RELATIVE CONTRIBUTIONS OF THREE DESCRIPTIVE METHODS: IMPLICATIONS FOR BEHAVIORAL ASSESSMENT

SACHA T. PENCE, EILEEN M. ROSCOE, JASON C. BOURRET, AND
WILLIAM H. AHEARN

NEW ENGLAND CENTER FOR CHILDREN

NORTHEASTERN UNIVERSITY

This study compared the outcomes of three descriptive analysis methods—the ABC method, the conditional probability method, and the conditional and background probability method—to each other and to the results obtained from functional analyses. Six individuals who had been diagnosed with developmental delays and exhibited problem behavior participated. Functional analyses indicated that participants' problem behavior was maintained by social positive reinforcement ($n = 2$), social negative reinforcement ($n = 2$), or automatic reinforcement ($n = 2$). Results showed that for all but 1 participant, descriptive analysis outcomes were similar across methods. In addition, for all but 1 participant, the descriptive analysis outcome differed substantially from the functional analysis outcome. This supports the general finding that descriptive analysis is a poor means of determining functional relations.

DESCRIPTORS: descriptive analysis, functional analysis, problem behavior

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Functional analysis procedures, described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), have made a substantial impact in the field of applied behavior analysis. Since the advent of this assessment, hundreds of direct and systematic replications have been conducted across populations, settings, and topographies of problem behavior. In a review by Hanley, Iwata, and McCord (2003), the authors noted a sharply increasing trend in the publication rates of research involving functional analyses, suggesting growth in the use of functional analysis as the primary method of behavior assessment. The main advantage of conducting a functional analysis is that, by identifying the variables that maintain problem behavior, effective function-based interventions can be developed. For example, if results of a functional analysis indicated behavioral sensi-

tivity to attention, an appropriate alternative response might be taught that resulted in access to attention.

Although a functional analysis is the only functional assessment method that allows identification of the function of problem behavior, a number of clinicians and researchers have attempted to use descriptive analysis for this purpose (Desrochers, Hiles, & Williams-Moseley, 1997; Ellingson, Miltenberger, & Long, 1999; Kern, Hilt, & Gresham, 2004). Descriptive analysis provides information about naturally occurring behavior–environment relations (Baer, 1973; Bijou, Peterson, & Ault, 1968). However, this information is purely correlational and has frequently been shown to suggest behavioral functions that do not correspond with conclusions drawn from experimental analysis (e.g., Lerman & Iwata, 1993; Thompson & Iwata, 2007). For example, if a student's problem behavior results in attention 90% of the time and escape 10% of the time, the most common consequence identified in a descriptive analysis would be attention. However, it would be an error to assume that the behavior is sensitive to attention because other factors, such as a behavioral

program that involves interrupting or preventing the behavior, may be responsible for the observed contingency.

Because a considerable body of evidence suggests that descriptive analysis is not useful for the identification of behavioral function, alternative applications of the method may warrant further investigation. For example, for an individual whose problem behavior is sensitive to attention, a clinically appropriate environment might be one in which attention following problem behavior is unlikely and attention following an appropriate request is very likely. This information might be useful in identifying problematic environmental arrangements or as a way of measuring the effects of staff training procedures.

Three common descriptive analysis methods are the antecedent-behavior-consequence (ABC) method (Sulzer-Azaroff & Mayer, 1977), the conditional probability method (Lerman & Iwata, 1993), and the conditional and background probability method (Vollmer, Borrero, Wright, Van Camp, & Lalli, 2001). In the ABC method, antecedent and consequent environmental events associated with each instance of problem behavior are recorded (Sulzer-Azaroff & Mayer), indicating the proportion of problem behavior preceding or following various environmental events. An example of the ABC method was reported by Sasso et al. (1992), who examined the correspondence between functional analysis outcomes and ABC descriptive analysis outcomes in a classroom setting. Results from the functional analysis and descriptive analysis suggested that 1 participant's behavior was maintained by social negative reinforcement and social positive reinforcement (tangible items), and the 2nd participant's behavior was maintained by social negative reinforcement. These findings indicated that ABC descriptive analysis outcomes were consistent with functional analysis outcomes for both participants. A limitation of this method is that observers record antecedent and conse-

quent environmental events only when problem behavior occurs, making it unclear how often these environmental events occur in the absence of problem behavior (Lerman & Iwata, 1993). In addition, a match between descriptive analysis and functional analysis outcomes for a single participant does not imply that such outcomes would generally match with other individuals.

A second method, the conditional probability method, was reported by Lerman and Iwata (1993). They compared outcomes from a functional analysis with results from a descriptive analysis for 6 participants who exhibited self-injurious behavior (SIB). Observations for the descriptive analysis were conducted across a variety of settings. Data were collected on the occurrence and sequence of participants' SIB and environmental events (attention, instructions, attention removal, instruction removal, materials) using 10-s partial-interval recording. Session-by-session conditional probabilities were calculated to determine the proportion of SIB that occurred prior to or following environmental events and the proportion of environmental events that preceded or followed SIB. Results showed that descriptive outcomes were consistent with functional analysis outcomes for only 1 of the 6 participants. The result that yielded a consistent outcome was for a participant who exhibited SIB maintained by automatic reinforcement. The other 5 participants exhibited SIB maintained by social reinforcement.

A third method is the conditional and background probability method. Vollmer et al. (2001) evaluated this method for 11 participants who exhibited SIB, aggression, or disruption in a hospital setting. Observers collected data on the occurrence of problem behavior and the duration of environmental events (low or diverted attention, instructions, restricted access to materials, attention, instruction termination, and access to materials). The conditional probability of each environmental event given

the occurrence of problem behavior was compared with the background probability of that environmental event to identify potential positive, neutral, or negative contingencies. When the conditional probability was greater than, equal to, or less than the background probability, the data indicated a potential positive, neutral, or negative contingency, respectively. Positive contingencies, which indicated potential reinforcement contingencies, were identified for only 7 of the 11 participants. Although this method was not developed to replace functional analysis, the fact that response–stimulus contingencies are identified may invite such usage. To date, no research has compared the results of this descriptive analysis method to those obtained from a functional analysis.

Previous research has compared outcomes from descriptive analysis to those obtained from functional analyses. However, no study has compared the relative outcomes of different descriptive analysis methods used to analyze the same data. This sort of comparison might be useful in determining if some descriptive analysis methods are more efficient (e.g., involve simpler methods of data collection and analysis) or produce more easily interpreted data than others. In addition, the inclusion of a functional analysis allows interpretation of the descriptive data in light of identified functions of problem behavior. Thus, the purpose of this study was to compare the outcomes of three descriptive analysis methods (ABC, conditional probability, and conditional and background probability method) to each other and to the outcomes of functional analyses.

GENERAL METHOD

Participants and Setting

Six individuals who attended a residential school for children with autism participated. All participants had been reported to engage in problem behavior that interfered with their skill acquisition and social interaction. Participants were selected based on the outcomes of their functional analyses (i.e., the first 2 who showed sensitivity to attention, the first 2 who showed sensitivity to escape, and the first 2 who showed sensitivity to automatic reinforcement). Gina was a 10-year-old girl who had been diagnosed with Smith-Magenis disorder. She communicated using full sentences and engaged in self-injury. Casey was a 10-year-old girl who had been diagnosed with autism. She communicated using full sentences and exhibited aggression. Jake was an 8-year-old boy who had been diagnosed with autism. He communicated using two- to three-word utterances and exhibited aggression. Larry was a 19-year-old man who had been diagnosed with autism. He communicated using sign language and exhibited disruptive behavior. Hannah was a 13-year-old girl who had been diagnosed with autism. She communicated using three- to five-word sentences and exhibited motor stereotypy. Charlie was a 14-year-old boy who had been diagnosed with pervasive developmental disability. He communicated using one- to two-word utterances and pictures, and he exhibited motor stereotypy.

For each participant, a separate functional analysis and descriptive analysis were conducted. Functional analysis sessions were conducted in a therapy room (2.5 m by 3.8 m) that contained a table and chair or in a quiet area of participants' classrooms. For the descriptive analysis, observations in participants' classrooms were videotaped. Classrooms contained two to three partitioned academic areas with a desk, chairs, and task materials and a leisure area with a couch, television, and various leisure items. One to four students and one to two teachers were present in the classroom.

FUNCTIONAL ANALYSIS

Response Measurement and Interobserver Agreement

Data were collected on participants' problem behavior, including SIB, aggression, disruption, and motor stereotypy. *Self-injury* (Gina) was defined as any contact from 5 cm or greater

between the participant's head and a stationary object or between the participant's hand and head. *Aggression* (Casey and Jake) was defined as any grabbing, pinching, kicking, biting, punching, hair pulling, or scratching. *Disruption* (Larry) was defined as any ripping, breaking, or sweeping of an object or any instance of hitting the wall or door with an open hand or fist. *Motor stereotypy* (Hannah and Charlie) was defined as any noncontextual movement in the forms of hand flapping, rocking, tapping, clapping, jumping up and down, or shirt twirling (holding on to one's shirt with two or more fingers while moving one's wrist or arm in a back and forth motion).

Sessions were either 5 min (Charlie only) or 10 min long. Observers were graduate students who had received a minimum of 5 hr of training on data-collection procedures and had obtained agreement scores above 90% with previously trained observers on the same target response. Observers collected data on all target responses using paper and pencil. For motor stereotypy, observers recorded duration using a data sheet segmented into 1-s bins, and data were summarized as total duration. For disruption, self-injury, and aggression, observers recorded frequency using a data sheet segmented in 10-s bins, and data were summarized as responses per minute.

Agreement data were collected by having a second observer independently record data during 52%, 43%, 38%, 60%, 37%, and 33% of Gina's, Casey's, Jake's, Larry's, Hannah's, and Charlie's sessions, respectively. Agreement data for frequency were calculated by comparing observers' records during each 10-s interval and dividing the smaller number of occurrences in each interval by the larger number of occurrences in each interval. These fractions were then summed, divided by the total number of intervals, and converted to a percentage. Interobserver agreement data for duration were calculated by comparing observers' records during each 10-s interval and dividing the smaller number of seconds by the larger number of seconds in each interval. These fractions were

then summed, divided by the total number of intervals, and converted to a percentage. When calculating interobserver agreement for frequency and duration, agreements on the nonoccurrence of problem behavior were scored as 100% agreement intervals. Mean interobserver agreement was 99% (range, 94% to 100%) for Gina, 100% for Casey, 98% (range, 93% to 100%) for Jake, 100% for Larry, 91% (range, 78% to 100%) for Hannah, and 96% (range, 92% to 100%) for Charlie.

Procedure

For each participant, a functional analysis (based on procedures described by Iwata et al., 1982/1994) was conducted prior to the descriptive analysis to identify an equal number of participants (*n* = 2) who exhibited behavior that was maintained by social positive reinforcement, social negative reinforcement, or automatic reinforcement. The functional analysis included the following conditions: alone or no interaction, play, attention, demand, and tangible. Conditions were randomly presented using a multielement design. An alone or no-interaction condition was not conducted for participants whose problem behavior was aggression.

For participants whose initial functional analysis did not include a tangible condition, an additional functional analysis phase was conducted. During this phase, a tangible condition was alternated with the play condition using a pairwise design. For participants whose initial functional analysis indicated maintenance by automatic reinforcement and whose tangible condition resulted in differentially higher levels than the play condition (Hannah and Charlie), a modified control condition was conducted and alternated with the tangible condition. During the modified control condition, leisure items were presented on a fixed-time schedule yoked to the schedule observed during the preceding tangible conditions. The purpose of this condition was to evaluate whether higher levels of problem

behavior during the tangible condition were due to fewer opportunities to engage with leisure items that may have competed with behavior relative to the control condition. If behavior occurred at lower levels during the tangible condition relative to the modified control, it would indicate that their behavior was not maintained by social positive reinforcement (i.e., tangible items). During the tangible condition, the therapist presented preferred leisure items (the same items presented during the play condition) for 1 to 2 min prior to the session. At the start of the session, the therapist stated, ''It's my turn,'' and removed the leisure items. Contingent on the occurrence of the problem behavior, the therapist delivered the leisure items for 30 s.

Results

Results from the functional analysis are depicted in Figure 1. For Gina and Casey, problem behavior occurred at differentially higher levels during the demand condition, suggesting maintenance by negative reinforcement in the form of escape from demand. For Jake and Larry, problem behavior occurred at differentially higher levels during the attention condition, indicating maintenance by social positive reinforcement in the form of attention. For Hannah, variable levels of problem behavior were observed across all conditions. During an extended series of no-interaction sessions, problem behavior increased, indicating maintenance by automatic reinforcement. For Charlie, problem behavior occurred at differentially higher levels during the alone condition, indicating maintenance by automatic reinforcement.

DESCRIPTIVE ANALYSIS

Videotape Observation

For the descriptive analysis, videotape observations of the participant were conducted in his or her classroom. Prior to videotaping, teachers were given a memo and told that the participant would be videotaped during his or her regularly scheduled activities. Teachers were also instructed (or asked) to interact with the participant as they normally would. The observer vocally provided this instruction a second time immediately before videotaping. The participant was videotaped in his or her classroom under a variety of environmental contexts. To ensure that the descriptive analysis captured the participant in his or her typical environment, teachers, tangible items, and instructions present during the assessment were not systematically selected, nor were they held constant across the assessment. In addition, stimuli present during the descriptive analysis were not identical to those included in the functional analysis. During each observation period, participants were videotaped for one to three 10-min periods. The observer videotaped as covertly as possible by standing away from the participant or videotaping behind a one-way mirror. The observer followed the participant when the participant moved from one area to another in the classroom or common areas. The observer stopped the videotape if the participant entered the bathroom or was placed into a restrictive procedure that prevented the problem behavior from occurring or from being observed (e.g., time-out or a protective hold). Videotaping was resumed once the participant exited the bathroom or was released from time-out or a protective hold. Criteria for completion of videotaping for each participant included a minimum of 60 min of video footage, a minimum of 20 instances of problem behavior captured on videotape, and a minimum of 20 min of each environmental event captured on videotape.

Response Measurement and Interobserver Agreement

Trained graduate students served as observers and collected data on problem behavior (as noted for the functional analysis) and environmental events from the videotaped footage using laptops or handheld computers. Two types of environmental events were recorded:
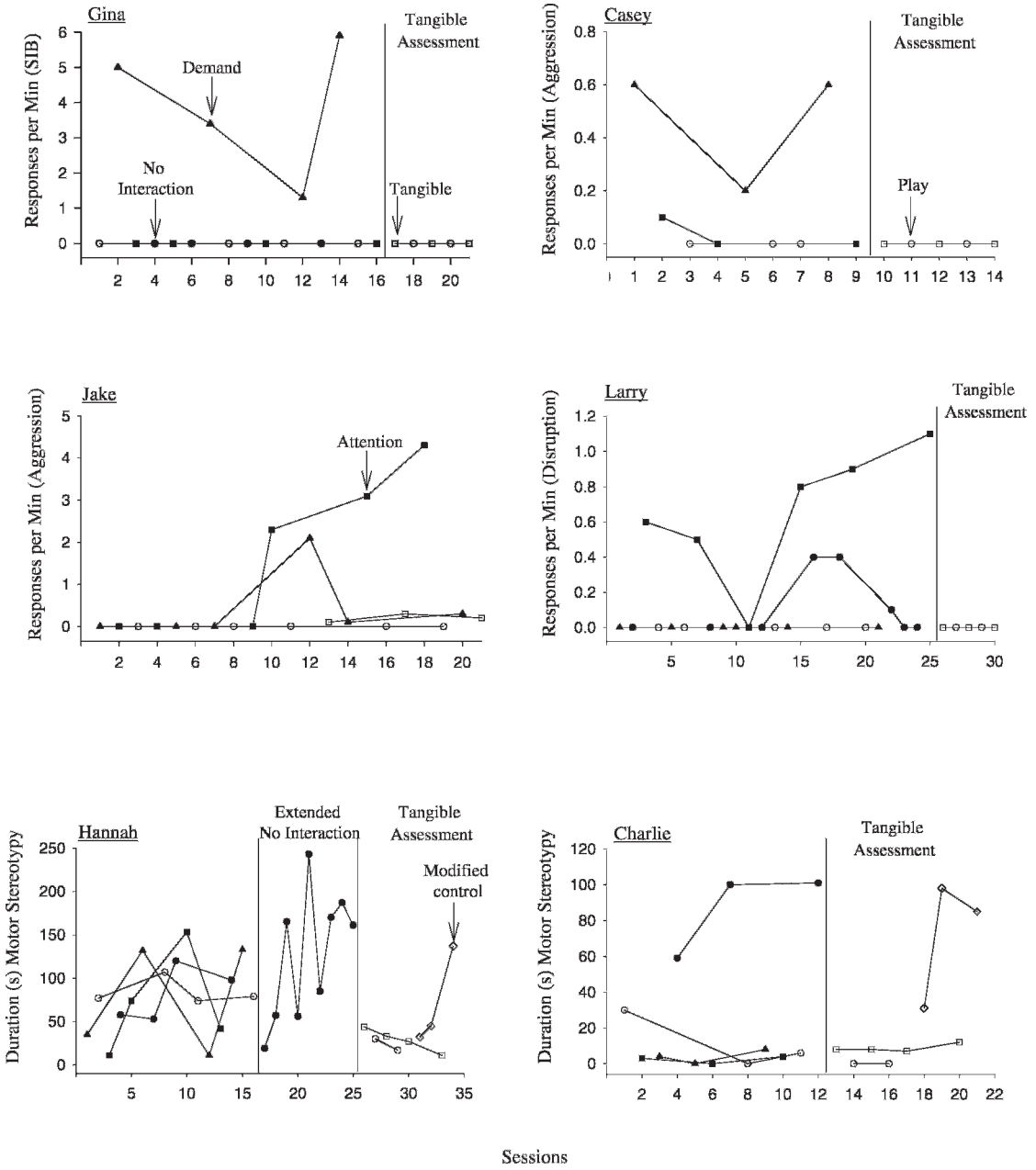
Figure 1. Functional analysis outcomes for Gina and Casey (top), Jake and Larry (middle), and Hannah and Charlie (bottom).

antecedent environmental events and consequent environmental events. Antecedent environmental events included no attention, demand, and no materials. *No attention* was defined as 5 s without vocal or physical interaction (instructional or otherwise). *De-*

mand was defined as any vocal, model, gestural, or physical prompt (including the presence of ongoing instructional activity) to engage in a behavior. *No materials* were defined as the participant not having contact with or access to edible or leisure items. Consequent environ-

mental events included attention, no demand, and materials. *Attention* was defined as the teacher vocally or physically interacting with the participant. *No demand* was defined as the absence of vocal, model, gestural, or physical prompts to engage in a behavior for 5 s. *Materials* were defined as having access to or contact with leisure or edible items. The videotapes for each participant were divided into 10-min periods. Problem behavior was measured using frequency of occurrence (aggression, SIB, and disruption) or total duration (motor stereotypy), and environmental events were measured using total duration. Predetermined keys were used to score occurrences or the onset and offset of problem behavior and environmental events. For duration recording, a key was pressed when the environmental event started and was released when the environmental event ended.

Agreement data were collected during 60%, 42%, 36%, 36%, 33%, and 33% of observations for Gina, Casey, Jake, Larry, Hannah, and Charlie, respectively. Agreement data were obtained by having a second observer independently score the same videotapes. Session data were divided into 10-s bins, and interobserver agreement was calculated by dividing the smaller number of seconds of problem behavior or environmental events by the larger number in each 10-s interval, summing these fractions, dividing this sum by the total number of intervals in a session, and converting this ratio to a percentage. Mean agreement for problem behavior was 97% (range, 91% to 100%) for Gina, 98% (range, 92% to 100%) for Casey, 98% (range, 93% to 100%) for Jake, 99.8% (range, 90% to 100%) for Larry, 95% (range, 90% to 99%) for Hannah, and 97% (range, 94% to 100%) for Charlie. Mean agreement for environmental events was 94% (range, 82% to 100%) for Gina, 95% (range, 75% to 100%) for Casey, 84% (range, 77% to 92%) for Jake, 85.0% (range, 81% to 90%) for Larry, 88% (range, 87% to 88%) for Hannah, and 88% (range, 76% to 99%) for Charlie.

Data Analysis

Descriptive data were analyzed using three different methods: the ABC method, the conditional probability method, and the conditional and background probability method. For problem behavior and environmental events scored as duration, each second of problem behavior or environmental event was considered an instance for the analyses described below (e.g., if a problem behavior was scored as occurring during Seconds 1, 2, and 3, then that would be considered three instances of the problem behavior, one in each second). For calculations involving antecedent environmental events, problem behavior and environmental events that occurred at any time during the session were included. For calculations involving consequent environmental events, only problem behavior and environmental events that occurred in the presence of potential establishing operations (EOs; i.e., low attention, demand, and no materials) were included. Consequent environmental events were defined as stimulus changes in which the putative EO ceased and the putative reinforcer began.

For the ABC method, the proportion of problem behavior preceded by environmental events and the proportion of problem behavior followed by environmental events was calculated. The proportion of problem behavior preceded by events was calculated by dividing the number of instances of problem behavior preceded by environmental events (i.e., environmental events that occurred within 10 s prior to problem behavior) by the number of instances of problem behavior. The proportion of problem behavior followed by environmental events was calculated by dividing the number of instances of problem behavior followed by environmental events (i.e., environmental events that occurred within 10 s following problem behavior) by the number of instances of problem behavior.

For the conditional probability method, four calculations were conducted. The antecedent environmental event analyses consisted of the

proportion of problem behavior preceded by environmental events (as described above) and the proportion of environmental event intervals that preceded problem behavior. This was calculated by dividing the number of instances of an environmental event that preceded problem behavior (environmental events that occurred within 10 s prior to problem behavior) by the number of instances of the environmental event. The consequent environmental event analyses included the proportion of problem behavior followed by environmental events (as described above) and the proportion of environmental event intervals preceded by problem behavior. This was calculated by dividing the number of instances of the environmental event preceded by problem behavior (i.e., environmental events that occurred within 10 s following problem behavior) by the number of instances of the environmental event.

For the conditional and background probability method, the antecedent environmental event analysis involved comparing the proportion of environmental event intervals that preceded problem behavior (as described above) and the background probability of problem behavior. The background probability of problem behavior was calculated by generating 10-s intervals beginning with each second of the session until and including the final 10 s of the session (e.g., 1–10, 2–11, 3–12, 4–13, …, 591–600) and then dividing the number of intervals with problem behavior by the total number of intervals. These calculations were then analyzed for the emergence of any positive, negative, or neutral contingencies. The consequent environmental event analyses involved comparing the proportion of problem behavior followed by environmental events (as described above) with the background probability of environmental events. The background probability of the consequent environmental event was calculated by generating 10-s intervals beginning with each second of the putative EO and then dividing the number of intervals with an environmental event by the total number of intervals. These calculations were then analyzed for the emergence of any positive, negative, or neutral contingencies.

The conditional and background probabilities were compared to identify positive, negative, or neutral contingencies. A positive contingency was observed when the conditional probability was greater than the background probability and indicated that problem behavior was more likely to occur following an environmental event than the background probability of problem behavior (for antecedent environmental events) or that the environmental event was more likely to follow problem behavior than the background probability of the environmental event (for consequent environmental events). A negative contingency was observed when the conditional probability was less than the background probability and indicated that problem behavior was less likely following the environmental event than the background probability of problem behavior (for antecedent environmental events) or that the environmental event was less likely following problem behavior than the background probability of the environmental event (for consequent environmental events). A neutral contingency was observed when the conditional probability and background probabilities were equal and indicated that the relation between the environmental event and problem behavior was equal to the background probability of problem behavior or environmental event.

Data Interpretation

In the ABC method, relations between environmental events and problem behavior were based on the relative proportions of problem behavior associated with each environmental event. The environmental event associated with the highest proportion of responding was identified as most common. In the conditional probability method, relations between environmental events and problem behavior were based on the relative proportions of problem behavior associated with each environmental event, as in the ABC method,

and, in addition, on the relative proportions of environmental events associated with problem behavior. For this analysis, the environmental event associated with the highest proportion of problem behavior and the environmental event for which the highest proportion was associated with problem behavior were both identified as most common. In the conditional and background probability method, relations between environmental events and problem behavior were based on whether or not a potential positive contingency was identified. Because more than one potential positive contingency could be observed, multiple antecedent and consequent relations could be identified.

Across all descriptive analysis methods, the criteria for identifying an environmental event as a reinforcer were based on both antecedent and consequent relations. Because antecedent environmental events were putative EOs, and by definition, an EO establishes consequences as reinforcers, it seemed reasonable to use antecedent environmental events as suggestive of potential reinforcers. Automatic reinforcement was suggested when the most common antecedents were no attention or no attention and no materials and the most common consequence was no demand. Automatic reinforcement was also suggested when no change in environmental events was observed following problem behavior.

For all methods, there were no criteria on the size of the effect necessary for identification of a relation. Because criteria for determining relations during descriptive analyses are arbitrary, can vary greatly across and within methods, and have not been empirically evaluated, we selected the least stringent criterion for determining potential maintaining variables to increase the likelihood of detecting a potential relation and to minimize the possibility of not detecting a potential relation.

Results

Figure 2 depicts results from Gina's descriptive analyses. For the ABC descriptive analysis, the highest proportion of problem behavior was preceded by no materials, indicating that no materials was the most common antecedent environmental event. The highest proportion of Gina's problem behavior was followed by attention, indicating that attention was the most common consequent environmental event. Results from the ABC data analysis method suggest that Gina's problem behavior was potentially maintained by attention, materials, or both.

For the conditional probability method, the proportion of problem behavior preceded by environmental events and the proportion of environmental events that preceded problem behavior were highest for no materials, indicating that no materials was the most common antecedent event. However, for the proportion of environmental events that preceded problem behavior, the differences between no materials and the other antecedent environmental events were small. The proportion of problem behavior followed by environmental events and the proportion of environmental events preceded by problem behavior were highest for attention, indicating that attention was the most common consequent environmental event. Results from the conditional probability method suggested that Gina's problem behavior was potentially maintained by attention, materials, or both.

For Gina's conditional and background probability data analysis, positive contingencies were observed between no attention and problem behavior and between no materials and problem behavior. However, differences between the conditional probabilities and the relevant background probability were small. When the probability of environmental events given problem behavior was compared to the background probability of environmental events, a positive contingency between problem behavior and attention was observed. The results of the conditional and background probability method suggested that Gina's problem behavior was maintained by attention, materials, or both.

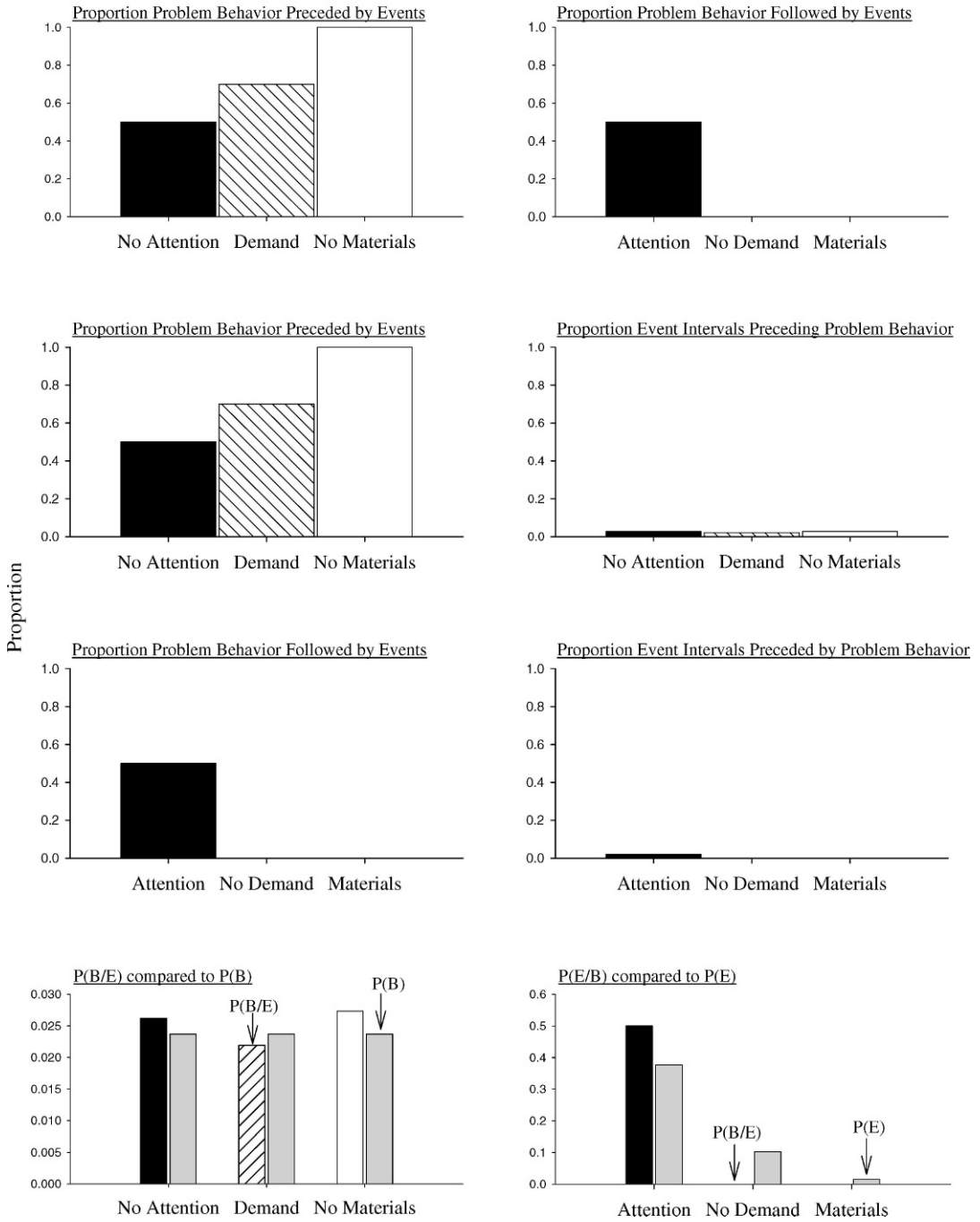Figure 3 depicts results from Casey's descriptive analyses. For the ABC descriptive analysis,

Gina

Figure 2.   ABC method outcomes (top), conditional probability outcomes (second and third panels), and conditional and background probability outcomes (bottom) for Gina.
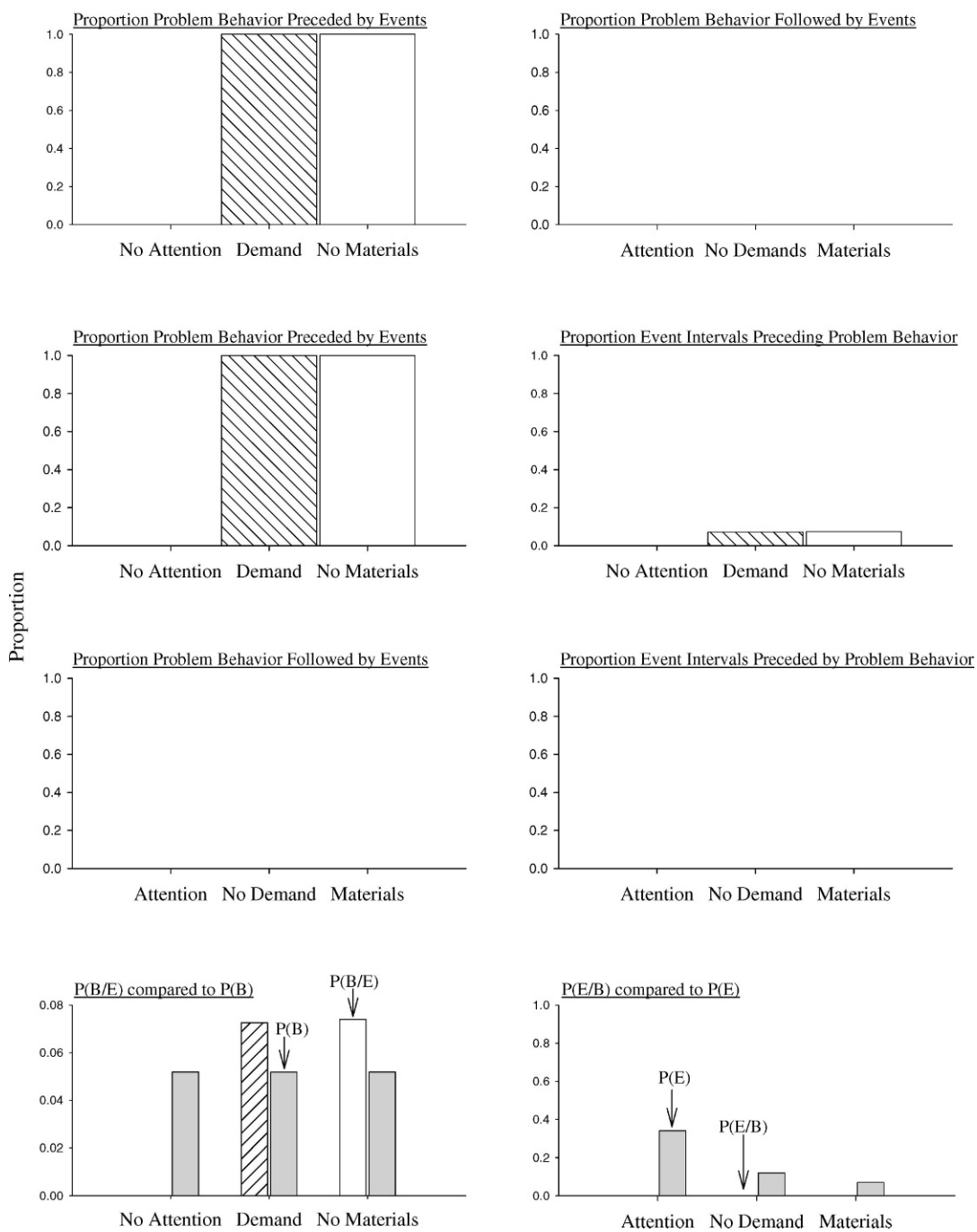
Figure 3. ABC method outcomes (top), conditional probability outcomes (second and third panels), and conditional and background probability outcomes (bottom) for Casey.

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the highest proportion of problem behavior was preceded by demand and no materials, indicating that demand and no materials were the most common antecedent environmental events. However, problem behavior was never followed by the occurrence of environmental events, indicating that the most common consequence was no change in environmental events. Results from the ABC data analysis method suggested that Casey's problem behavior was maintained by escape, materials, automatic reinforcement, or some combination.

For the conditional probability method, the proportion of problem behavior preceded by environmental events was highest for demand and no materials, indicating that demand and no materials were the most common antecedent environmental events. The proportion of environmental events that preceded problem behavior was highest for no materials, indicating that no materials was the most common antecedent environmental event. However, differences between the most common antecedent event and the other events were small. For both the proportion of problem behavior followed by environmental events and for the proportion of environmental events preceded by problem behavior, problem behavior did not occur, indicating that there were no changes in environmental events following problem behavior. Results from the conditional probability method suggested that Casey's problem behavior was maintained by escape, materials, automatic reinforcement, or some combination.

For Casey's conditional and background probability data analysis, the probability of problem behavior given environmental events showed positive contingencies between demand and problem behavior and between no materials and problem behavior, indicating that the probability of problem behavior increased following demand and no materials. However, the difference between the conditional probabilities and the relevant background probability

was small. The probability of environmental events given problem behavior showed that changes in environmental events never followed problem behavior. The outcomes of the conditional and background probability method suggested that Casey's problem behavior was maintained by escape, materials, automatic reinforcement, or some combination.

Figure 4 depicts results from Jake's descriptive analyses. For the ABC descriptive analysis, the highest proportion of problem behavior was preceded by demand, indicating that demand was the most common antecedent environmental event. The highest proportion of problem behavior was followed by attention, indicating that attention was the most common consequent environmental event. Outcomes from the ABC data analysis method suggested that Jake's problem behavior was maintained by attention, escape, or both.

For the conditional probability method, the proportion of problem behavior preceded by environmental events was highest for demand. The proportion of environmental events that preceded problem behavior was highest for no materials. These findings indicate that demand and no materials were the most common antecedent environmental events. However, for the proportion of environmental events that preceded problem behavior, it is important to note that the differences between the most common antecedent environmental event and the other environmental events were very small. The proportion of problem behavior followed by environmental events was highest for attention, indicating that attention was the most common consequent environmental event. The proportion of environmental events preceded by problem behavior was highest for materials, indicating that materials were the most common consequent environmental event. Therefore, when combined, the consequent analysis calculations indicated that attention and materials were the most common consequent environmental events. Results from the conditional probability method
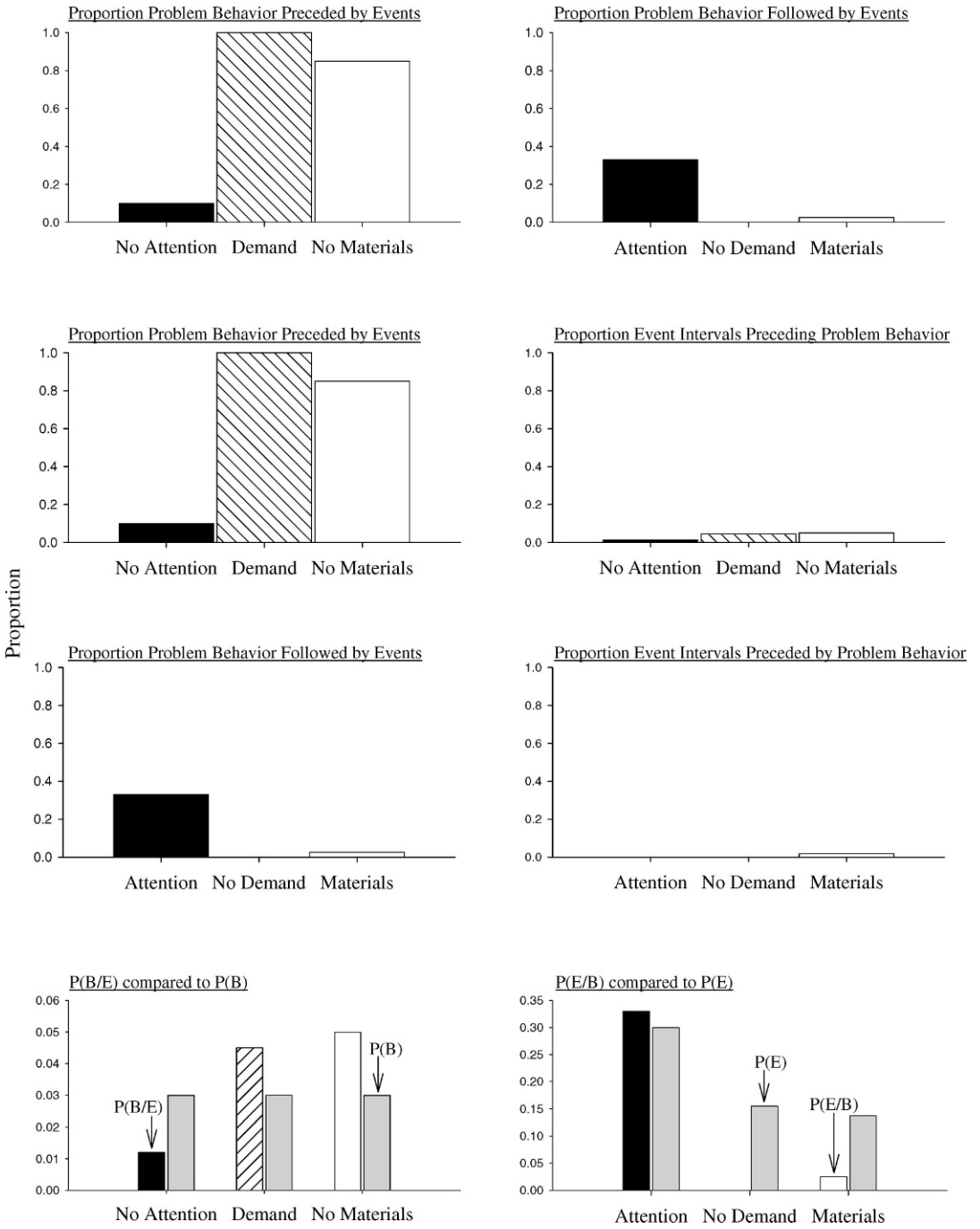
Proportion

Figure 4. ABC method outcomes (top), conditional probability outcomes (second and third panels), and conditional and background probability outcomes (bottom) for Jake.

suggested that Jake's problem behavior was maintained by attention, escape, materials, or some combination.

For the conditional and background probability method, when comparing the probability of problem behavior given an environmental event to the background probability of problem behavior, positive contingencies were observed between demand and problem behavior and between no materials and problem behavior, indicating that the probability of problem behavior increased given demands and given no materials. However, the differences between the conditional probabilities and the background probability were small. When comparing the probability of environmental events given problem behavior to the background probability of environmental events, a positive contingency was observed between problem behavior and attention. Results from the conditional and background probability method suggested that Jake's problem behavior was maintained by attention, escape, materials, or some combination.

Figure 5 shows the results from Larry's descriptive analyses. For the ABC descriptive analysis, the proportion of problem behavior preceded by environmental events was highest for no attention, indicating that no attention was the most common antecedent environmental event. The proportion of problem behavior followed by environmental events was highest for attention, indicating that attention was the most common consequent environmental event. Results from the ABC data analysis method suggest that Larry's problem behavior was maintained by attention.

For the conditional probability method, the proportion of problem behavior preceded by environmental events and the proportion of environmental events that preceded problem behavior was highest for no attention, indicating that no attention was the most common antecedent environmental event. However, for the proportion of environmental events that

preceded problem behavior, differences between the antecedent environmental event with the highest proportion and the other environmental events were small. The proportion of problem behavior followed by environmental events and the proportion of environmental events preceded by problem behavior was highest for attention, indicating that the most common consequent environmental event was attention. However, the differences between the proportion of problem behavior followed by attention and the other environmental events were minor. Results from the conditional probability method suggested that Larry's problem behavior was maintained by attention.

For Larry's conditional and background probability data analysis, when comparing the probability of problem behavior given environmental events with the background probability of problem behavior, a positive contingency was observed between no attention and problem behavior. However, the difference between the conditional probability of problem behavior given no attention and the background probability of problem behavior was small. When comparing the probability of environmental events given problem behavior to the background probability of environmental events, no positive contingencies were observed, suggesting that there were no reliable changes in environmental events following problem behavior. The outcomes of the conditional and background probability method suggest that Larry's problem behavior may be maintained by attention, automatic reinforcement, or both.

Figure 6 depicts results from Hannah's descriptive analyses. For the ABC descriptive analysis, the proportion of problem behavior preceded by events was highest for no attention, indicating that no attention was the most common antecedent environmental event. The proportion of problem behavior followed by environmental events was highest for attention, indicating that attention was the most common consequence. Results from the ABC data
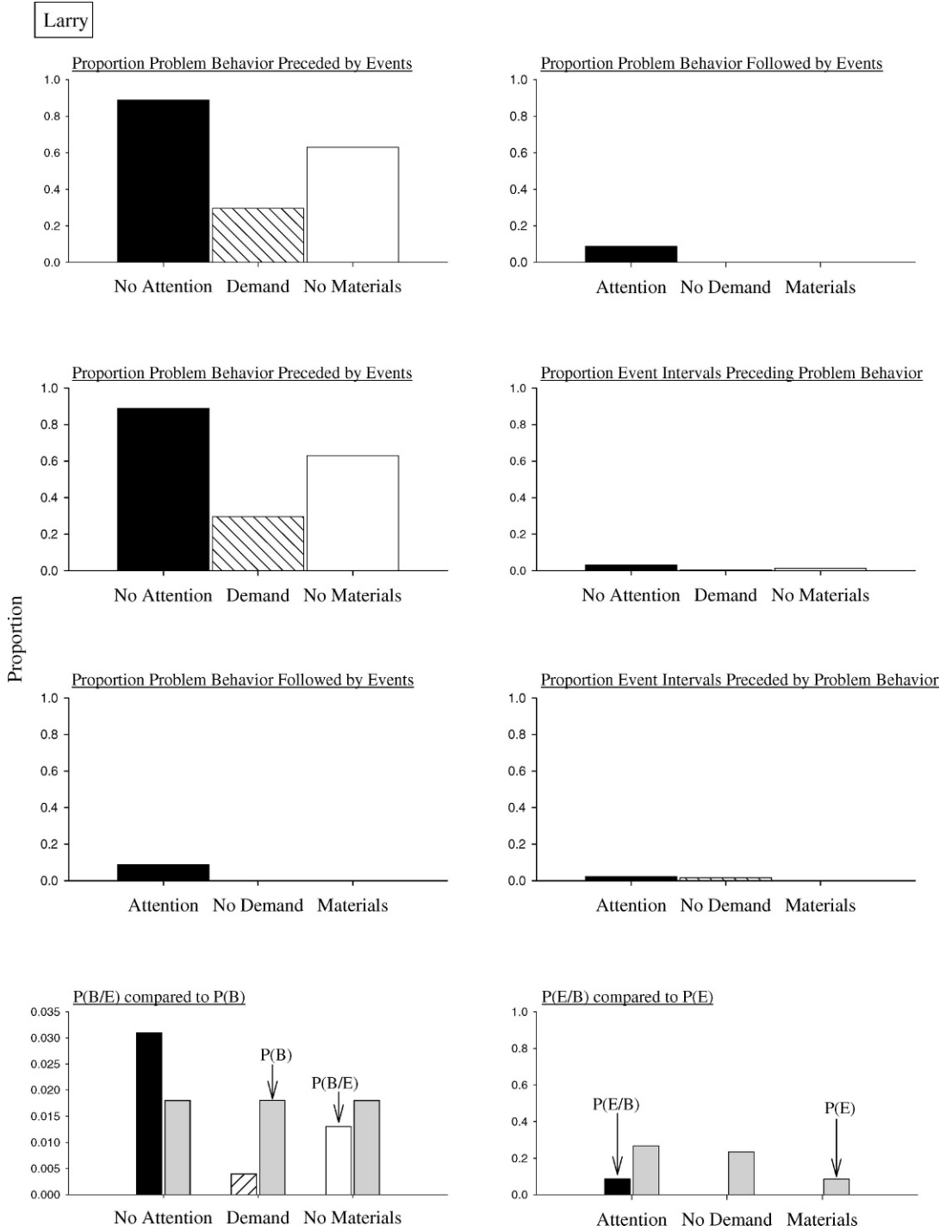
Figure 5.   ABC method outcomes (top), conditional probability outcomes (second and third panels), and conditional and background probability outcomes (bottom) for Larry.
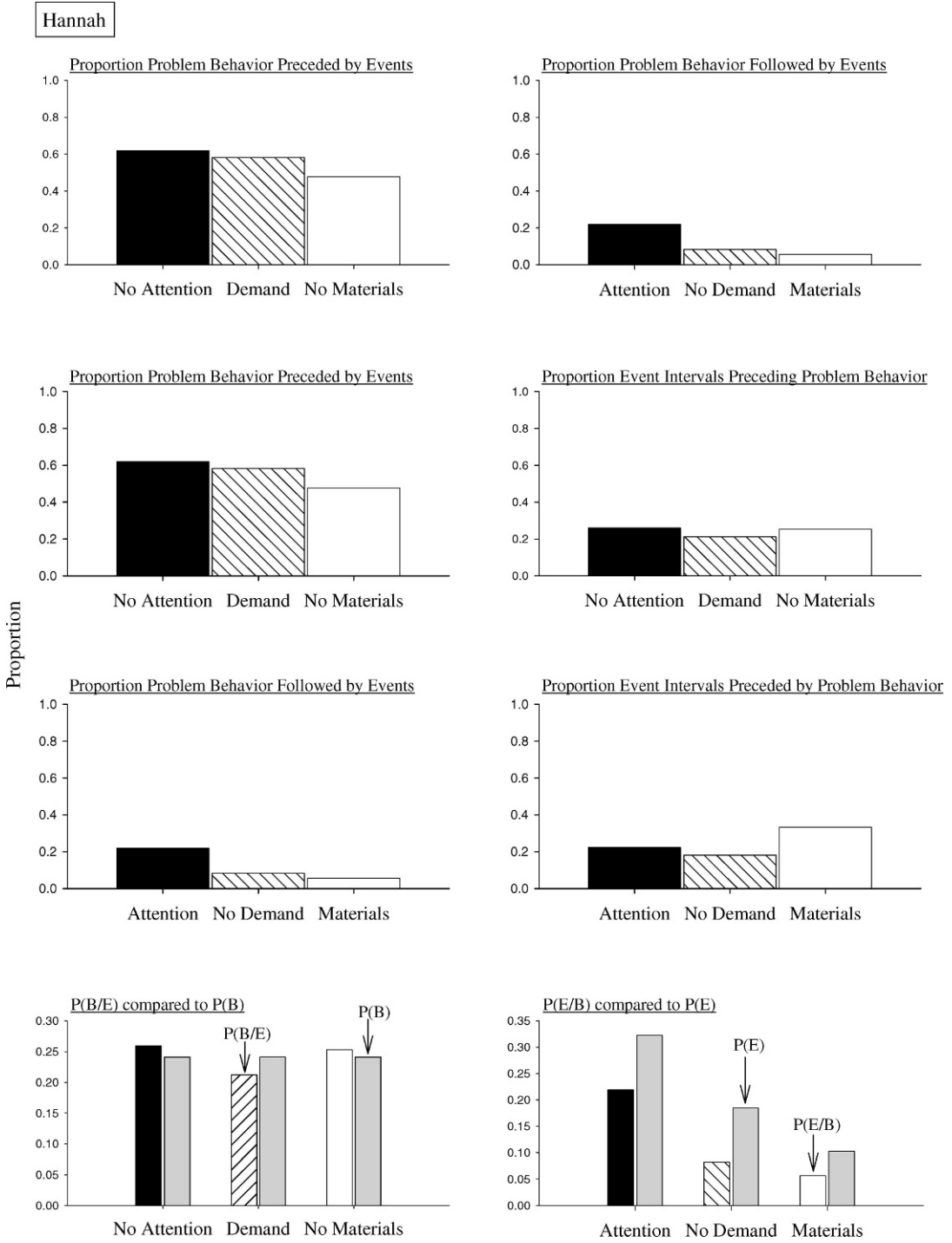
Figure 6.   ABC method outcomes (top), conditional probability outcomes (second and third panels), and conditional and background probability outcomes (bottom) for Hannah.

analysis method suggested that Hannah's problem behavior was maintained by attention.

For Hannah's conditional probability descriptive analysis, the proportion of problem behavior preceded by environmental events and the proportion of environmental events preceding problem behavior was highest for no attention, indicating that no attention was the most common antecedent environmental event. However, for the proportion of environmental events that preceded problem behavior, the differences between the most common antecedent environmental event and other environmental events were small. The proportion of problem behavior followed by environmental events was highest for attention, indicating that attention was the most common consequent environmental event. The proportion of environmental events preceded by problem behavior was highest for materials, indicating that materials was the most common consequent environmental event. Again, the differences between the most common consequent environmental event and other environmental events were small. When combined, the consequent analysis calculations indicated that attention and materials were the most common consequent environmental events. Results from the conditional probability method suggested that Hannah's problem behavior was maintained by attention, materials, or both.

For Hannah's conditional and background probability data analysis, when comparing the probability of problem behavior given environmental events to the background probability of problem behavior, positive contingencies were observed between no attention and problem behavior and between no materials and problem behavior. However, the differences between the conditional probabilities of environmental events and the background probability of problem behavior were small. When comparing the probability of environmental events given problem behavior to the background probability of environmental events, changes in environmental events never followed problem behavior, indicating no differentially higher probability of environmental events following problem behavior. The outcomes of the conditional and background probability method suggest that Hannah's problem behavior may be maintained by attention, materials, automatic reinforcement, or some combination.

Figure 7 depicts the outcomes of Charlie's descriptive analyses. For the ABC descriptive analysis, the proportion of problem behavior preceded by environmental events was highest for no attention, indicating that no attention was the most common antecedent environmental event. The proportion of problem behavior followed by environmental events was highest for no demand, indicating that no demand was the most common consequent environmental event. Results from the ABC data analysis method suggested that Charlie's problem behavior was maintained by attention, escape, or automatic reinforcement, or some combination.

For the conditional probability method for Charlie, the proportion of problem behavior preceded by environmental events and the proportion of environmental events that preceded problem behavior was highest for no attention, indicating that no attention was the most common antecedent environmental event. However, for the proportion of environmental events that preceded problem behavior, the difference between the most common antecedent environmental event and the other environmental events was small. The proportion of problem behavior followed by environmental events was highest for no demand, and the proportion of environmental events preceded by problem behavior was highest for materials, indicating that the most common consequent environmental events were no demand and materials. Results from the conditional probability method suggest that Charlie's problem behavior was maintained by attention, escape, materials, or some combination.

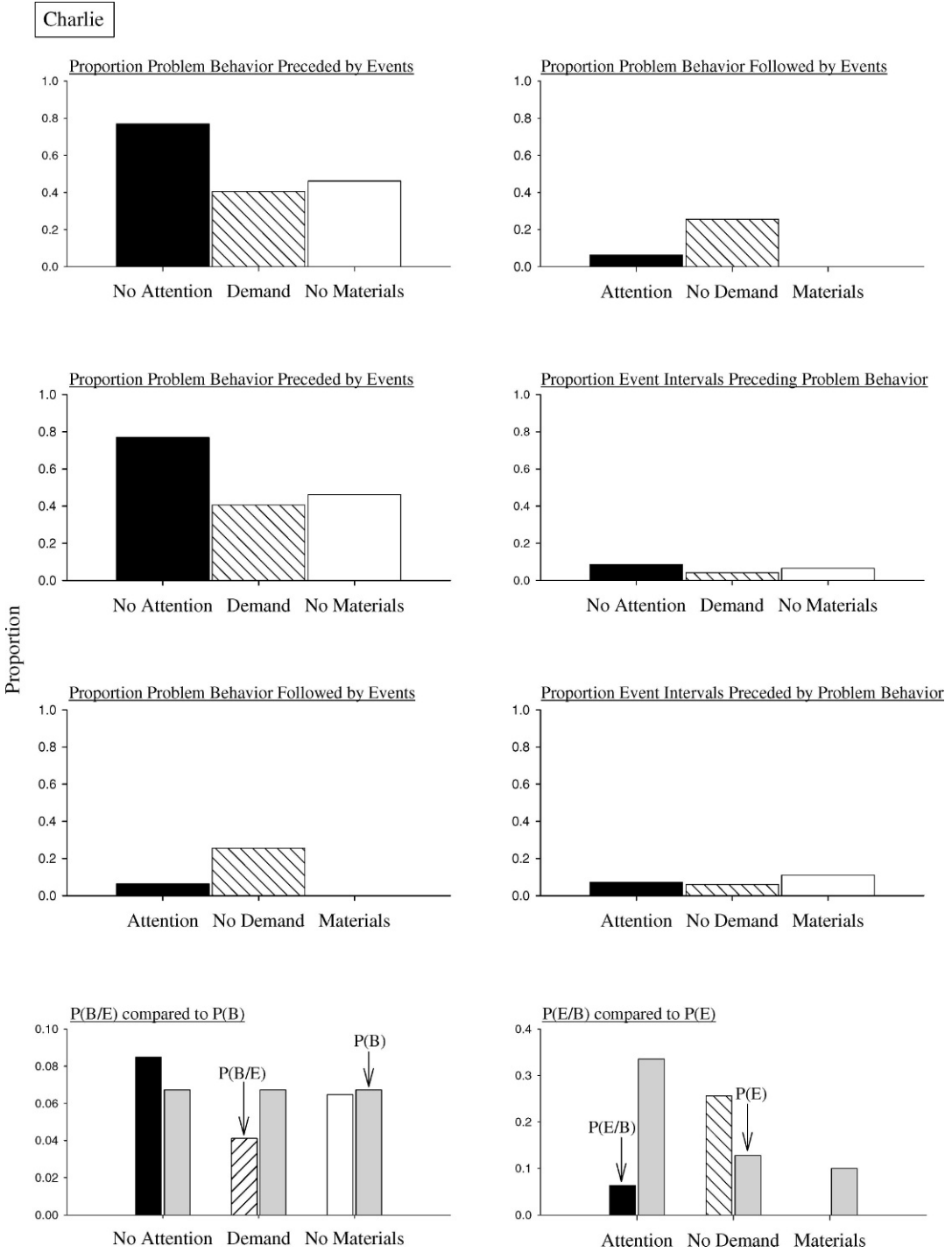For Charlie's conditional and background probability data analysis, when comparing the

Figure 7. ABC method outcomes (top), conditional probability outcomes (second and third panels), and conditional and background probability outcomes (bottom) for Charlie.

Table 1
Summary of Descriptive Analysis and Functional Analysis Outcomes

Assessment	Gina	Casey	Jake	Larry	Hannah	Charlie
ABC antecedent	No materials	Demand, no materials	Demand	No attention	No attention	No attention
ABC consequence	Attention	No change	Attention	Attention	Attention	No demand
ABC interpretation	Attention, materials	Escape, materials	Attention, escape	Attention	Attention	Attention, escape, automatic reinforcement
Conditional antecedent	No materials	Demand, no materials	Demand, no materials	No attention	No attention	No attention
Conditional consequence	Attention	No change	Attention, materials	Attention	Attention, materials	No demand, materials
Conditional interpretation	Attention, materials	Escape, materials	Attention, escape, materials	Attention	Attention, materials	Attention, escape, materials
Conditional and background antecedent	No attention, no materials	Demand, no materials	Demand, no materials	No attention	No attention, no materials	No attention
Conditional and background consequence	Attention	No change	Attention	No change	No change	No demand
Conditional and background interpretation	Attention, materials	Escape, materials	Attention, escape, materials	Attention, automatic reinforcement	Attention, materials, automatic reinforcement	Attention, escape, automatic reinforcement
Functional analysis	Escape	Escape	Attention	Attention	Automatic reinforcement	Automatic reinforcement

probability of problem behavior given environmental events, a positive contingency was observed between no attention and problem behavior. However, the difference between the conditional and background probabilities was small. When comparing the probability of environmental events given problem behavior to the background probability of environmental events, a positive contingency was observed between problem behavior and no demand. The outcomes of the conditional and background probability method suggest that Charlie's problem behavior was maintained by attention, escape, automatic reinforcement, or some combination.

Table 1 summarizes the extent to which the antecedent, consequence, or both descriptive analysis outcomes were or were not consistent with functional analysis outcomes for each participant.

DISCUSSION

The outcomes of three types of descriptive analysis (ABC, conditional probability, and conditional and background probability) were compared to determine the extent to which consistent outcomes would be obtained across methods and between each method and results from a functional analysis. For 5 of 6 participants, similar outcomes were obtained across the three descriptive analysis methods. For 1 of those (Casey), identical outcomes were obtained across descriptive analysis methods. For the 4 others (Gina, Jake, Larry, and Charlie), similar outcomes were obtained. For Gina, an additional antecedent environmental event relation was identified with the conditional and background probability method. For Jake, an additional antecedent environmental event relation was identified with the conditional probability and conditional and background probability methods, and an additional consequent environmental event relation was identified with the conditional probability method. For Larry, a consequent environmental event relation identified with the ABC and conditional probability methods was not identified with the conditional and background

probability method. For Charlie, a consequent environmental event relation identified with the conditional probability method was not identified with the ABC and conditional and background probability methods. For the remaining participant, Hannah, one additional consequent environmental event relation was identified during the conditional probability method, and one additional antecedent environmental event relation was identified during the conditional and background probability method. In addition, the consequent environmental event relations identified during the ABC and conditional probability methods were not identified during the conditional and background probability method.

A main finding of the current study was that descriptive analysis outcomes did not match those of the functional analyses. For 1 participant (Gina), all descriptive analyses yielded outcomes that were entirely inconsistent with those of the functional analysis. For 4 participants (Casey, Jake, Hannah, and Charlie), descriptive analyses yielded outcomes that were partially inconsistent with those of the functional analysis. For only 1 participant (Larry), descriptive analysis findings matched those of the functional analysis for two of the descriptive analysis methods (i.e., the ABC and conditional probability method, but not the conditional and background probability method). This is inconsistent with Lerman and Iwata (1993), in that the descriptive analysis did not match the functional analysis for automatically reinforced problem behavior. In addition, the current findings replicate previous research showing that attention is often delivered as a consequence for problem behavior (McKerchar & Thompson, 2004; Thompson & Iwata, 2001) and that descriptive analyses often falsely suggest attention as a potential maintaining variable (St. Peter et al., 2005; Thompson & Iwata, 2007). In the current study, for 4 of the 6 participants, attention was identified as a common consequent environmental event by at least two descriptive analysis methods. For 2 of the 4 participants, identification of attention was inconsistent with their functional analysis outcomes (i.e., 1 participant exhibited problem behavior maintained by escape, and 1 participant exhibited problem behavior maintained by automatic reinforcement).

Because descriptive analysis is still being used to identify the operant function of problem behavior, one of the purposes of this study was to determine the degree to which descriptive analysis outcomes matched functional analysis outcomes. In this study, the descriptive analysis methods generally did not yield the same outcome as the functional analysis in terms of identifying operant function. This finding reiterates the assertion that descriptive analysis should not be used as a replacement for functional analysis. However, the results of the descriptive analyses do suggest that such methods can be used to identify current contingencies between problem behavior and the environment. The clinical implication is that if reinforcers are identified via functional analysis, the descriptive analysis can be used as a snapshot of the environment to evaluate whether existing contingencies are therapeutic. For Gina and Casey, whose problem behavior was maintained by escape based on the results of their functional analyses, the contingencies in effect in the natural environment were therapeutic (i.e., the probability of escape given problem behavior was lower than the background probability of escape). For Jake and Larry, given that their functional analyses identified attention as positive reinforcement for their problem behavior, the contingency in the natural environment was not therapeutic for Jake (attention was more likely given problem behavior than it was unconditionally) but was for Larry (attention was less likely given problem behavior than it was unconditionally). For Hannah and Charlie, whose problem behavior was maintained by automatic reinforcement, the conditional and background

probability method showed that escape or no consequence was more likely to occur following problem behavior. These findings indicate that the clinical environment may be therapeutic because the environment is set up to protect against inadvertent social reinforcement for automatically reinforced problem behavior. That is, social positive and negative consequences (for Hannah) and social negative consequences (for Charlie) were less likely following problem behavior, reducing the likelihood that attention, escape, and materials can reinforce problem behavior.

A noteworthy feature of this study was that we examined the antecedent and consequent environmental events separately for each descriptive analysis method. Examining the data in this manner allowed a comparison of the predictive validity of descriptive analyses when only antecedents or only consequences were used as part of the analysis. Conducting antecedent-based descriptive analyses may be useful for clinicians and care providers who work in settings with consistent programming that allows little fluctuation in behavioral consequences. When we compared outcomes of antecedent-only and consequence-only portions of descriptive analyses to outcomes of the functional analysis, results showed different interpretations across antecedent and consequence portions of descriptive analyses, both within and across participants. For example, partial matches between descriptive analyses and functional analyses were observed for 5 of the 6 participants. For Casey, an antecedent-only evaluation yielded more consistent outcomes with a functional analysis, whereas for Jake, a consequence-only evaluation was more consistent. Because it was not possible to predict the portion of the descriptive analysis that was more likely to correspond to the functional analysis, our findings suggest that descriptive analysis of antecedents or consequences alone may not be useful.

In summary, the two main findings of the current study were that although descriptive analyses often yielded similar information when compared across methods, they did not match the results of functional analyses. Thus, descriptive analyses should not be used to identify the operant function of problem behavior. However, descriptive analysis can be used to evaluate current contingencies in the environment to determine whether existing contingencies are clinically therapeutic. Descriptive methods could be similarly useful in other contexts. For example, it may be helpful to evaluate whether the contingencies present in hospitals, day-care settings, college campuses, and corporate settings are likely to support problematic or appropriate behavior, given the outcome of a functional analysis.

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