Dynamic Stability of Behavior: The Rhythms of Our Interpersonal Lives

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ABSTRACT The authors examined whether variations in day-to-day estimates of personality characteristics, which are often treated as error, are instead predictable and meaningful. Using event-sampling and spectral analysis, they found that variations in interpersonal behavior over weekly periods were cyclic and normative. Dominant, submissive, agreeable, and quarrelsome behaviors rose during the week and fell on the weekend. The more general dimensions of agency and communion exhibited opposite patterns of cyclicity, with agency rising and communion falling during the week. Interpersonal traits were not useful in predicting behavior cyclicity. Extraverts exhibited a daily cycle, partially mediated by more varied partners and social behaviors during evenings. Findings are discussed with reference to conceptions of personality expression as dynamic yet stable processes.

In the early days of psychology, individual difference characteristics were conceptualized as fixed entities or qualities (e.g., Galton, 1883). In a pure

This research was supported by a McGill Major Fellowship to the first author and by grants from the Social Sciences and Humanities Research Council of Canada and Fonds pour la Formation de Chercheurs et l'Aide à la Récherche du Québec to the second author. Comments by Richard Koestner, Brian Little, Morton Mendelson, Lawrence Pervin, Howard Tennen, and three anonymous reviewers resulted in substantial improvements to the presentation of this research. Appreciation and affection are extended to Eun Jung Suh for help in conducting the study. Rhonda Amsel, Keith Worsley, and David Zuroff generously provided statistical assistance. Address correspondence to D. S. Moskowitz, Department of Psychology, McGill University, 1205 Dr. Penfield Avenue, Montreal, Quebec, Canada, H3A 1B1. Electronic mail may be sent to dsm@ego.psych.mcgill.ca.

Journal of Personality 66:1, February 1998.

trait view, little or no allowance was made for the impact of situational influences on behavior that reflected enduring characteristics. In its most rudimentary form, the expression of personality could be viewed as an arrow moving through time, with minimal meaningful changes in expression occurring as a result of environmental influences. A later perspective on the stability of personality, proposed first by Murray (1938) and then by Rotter (1954), Fiske (1961), and Cattell (1973), among others, suggested that personality characteristics, rather than being fixed and unchanging over time, are subject to fluctuations in expression brought about by psychological and social influences. While variations in the expression of personality are now commonly acknowledged, *in practice*, these fluctuations have been considered difficult to predict in any systematic fashion. As such, variability in behavior has been treated as error, and the underlying structure of personality has been considered to remain essentially the same over time and situations. The prevalent use of one-occasion trait measures for descriptive and predictive purposes has arisen from this view on personality expression.

In contrast to the classical trait view, a number of investigators have proposed that variability in personality expression is meaningful, informative, and often predictable (e.g., Nesselroade, 1991). Recent research by Mischel, Shoda, and Wright (e.g., Mischel & Shoda, 1995; Shoda, Mischel, & Wright, 1994) has shown that variability in the expression of social behavior brought about by various psychological and social phenomena is a central and stable feature of personality. Similarly, Larsen (e.g., 1987; Larsen & Kasimatis, 1990) and others (Penner, Shiffman, Paty, & Fritzsche, 1994) have found that intraperson variability in mood occurs in stable and reliable patterns, and the variability itself is traitlike in form. Other research has found stable, and often sizable, intraindividual variability in locus of control (Roberts & Nesselroade, 1986), temperament (Hooker, Nesselroade, Nesselroade, & Lerner, 1987), and self-esteem (e.g., Kernis, Granneman, & Barclay, 1992). This line of research suggests that one-occasion measures that require general or global descriptions of behavior, and even aggregation of multiple measurements, may miss important fluctuations in personality expression.

The apparent difference between the two positions on personality expression—the classical trait view and the variability view—raises important questions for our understanding of personality processes. Whether variability across time and situations in the expression of personality is treated as generally uninformative or as highly meaningful

has important implications for the description and prediction of behavior. The present study was designed to bring both positions to bear on the study of personality expression at the day-to-day level. Interpersonal behavior was measured over time to observe the nature and extent of its variability, and trait measures were applied to the prediction of this day-to-day behavior.

Historically, recognition of the error inherent in one-occasion measurement led to the proposal to aggregate measures across time. Aggregation of multiple measures has been seen as a means of canceling out random errors and producing a score that is an improved approximation of the true score of a particular trait or characteristic. The substantial benefit of aggregation for increasing estimates of stability over time and generality across situations has been well demonstrated (Epstein, 1979, 1980; Moskowitz, 1982, 1994; Moskowitz & Schwarz, 1982).

The validity of the process of aggregation rests upon the assumption that nothing of real importance to personality expression happens between measurement points. If aggregation is done over all possible situations and time points, information about the systematic effects of psychological and situational factors on the expression of personality characteristics is lost—for example, the effects of status on agency (Moskowitz, Suh, & Desaulniers, 1994) and the effects of perception of the other on aggression (Dodge, 1986). Thus, while past research has suggested that aggregation is necessary to produce consistency in behavior across time and situations, aggregation may not be sensitive to systematic influences of specific times and specific situations on behaviors that reflect personality characteristics (Epstein, 1984; cf. Pervin, 1976).

An alternative perspective to demanding consistency in the evaluation of personality constructs and measurements is to demand replicability. A basic question about personality can then evolve from "Will the person be the same under changing circumstances?" to "Under which circumstances will the person's behavior be the same?" The process of aggregation assumes that individuals are more likely to show replicable behavior when sufficient instances of the behavior have been aggregated. Most commonly, aggregation has been described as an isolation of true variance from the mix of true and error variances. The process of aggregation can also be conceptualized as curve smoothing that is designed to separate signal from noise.

In curve smoothing, behavior is represented as a function. This function can be selected to provide an estimate of a variable at a single

point in time, such as is done in aggregation, when the mean of a specified set of measurements is used to provide a single estimate of a variable. Aggregation, then, involves maximum smoothing. But it is not necessary to aggregate across all points to produce a smooth curve that highlights the signal (or true score) while minimizing the effects of error. It is possible to separate signal from noise by identifying more local smoothed curves. A curve can be constructed to fit a specified set of points that may identify substantial signal within limited time frames. In this way, a function is selected to match characteristics of the data occurring over time (Ramsay & Silverman, 1997). For example, the data points may correspond to a sine curve that rises and falls when matched with time.

Fluctuations in an individual's behavior have been shown to occur predictably over specific spans of time. Many kinds of behavior demonstrate, for example, regular rhythmic cycles: monthly hormonal changes in women, diurnal immunological cycles, and daily sleep-wake patterns—to name just a few. There are indications that affect manifests predictable weekly cyclicity, and that such cyclicity accounts for a sizable proportion of variance in affective expression (Larsen & Kasimatis, 1990).

The present study examined whether there are meaningful fluctuations in interpersonal behavior. The search for variability focused on behaviors selected from the interpersonal circumplex. This model has a long history of use in the organization of trait domains relevant to interpersonal behavior (e.g., Carson, 1969; Foa, 1961; Kiesler, 1983; Leary, 1957; Wiggins, 1979, 1982). Theoreticians typically organize the interpersonal characteristics into a circle defined by two major axes. One formulation is to label the axes as agency and communion (Wiggins, 1991). Agency and communion are meta-constructs that refer to modes of relating to the world. Wiggins defined agency as strivings for mastery and power that would enhance and protect the differentiation of the individual. Agentic behavior would be expressed by frequent dominant acts and infrequent submissive acts. Communion has been defined as strivings for intimacy, union, and solidarity with a social or spiritual entity and would be reflected in frequent agreeable behaviors and infrequent quarrelsome behaviors.

Several models are possible concerning the fluctuation of interpersonal behavior. The oldest view historically is that the level or frequency of each individual's interpersonal behavior remains generally constant over time and situations. A second view would assert that there is irregular

fluctuation in interpersonal behavior that corresponds to situational variations (Shoda et al., 1994); these situations would not necessarily occur regularly in time. For example, the situations that lead individuals to increase or decrease dominance may occur irregularly; such changing situations will correspond to variations in behavior, but neither situational nor behavioral variations would necessarily correspond to regular temporal markers, such as the day or the week.

A third possibility is that there is regular fluctuation in our interpersonal behavior that responds to the rhythms of our daily and weekly lives. There are regular changes in tasks, projects, and goals that lead to regular changes in interpersonal behavior. There may also be regular changes in the people we interact with over the course of the waking day, for example, from daytime to evening hours, and across the days of the week. Thus, there may be both inner, psychological, and external, social, reasons to expect regular variation; rhythms in interpersonal behavior may be due to changing patterns in motivations, expectations, and goals across time and to responsivity to changes in the individuals we regularly encounter at different times of the day and at different points in the week.

Perhaps the most salient features of the day and the week are expectable changes in situations tied to the workday and the work week. For many adults, mornings and afternoons are spent with coworkers, clients, and others. Evenings are often spent with family or friends. The changes in setting and the people available for interaction in these settings are likely to produce changes in major dimensions of interpersonal behavior, such as dominance, submissiveness, agreeableness, and quarrelsomeness. Interactions in the workplace often involve, implicitly or explicitly, status, power, and mastery. As such, agentic behavior such as dominance should regularly change on a rhythm that co-occurs with time spent at work and away from work. If "home is where the heart is," communal behavior that connects individuals, such as agreeableness, should rise and fall with time spent in and away from home. This picture of regular increases and decreases in agentic and communal behaviors views time as a systematic normative influence upon levels of such interpersonal behavior, because time reflects regularly recurring situations for many working people. The present study tested whether fluctuations in interpersonal behavior can be modeled normatively with a daily or a weekly cycle.

Systematic differences *between* individuals in behavior variations can also be expected, and these differences may be predicted by specific

personality traits. Individuals who score highly on a trait corresponding to a set of behaviors could be said to have a greater "investment" in the behavior, and could be expected to manifest trait-consistent behavior more strongly or more regularly than individuals low on the trait. This trait investment may be manifested in two ways: (1) less frequent change in the behavior, and consequently reduced cyclicity; and (2) a lower amplitude of variation across time. When the frequency of change is low, change in behavior—from, say, high to low dominance—is slow, in relative terms, from situation to situation; the cycles of the behavior are long. When the amplitude of change in behavior is low, an individual shows comparatively small increases and/or decreases in the expression of the behavior over occasions. A common index of amplitude is standard deviation. So, for example, an individual scoring high on the trait of dominance may have a smaller amplitude or standard deviation of change across time and a lower frequency or cyclicity of change in the expression of dominant behavior than an individual low in trait dominance.

There may also be broadband traits that predict greater or lesser cyclicity in interpersonal behavior. Individuals scoring high on extraversion have been found to be more sensation-seeking and more gregarious than individuals who score lower on this personality trait (Eysenck & Eysenck, 1983). As such, highly extraverted individuals may engage in more social interactions (Argyle & Lu, 1990; Diener, Larsen, & Emmons, 1984) with a greater variety of partners than those low on this trait. The extravert's responsivity to the behavior of these diverse partners may encourage a greater variety, or a greater variability of their own behavior over time. Such variability may coincide with the time of day or the day of the week. Distinctive daily cycles could be expected based on evidence showing that extraverts have higher arousal levels in the evening than do introverts (Blake, 1971; Eysenck, 1981). If this difference translates into more varied social behavior among extraverts, they may show characteristic cyclicity patterns that differ from those of others.

The purpose of the present research was to examine whether predictable cyclicity can be identified in day-to-day interpersonal behavior, and whether individuals differ reliably in such cyclicity. We refer to regular cyclicity in behavior as "dynamic stability" (cf. Capra, 1982; de Rosnay, 1979). Several questions were of primary interest to the present research: First, to what extent do these cycles occur in interpersonal behavior? Second, if they do occur consistently, over what periodicity or length of

time? Third, can these dynamic patterns be predicted from trait variables measured at a fixed point in time?

The present study had three hypotheses. First, dominant, submissive, agreeable, and quarrelsome behaviors were expected to rise and fall as a function of a daily and a weekly cycle. The goals pursued during working hours were expected to lead to an increase in agentic behavior during work periods compared to off-work periods. In contrast, communal behavior was expected to rise and fall in an inverse pattern to agency. Second, it was hypothesized that individuals higher on the interpersonal traits of dominance, submissiveness, agreeableness, and quarrelsomeness would manifest less variability in behaviors corresponding to these traits. Less variability would be manifested in lower frequencies of change and smaller amplitudes of behavior across time. Third, individuals high on extraversion were hypothesized to demonstrate more rapid (i.e., more frequent) cycles of change than individuals low on extraversion. If extraverts engage in more frequent social interactions, they may interact with a more varied group of individuals. Social responsiveness to these individuals may lead extraverts to greater variability and thus to shorter cycles of dominant, submissive, agreeable, and quarrelsome behaviors.

METHOD

Subjects

Participants responded to advertisements placed in local newspapers. No condition was placed on their participation except that they be working at least 30 hours per week in regular daytime hours. Of 100 individuals who began the study, 72 (33 males, 39 females) ranging in age from 19 to 63 years completed the study successfully without significant amounts of missing data (22 participants lost) or errors in data collection (6 participants lost).[1] Study completers

1. The most common reasons for missing data were absence of social interactions during particular time periods and loss of completed forms in the mail. Participants' data were excluded from analyses if less than 67% of data were available across the 60 time points. Of the 4,320 possible data points (72 participants × 60 time points), 3,657, or 85%, were available for analyses. When a missing value occurred in a participant's time series of data, it was replaced by linear interpolation from the surrounding values in the series. Such missing value replacement was a necessary requirement for the time series analysis reported here.

and attritors did not differ in age, sex, or education level, nor on the scales given at the initial briefing session: the IAS-R (Wiggins, Trapnell, & Phillips, 1988) and the NEO-FFI (Costa & McCrae, 1992). In the event-sampled data, those who were subsequently excluded from analyses completed significantly fewer forms than the other participants on the second and following days of the study, *p*s < .05 (comparisons done for Days 1 to 7). Participants were paid $100 for taking part in the study.

Procedure

Participants completed a detailed, 1-page form as soon as possible following every social interaction of 5 minutes duration or longer, every day for 20 days. The form requested information on the time of the interaction, a brief description of the interaction, with whom the interaction took place, and the interpersonal behaviors engaged in by the participant. Participants were given 10 forms to use per day, since previous research (Moskowitz, 1994) indicated that most people recorded an average of six interactions per day. Twenty forms were given to those who indicated that they would likely use more than 10 each day, but all were told to use as few or as many as their *natural* day-to-day behavior dictated. Participants used stamped, addressed envelopes to return completed forms to the researchers on the first subsequent weekday after daily recording.

Signaling devices (beepers) were also given to participants; they were signaled on a quasi-random schedule three times per day on weekdays, and twice per day on weekends, at which time they were to complete a form indicating the time that the signal occurred. These records were obtained to help ensure that interaction forms for the study were being completed throughout the day. Records of signal times were approximately 90% accurate. Each day's returned forms were also checked to ensure that they were being completed appropriately and throughout the day.

Participants completed, on average, more than six forms per day across the 20 days of the study. For purposes of analysis, the event-sampled data were grouped into morning (6 A.M. to noon), afternoon (noon to 6 P.M.), and evening (6 P.M. to 6 A.M.) periods according to the time of day in which reports were completed.[2] Participants completed an average of 2.1 forms during each morning period, 2.8 forms during each afternoon period, and 1.6 forms during each evening period. When more than a single report was completed within a time

2. Virtually all of the evening forms were completed in the 6-hour period between 6 P.M. and midnight. Grouping of the event-sampled data into equal time intervals was necessary to prepare it for the spectral analysis that follows. Spectral analysis, as with other forms of time series analysis, requires observations to be equally spaced in time. Analysis of the raw event-sampled data would have violated this assumption.

period, mean values for each variable were calculated. Thus, except for occasional missing data, each participant contributed 60 data points.

Measures

Event-sampled personality measure. The version of the interpersonal circumplex proposed by Wiggins (1979, 1982, 1991) was used as a model for an event-sampled measure of personality. Forty-six behavioral statements were used to measure the four personality dimensions of dominance, submissiveness, agreeableness, and quarrelsomeness. Previous research has shown that these statements provide reliable behavioral measures of the four dimensions, with good convergent and discriminant validity (Moskowitz, 1994; Moskowitz & Coté, 1995). Four different forms were used, such that on each day of the study participants were given a subset of the 46 statements to measure their behavior; 11statements were used on Form 1, 11 on Form 2, 12 on Form 3, and 12 on Form 4. Participants began the study with Form 1 on Day 1, Form 2 on Day 2, and so on, returning to Form 1 after each 4-day cycle. Within each form, a roughly equivalent number of statements measured each of the four circumplex dimensions. Within each dimension, assignment of statements to forms was done randomly. The internal consistencies among the items comprising each behavior dimension on each form were high: the interitem coefficient alphas for each of the four forms averaged .70 for dominance, submissiveness, and agreeableness, and .68 for quarrelsomeness. Across all four forms, the interitem coefficient alphas were .91 for dominance and agreeableness, and .90 for submissiveness and quarrelsomeness.

On each form, participants were asked: "Did you do any of the following acts?", and then were instructed to fill in a bracket beside each act they had done in the just-completed interaction. Examples included "I waited for the other person to act or talk first" (indicating submissiveness) and "I listened attentively to the other(s)" (indicating agreeableness). Scores for dominance, submissiveness, agreeableness, and quarrelsomeness were calculated in the following way (see also Moskowitz, 1994; Moskowitz & Coté, 1995): First, for each participant, the frequency of statements associated with each dimension were calculated within each time period in each day of the study. Second, the average number of statements checked over all four dimensions within each time period and day was computed for each participant. Third, this latter score was then subtracted from the frequency of each of the four dimension scores. This resulted in 60 (3 time periods × 20 days) "ipsatized mean scores" for each of the four dimensions. Ipsatizing the frequencies adjusts for individual differences in rates of checking statements. The average number of behaviors per interaction that were checked for each dimension, each time period, each day was then computed

by dividing the ipsatized frequency scores by the number of forms used in each corresponding time period and day.

Personality questionnaires. Two personality measures were administered before the event-sampling phase of the study. The IAS-R (Wiggins et al., 1988) is a highly refined, 64-item instrument that assesses the circumplex of interpersonal behavior. For purposes of the present study, four dimension scores were calculated: dominance, submissiveness, agreeableness, and quarrelsomeness. In the present sample, the interitem coefficient alphas across the four dimensions ranged from .77 to .88.

The NEO-FFI (Costa & McCrae, 1992) was also administered. It is a well-validated, 60-item measure of the five-factor model of personality, measuring neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. In the present sample, the interitem coefficient alphas for the five scales were .89, .71, .65, .76, and .81, respectively.

RESULTS

Stability of Behavior over Time

Traditionally, stability has been assessed by calculating a consistency estimate across administrations of a measure. Stability across days can be indexed by calculating coefficient alpha to assess the reliability of assessment given a specified number of times the characteristic has been measured (Cronbach, 1951). Stability across days was quite high for all four personality characteristics when coefficient alpha was calculated on the behavior dimension scores across the 20 days of the study; the stability coefficients ranged from .83 for dominance to .90 for quarrelsomeness (see Table 1).

Table 1
Stability Alpha Coefficients Across Days for Four Interpersonal Circumplex Behaviors, According to Number of Days of Data Aggregation

Interpersonal behavior	Number of days of measurement				
	4	8	12	16	20
Dominance	.45	.65	.75	.81	.83
Submissiveness	.53	.69	.77	.84	.87
Agreeableness	.50	.74	.83	.87	.90
Quarrelsomeness	.54	.77	.84	.87	.90
Mean	.51	.71	.80	.85	.88

Table 1 also presents stability coefficients based on smaller samples of days: the first 4 days, the first 8 days, the first 12 days, and the first 16 days of the study. Inspection of these coefficients indicates that high stability would also be obtained with measures based on fewer days. The stability coefficients for 16 days were all greater than .81, and the stability coefficients for 12 days were all greater than .75. In sum, when aggregated, these behavior dimensions appear to be highly stable across time.

Overview of Within-Subjects Spectral Analyses

Spectral analysis involves decomposing a time series into a number of periodic or cyclical functions using sine-cosine waves, each one accounting for some degree of variation in the data. The functions fit to each time series range from very slow changing, or long periods, to very quick changing, or short periods. Thus, for example, one person's time series data may show a stable, or reliable cycle of period 60 (or 20 days in the present study), and the spectral estimate at period 60 will be comparatively large, indicating a good fit of the spectral model to the data. If this is the only period that fits this person's data reliably, the spectral estimates at other periods will be smaller, because the model will not fit such periods well. Similarly, if another person's data cycles more quickly, say at period 3 (or 1 day in this study), the period 3 spectral estimate will be large.

For each participant's time series data on each interpersonal behavior, a collection of spectral estimates were produced, called the spectral density function, which represented a range of periods or frequencies, from very slow to very fast. Mathematically, each estimate is the average squared amplitude of the sinusoids at its corresponding period or frequency. The larger the estimate that is associated with a particular period, the more stable is the pattern of change that repeats itself across the time series of data. In the present study, spectral estimates ranged from 2 to 60 periods and were produced using the BMDP 1T program (Dixon, 1992).

The event-sampled raw data were prepared for spectral analyses in a manner similar to that done by Campbell, Chew, and Scratchley (1991) and by Larsen (1987). The data were first detrended and centered at zero using the BMDP 1T program. Inspection of the data indicated that the four event-sampling forms differed systematically due to differences in the composition of behavioral statements used on each form. To

counteract this problem, the form differences were statistically controlled by deseasoning, an adjustment of the data to eliminate user-specified periodic, repeated patterns in the time series that may mask underlying trends in the data (Bowerman & O'Connell, 1993). Following these adjustments, the residual scores were input into the spectral analyses.

Spectral analyses were conducted on each participant's data individually and then combined, following normalization of the estimates, for nomothetic analyses. Figure 1 displays the resulting spectral estimates across periods; mean values across participants have been calculated at each period. Larger spectral estimates were found for longer, or more slowly changing, periods. All four circumplex dimensions followed a very similar pattern across periods, with some variation in the data explained by comparatively fast cycles (e.g., of 1 and 2 days in length), and the largest amounts of variation accounted for by longer cycles. All four dimensions show the largest spectral estimate at the 20-period mark, which corresponds to an approximately 7-day cycle.

To determine how much variance could be accounted for by this predominant 7-day cycle, a sine wave was fit to the daily data (cf. Larsen & Kasimatis, 1990). If the 20-day data were truly rhythmic or cyclical at a 7-day period, a reasonably good fit of the sine wave to the data should be obtained. Sine wave values were calculated for each of the 20 days, assuming a 7-day cycle, and these values were correlated with the corresponding daily data after averaging each day's morning, afternoon, and evening data into single scores (yielding 20 data points for each participant and for each behavior). Because different participants began the study on different days of the week, missing values were created in some participants' data for this analysis to register all participants' starting points to the same day of the week. This ensured that the values for a single sine wave pattern could be correlated with data from the entire group. The correlations between the sine wave and the behavioral data were moderately large for all four circumplex dimensions: .44 for dominance, .57 for submissiveness, .41 for agreeableness, and .34 for quarrelsomeness.

To further explore the nature of the weekly cycle, participants' data for each of the 20 days were grouped according to the day of the week on which the behaviors were reported. The data were then standardized across participants to provide an objective index of behavioral change over time. As Figure 2 shows, all four behaviors show an inverted-U shape over the week, indicating that rates of dominance, submissiveness,

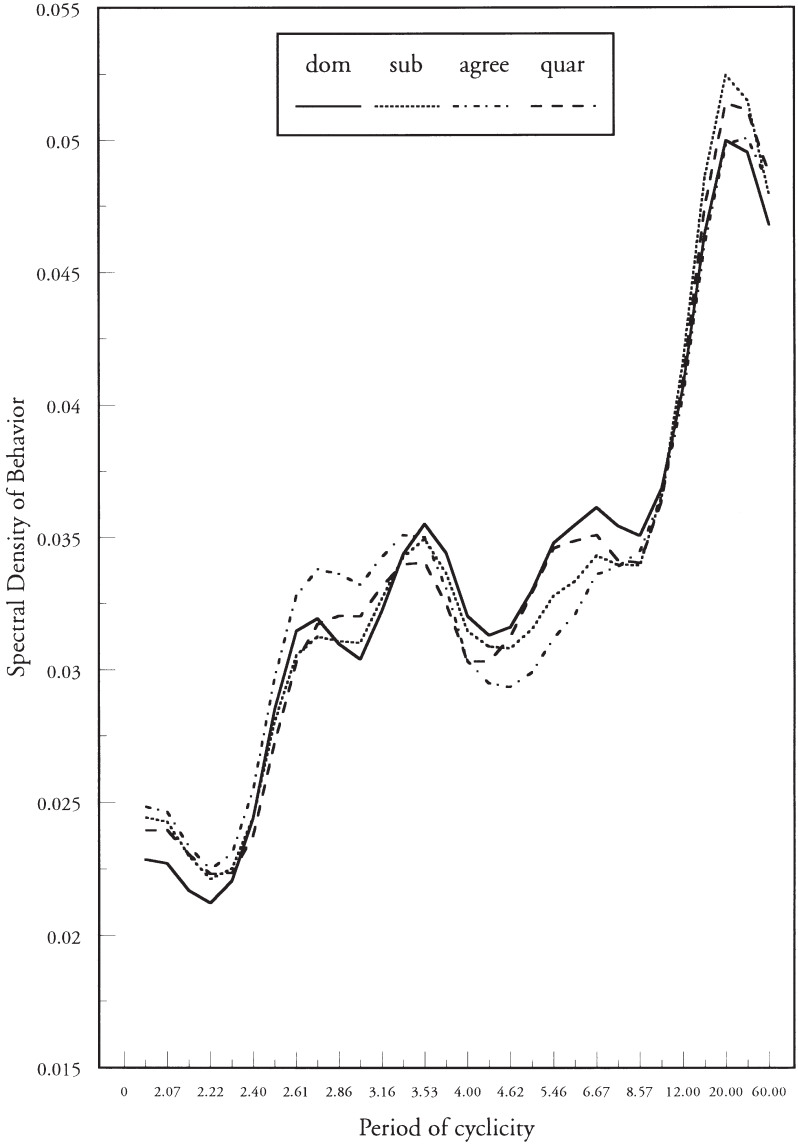

Figure 1
Plot of spectral density of event-sampled interpersonal behavior by period of cyclicity.

Note. Larger spectral estimates indicate a better fit of the sinusoidal cycle to the data. Each period divided by three corresponds to the number of days (or part thereof) over which each cycle occurs (period 3 = 1 day, period 6 = 2 days, etc.).

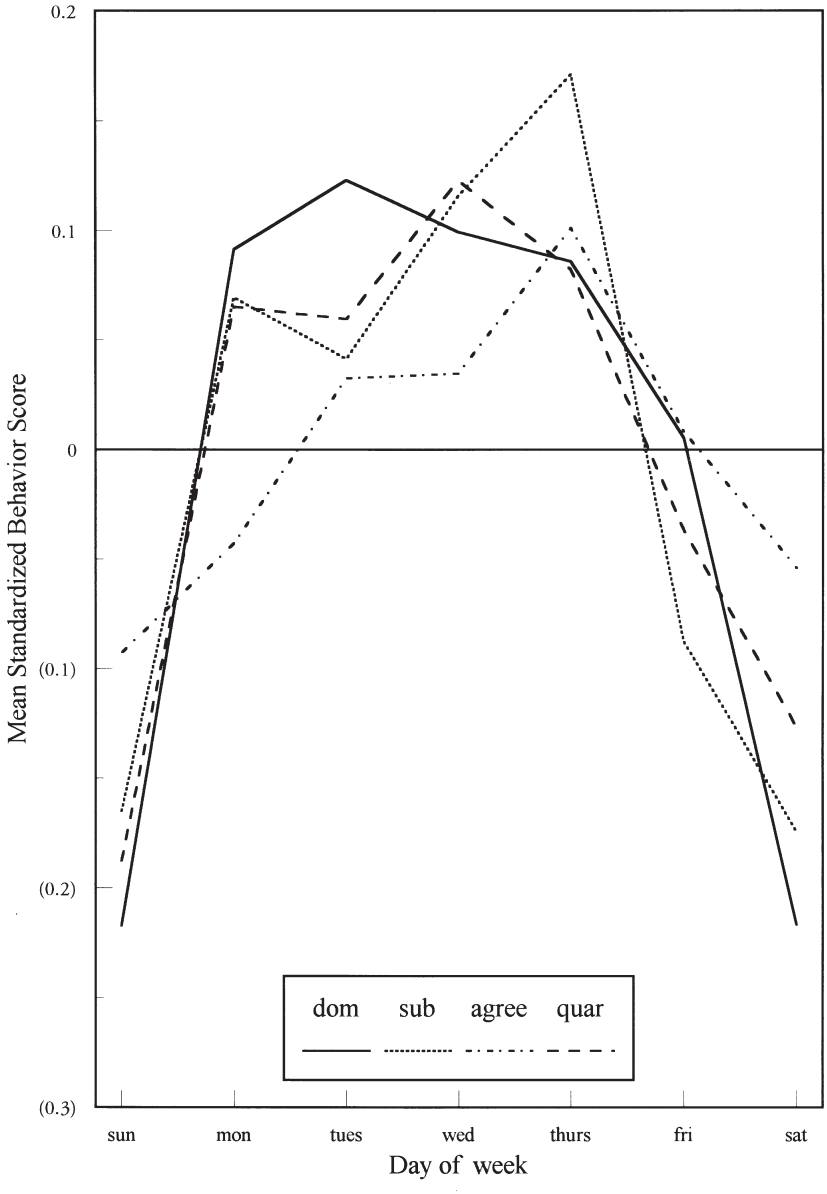

Figure 2
Means levels of dominant, submissive, agreeable, and quarrelsome behavior by day of the week.

agreeableness, and quarrelsomeness increased from Sunday into the first half of the work week and then declined toward the end of the work week and into the weekend. Dominance behavior showed the largest rise and fall over the 7-day week, while agreeableness showed the smallest changes. Submissive and quarrelsome behaviors showed degrees of change in between these two.

Repeated-measures analyses of variance were conducted on the mean values of each behavior separately to determine the nature of the trend over the weekly cycle. Trend analyses showed that all four behaviors displayed a significant quadratic pattern [dominance: $F(1, 497) = 61.41$, $p < .0001$; submissiveness: $F(1, 497) = 39.17$, $p < .0001$; agreeableness: $F(1, 497) = 9.19$, $p < .01$; quarrelsomeness: $F(1, 497) = 34.10$, $p < .0001$].

Agency scores were calculated by subtracting submissive scores from dominance scores. A repeated measures ANOVA showed trends toward significance for a quartic trend, $F(1, 497) = 3.34$, $p < .07$, and for a quadratic trend, $F(1, 497) = 2.75$, $p < .10$. Agentic behavior was reported more during the work week and less on the weekend (see Figure 3). The quartic trend was driven by a decline in agency on Thursday. The peaks for dominance and submissiveness were out of phase, such that while submissiveness peaked on Thursday dominance was on the decline by this day, leading to an overall drop in agency on Thursday.

Communal behavior was predicted to drop during the work week from higher levels on the weekend. Communion scores were calculated by subtracting quarrelsome scores from agreeable scores. A repeated measures ANOVA showed a significant quadratic trend over the week, $F(1, 497) = 4.30$, $p < .05$. Communal behavior was higher during the weekend than during the work week (see Figure 3). This result might be considered paradoxical given the previous finding that the rate of all four behaviors increased during the work week. However, communal behavior declined during the work week because the rate of quarrelsome behavior rose more rapidly than the rate of agreeable behavior over this time period.

An indication of the magnitude of behavioral changes occurring over the week is provided in Table 2. The average change in behavior within weekly time spans was between 3 and 4 standard deviations. Wide individual variability in the degree of change from period to period was evident; some individuals showed extremely large changes, of more than 6 *Z*-score units.

It is important to note that the present results cannot be explained by changes in the *frequency of interaction* occurring over the 7-day cycle.

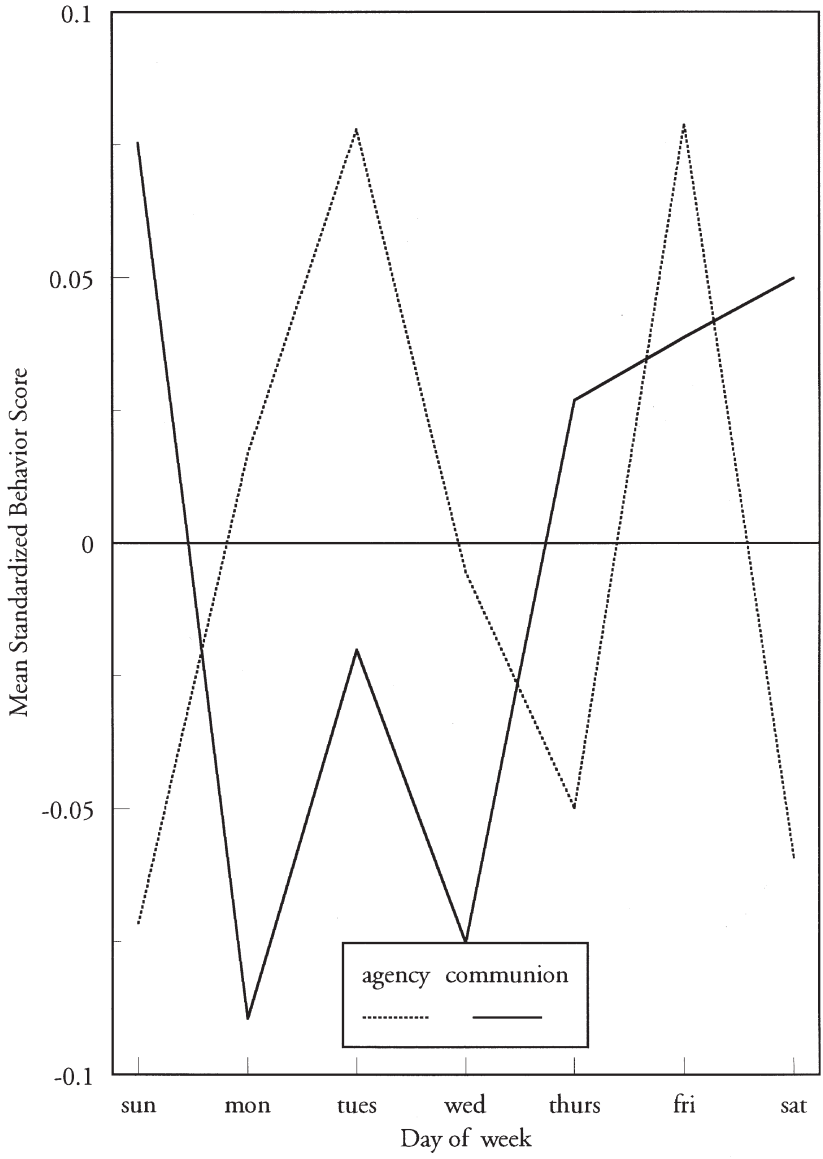

Figure 3
Mean levels of agentic and communal behavior by day of the week.

Table 2
Mean, Standard Deviation, and Minimum & Maximum Range Values of Interpersonal Behavior Occurring Within Weeks, in Standardized (*Z*) Units

Interpersonal behavior	Mean range	SD	Minimum	Maximum
Agency	3.79	1.00	1.70	6.82
Dominance	3.70	0.98	1.18	7.55
Submissiveness	3.66	1.06	1.05	6.53
Communion	3.79	1.10	1.32	7.12
Agreeableness	3.78	1.06	1.63	7.30
Quarrelsomeness	3.70	1.10	1.32	7.12

The data were corrected for both rate of responding and the number of forms used in each time period. The cyclical changes in behavior reflect changes in the rate at which each type of behavior was endorsed, not in the number of interactions reported from day to day. Thus, for example, participants became, on average, more agentic and less communal during the work week because the interactions in which they engaged generally called forth more agentic and less communal behaviors during the work week than on weekends.

Individual Differences

We hypothesized individual differences in the dynamics of day-to-day behavior. It was predicted that individuals scoring high on a trait measure would exhibit both (1) less change or longer cycles, and (2) a lower amplitude or standard deviation in the corresponding event-sampled behavior than individuals who were not high on the trait. To test the first prediction, IAS-R scores were correlated with each of the 30 spectral estimates for the corresponding behavior. In general, the IAS-R scores did not correlate with frequency of event-sampled behavior change, as measured by the spectral estimates, in any systematic way.[3] Turning to

3. Based on 30 correlations between each trait score and the set of spectral estimates, 2 could be expected by chance. Only IAS-R dominance and quarrelsomeness (coldheartedness) were correlated with more than 2 spectral estimates. Dominance was significantly related to 3 estimates in the 4-day cycle range and quarrelsomeness was related to 4 estimates in the 8-day cycle range.

amplitude of behavior change, none of the IAS-R scores were correlated with the standard deviations of their corresponding event-sampled behaviors (all *p*s > .05). Thus, interpersonal trait score level did not systematically predict cyclicity; individuals who scored highly on an interpersonal trait measure did not generally show less frequent behavior change or lower amplitude of behavior than those lower on the trait.

We also hypothesized that individuals high on extraversion would exhibit relatively shorter cycles than those lower on this trait. Extraversion was the only NEO-FFI scale that systematically correlated with the spectral estimates. Consistent with the prediction concerning daily cycles, there were significant positive correlations between extraversion and many spectral estimates at periods within single 24-hour days. Correlations between extraversion and the averaged within-24-hour spectral estimate values were significant for dominance, $r(70) = .25$, $p < .05$; for submissiveness, $r(70) = .34$, $p < .01$; and for agreeableness, $r(70) = .33$, $p < .01$. Extraverts showed more fluctuation or variability in these three behaviors within single days than those low on extraversion.

There are at least two reasons why such within-day variability may occur among extraverts. Extraverts may vary their behavior from interaction to interaction more regularly than others. In other words, extraverts may show more behavioral flexibility over the course of a day, regardless of the frequency of interaction partners. Alternatively, extraverts may seek out more interaction partners over the course of a day than others.

These two hypotheses were tested by entering extraversion scores, behavioral flexibility scores, and interaction frequency scores into structural equation models used to predict within-day behavioral cyclicity. To represent behavioral flexibility independent of partner frequency, four sets of scores were derived: the first score reflected the mean number of different behaviors or acts engaged in over the course of the study; the other three scores represented the mean number of behaviors endorsed across mornings, afternoons, and evenings of the study. To represent interaction quantity or number of partners, four sets of scores were derived indicating the number of different people interacted with by each participant over the entire period of the study, and over mornings, afternoons, and evenings. There were significant correlations between the mean number of partners and the mean number of behaviors within each of the three time periods—morning: $r(70) = .28$, $p < .05$; afternoon: $r(70) = .29$, $p < .05$; and evening: $r(70) = .49$. $p < .0001$. Thus, these measures overlap, but each has considerable variance not shared by the other.

The daily, morning, afternoon, and evening data were used in separate structural models. Since the partner and act frequency variables were correlated, they were subsumed under a latent variable called "social activity." Mean within-24-hour spectral estimate values for each of the four event-sampled behaviors were also intercorrelated and clustered under a latent variable called "within-day cyclicity." Each of the models reported on here provided a close fit to the data. In the model including daily data, neither extraversion nor social activity predicted cyclicity (*p*s < .05). In the models incorporating morning and afternoon partner and act data, only extraversion predicted behavioral cyclicity (both path coefficients > .40). Extraversion did not predict social activity frequency. When the evening data were used, extraversion predicted social activity, and social activity correlated with cyclicity. The relations between these variables are shown in the model presented in Figure 4. This model could not be rejected as a description of the data, $\chi^2(12) = 12.87$, $p = .38$. The value of the Goodness of Fit Index (GFI; Jöreskog & Sörbom, 1988) was

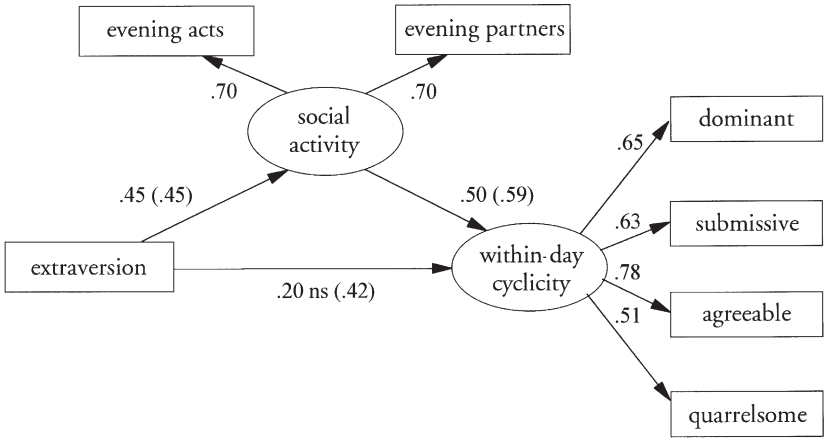

Figure 4
Path diagram for model testing direct and indirect effects of extraversion on within-day behavioral cyclicity using evening behavioral flexibility and interaction partner frequency variables.

Note. Values outside parentheses are standardized path coefficients. Values inside parentheses are simple correlations. All relations are significant unless otherwise indicated. Error terms for each measured variable were included in the structural models but are not displayed here.

.95, indicating an excellent-fitting model. The findings indicate that extraversion had indirect effects on behavior cyclicity through both behavioral flexibility and interaction quantity during the evening hours. Thus, both of these evening time period social activity variables were factors helping to explain the distinctive within-day cyclicity of the behavior of extraverts.

DISCUSSION

For much of the history of personality psychology, researchers have attempted to derive point estimates that best describe and predict personality characteristics. However, as Epstein (1994) notes, while point estimates are useful for describing what people are like (personality structure), they are not so useful for describing how they operate (personality process). Increasingly, personality has come to be seen as a process that unfolds over time (Larsen, 1989; Tennen, Suls, & Affleck, 1991) and that is embedded in day-to-day behavior (Little, 1987). The study of personality at this level reflects an interest in process and patterning, the *movement* of behavior through time (Pervin, 1983, 1994). Building upon the work of others (Larsen, 1987; Nesselroade, 1991; Penner et al., 1994; Shoda et al., 1994) who have found that intraperson variability in social behavior and mood are central features of personality expression, the present study found that intraperson variability in interpersonal behavior was normative. Individual differences in the dynamic patterning of the behavior were predicted by only one trait, extraversion.

A traditional means of assessing consistency in behavior over time is to examine stability coefficients derived from data that have been aggregated over time and situations. In the present study, high stability coefficients were found when the data were collapsed across occasions. This finding is consistent with those of other reports (e.g., Epstein, 1979; Moskowitz & Schwarz, 1982) that have advocated the benefits of aggregation for producing high stability coefficients. However, the present study sought to determine whether consistency exists in behavior examined at a more local or condition-bound level.

We hypothesized that interpersonal behavior would show a daily cycle and a weekly cycle. The results clearly indicated that a weekly cycle was normative for most individuals. Spectral analyses demonstrated a stable pattern of rhythmic change over time and situations in the four circumplex behaviors studied. In fact, all four dimensions of behavior showed

highly similar wave patterns indicating that the working adults in this sample gradually increased the rate of their dominant, submissive, agreeable, and quarrelsome behavior in the transition from Sunday into the middle of the work week, and then showed a decline in these behaviors from the latter half of the week into the weekend. However, when the data were examined in terms of agency and communion, there was a tendency for agentic behavior to be expressed at a higher rate during the work week than during the weekend, while communal behavior was expressed in an opposite pattern, with a lower rate of expression during the work week than on the weekend.

It is important to note that these dynamic changes are not reducible to a steplike pattern of change from weekday to weekend, in which behavior jumps from a high to a low level of expression (or vice versa) across the week. Rather, the four behaviors examined here manifested a fairly smooth rhythmicity, in which gradients of increase and decrease, not abrupt changes in expression, were observed. Moreover, there were phase differences between the behaviors, such that submissiveness and agreeableness peaked later in the week than did dominance and quarrelsomeness.

We have conceptualized this stable pattern of regular weekly change in behavioral expression as a periodic wave pattern. An alternative conceptualization of this consistent change is to represent the examined behavior on Wiggins's interpersonal circle (1979). On this circle, the four primary dimensions of behavior are placed on the four poles or axes, and the degree to which a behavior is expressed is represented by a point at some distance away from the center, or toward the perimeter of the circle. Thus, an individual expressing high dominance would have a point close to or on the perimeter of the circle, while a person displaying low dominance would have a point close to the center of the circle on the dominance axis. Traditional trait thinking has assumed that each individual's behavior can be represented by fixed points on the interpersonal circle. However, the present results suggest that the behavior of individuals in general does not remain fixed at particular points over time but instead moves toward and away from the center of the circle in a regular dynamic fluctuation or oscillation corresponding to the weekly cycle. If distance from the center of the interpersonal circle can be interpreted as reflecting intensity of behavioral expression (Orford, 1994), then fluctuations become more readily understandable, as individual behavior can be expected to vary in intensity from situation to situation.

Why Does Behavior Manifest a Dynamic Pattern?

There are several explanations for the behavioral variability observed here. Social role may have a strong influence on regular behavior rhythms. Role changes occur in a highly regular fashion over the course of the 7-day week. For example, work roles often call for dominance behavior on the job, but such behavior is less functional in the roles of romantic partner or friend. Agentic and communal behaviors do vary as a function of role and setting (Moskowitz et al., 1995; Coté & Moskowitz, 1996). However, changes in social roles and setting demarcate both the day and the week, and normative cycles were found only at the weekly level. Moreover, changes in social role and setting are abrupt, and the patterns of rhythmicity observed here reflected gradual changes. Consequently, changes in social role may contribute to the weekly cycle, but they are not a complete explanation of that cycle.

Regular changes in behavior over the week may also be due to periodic changes in the preeminence of different goals, projects, or strivings (cf. Emmons, 1989; Little, Lecci, & Watkinson, 1992; Pervin, 1983). Pervin (1983) presented evidence to suggest that different goals are linked to two broad categories of interpersonal situations: work-related and social-related. If the relative strength of these goals changes gradually across the week, this may contribute to the pattern of fluctuations in interpersonal behavior observed here.

The social-role and goal approaches to behavioral variability are, at least in theory, compatible with each other. The graded increases and decreases in behavior occurring between weekends and weekdays may represent the individual's attempt to ease in and out of the work mode at the beginning and end of the week. At the start of the work week, the change in social roles may be accompanied by both work-related goals and social-related goals; as the week progresses, goals may become more purely work-oriented, more focused on "getting the job done." The opposite pattern, the relative weakening of work-related goals relative to social goals, may occur as the work week winds down.

In addressing the question as to why behavioral rhythmicity occurs, it is important to note that behavioral variability that is tied to situational factors is likely to be adaptive (Epstein, 1984), whereas "consistency" in the form of insufficient sensitivity to changing consequences may be an indicator of maladaptive functioning. As Mischel (1990) noted, social behaviors usually lead to positive consequences in some situations but

not in others, so highly discriminative specific expectancies tend to evolve. The relatively low correlations typically found among a person's response patterns across particular kinds of situations (e.g., Moskowitz, 1994) then become theoretically understandable.

Individual Differences in Dynamic Patterns

Contrary to prediction, trait measures of dominance, submissiveness, agreeableness, and quarrelsomeness were unimportant to the observed patterns of behavior change. Using the same sample of individuals, these traits have been shown to predict average levels of corresponding social behavior (Moskowitz & Coté, 1995). However, the present research found that they did not provide adequate information to predict behavior variability and fluctuation across time. In other words, interpersonal trait scores were not useful for making "local" and condition-bound predictions about the corresponding interpersonal behaviors. Thus, for example, a highly dominant individual, as measured by a trait scale, can be expected to show the same degree of variance and fluctuation in actual behavior from occasion to occasion as a low dominant individual, even though their overall levels of dominant behavior across time could be expected to differ.

One important individual difference did emerge: more extraverted individuals manifested stronger behavioral cyclicity within days than others. During the evening hours, this heightened variability among extraverts was partially accounted for by a greater number of different interactions and a greater differentiation in their behavior. For many people, the workday provides a sizable degree of structure that limits the individualized expression of social behavior. During the evening hours, situations are relatively less structured and role expectations are typically less rigid. This allows for greater freedom in social expression which, for the extravert, becomes a daily opportunity for interacting with more people and engaging in a greater diversity of social behavior. However, it must be noted that extraverts also showed greater daily cyclicity during the daytime hours when, at least during the work week, social behaviors are often relatively more constrained by work-related activities. Thus, more varied interpersonal behavior and a greater number of interactions helped to account for more rapid cyclicity in the evenings, but the mechanism(s) by which the daytime cyclicity among extraverts occurs have not yet been identified.

The present findings may serve as a bridge between two separate lines of inquiry that have been actively pursued in the extraversion literature: diurnal rhythmicity and social participation. The results reported here suggest that the higher levels of social activity reported by extraverts (e.g., Argyle & Lu, 1990) may be primarily manifested in the evening hours, at least among working adults, when extraverts show higher levels of arousal than others (e.g., Blake, 1971). It has been hypothesized that a biological basis exists for individual differences in arousal and diurnal rhythms (e.g., Eysenck & Eysenck, 1983) which then predispose to differences in activity levels. There may be a link between increased arousal levels and greater social activity. The temporal relation between diurnal biological arousal and social activity could be tested empirically using time-sampling methodologies (cf. Brown & Moskowitz, 1997). Such a test would help to clarify our understanding of whether extraverts' social behavior leads or follows change in arousal levels.

Implications for Current Conceptions of Personality

The evidence presented here suggests that interpersonal behaviors can be conceptualized as stable yet dynamic phenomena. Rather than being fixed over time, personality appears to be fluid in nature, with sizable proportions of variance explained by predictable rhythmic changes in the overt expression of characteristics. In other words, interpersonal behavior appears to manifest in consistent patterns of change (Larsen, 1989).

In the present study, the observed patterns of behavioral fluctuation were substantially large, measured in standard deviation units, and thus appear to be important features of interpersonal behavior. When information on such consistent changes in behavior is retained, the temporal generalizability of the information is taken into account (cf. Larsen, 1989; Nesselroade & Ford, 1985). This information appears to be particularly important because day-to-day changes in the expression of behavior could not be predicted from knowledge of the corresponding trait measures of personality functioning. Accounting for intraindividual variability in behavior will entail important modifications in measurement, research design, and data analysis procedures (Nesselroade, 1991).

Trait measures may be most useful when the focus of interest is global functioning of the individual across time, but they cannot be relied upon to provide pictures of day-to-day or situation-to-situation behavior ex-

pression. Epstein (1984) notes that behavior is apt to have both a specific and a general component, and the use of a single score of behavior can mask the unique effects associated with specific stimuli, situations, or occasions; the common failure to take such effects into account often results in incorrect predictions. Local or condition-bound prediction of behavior may be necessary for particular purposes. For example, Schmit and Ryan (1993) found that the fit of the broadband five-factor model to the NEO-FFI was significantly poorer in a job applicant sample than in a student sample. Schmit, Ryan, Stierwalt, and Powell (1995) found that items on the Conscientiousness scale of the NEO-PI that had been modified to be context-specific (work-specific) had greater validity in a personnel selection context than the original general context items. A number of personality and personnel researchers (e.g., McAdams, 1992; Schmit & Ryan, 1993) have noted that the five-factor model is too broad to have predictive usefulness for specific purposes. A primary implication of the present results is to suggest that when one's purposes require contextual predictions, time-sensitive or context-dependent measures should be employed.

Another implication of the present study is to suggest a reconciliation between two prevailing interpretations of intraperson variability: one, put forth by Mischel (1990) among others, hypothesizes that such variability corresponds to changes in situations and their differing characteristics; the second, argued by Larsen (e.g., 1989) and others (e.g., Cattell, 1973; Penner et al., 1994), regards intraperson variability as an individual difference characteristic. The present findings, in combination with previous research concerning situational variability in agency and communion (Moskowitz et al., 1994; Coté & Moskowitz, 1996), provide support for both interpretations of intraperson variability. The general pattern of rhythmic change may be partly attributable to regular changes in situations and the social roles and goals that accompany them, but the extraversion findings indicate individual differences in the cyclicity of daily social behavior.

Limitations and Future Research Directions

The fundamental limitation of the present research is that it was based on self-reports. The distortions and self-presentation biases that sometimes affect other self-report data may well have affected the multiple reports obtained here. However, the event-sampling methodology requires

less retrospection and less implicit aggregation than do one-occasion self-report questionnaires. Consequently, the event-sampled reports may be less prone to the influences of preexisting characteristics. In this vein, Brown and Moskowitz (1997) demonstrated that event-sampled symptom reports were less affected by neuroticism than symptom reports that were provided at the end of the day. Moreover, the construct validity of the scores produced by the event-sampling methodology used in the present study has been well documented (Moskowitz, 1994; Moskowitz & Coté, 1995), and the stability of the observed cyclicity in this study indicates that the self-reported patterns were replicable.

Future research into the dynamic stability of interpersonal behavior could be pursued along several fronts. First, the observed behavioral variability correlated moderately well with a sine wave pattern. It would be of interest to know whether the variation that remained unexplained represents mere noise or, in fact, is meaningful, and simply could not be tapped by the analyses employed here. Given a sufficient quantity of data, the mathematics of nonlinear dynamics could provide a window onto complex patterns in day-to-day social behavior (cf. Vallacher & Nowak, 1994), patterns that have been explored in several areas in psychology, including day-to-day affect (Combs, Winkler, & Daley, 1994).

The question can also be asked whether individuals who break with the normative weekly cycle can be identified from other preexisting characteristics. The present research indicated that extraverts conform better to a daily behavioral cycle, partly due to greater variability in their evening social activities than other individuals. More generally, future research may ask what predicts day-to-day social behavior dynamics. Daily sampling studies could measure psychological and/or situational features that are hypothesized to vary in patterns similar to those of social behavior. The weekly cycle observed here could perhaps be better understood by collecting data once per day on variables—mood, expectancies, goals, physiological events, and so on—thought to underlie social behavior fluctuation.[4]

Another direction of research could explore what the consequences are of behavior that does not conform to the normative weekly cycle and that is not subject to the external influences and internal processes that appear to modulate an individual's social behavior. Such consequences may have implications for the development and maintenance of interper-

4. We are grateful to an anonymous reviewer for this suggestion.

sonal relationships (cf. Epstein, 1984; Mischel, 1990). For example, individuals who do not reduce their rates of agentic behavior during off-work periods may have difficulty living with partners who do reduce their levels of agency, or they may be most compatible with partners who can tolerate an imbalance in relative levels of dominance and submissiveness. On a related point, it can be assumed that there are particular events or circumstances that serve to push an individual outside the envelope of his or her cyclic patterns of behavior. Insights may be gained into, for example, the nature of stress and its consequences by exploring behavior using the dynamic approach outlined in this article.

CONCLUSION

In many fields of science, phenomena are studied closely over time in order to make inferences and deductions about patterns of "behavior" and to allow for predictions of future stability and change. The present research attempted to address the need to examine personality as both stasis and flow (Pervin, 1994). A process approach was taken to show that day-to-day expression of interpersonal characteristics is dynamic yet stable and predictable in form. Continued examination of how social behavior varies over time will provide a doorway into the study of the dynamic nature of personality expression.

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