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USE OF A SHORT-TERM INPATIENT MODEL TO EVALUATE ABERRANT BEHAVIOR: OUTCOME DATA SUMMARIES FROM 1996 TO 2001

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Previous outcome studies have provided descriptions of functional analyses conducted in outpatient clinics (Derby et al., 1992), long-term inpatient programs (Iwata, Pace, et al., 1994), and home environments (Wacker et al., 1998). This study provides a description of 138 children and adults with and without developmental disabilities who were evaluated and treated for aberrant behaviors on a short-term inpatient unit. The results indicated that the functional analyses conducted during a short-term inpatient evaluation were successful for 96% of the participants in identifying maintaining reinforcers of aberrant behavior and leading to an 80% or greater reduction in aberrant behavior for 76% of the participants in an average of 10 days.

DESCRIPTORS: aberrant behavior, epidemiological studies, functional analyses, inpatient evaluation, outcome, short-term treatment

In recent years, several epidemiological studies have been published that describe the methodology and findings for functional analyses and matched treatments conducted with children and adults with significant behavior problems and developmental disabilities (Derby et al., 1992; Iwata, Pace, et al., 1994; Wacker et al., 1998). Each of these studies described initial assessments based on the functional analysis procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), with variations in the number and duration of sessions and conditions conducted. Overall, these summaries reported success in identifying the maintaining variables of aberrant behavior.

For example, Iwata, Pace, et al. (1994) summarized the findings for 152 participants seen over an 11-year period. Functional analyses and treatment of self-injurious behavior (SIB) were conducted over an extended period for individuals who resided in residential and long-term inpatient settings. The participants were individuals who exhibited SIB, were between the ages of 1 and 51 years, and had been diagnosed with developmental disabilities (DD; 93% diagnosed with severe or profound DD). Functional analyses consisted of an average of 26.2 15-min sessions (total of 6.5 hr of assessment per participant on average). Negative reinforcement was the most prevalent function identified for SIB (38%), followed by positive reinforcement and automatic reinforcement (26% each), then undifferentiated (uncontrolled results) (5%), then a combination of negative and positive reinforcement (3%) and finally, automatic reinforcement and one social function (2%). Relevant and irrelevant treatments were then

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evaluated with 121 of the participants. Self-injury was reduced to below 10% of baseline (mean of last five relevant baseline sessions compared to mean of last five treatment sessions) for 80% of participants. Iwata, Pace, et al. demonstrated that with extended analyses and maximum control of relevant features of the environment, significant reductions were obtained for 80% of participants for whom treatment was implemented.

Wacker et al. (1998) summarized the findings of extended functional analysis and treatment (functional communication training) of aberrant behaviors (i.e., SIB, aggression, stereotypy, destruction) conducted in home settings. The participants consisted of 28 children between the ages of 1 and 6 years (average age was approximately 3 years) with developmental delays or multiple disabilities. All assessment and treatment conditions were conducted in each child's home with the parent serving as the primary therapist. Experimenters conducted 5- to 10-min functional analysis probes on a weekly basis. Similar to Iwata, Pace, et al. (1994), negative reinforcement was the primary function identified (46%) for these participants. Positive reinforcement accounted for 21% of the functions identified, negative and positive reinforcement accounted for 18%, and behavior maintained by automatic reinforcement accounted for the remaining 4%. Results of the functional analyses were used to develop treatment, and results showed an average reduction in aberrant behavior of 87% after 3 months of treatment (mean of relevant baseline sessions compared to mean of last three treatment conditions). In addition, an average of 69% improvement in positive collateral behaviors was observed. Wacker et al. demonstrated that the model described by Iwata, Pace, et al. could be successfully adapted to home settings, with weekly visits, and with other behavior topographies (in addition to SIB).

Derby et al. (1992) described a brief (90-min) functional analysis assessment model of aberrant behavior (i.e., SIB, aggression, stereotypy, and destructive behavior) conducted in an outpatient clinic setting. Data on 79 cases conducted over a 3-year period were summarized. Participants were between the ages of 1 and 35 years (average age was 15 years) with DD and aberrant behavior. Parents or care providers most often provided the programmed consequences during the functional analysis, and subsequent treatment was based on the identified function. When aberrant behavior was displayed in the clinic setting, the procedures identified specific functions of aberrant behavior for 74% of the participants. Negative reinforcement was identified as the maintaining reinforcer of aberrant behavior for 48% of the participants, positive reinforcement was identified for 36% of the participants, and automatic reinforcement was identified as the function of aberrant behavior for 34% of the participants. Brief treatment probes were conducted in the clinic for 63% of the participants, and decreased aberrant behavior occurred for 54% of those participants ($n = 20$). Derby et al. demonstrated that even with the limits imposed by the outpatient clinic setting, the functional analysis methodology of Iwata et al. (1982/1994) successfully identified the function of multiple topographies of aberrant behavior. The major limitation of the brief functional analysis conducted by Derby et al. was that 37% of the participants did not display aberrant behavior in the clinic setting. Therefore, the identification of a maintaining reinforcer for aberrant behavior and the ability to implement treatment were limited in a relatively large number of cases.

Each of the studies summarized thus far demonstrated that the functional analysis methodology is robust in that it enabled identification of the maintaining contingencies of a wide array of aberrant behaviors and resulted in implementation of successful pro-

cedures across settings and participants with DD. Iwata, Pace, et al. (1994) and Wacker et al. (1998) demonstrated substantial reductions in aberrant behavior from baseline to treatment; however, the latency from assessment to treatment was often lengthy (e.g., 3 months in the Wacker et al. study). Derby et al. (1992) reduced the length of time considerably, but at the cost of being unable to treat the aberrant behavior of a relatively large number of individuals who did not demonstrate the target behaviors during assessment. Outcome data on large numbers of persons without DD have not been summarized to date (Cooper, Wacker, Sasso, Reimers, & Donn, 1990; Cooper et al., 1992). The present study had two purposes. First, we sought to replicate the previous studies relative to findings, functions, and treatment outcomes with the use of a brief (approximately 2-week) inpatient program. Second, we extended previous studies by including a sample of nondisabled (ND) participants who received the same functional analysis and treatment procedures described by Iwata, Pace, et al., Wacker et al., and Derby et al. In essence, we sought to evaluate a large group of individuals using similar methods under the constraints of a clinical setting. The goal of the inpatient program was to reduce aberrant behavior by at least 80% during a 10- to 14-day admission period. We summarized the findings over a 5-year period (1996 to 2001) for the Biobehavioral Inpatient Service (BIS) at the University of Iowa Center for Disabilities and Development. The 138 cases evaluated over that period are summarized relative to outcomes associated with assessment, treatment, and overall reduction in aberrant behavior from baseline to treatment.

METHOD

Participants and Setting

Participants were first evaluated in the outpatient Biobehavioral Service (cf. Derby et al., 1992) at the University of Iowa Center for Disabilities and Development prior to admission. Outpatient failure (i.e., aberrant behaviors were not reduced to acceptable levels with outpatient recommendations) was required for the participant to be admitted to the inpatient service.

During the five-year period, 152 individuals were evaluated. Fourteen individuals (9%) did not display aberrant behavior during the first 3 days of admission, and were discharged prior to completion of a full evaluation. Therefore, 138 individuals (30% female, 70% male) who completed the typical inpatient admission were included in the data summaries. The participants varied across a wide range of functioning (both ND and DD individuals) based on estimated level of cognitive functioning diagnosed at the time of discharge. Categories of cognitive functioning were based on the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 1994) and included mild (11%), moderate (10%), or severe to profound mental retardation (17%), mental retardation level unspecified (48%), or average cognitive functioning (14%). Each individual exhibited severe aberrant behavior and ranged in age from 1 to 49 years old (DD $M = 10$; ND $M = 6$; all participants $M = 10$). Participants were inpatients on the BIS between March 1996 and September 2001. There were 2 to 3 participants receiving inpatient services at any given time.

After referral, indirect methods (file review, phone interviews) were employed to identify (a) history and topography of aberrant behavior, (b) living situation (e.g., residence, primary care provider, etc.), (c) mode of communication (e.g., verbal, manual sign), and (d) educational history and information about current individual education plan (IEP) or work-based goals. This information was updated and verified during an intake conference on the day of admis-

sion. Based on this information, hypotheses were generated regarding the function of aberrant behavior.

Outcome Data Summary Procedure

Participant information was retrospectively obtained from several sources including the participant's medical record, the participant's log of all data sessions completed, the final functional analysis and treatment graphs, operational definition sheet, and the completed inpatient multidisciplinary report. To summarize the data, an outcome data-collection sheet was designed to record each participant's information and categorize assessment and treatment information for entry and analysis in Microsoft® Access and Microsoft® Excel computer programs (data sheet available from the authors upon request). Categories were not mutually exclusive. Data were summarized using mean and range calculations or percentage data.

Days of Admission, Assessment, and Treatment

The participant's dates of admission and discharge were recorded. Length of admission was calculated by adding the total number of days admitted, including the day of admission and the day of discharge (e.g., August 2, 1999 to August 13, 1999 = 12 days). Participants were admitted for an average of 10 days (range, 4 to 15 days).

The total number of days and number of sessions that were conducted in each phase were reported. When the functional analysis ended on the same day that treatment began, the day was counted for both phases. Therefore, the total number of days in assessment and treatment could exceed the total number of days of admission. Assessment across all participants was completed in an average of 4 days (range, 1 to 10), with an average of 6 days (range, 1 to 11) of treatment conducted during each admission. Functional analyses averaged 51 sessions or 4 hr (range, 10 to 131 sessions; 50 min to 11 hr), and treatment analyses averaged 53 sessions or 4 hr (range, 2 to 153 sessions; 10 min to 13 hr) across participants. Similar averages were obtained for both DD and ND participants, but specific category breakdowns are available by request.

Response Definitions

Aberrant behaviors were identified from the operational definition sheet created at admission for each participant. When the participant engaged in more than one aberrant behavior, each was recorded separately. An average of three individually defined topographies of aberrant behavior (range, 1 to 4) were recorded for each participant. Of the participants, 11% exhibited one topography, 23% exhibited two topographies, 38% exhibited three topographies, and 28% exhibited four topographies. Topographies included SIB, aggression, stereotypy, destruction, disruption, and other (i.e., pica, elopement, rumination). Specific response definitions are provided in Table 1.

Settings, Staff, and Therapists

The BIS is an interdisciplinary service, consisting of psychologists, behavior specialists, speech therapists, social workers, physical therapists, occupational therapists, recreational therapists, nutritionists, physicians, pediatric nurse practitioners, registered nurses, and nurses' aides.

A typical participant's schedule consisted of three daily 45-min assessment or treatment observation periods. When not in assessment or treatment sessions, the participants were in the inpatient school (if 21 years or younger) taught by special education teachers, or worked on other inpatient goals (e.g., physical therapy, wheelchair repositioning). Time was also spent in structured recreation activities and free time on the unit with their aides or primary care provider.

Table 1
Response Topographies and Operational Definitions

Topography	Definition	DD	ND	All
Disruption	At least two of the following behaviors had to occur simultaneously: crying, screaming, stomping feet, flopping to floor	70%	95%	74%
Aggression	Kicking, hitting, biting, pinching, pushing, throwing items at another person	81%	85%	82%
Self-injury	Head hitting with open or closed hand; banging head on floor or other object; slapping, hitting, biting, or pinching self; eye poking; or other self-inflicted behaviors that had the potential to injure the participant	64%	25%	58%
Destruction	Throwing objects, knocking over objects, tearing or breaking objects, kicking or hitting objects, and any other behavior that damaged objects	37%	55%	40%
Stereotypy	Repetitive, nonadaptive motor behavior such as hand flapping, hand mouthing	19%	15%	18%
Other	Ingestion of a nonfood item (pica), removal of clothing (disrobing), contact of object against lips or tongue (mouthing), attempting to or leaving session room without staff or caregiver (elopement), regurgitation of small amounts of food (rumination), rapid or deep breathing (hyperventilation), spitting, licking table or objects	11%	10%	11%

Note. DD = developmental disabilities; ND = nondisabled.

Most sessions were conducted in a therapy room (3 m by 6 m) that contained a couch, sink and cabinets, three closable storage units, a one-way mirror, and a remote-controlled camera mounted at the top of one wall. Approximately 50% of the care providers stayed for the majority of the admission, and they participated in conducting the assessment and treatment sessions with coaching provided by staff. If the primary care provider did not stay for the admission, the behavior specialists conducted all assessment and treatment sessions. When the primary care provider did not stay for the admission, they participated in treatment training sessions prior to discharge. Teachers and other care providers (e.g., group-home staff) were also offered this type of training prior to discharge.

Materials and Tasks

On the 1st day of admission, a paired-choice preference assessment (Fisher et al., 1992) or a free-operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998) was conducted with five to seven items (toys, leisure materials, and rarely, food). The materials assessed were based on care provider report of preferred items. The highest three to four ranked items in the preference assessment were available to the participants in the free-play condition. The highest preferred item was used in the tangible condition.

Tasks for the escape sessions were chosen based on care provider reports, IEP, work plans, and observations in the inpatient classroom. Tasks varied for each participant and included towel folding, placing pegs in a board, academic tasks, and so forth.

Design and Data Collection

Observation periods were typically 45 min long. Session length varied between 5 and 15 min, but most commonly 5-min assessment and treatment sessions were con-

Table 2
Summary of Functions of Behavior

	DD	ND	All
Negative and positive reinforcement	39%	50%	40%
Negative (escape) reinforcement	27%	40%	29%
Positive (tangible or attention) reinforcement	14%	0%	12%
Automatic reinforcement	7%	10%	7%
Automatic and one or more social reinforcement functions	9%	0%	8%
Undifferentiated	4%	0%	4%

Note. DD = developmental disabilities; ND = nondisabled.

ducted. Each session was recorded from a wall camera. Data were most often collected live but were scored from videotapes when necessary.

Two types of data-collection systems were used to record behavior during functional analysis and treatment sessions. Data were collected on aberrant behavior and mands (during treatment) using either a pen-and-paper 6-s partial-interval recording system (1996 to 1998) or a computer-based data-collection program (1999 to 2001) that permitted real-time data collection. For participants whose behavior was observed using the first system, behavior was summarized as a percentage-of-intervals measure. For participants whose behavior was observed using the second system, behavior was reported as either a rate measure or as a percentage-of-intervals measure.

A multielement or pairwise design (Iwata et al., 1982/1994; Iwata, Duncan, Zarcone, & Lerman, 1994) was used during functional analyses. Treatment was conducted using an AB or reversal design.

Data Analysis

Functional analysis. Based on the findings of the functional analysis, aberrant behavior was classified as being maintained by negative reinforcement, positive reinforcement (attention or tangible), automatic reinforcement, negative and positive reinforcement, automatic and one or more social reinforcement functions, or undifferentiated (Iwata, Pace, et al., 1994). For each individual, data were graphed and reviewed daily. Graphs consisted of session-by-session values for each of the sessions conducted during the previous day. The first or second author and a team of clinicians that included one or two graduate students and one or two behavior specialists reviewed the data. Thus, three to five individuals with experience in behavior analysis reviewed each data set daily. Assessment was concluded when the clinical team (psychologist, graduate student, and behavior specialist) reached consensus regarding (a) the function of the target behavior or (b) the apparent lack of an interpretable function (undifferentiated).

The functional analysis and treatment data were analyzed using single-subject designs. Line graphs were used to visually inspect the data (either percentage of intervals with target behaviors or the responses per minute of target behaviors). Conditions with consistently higher levels of aberrant behavior than the control condition (free play) or all other conditions were used to identify maintaining variables for aberrant behavior. Specifically, if three consecutive data points in a particular condition showed an upward trend or were stable above the free-play sessions, then the reinforcer for aberrant behavior was identified. If two or three conditions met the criteria as a reinforcer for the

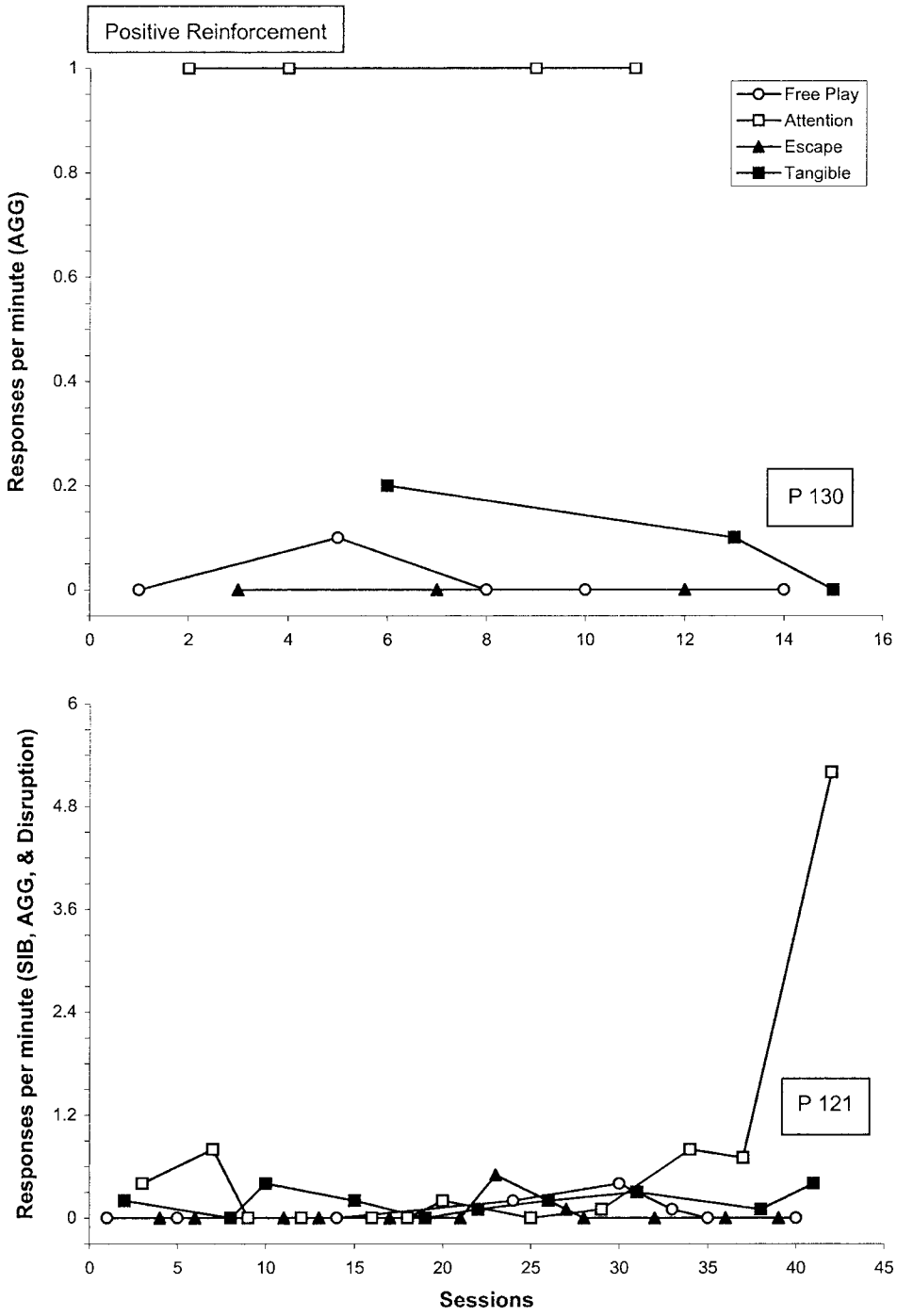

Figure 1. Responses per minute of aggression (top panel) and self-injury, aggression, and spitting (bottom panel) during functional analyses that demonstrated maintenance via positive reinforcement for Participant 130 (attention, top panel) and Participant 121 (attention and tangible, bottom panel).

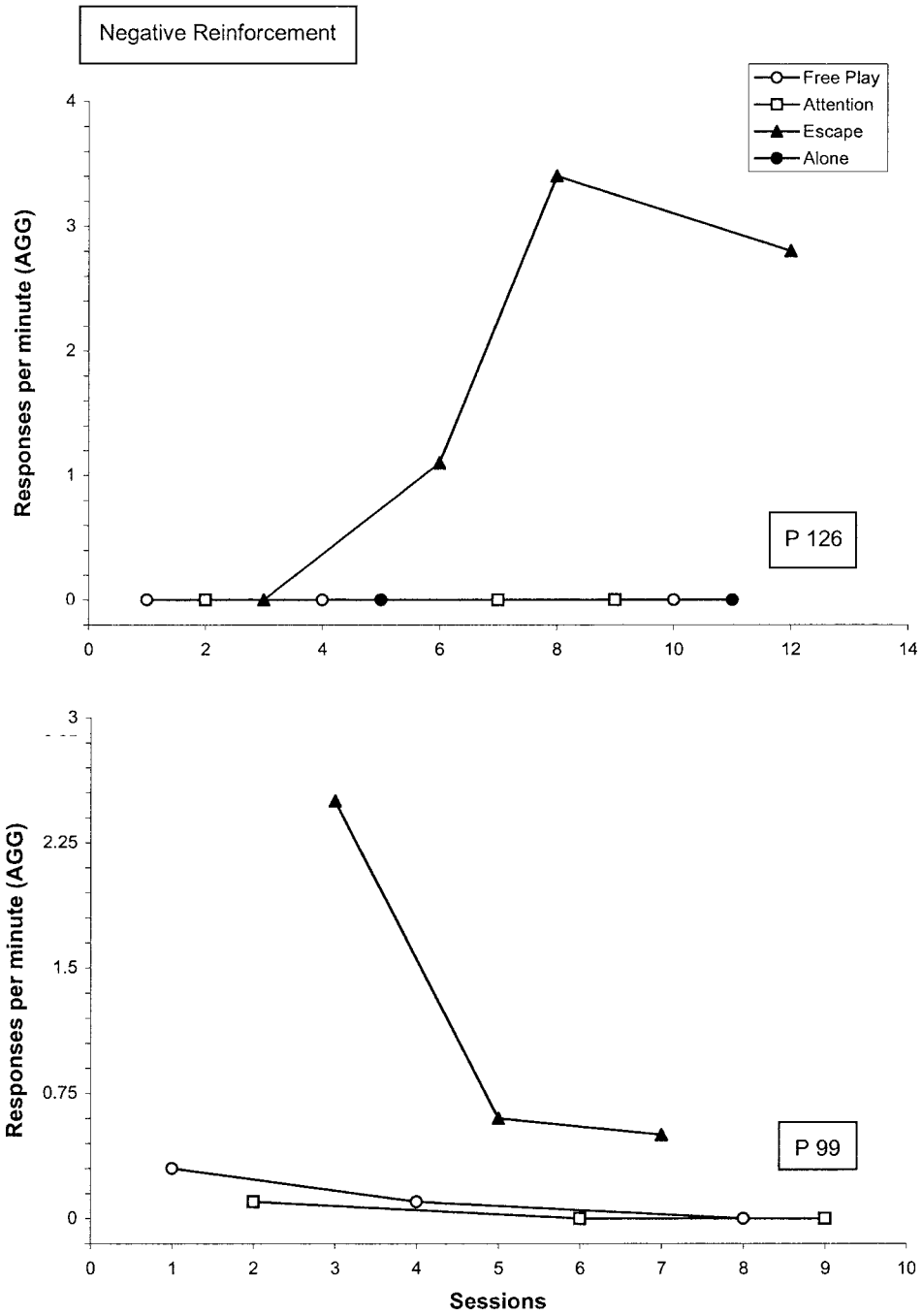

Figure 2. Responses per minute of aggression (top and bottom panels) during functional analyses that demonstrated maintenance via negative reinforcement for Participant 126 (top panel) and Participant 99 (bottom panel).

same aberrant behavior, both were reported. For each function identified, the percentage or rate of aberrant behavior in each session of the functional analysis test condition was summed and divided by the total number of sessions conducted to obtain a baseline average for aberrant behavior. For example, if the function of aberrant behavior was identified as negative reinforcement (escape), the total percentage or rate of aberrant behaviors displayed in each escape session of the functional analysis was summed and divided by the total number of escape sessions conducted in the functional analysis.

Treatment. Treatment sessions were analyzed by comparing the level of aberrant behavior in the baseline (described above) to the treatment sessions. For the treatment session comparison, the total percentage or rate of aberrant behaviors observed in the last three treatment sessions was added and divided by three.

Reduction in aberrant behavior. The mean percentage or rate of aberrant behavior in the last three treatment sessions was compared to the mean percentage or rate of aberrant behavior in baseline. For example, if the participant's aberrant behavior was maintained by negative reinforcement, the mean of aberrant behavior in the functional analysis escape sessions (e.g., 50%) was compared to the mean in the last three escape treatment sessions (e.g., 5%). This measure was calculated by subtracting the mean from the last three treatment sessions from the mean from the functional analysis baseline sessions, divided by the mean from the functional analysis baseline sessions; for example, (50% − 5%)/50% = 90% reduction. If two or more treatments were implemented for 1 participant (n = 27), then the reduction in aberrant behavior was reported as an average of the treatments; for example, if Treatment 1 reduction was 90% and Treatment 2 reduction was 100%, (90% + 100%)/2 = 95% reduction. We did this to avoid counting treatment for any given participant more than once. Each participant's reduction in aberrant behavior was then averaged across all participants to identify an overall average reduction in aberrant behavior. Average reductions were categorized as follows: 90% or greater, 80% to 89%, 70% to 79%, 60% to 69%, 50% to 59%, 20% to 49%, and 0%.

Interobserver Agreement

Over the 5 years, interobserver agreement was evaluated on an average of 21% of sessions by having a second observer simultaneously but independently record aberrant behavior and appropriate replacement behaviors (during treatment). For percentage-of-interval data, an agreement was defined as both observers recording target behavior within the same 6-s (if pen-and-paper recording method was used) or 10-s interval (if computer method was used). Interobserver agreement coefficients were then calculated by summing the number of intervals with agreements in a session and dividing that sum by the number of intervals in the sessions and multiplying by 100%. For frequency data, an agreement was calculated by dividing the smaller number of behaviors recorded by the larger number of behaviors recorded during each 10-s interval of the session. These fractions were then summed and divided by the total number of 10-s intervals for the session and expressed as a percentage. The percentage of sessions during which agreement was assessed for individual participants ranged from 0% (3 participants) to 61% (M = 21%). Interobserver agreement for individual participants averaged 94% and ranged from 61% to 100% across participants.

Interobserver agreement data were also obtained on the information recorded on the outcome data-collection sheet by the authors. Two authors independently recorded 23 pieces of information (e.g., day of admission, day of discharge, date of birth,

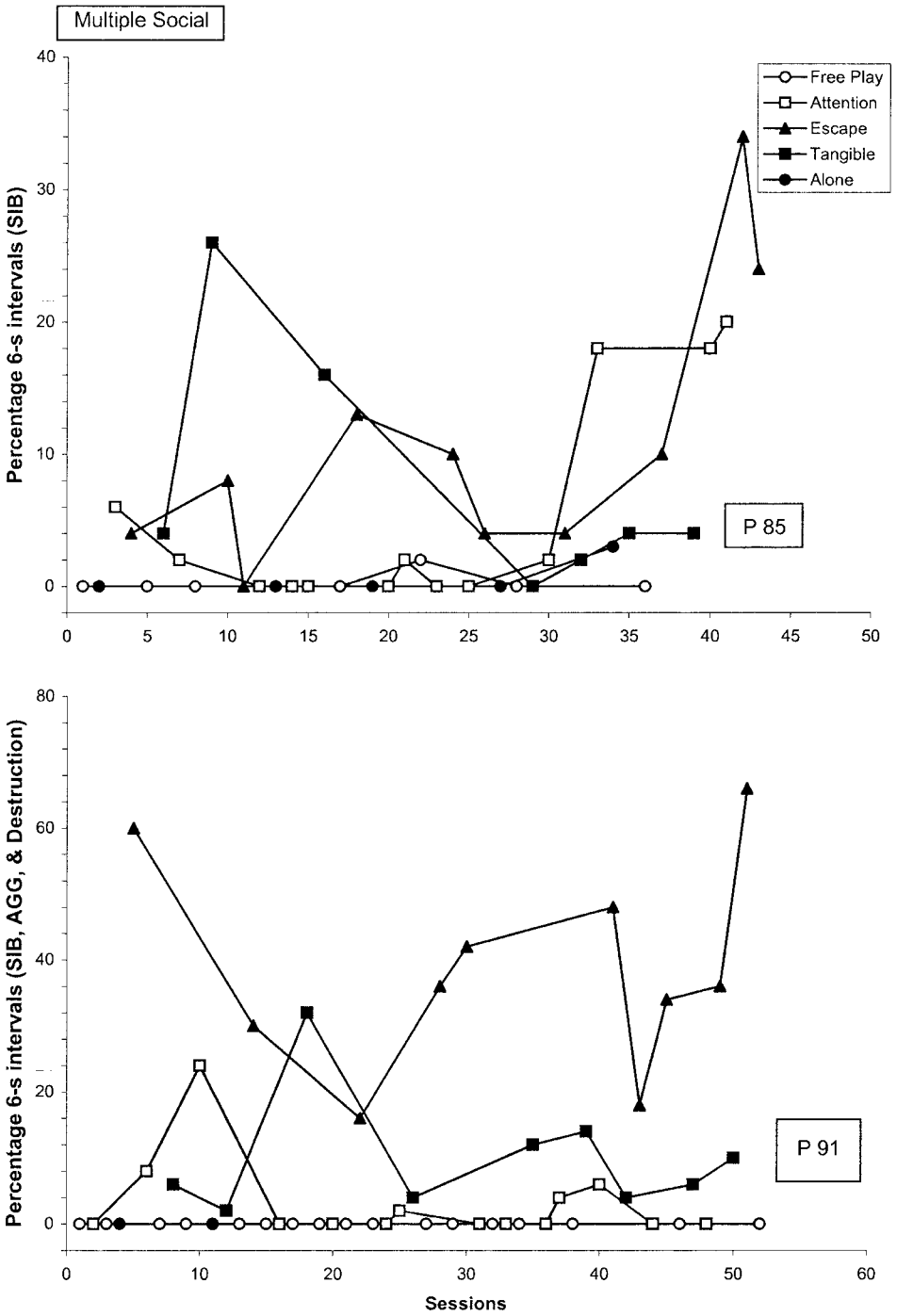

Figure 3. Percentage of 6-s intervals of self-injury (top panel) and self-injury, aggression, and destruction (bottom panel) during functional analyses that demonstrated multiple social reinforcement functions for Participant 85 (positive [attention] and negative [escape] reinforcement, top panel) and Participant 91 (positive [tangible] and negative [escape], bottom panel).

function of behavior, mean of last three treatment sessions) on the outcome data-summary sheet, and the two data sheets were compared to obtain an agreement score. Agreement was obtained for 30% of the cases. Agreement was computed by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Interobserver agreement averaged 92%, ranging from 81% to 100%.

PROCEDURE

Functional Analysis

The functional analyses were conducted to evaluate the maintaining contingencies of aberrant behavior. Aberrant behaviors were operationally defined based on file review, care provider report, and direct observation. Most participants (89%) displayed multiple aberrant behaviors (e.g., SIB, destruction, and aggression). The functional analysis sessions were conducted based on the procedures described by Iwata et al. (1982/1994) with some modifications.

During the free-play condition, the participant had access to preferred items, attention was provided every 15 to 30 s, and no demands were presented. There were no programmed consequences for aberrant behavior. During the tangible condition, the participant had access to a preferred item for approximately 1 min prior to the start of the condition. The item was then removed with a statement similar to "It is my turn now." The item was returned for 30 s contingent on aberrant behavior. This process was repeated for the remainder of the condition. During the attention condition the participant was told something similar to "I have some work to do; you need to play by yourself," with the therapist immediately diverting his or her attention to reading a magazine or book (or other activity). The participant was provided approximately 30 s of access to attention in the form of verbal reprimands contingent on aberrant behavior. During the escape condition, the participant was directed to complete a task. Directives followed a three prompt sequence: verbal (e.g., "Put the peg in the board"), model (e.g., the therapist demonstrated how to put the peg in the board), and guidance (e.g., the therapist physically guided the participant to put the peg in the board). A 30-s break from the task was provided contingent on aberrant behavior. Passive noncompliance resulted in guidance to complete the demand. The alone condition consisted of the participant being left alone in a room with no access to tangibles, attention, or demands. An ignore condition was conducted with young children or participants who engaged in behaviors that put them at risk for serious injury (e.g., severe SIB) in place of alone conditions. An ignore condition was identical to the alone condition with the exception that an adult remained in the room and ignored all aberrant behavior unless it became potentially harmful. In this case, the session was terminated. No other consequences were provided for any occurrence of aberrant behavior during either the alone or ignore conditions.

Treatment

Following assessment, all of the participants participated in treatment evaluations in which the findings of the functional analysis were directly tested. That is, the independent variable manipulated during treatment was directly tied to the function identified during assessment. All treatments in which a social reinforcement function was identified involved differential reinforcement procedures, with most using functional communication training (Carr & Durand, 1985) plus a reduction procedure. Because participants varied in their communication skills, communication responses varied and included microswitches that emitted a prerecorded verbal statement (e.g., "play please"), sign

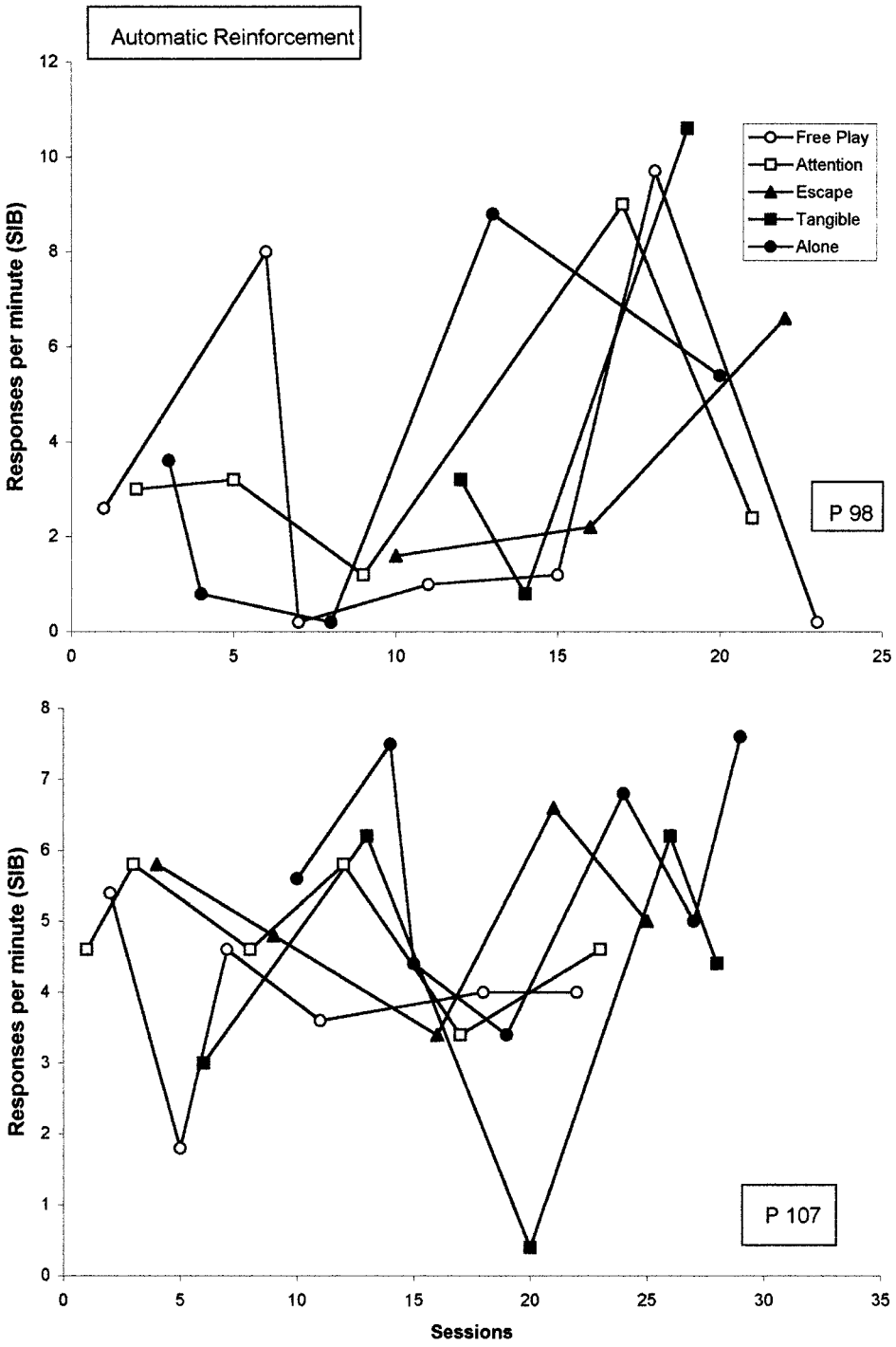

Figure 4. Responses per minute of self-injury (top and bottom panels) during functional analyses that demonstrated maintenance via automatic reinforcement for Participant 98 (top panel) and Participant 107 (bottom panel).

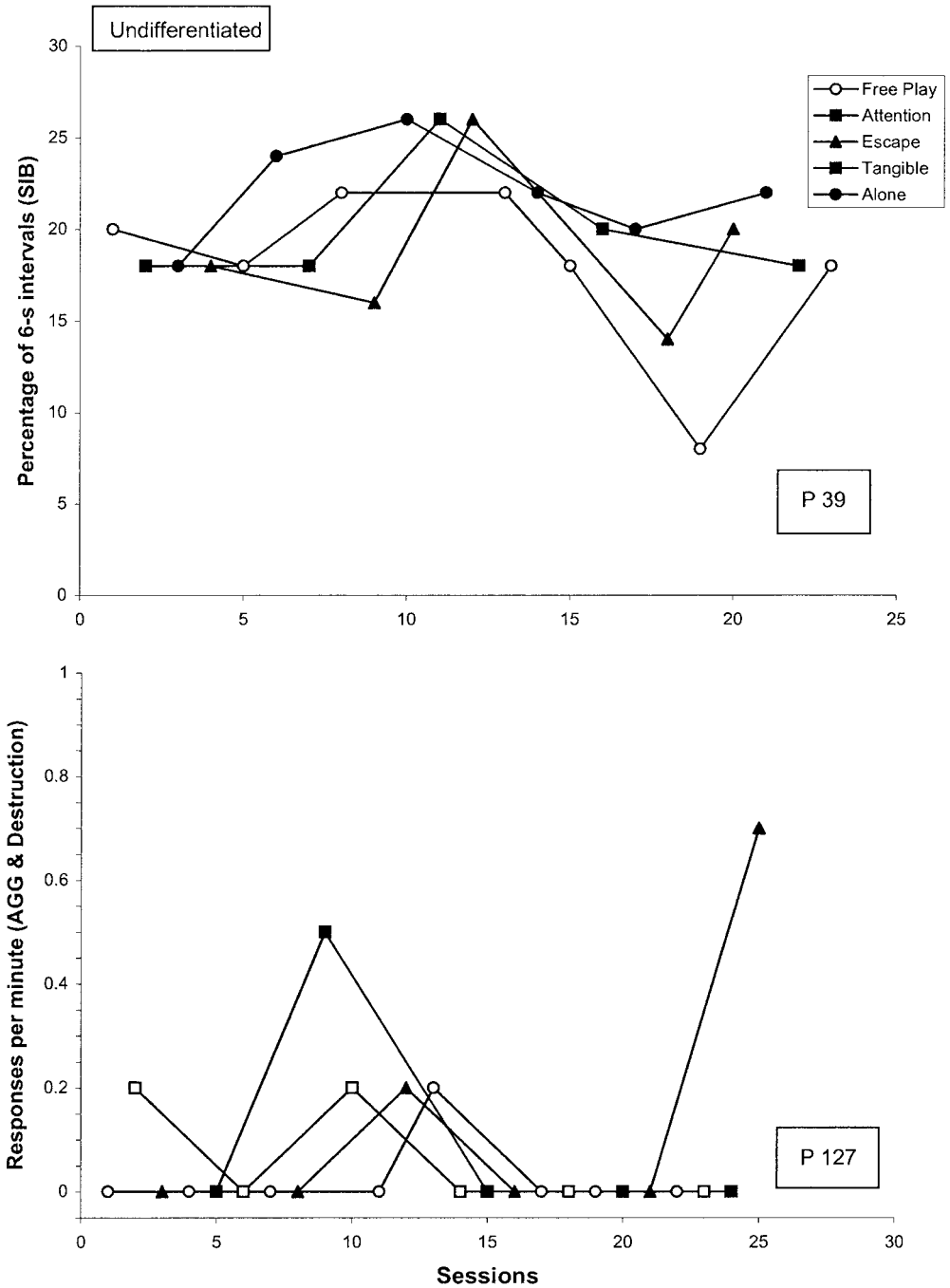

Figure 5. Percentage of 6-s intervals of self-injury (top panel) and responses per minute of aggression (bottom panel) during functional analyses that demonstrated undifferentiated results for Participant 39 (top panel) and Participant 127 (bottom panel).

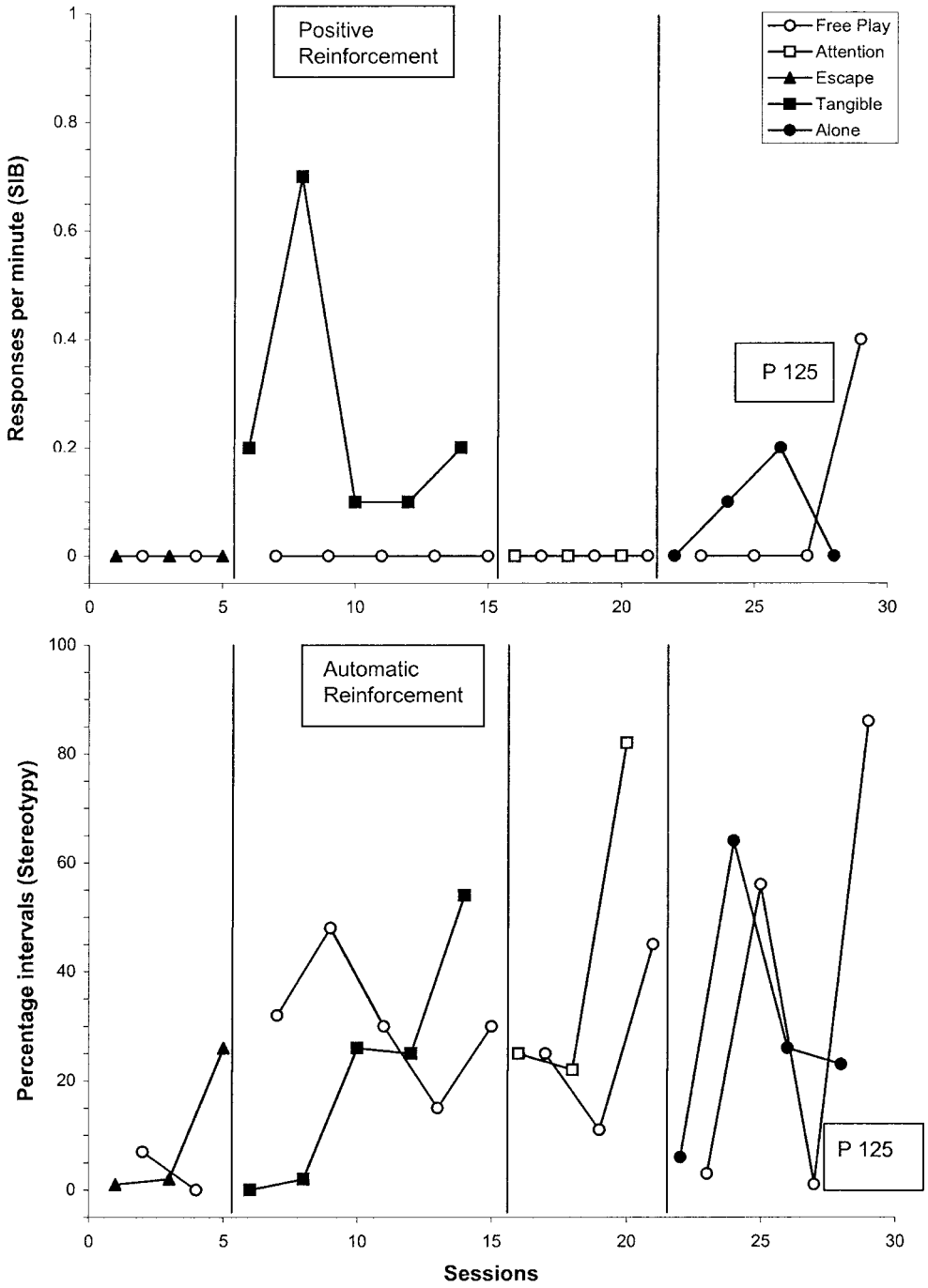

Figure 6. Responses per minute of self-injury and aggression (top panel) and percentage of 1-s intervals of body rocking or stereotypy (bottom panel) during functional analyses that demonstrated social reinforcement function (positive [tangible] reinforcement; top panel) and automatic reinforcement (bottom panel) for Participant 125.

language (e.g., signing "please"), or verbal communication (e.g., "play please"). The following types of treatment components for each type of identified function are summarized.

Positive reinforcement. Differential reinforcement (either differential reinforcement of alternative or other behavior) with extinction (attention was not provided for target behavior but for appropriate alternative communicative behavior) was the primary treatment component used when either the attention or tangible sessions resulted in higher levels of target behavior than all other sessions (100% of participants with a positive reinforcement only function). For example, if the functional analysis showed that aberrant behavior was maintained by positive reinforcement in the form of attention, aberrant behavior resulted in extinction. However, the participant was also taught to display a mand ("play please") that resulted in access to attention. Additional components used for some participants included punishment (time-out) (19% of participants) and antecedent components such as noncontingent attention (or access to preferred materials for behaviors maintained by access to tangible items; 38% of participants).

Negative reinforcement. Differential reinforcement (negative reinforcement for appropriate behavior) with extinction (escape was not provided for target behavior but for appropriate alternative communicative behavior; 100% of participants with a negative reinforcement only function) and guided compliance (punishment; 15% of participants) if the participant did not initiate task completion were the primary treatment components used when the escape sessions resulted in higher levels of target behavior than all other conditions. For example, for a participant whose aberrant behavior was maintained by escape from demands, the task was presented using a three-step sequence: (a) verbal direction to complete the task, (b) model of task completion, (c) guidance to complete the task. Contingent on compliance (and the absence of target aberrant behavior), the participant was allowed a break from the task. The amount of the task to be completed was increased as success was observed in previous sessions. Additional components used with a few participants included antecedent interventions such as noncontingent escape (18%) and response blocking (3%) for 1 individual.

Automatic reinforcement or undifferentiated. Noncontingent reinforcement (NCR), which consisted of continuous or fixed-time delivery of other sources of stimulation (e.g., preferred materials), and differential reinforcement (either differential reinforcement of alternative, other, or incompatible behavior) were the primary treatment components used when the alone or ignore sessions resulted in higher levels of target behavior than all other sessions or when all sessions produced high levels of target behavior (93% of participants with automatic or undifferentiated results only, or low to moderate levels for undifferentiated findings). For example, for a participant who engaged in hand flapping primarily during alone or ignore sessions, hand flapping was redirected to appropriate toy play (DRA) or to a specified number of work demands (DRI), or to noncontingent access to preferred materials (NCR). Additional components used with a few participants included response blocking (27%) and enriched environment (7%).

Negative and positive reinforcement. Combinations of the procedures described previously for positive reinforcement and negative reinforcement were used when the escape, attention, or tangible sessions resulted in higher levels of target behavior than all other sessions.

Automatic and one or more social functions. Combinations of the procedures described previously for automatic reinforcement and

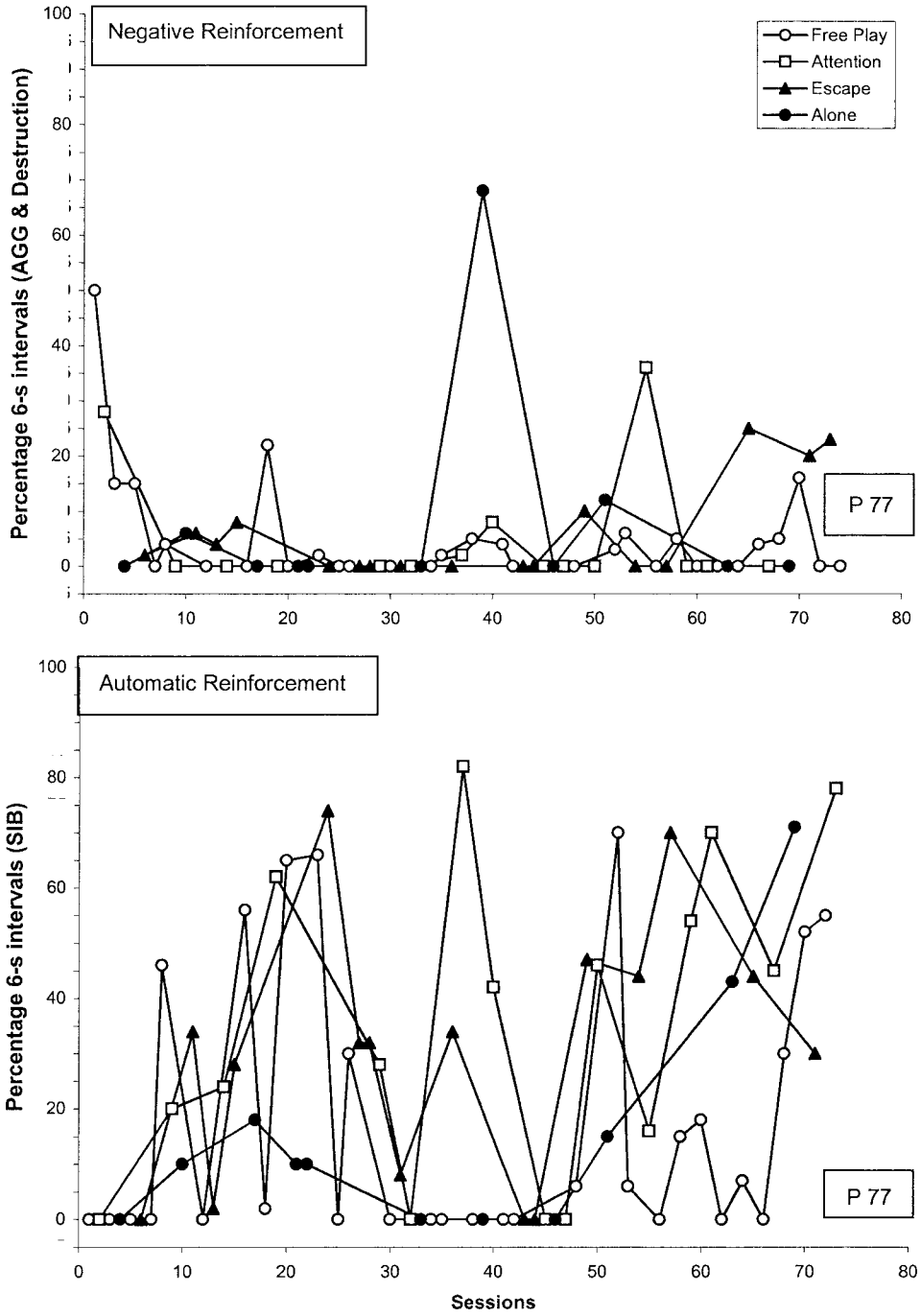

Figure 7. Percentage of 6-s intervals of aggression and destruction (top panel) and self-injury (bottom panel) during functional analyses that demonstrated maintenance via social reinforcement (negative reinforcement, top panel) and automatic reinforcement (bottom panel) for Participant 77.

Table 3
Summary of Percentage Reduction in Aberrant Behavior

	DD	ND	All
90% to 100% reduction	65%	70%	66%
80% to 89% reduction	10%	10%	10%
70% to 79% reduction	4%	15%	6%
60% to 69% reduction	6%	5%	6%
50% to 59% reduction	5%	0%	4%
20% to 49% reduction	6%	0%	5%
0% reduction	3%	0%	3%
Mean	82%	91%	83%
Range	0% to 100%	60% to 100%	0% to 100%

Note. DD = developmental disabilities; ND = nondisabled.

negative or positive reinforcement were used when the alone, ignore, escape, attention, or tangible sessions resulted in higher levels of target behavior than other conditions.

RESULTS

Functions of Behavior

As shown in Table 2, a maintaining contingency of aberrant behavior was identified for 96% of the participants (4% were undifferentiated). The most common function of aberrant behavior for all participants was identified as both positive and negative reinforcement (40%), followed by negative reinforcement (29%), positive reinforcement (12%), automatic reinforcement plus one or more social functions (8%), and automatic reinforcement (7%). This order of frequency for the maintaining contingency of aberrant behavior was the same whether the participant was classified as DD or ND, with the exception of positive reinforcement, which was not identified as the maintaining reinforcer for any of the ND participants' aberrant behavior. For 49% of the participants evaluated, two or more functions of aberrant behavior were identified. Figures 1 through 7 present examples of each type of function, including positive reinforcement, negative reinforcement, negative and positive reinforcement, automatic reinforcement, automatic plus social reinforcement, and undifferentiated.

For Figures 1 through 6, we attempted to identify and present one clear example of the operant function identified and one in which the results were less clear. For example, the top panel of Figure 1 shows the clear results obtained with Participant 130, for whom we identified a positive reinforcement function (attention). We also present a less clear example of a positive reinforcement function for Participant 121 (see the bottom panel of Figure 1), and these results should be interpreted with caution.

Reduction in Aberrant Behavior

Table 3 presents the percentage reduction in aberrant behavior for all participants. Problem behavior was reduced for 97% of the participants during the treatment evaluation. For a majority of participants (66%), problem behavior decreased by 90% or more when the baseline average was compared to the last three treatment sessions. For 76% of the participants, 80% or greater reduction in aberrant behavior was observed. Four of the 138 participants (3%), all with DD, did not show any reduction in aberrant behavior during treatment. Reduction in aberrant behavior for all ND participants met or exceeded 60%.

DISCUSSION

Functional analyses and treatment evaluations were conducted for 138 participants over a 5-year period on the BIS at the University of Iowa Center for Disabilities and Development. Aberrant behavior was reduced by 90% for the majority (66%) of the participants in an average time frame of 10 days. Reduction of 20% or more was seen for all but 4 of the 138 participants. This outcome summary adds to the literature base in at least three ways. First, these data provide support for the clinical model of short-term inpatient admissions as a way to develop and implement treatment effectively and consistently. We viewed the admission as a way to identify experimentally the function of target behavior to develop an effective intervention for aberrant behavior. Although inpatient admissions can be costly, this short-term model demonstrated that effective results can be obtained in relatively brief periods and can be comparable to results obtained during more extensive admissions (Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Iwata, Pace, et al., 1994) or home-based evaluations (Wacker et al., 1998). Extended functional analysis and treatment evaluations were implemented for a variety of aberrant behaviors rather than a specific topography (e.g., Iwata, Pace, et al.), age range (e.g., Wacker et al.), or level of disability (e.g., Iwata, Pace, et al.). This information provides additional documentation of the effectiveness of functional analysis to identify behavioral function and to reduce that behavior with treatment matched to function across topography, age categories, and disabled and nondisabled persons.

Second, our intent was to determine if we could combine the effectiveness of the results obtained for reductions in aberrant behavior similar to the summaries described by Iwata, Pace, et al. (1994) and Wacker et al. (1998) with the use of an extended but short-term model of assessment most similar to Derby et al. (1992). When comparing the demographics across all three other epidemiological studies, the number of participants evaluated was most similar to Iwata, Pace, et al. (152 to our 138) in an 11-year (Iwata, Pace, et al.) versus a 5-year period. Wacker et al. and Derby et al. evaluated fewer participants (28 and 79, respectively) in a shorter period (3 years). The age range we evaluated (1 to 49 years, DD $M = 10$; ND $M = 6$) was similar to the extended range evaluated by Iwata, Pace, et al. (1 to 51 years old, no mean reported) and Derby et al. (1 to 35 years, $M = 15$), whereas Wacker et al. (1 to 6 years, $M = 3$) focused only on young children. However, in general, younger children (1 to 10 years) made up the majority of the participants evaluated in our study. Finally, we extended the previous epidemiological studies by including nondisabled participants (14%) in our evaluation.

Relative to the numbers of functional analysis sessions and total hours of assessment, only the findings reported by Iwata, Pace, et al. (1994) are available for comparison. We conducted twice as many sessions ($M = 51$ vs. $M = 26$ for Iwata, Pace, et al.) in approximately 2 hr less time ($M = 4$ hr vs. $M = 6.5$ hr for Iwata, Pace, et al.). These numbers can be explained by the fact that Iwata, Pace, et al. used 15-min sessions and we used 5-min sessions. Even though we conducted more sessions, it was possible to reduce assessment time by 2 hr using shorter session length.

In comparing the findings of the prevalence of reinforcers identified via the functional analysis, Iwata, Pace, et al. (1994), Wacker et al. (1998), and Derby et al. (1992) all found negative reinforcement to be the most prevalent reinforcer of target behavior (38%, 48%, and 46%, respectively). The majority of participants in this study exhibited target behaviors that were con-

trolled by multiple social reinforcers (negative and positive reinforcement) (DD, 39%; ND, 50%; DD + ND, 41%). However, negative reinforcement was the second most prevalent function for both DD (29%) and ND (40%) participants. One possible explanation for the increased numbers of target behaviors controlled by multiple social reinforcers could be that the age of the participants increased the likelihood that their target behaviors were maintained by more than one type of reinforcement. Wacker et al. reported increased occurrence of multiple social reinforcers for target behaviors with a very young population of participants. Because the average age of the participants in this study (M = 10 years) was younger than that in Iwata, Pace, et al. and Derby et al., it is possible that as a longer history of reinforcement occurs, one or more of these functions drops out over time. This possibility could be evaluated systematically by studying changes in behavioral function over time.

The other identified functions of target behavior were comparable to the findings of the other three published epidemiological papers, with the exception that no target behaviors of ND participants from this study were maintained solely by positive reinforcement. When positive reinforcement was identified as a reinforcer for ND participants, it was always accompanied by a negative reinforcement function. One possible explanation for this is that negative reinforcement played a pivotal role in maintaining ND participants' target behavior. Given that their age averaged 6 years (range, 3 to 12), it is possible that school behavior plans that used time-out as a management strategy may have strengthened the negative and weakened the positive reinforcement function of target behavior for these participants.

When examining the reduction in target behavior from assessment to treatment, our results are comparable to those of Iwata, Pace, et al. (1994) (100% of the 80% of participants who participated in treatment evaluations reduced their aberrant behavior to 10% below baseline mean) and Wacker et al. (1998) (average reduction of 87% after 3 months of treatment). In the present study, the average reduction in target behavior from baseline to treatment for DD participants was 82% and was 91% for ND participants.

Overall, then, it appears that we were able to match the significant reductions in aberrant behavior reported by Iwata, Pace, et al. (1994) and Wacker et al. (1998) with the use of a short-term clinical model of assessment. In addition, we were able to streamline and condense assessment time (with increased number of sessions) as well as overall treatment length needed to produce those reductions. Finally although there were similarities in the functions identified for participants, the most significant departure from other epidemiological studies was the larger number of participants whose behavior was controlled by multiple reinforcers. This study replicates the work done by others with the focus on clinical setting constraints, similar to those addressed by Derby et al. (1992) but with increased ability to identify reinforcers and match those reinforcers to develop effective treatments for the majority of individuals.

Third, 20 of the 138 (14%) participants evaluated were of average intellectual functioning and were between the ages of 3 to 12 years (M = 6 years). The average percentage reduction in aberrant behavior for these 20 individuals was 91% (range, 60% to 100%). Although Cooper et al. (1990) evaluated 8 nondisabled participants, no comprehensive outcomes study to date has evaluated participants without developmental disabilities using consequence-based analyses. Therefore, these data further document the effectiveness of functional analysis methods for persons with average intellectual abil-

ities and aberrant behavior. These results suggest that similar results and findings can be obtained for ND participants and DD participants.

There were several limitations to this study that should be noted. First, there was a lack of reversals or component analyses in the treatment phase. This limitation was, in part, a result of time limitations of the short-term clinical model of inpatient admission. In our view, it was more important clinically that the function of behavior was correctly identified, and thus the analysis during assessment was often more extensive and complete than during treatment. In each case, the treatment was matched to the identified functions and the replication across cases as well as the substantial decrease in target behavior from baseline to treatment are strong clinical features. Research has consistently shown that interventions based on an experimental analysis of environmental conditions are more effective than the generic application of behavior-management techniques (Carr, Robinson, & Palumbo, 1990; Hanley, Iwata, & McCord, 2003). Knowing the correct function increased our confidence in the treatments selected, and also assisted in consultation with parents or other care providers because it allowed us to better understand the behavior. In essence, our intent was not to demonstrate an experimental link between the functional analysis findings and treatment but to utilize the functional analysis findings during a brief inpatient stay to develop treatment based on rigorous assessment findings and conduct treatment probes based on those assessment findings. Experimental control of the functional reinforcer was shown during the functional analysis, and thus we felt that there was little need conceptually to show a functional relation during treatment. In addition, from a clinical standpoint, there was a far greater need to train parents and other care providers on how to conduct the treatments than to confirm the reasons for treatment efficacy because of the initial efforts to match treatment to the function of aberrant behavior.

A second limitation was that generalization and follow-up data were not consistently collected. Participants were scheduled for follow-up visits within 3 months of admission, but they often did not return. Also, social validity data were not collected. We initially attempted to gain social validity data by having parents or care providers fill out a rating scale on the acceptability of assessment and treatment. However, these forms were provided at the time of discharge and were usually not returned.

A third limitation is that the criteria used to assign a function may have resulted in some false-positive findings (i.e., assigning an operant function when one was not clearly present). For example, Participant 121, whose functional analysis data are presented in the bottom panel of Figure 1, was assigned a positive reinforcement function because the last three data points for the attention condition showed an upward trend and the rates of problem behavior were above the range observed for the control condition (free play). However, problem behavior did not occur in five of the first nine attention sessions conducted with this participant, and in only one of those nine sessions (Session 7) was the rate of problem behavior above the range observed in the control condition. Similarly, over 70 sessions were conducted with Participant 77 before three consecutive demand sessions showed levels of aggression and destruction that were higher than those in the control condition. Thus, it is possible that the positive reinforcement function identified for Participant 121 and the negative reinforcement function identified for Participant 77 represent false-positives, and caution is warranted in interpreting these data sets. Fortunately, functional analysis data sets like the ones obtained for Participants 121 and 77 were the exception rather

than the rule, and thus more conservative interpretive criteria would not have substantially altered the percentages presented in Table 2.

Overall, the data indicate that the functional analysis model of assessment proposed by Iwata et al. (1982/1994) has again been demonstrated to be robust. It was effective in identifying maintaining contingencies of aberrant behavior for 96% of the individuals evaluated in an average of 4 days of assessment. The appropriate identification of the function of aberrant behavior led to the development of effective and efficient treatments for all but 3% of the individuals evaluated. Finally, the functional analysis model was shown to be applicable for use with typically developing children who engage in severe aberrant behaviors.

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STUDY QUESTIONS

1. What is the main advantage and the main limitation of the brief functional analysis?

2. What two types of experimental designs were used to conduct functional analyses?

3. What was the most prevalent function of problem behavior and how did it compare to previous epidemiological studies?

4. Briefly describe the most common treatments for (a) problem behavior maintained by social reinforcement and (b) problem behavior maintained by automatic reinforcement.

5. The authors suggested that one possible explanation for the large number of participants for whom problem behavior was maintained by multiple social reinforcers was age. How might age have influenced behavior?

6. The authors indicated that Participant 98 (Figure 4) showed problem behavior maintained by automatic reinforcement and that Participant 39 (Figure 5) showed undifferentiated responding. What alternative interpretation is consistent with the data?

7. Admission data indicated that participants spent an average of 4 days undergoing assessment. How did the authors justify the extensive amount of time spent on assessment?

8. The authors suggested the possibility that some of their conclusions about behavioral functions may have represented false positives. How would one determine whether a given conclusion represented a false positive?

Questions prepared by Pamela Neidert and Sarah E. Bloom, University of Florida