Now and then, them and us, this and that: Studying relationships across time, partner, context, and person

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Abstract

Personal relationships are frequently studied using methods and analyses that reflect an interest in relationships as between-persons phenomena. Although informative, there is much to be learned from examining relational phenomena from a within-persons perspective. The present article reviews the application of within-persons approaches to both the conceptualization and investigation of relational phenomena. The benefits of studying variation in psychologically meaningful constructs across multiple relationships, across different contexts within a relationship, and across time are outlined. Moreover, combinations of between- and within-persons strategies that can examine how relational, contextual, and temporal variation differs across people are discussed. Methodological and statistical considerations important to such designs are also outlined, and their limitations are discussed.

There are more truths in twenty-four hours of a man's life than in all the philosophies.

-Raoul Vaniegem (1967/1979)

Relationship researchers typically examine relationship processes with betweenpersons designs. For example, Howes, Droege, and Matheson (1994) contrasted communication skills of toddlers in longterm friendship dyads to the skills of toddlers in short-term friendship dyads. Highand low-dominance women have been paired with either high- or low-dominance men to examine conditions under which women assume leadership roles (Davis & Gilbert, 1989). Nezlek, Imbrie, and Shean (1994) compared the quality and quantity of social interactions reported by depressed and nondepressed persons. And the problem-solving strategies that distinguish distressed and nondistressed couples have been examined in many studies (e.g., Burleson & Denton, 1997).

The strategy embodied in these examples compares individuals possessing certain characteristics or situated in particular circumstances in an effort to understand relationships and relationship processes. The basic design of such studies is betweenpersons, which investigates how people who differ along some theoretically defined dimension behave on variables of interest, or how people in general respond to situational variations. Thus, researchers interested in studying intimacy might relate levels of reported intimacy in friendships or marriage to dispositional variables such as neuroticism, depression, sex, or religious

This work was supported by National Institutes of Mental Health Fellowship MHJ11766 awarded to the first author and by assistance from the Psychology Department, University of California at Santa Barbara.

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background. Similarly, researchers interested in the effects of power on conflict resolution style might design experiments in which people are randomly assigned to one of several conditions varying in level of status or control.

The between-persons approach has provided much valuable information about personal relationship processes and their outcomes. Even casual perusal of the literature reveals the important insights that have been accrued concerning the influence of personality, gender, age, and other person-variables on relationship processes. Between-persons research also has enhanced understanding of the impact of situational contexts on relationship processes. Nevertheless, this approach overlooks other important sources of variability: People have multiple relationships with different partners; they interact with the same partners in different contexts and roles; and their relationships fluctuate and evolve over time. The within-person approach reflects this conceptually important reality, and makes it the target of investigation.

In a within-person design, each participant provides the dependent variable of interest for multiple instances—for example, across different relationship partners, contexts,¹ or simply at more than one time. Within-person approaches are statistically more sensitive than between-person studies; however, their benefits for relationship research go well beyond statistical considerations in giving investigators the opportunity to examine consistency and variation within sampling units. As we will show, adoption of within-person strategies represents an important conceptual decision, more than a methodological convenience or a statistical necessity. Explicit recognition of this distinction and its conceptual implications can help clarify many ambiguities in theory and research. Investigators sometimes have unintentionally adopted between-persons methods when their hypotheses or questions were more appropriately construed in within-persons terms. This article is intended to help researchers clarify their thinking about this distinction and adopt methods appropriate to their theorizing.

Consider how the studies listed in the opening paragraph of this article might have been framed in within-person terms. Communication skills of toddlers might have been compared as they varied across the same toddler's long-term, intermediateterm, and short-term friendships. Leadership role-taking might have been studied by observing how the behavior of high- or lowdominance women varied when their male partner was high or low in dominance. Fluctuations in emotional and physical wellbeing around an individual's average level might be associated with daily variations in social activity and emotions. Finally, the same couple's problem-solving strategies might be contrasted during periods in which they are feeling relatively content and distressed. It is not just that each study would look methodologically different had the investigators chosen these designs; rather, we will argue that these alternatives offer somewhat distinct (and conceptually complementary) insights.

We are not implying that within-persons approaches have been ignored in relationship research. There are numerous examples in the literature, and in several areas this approach is fairly common (for example, diary studies [e.g., DePaulo & Kashy, 1998] and studies of social networks [e.g., Van Aken & Asendorpf, 1997]). However, the large majority of published research adopts a between-persons approach to the relative exclusion of within-subjects studies, even when the latter perspective might be theoretically more appropriate. Moreover, even less common are studies that combine

By context, we refer to aspects of the situation that have important psychological consequences and modify the individual's experience of that situation. Context varies within relationships, so that relationship behavior, even between the same partners, is often enacted under substantially different circumstances. For example, one could examine nonverbal communication used by spouses when discussing child-rearing plans versus when discussing financial matters. Or, two friends' tendency to compete or cooperate can be examined as a function of shared versus individual outcomes.

these two levels of analysis to examine interactions between dispositional factors and within-person variation. In the present report we outline benefits and limitations of the within-persons approach for investigating personal relationships. We illustrate how important questions may be addressed from this perspective, and we describe recent statistical and methodological advances that facilitate within-person analyses. In so doing, we advocate flexibility in relying on both perspectives as an important tool for enhancing the methodological diversity of relationship research and thereby increasing its validity (Brewer, in press).

Why a Within-Persons Approach?

The within-persons approach is ideal for examining variations in relationship phenomena manifested across different relationships, contexts, and time. These variations provide an informative counterpoint to individual differences, which, although undoubtedly important, typically account for relatively small proportions of variance in social behavior, as often noted (e.g., Hinde, 1995; Mischel, 1968). In the relationships area, this consideration is particularly critical. What makes a relationship "special," as Kenny (1990) noted, is the extent to which the partners' behavior with each other differs from their behavior with people in general. If Laura self-discloses to Marisa to the same extent as she does to her other friends, and if Marisa receives the same amount of self-disclosure from Laura as she does from others, then the concept of relationship is not needed to explain their behavior; dispositional constructs will suffice. In contrast, Miller and Kenny (1986) demonstrated that the lion's share of variance in self-disclosure is attributable to relationships, and not dispositions. In other words, Laura's self-disclosure to Marisa depends more on their relationship with each other than on their dispositional tendencies to give and receive self-disclosure. Of course, their self-disclosures are also likely to vary across contexts and time.

Studying variability across relationships

Ignoring variability across relationships bypasses a central principle of relationship theorizing, which is that people behave differently with different partners. Miller and Kenny's (1986) self-disclosure research, cited above, makes this point clear. Similarly, verbal and nonverbal communication behavior varies in interactions with samesex friends, opposite-sex friends, and romantic partners (Guerrero, 1997). Wheeler and Nezlek (1977) found differences in the quantity and quality of social interaction with same-sex and opposite-sex friends depending on level of acquaintance. DePaulo and Kashy (1998) showed that lying, and feelings about having lied, varied across relationships as a function of closeness. Indeed, it is hard to imagine an individual whose behavior does not vary from one partner to another, and typically these variations reflect consistencies within particular relationships and within types of relationships (e.g., superficial friendships versus romantic relationships).

Graziano, Jensen-Campbell, and Hair (1996) demonstrate how a within-persons approach may contribute different information from that of the between-persons approach. They investigated the relation of an individual difference variable, agreeableness, to interpersonal conflict. Participants rated the effectiveness of three styles of conflict resolution (power assertion, disengagement, and negotiation) across five relationships: parents, siblings, roommates, friends, and romantic partners. Betweensubjects analyses showed that low agreeable persons viewed power assertion more favorably than did high agreeable persons. That this finding is less than fully informative is shown by the within-persons (relationship type) effect that they also found: Power assertion was considered more effective with siblings than with other partners, whereas disengagement and negotiation were more effective with parents. In other words, type of relationship moderated the perceived efficacy of different conflict resolution tactics.

Studying variability across contexts

Ignoring variability across contexts fails to identify the role of interaction contexts in interpersonal behavior, even with the same partner. For example, the quality of marital interaction is influenced by stress experienced at work (Repetti, 1989). Reactions to a partner's success and failure depend on the extent to which the task is relevant to one's own self-concept (Tesser, 1988). And, interaction between romantic partners may be altered by the presence of other members of one's social or family network (Milardo, Johnson, & Huston, 1983).

The importance of considering the context of relational behavior is illustrated by Pietromonaco and Feldman Barrett's (1997) diary study of attachment-related differences in social interaction. Attachment styles were modestly associated with intimacy, satisfaction, and emotion experienced in everyday social activity. However, these main effects were qualified by an important interaction: Attachment style related strongly to these variables in high conflict interactions (which, according to attachment theory, activate concerns about relationship security), whereas the association was much weaker during low conflict interactions. In many cases, the correlation among relationship variables is likely to vary substantially depending on the processes activated by the situation.

Studying variability across time

Ignoring variability across time overlooks the importance of temporal fluctuations. Sometimes these variations reflect the ebb and flow of everyday activity. For example, Hays (1989) showed that even in the most intimate relationships, most conversations are relatively superficial; highly intimate topics are discussed only sporadically. Patterns of covariation over time and circumstance can be informative about relationship processes. For example, Reis, Sheldon, Gable, Roscoe, and Ryan (in press) had participants report the nature of their social activities for 2 weeks. The more the participants felt understood and appreciated during social activity, and the more often they engaged in meaningful conversations, the greater their general sense of relatedness at the end of the day. Feelings of relatedness in turn predicted day-to-day fluctuations in emotional well-being and vitality, above and beyond mean levels across the 2 weeks. Studying within-person, day-to-day variations is becoming increasingly important in emotion research as a complement to dispositional predictions of mean levels of well-being (Diener, 1996; Kernis, 1993), and we envision a similar role in relationship research.

Temporal variations may also represent more systematic development. Many properties of interactions and relationships vary developmentally not only during childhood (Hartup, 1996), but also during early adulthood and later life. For example, Reis, Lin, Bennett, and Nezlek (1993) showed that intimacy levels increase from the college years to approximately age 30, and Carstensen (1992) found that adults tend to withdraw from superficial relationships but not primary emotional ties as part of their adaptation to old age. Time factors also operate within particular relationships. For example, the longer perceivers know their partners, the more elaborate and confident their impressions of them are (Swann & Gill, 1997).

It may be difficult to distinguish among relationship, context, and temporal factors as explanations for within-person effects. Variations from one data point to another can be attributed to relationship effects only if specific partners (or role relationships) are differentiated. Similarly, context effects can be identified only if the relevant features of context are specified and assessed. More problematical, some relationships embody certain contexts more than others do (e.g., work relations are more likely to be task-oriented, whereas romantic relations are more likely to be affectionate), so it can be important to unconfound relationship and context. Strategies for doing so include sampling a sufficient range of partners/contexts and experimental control. By its nature, time is easier to specify as a predictor.

Theoretical development

More often than not, relationship theories describe processes that implicitly address within-persons questions. Theories about closeness and commitment, for example, are not so much directly targeted at understanding differences between Josh and Sarah's committed relationship and Raoul and Kristin's uncommitted relationship as with determining how Raoul and Kristin's relationship will develop if and when their commitment grows, or what will happen to Josh and Sarah if their commitment wavers. Yet too often, researchers limit their examination of such processes to between-persons methodology, which confounds level of commitment in the two relationships with the commitment processes within each relationship. Consider a casual encounter with an old friend who asks, "How's your love life?" It seems unlikely that one would reply by comparing one's current circumstances to those of other persons. Instead, the answer is more likely to be "good" if recent events were trending positively in reference to personal baselines, and "not so good" if current trends were deteriorating (Kahneman & Miller, 1986). These replies are within-person assessments.

As knowledge about personal relationships accumulates, conceptualizing and investigating relational behavior in terms of relationship, context, and time variation seems central to a natural progression toward more complex and comprehensive theories. Shifting focus from between- to within-person questions may provide distinctive insights into relationship processes. Consider attachment theory (Bowlby, 1969), a thriving topic in the relationships literature, that is often investigated with betweenperson strategies; for example, dispositional differences in adult romantic attachment styles are associated with diverse relationship variables and personal outcomes, such as emotions experienced during social interaction, methods of coping with distress, jealousy, loneliness, and vulnerability to depression (Reis & Patrick, 1996). In many of these studies, an individual's standing on dispositional attachment style measures is correlated with other variables.

Alternatively, from a within-persons perspective, one might investigate how attachment-relevant behaviors differ as a function of context-for example, anxiety experienced during conflict or after rejection compared to nonconflictual, nonrejectcircumstances (Downey, ing Freitas. Michaelis, & Khouri, 1998; Pietromonaco & Feldman Barrett, 1997). Similarly, differences in attachment representations with different partners (e.g., felt security differences with mother, father, spouse, and friend) or across time (e.g., variations in avoidance behavior over the course of a developing relationship or at different life stages) may be examined. Results from such studies would complement existing findings by highlighting the importance of contextual and temporal factors, rather than dispositions. Often researchers wax theoretic about phenomena that seem fundamentally within-person, but instead investigate between-person differences.

It might be noted that laboratory experiments, although usually conducted in a between-persons framework, are logically consistent with the advantages of the within-persons perspective. The impact of contextual manipulations is studied by randomly assigning subjects to conditions, thereby eliminating extraneous preexisting differences, including dispositions (if randomization is successful), and making possible causal attribution to the contextual manipulation. Within-persons research is designed to accomplish the same conceptual goal.

Combining Approaches

Combining between- and within-person strategies addresses the timely and important question of how between-person factors may moderate within-person effects. Dispositional variables, such as personality traits, sex, and age, often influence variability across relationships, contexts, and time. For example, the association between stress and relationship satisfaction may differ for people in committed versus uncommitted romantic relationships. Or, men's tendency to increase self-disclosure over time in a new romantic relationship may vary from that of women. Any construct that differentiates individuals potentially moderates within-person processes, and these interactions represent some of the most important and engaging constructs in the study of personal relationships.

For example, Barnett, Raudenbush, Brennan, Pleck, and Marshall (1995) examined the impact of changes in job and marital quality on distress in dual-earner couples. Over time, decreases in job quality predicted increasing distress for both men and women, a within-person effect that was not moderated by sex. However, whereas decreases over time in marital quality were associated with increased distress for both men and women, this correlation was significantly stronger for women than for men. In other words, if marital quality declined, women's distress escalated more than did men's. This finding exemplifies a betweenperson variable (sex) moderating a withinperson effect (the correlation of marital quality and distress).

By examining between- and withinperson effects simultaneously, researchers can also compare the relative impact of dispositional and situational factors. To the extent that between-person factors account for variance in relationship behavior (i.e., behavioral consistency across relationships, contexts and time), dispositional explanations are indicated; on the other hand, to the extent that within-person factors account for variation (i.e., behavioral inconsistency across relationships, contexts, or time) more situational explanations are to be preferred. Interactions (i.e., moderator effects) point toward processes involving both levels of explanation.

Following this logic, theories supported primarily by evidence from betweenperson studies might be evaluated from a within-person perspective in order to help confirm, refute, or clarify explanatory mechanisms. Bolger, DeLongis, Kessler, and Wethington (1990) provide an excellent example of this process. Prior studies of role-related stress used largely crosssectional (i.e., between-persons) designs and found conflicting results: Multiple roles had health-damaging effects in some studies, but were health-promoting in other studies. The 6-week daily diary study by Bolger and colleagues focused on covariates of daily role-related stress, finding that multiple roles may have conflicting results because stressful events in one domain of life (work) tend to produce stressful events in another domain (family). This sort of effect is unlikely to emerge from a study investigating stress in a single context or at a single point in time; in contrast, it is fundamental to within-subjects studies that examine the interplay of different types of daily events over time and across contexts.

Documenting the extent of homogeneity or heterogeneity in a phenomenon across relationships, contexts, and time provides an intrinsically important question in its own right, having to do with the nature of the phenomenon itself; yet relationship researchers, like most of their peers in other behavioral sciences, rarely seek to quantify these values (despite the importance that such documentation has played in the natural sciences). An important exception is the work of Kenny, Kashy and their colleagues on the Social Relations Model, which is expressly designed to decompose variance into its sources (Kashy & Kenny, in press; Kenny & La Voie, 1985).

Methodological Considerations

The distinguishing characteristic of withinpersons research is repeated measures: Variables under investigation are assessed multiple times—for example, each relationship, context, or time under consideration. Thus, within-person methods for relationship research build directly on repeatedmeasures techniques commonly available in the behavioral sciences. Traditional repeated-measures analysis of variance, for example, can determine the impact of different contexts (e.g., behavior in public or in private) on social interaction. Similar methods can be used to inquire into variations over partners and time. The classic example of a within-persons approach to time is the longitudinal study. Daily experience studies, such as those that follow social activity for 2 weeks, might be considered short-term longitudinal studies.

Although the diary study is prototypical, it is not the only methodology that can readily accommodate within-person approaches. In fact, the within-person perspective is applicable with most types of research. We illustrate this point by considering each of the three general research strategies described by Reis and Gable (in press): studies of exemplary experience, reconstructed experience, and ongoing experience. The first, exemplary experience, refers to studies conducted in specialized setting and contexts, such as laboratories, living rooms, and therapy offices. In this domain, within-persons research might observe the same dyad's interaction in two or more situations, or in settings modified to create particular psychological contexts (e.g., threatening versus safe). Or, within a fixed setting, one might examine the same individual's behavior with different partners (counterbalancing order, of course); for example, comparing emotional expressiveness with a parent and a romantic partner.

Reconstructed experience pertains to general, global, or recollected accounts of behavior, such as self-reported ratings that summarize past experience with a partner or in a particular situation (e.g., when support was sought). Within-person designs are easily adapted to study reconstructed experience. Respondents might, for example, answer identical or parallel questions about multiple persons with whom they have had similar relationships; about partners occupying different social roles; or about relationships varying along psychologically meaningful dimensions (e.g., degree of closeness or attitude similarity). Similarly, self-reported ratings across contexts might compare global impressions of social life in

different settings (e.g., at home or at work) or under different circumstances (e.g., when motivated by exchange as opposed to communal goals). Finally, questionnaire methods can illuminate temporal variations. Asking about several time periods in a single questionnaire may highlight personal beliefs about how one has changed over time, whereas comparisons of data collected at different times provide insight into actual changes (Ross, 1989; Sprecher, 1999).

The third and final category, ongoing experience, includes studies that examine thoughts, feelings, and behavior in everyday naturalistic contexts. Repeated measurement of ongoing experience describes most diary methods, including the Experience Sampling Method (Larson & Csikszentmihalyi, 1983), Ecological Momentary Analysis (Schiffman & Stone, 1998), and the Rochester Interaction Record (Reis & Wheeler, 1991). From these data, it is possible to create detailed and accurate descriptions of everyday, voluntary behavior, especially if participants record their activities with little or no time delay. Ecological validity is a major benefit of such studies; more generally, patterns of covariation in these data may implicate and clarify theoretically important contextual, temporal, or relationship processes (Reis & Gable, in press).

There are three general strategies for sampling ongoing experience, as described by Wheeler and Reis (1993). Intervalcontingent studies obtain data at regularly scheduled intervals (e.g., once a day). Signalcontingent methods require a report whenever a stimulus prompt is received, usually from pagers, preprogrammed wristwatches, or palmtop computers. Signals may follow a fixed or random schedule, or may be randomized within fixed intervals. Eventcontingent reports are obtained whenever relevant events, such as a social interaction or a stressful event, have occurred. Reis and Gable (in press) discuss the relative benefits and limitations of each sampling scheme. For present purposes, we note that all three strategies are conducive to within-persons research. Ongoing experience measures are designed expressly to describe behavior across naturally occurring variations, characterized according to whatever dimensions are of theoretical interest or along temporal lines. Because ongoing experience studies typically amass relatively large data sets encompassing many and repeated variations, their conceptual yield is likely to be particularly rich when used with within-persons strategies and analyses, as opposed to global aggregation.

Limitations of within-persons designs

In addition to the conceptual benefits noted above, within-person designs afford increased statistical power by controlling for individual difference variance. This benefit, of course, does not come without costs. Chief among them is the problem of reactivity, a well-known concern in experimental research. For example, interaction with a romantic partner is likely to be influenced by having first interacted with a particularly attractive and responsive stranger. Less commonly acknowledged is the manner in which repeated administration of the same items or stimuli may alter responses. Answering questions about social support may prime participants to think about instances in which significant others have not been available, which might affect subsequent responses to a mood measure. Or, participants may become more aware of research aims and hypotheses through repeated exposure to the same materials, and may attempt to modify their data accordingly.

Somewhat more insidiously, repeated administrations may lead respondents to introspect about variations in their behavior across settings or time. For example, a daily diary that assesses marital conflict each day may make salient a researcher's interest in tracking temporal change, inducing respondents to compare each day to the prior day rather than describing each day for itself. As Ross (1989) has shown, ratings of change may reflect personal beliefs about change more than they reflect actual change. Even worse, including questions about health and conflict in the same daily diary may sensitize respondents to consider how fluctuations in conflict influence health. Although potentially interesting in its own right, this information is not equivalent to an unbiased assessment of health status.

A final limitation of repeated-measures designs is the possibility of boredom and fatigue. Data quality can be affected by boredom or fatigue in several ways: errors of inattention, stereotypic or socially desirable responding, failure to comply with instructions, hostility, or selective attrition in the sample (e.g., busy or less conscientious persons may drop out sooner).

Although there are no easy or quick solutions to these problems, their impact can be estimated and minimized. When possible, designs should be counterbalanced to control for order effects. Possible effects of habituation can be identified by comparing early and late responses. For example, in a diary study spanning two equivalent weeks, the first and second week may be compared along basic descriptive statistics. Researchers should always establish through pilot-testing that their procedures are not so burdensome as to be problematic. Schwarz, Groves, and Schuman (1998) provide a more general discussion of these and other strategies for minimizing bias in questionnaire construction and analysis.

Time series designs

Investigating relationships across time frequently involves special design and analysis considerations (Ostrom, 1990). There are three general sorts of issues that relationship researchers might wish to examine. The first involves understanding trends over time-for example, how does relationship satisfaction evolve over time, and to what extent are these patterns modified by moderator variables (e.g., personality traits, work stress, parenthood, or physical separation)? Typically, these questions are studied longitudinally within individuals or relationships, and they are analyzed with standard repeated-measures techniques or with newer techniques such as growth curve analysis, which examines the slope of within-individual (or relationship) change over time (e.g., Lindsey, 1993; Vandenboom & Hoeksma, 1994). The key methodological consideration in studying patterns of change and consistency over time involves determining the proper length of time to assess a phenomenon, and assessing it frequently enough within this interval to identify cyclical time trends. Collins and Sayer (in press) provide a thorough introduction to design and statistical issues in longitudinal research.

A second temporal issue relevant to relationship research concerns cyclicity. Cycles are rarely studied in the relationships area, despite the prevalence of well-known cycles such as the day, characterized by regularities in activity schedules and diurnal rhythms in internal states such as mood, fatigue, and attentiveness. Weekly cycles may also matter. For example, Larsen and Kasimatis (1990) found that 40% of the variance in daily mood was attributed to the weekly cycle, and Reis et al. (in press) found that relatedness needs were more likely to be satisfied on weekends than on weekdays, paralleling (and perhaps explaining) the well-known improvement of mood on weekends relative to weekdays. Other cycles relevant to relationships might be based on fertility and sexual interest, work patterns (e.g., academic calendars among teachers), seasons (e.g., activity or weather-related variations), or anniversaries of important events. Aside from their intrinsic value, identification of cycles and rhythms may help identify causal factors responsible for variations in basic relational processes, such as conflict and satisfaction. Individual and group differences in cyclicality also might be explored, as Larsen and Kasimatis (1990) did, finding that extroverts were less entrained to the weekly mood cycle than were introverts. Larsen (1987) provides a useful introduction to spectral analysis, a special class of time-series methods for detecting cycles and rhythms in sequential data.

Third and particularly important is the analysis of sequential effects, especially germane to studies of interaction. Some phenomena are intrinsically sequential—interaction almost always depends on a

partner's preceding behavior, for example-and therefore require identification of behavioral sequences. A recognized interaction sequence is known as negative affect reciprocity, identified by several marital researchers (e.g., Gottman, 1994). Although negativity during observed interaction predicts marital distress, a spouse's reciprocation of the other's negative affect (as opposed to a more constructive response) is a particularly good indicator of distress. Sequential effects are usually immediate but may also be more complex. For example, Margolin, Christensen, and John (1996) obtained daily telephone reports of family conflict for 2 weeks, subdivided into mornings, afternoons, and evenings. Distressed and nondistressed families were differentiated by the continuance of tension at lag 3 (i.e., from one day to the same time the next day), but not before then (lags 1 and 2). In other words, the duration of a conflictual atmosphere might be the hallmark of familial distress.

Lagged effects can also be identified with categorical variables. A major advantage of this approach is in distinguishing sequential (conditional) probabilities from base-rates (for example, whether the likelihood of a given event—a husband's hostile comment—is greater following a particular antecedent—a wife's provocative comment—than in general). Time-series methods require careful attention to the spacing and timing of measurements. Introductions to the application of time-series analysis in relationship research are provided by Gottman (1981, 1987).

The temporal structure of sequential data may also be used to investigate causal effects, an added benefit when investigating naturally occurring, as opposed to experimentally induced, behaviors and events. Often relationship variables are assessed synchronously (e.g., the co-occurrence of self-disclosure and liking among new acquaintances), prohibiting determination of which variable is cause and which is effect. However, temporal precedence may support certain hypotheses while ruling out others by evaluating lagged effects—variable *Y*

at time t predicted from variable X at time t-1, controlling for variable Y at time t-1(West, Biesanz, & Pitts, in press). Lagged tests are likely to be especially compelling with repetitive data-multiple sequences during interaction or multiday (multievent) diaries in event-sampling research. A good example is offered by Downey et al. (1998), who, for 28 days, collected daily ratings of perceived rejection, conflict, and relationship satisfaction from romantic partners. Following days in which they felt rejected, rejection-sensitive women were more likely to engage in conflictual interaction, and their partners reported diminished satisfaction. By examining lagged effects, Downey et al. were not only able to demonstrate temporal precedence but were also able to rule out the reverse causal pattern (i.e., that conflict engenders felt rejection). In tests of this sort, it is feasible to establish temporal sequences using multilevel models of the sort discussed later in this article. West and Hepworth (1991) provide an excellent introduction to temporal analyses of diary data.

Data Analytic Considerations

Studies that fit the traditional repeatedmeasures model (all participants receive all treatments or are assessed in the same time intervals) may be analyzed as classic repeated-measures ANOVA. In this case treatments are crossed with subjects. Traditional ANOVA approaches to repeated measures and mixed designs are reviewed in most advanced statistics textbooks and can also be analyzed with standard multiple regression programs (Judd, in press).

In the more general case, within-person data structures are hierarchically nested at multiple levels. That is, in a diary study in which participants describe social activity at the end of each day, days are nested within persons, meaning that each person's data set includes one record for each day.² This is a two-level model in which the lower level is days and the upper level is persons. Another example of a two-level model compares ratings of social support received from each of several partners (e.g., romantic partner, best friend, roommate, sibling). The lower-level units here are the ratings (one for each relationshp) that are nested in the upper-level unit, person. In relationship research the most common upper-level unit is the person, although other units (e.g., families, classrooms, or census tracts) are also feasible.

Hierarchically nested models (also called multilevel models and hierarchical linear models) may have more than two levels. For example, participants in a diary study might describe interactions with each of five different partners every day for 2 weeks. This is a three-level model: Daily interactions (lowest-level) are nested within relationships (middle-level), which in turn are nested within persons (highest-level). Or, in a study of the impact of teacher communication styles on student learning in different cultures, students (lowest-level) are nested within teachers (middle-level), who are nested within cultures (highest-level).

Analyzing hierarchical models

Standard repeated-measures ANOVAs are not appropriate for analyzing hierarchically nested models when one or more independent variables are continuous, when there are unequal numbers of repeated measurement, or when effects are random rather than fixed.³ Below we outline the application of statistical techniques devel-

Note that in traditional between-persons research each participant (or each couple, group, etc.) provides only one record of interest. Therefore, there is no nesting and the model can be considered a one-level model.

^{3.} Random effects are those that are estimated from variables whose levels are unsystematically or randomly selected from a larger population of possible levels. For example, when students are nested within classrooms, both the students and the classrooms are random variables because students are randomly selected from a larger population of students in the classroom, and classrooms are randomly selected from a larger population of classrooms. Inferences about fixed effects are limited to the levels of variables investigated in the research. In relationships research, many effects of interest are random.

oped to address the special challenges of hierarchically nested data structures to relationship research. Bryk and Raudenbush (1992) provide a comprehensive introduction to these methods (see also Kreft & de Leeuw, 1998). A somewhat more general conceptual overview is presented by Kenny, Kashy, and Bolger (1998).

In the most general sense, hierarchically nested analyses can be thought of as multilevel regression. Thus, for each upper-level unit a regression equation is calculated using lower-level predictors, thereby controlling for the impact of upper-level predictors. Imagine a study in which on each day for 14 consecutive days, participants are asked to rate their mood and levels of social support received. An equation regressing mood on support might be computed for each participant, treating the 14 days as "cases." The obtained regression coefficients (i.e., slopes) calculated for each participant may then be averaged to arrive at a sample-wide estimate of the impact of support on mood. This equation is used to estimate the lower-level (i.e., within-person) effect. The intercepts of these person-byperson equations represent the mean mood rating for each person across the 14 days, and when averaged estimate the samplewide average mood on an average day. The degree to which variations in the personby-person intercepts are associated with upper-level variables (e.g., sex, self-esteem) represents the between-person effect. Upper-level variables may also moderate the magnitude of the support-mood slope calculated for each participant; in other words, the support-mood slope may be larger for some individuals (e.g., men) than for others (e.g., women). As described below, hierarchically nested models provide flexible and statistically precise methods for estimating these effects.

Suppose that in the hypothetical study just described, each participant's attachment style was rated on a continuous scale from insecure to secure. This is a two-level model in which days (lower-level) are nested within persons (upper-level). The criterion variable is daily mood, which the researcher is trying to predict from a within-persons predictor (rating of support received that day), a dispositional variable (attachment style), and their interaction. For each participant, daily mood can be computed from the equation:

$$Y_{ij} = b_{0j} + b_{1j}X_{ij} + e_{ij}$$
 (1)

where Y_{ij} refers to the participant's mood on a given day (the jth participant on the ith day), b_{0j} refers to that participant's average mood across all 14 days, b_{1j} is the regression coefficient quantifying the effect of support on mood for that participant, X_{ij} is the participant's support rating for that day, and e_{ij} is error. The innovative part of the analysis occurs in estimating b_{0j} and b_{1j} . The intercept for each individual, b_{0j} , is predicted as:

$$b_{0j} = a_{00} + a_{01}Z_j + u_{0j}$$
 (2)

where a_{00} is the sample-wide average mood (i.e., the mood rating on an average day of a person with an average attachment score), a_{01} is the regression coefficient quantifying the effect of attachment style on the intercept (i.e., average mood), Z_j is the individual's attachment style score, and u_{0j} is error. In other words, each person's intercept for assessing daily mood in equation 1 is a function of the sample-wide average and the individual's attachment score weighted by its corresponding sample-wide regression coefficient.

The individual slopes, b_{1j} , are predicted as:

$$b_{1j} = a_{10} + a_{11}Z_j + u_{1j} \tag{3}$$

where a_{10} is the average slope of daily support on mood (i.e., the association between daily support and mood for a person with an average attachment score), a_{11} is the regression coefficient quantifying the degree to which the slope of support on mood is moderated by attachment style, Z_j is again the individual's attachment score, and u_{1j} is error. In other words, each person's slope for estimating the effect of support on mood in equation 1 is a function of the sample-wide average support-mood slope and the degree to which attachment score moderates that slope. All of these values are estimated simultaneously, controlling for one another.

How do these coefficients translate to the substantive questions in which researchers are likely to be interested? This design has three basic questions. The first is the classic between-persons question: "Does attachment style relate to participants' average mood?" This question is addressed by the coefficient a_{01} in equation 2, which indexes the degree to which each participant's mood intercept differs from the sample mean as a function of attachment style.

The second, strictly within-persons, question asks: "On days in which others are perceived to be supportive, is mood higher?" This question ignores all individual differences, including attachment style, and is addressed by the coefficient a_{10} in equation 3, which denotes the degree to which an average participant's mood varies from day to day as a function of social support.

The third and final question concerns the interaction: "Does the magnitude of the daily support-mood relationship depend on attachment style?" The coefficient a_{11} in equation 3 tests this hypothesis. The impact of a_{11} on daily mood is best seen by inserting the expression for b_{1j} (equation 3) into equation 1.⁴

$$Y_{ij} = b_{0j} + (a_{10} + a_{11}Z_j)X_{ij} + e_{ij} \quad (4)$$

Thus, for each individual, the slope for predicting daily mood from support received is a_{10} , an average person's slope, adjusted by the product $a_{11}Z_j$, which indexes the degree to which the slope becomes larger or smaller for each individual as a function of attachment style.

Although computation of these values is often intricate and sometimes confusing, it is important to recognize that the coefficients generated by multilevel models correspond conceptually to these three general questions, with which most researchers are readily familiar. One other general consideration bears note. Interpretation of the coefficients produced by multilevel-model equations depends on the metric of one's data, and in particular on whether or not the data are centered. In the example outlined above, we implicitly assumed that the day-level predictor (support) was centered around each individual's mean rating across days and that the person-level predictor (attachment style) was centered around the sample mean. Centering results in coefficients that quantify effects of fluctuation around each person's mean support, as well as the effects of attachment style deviations from the grand mean. Centering is a difficult but important issue whose implications are illustrated in the examples that follow. Bryk and Raudenbush (1992) present a fuller discussion of this issue.

Two illustrative examples

In the following section we outline two examples using real data; the first study concerns within-person variations across time, and the second focuses on across-relationship variations.

One hundred thirteen adults between the ages of 27 and 31 kept the Rochester Interaction Record for 2 weeks, describing each social interaction lasting 10 minutes or longer along various features, including interaction quality (Reis et al., 1993). They also completed the UCLA loneliness scale several days after completing the diary study. Figure 1 displays mean ratings of interaction quality for each day of the week, distinguishing persons above and below the median loneliness score. Casual inspection of Figure 1 suggests that these groups differ in their average reported interaction quality (i.e., collapsing across day of the week)

^{4.} The error term from equation 3 (u_{1j}) is excluded from equation 4 for simplicity.



Figure 1. Mean quality of interaction during the week for lonely and not lonely subjects.

and in the pattern of variation across the week.

The data were analyzed with HLM 4.03 (Bryk, Raudenbush, & Congdon, 1996). As a multilevel model, daily interaction quality can be predicted from a lower-level variable, day of the week (which in this analysis we simplify to comparing weekdays and weekends), and an upper-level continuous variable, loneliness. The data set is organized as follows: At the lower level each person provides 14 records, each containing two variables-a rating of interaction quality for that day and a dummy code representing day of the week (0 = Monday)through Friday, 1 =Saturday and Sunday); at the upper level each person provides one record containing one continuous variable-the person's loneliness score (standardized for convenience). Thus, general equations 1 through 3, presented above, can be specified as follows:

At the lower level:

$$Y_{ij} = b_{0j} + b_{1j}(day \text{ code}) + e_{ij} \quad (1a)$$

And at the upper level:

$$b_{0j} = a_{00} + a_{01}(\text{loneliness}) + u_{0j}$$
 (2a)

$$b_{1i} = a_{10} + a_{11}$$
(loneliness) + u_{1i} (3a)

These three equations embody three questions of substantive interest in this research. The intercept in the lower-level equation ($b_0 = 4.76$) represents the grand mean (i.e., average interaction quality for a person of average loneliness on a weekday). Question 1, the purely within-person question, asks, "How does day of the week relate to interaction quality?" The slope predicting interaction quality from day of the week was significant ($a_{10} = .26, p < .26$.001). Note that because day of the week was dummy-coded (0,1), this coefficient should be interpreted as the average quality rating difference between weekdays and weekends. Thus, for a person of average loneliness, on weekdays the interaction quality was 4.76 (i.e., a_{00}), and on weekends it was 5.02 (i.e., 4.76 + .26).

The second, purely between-person, question asks, "Does loneliness predict average interaction quality?" and is assessed by the upper-level equation intercept, $a_{01} =$ -.14, p < .001. This value should be interpreted as the amount of decrease in average interaction quality (on weekdays) associated with each standard deviation increase in loneliness scores.⁵

The third question, embodying the interaction, asks, "To what extent is the association between day of the week and interaction quality moderated by an individual's level of loneliness?" This coefficient was also significant, $a_{11} = -.10$, p < .01, indicating that the day-of-the-week effect is weaker to the extent that individuals are lonelier. Specifically, the coefficient of -.10should be interpreted as the degree of change in the slope between the day-of-theweek and interaction quality for each unit increase in loneliness. Recall that someone average on loneliness showed an increase of .26 $(a_{10} = .26)$ in interaction quality on the weekend; therefore, a person who is one unit above the mean in loneliness would experience only a .16 increase on the weekend (.26 + -.10).

To summarize, in general weekend interactions are experienced as more pleasant than weekday interactions. Loneliness is associated with lower overall interaction quality and a smaller difference between weekday and weekend interaction quality. That is, whereas weekend interactions appear to be substantially more enjoyable for nonlonely persons, lonelier individuals seem not to benefit from this increment. An interesting implication of this finding is that researchers wishing to identify interactional consequences of loneliness would be advised to conduct their assessments on weekends.

Attachment across relationships. Our second example illustrates use of withinperson methods for investigating variability as a function of relationship—that is, how people behave differently with different partners. One issue in the attachment literature concerns the extent to which feelings of attachment reflect qualities of particular relationships. LaGuardia, Ryan, Couchman, and Deci (1999) examined this question by predicting need satisfaction within various relationships from differences in attachment-process qualities across these relationships.

For each of six relationships (mother, father, romantic partner, best friend, roommate, and other adult figure), participants completed two sets of measures, one concerning attachment styles (secure, dismissive, preoccupied, and fearful; Bartholomew & Horowitz, 1991) and the other concerning satisfaction of three basic needs (autonomy, competence, and relatedness; Deci & Ryan, 1985; Ryan, 1995). In this two-level example, relationships are nested within participants. The lower-level equation, analogous to equation 1 above, predicts need satisfaction within each relationship from the four attachment ratings relevant to that relationship.

$$Y_{ij} = b_{0j} + b_{1j}(sec) + b_{2j}(dis) + b_{3j}(preocc) + b_{4j}(fear) + e_{ij} (1b)$$

The upper-level equations include terms to capture the effect of a between-persons variable, sex of participant, on overall need satisfaction (the intercept in equation 1b) and on the attachment-satisfaction slope—that is, whether sex moderates the attachment-satisfaction effect. Sex was entered as a 0,1 dummy-code and did not significantly affect mean levels of need satisfaction (i.e., a_{01} was not significant).

Lower-level effects for attachment dimensions $(b_{1j}, b_{2j}, b_{3j}, and b_{4j})$ were qualified by sex, as shown in Figure 2. Secure feelings were associated with greater need satisfaction in relationships for both men and women. However, dismissive feelings predicted lesser satisfaction only among women, and fearful feelings predicted lesser satisfaction only among men. Preoccupation did not predict need satisfaction

^{5.} A unit increase in this example is a standard deviation increase because loneliness scores were z-scores of the loneliness scale. When raw scores are used, a unit increase refers to a unit increase in the scale of the variable. Also, the upper-level predictor variable (loneliness) was centered around the grand mean; therefore, a score of 0 on the scale represents a person of average loneliness. This is another example of the importance of centering in the interpretation of data.



Women



Figure 2. The association among the four attachment styles and need satisfaction in relationships for men and women. * = p < .01, coefficients are significantly different from 0.

significantly for either sex. The coefficients in Figure 2 represent the average gain in need satisfaction associated with rating a particular relationship's attachment feelings one point higher than the person's average attachment rating. For example, the 2.59 coefficient for men's security indicates that for men, a one-unit increase in rated security above their personal security mean implies a 2.59-unit increase in need satisfaction. These results indicate that the field's overemphasis on dispositional effects of attachment styles may have obscured important processes better attributed to the qualities of particular relationships (consistent with Bowlby's conceptualization of attachment as a set of normative rather than individual-difference processes).

Generalizing to more complex models

The loneliness example described above featured a dichotomous predictor variable at the lower level (day-of-the-week) and a continuous predictor at the upper level (loneliness). The attachment example used four continuous predictors at the lower level (attachment ratings) and one dichotomy at the upper level (participant sex). Multilevel models are readily expandable to incorporate multiple predictors, continuous or dichotomous, at each level of analysis. For example, daily measurements might index the relative contributions of two variables-day of the week and support received, as well as their interaction. Support might further be subdivided into dimensions such as tangible, emotional, and informational support. Multiple dispositional predictors can also be included. As mentioned earlier, it is also possible to specify more than two levels of analysis (although in practice current programs have difficulty with more than three levels). For instance, one might obtain daily ratings of support received from each of four target persons-spouse, best friend, co-worker, and sibling. Here, days are nested within relationships, which in turn are nested within persons. Relationship type would be represented by planned contrasts or dummycodes.

Multilevel analysis is particularly adept at handling missing data and unequal numbers of units in the lower level. In the loneliness example, some participants did not record interactions for all 14 days. In the attachment example, some participants did not have a romantic partner or roommate. These omissions are a common but vexing problem in relationship research, and the flexibility of multilevel models for contending with them is a major strength.

Furthermore, multilevel models are not limited to data structures in which the upper-level unit is the person. Units that are themselves aggregations are also feasible, such as census tracts nested within geographical regions (to examine correlations among social indicators) or employees nested within work groups (to study the impact of worker social relations on productivity). Researchers would then be examining within-tract (group) questions, between-tract (group) questions, and their interaction. Of particular relevance to relationship research is the possibility of nesting individuals within social units-social networks, families, or couples. The advantage of the multilevel modeling approach, in contrast to more traditional forms of analysis, is that it encourages researchers to design studies that take full and flexible advantage of conceptualizing relationship processes in within-unit terms.

Discussing particular programs for multilevel analysis goes beyond the scope of this article. Kenny et al. (1998) provide an overview of three popular methods-ordinary least squares (OLS), weighted least squares (WLS), and maximum likelihood estimation (MLE). Relationship researchers are likely to be particularly interested in a study by Raudenbush, Brennan, and Barnett (1995), in which they describe a method for handling within-dyad dependencies with two-level models. This method can be applied to control or investigate dyadic dependencies common, for example, in studies of marital and romantic partners. Articles by Snijders and Kenny (this issue) and Kenny and Cook (also this

issue) illustrate applications of multilevel modeling with families and couples, respectively.

Concluding Comments

A fundamental tenet of the field of personal relationships is that there is something special about a relationship that goes beyond the dispositional characteristics of the individuals involved. We find it somewhat ironic, therefore, that questions about relationships and relationship processes are often investigated and sometimes even framed in dispositional terms. We suspect that this tendency grows out of our intellectual heritage in disciplines that view the individual as the central unit of action, and also from the convenience and simplicity of methods and software designed to examine the behavior of individuals.

When theories are constituted at that level, there is no error in investigating phenomena from a dispositional perspective, of course. Our position does not imply that dispositional factors are unimportant or uninteresting to understanding interpersonal activity. However, many of the most fascinating and substantial questions in the relationships field concern the impact of context, partners, and time, factors whose impact cannot be illuminated by solely studying differences between individuals. To explore these questions, researchers will need to become adept in conceptualizing phenomena in within-persons terms, and then conducting empirical studies that take full advantage of this level of analysis. Doing so is likely to bring our findings and theoretical knowledge into closer correspondence with the ways in which people experience their relational lives.

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