

**FUNCTIONAL ANALYSIS AND TREATMENT
OF HUMAN-DIRECTED UNDESIRABLE BEHAVIORS
IN CAPTIVE CHIMPANZEES (*PAN TROGLODYTES*)**

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**FUNCTIONAL ANALYSIS AND TREATMENT
OF HUMAN-DIRECTED UNDESIRABLE BEHAVIORS
IN CAPTIVE CHIMPANZEES (*PAN TROGLODYTES*)**

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Dedicated to my parents for their unconditional love and unwavering support.

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SUMMARY

Functional analysis techniques traditionally used in the assessment of problem behaviors in humans were used to identify the reinforcing consequences for undesirable, human-directed behaviors such as feces throwing and spitting in two captive adult chimpanzees (*Pan troglodytes*). The first subject's problem behaviors were maintained by both positive and negative reinforcement contingencies, with rates being highest when the display of inappropriate behaviors resulted in access to social attention and juice. The implementation of a function-based treatment plan combining functional communication training with extinction resulted in a 90% reduction in the chimpanzee's inappropriate behaviors. No function was identified for the second subject's inappropriate behaviors. This project represents one of the first attempts to apply these function-based behavioral techniques to a non-human subject.

CHAPTER 1

INTRODUCTION

Captive chimpanzees housed in zoological parks and animal research facilities sometimes exhibit undesirable human-directed behaviors toward animal care staff or zoo visitors. These behaviors include spitting water, throwing feces or other objects at animal care staff (National Research Council of the National Academies [NRC], 2003) or zoo visitors (Maple, 1979), engaging in aggressive charging and drumming displays (NRC, 2003), and screaming. While many of these behaviors are considered normal behaviors in chimpanzees living in their natural environments (Goodall, 1986); when primates are kept in captivity, these behaviors can pose potential health risks to animal care staff (NRC, 2003), erode the relationship between the chimpanzee and its care staff, and intimidate or injure zoo visitors. The purpose of this study was to provide both a technique that may allow a better understanding of the cause and purpose of these behaviors and to identify an effective method for reducing these behaviors in the captive chimpanzee.

It is possible that the responses of care staff, researchers, or visitors during and/or after the occurrence of these undesirable behaviors inadvertently maintain or increase the occurrence of these behaviors. Animal care personnel often report that chimpanzees display these behaviors in an attempt to gain attention, get an individual to leave the area, or to escape a stressful situation. In academic literature, there are anecdotal reports suggesting that behaviors such as feces throwing increase if a potential human target reacts by screaming or laughing (Butovskaya & Kozintsev, 1996; NRC, 2003). This

suggests that these behaviors could be reinforced by human attention. At primate facilities, it is not uncommon to observe animal care staff and researchers providing chimpanzees with social attention and tangible items such as food following episodes of these problem behaviors in an attempt to scold or calm the animal. Instead of having the desired effect of eliminating the behavior, the delivery of attention and tangible items may act as a reinforcer and thus increase the likelihood of the behavior occurring in the future. This would suggest that these behaviors are sensitive to positive reinforcement.

Alternatively, these behaviors could be sensitive to negative reinforcement. That is, if a chimpanzee finds the presence of a human stressful, any behavior that removes that stress (i.e. gets the person to leave) is likely to be repeated. In primate facilities, care staff and researchers may quickly leave an animal area when a chimpanzee throws feces or begins its loud displays. Past research has established that both the presence of humans (Chamove, Hosey, & Schaetzel, 1998; Lambeth, Bloomsmith, & Alford, 1997) and routine husbandry tasks (Clarke, Mason, & Moberg, 1988; Line, Morgan, Markowitz, & Strong, 1989) are correlated with increased stress and problem behaviors in captive nonhuman primates. Therefore, it is possible that problem behaviors are being negatively reinforced by the removal of aversive stimuli when care staff, veterinarians, or researchers leave the area after the occurrence of these behaviors.

Despite multiple possible explanations for these human-directed problem behaviors, there have been no published studies that have tested these hypotheses empirically. One technique that could be useful in determining the reinforcing contingencies for these problem behaviors is the functional analysis technique. The purpose of a functional analysis is to identify the factors that reinforce and maintain a

particular problem behavior. Originally outlined by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), functional analysis techniques have historically been applied to self-injury (e.g. Iwata, Pace, Dorsey et al., 1994), aggression (e.g. Derby et al., 1994; Mace, Page, Ivancic, & O'Brien, 1986; Thompson, Fisher, Piazza, & Kuhn, 1998), stereotypies (e.g. Derby et al., 1994; Goh et al., 1995), food refusal (e.g. Munk & Repp, 1994; Piazza et al., 2003), and other problem behaviors in developmentally disabled children and adults (see Hanley, Iwata, & McCord, 2003 for a review). The value of using these techniques to assess and treat behavioral problems in captive animals is just beginning to be discussed and explored (see Bloomsmith, Marr, & Maple, 2007). In one project, a researcher was able to use functional analysis techniques to identify social attention from humans as a reinforcer for self-injurious behavior in a captive olive baboon (*Papio hamadryas anubis*) (Dorey, 2004).

During a functional analysis, subjects are exposed to a series of well-controlled conditions designed to determine under what conditions a behavior is more or less likely to occur. Contingent on the occurrence of the problem behavior(s) being studied, an experimenter provides the subject with putative reinforcers such as social attention, escape from a task, or access to a tangible item. The rates of problem behavior in these test conditions are compared with the rates of problem behavior in a control condition in which there are no demands placed on the subject and the subject is given response-independent social attention and/or tangible items (Iwata, Dorsey, et al. 1982/1994). By analyzing which contingencies result in higher rates of problem behavior as compared to a stable baseline in the control condition, the function of the problem behavior can be determined.

Determining a function of the behavior allows for the development of an effective treatment plan for decreasing the problem behavior. For example, problem behaviors reinforced by attention or escape can be reduced by implementing extinction of the reinforcer (i.e. not allowing escape or providing attention contingent on the behavior) and/or by delivering the reinforcer contingent on alternate, appropriate behaviors such as compliance or appropriate communication (e.g. Carr & Durand, 1985; Hanley, Piazza, Fisher, & Maglieri, 2005; Piazza et al., 1997). In some cases, extinction alone may result in the reduction of problem behaviors (e.g. Iwata, Pace, Cowdery, & Miltenberger, 1994; Repp, Felce, & Barton, 1998). However, extinction alone is rarely recommended as a behavioral treatment plan (Iwata, Pace, Cowdery et al., 1994). More often, reinforcement-based components are added to the treatment package. These additional components are added both to increase the effectiveness of the treatment and to reduce the occurrence of undesirable side effects of using extinction-only approaches. Two undesirable side effects of extinction procedures are often reported – extinction-induced aggression and extinction bursts. An extinction burst is a temporary increase in the frequency, magnitude, or length of the problem behavior as a result of the extinction procedure. Extinction-induced aggression is an increase in aggression that occurs with the onset of extinction. This aggression has been reported both in laboratory studies with pigeons (Azrin, Hutchinson, & Hake, 1966) and in human clinical settings. Lerman, Iwata, and Wallace (1999) found that in children undergoing behavioral treatment at their clinic, extinction-only treatment packages resulted in an extinction burst 62% of the time and in extinction-induced aggression 29% of the time. In contrast, when treatment packages included reinforcement components, extinction bursts occurred in only 15% of

the cases and aggression in 15% of the cases. Thus, reinforcement based treatment components are often added to a treatment package to reduce these side effects. In addition, it is generally desirable to develop a treatment plan that provides not only for the reduction of the problem behavior but also for the replacement of those behaviors with more socially useful behaviors (Carr & Durand, 1985). Reinforcement-based methods, when used together with extinction, can be used to accomplish both goals.

One reinforcement-based treatment technique studied in human literature is functional communication training (FCT). Originally outlined by Carr and Durand (1985), FCT is a specialized form of differential reinforcement of an alternative behavior (DRA). However, in functional communication training, the reinforcer used is not chosen arbitrarily but is the same reinforcer that has been shown through a functional analysis to maintain the problem behavior the investigator wishes to reduce. In addition, the response required to gain the reinforcer is often a specific request for that reinforcer. That is, FCT involves teaching a subject to make a socially appropriate request for the same reinforcer that maintains the inappropriate target behavior. The chimpanzee could be taught a behavior that, in effect, would allow the subject to communicate “Play with me” or “Go away.” In humans, FCT has been shown to be an effective technique for reducing severe behavior problems such as aggression, disruptive behavior, and self-injury and for increasing more socially appropriate forms of communication (e.g. Bailey, McComas, Benavides, & Lavasz, 2002; Carr & Durand, 1985; Fisher et al., 1993; Wacker et al., 1990). However, further analysis has shown that FCT is most effective when it is combined with extinction rather than used alone (Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquistio, & LeBlanc, 1998). Thus, it seems promising that a treatment plan

including both extinction and functional communication training could be used successfully to reduce problem behaviors of nonhuman primates.

In this study, a functional analysis was conducted on two captive chimpanzees housed at the Yerkes National Primate Research Center (YNPRC). Based on evidence that the behaviors of feces throwing, object throwing, spitting, engaging in aggressive displays, and screaming could be reinforced by both positive and negative reinforcement contingencies, we conducted two test conditions. In the positive reinforcement condition, the chimpanzee was given access to social attention and fruit juice contingent on the target behaviors. In the negative reinforcement condition, we created an avoidance paradigm by showing the chimpanzee a syringe while directing the animal to present for an injection. The experimenter left the animal's area (i.e. remove the potentially aversive stimuli) contingent on the display of the target behaviors. We compared the rates of the problem behaviors under these conditions to rates of behavior in a control condition in which there were no demands placed on the chimpanzee and response-independent social attention and fruit juice were provided. We predicted that the functional analysis technique would be successful in identifying a function for human-directed undesirable behaviors in our subjects.

When a function for the inappropriate behaviors was identified by the functional analysis, we conducted a function-based treatment assessment evaluating the effectiveness of both extinction alone and extinction with FCT. At our current research site, animal care staff members are often advised that if they ignore the chimpanzee's inappropriate behaviors that the animal will stop exhibiting these problem behaviors. Therefore, an extinction condition was conducted to help to evaluate the effectiveness of

this recommendation in this environment and to determine whether or not extinction used alone would result in undesirable side effects in these subjects. However, given previous research showing the increased effectiveness of a combination treatment involving both extinction and FCT components, we evaluated this combination treatment as a final treatment package for the subjects. We hypothesized that rates of the problem behaviors for both subjects would be reduced following the implementation of function-based treatments.

CHAPTER 2

GENERAL METHOD

Subjects and Setting

The subjects were adult male chimpanzees born and nursery-raised at the Yerkes National Primate Research Center (YNPRC) and housed as part of the general research colony at the YNPRC main station in Atlanta, Georgia. The chimpanzees were chosen as subjects for the study based on their histories of engaging in the target behaviors with care staff and researchers at the facility. Subject 1 was 27 years old and was singly housed in an indoor / outdoor enclosure that allowed him access to both an outdoor run that measured 2.29 m wide, 4.27 m deep, and 2.44 m tall and a climate-controlled indoor area measuring 2.29 m wide, 2.29 m deep, and 2.54 m tall. Subject 2 was 17 years old and was socially housed with two adult female chimpanzees. Subject 2's group was housed in two connected runs, each with the same dimensions as Subject 1's enclosure.

The same experimenter (the author) conducted all sessions. During sessions, the experimenter was separated from the chimpanzee by metal caging and was positioned in a corridor in front of the indoor portion of the chimpanzee's enclosure. Appropriate personal protective equipment, including latex gloves, a facial mask, and a plastic facial shield, was worn at all times. Before each session block, the chimpanzee was locked in the indoor portion of his enclosure. The subject was given verbal praise and a food item for coming inside and allowing the door to be closed. Because Subject 2 was socially housed, he was also separated from the other members of his social group prior to each session block. Positive reinforcement training was conducted with each member of his

group. The chimpanzees were given food items and verbal praise contingent on complying with commands to move to a different location and remain still while doors were closed. The subjects were allowed access to the outdoor portion of their enclosures immediately following each session block and were again given a food item for complying with the door opening procedure.

Due to factors such as cage cleaning schedules, ongoing environmental enrichment protocols at the facility, and the ability of the subjects to move objects between the indoor and outdoor portions of their enclosures, the objects available to the subjects varied between session blocks. These objects included items such as rubber toys, balls, barrels, and destructible items. The amount of feces present in the cage also varied from session to session. In addition, music was played on the great ape wing during some testing times as part of an existing enrichment protocol. Due to previous research on the possible influence of idiosyncratic stimuli on functional assessments (Carr, Yarbrough, & Langdon, 1997; Van Camp et al., 2000), data were taken on these variables for each session so that the influence of these varying events could be further analyzed if warranted. Regardless of these variations, the subjects always had either a food biscuit or feces available for throwing, water available for spitting, and the ability to display or scream in each session.

No food deprivation was used as a part of this study. The subjects remained on their normal diets consisting of commercial primate chow supplemented with fruits, vegetables, and other dietary enrichment. The subjects had access to water at all times. The YNPRC is accredited by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC). All research was conducted with

approval from Emory University's Institutional Animal Care and Use Committee (IACUC).

Response Definitions and Data Collection

The targeted inappropriate behaviors for the initial assessments included object throwing, feces throwing, spitting, screaming, and engaging in aggressive displays such as cage shaking, cage rushing, and barrel scraping. Object or feces throwing was scored when the subject picked up fecal matter or another item with his hands and threw the item at least 30 cm from his body. Spitting was scored when the chimpanzee expelled liquid that traveled at least 15 cm from his mouth. Screaming was defined as a high-pitched, loud vocalization. Displaying was broken down into cage rushing, cage shaking, and barrel scraping. Cage rushing was scored when the chimpanzee moved toward and made contact with the front of the cage with enough force to cause an audible rattling of the cage. Cage shaking was defined as the subject holding onto the cage or cage door with his hands as he pushed and pulled the material with enough force to make an audible sound or by the subject repeatedly kicking his cage or cage door. Barrel scraping was scored when the chimpanzee moved the barrel back and forth making an audible scraping sound. Barrel scraping was only to be scored if the barrel was displaced at least 30 cm.

An additional distinction was made between behaviors that occurred with the establishing operations (EO) present or absent (see Michael, 1993, for a discussion of establishing operations). For example, in positive reinforcement conditions, the establishing operation was attention deprivation. Therefore, target behaviors occurring while the experimenter was ignoring the subject were scored as EO present while behaviors occurring during the delivery of attention and juice were scored as EO absent.

Similarly, behaviors occurring when the aversive stimuli were present during the negative reinforcement condition were scored as EO present and those occurring when the experimenter was standing away from the cage and the syringe was not visible were scored as EO absent. Because of the importance of considering EO effects in both the assessment and treatment of problem behaviors (see McGill, 1999), this method of data collection was used to allow for further analyses of the data if warranted.

All sessions were videotaped with a digital camcorder set up on a tripod located diagonally in front of the animal's enclosure. Due to the complexity involved with simultaneously delivering the necessary reinforcement contingencies, operating timers, and collecting data, sessions were scored by the experimenter via videotape for accuracy. The experimenter operated both a 10 min session timer and a 20 s reinforcement or demand timer during each session. Subject 1's functional analysis was scored on paper data sheets. For data collection purposes, each session was divided into 30 s intervals, and the observer scored the number of times that each target behavior (object throwing, feces throwing, spitting, screaming, hooting, or displaying) occurred during each interval in addition to whether or not reinforcement was provided during each interval. All other assessments were scored on a handheld HP iPAQ computer (hx2400 series) using the The Observer® software (Noldus Information Technology, version 5.0.31). The Observer® software allowed for real-time data scoring in which the duration and sequence of all behaviors were recorded. In addition to the target behaviors, the ethogram configuration allowed the observer to score the presence or absence of reinforcement.

Interobserver Agreement

A second, trained observer scored 43% of all sessions including at least 35% of all sessions in each assessment. An observer was considered trained if he/she achieved 80% or higher interobserver reliability on three consecutive sessions. Percent agreement was calculated by dividing the number of matches by the sum of the number of matches and errors and multiplying that result by 100. For Subject 1's functional analysis, this was calculated by hand. Matches were defined as 30 second intervals in which the two observers agreed on the nonoccurrence or the exact number of occurrences of all behaviors in that interval. Errors were defined by any interval that included a disagreement between the observers. For this assessment, agreement averaged 92.5% (range 70 – 100%). For all other assessments, interobserver reliability was calculated using The Observer® software. A duration and sequence based analysis was run in which a match was scored for each second of the observation in which the same behaviors in the configuration were scored by the two observers. An error was scored for any second in which the observers scored different behaviors. For Subject 2's functional analysis, the average percent agreement was 99% (range 96.1 – 99.9%). For Subject 1's treatment assessment, the average percent agreement was 94.6% (range 79.1 – 98.7%). For Subject 1's generalization assessment, percent agreement averaged 98.1% (range 97.3 – 98.8%).

Data Analysis

The data for all assessments were interpreted via visual inspection. While structured criteria have been developed for interpretation of single-case designs (Hagopian et al., 1997; Fisher, Kelley, & Lomas, 2003), we felt that visual inspection was more appropriate for our data sets. The structured methods are most useful when the

difference in the level of a dependent variable between two phases is difficult to determine. Clinically, we were looking for obvious differences in the levels between two phases. That is, even if statistical methods detected a small change in rates of inappropriate behaviors between phases, it would not be meaningful to our assessment unless the rates obviously increased or decreased between phases. In addition, structured criteria are often not as useful when the contingencies produce carry-over effects or extinction bursts. For our study, sessions were conducted until a clear trend was identified by the experimenter and a second rater, both with previous single-case design experience. Conditions showing differentiation from the control condition were repeated in order to establish replication and experimental control.

CHAPTER 3

EXPERIMENT 1: SUBJECT 1 FUNCTIONAL ANALYSIS

Method

A functional analysis (Iwata, Dorsey, et al., 1982/1994) was conducted to identify the reinforcers maintaining Subject 1's inappropriate human-directed behaviors. Each session was 10 min in length. Multiple sessions were conducted back-to-back, with the number of sessions conducted during one block ranging from two to five. Sessions were run between the hours of 12:00 p.m. and 1:00 p.m. or 3:30 p.m. and 5:30 p.m. These times allowed for a minimal number of distractions from husbandry procedures such as feeding and cage washing.

The functional analysis was conducted in a reversal (ABAC) design. The initial order of the test conditions (B and C) was chosen at random. The analysis compared the test conditions of positive and negative reinforcement to a control condition. During the control condition, the experimenter provided the subject with continual social interaction in the form of talking, playing, imitating, touching, and/or grooming the subject. In addition, diluted sugar-free fruit juice was delivered via a squeeze bottle every 20 s on a fixed time (FT 20 s) schedule. During the positive reinforcement condition, the experimenter sat on a stool positioned approximately 1.2 m from the chimpanzee's enclosure and faced away from the subject. The experimenter ignored the subject while pretending to work on paperwork. When the chimpanzee engaged in a target behavior, the experimenter approached the chimpanzee and provided 20 s of social attention in the form of verbal reprimands and coaxing (e.g. "Don't throw that at me." "Put that down,"

“You need to calm down,” etc.) and 20 s of access to fruit juice. During the negative reinforcement condition, the experimenter wore a white, disposable Tyvek® suit. She stood directly in front of the chimpanzee’s enclosure and held a capped syringe up to the cage bars while giving the command to “present” for injection on an FT 20 s schedule. If the chimpanzee complied with the demand by pressing his shoulder or thigh up to the bars and allowing the experimenter to place the capped syringe against his skin for 2 s, the experimenter delivered brief verbal praise, put the syringe out of sight, and stepped back a few steps from the chimpanzee’s enclosure. When the chimpanzee engaged in a target behavior, the experimenter provided the subject with 20 s of escape by removing the syringe and going out of sight of the chimpanzee for 20 s.

Results and Discussion

Figure 1 shows the results of the reversal design functional analysis of the chimpanzee’s inappropriate human-directed behaviors. The number of combined inappropriate behaviors occurring per minute is graphed as a function of session number and conditions. When broken down into percentages, 59.8% of the inappropriate behavior consisted of spitting, 29.3% consisted of feces throwing, 10.3% were instances of object throwing, and one scream represented 0.5% of the data. No aggressive displays were observed during the sessions. Overall rates of inappropriate behavior were highest in the positive reinforcement condition ($M = 0.67$, $SD = 0.47$) and lowest in the control condition ($M = 0.10$, $SD = 0.26$). Rates in the negative reinforcement condition fell between these two values ($M = 0.38$, $SD = 0.25$).

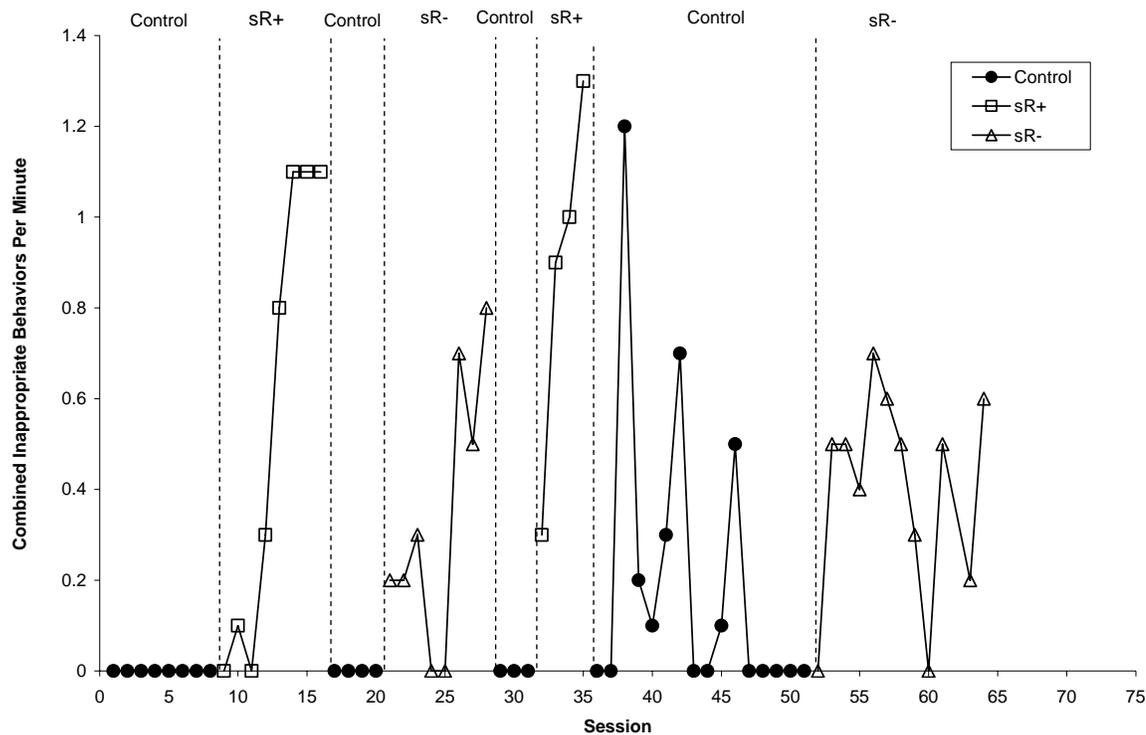


Figure 1. Number of inappropriate behaviors per minute in control, positive reinforcement (sR+), and negative reinforcement (sR-) conditions during Subject 1's functional analysis.

In the initial control phase, no inappropriate behaviors occurred. Inappropriate behaviors rose sharply beginning in the fourth session of the first positive reinforcement phase and leveled off at a rate of 1.1 behaviors per minute. This was followed by a reversal back to zero rates of inappropriate behaviors in the subsequent control phase. An increasing, although more variable, trend was demonstrated in the first negative reinforcement condition. The following control phase shows that the implementation of response-independent reinforcement and the absence of demands once again resulted in an immediate reversal to zero rates of problem behavior. The second positive

reinforcement phase shows replication of high and increasing rates of problem behavior in this condition. Unlike the previous rapid reversals, the control phase following this second positive reinforcement condition showed variable rates of problem behavior before once again stabilizing at zero. The final negative reinforcement phase shows rates of problem behavior that are variable but at a level higher than that seen in the control phases. These data suggest that the subject's inappropriate behaviors may be sensitive to both positive reinforcement and negative reinforcement contingencies. However, rates of inappropriate behavior were highest under positive reinforcement contingencies suggesting that Subject 1's problem behaviors may be more sensitive to these contingencies.

There was variability in the data during the third control reversal. The variability seen in this phase could be due to a number of factors. It could be representative of an extinction burst occurring due to carry-over effects from the previous positive reinforcement condition. While the subject did receive constant attention during the control phase, the occurrence of the target behaviors did not result in a specific reaction from experimenter like it did in the positive reinforcement condition. Thus, the characteristic and quality of the reinforcement was different. If the reactivity of the experimenter was reinforcing to the subject, the elimination of this component in the control phase could represent placing this aspect of the reinforcer on extinction, and an extinction burst would be likely to occur. Indeed, these data are suggestive of such a pattern. Alternatively, the variable rates of behavior could be the result of negative side effects from the response-independent reinforcement provided in the control condition (see Vollmer, Ringdahl, Roane, & Marcus, 1997). The fixed-time delivery of the fruit

juice during the control phase could have inadvertently maintained the problem behaviors. Since the juice was delivered regardless of the chimpanzee's behavior, during sessions in which problem behaviors occurred, the delivery of juice occasionally coincided with the display of these behaviors. Thus, the response-independent delivery of juice was occasionally mixed with incidental response-dependent delivery that could have maintained these behaviors. Vollmer et al. found that the implementation of a momentary differential reinforcement of other behavior procedure (MDRO) can counteract these negative side effects. Therefore, we determined that if a similar data pattern was seen in future functional analyses, an MDRO procedure where the occurrence of a target behavior in the control condition "resets" the 20 s reinforcement timer would be implemented to ensure that no incidental reinforcement of the inappropriate behaviors occurs.

It is important to note that there were key differences between the negative reinforcement condition run in our assessment and the demand phase typically run in human functional analyses. In a typical functional analysis, the child (or adult) is presented with demands to complete a task. If the subject does not comply, the experimenter uses physical guidance to compel the subject to complete the task (Iwata, Dorsey, et al., 1994). Thus, the only way for the subject to escape the task during the session is to display a target behavior. However, in our assessment, the chimpanzee was able to escape presenting for the syringe simply by sitting at the back of his cage and not complying with the demand. What the chimpanzee could not avoid was the presence of the experimenter and the repeated demands to present for an injection. While this is not a true escape paradigm in the sense that the animal was unable to escape the task, the

contingencies do reflect the contingencies most commonly found in the animal's environment. At the YNPRC, humans do not enter the chimpanzees' enclosures. Chimpanzees are trained to comply with everyday husbandry tasks, routine veterinary procedures, and research tasks such as using computer touch screens. Participation in these tasks is voluntary. Thus, if the animals' inappropriate behaviors are being maintained by negative reinforcement, it is likely that the function is to avoid the presence of humans or the repeated demands to comply with tasks – not to actually avoid the task (since that can be accomplished through passive noncompliance). It is likely that an escape paradigm involving something that the animal could not escape from (such as a veterinary dart gun) would produce different results. However, we feel that our contingencies more closely resemble those found in the animals' everyday lives.

CHAPTER 4

EXPERIMENT 2: SUBJECT 2 FUNCTIONAL ANALYSIS

Method

The procedures for the second functional analysis were the same as those used with Subject 1. However, when no meaningful differences in levels of inappropriate behaviors were observed in the positive or negative reinforcement conditions for Subject 2, an additional target behavior, hooting, was added to the assessment. Hooting was defined as repeated, low-pitched, moderately loud calls made with lips pursed in a pout. We observed that, outside of sessions, Subject 2's inappropriate behaviors often began with hooting. The hooting would then escalate into screaming, displaying, or throwing. Indeed, in wild chimpanzees, certain types of pant-hoots often end in screaming or displaying (Goodall, 1986). Based on these observations, we believed that hooting might be part of the same response class as the other target behaviors. A response class is a group of responses that all have the same function (Skinner, 1969, Pierce & Cheney, 2004). Changing the contingencies for one topography in the response class can influence other topographies in the class (Sprague & Horner, 1992). The different topographies in a response class may be hierarchically related (Lalli, Mace, Wohn, & Livezey, 1995). That is, an individual may display the behaviors in the response class in a particular temporal order. Lalli et al. found that when treatment was applied to the last topography in the response hierarchy, all of the behavioral topographies were generally displayed in sequence. However, when treatment was applied to topographies earlier in the hierarchy, subsequent topographies were not displayed. In the test conditions of our functional

analysis, only our target behaviors were reinforced. Since hooting was not a target behavior for our first two test conditions, it was never reinforced. Thus, if our subject's response-class hierarchy consisted of hooting, displaying, and then screaming and/or throwing, then the contingencies in place for our functional analysis may have been inadvertently extinguishing the entire response class. To test this hypothesis, we re-scored all previously conducted sessions with hooting added to the ethogram. Since hooting had occurred primarily in the positive reinforcement condition, a second positive reinforcement condition was conducted in which hooting was reinforced in addition to the other target behaviors.

Results and Discussion

No function was identified for Subject 2's inappropriate behaviors. The chimpanzee displayed very few inappropriate behaviors during the initial three phases of the functional analysis (Figure 2). The subject only displayed four inappropriate behaviors, screaming twice and cage shaking twice. There were no inappropriate behaviors in the control or negative reinforcement conditions, and the rate of inappropriate behaviors in the first positive reinforcement condition (without hooting) were very low ($M = 0.03$, $SD = 0.06$). Hypothesizing that hooting could represent the first behavior in a response-class hierarchy (Lalli et al., 1995), we re-scored the previously run sessions and ran a second positive reinforcement condition in which hooting was reinforced. However, the rate of hooting did not differ substantially between the positive reinforcement conditions in which hooting was ($M = 0.13$, $SD = 0.17$) and was not ($M = 0.16$, $SD = 0.26$) reinforced, and the duration of hooting was actually somewhat lower when hooting was being reinforced ($M = 1.19$, $SD = 2.14$) as compared

to when it was not ($M = 7.81, SD = 10.38$) (Figure 3). The rates of inappropriate behavior in the second positive reinforcement phase ($M = 0.16, SD = 0.26$) are slightly higher than those seen in the first positive reinforcement phase ($M = 0.03, SD = 0.06$) (Figure 2). However, this is due simply to the inclusion of the hooting data. If the hooting data is included in both positive reinforcement phases, the rates of inappropriate behavior are nearly identical ($M = 0.15, SD = 0.20$ and $M = 0.16, SD = 0.26$).

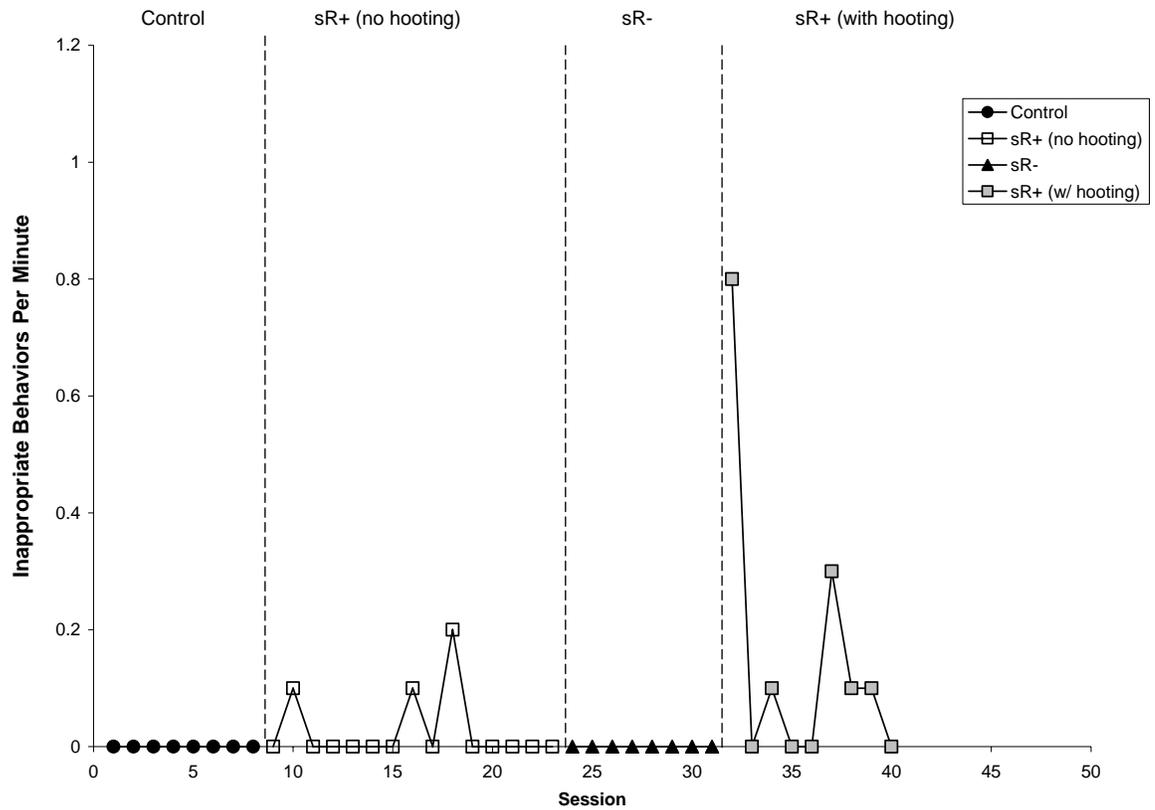


Figure 2. Number of inappropriate behaviors per minute in control, positive reinforcement (sR+), and negative reinforcement (sR-) conditions during Subject 2's functional analysis.

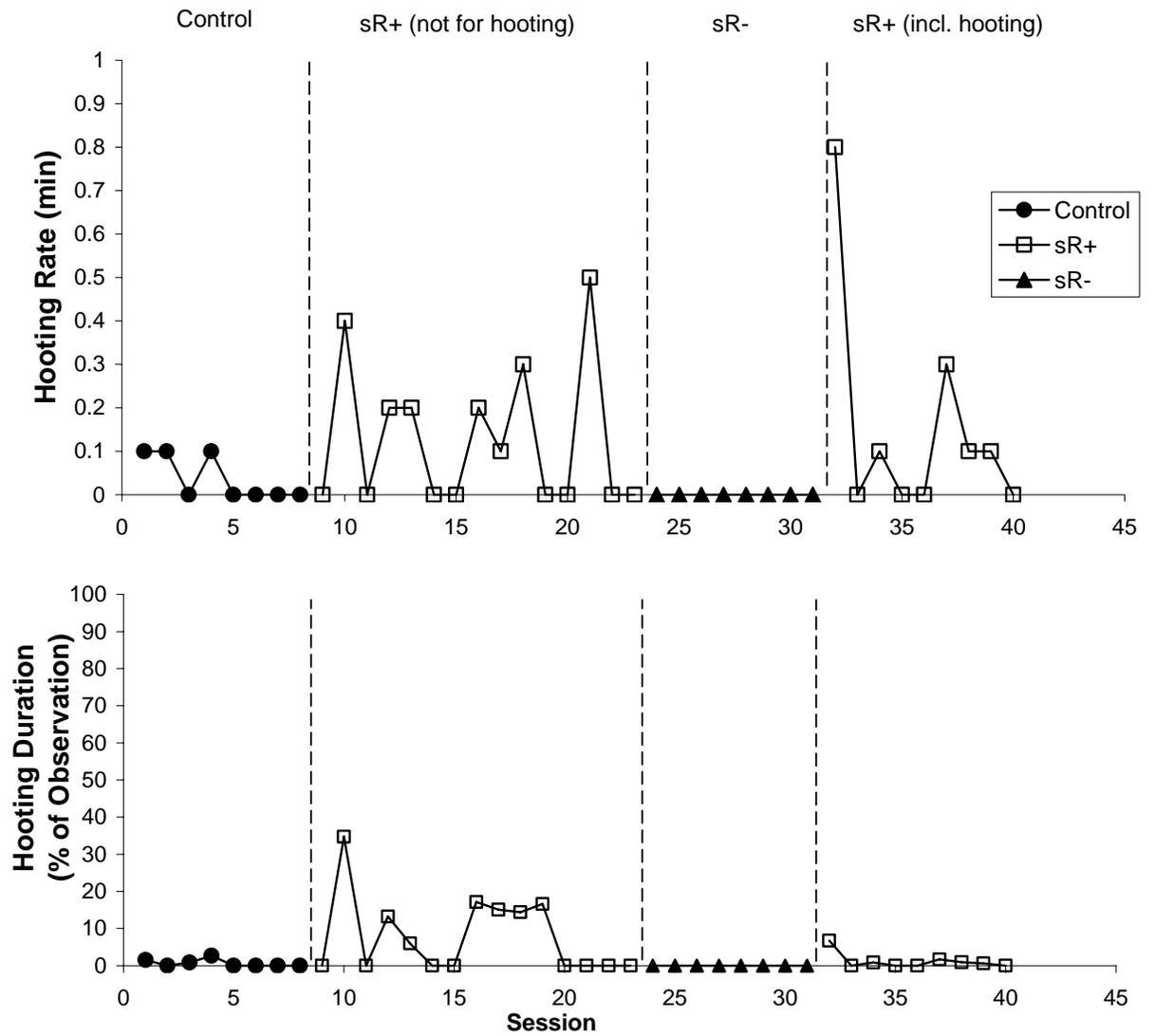


Figure 3. Rate (min) and Duration (% of session) of hooting in control, positive reinforcement (sR+), and negative reinforcement (sR-) conditions during Subject 2's functional analysis.

Our functional analysis failed to identify the maintaining variables for Subject 2's inappropriate behaviors. In humans, problem behaviors are thought to be maintained by three general classes of behavior – positive reinforcement, negative reinforcement, or non-environmental, automatic reinforcement (Iwata, Vollmer, & Zarcone, 1990). Our functional analysis tested two specific positive and negative reinforcement paradigms. The fact that Subject 2's behaviors did not respond to these specific contingencies should not be generalized to conclude that the subject's behaviors are not sensitive to the broad categories of positive or negative reinforcement. Problem behaviors are often sensitive to very specific aspects of these reinforcement categories (Carr, Yarbrough, & Langdon, 1997; Van Camp et al., 2000). Carr et al. state that the influence of idiosyncratic variables should be suspected when there is a discrepancy between interview or observational data and functional analysis results. Indeed, individuals working with Subject 2 on a regular basis reported that the subject displayed frequent problem behaviors including hooting, displaying, and throwing. However, rates of these behaviors were very low in our functional analysis. It is important that the specific events or conditions that precede or maintain a behavior are identified and included in a functional analysis. If they are not included, little or no problem behaviors may be observed (Van Camp et al.). Research has shown that seemingly small differences in the antecedents or consequences for a behavior can alter the results of a functional analysis. For example, one child would engage in high rates of problem behavior in the positive reinforcement (social attention) condition when the therapist read a magazine while ignoring the child during the session but not when the therapist read a book (Carr et al.). Other factors such as the nature of the demand (Fisher, Adelinis, Thompson, Worsdell, & Zarcone, 1998; Iwata, Pace, Kalsher,

Cowdery & Cataldo, 1990), the presence of music (Iwata, Pace, Dorsey et al., 1994), and the presence of specific staff members (Halle & Spradlin, 1993) have also been shown to influence rates of problem behaviors. Thus, given the discrepancy between Subject 2's reported rates of problem behavior and the rates observed in the functional analysis, it seems likely that our assessment did not contain the specific contingencies that maintain his problem behaviors. Interview data and personal observation reveals that factors such as individual staff members, staff members giving attention to neighboring chimpanzees, and staff members walking (as opposed to simply standing or sitting) in front of the subject's cage may make it more likely that the subject will engage in inappropriate behaviors. In order to investigate this possibility, a descriptive analysis (e.g. Carr et al., 1997; Sasso et al., 1992) could be conducted to try to identify the idiosyncratic variables that could be influencing Subject 2's problem behaviors, and an additional functional analysis including these variables could be conducted.

CHAPTER 5

EXPERIMENT 3: SUBJECT 1 TREATMENT ASSESSMENT

Method

The functional analysis for Subject 1 showed that his inappropriate behaviors were maintained by both positive and negative reinforcement, with rates highest in the positive reinforcement condition. Therefore, we designed a treatment plan that incorporated extinction of the strongest maintaining reinforcer (positive reinforcement) in response to the subject's inappropriate behaviors and an alternative way for the subject to access that reinforcer. We conducted a treatment assessment to compare his rates of inappropriate behavior under extinction only and extinction with FCT contingencies compared with a positive reinforcement baseline in a reversal design. The sessions were 10 min in length and were conducted in the same setting and at the same times as the subject's functional analysis.

Baseline

The contingencies for the treatment baseline condition were almost identical to the positive reinforcement condition of the functional analysis. The experimenter ignored all behaviors except for the target behaviors. Contingent on the occurrence of the target behaviors, the experimenter provided the subject with 20 s of social attention and access to fruit juice. The only addition to the baseline phase was that the subject had access to the functional communication device. This device was a 2.5 cm wide poly-vinyl chloride (PVC) ring cut from a section of PVC pipe 17 cm in diameter. The ring was hung on the outside of the subject's cage by placing it over a metal dowel that was secured to the cage

with two metal plates (see Figure 4). During the baseline phase, all interaction with the PVC ring was ignored.



Figure 4. Photograph of chimpanzee using the functional communication training (FCT) device

Extinction

In this phase, the experimenter stood in front of the chimpanzee's cage, facing away from the subject. She did not provide the subject with any social attention or juice regardless of the chimpanzee's behavior. Again, the FCT communication device was accessible to the subject during this phase, but all interaction with the device was ignored.

FCT Training

Prior to the FCT phase of the treatment analysis, a shaping procedure was used to train the chimpanzee on the appropriate functional communication response. The final response consisted of the chimpanzee grasping the PVC ring with at least two fingers and holding it for at least 2 seconds. The target response was shaped using the clicker training method. The subject had been previously exposed to this training method by both the experimenter and others at the facility for training basic husbandry and veterinary tasks. In this training method, a conditional reinforcer and bridge (the click) was established through repeated pairings with a food item. To shape the appropriate FCT response, the click / food item combination was used to reinforce closer and closer approximations of the final behavior (see Laule & Whittaker, 2001; Pryor, 1985). The behaviors of looking at, approaching, touching, and then holding the ring were reinforced. Fruit juice, grapes, dried apricots, and banana slices were used as food rewards. Social praise was also provided. The subject was considered trained when he independently offered the response three times in a row for three training sessions in a row. Training sessions were videotaped. It took 21 min of training time spread out across 5 sessions and 3 days for the chimpanzee to meet criteria on the FCT response.

FCT with Extinction

During this phase, the experimenter ignored all inappropriate behaviors just as she did in the extinction alone phase. However, if the chimpanzee displayed the appropriate functional communication response (i.e. holding the PVC ring with at least two fingers for at least 2 s), 20 s of social attention and access to fruit juice were provided.

Results and Discussion

During this assessment, the subject's inappropriate behaviors consisted of 47% feces throwing, 42% spitting, 10% object throwing, and 1% screaming. Results for the treatment assessment are shown in Figure 5. High rates of inappropriate behavior were seen in the initial baseline phase ($M = 0.94$, $SD = 0.33$). The implementation of extinction resulted in an extinction burst, with Subject 1 exhibiting 2.7 inappropriate behaviors per minute in the first extinction session. Rates of inappropriate behaviors during the remainder of the extinction phase were variable but high ($M = 0.79$, $SD = 0.66$). After a total of 2.5 hrs of data collection in this phase without a meaningful reduction in inappropriate behaviors, we made the decision to move to the assessment of the combination treatment of extinction and FCT. Rates of inappropriate behaviors showed a high and increasing trend in the second baseline phase ($M = 1.7$, $SD = 0.5$). Once extinction with FCT was implemented, inappropriate behaviors decreased ($M = 0.18$, $SD = 0.2$) while FCT responses increased from zero in the previous baseline condition to an average of 1.59 responses per minute ($SD = 0.44$) in the extinction with FCT condition. A reversal to baseline conditions resulted in high rates of inappropriate behaviors ($M = 1.93$, $SD = 0.5$) and decreasing levels of FCT responses ($M = 0.37$, $SD = 0.38$). Re-implementation of the treatment package once again resulted in low rates of inappropriate behaviors ($M = 0.17$, $SD = 0.25$) and high rates of FCT responses ($M = 2.06$, $SD = 0.38$). These results indicate that the combination of extinction and FCT was successful in reducing the subject's inappropriate behaviors.

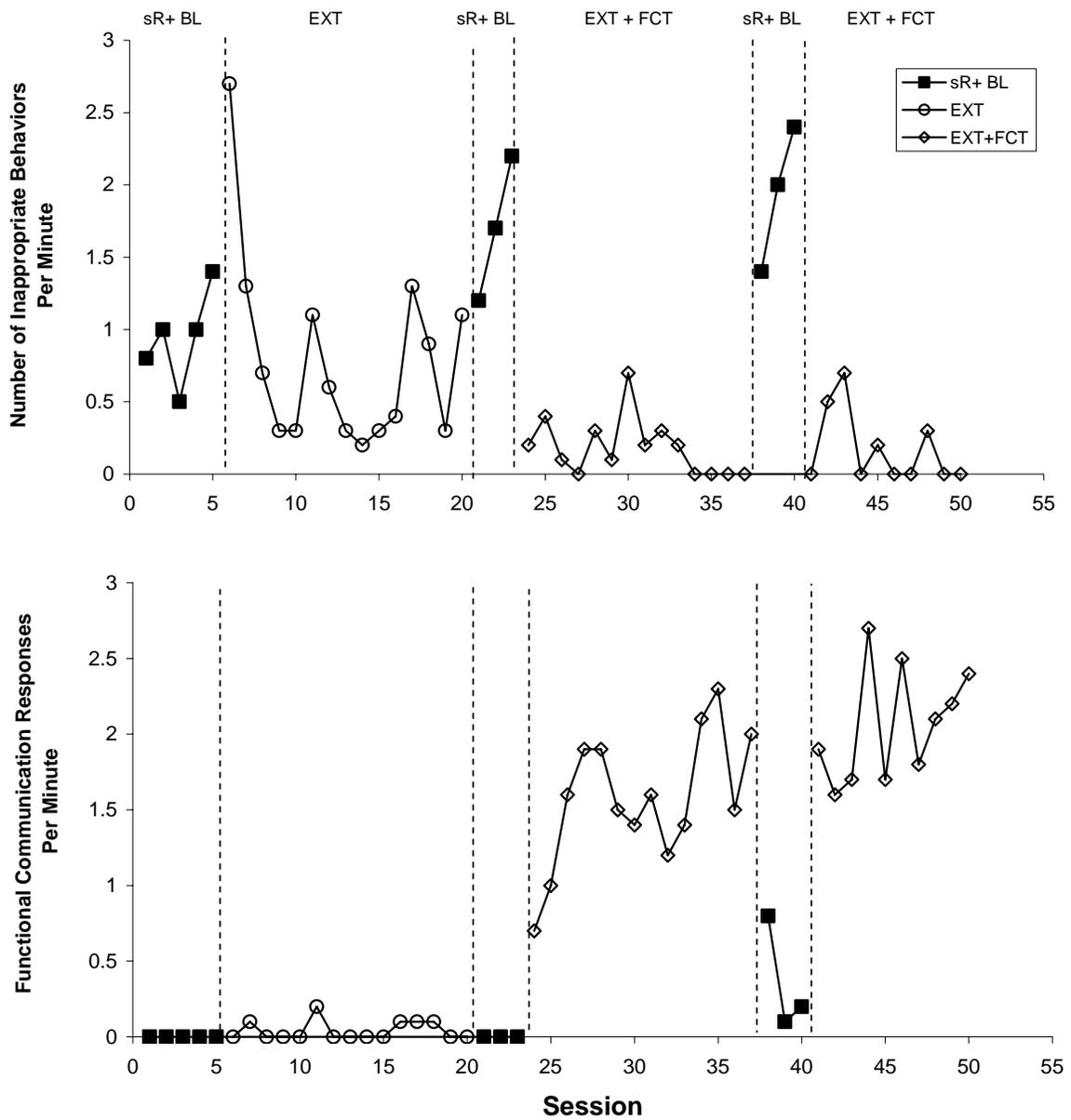


Figure 5. Number of inappropriate behaviors and functional communication responses per minute in positive reinforcement baseline (sR+ BL), extinction (EXT), and extinction with functional communication training (EXT + FCT) conditions in Subject 1's treatment assessment

The data from the extinction-only phase suggest that the subject's inappropriate behaviors are resistant to extinction. This is not surprising given the subject's long history of being reinforced for these behaviors. In addition, even though no reinforcement was being provided for these behaviors during sessions, the subject was likely still receiving reinforcement for these behaviors from other staff members outside of session times. This assessment does not address whether or not the subject's inappropriate behaviors would be reduced if everyone at the primate facility implemented extinction contingencies for these behaviors for an extended period of time. However, it does suggest that an implementation of extinction-only contingencies is likely to result in an extinction burst and would need to be implemented long-term before a reduction in inappropriate behaviors was seen.

In contrast, when the opportunity for the subject to gain access to reinforcement was added to the treatment plan, inappropriate behaviors were quickly reduced without the presence of an extinction burst. In addition, training the subject to make the appropriate FCT response took only a short amount of time. This treatment assessment suggests that integrating the subject's functional analysis results into a treatment package was successful in reducing his inappropriate human-directed behaviors.

CHAPTER 6

EXPERIMENT 4: SUBJECT 1 GENERALIZATION ASSESSMENT

Great apes such as chimpanzees often do not trust unfamiliar people (NRC, 2003). The presence of unfamiliar humans is generally thought to be stressful for primates (Chamove et al., 1988; Cook & Hosey, 1995; Hosey, 2005), and the presence of these unfamiliar humans has been found to result in high rates of aggression and displaying directed both at other chimpanzees and at the unfamiliar humans (Maki, Alford, & Bramblett, 1987; Rumbaugh, 1988). In primate facilities, this is often demonstrated when inspectors and other visitors are guided through the facility only to be greeted with loud, aggressive displays and a barrage of feces, pieces of food, or saliva. In order to assess whether our treatment plan would also reduce the chimpanzee's inappropriate behavior toward unfamiliar strangers, we conducted a generalization assessment in which Subject 1's rate of inappropriate behavior toward strangers was recorded under baseline and treatment contingencies.

Method

Eight confederates were recruited for the study. The confederates were employees at YNPRC and worked regularly with non-human primates but were unfamiliar to the chimpanzees at the facility. The confederates were randomly assigned to the baseline or treatment phase. Two substitutions had to be made in the treatment phase due to changes in staff availability. Sessions were 5 min in length. In both conditions, the confederates would stand with the experimenter in front of the subject's cage. Confederates were instructed to ignore the chimpanzee. The confederate and experimenter engaged in

conversation similar to what would be expected if the experimenter was giving a tour of the facility. The FCT device (PVC ring) was available to the subject during all sessions. Baseline sessions were conducted across three days during the baseline phase of the treatment assessment. In the positive reinforcement baseline, the experimenter ignored the chimpanzee unless a target behavior was displayed. Just as in the baseline phase of the treatment assessment, the experimenter would give 20 s of social attention in the form of reprimands and coaxing (e.g. “That wasn’t nice.” “Don’t throw at her.” “You need to calm down.” “Come have some juice and calm down.” etc.) and access to fruit juice contingent on the display of an inappropriate behavior. Treatment sessions in which the extinction with FCT treatment package was implemented were conducted across three days after the completion of Subject 1’s treatment assessment. During the treatment phase, the experimenter ignored all inappropriate behaviors but provided 20 s of social attention in the form of praise and play in addition to access to fruit juice contingent on the chimpanzee exhibiting an appropriate FCT response (i.e. grasping the PVC ring). The confederate did not interact with the chimpanzee during either phase.

Results and Discussion

During the generalization assessment, 76% of the subject’s inappropriate behavior was feces throwing, 14% was spitting, 5% was object throwing, and 5% was cage shaking. Results from the generalization assessment are shown in Figure 6. During the positive reinforcement baseline phase, rates of inappropriate behavior were high ($M = 0.89$, $SD = 0.34$), and there were no FCT responses. During the treatment phase, the subject exhibited decreased rates of inappropriate behavior ($M = 0.15$, $SD = 0.19$) and increased rates of FCT responses ($M = 1.20$, $SD = 0.71$). Our results suggest that the

effects of our treatment plan are quite robust, reducing levels of inappropriate behavior even in the presence of unfamiliar humans.

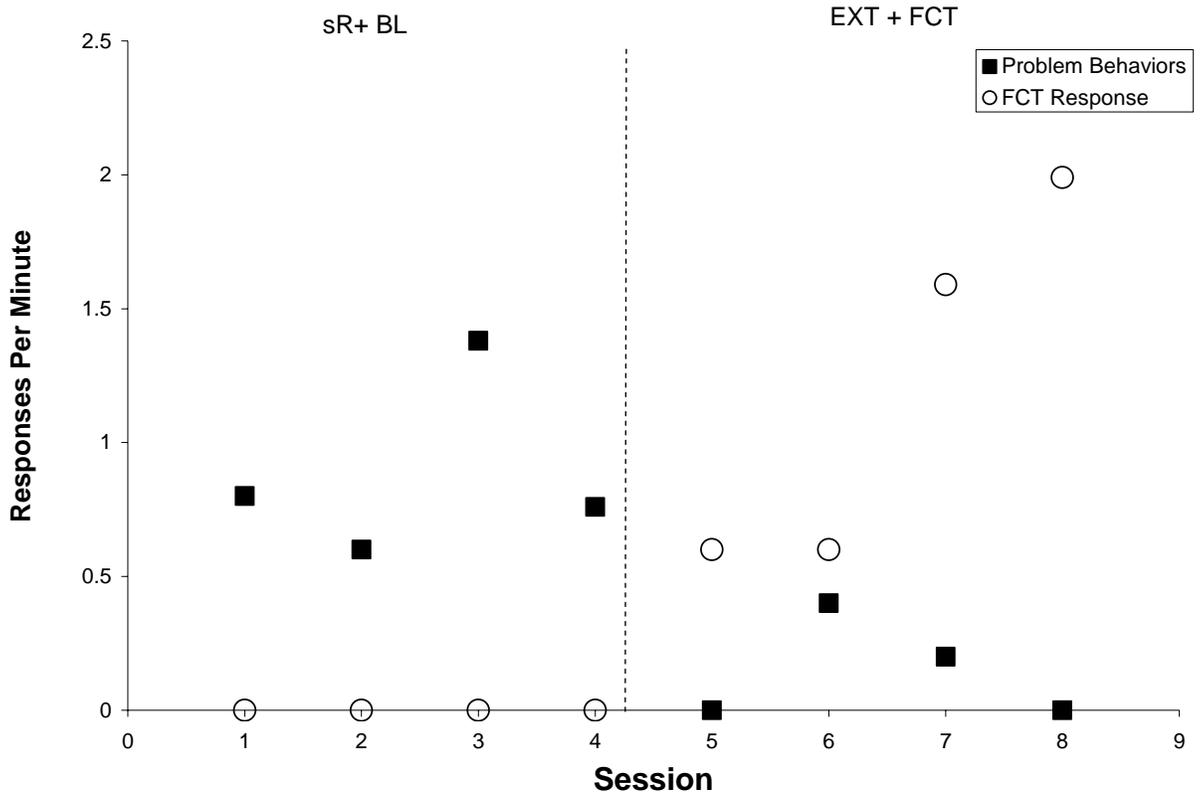


Figure 6. Problem behaviors and functional communication training (FCT) responses per minute in positive reinforcement baseline (sR+ BL) and extinction with functional communication training (EXT + FCT) conditions in Subject 1's generalization assessment.

CHAPTER 7

GENERAL DISCUSSION

Functional analyses methodology originally developed for the assessment and treatment of self-injurious behaviors in developmentally disabled children (Iwata, Dorsey, et al., 1994) have been applied to the assessment and treatment of a variety of problem behaviors in children and adults (Hanley et al., 2003). This study investigated its use in the assessment and treatment of problem behaviors in captive chimpanzees. While the function of Subject 2's inappropriate behavior was not able to be determined by our specific contingencies, the functional analysis methodology did reveal that Subject 1's problem behaviors were maintained by both positive and negative reinforcement. Since his rates of problem behaviors were highest under positive reinforcement contingencies, a function-based treatment plan was developed in which positive reinforcement for inappropriate behaviors was placed on extinction and, through functional communication training, the subject was taught a more socially appropriate way to gain access to his identified reinforcers. The treatment plan was highly successful, resulting in a 90% reduction in the chimpanzee's inappropriate behaviors. It also decreased inappropriate behaviors even in the presence of unfamiliar humans, a situation that is a source of stressful excitement to captive chimpanzees.

While our results are encouraging for the effectiveness of function-based assessments and treatments for captive chimpanzees, several follow-up steps are necessary to meet our ultimate goals for reducing our subjects' inappropriate behaviors. In order to reduce Subject 2's inappropriate behaviors, additional descriptive and

functional analyses will need to be conducted so that an effective, function-based treatment plan may be developed and implemented.

While the treatment for Subject 1's inappropriate behaviors was highly successful, the treatment plan is labor intensive and has only been conducted with one experimenter. In order for Subject 1 and his caregivers to truly benefit from this treatment plan, other staff members will need to be trained. This could be accomplished similar to the way that parent-training is conducted in human settings. For example, Lafasakis and Sturmey (2007) used behavioral skills training consisting of instructions, modeling, rehearsal, and feedback to successfully train parents of autistic children to implement an educational methodology called discrete-trial teaching. In this study, parents successfully learned the methodology and generalized their skills to novel tasks. In addition, the children's correct responding increased. Similarly, functional communication contingencies are often taught to parents or other staff members in order to generalize a child's treatment (e.g. Bailey et al., 2002; Durand, Berotti, & Weiner, 1993). Behavioral skills training on Subject 1's treatment plan could be conducted with staff members working with Subject 1 so that he receives consistent consequences for his inappropriate and appropriate behaviors.

In addition, Subject 1's reinforcement schedule must be faded in order for his treatment plan to be manageable. During treatment sessions, Subject 1 had constant access to his functional communication device, and any appropriate response resulted in immediate social attention and access to fruit juice. This reinforcement schedule is not practical given the limited time available for caregivers to devote to each chimpanzee. Several schedule-thinning procedures for communication responses during FCT have

been established (see Hanley, Iwata, & Thompson, 2001 for a review). We propose using a delay-to-reinforcement procedure in which the subject will only gain access to the FCT device after increasing amounts of time in which no inappropriate behaviors are exhibited. In this differential reinforcement of other behavior (DRO) procedure, any display of inappropriate behaviors during the delay period will re-set the reinforcement timer. The subject will be required to go increasing lengths of time without an inappropriate behavior before being given access to his FCT device (and thus the opportunity for reinforcement). While FCT schedule thinning procedures are generally effective, problem behaviors can increase during this schedule fading. If this occurs, several techniques may be used to further decrease the problem behaviors. For example, punishment procedures such as a time out can be added to the treatment package (e.g. Hagopian et al., 1998). Alternatively, competing stimuli may be added to the subject's environment in order to increase his tolerance for the reinforcement delay (e.g. Hagopian et al., 2005). This second option fits in well with the general environmental enrichment program at our facility. Chimpanzees are often given enrichment items such as foraging devices, puzzle-feeders, or destructible items. These items could serve as competing stimuli and increase the success of a schedule-thinning procedure.

As discussed in Bloomsmith, Marr, and Maple (2006), captive primates exhibit many of the same severe behavior problems as developmentally disabled children, including aggression, stereotyped behavior, and self-injurious behavior. We believe that primates in captivity could benefit from the function-based assessments and treatments used in the human population, and this study represents a first step toward this goal.

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