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TEMPORAL DISTRIBUTIONS OF PROBLEM BEHAVIOR BASED ON SCATTER PLOT ANALYSIS

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The scatter plot is a commonly used assessment tool for identifying temporal patterns in the occurrence of behavior problems. However, the extent to which such patterns are frequently observed is unknown because little research has evaluated the general utility of the scatter plot. We conducted a large-scale analysis of within- and across-day occurrences of problem behavior by conducting continuous observations of 20 individuals living in four residential facilities. Data were recorded during 30-min intervals throughout participants' waking hours for 30 days by direct care staff and were converted into scatter plot formats. Five sets of data were excluded from further analysis due to poor interobserver agreement (below 80%). Visual analysis of the remaining 15 scatter plots indicated that none showed any reliable temporal pattern of responding. However, when the data were transformed into aggregate "control charts" based on statistical process control procedures, 12 of the 15 sets of data revealed one or more 30-min intervals during which problem behavior was more likely to occur. Results are discussed in terms of the practicality of applying statistical analyses to scatter plot data and of collecting data for the length of time needed to show statistical significance. It was concluded that detailed functional or descriptive analyses, which would reveal cause-effect or correlational relationships between behavior and specific environmental events, may be both more precise and more efficient forms of assessment.

DESCRIPTORS: behavior problems, behavioral assessment, descriptive analysis, observation procedures, scatter plot, statistical process control

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Research on the treatment of severe behavior disorders conducted over the past 15 years has focused greater attention on the determinants of behavior as the primary bases for treatment development. Assessment techniques used for identifying such determinants have been called collectively *functional analysis* or *functional assessment* procedures (see Iwata, Vollmer, & Zarcone, 1990; Mace, Lalli, & Pinter-Lalli, 1991, for reviews), and those based on experimental methodology (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) have been shown to be highly reliable in revealing cause-and-effect environment–behavior in-

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teractions. Nevertheless, it has been suggested that experimental analyses may be too complex or time consuming and that descriptive analyses, which involve direct observation under less controlled conditions, may represent viable alternatives for identifying behavioral function (Groden, 1989; Sprague & Horner, 1995).

Some descriptive analyses involve detailed observations of behavioral sequences and their temporal contiguity with ongoing events, which are used either as the primary method of assessment (e.g., Repp, Felce, & Barton, 1988) or as the basis for conducting subsequent experimental analyses (e.g., Lalli, Browder, Mace, & Brown, 1993). An approximation to these approaches involves recording temporal characteristics of behavior independent of environmental context and is perhaps best illustrated by the scatter plot analysis (Touchette, MacDonald, & Langer, 1985). The scatter plot is a grid in which time intervals (usually 30 min) are blocked within and across days. Observers record absolute or relative occurrences of behavior within these intervals across successive days in an attempt to identify time-correlated patterns of responding. If any such patterns emerge, they may be cross-referenced with regularly occurring environmental events, such as specific activities, that might influence the occurrence of behavior.

Touchette et al. (1985) presented scatter plot data for 3 individuals who had been diagnosed with mental retardation and who engaged in self-injurious behavior (SIB) or aggression. The data for 2 individuals showed relatively clear temporal patterns of responding that were correlated with work (for 1 individual) and the presence of a particular staff member (for the other). The 3rd individual's scatter plot was uninterpretable. The authors concluded that the scatter plot may be a useful tool for identifying stimulus control over problem behavior and that, for purposes of assessment, it provides more information than a typical line graph, which reflects overall responding but not its temporal distribution. Other suggested advantages of the scatter plot included its general utility across a wide range of behaviors and situations and the fact that data collection and analysis require minimal training.

In a recent survey of 125 members of the Psychology Division of the American Association on Mental Retardation, Desrochers, Hile, and Williams-Mosely (1997) found that about two thirds (n = 120) reported having used the scatter plot in the assessment of SIB at least "a few times," and that, of those two thirds, 32.5% (n = 27) reported having used the scatter plot for at least 10% of all their cases. These data suggest that the scatter plot is used as an assessment tool in clinical practice, in spite of the fact that no replications of the Touchette et al. (1985) findings have appeared in the literature. Although reference to the use of the scatter plot can be found in a number of studies (Arndorfer, Miltenberger, Woster, Rortvedt, & Gaffaney, 1994; Cameron, Luiselli, Littleton, & Ferrelli, 1996; Durand & Kishi, 1987; Kennedy & Itkonen, 1993; Kennedy & Souza, 1995; Lalli et al., 1993; Linscheid, Iwata, Ricketts, Williams, & Griffin, 1990; Ricketts et al., 1993, 1994), none of those reports presented the actual data. Thus, the extent to which behavior problems show temporal characteristics such as those observed for 2 of the participants in the Touchette et al. study remains largely unknown.

The purpose of this study was to conduct an extensive replication of the original Touchette et al. (1985) study by examining response patterns in a large sample of scatter plots. Data interpretation was based on visual analysis, which was supplemented by statistical analysis. We also examined reliability of data collection in greater detail. Touchette et al. reported 100% agreement for all of their data but did not indicate the number of intervals for which reliability data were collected.

METHOD

Participants and Setting

Scatter plot analyses were completed for 20 individuals (6 females, 14 males) living in four residential facilities (one in Florida, one in New Jersey, and two in Texas) for persons with mental retardation. Participants' ages ranged from 7 to 43 years (M = 26), and the majority of the individuals (16) had been diagnosed with severe to profound mental retardation. Behavior problems exhibited by the participants included SIB, vomiting, aggression, or property destruction. Demographic characteristics and response definitions, developed on the basis of parent and staff interviews and informal observations, are shown in Table 1.

Data Collection and Reliability

Each participant followed a daily schedule that was based on an individualized service plan, which included vocational or academic training, speech or physical therapy, and various other activities. Designated observers recorded actual frequencies of the problem behavior within successive 30-min intervals. Exceptions to this procedure were Will, Louis, and Trish, who engaged in episodic SIB lasting for long periods of time; therefore, their behaviors were recorded as response duration. These frequencies or durations were later transformed into three levels of behavior (none, low, and high), which were defined for each individual based on the typ-

Table 1
Participant Characteristics and Response Topographies

Name	Age	Sex	Diagnosis	Target responses
Emilio	10	M	Moderate MR	Head hitting and banging; hitting and scratching others; kicking, hitting, or throwing objects
Rachel	24	F	Profound MR	Ingestion of inedible items (pica)
Mike	19	M	Severe MR	Head hitting and banging, hitting and scratching others, hitting walls and furniture, ripping paper or other objects
Kathy	25	F	Profound MR	Hitting others
Wayne	13	M	Autism	Hitting and pinching others, throwing and hitting objects
Alex	24	M	Profound MR	Head banging
Todd	7	M	Mild MR	Picking and hitting self, hitting and pinching others, hitting walls and furniture
Al	8	M	Severe MR	Head hitting and banging, hand biting, hitting and scratching others
Therese	18	F	Mild MR	Scratching and hitting self, head banging, hitting others, throwing and hitting objects, spitting
Hans	17	M	Severe MR	Head hitting and banging, hitting and biting others, throwing and hitting objects
Will	34	M	Profound MR	Head banging, arm biting
Lynn	40	F	Profound MR	Vomiting
Bob	31	M	Severe MR	Head hitting
Greg	41	M	Profound MR	Hitting others
Nancy	31	F	Profound MR	Biting and rubbing self
Garrett	34	M	Profound MR	Head hitting and banging
Sam	43	M	Profound MR	Head hitting
Trish	30	F	Profound MR	Head hitting and banging, hand biting
Shawn	33	M	Profound MR	Head hitting
Louis	38	M	Profound MR	Head scratching and rubbing, hair pulling

ical rate or duration of responding observed throughout the day. To ensure that adequate samples of behavior had been obtained, observations were conducted throughout the entire day (i.e., during all waking hours) for 30 days. Data were collected by direct care staff, who were trained by behavior analysts familiar with scatter plot methodology.

Independent observers collected data during a proportion of intervals (entire 30-min segments) for each participant. All reliability observers were behavior analysts or advanced undergraduate psychology majors enrolled in a laboratory class in applied behavior analysis. In comparing observers' records, an interval was scored as an agreement if both observers recorded the same level (none, low, or high) of the target behavior. Interobserver agreement was calculated by dividing the number of agreement intervals by the total number of intervals and multiplying by 100%.

Data Analysis

Visual inspection of scatter plots. All data were summarized in scatter plot form (30-min grids within each day, repeated across successive days) and were examined by eight behavior analysts with experience in collecting and analyzing observational data in a variety of formats. The evaluators examined and discussed each scatter plot as a group, and attempted to identify any intervals (or interval clusters) within a day during which problem behaviors were more likely to occur. If any such intervals were identified, and if a similar distribution of behavior was observed across a series of days, a temporal pattern of responding was said to exist. Using this process, a consensus was reached about the presence or absence of any temporal patterns of responding in each scatter plot.

Statistical analysis. Although visual inspection is the most common method for interpreting single-subject data, including those generated via scatter plots, it is possible that certain complex data arrays may contain patterns that escape visual detection. Therefore, in an attempt to apply precise quantitative rules to the process of interpretation, we constructed an aggregate "control chart" (Pfadt & Wheeler, 1995) for each scatter plot. Such charts are often used in statistical process control (SPC), which is a collection of statistical procedures typically applied to industrial manufacturing output to detect patterns of variation in production (see Wheeler & Chambers, 1992). SPC identifies patterns of variability attributable to special causes that are said to be "out of statistical control." In a control chart, the mean value (central line) and variability (control limits) during a series of observations are calculated. Control limits (upper and lower) are established by converting the distribution of data into sigma values based on standard deviation (*SD*) units. Thus, control limits identify those scores (data points) that occur infrequently, and data are said to be out of statistical control if they conform to one of the following criteria (Wheeler & Chambers, 1992):

1. At least 8 consecutive points or 12 of 14 successive points fall on the same side of the central line.
2. At least 4 of 5 successive points fall on the same side of and more than one sigma unit away from the central line (±1 *SD*).
3. At least 2 of 3 successive points fall on the same side of and more than two sigma units away from the central line (±2 *SD*).
4. A single point falls outside the three-sigma control limits (±3 *SD*).

In applying this form of analysis to a scatter plot, we assigned to each 30-min interval a numerical value corresponding to the amount of behavior observed during that interval (none = 0, low = 1, high = 2). Values for each 30-min interval were summed across the 30 days and plotted on a line graph. The central (mean) line and upper control limits were then calculated and

Table 2
Summary of Interobserver Agreement

Name	Interobserver agreement (%)	Percentage of intervals assessed
Emilio	97.1	28.7
Rachel	96.2	9.3
Mike	95.7	38.0
Kathy	94.9	6.4
Wayne	94.8	27.4
Alex	93.6	14.4
Todd	93.0	33.2
Al	93.0	13.2
Therese	90.4	11.0
Hans	85.8	18.1
Will	82.5	11.8
Lynn	82.5	7.7
Bob	81.7	10.1
Greg	81.6	5.6
Nancy	81.4	4.9
Garrett	75.0	7.2
Sam	66.7	17.6
Trish	50.8	6.3
Shawn	44.7	11.6
Louis	29.6	7.4

drawn onto each graph (lower control limits were not calculated because the usual purpose of the scatter plot is to identify periods of high responding, i.e., points above the central line). Finally, those data points (time intervals) that met the criteria for being out of statistical control were identified.

RESULTS

Interobserver Agreement

Table 2 shows the proportions of intervals during which reliability was assessed and the obtained agreement percentages for all 20 participants. Across participants, agreement data were collected during a mean of 14.5% of the intervals (range, 4.9% to 38.0%), and the mean agreement score was 80.6% (range, 29.6% to 97.1%). Using 80% as the minimum cutoff for acceptable interobserver agreement, we excluded 5 of the 20 data sets from further analysis.

Data Analysis

Based on the visual inspection of each scatter plot by the eight behavior analysts, none of the 15 remaining scatter plots showed any clear or reliable temporal patterns of responding. By contrast, 12 of the 15 control charts contained some data points that were out of statistical control. For purposes of illustration, all of the control charts are shown in Figure 1. Each control chart is a line-graph representation showing the 0, 1, and 2 values for each 30-min interval summed across 30 days. None of the data for Emilio, Will, and Wayne satisfied any of the criteria for values out of control, whereas data for the other individuals met one or more of the criteria: (a) 8 consecutive or 12 of 14 points above the mean line (Therese, Hans, Todd, Alex, Rachel, Mike, Al, Kathy), (b) 4 of 5 points $\geq +1$ *SD* (Rachel, Bob, Nancy), (c) 2 of 3 points $\geq +2$ *SD* (Rachel), (d) one point $\geq +3$ *SD* (Alex, Kathy, Lynn, Greg). Thus, based on the SPC analysis, the majority of the scatter plots showed some temporal pattern of responding.

To allow comparisons between results portrayed in control chart and scatter plot formats, we reproduced a subset of the scatter plots. Figure 2 shows scatter plots illustrating two contrasting response patterns. Emilio's data (left panel) indicate very high rates of behavior both within and across days, whereas Will's data (right panel) indicate very sporadic occurrences of behavior. Neither of these scatter plots, when viewed as control charts (Figure 1), met any of the statistical criteria.

Figure 3 shows four scatter plots, which, when viewed as control charts in Figure 1, illustrated the four criteria for identifying data points that are out of statistical control. Therese's control chart (Figure 1) contained 12 of 14 consecutive data points above the mean line. Thus, based on SPC

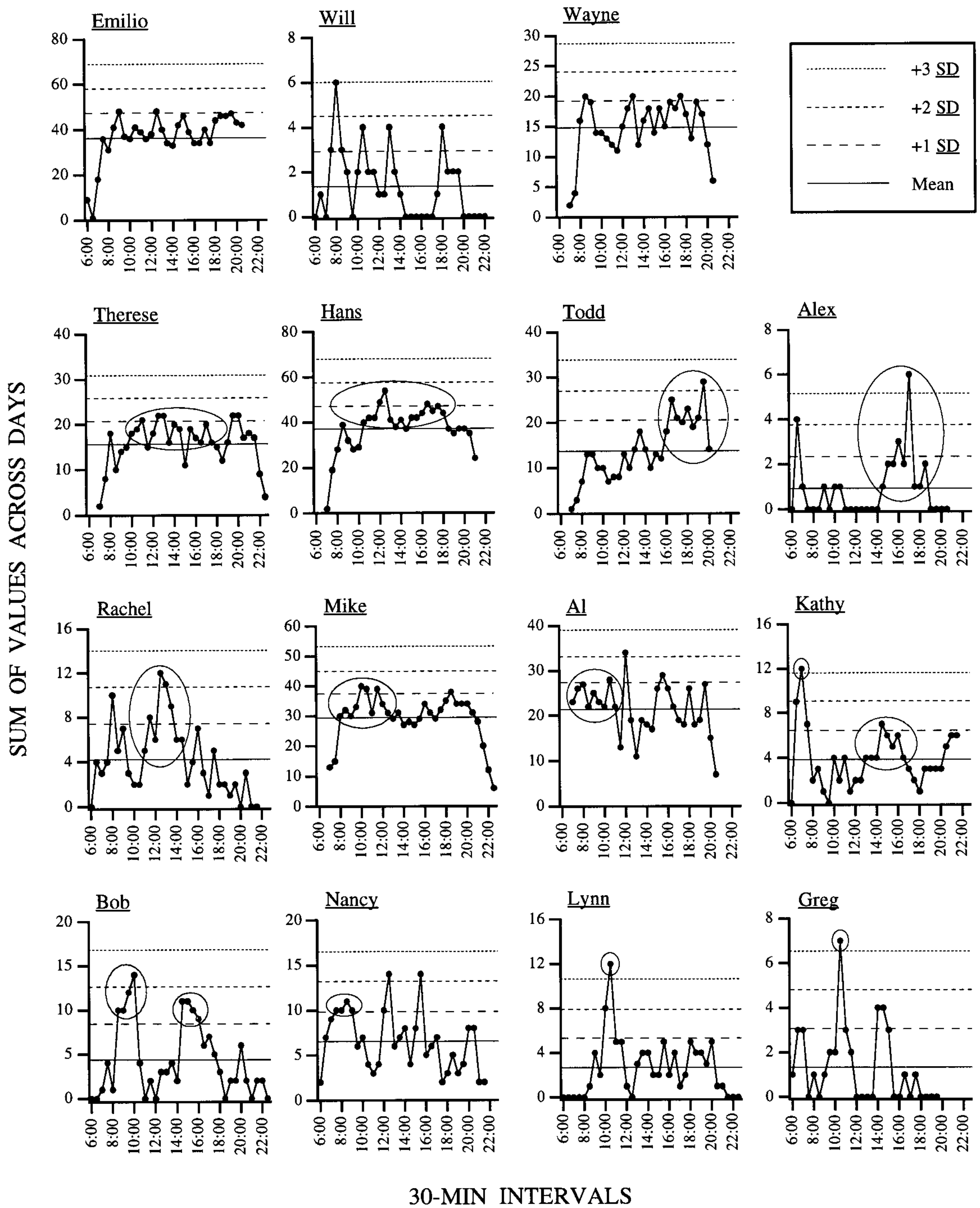

Figure 1. Statistical control charts based on scatter plot data for the 15 participants for whom interobserver agreement was 80% or higher. In each chart, values obtained during the same 30-min interval (e.g., 8:00 a.m. to 8:30 a.m.) were summed across the entire 30 days. Circled data points (intervals) meet one or more criteria for identifying data that are "out of statistical control."

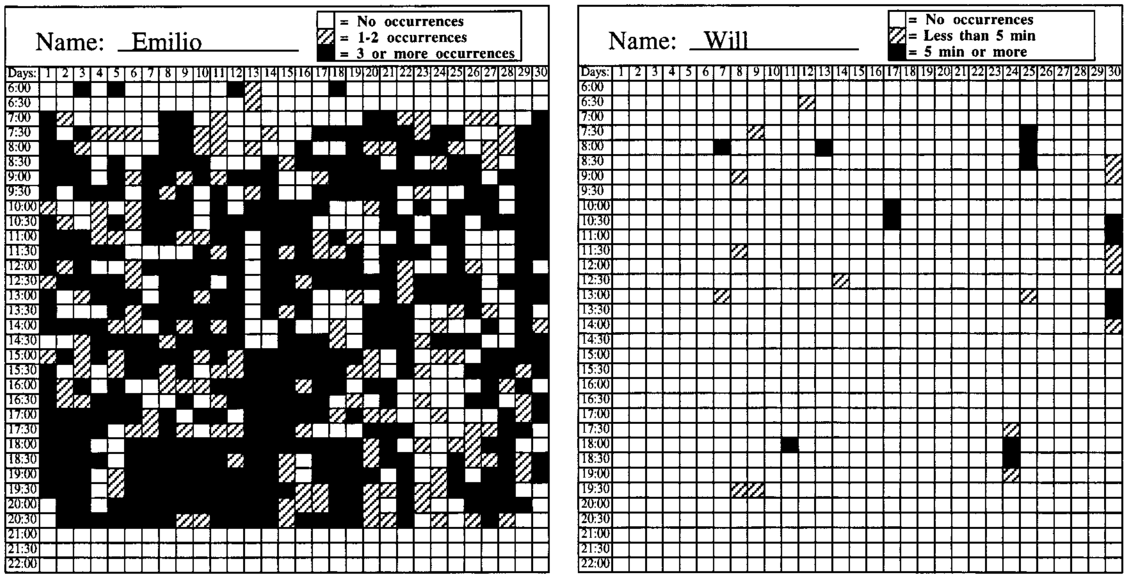

Figure 2. Scatter plots for 2 participants whose control charts revealed no outlying data points. Open squares represent no occurrences of the target behavior, shaded squares represent low levels of responding, and filled squares represent high levels of responding.

analysis, it appeared that Therese engaged in higher rates of problem behavior between 10:00 a.m. and 6:00 p.m. The intervals containing these data are bracketed by arrows on her scatter plot (Figure 3, top left panel). Her scatter plot was judged to reflect no particular temporal distribution of behavior because high rates of problem behavior also occurred before 10:00 a.m. and after 6:00 p.m. on at least 12 days. Thus, on many days, Therese's problem behavior extended from early in the morning until late at night. Bob's control chart (Figure 1) contained two sequences in which 4 of 5 data points were higher than +1 *SD* (8:30 a.m. to 10:30 a.m. and 2:30 p.m. to 4:30 p.m.). These intervals are bracketed on his scatter plot (Figure 3, top right panel). His scatter plot was judged to reveal no temporal pattern of responding because occurrences of behavior during these intervals were highly intermittent across days and were unlikely to be correlated with any regularly scheduled event. In addition, high or moderate rates of behavior also occurred sporadically at other times. Rachel's control chart (Figure 1) met the third criterion: 2 of 3 points higher than +2 *SD* (12:30 p.m. to 1:30 p.m.). (Her data also met two additional criteria: 8 consecutive points above the mean line, 11:00 a.m. to 3:00 p.m.; and 4 of 5 points higher than +1 *SD*, 11:30 a.m. to 2:00 p.m.) Because data meeting these three criteria were collected during adjacent intervals, all of them are bracketed in her scatter plot (Figure 3, lower left panel). Her scatter plot was judged to reflect no specific pattern of responding because, in addition to observing frequent occurrences of problem behavior between 11:00 a.m. and 3:00 p.m., we noticed a roughly similar pattern between 6:30 a.m. and 9:30 a.m., and occurrences of behavior during both of these time clusters were intermittent across days. Finally, Lynn's control chart (Figure 1) contained data meeting the fourth criterion of having a single point higher than +3 *SD* (10:30 a.m. to 11:00

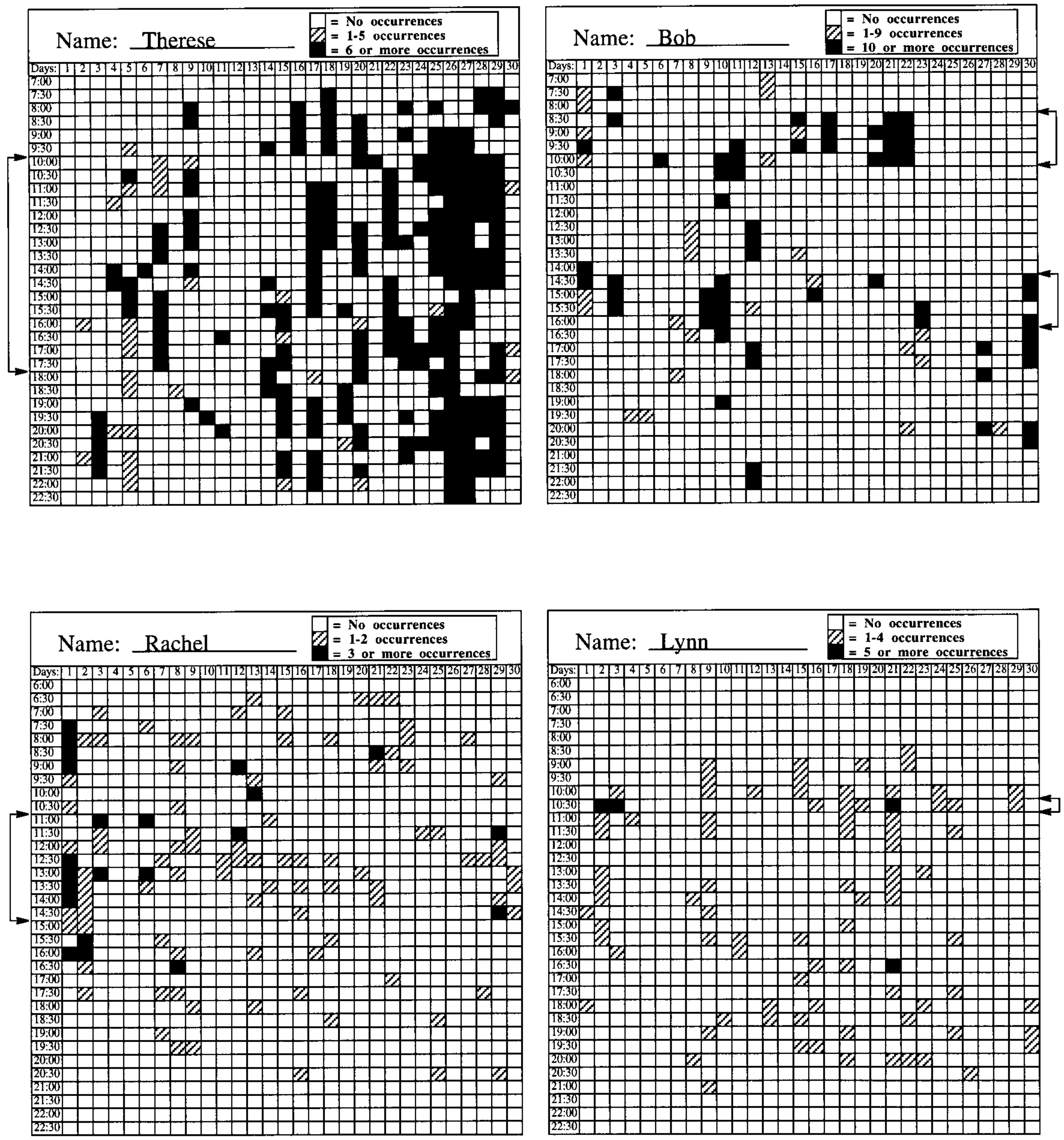

Figure 3. Scatter plots for 4 participants whose control charts revealed outlying data points based on different statistical criteria (see text for additional details). Bracketed arrows denote intervals that, in the corresponding control charts, show outlying data points.

a.m.), which is bracketed on her scatter plot (Figure 3, lower right panel). Her scatter plot was judged to reveal no temporal patterning because she seemed to exhibit problem behavior at moderate rates throughout the day and inconsistently across days.

DISCUSSION

Some problem behaviors may occur at particular times both during the day and across days because they are correlated with regularly scheduled events or the presence of specific persons, as was the case with 2 of 3 participants whose data were subjected to scatter plot analysis in the Touchette et al. (1985) study. It is likely that data presented in that study were selected to illustrate the fact that behavior problems *may have* recurring temporal characteristics. Thus, the authors did not suggest that such patterns would be observed routinely, and the generality of their findings was unclear because of their small data sample. However, the extent to which similar patterns of responding *are likely* to be observed is an important consideration because the scatter plot has emerged as a relatively common assessment tool (Desrochers et al., 1997). Our data, which represent the largest sample of scatter plots published to date, suggest that temporal response patterning is not easily identified. Visual inspection of 15 scatter plots failed to detect any reliable temporal distribution in the occurrence of behavior problems.

It is possible that our failure to identify recurring response patterns was simply a function of error resulting from the application of idiosyncratic criteria. To reduce the likelihood of such errors, we subjected all of the scatter plots to evaluation by a group of eight behavior analysts, which is probably the most common method of interpretation found in both research and clinical practice. Using this process, a consensus was reached that none of the scatter plots showed interpretable results. Nevertheless, it is possible that others viewing the same scatter plots would have reached different conclusions. Alternatively, the definition used to identify patterns of responding (periods within a day in which problem behavior occurred) may have been overly restrictive. Had we included additional criteria, such as periods when responding did not occur or weekdays versus weekends, visual interpretation of the scatter plots may have been different. For these reasons, we reproduced scatter plots (see Figure 1) meeting each of the four criteria used to identify statistically outlying data points (Wheeler & Chambers, 1992).

Given the highly discrepant results obtained from visual analysis of the daily scatter plots versus statistical analysis of the aggregate control charts, another possible conclusion is that the data collection method used in this study *did* reflect recurring temporal characteristics in behavior but that visual analysis of the scatter plots was insensitive to those characteristics. However, if recurring response patterns are sufficiently obscure so as to require statistical analyses such as SPC, one of the main advantages of the scatter plot—easy visual interpretation—seems to be compromised.

It is also important to note that each data set in this study was collected over a period of 30 days, which far exceeded the number of days for which data were collected in the Touchette et al. (1985) study (the two interpretable scatter plots in that study were based on 21 and 5 days of data collection, respectively, during the initial evaluations). In the present study, a month of what essentially amounted to all-day observations represented a considerable investment of time; in fact, a number of attempted scatter plots in addition to those presented here could not be completed because of a variety of interruptions. Thus, in clinical practice, it is likely that scatter plots would be based on smaller samples of behavior or that unproductive scatter plotting would be abandoned after a couple of weeks. Although we did not construct control charts on smaller samples (e.g., 15 days), it is certain that they would have reflected a smaller proportion of outlying data points. Thus, response patterns detectable only through statistical analysis still required extensive data collection.

Other explanations for the results obtained via scatter plot analysis include the possibility that participants' daily schedules were highly irregular, or that schedules were regular but shifted somewhat from day to day. We did not collect data on the actual correspondence between scheduled and observed activities; thus, the extent to which schedule variability affected our results is unknown. However, the first possibility seems unlikely because participants usually were observed by the primary observers during the same activities across days (this was verified by reliability observers, who were sent to conduct independent observations at different times and locations based on participants' schedules). The second possibility did occur periodically, but it resulted in only small temporal shifts in a participant's schedule (e.g., displacement of an activity somewhat earlier or later across days), which should have been detectable when examining response patterns across larger blocks of time (1 to 2 hr) and across days. We believe that the most likely explanation for our findings is that behavior and activity were correlated only moderately within given 30-min periods, such that a variety of situational changes, some of which occurred only briefly or intermittently, were distributed across many (or few) of the observational intervals. More detailed forms of descriptive analyses, involving shorter time periods and recording of behavioral antecedents and consequences, may have captured these activities. Unfortunately, as Touchette et al. (1985) pointed out, intervals of less than 30 min are not very practical for all-day recording.

In some settings it may be common practice to record data on behavior more or less continuously throughout the day. Because it is relatively easy to transform such data into scatter plot format, it is possible that the scatter plot, when supplemented with statistical procedures such as SPC, might be beneficial as a preliminary means of assessment when other methods are uninformative (e.g., when behavior occurs at very low rates or inconsistently across activities). However, as previously noted, there are difficulties associated with obtaining continuous data. In addition, data for 25% of our participants were unreliable by typical standards (80% agreement). In some of these cases, poor agreement was a function of the direct care staff's inability to maintain continuous observation for an entire interval due to temporary interruptions. This problem suggests that in some cases it may be necessary to assign a 1:1 staff-to-client ratio while scatter plot data are being collected.

Perhaps the most significant limitation of the scatter plot is that, although it yields quantitative data, it provides no means for identifying the specific antecedent and consequent events that are the determinants of behavior (Axelrod, 1987). Touchette et al. (1985) suggested that it may not always be necessary to understand the variables that control problem behavior in order to change it and illustrated this point with their 2nd participant (Tom), whose SIB was correlated with the presence of a particular staff person. Without knowing what characteristics of the staff person's behavior were functionally related to the occurrence of SIB, they were able to eliminate Tom's SIB by removing the staff member from the environment. This demonstration was compelling and showed that behavior can be changed sometimes through manipulation of "global" events. Nevertheless, we suggest that there may have been value in identifying the functional characteristics of Tom's SIB through more systematic analysis. Given Tom's sensitivity to the behavior of the one staff member, is it possible that Tom could encounter different staff members at some future time who behaved in a similar manner. Alternatively, it is possible that the reassigned staff member might reproduce similar behavior problems in other clients. Knowing what features of staff behavior occasioned and maintained Tom's SIB, which could only have been accomplished through more detailed experimental or descriptive analysis, would have allowed therapists to prevent both types of problems or at least to identify and rectify them quickly. Given the amount of time typically required to conduct experimental and descriptive analyses, *both* forms of assessment could have been completed for all of the participants in this study in far less time than that used for collecting scatter plot data.

REFERENCES

Arndorfer, R. E., Miltenberger, R. G., Woster, S. H., Rortvedt, A. K., & Gaffaney, T. (1994). Home-based descriptive and experimental analysis of problem behaviors in children. *Topics in Early Childhood Special Education, 14,* 64–87.

Axelrod, S. (1987). Functional and structural analyses of behavior: Approaches leading to reduced use of punishment procedures? *Research in Developmental Disabilities, 8,* 165–178.

Cameron, M. J., Luiselli, J. K., Littleton, R. F. J., & Ferrelli, L. (1996). Component analysis and stimulus control assessment of a behavior deceleration treatment package. *Research in Developmental Disabilities, 17,* 203–215.

Desrochers, M. N., Hile, M. G., & Williams-Mosely, T. L. (1997). Survey of functional assessment procedures used with individuals who display mental retardation and severe problem behaviors. *American Journal on Mental Retardation, 101,* 535–546.

Durand, V. M., & Kishi, G. (1987). Reducing severe behavior problems among persons with dual sensory impairments: An evaluation of a technical assistance model. *Journal of the Association for Persons with Severe Handicaps, 12,* 2–10.

Groden, G. (1989). A guide for conducting a comprehensive behavioral analysis of a target behavior. *Journal of Behavior Therapy and Experimental Psychiatry, 20,* 163–169.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982)

Iwata, B. A., Vollmer, T. R., & Zarcone, J. R. (1990). The experimental (functional) analysis of behavior disorders: Methodology, applications, and limitations. In A. C. Repp & N. N. Singh (Eds.), *Perspectives on the use of nonaversive and aversive interventions for persons with developmental disabilities* (pp. 301–330). Sycamore, IL: Sycamore.

Kennedy, C. H., & Itkonen, T. (1993). Effects of setting events on the problem behavior of students with severe disabilities. *Journal of Applied Behavior Analysis, 26,* 321–327.

Kennedy, C. H., & Souza, G. (1995). Functional analysis and treatment of eye poking. *Journal of Applied Behavior Analysis, 28,* 27–37.

Lalli, J. S., Browder, D. M., Mace, F. C., & Brown, D. K. (1993). Teacher use of descriptive analysis data to implement interventions to decrease students' problem behaviors. *Journal of Applied Behavior Analysis, 26,* 227–238.

Linscheid, T. R., Iwata, B. A., Ricketts, R. W., Williams, D. E., & Griffin, J. C. (1990). Clinical evaluation of the Self-Injurious Behavior Inhibiting System (SIBIS). *Journal of Applied Behavior Analysis, 23,* 53–78.

Mace, F. C., Lalli, J. S., & Pinter-Lalli, E. (1991). Functional analysis and treatment of aberrant behavior. *Research in Developmental Disabilities, 12,* 155–180.

Pfadt, A., & Wheeler, D. J. (1995). Using statistical process control to make data-based clinical decisions. *Journal of Applied Behavior Analysis, 28,* 349–370.

Repp, A. C., Felce, D., & Barton, L. E. (1988). Basing the treatment of stereotypic and self-injurious behaviors on hypotheses of their causes. *Journal of Applied Behavior Analysis, 21,* 281–289.

Ricketts, R. W., Goza, A. B., Ellis, C. R., Singh, Y. N., Chambers, S., Singh, N. N., & Cooke, J. C. (1994). Clinical effects of buspirone on intractable self-injury in adults with mental retardation. *Journal of the American Academy of Child and Adolescent Psychiatry, 33,* 270–276.

Ricketts, R. W., Goza, A. B., Ellis, C. R., Singh, Y. N., Singh, N. N., & Cooke, J. C. (1993). Fluoxetine treatment of severe self-injury in young adults with mental retardation. *Journal of the American Academy of Child and Adolescent Psychiatry, 32,* 865–869.

Sprague, J. R., & Horner, R. H. (1995). Functional assessment and intervention in community settings. *Mental Retardation and Developmental Disabilities Research Reviews, 1,* 89–93.

Touchette, P. E., MacDonald, R. F., & Langer, S. N. (1985). A scatter plot for identifying stimulus control of problem behavior. *Journal of Applied Behavior Analysis, 18,* 343–351.

Wheeler, D. J., & Chambers, D. S. (1992). *Understanding statistical process control* (2nd ed.). Knoxville, TN: SPC Press.

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STUDY QUESTIONS

1. What is a scatter plot, and what type of information is it designed to provide?

2. Given that the scatter plot has been used in both research and clinical practice for a number of years, why did the authors conduct this study?

3. Briefly describe the data-collection procedure and the method for assessing and calculating reliability.

4. How were the data analyzed visually to determine whether temporal patterns of responding were evident in any given scatter plot? Can you suggest a more stringent method of visual analysis?

5. Why did the authors also conduct a statistical analysis of the data, and what form did this analysis take?

6. Summarize and compare the results obtained from the two types of data analysis.

7. According to the authors, what are some limitations of the scatter plot as an assessment tool?

8. Can you suggest some ways in which the scatter plot might provide useful information to clinicians?

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