (e.g., S. Cohen & Wills, 1985; Thoits, 1982), we used the negative events inventory.

Social Support

The PHS interview included a 35-item battery of items concerning the respondent's social network and the support provided by that network. Factor analyses of the 35 items led to the creation of five support indices: satisfaction with social support (4 items), perceived social support (7 items), frequency of social interaction (4 items), size of the social network (4 items), and instrumental support (13 items) (George, Blazer, Hughes, & Fowler, 1989). The factor analysis procedure used was principal factoring with iteration and varimax rotation. Five factors with eigenvalues greater than 1 were observed and the five-factor solution explained 82% of the variance among items. Only items with factor loadings of .40 or greater were assigned to the five scales.

Previous research strongly suggests that subjective perceptions of social support are most strongly related to mental health outcomes in terms of both main and interactive effects (e.g., S. Cohen & Wills, 1985; Kessler & McLeod, 1985). Thus, we selected the measures of satisfaction with social support (alpha = .64) and perceived social support (alpha = .80) for the analyses in this paper. (See Appendix B.) Tests for nonlinearity indicated that both support measures were nonlinear in their relationships to depression.

Examination of means on the depression measures within levels of support indicated threshold effects that could be adequately modeled with squared terms. Two dichotomous measures of social support also were coded, using cutpoints that approximated the observed thresholds. A dichotomous measure of satisfaction with support was coded 1 (adequate support) for those in the upper 85% of the distribution, and 0 (inadequate support) for those in the lower 15% of the distribution. The dichotomous measure of perceptions of social support was coded 1 (adequate support) for those in the upper 67% of the distribution, and 0 (inadequate support) otherwise. Parallel analyses were performed using (a) continuous support measures plus support squared terms and (b) the dichotomous support measures. The continuous measures plus squared terms did not substantially improve the predictive power of the dichotomous measures; thus, we chose to use the latter. Although the dichotomous support measures do not model the relationship between support and depression as precisely as the continuous measures plus squared terms, the dichotomous measures greatly simplify the presentation of interactive effects and demonstration of how OLS and logistic regression differ with respect to how interactions are modeled.

As with negative life events, subjective social support measures are subject to problems of confounding with the measures of depression (Slavin & Compas, 1989). These potential confounding problems, as well as the cross-sectional nature of the data, render this study inadequate for resolving the causal relations among life events, social support, and depression. The measures and data are consistent with most prior research, however, and are appropriate for the statistical and methodological issues of primary concern in this paper.

Control Variables

Based on previous research, a number of variables were statistically controlled in examining the main and interactive effects of life events and social support on depression: age, sex, race (black vs. nonblack), self-reports of

childhood poverty, education, urban versus rural residence, and respondent's income during the year prior to interview.

Methods of Analysis

Ordinary least squares regression is used to estimate the effects of predictors on number of depressive symptoms. Logistic and OLS regression are used to predict major depressive episode. Logistic regression usually is statistically superior to OLS in predicting binary responses (Hanushek & Jackson, 1977). When the dependent variable is dichotomous, OLS estimates are inefficient and may lead to predicted probabilities outside the 0–1 range. Heteroscedasticity and nonnormality of errors also tend to render OLS significance tests inaccurate. These problems tend to be especially pronounced when the splits on the dependent variable fall outside the 90–10% range. In these data, only 2% of the respondents experienced major depression with 6-month recency. Because it entails fewer assumptions (e.g., no multivariate normality assumption for covariates), the logistic model also is generally preferred over discriminant analysis when the dependent variable is dichotomous (Press & Wilson, 1978). The rationale for using OLS to predict major depression, despite its well-known statistical limitations, was provided by Kessler (1983, pp. 286-290). He showed that, in certain situations, sigmoid (like logistic) and linear probability (like OLS) models can generate discrepan results regarding interactive effects. In particular, nonadditive changes in the absolute risk of an event may be overlooked if only logistic models are exa mined. As these nonadditive changes may have theoretical and practical im port, Kessler advised examining both logistic and linear probability models The results reported below support Kessler's recommendation.

RESULTS

In the tables below, unless stated otherwise, the main and interactiv effects of life events and social support are reported net of the control varia bles. To simplify presentation, however, coefficients for the control varia bles are not presented. In general, the control variables were significar predictors of the depressive outcomes. As expected, both depressive symp toms and major depressive episode were significantly related to female se black race, lower levels of education, urban residence, and lower incom Childhood poverty was a significant predictor of depressive symptoms bu not of major depression. Age was not a significant predictor of either depre sive outcome.

Table I. OLS Regression Effects of Stressful Life Events and Social Support on DIS Depressive Symptoms (6-Month Recency; Weighted $N = 3{,}732$)[a]

	Model 1		Model 2		Model 3	
Predictors	b	β	b	β	b	β
No. of negative life events	$.27^c$	.23	$.41^c$	.35	$.36^c$	.31
Satisfaction with social support	$-.56^c$	$-.19$	$-.41^c$	$-.14$	$-.55^c$	$-.18$
Perceived social support	$-.21^c$	$-.09$	$-.20^c$	$-.09$	$-.10^b$	$-.05$
Life Events × Satisfaction With Social Support			$-.20^c$	$-.15$		
Life Events × Perceived Social Support					$-.16^c$	$-.11$
R^2		$.17^c$		$.17^c$		$.17^c$

[a]Missing data on the independent and control variables were recoded to the mean. For predictors with ≥5% missing (i.e., childhood poverty, income), missing data dummy variables were included in the regression equations as recommended by J. Cohen and Cohen (1975, pp. 265-290). In order to highlight the main and interactive effects of stress and social support, coefficients for the control variables are not presented. R^2 equals the explained variance for the entire models, including control variables.
[b]$p \leq .05$.
[c]$p \leq .01$.

Table I presents the effects of negative life events and social support on depressive symptoms. The results are consistent with prior research. The main effects model (Model 1) shows life events positively related to depressive symptoms ($b = .27$) while both social support measures are negatively related ($b = -.56$ and $-.21$). The standardized coefficients (betas) indicate that life events and support have larger effects than any of the control variables. Consistent life event by support interaction effects also are present. In Model 2, the effect of events on depressive symptoms is .41 among those low on satisfaction with support, and .21 (.41 – .20) among those high on satisfaction with support. A similar pattern is observed for perceived support in Model 3. The effect of life events among those low on support (.36) is nearly twice its effect (.36 – .16 = .20) among those high on support.

In Table II, logistic regression is used to estimate the effects of predictors on the dichotomous measure of major depressive episode. The logistic model estimates the effects of independent variables on the natural log of the odds of having an episode. The *OR* coefficients in Table II are antilogs of the logistic beta coefficients. They represent the (net) multiplicative change in the odds of having major depression per unit change in a predictor, or (for dummy variables) relative to an omitted category. The *R* statistics in Table II measure the (net) explanatory power of the independent variables and are used to compare the relative effects of differently scaled predictors (Harrel, 1983).

In Model 1 of Table II, life events has a significant positive effect (*OR* = 1.59), while satisfaction with support (0.22) and perceived support (0.44) have significant negative effects on major depression. The *R* statistics indi-

Table II. Logistic Regression Effects of Stressful Life Events and Social Support on DIS Major Depressive Episode (6-Month Recency; Weighted $N = 3{,}732$)[a]

	Model 1		Model 2		Model 3	
Predictors	*OR*	R^b	*OR*	R^b	*OR*	R^b
No. of negative life events	1.59^d	.16	1.58^d	.11	1.61^d	.13
Satisfaction with social support	0.22^d	$-.20$	0.22^d	$-.15$	0.22^d	$-.20$
Perceived social support	0.44^d	$-.10$	0.44^d	$-.10$	0.46^d	$-.06$
Life Events × Satisfaction With Social Support			1.02	0		
Life Events × Perceived Social Support					0.96	0
R		$.41^c$		$.40^d$		$.40^d$
–2 Log likelihood		570		570		570

[a]Missing data on the independent and control variables were recoded to the mean. For predictors with ≥5% missing (i.e., childhood poverty, income), missing data dummy variables were included in the regression equations as recommended by J. Cohen and Cohen (1975, pp. 265-290). In order to highlight the main and interactive effects of stress and social support, coefficients for the control variables are not presented. Summary statistics (i.e., *R* and –2 log likelihood) are based on the complete models, including control variables.
[b]The logistic regression program sets *R* to zero when the significance level for a given odds ratio ≥ .16 (Harrel, 1983).
[c]$p \leq .05$.
[d]$p \leq .01$.

cate that events and support have the largest effects in the model. However, neither life event by support interactions is significant (Models 2 and 3).

Table III presents the effects of life events and social support on major depression using OLS regression. With a dichotomous response variable, the *b* coefficients from OLS estimate the effects of predictors on the probability of having major depression. The results in Table III resemble those in Table I, rather than those in Table II, in that both interactive and main effects of life events and support are present. The effect of events on the probability of having major depression is greater among those low on support than among those high on support. Among those low on satisfaction with support, each additional stressor increases the probability of major depression by .03. Among those satisfied with support, the coefficient for life events is (.03 – .03). A similar pattern is observed for perceived support, with the effects of life events being .02 and 0, respectively.

Because the PHS data are based on a complex stratified sample design, significance tests that assume simple random sampling can be misleading (Kalton, 1983). Therefore, the interactive effects of life events and support were retested using specialized software developed by Holt (1977) for OLS regression analysis. The interactive effects of life events with both satisfaction with support and perceived support in the OLS equations remained statistically significant for both depressive disorder and depressive symptoms.

Table III. OLS Regression Effects of Stressful Life Events and Social Support on DIS Major Depressive Episode (6-Month Recency; Weighted N = 3,732)[a]

Predictors	Model 1 b	Model 1 β	Model 2 b	Model 2 β	Model 3 b	Model 3 β
No. of negative life events	.01[c]	.09	.03[c]	.22	.02[c]	.16
Satisfaction with social support	−.05[c]	−.13	−.03[c]	−.07	−.05[c]	−.12
Perceived social support	−.02[c]	−.05	−.02[c]	−.05	−.01	−.01
Life Events × Satisfaction With Social Support			−.03[c]	−.16		
Life Events × Perceived Social Support					−.02[c]	−.10
R^2		.05[c]		.06[c]		.06[c]

[a]Missing data on the independent and control variables were recoded to the mean. For predictors with ≥ 5% missing (i.e., childhood poverty, income), missing data dummy variables were included in the regression equations as recommended by J. Cohen and Cohen (1975, pp. 265-290). In order to highlight the main and interactive effects of stress and social support, coefficients for the control variables are not presented. R^2 equals the explained variance for the entire models, including control variables.
[b]$p \leq .05$.
[c]$p \leq .01$.

Reconciling the Results of OLS and Logistic Regression

In Table IV, major depressive episode is cross-tabulated by stressful life events and satisfaction with support. This table illustrates a pattern of three-way association that results in a significant life events by support interaction term in OLS but not in logistic regression. (A similar pattern is observed when perceived support is the stratifying variable.) Additional OLS and logistic regression equations were calculated also. In these equations, the dichotomous measure of major depression was regressed on number of negative life events within each level of social support (i.e., adequate and inadequate). Results of those regression equations are summarized in Table V. To simplify the presentation, covariates were not included in the analyses reported in Tables IV and V.

For the inadequate support group, Table IV shows that the probability of having depressive disorder increased from about 5% among those with no life events to about 20% in the two highest event categories—an increase of about 15%. The average increment to the probability of having depressive disorder is 2.41% for each life event (see Footnote *a*, Table IV). In the adequate support group, the probability of having major depression increases from 0.55% in the zero event category to only 3.3 and 1.4% in the two highest event categories. The average probability increment (0.68%) also is smaller among those with adequate support.

Unstandardized OLS (*b*) coefficients estimate the average change in the probability of having major depression per unit change in life events. The

Table IV. Diagnosis of Major Depressive Episode by Number of Stressful Life Events by Satisfaction With Social Support

	No. of Stressful Life Events					
	0	1	2	3	4+	(Total N)
			Low (inadequate) support			
DIS diagnosis						
No (%)	94.57	96.84	90.09	79.25	79.35	(508)
Yes (%)	5.43	3.16	9.91	20.75	20.65	(39)
Total n	(276)	(132)	(79)	(39)	(21)	(548)
% change[a]	—	−2.27	6.75	10.84	−0.10	—
Odds[b]	.06	.03	.11	.26	.26	—
Odds change[c]	—	0.50	3.67	2.36	1.00	—
			High (adequate) support			
DIS diagnosis						
No (%)	99.45	98.96	97.56	96.72	98.56	(3,082)
Yes (%)	0.55	1.04	2.44	3.28	1.43	(28)
(Total n)	(2,037)	(677)	(277)	(87)	(32)	(3,110)
% change[a]	—	0.49	1.40	0.84	−1.85	—
Odds[b]	.01	.01	.03	.03	.01	—
Odds change[c]	—	1.00	3.00	1.00	0.33	—

[a]The change in percentage with a DIS diagnosis of major depressive episode relative to the prior life event category (e.g., −2.27 = 3.16 − 5.43). Weighted average percentage changes also were calculated for each social support level. For the low support respondents, the weighted average percentage change was 2.41; for high support respondents, it was 0.68.
[b]The odds of having a DIS diagnosis of major depressive episode within a given level of life events (e.g., .06 = 5.43/94.57).
[c]The ratio change in the odds of having a DIS diagnosis of major depressive episode relative to the prior life event category (e.g., 0.50 = 0.03/0.06). Weighted average odds changes also were calculated for each social support level. For low support respondents, the weighted average odds change was 1.67; for high support respondents the corresponding figure was 1.94.

OLS *b* for life events in the inadequate support group in Table V is .04, which is four times larger than that for the adequate support group (b = .01). It is this difference in *b*s that results in the significant life events by support interaction when OLS is employed (also observed with covariates in Table III). As Kessler (1983) elaborated, OLS estimates differences in the linear

Table V. Summary of OLS and Logistic Regression Effects of Stressful Life Events on Major Depressive Episode, Within Levels of Social Support (Covariates Excluded)

Estimate of effect	Low support	High support
OLS *b*	.04	.01
Logistic beta	.46	.54
Odds ratio (antilog logistic beta)	1.59	1.69
Logistic effect on the probability of having major depressive episode	.04	.01

probability of the outcome. The OLS test for interaction tests whether those differences vary across levels of a modifying variable (here, support).

Although there are substantial differences in the effect of life events on the linear probability of depressive disorder, the adequate and inadequate support groups are similar with regard to the effect of life events as measured by odds ratios. In the inadequate support group, those in the two highest life event categories are about four times (20/5) as likely to have major depression as those reporting no life events. Among those with adequate support, the two highest life event categories are six and three times as likely to have major depression as those with no negative events. Because the baseline probability of having major depression is only about one tenth as large (0.55/5.4) in the adequate support group, a 2.7% probability increase (3.28 vs. 0.55%) translates into a larger probability ratio (6:1) than a 15% increase (20 vs. 5% = 4:1) in the inadequate support group.

Logistic regression models are based on odds ratios rather than on probability differences (as with OLS). The rows labeled "odds" in Table IV report the odds of having major depression within categories of life events. The rows labeled "odds change" report the ratio change in the odds of having major depression as life events increase. These odds ratios (in log form) are modeled by logistic regression. The logistic "beta" coefficient estimates the change in the log odds of an outcome per unit change in a predictor. In anti-log form, the logistic coefficient estimates the ratio change in the odds of an outcome per unit change in a predictor. The average ratio change in the odds is similar across social support levels: 1.67 versus 1.94 (see Footnote *c* of Table IV). The anti-log logistic coefficients in Table V are 1.59 and 1.69, also reflecting this similarity (a pattern also observed with covariates in Table II). The effects of life events measured by odds ratios do not vary across levels of support.

Despite the statistical limitations of OLS when the dependent variable is dichotomous (Hanushek & Jackson, 1977), the substantive implications of the OLS and logistic models are more consistent than discrepant when probability differences are examined. In Table V, the logistic effect of life events on the probability of having major depression is .04 in the inadequate support group and .01 in the adequate support group.[4] OLS estimates for

[4]Peterson (1985) presented the formula for calculating logistic effects as probability differences. Using this formula, the logistic stress effects on the probability of having major depressive episode for respondents with high and low social support are calculated as P_1-P_0, where

P_0 = the mean probability of disorder for the subgroup
$P_1 = P_0$ + (the predicted increment to the probability of depressive episode at the subgroup mean resulting from a unit increase in stress)
$= EXP\,(L_0 + \beta)/[1 + EXP\,(L_0 + \beta)]$, where

$L_0 = LN\,[P_0/(1-P_0)]$
β = logistic beta for stress in subgroup
P_0 = .071 (low support) and .009 (high support)

Because the Stress × Support interaction term was nonsignificant in the logistic regression equation for the total sample (Table II), a more reliable estimate of subgroup stress effects can be obtained by using the overall logistic beta (β = .492) rather than the subgroup betas in Table V. Making this substitution, the logistic stress effect in the low support group is .04 and is calculated as follows: L_0 = LN (.071/.929) = −2.571; EXP ($L_0 + \beta$) = EXP (−2.571 + .492) = 0.125; P_1 = .125/1.125 = 0.111; P_1-P_0 = .111-.071 = .04. The logistic stress effect in the high-support group, calculated in the same manner, is .01. After rounding, these results (based on the total sample) are identical to those based on the subgroup equations.

the same effects (Table V) also are .04 and .01. This consistency across models illustrates Kessler's (1983, p. 287) point that with logistic regression models, interactive effects are captured by first-order terms. Substantial subgroup variation in probability differences but not in odds ratios is most likely to occur in situations (like this) where the outcome is quite rare and the baseline probability in one subgroup is a small fraction of that in another.

DISCUSSION

The results of this study demonstrate that the way interaction is conceptualized and estimated can strongly affect conclusions about the stress buffering properties of social support. When interaction was conceptualized as probability differences, significant life event by support interactions were observed for both depressive symptoms and a diagnosis of major depression. In line with the stress buffering hypothesis, life events exhibited significantly stronger effects on depressive outcomes among respondents with inadequate support than among those with adequate support. When interaction was conceptualized as differences in odds ratios, however, no significant life event by social support interactions were observed—though both life events and social support exhibited significant main effects in predicting the depressive outcomes. We also demonstrated that, regardless of the metric of the dependent variable (i.e., continuous or dichotomous), consistent conclusions were reached so long as interaction was conceptualized and estimated in the same manner (i.e., as differences in probabilities or odds).

Unfortunately, most investigators appear to ignore the issue of how statistical interaction can best be defined for purposes of testing the stress buffering hypothesis. Instead, choice of a method of estimation is usually based on the metric of the dependent variable, with linear regression techniques used for continuous outcome measures and logistic regression or log-linear models used for dichotomous outcomes. This pattern suggests that some of the inconsistent findings across studies of the stress buffering hypothesis may reflect differences resulting from choice of an estimation technique.

Epidemiologists studying risk factors for physical illnesses also have noted the "method dependence" of interaction tests. For example, odds ratios for the effects of smoking on lung cancer are the same across levels of asbestos exposure, whereas probability differences indicate that the effect of smoking on lung cancer is substantially greater among the exposed (Saracci, 1977). Similarly, odds ratios for cerebrovascular complications from the use of oral contraceptives are about the same for hypertensive and nonhypertensive women, but the increase in absolute risk is greater for hypertensive women (Rothman, Greenland, & Walker, 1980). There is general agreement in this literature that how to define interaction cannot be resolved on statistical grounds. Kleinbaum, Kupper, and Morgenstern (1982), for example, concluded that interaction can be meaningfully defined on either an additive (i.e., probability differences) or on a multiplicative (i.e., odds ratios) basis.

We believe that interactive effects on the probability, as well as on the odds, of an event can be substantively important. For example, stress by support interactions on the probability of depressive disorder mean that the prevalence of depression—and, consequently, its public health costs to individuals and society—depend not only on the independent effects of life events and low support but also on the degree to which they occur jointly. Therefore, we agree with Kessler's (1983) suggestion that both linear and logistic models be estimated when the outcome measure is dichotomous. We further recommend that interactions based on probability differences and odds ratios be carefully distinguished in future work and that investigators report the presence or absence of both kinds of interaction.

APPENDIX A

Life Events Scale—Duke University Epidemiologic Catchment Area Project

During the past year, did . . . (IF YES, ASK PART B)

. . . you experience an illness or injury that required staying overnight or longer in the hospital?

. . . you experience an illness or injury that kept you from your usual activities (work, housework, school) for a week or more?

. . . a member of your family or household experience a serious illness or serious injury?

. . . you get married or begin living with someone as though married?

. . . you separate for a few weeks or longer from (your husband/your wife/someone with whom you were living as though married)?

. . . you get a divorce or have a love relationship or important friendship end?

. . . you get back together with (your husband/your wife/someone with whom you were living as though married) after a period of separation?

. . . (your husband/your wife/someone with whom you were living as though married) die?

. . . you become a parent or step-parent or start acting as a parent for a child?

. . . a child or other household member move out or leave your home?

. . . a loved one [other than (your husband/your wife/someone you lived with as though married)] die?

. . . you or a family member have any legal trouble?

. . . Were you unemployed and unable to find work for at least a month?

. . . you start work or start working somewhere else?

. . . Were you fired from a job?

. . . you retire from work?

. . . your (or your family's) financial situation improve considerably?

. . . your (or your family's) financial situation get considerably worse?

. . . you move?

Response categories: 0. No 1. Yes

Part B: • Did this have a negative, neutral, or positive effect on you?

Response categories: 1. Negative 2. Neutral 3. Positive

APPENDIX B

Social Support Scales

Satisfaction With Social Support

Are you satisfied with how often you see your friends and relatives; that is, do you see them as often as you want to?

Response categories: 1. Very dissatisfied
2. Somewhat dissatisfied
3. Satisfied

In times of trouble, can you count on at least some of your family and friends, most of the time, some of the time, or hardly ever?

Response categories: 1. Hardly ever
2. Some of the time
3. Most of the time

How satisfied are you with the kinds of relationships you have with your family and friends—very dissatisfied, somewhat dissatisfied, or satisfied?

Response categories: 1. Very dissatisfied
2. Somewhat dissatisfied
3. Satisfied

Do you wish that your family and friends would give you more help?

Response categories: 1. Yes
2. No

Perceived Social Support

When you are with your family and friends how often do you feel lonely—most of the time, some of the time, or hardly ever?

Response categories: 1. Most of the time
2. Some of the time
3. Hardly ever

Does it seem that your family and friends understand you most of the time, some of the time, or hardly ever?

Response categories: 1. Hardly ever
2. Some of the time
3. Most of the time

Do you feel useful to your family and friends most of the time, some of the some of the time, or hardly ever?

Response categories: 1. Hardly ever
2. Some of the time
3. Most of the time

Do you know what is going on with your family and friends most of the time, some of the time, or hardly ever?

Response categories: 1. Hardly ever
2. Some of the time
3. Most of the time

When you are talking with your family and friends, do you feel you are being listened to most of the time, some of the time, or hardly ever?

Response categories: 1. Hardly ever
2. Some of the time
3. Most of the time

Do you feel that you have a definite role in your family and among your friends most of the time, some of the time, or hardly ever?

Response categories: 1. Hardly ever
2. Some of the time
3. Most of the time

Can you talk about your deepest problems with at least some of your family and friends most of the time, some of the time, or hardly ever?

Response categories: 1. Hardly ever
2. Some of the time
3. Most of the time

Note: If respondent indicated that best response was different for family than for friends, the answer coded was that that reflected the *most* support.

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Factors Affecting the Birth and Death of Mutual-Help Groups: The Role of National Affiliation, Professional Involvement, and Member Focal Problem[1]

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Examined the predictive relationship of three variables to the birth and death of mutual-help groups for a statewide New Jersey sample of 3,152 groups over a 2-year period. The three variables studied were group affiliation with a national mutual-help organization, local professional involvement in group activities, and group members' type of focal problem. Log-linear logit analysis revealed that the best-fitting model included Affiliation Status × Professional Involvement, and Affiliation Status × Focal Problem interactions. Among unaffiliated groups, professional involvement was related to lower group mortality, while among affiliated groups it was related to higher group mortality. Unaffiliated behavior control groups had higher odds for mortality and for birth than either unaffiliated life stress groups or unaffiliated medical groups. Among main effect findings, unaffiliated groups had consistently higher odds for birth than affiliated groups. The implications for research and action are discussed.

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