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Daily and Within-Day Event Measurement

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In this chapter we review methods that assess stressful experiences at the daily level, primarily through self-reports using some form of daily diary or record. Although other forms of self-recording devices are available to measure bodily states, such as blood pressure (see Chapter 10), these techniques are less relevant to the assessment of exposure to stressors or the cognitive or behavioral responses to stress and, as such, will not be emphasized here.

There are compelling reasons why a researcher may choose to assess stressful experiences and related constructs such as coping at the daily level (Stone & Shiffman, 1992; Verbrugge, 1980). Measurement at the daily level affords the researcher with the equivalent of a behavioral science microscope. By recording the details of human thoughts, feelings, and actions, diaries have a resolving power that cannot easily be achieved through the use of standard interviews or questionnaires. For stress researchers, this resolving power can be used to tackle important theoretical problems such as the nature of chronic stress, the mechanisms through which major stressors exert their effects, and the role of personality and social structure in the stress process.

Traditionally, to measure chronic and acute stressors, stress researchers obtained retrospective reports stretching back over months and years. Such methods are prone to a variety of recall biases that limit their accuracy. Although they are not applicable to all types of stress research, diary designs can be used prospectively to study chronic and acute stressors over periods of weeks and months. Furthermore, as theories of stress focus increasingly on intervening processes and mechanisms (Kessler, Price, & Wortman, 1985), the value of methods that can tap into everyday thoughts, feelings, and actions increases. Finally, the prospective nature of diary data helps to address some of the causal ambiguity inherent in retrospective survey data.

Short History of Daily Life Event Research

Wheeler and Reis (1991) have recently reviewed the history of methods of self-recording of everyday life events. Additional historical references for the use of

health diaries are provided by Verbrugge (1980). Excellent summaries of available methodologies for the daily assessment of stressful events have been published by Stone, Kessler, & Haythornthwaite (1991) and Stone and Shiffman (1992). Suls and Martin (1993) also provide a brief history of daily recording methods. What is clear from these reviews is that daily methods, while not playing a prominent role in behavioral science research, have enjoyed a rather long history and are becoming increasingly popular. The latter is evidenced by the appearance of two recent special issues of journals devoted to research using daily reports and self-recording methods (*Journal of Personality* 59:3, 1991; *Annals of Behavioral Medicine* 15:1, 1993).

Some of the early uses of daily records or diaries were in consumer expenditure surveys, studies of food consumption, and time use surveys (e.g., Sudman & Ferber, 1971; Szalai, 1972). Verbrugge (1980) reports even earlier uses of diaries in health studies, beginning with the Baltimore Morbidity Survey from 1938 to 1943 (Downes & Collins, 1940). In such early health studies, the diary was used primarily as a memory aid when researchers conducted interviews about illness episodes. More recent health studies have also used diaries, including the National Medical Care Expenditure Survey, in which respondents keep a diary of medical expenses. As Verbrugge (1980) points out, these health studies have included diaries primarily as a methodological check on the accuracy of data on health-related episodes and behaviors collected with more conventional interviews, questionnaires, or health records. Compared to these other methods, diaries generally yield higher incidence rates for acute and chronic conditions (Verbrugge, 1980).

In the field of psychology, Wheeler and Reis (1991) point to several trends that fueled an interest in methods to assess everyday experience. The renewed interest in inner experience in the 1960s along with the appearance of research instruments designed to assess momentary psychological states (e.g., the Nowlis Mood Adjective Checklist; Nowlis, 1965) have led to many studies that have explored the stability of mood over several days, the correlates of changes in mood, and the relation of mood changes to more major changes in physical or psychological health status (see Chapter 7).

Research and therapy based on behaviorist theories has also generated an interest in assessing daily experience. Research on psychological disorders, such as depression has benefited from examining the behavioral correlates of positive and negative mood states on a daily basis (e.g., Lewinsohn & Libet, 1972; Lewinsohn & Talkington, 1979). In the therapeutic context, diaries have served as a method for identifying behaviors that may be the focus of treatment and for evaluating the effectiveness of treatment strategies. In this tradition, the assumption was that the act of recording everyday thoughts, feelings, and behaviors may itself modify behavior (see Duncan, 1969). The reactive nature of these techniques, although viewed as a strength among the behavioral therapists, remains a source of concern among researchers using these methods primarily as a data collection tool.

Personality psychologists have also recognized the value of assessing daily experiences as a way to explore stability and change in personality constructs over time (e.g., Epstein, 1979, 1980). Csikszentmihalyi and his colleagues (e.g., Csikszentmihalyi, Larson, & Prescott, 1977) have utilized the "experience sampling method" (ESM) to tap into subjects' (usually adolescents') thoughts or behaviors at

random intervals over several days. An electronic paging device is used as the signal for the subject to record (see Hormuth, 1986, for a review of these methods). These methods have been valuable in documenting the prevalence and stability of psychological states (e.g., negative affect; Larson & Ham, 1993) as well as behaviors (e.g., time studying) and in exploring the co-occurrence of these states and behaviors (e.g., Wong & Csikszentmihalyi, 1991).

One of the earliest uses of the diary method in stress research was a study by Meyer and Haggerty (1962) in which families kept diaries of stressful family events, that were then related temporally to the outbreak of streptococcal infections. This was followed by a community-based study by Roghmann and Haggerty (1972, 1973) in which a large sample of adults kept daily diaries of stressful events, illnesses, and the use of health services. These studies established some of the first links in the literature between minor daily stressors and health-related outcomes. Studies in the early 1980s by Eckenrode and colleagues (Caspi, Bolger, & Eckenrode, 1987; Eckenrode, 1984; Gortmaker, Eckenrode, & Gore, 1982); and by Verbrugge as part of the Health in Detroit Study (e.g., Verbrugge, 1985), used a simple, open-ended question or an abbreviated checklist to record stressful events, and then related these daily measures to mood, illnesses, or health behaviors.

At about this time, several other research groups began exploring daily stressors and their relation to psychological or physical health outcomes. Mirroring the earlier development and widespread usage of the Schedule of Recent Experiences (SRE; Holmes & Rahe, 1967), the measures of daily stressors typically involved checklists. Lewinsohn and associates developed the Pleasant Events Schedule to explore the relationship between depression and levels of daily positive experiences and activities (Lewinsohn & Libet, 1972), as well as its counterpart, the Unpleasant Events Schedule (Lewinsohn & Talkington, 1979).

Emerging from their transactional view of the stress process, Lazarus and his colleagues began to explore the nature of everyday stressors as a complement to major life events. This research group produced the 117-item Hassles Scale and the 135-item Uplifts Scale which originally were used as monthly measures (Kanner, Coyne, Schaefer, & Lazarus, 1981) but were also adapted for use as a daily measure (DeLongis, Folkman, & Lazarus, 1988). Although there has been some controversy concerning the extent to which the Hassles Scale is confounded with mental health outcomes (see Dohrenwend, Dohrenwend, Dodson, & Shrout, 1984; Lazarus, DeLongis, Folkman, & Gruen, 1985), its popularity has served to focus the attention of stress researchers on small life events. It has also served as the basis for the development of other measures that assess hassles generally or in specific domains, such as the Parenting Daily Hassles Scale (Crnic & Greenberg, 1990).

The early 1980s also saw the development of checklist measures specifically designed to be used on a daily basis. Stone and associates developed the Assessment of Daily Experience (ADE) measure (Stone & Neale, 1982). This 66-item scale included both positive and negative experiences distributed across five major domains (e.g., work-related activities, leisure activities). The current version, the Daily Life Experience (DLE) checklist, contains 78 items (Stone, Neale, & Shiffman, 1993). In addition to engaging in extensive piloting studies to generate scale items, these researchers have also reported concordance data between husband and

wife couples as a way to address validity issues. Such checklist measures are reviewed in more detail below.

Currently, researchers are adapting these earlier efforts to address a range of theoretical issues in stress research. As more researchers have utilized daily approaches to the assessment of stressful experiences, discussions of methodological and analytic issues in daily studies have also become more commonplace (e.g., Jaccard & Wan, 1993; Kenny, Kashy, & Bolger, 1993; Stone, Kessler, & Haythornthwaite, 1991; West & Hepworth, 1991).

Research Questions That Can Be Addressed with Daily Event Measures

Daily event measures can be used to address a wide range of research questions. We list some of the major ones below and give examples of studies in each case. Note that we assume that the measures are used in a daily diary design—namely, a longitudinal design that involves repeated assessments of daily stressors over the course of a single day, over multiple days, or both. The daily data that are collected in such designs can be aggregated over days to obtain person-level stress measures, such as the total number of days on which work conflicts occurred. Such stress measures may be less prone to recall biases than retrospective reports covering that same time period, but it is questionable whether the costs of using diary data in this way outweigh any benefits in reducing measurement error. A much better use of diary data is to preserve the longitudinal nature of the data by keeping the analysis at the level of the person-day. Analyses at the daily level can examine temporal relationships between daily stressors and daily outcomes, while still allowing the researcher to examine individual differences in these processes. We discuss data analysis issues later in this chapter.

The first and most obvious use of daily event measures is to document people's exposure to stressors. In studies of work stress, for example, researchers may be interested in knowing how often workers are exposed to various types of daily problems such as work overloads and interpersonal conflicts with co-workers, supervisors, or subordinates. A recent study by Bolger et al. (1989) found that work overloads and work conflicts differed dramatically in their prevalence. Workers complained of being overloaded with work on 1 out of every 3 days, whereas they complained of having work conflict only once a month.

It is commonly believed that negative events can have a cascading effect such that "one bad thing leads to another." A second use of daily event measures is to investigate this belief by studying the interrelationships between daily events over time. For example, one way in which the management of work and family roles creates distress is that stressful events in one domain lead to stressful events in the other domain (Bolger, DeLongis, Kessler, & Wethington, 1989).

A third use of these measures, and the one that has received the most research attention, is to study the impact of daily events on physical and mental health. Initial work demonstrated associations between summary measures of daily events and psychological distress (Kanner et al., 1981). This work has been expanded to

examine the emotional impact of specific categories of daily events (Bolger, DeLongis, Kessler, & Schilling, 1989; Stone, 1987). For example, the Bolger et al. (1989b) study mentioned earlier found that work conflicts are the most distressing of all daily events, whereas the much more common work overloads were not very distressing. Progress has also been made on understanding the relationship of daily events to physical symptoms (DeLongis, Coyne, Dakof, Folkman, & Lazarus, 1982; DeLongis et al., 1988).

A fourth type of question that can be addressed using daily event measures is the extent to which daily events make up the elements of chronically stressful experiences (see Chapter 5). For example, daily event measures can permit investigators to identify the discrete events (overloads, conflicts) that make up a chronically stressful marriage or occupation. Consistent with this idea, Eckenrode (1984) has shown that daily events are predicted by measures of chronic stress.

Daily events are also predicted by measures of major life events. This is thought to occur because major life events affect health outcomes, in part through increasing daily problems (Eckenrode, 1984; Kessler, Price, & Wortman, 1985). Therefore, a fifth use of daily event measures is to assess the extent to which they mediate the effects of major life events. For example, in a study of low-income mothers, Eckenrode (1984) showed that major life events predicted subsequent daily events which, in turn, predicted daily distress. Pearlin and colleagues (1981) demonstrated that the effects of major work disruptions such as unemployment include chronic role strains and thereby increased depression. As noted above, daily events are likely to be the key elements of chronic stress.

More generally, a fruitful area of research is the extent to which daily events mediate the effects of personality and social variables on disease. For example, daily events have been shown to explain partially the effects of personality variables, such as neuroticism, on daily distress (Bolger & Schilling, 1991) and physical symptoms (Larsen & Kasimatis, 1991).

Finally, as is the case of major events, people differ in the extent to which they are emotionally and physically affected by daily stressors. Researchers have begun to explore personality and social variables that modify the impact of these stressors. For example, the effects of daily stressors have been shown to depend on self-esteem (Campbell, Chew, & Strachey, 1991; DeLongis et al., 1988), neuroticism (Bolger & Schilling, 1991; Larsen & Kasimatis, 1991), and social support (Caspi, Bolger, & Eckenrode, 1987; DeLongis, Folkman, & Lazarus, 1988).

All of the above questions can be answered within a data-analytic framework variously known as the multi-level model, the mixed model, the hierarchical linear model, and the covariance components model. The essential feature of these models is that they recognize that diary data have two random components: one due to the sampling of persons (or couples, families, etc.), and the other due to the sampling of repeated measurements within persons (e.g., days). To make correct inferences from diary data, both of these sources of variance need to be considered. Using statistical models that fail to take both random components into account (e.g., conventional regression and ANOVA models) can produce very misleading results. Kenny, Kashy, and Bolger (1993) provide an overview of analysis approaches to diary data and explain in detail why it is necessary to use multi-level analytic

models. Guidance on diary data analysis is also provided by West and Hepworth (1991) and Jaccard and Wan (1993).

Software for correctly analyzing these data is available mostly in specialized programs such as HLM (Bryk & Raudenbush, 1992), ML3 (Prosser, Rasbash, & Goldstein, 1991), GENMOD (Mason, Anderson, & Hayat, 1988), MIXREG (Hedeker, 1993), and VARCL (Longford, 1986). Equivalent programs are also available within standard statistical packages: MIXED is available as part of SAS software, and 5V is available as part of BMDP software. All these programs use a multiple-step Maximum Likelihood approach to estimation and testing. Kenny, Kashy, and Bolger (1993) describe a simpler, one-step Weighted Least Squares approach that can be carried out using SAS's GLM program.

Choosing an Appropriate Measure

It is useful to categorize methods used in daily stress assessment as an aid to researchers who are considering using a daily approach. Such a taxonomy will also be useful in pointing out the limitations of this review, which is focused primarily on a subset of all possible methods.

Wheeler and Reis (1991) describe three generic types of daily self-report methods: (1) interval-contingent recording; (2) signal-contingent recording; and (3) event-contingent recording. Suls and Martin (1993) added a fourth category to this scheme, continuous recording, which will not be discussed here since it is less relevant to stress research. Although interval-contingent recording has been by far the most frequently used method in stress research, we describe both signal-contingent and event-contingent methods because of their potential benefit to researchers in this field.

Interval-Contingent Recording

In this method, data are collected at regular intervals, determined ahead of time by the researcher. Typically the time interval has been a day, although shorter and longer time periods have been used. The respondent will usually report on events that have occurred since the last self-report, although specific research questions may require that events covering a shorter period of time between recordings be assessed. For example, in her study of work stress and marital interaction among air traffic controllers and their spouses, Repetti (1989) had respondents complete daily diaries that asked them to report on marital behavior for that evening, since the research question concerned the effects of the work day on subsequent marital interactions.

Signal-Contingent Recording

This method involves having respondents record their experiences whenever signaled by the researcher. Typically, the interest is with what the respondent is experi-

encing at the precise moment they are signaled. As such, the time period covered is very brief. A good example of this method is the Experience Sampling Method (ESM) developed by Csikszentmihalyi and Larson (Csikszentmihalyi & Larson, 1987; Larson & Csikszentmihalyi, 1983). In their work, electronic "beepers" worn by respondents are used to signal the recording period. Respondents may be signaled several times a day, at random or during prespecified times. These methods may be particularly useful in recording inner experiences, such as mood, that may fluctuate often during the day, and thus be subject to recall biases if assessed several hours or days later.

Event-Contingent Recording

This method requires respondents to make a report every time a predetermined event has occurred. For example, in research with the Rochester Interaction Record (Wheeler & Nezlek, 1977) and the Iowa Communication Record (Duck, 1991), respondents are instructed to use diaries or logs to answer questions about social interactions as they occur. Depending on the research question being addressed, the event may be a predictor variable, such as an argument with a spouse, or an outcome variable, such as a headache or other physical symptom. Since the events in question may occur at any time, the length of time between records varies. Such an approach is well suited to events with a well-defined beginning and ending, such as an argument, but is less appropriate for experiences that may be less temporally defined, such as feeling sad.

Comparing Methods

Each of the methods described above has distinct advantages and disadvantages. Choosing a method requires the researcher to consider the nature of the stressor to be assessed and the research questions or hypotheses to be tested. There are also important logistical considerations in choosing a method. Sometimes, limitations of a given method can be overcome by combining different methods within the same study.

Interval-contingent methods are useful in documenting the amount of exposure an individual has to particular types of stressors or in assessing overall exposure levels in a given period of time. For example, a researcher may be interested in the number of arguments between spouses over a particular time period (e.g., a week, a month). As Stone et al. (1991) point out, the frequency with which records are kept (several times a day, once a day, once a week), as well as the total number of recording periods (e.g., 30 consecutive days, 6 consecutive months) should be based on an understanding of the stressor in question, the temporal relationship between the stressor and relevant outcomes, and a consideration of the statistical power needed for the analyses to be conducted. For example, as noted above, Bolger et al. (1989b) found that work conflicts were reported only about once every month. If a researcher was interested in the relationship between work conflict and

mental health, it would clearly be inadequate to ask respondents to keep a daily diary for a total of one month, since this would yield an average of only one incident. However, a reliable estimate of instances of work overload, a much more common stressor for many people, may well be achieved with a daily diary kept for one month.

The nature of the outcome in question is also an important consideration in determining the length of time respondents should be asked to keep diaries. For example, if mood is the outcome of interest, daily recordings for 3 or 4 weeks will usually yield sufficient variability in mood scores to allow the investigator to explore the temporal relationship between a daily stressor such as work overload and changes in mood. However, rarer discrete outcomes such as absenteeism and utilization of health services would require that the study be lengthened to allow for enough of these events to occur.

There are two potential problems with interval-contingent methods. The most obvious is that respondents may be recording the data several hours or days after the event in question took place. This makes these methods susceptible to forgetting and biased recall (Suls & Martin, 1993; Wheeler & Reis, 1991). This problem is greater for continuous phenomena that vary considerably over relatively short time periods (e.g., mood, amount of perceived work stress, levels of concentration) than discrete events with a well-defined time of onset (e.g., argument, exercise, headache). Having respondents record information at more frequent intervals may help solve this problem, but may have the undesirable effect of overburdening the respondent.

Diary studies often instruct respondents to complete the diaries at the end of each day. An advantage to this practice is that respondents get accustomed to a regular routine of completing the diaries, making it less likely for them to forget to complete the record (although telephone reminders and daily collection of diaries help reduce this problem). It is also logical in terms of having respondents summarize their day. However, some research questions might dictate completion of the diaries at times other than the end of the day. For example, a work stress study may want respondents to complete the diary immediately after work; or a study investigating physiological changes related to myocardial ischemia may want recording to occur toward the end of the morning since there is evidence that there is a higher incidence of ischemia in the morning hours (Krantz et al., 1993). However, a potential problem with using any fixed time interval for recording daily, weekly, or monthly data may occur if the phenomenon being measured tends to have a regular cyclical pattern. For example, more undesirable life events tend to be reported on weekdays, compared to weekends (Stone et al., 1985). As such, estimating the prevalence of such events based on a daily diary completed once a week for several weeks may be biased if always completed on either a weekday or a weekend.

Signal-contingent methods effectively eliminate the recall problem by having respondents immediately record their thoughts, feelings, or behaviors when they are signaled by the researcher. Since the respondents can be signaled at any time, this method may also eliminate the potential bias introduced by having the respondents complete the diaries at the same time of day or day of week. For assessing frequently occurring activities, as well as inner psychological and physiological states, signal-contingent methods would appear very useful. Studies using these methods

have been particularly useful in documenting how various groups of people spend their daily lives, and as well as how inner psychological states co-vary with certain activities. For example, Csikszentmihalyi and Larson (1984) report that, among students, studying tends to be associated with negative mood, especially among low achievers.

There are at least two disadvantages to signal-contingent methods (Suls & Martin, 1993; Wheeler & Reis, 1991). First, because they are designed to assess immediate experience versus recall over a longer time period, they are impractical as a way to study infrequently occurring events or stressors. For example, if the research question concerns the relationship between arguments and physical symptoms, ESM-type methods would be unlikely to sample enough episodes of arguments to allow for a meaningful analysis. However, if the researcher is interested not in investigating a particular class of stressor, but, rather in assessing whether *any* stressor was occurring at that time, then ESM methods would be more feasible. Chronic stressors rather than acute stressors are more likely to be assessed with this method. This is especially true if samples of individuals susceptible to the chronic stressor in question are studied. For example, Williams et al. (1991) studied the relationship between juggling multiple roles and mood in a sample of working mothers using ESM methods.

The second major disadvantage of signal-contingent methods is that they are more intrusive than other methods since respondents have no control over when they will complete the records. As such, they may be signaled at times when it is inconvenient to fill out the data form (e.g., in class, at dinner, feeding the baby, in the shower, jogging). Some ESM studies allow respondents to turn off the signal devices when they do not want to be disturbed. For both reasons, respondents will not respond to a certain percentage of signals; thus some data will be missing. For example, Larson (1979), using an adolescent sample, reported that one-third of the signals were missed. Other studies with adults and children report a rate of missed signals of between 15 and 20 percent (e.g., Csikszentmihalyi & Graef, 1980; Larson & Lampman-Petratis, 1989). Although we found no data on this issue, it seems logical to assume that the ability of respondents effectively to tolerate the intrusiveness of these methods would decrease as the level of disorganization and stress in their lives increased. If so, missing data may not be random in the sample studied. Pilot testing with high-risk samples is necessary to ensure that respondents can use these methods effectively.

Event-contingent methods, like signal-contingent methods, overcome problems with forgetting and selective recall by having respondents complete a record every time a particular type of event occurs. Unlike signal-contingent methods, these methods also can be used to study events with varying frequencies. The event that triggers the record could be either a predictor variable (e.g., stressful interpersonal interactions) or an outcome variable (e.g., asthma attacks, drug use). These methods are particularly useful for studying the immediate circumstances surrounding specific acute stressors or discrete outcomes. They are less feasible for studying chronic stressors since time of onset is not likely to be well defined (although some chronic stressors have an acute onset). Advances in the technology of physiological measurement will also expand the range of bodily conditions that could trigger a record (e.g., increased blood pressure or heart rate).

Event-contingent approaches require that respondents be well trained in the definition of the event to be studied. Most events involving social interaction, for example, will vary considerably in intensity and duration. For instance, a study of work stress may require respondents to complete a record every time they experience conflict with a supervisor. In such a study, clear instructions regarding the researcher's definition of "conflict" would need to be given to respondents to prevent them from being overly exclusive or inclusive. Even with extensive training, it is helpful to have respondents provide some open-ended descriptive information about the event so that the researcher can confirm that the incident being recorded meets the study definitions. An alternative approach, advocated by Stone, Kessler, & Haythornthwaite (1991), is to have interviewers who are trained to probe for relevant events make daily phone calls to respondents.

An interesting variant of the event-contingent approach was a study conducted by Bolger (Bolger, 1990; Bolger & Eckenrode, 1991) in which college students preparing for a medical school admission test kept daily diaries for 2½ weeks before and 2½ weeks after the exam. The stressful event, the exam, was therefore pre-selected by the researcher. The diary data could then be used to assess the students' psychological states and coping responses leading up to the exam. These data were particularly useful in documenting differences in the adjustment of the students to this stressor as a function of social integration and personality characteristics, measured prior to the diary period. This is an example of how diary methods can be used to study the impact of major as opposed to minor stressors. This approach is, of course, feasible only with events that can be anticipated.

Since they involve intensive self-monitoring of behavior over several occasions, all the methods described here are potentially reactive in nature. But this may be particularly true of event-contingent methods, depending on the amount of control the respondent has over the event in question. For example, if the event involves a behavior such as smoking or substance use, or a type of social interaction over which the respondent has some control, such as an argument with a spouse or child, completing a record every time such an event occurs may cause the behavior to change over time. This may contribute to the commonly observed pattern of response decay over time in diary studies (Stone et al., 1991; Verbrugge, 1980), although it is often difficult to determine whether a decrease in the rate of reporting events over time is due to fatigue, or to changes of feelings or behaviors resulting from the task. This uncertainty may be partly resolved by debriefing respondents after the diary-reporting period of the study is completed, asking them directly about the diary task and changes in their behavior over time. The diary period may also be shortened to prevent fatigue or sensitization. However, this may require a larger number of subjects to compensate for the loss of statistical power due to reducing the number of days.

Specific Daily Stress Measures

For each of the methods reviewed above, there are a variety of approaches to eliciting information about daily stressors, ranging from single open-ended questions (e.g., Eckenrode, 1984) to structured checklists (e.g., Stone & Neale, 1982).

The choice of approach depends on the focus of the study, the mode of data collection (e.g., paper-and-pencil diaries versus daily phone calls), and the circumstances and tolerance of the population being studied. We concentrate on checklist approaches here, although we first briefly discuss open-ended methods since they may be more suitable for some researchers.

An open-ended method was used by Eckenrode (1984) in a study of low-income women and children using a neighborhood health center in Boston (see also Caspi, Bolger, & Eckenrode, 1987; Gortmaker, Eckenrode, & Gore, 1982). In this study, these women were asked to complete a one-page diary at the end of each day for 28 days. The single question regarding stress was: "Did anything go wrong today in the house, with the children or others in the household, at work, or elsewhere?" If a respondent answered "yes," she were then asked to describe what happened. Such responses could then be classified into discrete categories. This diary was a modification of a diary used by Roghmann and Haggerty (1972), who asked three separate open-ended questions, beginning with the stem question "Did anything go wrong today?" and then varying the domain ("at work or in the house"; "with the school or the children"; "getting along with friends, relatives, husband"). More recently, Emmons (1991) had undergraduate subjects keep a daily diary (completed twice a day) in which they were asked to list four events or thoughts, two that contributed to negative mood and two to positive mood. Coders then categorized events into categories (e.g., achievement, interpersonal).

As Stone et al. (1991) point out, there are both advantages and disadvantages to such an open-ended approach. Simple, open-ended questions are easy for respondents to understand and to complete in little time. This may be attractive in studies where stress is not the major focus of the study and where time is limited. If phone interviews are used rather than paper-and-pencil diaries, open-ended questions can also establish a more conversational style and greater rapport with respondents. If combined with probes for various domains of stress, the resulting data can then be coded by the researcher into discrete categories of stressful events.

There are also several disadvantages to open-ended approaches. In paper-and-pencil versions, they require respondents to write out a description of the events. The amount of detail provided by respondents will vary greatly, leading to potential problems in classifying responses. Recall is also more likely to be biased by personality traits or transient mood states when an open-ended versus a structured format is used, although for minor stressors, the amount of recall error with diaries will generally be much lower than with retrospective interviews. Finally, open-ended questions will tend to underestimate the total exposure of respondents to stressors on a given day. If the researcher is interested in knowing only whether *any* stressor occurred that day, these methods may be adequate. However, if the research question requires a more complete assessment of all stressors occurring that day, other approaches, such as the checklist methods described below, are more appropriate.

As an alternative to open-ended questions about stressful events, some studies have used brief global ratings of perceived stress levels. For example, in a study of the relationship between daily stress and recurrence of genital herpes simplex, Rand and colleagues (1990) had respondents complete a Daily Stress Questionnaire which asked them to indicate on a 4-point Likert scale how much stress they felt that day in

six areas (e.g., physical health, financial, relations with family). Watson (1988), in a daily study of the correlates of negative and positive affect, asked college students, "How much stress (e.g., because of hassles, demands) were you under today?" Responses were recorded on a 5-point Likert scale (1 = felt very slightly or not at all; 5 = felt very much). Such approaches may provide convenient summary measures of perceived stress at the daily level, and may be a practical alternative to more comprehensive assessments of daily events when the amount of space devoted to stress assessment in the diary is very limited. However, these approaches may sample only a small portion of potentially stressful experiences, or measure stress at such a global level so as to preclude analyses that differentiate between types of stressors. Global assessments of perceived stress also tend to confound the objective exposure to stressors with the respondent's reaction to them (e.g., distress), a problem similar to that faced by the assessment of major life events (see chapters 2 and 3).

Most studies where stress is a major focus of interest now use some form of checklist. Researchers sometimes supplement the checklist with open-ended questions to assess events that may have been missed with the checklist, and to obtain more detailed contextual information about checked events. In the next section we review a sample of checklist measures. Although our survey of checklist measures is not a comprehensive list, it is designed to represent the diversity of approaches in current use.

Daily Life Experience (DLE) checklist

This checklist was originally named the Assessment of Daily Experience (ADE), with its development described by Stone and Neale (1982). Its current version is called the Daily Life Experience checklist (DLE).¹ It contains 78 events organized into five major domains (i.e., Work; Leisure; Family and friends; Financial; Other). Respondents are asked to rate those events that "happened since you first awoke this morning." For events that are checked, respondents also rate the desirability of the event on a 6-point scale, from "extremely undesirable" to "extremely desirable"; as well as the meaningfulness of the event on a 3-point scale from slightly to extremely meaningful. Events generally rated as positive (e.g., promotion or raise) as well as negative (e.g., argument with spouse) are included. Respondents can also write in any events not on the list, and are asked to write in the "worst or most bothersome problem of the day." Typically the diary also contains mood and symptom items. The diary takes approximately 10 minutes to complete.

A desirable feature of this instrument is that events were sampled by having persons in the population to be studied nominate, in an open-ended format, events that occurred to them over 14 days. The large number of generated events were then summarized into major and minor categories, with the resulting structured checklist used in subsequent diary studies. This procedure ensured that events were representative of the population from which research samples would be drawn.

Another distinctive feature of this research program is the researchers' use of couples as part of a "target-observer" procedure. Married couples were recruited

from the community, and each was asked to complete diaries for the same days. Husbands were the target respondents; the wives were the observers, filling out the forms in terms of events that had occurred to the husbands. Each would fill out the forms independently, then meet to discuss and revise their lists. In this way, many events initially overlooked by the respondents (husbands) could be added to the list, yielding a more reliable daily score. Degree of concordance between partners was also assessed and used as a method to assess the validity of the data collected with the instrument (see Stone & Neale, 1982).

The Hassles Scale

The original Hassles Scale (DeLongis et al., 1982; Kanner et al., 1981) consists of a list of 117 items generated by the research staff covering the areas of work, health, family, friends, the environment, practical considerations, and chance occurrences. Respondents also rated the severity of items on a 3-point scale (somewhat, moderately, extremely), yielding a frequency score (count of number of hassles checked), and an intensity score (mean severity rating). Although developed as a measure of everyday stressors, the scale was originally intended not for daily use, but rather, for once-a-month administration for several consecutive months. A companion Uplifts Scale was also developed by these researchers, consisting of 135 items reflecting positive experiences in areas similar to those in the Hassles Scale.

The original research with 100 community residents of Alameda County, California clearly points out that such checklists frequently tap into the everyday manifestations of chronic stressors as well as discrete microstressors not necessarily tied to enduring difficulties. The five most frequently cited hassles in this sample were "concerns about weight," "health of a family member," "rising prices of common goods," "home maintenance," and "too many things to do." Although the distinctiveness of daily stress measures from more aggregate measure of chronic stress is an important theoretical and methodological issue (see Chapter 5; Wheaton, *in press*), the issue that has resulted in more controversy regarding the Hassles Scale concerns possible confounding of items with measures of psychological distress or psychopathology (Dohrenwend, Dohrenwend, Dodson, & ShROUT, 1985; Dohrenwend & ShROUT, 1985; Lazarus, DeLongis, Folkman, & Gruen, 1985; Monroe, 1983). Some items, such as "you have been lonely," "you have troubling thoughts about your future," seem less focused on environmental stressors than on internal states.

In a study of 75 married couples, DeLongis, Folkman, and Lazarus (1988) report on a revised 53-item Hassles and Uplifts Scale that attempts to remove items that are redundant or that suggest psychological or somatic symptoms. For each item respondents rate on 4-point scales the extent to which it was a hassle and an uplift, allowing items to contain both qualities. In this study the scale was completed for 4-day periods between each of six monthly interviews, resulting in 20 daily assessments. This scale appears to overcome some of the conceptual and methodological limitations of the original scale and is short enough to be practical for daily use.

Other investigators have modified the Hassles Scale for specific research questions or populations. For example, Lepore, Evans, and Palsane (1991), in a study of males in urban India, constructed a 5-item "social hassles" scale from items in the Hassles Scale, asking respondents to report how often they experienced these within the last 2 months. Wheaton (in press) recently used an abbreviated daily hassles measure composed of 25 items from the original Hassles Scale within an interview format as part of a community survey. As with measures of major life events, such as the Schedule of Recent Experiences (SRE; Holmes & Rahe, 1967), researchers will continue to adapt such measures to address specific research questions or meet the unique needs of their research designs.

Additional measures modeled after the original Hassles Scale have begun to appear in the literature even if their component items are not drawn directly from it. For example, the Parenting Daily Hassles Scale (Crnic & Booth, 1991; Crnic & Greenberg, 1990) is a 20-item scale used in a paper-and-pencil questionnaire format in which parents report on the frequency and intensity of everyday events in parenting and parent-child relationships (e.g., continually cleaning up kids' messes; being nagged, whined at, or complained to). These studies have used a 6-month recall period, although the investigators also claim having used the scale covering "the past several days." To date, this scale has not been used as part of a daily diary methodology, but with minor modifications seems appropriate in such studies.

Bolger et al. Daily Stress Scale

A 22-item daily event scale has been reported as part of a daily diary study involving 166 married couples drawn from a larger study of 778 couples in the Detroit metropolitan area (Bolger & Schilling, 1991; Bolger et al., 1989a, 1989b). The 22 events were selected on the basis of earlier pilot testing with a sample of 64 married couples where an open-ended format was used to identify common daily stressors in this population. Events selected for the final scale occurred on at least 5 percent of the days and were shown to be associated with distressed daily mood in the pilot sample. Respondents are asked to check whether the event happened to them over the preceding 24 hours.

In one study (Bolger et al., 1989a), the 22 events were aggregated into 10 summary event categories (e.g., overload at home, family demands, interpersonal conflicts or tensions with one's spouse), with each category being represented as a dummy variable in a regression analysis. In another study (Bolger et al., 1989b), 7 of the items were examined, involving overloads or interpersonal tensions or arguments since the research questions focused on the contagion of stress across work and family roles.

Because this study had a particular interest in interpersonal tensions or arguments, respondents were also asked to identify the most serious event of this kind on each day. A series of follow-up questions were then asked to provide more detailed information about that event (e.g., felt responsibility; amount of perceived control; who was helpful or made the situation worse; coping responses). This is a good example of how a diary method can be used to assess generalized exposure to minor

stressors while also gathering detailed information on a specific class of stressor. Of course, individual researchers could modify such a diary instrument to focus attention on any of several categories of events.

Inventory of Small Life Events (ISLE)

This inventory contains 178 items, 98 undesirable and 80 desirable events (see Zautra, Guarnaccia, & Dohrenwend, 1986, for a complete list). Similar to the Hassles Scale, this inventory is designed for use within an interview format with a 1-month recall period. Its length makes it impractical for use in most daily diary studies.

The authors claim that this scale addresses some of the problems of other checklists by (1) excluding items that could be confounded with psychological states; (2) distinguishing events from ongoing or habitual activities by defining them as changes from usual day-to-day occurrences; (3) distinguishing on an a priori basis desirable from undesirable events; (4) including only observable events; and (5) distinguishing small events from major life events. In the latter respect, the inventory is designed to complement the PERI life event scale (B. S. Dohrenwend, Krasnoff, Askenasy, & Dohrenwend, 1978).

Events were selected from previous scales, with items modified and new items added based on input from other researchers and from pilot studies. As part of the scale's development, expert judges and students provided readjustment ratings, using procedures similar to those employed with the PERI. A cutoff score of 250 was used to distinguish small from large events (for each category of events, subjects were provided an anchor event from the PERI). Desirability ratings also were collected with these samples to verify the initial classifications of events. Scores are based on counts across the entire inventory or within categories of events.

A modified version of the ISLE, with items rewritten to reflect events appropriate for older adults is reported in a study by Zautra and associates (Zautra, Finch, Reich, & Guarnaccia, 1991; Zautra, Reich, & Guarnaccia, 1990). As with the original inventory, experts were used to rate the degree of readjustment required by the events as well as event desirability. Respondents completed the inventory once a month for 10 months, a procedure that allows for the identification of recurring events. For example, whereas the event "criticized by spouse/mate" was reported by only 8.8 percent of the sample in the first interview, for those who reported the event there was a 26 percent chance of recurrence in the subsequent month.

Daily Stress Inventory

The Daily Stress Inventory (DSI) is a 58-item questionnaire designed to assess the sources and magnitude of minor stressful events (Brantley & Jones, 1989, 1993). A manual is available describing the development of the inventory, its administration, and scoring information, as well as normative data from adult, student, and medical patient samples.

Items were selected for the scale based on responses to open-ended questions regarding stressful events in diaries completed over a 2-week period by samples of psychology graduate students, community volunteers, and persons seeking counseling services. The item pool was further refined in a community study of 433 adults. Items are grouped into six categories: interpersonal problems (e.g., "argued with another person"), personal competency (e.g., "was late for work/appointment"); cognitive stressors (e.g., "heard some bad news"); environmental hassles (e.g., "had minor accident"); and varied stressors (e.g., "misplaced something"). Respondents read through the list and rated those events that had occurred on a 7-point scale ranging from 1 = "occurred but was not stressful" to 7 = "caused me to panic." No explanation is given for why extreme perceived stress is characterized by "panic," rather than other psychological states such as depression. This appears to be a limiting feature of this instrument.

An attempt was made to eliminate items overtly referring to psychiatric or physical illness. Scores representing the total number of events checked and their impact (based on summated rating scores) have been used in studies by these researchers. The manual presents reliability and validity data (see also Brantley, Cocke, Jones, & Goreczny, 1988). To date, the measure has been used mainly in studies examining physiological responses to stress (e.g., Brantley, Dietz, McKnight, Jones, & Tully, 1988) and daily fluctuations in symptoms associated with psychosomatic disorders such as asthma (e.g., Goreczny, Brantley, Buss, & Waters, 1988).

Future Directions

Our review has provided an introduction to existing measures of daily stressors and some guidelines for choosing among these measures. In this final section we briefly discuss some promising future directions in the measurement of daily stress.

Checklist measures of major life events have a number of significant limitations relating to the reliability and validity of the event categories. The work of Brown and others has demonstrated that the measurement of life events can be significantly improved by use of in-depth interview measures, such as the Life Events and Difficulties Schedule (LEDS), that involve intensive probes for the degree of threat posed by each event (see Chapter 3). Checklist measures of daily events are prone to many of the same limitations as are checklist measures of major stressors. In principle, then, the measurement of daily stress could be improved upon by use of an interview approach. Obviously, a face-to-face interview would be impractical for daily stress assessment, but a nightly telephone interview might be feasible. To our knowledge, though, no work is currently underway to adapt interview-based methods to the study of daily stressors. (See Stone et al., 1991, for a discussion of the potential advantages of phone interviews in diary studies.)

In studies of daily stress, it is customary to have subjects complete measures at least at daily intervals, although sometimes the unit of analysis is less frequent than that. Yet, arguably, the unit of analysis in daily event studies should be smaller than a single day. For example, a daily event that occurs in the morning is likely have its greatest effect soon after it occurs and may have no detectable (residual) effect by

bedtime. Yet many daily event measures are not suitable for frequent use during a single day, and none of the daily event measures reviewed above has been specifically tailored for such use. Stone, Neale, and Shiffman (1993) have recently pointed out that lagged or prospective effects of daily stressors have rarely been found in the literature. It is conceivable that measures of daily stress and mood taken at sufficiently frequent intervals would show prospective effects. Such measures, of course, would need to be considerably shorter than most existing daily stress measures.

One potentially promising innovation for daily stress measurement has been the development of ambulatory mood-measurement instruments. Shiffman and his colleagues have had subjects use small hand-held recording devices to make simple ratings of moods at many points during a day (Shiffman, Paty, Gnys, & Kassel, 1992). As yet, these devices have not been used to measure daily events—and of necessity the number of event categories used would need to be quite small—but this seems to be a very fruitful area for further research.

To date, most daily stress research has either ignored event content or attempted to cover a wide range of event content. What is emerging, however, is that not all types of daily events are equally stressful. For example, Bolger and colleagues (1989a) found that adult interpersonal conflicts were by far the most stressful types of daily events in their sample. This observation suggests the usefulness of developing daily stress measures that focus on specific types of events and that probe into the characteristics of these events in depth. Few such measures currently exist. Furthermore, it may be valuable to use an event-contingent measurement strategy to record exposure to particular events such as daily conflicts, a strategy where subjects complete a very short diary each time an event of a certain type occurs. In this way, researchers could obtain more fine-grained information about the characteristics and contexts of specific classes of stressors.

One neglected issue in the study of daily events is the likely reactivity of daily event measures when they are used in a daily diary study. For example, event frequency declines as the number of days of diary recording increases (Bolger et al., 1989a). Also, distress is higher during the first few days of a diary study than on later days (Bolger, 1990). There are two possible solutions to these problems. First, where the research question of interest is the association between events and outcomes, day can be used as a control variable in the statistical analyses. Second, it may be feasible to discard the first few days' data if these seem to be strongly affected by subject reactivity (Tennen, Suls, & Affleck, 1991).

Finally, the issue of cultural, racial, ethnic, or social class variability in the experience of daily stress has not been adequately addressed by research to date. Although several daily stress measures described above were developed with community samples, the reported analyses generally do not focus on social group differences in daily stress processes. There is also little information in the literature regarding the feasibility of conducting daily stress studies with children.

It is clear that daily diary studies provide a window into the stress process that more traditional interview and questionnaire methods cannot hope to achieve. On the other hand, these methods are labor- and cost-intensive, and as such, the decision to use these measures should be taken with care. The researcher using daily

assessment methods is faced with a number of difficult decisions (see Stone et al., 1991), the most important being whether measuring stress at a daily level can yield data that can address important theoretical issues. As with other areas of measurement reviewed in this volume, there is no one best measure to fit all research needs. Rather than recommend specific measures, we have attempted to provide the researcher with an overview of this emerging area of research and the measurement approaches currently found in the literature.

Note

1. Information regarding this scale can be obtained from Dr. Arthur Stone, Department of Psychiatry and Behavioral Science, School of Medicine, SUNY at Stony Brook, Putnam Hall, South Campus, Stony Brook, NY 11794.

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