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# An analysis of the effects of contingent delivery of tasks with different difficulty and noncontingent delivery of tasks with different preference

Ernest Whitmarsh
*Louisiana State University and Agricultural and Mechanical College*, ewhitma@lsu.edu

# AN ANALYSIS OF THE EFFECTS OF CONTINGENT DELIVERY OF TASKS WITH DIFFERENT DIFFICULTY AND NONCONTINGENT DELIVERY OF TASKS WITH DIFFERENT PREFERENCE

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ABSTRACT

This investigation examined instructional strategies derived from the Premack principle and task interspersal strategies for four students with moderate to severe developmental disabilities. In both studies, baseline consisted of massed instruction of thirty trials. During study one, students were given contingent access to preferred easy tasks for correct responding in one condition. In the second condition, students were given contingent access to preferred difficult tasks for correct responding. During study two, students were given noncontingent access to preferred easy tasks for correct responding in one condition. In the second condition, students were given noncontingent access to nonpreferred easy tasks for correct responding. A reversal design was used to evaluate the results. Tasks were identified using a task preference assessment based on the free operant preference assessment. For study one, results indicated that four out of four participants had higher response accuracy when preferred easy tasks were presented contingently. Four out of four participants had lower response accuracy when given contingent access to preferred difficult tasks when compared to the contingent preferred easy task condition. For study two, results indicated that four out of four participants had higher response accuracy when preferred easy tasks were presented noncontingently. Three out of four participants had levels of response accuracy equal to or lower than baseline when nonpreferred easy tasks were presented noncontingently.

# INTRODUCTION

Although the primary mission of educational institutions is teaching, the specific targets of instruction change across educational contexts and students. For example, the goal of a third grade regular education mathematics teacher may be teaching students to solve arithmetic sentences for one unknown. The goal of a special education teacher may be to increase appropriate social skills of the students. When students do not learn at all or learn too slowly, educational institutions have failed to achieve their primary institutional mission. Behavior analytic approaches to teaching have focused on the prevention and remediation of learning problems. In contrast to other models where the emphasis is on making changes within the individual, the focus of behavior analysis is analysis and modification of environmental factors to solve learning problems.

The core of the behavioral analysis of learning is the three-term contingency. The components of the three-term contingency are antecedents, behaviors, and consequences. Antecedents are followed by behaviors that lead to consequences. These environmental events are crucial to understanding and changing human behavior (Heward, 1987). Antecedent stimuli are the stimuli existing in the environment when a response occurs or occurring prior to an instance of the behavior (Skinner, 1969). Consequences are the changes in stimuli in the environment that occur contingent upon a response (Skinner, 1969). The instructional interaction can be described and analyzed based on the three-term contingency. For example, an instruction such as “write the letter A” can be viewed as an antecedent, the attempt of the student to write the letter is a behavior, and teacher feedback regarding the student’s work can be viewed as a consequence.

The consequence component of the three-term contingency has frequently been manipulated to change student behavior. Numerous studies have examined the use of contingency management in education. The use of contingent reward in the classroom has taken multiple forms such as incentives for reading (Allyon & Roberts, 1974; Lovitt, Eaton, Korkwood, & Pelander, 1971; Staats, Minke, Finley, Wolf, & Brooks, 1964) and math (Broughton & Lahey, 1978). Another form includes the use of performance feedback (VanHouten & Lai Fatt, 1981;VanHouten & Thompson, 1976), which is the delivery of response-contingent feedback about performance. Students can also monitor their own performance by correcting their own work. Self-monitoring can be effective when used to increase academic performance (Hoge & Andrews, 1987; Maag, Reid, & DiGangi, 1993; Skinner & Smith, 1992). Another consequence-based strategy is positive practice overcorrection. Ollendick, Matson, Esvelt-Dawson, and Shapiro (1980) and Foxx and Jones (1978) used positive practice to improve spelling performance. Other consequence-based procedures include contingency contracting or behavioral contracting (White-Blackburn, Semb, & Semb, 1977) and token economies (McLauphlin, 1981; Robinson, Newby, & Ganzell, 1981).

The manipulation of behavior's antecedents has also been examined. The presentation of prompts with or in the presence of discriminative stimuli has been a common antecedent manipulation. Prompting has been used to increase academic skills such as reading (Bradley-Johnson, Sunderman, & Johnson, 1983), numeral identification (Ault, Wolery, Gast, & Doyle, 1988), and object identification (Godby, Gast, & Wolery, 1987).

The presence or absence of models can also be considered an antecedent manipulation. Models have been used across a range of concerns including skills such as toilet training (Wilson & Jackson, 1980) and coping with phobias (Jackson & Hooper, 1981). Components of academic interventions have also contained modeling. One example, the "cover-copy-compare" procedure, has been used to improve performance in mathematics (Skinner, Bamberg, Smith, & Powell, 1993; Skinner, Ford, & Yunker, 1991). For reading, listening previewing procedures have been shown to be effective (Rose, 1984; Rose & Sherry, 1984). For spelling, peer tutoring has been shown to be effective (Greenwood, Carta, & Hall, 1988). The peer tutoring procedures include a modeling error-correction procedure in which the tutors demonstrated correct spelling.

Other manipulations of antecedents have included altering the sequence in which demands are presented. Mace (1996) describes efforts in which advances in basic research are applied to human behavior. For example, the study of behavioral momentum in basic research can be applied to research with children. The high-probability (high-p) treatment for noncompliance (Mace et al., 1988) was based on the general behavioral relations presented by Nevin, Mandell, and Atak (1983). This behavioral relation labeled behavioral momentum is the persistence of behavior as a positive function of rate of reinforcement. High probability commands were requests or instructions with which the subject had a history of complying. In the studies reported by Mace and colleagues, a sequence of three high-p commands such as "give me five" were followed by one low probability command such as "please put your lunch box away." There have been a number of extensions of the research by Mace et al. (1988). Mace and Belfiore (1990) used the high-p demand sequence to increase the compliance of a woman with severe mental retardation whose behavior was maintained by escape from demands. Ducharme and Worling (1994) also utilized the high-p demand sequence to increase compliance for 5-year-old-boy with developmental disabilities. The authors faded the number of high-p requests and increased the latency from the high-p request to the low-p request. Other studies have utilized high-p treatments to increase the academic behavior of students without developmental disabilities (Ardoin, Martens, & Wolfe, 1999; Belfiore, Lee, Vargas, & Skinner, 1997; Rortvedt & Miltenberger, 1994). For example, Ardoin et al. (1999) trained a teacher to give three high probability (high-p) instructions followed by one low probability (low-p) instruction to increase compliance of three students during transition time in a regular education classroom. Results indicated that the intervention was effective for two of the three participants.

Another manipulation of antecedents is based on the inclusion of known items among instructional trials for unknowns. For example, Neef, Iwata, and Page (1980) investigated interspersing known items when teaching new spelling words to three mentally retarded students. The interspersing condition led to greater acquisition and retention of instructed words when compared to baseline and the reinforcement conditions. In another example, Dunlap (1984) evaluated affect and rate of task acquisition for children diagnosed with autism under three conditions: a constant task, a varied-acquisition-task condition, and a varied-with-maintenance-task condition. The results indicated more efficient learning under the varied-maintenance condition. Roberts and Shapiro (1996) examined the effectiveness of interspersing different ratios of known to unknown words on the reading progress of 46 regular education students. There were four experimental conditions: 80% known items, 50% known items, 20% known items, and an assessment only group. The primary dependent variable was the mean cumulative words learned. Results indicated that students learned a greater proportion of unknown words in the 80% known, 20% unknown condition when compared to the 20% known, 80% unknown condition. Browder and Shear (1996) interspersed known items to teach sight words to three students with behavior disorders. The primary dependent variable was the number of unknown words read correctly in a sight word test. The students learned all 10 new words in 9-31 days. This was notable when compared to the acquisition of only 30 words after several years of instruction. Generally these studies have concluded that the inclusion of known items leads to more effective learning.

Other researchers have used academic interspersal strategies by imbedding preferred tasks within non-preferred tasks. Studies have analyzed student preference for a particular instructional task. Wildmon, Skinner, McCurdy, and Sims (1999) evaluated student preference, on-task levels, and assignment completion rates for math word problems when given a control assignment with multiplication problems and an experimental assignment that contained three interspersed addition problems among the multiplication problems. Students completed more problems on the experimental assignment. Clarke et al. (1995) modified instruction for four elementary school boys by incorporating their interests into the curriculum. Results indicated that the inclusion of interesting activities into the problematic assignment reduced disruptive behavior. Foster-Johnson, Ferro, and Dunlap (1994) found that students displayed less disruptive behavior and more appropriate behavior when they were required to work on a preferred task.

The following is a review of the literature related to the manipulation of antecedents and consequences to resolve learning problems. A review of antecedent-based procedures to improve target behaviors will be followed by a review of procedures used to modify consequences of behavior. Second, problems with typical consequence based strategies will be discussed. Interspersing of tasks will be discussed as an alternative. This will be followed by the justification of an assessment procedure that will analyze the contingent and noncontingent delivery of tasks with differing preferences and difficulties.

## REVIEW OF LITERATURE

### Antecedent Manipulation Strategies

An alternative to the use of consequence-based strategies to increase appropriate behavior involves the manipulation of antecedents. Antecedent-based strategies involve the manipulation or introduction of stimuli before a behavior occurs. As noted earlier, the concept of antecedents of behavior is a fundamental component of the three-term contingency which is a basic element of behavior analysis. The following is a review of the literature related to the manipulation of antecedents to increase target behaviors.

Functional Analysis. Functional analysis, a form of behavioral assessment, has included the manipulation of antecedents to identify behavior maintaining contingencies. Iwata et al. (1982/94) pioneered the use of functional analysis to determine behavior maintaining contingencies for individuals with severe and profound developmental disabilities. Since then the use of functional analysis has been extended to different environments, behaviors, and populations. The practical use of functional analyses has been studied in general education classrooms (Broussard & Northup, 1995; Broussard, Jones, George, Vollmer, & Herring, 1995; Umbreit, 1995). In functional analyses, antecedents such as the presence of demands, the availability of tangible items (e.g. food, toys), availability of social attention (e.g. praise, reprimands), and the absence of social consequences, have been examined in conjunction with the relevant contingencies. Treatments are then derived based on the information gathered from the functional analysis. Interventions derived from functional analysis have been shown to be more effective than arbitrary implementation of an intervention (Iwata et al., 1994; Lalli, Browder, Mace, & Brown, 1993).

Prompting and Modeling. Prompts are often used to transfer stimulus control from a prompt to a target discriminative stimulus. For example, when teaching a student multiplication facts the goal may be to have the student correctly respond to the presence of the flash card. The use of prompts to increase target behaviors has taken several forms: time delay procedures, system of least prompts, most-to-least prompts, and graduated guidance.

In the system of least prompts, the student is given the opportunity to correctly respond without prompting. If the required response does not occur after a specified period of time, a prompt of least assistance is given. The first prompt is often a verbal prompt. The second prompt, if necessary, is often a gesture. The third prompt, if necessary, is often full physical guidance (Cooper, 1987). Duker and Morsink (1984) used graduated guidance to train four profoundly retarded individuals to use manual signs. A multiple baseline design was utilized to evaluate the effectiveness of the procedure. Results indicated that the students acquired the manual signs and maintenance and generalization was established across settings (classroom, ward) and persons (teachers, ward staff).

Although more research has been allocated to least-to-most prompting, most-to-least prompting has been examined in the literature. When using most-to-least prompts, the teacher initially guides the student through the whole task. The amount of guidance is reduced as the student learns the task (Cooper, 1987). Walls, Christ, Sienicki, and Grant (1981) compared a least-to-most restrictive sequence, a most-to-least restrictive sequence, and a within-mode physical guidance fading procedure to teach independent living skills. Participants included fourteen vocational rehabilitation clients. The dependent measures were the number of errors to reach criteria, the number of seconds to criteria, and the percent correct. Results showed no differences between the prompting procedures.

Graduated guidance is a prompting procedure in which prompts are provided only when it is necessary. The prompts are faded immediately when the student responds correctly (Cooper, 1987). MacDuff, Krantz, and McClannahan (1993) used a multiple baseline across participants design to evaluate the effectiveness of graduated guidance to teach four boys with autism to follow photographic activity schedules to increase on-task and on-schedule behavior.  Graduated guidance was used to expedite the completion of activities in the student's photographic activity schedule. Guidance was delivered by using manual prompts to move the student through the activity. When the child independently completed an activity the manual prompt was replaced with shadowing. Shadowing involved following the child's movements without providing physical contact. If the child was scored as on-task and on-schedule for at least 80% of the time samples, teacher proximity was faded. On-task was measured as the child visually attending to activity materials, manipulating activity materials, or in transitioning from one activity to another. On-schedule was defined as a time sample in which the student was engaged in the activity in the photographic activity binder. Results indicated that the use of graduated guidance produce consistent on-task and on-schedule behaviors for the participants when compared to baseline.

Two common time delay prompting procedures are progressive time delay and constant time delay. With progressive time delay procedures the time interval between the delivery of the target discriminative stimulus and the prompt is gradually increased over trials or blocks of trials (Ault et al., 1988). With the constant time delay procedure the time interval between, the delivery of the target discriminative stimulus and the prompt is increased to a fixed interval that remains the same for all subsequent trials (Wolery et al., 1992).

Godby, Gast, and Wolery (1987) compared progressive time delay procedures to a system of least prompts. Three students with severe handicaps participated in the comparison. Each student was taught to identify eight functional objects, four objects with each prompting procedure. Effectiveness was measured by establishing criterion level responding. Efficiency was evaluated by measuring sessions and trials to criterion, errors to criterion, and the number of minutes of direct instructional time. A parallel- treatments design was used for this study. Results indicated that both procedures were effective to teach the students to criterion levels. Additionally, during the post-training probes, correct responses remained at 100% correct. The progressive time delay procedure was more efficient than the system of least prompts. The progressive time delay procedures took less time, required fewer sessions to reach criterion, and had fewer errors to reach criterion.

Ault et al. (1988) compared a constant time delay procedure to a system of least prompts while teaching three students to name 16 numerals. Two male students diagnosed with autism participated in the study. A third participant was diagnosed as falling into the "autistic continuum." A parallel-treatments design was used to evaluate effectiveness and efficiency of the two procedures. Results indicated that both procedures were effective in teaching the two autistic participants. Stimulus shaping was required for the third participant. The constant time delay procedure was more efficient, requiring 72% of the time required by the system of least prompts.

Bradley-Johnson et al. (1983) compared a delayed prompting procedure to a fading procedure to teach preschoolers easily confused letters and numbers. Thirty-nine preschoolers participated in the study. Students in the delayed prompting group were required to point to the correct letter card among six within four seconds of the demand, “Point to the letter __”, to receive a reward in the form of tokens. The tokens were exchanged for small toys. For students in the fading group the correct answer was highlighted. The highlighting was gradually faded as the students correctly responded. Results indicated that both procedures required equal number of training sessions to reach criteria, but the delayed prompting procedure produced fewer errors than the fading procedure.

Task Sequencing. In the literature the sequencing of tasks refers to the temporal placement of tasks within a block or sequence of instructional tasks. One form of task sequencing involves interspersing of tasks. Specifically, studies have examined the effect of interspersing known items among unknown items. For example, Neef et al. (1977), investigated interspersing known items when teaching three students with mental retardation new spelling words. Two conditions were analyzed using a multielement design. In the interspersal training sessions, ten words that were correctly spelled on a pretest were presented alternately with ten words that were spelled incorrectly on a pretest. During the baseline condition ten words were presented without alternating known words. During later baseline sessions social reinforcement was provided contingent upon on-task related behavior. The interspersing condition led to greater acquisition and retention of instructed words when compared to baseline and the reinforcement conditions.

Neef et al. (1980) compared the acquisition and retention of spelling words during a known item interspersal condition and a high-density of social reinforcement condition. Three male students with ages ranging from 19 to 24 years participated in the study. One of the men was diagnosed as profoundly deaf. The other two men were diagnosed as trainable mentally retarded. A baseline condition in which ten words were presented without interspersing known words was followed by a multielement design in which an interspersal training condition was compared to high-density reinforcement condition. All students mastered more words during the interspersal conditions than during the baseline or high-density reinforcement conditions. When given a choice between the interspersal and high-density conditions two of the students chose the interspersal condition three out of four times. The third student chose the interspersal condition four out of four times. The authors note that the preference for the interspersal condition could be explained by the rarity of consecutive incorrect responses during the interspersal condition. In other words, the students preferred the condition in which they made more correct responses.

Cuvo, Klevans, Borakove, Borakove, Landuyt, and Lutzker (1980) examined the relative effects of three stimuli presentation methods on object naming tasks. Ninety-six students participated in the study. College adults, children and adolescents with mental retardation, and preschool children were taught to produce the names of five Hebrew letters, English words, or American coins in three experiments. Results were analyzed using between-subjects treatment in a factorial design. During the successive training condition, stimuli were presented one at a time. When the student met criteria for those stimuli, the next stimuli were presented. During the simultaneous training condition, all of the stimuli were present on the table at once. Training trials were presented until the student made fifteen correct responses for each stimulus. During the combined training condition a procedure was developed that utilized both successive and simultaneous presentation of stimuli. For example, in experiment one Hebrew and English letters were presented successively for six correct trials and again simultaneously with all other letters previously taught. Two dependent variables were used to evaluate the effectiveness of the procedures: total number of training trials to reach criteria and proportion correct on the posttest. For experiment one (college students), results indicated that the simultaneous condition required significantly more trials to meet criteria than the successive and combined conditions. Posttest results indicate that performance during the successive condition was significantly poorer than the simultaneous and combined conditions. For experiment two (adolescents with mental retardation), results indicated that the simultaneous condition took more training trials to reach criteria than the successive condition. Performance on the posttest was lower for the successive condition than the simultaneous and combined conditions. For experiment three (preschool children), the successive condition required fewer training trials, while the simultaneous and combined conditions produced higher performance on the posttest. Cumulatively, the results indicate that posttest performance was superior for the simultaneous and combined conditions. This study demonstrates the effectiveness of strategies like the simultaneous and combined conditions that contain a variety of presented stimuli, rather than the massed presentation of stimuli in the successive condition.

Cuvo, Davis, and Gluck (1991) compared the effectiveness of cumulative and interspersal task sequencing of self-paced instruction. Participants included twenty young adults with mild handicaps. During the cumulative task sequencing condition a workbook was constructed that taught savings account, bill paying, and money order skills. A set of four practice problems was presented first. Then a second set of practice problems was presented that represented all previous sets of problems. During the interspersal task condition a workbook was constructed that taught the same skills as the cumulative condition, but the problems were interspersed with previously trained problems. The dependent variable was the percentage of correct problems on the pre-, post-, and follow-up tests. The permanent products were scored using task analysis. A problem was scored correct if all steps of the task analysis were correct. Results indicated that both methods increased scores from the pretest to the posttest. There was no significant difference between the cumulative and the interspersal condition. The authors state that the similar efficacy of the cumulative and interspersal condition indicates that both strategies would be appropriate for self-paced instruction for persons with mild handicaps. Additionally, caregivers should choose strategy based on other factors such as ease of construction and implementation.

In another example, Dunlap (1984) evaluated autistic children's affect and rate of task acquisition under three conditions. The first condition was a constant task condition where only an acquisition task was presented during the session. In the varied-acquisition-task condition, 10 acquisition tasks were randomly interspersed throughout each session. In the third condition, a varied-with-maintenance-task condition, five acquisition tasks and five acquired tasks were randomly interspersed. Five children between the ages of four and ten years participated in the study. Results indicated more efficient learning under the varied-maintenance condition. Efficiency was evaluated by measuring the trials required to reach criterion. Additionally, most positive judgments about the student's affect were produced in the varied-maintenance condition. To evaluate affect, at least one observer completed four 6-point rating scales at the end of each session. These scales measured activity, happiness, and general behavior (Dunlap & Koegal, 1980a; Koegel & Egel, 1979).

Cooke and Guzaukas (1993) analyzed the effects of different new to review item ratios across three experiments. During experiment one 30% new with 70% review item ratio was compared to traditional drill of 100% new items. The dependent variables included the number of spelling words spelled correctly, number of words spelled per minute, and percentage correct on maintenance tests given at the end of every fifth session. An alternating treatments design was utilized for each experiment. Four students who met the North Carolina definition for behavior/emotional handicaps participated in the study. Both conditions increased spelling acquisition for all students, but the 100% new item condition, by its nature, produced mastery of ten new words versus three in the 30/70% condition. Not surprisingly, students preferred the 30/70% condition because “it was easier.”

Participants in experiment two included three students who were diagnosed with learning disabilities. The primary dependent variable was the number of correctly written digits per minute on daily generalization probes. The second dependent variable was number of correct answers on oral maintenance tests. Students achieved higher fluency in the 30/70% condition. Maintenance test results were similar for both conditions. Students preferred the 30/70% condition.

Participants in study three were six students enrolled in a self-contained, cross-categorical special education class in a public elementary school. The dependent variables included the number of correct words per minute from initial to final reading of each passage, the mean number of words meeting mastery criterion per 2-minute instructional session, and the number of correct words on maintenance checks every fifth session. Both conditions produced gains in correct words per minute. The 100% condition had more words meet mastery criterion each session. These results suggest that the 30/70% condition presented a "low learning ceiling." Both conditions produced high maintenance test results.

Cooke and Reichard (1996) compared the effects of three different interspersal drill ratios on acquisition and generalization of multiplication and division facts. Six fifth-grade students participated in the study. Five were diagnosed with learning disabilities and one student was diagnosed with behavioral-emotional handicaps. Three ratios were compared: 1. 30% unknown – 70% known 2. 50% unknown – 50% known 3. 70% unknown – 30% known. The dependent variables were the mean number of acquisition facts per day, the number of correct digits on the first 15 problems of the generalization probe sheet, and an oral interview regarding student preference. Four of six students mastered acquisition facts at the fastest rate in the 70%-30% condition. One student had higher rates in the 50%-50% condition. The final student had higher rates in the 70%-30% and the 50%-50% conditions. Three students indicated preference for the 70%-30% condition. The other three students did not demonstrate a preference.

Roberts and Shapiro (1996) examined the effectiveness of interspersing different ratios of known to unknown words on the reading progress of 46 regular education students. There were four experimental conditions: 1. 80% known, 20%unknown 2. 50% known, 50% unknown 3. 20% known, 80% unknown 4. assessment only group. The primary dependent variable was the mean cumulative words learned. Results indicated that students learned 65.73% of the unknown words in the 80% known, 20% unknown condition and 35.1% of the unknown words in the 20% known, 80% unknown condition. The authors note that the higher percentage of words learned in the 80% known, 20% unknown condition was despite the fact that students were only exposed to four new words out of a total of twenty, while they were exposed to 16 new words out of a total of twenty in the 20% known, 80% unknown condition.

Browder and Shear (1996) interspersed known items to teach sight words to three students with behavior disorders. The primary dependent variable was the number of unknown words read correctly in a sight word test. The known to unknown word ratio was created using methods described by Coulter and Coulter (1989). The interspersal sequence created 30 trials of new words and 71 trials of known words. The students learned all 10 new words in 9-31 days. Which was notable when compared to the acquisition of only 30 words after several years of instruction.

Rowan and Pear (1985) compared the effects of interspersal and concurrent training sequences on acquisition, retention, and generalization of picture names. In the interspersal condition, trials with previously learned items are interspersed with trials for each new item until the new item has been trained to criterion. In the concurrent training condition two or more new items are trained together by alternating between the items. Three children with mental handicaps in a residential and training facility participated in the study. Results indicated that learning rates were greater in the interspersal condition.

Wildmon, Skinner, McCurdy, and Sims (1999) evaluated student preference, on-task levels, and assignment completion rates for math word problems when given a control assignment with multiplication problems and an experimental assignment that contained three interspersed addition problems among the multiplication problems. Eighty high school students participated in the study. Results indicated that students completed more problems on the experimental assignment. Interestingly, students chose the experimental assignment for homework 62% of the time even though the experimental assignment contained more problems than the control condition.

Charlop, Kurtz, and Milstein (1992) examined interspersal procedures further by assessing differing reinforcement schedules during task interspersal procedures. Five children diagnosed with autism participated in the study. The childrens' ages ranged from 4 to 6 years old. The primary dependent variable was the percentage correct for an acquisition task. An acquisition task was a task never presented to the child before. Maintenance tasks were tasks that the child performed at an average of 80% accuracy. Throughout the study, task interspersal procedures were in place. Fifteen trials of the acquisition task and four trials each of the three maintenance tasks totaled 27 trials. The order of presentation was determined randomly, with the restriction that no more than two acquisition tasks could be presented consecutively. During baseline typical reinforcement procedures were in effect. For each correct acquisition and maintenance task the child was given praise and a food reinforcer. For incorrect performance the therapist told the child "no." During the no-reinforcer condition, reinforcement for the maintenance tasks (praise and food) was removed. Food and praise were given for correct performance on the acquisition task. During the praise-only condition, only praise was given for satisfactory completion of the maintenance task. Food and praise were provided when the student correctly responded on an acquisition task. Results indicated that none of the children reached criteria during baseline. All children reached criteria for the acquisition task when contingencies for the maintenance task were changed. The children's' performance did not decrease when baseline was reintroduced. The authors note that the experimental conditions provided richer schedules of reinforcement in terms of magnitude and quality for the acquisition tasks.

Not all interspersing procedures have been evaluated by their ability to increase academic responding. Horner, Day, Sprague, O'Brien, and Heathfield (1991) evaluated the effects of interspersing procedures on aggressive and self-injurious behavior. Three children between the ages 12-14 participated in the study. Each child had been diagnosed with severe mental retardation. Dependent variables included self-injury or aggression and attempting to complete the task. An A-B-A-B-C-B-C-D-E within-subject reversal design was utilized. During the easy phase, task materials were presented with an instruction to complete the task. During the hard condition, tasks were presented that were considered difficult by the task. The participants correctly performed the tasks with 33% accuracy. During the hard plus interspersed request condition, procedures were identical to the hard condition except after about three training trials or after any sign of resistance (whining, grunting, etc.) the therapist provided three to five short simple requests. These tasks were identified by the trainers as requests that required short responses and that the person had a high probability of performing correctly (e.g., "give me five," "give me the pen"). Results indicated that self-injury and aggression were less frequent during the easy and hard plus interspersed task conditions when compared to the hard task conditions. One of the participants attempted to complete tasks across all conditions. The other two participants had fewer attempts during the hard condition.

Behavioral Momentum. An alternative to contingent reward is based on behavioral momentum. Nevin, Mandell, and Atak (1983) suggest that the resistance of behavior to change can be analyzed by using an analogy to classical physics where momentum is defined as the product of mass and velocity. The persistence of behavior when exposed to different conditions may be explained by considering learned behavior as possessing momentum (Nevin, Mandell, & Atak, 1983). The behavioral mass can be viewed as the tendency for responding to continue under different conditions, while behavioral velocity can be viewed as the ongoing response rate. According to Nevin et al. behavioral momentum depends on a stimulus-specific history of reinforcement. When rate of reinforcement is increased the behavioral mass is increased thus increasing momentum or the resistance of behavior to changes in conditions.

Mace et al. (1988) used the term behavioral momentum to describe a method to increase compliance in adults with mental retardation which involved presenting low probability (low-p) instructions (e.g. “clean the table”) after a series of three high probability (high-p) requests (e.g. “give me five”). For all three experiments, the dependent variable was the percentage of compliance to low-probability “do” and “don’t” commands. The independent variable was the inclusion of three high probability demands immediately before the low-probability demands. High-p requests were requests in which the subject had a history of compliance. For the subject in experiment one, compliance increased from 47% for “do” requests in baseline to 93% during the final phase in which the high-p demand sequence came before the low-p request. For “don’t” requests compliance increased from 53.5% during baseline to 90% during the final phase.

The purpose of the second experiment was to assess the generality of the first experiment and to determine if positive attention alone would increase compliance. During baseline the second subject’s mean compliance was 26%. When attention preceded the low-p request, compliance was similar to baseline (*M* = 35%). When the high-p command sequence was included mean compliance increased to 73%. The major findings of experiment two were that the effects of high-p sequence generalized across subjects and experimenter attention was not enough to increase compliance.

The purpose of the third experiment in the Mace et al. (1988) study was to determine if an increase in the interval between the last high-p command and the statement of the low-p command. The hypothesis was that increasing this interval would decrease the rate of reinforcement, therefore decreasing behavioral momentum. For this experiment the independent variable was interprompt time (IPT). IPT was defined as the time interval beginning with the cessation of the last high-p command in the high-p command sequence and ending with the onset of the low-p command. High-p command sequences with an IPT of 5-s resulted in higher compliance (*M* = 83%) than with an IPT of 20-s (*M* = 53%). The results of the third experiment suggest the effects of momentum produced in the high-p sequence depend on the temporal contiguity between the high-p command sequence and the low-p command.

The high-probability (high-p) treatment for noncompliance (Hock and Mace, 1986; Mace et al., 1988) was based on the general behavioral relations presented by Nevin, Mandell, and Atak (1983). This behavioral relation labeled behavioral momentum is the persistence of behavior as a positive function of rate of reinforcement. Mace (1996) points out that the use of the term behavioral momentum may be a premature descriptor of the high-p treatment presented in Mace (1988). Despite Mace's reservations, the term has been utilized in similar research from 1988-1996. More recent research from 1997-present utilizes the term high-p treatment.

There have been a number of extensions of the research by Mace et al. (1988). One of these was conducted by Mace and Belfiore (1990). Descriptive and experimental analyses indicated that the stereotypy of a 38-year-old woman with severe mental retardation was maintained by escape from demands. After the initiation of a treatment utilizing a series of high-p requests before the low-p request resulted in an increase of compliance from a range of 22-34% in baseline to a range of 52-88% during treatment. Additionally, reductions in stereotypic touching response (STR) were evident with a reduction of STR from a range of 2.8-4.0 during baseline to a range of 1.4-1.7 during the high-p procedure.

Another extension of Mace et al. (1988) was a study by Ducharme and Worling (1994). Ducharme and Worling (1994) attempted to increase the feasibility of interventions based on behavioral momentum by systematically decreasing the number of high-probability requests using stimulus fading. After compliance to low-probability requests stabilized at high levels the high probability requests were faded gradually by reducing the number of high-p requests and increasing the time between the high-p request and the low-p request. First the high-p requests were reduced from three to one then the time between the high-p request and the low-p request was increased from 10 s to 20 s. Results indicated that the fading procedures were successful for both subjects.

Additionally, the experimenters extended the use of the procedures into the subjects' homes with the parents serving as therapists.

One study that attempted to utilize behavioral momentum to increase academic behavior was conducted by Belfiore, Lee, Vargas, and Skinner (1997). Belfiore et al. utilized high preference of single-digit mathematic problems to promote behavioral momentum for two teenage students in an alternative education school. After an initial forced choice preference assessment it was determined that the students preferred the worksheets that contained single-digit math problems. During the intervention phase three single digit math problems were presented before presenting one three-digit math problem. Results indicated that the high preference condition reduced the latency to initiation of math problems.

The effectiveness of treatments based on a high-p instructional sequence can be influenced by the reinforcer quality. Mace, Mauro, Bovajian, and Eckert (1997) tested resistance to treatment by varying reinforcer quality in two applied studies and a basic laboratory experiment. In the first experiment the compliant behavior of two adolescent boys increased when food and praise were delivered for compliance versus praise alone. During experiment two, the resistance to behavior change was examined for one of the participants in the first experiment by increasing the number of low-p instructions after the presentation of the high-p instructions. The slope of the line depicting percent of compliance was much steeper for the praise only condition versus the praise plus food condition after the number of low-p instructions was increased from one to five. In the final experiment resistance to behavior change was examined in four rats when sucrose was presented for compliance versus citric acid. The sucrose conditions produce more resistance to change. Taken together these studies illustrate the general functional relation between quality of reinforcers and momentum. Low-p compliance decreases less rapidly when higher quality reinforcers are presented.

While most treatments based on behavioral momentum have focused on an increase in compliance, research has demonstrated that momentum-based treatments can be combined with extinction to reduce aberrant behavior. Zarcone, Iwata, Mazaleski, and Smith (1994) combined extinction and momentum in a treatment to increase compliance and decrease self-injurious behavior of two men residing in a state facility for persons with developmental disabilities. The momentum component of the treatment consisted of the delivery of three preferred instructions followed by one low-preferred instruction. The extinction component of treatment consisted of the removal of escape when the participant engaged in self-injurious behavior. Rates of self-injurious behavior decreased and compliance increased when extinction was included in the momentum treatment.

The use of interventions based on momentum have not been limited to individuals with developmental disabilities. Rortvedt and Miltenberger (1994) attempted to use a high-p request procedure to increase compliance to low-p requests. Two developmentally normal 4-year-old girls participated in the study. A list of 12 low-p requests and 12 high-p requests were developed using parent interview. During baseline the mother delivered five to eight low-p requests selected randomly from the pool of twelve. During the high-p sequence phase, the parent delivered three high-p requests before the delivery of the low-p request. The high-p sequence increased compliance for one of the participants. For the other participant, compliance was reduced when the high-p sequence was implemented. For both participants, a time-out procedure was implemented to increase compliance. The implementation of the time-out procedure increased compliance for both subjects. The authors state that one reason the high-p procedure failed for one child was that a descriptive rather than functional analysis was utilized to identify the reinforcer for noncompliance.

Another study that extended the research of Mace et al.(1988) and utilizes developmentally normal subjects was conducted by Ardoin et al. (1999). In this article the references to behavioral momentum are omitted indicating a shift in the literature from earlier uses of the term. Ardoin et al. trained a teacher to give three high probability (high-p) instructions followed by one low probability (low-p) instructions to increase compliance of three students during transition time in a regular education classroom. Results indicated that the intervention was effective for two of the three participants. A fading procedure was utilized to decrease the number of high-p instructions from three to one.

Consequence-Based Strategies

Positive Practice Overcorrection. Positive practice overcorrection is a procedure in which the student has to complete additional tasks contingent upon errors on the target task. The additional tasks are usually designed to increase practice for the target task. For example, Fox and Jones (1978) utilized positive practice in a remediation program for spelling achievement of elementary and junior high school students. Twenty-nine students from grades 4,5,7, and 8 from an elementary-junior high school participated in the study. Students with an average spelling score of 85% correct or lower were selected for the program. Five experimental conditions were analyzed.

During baseline conditions the teacher taught spelling as she had always done. During the pretest-test condition, a pretest was given on Wednesday and a test was given on Friday. During the test/positive practice condition weekly tests were given on Friday. For each misspelled word the student had to write its correct spelling, its correct phonetic spelling, its part of speech, its complete dictionary definition, and its correct usage in five sentences. The students had one day to complete the positive practice assignment. During the pretest/positive practice/test condition students were given a pretest on Wednesday. The students were required to complete the positive practice assignment and a test was given on Friday. The final condition included a Wednesday pretest, positive practice between the pretest and test, the Friday test, and positive practice assignment after the Friday test. Results indicated that the conditions including positive practice were superior. The pretest/positive practice, test/ positive practice test produced the greatest increase in spelling for grades 4 and 8. For grade five pretest/positive practice/ test condition was superior. Finally, for grade 7 the test/ positive practice condition produced the highest increase in spelling average.

Contingent Reward. There has been a historic use of contingent reward to increase academic behavior. The use of contingent reward in the classroom has taken multiple forms. One form involves the delivery of incentives for reading (Allyon & Roberts, 1974; Lovitt et al., 1971; Staats et al., 1964) and math (Broughton & Lahey, 1978). Ayllon and Roberts (1974) directly reinforced academic behavior rather than reinforcing non-disruptive behavior. Systematic token reinforcement was applied to reading performance. Five participants were chosen from a fifth-grade class of 38 students. The five boys chosen were independently ranked by two teachers as the most disruptive. The dependent variable was the percentage of correct answers on a daily reading test. The presence of the token economy was evaluated using an ABA reversal design. In the token economy system points could be exchanged for activities and privileges. Results indicated that reinforcement of reading increased reading performance for the five students. Additionally, disruptive behavior was reduced from 40% in baseline to 5% during treatment.

Broughton and Lahey (1978) examined the relative effects of positive reinforcement and response cost on academic and on-task behavior. Thirty-three fourth and fifth-grade students in four remedial math classes participated. The two major dependent variables were the percent correct for the daily math problems and the percent of time on-task. On-task behavior was scored if the student was at his desk, writing on or looking at his paper, counting to himself, or talking with the teacher on a task-related topic. Students were considered off-task if they were away from their desks, talking to peers, calling out, working on materials other than the worksheet, looking at another's work, sitting at their desk without working, or hitting, poking, or pushing another pupil or his materials. Each of the four classes was randomly assigned to a treatment condition. Within each group an ABA reversal design was used. The first condition was the baseline condition. During this condition the only contingency in effect was response feedback. In the positive reinforcement condition students earned one point for each correct math problem. Points could be exchanged for free-time activities. During the response cost condition each student started with twenty points and lost a point when they incorrectly answered a math problem. During the mixed condition each student started with twenty points and could either gain or lose points depending on performance. All groups displayed increases in percent correct when compared to baseline. There was not a significant difference between the three contingency groups. Each contingency group showed increases in on-task behavior when compared to baseline.

Another form of contingent reward that has been utilized to increase academic behavior has been labeled contingency contracting or a behavioral contract. A contingency contract is a document that specifies a contingent relationship between the completion of a specified behavior and access to, or delivery of, a specified reward (Heward, 1987). White-Blackburn et al. (1977) measured the on-task behavior, disruptive behavior, daily assignment completion, and weekly grades of four sixth-grade students while the behavior contract was in effect. The students were given a list of appropriate behaviors and a list of disruptive behaviors daily. The students were also a given a list of rewards and penalties. When the contract was in effect the behavior of the target students matched the performance of three model students.

The token economy can also be considered a contingent reward system. The use of token economies for behavior modification can be traced to the early 1800s with Joseph Lancaster's "Monitorial System" in England. In this system schoolboys were rewarded with tickets that indicated superior performance. Prizes were received for receiving tickets (Kazdin, 1977). Kazdin (1977) traces the existence of token reinforcement in the United States in the late 1880s to the "Excelsior School System." In this system students received tokens in the form of certificates that read "excellent" or "perfect." These certificates were exchanged for merits that could be exchanged for a special certificate from the teacher that noted commendable performance. Token economies have been used to modify numerous behaviors including social behavior and academic behavior for children (McLauphlin, 1981). Specifically, Robinson et al. (1981) utilized a token economy to increase the reading and vocabulary of an 18-member class of third-grade hyperactive boys. The tokens could be exchanged for fifteen minutes of play with video games. Tokens could also be earned by proctoring other students who had not yet completed the assignment. The results indicated that a token economy could be used to increase the academic behavior of a large classroom of hyperactive children.

Potential Problems with Contingent Reward. When proposed in the literature the use of contingent reward to increase behavior sometimes begins with the identification of preferred stimuli (tokens, candy, games, removal of tasks etc.). The preferred stimuli is presented contingent on correct performance. The presentation of reward is not without its side effects. Balsam and Bondy (1983) identified a number of problems with contingent reward. Just as there are elicited or emotional effects associated with the delivery of aversive stimuli, there are emotional effects of reward. These effects include aggression and ritualistic behavior. These behaviors have also been named schedule induced, adjunctive, or interim behaviors. Powerful appetitive stimuli (reward) could also elicit behaviors such as reaching or staring that can compete with the target response. When a signal reliably predicts reward, the individual may try to increase proximity to the rewarding agent. For example, a child may constantly approach a teacher, parent, or therapist thus interfering with appropriate training. Although Balsam and Bondy (1983) did not provide any frequency data related to these side effects, they propose documentation of the side effects of reward as an "extremely valuable line of future research."

Another category of side effects presented by Balsam and Bondy (1983) are operant effects. One of these effects is related to generalization and discrimination. Improved behavior may only take place in the environment in which contingent reward is in place. For example, children who receive token reward during a particular class period may engage in inappropriate behavior during other times of the day. Another side effect presented by Balsam and Bondy (1983) is response induction. The reinforcement of a particular topography may induce behavior that leads to the same consequence. For example, strong reinforcers could lead to lying, conniving, stealing, or cheating.

The use of contingent reward in the classroom may produce problems unique to that environment. Sharpley (1985) suggests that the application of contingent reward in a classroom setting can be perceived as direct rewards by the target subject and implicit rewards by the student who observes the reward being received by the target student. Sharpley (1985) makes this distinction to clarify the effects of contingent reward on the target student and the other students in the classroom. In some cases the effect on other students could be positive. For example, a student may observe another student being rewarded for appropriate behavior then engage in appropriate behavior and receive the same reward. Kazdin (1973) demonstrated with four moderately retarded elementary school students that the reinforcement of attentive behavior had a vicarious effect on the other students. Attentive behavior of the non-target students increased. Kazdin (1975) notes that the rewarding of the target child should be viewed as a discriminative stimuli to other children.  In other words, the reward acts as a signal to other children that "being good" is now being rewarded.  Although this may not seem to be detrimental side effect, a scenario could be in place in a particular classroom where vicarious reinforcement effects may be harmful.  When the non-target child is "being good" there are two possible outcomes.  The non-target child's behavior can be reinforced or ignored.   If the child is ignored an extinction schedule is in place.  According to Sharpley (1985), under the time constraints that are part of teaching a class an extinction schedule becomes more likely thus decreasing the likelihood that the non-target child's behavior will persist.  When appropriate behavior is placed on an extinction schedule other behavior could become prevalent. Some of these behaviors may be problematic.

The manipulation of consequences does not necessarily have to include the use reward such as tokens or candy. Access to preferred activities contingent upon completion of a target activity may alleviate some of the potential problems with contingent reward presented by Balsam and Bondy (1983). In the classroom, the contingent delivery of preferred activities may be less noticeable to other students than the delivery of non-instructionally relevant stimuli such as stickers. The potential discreteness of the contingent delivery of preferred activities may eliminate the possibility of vicarious reinforcement presented by Sharpley (1985). The contingent delivery of preferred activities is not a new concept to behavior analysis. The Premack principle is directly related to the contingent delivery of preferred activities. The following is a review of the literature related to the Premack principle.

Premack Principle. Traditionally, applied researchers have viewed reinforcement according to the Empirical Law of Effect (Skinner, 1935; Spence, 1956). A stimulus is a reinforcer if its presentation or removal after a response increases the probability that the response will occur again in the future. Instead of determining the effectiveness of a reinforcer after its application, the Premack principle allows a priori prediction of the effectiveness of a reinforcer. This principle is promising for increasing academic behavior. Premack (1959) states that "reinforcement results when a response of a lower independent rate coincides, within temporal limits, with the stimuli governing the occurrence of a response of a higher independent rate." Simply stated, the Premack principle predicts an increase in responding when access to a high probability behavior is made contingent on the occurrence of low probability behavior. The general postulate of the Premack principle states that there must be a probability differential between the instrumental and contingent responding during free performance. Contingent responding is defined as the responding during access to the high-p behavior. Instrumental responding is defined as the responding necessary to gain access to the high probability behavior. Research suggests that the probability differential may not be necessary (Konarski, Johnson, Crowell, & Whitman, 1980). Timberlake and Allison (1974) developed the Response Deprivation Hypothesis. Similar to the original Premack principle, freely occurring levels of instrumental and contingent responding are responsible for schedule effectiveness, but according to the Response Deprivation Hypothesis the subject increases instrumental responding to remove the state of deprivation required by the schedule. Therefore, any behavior that an individual can perform can serve as a potential reinforcer if response deprivation is in effect. In an educational setting the Premack principle modified by the Response Deprivation Hypothesis implies that the scheduled access to academic tasks can be manipulated to produce instrumental responding for one task and contingent responding for the other.

The Konarski et al. (1980) study provides support for the response deprivation hypothesis. In two experiments schedules were presented to first-grade children that fulfilled conditions of one, both or neither of the Premack Principle and the Response Deprivation Hypothesis. In experiment one coloring was identified as the higher probability behavior and math was identified as the lower probability behavior for two children. In the response deprivation present condition the children increased their coloring when access to math was given contingent on coloring. This result contradicts the Premack Principle because the high probability task does not necessarily have to be the reinforcer.

Experiment two was designed to test the prediction that a higher-probability contingent response would increase instrumental performance only when response deprivation was present. Two children participated in this experiment. The two tasks utilized were math and coloring. Results indicated that the students' performance did not increase in the absence of response deprivation. This suggests that response deprivation may be necessary requirement for the schedule to be effective. Both experiments together indicate that response deprivation was sufficient and necessary to produce reinforcement effects.

Mitchell and Stoffelmayr (1973) applied Premack's principle with two inactive schizophrenic patients. In this study sitting was used as a reinforcer for completion of a wire-stripping task. The patients had previously refused tangible reward. Browder, Hines, & Fees (1984) utilized the Premack principle to increase sight word recognition for adults with moderate mental retardation. The preferred task was the opportunity to perform daily living skills. The nonpreferred task was academic instruction for sight word recognition. Opportunities to perform daily living skills were given contingent on attempts to recognize sight words. The use of the Premack principle was a component of a treatment package that included an instruction booklet and a time delay procedure.

Hanley, Iwata, Thompson, and Lindberg (2000) utilized the Premack principle in a component analysis of stereotypy as reinforcement for alternative behavior. Three individuals diagnosed with profound mental retardation participated in the study. All participants engaged in continuous stereotypic behaviors such as hand mouthing, skin pressing, and clothes twisting. Preference assessments were unsuccessful in identifying preferred items. In the first phase a functional analysis was conducted following the procedures described by Iwata et al. (1982/1994). All three participants displayed high levels of stereotypy in all conditions. In phase two four conditions were evaluated using a multiple baseline across subjects design. Baseline procedures were similar to the alone condition of the functional analysis except that leisure materials were available. During the prompting condition the therapist prompted the participant to manipulate the leisure materials every thirty seconds. During the blocking condition the therapist stood behind or in front of the participant. Attempts to engage in stereotypy were blocked. The fourth condition included contingent access to stereotypy. Initially 5 seconds of object manipulation was required before thirty seconds of access to stereotypy was provided. This condition was utilized for one of the participants. Results indicated that prompts and blocking were necessary to increase object manipulation and decrease stereotypy for two participants. For the third participant, contingent access to stereotypy was necessary to increase object manipulation and decrease stereotypy.

Mithaug and Mar (1980) demonstrated the Premack principle while examining the relation between choosing and working prevocational tasks. Two young adults diagnosed with severe retardation participated in the study. Relative preference for the prevocational tasks was evaluated by pairing an object related to a task with an object from another task. Choice was determined by which object the participant picked up. Three conditions were presented. In the baseline condition, the participants worked on the tasks indicated by their object choice. In the next condition, the participants worked on tasks that were more preferred than their task object choice. For example, if the participant chose the sorting object (less preferred) they would have to work on stuffing (more preferred). In the final condition, the participants worked on tasks that were less preferred than their task object choice.  For example, if the participant chose a collating object (more preferred) they would have to work on flour sifting (less preferred). Results indicated that access to preferred tasks increased choices of less preferred task objects and access to nonpreferred tasks decreased choices of more preferred task objects. These results supports the Premack principle which states that high frequency responses can serve as reinforcers. The results also support the notion that low frequency response can serve as punishers.

Amari, Grace, and Fisher (1995) utilized the Premack principle to develop a treatment to increase compliance with the ketogenic diet. A 15-year-old female diagnosed with severe retardation participated in the study.  Relative preference for 33 foods was evaluated utilizing stimulus-choice procedures presented by Fisher, Bowman, Hagopian, Owen, and Slevin (1992). During the treatment condition, access to preferred food was presented contingent upon consumption of non-preferred foods. Results indicated that the procedure effectively increased the participants' consumption of nonpreferred foods.

The use of the Premack principle has been explored with normally developing children as well. Homme, DeBaga, Devine, Steinhorst, and Rickert (1963) utilized the Premack principle to increase compliance of three 3-yr-old nursery school students. High probability behavior included running around the room, screaming, pushing chairs, or quietly working jigsaw puzzles. Access to these activities was made contingent on sitting quietly in a chair. Later, tokens were given for sitting quietly in a chair. These tokens could be traded later for access to the high probability behaviors. According to the authors, control was "perfect" after a few days. The main problem with this study was that it was an unsystematic observation of the use of the Premack principle. Only anecdotal data were collected.

In a systematic study Hosie, Gentile, & Carroll (1974) demonstrated the use of the Premack principle with fifth and sixth grade regular education students. Students were observed to determine preference for a particular task. The two tasks were painting and modeling clay. In experiment one the amount of time at each activity was recorded. The preferred activity was the activity at which the student spent the most time. Seven subjects preferred painting and seven subjects preferred clay. In the second experiment a student had to spend at least twice as much time in one activity as any other to be considered preferring that activity. Students that were allowed to perform preferred academic tasks (painting, modeling clay) after completing a nonpreferred task (report writing) performed the nonpreferred more quickly than students who were not given access to preferred activities.

Preference Assessment

Several systematic methods have been presented in the literature to identify preferred stimuli that can later be used as reinforcers. One of these was presented by Pace, Ivancic, Edwards, Iwata, and Page (1985). With this procedure approaches to sixteen items were counted to identify preferred and non-preferred stimuli. The major weakness of this method is that some individuals tend to approach all or none of the stimuli.

A second method was presented by Fisher, Piazza, Bowman, Hagopian, Owens, and Slevin (1992). With this procedure two stimuli are presented simultaneously and access is given to the first stimuli approached. Results indicated that all of the items identified as highly preferred by Pace, Ivanic, Edwards, Iwata, and Page (1985) were identified as highly preferred using the forced choice method. In addition, this procedure produced greater differentiation among stimuli than the Pace et al. method. The major weakness of this method is the amount of time required to complete the assessment. When 16 stimuli are compared, 120 pairings are required.

Another method to identify preferred stimuli presented by Roane, Vollmer, Ringdahl, and Marcus (1998) utilizes a free operant approach. With this method participants had free access to an array of stimuli. During the five minute session, contact with stimuli were measured using partial interval recording. Results demonstrated that this method was as effective as the Fisher et al. (1992) method, but was associated with less problem behavior and required less time to complete. The Roane et al. method appears to be as valid and more time efficient than the other described methods. Noell, Whitmarsh, VanDerheyden, Gatti, & Slider (in press) extended Roane et al. (1998) by utilizing a free operant preference assessment to identify potentially reinforcing tasks. Although it is only a preliminary study, the use of free operant preference assessment procedures to identify potentially reinforcing tasks broadens the use of the free operant procedure to increase the occurrence of socially significant behaviors such as academic tasks.

Research based on Premack's principle and interspersing procedures has relied on the identification of preferred tasks. Preference for tasks has been shown to effect student responding. Clarke et al. (1995) modified instruction for four elementary school boys by incorporating their interests into the curriculum. Results indicated that the inclusion of interesting activities into the problematic assignment reduced disruptive behavior. Foster-Johnson et al. (1994) found that students displayed less disruptive behavior and more appropriate behavior when they were required to work on a preferred task. The primary limitation of these studies is that the identification of preferred tasks relied on teacher report and observation. Other studies (Wildmon et al., 1999; Neef et al., 1980) have only analyzed preference for tasks post hoc.

The problems with identifying preferred tasks with teacher report and observation can be compared to the problems associated with identifying preferred stimuli using the same approach. Most importantly, caregiver opinion may not be accurate (Favell & Cannon, 1976). Second, asking students their preference may not be possible when mental and physical impairments are present (Pace et al. 1985). Northup et al. (1995) compared reinforcer assessment methods for ten children with attention deficit hyperactivity disorder. The reinforcer assessment methods included child nomination, forced-choice questionnaire, and direct observation. The relative reinforcement value associated with toys was evaluated by measuring the amount of time the children spent engaging in tasks that resulted in access to toys identified with the reinforcer assessment methods. Assessment methods disagreed for all but one child. These results indicate that children's verbal nomination may not agree with systematic reinforcer assessment methods.

Justification for this Study

Two experiments were designed to examine the relative importance of preference and task difficulty of academic tasks provided as reinforcers noncontingently or contingent upon accurate responding for a target academic task. Experiment one examined the effectiveness of a preferred task to act as a reinforcer with differing difficulty levels. The independent variable was the contingent delivery of the preferred task when the student responded correctly to the target task. This experiment was designed as a follow-up to previous work demonstrating that preferred academic tasks can be used to reinforce performance on less preferred tasks (e.g., Homme et al., 1963; Hosie et al., 1974; Noell et al., in press). These studies have not separated the relative importance of task difficulty and preference. For example Noell et al. (in press), found that although preferred tasks could act as effective reinforcers, those tasks were also easier than the target task. Improved performance may have resulted from access to preferred tasks or from tasks that were typically responded to correctly.

During the baseline condition five minutes of massed instruction were delivered in thirty trials. During the second condition an easy preferred task was presented contingent upon correct completion of the target task. During the third condition a difficult version of the preferred task was presented contingent upon correct completion of the target task. The primary dependent variable for experiment one was the accurate completion of the target tasks. This experiment was designed to examine the extent to which task difficulty may moderate the effectiveness of a preferred task as a reinforcer for a targeted academic task.

The Premack principle predicts that students will improve performance on tasks when given access to preferred tasks contingent upon the completion of a non-preferred task, however it does not making any predictions regarding whether task difficulty will moderate this effect. Specifically, experiment one contributes to the assessment of instructional modification by using a systematic approach to determine the effects of the contingent delivery of preferred tasks with differing levels of difficulty. Other studies have examined the use of the Premack principle to increase performance on a target task (Browder et al., 1984; Hanley et al., 2000; Homme et al., 1963; Hosie et al., 1974; Mitchell & Stoffelmayr, 1973; Noell et al., in press), but have not analyzed the influence of task difficulty of the contingent task on target task performance.

Experiment two examined the noncontingent delivery of preferred and non-preferred easy tasks interspersed among the target task. Difficulty was held constant by using high accuracy tasks. The independent variable was preference for the noncontingent task. During the baseline condition, five minutes of massed instruction were delivered in thirty trials. During the first condition preferred easy tasks were presented noncontingently interspersed between trials of the target task. During the second condition nonpreferred tasks were presented noncontingently interspersed between trials of the target task. The primary dependent variable for experiment two was the accurate completion of the target tasks.

The second experiment examined the extent to which the interspersing known tasks with trials of the target task is moderated by the students' preference for those tasks. Previous research has demonstrated the interspersal of known tasks can improve academic performance (Browder & Shear, 1996; Cooke & Guzaukas, 93; Cooke & Richard, 1996; Horner et al., 1991; Koegal & Koegal, 1986; Neef et al., 1977; Neef et al., 1980; Roberts & Shapiro, 1996; Rowan & Pear, 1985). However, these studies have not examined the extent to which that this effect is moderated by task preference. It may be the case that students prefer easy tasks and that interspersing easy tasks simply reduces the aversiveness of the task by increasing contact with preferred tasks. The extent to which the task is easy or difficult may not be relevant. This study will extend the current literature by examining the effectiveness of the noncontingent delivery of preferred versus non-preferred easy tasks.

Few studies have examined the interspersal of preferred tasks. Clarke et al. (1995) incorporated student's interests into nonpreferred tasks. Although the incorporation of student's interests decreased problem behavior, no systematic evaluation of task preference was completed. Belfiore et al. (1997) interspersed high preference math problems among multi-digit math problems. A forced-choice preference assessment was conducted to indicate preference for the single-digit math problems over the multiple-digit multiplication problems.

For both experiments preference for tasks will be evaluated. Task preference will be measured utilizing a systematic approach based on free-operant procedures (Roane et al., 1998) to identify preferred tasks rather than arbitrarily determining which task is preferred. Pre-experimental curriculum-based probes will be used to identify the participants' current accuracy for presented tasks. The proposed experiments will evaluate the extent to which this task preference assessment will identify potentially reinforcing tasks. Preference assessment research has been used to identify preference for stimuli. Recent research has extended the use of free-operant preference assessments to identify preferred tasks (Noell et al., in press). This study will contribute to the preference assessment literature by further examining the use of free operant preference assessment procedures to identify preferred tasks.

As noted earlier, research based on the Premack Principle predicts that access to preferred activities contingent upon the completion of non-preferred activities will increase the likelihood that an individual will engage in the non-preferred task. Preferred academic tasks will be delivered contingent upon correct completion of a non-preferred academic task. Research based on the interspersing of known tasks indicates that this relatively simple strategy can improve performance. Instructional strategies based on the Premack principle and interspersing known tasks have several advantages over other antecedent or consequence manipulations. First, the contingent or noncontingent delivery of instructional activities has increased instructional relevance when compared to other strategies such as contingent reward, which typically involves the delivery of non-instructionally relevant stimuli. The use of instructionally relevant stimuli contingent upon academic performance may reduce potential side effects associated with the use of non-instructionally relevant stimuli such as candy or playtime. Second, instructional procedures based on the Premack principle or interspersal of known tasks could be more useful in the classroom. Instructional techniques can be viewed as antecedents that can be manipulated thus establishing and maintaining stimulus control in the classroom (Martens and Kelly, 1993). Third the use of academic tasks in interventions based on Premack's principle or interspersal of knowns will provide the student more opportunities to practice relevant educational materials. Observational studies have indicated that students frequently are provided with few opportunities for active responding (Hall, Delquadri, Greenwood, & Thurston, 1982; Ninnes, 1988). Finally, continuity and momentum in the classroom have been identified as variables that lead to effective teaching (McKee & Witt, 1990). If a teacher is frequently rewarding one student while trying to teach other students, the teacher may not be able to maintain a reasonable flow during classroom instruction.

In summary, the two experiments expand the literature on interspersal strategies and the Premack principle by examining the interaction of task difficulty and preference. The influence of task difficulty on a preferred tasks' efficacy as a reinforcer was examined with experiment one. Experiment two extends the research base examining the interspersal of known items by examining the impact of preference on performance. Finally, as a whole, this study examined methods that may prove to be both instructionally relevant and academically productive extensions of well-developed traditional approaches to behavior analytic intervention in classrooms.

## METHOD

### Subjects and Setting

Four individuals with moderate to severe developmental disabilities participated in each study. The participants were inpatient or outpatients at the Marcus Behavior Center. Participants were identified by teachers, parents, and/or therapists as noncompliant when asked to perform academic tasks. All sessions took place in treatment rooms at the Marcus Behavior Center. Paco was a 14-year-old boy who was receiving treatment for pica at the day treatment Marcus Behavior Center. He functioned in the moderate to severe range of mental retardation. His teacher reported that he had a vocabulary of about 100 words. His adaptive skills included independent dressing, bathing, and toileting. His academic skills were described as preschool level. Fred was an 18-year-old boy who was receiving treatment for aggression at the Marcus Behavior Center School. He was diagnosed with autism. He had a vocabulary of about 100 words that were mostly used for manding. Fred could read, but he could not answer simple comprehension questions. His adaptive skills included independent dressing, bathing, and toileting. Jerry was a 10-year-old boy diagnosed with cerebral palsy and mental retardation. He was receiving treatment at the Marcus Behavior Center School for pica. He was also in treatment maintenance for previously treated aggression. Jerry's adaptive skills were limited due to his physical handicap. At the time of this study he was in maintenance for a toileting program. His vocabulary was limited to about 25-50 words. Mark was a 5-year-old boy diagnosed with autism and mental retardation who was receiving treatment for severe tantrums at the outpatient treatment program at the Marcus Behavior Center. Adaptive skills included independent dressing except for his shoes, toileting with occasional accidents, and limited bathing skills. Mark had an age-typical vocabulary, but his parents expressed a desire for his academic weaknesses to be addressed by this study.

### Target Task Identification and Materials

Treatment rooms contained a table for the tasks and two chairs. Materials that are required for each task were included in the room. For example, for the coin identification task materials included a penny, nickel, dime, and a quarter. For the addition task materials included a worksheet with math problems and a pencil. For a complete list of tasks and materials refer to the tables in appendix A.

For each participant a target task was identified. These tasks were significant sources of concern for participants' parents and/or teachers. For Fred, single digit multiplication facts were the target tasks for both experiments. This task was identified by his individualized education plan and teacher report. Attempts for this task were defined as saying or writing a number. Accurate responses were defined as writing the correct answer and no other answer on the multiplication worksheet within ten seconds of the demand. For Paco, word identification was identified by his individualized education plan as a target task. This task was his target task for both experiments. The words were printed on flash cards that were described by the manufacturer, TREND enterprises inc., as being first to second grade words. Three cards were placed in front of Paco. An attempt was defined as touching any card when prompted by the therapist. An accurate response was defined as touching the correct card exclusively within ten seconds of the demand. For Jerry two tasks were identified to accommodate a request by another therapist working with him to use the color peg task during other class times.

Sorting color pegs was the target task for experiment one. For experiment two, sorting shapes was the target task. Both tasks were identified by his individualized education plan. For the color peg task three cups with yellow, blue, or red pegs were placed in front of Jerry. An attempt was defined as touching the unsorted peg. An accurate response was defined as placing the unsorted peg into the correct cup when the demand was delivered. For the shape-sorting task a peg-board with circle, square, triangle, and rectangular pegs was placed in front of Jerry. An attempt was defined as touching the shape cutout that corresponded to one of the pegs. An accurate response was defined as placing the cutout over the correct peg within ten seconds of the demand. For Mark, the target task for experiment one and two was counting up to ten objects. This task was considered by his parents to be important, but it was not included as a goal on his individualized education plan. A picture card that contained 0-10 objects was placed in front of Mark. An attempt was defined as verbalizing any number. An accurate response was defined as verbalizing the correct response and no other number for three seconds. The counting had to be complete within ten seconds.

For the task preference assessment a list of at least five non-target tasks were identified. These tasks were generated from parent report, teacher report, and/or therapist report. Refer to appendix A for a complete list of the tasks.

Response Definitions

When a participant touched an object related to the task or produced verbalizations related to the task an attempt was scored. The primary dependent measure was response accuracy. When the participant correctly completed the task within 10-s a correct response was recorded. For each task correct responses were defined before baseline sessions began. Complete response definitions are provided in the method sections for each experiment that follows.

Data Collection Procedures

Data were collected by direct observation by observers located in the treatment rooms. Data were collected using data sheets that measured attempts and response accuracy. The observer will record the task delivered, attempts for the task, and correct responses for each trial.

Inter-observer Agreement

Trained independent observers recorded data for at least 25% of all sessions to obtain a measure of inter-observer agreement. A trial-by-trial method was used to measure inter-observer agreement. The number of trials in which the observers agreed was divided by the number of trials the observers agreed plus the number of trials in which the observers disagreed. This number was be multiplied by one hundred percent to obtain percent agreement. For study one, inter-observer agreement was obtained for 50% of Fred's sessions, 28% of Jerry's sessions, 44% of Mark's sessions, and 51.6% of Paco's sessions. Average IOA for response accuracy for the target task for Fred was 99.8% (range, 96.7% to 100%), for Jerry was 98.1% (range, 90% to 100%), for Mark was 100%, and for Paco was 99.2% (range, 90% to 100%). Average IOA for response accuracy for attempts for the target task for Fred was 99.8% (range, 96.7% to 100%), for Jerry was 98.1% (range, 90% to 100%), for Mark was 100%, and for Paco was 99.4% (range, 90% to 100%). Average IOA for response accuracy for the consequent task for Fred was 100%, for Jerry was 100%, for Mark was 100%, and for Paco was 100%. Average IOA for attempts for the consequent task for Fred was 100%, for Jerry was 100%, for Mark was 100%, and for Paco was 100%.

For study two, inter-observer agreement was obtained for 37.5% of Fred's sessions, 61.5% of Jerry's sessions, 34.6% of Mark's sessions, and 33.3% of Paco's sessions. Average IOA for response accuracy for the target task for Fred was 99.2% (range, 93.3% to 100%), for Jerry was 97.7% (range, 93.3% to 100%), for Mark was 98.5% (range, 93.3% to 100%), and for Paco was 98.5% (range, 93.3% -100%). Average IOA for response accuracy for the non-contingent task for Fred was 99.04% (range, 93.3% to 100%), for Jerry was 100%, for Mark was 97.3% (range, 93.3% to 100%), and for Paco was 100%. Average IOA for attempts for the target task for Fred was 99.4% (range, 93.3% to 100%), for Jerry was 97.1% (range, 93.3% to 100%), for Mark was 98.5% (range, 93.3% to 100%), and for Paco was 98.5% (range, 93.3% - 100%). Average IOA for attempts for the non-contingent task for Fred was 99.04% (range, 93.3% to 100%), for Jerry was 100%, for Mark was 97.3% (range, 93.3% to 100%), and for Paco was 100%.

Study 1 – Contingent Delivery of Preferred Tasks with High and Low Accuracy

Consequent Task Identification. Two alternative tasks were identified for each participant that were delivered following correct responses on the target task. These tasks were preferred tasks on which the participants responded with either high or low accuracy. The task preference assessment was conducted following baseline (described below). The preference assessments were conducted to identify which tasks are more preferred than the target task by the student.

Before the task preference assessment the student's accuracy for each task was determined. A thirty trial probe similar to the baseline condition for the target task was conducted for each task in the task preference assessment. For each task an easy and difficult level was determined. For example, a puzzle with one piece missing would be defined as high-accuracy if the participant placed the missing piece in the puzzle with 80% accuracy. In contrast, a puzzle with five pieces missing might result in 25% accuracy and be identified as a low-accuracy task. A task with 10-40% accuracy was defined as difficult. If student was 70-100% accurate for a task it was operationally defined as easy.

The task preference assessment conducted was based on the brief stimulus preference assessment developed by Roane, Vollmer, Ringdahl, and Marcus (1998). There are a number of advantages and disadvantages to the described task preference method. The Roane et. al (1998) method was as effective as the forced choice paradigm presented by Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin (1992) in identifying preferred stimuli, but was associated with less problem behavior and required less time to complete. Certainly, one would prefer to utilize methods that are more efficient, but the Roane et al. method presents some unique problems when conducting a task preference assessment. First, during the free operant assessment the participant may play with the task without completing the task. Second, the free operant task preference assessment may not lend itself to creating a hierarchy of task preference. Participants may choose to respond exclusively to one task. This problem may be eliminated by removing this task from a second free operant task preference assessment, but if a second, third, or perhaps, fourth assessment is necessary the time advantages of the free operant method are dissolved. The paired choice method may produce a hierarchy of tasks that is more appropriate for this assessment in the same amount of time. The disadvantage of the Fisher et al. (1992) method is that it was associated with more problem behavior than the free operant procedure.

During this five-minute free operant task preference assessment five stations were setup in the treatment room. The materials related to each of the five easy tasks and the target task were situated at each station. Before each session the participant was told that they could do any of the tasks. The experimenter then demonstrated the completion of each task to the participant. If the participant touched any object related to the task the experimenter used a three step guided compliance procedure to deliver the demand. First, the experimenter gave the demand. If the participant did not comply within 5 seconds the experimenter repeated the demand with a gestured prompt. If the participant did not comply within another 5 seconds the experimenter physically guided the participant through the task. A trained independent observer recorded the number of ten second intervals in which the participant touched items related to each task.

A three-step guided compliance procedure was utilized for the following reasons. First, pre-academic tasks such as puzzles, coloring books, or form fitter boxes may not appear to be different from other toys. The purpose of the assessment is to identify preferred tasks rather than preferred stimuli (toys). In other words the primary goal of the task preference assessment is to identify preferred stimuli associated with a task and the requests placed on the participant during the task. During the task preference assessment it must be demonstrated that touching of the materials related to a particular task will result in a series of demands from the therapist rather than free access to preferred items. The inclusion of the three-step prompt may prevent participants from “playing” with task materials and failing to sample other tasks in the free operant task preference assessment.

During the preference assessment participant's interaction with each task was recorded using 10-s partial interval recording. Interaction with the task was defined as touching any object related to the task or verbalizations related to the task. The total time the participant spends interacting with each task was used as an index of preference (Roane et al., 1998). Tasks were ranked for preference based on the amount of time the participant interacts with each task. Preferred tasks, for this experiment, were tasks that the participant spends more time interacting with than the target task. Additionally, the time required to complete this assessment was recorded to assess the cost and practicality of this form of assessment.

To ensure that the high difficulty preferred task was more preferred than the target task a two choice (target task versus high difficulty preferred task) free operant task preference assessment was conducted.

Study 1: Experimental Design and Conditions

The experimental design for this study was a reversal design. A baseline phase was followed by a task preference assessment. The next two phases will analyzed the relationship between task preference and task difficulty. In the first condition following baseline the participant was presented with a preferred task for which their response accuracy was low. In the next condition the same task was presented, but exemplars of the task were presented for which the participant exhibits high response accuracy. These phases were followed by a return to baseline and then representation of the preferred task conditions in a counter balanced order randomized across and within subjects (i.e., A-B-C-A-C-B or A-C-B-A-B-C).

Baseline. This phase consisted of the presentation of the target task only. All sessions consisted of thirty trials. The therapist told the participant before the session “I have some work for you to do.” The student was presented a task during the first trial. Regardless of the student’s performance the next trial was presented. If the child correctly responded or attempted the task within ten seconds of presentation the therapist told the child “Good Try.” An attempt was defined as any touching of objects related to the task or verbalizations related to the task. When the child completed the task the next trial was presented immediately. Response accuracy for the session was determined by dividing the number of correct responses by the number of presentations.

Contingent preferred low accuracy task. Each session contained thirty trials. This condition consisted of contingent access to highly preferred low accuracy tasks. The therapist told the participant before the session “If you complete these tasks correctly when I ask you to do them, you can work on the preferred task.” The student was presented the target task during the first trial. If the student completed the task correctly within ten seconds of presentation, the student had access to the preferred task for the next trial. If the student failed to complete the task correctly, the therapist presented the non-preferred task again for the next trial.

Contingent preferred high accuracy task. In the second condition, the participant received access to a preferred high accuracy task contingent on correct completion of the target task. The therapist told the participant before the session “If you complete these tasks correctly when I ask you to do them, you can work on the preferred task.” The student was presented the target task during the first trial. If the student completed the task correctly within five seconds, the student had access to the preferred task for the next trial. If the student failed to complete the task correctly, the therapist presented the non-preferred task again for the next trial.

Treatment Integrity

To assure that the procedures are implemented as planned, treatment integrity was measured. For each trial the observer recorded the task presented. The number of correct tasks presented was divided by the number of correct tasks presented plus the number of incorrect tasks presented. This number was multiplied by one hundred. A correct task presentation will be defined as the delivery of the correct task and correct materials to complete the task. For study one, average treatment integrity for Fred was 100%, for Jerry was 100%, for Mark was 100%, and for Paco was 100%.

Study 2 – Non-contingent Delivery of Easy Tasks (High preference – high accuracy tasks versus low preference - high accuracy tasks)

This study compared the efficacy of non-contingent access to two different tasks that were interspersed among the target task. This study followed similar procedures as study one.

Noncontingent Task Identification.The free operant preference assessment describe above was used to identify a preferred task that the participant completed with 70-100% accuracy. A high accuracy low preference task was identified by selecting a low preference task from the free operant preference assessment that the participant completed with 70-100% accuracy. The low preference task was defined as a task that ranked last on the free operant task preference assessment.

Experimental Design and Conditions

The experimental design for this study was a reversal design. A baseline phase was followed by two phases that examined how non-contingent access to low difficulty tasks of varying preference influenced performance on the target task. In the first condition following baseline the participant was presented with a preferred task for which his or her response accuracy is high non-contingently following each trial of the target task. In the second condition the participant was presented with a low preference task for which his or her response accuracy is high non-contingently following the target task. These phases were followed by a return to baseline and then representation of the preferred task conditions in a counter balanced order randomized across and within subjects (i.e., A-B-C-A-C-B or A-C-B-A-B-C).

Baseline. This phase consisted of the presentation of the target task only. All sessions consisted of thirty trials. The therapist told the participant before the session "I have some work for you to do." The student was presented a task during the first trial. Regardless of the student's performance the next trial was presented. If the child correctly responded or attempted the task within ten seconds of presentation the therapist told the child "Good Try." An attempt was defined as any touching of objects related to the task or verbalizations related to the task. When the child completed the task the next trial was presented immediately. Response accuracy for the session was determined by dividing the number of correct responses by the number of presentations.

Noncontingent preferred high accuracy task. Each session contained thirty trials. The first phase consisted of non-contingent access to highly preferred high accuracy tasks. The therapist told the participant before the session "I am going to give you some tasks to do. The first one will be the preferred task. After the preferred task I am going to give you the target task." The student was presented the preferred task during the first trial. The student had access to the target task for the next trial.

Noncontingent low preference high accuracy. In the second condition, the participant received access to a low preference high accuracy task following each trial of the target task. The therapist told the participant before the session "I am going to give you some tasks to do. The first one will be the preferred task. After the preferred task I am going to give you the target task." The student was presented the low preference high accuracy task during the first trial. The student was presented the target task during the next trial. This sequence continued for thirty trials.

Treatment Integrity

To assure that the procedures are implemented as planned, treatment integrity was measured. For each trial the observer recorded the task presented. The number of correct tasks presented was divided by the number of correct tasks presented plus the number of incorrect tasks presented. This number was multiplied by one hundred. A correct task presentation will be defined as the delivery of the correct task and correct materials to complete the task. For study two, average treatment integrity for Fred was 99.4% (range, 93.3% to 100%), for Jerry was 100%, for Mark was 100%, and for Paco was 100%.

# RESULTS

## Study 1 – Contingent Delivery of Preferred Tasks with High and Low Accuracy

Consequent Task Identification. During the free-operant preference assessment Fred interacted almost exclusively with the items associated with the easy addition task (see Appendix B). Fred interacted with these items 90% of the ten second intervals. During the two-choice (target task versus high difficulty preferred task) free operant task preference assessment Fred interacted with the addition items 50% of the intervals. He did not interact with the target task materials. Jerry interacted with the zipping task materials 63.3% of the ten second intervals. During the two-choice (target task versus high difficulty preferred task) free operant task preference assessment Jerry interacted with the zipping task materials 36.7% of the ten second intervals. Mark interacted with the letter writing materials exclusively for 100% of the ten second intervals (see Appendix B). During the two-choice (target task versus high difficulty preferred task) free operant task preference assessment Mark interacted with the letter writing materials 83.3% of the intervals. He did not interact with the target task materials. Paco interacted with the puzzle materials exclusively for 23.3% of the ten second intervals (see Appendix B). During the two-choice (target task versus high difficulty preferred task) free operant task preference assessment Paco interacted with the puzzle materials 66.7% of the intervals. He did not interact with the target task materials.

Fred. Fred's response accuracy is presented in Figure 1. During the initial baseline Fred's responding for the multiplication task was low with a mean response accuracy of 1.34%. When access to preferred easy tasks was given contingent upon correct responding Fred's accuracy increased and exhibited a positive trend (mean =

38.3%). When access to preferred difficult tasks was given contingent upon correct responding Fred’s accuracy decreased (mean = 10.7%). When baseline conditions were reinstated Fred’s responding did not reverse to the initial baseline levels, but were lower (mean = 13.9%) when compared to the initial treatment condition. During the reversal to the second treatment condition (contingent access to preferred difficult tasks) responding remained low (mean 13.0%). When the initial treatment condition (contingent access to preferred easy tasks) was reinstated, response accuracy increased and exhibited a positive trend (mean = 60.1%).

Jerry. Jerry’s response accuracy is presented in Figure 2. During baseline Jerry’s response accuracy for the shape-sorting task was low with a mean of 6.7%. When access to preferred easy tasks was provided contingent upon correct responding, response accuracy increased (mean = 23.7%). When access to preferred difficult tasks was provided contingent upon correct responding, response accuracy remained similar to the previous treatment condition (mean = 18.4%). When baseline conditions were reinstated response accuracy decreased (13.3%). When the second treatment condition (access to preferred difficult tasks) was reintroduced, response accuracy remained low (mean = 7.1%). When the initial treatment condition (access to preferred easy tasks) was reintroduced in the last phase response accuracy increased (mean = 26.5%) and exhibited a positive trend.

Mark. Mark’s response accuracy is presented in Figure 3. During the initial baseline Mark’s responding for the letter writing task was low with a mean response accuracy of 33.3%. When access to preferred difficult tasks was given contingent upon

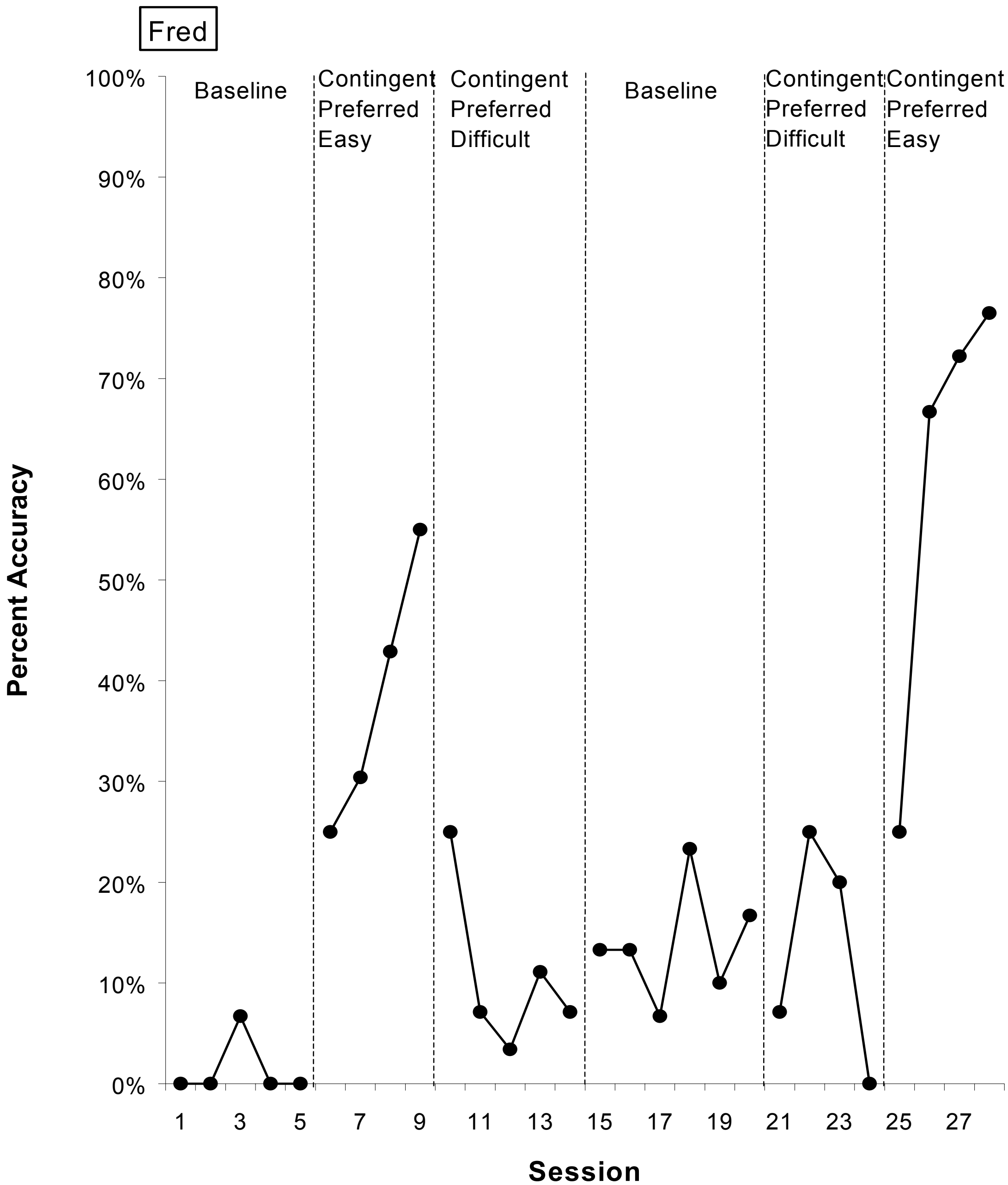


Figure 1. Percent response accuracy for Fred (study 1).

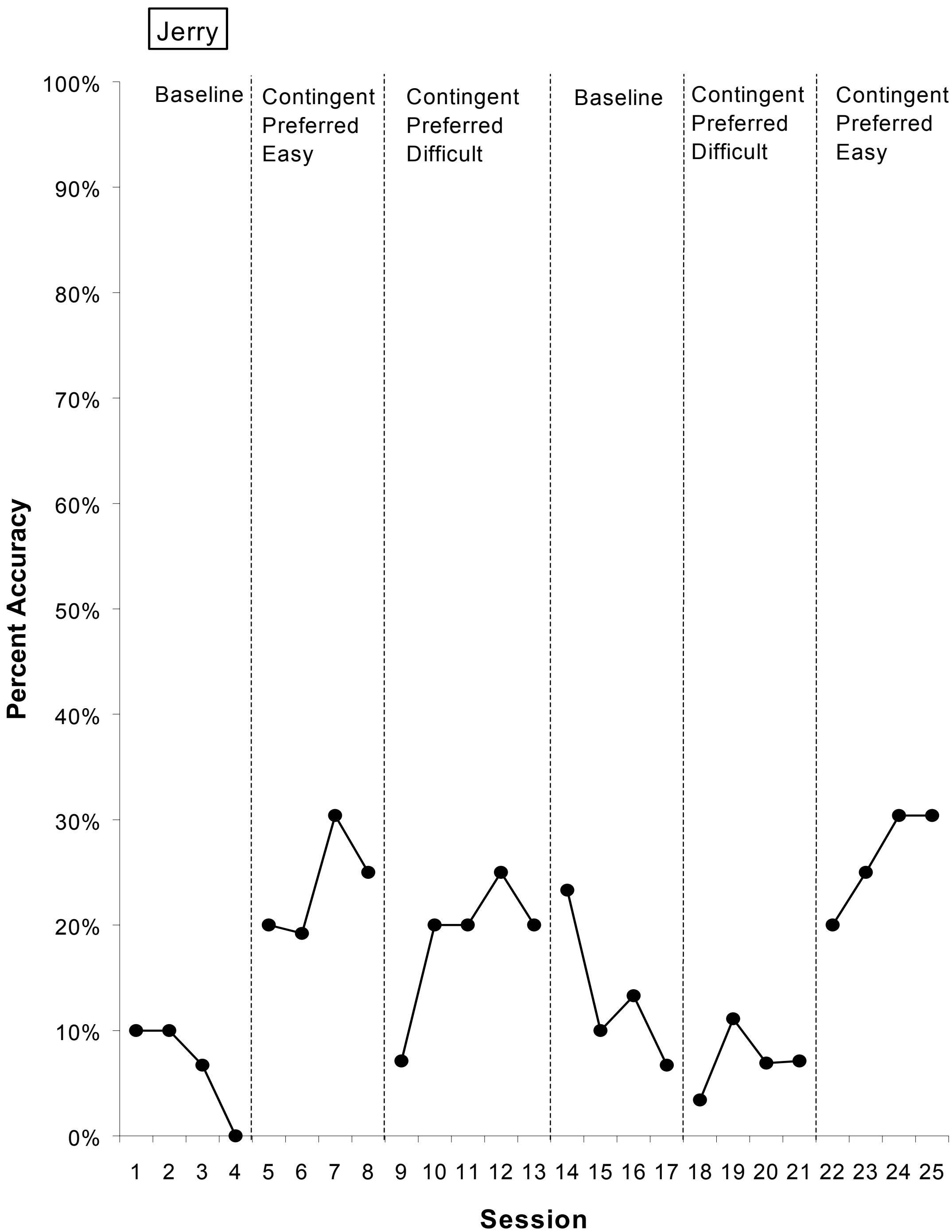


Figure 2. Percent response accuracy for Jerry (study 1).

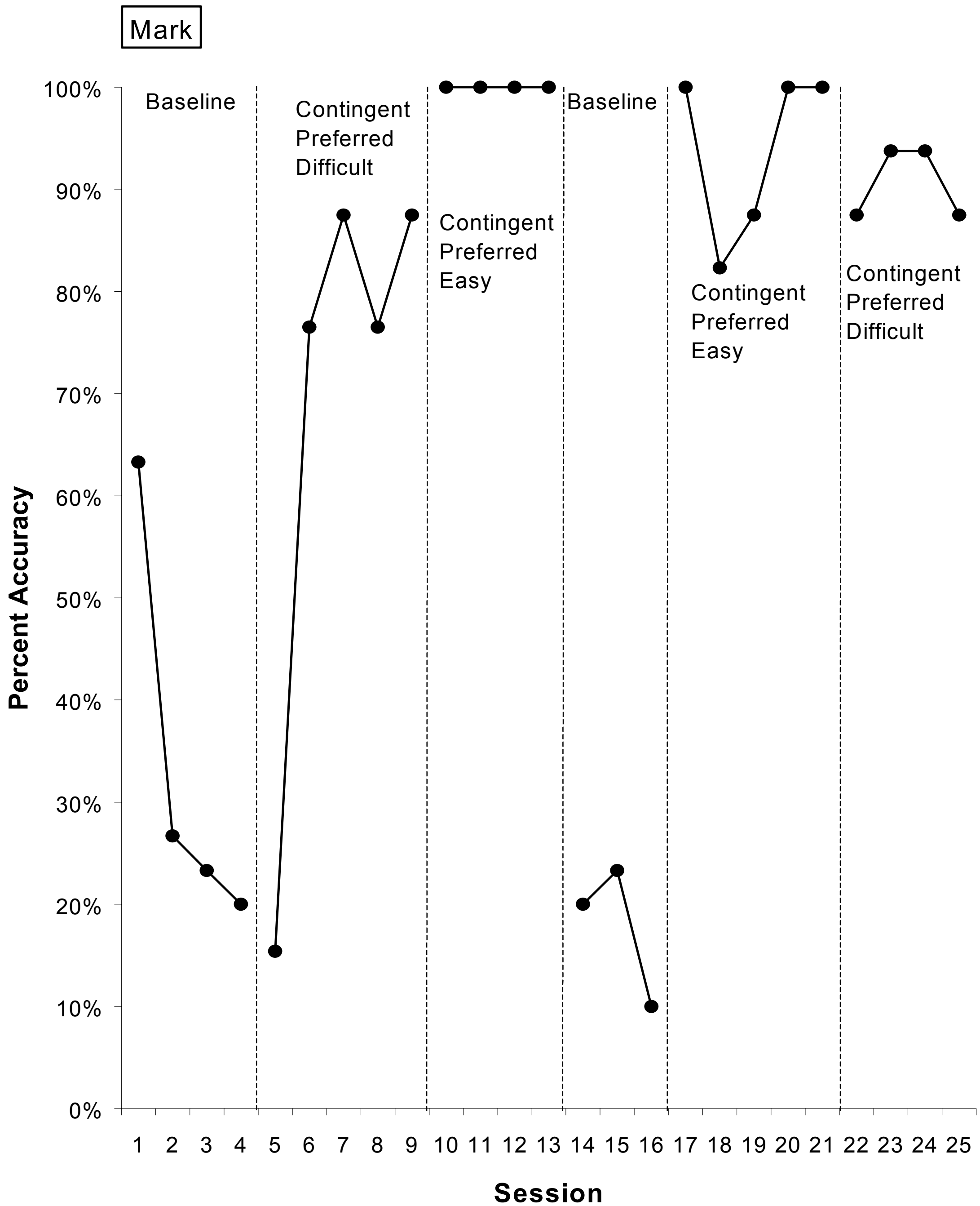


Figure 3. Percent response accuracy for Mark (study 1).

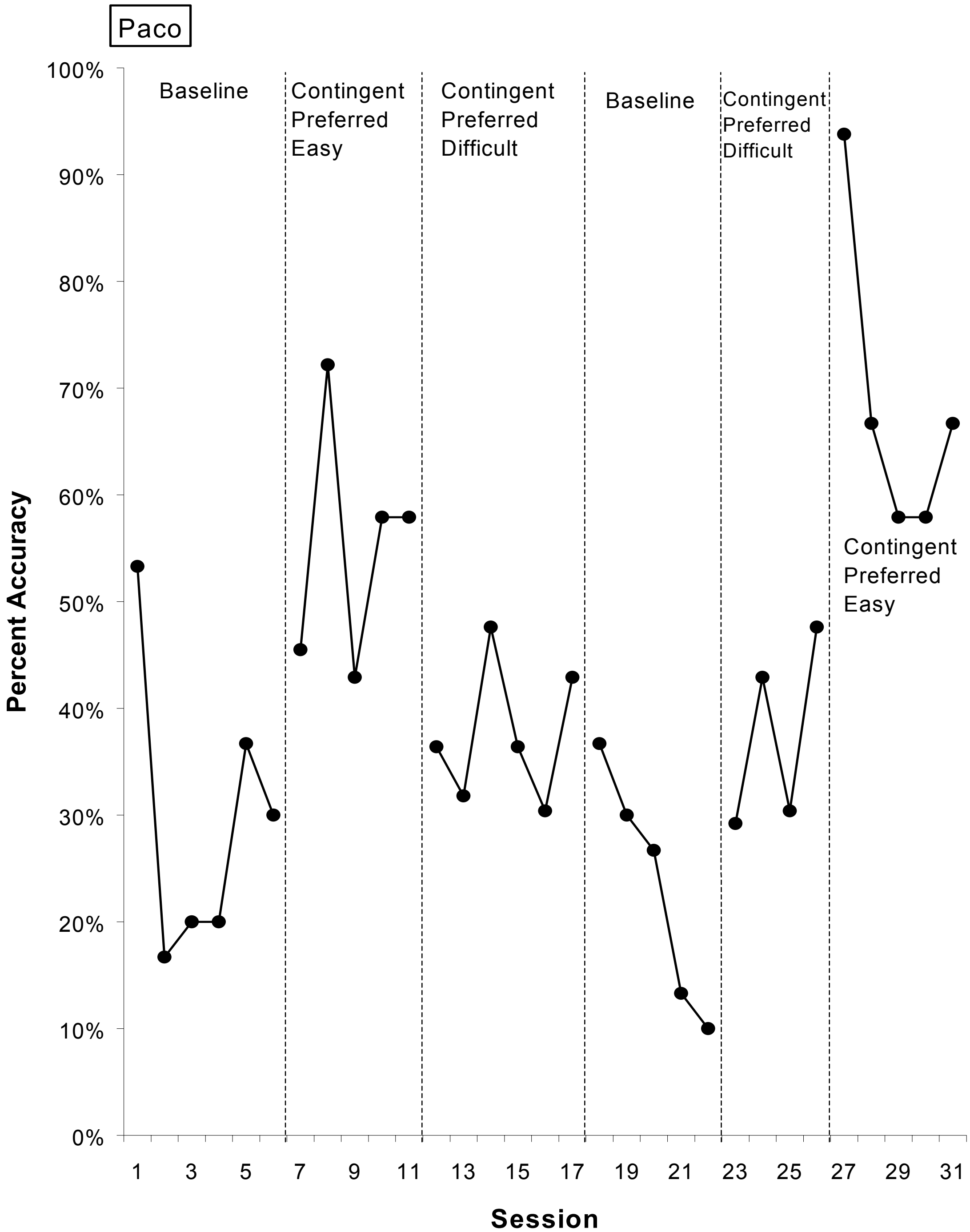


Figure 4. Percent response accuracy for Paco (study 1).

correct responding Mark's accuracy increased (mean = 68.7%). When access to preferred easy tasks was provided contingent upon correct responding Mark's accuracy increased to perfect levels (mean = 100%). When baseline conditions were reinstated Mark's responding decreased (mean = 17.8%). During the reversal to the second treatment condition (contingent access to preferred easy tasks) responding increased (mean = 93.6%). When the initial treatment conditions (contingent access to preferred difficult tasks) were reinstated, response accuracy increased compared to the previous application of this condition, but remained relatively high (mean = 90.6%).

Paco. Paco's response accuracy is presented in Figure 4. During the initial baseline Paco's responding for the word identification task was low with a mean response accuracy of 29.5%. When access to preferred easy tasks was given contingent upon correct responding Paco's accuracy increased (mean = 55.3%). When access to preferred difficult tasks was given contingent upon correct responding Paco's accuracy decreased (mean = 37.6%). When baseline conditions were reinstated Paco's responding decreased with a downward trend (mean = 23.3%). During the reversal to the second treatment condition (contingent access to preferred difficult tasks) responding increased to levels similar to the initial application of this phase (mean = 37.5%). When the initial treatment condition (contingent access to preferred easy tasks) was reinstated, response accuracy increased, but was variable (mean = 68.6%).

Study 2 – Non-contingent Delivery of Easy Tasks (High preference – high accuracy tasks versus low preference - high accuracy tasks)

Noncontingent Task Identification. During the second free-operant task preference assessment, Fred interacted almost exclusively with the items associated with the easy addition task (see Appendix C). Fred interacted with these items 80% of the ten second intervals (see Appendix C). Jerry interacted with the zipping task materials 80% of the ten second intervals (see Appendix C). Mark interacted with the letter writing materials exclusively for 100% of the ten second intervals (see Appendix C). Paco interacted with the puzzle materials exclusively for 40% of the ten second intervals (see Appendix C).

For this study, a second noncontingent task was identified that was less preferred than the most preferred noncontingent task. Multiple free-operant assessments were necessary to achieve a hierarchy. The task identified as most preferred was removed from the subsequent assessments. This procedure identified functional/warning signs as the least preferred task for Frank. The color puzzle was the least preferred task for Jerry. For Mark, the puzzle task was identified as the least preferred task. For Paco, shape identification was identified as the least preferred task.

Fred. Fred's response accuracy is presented in Figure 5. During the initial baseline Fred's responding for the multiplication task displayed a downward trend (mean = 43.9%). When access to noncontingent preferred easy tasks was provided Fred's accuracy stabilized in a range that was in the upper end of the distribution of baseline data points (mean = 45.4%). When access to nonpreferred easy tasks was provided noncontingently, Fred's accuracy decreased below baseline levels (mean = 28.9%). When baseline conditions were reinstated Fred's responding nearly returned to previous baseline levels (mean = 37.3%). During the reversal to the second treatment condition (noncontingent access to nonpreferred easy tasks) responding decreased below baseline levels (mean = 20%). When the initial treatment conditions (noncontingent access to preferred easy tasks) were reinstated response accuracy increased to a mean of 55.6%.

Jerry. Jerry's response accuracy is presented in Figure 6. During the initial baseline Jerry's responding for the shape-sorting task was low (mean = 16.7%). When access to noncontingent preferred easy tasks was given, Jerry's accuracy increased and exhibited a positive trend (mean = 37.3%). When access to nonpreferred easy tasks was given noncontingently Jerry's accuracy decreased below baseline levels (mean = 6.7%). When baseline conditions were reinstated Jerry's responding nearly returned to previous baseline levels (mean = 13.3%). During the reversal to the second treatment condition (noncontingent access to nonpreferred easy tasks) responding remained low (mean = 13.4%). When the initial treatment conditions (non-contingent access to preferred easy tasks) were reintroduced response accuracy increased to a mean of 44.0%.

Paco. Paco's response accuracy is presented in Figure 7. During the initial baseline Paco's responding for the shape-sorting task was low (mean = 38.7%). When access to noncontingent preferred easy tasks was given, Paco's accuracy increased (mean = 63.4%). When access to non-preferred easy tasks was given noncontingently, Paco's accuracy was low in the first two sessions, but stabilized at the end of the phase with a mean of 41.3%. When baseline conditions were reintroduced Paco's responding increased slightly when compared previous baseline levels (mean = 45%). During the reversal to the second treatment condition (non-contingent access to non-preferred easy

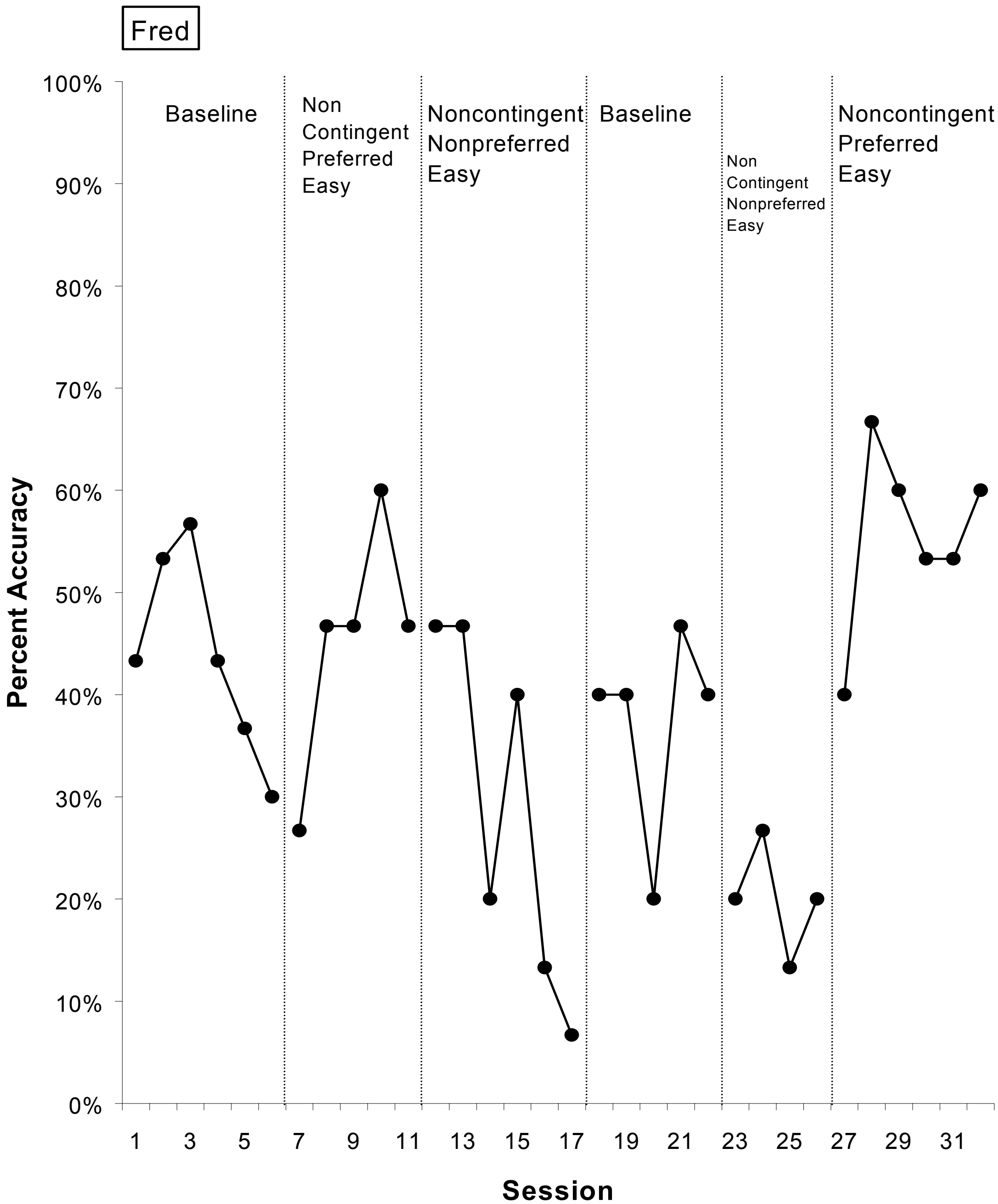


Figure 5. Percent response accuracy for Fred (study 2).

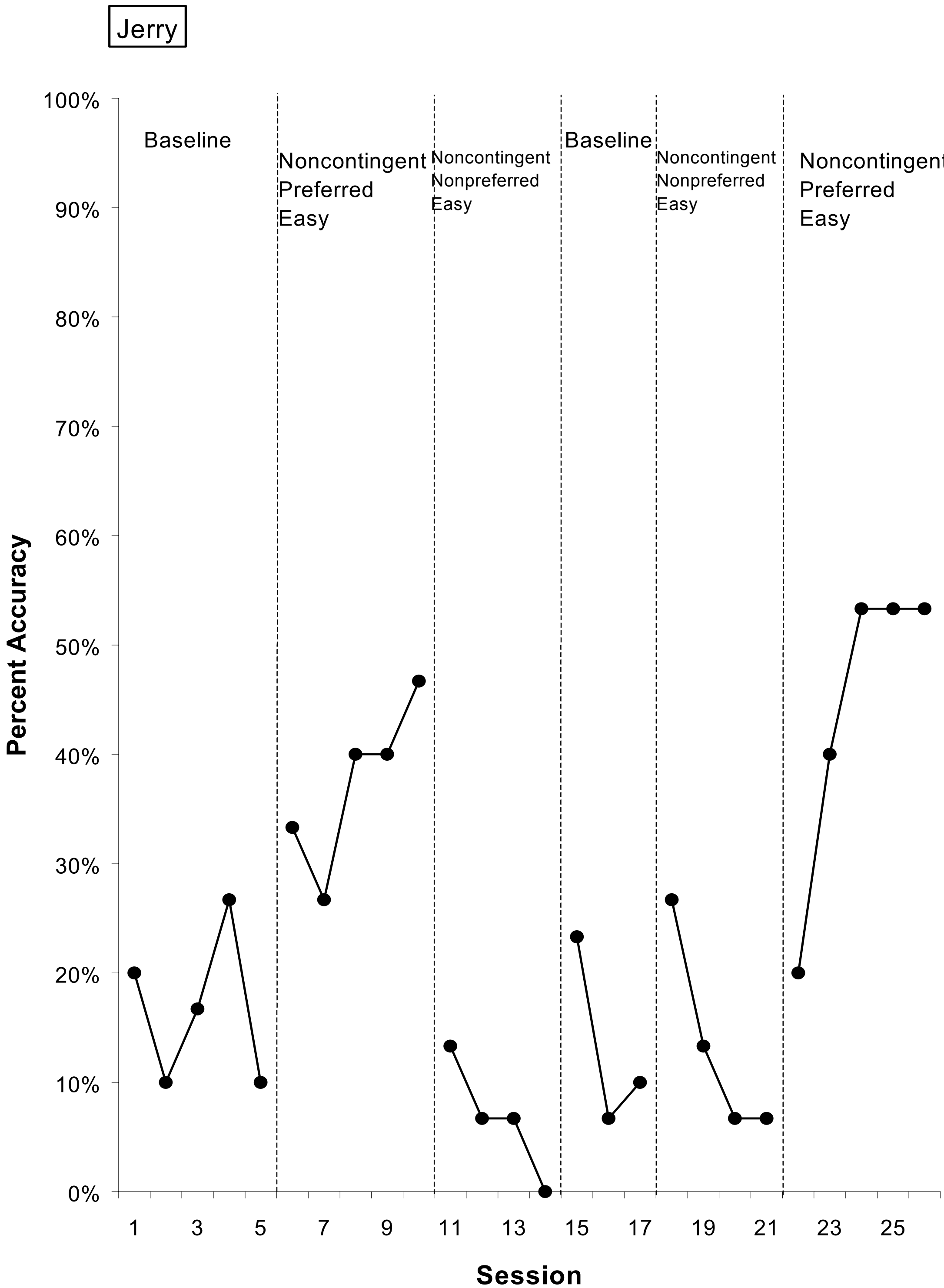


Figure 6. Percent response accuracy for Jerry (study 2).

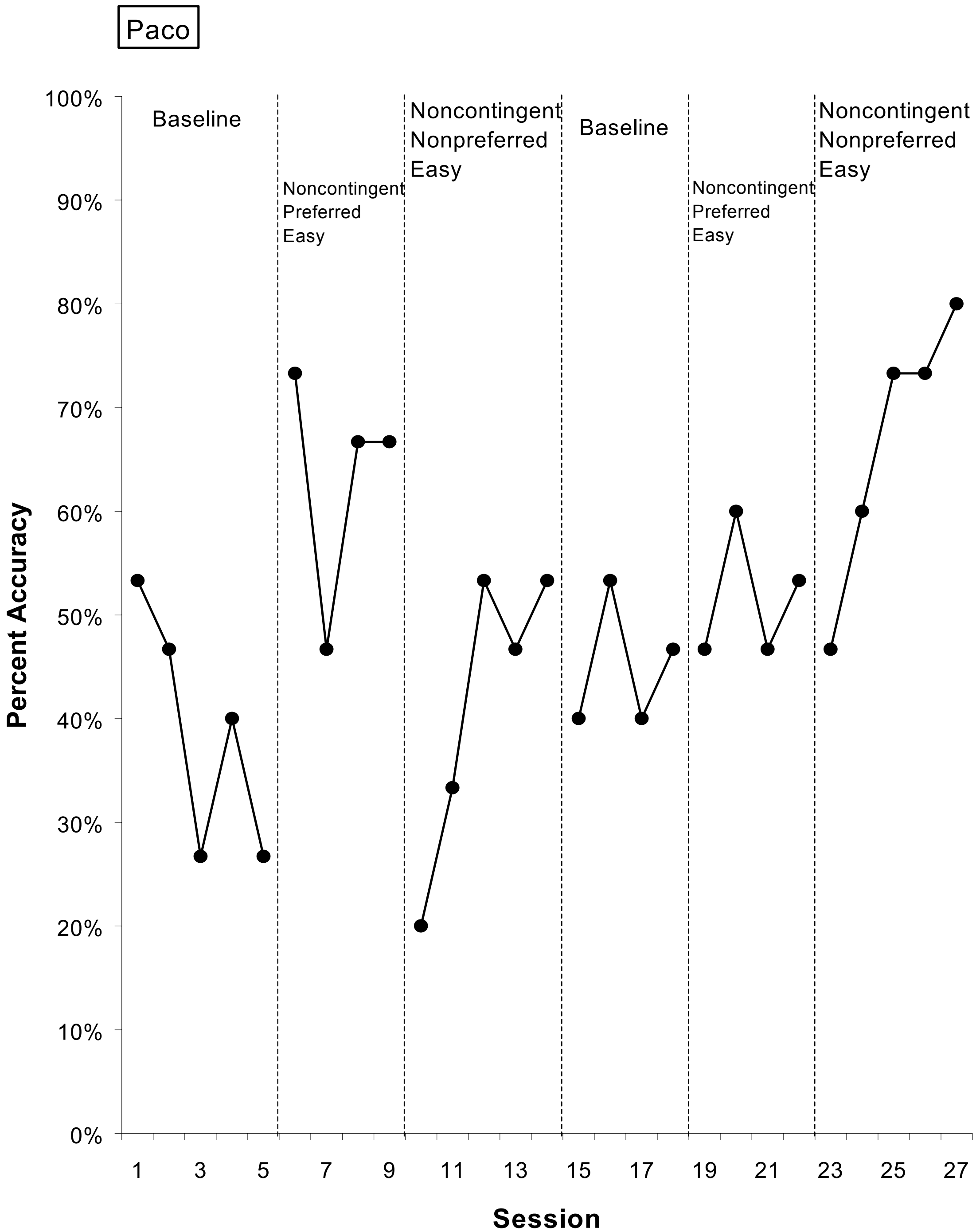


Figure 7. Percent response accuracy for Paco (study 2).

tasks) responding remained near levels of the first phase of non-contingent access to non-preferred easy tasks (mean = 51.7%). When the initial treatment conditions (non-contingent access to preferred easy tasks) were reintroduced response accuracy increased with a steep upward trend (mean = 66.7%).

Mark. Mark's response accuracy is presented in Figure 8. Mark's responding was low during baseline with a mean of 40%. When access to noncontingent non-preferred easy tasks was introduced Mark's accuracy decreased below baseline levels (mean = 20.0%). When access to preferred easy tasks was provided noncontingently, Mark's accuracy increased (mean = 85.3%). When a reversal to baseline conditions was conducted Mark's response accuracy returned to previous baseline levels (mean = 19.2%). During the reversal to noncontingent access to preferred tasks Mark's responding increased again (mean = 81.7%). During the reversal to noncontingent access to nonpreferred tasks Mark's responding decreased (mean = 38.7%).

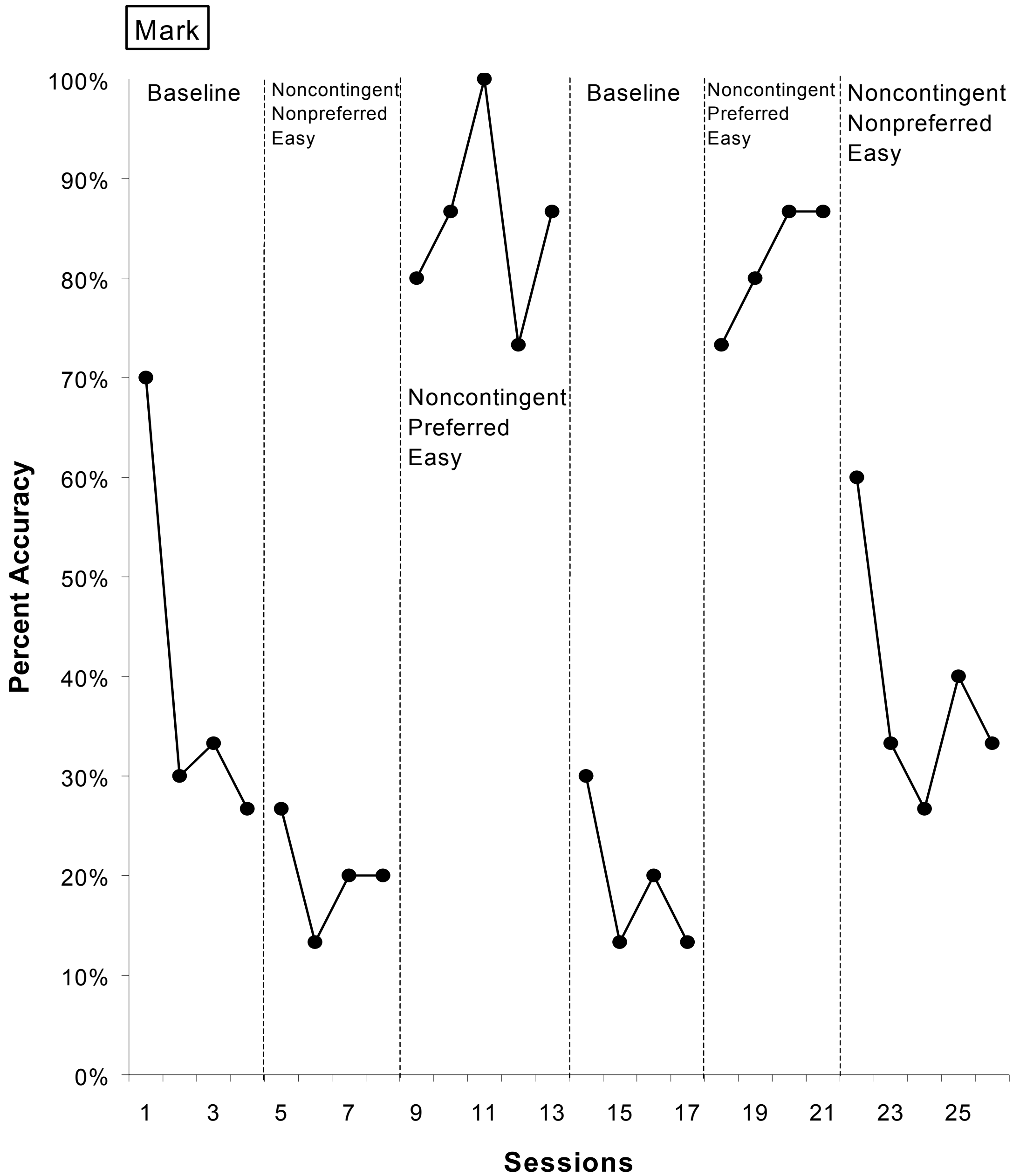


Figure 8. Percent response accuracy for Mark (study 2).

## DISCUSSION – STUDY 1

Study one examined the delivery of easy and difficult preferred tasks contingent upon accurate responding for the target task. The data indicate that contingent access to preferred easy tasks improved response accuracy for the target task for all four participants when compared to baseline. For Mark, access to preferred difficult tasks also produced significant increases in response accuracy when compared to baseline. For Paco, access to preferred difficult tasks produced modest increases in response accuracy when compared to baseline. For Fred and Jerry, results were mixed when contingent access to preferred difficult tasks was provided. The first application of contingent access to preferred difficult tasks produced an increase in response accuracy, but during the reversal, levels of response accuracy remained near baseline levels. Prior exposure to the easy version of the preferred task may have created a sequence effect that changed the efficacy of preferred difficult tasks. All participants demonstrated higher response accuracy during the contingent preferred easy condition than the contingent preferred difficult condition.

These results are consistent with research on the Premack principle which suggests that access to preferred tasks increases performance for the nonpreferred task (Browder et al., 1984; Hanley et al., 2000; Homme et al., 1963; Hosie et al., 1974; Mitchell & Stoffelmayr, 1973; Noell et al., in press). Browder et al. (1984) provided access to preferred tasks (daily living skills) for reading performance. However, preference for the tasks was not systematically evaluated, but was arrived at based on anecdotal evidence. Hosie et al. (1974) demonstrated the Premack principle with fifth and sixth grade regular education students by providing access to painting or modeling clay contingent upon report writing. Preference for the tasks was determined using direct observation. Difficulty of the tasks was not evaluated. Mitchell and Stoffelmayer (1973) increased work behavior of four adults diagnosed with schizophrenia by providing access to sitting. Sitting was determined by direct observation to be the most common activity for the inactive patients. For one participant during the Hanley et al. (2000) study, contingent access to stereotypy was necessary to increase object manipulation and decrease stereotypy. Homme et al. (1963) used the opportunity to "run and scream" to reinforce "sitting and looking at the blackboard." None of these studies evaluated the difficulty of the task. They also did not use a habilitative activity as the potentially reinforcing consequence. The "preferred" tasks can best be described as simple (e.g. sitting, running and screaming, stereotypy) which may attenuate the social validity of the studies. Additionally, preference was evaluated by direct or anecdotal observation. No systematic or validated preference assessment was conducted.

Noell et al. (in press) compared contingent access to preferred tasks to noncontingent access to preferred tasks for five children with delayed language development. Three out of five of the children displayed improved response accuracy in the contingent access condition when compared to the noncontingent access condition. Preference for the tasks was evaluated using free operant task preference assessment, but difficulty was not measured prior to the analysis. Student performance data indicated that the preferred task was easier than the target task for all participants. These data did not clarify the relative importance of task difficulty and preference. Finally, assessment of task difficulty for academic or vocational tasks may be a necessary requirement for the success of Premack-based strategies. Results for study one demonstrate that preferred easy tasks are more effective reinforcers than preferred difficult tasks.

The contingency component of study one meant that correct responding resulted in the delivery of more preferred tasks and more known (easy) tasks. The literature on the non-contingent interspersal of tasks may contribute to the interpretation of the results obtained in study one. In general, past studies have demonstrated that the inclusion of known tasks within an instructional session improved responding for the instructional task (Browder & Shear, 1996; Koegal & Koegal, 1986; Neef et. al, 1977; Neef et. al, 1980; Rowan & Pear, 1985). When difficult preferred tasks were provided contingent upon accurate responding, response accuracy decreased compared to contingent access to preferred easy tasks for all four participants in study one. During the contingent preferred difficult condition, more unknowns were presented than knowns. The results were consistent with past research that indicates performance increases when knowns (easier tasks) are interspersed among unknown task (difficult tasks).

Neef et. al (1977) and Neef et. al (1980) found that interspersing known spelling words among unknown spelling words increased the number of words mastered for all participants. Koegal and Koegal (1986) increased the academic performance in four areas (spelling, reading, word-finding, and memory) of a severe childhood stroke victim when maintenance tasks were interspersed with acquisition task trials. Browder and Shear (1996) taught sight words at a higher rate when known words were interspersed with unknown words. Rowan and Pear (1985) compared a concurrent training condition to interspersal training condition. During the interspersal condition, previously learned items were interspersed with trials for a new item. Learning rates were greater in the interspersal condition.

The optimum ratio of knowns to unknowns is still in debate. When the number of knowns is greater than unknowns, studies have found positive effects for learning. Participants in the Roberts and Shapiro (1996) study learned more unknown reading words in the 80% known, 20% unknown condition when compared to the 20% known, 80% unknown condition. Cooke and Guzaukas (1993) increased multiplication fluency for all three participants in study two during the 30% new with 70% review item condition when compared to a 100% new item condition. No difference between the two conditions (30% new/70% review versus 100% new) was observed during the other two studies. Other researchers have demonstrated increased learning when more unknowns are presented than knowns. Cooke and Reichard (1996) compared three different ratios of known to unknown multiplication and division facts. Four of the six participants mastered acquisition facts at the fastest rate in the 70% unknown, 30% known condition. One student had higher rates in the 50%-50% condition. A final student mastered facts at the same rate in the 70%-30% and the 50%-50% condition.

There are several reasons why interspersing knowns may improve student learning. Dunlap (1984) suggests that interspersing knowns may have its effect by increasing contact with reinforcement. The increased contact with success may decrease the risk of learned helplessness. Neef et al. (1980) and Dunlap (1984) further state that increasing the density of reinforcement for task-specific stimuli may increase responding for all instructional stimuli. In this study, brief praise was provided for correct responding. Correct responses were more likely during the easy task presentation. The reinforcement in the form of praise or the possibly automatic reinforcement produced by correct responding for the easy task may have resulted in an increase in responding for all instructional stimuli including the target task. Neef et al. (1980) state that the interspersing of knowns could also decrease emotional responses associated with consequences for an incorrect response. Although consequences may not have been provided for an incorrect response, a learning history of consequences for incorrect responding could have influenced behavior during this study. These emotional responses could interfere with attending behaviors, thus decreasing optimal performance. With interspersing there is a smaller chance that the student will come in contact with repeated incorrect responses. Koegal and Koegal (1986) note that the interspersal of knowns may be especially useful for individuals with brain impairments. The interspersal of knowns divides the task into smaller components thus making the task more manageable for individual with decreased attention spans. This may be true for all individuals with developmental disabilities. Interspersing of knowns may also create the "momentum-like" effects demonstrated by high-p sequence research (Ardoin et al., 1999; Belfiore et al., 1997; Ducharme & Worling, 1994; Mace et al., 1988; Mace & Belfiore, 1990; Rortvedt & Miltenberger, 1994). It must be noted that during this study that any possible "momentum-like" effects may have been attenuated by the one to one ratio of tasks rather than the three to one ratio used in high-p studies. Finally, because of the contingency component of study one, correct responding resulted in the delivery of more preferred tasks and more known tasks.

The results of study one indicate that the reinforcing effects of a preferred task are substantially mediated by difficulty. The extent to which the reinforcing effects of a preferred task were decreased when the preferred task was difficult were differentiated by participant. One could argue that Mark's decreased response accuracy during the contingent preferred difficult condition was not educationally significant. In other words, caregivers may prefer the contingent preferred difficult condition in which Mark is more "challenged" rather than the contingent preferred easy task condition. Fred's response accuracy during the contingent preferred difficult condition was higher than the initial baseline, but response accuracy was not higher than the second baseline. Jerry's response accuracy during the contingent preferred difficult condition was higher than the initial baseline, but responding during the second phase of contingent preferred difficult tasks was lower than the second baseline. Paco's response accuracy during the contingent preferred difficult task condition can be best described as better than baseline, but not as impressive as the contingent preferred easy task condition. Future research is needed to determine at what threshold the reinforcing properties of preferred task are eliminated by increased difficulty.

## DISCUSSION – STUDY 2

Study two examined the influence of noncontingently interspersing easy tasks between target tasks. This study follows previous research (e.g., Browder & Shear, 1996; Koegal & Koegal, 1986; Neef et. al ,1977; Neef et. al, 1980; Rowan & Pear, 1985) that has examined introducing known tasks into an instructional sequence. The data indicate that the noncontingent delivery of easy preferred tasks was effective for three participants. For Fred, response accuracy remained near baseline levels when easy preferred tasks were noncontingently interspersed among trials of the target task. When easy nonpreferred tasks were interspersed among the target tasks, response accuracy decreased for all four participants when compared to the easy preferred condition. For Jerry and Fred, response accuracy was at or below baseline levels during the easy nonpreferred task condition.

These results replicate and extend previous studies that have found that interspersal of known tasks can improve responding for a target task (Browder & Shear, 1996; Cooke & Guzaukas, 1993; Cooke & Richard, 1996; Horner et al., 1991; Koegal & Koegal, 1986; Neef et al., 1977; Neef et al., 1980; Roberts & Shapiro, 1996; Rowan & Pear, 1985). As noted earlier, these studies generally found that interspersing knowns increased performance for the unknowns. Based on the results of study two, it appears that preference for the interspersed task may influence the effectiveness of interspersal strategies. Unfortunately, very few studies have evaluated preference for the interspersed task before the interspersal strategies were attempted. During previous studies, the interspersed tasks were easy versions of the target task. Preference for the interspersed task and target task may have been similar. Noell et al. (in press) found that one participant's responding increased during the noncontingent interspersal procedure exclusively. For another participant, both contingent and noncontingent interspersal resulted in increased responding compared to baseline. Response accuracy for the preferred tasks indicated that these tasks were easy. It was not known whether the effects of the interspersed task were due to preference for the task or difficulty of the task.

The results of study two replicate studies that demonstrate that inclusion of preferred tasks among nonpreferred tasks improves performance for the nonpreferred task. Clarke et al. (1995) incorporated student interests within a task to increase response rate and work completion. The students' interests were evaluated using direct observation and teacher interviews. Belfiore et al. (1997) interspersed preferred single-digit multiplication problems among nonpreferred multiple-digit multiplication problems. A forced choice preference assessment that included the preferred and nonpreferred tasks was conducted before the interspersing procedures began. The results showed that the latency to initiate the nonpreferred math problems decreased when preferred math problems were interspersed with the nonpreferred math problems.

The results of study two indicate that the efficacy of interspersal procedures may be moderated by the student's preference for the interspersed task. Furthermore, the interspersal of nonpreferred tasks may produce results that are worse than baseline. These results may be due to interspersing of nonpreferred tasks, making the instructional session aversive. As the interspersed task becomes less preferred, the instructional session becomes similar to baseline. Past research has demonstrated that the inclusion of preferred tasks within nonpreferred tasks improves responding for the nonpreferred task (Belfiore et al., 1997; Clarke et al., 1995). Based on the results of the current study, the opposite may also be true. The inclusion of nonpreferred tasks within the target task may decrease responding for the target task.

# GENERAL DISCUSSION

Both studies contribute to a small research base demonstrating the use of systematic preference assessments to identify preferred tasks and then use those tasks to change socially significant behaviors (Belfiore et al., 1997; Noell et al. 2000). This study utilized a free-operant method based on Roane et al. (1998) to identify instructionally relevant preferred tasks that were used contingently in study one and interspersed noncontingently in study two. The validity of the free-operant preference assessment results for study one are supported by the demonstration that the identified tasks functioned as reinforcers for three of the four participants. The failure of Jerry 's response accuracy to increase may be due to the lack of preference for the contingent task or the use of tasks in general as reinforcers for Jerry's responding may not be effective. The validity of the results of the free-operant task preference assessment for study two is supported by the demonstration of the differential effectiveness of the preferred and nonpreferred interspersed task.

Although the two studies were conducted as independent analyses, some comparisons between contingent and noncontingent strategies can be made. For three out of the four participants, contingent access to preferred easy tasks was a more effective strategy than noncontingent interspersing of known tasks. For Jerry, noncontingent interspersing of known tasks appeared to be the superior strategy if the tasks were preferred.

## Limitations and Directions for Future Research

For experiment one, the effects of preferred tasks as reinforcers were moderated by the difficulty of the preferred task. Mark's responding did not decrease as dramatically as the other participants when a preferred difficult task was presented contingent upon accurate responding. This may be the result of the difficult task being less difficult than the brief screening assessment indicated. A more extensive analysis of performance for different difficulties could possibly act as better control for difficulty. Perhaps future studies could utilize probes over a series of days or weeks to get a better assessment of difficulty for a particular task.

Another limitation is related to Jerry's responding. Jerry's highest response accuracy appeared during the noncontingent delivery of preferred easy task conditions. Unfortunately response accuracy for Jerry was never much better than chance. Contingent delivery of preferred easy tasks was not effective for increasing response accuracy to a substantive degree. His low response accuracy may have been due to lack of contact with the reinforcer. His low response accuracy could also be due to inclusion of only six tasks in his preference assessment. Future studies could increase the number of tasks in the preference assessment to increase the likelihood that a preferred task will be identified.

The third limitation of this study is the lack of any index of which procedure is easier to implement. Study one clearly produced better results than study two for three of the participants. Perhaps response accuracy should not be the only measure of success. Study two increased response accuracy for three of the four participants although response accuracy was not as high as the highest response accuracy for study one. Future studies could analyze teacher and student preference for contingent or noncontingent based strategies. Differential preference for one strategy over another could produce better response accuracy for a longer period of time beyond the time this study was conducted. Future studies could analyze the long-term effects of the different procedures or the extent to which the inclusion of contingent or noncontingent tasks can be faded. Finally, future research could analyze the effects of these procedures in the context of a complete instructional package, which may include prompting, modeling, progressive curriculum, and so on. These procedures may be more or less effective in the presence of these other instructional strategies.

In conclusion, both studies contribute to research examining instructional task sequencing replicating and extending previous studies. Study one demonstrates the importance of difficulty when selecting preferred tasks to deliver contingent upon accurate task completion. Difficult preferred tasks were not as effective reinforcers as easy preferred tasks. Study two demonstrates that interspersal of known tasks is more effective when the interspersed task is preferred. The interspersal of nonpreferred tasks can be detrimental. The utility of a free-operant task preference assessment was also supported. Finally, both studies support the use of instructionally relevant stimuli when developing instructional strategies. For both studies the contingent and noncontingent tasks were instructionally relevant tasks which maximized students opportunities to respond to instructionally relevant demands.

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APPENDIX A

LIST OF TASKS AND PROBE RESULTS

**Paco**

| **Task** | **Materials** | **Response Definition** | **Easy Version** | **Probe Results** | **Difficult Version** | **Probe Results** |
|---|---|---|---|---|---|---|
| 24-piece Puzzle | 24-piece puzzle | Place a piece in the puzzle completely | Place the last piece in the puzzle | 80% | Place a piece in the puzzle with ten pieces missing | 23.3% |
| Warning/Adaptive Sign ID | Set 20 signs | Touch the correct sign when asked | Touch correct sign from an array of 3 | 93.3% | Touch correct sign from an array of 5 | 30% |
| Shape ID | Cardboard shapes (triangle, square, circle, oval, rectangle | Touch the correct shape when asked | Touch correct shape from array of 3 | 70% | Touch correct shape from an array of 5 | 40% |
| Color ID Keyboard | Keyboard with eight colored keys | Hit the correct colored key on the keyboard | Hit correct key from three keys | 70% | Hit correct key from six keys | 20% |
| Coin Identification | One penny, nickel, dime, and quarter | Pick-up the correct coin when asked | Pick from a penny and a quarter | 73.3% | Pick from a penny, nickel, dime, and quarter | 16.7% |

**Jerry**

| Task | Materials | Response Definition | Easy Version | Probe Results | Difficult Version | Probe Results |
|---|---|---|---|---|---|---|
| Color egg sorter | Five plastic colored eggs (blue, red, yellow, orange, green) and carton | Place the egg top on the correct egg bottom | Place the egg top on the correct egg in an array of two | 70% | Place the egg top on the correct egg in an array of five | 13.3% |
| Zipping | A zipper board | Zip the zipper completely | Zip the zipper completely from half way | 93.3% | Zip the zipper completely from the bottom | 20% |
| Shape Sorter | Peg board with different shaped pegs, cutouts that correspond to each peg | Put the cutout on the correct peg | Put the cutout on the peg when the correct cutout is placed directly in front of correct peg | 80% | Put the cutout on the peg when the correct cutout is placed in hand. | 33.3% |
| Color Puzzle | 3-piece blue,green, red puzzle | Place the correct piece in the puzzle. | Put last piece in the puzzle | 90% | Put a piece in the empty puzzle | 26.7% |
| Line Drawing | Piece of paper and black crayon | Write at least a one-inch line when asked | Write line on paper without writing on desk | 96.7% | Write line on bottom half of paper | 13.3% |
| Form Fitter | Form fitter and blocks | Place a block in form fitter | Put form in fitter when correct side is placing up | 93.3% | Put form in fitter when random side is facing up | 16.7% |

**Fred**

| Task | Materials | Response Definition | Easy Version | Probe Results | Difficult Version | Probe Results |
|---|---|---|---|---|---|---|
| Warning/Adaptive Sign ID | Set 20 signs | Touch the correct sign when asked | Touch correct sign from an array of 3 | 80% | Touch correct sign from an array of 5 | 23.3% |
| Spelling | A list of thirty spelling words | Write the spelling word correctly | List of two syllable words | 73.3% | List of three syllable words | 33.3% |
| Subtraction | A worksheet with thirty problems | Write the correct answer to the problem | Subtraction facts 0-5. | 96.7% | Two by one subtraction no regrouping. | 30% |
| Addition | A worksheet with thirty problems | Write the correct answer to the problem | Two by two addition facts with no regrouping with a calculator | 96.7% | Two by two addition facts with no regrouping without a calculator | 16.7% |
| Coin Identification | One penny, nickel, dime, and quarter | Pick-up the correct coin when asked | Pick from a penny and a quarter | 80% | Pick from a penny, nickel, dime, and quarter | 36.7% |

**Mark**

| Task | Materials | Response Definition | Easy Version | Probe Results | Difficult Version | Probe Results |
|---|---|---|---|---|---|---|
| Picture ID | Set of 75 photo cards | Touch the correct picture when asked | Touch correct picture from an array of 3 | 76.7% | Touch correct picture from an array of 6 | 10% |
| Shape ID | Cardboard shapes (triangle, square, circle, oval, rectangle | Touch the correct shape when asked | Touch correct shape from array of 3 | 90% | Touch correct shape from an array of 3 | 33.3% |
| Letter Writing | A blank piece of paper and a marker | Write the correct letter | Write upper-case letters only | 83.3% | Write upper and lower case letters. | 16.7% |
| 24-piece Puzzle | 24-piece puzzle | Place a piece in the puzzle completely | Place the last piece in the puzzle | 90% | Place a piece in the puzzle with ten pieces missing | 33.3% |
| Coin Identification | One penny, nickel, dime, and quarter | Pick-up the correct coin when asked | Pick from a penny and a quarter | 80% | Pick from a penny, nickel, dime, and quarter | 36.7% |

APPENDIX B

FREE-OPERANT TASK PREFERENCE RESULTS – STUDY 1

| **Mark** | Letter Writing | Shape ID | 24-piece Puzzle | Coin ID | Picture ID | Counting |
|---|---|---|---|---|---|---|
| **Percent of Intervals with Interaction** | 100% | 0% | 0% | 0% | 0% | 0% |

| **Fred** | Addition | Spelling | Subtraction | Coin ID | Warning Sign ID | Multiplication |
|---|---|---|---|---|---|---|
| **Percent of Intervals with Interaction** | 50% | 13.3% | 0% | 0% | 0% | 0% |

| **Jerry** | Zipping | Shape Sorter | Color Egg Sorter | Color Peg Sorter | Color Puzzle | Line Drawing | Form Fitter |
|---|---|---|---|---|---|---|---|
| **Percent of Intervals with Interaction** | 63.3% | 0% | 16.7% | 0% | 0% | 0% | 0% |

| **Paco** | 24-piece Puzzle | Warning Sign ID | Shape ID | Color ID Keyboard | Coin ID | Word ID |
|---|---|---|---|---|---|---|
| **Percent of Intervals with Interaction** | 23.3% | 0% | 0% | 0% | 0% | 0% |

APPENDIX C

FREE-OPERANT TASK PREFERENCE ASSESSMENT RESULTS – STUDY 2

| **Paco** | 24-piece Puzzle | Warning Sign ID | Shape ID | Color ID Keyboard | Coin ID | Word ID |
|---|---|---|---|---|---|---|
| Preference Assessment 1 | 40% | 0% | 0% | 0% | 0% | 0% |
| Preference Assessment 2 | NA | 16.7% | 0% | 0% | 0% | 0% |
| Preference Assessment 3 | NA | NA | 20% | 0% | 0% | 0% |
| Preference Assessment 4 | NA | NA | NA | 33.3% | 0% | 0% |
| Preference Assessment 5 | NA | NA | NA | NA | 6.7% | 0% |

| **Fred** | Addition | Spelling | Subtraction | Coin ID | Warning Sign ID | Multiplication |
|---|---|---|---|---|---|---|
| Preference Assessment 1 | 80% | 0% | 0% | 0% | 0% | 0% |
| Preference Assessment 2 | NA | 20% | 13.3% | 0% | 6.7% | 0% |
| Preference Assessment 3 | NA | NA | 23.3% | 0% | 0% | 0% |
| Preference Assessment 4 | NA | NA | NA | 10% | 3.3% | 0% |
| Preference Assessment 5 | NA | NA | NA | NA | 3.3% | 0% |

| **Jerry** | Zipping | Line Drawing | Color Egg Sorter | Color Peg Sorter | Form Fitter | Color Puzzle | Shape Sorter |
|---|---|---|---|---|---|---|---|
| Preference Assessment 1 | 80% | 0% | 0% | 0% | 0% | 0% | 0% |
| Preference Assessment 2 | NA | 40% | 10% | 3.3% | 6.7% | 0% | 0% |
| Preference Assessment 3 | NA | NA | 23.3% | 0% | 0% | 0% | 0% |
| Preference Assessment 4 | NA | NA | NA | 6.7% | 3.3% | 0% | 0% |
| Preference Assessment 5 | NA | NA | NA | NA | 3.3% | 0% | 0% |
| Preference Assessment 6 | NA | NA | NA | NA | NA | 10% | 0% |

| **Mark** | Letter Writing | Picture ID | Shape ID | Coin ID | 24-piece Puzzle | Counting |
|---|---|---|---|---|---|---|
| Preference Assessment 1 | 100% | 0% | 0% | 0% | 0% | 0% |
| Preference Assessment 2 | NA | 93.3% | 0% | 0% | 0% | 0% |
| Preference Assessment 3 | NA | NA | 100% | 0% | 0% | 0% |
| Preference Assessment 4 | NA | NA | NA | 73.3% | 26.7% | 0% |
| Preference Assessment 5 | NA | NA | NA | NA | 10% | 0% |

# VITA

Ernest Whitmarsh was born on April 27, 1973, in Metairie, Louisiana. He attended Covington High School where he obtained his diploma in May 1991. He attended Louisiana State University where he obtained his Bachelor of Science degree in psychology in May 1995. He obtained his Masters of Arts degree in psychology from Louisiana State University in December 1997. From June 2000 to July 2001 he completed his predoctoral internship at the Marcus Institute in Atlanta, Georgia, which is an affiliate of Kennedy Krieger Institute in Baltimore, Maryland. He will receive the degree of Doctor of Philosophy in psychology from Louisiana State University in May 2002.