The Use of Additional Analyses to Clarify the Functions of Problem Behavior

BY

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Abstract

Functional analysis methodology has proven useful for identifying environmental contingencies that influence problem behavior. Extensions of traditional functional analysis methodology have shown that problem behavior may only occur in specific contexts or be influenced by multiple or idiosyncratic sources of reinforcement. When these contexts or sources of influence are not assessed in a functional analysis (FA), further assessment may be necessary to identify the specific antecedents and consequences that influence behavior. In the current study, initial FA results identified a specific source(s) of reinforcement for the problem behavior of two preschool children. Function-based treatments were implemented to increase appropriate behavior and decrease problem behavior; however, treatment did not result in clinically-significant reductions in problem behavior in all cases. Additional within-session analyses and experimental analyses were used to clarify the functions of problem behavior, and modified function-based treatments were used to decrease problem behavior and increase appropriate behavior. Finally, these treatments were taught to the classroom teachers to implement throughout the day.

The Use of Additional Analyses to Clarify the Functions of Problem Behavior

Functional analysis methodology (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) involves the manipulation of environmental antecedents and consequences (that commonly occur in the natural environment) to identify the variables that maintain the occurrence of a particular problem behavior. Common functions of problem behavior tested in functional analysis include social positive reinforcement (e.g., attention or access to tangible items), social negative reinforcement (i.e., escape from aversive events such as task demands), and automatic reinforcement (e.g., sensory stimulation).

Functional analyses are often effective in determining the function of problem behavior and for prescribing an effective function-based treatment (Arndorfer & Miltenberger, 1993; Hanley et al., 2003; Iwata et al., 1994; Kurtz et al., 2003; Neef & Iwata, 1994; Wacker et al., 1994). Iwata et al. conducted an epidemiological analysis of the functions of self-injurious behavior (SIB) for 152 children with developmental disabilities. The authors determined functions for 95.4% of the subjects, with the most common function being negative reinforcement in the form of escape from task demands. In addition, treatments based on these functional analyses were effective at reducing the levels of SIB to low levels. Kurtz et al. (2003) conducted functional analyses of problem behavior of 27 young children (10 months – 5 years of age) and determined functions for 87.5% of the subjects, with the most common function being positive reinforcement in the form of attention from therapists. In addition, treatments based on these functional analyses resulted in a reduction of SIB from 77%-100%. Hanley et al. conducted a literature review of 277 studies that included functional analyses. In these studies, 95.9% of functional analyses produced differentiated outcomes. That is, a vast majority of the functional analyses showed a clear function for problem behavior. Although these results

suggest that a majority of published functional analyses are successful in identifying the function of problem behavior, the authors suggested that the contingencies for publication may promote a higher level of positive findings in the literature, and these data may not be representative of the actual success rates of functional analyses.

Although functional analyses are often successful in determining the variables influencing problem behavior, there are certain situations in which functional analyses may not produce clear results (Kuhn, DeLeon, Fisher, & Wilke, 1999; Vollmer, Marcus, Ringdahl, & Roane, 1995). Functional analyses may yield unclear results when behavior is undifferentiated across conditions (Smith, Iwata, Vollmer, & Zarcone, 1993; Conners et al., 2000) or behavior occurs at low or zero rates during the functional analysis (Call, Wacker, Ringdahl, & Boelter, 2005; Carr, Yarbrough, & Langdon, 1997; Kahng, Abt, & Schonbachler, 2001). In addition, it is possible that clear functional analysis results may produce a false positive or false negative with respect to the function(s) of problem behavior, possibly resulting in the implementation of treatments that are less than optimally effective. In the case of unclear functional analysis results or less than optimally effective function-based intervention, additional assessments and/or experimental analyses may be warranted to clarify the function of problem behavior.

There are several possible explanations for unclear functional analysis results due to undifferentiated responding (i.e., elevated levels of problem behavior across all or several functional analysis conditions) that should be considered for analysis. That is, problem behavior across several conditions might suggest (a) maintenance by automatic reinforcement, (b) discrimination difficulties or interaction effects (associated with the use of the multielement design), or (c) maintenance of problem behavior by multiple sources of reinforcement (i.e.,

multiple control). Thus, research has shown that additional analyses may be conducted to clarify functional analyses when undifferentiated responding occurs.

Several studies have shown that undifferentiated functional analysis results may be due to maintenance of problem behavior by multiple reinforcers (i.e., multiple control; Day, Horner, & O'Neill, 1994; Neidert, Iwata, & Dozier, 2005; Smith, Iwata, Vollmer, & Zarcone, 1993). For example, problem behavior might be maintained by social positive and social negative reinforcement (Day et al., 1994; Neidert et al., 2005), social positive and automatic reinforcement (Piazza et al., 1998), or social negative and automatic reinforcement (Kennedy, Meyer, Knowles, & Shukla, 2000). Kennedy et al. used functional analyses to determine the function of stereotypy for five subjects with autism. For all subjects, results were undifferentiated between at least two conditions suggesting that it is possible that problem behavior was maintained by multiple reinforcers. Using a multiple baseline across functions design, the authors implemented functional communication training (FCT) across each context in which problem behavior occurred during the functional analysis. The effectiveness of FCT for reducing problem behavior within each context verified the results of the functional analysis (i.e., problem behavior was multiply controlled).

Functional analyses may be unclear if problem behavior occurs at low or zero rates across all functional analysis conditions. Recently, several procedures have been identified for possibly increasing the occurrence of problem behavior during functional analyses (for the purpose of determining the function of the problem behavior). These methods include (a) increasing session duration (Kahng, Abt, & Schonbachler, 2001), (b) enhancing common establishing operations and consequences (Call et al., 2005; Tiger, Fisher, Toussaint, Kodak, 2009; Rolider, Iwata, Camp, & Fritz, 2007), (c) assessing the effects of additional establishing

operations such as illness or sleep deprivation (O'Reilly, 1995; 1997), and (d) testing for idiosyncratic variables (Carr et al., 1997; Vollmer, Iwata, Smith, and Rodgers, 1992). For example, function analyses may be inconclusive if problem behaviors are influenced by or maintained by idiosyncratic stimuli (or contexts) that are not manipulated in the functional analysis. Carr et al. used descriptive analyses to determine idiosyncratic antecedent stimulus variables that may influence problem behavior in the natural environment. The authors then conducted functional analysis conditions with the antecedent stimuli present and absent. Higher levels of problem behavior for all three participants were observed when specific idiosyncratic stimuli were present during functional analysis conditions. The authors formed four heuristic guidelines for investigating idiosyncratic variables. First, the authors suggested investigating these variables when verbal report of caregivers does not match the results of the functional analysis. Second, idiosyncratic variables should be considered when functional analysis conditions yield different results across different settings. Third, idiosyncratic variables should be investigated when the level of problem behavior during functional analyses varies across days. Fourth, an examination of within-session patterns of responding may be necessary to clarify the functional analysis results when idiosyncratic variables are suspected to influence the results.

Few studies have investigated the possibility of false positives or false negatives with respect to functional analysis results (Kuhn et al., 1999; Shirley, Iwata, Smith, & Kahng, 1999; Vollmer et al., 1992). A false-positive result would be indicated when functional analysis results suggest a particular function that is not an actual function of the problem behavior (i.e., the problem behavior is not maintained by that variable in the natural environment). A false-negative result would be indicated when functional analysis results do not suggest a particular

function that is an actual function of the problem behavior. Both false-positive and false-negative results would suggest an incorrect (or at least incomplete) function of the problem behavior, thereby resulting in less than optimal treatment effects. For example, if a treatment is implemented based on the outcome of a function analysis that does not result in a significant decrease in problem behavior, then the functional analysis may have provided a false-negative result.

A few studies have suggested methodologies to identify false positives and false negatives in functional analyses. Kuhn et al. (1999) conducted a functional analysis of an adult's SIB and found that his problem behavior was maintained by automatic reinforcement and negative reinforcement. The experimenters used a multielement design to compare treatments involving sensory extinction (helmet use) and escape extinction. Only sensory extinction was effective in reducing problem behavior to clinically significant levels. The authors suggested that the functional analysis yielded false-positive results (escape) and suggested that using treatment analyses to clarify ambiguous functional analysis results may be more efficient than conducting extended functional analyses.

Shirley et al. (1999) conducted a functional analysis of hand mouthing and found that problem behavior was maintained by social positive reinforcement (in the form of tangible items) and automatic reinforcement. The authors conducted a descriptive analysis in the subject's home and found that (a) the most common consequence for hand mouthing was ignoring the behavior and (b) the only tangible item delivered for problem behavior was a towel. In addition, subsequent functional analyses showed that access to the towel did not function as a reinforcer. The authors concluded that although the behavior may have been sensitive to tangible items as a reinforcer, access to tangible items did not maintain the problem behavior in

the home environment. Therefore, these data suggest that the functional analysis may have produced a false positive. The authors suggested the use of descriptive assessments as a possible supplement to functional analyses in order to clarify functional analysis results.

Vollmer et al. (1992) conducted a standard functional analysis with one subject. The results of this functional analysis showed low levels of problem behavior across all conditions, but slightly higher levels in some of the demand sessions. In an attempt to further clarify the results of the functional analysis, data from interviews were used to create additional assessments. Interview results suggested that problem behavior occurred during self-help tasks. Additional information suggested that the most common consequence for problem behavior was physical prompting to complete the task. Therefore, a modified demand condition was used to assess whether problem behavior was maintained by escape from self-care tasks. Results of this analysis showed that problem behavior decreased in this condition. However, when a self-care condition was implemented in which problem behavior resulted in a simulated struggle (physical attention) with the therapist, problem behavior occurred at high levels. In summary, the initial functional analysis did not suggest that problem behavior was maintained by attention; however, additional analyses suggested that problem behavior was maintained by attention, but only in the context of demands. Therefore, the initial functional analysis produced a false negative in that the results suggested that problem behavior was not maintained by attention.

The results of these studies suggest that various procedures may be used to determine whether false-positive or false-negative functions are shown in a functional analysis. First, function-based treatments can be used to determine which functions identified in the functional analysis maintain problem behavior (Kuhn et al., 1999). Second, descriptive analyses and interviews may be used to determine specific environmental events that occur in the natural

environment (Shirley et al., 1999; Vollmer et al., 1992). Third, additional experimental manipulations may be used to further clarify the function of problem behavior and determine if outcomes indicate false-positive and false-negative functions (Vollmer et al.).

In the current study, two preschool children were referred for the assessment and treatment of problem behavior. Following initial functional analyses, treatments based on these analyses did not produce clinically-significant changes in problem behavior in all cases. As suggested by Carr et al. (1997) and Vollmer et al. (1995), we conducted within-session analyses to derive hypotheses that could then be experimentally evaluated. We conducted additional experimental analyses to clarify the functions of problem behavior. Treatments based on the initial functional analyses and the additional analyses were implemented to verify the results. Finally, these treatments were successfully transferred to the preschool classroom teachers.

Method

Participants and Setting

Participants were two children enrolled in a university-based preschool classroom who were referred for the assessment and treatment of problem behavior (i.e., aggression and property destruction). Both children were able to follow multi-step instructions and communicate using vocal speech. Andrew was a typically-developing, 4-year-old boy. Samantha was a 4-year-old girl diagnosed with Fetal Alcohol Syndrome.

Sessions were conducted 3 to 5 days per week, 2-5 times per day in a preschool classroom or session room. During sessions in the classroom, teachers and peers were present. Graduate student therapists conducted all functional analysis, initial treatment, additional experimental analysis, and some combined treatment sessions. Classroom teachers were taught

to implement the combined treatment in the classroom. Specific items were available during all sessions to ensure equal opportunity to engage in property destruction.

Response Measurement and Interobserver Agreement

The dependent variables were instances of problem behavior (aggression and property destruction) and appropriate behavior (mands for the relevant reinforcer and compliance). Aggression was defined as any motion of the subject's limb or grasped object that forcefully contacted another person (including attempts within 3 in.). Property destruction was defined as any forceful motion of the subject's limb that resulted in an object moving more than 1 ft from the point of contact or any forceful motion of a limb or grasped object that came into contact with another object. Mands were defined as vocal requests for the relevant reinforcer (specific to each condition). Compliance was defined as following a therapist's request after a vocal or model prompt during a three-step prompting sequence.

Data were recorded by trained observers on palm pilots. Data were collected on the frequency of aggression, property destruction, and mands; these data were converted to responses per minute. Data were also collected on the frequency of compliance and the number of demands; these data were converted to a percentage by dividing the frequency of compliance by the frequency of demands. To determine interobserver agreement, a second independent observer collected data during 31% and 30% of all sessions for Andrew and Samantha, respectively. Interobserver agreement coefficients were calculated by dividing the session time into 10-s intervals and comparing observer data on an interval-by-interval basis. If exact agreement occurred, that is, both observers scored the same number within a 10-s interval, a score of 1 was given for that interval. For any disagreements, the smaller score in each interval

was divided by the larger. The interval scores were summed, divided by the total number of observation intervals, and multiplied by 100%.

During the functional and additional analyses for Andrew, mean interobserver agreement for problem behavior and compliance was 94.4% (range, 95%-100%) and 91.4% (range, 78%-100%), respectively. During the treatment evaluation for Andrew, mean interobserver agreement for problem behavior, mands, and compliance was 98.7% (range, 94%-100%), 93.4% (range, 85%-100%), and 95.6% (range, 93%-100%), respectively. During the functional and additional analyses for Samantha, mean interobserver agreement for problem behavior and compliance was 96.3% (range, 88%-100%) and 90.2% (range, 75%-97%), respectively. During the treatment evaluation for Samantha, mean interobserver agreement for problem behavior, mands, and compliance was 97.6% (range, 80%-100%), 96.2% (range, 87%-100%), and 94.3% (range, 89%-100%), respectively.

General Procedures

For each child, we first conducted a functional analysis to determine the variables maintaining problem behavior. Next, we used the results of the functional analysis to create a function-based intervention for the purpose of reducing problem behavior and increasing an appropriate replacement behavior (i.e., differential reinforcement of alternative behavior; DRA). Data from this initial treatment evaluation suggested that the function-based treatments were ineffective for reducing problem behavior to clinically-significant levels in some cases. Therefore, we conducted additional analyses for the purpose of clarifying the function of problem behavior. Direct observation of treatment sessions suggested that in some conditions, the children were engaging in problem behavior when the relevant establishing operation (EO) was absent (EO off) and when the EO was present (EO on). Therefore, we calculated the

percentage of problem behavior that occurred during EO-on and EO-off periods during these relevant sessions. The results of this analysis confirmed this hypothesis and allowed us to derive further hypotheses that problem behavior during the EO-off period was occurring either to gain access to other reinforcers (i.e., attention) or to avoid representation of the EO (i.e., the aversive event). To test (or rule out) the former, we conducted additional experimental analyses to determine whether problem behavior was occurring during the EO-off period to access attention as a reinforcer. Results of this analysis suggested that both children were continuing to engage in problem behavior during EO off to access attention as a reinforcer. The information from our functional analysis, initial treatment, and additional analysis was used to create a combined treatment. Finally, this treatment was taught to the classroom teachers to implement throughout the day in the classroom.

Functional Analysis

We conducted functional analyses similar to those conducted by Iwata et al. (1982/1994). Five conditions (ignore, attention, play, escape, and tangible) were presented (see condition descriptions below). Discriminative stimuli (colored shirts) were used to enhance discrimination between conditions. Sessions were 10 min in length. Andrew's functional analysis was conducted in a session room, and Samantha's functional analysis was conducted in the classroom. Multielement (Andrew and Samantha) and reversal (Andrew) designs were used to demonstrate experimental control.

Ignore. During ignore sessions, no attention was provided to the subject regardless of his or her behavior. The purpose of the ignore condition is to test for problem behavior maintained by automatic reinforcement.

Attention. During attention sessions, attention was withheld throughout the session unless the subject engaged in the target problem behavior. Contingent on problem behavior, the therapist provided brief (3-5 s) reprimands (e.g., “stop doing that” or “it’s not nice to hit”). The purpose of the attention condition is to test for problem behavior maintained by social positive reinforcement in the form of attention.

.**Play.** During play sessions, the subject was given continuous attention and access to preferred toys. In addition, no demands were delivered. The purpose of the play condition is to serve as a control condition to which levels of problem behavior in other conditions is compared.

Escape. During escape sessions, demands were delivered continuously using a three-step graduated guidance procedure (vocal prompt, model prompt, physical prompt), and brief praise was provided for compliance. Contingent on the target problem behavior, demands and task materials were removed, and the subject was allowed 30 s of escape from demands. After 30s, the demands resumed. The purpose of the escape condition is to test for problem behavior maintained by social negative reinforcement in the form of escape from demands.

Tangible. Prior to the start of tangible sessions, the subject was provided access to preferred toys for 2 min. At the start of the session, the therapist restricted access to all tangible items. Contingent on target problem behavior, the subject was given the restricted items for 30 s. Following the 30-s access period, the items were again removed. The purpose of the tangible condition is to test for problem behavior maintained by social positive reinforcement in the form of access to tangible items.

Initial Treatment

Initial treatments were based on the function of problem behavior as determined by the functional analysis. Treatment was differential reinforcement of alternative behavior (DRA) plus

extinction (EXT). That is, children were taught an alternative communicative response (mand) to access the relevant reinforcer, and problem behavior no longer resulted in the relevant reinforcer. Prior to the start of each treatment session, we provided the children with rules regarding the contingencies for problem behavior and mands. For example, prior to sessions involving treatment for escape-maintained problem behavior, the therapist told the child, "If you ask for a break, I will give you a break; if you hit me or throw things, we will keep working"). During the initial phases of treatment, children were prompted every 30 s to mand; however, this prompt was quickly faded when the participant began engaging in independent mands. Sessions were 10 min in length and conducted in the classroom. Based on the results of the functional analysis, a treatment was implemented for problem behavior maintained by escape (ESC) for Andrew, and three treatments were implemented for problem behavior maintained by attention (ATTN), escape (ESC), and tangibles (TANG) for Samantha. Reversal (Andrew and Samantha) and multiple-baseline-across-functions (Samantha) designs were used to demonstrate experimental control.

Baseline. The baseline condition for Andrew was identical to the escape condition of his functional analysis. The baseline conditions for Samantha were identical to the attention, escape, and tangible conditions of her functional analysis.

DRA + EXT (ATTN). The DRA + EXT (ATTN) condition was implemented with Samantha and was similar to her attention baseline condition, except that contingent on vocal mands for attention (i.e., "play with me" or "talk to me"), the therapist provided brief (5 s) vocal and physical attention to the child. In addition, problem behavior no longer resulted in therapist attention (EXT).

DRA + EXT (ESC). The DRA + EXT (ESC) condition was implemented with both Andrew and Samantha and was similar to the escape baseline condition, except that contingent on vocal mands for escape (i.e., "break, please"), the therapist removed demand materials and turned away from the child for 30 s. After 30 s had elapsed, the therapist again presented demands. In addition, problem behavior no longer resulted in escape (EXT).

DRA + EXT (TANG). The DRA + EXT (TANG) condition was implemented with Samantha and was similar to the tangible baseline condition, except that contingent on vocal mands for tangible items (i.e., "toys, please"), the therapist provided 30-s access to the items. After 30 s had elapsed, the therapist again removed the items from the subject. In addition, problem behavior no longer resulted in access to tangible items (EXT).

Additional Analysis

Some initial treatments were ineffective in decreasing target problem behavior to clinically-significant levels (DRA + EXT [ESC)] for Andrew; DRA + EXT [TANG] for Samantha). During these treatment conditions, direct observation suggested that target problem behaviors were primarily occurring during the period of time when the relevant establishing operation was absent (the escape period for Andrew; the tangible-access period for Samantha). Therefore, we conducted within-session analyses to determine the percentage of problem behavior occurring during periods in which the EO was present (EO on) or absent (EO off). The results of this analysis suggested that the majority of problem behavior was occurring during the EO-off period. Based on these results, we hypothesized that the target problem behavior during the EO-off period was occurring to either avoid the EO-on period (representation of demands for Andrew; removal of tangible items for Samantha) or to access attention. To test these hypotheses, we designed additional analyses. For example, for Andrew we conducted sessions

in which demands were represented contingent on target problem behavior during the EO-off period, which allowed us to test for attention as a reinforcer. In addition, a control procedure for attention consisted of non-contingent attention during the EO-off period. Sessions were 10 min in length and were conducted in the classroom. A pairwise (test vs. control) design was used to demonstrate experimental control.

DRA + EXT (ESC) +CA (Andrew). Following initial treatment with Andrew, this condition was conducted to assess additional contingencies that might be maintaining problem behavior. This condition was identical to the DRA + EXT (ESC) condition, except that during the escape interval, if the subject engaged in problem behavior, demands were immediately represented.

DRA + EXT (ESC) + NCA (Andrew). This condition was used as a control condition for the DRA + EXT (CA) condition. This condition was identical to the DRA + EXT (ESC) condition, except that during the escape interval, the therapist provided continuous vocal and physical attention.

DRA + EXT (TANG) + CA (Samantha). Following initial treatment with Samantha, this condition was conducted to assess additional contingencies that might be maintaining problem behavior. This condition was identical to the DRA + EXT (TANG) condition, except that during the tangible-access interval, when the subject engaged in problem behavior, brief reprimands were immediately presented.

DRA + EXT (TANG) +NCA (Samantha). This condition was used as a control condition for the DRA + EXT (TANG) + CA condition. This condition was identical to the DRA + EXT (TANG) condition, except that during the tangible-access interval, the therapist provided continuous attention.

Final Treatment

Given the information from the initial functional analyses and the additional analyses, we created treatments to treat all of the functions of problem behavior that were determined for each subject. In addition, tokens were used to increase compliance with demands, enhance discrimination, and aid in the thinning of reinforcement schedules. First, a therapist implemented the interventions until low rates of problem behavior, moderate rates of mands, and high levels of compliance were maintained. Next, we trained the classroom teachers to implement the treatment throughout the day. Following this, 10-min observations were conducted throughout the school day to assess the effectiveness of the treatment as implemented by the teachers.

At the start of each session, rules about the contingencies for problem behavior and mands were stated to the subjects. Sessions (or observation periods) were 10 min in length. A reversal design was used to demonstrate experimental control (Samantha only).

DRA + EXT (ESC + ATTN). This condition was conducted with Andrew and involved several interventions to decrease problem behavior, maintain mands, and increase compliance during instructional situations. Prior to the start of this phase, Andrew was shown the token board and given rules regarding earning tokens (e.g., “You will get a token when you do what we ask you to do. Once you have 10 tokens, you will be able to have a special prize that you can share with friends”). During sessions, the therapist (or teacher) presented demands intermittently. Problem behavior did not result in a break from demands (EXT), and mands for a break resulted in a 30-s break from task demands (DRA). In addition, attention was provided noncontingently throughout the session (i.e., at least once every 3 min). Furthermore, compliance resulted in the delivery of a token, and an instance of problem behavior resulted in a

removal of a token. Once Andrew had earned 10 tokens, he was given a longer break (5 min) and an opportunity to exchange his tokens for access to quality attention (i.e., one-on-one attention with the therapist and a preferred peer and access to preferred items and activities). Once treatment effects were observed, the schedule for token delivery was thinned. That is, Andrew was required to comply with more demands to earn each token. Throughout the phase, the schedule was thinned from an fixed-ratio 1 (FR1) to a variable-ratio 5 (VR5) schedule of reinforcement for compliance. Starting at session 51, teachers began implementing the intervention throughout the day in the classroom.

DRA + EXT (ESC + ATTN + TANG). This condition was conducted with Samantha and involved several interventions to decrease problem behavior, maintain mands, and increase compliance during instructional situations. Prior to the start of this phase, Samantha was shown the token board and rules regarding earning tokens were described (e.g., "You will get a token when you do what we ask you to do. Once you have 10 tokens, you will be able to have a special prize and be able to play with me"). During sessions, the therapist (or teacher) presented demands intermittently. Problem behavior did not result in a break from demands (EXT), and mands for a break resulted in a 30-s break from task demands (DRA). In addition, mands for attention resulted in brief (3-5 s) delivery of attention (DRA), and mands for tangible items resulted in access to those tangible items (DRA) at any point in time during the session. Furthermore, compliance resulted in the delivery of a token, and an instance of problem behavior resulted in a removal of a token. Once Samantha had earned 10 tokens, she was given a longer break (5 min) and an opportunity to exchange her tokens for access to quality attention and tangible items (i.e., one-on-one attention with the therapist and access to preferred items and activities she could pull from a treasure box). Once treatment effects were observed, the

schedule for token delivery was thinned from an FR1 to an FR5 schedule. Starting at session 48, teachers began implementing the intervention throughout the day in the classroom.

Results

Functional analysis results for Andrew and Samantha are depicted in Figure 1. The initial multielement functional analysis results for Andrew (top panel) showed low levels across all conditions; however, when problem behavior did occur, it was in the escape condition. Because these results were somewhat unclear, we conducted a sequential pairwise multielement design to possibly enhance discrimination between conditions (Vollmer et al., 1995). During this phase, there were high levels of problem behavior in the demand condition as compared to the play condition. During the evaluations of positive reinforcement in the form of attention and tangible items respectively, problem behavior maintained at low, undifferentiated levels. The results of Andrew's functional analysis indicated that his problem behavior was maintained by escape from task demands.

The functional analysis for Samantha (bottom panel) showed initially variable levels of problem behavior across all conditions with little differentiation. However, over time, we began to see increasing trends in problem behavior in the attention, escape, and tangible conditions. The higher levels of problem behavior in these conditions as compared to the play condition indicated that her problem behavior was maintained by multiple functions, specifically access to therapist attention, escape from task demands, and access to tangible items.

Insert Figure 1 here

Initial treatment, additional analysis, and final treatment data for Andrew are depicted in Figure 2. During the initial baseline phase, we saw high levels of problem behavior and low levels of compliance. Next, we implemented DRA + EXT (ESC) in order to reduce problem behavior and increase appropriate mands for escape. Following the implementation of DRA + EXT (ESC), we initially saw a reduction in problem behavior to near zero levels, an increase in compliance to near 100%, and an increase in mands for escape to moderate levels (mean 2 rpm). However, as we continued in this phase, problem behavior increased and maintained at moderate levels (although lower than baseline levels) and compliance decreased to levels similar to baseline. Mands continued to occur at moderate levels. During the DRA+EXT (ESC) phase, we observed that problem behavior was occurring during the escape interval (i.e., when the EO for escape was absent). Therefore, we conducted a within-session analysis to determine levels of problem behavior during situations when the EO for escape was present (EO on) or not present (EO off). Using the data streams from the sessions in the functional analysis and initial treatment, we determined the frequency of problem behavior during periods in which the EO was present and absent. We then divided each frequency by the total frequency of problem behavior in each session. Finally, we averaged the percentages across sessions in that phase. Table 1 shows the results of this analysis. During Andrew's functional analysis, we saw higher percentages of problem behavior occurring when the EO was on as compared to when the EO was off (as determined by calculating the percentage of problem behavior occurring during all escape sessions as well as during the last five escape sessions). During DRA+EXT (ESC), we saw relatively similar percentages of problem behavior occurring when the EO was on and when the EO was off. However, when we calculated the percentages during the last five sessions, we saw that the majority of Andrew's problem behavior (85.7%) occurred when the EO for escape

was off (i.e., when no demands were issued). We hypothesized that this problem behavior was occurring to access attention or to avoid representation of demands during the break interval. Therefore, we conducted an additional analysis to assess whether attention or the avoidance of demand representation was maintaining problem behavior.

The additional analysis conducted with Andrew involved comparing levels of problem behavior under DRA + EXT conditions in which attention was delivered contingent upon problem behavior during the escape interval (DRA + EXT [CA]) or noncontingently during the escape interval (DRA + EXT [NCA]). During this comparison phase, we observed high levels of problem behavior during the DRA + EXT (CA) condition and zero levels of problem behavior in the DRA + EXT (NCA) condition. In addition, Andrew continued to mand for a break during both conditions. Across both of these conditions, compliance maintained at zero levels. These results suggested that Andrew's problem behavior during the escape interval was maintained by access to therapist attention.

Following the additional analysis for Andrew, we implemented DRA + EXT (ESC + ATTN) in order to treat both functions identified in the initial functional analysis and additional analysis (escape and attention). Following implementation, we saw a decrease in problem behavior to near zero levels as well as an increase in compliance. We also saw occasional mands to escape demands. These results maintained as the schedule of reinforcement for compliance was thinned from an FR1 to an FR5 schedule. Following sustained low levels of problem behavior and high levels of compliance, Andrew's classroom teachers were trained to implement the procedures throughout the day. Problem behavior maintained at low levels, compliance maintained at moderate to high levels, and mands occurred occasionally.

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Insert Table 1 here

Insert Figure 2 here

Initial treatment and additional analysis data for Samantha are depicted in Figure 3. Following our functional analysis, we first implemented DRA + EXT (ATTN) for attention-maintained problem behavior. During baseline, we saw variable rates of problem behavior. Following the implementation of treatment, rates of problem behavior decreased to low and stable levels, and mands for attention maintained at moderate levels. We next implemented DRA + EXT (ESC) for escape-maintained problem behavior. During baseline, we saw moderate but variable levels of problem behavior and compliance. Upon implementing the treatment, problem behavior decreased to low and stable levels, and mands for escape maintained at moderate levels. Percent compliance with task demands, however, steadily decreased throughout this phase. We next implemented DRA + EXT (TANG) for problem behavior maintained by tangible reinforcement. During baseline, we saw moderate and stable levels of problem behavior. Upon implementing treatment, problem behavior did not decrease to clinically-significant levels; however, mands for tangible items maintained at moderate and stable levels. We conducted a within-session analysis to determine levels of problem behavior during situations when the EO for access to tangible items was and was not present. Table 1 shows the

results of this analysis. During Samantha's functional analysis, we saw similar percentages of problem behavior occurring when the EO was on and when the EO was off (as determined by calculating the percentage of problem behavior occurring during all tangible sessions as well as during the last five escape sessions). During DRA+EXT (TANG), we saw higher percentages of problem behavior occurring when the EO was on as compared to when the EO was off (i.e., 72.1% across all treatment sessions and 77.6% during the last five sessions). Based on these data, we hypothesized that this problem behavior was maintained by either attention or avoidance of the removal of tangible items; therefore, we conducted an additional analysis to assess other variables that may have been influencing problem behavior.

The additional analysis conducted with Samantha involved comparing levels of problem behavior under DRA + EXT (CA) and DRA + EXT (NCA) conditions. Levels of problem behavior occurred at higher levels in the DRA + EXT (CA) as compared to the DRA + EXT (NCA) condition. In addition, Samantha continued to mand for access to tangible items during both conditions. These results suggested that Samantha's problem behavior during the tangible-access interval was maintained, at least in part, by access to therapist attention.

Insert Figure 3 here

Following the additional analysis for Samantha, we implemented DRA + EXT (ESC + ATTN + TANG) in order to treat all of the functions identified in the functional analysis and additional analysis (attention, escape, and tangible). Following implementation, we saw a decrease in levels of problem behavior to near zero levels as well as an increase in compliance.

We also saw occasional mands for escape, attention, and access to tangible items. These results maintained as the schedule of reinforcement for compliance was increased from an FR1 to an FR5 schedule. We briefly reversed to baseline (FA conditions) and saw an increase in problem behavior and a decrease in mands and compliance. Upon reversal to DRA + EXT (ESC + ATTN + TANG) phase, problem behavior decreased and compliance and mands increased, even as the schedule of reinforcement for compliance increased from an FR1 to an FR5. Following sustained low levels of problem behavior and high levels of compliance, Samantha's classroom teachers were trained to implement the procedures throughout the day. Problem behavior maintained at low levels, and compliance and mands maintained at moderate to high levels.

Insert Figure 4 here

Discussion

In the current study, multiple experimental analyses were necessary to identify the functions of problem behavior for both subjects. For Samantha, the initial multielement functional analysis was effective in identifying the functions of her aggression and property destruction. For Andrew, the multielement functional analysis was unsuccessful due to low, undifferentiated rates of problem behavior. Using the suggestions of Vollmer et al. (1995), a pairwise design was used to clarify the undifferentiated results, and was successful in identifying a function for problem behavior, possibly due to enhanced discrimination between conditions. For both subjects, function-based treatments were implemented to verify the results of the

functional analyses. When treatments for some of the functions identified did not result in a clinically-significant reduction in problem behavior, within-session analyses were used to identify patterns of responding that suggested additional variables that influenced problem behavior (as suggested by Carr [1997]). This information was used to conduct additional experimental analyses, which allowed us to determine reinforcers influencing problem behavior under specific antecedent conditions (specifically instructional situations for Andrew and tangible-access situations for Samantha). Treatments based on these results were created to address all of the functions identified in the experimental analyses and to increase compliance. Finally, the treatments were successfully transferred to the teachers in the classroom environment.

This study suggests that analyses may be conducted when treatments based on the outcome of an FA are ineffective. In the current study, we first used direct observation and within-session analyses (specifically under conditions when the EO was present or absent) to obtain additional information about specific variables that might influence problem behavior when function-based treatments (created based on functional analysis results) were ineffective. We then used this information to develop additional experimental analyses to test the influence of these additional variables on problem behavior. The results (in addition to the results of other studies) suggest that although functional analyses are effective for prescribing treatment for a large number of cases, some cases are more complex, and require additional analyses to determine all of the variables relevant to the treatment of problem behavior.

For Andrew, we identified a false-negative outcome of the functional analysis. During the initial functional analyses, problem behavior did not occur at high levels in the attention condition. However, with additional analyses, we identified attention as a reinforcer for problem

behavior, but only in a demand context. Similar to Vollmer et al. (1992), additional analyses (direct observation and within-session in this case) were helpful in identifying contextual variables that may have been influencing problem behavior and allowed us to identify and successfully treat problem behavior whose function was not identified in the initial functional analysis.

For Samantha, additional analyses were conducted in order to determine if problem behavior occurring in the tangible treatment context was maintained by attention. We had previously determined that Samantha's problem behavior was maintained in part by attention in the functional analysis. When implementing treatment for each separate function, we could have used this information to control for problem behavior maintained by attention in the tangible context (such as during the DRA + EXT [TANG] + CA condition). Future researchers may want to evaluate the use of control procedures when treating problem behavior maintained by multiple functions.

There are several limitations to the current study. First, for both subjects, we conducted one functional analysis on several topographies of problem behavior (aggression and property destruction) rather than conducting separate functional analyses for each topography. It is possible that different topographies of problem behavior may have been maintained by different functions (Derby et al., 2000; Richman, Wacker, Asmus, & Casey, 1998). However, both topographies of problem behavior were observed throughout all phases of the study for both subjects, so this is less likely. Second, the tangible condition in the functional analysis is very similar to the attention condition in that attention is restricted and then delivered when tangible items are provided contingent upon problem behavior. Therefore, it is possible that Samantha's problem behavior was solely maintained by access to attention and escape from demands.

However, mands for tangible items continued to occur throughout the study suggesting that tangible items were a reinforcer. It is possible that additional manipulations to the treatment of separate functions of multiple control could be used; specifically, one could control for EOs of other reinforcers in evaluating treatments for each of the functions (e.g. noncontingent attention in the tangible condition). Third, although we showed for both participants that attention was a reinforcer during reinforcement intervals for other reinforcers, we did not rule out the possibility that problem behavior was also occurring as an avoidance response. That is, it is possible that Andrew was also engaging in problem behavior during the break interval to access attention and to avoid the representation of demands, and Samantha was engaging in problem behavior during the tangible-access interval to access attention and to avoid the removal of tangible items. To test this, we could have conducted an additional condition (similar to the DRA + EXT condition) in which the presentation of demands (Andrew) or the removal of tangible items (Samantha) was delayed or prevented contingent on problem behavior during the EO-off period. Fourth, we did not show experimental control with respect to the effects of Andrew's final treatment. He was in his last few weeks at the preschool, and we were unable to reverse prior to this transition.

The current study evaluated the use of treatments by teachers in the subjects' classrooms, and showed that problem behavior maintained at low levels and appropriate behaviors maintained at high levels. Future researchers should continue to evaluate treatments suggested by functional analysis outcomes when being implemented in socially-relevant conditions. Doing so would further extend the generality of our findings with respect to functional analyses and function-based treatments and possibly suggest methods for transferring treatments to caregivers.

Future researchers should conduct further assessments of the conditions that may influence problem behavior that may not be controlled for in standard functional analyses.

Direct observation, within-session analyses, and additional experimental analyses may be warranted if function-based treatments are ineffective. Future researchers may also attempt to develop a model for identifying idiosyncratic contingencies or contexts that may influence problem behavior prior to conducting a functional analysis. For instance, questionnaires (Vollmer, 1992) and DAs (Carr et al., 1997) could be conducted prior to functional analyses in order to determine variables to include in the functional analysis. If specific consequences regularly occur in specific contexts (e.g., attention during task demands), modified conditions could be added to the functional analysis to test for additional maintaining variables. In the current study, if we had initially conducted within-session analyses during the functional analysis, we may have had additional information to assess some additional variables prior to conducting treatment.

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Tables and Figures

Table 1

		EO on (phase)	EO off (phase)	EO on (last 5 sessions)	EO off (last 5 sessions)
Andrew	FA (ESC)	76.10%	23.90%	65.50%	35.50%
	DRA + EXT (ESC)	44.40%	55.60%	14.30%	85.70%
Samantha	FA (TANG)	56.30%	43.70%	49.50%	50.70%
	DRA + EXT (TANG)	27.90%	72.10%	22.90%	77.60%

Table 1. This table depicts the percentage of sessions in which problem behavior occurred during periods when the EO for escape (Andrew) or access to tangible items (Samantha) was and was not present. Data are separated for the initial functional analyses conditions in which higher levels of problem behavior occurred (escape for Andrew; tangible for Samantha) and the initial treatments for these specific functions for both subjects. In addition, data are depicted for condition means and means during the last 5 sessions of the condition.

Figure 1

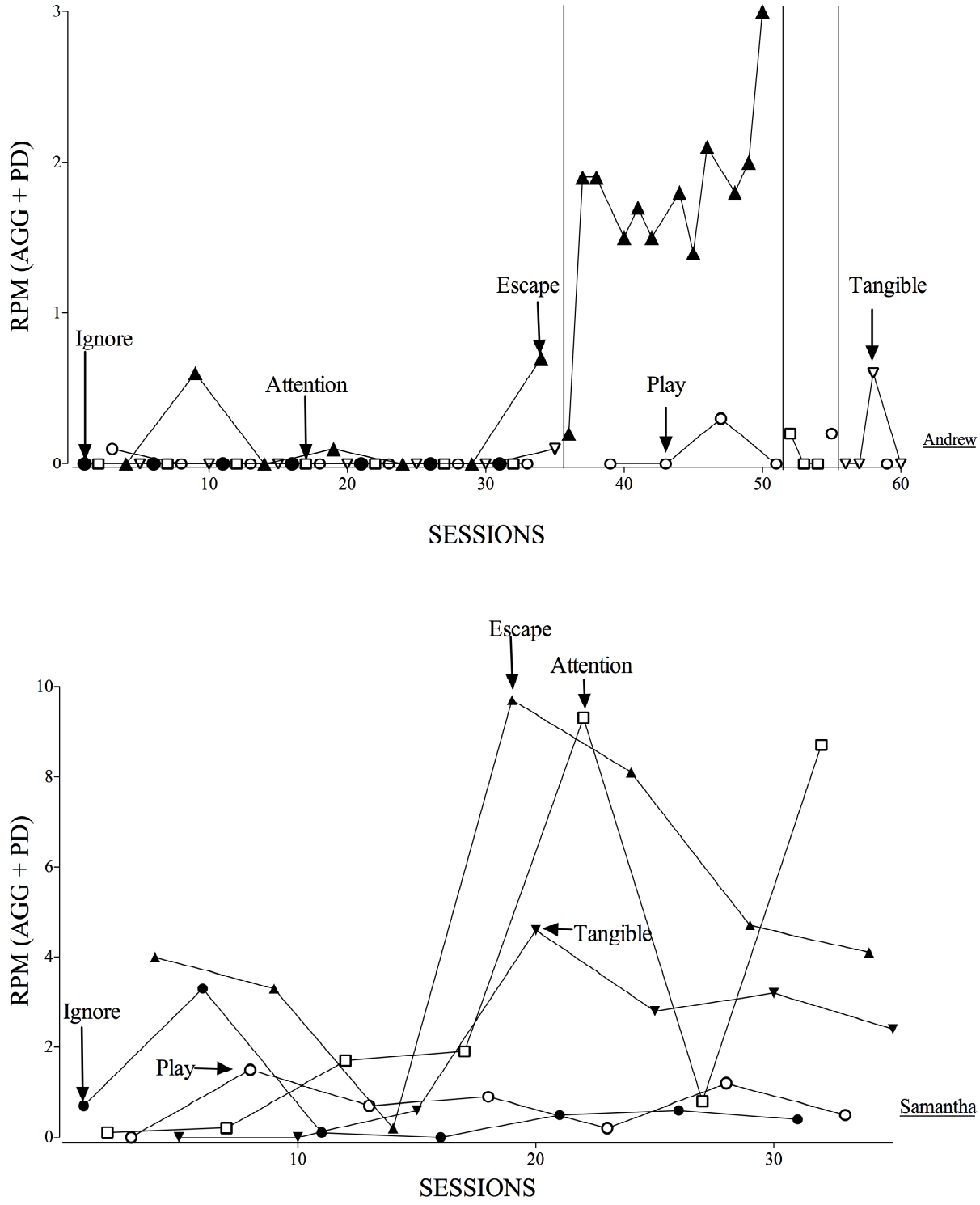
RPM (AGG + PD)
SESSIONS
Ignore
Attention
Escape
Play
Tangible
Andrew
Samantha

Figure 1. Rate of combined aggression and property destruction during functional analyses for Andrew (top panel) and Samantha (bottom panel).

Figure 2

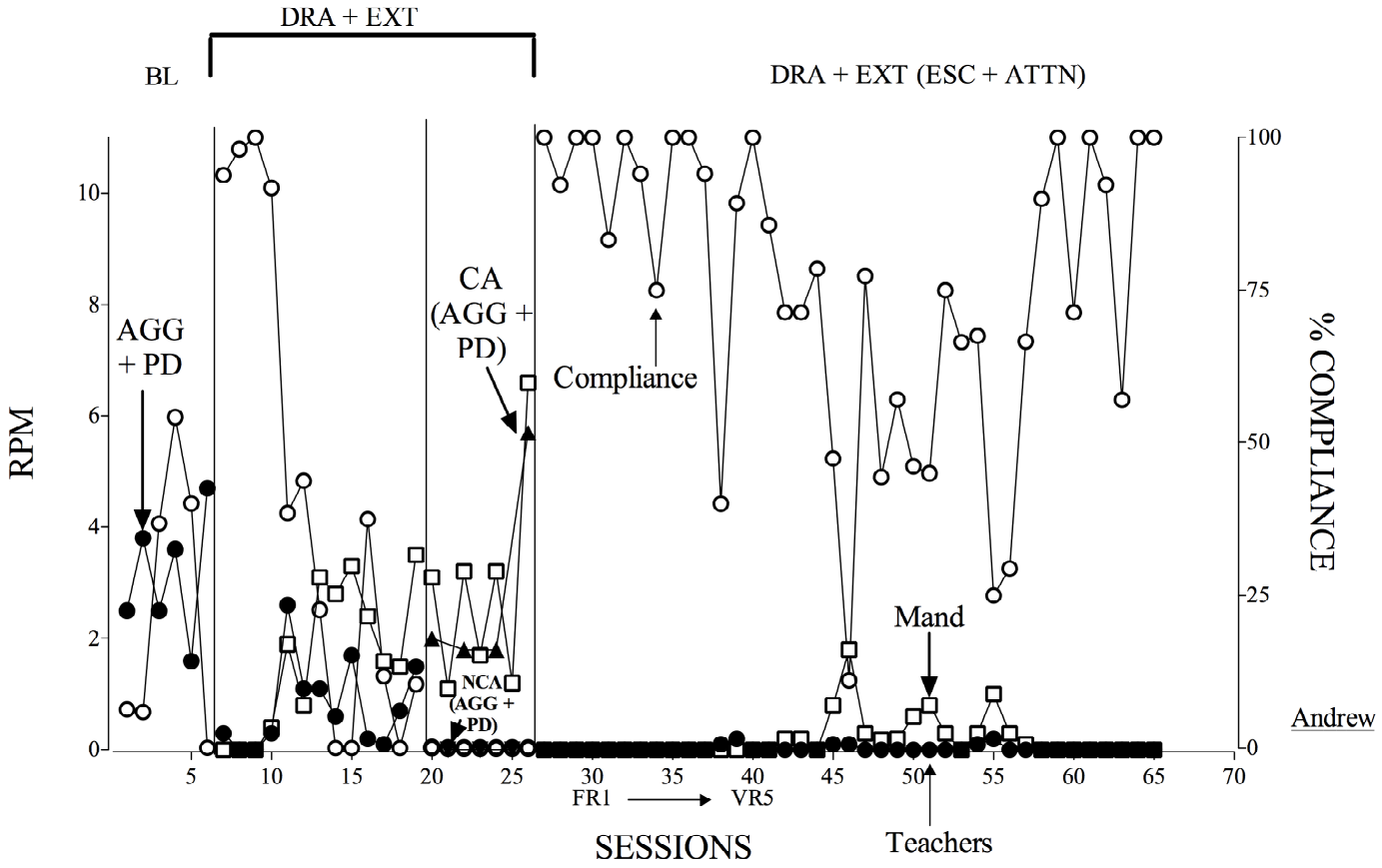

Figure 2. Data for the initial treatment, additional analysis, and final treatment for Andrew. Rate of combined problem behavior (aggression and property destruction) and appropriate mands are scaled on the left y-axis. The percentage of compliance is scaled on the right y-axis

Figure 3

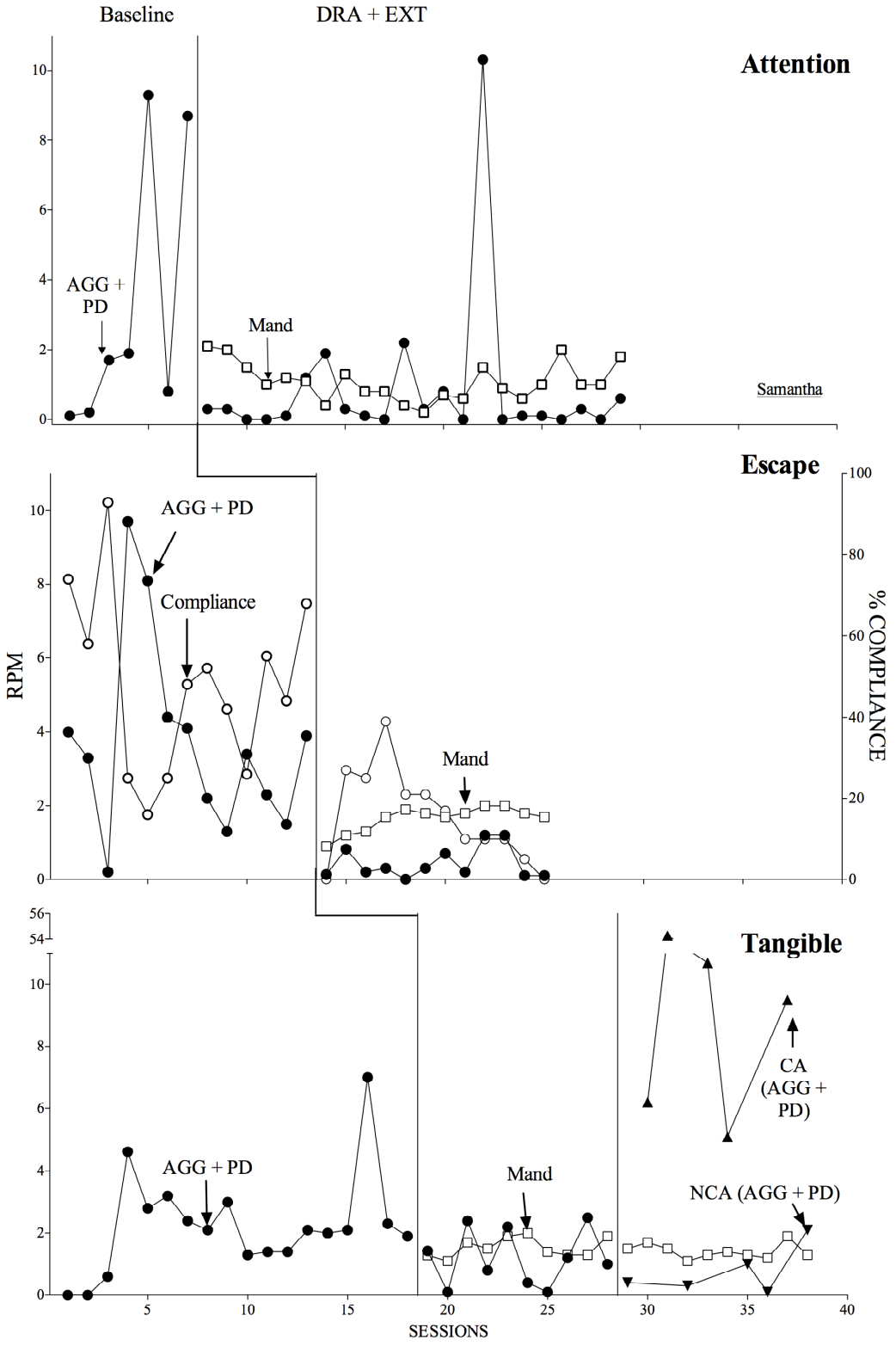
Baseline
DRA + EXT
Attention
AGG + PD
Mand
Samantha
Escape
AGG + PD
Compliance
Mand
RPM
% COMPLIANCE
Tangible
AGG + PD
Mand
CA (AGG + PD)
NCA (AGG + PD)
SESSIONS

Figure 3. Data for the initial treatment and additional analysis for Samantha. Rate of combined problem behavior (aggression and property destruction) and mands are scaled along the left y-axis. The percentage of compliance is scaled along the right y-axis. The top panel shows the baseline and treatment for the attention function; the middle panel shows the baseline and treatment for the escape function; the bottom panel shows baseline treatment and additional analyses for the tangible function.

Figure 4

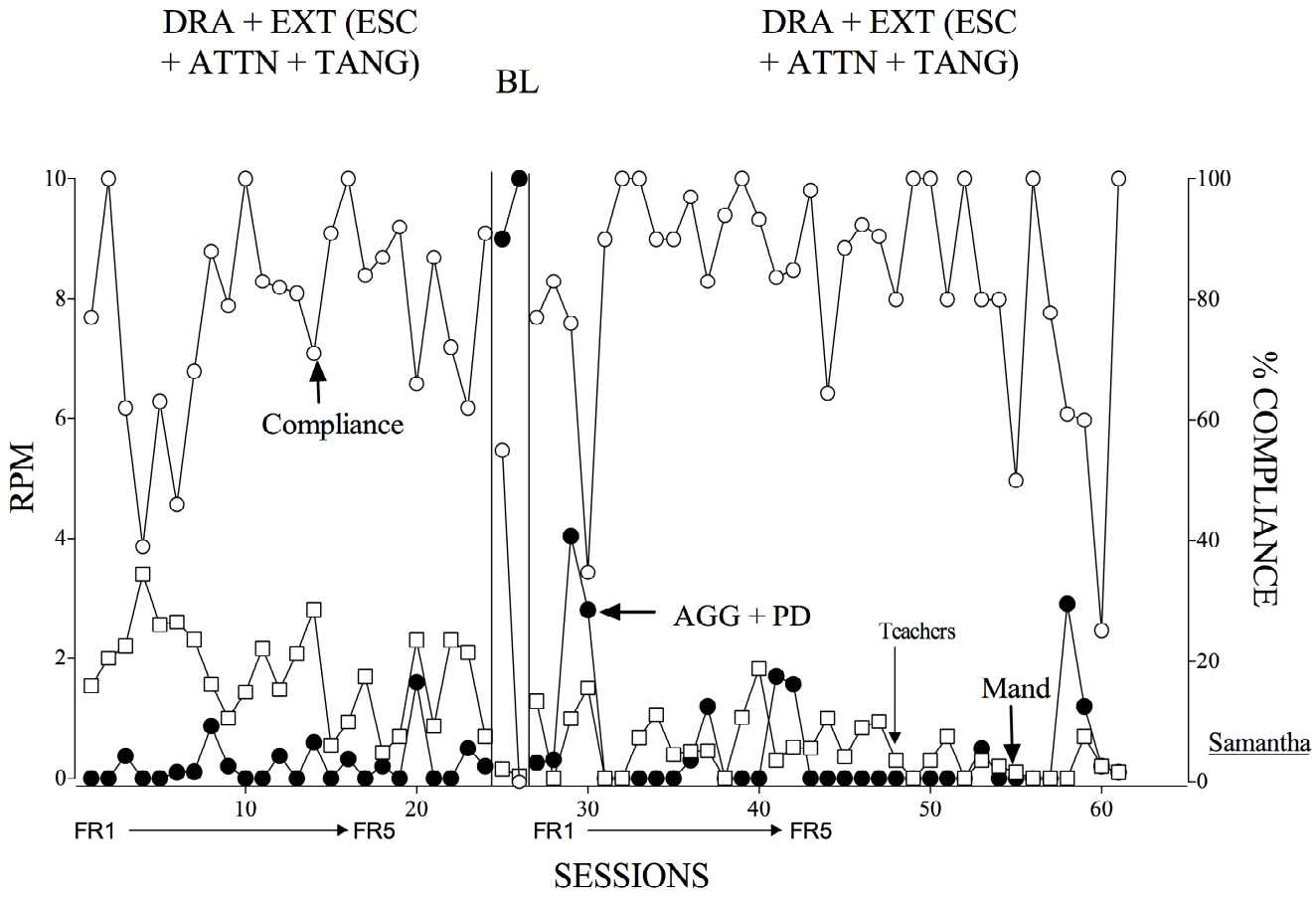

Figure 4. Final treatment analysis for Samantha. Rate of combined problem behavior (aggression and property destruction) and mands are scaled along the left y-axis. The percentage of compliance is scaled along the right y-axis.