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Predicting the Big Two of Affect from the Big Five of Personality

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This article reports a study ($N = 217$) predicting self-reported momentary affect from personality. Affect was described with a two-dimensional space that integrates various affect models including the valence/arousal and the positive affect/negative affect models. Three models of personality were compared: Extraversion and Neuroticism, the Five Factor Model (which adds Agreeableness, Conscientiousness, and Openness to Experience), and Digman's Alpha and Beta. Both linear and nonlinear (interaction and quadratic) effects were examined. Results favored the Five Factor Model. Nonlinear effects were small. Personality was not linked to affect in a way consistent with the claim that certain dimensions (Positive Affect and Negative Affect) are more basic; indeed, neuroticism was maximally correlated with the Pleasant versus Unpleasant axis rather than with Negative Affect.

One typically feels happy with good news, nervous before a major decision, and relaxed on vacation: Affect obviously can be predicted from the immediate context. What is less obvious is that one's affect can also be predicted from one's enduring personality traits (Diener, 1984; Larsen & Ketelaar, 1991; McCrae & Costa, 1991): Some persons are typically happy, others typically nervous, and still others typically relaxed. The relation of affect to personality is our topic in the present article.

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Clarifying the exact pattern of relations between momentary affect and enduring personality can shed light on both. The preferred model of personality is the one that best predicts and explains affect (as well as behavior, cognition, and other psychological processes). Indeed, some personality dimensions might predict behavior indirectly via their association with affect. The study of affect too is enhanced through establishing its link to personality. For instance, our understanding of the nature of affect will depend on the degree to which it is more context- or personality-dependent, and it has been proposed that correlations between personality and affect can help locate the fundamental axes in the structure of affect.

In this article, we use as a tool a structure of affect that integrates the traditional pleasure and arousal axes, the circular ordering of affect, Thayer's dimensions of activation, and the dimensions that Watson and Tellegen (1985) called Positive Affect and Negative Affect (changed by Watson, Wiese, Vaidya, & Tellegen, 1999, to Positive Activation and Negative Activation). We examine the use of personality correlates to address the question of how to rotate the axes in the affective space. We compare three models of personality—an Extraversion–Neuroticism model, the Five Factor Model, and Digman's Alpha and Beta—in their ability to predict current self-reported affect. We explore linear and nonlinear (interaction and quadratic) effects, as emphasized by McFatter (1994).

Our Model of Affect

The adequacy of any study on the links between affect and personality depends on the adequacy of its description of affect. The present study relies on recent work in which the major two-dimensional structures of affect were integrated (Yik, Russell, & Feldman Barrett, 1999). The two-dimensional Cartesian space defined by the bipolar axes of Pleasant versus Unpleasant and Activated versus Deactivated states was shown to be capable of incorporating other two-dimensional models of self-reported momentary affect, including Thayer's (1996) Tense and Energetic Arousal, Watson and Tellegen's (1985) Positive and Negative Affect, and Larsen and Diener's (1992) Pleasant and Activated dimensions of affect (Carroll, Yik, Russell, & Feldman Barrett, 1999; Feldman Barrett & Russell, 1998; Russell, Yik, & Steiger, 2001; Yik, Russell, & Feldman Barrett, 1999). Supportive evidence of the integrated space was also found in respondents who speak Spanish, Chinese, Japanese, and Korean (Yik, 1998).

Although there is widespread agreement on a two-dimensional structure of affect, the proper rotation of the two axes remains controversial. Pleasure and arousal are used as the horizontal (0°) and vertical axes (90°) in our model (shown in Fig. 3); this rotation is one of the viable alternatives, but any other pair of nonredundant axes explains the same amount of variance and defines the space equally well—mathematically. Some investigators

have argued that the basic dimensions are at 45° and at 135°. These diagonal axes are Pleasant Activated versus Unpleasant Deactivated and Unpleasant Activated versus Pleasant Deactivated. They are captured by what Watson and Tellegen (1985) defined as Positive Activation and Negative Activation.

One argument for this latter rotation centers on the location of personality correlates: Affect dimensions at 45° and 135° are basic, it is said, because they correlate with the personality dimensions of Extraversion and Neuroticism (Costa & McCrae, 1996; Meyer & Shack, 1989; Watson & Tellegen, 1985). On the other hand, Larsen (1989) examined a broader range of personality correlates of affect and found that personality variables did not cluster at 45° and 135°. Instead, they fell at a variety of locations around the affective space. Indeed, some came just as close to the horizontal axis of Pleasant versus Unpleasant states or to the vertical axis of Activated versus Deactivated.

In the present article, we rely on a method for representing the correlation of an external variable, such as a personality trait, with the entire circumplex of affect (Russell, Yik, & Steiger, 2001). In this way, we can reexamine the question of rotation from a new perspective.

Three Models of Personality

In parallel fashion, the adequacy of any study on the links between affect and personality depends on the adequacy of its description of personality. Much work on this topic has relied on the two broad dimensions of Extraversion and Neuroticism (e.g., Emmons & Diener, 1986; Gross, Sutton, & Ketelaar, 1998; Larsen & Ketelaar, 1991; Lucas, Diener, Grob, Suh, & Shao, 2000; Pavot, Diener, & Fujita, 1990). The robustness of the findings led Tellegen (1985; Watson & Clark, 1984) to argue that Extraversion (E) and Neuroticism (N) be renamed as ''Positive Emotionality'' and ''Negative Emotionality,'' respectively.

In recent years, psychologists have witnessed the emergence of the Five Factor Model (FFM) as a consensual descriptive map for assessing personality (Costa & McCrae, 1992; Digman, 1990; Goldberg, 1993; McCrae & John, 1992; Wiggins & Trapnell, 1997). In addition to E and N, many students of personality now agree that Agreeableness (A), Conscientiousness (C), and Openness to Experience (O) are essential in providing an adequate description of personality. McCrae and Costa (1997) have replicated the FFM in many societies, thus arguing for its universality (see also Costa & McCrae, 1992).

One proponent of the FFM, Digman (1997), reanalyzed 14 studies of the FFM and found the five factors are themselves organized into two higher order factors: Factor Alpha consists of Agreeableness, Conscientiousness, and Emotional Stability (low Neuroticism); Factor Beta consists of Extraversion and Intellect (or Openness to Experience). Digman also offered an ex-

planation of the origins of these two higher order factors. Alpha represents the socialization process, describing how much a child develops in accordance with society's blueprint. Beta represents personal growth, describing how much a child explores the world on his or her own and is open to that experience.

Relating Affect to Personality

Various questions arise about the relation of affect to personality (e.g., Carver, Sutton, & Scheier, 2000; Fossum & Feldman Barrett, 2000; Gross, Sutton, & Ketelaar, 1998; Lucas & Fijita, 2000; Moskowitz, Brown, & Côté, 1997). But most research has been focused on the prediction of affect from personality, and that is our topic.

The superfactors of Extraversion and Neuroticism have long been argued as temperamental traits that influence feelings and behaviors (H. J. Eysenck, 1992; H. J. Eysenck & M. W. Eysenck, 1985; Tellegen, 1985). Much research has been reported to show that they are related to affect (Costa & McCrae, 1980, 1984; Diener & Emmons, 1984; Izard, Libero, Putnam, & Haynes, 1993; Meyer & Shack, 1989; O'Malley & Gillett, 1984; McCrae & Costa, 1991; Thayer, Takahashi, & Pauli, 1988; Warr, Barter, & Brownbridge, 1983; Watson & Clark, 1992, 1997; Williams, 1981).

Fewer studies have been conducted to examine the predictive utility of Agreeableness, Conscientiousness, and Openness to Experience on affect. Positive relations were reported between Openness to Experience and positive affective states (Costa & McCrae, 1984; McCrae & Costa, 1991; Watson & Clark, 1992). Both Agreeableness and Conscientiousness were found to correlate positively with positive affective states and negatively with negative affective states (McCrae & Costa, 1991; Watson & Clark, 1992).

In short, both empirical and conceptual considerations indicate reliable and meaningful links between personality and affect. However, the findings are questionable. From the evidence available, it is not clear what the precise relation is between affect and any one personality trait, how large that relation is, or how these links can be used to determine the best rotation of the affective space. We make this statement for four reasons.

Construct overlap. In principle, personality and affect are two separate domains. Personality is a relatively permanent or at least long-term matter of predispositions. Affect is a momentary or at least short-term matter of consciously accessible feelings. In practice, the operational measures of personality and affect are not as distinct.

Operational definitions of affect and personality have been such that the reported findings may be more conceptual than empirical. Suppose that a researcher operationally defined personality with the E and N scales from the NEO Five Factor Inventory (Costa & McCrae, 1992) and operationally defined affect with Positive Affect and Negative Affect Schedule (Watson,

Clark, & Tellegen, 1988). The result is typically a significant correlation between Extraversion and Positive Affect and between Neuroticism and Negative Affect. Now suppose that the researcher wondered what exactly the respondents were reporting and decided to examine the individual items on the various questionnaires administered. She noticed that the Positive Affect scale contains the terms *active, enthusiastic,* and *inspired;* the Extraversion scale contains the statements ''I am a very *active* person'' and ''I am a *cheerful, high-spirited* person.'' The Negative Affect scale contains the terms *jittery, afraid, scared, nervous,* and *ashamed;* the Neuroticism scale contains the statements ''I often feel *tense* and *jittery,*'' ''I rarely feel *fearful* or *anxious*'' (negatively keyed), and ''At times I have been so *ashamed* I just wanted to hide.'' Even when the terms are not exactly the same, similar ideas are found on both the personality and affect scales. Thus the empirical relations reported might to some extent reflect conceptual overlap in the scales used. Such conceptual overlap may be entirely appropriate, but an empirical test of the relations hypothesized requires that the conceptual overlap be minimized.

The significant personality-affect correlations can be further exaggerated by a shared time frame. For instance, some studies cited as establishing the link between affect and personality used a trait version of the affect scales (Watson & Clark, 1992). In the trait instruction of PANAS, respondents are instructed to ''indicate to what extent you generally feel this way, that is, how you feel on average.'' Similar instructions are used in most personality trait inventories. Asking respondents to describe how they feel in general or over a long period of time may invoke the same reconstructive procedure of remembering involved in describing their own personality.

The conceptual overlap between affect and personality perhaps cannot be (and perhaps should not be) eliminated, but for empirical testing needs to be minimized. In the present study, we sought to do so by emphasizing the momentary quality of affect. In our affect assessment, we asked participants to consider one moment of time. This approach helps minimize the influence of reconstructive process of memory in affect. In our personality assessment, we asked respondents to use information accumulated over their life time and to provide their ratings about how they think and feel in general.

Measurement errors. Previous research has typically been focused on the zero-order correlations between affect and personality (e.g., McCrae & Costa, 1991; Watson & Clark, 1992). The random and systematic errors inherent in measurement might make such observed correlations over- or underestimates of the true magnitude of the relation (Hunter & Schmidt, 1990; Jaccrad & Wan, 1995; Moosbrugger, Schermelleh-Engel, & Klein, 1997). In the study of the relation between affect and personality, it is therefore important to separate those aspects of the data that derive from measurement error from the aspects that are due to affect and to personality. Green,

Goldman, and Salovey (1993) proposed a multiformat procedure in which the resultant data are analyzed with a structural equation model. In accord with their procedure, the present study assessed each affective state with three different formats and each personality dimension with three different inventories.

Nonlinear effects of personality. Most research has been focused on simple linear relations, as captured for example by the zero-order correlation coefficient. But interaction and curvilinear relations are also possible. Admittedly, evidence for interaction effects is mixed (e.g., Pavot, Diener, & Fujita, 1990): Significant E × N interaction effects were reported in some studies (e.g., Hotard, McFatter, McWhirter, & Stegall, 1989; McFatter, 1994), but discarded as Type I errors in others (e.g., Allik & Realo, 1997; Hepburn & Eysenck, 1989; McCrae & Costa, 1991). McFatter (1994) strongly argued for a significant E × N interaction effect and concluded from his data that ''both positive and negative affect were strongly related to Extraversion only among neurotic subjects'' (p. 570).

The mixed evidence can be partly attributed to the fact that different studies used different measures to define personality and affect and that, within a single study, only a single measure of personality and a single measure of affect were used at a time. Thus, results may be unique to the measuring scales used. The present study reexamined the nonlinear effects using three different personality inventories and three different measures of positive and negative affective states.

Correlation with entire affective space. Much empirical effort has gone into demonstrating that a particular personality variable is correlated with a particular affect variable. The most common finding is phrased this way: Extraversion but not neuroticism is correlated with ''Positive Affect.'' Neuroticism but not extraversion is correlated with ''Negative Affect.'' Thus, results are dichotomized into ''correlated'' and ''not correlated'' and only two vectors in the entire structure of affect are sampled. Implicitly, the assumption is that ''correlated'' means ''maximally correlated.'' It is time to move beyond these oversimplifications.

In the present study, we demonstrate that the entire affective space can be employed at the same time to study the personality–affect relation. That is, we can rely on the known structured quality of affect to examine how a specific personality trait correlates with all affect variables. Our model of affect predicts that the pattern of correlations forms a sine wave. This approach puts prior evidence in a broader context. That Extraversion and Neuroticism correlate reliably with affect vectors at 45° and 135° does not imply that they correlate *maximally* with affect at those specific angles. Instead, they are predicted to correlate with various affective variables to various degrees and the question is this: Where precisely in the two-dimensional space does each personality variable achieve its maximum correlation?

Overview of Present Study

In the present study, we report data from a larger study. Yik et al. (1999) reported the portion of the same data concerned with the structure of affect. Here we report data not previously analyzed on respondents' personality and its correlation with current affect. The present investigation aimed at extending the study of affect and personality in the following specific ways:

(a) Rather than being restricted to certain segments of affective space, we used the full spectrum of an integrated descriptive structure of affect.

(b) Rather than being restricted to Extraversion and Neuroticism, we studied the full FFM and Digman's superfactors of Alpha and Beta.

(c) Rather than assess a trait version of affect (''generally feel''), we assessed respondents' current momentary affect. This procedure helps minimize the conceptual overlap between affect and personality.

(d) Rather than being restricted to linear effects of personality, we examined interaction and curvilinear effects.

(e) Rather than being restricted to the observed correlations between affect and personality, we estimated latent correlations by structural equation modeling and used Green et al.'s (1993) multiformat procedure to control measurement errors.

(f) Rather than rely on zero-order correlations to determine the locations of personality variables, we used our sine wave procedure in order to make use of the whole affective space (Russell et al., 2001).

METHOD

Participants

Participants were 217 undergraduates of the University of British Columbia. They were enrolled in various psychology courses and received course credit in exchange for their participation.

Procedure

Participants completed a battery of questionnaires during class time. The front page of the battery gave general instructions, including the request that ''Before you begin, please pause to consider how you are feeling RIGHT NOW, THIS INSTANT.'' Four affect questionnaires followed that were to be answered with respect to that moment. Participants were reminded specifically *not* to describe their feelings as they changed over the time they were completing the battery, but to describe how they had felt in that instant just at the beginning of the instructions.

Following the four affect questionnaires were three personality measures. Participants were asked to describe themselves as they typically and generally are. The same order of questionnaires was used for all respondents. On average, completion of the entire battery took approximately 30 min.

Affect Measures

Four different response formats are used: (a) semantic differential scales of Pleasure and Arousal (Mehrabian & Russell, 1974); (b) an adjective list with each item accompanied by

a 5-point Likert scale ranging from 1, *not at all,* to 5, *extremely* (Adjective Format); (c) a list of statements with which participants were asked to indicate their degree of agreement, ranging from 1, *strongly disagree,* to 5, *strongly agree* (Agree–Disagree format); and (d) a list of statements for each of which participants were to indicate how well it described their feelings, ranging from 1, *not at all,* to 4, *very well* (Describes-Me format).

We created the bipolar version of each response format by taking the difference between the mean bipolar opposite scales. For instance, the bipolar version of the adjective format of the Pleasant vs Unpleasant score was computed as the differences between the means of Pleasant and Unpleasant adjective scales. Yik et al. (1999) provided the rationale for combining these scales into bipolar variables.

The last three questionnaires included items from (a) Feldman Barrett and Russell's (1998) Current Mood Questionnaire (CMQ) scales assessing Pleasant, Unpleasant, Activated, and Deactivated affective states; (b) Thayer's (1996) Energy, Tiredness, Tension, and Calmness affective states; and (c) Larsen and Diener's (1992) Activated Unpleasant, Unactivated Unpleasant, Activated Pleasant, and Unactivated Pleasant affective states. Adjectives were taken directly from the authors. Agree–Disagree and Describes-Me statements were constructed with same or similar adjectives. All items are available from the authors.

Personality Measures

Participants completed ratings on three personality inventories in the following order.

Big Five Mini-Markers (abbreviated ''MM''). Saucier (1994) derived 40 unipolar markers for the FFM on the basis of reanalyses of 12 data sets. The 40 markers, 8 for each dimension of the FFM, were a subset of Goldberg's (1992) 100 adjectives. Participants were asked to indicate how accurately each adjective describes themselves on a 9-point rating scale, ranging from 1, *Extremely Inaccurate,* through 5, *Neutral,* to 9, *Extremely Accurate*.

Big Five Inventory (abbreviated ''BFI''). Based on a prototype approach (John, 1990), John, Donahue, and Kentle (1991) developed a 44-item scale for the Five Factor Model. The 44 items were written with third-person phrases for self-rating. Participants were asked to indicate how much they agreed with each phrase on a 5-point rating scale, ranging from 1, *Disagree strongly,* through 3, *Neither agree nor disagree,* to 5, *Agree strongly*.

Transparent Bipolar Rating Scales (abbreviated ''BRS''). Goldberg (1992) developed 50 bipolar rating scales, 10 for each of the FFM. The scales were ordered such that those expected to be associated with the same factor were placed next to each other; each group of scales was separated by the hypothesized factor title; the more desirable pole was always on the right side. Participants were asked to indicate how accurately each adjective describes themselves typically on a 9-point rating scale, ranging from 1, *Extremely Inaccurate,* through 5, *Neutral,* to 9, *Extremely Accurate*.

Analysis

Correlation matrices for manifest variables were submitted to confirmatory factor analyses and structural equation modeling using SEPATH in Statistica (Steiger, 1995). Completely standardized solutions were obtained. (Thus, both latent and manifest variables are scaled to a variance of 1.) To control systematic error variance, we estimated the correlations between the error terms for manifest scales with the same response format.

RESULTS

The affect data from the present study had been analyzed for the psychometric and structural properties and reported by Yik et al. (1999). Here we report four additional analyses: First, we examine the measurement models

for personality constructs to determine how well the Five Factor Model accounts for the variations of the personality variables. Second, we compare the predictive utility (linear effects) of an E-and-N Model, the Five Factor Model, and Digman's Alpha and Beta factors. Third, we examine the possibility of interaction and curvilinear relations in predicting affect from personality. Fourth, we examine exactly where in the affective space falls each personality dimension.

The FFM

The structure of FFM has been extensively examined with exploratory factor analysis (e.g., Costa, McCrae, & Dye, 1991) but only rarely with confirmatory factor analysis (e.g., Borkenau & Ostendorf, 1990; Church & Burke, 1994; John & Srivastava, 1999). In a confirmatory factor analysis, we specified five latent constructs corresponding to N, E, O, A, and C. Each latent construct was indicated by the appropriate scales from the three personality inventories. We estimated the following parameters: (a) factor loading between each manifest variable to its intended latent construct, (b) error term associated with each manifest variable, (c) correlations between error terms using the same personality inventory, and (d) correlations among latent constructs.

The hypothesized model fit the data well: χ^2 (50, N = 217) = 137.02, RMSEA = .08 (90% Confidence Interval = .07/.10), APGI = .89 (90% Confidence Interval = .84/.93), CFI = .96. Details of the measurement model are given in Table 1.

The significant correlations among the latent constructs indicate that the five factors of personality are not completely independent of each other. In order to examine the significance of these interfactor correlations, we also constructed an orthogonal comparison model whose model specifications were identical to that of the preceding one except that the correlations among the five latent factors were fixed to zero. The orthogonal comparison model fit the data only moderately well: χ^2(60, N = 217) = 235.08, RMSEA = .13 (90% Confidence Interval = .11/.14), APGI = .78 (90% Confidence Interval = .73/.82), CFI = .91. The original measurement model (with correlated latent constructs) fit the data significantly better than did the comparison model: $\Delta\chi^2$ (10, N = 217) = 98.06, $p < .001$, and RMSEA changed from .08 to .13.

Linear Effects of Personality on Affect

To explore the links between personality and affect, we first defined six bipolar dimensions of affect to serve as endogenous variables: (a) Pleasant versus Unpleasant, (b) Activated versus Deactivated, (c) Thayer's Energy versus Tiredness, (d) Thayer's Tension versus Calmness, (e) Larsen and Diener's Activated Pleasant versus Unactivated Unpleasant, and (f) Larsen and

TABLE 1
The Five Factor Model of Personality: A Confirmatory Factor Analysis

Personality variable	Measure	N	E	O	A	C	*M*	*SD*	α
				Standardized factor loadings					
Neuroticism	MM	.69*					5.17	1.15	.77
Neuroticism	BFI	.84*					3.19	.73	.83
Neuroticism	BRS	.84*					4.42	1.34	.90
Extraversion	MM		.87*				5.11	1.34	.84
Extraversion	BFI		.98*				3.06	.79	.86
Extraversion	BRS		.80*				5.69	1.39	.93
Openness to Experience	MM			.75*			6.29	1.09	.78
Openness to Experience	BFI			.84*			3.50	.63	.80
Openness to Experience	BRS			.80*			6.73	1.05	.90
Agreeableness	MM				.87*		6.95	.95	.76
Agreeableness	BFI				.79*		3.72	.60	.76
Agreeableness	BRS				.64*		7.04	1.03	.89
Conscientiousness	MM					.84*	6.04	1.21	.81
Conscientiousness	BFI					.92*	3.38	.67	.81
Conscientiousness	BRS					.70*	6.63	1.20	.90
				Interfactor correlations					
Neuroticism		—							
Extraversion		−.19	—						
Openness to Experience		−.27*	.33*	—					
Agreeableness		−.30*	.22	.38*	—				
Conscientiousness		−.22	.10	.34*	.41*	—			

Note. $N = 217$. N = Neuroticism, E = Extraversion, O = Openness to Experience, A = Agreeableness, and C = Conscientiousness. MM = Saucier's (1994) 40 Mini-Markers; BFI = John, Donahue, and Kentle's (1991) Big Five Inventory; BRS = Goldberg's (1992) Bipolar Rating Scale. *M* = mean of the items defining the FFM measure; *SD* = standard deviation of the items defining the FFM measure. Possible mean scores range from 1 to 9 for MM and BRS; 1 to 5 for BFI.

* $p < .001$.

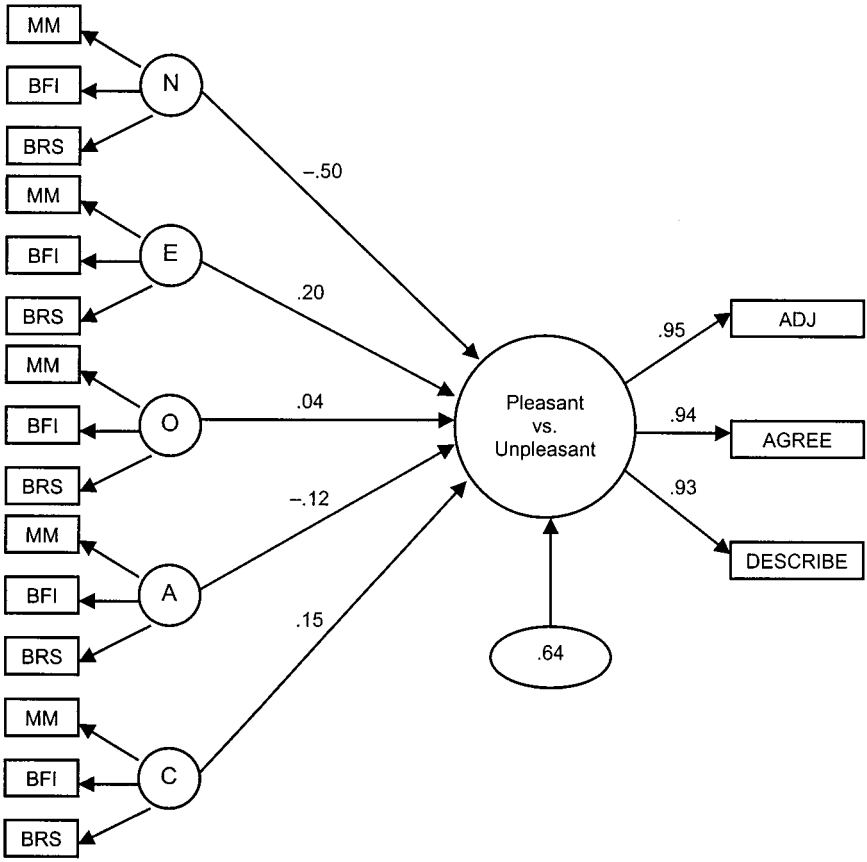

FIG. 1. Path diagram showing a structural equation model for the bipolar affect dimension of Pleasant vs. Unpleasant. Correlations among the FFM dimensions, error terms, and correlation between error terms using the same response formats were estimated, but are not shown.

Diener's Activated Unpleasant versus Unactivated Pleasant. Each affect variable, indicated by three scales with different response formats, was treated in turn as the endogenous construct. Exogenous constructs were personality dimensions, and three different models of personality were compared. There are thus a total of 18 structural equation models (6 affect dimensions × 3 personality models). One such analysis is diagrammed in Fig. 1 and the full set of results is given in Table 2.

The question was, for each bipolar dimension of affect, which model of personality was the best predictor. The E-and-N model fit the data well, with a mean RMSEA of .07. The variance explained ranged from 12.2 to 34.8%, with a mean of 28.8%. The FFM also fit the data well, with a mean RMSEA

TABLE 2
Predicting Affect from Personality: Fit Indices for the 18 Structural Equation Models

Affect (endogenous variable)	Personality Model (exogenous variables)	χ^2	$\Delta\chi^2$	RMSEA (90% CI)	APGI (90% CI)	CFI	VAF (SE)	VAF by O, A, and C[a]
Pleasant vs Unpleasant[b]	E-N	192.22		.07 (.05/.08)	.92 (.88/.95)	.96	33.2 (5.9)	
	FFM	186.34	5.88	.07 (.05/.08)	.92 (.88/.95)	.97	35.7 (6.0)	2.5
	Alpha-Beta	78.45		.11 (.09/.14)	.89 (.83/.93)	.97	16.5 (5.0)	
Activated Pleasant vs Unactivated Unpleasant[c]	E-N	198.20		.07 (.06/.08)	.91 (.88/.94)	.96	31.6 (6.0)	
	FFM	189.62	8.58*	.07 (.05/.08)	.92 (.88/.95)	.96	33.8 (6.0)	2.2
	Alpha-Beta	87.61		.12 (.09/.14)	.87 (.81/.92)	.96	11.0 (4.4)	
Energy vs Tiredness[d]	E-N	201.66		.07 (.06/.08)	.91 (.87/.94)	.96	26.4 (5.7)	
	FFM	187.13	14.53**	.07 (.05/.08)	.92 (.89/.95)	.97	32.9 (6.0)	6.5**
	Alpha-Beta	86.38		.11 (.09/.14)	.88 (.82/.92)	.96	14.4 (4.8)	

Activated vs Deactivated[b]	E-N	206.88		.07 (.06/.09)	.91 (.87/.94)	.95	12.2 (4.6)	
	FFM	197.34	9.54*	.07 (.06/.08)	.91 (.88/.95)	.96	17.8 (5.4)	5.6**
	Alpha-Beta	95.17		.13 (.10/.15)	.85 (.79/.90)	.94	4.1 (3.0)	
Tension vs Calmness[d]	E-N	204.45		.07 (.06/.08)	.91 (.88/.94)	.96	34.8 (5.9)	
	FFM	199.13	5.32	.07 (.06/.09)	.91 (.87/.94)	.96	38.5 (6.0)	3.7*
	Alpha-Beta	87.61		.12 (.10/.15)	.87 (.81/.91)	.96	16.6 (5.1)	
Activated Unpleasant vs	E-N	194.16		.07 (.05/.08)	.92 (.89/.95)	.96	34.4 (6.1)	
Unactivated Pleasant[c]	FFM	187.10	7.06	.07 (.05/.08)	.92 (.89/.95)	.96	37.5 (6.1)	3.1
	Alpha-Beta	79.35		.11 (.08/.14)	.89 (.83/.93)	.96	12.3 (4.6)	

Note. $N = 217$; *df* for E-N = 93; *df* for FFM = 90; *df* for Alpha-Beta = 22. The E-and-N model and FFM are nested and the $\Delta\chi^2$ ($\Delta df = 3$) was computed as the difference between the E-and-N model and FFM. RMSEA = Root Mean Square Error of Approximation; APGI = Adjusted Population Gamma Index; CFI = Comparative Fit Index; 90% CI = 90% Confidence Intervals; SE = Standard Errors; VAF = Variance Accounted For.

[a] No standard errors are available for the Variance Explained by O, A, and C because it was computed as the difference between the Variance Explained by FFM and the Variance explained by the E-and-N model. Significance level for VAF by O, A, and C indicates that the portion of variance contributed significantly above and beyond the Variance Explained by the E-and-N model; significance level was determined by a Monte Carlo simulation.

[b] Feldman Barrett & Russell (1998).

[c] Larsen & Diener (1992).

[d] Thayer (1996).

* $p < .05$.

** $p < .01$.

of .07. The variance explained ranged from 17.8 to 38.5%, with a mean of 32.7%. The additional variance contributed by O, A, and C ranged from 2.2 to 6.5%, with a mean of 3.9%. Digman's Alpha and Beta[1] fit the data less well than the other two models of personality, with a mean RMSEA of .12. The variance explained ranged from 4.1 to 16.6%, with a mean of 12.5%.

Because the E-and-N model was nested within the Five Factor Model, we report the chi-square difference between the two. As seen in Table 2, in all six cases, the chi-square statistic favored the FFM. In three of the six, the difference was statistically significant, indicating a reliable improvement in model fit by adding O, A, and C to E and N. The mean RMSEA for both models remained the same, even though the full FFM carried three more parameters than did the E-and-N model. Taken together, evidence supported the FFM as the more powerful model of personality in the prediction of momentary affective feelings.

Despite the preceding analyses, the question remains whether improvement in variance explained by adding O, A, and C was reliable. The last column of Table 2 presents the significance level of the variance contributed by O, A, and C.[2] Three of six values were statistically significant. Although the portion of variance explained by O, A, and C was small, these three dimensions did contribute a reliable amount of variance in predicting affective states.

The regression weights for the FFM dimensions on the six bipolar affect variables are given in Table 3. Consistent with past findings, the Unpleasant Activated variables (Thayer's Tension versus Calmness and Larsen and Diener's Activated Unpleasant versus Unactivated Pleasant) correlated significantly and positively with Neuroticism. The Pleasant Activated variables (Thayer's Energy versus Tiredness and Larsen and Diener's Activated Pleasant versus Unactivated Unpleasant) related significantly to both Extraversion

[1] The precise specification of Digman's (1997) model was not clear from his writings. We therefore chose to define his superfactors in line with his theoretical model. In subsequent analyses, we defined Digman's factors in the following way. First, we computed *z* scores of all 15 personality scales (3 inventories $\times$ 5 personality variables). Second, for each inventory, we created a summation score for Alpha by summing the *z*-transformed N, A, C and a summation score for Beta by summing the *z*-transformed E and O. Third, for each inventory, the two summation scores were transformed into *z* scores. Finally, we created the superfactor Alpha by linearly combining three *z* scores of different personality inventories and Beta by linearly combining three *z* scores of different personality inventories.

[2] To the best of our knowledge, there was no available statistical procedure to answer this question with structural equation modeling. We therefore conducted six Monte Carlo simulation analyses, one for each endogenous variable. We compared the empirical values of the additional variance explained by O, A, and C in Table 2 with the values computed in the Monte Carlo analyses. This comparison allows us to estimate whether the empirical variance explained was statistically significant.

TABLE 3
Relating the Bipolar Affect Constructs to the FFM Dimensions: Regression Weights Used to Predict Affect from FFM

Affect (endogenous variable)	Regression weights of exogenous variables					VAF
	N	E	O	A	C	
Pleasant vs Unpleasant[a]	−.50**	.20**	.04	−.12	.15*	35.7
Activated Pleasant vs Unactivated Unpleasant[b]	−.46**	.35**	−.13	−.08	.19**	33.8
Energy vs Tiredness[c]	−.42**	.29**	−.16*	−.10	.26**	32.9
Activated vs Deactivated[a]	−.09	.39**	−.20*	−.07	.20**	17.8
Tension vs Calmness[c]	.56**	.15*	−.15*	.11	−.04	38.5
Activated Unpleasant vs Unactivated Pleasant[b]	.59**	.04	−.12	.17*	−.09	37.5

Note. $N = 217$; N = Neuroticism; E = Extraversion; O = Openness to Experience; A = Agreeableness; C = Conscientiousness; VAF = Variance Accounted For. Regression weights in each row are results of a separate structural equation model having the FFM dimensions as the exogenous variables and one affect dimension as the endogenous variable.

[a] Feldman Barrett & Russell (1998).

[b] Larsen & Diener (1992).

[c] Thayer (1996).

* $p < .05$.

** $p < .01$.

(positively) and, inconsistent with past findings, to Neuroticism (negatively). Beyond these, other personality predictors were significant. Importantly, the horizontal axis (Pleasant versus Unpleasant) was as related to personality, although the vertical axis (Activated versus Deactivated) less so, as the diagonal dimensions.

Summary

The E-and-N model, the FFM, and Digman's Alpha and Beta all were able to predict current momentary affective feelings, accounting for 29, 33, and 13% of variance on average, respectively. The FFM fit the data slightly better than did the E-and-N model and was able to account for a small but significant amount of additional variance. The E-and-N model is more parsimonious and represents a reasonable choice in predicting affect, but the FFM accounts for more of the affect variance.

Nonlinear Effects of Personality on Affect

McFatter (1994) argued that the kind of analyses we have reported so far might be misleading because they allow only linear relations between affect and personality. McFatter offered widely cited evidence for interaction effects and curvilinear relations. In this section, we explore McFatter's hypothesis. McFatter focused on two dimensions of affect: Watson and Tellegen's (1985) Positive and Negative Affect. We therefore focused on these two dimensions as well, although we used Thayer's (1996) and Larsen and Diener's (1992) versions (which are known to be highly correlated with Watson and Tellegen's scales; see Yik et al., 1999). On the personality side, following McFatter, we restricted our examinations to Extraversion and Neuroticism.[3]

To examine the curvilinear and interaction effects of personality on affect, we computed a series of hierarchical linear multiple-regression equations.[4] This form of analysis allows the most direct comparison with the analyses reported by McFatter (1994). We first reanalyzed McFatter's data. In addition, our own data provided 18 replications of his results (3 predictors $\times$ 2 constructs $\times$ 3 response formats).

[3] We also repeated the three-step regression analyses with O, A, and C. Similar to what was reported here, the nonlinear effects contributed negligible amount of variance. Further, we also examined the performance of E and N in predicting the CMQ constructs (Pleasant, Unpleasant, Activated, and Deactivated affect). Again, nonlinear effect contributed small amount of variance.

[4] Although statistical software is available to examine the nonlinear effects in the structural equation modeling approach, each has problems (Moosbrugger, Schermelleh-Engel, & Klein, 1997). Following McFatter (1994), we decided to use a multiple-regression approach in analyzing the nonlinear effects of personality on affect.

In each regression equation, one affect variable (e.g., the adjective version of Thayer's Energy) served as the criterion variable. The Extraversion and Neuroticism scales of one inventory (e.g., Saucier's 40 Mini-Markers) served as predictor variables. In Step 1, the main effects of E and N were entered into a regression equation and the variance explained was computed. In Step 2, the E × N interaction term was entered into the regression equation and the additional variance explained by this term, over and above that from Step 1, was computed. Finally, in Step 3, the quadratic terms E^2 and N^2 were entered into the regression equation and the additional variance explained by these terms, over and above those from Steps 1 and 2, was computed.

Pleasant activated states. Table 4 gives the regression coefficients for the final equation obtained in Step 3 and the R^2 change for each step of the hierarchical regression for the pleasant activated states. The 1st row of the table gives a reanalysis McFatter's (1994) data following the above three-step regression analysis for comparison purpose.[5] The next 18 rows give replications of McFatter's results.

Consider first the total variance explained, adjusted R^2 (the last column), by all three steps in each regression equation. McFatter's (1994) data yielded a figure of 19%. In the present data, the variance explained ranged from 13 to 27%, with a mean of 20.7%. In this regard, our results replicated McFatter's quite well.

Turn now to Step 1. In McFatter's (1994) data, 19% of the total variance was explained by the main effects of E and N; the result was significant. In the present data, the variance explained in Step 1 was statistically significant in every case and ranged from 13 to 22%, with a mean of 18.9%. Our analyses replicated McFatter's quite well in this regard. McFatter obtained a positive nonsignificant regression coefficient for E, and this sign was replicated in the present data. McFatter obtained a negative significant coefficient for N, but the regression coefficients associated with N were all positively signed in the present data; only four replications were statistically significant.[6]

Turn now to Step 2. In McFatter's (1994) data, an additional 1% of the variance was explained by adding E × N interaction term; the result was nonsignificant. In the present data, the additional variance explained ranged

[5] To provide results for each of the three steps, McFatter's (1994) data were reanalyzed by following the three-step regression analysis. By and large, we found similar results as reported by McFatter. However, since we have preference for corrected statistics (e.g., standardized regression weights and adjusted R^2) and a conservative approach in hypothesis testing ($p < .01$), results reported here look slightly different from those reported by McFatter. The effect of E^2 on PA and the effects of E × N and N^2 were reported to be statistically significant at .05 level by McFatter; these effects were regarded as Type I error in Tables 4 and 5.

[6] In a linear regression with E and N as the predictors, the signs in the present data replicated McFatter's (1994) and are all negative. The curious results of Table 4 show what happens when E × N, E^2, and N^2 were all entered into a regression equation.

TABLE 4
Examining Nonlinear Effects on Pleasant Activated Affective States

Criterion variable	Predictor variable	Standardized regression coefficients: Step 1 E	Step 1 N	Step 1 R^2	Step 2 E × N	Step 2 ΔR^2	Step 3 E^2	Step 3 N^2	Step 3 ΔR^2	Adjusted R^2
					Watson, Clark, and Tellegen's (1988) Positive Affect[a]					
Adjective	EPI	.45	−.71*	.19*	.39	.01	−.47	.07	.01	.19
					Thayer's (1996) Energy[b]					
Adjective	MM	.24	1.33*	.17*	−.84*	.03*	.77	−.94	.03	.20
Adjective	BFI	1.07	.48	.17*	−.81	.03*	−.08	−.06	.00	.18
Adjective	BRS	.72	.62	.18*	−.65	.02	.13	−.18	.00	.19
Agree–Disagree	MM	.60	.88	.16*	−.63	.02	.20	−.71	.01	.17
Agree–Disagree	BFI	1.19	.08	.21*	−.60	.01	−.42	.07	.00	.21
Agree–Disagree	BRS	.99	.52	.20*	−.76	.03*	−.11	−.06	.00	.22
Describes Me	MM	.79	1.18*	.21*	−1.07*	.04*	.38	−.76	.01	.25
Describes Me	BFI	1.17	.55	.22*	−.92*	.03*	−.11	−.14	.00	.23
Describes Me	BRS	.80	.73	.21*	−.81*	.04*	.14	−.22	.00	.23
					Larsen and Diener's (1992) Activated Pleasant[b]					
Adjective	MM	.31	1.43*	.13*	−.86*	.03*	.66	−1.02	.03	.16
Adjective	BFI	1.34	.75	.18*	−.83	.02	−.37	−.36	.01	.18
Adjective	BRS	1.04	.93	.19*	−.89*	.04*	−.03	−.31	.00	.21
Agree–Disagree	MM	.31	.52	.14*	−.39	.01	.32	−.45	.01	.13
Agree–Disagree	BFI	1.17	.11	.20*	−.66	.02	−.36	.10	.00	.20
Agree–Disagree	BRS	.94	.33	.22*	−.69	.03	−.11	.04	.00	.23
Describes Me	MM	.89	1.34*	.20*	−1.01*	.04*	.24	−.94	.02	.24
Describes Me	BFI	1.54*	.76	.20*	−1.01*	.03*	−.39	−.26	.01	.22
Describes Me	BRS	.67	1.35	.21*	−1.09*	.06*	.46	−.64	.02	.27

Note. A hierarchical multiple regression was computed for each criterion variable. In Step 1, E and N were entered into the regression equation. In Step 2, the E × N term was entered. In Step 3, the quadratic terms of E^2 and N^2 were entered. Regression coefficients reported are adopted from Step 3.

[a] Reanalysis of McFatter's (1994) data ($N = 384$); Eysenck Personality Inventory (H. J. Eysenck & S. B. G. Eysenck, 1964) was used.

[b] Analysis of the present data ($N = 217$). MM = Saucier's (1994) 40 Mini-Markers; BFI = John, Donahue, and Kentle's (1991) Big Five Inventory; BRS = Goldberg's (1992) Bipolar Rating Scale.

* $p < .01$.

from 1 to 6%, with a mean of 2.9%. Eleven of 18 replications were statistically significant. McFatter obtained a positive coefficient for the E × N term. All 18 replications with the present data obtained a negatively signed coefficient; nine replications were statically significant.

Turn now to Step 3. In McFatter's (1994) data, an additional 1% of the variance was explained by adding the quadratic terms E^2 and N^2; his result was nonsignificant. In the present data, the variance explained was similar, ranging from 0 to 3%, with a mean of 0.8%. The predictive power of the quadratic terms was always low. McFatter obtained a negative coefficient for E^2 and a positive coefficient for N^2. Of the 18 replications, only 3 replicated this pattern. In all, for pleasant activated affect, the quadratic terms made a negligible contribution in explaining the variance.

Unpleasant activated states. Table 5 gives a parallel set of analyses for unpleasant activated affect. The regression coefficients in the final equation and the change in R^2 for each step of the hierarchical regression were given. Again the first row of the table gives a reanalysis McFatter's (1994) data and the next 18 rows give replications of McFatter's results.

McFatter's (1994) data yielded 31% of the total variance explained. In the present data, the variance explained ranged from 7 to 21%, with a mean of 14.8%. Our data explained only half as much variance as McFatter's did in unpleasant activated states.

In Step 1, McFatter's (1994) data showed 30% of the variance explained by the main effects of E and N; the result was significant. In the present data, the figure was 15.9%; all were statistically significant. McFatter obtained a negative regression coefficient for E but a positive coefficient for N. Of 18 replications in the present data, only 6 replicated this pattern.

In Step 2, McFatter's (1994) data showed an additional 1% for the variance explained by adding the E × N interaction term; the result was not significant. In the present data, the figure was 0.2%; none was statistically significant. McFatter obtained a negative coefficient for E × N. Of 18 replications, 6 cases replicated McFatter's result.

In Step 3, McFatter's (1994) data showed an additional 1% of the variance by adding the quadratic terms of E^2 and N^2; the result was not significant. In the present data, the figure was 0.6%; none was significant. McFatter obtained a positive coefficient for both E^2 and N^2. Of the 18 replications, six replicated the pattern.

Summary. The main (linear) effects of E and N are large and important, although they account for less of the variance in our data than in McFatter's (1994) for unpleasant activated affects. The discrepancy is interesting and may stem from a difference in method. McFatter's participants provided affect ratings based on the past 2 weeks, whereas our participants provided affect ratings for an instant of time–current affect.

Nonlinear effects of E and N were found less important. For pleasant acti-

TABLE 5
Examining Nonlinear Effects on Unpleasant Activated Affective States

Criterion variable	Predictor variable	Standardized regression coefficients: Step 1 E	Step 1 N	Step 1 R^2	Step 2 E × N	Step 2 ΔR^2	Step 3 E^2	Step 3 N^2	Step 3 ΔR^2	Adjusted R^2
Watson, Clark, and Tellegen's (1988) Negative Affect[a]										
Adjective	EPI	−.10	.35	.30*	−.34	.01	.25	.47	.01	.31
Thayer's (1996) Tension[b]										
Adjective	MM	−.34	.85	.09*	.01	.00	.44	−.58	.01	.07
Adjective	BFI	.02	.17	.13*	.06	.00	.09	.14	.00	.11
Adjective	BRS	−.94	−.56	.11*	.63	.01	.58	.32	.01	.10
Agree–Disagree	MM	.26	1.02	.11*	−.16	.00	−.15	−.59	.01	.10
Agree–Disagree	BFI	.81	.86	.20*	−.35	.00	−.46	−.15	.01	.18
Agree–Disagree	BRS	−.11	.31	.19*	.21	.00	−.02	−.06	.00	.18
Describes Me	MM	−.05	.98	.11*	−.22	.00	.17	−.51	.01	.10
Describes Me	BFI	.37	.27	.20*	.09	.00	−.38	.13	.00	.19
Describes Me	BRS	−.79	−.18	.19*	.59	.01	.38	.09	.00	.19
Larsen & Diener's (1992) Activated Unpleasant[b]										
Adjective	MM	−.32	.64	.11*	−.22	.00	.48	−.16	.01	.09
Adjective	BFI	−.06	.10	.13*	.03	.00	.08	.25	.00	.11
Adjective	BRS	−.83	−.57	.13*	.52	.00	.43	.45	.01	.12
Agree–Disagree	MM	.08	.83	.15*	.31	.00	−.38	−.66	.02	.15
Agree–Disagree	BFI	.78	.33	.22*	−.05	.00	−.73	.17	.01	.21
Agree–Disagree	BRS	−.68	.21	.21*	.44	.01	.31	−.17	.00	.21
Describes Me	MM	.01	.82	.16*	−.15	.00	−.03	−.35	.00	.14
Describes Me	BFI	.17	.26	.23*	.01	.00	−.24	.19	.00	.21
Describes Me	BRS	−.69	−.14	.20*	.52	.01	.22	.08	.00	.20

Note. A hierarchical multiple regression was computed for each criterion variable. In Step 1, E and N were entered into the regression equation. In Step 2, the E × N term was entered. In Step 3, the quadratic terms of E^2 and N^2 were entered. Regression coefficients reported are adopted from Step 3.

[a] Reanalysis of McFatter's (1994) data ($N = 384$); Eysenck Personality Inventory (H. J. Eysenck & S. B. G. Eysenck, 1964) was used.

[b] Analysis of the present data ($N = 217$). MM = Saucier's (1994) 40 Mini-Markers; BFI = John, Donahue, and Kentle's (1991) Big Five Inventory; BRS = Goldberg's (1992) Bipolar Rating Scale.

* $p < .01$.

vated affect, the E × N interaction term was found to explain, on average, a significant additional 3% of variance in the present data, which is higher than the 1% reported by McFatter. For the unpleasant activated affect, the E × N interaction term and the quadratic terms of E^2 and N^2 were all found to contribute a negligible portion of variance. Thus, the E × N interaction is small but possibly significant, and the quadratic effects are tiny, if existent at all. Perhaps more theoretically driven analyses—predicting why and where specific nonlinear effects are to be expected—can yield more power, but overall our results were discouraging.

Structural Convergence of Personality Variables and the Circumplex Model of Affect

Various investigators have argued that the basic dimensions of affect correspond to the locations of Extraversion and Neuroticism in the affective space (Meyer & Shack, 1989; Tellegen, 1985). But where, precisely, do these (and other) personality dimensions lie in that space? Zero-order correlations are not that helpful. Table 6 gives the zero-order correlations of personality with the affect variables. As predicted, the Neuroticism scales correlated with the unpleasant activated states, but Neuroticism also correlated with other affect scales. As predicted, the Extraversion scales correlated with the pleasant activated states, but Extraversion also correlated with other affect scales. In this section, we take an alternative approach to this issue.

Structural equation model. Results from previous studies (e.g., Feldman Barrett & Russell, 1998; Yik et al., 1999) showed that the two-dimensional affective space can be well captured by Pleasant versus Unpleasant and Activated versus Deactivated affect axes. To place the seven personality variables into the affect space, we created a separate structural equation model for each personality variable—seven structural equation models in all. Within each model were two exogenous constructs (Pleasant versus Unpleasant and Activated versus Deactivated) and one endogenous (personality) constructs. Parameter estimates, including factor loadings and error variance associated with the manifest variables and correlated error terms on the exogenous side, were fixed at the predetermined values obtained in a multisample analysis that provided stable parameter estimates for the cornerstones of the two-dimensional affective space (see Model 3 of Yik et al., 1999).

We estimated the following parameters for each endogenous (personality) construct: (a) factor loadings between each manifest variable on its intended first-order latent construct, (b) error term associated with each manifest variable, (c) correlations between error terms with the same inventory, (d) regression weights of each personality variable on the exogenous constructs, and (e) the disturbance term associated with each personality variable. The two regression weights for the personality variable serve as coordinates for projecting it onto the affective space. Resulting angle for each personality variable is given in Table 7.

TABLE 6
Zero-Order Correlations between 36 Affect Scales and the Neuroticism and Extraversion Scales

Construct	Format	Extraversion			Neuroticism		
		MM	BFI	BRS	MM	BFI	BRS
Pleasant[a]	Adjective	.27	.30	.37	−.26	−.37	.41
	Agree–Disagree	.25	.29	.33	−.26	−.34	−.38
	Describes Me	.27	.30	.38	−.28	−.45	−.45
Activated Pleasant[b]	Adjective	.33	.35	.39	−.12	−.30	−.31
	Agree–Disagree	.33	.34	.39	−.16	−.35	−.38
	Describes Me	.37	.38	.38	−.21	−.32	−.38
Energy[c]	Adjective	.38	.37	.40	−.13	−.26	−.27
	Agree–Disagree	.33	.35	.39	−.21	−.36	−.35
	Describes Me	.39	.38	.40	−.23	−.34	−.35
Activated[a]	Adjective	.31	.31	.31	−.07	−.16	−.18
	Agree–Disagree	.31	.30	.25	−.03	−.10	−.10
	Describes Me	.27	.25	.22	.01	−.09	−.00
Tension[c]	Adjective	.11	.08	−.01	.27	.32	.31
	Agree–Disagree	.01	−.03	−.12	.34	.44	.43
	Describes Me	−.02	−.03	−.12	.34	.44	.44
Activated Unpleasant[b]	Adjective	.01	−.04	−.13	.32	.36	.36
	Agree-Disagree	−.06	−.08	−.19	.38	.46	.46
	Describes Me	−.12	−.15	−.22	.37	.47	.45

Unpleasant[a]	Adjective	−.09	−.16	−.24	.32	.37	.36
	Agree–Disagree	−.13	−.19	−.28	.33	.42	.40
	Describes Me	−.19	−.23	−.33	.38	.49	.48
Tiredness[c]	Adjective	−.16	−.13	−.21	.25	.27	.28
	Agree–Disagree	−.30	−.27	−.36	.25	.39	.34
	Describes Me	−.21	−.23	−.31	.26	.37	.33
Unactivated Unpleasant[b]	Adjective	−.15	−.10	−.18	.22	.25	.31
	Agree–Disagree	−.11	−.11	−.20	.23	.35	.33
	Describes Me	−.16	−.14	−.21	.27	.35	.35
Deactivated[a]	Adjective	−.28	−.24	−.22	.11	.16	.11
	Agree–Disagree	−.19	−.17	−.10	.02	.08	.02
	Describes Me	−.25	−.19	−.21	.02	.06	.04
Calmness[c]	Adjective	−.10	−.07	−.00	−.24	−.24	−.27
	Agree–Disagree	−.09	−.02	.07	−.24	−.35	−.37
	Describes Me	−.13	−.07	.03	−.21	−.22	−.24
Unactivated Pleasant[b]	Adjective	.01	.03	.11	−.26	−.35	−.34
	Agree–Disagree	−.03	.01	.14	−.31	−.40	−.40
	Describes Me	−.01	.02	.10	−.25	−.38	−.36

Note. N = 217; MM = Saucier's (1994) 40 Mini-Markers; BFI = John, Donahue, and Kentle's (1991) Big Five Inventory; BRS = Goldberg's (1992) Bipolar Rating Scale. Correlation coefficients greater than |.18| are significant at .01 level, two-tailed.

[a] Feldman Barrett & Russell (1998).

[b] Larsen & Diener (1992).

[c] Thayer (1996).

TABLE 7
Empirical Locations of the Personality Dimensions on the Two-Dimensional Affective Space

Personality variable	Structural Equation Model[a]		CIRCUM-Extension	
	Angular estimate	Variance explained (%)	Angular estimate	Communality index
Neuroticism	184°	29	180°	.72
Extraversion	46°	15	36°	.48
Openness to Experience	355°	5	354°	.24
Agreeableness	23°	2	24°	.15
Conscientiousness	31°	7	21°	.29
Alpha	14°	16	9°	.52
Beta	27°	12	22°	.43

Note. $N = 217$. Communality index indicates the correlation between the personality dimension and the common score of the affective space.

[a] RMSEAs range from .06 to .08, with a mean of .07.

CIRCUM-Extension procedure. The preceding analysis based on a structural equation model uses only some of the affect dimensions, and we therefore prefer a more powerful technique. The circumplex provides a prediction about the pattern of correlations between the whole array of affect variables and any external variable: The correlations of any one external variable with the 12 affect constructs should form a sine wave. Following Russell et al. (2001), we therefore fit a sine function to seven series of correlations, one for each personality variable. Figure 2 illustrates this method: 12 affect variables form the abscissa; and the correlation of each affect variable with Neuroticism is the ordinate. As shown there, the correlations indeed follow a sine wave.

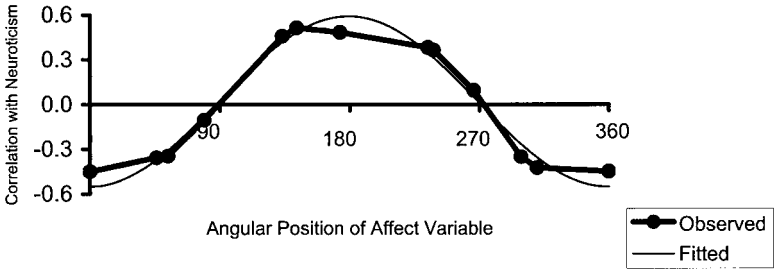

FIG. 2. $N = 217$. The correlation of affect variables with the personality dimension of Neuroticism as a function of the angle within the circumplex for 12 affect variables. The value for the affect variable at 0° is repeated at 360° to show the complete curve.

We computed a score for each of the 12 unipolar affect constructs by summing the *z* scores of its three constituent scales and a score for each of the personality dimension by summing the *z* scores of its three constituent personality inventories. Next, we computed correlations between each personality dimension and the 12 affect constructs. A sine function was fitted to each series of correlation. The pattern of correlations approximated a sine curve for all personality variables. The variance explained by the fitted function was used to evaluate the model fit. Variance explained was 97% for Neuroticism, 96% for Extraversion, 96% for Openness to Experience, 86% for Agreeableness, 91% for Conscientiousness, 96% for Factor Alpha, and 97% for Factor Beta. The mean variance across the seven personality variables was 94%.

To project the personality variables on the circumference of the two-dimensional affective space, we used Browne's (1999) CIRCUM-Extension procedure, which provides a maximum likelihood estimate of the angular location of each personality variable (see Russell et al., 2001 for details). Results are graphed in Fig. 3.

Where within the two-dimensional affective space did each personality trait fall? That is, what was the vector of the affective space that was maxi-

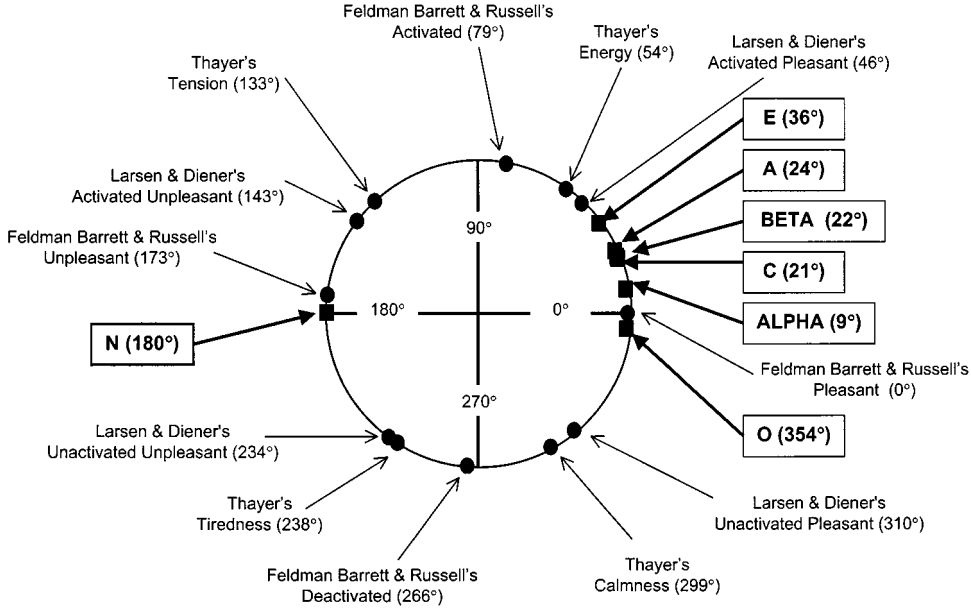

FIG. 3. *N* = 217. A circumplex representation of 12 affect constructs via CIRCUM (Browne, 1992) and five personality variables via CIRCUM-Extension (Browne, 1999). N = Neuroticism; E = Extraversion; O = Openness to Experience; A = Agreeableness; C = Conscientiousness.

mally correlated with each personality dimension? The structural equation models provided one estimate of this angle and the CIRCUM-Extension procedure provided a second. These two estimates are based on different methods of analysis (regression weights with the horizontal and vertical axes in the first case and correlation with 12 affect scales in the second) and therefore need not be identical. The results shown in Table 7 are indeed not identical. Nonetheless, they are similar. The discrepancy between the two estimates ranged from 1° to 10°, with a mean of 5°.

How should the affective space be rotated? The results were perfectly ambiguous. (The zero-order correlations of Table 6 support a similar conclusion.) Consider first E and N. E fell in the upper right-hand quadrant of the affective space; the result (36°) is close to Watson and Tellegen's (1985) and Meyer and Shack's (1989) prediction that E corresponds to a vector near 45°. On the other hand, N fell on the horizontal axis (180°), far from the predicted 135°. If personality correlates are taken as the criterion for rotation, the result with E thus favored the Watson–Tellegen rotation, whereas the result with N favored the valence/arousal rotation used in our model and shown in Fig. 3. O fell near the horizontal axis, but A and C were roughly midway between the horizontal axis and the 45° alternative. Alpha and Beta similarly provided mixed results. Altogether, these results support neither rotational scheme commonly thought to be in competition.

GENERAL DISCUSSION

Affective Space

Our structure of affect was not tested here, but used as a tool. Nevertheless, the data lent some support to that structure in that we had predicted that all affect variables could be linked to each personality trait via a sine wave. This prediction was borne out in seven of seven cases examined. We used a procedure that allowed the calculation of where in the affect circumplex is the vector maximally correlated with a given personality trait. The values obtained from this method agreed with estimates obtained with structural equation models. These maximum correlations in turn had been thought to be indicators of where the axes of the affect structure might best be located. On this point, our results were negative. No one rotation received more support than any other.

Consistent with Larsen's (1989) findings, personality dimensions fall throughout the affective space—leaving no hints on just which rotation is more ''basic'' than the other. In fact, of the FFM dimensions, two—Neuroticism and Openness to Experience—almost overlapped with the horizontal axis of Pleasant versus Unpleasant. Extraverts were found to be more likely to experience pleasant activated states. This result is consistent with previous findings in which E was repeatedly found to correlate with the pleasant acti-

vated affect (in Watson and Tellegen's term, Positive Affect or more recently Positive Activation). Neurotics were found to be more likely to experience unpleasant affect, but are as likely to be deactivated as activated (see both Table 6 and Fig. 3). This result may seem inconsistent with previous findings in which Neuroticism was repeatedly found to correlate with unpleasant activated affect (in Watson and Tellegen's term, Negative Affect or more recently Negative Activation), but these studies did not include measures of the horizontal Pleasant versus Unpleasant axis. Our results thus underscore the need to examine the full structure of affect and to search for the maximal correlation rather than relying on zero-order correlations between an affect dimension and one preselected personality dimension. In contrast to the claim that Neuroticism corresponds to the unpleasant activated affect, Neuroticism may correspond simply to the likelihood of unpleasant affect more generally (whether that the unpleasantness is combined with activation as in anxious states or with deactivation as in depressed states). Thus the present finding presents a challenge to the methodological approach taken and to the substantive conclusions drawn in previous studies.

The present study lends support to the argument that personality correlates do not help resolve the question of how to rotate the dimensions of affect. Personality does not point to the basic axes (Larsen & Diener, 1992). Of course, we believe that dimensions of personality could be found that are located at 135°; perhaps Eysenck and Eysenck's own scales would do so or perhaps another operational definition of N could be formed that does so. But we also believe personality dimensions can be found that fall at locations other than 135°, indeed perhaps at any angle. Thus, the choice between competing rotations should be made on the basis of conceptual considerations (e.g., Reisenzein, 1994; Russell & Feldman Barrett, 1999).

Personality

The present study compared the ability of three different personality models in predicting momentary affect. Extraversion and Neuroticism are the two dimensions most predictive of momentary affect. The FFM adds Agreeableness, Conscientiousness, and Openness to Experience to the E-and-N model. Doing so provides a small but significant improvement in the ability to predict affect. Digman (1997) proposed summarizing the FFM with two second-order factors, Alpha and Beta. Overall, Digman's proposal did not fare well in our analyses. Alpha and Beta were considerably less predictive of affect than the original five factors. Thus, by this lone criterion, the Five Factor Model proved superior overall.

State–Trait Relations

As in previous studies, we found a significant link between affect and personality. With the FFM, personality predicted roughly a third of the vari-

ance in a person's current momentary affect. The Pleasant versus Unpleasant dimension was considerably more predictable (variance explained = 36%) than was the Activated versus Deactivated dimension (variance explained = 18%). McFatter (1994) argued that by taking into account nonlinear effects, more of the variance could be accounted for. We did find a significant but small increment in variance accounted for by the Extraversion × Neuroticism interaction effect, but curvilinear effects were negligible.

Is one-third of the variance large or small? Affect changes from moment to moment and is obviously predictable from one's current circumstances. Therefore, it is actually rather astonishing that one-third of the variance in one's current momentary affect can be predicted from one's enduring personality traits. Our results suggested that personality predicts more than one-third of the variance along the dimension of Pleasantness versus Unpleasantness but less than a third of the variance along the dimension of Activation versus Deactivation. Thus, perhaps activation varies more rapidly or reliably with context or over the course of the day. For the sake of argument, suppose that half of the variance in current momentary affect is accounted for by one's current situation. Further suppose that another 10% of the total variance is inevitably due to the process of measurement. That would leave but 40% of the variance altogether that could be accounted for by personality. Of course, the numbers are fiction, but they suggest that the ability of the Five Factor Model to account for one-third of the variance in current momentary affect is a major accomplishment.

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