ANTECEDENT VERSUS CONSEQUENT EVENTS AS PREDICTORS OF PROBLEM BEHAVIOR

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Comparisons of results from descriptive and functional analyses of problem behavior generally have shown poor correspondence. Most descriptive analyses have focused on relations between consequent events and behavior, and it has been noted that attention is a common consequence for problem behavior even though it may not be a functional reinforcer. Because attention may be prescribed simply as a means of stopping serious problem behavior, it is possible that naturally occurring antecedent events (establishing operations) might be better predictors of problem behavior than consequences. We conducted descriptive and functional analyses of the problem behaviors of 7 participants. Conditional probabilities based on combined antecedent and consequent events showed correspondence with the functional analysis data for 4 of the 7 participants, but antecedent events were no better than consequent events in identifying the function of problem behavior.

DESCRIPTORS: descriptive analysis, functional analysis, problem behavior

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Functional analysis methodology involves the assessment of problem behavior under conditions in which antecedent and consequent events are experimentally manipulated (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/ 1994). This approach to assessment has been useful in identifying contingencies of reinforcement that maintain problem behavior and has been replicated in hundreds of studies (see Hanley, Iwata, & McCord, 2003, for a review). In addition to providing information about the determinants of behavior, results of a functional analysis facilitate the development of interventions that decrease problem behavior through individualized programs of extinction or differential reinforcement.

Another approach to assessment, the descriptive analysis, involves uncontrolled observations of behavior under more naturalistic conditions (Bijou, Peterson, & Ault, 1968). Although designed primarily for the purpose of gathering data on structural characteristics of behavior and the context in which it occurs, the descriptive analysis has been used occasionally to make inferences about the contingencies that maintain behavior and to design intervention procedures (Ellingson, Miltenberger, & Long, 1999; Kern, Hilt, & Gresham, 2004; Lalli, Browder, Mace, & Brown, 1993; Repp, Felce, & Barton, 1988).

A number of studies have compared outcomes obtained from functional and descriptive analyses to determine whether the reinforcers for problem behavior can be readily identified through naturalistic observation (Anderson & Long, 2001; Hall, 2005; Lerman & Iwata, 1993; Mace & Lalli, 1991; Sasso et al., 1992; St. Peter et al., 2005; Thompson & Iwata,

2007). Results of these comparisons generally have shown poor correspondence. For example, Mace and Lalli conducted both descriptive and functional analyses of the bizarre speech exhibited by an adult with mental retardation. Results of the descriptive analysis showed that bizarre speech was correlated with both the absence of attention and the presentation of task demands preceding the behavior, as well as with the delivery of attention and removal of task demands following the behavior. These data suggested that problem behavior was maintenance by both social positive and social negative reinforcement. Results of the functional analysis, however, indicated that bizarre speech was maintained only by social positive reinforcement, and subsequent interventions based on the use of positive reinforcement effectively decreased bizarre speech. Lerman and Iwata extended the findings of Mace and Lalli by comparing results from descriptive and functional analyses of the self-injurious behavior (SIB) exhibited by 6 adults with mental retardation and observed correspondence in only 1 of the 6 cases.

Results of other studies indicate that consequences for problem behavior commonly observed in descriptive analyses may not serve as reinforcers. Thompson and Iwata (2001) conducted descriptive analyses for 27 adults with developmental disabilities and found that the most frequently observed consequence for problem behavior was attention from staff. In a follow-up study, Thompson and Iwata (2007) examined data from functional analyses for a subset (12) of these participants and found that results of the original descriptive analyses matched those of the functional analyses for only 3 of 12 participants. Most notably, results of the descriptive analyses suggested maintenance by attention for 8 of 12 participants; however, the subsequent functional analyses confirmed that only 2 participants' problem behavior was maintained by attention.

St. Peter et al. (2005) took a different approach in conducting their comparative analysis. They used functional analyses to identify 3 students whose problem behavior was not maintained by attention. They then conducted descriptive analyses of the students' problem behavior in the classroom and found that, for all 3 students, the occurrence of problem behavior was highly correlated with attention, even though attention had been ruled out as the functional reinforcer.

Several factors might account for the lack of correspondence between results of descriptive and functional analyses. First, maintenance of problem behavior in the natural environment by intermittent reinforcement may result in a low correlation between the occurrence of behavior and the delivery of a reinforcer. For example, the probability that escape from task demands follows problem may never exceed.2 if escape is delivered on a variable-ratio 5 schedule and may be even lower if escape is delivered on a thin interval schedule.

Second, results of a descriptive analysis may not show high correlations between problem behavior and potential reinforcers if the problem behavior occurs at high rates or in bursts, such that consequences usually follow an episode of responding or a series of responses rather than each response. For example, Marion, Touchette, and Sandman (2003) examined descriptive analysis data for 45 participants who engaged in SIB and found that the event most highly correlated with SIB was SIB itself rather than any other environmental event.

Third, it is possible that certain events are highly probable as consequences for problem behavior regardless of the function of the problem behavior. Severe problem behaviors such as aggression or SIB often may produce attention simply as a safety precaution (to keep individuals from harming themselves or others), which may result in a spuriously high correlation between problem behavior and attention, as suggested by the Thompson and Iwata (2001) and the St. Peter et al. (2005) data.

Although reinforcing consequences are the most important determinants of problem

Table 1
Demographic Information

Participant	Target behavior	Age (years)	Diagnosis
Tara	SIB (skin picking)	28	Moderate mental retardation, Prader-Willi syndrome
Jerry	SIB (hand biting and mouthing)	19	Profound mental retardation, speech-language impaired, seizure disorder
Kevin	Property destruction	54	Profound mental retardation, visually impaired, seizure disorder
Travis	Property destruction	21	Profound mental retardation, Angelman syndrome, speech-language impaired
Wyatt	Property destruction	16	Educable mentally handicapped, Down syndrome, Kleinfelter syndrome
Anna	SIB (self-choking)	19	Autism, speech-language impaired
Bobby	SIB (face slapping)	37	Mild mental retardation, cerebral palsy, spastic hemiplegia, epilepsy

behavior, limitations such as those noted above may make it difficult to identify those consequences under naturalistic conditions. This raises the question of whether naturally occurring antecedent events more accurately predict the function of problem behavior because antecedent events may not be as readily influenced by other variables. For example, identification of escape as the reinforcer for problem behavior in a descriptive analysis may be difficult if caregivers provide escape following only some occurrences of problem behavior (i.e., intermittent reinforcement). However, it seems likely that most occurrences of escape-maintained problem behavior would be preceded by the presentation of a demand. With respect to spurious correlations such as that between problem behavior and the delivery of attention, the antecedent event that often occasions attention-maintained problem behavior (the absence of attention) also may be programmed to some extent. However, it seems that antecedents are more likely to be programmed according to a schedule of daily activities, irrespective of problem behavior, rather than as specific responses to problem behavior.

The purpose of the current study was to determine whether antecedent events are better predictors of the function of problem behavior than are consequent events by comparing the results of descriptive analyses of both antecedent and consequent events to those of traditional functional analyses.

METHOD

Participants and Setting

The participants were 7 individuals with developmental disabilities who were reported to engage in severe problem behavior. Their ages ranged from 16 to 54 years (see Table 1 for demographic information). All participants attended either a special education school or an adult vocational program. Descriptive analysis observations were conducted in the participants' assigned classrooms or work areas. Functional analysis sessions were conducted in therapy rooms at the school or vocational program.

Descriptive Analysis

Procedure. Observations were conducted using methods similar to those described by Thompson and Iwata (2001). Trained observers used handheld computers to record the occurrence of problem behavior and environmental events during continuous 10-s intervals. At least four 15-min observations were conducted for each participant; however, the number of observations was extended until at least 10 intervals of problem behavior were observed. Observations were conducted across the day during instruction or independent work time, lunchtime, recess, and so on. Before beginning an observation, observers informed the staff that they would be watching the participant and asked the staff to act as they typically would. No other instructions were given to the staff, and no attempts were made to program specific events.

Operational definitions. Problem behaviors included SIB (self-choking, hand biting and mouthing, and skin picking) and property destruction (breaking objects, throwing objects, banging on or turning over furniture) and were defined individually for each participant. Data also were collected on several environmental events, including the presentation of demands, the availability of attention or materials, and the presence of staff. Demand was recorded whenever a teacher or staff presented an instruction (e.g., ''put on your shoes'') or work materials (e.g., handed shoes to participant) or physically guided the participant to engage in a task (e.g., put shoes on the participant's feet). Demand termination was defined as the cessation of a demand for at least one interval (10 s) following its initial presentation, regardless of the action that preceded it (e.g., problem behavior, compliance, or the end of a scheduled work period). *Attention* was recorded when the staff initiated a verbal or physical interaction with the participant without presenting an instruction (e.g., engaged in conversation or gave a hug). The *absence of attention* was defined as any interval during which staff were present but not providing attention. *Access to tangible items* was recorded during any interval in which the participant had access to food or leisure items (e.g., staff provided a magazine or snack). The *absence of tangible items* was defined as any interval during which food or leisure items were not available. The *presence of staff* was recorded during any interval in which at least one staff person had an unobstructed view of the participant (e.g., the staff were able to observe the participant); this event was scored to differentiate between intervals during which the participant was alone (e.g., out of view of staff) and intervals during which staff were present but not delivering any attention. An event was scored at the time it occurred (data were time-stamped by the computer) and at the beginning of each subsequent interval if it continued to occur. For example, if tangible items were delivered at Second 23, it was recorded at that second and at the beginning of each subsequent 10-s interval as long as the tangible items were still available.

Interobserver agreement. A second observer independently collected data during a mean of 40% (range, 20% to 78%) of descriptive analysis sessions. Interobserver agreement was assessed by comparing each interval of the observers' records, dividing the number of agreement intervals by the total number of intervals, and converting this ratio to a percentage. Mean interobserver agreement across participants was 97% (range, 92% to 100%) for problem behavior and 93% (range, 90% to 94%) for environmental events in the descriptive analysis.

Data analysis. Following the observations, probabilities were calculated to identify correlations between the occurrence of problem behavior and other environmental events. First, conditional probabilities of antecedent or consequent events given problem behavior were calculated to determine the relation between problem behavior and those events. An event was considered an antecedent if it occurred prior to but in the same 10-s interval as problem behavior or in the immediately preceding interval. The conditional probability of an antecedent event given problem behavior was calculated by dividing the number of intervals during which a specific antecedent event preceded problem behavior by the total number of intervals with problem behavior. For example, if problem behavior occurred in five intervals, and no attention was available prior to problem behavior on two occasions, the conditional probability of the absence of attention as an antecedent to problem behavior would be .4.

The conditional probabilities of consequent events were calculated in the same manner. An event was considered a consequent event if it occurred in the same interval as problem behavior or in the immediately following

interval. The conditional probability of a consequent event given problem behavior was calculated by dividing the number of intervals during which a specific consequent event followed problem behavior by the total number of intervals with problem behavior. For example, if problem behavior occurred in five intervals and was followed by attention three times, the conditional probability of attention as a consequence would be .6.

These conditional probabilities were compared to the overall (unconditional) probabilities of the events. The unconditional probability of an event was the proportion of intervals during which the event occurred regardless of the occurrence of problem behavior and was calculated by dividing the number of intervals during which the event occurred by the total number of observation intervals. For example, a .2 unconditional probability of attention would indicate that attention was provided during 20% of the intervals. If the conditional probability of problem behavior that occurred with a specific antecedent or consequent event was greater than the unconditional probability of that event, the specific event might be considered a predictor of the problem behavior. According to the previous examples, if the conditional probability of the absence of attention as an antecedent to problem behavior was .4, the conditional probability of attention as a consequence for problem behavior was .6, and the unconditional probability of attention irrespective of problem behavior was .2, the analysis of both antecedent and consequent events (as well as the combination) suggests that problem behavior may be maintained by social positive reinforcement.

Functional Analysis

Procedure. The functional analysis was conducted using procedures similar to those described by Iwata et al. (1982/1994). Sessions were 10 min in duration, and conditions were presented in a multielement design. Trained observers used handheld computers to record the frequency of problem behaviors (identical to those observed in the descriptive analysis), and data were summarized as either responses per minute or percentage of intervals during which responding occurred. Data also were collected on therapist delivery of antecedent and consequent events (see below).

During the attention condition, the therapist and the participant were seated in a room (the participant had access to moderately preferred leisure items). The therapist pretended to read a magazine and ignored the participant. Contingent on any occurrence of a problem behavior, the therapist delivered brief verbal and physical attention (e.g., ''you're going to hurt yourself''). During the demand condition, the therapist used a three-step prompting sequence (verbal prompt, model, and physical guidance) to instruct the participant to complete academic or vocational tasks. Contingent on any occurrence of a problem behavior, the therapist removed the work materials and gave the participant a 30-s break. Prior to starting a session in the tangible condition, the therapist gave the participant 2-min access to a highly preferred leisure item. When the session began, the therapist removed the item. Contingent on any occurrence of a problem behavior, the therapist provided the participant with 30-s access to the item. During the alone condition, the participant sat alone in an empty room equipped with a one-way window. No programmed consequences were delivered following the occurrence of problem behavior. An ignore condition was conducted instead of an alone condition for some participants because a one-way window was not available. The ignore condition was identical to the alone condition except that a therapist was in the room. During the play (control) condition, the therapist provided the participant with noncontingent attention and access to preferred items and did not issue demands. No programmed consequences were provided for problem behavior. Functional analysis sessions were repeated until differential responding was observed in one or

more conditions, relative to the control condition, or until responding was observed at similar rates across all conditions and persisted during repeated alone or ignore sessions.

Interobserver agreement. A second observer independently observed a mean of 30% (range, 24% to 50%) of functional analysis sessions. Observers' records were divided into 10-s intervals and were compared on an interval-by-interval basis. Interobserver agreement was calculated by dividing the smaller number of responses by the larger number of responses recorded in each interval, summing these quotients, dividing this number by the total number of intervals, and converting this ratio to a percentage. The mean agreement for functional analysis sessions was 97% (range, 91% to 100%) for problem behavior and 95% (range, 92% to 98%) for therapist behavior.

Comparison of Descriptive and Functional Analyses

A team of 12 behavior analysts (2 PhDs and 10 doctoral students) examined the data obtained from both the descriptive and functional analyses. Each participant's descriptive and functional analysis data were graphed separately so that only one type of analysis could be examined at a time, and all identifying information was removed from the graphs. The members of the team viewed each graph, discussed pertinent features of the data, and reached a consensus about the function shown in a functional analysis or suggested in a descriptive analysis. When descriptive analysis data were presented, the team was asked to render an opinion based on (a) antecedent events only, (b) consequent events only, and (c) combined antecedent and consequent events. In examining conditional and unconditional probabilities in the descriptive analysis data, the emphasis was not strictly on high conditional probabilities but rather on the proportional differences between conditional and unconditional probabilities. When functional analysis data were presented, the team was asked to identify differential rates of responding in one

condition relative to the control condition or undifferentiated responding across conditions and persistent responding during repeated alone conditions. The conclusions reached by the group of behavior analysts are those reported below.

RESULTS

Figure 1 shows data for participants whose functional analyses indicated that their problem behavior was maintained by social reinforcement. Each pair of graphs shows the probabilities for antecedent and consequent events from the descriptive analysis (left) and the frequency or percentage of intervals of problem behavior across functional analysis conditions (right). Tara's descriptive analysis of antecedent events showed that the conditional probability of the absence of tangible items given problem behavior was higher than the unconditional probability of no tangible items; however, the unconditional probability was so high that the proportional difference between the conditional and unconditional probabilities of no tangible items was relatively small. Other antecedent events occurred equally often prior to and independent of problem behavior, as indicated by the low conditional probabilities for these other antecedent events compared to their unconditional probabilities. That is, problem behavior was correlated with each antecedent event at a level similar to the overall occurrence of those events, which suggested that problem behavior occurred across all of the events, including when she was alone. These results for antecedent events suggested that problem behavior may have been maintained by automatic reinforcement. Descriptive data on consequent events showed that the conditional probability of attention given Tara's problem behavior was somewhat higher than the unconditional probability of attention. In other words, Tara was more likely to get attention (and usually only attention) following problem behavior than at other times. These data suggested that problem behavior was main-
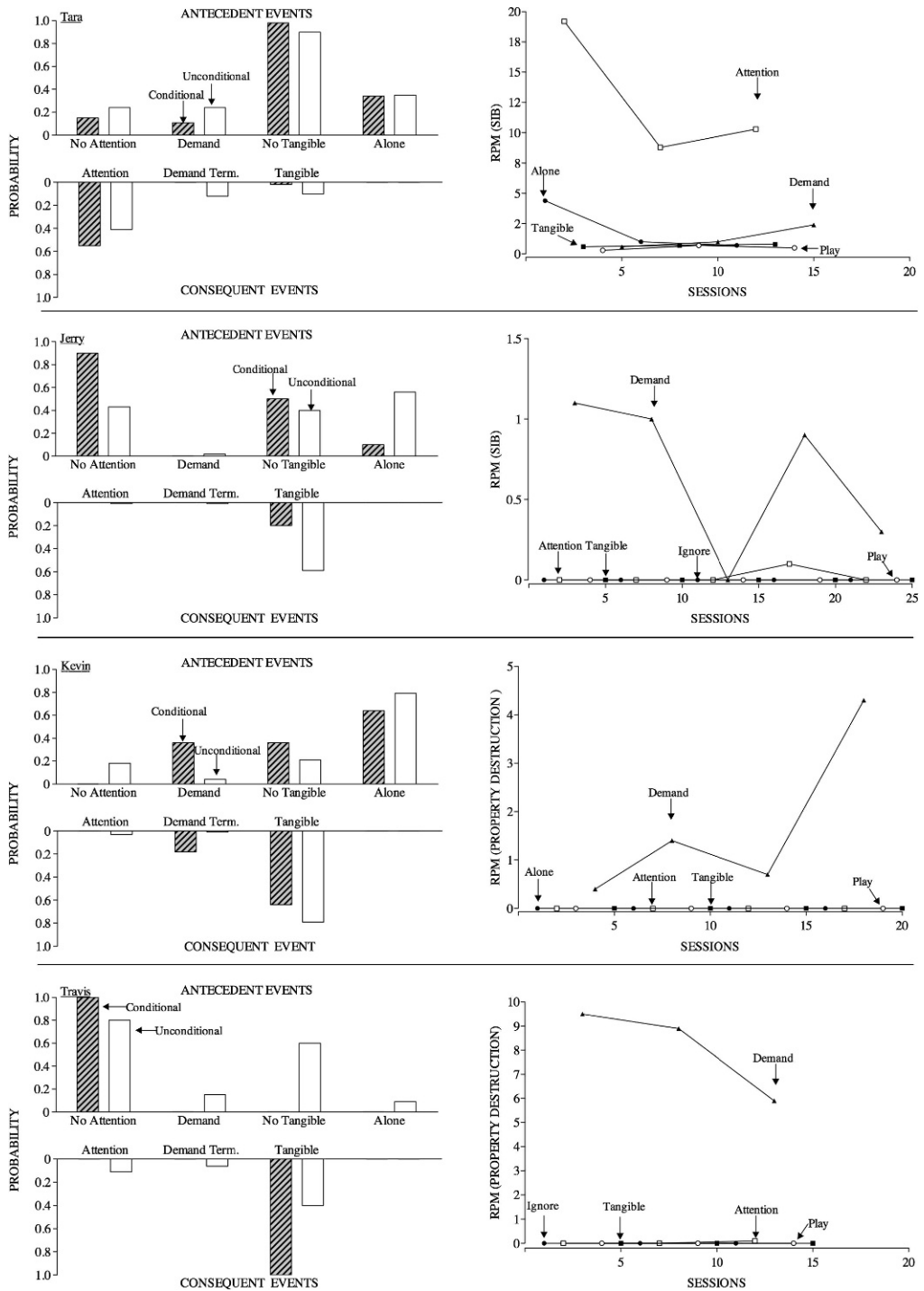
Figure 1. Results of descriptive analyses of antecedent and consequent events (left) and functional analyses (right) for Tara, Jerry, Kevin, and Travis.

tained by positive reinforcement in the form of attention. When the two sets of descriptive data were considered together, the antecedent analysis suggested automatic reinforcement and the consequent analysis suggested social reinforcement; thus, the combined descriptive analysis results were inconclusive.

Results of Tara's functional analysis showed that she engaged in high rates of problem behavior in the attention condition relative to the other test conditions and the play condition, indicating that her SIB was maintained by attention. Thus, correspondence was observed between results of the consequent descriptive analysis and the functional analysis (both indicated that Tara's problem behavior was maintained by attention) but not between results of the antecedent descriptive analysis or the combined descriptive analysis and the functional analysis.

Results of Jerry's descriptive analysis of antecedent events yielded a high conditional probability for the absence of attention given problem behavior relative to the unconditional probability of no attention. In addition, but to a lesser degree, the conditional probability of the absence of tangible items given problem behavior was greater than the unconditional probability of no tangible items. These results suggested that Jerry's problem behavior may have been maintained by social positive reinforcement in the form of attention, tangible items, or both. Results of Jerry's descriptive analysis of consequent events showed that social consequences typically did not follow problem behavior, suggesting that his problem behavior may have been maintained by automatic rather than social reinforcement. In the combined descriptive analysis, the fact that problem behavior often occurred in the absence of attention and tangible items (antecedent events) seemed less significant because these events rarely were delivered as consequences (i.e., attention was never delivered). Thus, his problem behavior appeared to have been maintained by automatic reinforcement.

During Jerry's functional analysis, problem behavior occurred almost exclusively in the demand condition, indicating that it was maintained by social negative reinforcement (escape from demands). These results were in stark contrast to those of his descriptive analysis because both the presentation and removal of demands were rarely observed during his descriptive analysis.

Kevin's descriptive analysis of antecedent events showed that the conditional probabilities of both the presence of demands and absence of tangible items given problem behavior were much higher than the unconditional probabilities of those events, suggesting that his problem behavior may have been maintained by social negative reinforcement (escape from demands), social positive reinforcement (tangible items), or both. His descriptive analysis of consequent events showed that the conditional probability of demand termination given problem behavior was much higher than the unconditional probability of demand termination. The conditional probability of access to tangible items given problem behavior also was high but not as high as the unconditional probability of access to tangible items, indicating that tangible items were available frequently regardless of the occurrence of problem behavior. Data from the consequent event analysis thus suggested that Kevin's problem behavior may have been maintained by social negative reinforcement. The combined descriptive analysis showed that problem behavior was much more likely when demands were presented and that problem behavior often was followed by the termination of those demands, suggesting that his problem behavior may have been maintained by social negative reinforcement.

Results of Kevin's functional analysis indicated that his problem behavior occurred exclusively in the demand condition. These results were consistent with those of his consequent descriptive analysis and his combined descriptive analysis and were partially

consistent with those of his analysis of antecedent events (which suggested that social positive reinforcement also may have maintained his problem behavior).

Travis's descriptive analysis contained only nine intervals of problem behavior instead of 10 because he graduated from school before the descriptive analysis could be completed. Nevertheless, his data were included because it is unlikely that the addition of one more instance of problem behavior would have changed the outcome. The analysis of antecedent events showed a 1.0 conditional probability of the absence of attention given problem behavior, whereas no other antecedent event was correlated with problem behavior. These results suggested that Travis's problem behavior was maintained by social positive reinforcement (attention). His analysis of consequent events showed a 1.0 probability for the delivery of tangible items given problem behavior (no other consequent event was observed), suggesting that Travis's problem behavior was maintained by social positive reinforcement (access to tangible items). Even though the conditional probabilities obtained in Travis's antecedent and consequent descriptive analyses were 1.0, the combined analysis was inconclusive. The influence of attention suggested in the antecedent analysis was not supported in the consequent analysis (attention was never delivered as a consequence for problem behavior), and the influence of tangible items in the consequent analysis was not supported in the antecedent analysis (problem behavior never occurred in the absence of tangible items). Thus, results of the combined descriptive analysis were inconclusive and did not suggest a function for his problem behavior.

Results of Travis's functional analysis showed that his problem behavior occurred at very high rates in the demand condition but never in any other condition, indicating that his problem behavior was maintained by social negative reinforcement. These results did not correspond with any outcome of his descriptive analysis, which showed that, although demands sometimes were delivered, problem behavior never occurred in their presence.

Figure 2 shows data for participants whose functional analyses indicated that their problem behavior was maintained by automatic reinforcement. Wyatt's descriptive analysis of antecedent events shows that the conditional probability of each antecedent event given problem behavior was less than or approximately equal to the unconditional probability of each antecedent, indicating no strong correlation between antecedent events and problem behavior. Although the conditional probability of consequent attention given problem behavior was low, it was four times greater than the unconditional probability of attention (i.e., Wyatt received attention much more often following problem behavior than he did otherwise), and attention was the only consequence observed. When the two sets of descriptive data were considered together, the high conditional probability of consequent attention was negated by the relatively low conditional probability of the absence of attention as an antecedent event. Thus, the results of the antecedent descriptive analysis and the combined (antecedent and consequent) descriptive analysis suggested that Wyatt's problem behavior may have been maintained by automatic reinforcement, based on the absence of high conditional probabilities for social events given problem behavior. By contrast, results of his descriptive analysis of consequent events suggested that problem behavior may have been maintained by social positive reinforcement (attention).

Results of Wyatt's functional analysis showed high levels of problem behavior only in the ignore condition, indicating that it was maintained by automatic reinforcement. Accordingly, correspondence was observed between results of the functional analysis and the antecedent descriptive analysis and between results of the
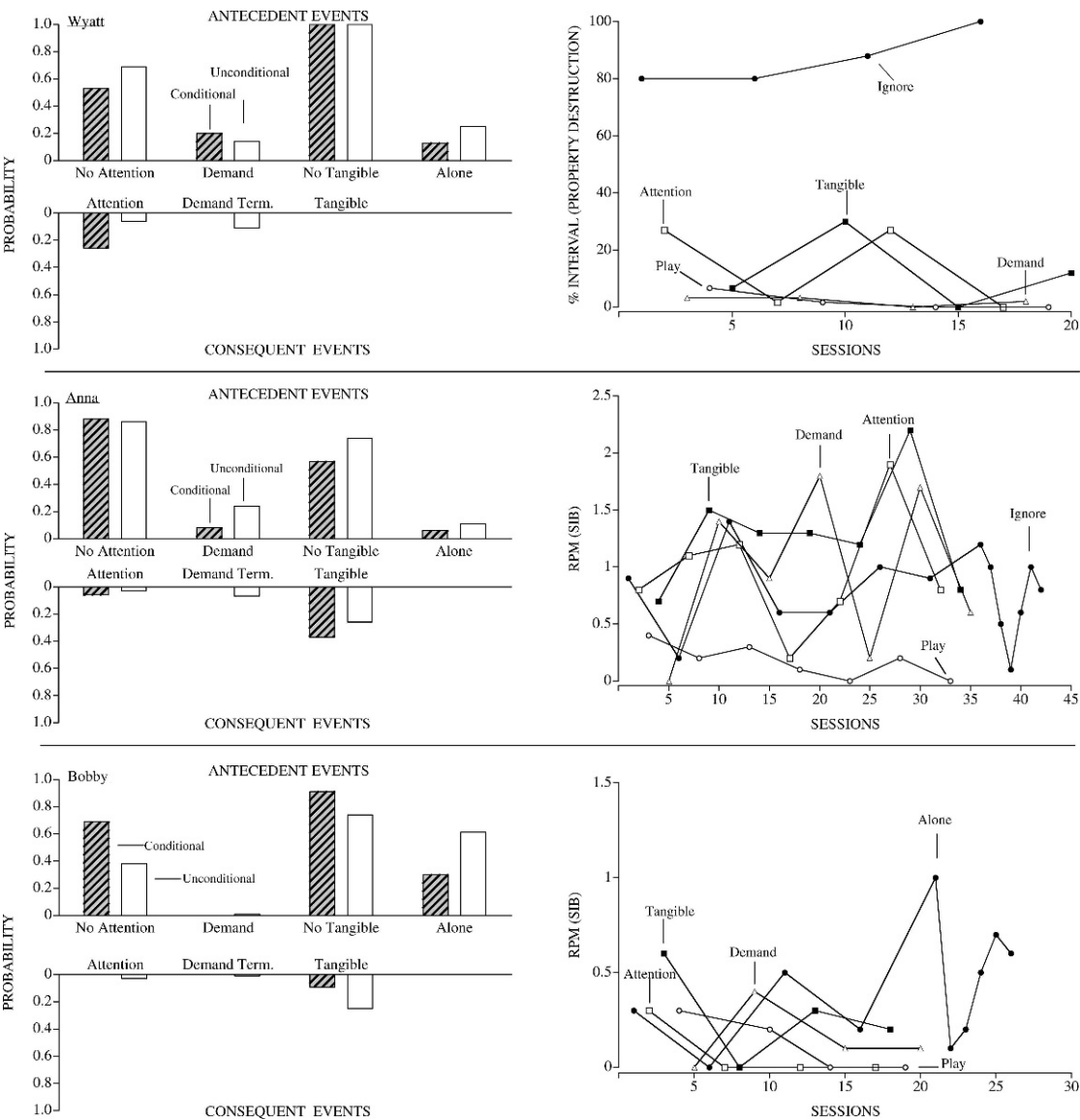
Figure 2. Results of descriptive analyses of antecedent and consequent events (left) and functional analyses (right) for Wyatt, Anna, and Bobby.

functional analysis and the combined descriptive analysis, but not between results of the functional analysis and the consequent descriptive analysis.

Results of Anna's descriptive analysis of antecedent events were similar to Wyatt's, in that the conditional probability of each antecedent event was less than or approximately equal to its unconditional probability, indicating no strong correlation between antecedent events and problem behavior. Anna's descriptive analysis of consequent events showed that the conditional probability of access to tangible items was larger than the unconditional probability of access to tangible items. Although the conditional probability of attention given problem behavior was slightly higher than the unconditional probability of attention, both

probabilities were low. The combined descriptive analysis showed that, although the conditional probability of consequent tangible items was larger than the unconditional probability, the conditional probability of the antecedent absence of tangible items was less than the unconditional probability of no tangible items, leaving no strong correlation between problem behavior and any social event. The results of the antecedent descriptive analysis and the combined descriptive analysis suggested that Anna's problem behavior may have been maintained by automatic reinforcement because no correlations with social events were observed, whereas results of her descriptive analysis of consequent events suggested that problem behavior may have been maintained by access to tangible items.

Results of Anna's functional analysis indicated that her problem behavior occurred at higher rates in all test conditions relative to the control condition, and it persisted during repeated alone sessions. These results indicated that her problem behavior was maintained by automatic reinforcement. Thus, results of the antecedent descriptive analysis and the combined descriptive analysis both corresponded to results of the functional analysis because they each indicated maintenance by automatic reinforcement, whereas results of the consequent descriptive analysis did not correspond to those of the functional analysis because the consequent descriptive analysis suggested maintenance by access to tangible items.

Results of Bobby's descriptive analysis of antecedent events showed that conditional probabilities for the antecedent absence of both attention and tangible items given problem behavior were larger than the unconditional probabilities for those events. These antecedent data suggested that his problem behavior may have been maintained by social positive reinforcement (access to attention, tangible items, or both). Results of his descriptive analysis of consequent events showed that the delivery of tangible items was the only event observed to occur following problem behavior; however, tangible items were rarely delivered following problem behavior and were delivered more often in the absence of problem behavior. Thus, the descriptive data on consequent events suggested that Bobby's problem behavior may have been maintained by automatic reinforcement. The combined descriptive analysis showed that, although antecedent events (the absence of attention and tangible items) were correlated with problem behavior, these events were not delivered as consequences, suggesting that problem behavior was maintained by automatic reinforcement.

Bobby's functional analysis data showed that his problem behavior occurred inconsistently across conditions but was maintained during repeated alone sessions in the absence of any social contingencies, indicating that his problem behavior was maintained by automatic reinforcement. Thus, results of his consequent descriptive analysis and combined descriptive analysis both corresponded to those of his functional analysis, but results of his antecedent descriptive analysis did not correspond because it suggested behavioral maintenance by access to attention or tangible items.

Table 2 summarizes the results for each of the assessments for all participants. The descriptive analysis of antecedent events corresponded to the functional analysis for 2 of 7 participants (28.5%), the consequent event analysis corresponded to the functional analysis for 3 of 7 participants (42.8%), and the combined antecedent and consequent descriptive analysis corresponded to the functional analyses for 2 participants (28.5%). It is interesting to note that, with the exception of one case of partial correspondence (Kevin), results of the descriptive analyses of antecedent events never showed complete correspondence with results of the analyses of consequent events.

To determine whether any specific features of the descriptive analysis data influenced conclu-

Table 2
Comparison of Descriptive and Functional Analyses

	Descriptive analysis			
Participant	Antecedents only	Consequents only	Combined antecedents and consequents	Functional analysis
Tara	Automatic	Attention	Inconclusive	Attention
Jerry	Attention and tangible	Automatic	Automatic	Escape
Kevin	Escape and tangible	Escape	Escape	Escape
Travis	Attention	Tangible	Inconclusive	Escape
Wyatt	Automatic	Attention	Inconclusive	Automatic
Anna	Automatic	Tangible	Inconclusive	Automatic
Bobby	Attention and tangible	Automatic	Automatic	Automatic

sions about the functions of problem behavior when the team of behavior analysts evaluated each graph, we calculated a ratio for each data set by dividing the conditional probability of each event by its unconditional probability. These ratios, shown in Table 3, indicate proportional differences between the conditional and unconditional probabilities of each event. For example, the data for Wyatt showed that the conditional probability of consequent attention given problem behavior was .26 and that the unconditional probability of attention was .06. The proportional change was 4.33, indicating that the probability of receiving attention following problem behavior was roughly four times larger than the overall probability of receiving attention.

Retrospective review of the behavior analysts' decisions based on proportional differences between conditional and unconditional probabilities showed that the team agreed about a suggested function for problem behavior only when (a) the conditional probability of an event was higher than .2 and (b) the proportional change between the conditional and unconditional probabilities was 1.23 or greater. That is, the behavior analysts concluded that the descriptive analysis showed a relation between an event and problem behavior if the event was correlated with problem behavior at least 20% of the time and the likelihood of the event occurring with problem behavior was at least 123% greater than the likelihood of the event independent of problem behavior. It appeared that both criteria must have been met to reach a

consensus that the data suggested a relation. Anna's data, for example, showed that the absence of attention (antecedent event) met the first criterion (.88 > .2) but not the second (1.02 < 1.23), whereas the delivery of attention (consequent event) met the second criterion (2.00 > 1.23) but not the first (.06 < .2).

One other interesting feature of the decisions rendered by the group of behavior analysts is the case of automatic reinforcement or inconclusive decisions about combined descriptive analyses. Because the antecedent and consequent descriptive analyses never fully corresponded for any participant, it was often the case that one analysis suggested automatic reinforcement whereas the other analysis suggested social reinforcement. When the antecedent descriptive analysis suggested automatic reinforcement and the consequent descriptive analysis suggested social reinforcement (for Anna, Tara, and Wyatt), the team of behavior analysts concluded that the combined analyses were inconclusive. However, when the antecedent descriptive analysis suggested social reinforcement and the consequent descriptive analysis suggested automatic reinforcement, the team indicated that the combined analyses suggested automatic reinforcement.

DISCUSSION

Results of this study were consistent with those of previous research (Lerman & Iwata, 1993; Mace & Lalli, 1991; St. Peter et al., 2005; Thompson & Iwata, 2007) in which

Table 3

Conditional and Unconditional Probabilities (CP, UP), Ratios, and Group Consensus Results for the Descriptive Analyses

Participant		Antecedent events				Consequent events		
		No attention	Demand	No tangible	Alone	Attention	Escape	Tangible
Tara								
	CP	.15	.11	.98	.34	.55	0	.02
	UP	.24	.24	.90	.35	.41	.12	.10
	CP:UP	0.63	0.46	1.09	0.97	1.34[a]	0	0.20
Jerry								
	CP	.90	0	.50	.10	0	0	.20
	UP	.43	.02	.40	.56	.01	.01	.59
	CP:UP	2.09[a]	0	1.25[a]	0.18	0	0	0.34
Kevin								
	CP	0	.36	.36	.64	0	.18	.64
	UP	.18	.04	.21	.79	.03	.01	.79
	CP:UP	0	9.00[a]	1.71[a]	0.81	0	18.00[a]	0.81
Travis								
	CP	1	0	0	0	0	0	1
	UP	.80	.15	.60	.09	.11	.06	.40
	CP:UP	1.25[a]	0	0	0	0	0	2.50[a]
Wyatt								
	CP	.53	.20	1	.13	.26	0	0
	UP	.69	.14	1	.25	.06	.11	0
	CP:UP	0.77	1.43	1	0.52	4.33[a]	0	0
Anna								
	CP	.88	.08	.57	.06	.06	0	.37
	UP	.86	.24	.74	.11	.03	.07	.26
	CP:UP	1.02	0.33	0.77	0.55	2.00	0	1.42[a]
Bobby								
	CP	.69	0	.91	.30	0	0	.09
	UP	.38	.01	.74	.61	.03	.01	.25
	CP:UP	1.82[a]	0	1.23[a]	0.49	0	0	0.36

[a] Group consensus based on visual inspection of actual data.

outcomes obtained from descriptive analyses of problem behavior generally did not match those obtained from functional analyses. The present study differed from previous studies in that the potential relations between antecedent events and problem behavior and between consequent events and problem behavior were examined both separately and together. Comparison of overall outcomes obtained from the descriptive and functional analyses yielded results similar to those reported previously, and the analysis of antecedent events was not superior to the analysis of consequent events in identifying the function of problem behavior.

Although our results indicated that descriptive analyses were not useful for identifying the function of problem behavior, some interesting findings are worth noting. First, three of the four matches between results of the combined descriptive analyses and the functional analyses were obtained for problem behavior maintained by automatic reinforcement, the same function accounting for the only match (one of six) reported by Lerman and Iwata (1993). Because behavior maintained by automatic reinforcement is not related functionally to any social consequences, it occurs in the absence of programmed contingencies in a functional analysis and independent of observed consequences in a descriptive analysis. Thus, a finding of no correlation between problem behavior and any events in a descriptive analysis might be considered highly suggestive of an automatic reinforcement function. In fact, the most straightforward way to identify the absence of such a correlation would be simply

to observe problem behavior under naturalistic conditions that most closely resemble the alone condition of a functional analysis.

A second interesting feature of the results was seen in the descriptive data for Travis and Jerry, whose problem behavior was maintained by social negative reinforcement. Although both participants showed very clear patterns of responding during their functional analyses, in which problem behavior occurred almost exclusively in the demand conditions, there was no evidence in their descriptive analyses that problem behavior was correlated with the presentation of demands. It is unclear why so few demands were presented to these participants, but one possibility is that Travis's and Jerry's teachers refrained from asking them to work as a means of preventing problem behavior. Carr, Taylor, and Robinson (1991) observed that teachers were less likely to deliver instructions to students who engaged in problem behavior relative to students who did not engage in problem behavior. Because the function of the students' problem behavior was unknown in that study, the same results might have been observed had problem behavior been maintained by attention (in which case teachers simply provided less attention, including instructions, as an antecedent event) or by escape (in which case teachers specifically avoided giving instructions). For this reason, information about the functional characteristics of problem behavior may help to clarify unusual patterns of interaction between teachers or parents and those who engage in problem behavior.

A third finding, and one not consistent with results of previous studies (e.g., St. Peter et al., 2005; Thompson & Iwata, 2001), was that attention was not the consequent event most likely to follow problem behavior. Results of the descriptive analysis suggested an attention function for only 2 of the 7 participants, Wyatt and Tara. Their problem behavior was no more dangerous than that of other participants, so the general finding that severe problem behavior often produces attention did not appear to characterize the social environment for most participants in this study.

In summary, results of this study indicated that outcomes of descriptive analyses do not typically identify the source of reinforcement for problem behavior, regardless of whether the descriptive data emphasize the potential role of antecedent or consequent events. Aside from providing information about the frequency of problem behavior and the general context in which it occurs, the benefits of conducting a descriptive analysis as part of the assessment-treatment process should be examined more closely. For example, one obvious benefit would be to initially identify environment–behavior correlations for further experimental analysis, as suggested originally by Bijou et al. (1968). A two-stage, descriptive-experimental analysis of this type may be helpful when little is known about potential causal relations. However, given that many problem behaviors are maintained by contingencies that are easily accommodated in most functional analyses, it is unclear whether results of a descriptive analysis actually facilitate the implementation of a functional analysis.

A second possible use of the descriptive analysis would be to identify response–response relations that may be indicative of a response class. For example, it has been observed that other (precursor) behaviors sometimes precede the occurrence of problem behavior and may share the same function as problem behavior (Richman, Wacker, Asmus, Casey, & Andelman, 1999; Smith & Churchill, 2002). The relation between precursor and problem behaviors may be subtle and is unlikely to be detected through casual observation if the environment is responsive only to severe forms of problem behavior. In other words, parents and teachers may simply miss the fact that problem behavior follows precursors because they are concerned only about (and provide consequences only for) severe problem behavior. If so, a descriptive analysis may help to determine which of any number of potential precursors are predictive of the occurrence of problem behavior.

Finally, because the descriptive analysis is flexible and can provide information about a wide range of environment–behavior sequences, it seems uniquely suited as a measure of treatment integrity. That is, once programmed therapeutic (antecedent and consequent) events have been specified, a descriptive analysis would be the most precise method of determining the extent to which these events consistently occur.

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