THE EFFECTS OF RATE CONTINGENT CONSEQUENCES AND CHARTING ON RESPONSE RATES FOR TWO CHILDREN WITH AUTISM

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This study investigated the effects of a precision teaching package on response rates of children with autism. Prior to both experiments a preference assessment was conducted to identify high preference activities for each participant. Experiment 1 investigated whether response rates would shift as a function of rate-contingent consequences during an academic task. Different activities were associated with different rates of responding. The experimental package of 1 minute timings, rate contingent consequences, and charting was successful in increasing the rates of responding when the most highly preferred activity was associated with high rates of responding. When the contingencies were switched and the most highly preferred activity was contingent on lower rates of responding, the participant's responding did not decrease. Experiment 2 was an attempt to replicate the results of Experiment 1 using a multiple baseline across tasks. The experimental package was not successful in increasing the rate of responding.

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INTRODUCTION

Precision teaching (PT) is a teaching technique characterized by a) systematic arrangement of instructional cues largely taken from programmed learning b) continuous measurement of frequency of correct response for evaluation and c) careful management of reinforcement contingencies (Brandstetter & Merz, 1978). Beginning in the 1960's, pioneer Ogden Lindsley and his associates applied functional behavior analysis, derived from the experimental laboratory, to the diagnosis and remediation of persons with mental retardation; and that led to the development of precision teaching (Binder, 1996). Lindsley's goal was to transfer scientific methods from free operant conditioning laboratories into the classroom (Lindsley 1992). According to White (1986) Lindsley borrowed 5 major tenets from B.F. Skinner's experimental analysis of behavior for precision teaching: 1) focus on observable behavior, 2) use of frequency as a universal measure of behavior 3), graphed data on charts, 4) make decisions based on performance data, and 5) adherence to the maxim that the learner knows best. The precision teacher measures learner behavior daily and adjusts procedures when indicated by the data to ensure progress.

Proponents of P T report that it has been used successfully with a wide range of learners (White 1986, Binder 1993) and with a broad range of academic and social behaviors (Lindsley 1992). One reason may be that it complements existing curricula by providing systematic procedures for measuring behavior and making educational decisions. Kubina (2002) stated that teachers who engage in systematic performance evaluation produce higher levels of student achievement.

Another possible advantage of PT is its focus on fluency. It is not enough that skills be accurate. Accurate performance must become fluent to be useful, remembered and applied (Johnson & Layng 1996). Fluency is defined as a combination of accuracy plus speed (Binder, 1996). In the behavior analytic community fluency has come to describe performance that is effortless, well practiced, and accurate (Johnson & Layng 1996).

Precision teachers first focus on developing fluent component skills. Component skills are prerequisites to more complex (or composite) skills. For example, Johnson and Layng (1992) discussed the composite skills of factoring equations and effective paragraph writing. They suggested that equation factoring is easily mastered when one is fluent in basic number writing, addition, subtraction, and multiplication skills. Similarly, paragraph writing is said to require fluency in component skills involving of letter and word writing speeds, sentence combining, and sentence sequencing. Precision teachers learned early on that to achieve competence on a given composite skill, the learner must accurately and quickly perform its components. Accumulating dysfluent component skills can limit and may even prevent acquisition of composite skills. Precision teachers label this problem, cumulative *dysfluency* (Binder, 1996)

According to proponents of PT there are several benefits of fluent performance. These are identified as *retention* (ability to perform a behavior over a significant time period), *endurance* (maintaining a given level of performance over time), *stability* (steady state of behavior after fluency is achieved), and *application* (ability to combine component behaviors into composite behavior (Binder, 1996; Johnson & Layng, 1996;

Kubina, 2002). Timings are the primary method of data collection in PT. Binder (1996) stated that precision teachers began to use brief timings as a rapid and inexpensive method for gathering descriptive information about various types of human behavior because they recognized the sensitivity of brief timings to differences in skilled performance. He stated that working for shorter intervals often enabled students to achieve high levels of performance.

Those who use the technology of precision teaching often report the success of learners in their classrooms and some have analyzed experimentally the efficacy of the technology. In 1976 Van Houten and Thompson investigated the effects of explicit timings on math performance of 20 second-grade students who were chosen based on their poor school performance. A reversal design was used and the three measures recorded included were overall correct rate (defined as the number of problems worked correctly during a 30-min period), local correct rate (defined as the number of problems worked correctly during the intervention divided by the actual time that children had available to work), and accuracy on math worksheets containing either basic addition or subtraction facts. In the baseline phase students were told to work on the worksheets and the teacher timed a 30-min session. Students were not informed that they were being timed. During the intervention phase the teacher instructed the students that the math period was 30 min and they would be timed at 1-min intervals for the 30-min period. At the end of each 1-min interval the students were instructed to draw a line after the last problem completed during that interval. Because it was not possible to get 30 1-min

timings done in a 30-min period actual time was also recorded during this phase. Baseline and the intervention phases were reversed one time.

Outcomes indicated that the rate of correctly worked problems increased from 3.5/min in baseline to 6.8/min during intervention. Rates fell to 5.5 correct/min during the second baseline but increased to 8.2-correct/ min, with the local rate at 11.5/min during the second intervention phase. The experimenters concluded that explicitly timing students' math performance increased rate of problems worked correctly while also maintaining the high accuracy achieved in baseline conditions.

Raggio and Bitgood (1982) investigated the effects of the number of math timings/day on math performance. Participants were 8 youths living in a group home. The independent variable was the number of 1-min math timings completed/ day. Each participant was assigned a different number of drills/day in each of the basic math operations (i.e., addition, subtraction, multiplication, and division). Timings/ day and math operations were counterbalanced across subjects. The experimenters displayed data representing averages of all the drills performed each day on a standard celeration chart. Across all 4 math operations, the two 1-min timings/day condition produced a celeration of X1.4 / week, while one 1-min timing a day produced a celeration of X1.3/ week. The experimenters concluded that two 1-min timings/day were likely to produce slightly faster learning than one 1-min timing/ day.

Diviaio and Ellis (1985) reported that students in a classroom for the trainable mentally handicapped achieved high see-say frequencies in a reading activity. One hundred word passages from a remedial reading series were designated. Within these

passages 10 high frequency vocabulary words were repeated throughout. Prior to the timings students were given opportunities for drill and practice on the high frequency words. Students were timed for 1min daily. When they reached their aims for 2 consecutive days, they moved ahead to the next story in the reading series and were introduced to 10 new vocabulary words.

Data were presented on 1 student in the classroom. The data depicted an increase in rate of words read from approximately 50 words/min to 100 words/min for 4 different stories. However, vague procedural description and lack of experimental design limit scientific conclusions.

The previously mentioned studies used timings to increase performance. Many studies in PT use timings in combination with data display to improve performance. Data display is most often recorded on a standard celeration chart. The charting provides feedback and enables the students to observe their progress as well as to project future performance (McDade, C.E., Cunningham, D.B., Brown, J.M., Boyd, B.B., & Olander, C.P. 1991). Precision teachers describe charting as essential to progress and suggest that it should occur as soon as possible after the targeted behavior is timed (Brandstetter & Merz, 1978; Crawford & Olson, 1990; Johnson & Layng, 1996; White, 1986). Studies using timings and chartings have included typical adults and children as well as the learning disabled and mentally handicapped.

Brandstetter and Merz (1978) investigated differences in the effects displaying performance data on linear graphs, semi-log graphs or recording raw data. The behavior graphed was reading sight words. Participants were typical 4th-grade students with no

previous charting experience. The children received 1-min timings daily on vocabulary words. Adults recorded or charted for the child, discussed the child's progress, and delivered verbal praise. In the first study the participants were divided into two groups of 7 children. One group of 7 children in a classroom was provided with 2 weeks of performance feedback in the form of raw scores, followed by 2 weeks of performance feedback as shown on linear graph paper. The order of the feedback conditions was reversed for the remaining 7 children in that classroom. In another classroom of 18 children, the same procedures were followed except that the graphs used were semi-log graphs (standard celeration charts) rather than linear graphs

The experimenters reported that there were significantly greater gains in response rates using a linear graph than when recording raw data. In the second study there was no significant difference in gains made when graphing on a semi-log graph or recording raw data. However, due to the inclusion of 2 atypical participants included in this study the experimenters warned against drawing conclusions and explained that the groups in the 2 classroom were too different to draw valid comparisons between them.

McDade et al. (1991) investigated the effects of timings and charting on reading rate for college students enrolled in a freshman level study skills course. In the first study 27 students enrolled in the study skills course served as the experimental group, while 27 students enrolled in a basic English skills course served as the control group. At the beginning of the semester and again after the intervention the students were given a standardized reading evaluation. Students in the experimental group read novel passages

daily for 1 min and plotted their rates on standard celeration charts. There was no intervention for the control group. In a second study,

76 students enrolled in the study skills course received the intervention described above, while 146 students enrolled in the same course did not receive any prescribed reading practice. Both groups were given the same pre-and post-test as in the first study.

During Study 1 the reading rate for the experimental group increased from an average 244 words/min to an average of 381 words/min, while in the control group the rates increased from 203 word/min to 209 words/ min. Study 2 yielded similar results. The experimenters concluded that daily timed readings and charting resulted in improved reading skills.

There have been a number of investigations into effectiveness of precision teaching techniques for teaching people with learning disabilities as well as for learners with mental and physical handicaps. Crawford and Olson (1990) used timings and assisted charting to improve basic math skills of 6 students with physical handicaps in a self-contained classroom. Participants were randomly assigned to either the experimental or control group, and a pre and posttest were administered. Those in the experimental group were given a 3-min timing using a math worksheet. Afterward they were assisted in checking accuracy, and charting the number of correct and incorrect problems they completed. Data indicated that students in the experimental group performed substantially better on the post-test than did those in the control group.

Carroll, C.L., McCormick,S., & Cooper,J.O. (1991) investigated the effects of 1-min timings, flashcard practice, and self- recording on the number of words read

correctly in a novel passage from a Direct Instruction® reading series text by 4 elementary students with severe behavioral handicaps. Same-grade-level passages on typed cards were used in a multiple probe design was used across passages. After each timing the teacher charted each student's rate while simultaneously explaining and demonstrating the procedure. After three demonstrations students charted their own reading rates on the standard celeration chart. During intervention the same reading passage was read twice a day until the participant reached the aim of 100 words/min. In addition to the repeated readings before each timing students practiced with flashcards containing incorrectly read words from previous readings. Data indicated increased reading rate during the intervention phase of the study. Because self-charting was used during baseline the experimenters attributed the improvement to the repeated readings plus word card drill.

Whalen, Willis, and Sweeney (1993) investigated the effects of timings and charting on math performance of a high school student with a behavior disorder. A time series analysis was used to evaluate the frequency of steps completed correctly in calculating fractions across different timing periods. The independent variable was amount of time in each trial and the dependent variable was number of steps correctly completed while calculating fractions. In an alternating treatment design (ref) the experimenters alternated timings of 1, 2, 3, and 4 min. During baseline students were told to complete as many problems as possible and to stop when told to do so. In the intervention phase, a timer was set and the student worked until it sounded. After each timing the teacher scored the work sheet, praised correct responses and compared scores

to students' previous performances as shown by the data on the chart. Corrective feedback was provided for incorrect responses. Data were variable for the different treatments (timings) so it was difficult to determine the effects, if any, of the different timing intervals. However, experimenters said the data suggested that generally the timed trials in general were effective in increasing overall performance on math problems.

Not all reports of the effects of PT on learners involve experimental analysis. Morrell, Morrell, and Kubina (1995) reported the effects of PT techniques on learning of Direct Instruction® sight words. Three second-grade students with learning disabilities practiced 1-min timings 3 to 5 times/ week reading flash cards containing sight words. After each timing the students charted their scores on standard celeration charts. They began with 10 cards and added 10 more to the deck after fluency aims had been achieved on the previous set. Results varied for the different participants. Participant 1 reached her first aim quickly and was able to move on to three more phases. Participants 2 and 3 had acceleration from baseline during the first intervention phase but were unable to reach their fluency aims before school ended for the summer.

Millar and Calkin (1997) employed timings and charting to improve special education students' performance on naming science equipment. The teacher used these techniques in all of her science classes. All classes had daily 1-min timings for 5 activities: 1) naming science equipment, 2) naming basic parts of the microscope, 3) labeling the 19 major bones of the skeleton, 4) reading and answering questions on flashcards, and 5) the last activity was individualized based on the area of science the

class was studying. For example, if the students were studying life science, they were timed on naming organs of the various systems in the human body. Data for 3 students were displayed on standard celeration charts and included in the report. The author described the students' performances as either showing "single improvement" (defined as correct responses increasing) or "double improvement" (defined as increased rate of correct responding and decreased rate of incorrect responding). Student 1 showed double improvement in 4 out of 5 activities, although improvement in the third activity required an added intervention. His greatest improvement was in the first activity. Student 2 showed double improvement in activities 1 and 2. His performance in the subsequent activities did not improve as much. Student 3 demonstrated double improvement during the first three activities but errors remained at approximately 4/min throughout intervention 4. For the class overall, 61 student performances showed double improvement, 14 showed single improvement, 9 maintained, and 8 worsened. From these data the teacher concluded that the students had been successful in their learning .

There is little research using PT with individuals with autism. Individuals with autism often display problems with generalization, stimulus overselectivity and prompt dependency. These deficits often make learning basic skills difficult and impede progression to higher level cognitive skills. Kubina (2002) stated that the guidelines from PT hold promise for augmenting educational programs and fostering vital learning environments for students with autism. Results from a few studies suggest that using PT techniques may be an effective practice activity for some children with autism.

La Porte and McLaughlin (1996) investigated the effects of self-recording and self-evaluation on welding skills of a high school student with autistic behavior. An ABC design was used and data were collected on the length of each weld, frequency of correct welds (defined as a bed that was smooth and continuous without ridges, bumps or bits, lacking wagon tracks, and even thickness), and number of incomplete welds (defined as a weld less than 1 in long). After baseline the experimenters stated that they implemented a self-evaluation and self-recording-plus- praise intervention, although their procedures do not describe the self-recording component. Length of correct welds increased during intervention from 2.71 to 3.12 inches long. During baseline the number of correct welds ranged from 4-8 increased during intervention to a range of 10-11. Errors decreased from an average of 3 to an average of 1.5. The investigators concluded that self-evaluation and self-recording did increase the subject's performance.

Malabello (1998) reported the effects of PT techniques on learners with autism enrolled in The Australian Optimal Learning Centre (TAOLC). TAOLC teaching methodology of is based on the principles of Applied Behavior Analysis and specifically, PT. TAOLC model of instruction uses specific behavioral techniques: 1) clearly defined target behaviors 2) clearly established baselines 3) an individual education program that included a logical and functional sequence of small steps 4) replacing dysfunctional behaviors 5) instruction in new behaviors delivered in fast-paced discrete trials until accurate performance is established 6) attaining fluent performance 7) precise continuous measurement systems 8) day-to-day changes to programs made based on children's data. The curriculum was designed around five stations: Imitation, Fine/gross motor,

Communication, Pre-academics, and Play. After attaining accuracy on a given skill the children practiced these skills in timed trials. None of the children "self-charted" but participated as their level of functioning allowed. Data from performances of 3 children attending TAOLC were presented. All children showed substantial increases in performance across all their target behaviors.

While these preliminary results are encouraging, there are many unknowns when using PT for individuals with autism. One concerns the role of reinforcers and formal motivational systems in PT. None of the above-mentioned studies discusses the role of reinforcers other than verbal praise. Many proponents of PT say that the fluency tasks themselves are fun, fluent performance is reinforcing, and the record (chart) of the child's progress is considered to be a reinforcer (e.g., Binder 1996; Brandstetter & Merz 1978; Lindsley 1995). However, most investigations have not included a component analysis of the experimental package. In addition, some of the studies described above do not contain enough information about their procedures to enable complete replication. Therefore, it is possible that reinforcement procedures were used and not included in the procedure descriptions. In a question-and-answer format on a standard celeration web site, Lindsley (2000) suggested that it is appropriate to help a learner select a reward he can earn for his performance. Apparently "rewards" are common practice, although they are rarely described in the PT literature.

Extending the procedures (described in the afore mentioned studies) to learners with autism may be difficult, if not impossible, given the nature of the disorder. Criteria for the diagnosis include deficits in initiating and sharing information, and in social

interactions (American Psychiatric Association, 1994). Individuals with autism do not show preferences for social events, such as praise, approval, or receipt of information (Charlop, Kurtz, & Casey 1990; Rincover &Newson 1985). Therefore, it may be erroneous to assume that individuals with autism would benefit from the same PT packages used by learners who are typical or who have other disabilities.

The study described below adapted PT techniques to investigate their use with 2 children with autism. The purpose of Experiment 1 was to evaluate the effects of charting and rate-specific consequences on academic response rates of a child with autism and to determine whether response rates will both increase and decrease as a function of rate-contingent consequences. Experiment 2 was conducted to systematically replicate the results of Experiment 1.

EXPERIMENT 1

Method

Participant and Setting

Participant 1 was an 11-year-old boy diagnosed with autism, attending school at the Connecticut Center for Child Development. He was selected because he demonstrated the prerequisite skills necessary to complete the experimental fluency tasks and to record his data on rate charts. Those skills were 1) rote counting up to a minimum of 100, 2) naming of a written Arabic number and 3) demonstrating verbal commenting and requesting skills.

All experimental sessions were conducted at the participant's desk in his classroom. There were 3 other children and 6 adults in the classroom. The experimenter periodically videotaped sessions to collect interobserver agreement (IOA) data.

Apparatus.

Preference assessment materials. The names of 31 activities were printed on 1-in. x 1/4-in. paper labels. All labels were laminated and affixed with Velcro® (www.velcro.com) to an 8-1/2 x 11-in. blank sheet of paper. These 31 activities were selected based on teacher report that the participant enjoyed these activities. (See Table 1 for complete list of activities used in preference assessment for Participant 1.)

Experimental materials. Task 1 consisted of 5 sheets of paper, each with 4 columns of typed lowercase alphabet letters. Through session 18 the columns contained 33 randomly arranged letters. After session 18 each column contained each letter of the alphabet once (i.e., 26 letters) to ensure that letters were equally represented on the task.

Each page was numbered on the back. The participant used a 3-x 5-in. index card to guide his reading responses as he read down each column on a page. The data collector used a digital timer to indicate the beginning and end of each 1-min timing as well as to time reinforcer breaks; a hand tally was used to record incorrect responses during the fluency task.

The participant recorded his data on a Microsoft Word® (www.microsoft.com) chart created by the experimenter. The chart consisted of 5 different colored, 1-in. wide rows and was printed on 8-1/2-in. x 14-in. legal sized paper. Timings were numbered on the horizontal axis and response rates on the vertical axis. A Sharpie® (www. sharpie.com) thin point red marker and 12-in. ruler were used to plot the data on the chart. Reinforcers associated with the chart (based on outcomes of a prior preference assessment) included coloring with assorted paint markers, watching a movie, playing a computer game, playing in a sand table, or playing Nintendo® (www.nintendo.com). A legend visible to the student displayed the reinforcer associated with each color on the chart. (Table 2 illustrates a sample chart)

Response Definitions and Data Collection.

Preference assessment. Participant 1's activity choices were recorded for 11 school days. The first time an activity was chosen its name was recorded and a tally mark placed in the box corresponding to that activity. Subsequently, each time an activity was chosen a tally mark was recorded in its corresponding box. (Figure 1 is an example of the data sheet used to collect preference data.)

Periodic preference probes. Data were collected on activities when the participant was presented either with only the 5 activities chosen for the chart or with all 31 activities from the student's choice board. (Figure 2 shows the data sheet used for the preference probes.)

Fluency task. A teacher working in the participant's classroom collected all data. The experimenter filled in the number of 1-min. timings, the condition, the sheet and the column number before giving it to the classroom teacher. Pieces of paper with the sheet number and column number were picked randomly out of hat by experimenter. The teacher filled in the date, time, and the number of correct and incorrect responses for each 1-min timing on the experimental task. (Figure 3 is an example of this data sheet.)

Correct responses were defined as accurately labeling alphabet letters in the sequence in which they appeared in typed columns. The participant read from the top of the page to the bottom of the page, continuing at the top of the next column until a timer rang. Self-corrected responses were recorded as correct when the entire label was included in the self-corrected response. (e.g., If the participant said, "24" and then "25", [the accurate label], "25" would be recorded as a correct response. Label repeats were accepted as correct responses.)

Incorrect responses were defined as any omission of labels in the sequence of letters, naming a letter other than the next letter in the sequence, and partial self-corrects. (e.g., If the participant initially responded, "24" and then quickly "5" [instead of saying, "25"] that response was recorded as incorrect.)

Interobserver agreement (IOA). The experimenter collected IOA data from videotaped sessions. Occasionally, a third observer viewed these videotapes sessions and recorded additional IOA data on the same data sheets used by the main data collector.

Experimental Design

The purpose of this study was to investigate whether or not response rates would shift as a function of rate-contingent consequences. A reversal design (Johnston & Pennypacker, 1993), in which one or both experimental conditions were presented and removed at least once, was used. The dependent variable was rate of responding (frequency of correct responses in 1-min. timings). Different frequencies were associated with different rewards-- the most highly preferred activity being placed at the top of the chart (contingent on highest rate of responding) or at the bottom (contingent on lowest rate of responding), depending on the experimental condition. The independent variable was an intervention package consisting of self-charted response rates and rate-contingent consequences arranged in order of preference. After consistent responding was established in the first condition the order of items on the chart was reversed so that the items previously contingent on the highest rates became contingent on lowest rates.

Procedures

Preference assessment. Participant 1's activity choices were recorded for 11 school days. The first time an activity was chosen its name was recorded and a tally mark placed in the box corresponding to that activity. Subsequently, each time an activity was chosen a tally mark was placed in its corresponding box. (Figure 1 is an example of the data sheet used to collect preference data.)

Periodic preference assessments. There were two parts in the periodic preference assessments. For the first probe the 5 activities on the chart were placed on the participant's desk. The instructor asked the participant what he wanted to do. After he made a choice he engaged in that activity for 3 min. These 5 choices were presented four more times. The second probe was done later the same day. All procedures were the same as above, except all the 31 activities from the student choice board, including the 5 chosen for the experimental task, were presented.

Pre-teaching. *Pre-teaching* was conducted for 7 days and consisted of the following procedures. Sheets (similar to those used in the experimental task) with columns of numbers were used to teach the participant how to complete the fluency task. He was prompted verbally, physically and with gestures to read the numbers in the columns from top to bottom and to move from left to right to the next column upon reaching the bottom of a column. Pre-teaching was concluded when the participant independently read the numbers from top to bottom and moved to the top of the next column without prompting.

Baseline. Sessions were conducted once a day over 3-5 days during each school week. Each session consisted of three 1-min timings. The task was presented to the participant and the data collector said, "We are going to do your letters. Read them from top to bottom." The timer was set for 1 min., and the data collector indicated the beginning of the timing by saying, "Ready, set, go!" and starting the timer. If the participant did not respond a zero was recorded on the data sheet but no prompting occurred. The data collector counted the incorrect responses on a hand tally. The session

ended when the timer sounded. The participant was told how many items were incorrect. Then the data collector counted the incorrect responses from the last completed response and indicated to the participant where to begin counting the number correct. The participant and data collector counted the number of correct responses; the data collector delivered general praise (e.g., "Good job") and then all materials were put away. Baseline was discontinued after 1 session to return to pre-teaching. After timing 18, new task sheets displaying all letters in the alphabet only once (i.e., each row contained 26 letters) were introduced. Timings 1-28 constituted the baseline.

Experimental fluency task. Sessions were conducted once/day over 3-5 days of the school week. Timings 28-52 began immediately when the task was presented. However, after timing 52 the following change in procedure was instituted: prior to each timing the data collector reviewed the chart with the participant, discussing the activities associated with particular rates of responding, the rate of responding the participant achieved on the last timing, and the activity that he had earned. Then the experimental task was presented and the participant was told, "We are going to do your letters. Read them from top to bottom." As in baseline, the timer was set for 1 min and the data collector indicated the beginning of the timing by saying, "Ready, set, go!" and starting the timer. If the participant did not respond a zero was recorded on the data sheet, and no prompting was provided. The data collector recorded incorrect responses on a hand tally.

A session ended when the timer sounded and general verbal praise (e.g., "Good job") was delivered. The data collector kept track of where the participant stopped with the index card the participant used to guide his responding. The participant was told how

many items were incorrect. Then the data collector counted up from the last completed response, the number of incorrect responses and indicated where the participant should begin counting the number correct. Both the participant and data collector counted the number of correct responses. Then the participant was prompted to use the red marker to place a mark on the chart corresponding to his number of correct responses and to connect the point he had just plotted with the previous data point. If the newly charted data point was not in the range needed to obtain the most preferred activity, the data collector indicated to the participant how many more or fewer correct responses were needed to earn the highly preferred activity. The participant then engaged in the activity associated with the obtained value for 3 min. After three timings followed by collection of rewards, all materials were returned and the session was ended.

Chart conditions. Table 3 illustrates rates of responding associated with each condition. After baseline the first condition was Preferred activity-High position (PH). The most highly preferred activity was in the top position on the chart, associated with 50-60 responses/min. In Preferred activity-Bottom (PB) position condition, the entire chart was reversed: the lowest preferred activity was moved to the highest position on the chart (50-60 responses/min.) and the most preferred reinforcer was in the bottom position (10-20 responses/min.). In *Shaping 1* condition the original positions of the reinforcers from the PH conditions were all moved down one level: The lowest preferred reinforcer was at the highest position on the chart; the highest preferred was second from the top, etc.

In the *Shaping 2* condition the reinforcers were again moved down one position on the chart. The highest preferred activity was third from the top, and the lowest preferred activity was second from the top, etc. In *Chart Removal (CR)* condition the chart was removed. Reinforcers were still associated with the same rates of responding as in *Shaping 2*. When the timer sounded the participant and instructor counted correct responses and then instead of charting the instructor informed the participant which reinforcer he had earned. The final condition consisted of a return-to-baseline condition.

Results

Preference Assessment

Figure 4 shows the results from the preference assessment for Participant 1. The five activities most preferred were chosen for the chart. In order of preference, they were paint markers, sand table, Nintendo®, movies, and computer.

Periodic Preference Probes

Three preference probes were conducted during the study. Results of these probes are presented in Figure 5. Probes A and B paint show markers as remaining the most preferred item. During probe C the participant chose all of the activities at least once and a most preferred activity could not be determined.

Experimental Fluency Task

Figures 6 and 7 show the results on the experimental fluency task for Participant 1. Overall the contingency between high rates of responding and the highly preferred reward along with self-charting and verbal instruction were successful in increasing frequency from baseline rates of 20-30 responses/min to 50-60 responses/min.

However, a reversal was not accomplished despite several interventions designed to bring rates down. Details are presented below.

Baseline. During baseline timings 1-3 participant 1 made only 1 correct response. Baseline was discontinued to pre-teach the task. Baseline was then continued and in timings 4-18 the participant's rate ranged from 10-33 correct responses/min with a mean of 25.6 responses/min. For timings 19-27 task materials were altered. During these timings the participant's rate ranged from 23 -34 corrects responses/min with a mean of 28.33 correct responses/min.

Preferred -high (PH) position. The chart was introduced in this condition and the most preferred activity corresponded with the response rate of 50-60 responses/min. During timings 28 through 51 the participant's responding increased slightly. His rate ranged from 24 to 47 correct responses/min with a mean of 35.75. Procedures for timings 52 through 81 were revised to include explanation of the chart before and after each timing. During this period response rate increased again. The range of correct responses was 35-60 /min with a mean of 45.76. The condition was not changed until responding stabilized in the range of 50-60 correct responses/min over 6 consecutive timings. This was achieved in timings 76-81.

Preferred-bottom position. In this condition the most preferred activity was in the bottom position on the chart corresponding with response rates of 10-20 responses/min. During this period response rates remained stable. The range of correct responses was 46-60 correct responses/min with a mean of 53.48.

Shaping 1. During this condition the most preferred activity was in the second position from the top on the chart. It corresponded with response rates of 40-50 correct responses/min. Response rates did decrease slightly; range of correct responses was 38-59 correct responses/ min with a mean 48.90.

Shaping 2. The most preferred activity corresponded with response rates of 30-40 correct responses/min. Data were similar to those obtained in the previous condition. Range of correct responses was 57-41 responses/min. with a mean of 48.86.

Chart removal. In this condition the participant did not chart his results but earned the activities. The correct responses ranged from 26-55 responses/min with a mean of 45.75.

Baseline 3. The range of correct responses was 40-55 responses/min with a mean of 48.

Interobserver Agreement (IOA). Interobserver agreement data were collected by the experimenter who observed all videotaped sessions and compared with the data collected by the teacher conducting the sessions. There were occasional checks by another observer. Agreement was calculated by dividing the lowest number of corrects counted by any observer by the total number of responses made. Agreement between teacher and experimenter ranged from 91%-100%. Agreement between the 2 observers working from videotaped sessions ranged 95%-100% .

Discussion Experiment 1

The experimental package was successful in increasing Participant 1's rate of responding to the goal rate of 50-60 correct responses/min for 6 consecutive timings.

However, when the contingencies were switched and the most highly preferred activity was moved to the bottom of the chart (PB) the participant's responding remained in the range of 50-60 per min.

An attempt was made to decrease the response rate by shaping. The most highly preferred activity (paint markers) was moved to the chart position second from the top (40-50 responses/min) during Shaping 1 condition and then third from the top (30-40 responses per minute during Shaping 2 condition. Responding did decrease during Shaping 1 condition to the goal of 5 consecutive timings under 50 correct responses/min but increased again during Shaping 2 and remained consistent when the chart was removed and when baseline conditions were reintroduced. The chart was removed to determine what role the visual chart had in maintaining the behavior. During this period the reinforcers were still delivered contingent on specific rates of responding. The rates of responding maintained when the chart was removed and continued to be steady when the reinforcers were removed during the return to baseline conditions. While responding was not as high as during the original preferred high condition data suggest that the task became reinforcing after fluent responding was established. The task being conditioned as a reinforcer or the difficulty to slow fluent skills may have both contributed to the fact that the rates of responding did not slow down when the chart contingencies were switched.

A probe was done every 2 weeks after daily data collection was discontinued, and these data indicated that higher-than-baseline responding was maintaining. In addition, preference probes were completed throughout the study, and the most highly

preferred item (paint markers) remained consistent, indicating that a switch in preference did not account for the maintaining rates of responding.

In summary, while the experimental package appeared to be successful in increasing rates of responding, chart contingencies were unable to reverse responding. Due to these results the experimental design was changed from a reversal to a multiple baseline (Johnson & Pennypacker 1993) for Experiment 2. The purpose of Experiment 2 was to investigate if charting and rate-specific consequences would increase the rates of responding on two see-say tasks for a child with autism.

EXPERIMENT 2

Method

Participant and Setting

Participant 2 was a 10 year-old girl diagnosed with autism, attending the Connecticut Center for Child Development. She was selected for the same reasons as Participant 1,i.e., she demonstrated the necessary prerequisite skills. These were rote counting up to a minimum of 100, naming of a written Arabic number, and demonstrating verbal commenting and requesting skills.

Again, all experimental sessions were conducted at the participant's desk in her classroom. There were 3 other children and 6 adults in the classroom. Another teacher in the classroom periodically videotaped sessions to collect interobserver agreement (IOA) data.

Apparatus

Preference assessment materials. The names of 19 activities were printed on 1-in. x 1/4-in. paper labels. All labels were laminated and affixed with Velcro® to an 8-1/2 x 11-in. blank sheet of paper. These 19 activities were selected based on teacher report that the participant enjoyed the activities. (See Table 4 for a complete list of activities used in the preference assessment for Participant 2)

Experimental fluency materials. Task 1 consisted of five sheets of paper each with four columns of typed lower case letters. The letters h,l,v,c,n,z were not used because of the participant's articulation difficulty. To remain consistent with participant

1 the letters a, b,d,e,f,g, were used twice in order to have 26 letters in each column. Task 2 consisted of five sheets of paper also with four columns of typed numbers 1-9. Numbers 1 through 8 were each used three times and number 9 was used twice in order to have 26 numbers in each column. Each page was numbered on the back. The participant used a 3-x 5-in. index card to guide her reading responses as she read down each column on a page. The data collector used a digital timer to indicate the beginning and end of each 1-min timing and to time reinforcer breaks; a hand tally was used to record incorrect responses during the fluency task. The participant recorded her data on a Microsoft Word® chart made by the experimenter. The chart consisted of five different colored, 1-in. wide rows and was printed on 8-1/2-in. x 14-in. legal sized paper. Timing numbers were on the horizontal axis and response rates on the vertical axis. A Sharpie® thin point red marker and 12-in. ruler were used to plot the data on the chart. Activities associated with the chart (based on outcomes of a prior preference assessment) included color by numbers, chair ride, an activity workbook, bubbles, and music. A legend visible to the student displayed the reinforcer associated with each color on the chart. (Table 2 illustrates a sample chart.)

Response Definitions and Data Collection.

Preference assessment. Participant 2's activity choices were recorded for 19 school days. The first time an activity was chosen its name was recorded and a tally mark placed in the box corresponding to that activity. Subsequently each time an activity was chosen a tally mark was placed in its corresponding box. (Figure 1 is an example of the data sheet used to collect preference data.)

Periodic preference probes. Data were collected on activities when the participant was presented either with only the 5 activities chosen for the chart or with all 17 activities from the student's choice board. (Figure 2 shows the data sheet used for the preference probes.)

Fluency task. A teacher working in the participant's classroom collected all data. The experimenter filled in the number of 1-min timings, the condition, the sheet and the column number before giving it to the classroom teacher. The teacher filled in the date, time, and the number of correct and incorrect responses for each 1-min. timing on the experimental task. (Figure 3 is an example of this data sheet.)

Correct responses were defined as accurately stating the label corresponding with a particular stimulus in the correct column and reading the typed column of letters from the top of the page to the bottom of the page, then continuing at the top of the next column. Self-corrected responses were recorded as correct when the entire label was included in the self-corrected response. (For example if the participant said, "24" and then "25", [the accurate label], "25" would be accepted as a correct response. Label repeats were considered 1 correct response.)

Incorrect responses were defined as any omission of labels in that row, naming a letter other than the next letter in the sequence, and partial self-corrects. (For example, if the participant initially responded, "24" and then quickly "5" [instead of saying, "25"] that response was recorded as incorrect.)

Interobserver agreement (IOA). The experimenter collected IOA data from videotaped sessions. Occasionally, a third observer viewed these videotapes sessions and recorded additional IOA data on the same data sheets used by the main data collector.

Experimental Design

A multiple baseline (Johnston & Pennypacker, 1993) across tasks was used. The intervention package was used with one of the tasks and the other task remained in the baseline conditions. The dependent variable was rate of responding (frequency of correct responses in 1-min timings). As in Experiment 1, different frequencies were associated with different rewards. The most highly preferred activity was placed at the top of the chart. The independent variable was an intervention package consisting of self-charting response rates and rate-contingent consequences arranged in order of preference.

Preference assessments. The procedures for the preference assessment and the periodic preference assessment were the same as those for participant 1 except that preference assessment data were collected for 19 days, and there were 19 activities from which to choose.

Pre-teaching. Pre-teaching was conducted for 15 days prior to baseline and consisted of the following procedures. Sheets (similar to those used in the experimental task) with columns of small black and white drawings were used to teach the participant how to complete the fluency task. She was prompted verbally, physically and with gestures to read the numbers in the columns from top to bottom and to move from left to right to the top of the next column when reaching the bottom of a column. Pre-teaching

was concluded when the participant independently read the numbers from top to bottom and moved to the top of the next column without prompting.

Baseline. Baseline procedures were the same as were used in Experiment 1. Tasks 1 and 2 were conducted on alternating days. Timings 1-12 constituted the baseline.

Experimental fluency task. Sessions were conducted once per day over 3-5 days of the school week. The intervention package was implemented for Task 1 while Task 2 remained under baseline conditions. Tasks were done on alternating days. Prior to each timing for Task 1, the data collector reviewed the chart with Participant 2, discussing the activities associated with particular rates of responding, rate of responding the achieved on the last timing, and the activity that she had earned. Then the experimental task was presented and the participant was told, "We are going to do your letters. Read them from top to bottom." As in baseline, the timer was set for 1 min and the data collector indicated the beginning of the timing by saying, "Ready, set, go!" and starting the timer. If the participant did not respond a zero was recorded on the data sheet, and no prompting was provided. The data collector recorded incorrect responses on a hand tally.

A session ended when the timer sounded and general verbal praise (e.g. "Good job") was delivered. The participant was told how many items were incorrect. The data collector then counted incorrect answers from the last completed response and indicated where the participant should begin counting the number correct. Both the participant and data collector counted the number of correct responses. Then the participant was prompted to place a mark using the red marker, on the spot that corresponding with the timing and value obtained on the fluency task. If there were already data points there the

participant was prompted to connect these points with a ruler. If the most preferred activity was not earned the data collector indicated to the participant how many more or fewer correct responses would have to be emitted to earn the highly preferred activity. The participant then engaged in the activity associated with the obtained value for 3 min. After three timings all materials were returned and the session ended.

Chart conditions. After baseline the activity indicated as the most highly preferred in the preference assessment was in the top position on the chart, associated with 90-100 responses/min. After timing 19 the experimenter was informed by the data collector that the participant had been requesting an activity that was in the lowered position on the chart and had not previously been chosen in the preference assessment. A periodic preference assessment was done and did indicate a change in preference had occurred. This activity was then moved to the top position on the chart, and the other activities were each moved down one position. In *Shaping 1* condition the highest preferred activity was placed in the position corresponding with rates of 60-70 response/min. (See table 5 for chart conditions for Participant 2)

Results

Preference Assessment

Figure 8 show the results from the preference assessment for Participant 2. Color by numbers was chosen the most highly preferred activity. Two other activities chosen during the preference assessment were chosen for the chart.

Periodic Preference Probes

One preference probe was taken during Experiment 2. Results of these probes are presented in Figure 9. During the preference probe music was chosen the most when the participant had to just pick from the chart choices and when she had all of her choice board activities to chose from.

Experimental Fluency Tasks

Figure 10,11 and 12 shows the results on the two experimental fluency tasks for Experiment 2. The contingency between high rates of responding and the highly preferred reward, together with self-charting and verbal instruction, did not result in rates above baseline rates.

Baseline. Baseline for Task 1 comprised Timings 1-12. The participant's rate ranged from 45-75 correct responses/min with a mean of 56.5 correct responses/min. Timings 1-39 comprise all of the timings done for task 2. All were done under baseline conditions. Correct responses/min ranged from 26-71 correct responses/min with a mean of 54.72 correct responses/min.

Chart/ Preferred-high position 1. The chart was introduced during this condition and the activity that was indicated as most preferred during the initial preference assessment was in the highest position on the chart and associated with response rates of 90-100 correct responses/min. During this period responding ranged from 50-65 correct responses/min with a mean of 57.83 correct responses/min.

Chart/Preferred high position 2. After a preference probe was done during the study it was determined that preference for activities had changed. An activity previously corresponding with rates of 50-60 responses/min was moved to the highest position on

the chart, which corresponded with response rates of 90-100 correct responses/min. During this period response rates ranged from 44-68 correct responses/min. with a mean of 52.44.

Shaping 1. Response rates during the previous 2 conditions stayed mainly between 50-60 correct responses/min. During the shaping condition the most highly preferred activity (music) was placed in the position second from the bottom on the chart and corresponded with rates of 60-70 correct responses/min. During this condition responding ranged form 48-61 correct responses/min with a mean of 54.83 correct responses/min.

Interobserver Agreement (IOA). Interobserver agreement was taken by the experimenter and occasionally by another observer. Agreement was calculated by dividing the lowest score of the 2 data collectors by the number of correct responses plus incorrect responses. Agreement ranged from 92%-100% agreement.

Discussion Experiment 2

The experimental package of rate specific consequences and charting was not successful in increasing the rates of responding for Participant 2. When the chart was introduced response rates did not increase but did become more stable. While during baseline response rates ranged from 45 to 71correct responses/min, after the chart was introduced response rates ranged from 50-65 correct responses/min and most rates were between 50-60 correct responses/min. When the Participant 2's reading rates were within this range she earned the activity of listening to music. The data collector reported that during timings 13-24 Participant 2 began requesting music before the timings. Music

corresponded with 50-60 correct responses/min. At this time a periodic preference probe was conducted, and it was determined that the participant's preference had switched from paint by numbers to listening to music.

The chart contingencies were then switched so that the highest rate of responding corresponded with music. Rates for task 1 dropped slightly after this revision was made. This may have been do to the fact that the participant was not coming into contact with her most preferred activity at all, unlike the previous condition when it was frequently earned. Based on this assumption the experimenter then tried to shape responding higher and moved the highest preferred activity (music) from the top chart position to the position that correspond with 60-70 correct responses/min. This was done with the expectation that moving the most highly preferred item to a range just above the participants current rates would make it more likely that the participant would come into contact with the reinforcer. However, her response rates did not increase but remained stable. The chart was never introduced for the second task due to the fact that responding for task 1 never increased. Responding for task 2 ranged from 26-73 responses/min with a mean of 54.72 responses/min.

GENERAL DISSCUSSION

The purpose of this study was to investigate the effects of a PT package including timings and charting on response rates for 2 children with autism. There were mixed results of the PT package. While charting and rate specific consequences were successful in increasing the rates of responding for Participant 1, chart contingencies were unsuccessful in reversing rates of responding. The experimental package did not succeed in increasing the rate of responding for Participant 2.

There are several factors that may have contributed to the differences between the 2 participants. Participant 1 had had previous experience with a chart similar to the one used in this study. He had used it for another academic task and had been taught to go fast to move to a higher position on the chart, associated with a more highly preferred activity. Although in this study there was no instruction or coaching on speed, the instructions may have generalized from his prior experience with the chart.

The prerequisite skills used to choose participants may have been inadequate. According to classroom teacher report, Participant 1 may possess more academic skills than required and they may be essential to using the chart introduced in this study. These skills included discriminating between fast versus slow and more versus less. Future research using PT with students should include investigating the basic cognitive skills necessary to be able to chart.

A preference assessment was done for each student. However, a reinforcer assessment was not conducted to demonstrate that the activities functioned as reinforcers.

The activities may not have been powerful enough to change the rate of responding. In addition, all of the activities on the chart were taken from a pool of choices available in the participant's motivational system. As such all of the activities may have functioned as reinforcers and therefore were not differentially effective in reinforcing rates of responding. In the future a reinforcer assessment should be conducted in addition to the preference assessment. Activities that are shown to function as reinforcers should be used to reinforce high rates of responding, while activities that do not function as reinforcers should be used on the bottom of the chart.

While the experimental package was successful in increasing rate of responding for Participant 1 but not for Participant 2, timings alone (baseline conditions) were not successful in increasing response rates of either participant. Current research in PT stresses timings and charting as strategies for producing fluent responding. Both experiments reported herein provided evidence that timings and charting are not sufficient for teaching children with autism. The results of this study suggest that a component analysis may be necessary to determine what aspects of PT will be effective teaching tools for children with autism.

Some precision teachers have said that fluency tasks, are fun and reinforcing (Binder 1996, Brandstetter & Merz 1978; Lindsley, 1995). Evidence from the current study suggests that this is not the case for some learners with autism. While the tasks initially did not appear to be reinforcing for either participant, the rate of responding did maintain for participant 1 when both the chart and reinforcers were removed. This

suggests that the tasks became reinforcing after they became fluent. The role of reinforcement needs to be investigated in future PT studies.

In addition to component analysis it may be necessary for precision teachers to demonstrate experimental control in their investigations. Some precision teachers report only the effect they observe in their classroom (e.g., Millar & Calkin 1997; Morrell et al., 1995) which makes drawing scientific conclusions difficult and replication impossible. Future PT studies should include strong experimental design, clearly stated methods and response definitions, measures for calculating IOA, and data analysis.

The success of PT with other populations (McDade et al., 1991; Raggio & Bitgood 1982; Van Houten 1976) still holds promise that PT can be effective for children with autism. As previously stated children with autism have difficulty with generalization, stimulus overselectivity, prompt dependency and maintenance. In Experiment 1 the probes completed several weeks after the daily data collection demonstrated that Participant 1 was able to maintain higher-than-baseline rates of responding. The advantages of fluent performance such as retention, endurance, stability and application are factors that would greatly enhance learning for children with autism.

In addition to investigating the role of reinforcers future research in PT could investigate the relationship between timing length and increasing response rate. While most studies in PT use 1-min timings, shortening the timing interval may influence response rates (Mallabello 1998). In addition, determining appropriate fluency aims for children with autism is another area that warrants further study. What rates of responding would children with autism have to achieve to be considered fluent in a skill? While

there are many questions to be investigated in using PT for learners with autism, the preliminary results of other investigations and the data from the current study suggest that PT may be an appropriate teaching tool for this population.

Table 1

Activities Used For Participant 1's Preference Assessment

Paint Markers	Dart Board	Nintendo
Movie	Building Logs	Legos® (www.hasbro.com)
Woodshop	Drawing	Sand table
Paint with water	Mirror	Playground
Paint by numbers	Bop it® (www.hasbro.com)	Coloring
Gym	Money Calculator	Running a race
Gameboy®(www.nintendo.com)	Computer	Music
Writing on Chalk board	Clay	Sticker book
Chair ride	Sorry Game®(www.hasbro.com)	Games

Table 2
Example of Data Chart

Table 3
Chart Conditions for Participant 1

Condition	Preferred Activity-High position	Preferred Activity-Bottom position	Shaping 1	Shaping 2	Chart Removal
Response Rate					
50-60 res./min	Paint markers	Computer	Computer	Movie	Movie
40-50 res./min	Sand Table	Movie	Paint Markers	Computer	Computer
30-40 res./min	Nintendo ®	Nintendo®	Sand table	Paint Markers	Paint Markers
20-30 Res./min	Movie	Sand Table	Nintendo®	Sand Table	Sand Table
10-20 res./min	Computer	Paint Markers	Movie	Nintendo®	Nintendo®

Table 4

Activities Used In Participant 2's Preference Assessment

Activity Workbook	Paint by #s	Color by #s
Cats Book	Book	Marshmallows
Marshmallow Peeps®(www.justborn.com)	Gum	Doritos®(www.fritolay.com)
Stickers	Video	Potato sticks
Doll	Fruit snacks	Chair ride
Nail polish	Wood Painting	Bubbles
Listening to music	Water Balloons	

Table 5

Chart Conditions for Participant 2

Condition	Preferred Activity-High position 1	Preferred Activity-High position 2	Shaping 1
Response Rate			
90-100 res./min	Color by #	Music	Chair Ride
80-90 res./min	Chair Ride	Color by numbers	Activity Workbook
70-80 res./min	Activity Workbook	Chair Ride	Color by #s
60-70 Res./min	Bubbles	Activity Workbook	Music
50-60res./min	Music	Bubbles	Bubbles

Figure 1
Preference Assessment Data Sheet

Participant _____ Date_____ Day_____
Data Collectors_____
Procedures for making choices_____
_____
_____
Choices Available_____
_____
_____

Choices					
# of times Chosen					
Choices					
# of times Chosen					

Participant _____ Date_____ Day_____
Data Collectors_____
Procedures for making choices_____
_____
_____
Choices Available_____
_____
_____

Choices					
# of times Chosen					
Choices					
# of times Chosen					

Figure 2
Preference Probe Data Sheet

Participant _____ Date _____

1. Place only the 5 chart choices on the desk and ask what participant wants to do. After a choice is made the participant can engage in the activity for 3 minutes. Record choice made. Repeat 5 times consecutively.

1. _____ 2. _____ 3. _____

4. _____ 5. _____

2. Present all choices from choice board with exception of edible reinforcers. Ask participant to make a choice. The participant can engage in activity chosen for 3 minutes. Record choice made. Repeat 5 times consecutively.

1 _____ 2. _____ 3. _____

4. _____ 5. _____

Figure 3
Fluency Task Data Sheet

Data Collector _______ Timing_____
Task ___________________________
Condition ____ Sheet _____ Row____
Date ________ Time_____
#correct _______ # incorrect ______

Data Collector _______ Timing_____
Task ___________________________
Condition ____ Sheet _____ Row____
Date ________ Time_____
#correct _______ # incorrect ______

Data Collector _______ Timing_____
Task ___________________________
Condition ____ Sheet _____ Row____
Date ________ Time_____
#correct _______ # incorrect ______

Data Collector _______ Timing_____
Task ___________________________
Condition ____ Sheet _____ Row____
Date ________ Time_____
#correct _______ # incorrect ______

Data Collector _______ Timing_____
Task ___________________________
Condition ____ Sheet _____ Row____
Date ________ Time_____
#correct _______ # incorrect ______

Data Collector _______ Timing_____
Task ___________________________
Condition ____ Sheet _____ Row____
Date ________ Time_____
#correct _______ # incorrect ______

Correct=Verbally stating the label that corresponds with the typed row of stimuli presented on the sheet of paper from top to bottom. Self corrections are counted as long as the whole label is stated. Ex. 24 to 25 but not 24 to 5

Incorrect= Any omissions of labels that appeared in the row, saying a different label then the one presented and partial self-corrects.

Figure 4
Preference Assessment Participant 1

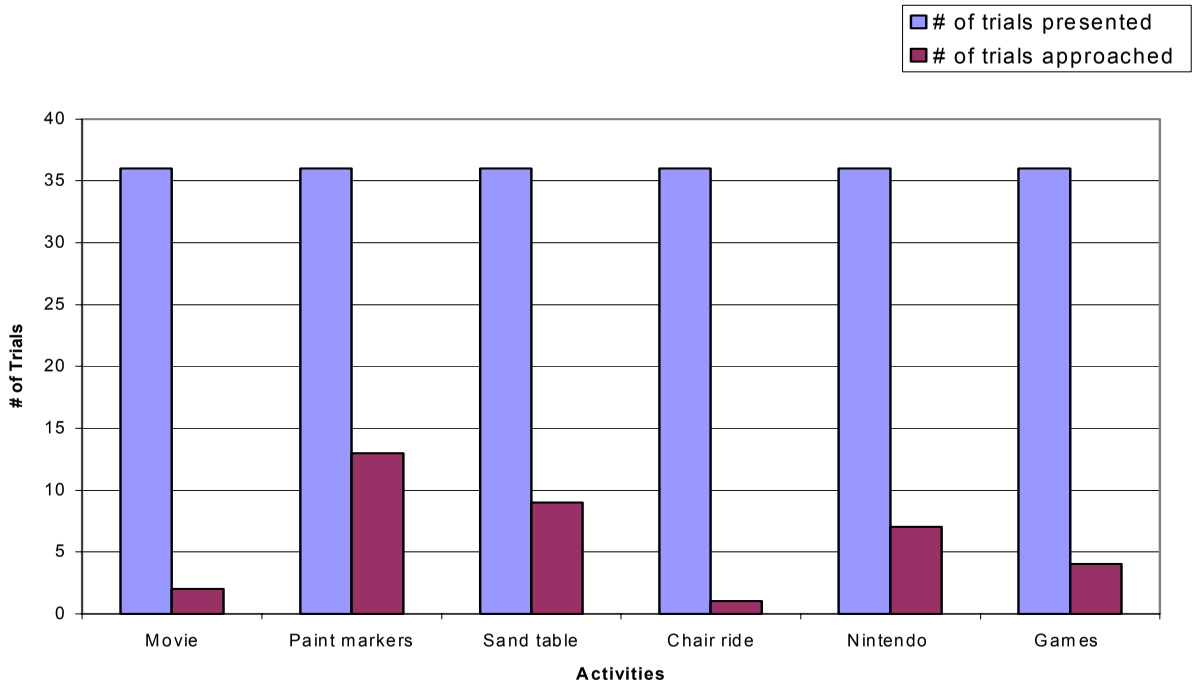
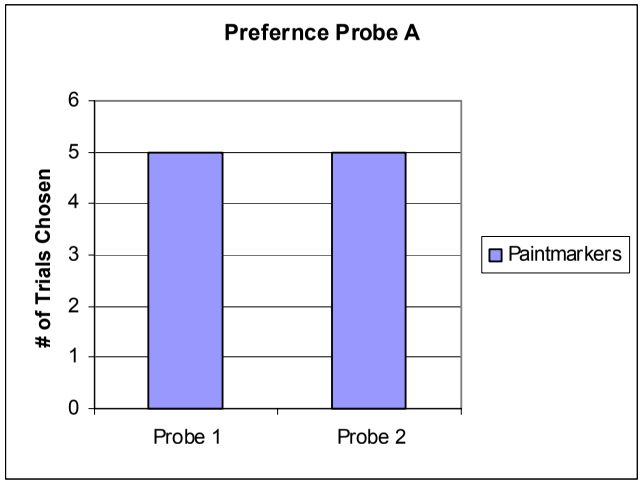
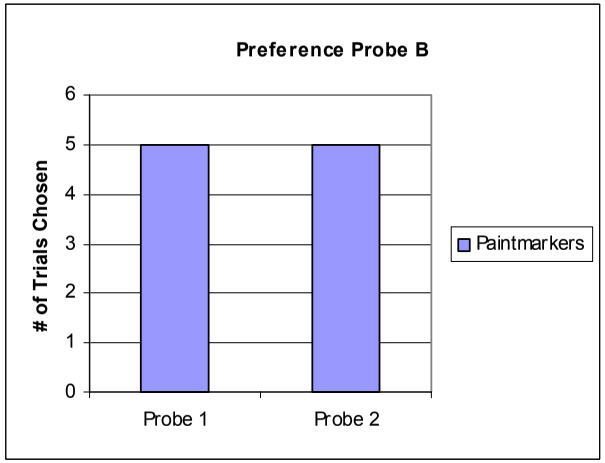


Figure 5
Preference Probes Participant 1





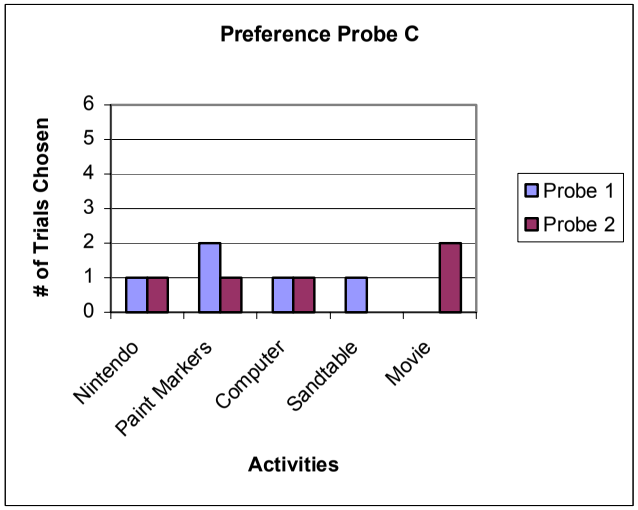


Figure 6: Participant 1 Experimental Data

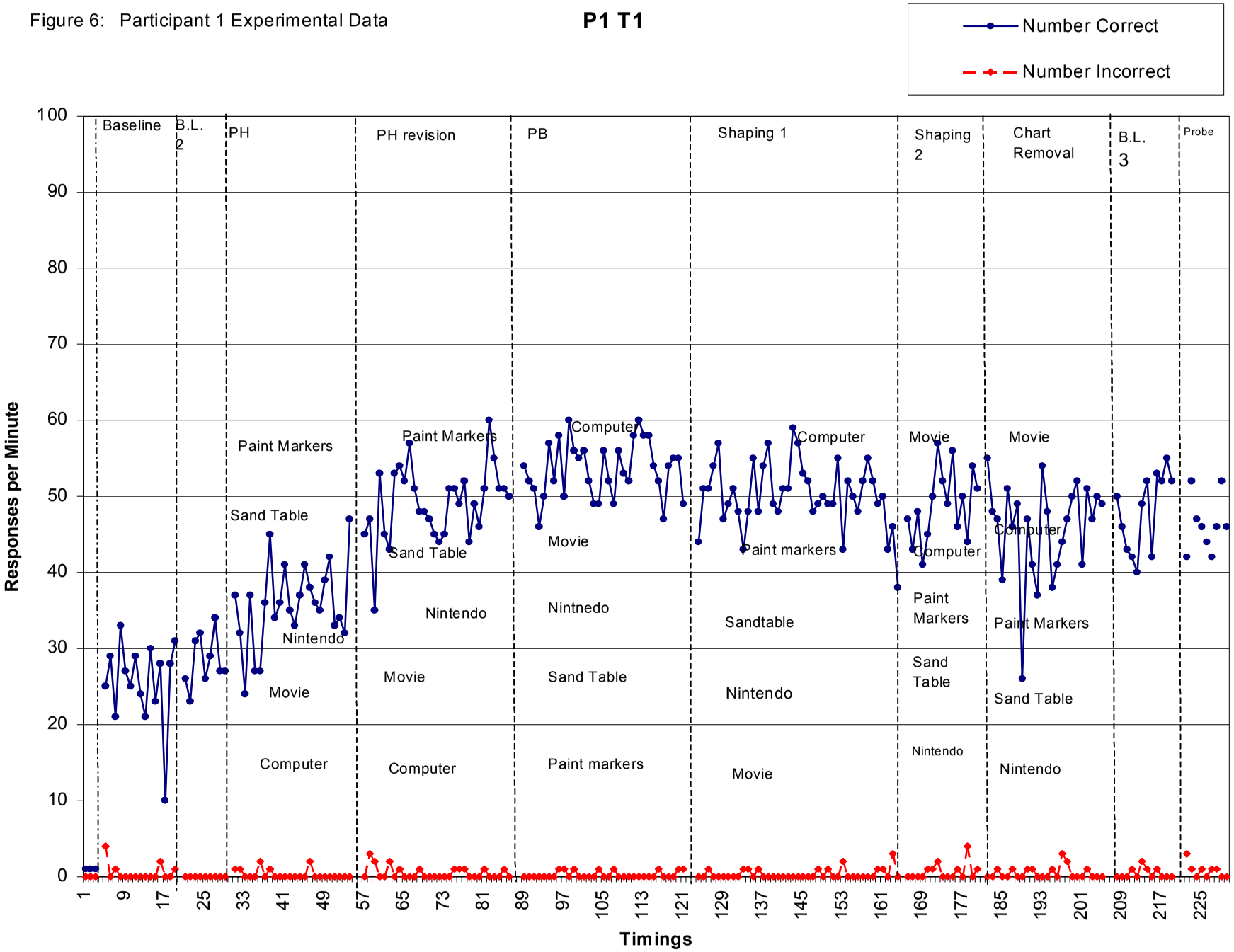


Figure 7
Preference Assessment Participant 2

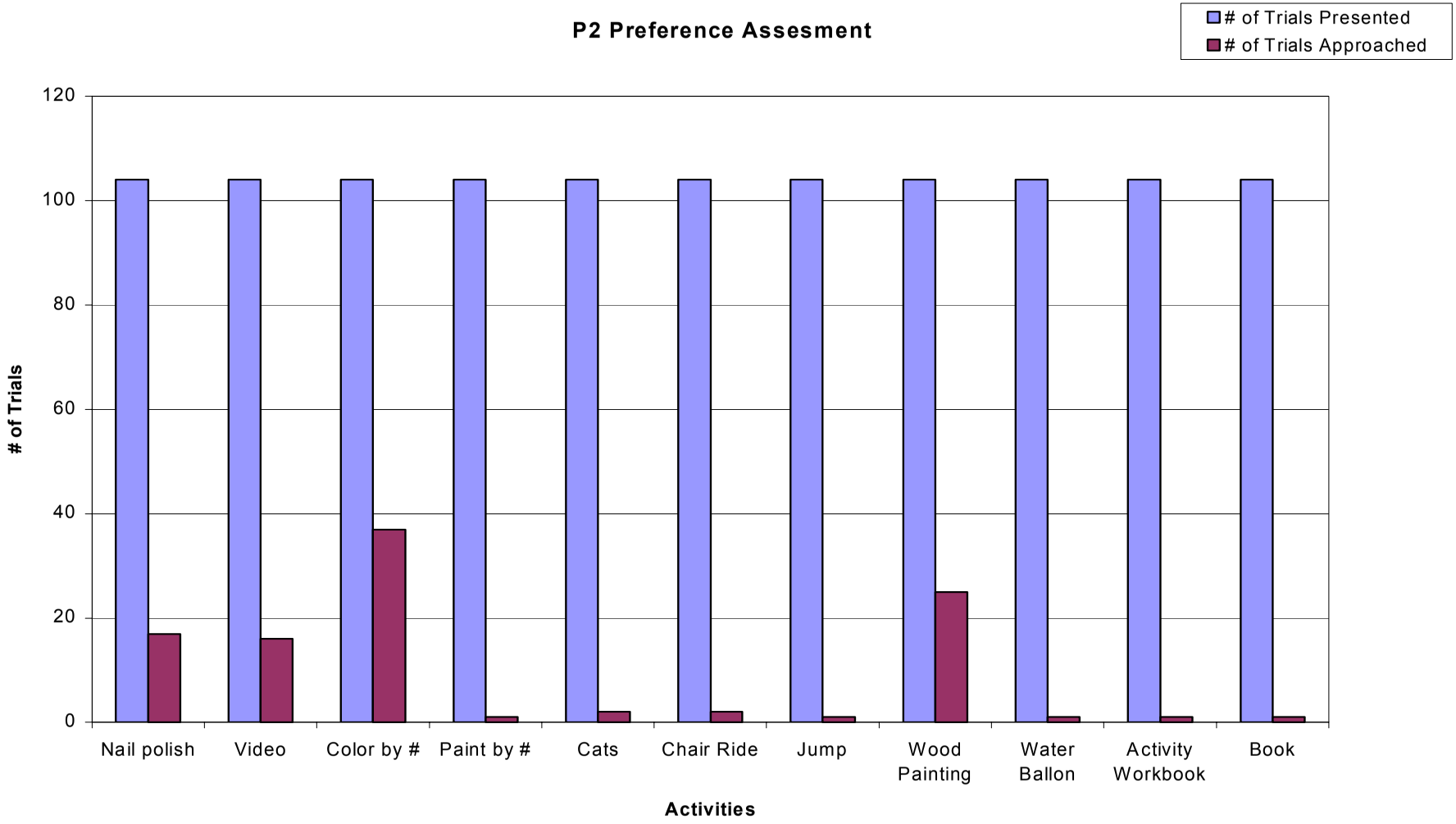


Figure 8
Periodic Preference Probe
Participant 2

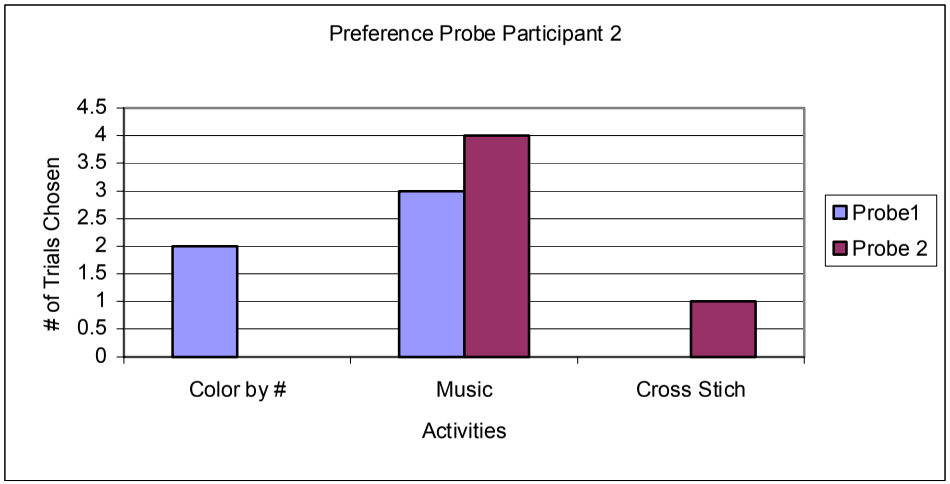
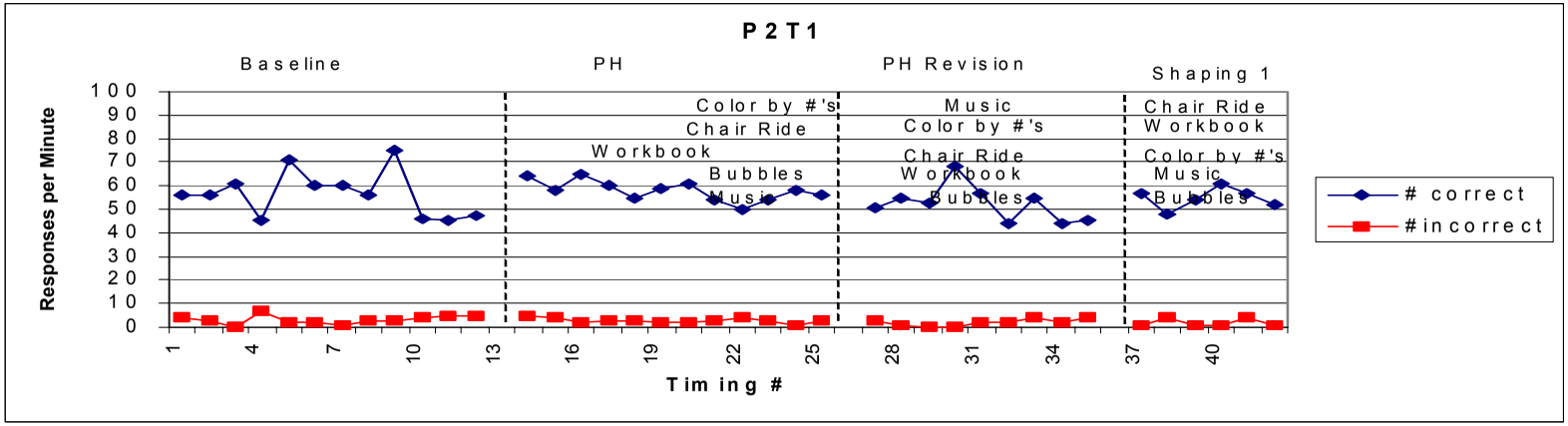
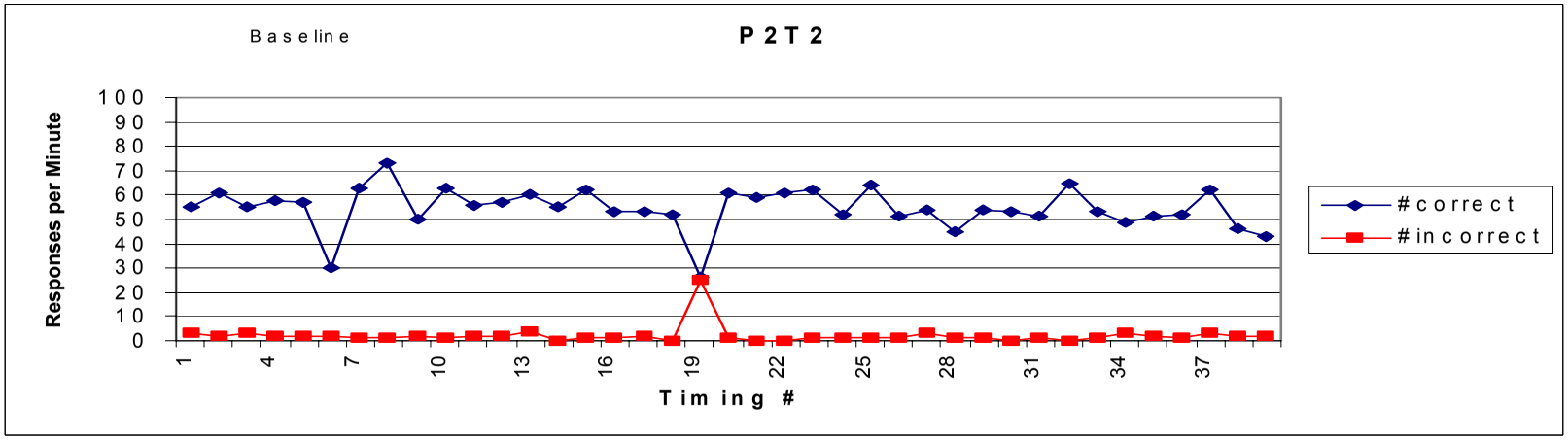


Figure 9
Participant 2 Experimental Task Data





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