RESPONSE RESTRICTION AND CONTINGENT ACCESS TO RESPONSES IN MULTI-RESPONSE ENVIRONMENTS

By

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In this investigation, the effects of response restriction and contingent access to responses in multi-response environments were evaluated in three studies. The same four participants took part in all studies. Kyle was a typically developing 13-year-old male. John was an 8-year-old male diagnosed with autism. Sarah was a typically developing 14-year-old female. Beth was a typically developing 7-year-old female. For all participants, caregivers selected reading and mathematics as responses in need of increase. In Study 1, participants were exposed to a brief response-restriction analysis, consisting of a short series of response restrictions. For all participants, reading was observed following the restriction of certain responses and, for all subjects other than Sarah, both reading and mathematics were observed during response-restriction phases. In Study 2, the efficacy of response restriction as a treatment method for increasing the likelihood of socially desirable targeted responses in naturally occurring multi-response environments was examined. The utility of the brief restriction analyses conducted in

Study 1 in identifying responses that compete with targeted behavior was evaluated by restricting access to these responses for greater periods of time and examining response reallocation. When restriction of these responses was insufficient to produce reliable increases in targeted responding, the restriction of additional responses was evaluated. Response restriction produced increases in targeted responding for 3 of 4 participants; however, these increases were only reliable and sustained for Kyle. In study 3, the effects of contingent access to responses on targeted behavior in multi-response environments were examined. For all participants, contingent access to multiple responses produced reliable increases in targeted behavior. Implications of the results for research and application are discussed.

CHAPTER 1
INTRODUCTION

Overview

Classifying stimuli functionally is a hallmark of behavior analysis. As stimulus operations are performed, their effects on behavior are the defining features used in differentiating one type of stimulus from another (Skinner, 1935). Take, for example, the classification of a stimulus as a reinforcer. Any stimulus that increases the probability of a response being emitted when its presentation or removal follows the response is classified as a reinforcer (Skinner, 1953). Thus, grain presented following the keypecking of a pigeon that results in an increased likelihood of keypecking, a token presented following completion of a math problem that results in an increased likelihood of completing math problems, and a demand that is removed following hitting a teacher which results in an increased likelihood of hitting the teacher would all be reinforcers. These would be classified as positive reinforcers in the case of those that are presented and negative reinforcers in the case of those that are removed.

The classification of stimuli, and reinforcers in particular, based on their function, or the effects they have on behavior, has proven fruitful in keeping research in behavior analysis conceptually systematic and engendering effective technologies for application to socially significant behavior (Catania, 1998; Hanley, Iwata, & McCord, 2003). This method of identifying reinforcers, however, has not been without criticism (Postman, 1947; Timberlake & Allison, 1974). Postman pointed out the circularity of defining a reinforcer based solely on its effect on responding. This definition occurs after the

operation has taken place and allows for no independent means of classifying the stimulus as a reinforcer. From a pragmatic standpoint this is troublesome. Without any independent characteristics of a stimulus identifying it as a reinforcer, we are left with identifying reinforcers through trial and error. For basic researchers, the fact that a stimulus is not identified as a reinforcer until it has been demonstrated to have a reinforcing effect may be an annoyance in that multiple stimuli may have to be tested until a reinforcer is identified. In the application of behavior analysis to socially significant behavior, it is sometimes critical to quickly and accurately identify reinforcing stimuli and a failure to identify a reinforcer can result in the failure of an important behavioral treatment.

Meehl (1950) proposed a partial solution to difficulties arising from post-hoc identification of reinforcers. Meehl argued that reinforcers should be considered transituational. A reinforcer identified in one context could then be used as a reinforcer in another context. Thus, researchers or clinicians in need of a reinforcer may simply make use of a stimulus that had previously been demonstrated to be a reinforcer. The argument of transituationality depends upon the assumption that stimulus functions have a certain amount of generality (Sidman, 1960). This assumption is commonly, and often effectively, made by behavior analysts. The logic behind the use of preference assessments to identify reinforcers for use in other contexts, for example, relies upon the generality of the stimuli identified as reinforcers (Timberlake & Farmer-Dougan, 1991). This generality, however, may be limited across varying levels of response effort, schedule parameters, motivating operations, or the availability of substitutable or

competing reinforcers (Timberlake & Allison, 1974; Timberlake & Farmer-Dougan, 1991).

The probability-differential hypothesis, introduced by Premack (1959), suggested an independent and a priori method of reinforcer identification. Premack conceptualized reinforcement as involving contingent access to responses rather than stimuli. Rather than grain as the reinforcer for the keypecking of a pigeon, according to this account, the reinforcer is access to eating. The probability-differential hypothesis, sometimes called the Premack principle, states that contingent access to a more probable response will reinforce a less probable response. The initial probabilities are determined in a paired-operant baseline. In this baseline, free access is permitted to both responses. Data are collected on duration of each of the two responses in baseline in order to determine which response is more probable. A reinforcement effect is then observed if access to the more probable response is restricted and provided contingent upon the less probable response. While there are conditions under which the Premack principle does not hold, it has proven to have broad generality and can be a heuristic that may help clinicians identify reinforcers (Catania, 1998; Timberlake & Farmer-Dougan, 1991).

Timberlake and Allison (1974) extended the Premack principle with the response-deprivation hypothesis. Like Premack (1959), Timberlake and Allison conceptualized reinforcement as involving contingent access to responses. Unlike Premack, they argued that the critical feature of a reinforcement contingency was not that contingent responses be more probable than instrumental responses (those that produce access to the contingent responses). They stipulated that contingencies like those used in common operant experiments disrupt the ratio of responding that would be observed if no

contingency were in place (e.g., a contingency involving access to water produced by the wheel running of a rat typically involves restricting access to drinking such that the ratio of running to drinking is greater than that which would be observed under a free-operant baseline) and that organisms are motivated to respond in a manner that makes relative response allocation more similar to that observed during free-operant baselines. Timberlake and Allison cite this "disequilibrium" produced by operant contingencies as the critical factor that determines a reinforcement contingency. They describe the necessary condition for a reinforcement effect as

$$\frac{I}{C} > \frac{O_i}{O_c}.$$

where I and C represent measures of instrumental and consequence responses respectively and O_i and O_c represent the operant level, or baseline level, of instrumental and consequence responses. A reinforcement effect is predicted if a contingency is arranged such that the ratio of instrumental to consequence responses is greater than that observed during baseline. It is important to note that as long as the units of analysis are constant across baseline and contingency conditions, they do not need to be the same for instrumental and consequence responses. For example, if, in a paired-operant baseline, a child read five pages of a book and watched television for one minute, the response-deprivation hypothesis predicts a reinforcement effect given the following

$$\frac{I}{C} > \frac{5_{pages-read}}{1_{\min-TV}}.$$

Thus, a contingency arranged such that reading 10 pages is required to produce one minute of television, or

$$\frac{10_{pages-read}}{1_{\min-TV}} > \frac{5_{pages-read}}{1_{\min-TV}},$$

would be expected to produce a reinforcement effect, whereas a contingency arranged such that reading three pages is required to produce one minute of television, or

$$\frac{3_{pages-read}}{1_{\min-TV}} > \frac{5_{pages-read}}{1_{\min-TV}},$$

would not be expected to produce an increase in pages read over what was observed during the free-operant baseline.

The manner in which the response-deprivation hypothesis expands upon the Premack principle becomes more apparent if both responses are measured using the same units. If, instead of pages read, minutes of reading were measured, the contingency required for reinforcement may be something like the following

$$\frac{I}{C} > \frac{4_{\min-reading}}{1_{\min-TV}}.$$

An arrangement of

$$\frac{5_{\min-reading}}{1_{\min-TV}} > \frac{4_{\min-reading}}{1_{\min-TV}}$$

should produce a reinforcement effect for reading. Thus, contingent access to a less probable response should reinforce a more probable response. The relative baseline probabilities of the responses are thus shown to be unimportant. The critical variable is the arranged ratio of instrumental to consequence response as compared to the ratio obtained during baseline (Timberlake & Allison, 1974).

The response-deprivation hypothesis has been demonstrated to be a useful heuristic in identifying conditions under which access to responses will serve as

reinforcers in multiple studies in both basic and applied behavior analytic literature (Allison & Timberlake, 1974; Amari, Grace, & Fisher, 1995; Charlop, Kurtz, & Casey, 1990; Hanley, Iwata, Thompson, & Lindberg, 2000; Homme, de Baca, Devine, Steinhorst, & Rickert, 1963; Konarski, Johnson, Crowell, & Whitman, 1980; Mitchell & Stoffelmayr, 1973; Osborne, 1969; Timberlake & Allison, 1974). A measure of responding on a paired-operant baseline can allow a priori identification of a reinforcer. An independent method of reinforcer identification helps alleviate the philosophical concern regarding the circularity of a purely functional definition of a reinforcer and also provides clinicians an additional method of reinforcer identification.

Some of the most promising areas for application of the response-deprivation hypothesis are complex, multi-operant, environments (e.g., homes) in which there are often a large number of available responses (e.g., watching television, playing video games, listening to a radio, talking on the phone, reading a book, or doing homework). Reinforcers identified through standard preference assessment methods, which are typically conducted in restricted-operant environments in which the number and type of responses available are well controlled, may be less effective in environments containing numerous alternative responses. The response-deprivation hypothesis suggests measuring baseline levels of responding in the environment in which the contingency is to be put into place. Thus, potentially competing sources of reinforcement are taken into account.

Surprisingly, however, very little research has explicitly evaluated the response-deprivation hypothesis in multi-operant environments (Bernstein, 1998). Most of the research on the response-deprivation hypothesis has been done using paired-operant

preparations, and the degree to which the same results would occur in multi-operant environments remains largely unknown. For example, the following would be expected to result in a reinforcement effect for reading given four minutes of reading and one minutes of watching television during a paired-operant baseline

$$\frac{5_{\text{min}-reading}}{1_{\text{min}-TV}} > \frac{4_{\text{min}-reading}}{1_{\text{min}-TV}}.$$

However, if, for example, baseline data collected in a multi-operant environment indicated that reading occurred for four minutes, television watching for one minute, playing video games for eight minutes, shooting pool for seven minutes, and talking on the telephone for 10 minutes, it is unclear if the above contingency would produce the same result. Perhaps the probability of reading would increase, or perhaps responding would be reallocated to playing video games, shooting pool, talking on the phone, or some new response. A paired-operant baseline does not permit the detection of such reallocation. In the following section, basic research on response deprivation in multi-operant settings is discussed.

Basic Research on Contingent Access to Responses as Reinforcement in Multi-Operant Environments

Research on the effects of response restriction and contingent access to responses in multi-operant environments with humans was pioneered in Bernstein's human-operant laboratory (Bernstein, 1998; Bernstein & Ebbesen, 1978; Bernstein & Michael, 1990). Bernstein and colleagues created a laboratory apartment in which human subjects lived, 24 hrs a day, for the duration of an experiment. Subjects made a list of desired activities upon initiation of a study and those activities were typically available in the laboratory apartment. Access to external stimuli and activities inside the apartment was controlled

by experimenters and data were collected on time spent engaging in various activities across experimental conditions.

The first major study to come from this laboratory was an explicit investigation of the effects of response restriction and contingent access to responses when multiple response options were available (Bernstein & Ebbesen, 1978). Three subjects participated, ranging in age from 19 to 39 years. The subjects lived in the experimental apartment from between 21 to 34 days. Each selected several activities before the beginning of the study and required materials for these activities were made available in the apartment. Data on the duration of engagement in these various activities were collected by observers who monitored the subjects from behind one-way mirrors. The experimenters attempted to examine the effects of response restriction alone and contingent access to responses in a multi-operant environment.

Responding was measured under three conditions: a free-operant baseline, in which there was no restriction on response availability; a contingency condition, in which a high-probability response, designated the contingent response, was restricted and provided contingent upon a low-probability response chosen as the instrumental response; and a matched-restriction condition, in which access to the response that was the contingent response in the contingency condition was restricted such that the access time was yoked to the time of access in the contingency condition. The contingencies and restrictions were described to the subjects in each condition. The times at which responses were restricted were signaled to the subjects by the illumination of labeled lights on a panel in the apartment.

For all three subjects, response contingencies resulted in increases in instrumental responding. For one subject, restriction of the consequence response alone produced reliable increases in instrumental responding. For the other two subjects, the effects of restriction alone were less reliable. One subject displayed no effect of response restriction alone; the other demonstrated an increase in one topography, but this effect was not replicated.

The Bernstein and Ebbesen (1978) study represented a move toward examining response restriction and contingent access to responses in a naturally occurring environment. Although the experiment took place in an operant laboratory and the number of available responses was still limited, subjects had access to more than two responses, and these were responses that are common in the natural environment. Their findings suggest that response contingencies hold promise for application in complex, multi-operant, human environments. They also suggest that, in some circumstances, response restriction alone may be sufficient to increase targeted responses in these environments.

The effects of response restriction on response allocation in a multi-response environment were explicitly examined by Lyons and Cheney (1984). Subjects were four adult, male rats and sessions took place in a chamber divided into five areas. Each area contained one of the following sources of reinforcement: turning off the light, viewing a female rat, turning off a white noise generator, water, or food. Free-operant baselines resulted in similar patterns of responding for all subjects, with the most preferred area being that which terminated the white noise. For each subject, two restriction conditions were tested. In one, the most likely free-operant response was restricted. In the other, the

least likely free-operant response was restricted. The experimenters used the outcomes restriction conditions to evaluate four rules for how responding might be re-allocated following response restriction. The first was the “constant ratio” rule, which states that the remaining responses will increase to occur during the same proportion of available time that they did with the high-probability response present. The second was the “most probable remaining response" rule, which stipulated that the second most likely response during baseline will increase relatively more than other remaining responses. The third was the “equal redistribution” rule, which stated that responding will be equally reallocated to all available responses. The final rule tested was the “sequential dependency” rule, which hypothesizes that the restriction of a response will also decrease the response most likely to occur following the restricted response. The results replicated those of Bernstein and Ebbesen (1978). Re-allocation of responding following restriction was idiosyncratic to the participant and varied depending on whether it was the highest or lowest probability response that was restricted. These data suggested that none of the four rules discussed was sufficient to predict the results of response restriction for any given subject. The reliability of the results, however, is unclear. For each subject, each restriction phase was conducted only once. While no a priori rule was found to describe the results, it may be that restriction effects are reliable within subject and that the effects of previous restrictions can be good predictors of the effects of subsequent restrictions.

Application of Response Restriction and the Response-Deprivation Hypothesis

Osborne (1969) evaluated the effects of contingent and noncontingent free time on the in-seat behavior of students in a school for the deaf. The six participants were female students between 11 and 14 years old with severe to profound hearing loss. The number of times each student got out of her seat during the daily recording period was

targeted for intervention. The experiment was designed as a reversal, with phase changes occurring simultaneously for all participants. In each condition, contingencies in effect were described to the participants. During baseline, there was no free time provided either contingently or noncontingently. In the first treatment condition, each participant was allowed 5 minutes of free time contingent upon 15 minutes without leaving her seat. This was immediately successful, with the number of times each participant left her seat reducing to near zero. Following this phase, a yoked-control condition was implemented in which 5 minutes of noncontingent access to free time was provided every 15 minutes. The level of responding in this condition was similar to that obtained in the contingent-access condition with very slight upward trends in response frequency for three participants. The noncontingent-access phase continued for five days for all participants. This was followed by 51 days of the contingent-access phase during which the frequency of participants leaving their seats remained near zero. Data collection was terminated at this point and a one-day follow-up probe was conducted approximately six-weeks later. In the intervening time, the free-time contingency remained in place and no participants were observed to leave their seats during the probe. In the week following the probe, a one day contingency reversal was implemented. Five minutes of free time during this reversal was contingent upon participants leaving their seats at least once during each 15-minutes period and the contingency was described to the participants. The frequency of seat leaving during the reversal was elevated during the contingency reversal for all participants.

Osborne (1969) was one of the first to use contingent access to responses for behavior management in a natural environment. This study demonstrated the

effectiveness of contingent access to responses in a multi-response environment and also illuminated some important issues with regard to manipulating access to responses in these environments. One potentially critical variable in this study is the presence of a possible negative reinforcement contingency. In the study conducted by Osborne, access to restricted responses was also paired with escape from a work context. The degree to which the obtained treatment effects were a function of contingent access to responses or contingent escape from work is unclear. It may have been the case that a break from the work context into a relatively impoverished environment would have been equally successful. In fact, the effectiveness of noncontingent free time periods in suppressing seat leaving suggests interpretation of the effects of treatment as an abolishing operation (Laraway, Snycerski, Michael, & Poling, 2003) in that frequent breaks may have made the demand context less aversive. An equally plausible explanation is that the free-time periods resulted in frequent access to responses otherwise only available contingent upon seat leaving and thus decreased the reinforcing efficacy of these responses. The relative effects of these potential abolishing operations and the omission contingency are also unclear.

Another important point of consideration is that the data collection, and the contingencies used, converted an environment in which numerous responses were available, presumably of different operant classes, into one in which only in-seat and out-of-seat behavior were available. This aggregation may have concealed some potentially interesting findings. The authors noted that out of seat activities included, but were not limited to, talking with classmates, conversing with the teacher, sharpening pencils, drinking water, and using the restroom. If seat leaving was maintained by access to

multiple responses, for example peer interaction and access to the restroom, contingent access to only one of the two may not have been sufficient to suppress responding. This is a particularly important case. If data collected in a free-operant condition indicated that interacting with peers was the most probable response, both the Premack principle and the response-deprivation hypothesis would predict that contingent access to this response would serve as reinforcement. However, access to a restroom may be potent enough to maintain seat leaving even if access to peer interaction were contingent upon the absence of seat leaving. A finding of this sort would contradict the Premack principle and the response-deprivation hypothesis; however, the aggregation of responses into large classes, while experimentally convenient, disallowed the detection of this sort of effect.

Mitchell and Stoffelmayr (1973) demonstrated the effectiveness of contingent access to a high-probability response as a reinforcer for the behavior of two individuals diagnosed with schizophrenia. Both participants resided in a psychiatric ward and were employed stripping copper wire from coils. Thirty-second partial interval data were collected on coil stripping over the course of 30-minute sessions and, during baseline, both participants engaged in no coil stripping for six consecutive sessions. The experimenters tested the effects of instructions alone, which consisted of one prompt to work delivered at the beginning of each session, and instructions plus reinforcement, which consisted of identical instructions and 90 seconds of sitting contingent upon the removal of wire from three coils. Sitting was used as a consequence response as it was identified as a high-probability response during pre-experiment data collection. Instructions alone were found to have no increasing effect on responding. Instructions

plus reinforcement, however, resulted in high and stable levels of coil stripping. Like Osborne (1969), Mitchell and Stoffelmayr demonstrated the use of contingent access to responding to increase the likelihood of a socially significant response. They also demonstrated that the generality of the reinforcement effects predicted by the response-deprivation hypothesis extends to the population of individuals diagnosed with schizophrenia. The effects of contingent sitting, however, were confounded with potential effects of restriction of sitting. It may have been the case that restriction of sitting alone would have resulted in increases in coil stripping. It is also difficult to assess the degree to which the results of this study speak to the effectiveness of contingent access to responses in multi-operant environments. All sessions took place in the room of the psychiatric ward where all of the work of the patients was done. The number of alternatively available activities was not clearly specified. The authors noted that the subjects had previously refused to engage with multiple potentially reinforcing items. Also, the fact that sitting rather than a more active response was chosen as the consequence response suggests that the environment was relatively devoid of reinforcing activities. A final concern involves the conceptualization of access to sitting as an instance of reinforcement in the form of access to a response. In the contingency condition, if the participants sat, their chair was tipped forward until they were forced to stand. Standing for extended periods may have been effortful for the participants and it may have been more appropriate to conceptualize the reinforcement effect as negative reinforcement in the form of escape from standing rather than positive reinforcement in the form of access to sitting.

The applied studies reviewed thus far have viewed restriction effects as potential confounds to be controlled for. Green and Striefel (1988) evaluated these effects directly in a multi-operant preparation composed of six available responses. Four children between the ages of six and 10, all diagnosed with autism, participated. The six activities were chosen by the children's classroom teacher and were either play or educational activities. The analysis tested four hypotheses regarding the redistribution of responding following restriction of the highest-probability response. The constant ratio rule, the equal distribution rule, and the most probable alternative rule, as tested by Lyons and Cheney (1984) were also tested by Green and Stiefel. The final hypothesis tested, the selective substitution rule, was that the pattern of redistribution may differ for each subject. The selective substitution rule is, essentially, that the outcome of restriction of the most probable response cannot be predicted based on baseline response probability.

For each participant, Green and Striefel (1988) conducted an initial free-operant baseline and then sequentially and cumulatively restricted access to the most probable response such that five responses were available in the second condition, four in the third, three in the fourth, and two in the third. Following the final restriction condition, another free-operant condition was conducted. The experimenters found that response redistribution followed no single pattern, thus supporting a selective substitution description of the effects of response restriction. These data replicated the idiosyncratic effects of response restriction alone discussed previously (Bernstein & Ebbesen, 1978; Lyons & Cheney, 1984). Some potential limitations exist concerning the generality of these findings extending into applied settings in which responding is not limited to experimenter-selected responses. The first potential limitation relates to questions about

the reliability of the effects of response restriction for any given subject. Although no general pattern of redistribution of responding was observed across participants, the degree to which patterns of redistribution for individual subjects would remain stable across multiple replications was not examined. It may be that reliable rules describing response reallocation can be generated for individual subjects given certain restrictions. A second concern involves the fact that responding could only be allocated to the responses arranged by the experimenters. The experimental preparation did not address the potential emergence of previously unobserved responses following restriction. In an environment with more available responses, the emergence of previously unobserved responses is always a possibility. A final potential limitation is that data were collected using 30-second partial interval data collection. Following completion of this study, the experimenters directly compared the partial interval data collection used with duration recording in scoring video tapes of sessions similar to the baseline sessions of the study. They found that the rankings of highest to lowest probability that would be assigned to responding based on the outcomes of these two types of measurement agreed 83.3% of the time. This suggests that the rankings obtained in the study may have been in error nearly 17% of the time.

In a study designed to explicitly examine components of a behavioral treatment involving contingent access to stereotypy as reinforcement, Hanley, Iwata, Thompson, and Lindberg (2000) evaluated the effects of response restriction in isolation as well as contingent access to behavior on engagement with leisure items. The experimenters examined the effects of prompting alone, prompting plus blocking of stereotypy, and prompting plus response blocking and contingent access to stereotypy. Participants were

three adults diagnosed with developmental disabilities who engaged in various forms of stereotypy. The provision of leisure items, with no further intervention, had no suppressive effect on stereotypy and item engagement was not observed for two participants and occurred at a low level for the third. Prompting engagement with the items resulted in no decreases in stereotypy for any participant and an increase in engagement for only one participant. Prompting plus response blocking produced decreases in stereotypy for all participants and increases in item interaction for two participants. For the third participant, item interaction was increased by allowing access to stereotypy contingent upon item engagement. The effects of response restriction alone in Hanley et al. have some important, and relatively novel, implications for clinicians attempting to produce increases in the appropriate behavior of their clients. Hanley and colleagues were able to increase a targeted, socially relevant, response for two participants without having to place a contingency on the response. While this study represents an important initial demonstration of the use of response restriction as a method for increasing a socially desirable response, it is important to note that sessions were conducted in relatively barren therapy rooms. Previous research has demonstrated that the effects of response restriction on reallocation of responding are idiosyncratic across participants when multiple alternative responses are available (Bernstein and Ebbesen, 1978; Green and Striefel, 1988). The degree to which clinicians can rely on response restriction as a method for increasing targeted responses in less controlled environments remains unknown.

Purpose

The present investigation was composed of three studies. All took place in naturally occurring environments in which the number of available responses was

uncontrolled (e.g., a child's home environment or a play area). These relatively unrestricted multi-response environments are those in which the transituationality of reinforcers identified in preference assessments is challenged, insofar as multiple potentially competing sources of reinforcement are available. Thus, an activity identified as highly preferred in an isolated preference assessment may not compete with the multiple sources of alternative reinforcement available in a child's home (e.g., television shows, movies, radio, or video games). A response-deprivation approach to reinforcer identification has promise for application in these settings. Following a response-deprivation model of reinforcer identification, the environment in which the response to be used as a reinforcer is identified is the same environment in which the contingency will be implemented. Thus, alternatively available sources of reinforcement are taken into account. As noted above, however, a number of questions remain to be answered before clinicians can reliably use response restriction and response-deprivation contingencies in complex, naturally occurring environments. The present studies represent an attempt to answer the following questions. One, can response restriction alone be used to reliably increase a targeted, socially desirable, response in a naturally occurring, multi-response environment? Two, can contingent access to behavior be used to increase socially important behavior in these same naturally occurring, unrestricted, environments or will access to multiple competing sources of reinforcement impede its effectiveness?

Study 1 was an evaluation of a brief response restriction analysis for identifying responses that may be competing with targeted responses in the setting in which treatment will be implemented. Study 2 was an examination of response restriction alone

as a treatment method for increasing socially important behavior. The purpose of Studies 1 and 2 was to determine if a brief restriction analysis would identify responses that would be effective as part of a response-restriction treatment and to determine if response restriction alone would produce reliable and sustained increases in desired behavior in a multi-response environment. Study 3 was an investigation of the use of contingent access to responses as a treatment designed to increase targeted behavior. The purpose of Study 3 was to determine the effectiveness of contingent access to responses as a method for increasing desired behavior in a multi-response environment.

The present studies extended previous research in two ways. One, by explicitly evaluating use of response restriction as a means of increasing a targeted, socially desirable, response in a naturally occurring, multi-response environment. Two, by explicitly evaluating the use of contingent access to behavior to increase socially important behavior in these same naturally occurring, unrestricted environments.

CHAPTER 2
STUDY 1: AN EVALUATION OF A BRIEF RESPONSE-RESTRICTION PROCEDURE IN A NATURALLY OCCURING MULTI-RESPONSE ENVIRONMENT

Previous research has demonstrated that the restriction of available responses can result in increases in other responses even in the absence of a contingency (Bernstein & Ebbesen, 1978; Green & Striefel, 1988; Hanley et al., 2000; Lyons & Cheney, 1984). However, the effects of response restriction in multi-response environments have varied across subjects and no single rule has been predictive of the outcome of these restrictions (Green & Striefel, 1988; Lyons & Cheney, 1984). In Study 1, participants were exposed to a brief response-restriction analysis, consisting of a short series of response restrictions. The outcome of these brief response-restriction analyses were used to identify responses that, when restricted, may result in increases in targeted socially desirable responses as well as to evaluate the reliability of the effects of response restriction on response reallocation.

Method

Participants and Setting

Participants were 4 individuals who had been referred by parents and caregivers due to their lack of independent engagement in academic and other socially desirable behavior. Kyle was a typically developing 13-year-old male. John, was an 8-year-old male diagnosed with autism. Sarah was a typically developing 14-year-old female. The final participant, Beth was a typically developing 7-year-old female. Each session was 5 minutes in duration and sessions were conducted 1 to 3 times per week. Sessions for

Kyle, Sarah, and Beth were all conducted in their respective homes. Sessions for these participants began in the room of their choice, however, participant's movement throughout their home was not restricted. For John, sessions were conducted in a play area at his school, in which a computer, a CD player, a television with a VCR and a number of movies, as well as a wide variety of games, toys, and other activities were available. For all participants, the materials necessary for the targeted academic responses were made available in the room in which the session began.

Response Recording and Reliability

Observers collected data using palm-top computers on duration of time spent engaging in various activities. Engagement was defined as orienting toward and, when appropriate, being in contact with materials necessary for given activities. Data collectors scored the occurrence of any identifiable response, if no identifiable response was observed the data collectors scored nothing. A second observer collected data independently on 37.8% of all sessions across all studies. Interobserver agreement was calculated by dividing each session into 10-second intervals, dividing the smaller duration of recorded responses by the larger across observers, averaging these scores across the session, and converting them to a percentage. Overall agreement scores for all participants across all measures averaged 97.3% (range 80.3% to 100%).

Procedure

The primary investigator met with the caregivers of each participant to identify responses to increase. For Kyle, Sarah, and Beth, age appropriate reading and mathematics activities were identified by caregivers as responses that were considered important for the children and which rarely happened at home. For John, working on

mathematics worksheets and reading were identified as important responses that did not occur unless he was explicitly prompted in an academic setting.

Each participant completed two to four brief restriction analyses. These analyses consisted of a series of five 5-minute sessions. The first 5 minutes were a free-operant period. Participants were instructed that they may do anything that they like. Following the free-operant session, the activity that was engaged in for the greatest duration was restricted and participants were told that they may do anything that they like other than the restricted activity. In each subsequent session, the activity engaged in for the longest duration in the previous session was also restricted and subjects were instructed that they may do anything that they like other than the restricted activities. Responses were restricted by instructing participants that they may not engage in these response and no participants attempted to engage in the responses that they were told were restricted. Two brief-restriction analyses were conducted with Kyle, three with Sarah and Beth, and four with John. At the time the brief restriction analyses were conducted, the duration of participation of Kyle, Sarah, and Beth in this series of studies was unclear. For this reason fewer brief restriction analyses were conducted with these participants to allow them to move on to the treatment studies in the series (Studies 2 and 3) more quickly. Only one brief restriction analysis was conducted per day for all participants.

Results and Discussion

Figure 1 shows the outcomes of the brief restriction analyses for Kyle. In the top panel, during the free-operant phase, Kyle spent his time playing video games. Following restriction of video games (Restriction 1), Kyle shot pool. When access to video games and shooting pool were restricted (Restriction 2), Kyle watched television. When television was also restricted (Restriction 3), Kyle spent his time reading.

Following the restriction of reading as well (Restriction 4), he allocated his time to a mathematics workbook. The bottom panel shows the results of the second restriction

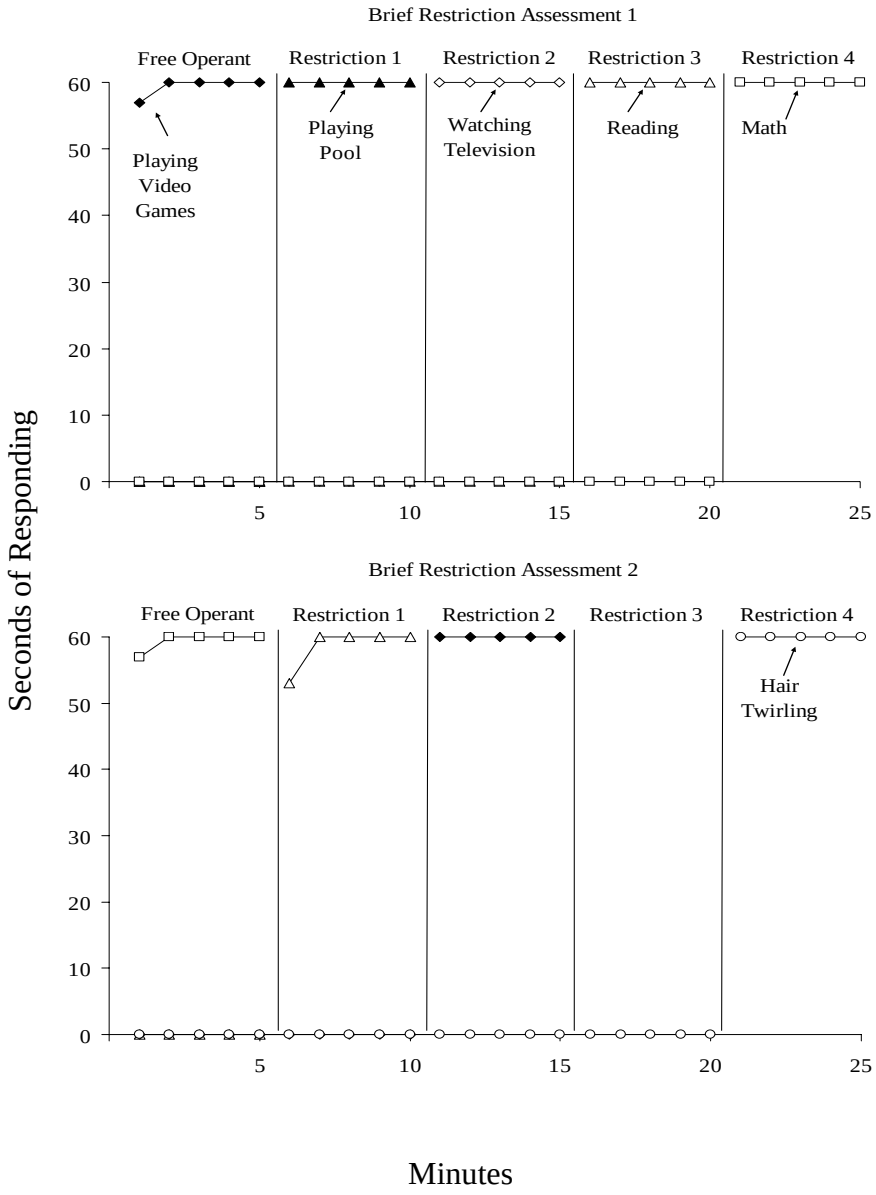

Figure 1. Seconds of responding during each minute of each session during brief response restriction for Kyle; sessions are denoted by phase change lines.

analysis for Kyle. In the free-operant phase, Kyle spent all of his time doing math. Following restriction of math (Restriction 1), Kyle allocated his time to reading. When both mathematics and reading were restricted (Restriction 2), Kyle played video games. Following the restriction of mathematics, reading, and video games (Restriction 3) Kyle sat on the floor, engaging in no particular identifiable response. Restriction 4 was identical to Restriction 3 as Kyle had emitted no identifiable response to be restricted. In Restriction 4, he remained seated on the floor and spent the session twirling his hair.

Figure 2 depicts the results of the brief restriction analyses for John. Data from the first analysis are plotted in the top panel. During the free-operant phase, John played computer games. Restriction of computer games (Restriction 1) resulted in John playing on a therapy ball. When computer games and the therapy ball were restricted (Restriction 2), he played with a handheld electronic game. When the handheld game was also restricted in Restriction 3, John watched a video. When access to videos was also restricted in (Restriction 4), John initially allocated his responding to mathematics worksheets during the first 2 minutes of the session, and primarily engaged in reading during the final 3 minutes.

The second panel shows the results of John's second brief restriction analysis. In the free-operant phase, he played computer games. With access to the computer restricted in Restriction 1, John watched videos. When both access to the computer and videos were restricted (Restriction 2), John played on a therapy ball. When access to computer, videos, and the therapy ball were all restricted (Restriction 3), he played with a handheld electronic game. When the handheld game was added into the restriction in

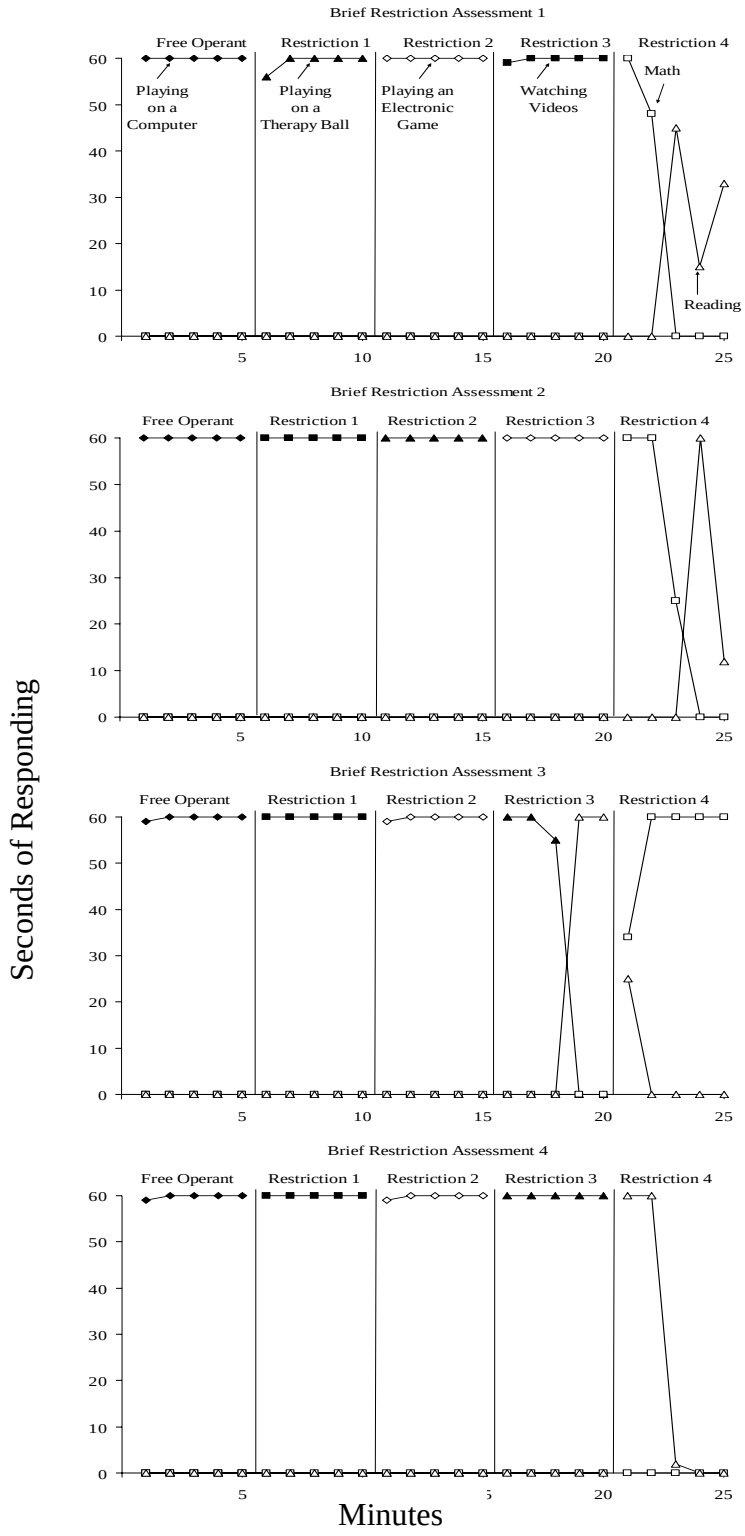

Figure 2. Seconds of responding during each minute of each session during brief response restriction for John; sessions are denoted by phase change lines.

Restriction 4, John spent time working on mathematics during the first 3 minutes and reading during the last 2.

The third panel depicts the results from John's third brief-restriction analyses. John played on the computer during the free-operant phase. When access to the computer was restricted in Restriction 1, he watched a video. When access to the computer and movies were restricted in Restriction 2, John played with a handheld electronic game. When the electronic game was also restricted in Restriction 3, he spent the majority of the first 3 minutes playing on a therapy ball and the last 2 reading. As playing on the therapy ball was the most probable response in the third restriction phase, this response was added to the restriction during Restriction 4. During the first minute of the Restriction 4, John spent time reading and doing mathematics and during the final 4 minutes John only worked on mathematics.

The bottom panel shows the results of the final brief restriction analysis for John. John played on the computer during the free-operant condition. When the computer was restricted in Restriction 1, John watched a video. With restricted access to the computer and movies in Restriction 2, he played with a handheld electronic game. When access to the computer, videos, and handheld game were all restricted in Restriction 3, John played on the therapy ball. When the therapy ball was also restricted in Restriction 4, he read during the first 2 minutes of the session but this decreased during the third minute and he sat quietly on the floor for the final two minutes.

Figure 3 depicts the results for Sarah. The top panel shows results of the first brief restriction analysis. In the initial free-operant phase, Sarah allocated most of her time to watching television. With television restricted in Restriction 1, Sarah watched a

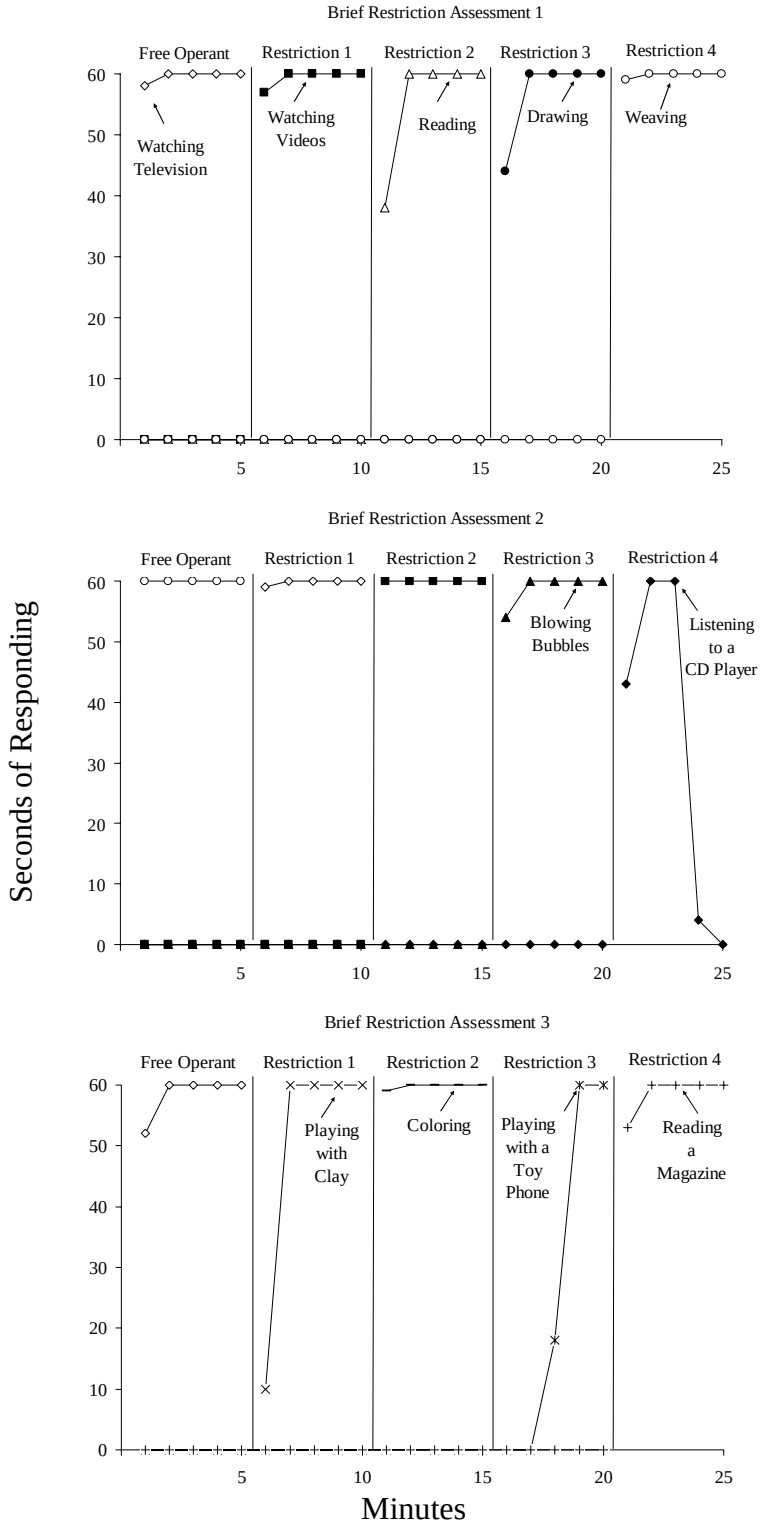

Figure 3. Seconds of responding during each minute of each session during brief response restriction for Sarah; sessions are denoted by phase change lines.

video. With both television and movies restricted in Restriction 2, Sarah allocated 100% of her time to reading. With reading also restricted in Restriction 3, she spent all of her time drawing. With television, videos, reading, and sketching restricted in Restriction 4, Sarah's responding was allocated to weaving.

The second panel shows the results for the second brief-restriction analysis. Sarah allocated all of her time to weaving in the free-operant phase. With weaving restricted in Restriction 1, Sarah watched television. When weaving and television were restricted in Restriction 2, she watched a video. When weaving, television, and movies were restricted in Restriction 3, Sarah spent her time blowing bubbles. With bubbles also restricted in Restriction 4, she listened to a CD player for the majority of the first 3 minutes and this response decreased during the final 2 minutes.

The bottom panel depicts the results for the third brief-restriction analysis for Sarah. In the free-operant phase, she spent most of her time watching television. With television restricted in Restriction 1, Sarah played with clay. With restriction of television and clay in Restriction 2, Sarah colored some pictures with markers. With restriction of television, clay, and coloring in Restriction 3, Sarah sat on her bed without engaging in any particular response for the first half of the session and played with a toy phone for the second half. With playing with the toy phone added to the restricted responses in Restriction 3, Sarah spent her time reading a magazine.

Figure 4 shows the results for the brief restriction analysis for Beth. In the top panel, the data for the first analysis are depicted. In the free-operant phase, Beth watched television. In Restriction 1, television was restricted and Beth worked on mathematics. In Restriction 2, with television and mathematics restricted, she played with dolls. With

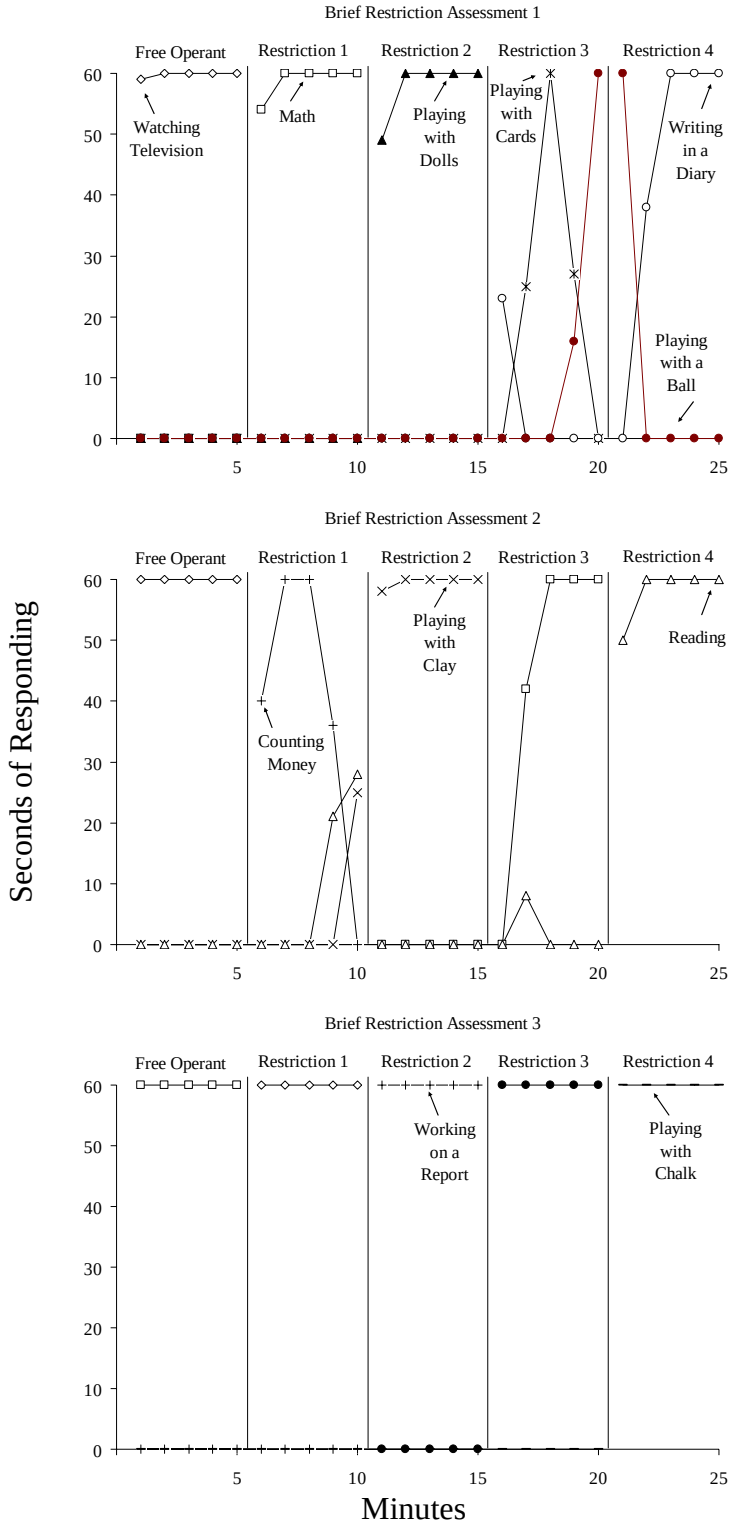

Figure 4. Seconds of responding during each minute of each session during brief response restriction for Beth; sessions are denoted by phase change lines.

television, mathematics, and dolls restricted in Restriction 3, Beth initially spent some time writing in her diary, then played with cards, and ended the session playing with a ball. As playing with cards was the most likely response in Restriction 3, this response was included in the restriction for Restriction 4. In Restriction 4, Beth spent the first minute playing with a ball and the majority of the rest of session writing in her diary.

The middle panel of figure 4 displays the results of the second brief-restriction analysis for Beth. When television was restricted in Restriction 1, Beth spent the initial portion of the session counting money in her purse. During the end of the condition, Beth spent her time reading and playing with a ball. As money counting was the most probable response during Restriction 1, both television and money counting were restricted in the second. In Restriction 2, Beth spent her time playing with clay. When clay was added to the restriction in Restriction 3, she worked on mathematics for the majority of the condition. With mathematics included in the restriction in Restriction 4, Beth spent most of her time reading.

The bottom panel of figure 4 depicts the results of the third brief-restriction assessment. During the free-operant phase, Beth worked on mathematics. When mathematics was restricted in Restriction 1, Beth watched television. With television and mathematics restricted in Restriction 2, Beth worked on a report for her social-studies class. When access to working on the report was also restricted in Restriction 3, Beth played with a ball. With television, mathematics, working on a social-studies report, and playing with a ball restricted in Restriction 4, she allocated her time to drawing with chalk.

The brief restriction analyses produced samples of free-operant responding and responding under various response restrictions. For all subjects, one of the targeted responses (reading) was observed following the restriction of certain responses and, for all subjects other than Sarah, both of the targeted responses (reading and mathematics) were observed during response-restriction phases. Although there was variability in effects of sequential restriction across replications for all subjects, the fact that, during some brief-restriction analyses, certain responses had to be restricted before targeted responses occurred suggests that these responses may also be competing with the targeted responses outside of experimental sessions. Also, the fact that targeted responses were observed in the absence of experimenter imposed contingencies suggests that these contingencies may not be necessary to produce targeted responding. The brief restriction analyses for Kyle suggested that playing video games, playing pool, and watching television may compete with reading and that playing video games, playing pool, watching television, and reading may compete with doing mathematics. For John, they suggested that playing on the computer, watching movies, playing a handheld electronic game, and playing on a therapy ball may compete with both reading and mathematics. For Sarah, watching television and movies were identified as responses that may compete with reading. For Beth, brief restriction analyses suggested that watching television, playing with money, playing with clay, and doing mathematics may compete with reading and also that watching television, playing with money, and playing with clay may compete with doing mathematics. In Study 2, a response-restriction treatment was implemented for each of these participants in which responses identified as possibly competing with targeted responses in brief restriction analyses were restricted for greater

periods of time in order to determine if restriction of these responses in the absence of an experimenter imposed contingency was sufficient to produce increases in targeted responding in naturally occurring, complex, multi-response environments.

CHAPTER 3
STUDY 2: AN EVALUATION OF RESPONSE RESTRICTION AS A METHOD FOR INCREASING SOCIALLY DESIRABLE RESPONSES IN A NATURALLY OCCURING MULTI-RESPONSE ENVIRONMENT

In Study 2, the efficacy of response restriction as a treatment method for increasing the likelihood of socially desirable targeted responses in naturally occurring multi-response environments was examined. The utility of the brief restriction analyses conducted in Study 1 in identifying responses that compete with targeted behavior was evaluated by restricting access to these responses for greater periods of time and examining response reallocation. When restriction of these responses was insufficient to produce reliable increases in targeted responding, the restriction of additional responses was evaluated.

Method

The participants and settings were identical to those in Study 1. During free-operant conditions, no restrictions were placed on responding. During the first response-restriction phase for all participants, those responses identified during the brief restriction analyses as potentially competing with one of the targeted responses were restricted. For Kyle, the restricted responses were playing video games, playing pool, and watching television. For John, the restricted responses were playing on the computer, watching movies, playing on a Leap Pad, and playing on a therapy ball. For Sarah, the restricted responses were watching television and movies. For Beth, the restricted responses were watching television, playing with money, and playing with clay. If restriction of these responses was not sufficient to produce increases in targeted responding, additional

restriction phases were implemented in which the most probable response observed in the previous restriction phase was also restricted. As in Study 1, responses were restricted by instructing participants that they may not engage in these responses. No participants attempted to engage in restricted responses. A reversal design was used in which free-operant conditions were alternated with each response-restriction condition. Data were collected on duration of observed responses and plotted in five-minute units. Data were collected during 15- to 30-minute periods, on one to three days per week depending upon the availability of the participants.

Results and Discussion

Figure 5 shows the results for the response-restriction treatment for Kyle. During the free-operant condition, reading and mathematics occurred briefly, but mainly he watched television and played video games. During the first exposure to the restriction condition (R1), Kyle allocated time toward mathematics during 100% of all sessions. In a brief reversal to free operant, he watched television exclusively. In the second exposure to the R1, he spent all of his time drawing. In another reversal to free operant, he began by engaging in mathematics, but ended the condition by watching television. In the third exposure to R1, he again spent 100% of his time drawing. Thus, the second restriction condition (R2) involved restriction of drawing in addition to restriction of the previously mentioned preferred activities. This modification resulted in exclusive responding to mathematics. When mathematics was restricted in addition to other preferred activities (during R3), he allocated all of his time toward reading.

Figure 6 displays the results for the response-restriction treatment for John. In the first free-operant condition, John exclusively spent his time playing computer games. In

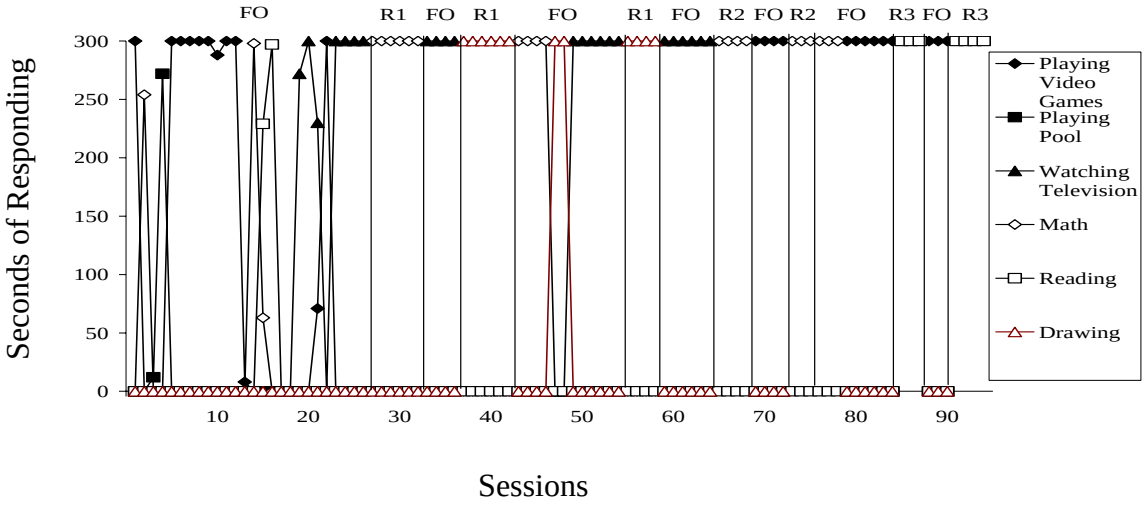

Figure 5. Seconds of responding during the response-restriction treatment for Kyle. FO signifies free-operant phases. During R1 phases, access to video games, pool and television was restricted. During R2, video games, pool, television, and drawing were restricted. During R3, video games, pool, television, drawing, and math were restricted.

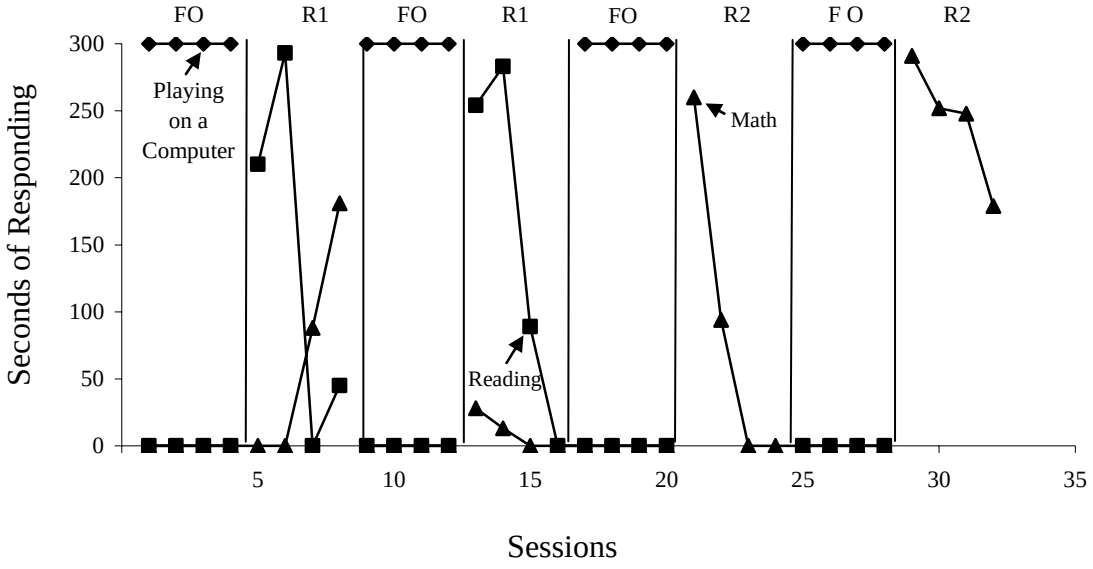

Figure 6. Seconds of responding during the response-restriction treatment for John. FO signifies free-operant phases. During R1 phases, access to the computer, videos, electronic game, and therapy ball was restricted. During R2 the computer, videos, electronic game, therapy ball, and books were restricted.

the first restriction phase (R1), reading initially increased but then decreased toward the end of the phase as he allocated more time to doing mathematics. In the following free-operant phase, John played computer games for the entire condition. In a second exposure to R1, reading again increased at the beginning of the condition but decreased over time. In the subsequent free-operant phase, John spent all of his time playing computer games. In the second restriction condition (R2), reading was restricted in addition to the responses restricted in R1 and mathematics initially increased but did not maintain. In another reversal to free operant, John played on the computer during 100% of all sessions. In a second exposure to R2, there was an initial increase in mathematics but a downward trend across the condition. As with Kyle, reliable increases in targeted responses were observed following response restriction, however, for John, increases in targeted responses did not maintain across restriction conditions. Nonetheless, in the final R2 condition, he spent over 16 of the 20 total minutes working on mathematics.

Figure 7 shows the results of the restriction treatment for Sarah. In the first free-operant phase, most of her time was spent watching television. In the first restriction phase (R1), playing with a singing toy, playing a handheld video game, playing with clay, and playing with cards were all observed, with the most likely response being playing with the singing toy. In a return to free operant, Sarah spent nearly all of her time watching television. In the following R1 phase, Sarah primarily worked on crafts. In another reversal to free operant, she spent 100% of her time watching television. In a return to R1, the most probable response was again doing crafts and in the subsequent free-operant phase she, again, spent all of her time watching television. During the

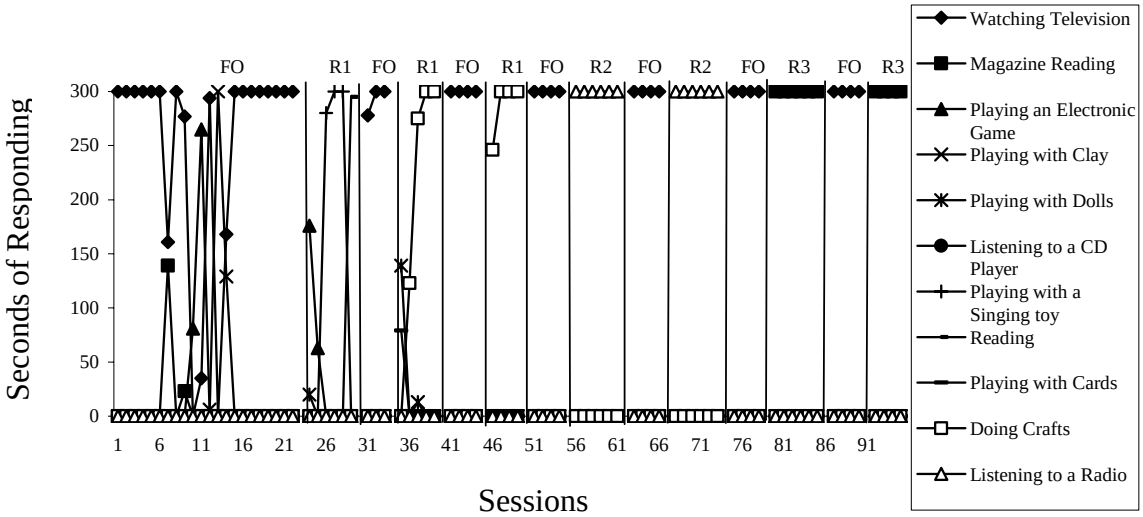

Figure 7. Seconds of responding during the response-restriction treatment for Sarah. FO signifies free-operant phases. During R1 phases, access to television and videos was restricted. During R2, television, videos, and crafts were restricted. During R3, television, videos, crafts, and the radio were restricted.

second restriction condition (R2), television, videos, and crafts were restricted and Sarah exclusively spent her time listening to music. In the next free-operant phase, Sarah watched television during 100% of all sessions. In a return to R2, she again exclusively listened to music. In the following free-operant condition, she spent all of her time watching television. In the third restriction condition (R3), access to a radio was restricted along with those responses restricted in R2 and Sarah spent 100% of her time reading a magazine. In the subsequent free-operant phase, she again exclusively watched television. In a return to R3, Sarah, again, read a magazine during 100% of all sessions. For Sarah, restriction of certain responses reliably increased certain other responses. While the response restrictions did not produce increases in the initially targeted academic-related reading and mathematics activities for Sarah, her caregivers indicated that they preferred her spending her time on the activities that were produced through response restriction (working on crafts, listening to music, and reading a magazine) to her watching television (her most common response during free-operant periods).

Figure 8 depicts the results for the response-restriction treatment for Beth. During the first restriction condition (R1), her responding was variable, with playing with dolls, reading, and mathematics all observed. During the first free-operant condition, Beth predominantly watched television. In a return to R1, she spent all of her time doing math. In the following free-operant phase, Beth allocated all of her time to watching television. In the next exposure to R1, Beth primarily worked on crafts during the first four sessions and mathematics in the final two sessions. In a return to free-operant, Beth's responding was variable, with reading, doing crafts, watching television, and playing a handheld video game all occurring. In the following restriction phase, Beth

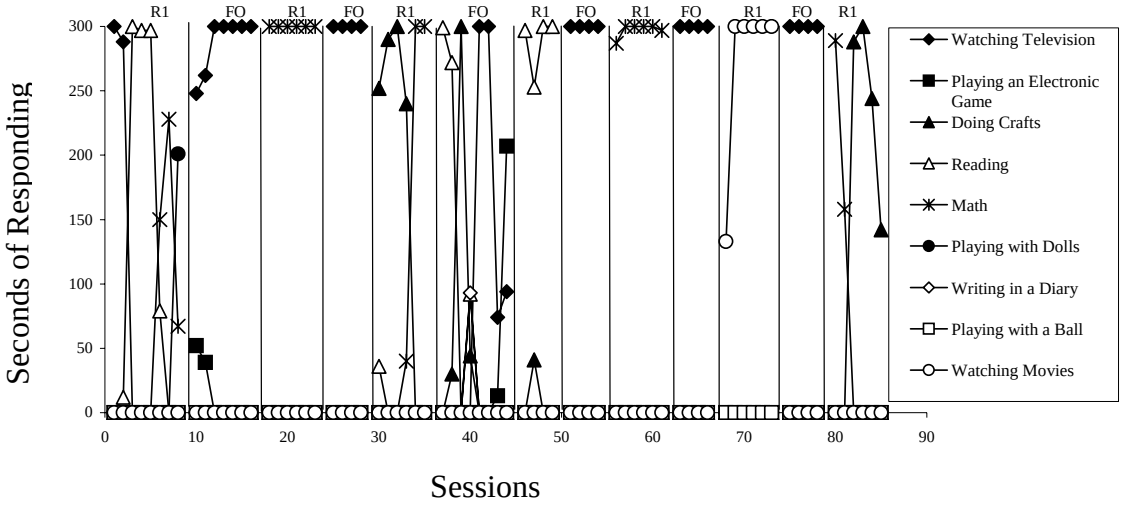

Figure 8. Seconds of responding during the response-restriction treatment for Beth. FO signifies free-operant phases. During R1 phases, access to television, counting money, and playing with clay was restricted.

spent most of her time reading. In the subsequent free-operant phase, she exclusively watched television. In the next response-restriction phase, Beth allocated most of her time to math. During the return to free operant, she again spent 100% of her time watching television. In the next R1 phase, Beth spent most of her time watching a movie. In the following free-operant phase, she exclusively watched television. In the final response-restriction phase, Beth worked on math during the beginning of the condition and worked on crafts during the end of the condition. For Beth, while no reliable effects of response restriction were observed, increases in targeted behavior were observed in various restriction phases.

Response restriction produced increases in targeted responding in naturally occurring, multi-response environments, for three of four participants. However, these increases were only reliable and sustained for Kyle. For John, response restriction produced reliable initial increases in targeted behavior, but these increases did not maintain. For Sarah, response restriction did not produce increases in targeted responses but did produce reliable increases in other desirable responses. In Beth's case, response restriction had variable effects, producing increases in targeted responding in some phases, but not reliably. In order to evaluate an alternative treatment for Kyle and to identify a method for producing more desirable treatment outcomes for John, Sarah, and Beth, the effects of contingent access to responses on targeted behavior in naturally occurring, multi-response environments for each participant were examined in Study 3.

CHAPTER 4
STUDY 3: AN EVALUATION OF CONTINGENT ACCESS TO RESPONSES AS A METHOD FOR INCREASING SOCIALLY DESIRABLE RESPONSES IN A NATURALLY OCCURING MULTI-RESPONSE ENVIRONMENT

Study 2 showed that response restriction alone reliably produced sustained increases in targeted responding for one of four participants. In study 3, the effects of contingent access to responses on targeted behavior in multi-response environments were examined for all four participants. Initially, the effects of contingent access to multiple responses were compared to either free-operant or response-restriction control conditions. Following this, the effects of contingent access to a single high probability response were examined.

Method

The participants and settings were identical to those in Studies 1 and 2. A single response was targeted for increase for each participant, reading for Kyle, math for John, and reading for Sarah and Beth. For Kyle and John, contingent responses were those that were likely to be observed under free-operant conditions and those observed to be probable following response restriction in Study 2, but not those which, when all were restricted, resulted in an increase in the targeted responses. This ensured that the contingent responses had a high likelihood of occurrence and that their restriction alone would not result in increases in targeted behavior. Because reliable increases in targeted behavior were not observed for Sarah and Beth, the same responses used in the initial response-restriction phases in Study 2 were used as initial contingent responses in Study

3. These responses were found to be likely under free-operant conditions or following restriction of probable responses, but their restriction did not produce increases in targeted behavior. For Kyle, the initial contingent responses were playing video games, watching television, playing pool, and drawing. For John, the initial contingent responses were playing on the computer, watching movies, and playing an electronic game. For Sarah, the initial contingent responses were watching television and movies. For Beth, the initial contingent responses were watching television, counting money, and playing with clay. For all participants, following the evaluation of a multiple-response contingency, the effects of contingent access to a single response were examined. For Kyle, the single contingent response used in this analysis was playing video games. For John, it was playing on a computer. For both Sarah and Beth it was watching television. The single contingent responses were those engaged in during periods in which access to contingent responses was delivered in the multiple-response contingency phases. During single-response contingency conditions, only the one contingent response was restricted and all other responses were concurrently available with the instrumental response.

Free-operant and response-restriction phases were conducted in a manner identical to those in Studies 1 and 2 except that participants were told which responses were restricted and that they were free to engage in targeted responses, other non-restricted responses, or nothing at all. For all participants other than John, during all response-contingency phases, access to contingent responses was restricted and each minute spent engaging in the targeted response produced a token exchangeable for one minute of access to restricted responses following the day's observation period. Poker chips were used as tokens for all participants. Observation periods lasted between 20 and

30 minutes. At the initiation of each response-contingency observation period, participants were told that they could earn tokens that they could exchange for access to restricted responses by doing targeted responses, and that they were free to choose to do the targeted response, another activity, or nothing at all. John's initial response-contingency phase was conducted in a manner identical to those of the other participants. Following this phase, for John, a 21.6 by 27.9 cm plastic board was constructed with 20 Velcro squares arranged in four rows of five on which John could place earned tokens. In this phase, tokens were poker chips with Velcro squares attached to one side. In all subsequent response-contingency phases for John, no tokens were used and each minute of engagement in targeted behavior produced one minute of access to restricted responses immediately. Session time was stopped during periods in which access to restricted responses was provided.

Results and Discussion

Figure 9 shows the data for the response-contingency analysis for Kyle. In phase 1, with access to playing video games, watching television, playing pool, and drawing contingent upon reading, Kyle spent all of his time reading. In the following free-operant condition, no reading was observed. Kyle spent 100% of his time during all sessions reading during a return to contingent access to video games, watching television, playing pool, and drawing. In the next free-operant phase, no reading occurred. We noted that during all token-exchange periods Kyle exclusively engaged in playing video games. When access to playing video games alone was contingent upon reading and Kyle spent all of his time reading. In the following video game restriction phase, reading was not observed. When access to playing video games was again contingent upon reading in the

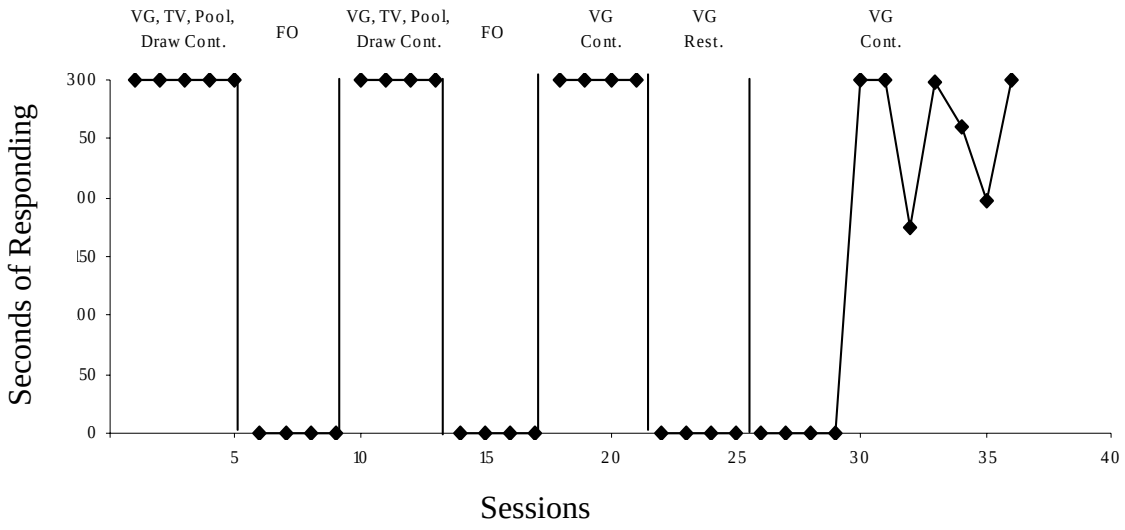

Figure 9. Seconds of responding during the contingency treatment for Kyle. FO signifies free-operant phases. The abbreviations Cont. and Rest. signify contingency and response restriction conditions respectively.

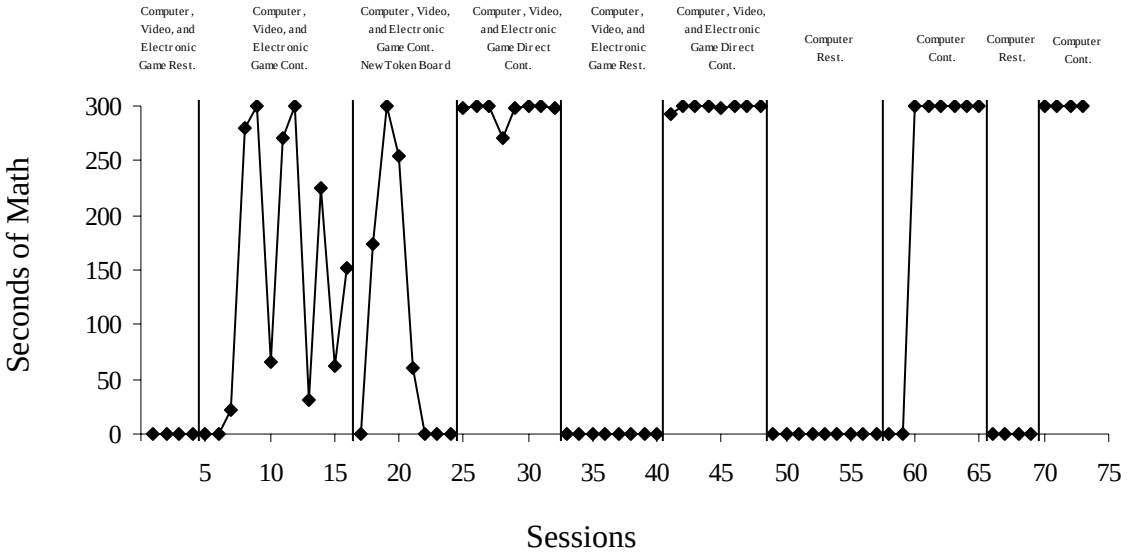

Figure 10. Seconds of responding during the contingency treatment for John. FO signifies free-operant phases. The abbreviations Cont. and Rest. signify contingency and response restriction conditions respectively.

subsequent phase, no reading was observed during the first four sessions, then responding increased for the remainder of the phase.

Figure 10 depicts John's results. In the first restriction phase, John spent no time doing math. In the first contingency phase, doing math increased and was observed at variable levels. In the subsequent phase, John was provided with a board on which he could place his tokens and his doing math remained variable during the first half of the phase but was eliminated during the final three five-minute periods. In the next phase, the tokens were removed and each minute of doing worksheets produced immediate access to restricted responses and John spent nearly all of his time on math. In a return to the restriction phase, no math was observed. In the following contingency phase, John spent almost all of his time doing math. As was the case with Kyle, John exclusively engaged in a single response during all periods in which contingent access to responses was permitted. For John, this response was playing on a computer. In phase 7, the effects of computer restriction alone were examined and John spent no time working on math. When access to the computer was made contingent upon doing math in the following phase, doing math increased in the third five-minute period and John exclusively engaged in this response for the remainder of the phase. In a return to computer restriction, John spent no time was spent on math. In the final contingent-computer phase, John allocated all of his time to doing math.

Figure 11 depicts the results for Sarah. During the first phase, access to watching television and videos was contingent upon reading and high levels of reading were observed. When watching television and movies were restricted with no contingency in the following phase, no reading was observed. In a return to contingent television and

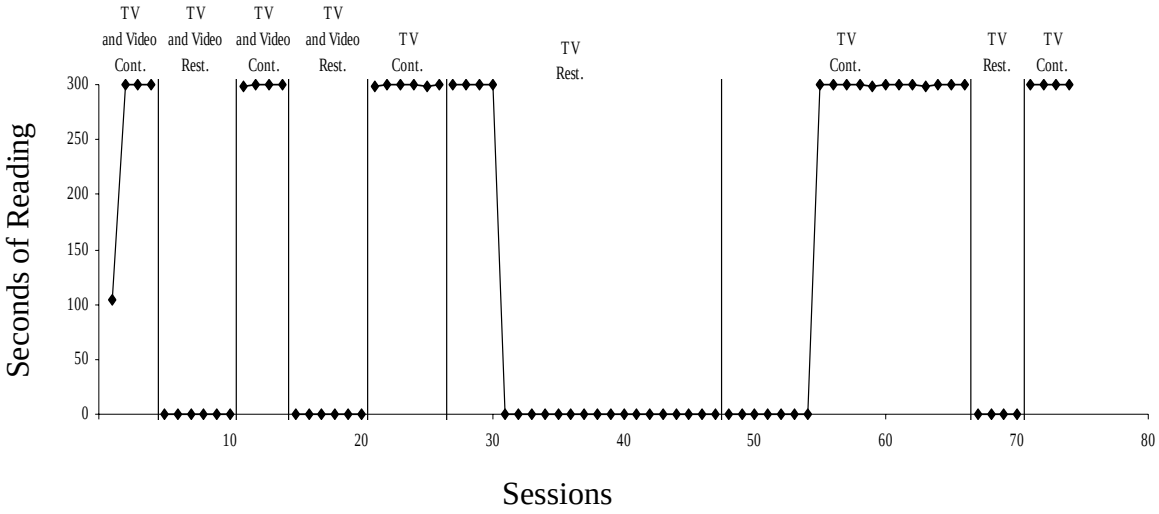

Figure 11. Seconds of responding during the contingency treatment for Sarah. FO signifies free-operant phases. The abbreviations Cont. and Rest. signify contingency and response restriction conditions respectively.

videos, Sarah spent all of her time reading. In a second restriction phase, no reading was observed. During all periods in which access to restricted responses was delivered during contingent access to responses phases Sarah exclusively watched television. In phase 5, contingent access to watching television alone resulted in Sarah spending all of her time reading. When access to watching television was restricted, with no contingency, in the following phase, reading occurred during the first four five-minute periods and then did not occur for the remainder of the phase. In a return to contingent television, reading was not observed during the first seven five-minute periods, but occurred during all subsequent sessions of the phase. In a second television-restriction condition, no reading occurred. In a final contingent-television condition, Sarah spent all of her time reading.

Figure 12 depicts the data for the response-contingency analysis for Beth. In the first television, counting money, and clay restriction, no reading was observed. When these responses were contingent upon reading, in the following condition, high levels of reading were observed. In a return to restriction, reading again decreased to zero levels. When the contingency was reinstated, Beth spent nearly all of her time reading. As was the case with Sarah, Beth exclusively watched television during token-exchange periods in which access to previously restricted responses was permitted. In phase 5, access to watching television was contingent upon reading and high levels of reading maintained. When access to watching television was restricted in the following phase, time spent reading decreased. In a return to contingent television, reading initially increased during the first four sessions, decreased to zero levels during the following eight sessions and then increased to high levels for the remainder of the phase (12 sessions). In a return to

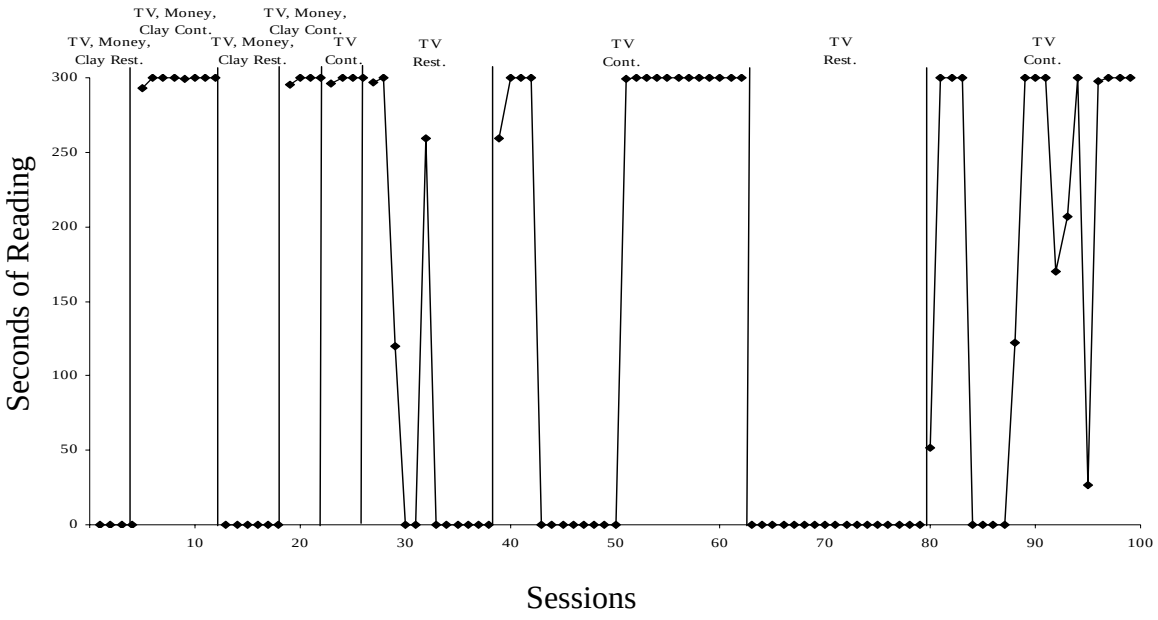

Figure 12. Seconds of responding during the contingency treatment for Beth. FO signifies free-operant phases. The abbreviations Cont. and Rest. signify contingency and response restriction conditions respectively.

restriction, reading was not observed for the entire phase. In another reversal to contingent television, reading increased and occurred at variable levels.

For all participants, contingent access to multiple responses produced reliable increases in targeted behavior in naturally occurring multi-response environments. When responses used as contingent responses were restricted in the response-restriction analysis (study 2), no increase in reading was observed suggesting that the response contingency was responsible for the increase in, and maintenance of, targeted behavior during the response-contingency analyses. Another finding common to all participants was that, during periods in which access to restricted responses was permitted in response-contingency phases, responding was allocated exclusively to a single behavior (playing video games for Kyle, playing on a computer for John, and watching television for both Sarah and Beth). While there was more variability in instrumental responding than was observed when multiple contingent responses were used, contingent access to this single response resulted in increases in targeted behavior for all participants even though multiple alternative responses were simultaneously available. These increases were not observed when the contingent responses were restricted but no contingency was in effect. This finding suggests that contingent access to a single high-probability response can serve as reinforcement for socially significant behavior in a complex, naturally occurring environment even with concurrently available access to multiple other potentially competing responses.

CHAPTER 5
GENERAL DISCUSSION

With the advent of preference assessment methodology, the empirical pre-treatment identification of reinforcers for use in clinical application has become standard in the field of applied behavior analysis (Hanley, Iwata, Lindberg, & Conners, 2003) and the utility of these methods in identifying reinforcers that are effective components of behavioral treatments has been demonstrated numerous times. Typical empirical reinforcement identification methods involve a relatively simple response being exposed to contingent access to a number of items or activities in an environment in which potentially competing responses are largely unavailable. The effectiveness of reinforcers identified in these preparations in application depends upon their generality extending across all of the variables that differ between the assessment and the application environments. Research on the response-deprivation hypothesis suggests an alternative method of reinforcer identification. Baseline levels of responding are measured in the treatment environment and access to a consequence response is provided contingent on an instrumental response such that the ratio of instrumental to consequence responses is greater than that observed during baseline. The response-deprivation hypothesis has been shown to effectively identify reinforcers and mitigate to some degree concerns regarding the circularity of post hoc reinforcer identification (Timberlake & Farmer-Dougan, 1991). Furthermore, as baseline levels of responding are measured in the environment in which the reinforcement contingency will be put into place, there is less risk that the generality of the identified reinforcers will not extend into the treatment context. The use of the

response-deprivation hypothesis for reinforcer identification would seem to have particular promise for use in naturally occurring environments in which access to many responses is available and in which the multiple sources of reinforcement maintaining these responses may compete with reinforcers identified in more restricted environments. Much research in this area, however, has occurred in the context of restricted operant preparations in which only a limited number of responses are available. The present series of studies extends prior work on response restriction, the Premack principle, and the response-deprivation hypothesis by explicitly examining the use of response restriction and contingent access to responses to increase socially desirable behavior in complex, naturally occurring, multi-response environments.

In Studies 1 and 2, the effects of response restriction alone were examined. Previous work has demonstrated that the restriction of access to behavior, in the absence of contingencies, can result in an increase in other behavior in both restricted- (Hanley et al., 2000) and multi-response (Bernstein & Ebbesen, 1978; Lyons & Cheney, 1984; Green & Striefel, 1998) environments. In previous studies, however, such increases in behavior have been idiosyncratic across subjects, with no single rule adequately describing response reallocation following the restriction of a response. The results of the present studies replicated this finding. The brief response restriction analyses conducted in Study 1 produced results that were both variable across participants and across replications within participant.

Under conditions of response restriction in Study 2, with no response contingency in place, increases in targeted responses were observed for three of four subjects (Kyle, John, and Beth). For Kyle, reliable and sustained increases were observed in both

reading and math. For John, reliable initial increases were observed in both reading and math, however, these increases were not sustained over extended periods of time. For Beth, increases in both math and reading, among other responses, were observed following restriction of competing responses, however, these increases were not reliable or predictable. One potentially important finding was the emergence of reasonably desirable responses that were not initially targeted for increase. For Kyle, an increase was observed in drawing following restriction of television and video games. For Beth, working on craft projects increased with restriction of television, counting money, and playing with clay. For Sarah, when television and movies were restricted, increases were observed in working on crafts, listening to music, and reading magazines. These findings suggest that the restriction of perhaps a less desired response (e.g., watching television) may result in the serendipitous increase in a more desired response (e.g., drawing) in the absence of imposed contingencies. Although the particular outcome of response restriction was idiosyncratic across participants, these data imply response restriction as a potentially effective method for use in multi-response environments. For example, at time when school work is not necessarily required, response restriction might be used to produce a greater diversity of leisure activities.

When effective, response restriction may provide a treatment option for clinicians or parents that is both relatively easy to implement and not prone to failures in treatment integrity (i.e., response restriction does not require counting of responses, timing, or the delivery of stimuli leaving relatively little room for error). The general methods of Studies 1 and 2 may serve as an initial guide for clinicians attempting to make use of response restriction as a treatment, Kyle's outcome is an example of the most favorable

result. Although the brief analyses of Study 1 produced variable outcomes, they were successful in identifying some responses that may have been competing with targeted behavior. This may provide a starting point for a more extended analysis which might identify further responses that may be competing with target behavior.

The factors responsible for changes in responding under response restriction remain to be identified. It may be that responses that increase in frequency are members of the same operant class as those restricted and might be considered members of a response-class hierarchy (Harding, Wacker, Berg, Barretto, Winborn, & Gardner, 2001; Lalli, Mace, Wohm, & Livezy, 1995; Richman, Wacker, Asmus, Casey, & Andelman, 1999). Alternatively, it may be that responses that increase in frequency are either automatically or socially reinforced and that restricted responses produced more potent reinforcement and thus competed with them. A third possibility is that some responses may never increase in frequency as a function of restriction of alternative responses alone (i.e., those that are not in a participant's repertoire or those that are not automatically or socially reinforced). Sources of control that may produce variability in behavior under conditions of response restriction have also not yet been identified. It is possible, for example, that fluctuations in motivating operations, the presence or absence of relevant discriminative stimuli, or changing contingencies on any number of responses may affect the outcome of restriction of access to responses in multi-operant environments.

In Study 3, the effects of contingent access to responses on socially important behavior in naturally occurring, unrestricted environments were examined. Both the Premack principle and the response-deprivation hypothesis would predict increases in instrumental responding given the contingencies arranged in Study 3 (i.e., more probable

responses were made contingent upon the occurrence of less probable responses in a manner that would make the ratio of instrumental to consequence responses greater than that observed in free-operant phases). However, both the Premack principle and the response-deprivation hypothesis are silent with regard to any possible effects of several alternative sources of reinforcement being available. In Study 3, contingent access to multiple high-probability responses and a single high-probability response arranged such that the ratio of instrumental to consequence responses was greater than that observed during free-operant periods produced reinforcement effects for all participants. This finding further extends the generality of the Premack principle and the response-deprivation hypothesis, showing reinforcement effects for socially desirable behavior in complex, naturally occurring, unrestricted environments.

The effectiveness of the methods used in Study 3 suggests some promise for general application in multi-response settings. The initial consequence responses were chosen based on the outcomes of Studies 1 and 2, but it may not have been necessary to conduct both studies to identify effective contingent responses. The single consequence response effective as a reinforcer for Kyle was playing video games, playing on a computer for John, and watching television for Sarah and Beth. The results from the free-operant phases of the brief response restriction analyses, conducted in Study 1, indicated that the most probable responses for Kyle were video game playing and math, playing on the computer for all assessments for John, watching television during two assessments and math during one for Sarah, and watching television during two assessments and weaving during one for Beth. When the data obtained during free-operant periods in Study 1 are aggregated (i.e., the durations of each response in each of

the free-operant periods are added), the most likely free-operant response observed in Study 1 is the same response that was demonstrated to maintain targeted behavior in Study 3 for all subjects other than Kyle. For Kyle, only two brief restriction analyses were conducted and playing video games was the most likely response in one of the two. Whether or not playing video games would have emerged as the most likely response in further brief free-operant periods is unknown, but seems likely based on subsequent data. These data, for three of four participants, suggest that effective contingent responses for use as reinforcers may be identified through relatively brief free-operant observation periods in the targeted environment. Furthermore, the most probable response observed in the initial free-operant phases in Study 2 for all participants was the response shown to serve as an effective reinforcer in Study 3, again suggesting that a pre-treatment measure of free-operant responding in a particular environment may be useful in identifying responses to use as reinforcers.

Research is needed in numerous areas to determine the conditions under which response restriction and contingencies will be most effective. First, because the current studies and previous research have found response restriction to produce idiosyncratic results, research is needed to examine the influences of potentially relevant variables including motivating operations, response effort, the presence or absence of discriminative stimuli, and contingencies for alternative responses under conditions of response restriction. Second, because both the Premack principle and the response-deprivation hypothesis predict the obtained reinforcement effect in Study 3, evaluations are needed using a less-probable response with the ratio of instrumental to consequence responses being greater than that observed during free-operant periods (the two models

make different predictions). Third, future research is needed to directly compare the effectiveness of Premack/response-deprivation approaches to identifying reinforcers to those based on relatively standard preference assessment methods (e.g., DeLeon & Iwata, 1996; Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin, 1992; Pace, Ivancic, Edwards, Iwata, & Page, 1985; Roane, Vollmer, Ringdahl, & Marcus, 1998; Windsor, Piche, & Locke, 1994). The outcome of such a comparison would speak directly to the applied utility of using contingent access to behavior observed in a treatment environment as reinforcement.

LIST OF REFERENCES

Allison, J. & Timberlake, W. (1974). Instrumental and contingent saccharin licking in rats: Response deprivation and reinforcement. *Learning and Motivation, 5,* 231-247.

Amari, A., Grace, N. C., & Fisher, W. W. (1995). Achieving and maintaining compliance with the ketogenic diet. *Journal of Applied Behavior Analysis, 28,* 341-342.

Bernstein, D. J. (1998). Establishment of a laboratory for continuous observation of human behavior. In K. A. Lattal & M. Perone (Eds.), *Handbook of research methods in human operant behavior* (pp. 509-539). New York: Plenum Press.

Bernstein, D. J. & Ebbesen, E. B. (1978). Reinforcement and substitution in humans: A multiple-response analysis. *Journal of the Experimental Analysis of Behavior, 30,* 243-253.

Bernstein, D. J. & Michael, R. L. (1990). The utility of verbal and behavioral assessments of value. *Journal of the Experimental Analysis of Behavior, 54,* 173-184.

Catania, A. C. (1998). *Learning.* Upper Saddle River, NJ: Prentice Hall.

Charlop, M. H., Kurtz, P. F., & Casey, F. G. (1990). Using aberrant behaviors as reinforcers for autistic children. *Journal of Applied Behavior Analysis, 23,* 163-181.

DeLeon, I. G. & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29,* 519-532.

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491-498.

Green, G. & Striefel, S. (1988). Response restriction and substitution with autistic children. *Journal of the Experimental Analysis of Behavior, 50,* 21-32.

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36,* 147-185.

Hanley, G. P., Iwata, B. A., Thompson, R. H., & Lindberg, J. S. (2000). A component analysis of "stereotypy as reinforcement" for alternative behavior. *Journal of Applied Behavior Analysis, 33,* 285-297.

Harding, J. W., Wacker, D. P., Berg, W. K., Barretto, A., Winborn, L., & Gardner, A. (2001). Analysis of response class hierarchies with attention-maintained problem behaviors. *Journal of Applied Behavior Analysis, 34,* 61-64.

Homme, L. E., de Baca, P. C., Devine, J. V., Steinhorst, R., & Rickert, E. J. (1963). Use of the Premack principle in controlling the behavior of nursery school children. *Journal of the Experimental Analysis of Behavior, 6,* 544.

Konarski, E. A., Jr. Johnson, M. R., Crowell, C. R., & Whitman, T. L. (1980). Response deprivation and reinforcement in applied settings: A preliminary analysis. *Journal of Applied Behavior Analysis, 13,* 595-609.

Lalli, J. S., Mace, F. C., Wohn, T., & Livezy, K. (1995). Identification and modification of a response-class hierarchy. *Journal of Applied Behavior Analysis, 28,* 551-559.

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36,* 407-414.

Lyons, C. A. & Cheney, C. D. (1984). Time reallocation in a multiresponse environment: Effects of restricting response classes. *Journal of the Experimental Analysis of Behavior, 41,* 279-289.

Meehl P. E. (1950). On the circularity of the law of effect. *Psychological Bulletin, 47,* 52-75.

Mitchell, W. S. & Stoffelmayr, B. E. (1973). Application of the Premack principle to the behavioral control of extremely inactive schizophrenics. *Journal of Applied Behavior Analysis, 6,* 419-423.

Osborne, J. G. (1969). Free-time as a reinforcer in the management of classroom behavior. *Journal of Applied Behavior Analysis, 2,* 113-118.

Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference and reinforcer value with profoundly retarded individuals. *Journal of Applied Behavior Analysis, 18,* 249-255.

Postman, L. (1947). The history and present status of the law of effect. *Psychological Bulletin, 44,* 489-563.

Premack, D. (1959). Toward empirical behavior laws: 1. Positive reinforcement. *Psychological Review, 66,* 219-233.

Richman, D. M., Wacker, D. P., Asmus, J. M., Casey, S. D., & Andelman, M. (1999). Further analysis of problem behavior in response class hierarchies. *Journal of Applied Behavior Analysis, 32*, 269-283.

Roane, H. S., Vollmer, T. R., Ringdahl, J. E., & Marcus, B. A. (1998). Evaluation of a brief stimulus preference assessment. *Journal of Applied Behavior Analysis, 31*, 605-620.

Sidman, M. (1960). *Tactics of scientific research.* New York: Basic Books.

Skinner, B. F. (1935). The generic nature of the concepts of stimulus and response. *Journal of General Psychology, 12,* 40-65.

Skinner, B. F. (1953). *Science and human behavior.* New York: Macmillan.

Timberlake, W. & Allison, J. (1974). Response deprivation: An empirical approach to instrumental performance. *Psychological Review, 81,* 146-164.

Timberlake, W. & Farmer-Dougan, V. A. (1991). Reinforcement in applied settings: Figuring out ahead of time what will work. *Psychological Bulletin, 110,* 379-391.

Windsor, J., Piche, L. M., & Locke, P. A. (1994). Preference testing: A comparison of two presentation methods. *Research in Developmental Disabilities, 15,* 493-455.

BIOGRAPHICAL SKETCH

Jason Bourret was born in Milwaukee, Wisconsin. He entered the University of Florida in 1995 and graduated in 1999 with a degree in psychology. During his undergraduate studies, he served as a volunteer in a basic behavior analysis research lab working on choice research and two applied behavior analysis labs working primarily on research focusing on the treatment of severe behavior problems in individuals diagnosed with developmental disabilities. In 1999, he enrolled in the behavior analysis program at the University of Florida to pursue a doctoral degree in psychology. He worked as a graduate research assistant under the direction of Dr. Timothy Vollmer. Over the course of his graduate career at the University of Florida, he has been involved in research on verbal behavior, quantitative analysis of behavior, response allocation in multi-response environments, descriptive analysis of behavior, and schedules of response-contingent and fixed-time reinforcement delivery. Expecting graduation in December, 2005, he plans on continuing his career in behavior analysis through conducting behavior analytic research with implications for application in clinical settings.