

Interactive Effects of Extraversion, Neuroticism, and Social Relationships on Subjective Well-Being

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Previous research has indicated that there is a relation between extraversion and subjective well-being (SWB), and that the sociability component of extraversion primarily accounts for this relation. Interactive effects of extraversion and social relationship variables on SWB were hypothesized and found in Study 1 using the Extraversion scale from the 16 PF, the Well-Being subscale of the Differential Personality Questionnaire, and several social relationship scales administered to 291 college students. Several multiple regression analyses indicated that strength of social relationships was a strong predictor of SWB only for introverted individuals. Study 2 replicated these findings with the Eysenck Personality Inventory and revealed important interactive relations between extraversion, neuroticism, and social relationships in predicting SWB. A strong relation between extraversion and SWB occurred only among individuals who were highly neurotic or who had poor social relationships.

Attempts to understand and predict happiness or subjective well-being (SWB) have identified a number of variables that seem to be consistently related to general satisfaction with one's life. Although demographic variables appear to be only weakly related to SWB (Diener, 1984), substantial evidence has been found that indicates that social contact and social relationships are more strongly predictive of SWB (Bradburn, 1969; Graney, 1975). The research program carried out by Campbell and his associates (Campbell, 1976, 1981; Campbell, Converse, & Rodgers, 1976) has provided much evidence of the importance of social relationships in predicting SWB. Campbell concluded that satisfactory marriage, family, and friendship relationships are very important in how people evaluate their lives overall. In addition, he noted that satisfaction in these relationship domains appears to be affected very little by considerations of income, education, or other aspects of status. Many other studies have found substantial correlations between social relationships and SWB (Freedman, 1978; Glenn & Weaver, 1979; Liang, Kahana, & Doherty, 1980; Ray, 1979). Fordyce (1977, 1983) has reviewed this research and constructed a program that uses sociability and social relationships to improve SWB.

Study 1

We conducted Study 1 in an attempt to more carefully analyze social relationships and their association with SWB. Our major interest was to analyze how different types of social relationships (acquaintances, friends, significant others) are related to SWB. We also included in the study a personality variable, extraversion, which is closely tied to social relationships and has been shown to be related to SWB, as we anticipated that social relationships might interact with this personality trait in predicting SWB.

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The relation between extraversion and SWB has also been the focus of many studies. Wilson (1967) concluded that extraverted people are happier than introverted people, and evidence since then has supported his position (Costa & McCrae, 1980; Emmons & Diener, 1986). Diener (1984) suggested, however, that although some evidence has corroborated this conclusion, the differences between extraverted and introverted individuals may be small. Emmons and Diener (1986) found that it was the sociability aspect of extraversion rather than that of impulsivity that correlated with SWB.

It appears that, in analyzing extraversion, most investigators adopt a relatively simple model of the relation of sociability, or extraversion, to SWB. The basic idea, as Wilson (1967) put it, is simply that happiness is consistently related to "successful involvement with people" (p. 304). He sees social relationships as directly satisfying needs for affection, acceptance, popularity, and so forth. Hence, extraverted people, who have more such relationships, are happier. A somewhat more elaborate analysis was suggested by Bradburn (1969). He proposed that

there is not a simple causal connection in either direction, but rather some sort of dynamic cycle. Those who feel good may be more likely to engage in social activities and engaging in those activities may increase the probability that they will encounter the kinds of experiences productive of positive affect. (Bradburn, 1969, p. 146)

We argue that even Bradburn's analysis may be too simple in that it fails to take into account individual differences in needs or desires for social relationships.

In examining SWB and social relationships, we looked at three different categories of relationships: relationships with acquaintances, relationships with friends, and relationships with significant others. We constructed separate self-report scales for each of these dimensions. The scores on the measures represented a composite of the quantity and quality of each kind of social relationship. For the purposes of this study, *acquaintances* were defined as people that one casually knows, whereas *friends* were defined as those with whom one shares activities,

interests, and broader conversations. *Significant others* refers to the people closest to an individual who play an important role in that individual's life. We examined each relationship's strength in predicting SWB.

In addition to breaking down social relationships, in Study 1 we focused on possible differences between the social relationships of extraverted and introverted individuals in predicting SWB. It may be that the relation between extraversion and SWB depends on the kind or degree of social relationships a person has, so that introverted and extraverted people arrive at happiness through different means. Therefore, we examined interactions between extraversion and the different types of social relationships.

We expected that, in accordance with earlier findings, extraverted individuals would generally tend to be happier than introverted individuals. We also expected, however, that introverted and extraverted individuals might have different requirements and proclivities with regard to social relationships, and that if this were the case, an individual's SWB could turn on the match between his or her personality and the kinds and number of social contacts actually available in his or her life. One plausible hypothesis was that the happiness of introverted people, who seem likely to have fewer social relationships overall, would be influenced more by social relationships with significant others than would the happiness of extraverted people. The happiness of extraverted people, on the other hand, might be expected to depend more strongly on the number of friends or acquaintances they have if the sociability component of extraversion reflects an underlying need or desire for a variety of social contacts.

If the effect of social relationships on SWB depends on a person's level of extraversion, then we would of course expect to find interactions between extraversion and social relationships in the prediction of SWB. In particular, a regression analysis predicting SWB from three kinds of social relationships and extraversion, with interactions represented by multiplicative terms, would take the following form:

$$\hat{W} = b_0 + b_1 E + b_2 A + b_3 F + b_4 S + b_5 EA + b_6 EF + b_7 ES,$$

where W = subjective well-being, E = extraversion, A = acquaintances, F = friends, and S = significant others. Regrouping the terms in this equation helps in interpreting the interaction coefficients:

$$\hat{W} = b_0 + b_1 E + (b_2 + b_5 E) A + (b_3 + b_6 E) F + (b_4 + b_7 E) S.$$

The terms in parentheses are, mathematically, simply the partial derivatives of W with respect to A , F , and S , respectively, and represent the importance of acquaintances, friends, and significant others in predicting SWB after statistically controlling for the other variables in the equation. When the interaction coefficients, b_5 , b_6 , and b_7 , are nonzero, then it is clear that the weights attached to A , F , and S depend on the level of extraversion. Moreover, if strong relationships with, for instance, significant others are more important to introverted people than to extraverted people, one would expect b_7 to be negative. If strong relationships with friends and acquaintances

are more important to extraverted than introverted people, one would expect b_5 and b_6 to be positive. Thus, we expected the sizes and signs of the interaction coefficients in a regression equation such as this one to provide useful information about how the importance of the different kinds of relationships in predicting SWB is related to extraversion. Study 1 focused on only one personality trait, namely, extraversion. The results of Study 1 and subsequent analysis suggested that neuroticism might be an important moderator of effects found. We discuss this variable in Study 2.

Method

Subjects. Subjects were college students enrolled in introductory psychology classes. In exchange for bonus points toward their final grades, 291 volunteers participated in the study. Of the 291 subjects, 169 were female and 122 were male. There were 208 White subjects, 55 Black subjects, and 28 subjects of other racial background. The participants consisted of 171 freshmen, 80 sophomores, 24 juniors, and 16 seniors.

Measures. Measures were obtained for each subject on subjective well-being, social relationships, and extraversion. To measure well-being, the Well-Being subscale of the Differential Personality Questionnaire (DPQ) was administered (Tellegen, 1979). The DPQ is a factor-analytically developed self-report instrument for which Tellegen (1979) reported acceptable reliabilities (.90 for the Well-Being subscale). High scorers on the well-being measure tend to describe themselves as having a happy, cheerful disposition; feeling good about themselves; seeing a bright future ahead; and living an exciting, active life. Low scorers describe themselves as having fewer experiences of joy and excitement and seldom being really happy. This scale may be considered a measure of the component of SWB that Emmons and Diener (1985) called *general satisfaction with life*. Items from the other DPQ subscales were also administered to the subjects as filler items.

We selected three types of social relationships for examination: acquaintances, friends, and significant others. Separate self-report scales were constructed for each of these dimensions.

We obtained each scale score by summing the subject's responses to each item of that scale. The Acquaintances scale primarily measured the number of acquaintances one encounters in various settings. We used settings appropriate for college students, including classroom, campus, living area (dormitory, house, or apartment), and social events. A high scorer on this scale would have many acquaintances and interact with them across many situations, whereas a low scorer would have few acquaintances and little social contact with them across a variety of situations. The Friends scale focused on the number of friends and activities with friends a person has. A high score on the Friends scale would indicate that the person has many friends and frequently shares activities and social outings with his or her friends. The Significant Others scale asked about the presence of close relationships with mother, father, spouse (or steady boyfriend or girlfriend), brothers, sisters, and other relatives. This scale also inquired about the amount of time spent with these people. A high scorer on this scale would have close relationships with several people and spend time with these people every day.

Subjects were furnished with the following definitions to facilitate responses to the scales.

Acquaintance. This is a person whom you know but not well. Conversations with an acquaintance tend to cover a very narrow range of topics. You know these people casually and talk to them about superficial, safe topics. There is no serious sharing of confidential information.

Friend. This is a person whom you know well. You would also have a care and concern for a friend. Conversations tend to be longer in time length and broader in subject range. You also share activities and interests with friends.

Table 1
All Variables and Interactions as Predictors of SWB

Variable	Raw coefficient	t ratio
Constant	-7.74	—
Acquaintances	0.422	2.80*
Friends	0.137	0.69
Significant Others	0.748	3.18*
Extraversion	2.584	4.06**
Acquaintances × Extraversion	-0.034	-1.45
Friends × Extraversion	-0.031	-0.97
Significant Others × Extraversion	-0.048	-1.26
$R^2 = .382$		
$R^2 = .366$, adjusted for degrees of freedom		
$F(7, 283) = 24.96***$		

* $p < .01$. ** $p < .001$.

Significant others. This term refers to the special relationships that you have with particular people. These people are very close to you and play an important role in your life. You share serious, confidential information with these significant others.

The final variable measured was the second-order Extraversion scale (in sten scores) from the Cattell Sixteen Personality Factor Questionnaire (16 PF). Several studies in the field of well-being have utilized this test (e.g., Costa & McCrae, 1980; Wessman & Ricks, 1966). The person scoring high on this Extraversion scale is a socially outgoing, uninhibited person who is good at making and maintaining interpersonal contacts. The person who scores low on this factor tends to be shy, self-sufficient, and inhibited in interpersonal contacts.

Results and Discussion

Several of Study 1's findings were consistent with our expectations and most previous research on SWB. We found extraversion to be a powerful predictor in all equations predicting SWB. This finding agrees with previous research (Costa & McCrae, 1980; Emmons & Diener, 1985; and Wilson, 1967). Emmons and Diener (1985) reported correlations between SWB and extraversion of .35 and .33, respectively, for their two samples. Our study found a higher correlation between these two variables ($r = .50$, $p < .001$), accounting for a quarter of the total variance in SWB. Thus, socially outgoing, uninhibited college students tended to report more well-being or happiness than their shy, inhibited counterparts.

We performed several regression analyses to examine the relations between social relationships, extraversion, and SWB. In the first analysis, the predictor variables entered into the standard regression equation were Acquaintances scale score, Friends scale score, Significant Others scale score, extraversion score, the interaction of acquaintances score and extraversion score, the interaction of friends score and extraversion score, and the interaction of significant others score and extraversion score. The interaction variables were simply the products of the two single variables involved. The results are presented in Table 1.

This regression equation accounted for 36.6% of the variance in SWB. The results indicated that the variables in this equation significantly predict SWB. $F(7, 283) = 24.96$, $p < .001$. Our primary interest in estimating this equation was in the interaction terms. (It is not generally appropriate in an equation con-

taining cross-product terms to interpret the nonproduct terms as main effects in an analysis of variance; see, e.g., Cohen, 1978.) Although the individual interaction terms were not significant in this first regression equation, they all had negative signs and were of approximately the same size. This result suggests that, if indeed the effect of social relationships on SWB depends on an individual's level of extraversion, the pattern is the same for all three kinds of relationships. The similarity of observed coefficients also suggests that the large number of variables in the equation might be masking a real interaction between social relationships *generally* and extraversion. That this is the correct interpretation of this equation is confirmed by the fact that dropping the interaction terms from the regression equation leads to a significant decrease in R^2 , $F(3, 283) = 3.43$, $p < .025$.

To help in interpreting this interaction, we constructed a total social relationship index by averaging the scores from the Acquaintances, Friends, and Significant Others scales. This index is a general composite measure of the quantity and quality of social relationships in a person's life. A regression equation predicting SWB ($M = 17.83$, $S = 4.50$) was estimated, using as predictors the social relationship index ($M = 16.37$, $S = 2.75$), the extraversion score ($M = 6.08$, $S = 2.23$), and the interaction between the social relationship index and extraversion score. The results are presented in Table 2.

In this equation, the predictor variables accounted for 33.6% of the variance in SWB. As indicated in Table 2, all three coefficients, including the interaction term, were significant.

It is our impression that how to correctly interpret regression equations containing cross-product terms is not widely understood among researchers. Therefore, we go into some detail in interpreting the equation contained in Table 2.

First, it is clear that there is a significant interaction in the equation. For the significance test for this term to be appropriate, it is necessary to have all lower-order terms of the interaction in the equation (Cohen, 1978). Consequently, even if the extraversion (E) or social relationships (S) terms had not been significant, it would have been necessary to keep them in the equation to test and interpret the interaction term correctly.

Second, it is not generally appropriate in an equation containing cross-product terms to interpret the nonproduct terms as main effects in an analysis of variance. Thus, for example, it is important not to interpret the coefficient of 2.39 for extraversion as indicating the effect of extraversion by itself in predicting

Table 2
Social Relationships, Extraversion, and Their Interaction as Predictors of SWB: Study 1

Variable	Raw coefficient	t ratio
Constant	-4.01	1.20
Social relationship index	1.06	4.32**
Extraversion	2.39	5.02**
Extraversion × Social Relationship Index	-0.10	-2.98*
$R^2 = .343$		
$R^2 = .336$, adjusted for degrees of freedom		
$F(3, 287) = 49.87***$		

* $p < .01$. ** $p < .001$.

SWB Response Surface

$$\hat{W} = -4.01 + 1.06 S + 2.39 E - .0989 ExS$$

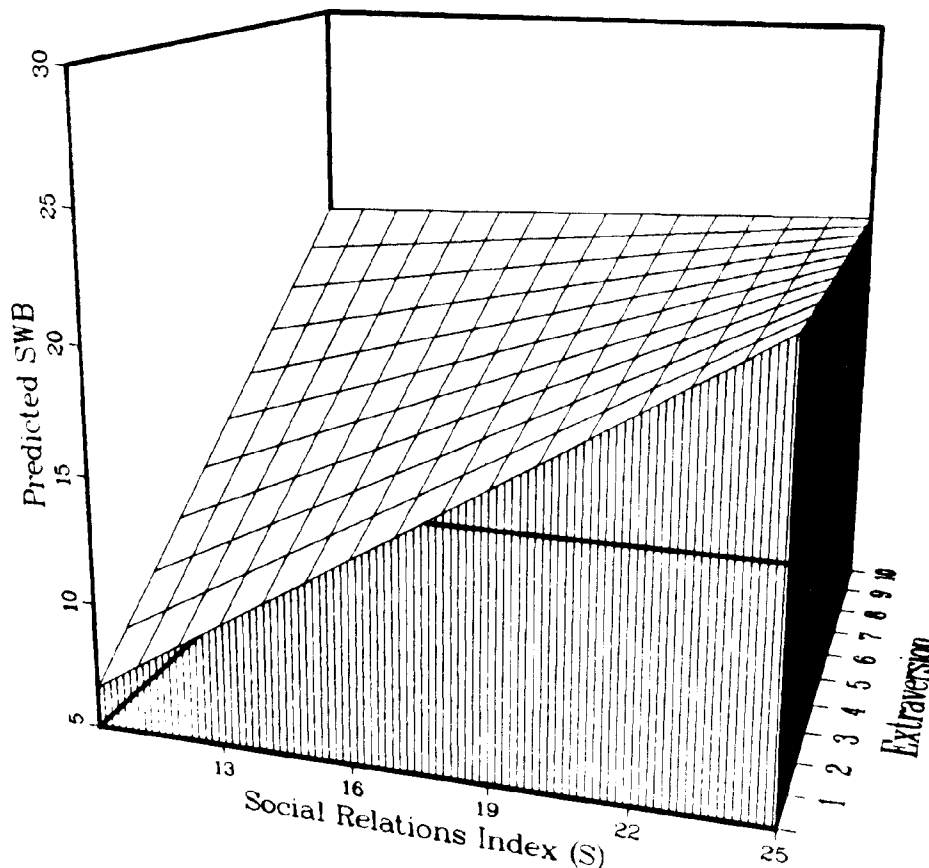


Figure 1. Response surface of subjective well-being (SWB) as a function of extraversion (E) and the social relations index: Study 1.

SWB, because there is another term in the equation containing E and the relation between E and SWB depends on an individual's level of social relationships.

The nature of the interaction between extraversion and social relationships in predicting SWB can be clarified by examining the regression equation more closely. The equation predicting SWB (W) from social relationships (S), extraversion (E), and their interaction (ES) can be written as follows:

$$\hat{W} = -4.01 + 2.39 E + (1.06 - .10 E) S, \quad (1)$$

with terms regrouped to facilitate interpretation. Note that the predictive "effect" of social relationships on SWB, after controlling for extraversion, is in parentheses and depends on the level of extraversion. Consider a highly extraverted person with an extraversion score of 9. The expression in parentheses, reflecting the importance of social relationships in predicting SWB, would equal .16 for this individual.

On the other hand, for a highly introverted person with an extraversion score of 1, the same expression would indicate an importance of .96 for social relationships in predicting SWB. Thus, the number of social relationships appears to be more strongly predictive of SWB for introverted people than for extraverted people. As far as we know, this important finding has not previously been reported and suggests that the role that social relationships play in SWB may depend on one's level of extraversion.

When the pattern of predicted SWB values implied by Equation 1 are examined for various combinations of extraversion and social relationships, it becomes clear that highly extraverted individuals tended to have high SWB scores regardless of the number of social relationships they reported. Introverted individuals who had many social relationships also tended to report at least average SWB. Introverted people with few social relationships, on the other hand, were characterized by markedly

SWB Response Surface

$$\hat{W} = -9.36 + 1.19 S + 1.84 E - .08 ExS$$

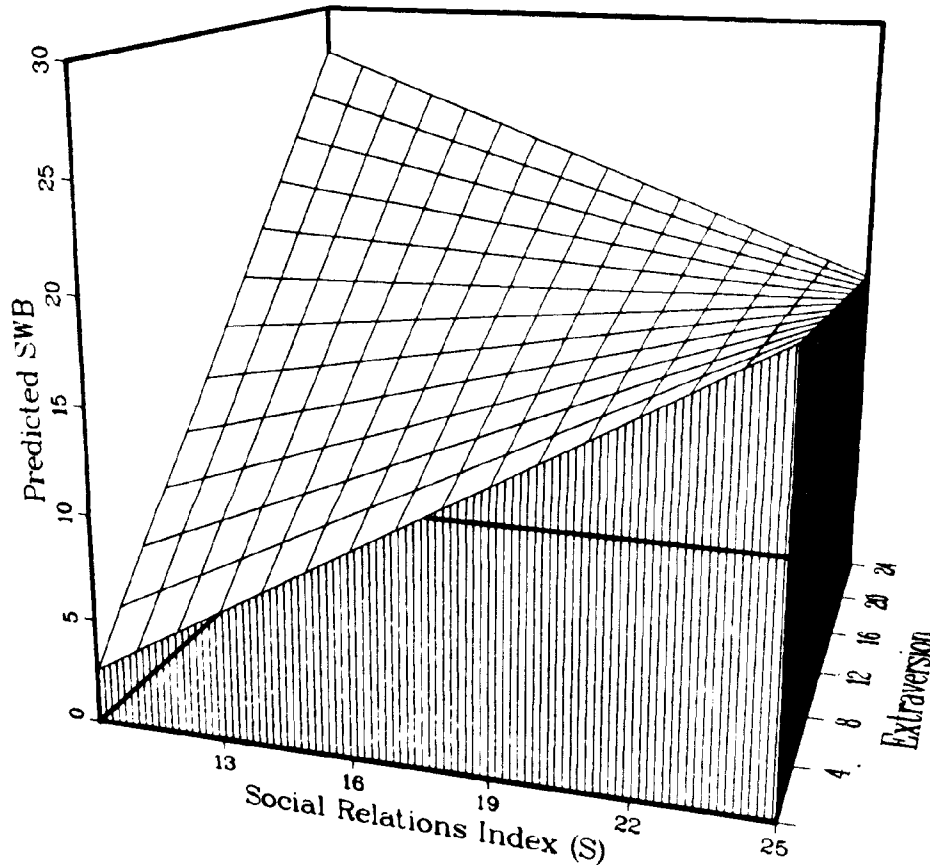


Figure 2. Response surface of subjective well-being (SWB) as a function of extraversion (E) and the social relations index: Study 2.

lower levels of SWB. When subjects were divided into four groups by dividing the sample at the median scores on extraversion and the social index, we found the following mean SWB scores: The introvert-low social index group (those below the mean on both extraversion and social index) had an average SWB score of 14.69 ($n = 92$); the introvert-high social index mean was 17.94 ($n = 63$); the extravert-low social index mean was 18.71 ($n = 42$); and the extravert-high social index mean was 20.44 ($n = 94$).

The pattern of the data can be most clearly seen by plotting the response surface associated with Equation 1 in the range of social index and extraversion values obtained in the study. Figure 1 shows this nonlinear response surface. The hatched surface shows the predicted SWB for individuals with given extraversion and social index scores. The response surface clearly displays the fact that only introverted people with poor social relationships had relatively low SWB.

Perhaps the most surprising result to emerge from our data was the finding that social relationships were more highly predictive of the happiness of introverted people than of extraverted people. Our initial expectation was that social relationships would be more important in predicting SWB for extraverted people than for introverted people, because extraverted people are more sociable. That the opposite turned out to be true, however, can be explained, we believe, in terms of an understanding of extraversion as advocated by Eysenck (Eysenck & Eysenck, 1985).

In Eysenck's view (Eysenck & Eysenck, 1985), much of the variance in personality can be explained by two basically independent factors, extraversion and neuroticism. The introversion-extraversion dimension is a behavioral counterpart of a more organismic variable, arousal. Extraverted people have a relatively unaroused or hard-to-stimulate nervous system, and introverted people are overaroused or oversensitive to stimula-

Table 3
Social Relationships, Extraversion, and Their Interaction
as Predictors of SWB: Study 2

Variable	Raw coefficient	<i>t</i> ratio
Constant	-9.36	-1.29
Social relationship index	1.19	2.72**
Extraversion	1.84	3.39***
Extraversion × Social Relationship Index	-0.08	-2.50*
$R^2 = .256$		
$R^2 = .239$, adjusted for degrees of freedom		
$F(3, 127) = 14.58***$		

* $p < .05$. ** $p < .01$. *** $p < .001$.

tion. Therefore, extraverted people typically seek to increase stimulation, and introverted people seek to decrease it. This difference is manifested by their different reactions to all stimulation, especially social stimuli. Neurotic introverted people and neurotic extraverted people interpret socially produced arousal differently and exhibit different reactions to it. Neurotic introverted people attribute their arousal to anxiety, withdraw from stimulation, and feel dysphoric; neurotic extraverted people attribute their arousal to attraction, seek to increase stimulation, and become manipulative. For Eysenck, dysthymia, or unhappiness, is particularly characteristic of the neurotic introverted person, whereas sociopathy is characteristic of the neurotic extraverted person.

Thus, Eysenck's model (Eysenck & Eysenck, 1985) would predict that neurotic introverted people would express more unhappiness than any other group, including neurotic extraverted people. It would also predict that neurotic introverted people would exhibit more social withdrawal than any other group, including normal introverted people. Accordingly, introversion, social withdrawal, and unhappiness would characterize a certain subset of the population, the neurotic introverted individuals. Our results seem consistent with this pattern as far as they go but suggest the need to examine neuroticism as a factor related to SWB.

Study 2

To examine these ideas more fully, we conducted a second study. If indeed Eysenck's model of personality (Eysenck & Eysenck, 1985), including the neuroticism variable, throws light on the relation between SWB and social relationships, it is important to look at that variable as well as at extraversion. The theoretical considerations taken from Eysenck's model suggest that the relations among neuroticism, extraversion, social relationships, and SWB ought to be complex rather than simple additive ones. In particular, the model suggests that neurotic introverted people should show especially low SWB. In addition, given the findings of Study 1, the question arises as to whether those introverted individuals with low social relationship scores are the same as the neurotic introverted individuals that Eysenck's model would identify as likely to be dysthymic.

Method

A sample of 131 introductory psychology students completed the same questionnaires as were used in Study 1; however, in addition to

Table 4
Regression Equations Predicting SWB From Extraversion,
Neuroticism, and Extraversion × Neuroticism:
Study 2 and Replication

Variable	Study 2 ($n = 131$)		Replication ($n = 109$)	
	Coefficient	<i>t</i> ratio	Coefficient	<i>t</i> ratio
Constant	23.79	—	24.46	—
EPI-E (<i>E</i>)	-0.121	-0.41	-0.082	-0.22
EPI-N (<i>N</i>)	-0.984	-3.72**	-1.25	-3.64**
<i>E</i> × <i>N</i>	0.0456	2.30*	0.054	2.18*
R^2	.39		.47	
R^2 (adjusted)	.38		.45	
	$F(3, 127) = 27.01**$		$F(3, 105) = 30.88**$	

Note. EPI = Eysenck Personality Inventory, *E* = extraversion, *N* = neuroticism.

* $p < .05$. ** $p < .001$.

those scales, subjects completed Extraversion and Neuroticism scales of the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1967).

Results

Inasmuch as we obtained two measures of extraversion (16 PF and EPI) in Study 2, analyses were carried out separately using each measure. The results were not appreciably different for the two measures, but the EPI extraversion measure almost always yielded slightly stronger findings. Consequently, we report results only for the EPI Extraversion scale.

We performed the first analysis to see if the interactive results

Table 5
Regression Equations Predicting Beck Depression Inventory
Scores From Extraversion and Neuroticism
Measures and Their Interactions

Variable	Coefficient	<i>t</i> ratio
Coughlin (1988; $n = 314$)		
Constant	-3.90	
EPI-Extraversion (<i>E</i>)	0.291	1.36
EPI-Neuroticism (<i>N</i>)	1.065	5.30***
<i>E</i> × <i>N</i>	-0.0313	-2.02*
$R^2 = .30$		
R^2 (adjusted) = .29		
$F(3, 310) = 43.60***$		
Hayes (1988; $n = 160$)		
Constant	-6.58	
Sociability (<i>S</i>)	0.362	2.19*
MMPI- <i>Pt</i>	0.881	6.39***
<i>S</i> × <i>Pt</i>	-0.0216	-3.05**
$R^2 = .49$		
R^2 (adjusted) = .48		
$F(3, 156) = 50.52***$		

Note. EPI = Eysenck Personality Inventory, MMPI = Minnesota Multiphasic Personality Inventory, *Pt* = Psychasthenia Scale.

* $p < .05$. ** $p < .01$. *** $p < .001$.

SWB Response Surface

$$\hat{W} = 23.79 - .121 E - .984 N + .0456 E \times N$$

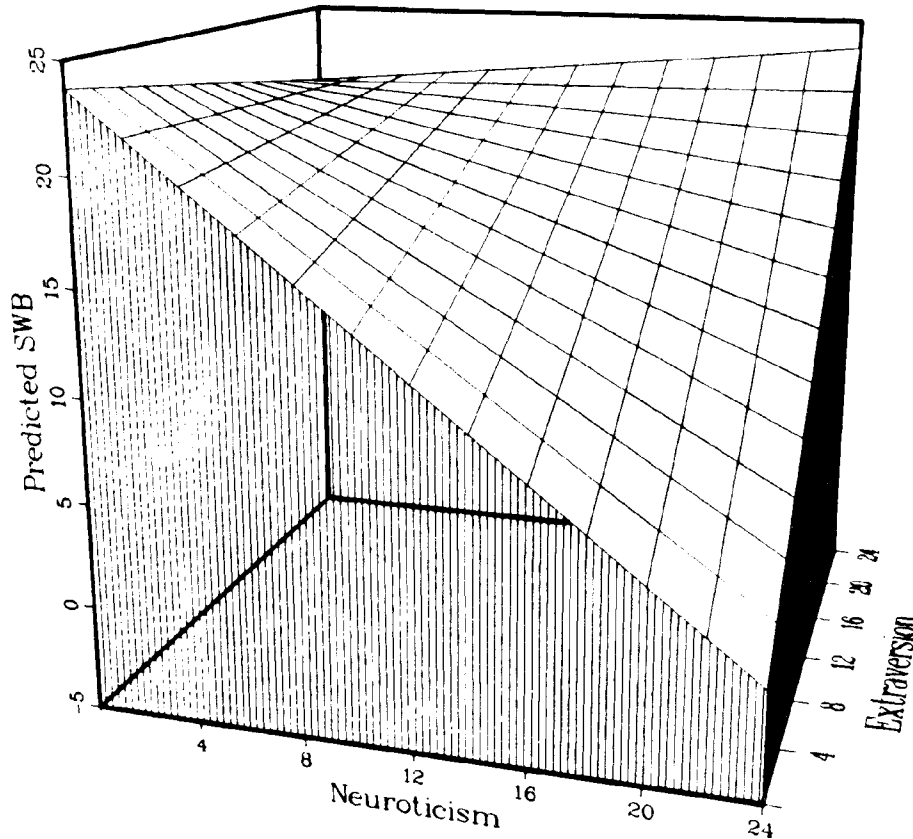


Figure 3. Response surface of subjective well-being (SWB) as a function of extraversion (E) and neuroticism (N).

found in Study 1 were replicated in Study 2. The social relationship index examined in Study 1 was constructed for the present data. A regression equation predicting SWB ($M = 17.09$, $S = 4.40$) was estimated, using as predictors the social relationship index ($M = 16.85$, $S = 2.63$), the extraversion score ($M = 13.31$, $S = 3.75$), and the interaction between the social relationship index and extraversion score. The results are presented in Table 3.

As indicated in Table 3, we found the same pattern in the Study 2 data as in Study 1. The magnitudes and signs of the coefficients are all similar to those of Study 1 and are all significant. The negative coefficient for the interaction between extraversion and social relationships again reflects the fact that social relationships are more predictive of SWB for introverted people than for extraverted people.

Figure 2 shows the response surface for the Study 2 data; they

clearly manifest the same nonlinear pattern as the Study 1 results.

Extraversion and neuroticism as predictors of SWB. In addition to examining the results from the social relationship variables, it is worth looking at the relation between SWB and the two personality variables, extraversion and neuroticism. Theoretical considerations had led us to expect that this relation would be nonadditive. Therefore, we performed a regression analysis, using E , N ($M = 13.50$, $S = 4.31$), and their cross-product, $E \times N$, as predictors of SWB. The left half of Table 4 presents the results of this analysis.

As indicated in Table 4, the $E \times N$ interaction term was significant ($p < .05$), indicating that an adequate account of the relation between extraversion, neuroticism, and SWB must take nonadditivity into account. Figures 3 and 4 show the nonlinear response surface of the equation in the left half of Table 4.

Predicted SWB Contours

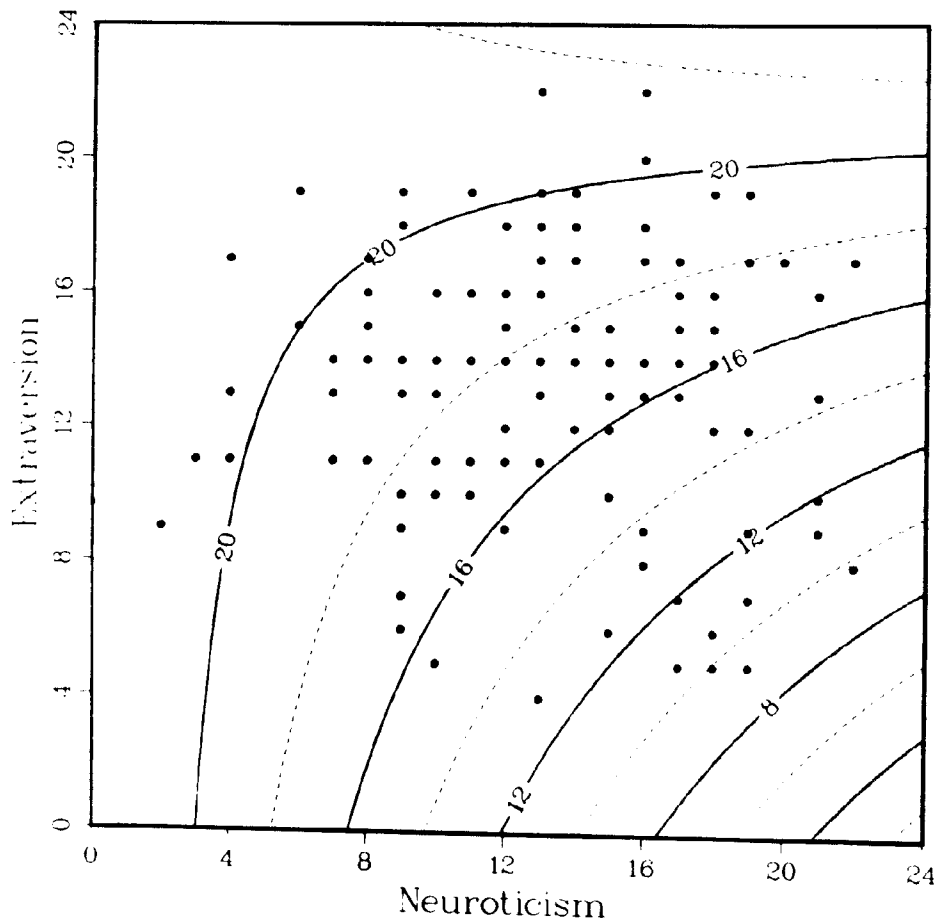


Figure 4. Contour map and scatterplot of response surface in Figure 3 (SWB = subjective well-being).

Figure 3 shows a three-dimensional view of the surface, whereas Figure 4 gives a contour map of this surface. To give a better picture of how scores relate to the response surface, Figure 4 includes a scatterplot of the relation between E and N for the Study 2 data. The contour lines of Figure 4 represent lines of equal predicted SWB. As clearly indicated in Figures 3 and 4, low SWB tends to be characteristic mainly of neurotic introverted subjects. Neurotic extraverted subjects, along with non-neurotic introverted and extraverted subjects, all reported relatively high SWB. This pattern is, of course, consistent with what we expected on the basis of Study 1.

Because this Extraversion \times Neuroticism interaction in predicting SWB has, to our knowledge, not been described in the literature on SWB, we collected additional data to check the reliability of the finding. A replication sample of 109 introductory psychology students completed questionnaires, including the EPI Extraversion and Neuroticism scales and the SWB scale from the DPQ. The regression equation from this data for predicting SWB ($M = 15.97$, $S = 5.29$) from E ($M = 13.17$, $S =$

3.86), N ($M = 13.65$, $S = 4.37$), and $E \times N$ is given in the right half of Table 4. The same pattern of results clearly was found in the replication, and the response surface for the replication equation is virtually identical to that shown in Figures 3 and 4.

Interaction using other measures of E , N , and SWB . In addition to the replication just described, we reanalyzed data from two other studies that had been designed for other purposes but that measured variables that could be used to check the interaction's external validity.

The first reanalysis used data taken from Coughlin (1988). In Coughlin's study, a sample of 314 introductory psychology students was administered, among other things, the Beck Depression Inventory (BDI; Beck, 1967), along with the EPI Extraversion and Neuroticism scales. It is possible to consider the BDI to be a (negative) measure of SWB and, with this data, to check for the presence of the $E \times N$ interaction in predicting BDI scores. In Coughlin's data, the means and standard deviations were as follows: BDI— $M = 8.47$, $S = 6.09$; E — $M = 12.56$, $S = 4.07$; and N — $M = 12.94$, $S = 4.76$.

BDI Response Surface

$$\hat{D} = -3.90 + .291 E + 1.07 N - .0313 ExN$$

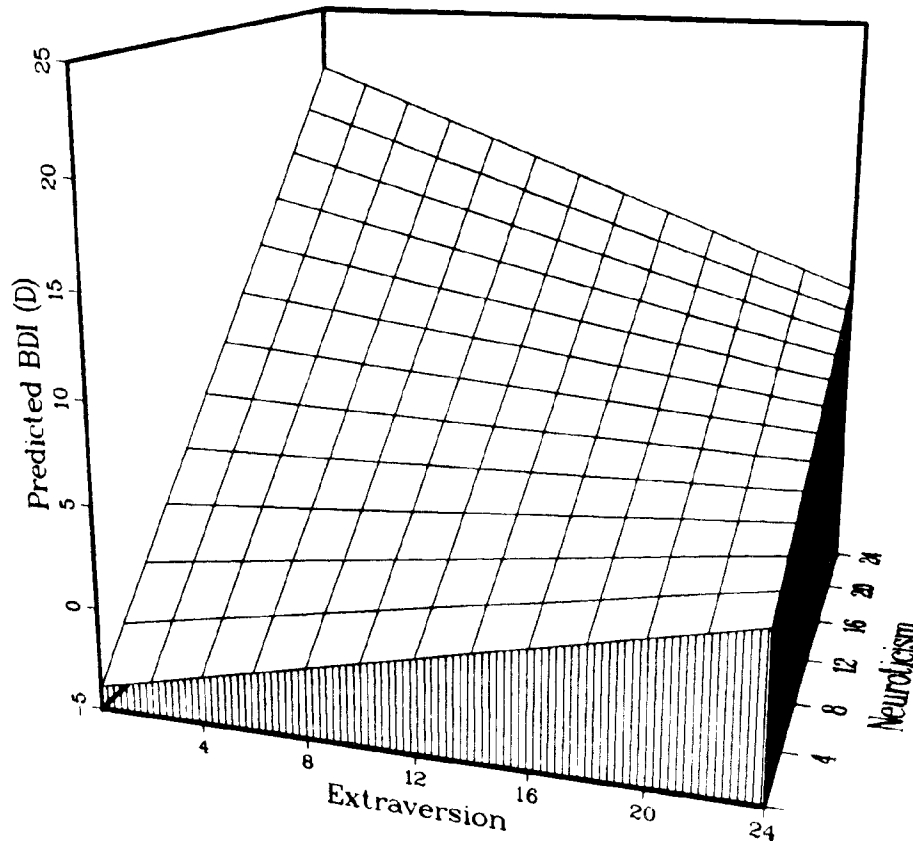


Figure 5. Response surface of Beck Depression Inventory (BDI) for Coughlin (1988) equation in Table 5. (E = extraversion, N = neuroticism.)

In addition, we reanalyzed another unrelated study (Hayes, 1988), conducted several years earlier, because it included alternative measures of all three of the variables under consideration. In Hayes's study, scores on the BDI, the Sociability scale of the Guilford-Zimmerman Temperament Survey (Guilford & Zimmerman, 1949), and the Psychasthenia (*Pt*) scale of the Minnesota Multiphasic Personality Inventory were obtained for 160 introductory psychology students. The BDI represents an alternative measure of SWB, and *Pt* has been found to be an excellent measure of neuroticism (Watson & Clark, 1984). There is much evidence that sociability is a major component of extraversion (Emmons & Diener, 1986; Rocklin & Revelle, 1981), so the Guilford-Zimmerman Sociability scale provided a measure of extraversion.

The regression equations found for predicting BDI scores from the extraversion, neuroticism, and interaction measures for the two studies are presented in Table 5. As indicated in the

table, the Extraversion \times Neuroticism interaction was significant in both studies. The sign of the interaction coefficient is negative, as would be expected, inasmuch as the BDI is a negative measure of SWB. One can confirm by examining the response surfaces of the equations in Table 5 that the interaction found in these studies using alternative measures is essentially the same as that found in Study 2 and its replication.

Figures 5 and 6 show, respectively, the response surface and its contour map for the Coughlin (1988) data regression equation in Table 5. As indicated in these figures, introversion is only associated with higher BDI scores among neurotic individuals. Among low neurotic individuals, if there is any relationship at all, introversion is associated with lower BDI scores.

The response surface for the equation using the *Pt* scale and the Guilford-Zimmerman Sociability scale to predict BDI scores looks virtually identical in shape to that shown in Figures 5 and 6. These results provide strong confirmation of the find-

Predicted BDI Contours

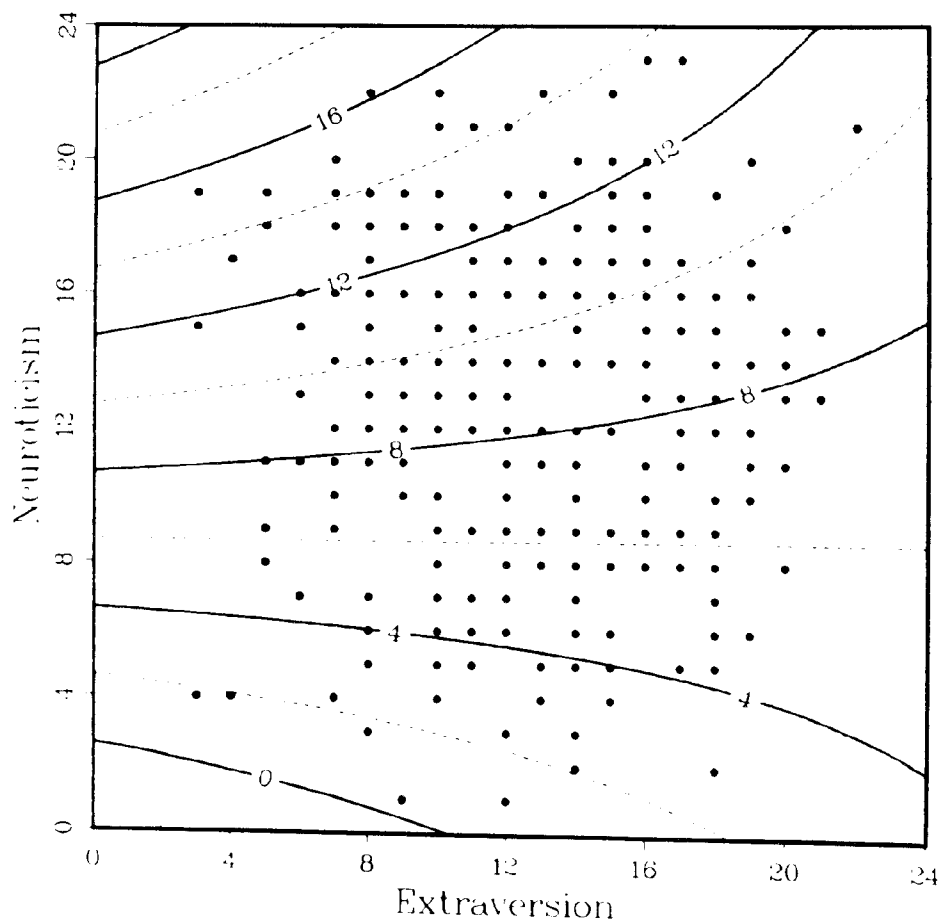


Figure 6. Contour map and scatterplot of response surface in Figure 5. (BDI = Beck Depression Inventory.)

ing, in Study 2 and its replication, that the positive relation between extraversion and SWB does not hold among low neurotic individuals.

It is conceivable that Study 1's main finding (that introverted people with low social relationships scores report markedly lower SWB) is a result of the fact that these individuals are primarily neurotic introverts—a group that, in Study 2 and the other studies, also reported low SWB. This explanation, however, is not supported by the data. A *t* test comparing the mean social relationships scores of the neurotic and nonneurotic introverted groups (groups obtained by splitting extraversion and neuroticism at their medians) revealed no significant difference ($M_s = 15.88$ and 15.95 , respectively), $t(57) = 0.10$, *ns*. The same conclusion is reached when the mean neuroticism scores for introverted subjects with low social relationships scores are compared with the mean neuroticism scores for introverted subjects with high social relationship scores (obtained by a median split). The mean neuroticism scores for the two groups

(13.85 and 12.37 , respectively) were not significantly different, $t(57) = 1.25$, *ns*.

General Discussion

The results of Studies 1 and 2 clarify the nature of a rather well-established finding, namely, that extraverted people report greater overall happiness than introverted people. Although the results of both studies were consistent with this finding, Study 1 revealed that the effect is primarily attributable to the low SWB of those introverted people with poor social relationships. Introverted people with better social relationships reported essentially the same relatively high SWB as did extraverted people. Because this finding suggested that Eysenck's model of personality (Eysenck & Eysenck, 1985) might be a fruitful approach to studying the issue, we performed Study 2 to examine the possibility that neuroticism might be the key to explaining this interaction.

The resulting data confirmed that only neurotic introverted people and introverted people with poor social relationships tended to report lower SWB than extraverted people. Nonetheless, it does not appear that these two groups of introverted people, who both reported lower SWB, necessarily overlap much. Perhaps it is simply that the increased sensitivity of introverted individuals induces them to report lower SWB when they experience any negative conditions, such as high anxiety or poor social relationships.

Thus, although the much-reported finding that extraverted people on average are happier than introverted people is true as far as it goes, it may be misleading. Among subjects who are not neurotic, or who have good social relationships, extraversion and SWB are only very weakly related, if related at all. The interactions reported in this article appear to be robust in the sense that they were found in studies using a variety of measures of the constructs involved. Moreover, taking account of the interactions among the variables studied here dramatically improved the proportion of variance in SWB accounted for over typical studies in this area. All these results taken together suggest that investigators in this area would do well to look for interactions predicted by theory and to routinely use methods capable of detecting such interactions.

There are, of course, many avenues of research that might be fruitfully pursued from this perspective. For example, it would be interesting for further research on SWB to examine how the course of SWB changes in response to environmental variations over time in the lives of individuals with differing personality characteristics. That is, what roles do neuroticism and extraversion play in the ways people respond to events that typically influence SWB, such as changes in the structure of one's social relationships network? Here again, however, both theory and our results suggest that relations among crucial variables are likely to be interactive.

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