

*CLASSROOM APPLICATION OF A TRIAL-BASED
FUNCTIONAL ANALYSIS*

SARAH E. BLOOM

UTAH STATE UNIVERSITY

BRIAN A. IWATA

UNIVERSITY OF FLORIDA

JENNIFER N. FRITZ

UNIVERSITY OF HOUSTON–CLEAR LAKE

AND

EILEEN M. ROSCOE AND ABBEY B. CARREAU

NEW ENGLAND CENTER FOR CHILDREN

We evaluated a trial-based approach to conducting functional analyses in classroom settings. Ten students referred for problem behavior were exposed to a series of assessment trials, which were interspersed among classroom activities throughout the day. Results of these trial-based functional analyses were compared to those of more traditional functional analyses. Outcomes of both assessments showed correspondence in 6 of the 10 cases and partial correspondence in a 7th case. Results of the standard functional analysis suggested reasons for obtained differences in 2 cases of noncorrespondence, which were verified when portions of the trial-based functional analyses were modified and repeated. These results indicate that a trial-based functional analysis may be a viable assessment method when resources needed to conduct a standard functional analysis are unavailable. Implications for classroom-based assessment methodologies and future directions for research are discussed.

Key words: functional analysis, trial-based assessment, classroom

Functional analysis procedures such as those described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994) have been replicated many times and are considered the standard in the field (Mace, 1994). A functional analysis involves systematic manipulation of antecedent and consequent events to identify contingencies that maintain problem behavior. They typically are conducted under controlled conditions to eliminate extraneous sources of influence. Once the function of a behavior is identified,

individualized treatments can be developed based on elimination of establishing operations (EOs), extinction, or differential reinforcement (Carr, Coriary, & Dozier, 2000; Iwata, Pace, et al., 1994).

Some potential limitations of the methodology have been noted, however. The typical FA involves repeated exposure to a series of conditions presented in 10- to 15-min sessions, which may be impractical when assessment time is limited. A solution to this problem has been the development of abbreviated procedures, most notably, the brief functional analysis (Northrup et al., 1991), which involves only one or two exposures to 5-min sessions. Although the brief functional analysis yields interpretable results only about half the time (Derby et al., 1992), it represents a clear

This research was supported in part by a grant from the Florida Agency on Persons with Disabilities. We thank Carrie Dempsey, Jennifer Hammond, and Griffin Rooker for their assistance in conducting the study.

Address correspondence to Sarah E. Bloom, Utah State University, 2865 Old Main Hill, Logan, Utah 84322 (e-mail: sarah.bloom@usu.edu).

doi: 10.1901/jaba.2011.44-19

improvement over informal interviews and may be the only way to obtain controlled data in outpatient clinics or during consultation.

Another potential limitation of functional analysis involves exposure to conditions that may occasion problem behavior, thereby posing additional risk (Repp, 1994; Smith & Churchill, 2002). Although this risk is no greater than that already posed by the problem behavior and is offset by the benefits of treatment derived from them (Hanley, Iwata, & McCord, 2003), attempts to minimize risk are nevertheless beneficial. Two alternative procedures have been suggested for addressing this problem. One involves conducting a functional analysis of less severe precursor behaviors that reliably precede the target behavior, which may reduce the frequency of the target response (Herscovitch, Roscoe, Libby, Bourret, & Ahearn, 2009; Najdowski, Wallace, Ellsworth, MacAleese, & Cleveland, 2008; Smith & Churchill, 2002). Another alternative is based on the use of latency rather than frequency, which limits the occurrence of the target behavior to a maximum of one per session (Thomason-Sassi, Iwata, Neidert, & Roscoe, 2011).

A third potential limitation of functional analysis and the one addressed in this study is that the assessment typically is conducted under specialized environmental conditions that may be unavailable in some service settings (Ervin *et al.*, 2001; Sterling-Turner, Robinson, & Wilczynski, 2001). This raises the question of whether functional analyses can be conducted under naturalistic conditions. McCord, Thompson, and Iwata (2001) conducted a series of transition trials (probes) throughout the day in settings commonly occupied by two subjects who engaged in self-injurious behavior (SIB) and examined the percentage of trials in which SIB occurred as a function of different types of transitions. Similar extensions of functional analysis methodology were described by Wacker, Berg, Derby, Asmus, and Healey (1998), who conducted the analyses in subjects'

homes, and by Wright-Gallo, Higbee, Reagon, and Davey (2006) who conducted the analyses in subjects' classrooms. Wallace and Knights (2003) described another variation in naturalistic settings by alternating between 1-min test and control sessions in a pairwise fashion in a vocational training context. Directly relevant to this study is a report by Sigafoos and Sagers (1995), who conducted trial-based functional analyses in a classroom setting. Their procedure consisted of a series of probes embedded into ongoing classroom activities, which were spread across 5 days. Each trial consisted of a 1-min segment during which an EO and contingency for problem behavior were present (test), followed by a 1-min segment during which the reinforcer was available continuously (control). Segments were terminated if and when problem behavior occurred. For example, tasks were presented during the first minute of a demand trial and were terminated if problem behavior occurred, whereas no tasks were presented during the second minute. Results showed that the problem behavior exhibited by two students was maintained by social-positive reinforcement. These findings are very encouraging but should be interpreted with caution. First, because the study was conducted with only two subjects who exhibited the same target behavior with a similar function, additional replications are needed. Second, results obtained from the trial-based assessment were not compared with those from a more complete functional analysis.

The procedures described by Sigafoos and Sagers (1995) warrant further examination because of their potential to extend functional analysis methodology to classroom settings, thus allowing consultants or teachers to conduct them under more naturalistic conditions. The assessment can be conducted a few minutes each day, eliminating the need to set aside longer periods or to make arrangements for the supervision of other students during the analysis. Other than a data sheet and a timer,

Table 1
Subject Information

| Subject | Gender | Age | Diagnosis | Level of intellectual disability | Target behavior |
|---------|--------|-----|---------------------------|----------------------------------|------------------------------------|
| Allen | male | 13 | autism | mild | aggression |
| Bo | male | 8 | autism | severe | aggression |
| Ryan | male | 13 | autism | moderate | aggression |
| Liv | female | 10 | Down syndrome | moderate | aggression |
| Amanda | female | 18 | autism | profound | self-injury |
| Ethan | male | 14 | autism | severe | bizarre vocalizations |
| Sammy | male | 6 | hearing impairment | mild | aggression |
| Brandon | male | 16 | speech and language delay | moderate | aggression, inappropriate touching |
| Jonas | male | 9 | autism | mild | aggression |
| Conrad | male | 12 | autism | mild | aggression |

no materials are required other than those already present in a typical classroom. The purpose of this study was to evaluate a variation of the procedures described by Sigafoos and Sagers by comparing results obtained from a trial-based functional analysis with those obtained from a more typical session-based analysis.

METHOD

Subjects, Setting, and Experimental Sequence

Ten individuals who had been referred for assessment and treatment of problem behavior participated. They ranged in age from 6 to 18 years, represented a variety of diagnoses, and exhibited varied problem behavior (see Table 1 for details).

Sessions were conducted in one of two schools for children with developmental disabilities. Trial-based functional analyses were conducted in each student's regular classroom across 4 to 6 days. Eight to 16 trials were conducted per day for a total of 20 trials per condition. Standard functional analyses were conducted in a session room two to five times per day, 3 to 5 days per week over 3 to 7 days.

The trial-based functional analysis was conducted prior to the standard functional analysis. This sequence was used to eliminate prior exposure to session contingencies in a standard analysis, which may have biased results in favor

of the trial-based analysis. By contrast, the trial-based analysis consisted of far fewer exposures to session contingencies, thus minimizing concerns about carryover effects from the trial-based to the standard analysis, which were commenced within several days to 2 weeks following the trial-based functional analyses.

Response Definition and Reliability

Observers recorded data on problem behaviors exhibited by subjects, as well as on antecedent and consequent events delivered by therapists, during each trial or session. The trial-based functional analysis was divided into 2-min segments, during which an observer recorded the presence or absence of problem behavior as well as the latency from the start of the trial segment to the occurrence of a response (the latency measures were included in secondary data analyses). The standard analysis consisted of 10-min sessions, during which an observer recorded the frequency of problem behavior.

An independent observer collected data during at least 32% of all trials ($M = 45\%$) and 21% of all sessions ($M = 35\%$). The independent observer also collected latency data. Reliability for the trial-based functional analysis sessions was determined by dividing the number of trials in which both observers recorded either the presence or absence of target behavior in each segment by the total number

of segments. Mean reliability for all trial-based data was 99.9% (range, 96% to 100%). Reliability for the trial-based latency data was calculated by dividing the number of trials on which both observers agreed on the second in which problem behavior occurred (within a 2-s window) by the total number of trials on which latency data were collected. Mean reliability for trial-based latency data was 93% (range, 78% to 100%). Reliability for the standard analysis data was calculated by partitioning the session into 10-s intervals, dividing the smaller number of recorded responses in each interval by the larger, and averaging these fractions across the total number of intervals. Mean reliability for all standard analysis data was 94% (range, 76% to 100%).

Trial-Based Functional Analyses

Although all trials were conducted in students' classrooms, graduate students rather than teachers served as therapists to ensure a high degree of procedural consistency. Opportunities to conduct trials presented themselves naturally throughout the day. For example, tangible and attention trials were conducted during free-play periods, whereas demand trials were conducted during instructional periods. All subjects were exposed to attention and demand trials, but only those for whom a tangible function was suspected (Alan, Bo, Amanda, Sammy, Brandon, and Conrad, based on teacher report or prior observation) were exposed to tangible trials. Subjects whose target behavior consisted of aggression were not exposed to ignore trials (because aggression requires the presence of another person, it was unlikely to be maintained by automatic reinforcement). Liv was an exception; ignore trials were conducted to determine whether she would approach others to exhibit aggression.

Because the Sigafoos and Sagers (1995) procedure involved a minimal amount of data collection per trial (single occurrences during 1-min test and 1-min control segments and no test for automatic reinforcement), a lack of

correspondence between results of the trial-based and standard functional analyses could be attributed simply to inadequate sampling. To reduce this likelihood, we made several modifications to the trial-based procedure.

First, the order of the test and control segments was the reverse of that used by Sigafoos and Sagers (1995) to avoid the possibility of carryover from the test (EO present) segment to the control (EO absent) segment. The inclusion of a third (control) segment both replicated the order used by Sigafoos and Sagers and provided a comparison with the first segment in determining which order (control–test or test–control) was preferable. Second, each trial was divided into three 2-min segments rather than two 1-min segments. During the first segment (control), the putative EO was absent (i.e., the reinforcer was freely available), and problem behavior produced no consequences. During the second segment (test), the EO was present, and problem behavior produced a specified consequence. The third segment (control) was a repetition of the first segment. As in the Sigafoos and Sagers study, the occurrence of problem behavior during any segment terminated that segment (except during ignore trials); also, problem behavior did not delay the onset of subsequent segments, even if it occurred in bursts. Our third modification to the trial-based procedure involved the inclusion of ignore trials as a test for problem behavior maintained by automatic reinforcement.

Attention. During the first and third segments (control), the therapist was seated with the subject, and a moderately preferred leisure item was available (one already present in the classroom). The therapist delivered attention throughout the segment. At the end of the first segment, the therapist initiated the second segment (test) by stating that she “had to do some work” and turning away from the subject. If the subject engaged in problem behavior, the therapist turned toward the subject, issued a

statement of concern, and delivered brief and gentle physical contact. If the subject left the seat at any time during the trial, the therapist followed the subject to maintain physical proximity but did not interact with the subject in doing so. If the subject's activities after leaving the seat interfered with any aspect of the trial (e.g., the subject interacted with a peer or classroom staff person during the test segment), the trial was considered failed and was so noted on the data sheet. That trial was conducted at a later time so that 20 completed trials of each type were included in data analysis.

Tangible. During the first and third segments (control), the therapist was seated with the subject, who was playing with a preferred leisure item (one already available in the classroom). Problem behavior produced no consequences. At the beginning of the second segment (test), the therapist removed the item from the subject's possession and kept it out of reach for 2 min. If problem behavior occurred, the therapist gave the item back to the subject immediately. If the subject left the seat at any time during the trial, the therapist followed him or her to maintain physical proximity but did not interact with the subject in doing so; however, attempts to interact with other toys in the classroom were blocked during the test segments of tangible trials. If the subject's activities after leaving the seat interfered with any aspect of the trial contingencies (e.g., another staff person handed the subject a preferred toy during the test segment), a failed trial was recorded on the data sheet, and the trial was conducted at a later time.

Demand. During the first and third segments (control), the subject was seated without access to leisure or task materials. The therapist was close enough to the subject to be a potential target for aggression (if that was the target problem behavior) but faced away from him or her. Problem behavior produced no consequences. At the beginning of the second segment (test), the therapist initiated instruc-

tional trials using a three-step prompting sequence (verbal prompt, modeled prompt, and physical prompt). If the subject engaged in problem behavior, the therapist terminated the segment and said, "Okay, you don't have to work." If the subject attempted to leave the seat during the test segment, the therapist blocked the attempt and continued the prompting sequence. The subject was not prevented from leaving the work area during the control segment, but if the subject's activities after leaving the seated area interfered with any aspect of the trial (i.e., another staff person placed a demand on the subject), a failed trial was recorded on the data sheet, and the trial was conducted at a later time.

Ignore. Instead of three alternating test and control segments, ignore trials consisted of three consecutive 2-min test segments in which the subject was seated alone, without access to leisure or task materials. Problem behavior produced no consequences and did not terminate that segment of the trial. The subject was permitted to leave the seat, but if the subject's activities interfered with any aspect of the trial (e.g., the subject interacted with a toy or someone spoke to him or her), a failed trial was recorded on the data sheet, and the trial was conducted at a later time.

Standard Functional Analyses

Subjects were exposed to a series of conditions based on those described by Iwata et al. (1982/1994), which were arranged in a multielement design. Differential responding was not observed during Jonas's multielement functional analysis, so a pairwise analysis was conducted in which each test condition was alternated singly with the control condition (Iwata, Duncan, Zarcone, Lerman, & Shore, 1994). Sessions continued until higher rates of responding were observed in one or more test conditions, and data were analyzed by comparing frequencies of problem behavior across conditions.

Prior to the standard functional analysis, a paired-stimulus preference assessment (Fisher et

al., 1992) was conducted to identify moderately preferred items to include in the attention condition and highly preferred items to include in the play and tangible conditions. Items that were used in the trial-based analysis (or similar items if we could not use the actual items from the child's classroom) were included in the paired-stimulus preference assessment.

Attention. The therapist was seated with the subject, who had access to moderately preferred leisure items. The therapist stated that she had "work to do" and turned away from the subject. If the subject engaged in the target behavior, the therapist issued a statement of concern and delivered brief and gentle physical contact.

Tangible. The therapist removed leisure materials from the subject at the beginning of the session. Attention (brief verbal statements) was delivered at least once every 30 s. Problem behavior resulted in 30-s access to the leisure materials.

Demand. The therapist was seated with the subject and initiated trials to complete academic tasks. Prompts were delivered in a three-step hierarchy (verbal, gestural, physical) with no more than 5 s between each prompt. Compliance resulted in brief praise. If the subject engaged in the target behavior, the therapist removed the work materials, issued a statement that the subject "didn't have to work," and then turned away from the subject for 30 s.

Alone or ignore. The subject was seated alone without materials. No consequences were delivered for the occurrence of target behaviors.

Play. The subject had continuous access to a preferred leisure item, and the therapist made friendly social comments at least once every 30 s. If the subject spoke to the therapist or played with the leisure items with the therapist, the therapist responded in kind. No consequences were delivered for target behaviors.

Data Analysis and Outcome Comparisons

Individual graphs of each functional analysis (with all identifying information removed) were shown separately to a team of 10 doctoral

students in behavior analysis who were not blind to the purpose of the study (four of them were involved in data collection for the study). Consensus was reached on the function depicted by data in each graph. These interpretations were used as the basis for determining correspondence or lack thereof between results of the two assessments.

Following completion of the trial-based functional analysis, data were analyzed by comparing the percentage of control and test segments in which problem behavior occurred for each condition. Secondary analyses were conducted on portions of the data to evaluate changes that we made to the original procedures used by Sigafoos and Sagers (1995). These involved comparing the test segment to the first or second control segment of each trial, deleting the second minute of each trial segment, and deleting all of the ignore trials (if applicable). Based on these secondary analyses, we noted that more aggression was observed in the second control segment of certain trials for five subjects (Ryan, Ethan, Sammy Brandon, and Jonas), suggesting a possible carryover effect from the test segment. As a result, we deleted the second control segment of the trial-based functional analyses as unnecessary and present data from only the first control segment and the test segment. Data also were analyzed based on the latency to problem behavior under each condition; these data did not reveal any additional differences and are not reported.

RESULTS

Figure 1 displays data for the six subjects whose results showed correspondence between the two assessments. During Allen's trial-based functional analysis, aggression occurred most often during his tangible-test trials. Although some aggression occurred during the test and control segments of his demand trials, it was observed during very few demand trials overall. During his standard functional analysis, aggression occurred only during the tangible condi-

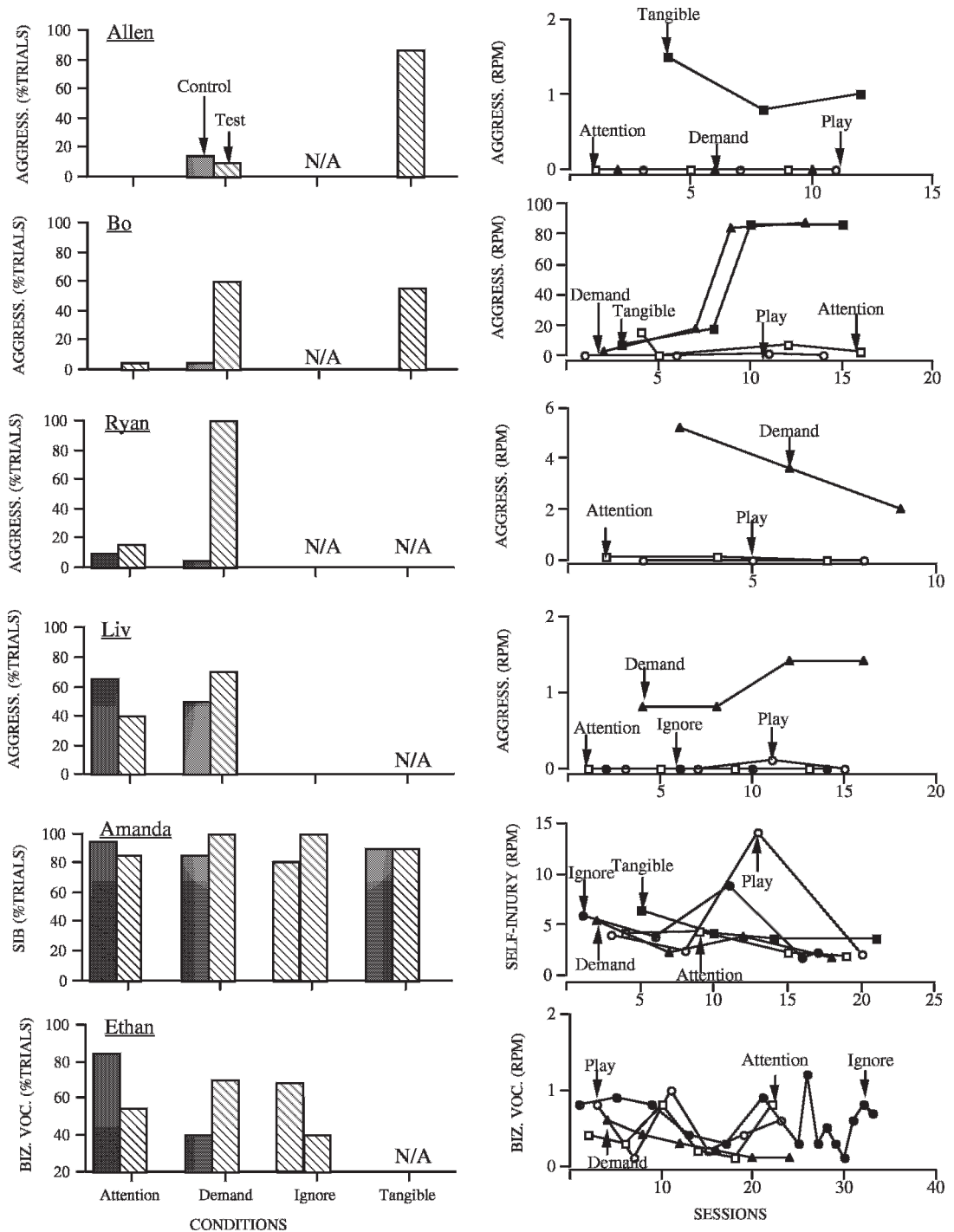


Figure 1. Results of trial-based (left) and standard (right) functional analyses for subjects whose assessment results showed correspondence.

tion. Thus, data from both assessments indicated that his aggression was maintained by access to social-positive (tangible) reinforcement.

During Bo's trial-based functional analysis, aggression occurred during a large proportion of his demand and tangible test trials. These results were similar to those of his standard analysis, in which high rates of aggression occurred during both the demand and tangible conditions.

Results of Ryan's trial-based functional analysis indicated that his aggression occurred during a large proportion of demand test trials. During his standard analysis, aggression occurred only in the demand condition.

During Liv's trial-based functional analysis, aggression occurred during both demand and attention trials; different patterns were observed, however. In the demand trials, aggression occurred more often during test relative to control segments, suggesting that aggression was maintained by social-negative reinforcement. The opposite was observed during attention trials: More aggression occurred during control relative to test segments. Although control segments are not designed as tests for any function, the control segments of attention trials involve continuous delivery of attention, which might serve as an EO for problem behavior maintained by escape from social interaction. Thus, frequent occurrences of problem behavior during test segments of demand trials, combined with frequent occurrences during control segments of attention trials, are suggestive of a social avoidance function. Although we did not directly examine a social-avoidance function, we did conduct ignore trials with Liv and observed no aggression in the presence of others who did not initiate any interaction with her. Thus, results of her trial-based functional analysis suggested an escape function, which was consistent with results of her standard analysis, in which aggression occurred almost exclusively in the demand condition.

Amanda's SIB and Ethan's bizarre vocalizations showed similar patterns during both assessments. That is, problem behavior occurred across all conditions of their trial-based functional analyses and across all conditions of their standard functional analyses. These results suggested that Amanda's SIB and Ethan's vocalizations were not differentially sensitive to social contingencies and instead were maintained by automatic reinforcement.

Figure 2 displays data for the four subjects whose trial-based and standard functional analyses showed a lack of correspondence. Results of Sammy's trial-based analysis indicated that his aggression was maintained by social-positive reinforcement (access to attention and tangible items). He also engaged in aggression during the attention and tangible conditions of the standard analysis; however, aggression occurred during the demand condition of the standard analysis, indicating that his problem behavior was maintained by social-negative as well as social-positive reinforcement. Thus, Sammy's trial-based and standard functional analyses showed partial correspondence. Although there was agreement for the social-positive reinforcement function, his trial-based analysis missed the social-negative reinforcement function. It is interesting to note that aggression occurred during a few test segments of his demand trials, although it was so low relative to that during his attention and tangible trials that it seemed insignificant. It is possible that Sammy's demand trials did not serve as an effective EO for problem behavior maintained by escape because the trials were too brief or because his exposure to the contingency was limited to once per trial. The latter possibility is supported by the low rates of aggression observed in the first session of his standard functional analysis.

Brandon's aggression occurred most often during the test segments of the attention trials of his trial-based functional analysis. A slight increase in aggression also was observed during

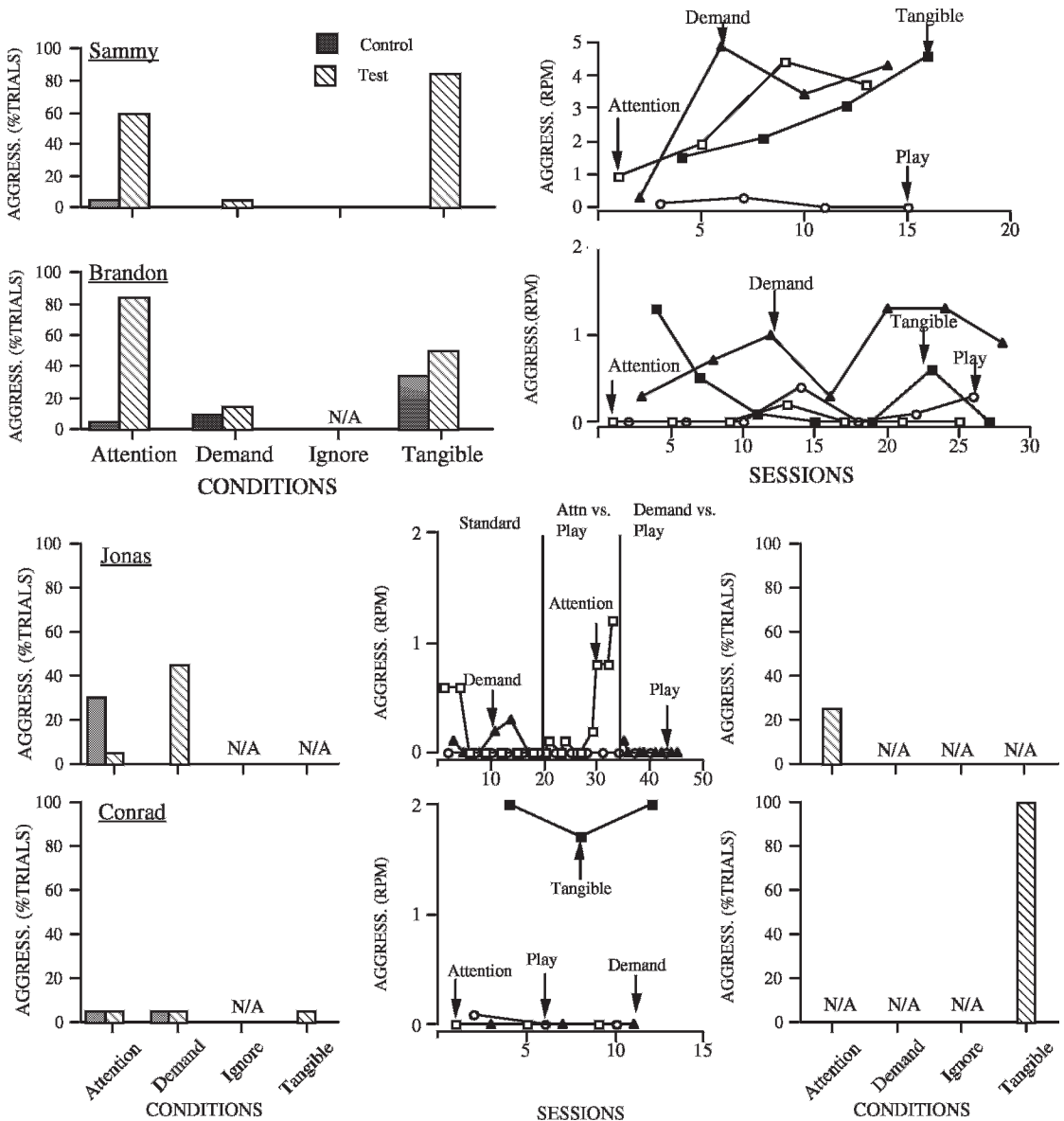


Figure 2. Results of trial-based and standard functional analyses for subjects whose assessment results showed partial correspondence, a lack of correspondence, or an initial lack of correspondence followed by a modified trial-based analysis that showed correspondence. The top two panels show the trial-based and standard functional analyses on the right and left, respectively. The bottom two panels show results for those subjects for whom a second trial-based analysis was conducted (the left panel shows the results of the first trial-based analysis, the center panel shows the results of the standard analysis, and the right panel shows the results of the modified trial-based analysis).

test trials relative to control trials of his tangible condition, but the difference was not large enough to suggest a tangible function. During his standard analysis, aggression occurred most often during the demand condition, indicating

maintenance by social-negative reinforcement. Aggression also occurred during initial sessions of his tangible condition, but it was not maintained over the course of his assessment. Thus, results of his trial-based analysis suggested

a social-positive reinforcement function, whereas those of his standard analysis indicated a social-negative reinforcement function. As was the case with Sammy, it is possible that the limited nature of the trial-based analysis did not allow detection of an escape function. It also is possible that some features of demand presentation in the classroom were insufficient to serve as EOs during Brandon's demand trials or that qualitative differences between leisure items used in tangible conditions of his trial-based and standard functional analyses accounted for the lack of correspondence. We observed the types of demands and leisure items used in Brandon's trial-based analysis and included identical demands and similar leisure items in his standard analysis. Thus, the exact reasons for lack of correspondence between the two functional analyses cannot be determined.

Jonas's aggression occurred most often in the test segment of the demand trials of his trial-based functional analysis, suggesting maintenance by social-negative reinforcement. His standard functional analysis, initially conducted in a multielement design, showed inconsistent responding in both the attention and demand conditions, but results of a subsequent pairwise design showed that aggression emerged and was maintained only in the attention condition, indicating maintenance by social-positive reinforcement. The initial ambiguity in his standard analysis suggested that lack of exposure to the contingencies during relatively brief trials may have resulted in unclear results in his trial-based analysis. To explore this possibility further, we again conducted his attention trials in the classroom with one change. Instead of using 2-min test and control segments, we lengthened the test segments to 5 min and shortened the control segments to 1 min to increase his exposure to test contingencies without increasing overall trial length significantly. Under this arrangement, his problem behavior occurred only during the test segments. Thus, although it is unclear why

aggression increased during the demand condition of his initial trial-based analysis, it appears that the absence of aggression during his attention trials was a function of the trial length. We did not reexamine the demand trials in his trial-based analysis because, based on the outcome of the standard (multielement and pairwise) analysis, we assumed that initial responding during the demand condition of his trial-based analysis was a false-positive finding.

Finally, little or no aggression occurred during any condition of Conrad's trial-based functional analysis. By contrast, aggression occurred almost exclusively in the tangible condition of his standard analysis, indicating that his aggression was maintained by social-positive (tangible) reinforcement. The absence of aggression during his trial-based analysis may have been due to the fact that his teacher had implemented a differential reinforcement of other behavior contingency for the absence of problem behavior in her classroom. When we reconducted 12 tangible trials when his teacher was absent, aggression occurred during 100% of the test segments and none of control segments. Thus, the absence of aggression in his initial trial-based analysis seemed to have been the result of stimulus control exerted by the presence of his classroom teacher.

Table 2 summarizes results of all trial-based and standard functional analyses. Correspondence between outcomes of the two assessments was observed for six of 10 subjects (Allen, Bo, Ryan, Liv, Amanda, and Ethan), and partial correspondence was observed for one subject (Sammy). A lack of correspondence was observed for the remaining three subjects (Brandon, Jonas, and Conrad). However, when modified trials were conducted with Jonas and Conrad, correspondence was observed between the trial-based and standard functional analyses.

When data were reanalyzed using the procedures as described originally by Sigafos and Sagers (1995), correspondence decreased

Table 2
Summary of Results Obtained from Trial-Based and Standard Functional Analyses

| Subject | Trial based | Standard | Match | Modified TBFA ^a match | Sigafoos and Sagers (1995) match |
|---------|------------------|------------------|---------|----------------------------------|----------------------------------|
| Allen | tangible | tangible | yes | | yes |
| Bo | tangible, escape | tangible, escape | yes | | yes |
| Ryan | escape | escape | yes | | yes |
| Liv | escape | escape | yes | | yes |
| Amanda | automatic | automatic | yes | | no |
| Ethan | automatic | automatic | yes | | no |
| Sammy | attention | attention | partial | | partial |
| | tangible | tangible | | | |
| | | escape | | | |
| Brandon | attention | escape | no | | no |
| Jonas | escape | attention | no | yes, attention | no |
| Conrad | none | tangible | no | yes, tangible | no |

^a Trial-based functional analysis.

from six of 10 subjects to four of 10 subjects. This was not due to reversing the sequence of test and control segments or changing the length of the trial segments. The only change made to the Sigafoos and Sagers procedures that affected the correspondence rate was the addition of the test for automatic reinforcement.

DISCUSSION

We compared results obtained from trial-based functional analyses conducted in subjects' classrooms to those obtained from session-based functional analyses conducted under more typical controlled conditions. In spite of the fact that the trial-based functional analyses were implemented during a variety of ongoing classroom activities, results matched those of the regular functional analyses analyses in 60% of the cases. These findings suggest that the trial-based format may be a viable assessment method when resources required to conduct a standard analysis are unavailable. Alternatively, the procedure might be considered a first attempt at conducting functional analyses in school settings, followed by more extensive analyses as needed for individuals whose results are unclear. The varied situations commonly found in classrooms throughout the course of a day present a number of opportunities to embed trials within work, leisure, or solitary

activities. And although our initial trials consisted of 6-min segments (2-min control, 2-min test, 2-min control), results of our supplemental data analysis suggested that 4-min segments (2-min control, 2-min test) would suffice. The control-test sequence may be slightly superior to the test-control sequence because the former arrangement is less likely to produce a carryover of problem behavior from one segment to the next.

Results of the present study also indicated that the trial-based functional analysis is not a replacement for the standard functional analysis. The brief duration of test trials seemed to account for at least two and perhaps three of the correspondence failures and may have resulted from either (a) limited exposure to EOs during 2-min trials or (b) limited exposure to relevant consequences, which were delivered only once per trial. By contrast, a standard analysis allows lengthier exposure to EOs as well as repeated exposure to both EOs and consequences during 10- or 15-min sessions. Thus, the trial-based functional analysis relies more heavily on immediate control by antecedent events than does the standard analysis. This raises the possibility that standard sessions of 10-min duration conducted in the classroom would have resulted in a higher degree of correspondence with the standard functional analyses. We did not conduct this specific comparison for

two reasons: (a) Repeated 10-min sessions seemed impractical in most classroom settings, and (b) the trial-based approach described by Sigafoos and Sagers (1995) seemed like an attractive alternative.

Contingencies present in the classroom seemed to account for another observed correspondence failure. When trial-based functional analyses are conducted in classroom settings, it may be necessary to suspend temporarily ongoing interventions that might suppress problem behavior across assessment conditions. Conrad's results suggested that the mere presence of the teacher might have resulted in the absence of problem behavior during his trial-based assessment.

Although the trial-based functional analysis offered the advantage of being conducted in the classroom, it did not result in a shorter assessment. Not counting time spent waiting for appropriate opportunities to conduct trials, the mean total durations of the trial-based and standard functional analyses were 4 hr 31 min and 3 hr 53 min, respectively. It should be noted that, if problem behavior is not observed early in the trial segments, and if all four test conditions are used, the trial-based functional analysis can take up to 5 hr (assuming that only one control segment is included). Thus, the principal benefit of the trial-based functional analysis derives from the fact that each trial can be conducted briefly, thereby minimizing disruptions to classroom routine. Overall efficiency, however, does not appear to be an advantage of the trial-based procedure. It is possible that fewer than 20 trials could be conducted, reducing duration accordingly but perhaps at the expense of precision. For example, we compared data for the first 10 trials from the trial-based functional analyses with those from the standard functional analyses and observed a lack of correspondence for two of our six matched cases.

Another feature of the trial-based functional analysis that should be emphasized is the

contiguous (back-to-back) scheduling of control and test segments. Because standard functional analyses are conducted under relatively constant environmental conditions (aside from test-specific contingencies), there is no reason to believe that responding under a test condition would differ from responding under a control condition merely as a function of time. The trial-based procedure, by contrast, is embedded in a larger context of ongoing classroom activities that can vary dramatically over the course of a day and sometimes within minutes preceding or following a trial. Because it would be very difficult to recreate the general environmental conditions surrounding a test segment merely to conduct a control segment at a different time, background variability is held relatively constant by conducting control and test segments contiguously. Background variability across trial types (e.g., attention vs. demand) also may influence assessment results; however, it did not seem to account for the lack of correspondence between outcomes of the trial-based and standard functional analyses in this study.

Finally, the trial-based functional analysis may require the presence of someone who is able to identify appropriate conditions for initiating trials and to determine when trials have been compromised by the actions of others. During this study, trials occasionally had to be stopped and repeated later because other students or staff interrupted a trial by delivering attention in ignore segments or by issuing demands in escape segments. Due to these problems, we had to reconduct a mean of seven (up to 13) trials per subject.

Given the encouraging results obtained in this study, further refinements of the trial-based functional analysis might be considered. For example, longer test segments than control segments (e.g., a 1-min control followed by a 3-min test) might improve accuracy through lengthier exposure to potential EOs. Alternatively, the brief durations of the trials might be offset through the use of salient discriminative

stimuli associated with each test and control condition (Conners et al., 2000). Trial-based functional analyses also may be improved by conducting preference assessments to identify items for use in the attention, play, and tangible conditions. Finally, because behavior analysts conducted the classroom-based assessments, future research might examine the conditions under which teachers can conduct trial-based functional analyses independently.

REFERENCES

- Carr, J. E., Coriaty, S., & Dozier, C. L. (2000). Current issues in the function-based treatment of aberrant behavior in individuals with developmental disabilities. In A. Austin & J. E. Carr (Eds.), *Handbook of applied behavior analysis* (pp. 91–112). Reno: Context Press.
- Conners, J., Iwata, B. A., Kahng, S., Hanley, G. P., Worsdell, A. S., & Thompson, R. H. (2000). Differential responding in the presence and absence of discriminative stimuli during multielement functional analyses. *Journal of Applied Behavior Analysis*, 33, 299–308.
- Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northup, J., Cigrand, K., et al. (1992). Brief functional assessment techniques to evaluate aberrant behavior in an outpatient setting: A summary of 79 cases. *Journal of Applied Behavior Analysis*, 25, 713–721.
- Ervin, R. A., Radford, P. M., Bertsch, K., Piper, A. L., Ehrhardt, K. E., & Poling, A. (2001). A descriptive analysis and critique of the empirical literature on school-based functional assessment. *School Psychology Review*, 30, 193–210.
- Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis*, 25, 491–498.
- Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis*, 36, 147–185.
- Herscovitch, B., Roscoe, E. M., Libby, M. E., Bourret, J. C., & Ahearn, W. H. (2009). A procedure for identifying precursors to problem behavior. *Journal of Applied Behavior Analysis*, 42, 697–702.
- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1982/1994). Towards a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, 27, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities*, 2, 3–20, 1982)
- Iwata, B. A., Duncan, B. A., Zarcone, J. R., Lerman, D. C., & Shore, B. A. (1994). A sequential, test-control methodology for conducting functional analyses of self-injurious behavior. *Behavior Modification*, 18, 289–306.
- Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., et al. (1994). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis*, 27, 215–240.
- Mace, F. C. (1994). The significance and future of functional analysis methodologies. *Journal of Applied Behavior Analysis*, 27, 385–392.
- McCord, B. E., Thomson, R. J., & Iwata, B. A. (2001). Functional analysis and treatment of self-injury associated with transition. *Journal of Applied Behavior Analysis*, 34, 195–210.
- Najdowski, A. C., Wallace, M. D., Ellsworth, C. L., MacAleese, A. N., & Cleveland, J. M. (2008). Functional analyses and treatment of precursor behavior. *Journal of Applied Behavior Analysis*, 41, 97–105.
- Northup, J., Wacker, D., Sasso, G., Steege, M., Cigrand, K., Cook, J., et al. (1991). A brief functional analysis of aggressive and alternative behavior in an outclinic setting. *Journal of Applied Behavior Analysis*, 24, 509–522.
- Repp, A. C. (1994). Comments on functional analysis procedures for school-based behavior problems. *Journal of Applied Behavior Analysis*, 27, 409–411.
- Sigafoos, J., & Sagers, E. (1995). A discrete-trial approach to the functional analysis of aggressive behavior in two boys with autism. *Australia & New Zealand Journal of Developmental Disabilities*, 20, 287–297.
- Smith, R. G., & Churchill, R. M. (2002). Identification of environmental determinants of behavior disorders through functional analysis of precursor behaviors. *Journal of Applied Behavior Analysis*, 35, 125–136.
- Sterling-Turner, H. E., Robinson, S. L., & Wilczynski, S. M. (2001). Functional assessment of distracting and disruptive behaviors in the school setting. *School Psychology Review*, 30, 211–226.
- Thomason-Sassi, J. L., Iwata, B. A., Neidert, P. L., & Roscoe, E. M. (2011). Response latency as an index of response strength during functional analyses of problem behavior. *Journal of Applied Behavior Analysis*, 44, 51–67.
- Wacker, D., Berg, W., Derby, K., Asmus, J., & Healey, A. (1998). Evaluation and long-term treatment of aberrant behavior displayed by young children with disabilities. *Journal of Developmental and Behavioral Pediatrics*, 19, 260–266.
- Wallace, M. D., & Knights, D. J. (2003). An evaluation of a brief functional analysis format within a vocational setting. *Journal of Applied Behavior Analysis*, 36, 125–128.
- Wright-Gallo, G. L., Higbee, T. S., Reagon, K. A., & Davey, B. J. (2006). Classroom-based functional analysis and intervention for students with emotional/behavioral disorders. *Education and Treatment of Children*, 29, 421–436.

Received October 31, 2008

Final acceptance May 23, 2010

Action Editor, Jennifer Zarcone