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A comparison of the stimulus delay procedure and simultaneous stimulus presentation.

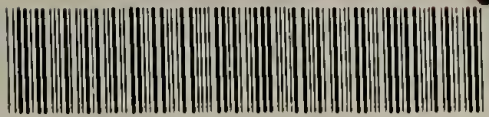
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A Comparison of the Stimulus Delay
Procedure and Simultaneous Stimulus Presentation

A Thesis Presented

by

Benjamin L. Handen

Submitted to the Graduate School of the
University of Massachusetts in partial fulfillment
of the requirements for the degree of

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Department of Psychology

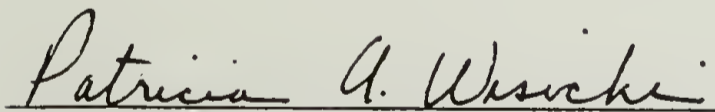
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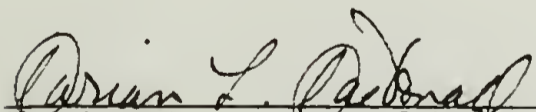
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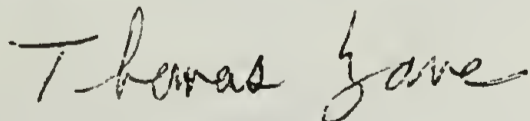
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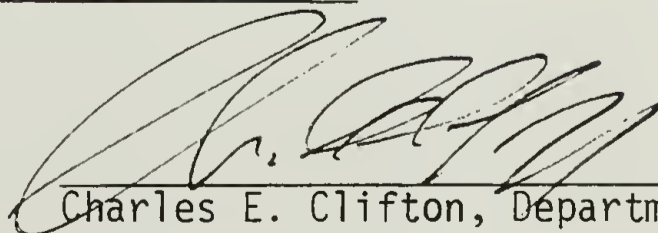
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Dedication

To my committee members: Pat, who always kept me on schedule with her contracts; Marian, who was available anytime of day or night to discuss seemingly endless procedural changes; and Tom whose interest in stimulus delay provided the impetus for this study. To Susan, who put up with me for an entire summer and provided much needed support while I conducted this study. And finally, to the staff of the Behavioral Development Center, who enthusiastically supported my research and made me feel that I was a welcome member of their organization.

Abstract

A comparison of a time delay and paired prompt (simultaneous stimulus presentation) procedure was conducted involving the teaching of a color identification task to two autistic adolescents. Time delay involved a gradual increase in the time between presentation of an instruction and prompt. Simultaneous stimulus presentation involved the concurrent presentation of instruction and prompt. One subject met criterion with the color identification task assigned to the simultaneous stimulus presentation condition. The remaining subject failed to meet criterion with either procedure.

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Introduction

The stimulus delay procedure (Touchette, 1971) is a time-based serial presentation of stimuli in which the subject is given an opportunity to anticipate a correct response. This is accomplished initially by presenting a neutral stimulus (S_1) - to which stimulus control is to be transferred, followed by a conditioned stimulus (S_2) that presently controls the desired response. As the delay between the presentation of S_1 and S_2 is gradually increased, the subject often begins to anticipate the correct response prior to the onset of S_2 . Consistent correct anticipation indicates that transfer of stimulus control from S_2 to S_1 has occurred. The data also provide a reliable measure of the exact moment at which the stimulus transfer occurred.

The concept and use of a delay is certainly not new to education. Classroom teachers have often used a variant of the procedure, such as asking a question (S_1), waiting a few seconds, and then providing the answer (S_2) if the correct answer is not anticipated by the student (the student responds by repeating the correct answer). Wolf, Risley, and Mees (1964) were the first to report the use of a delayed stimulus (called the "anticipation procedure") in a study describing the establishment of speech in a 3 1/2 year old autistic child, Dickey. The authors felt that a delay might increase the length of time Dickey looked at the various pictures presented by his teacher. In naming pictures and answering questions, Dickey was rewarded sooner if he anticipated correct responses instead of

waiting for a prompt. Gradually, Dickey began to look at the pictures and respond correctly without the need for the prompts. The same procedure was then used to teach Dickey to answer questions, such as, "What is your name?" or, "Where do you live?". The teacher would pause following each question and provide a prompt if Dickey did not answer. Correct responses, whether anticipated or whether following a prompt, were always reinforced.

Three years later, Risley and Wolf (1967) successfully used a combination of the "anticipation procedure" and a more standard fading program (Terrace, 1963a, 1963b) to establish functional speech in four echolalic children. In this study, the therapist held up an object and asked, "What is this?". Once a child established eye contact, s/he was prompted with the correct answer. The time between the therapist's question and the prompt was then gradually lengthened to more than 5 seconds. When a child did not anticipate the response prior to the prompt, a fading procedure was implemented. This involved gradually giving the prompts in a softer voice, then only a "mouthing" of the prompt by the therapist, and finally discontinuing prompting altogether as the child consistently responded to the question.

A number of other studies (Hart & Risley, 1968, 1974, 1975; Lovaas, 1966) have reported the use of delayed stimuli as a method of enhancing the transfer of stimulus control. The majority of research has focused upon increasing expressive language skills in children. The neutral stimuli (S_1) included either the presentation of desired toys/objects or the asking of simple questions such as,

"What do you want?" or "Where do you live?". Following the presentation of the neutral stimulus, a time delay, ranging from 5 to 30 seconds in length (depending upon the study), was implemented. If an incorrect answer was given or an appropriate response was not anticipated by the end of the delay period, a more intrusive prompt (often in the form of the correct answer) was usually provided by the teacher. The child was then reinforced for correct responding following this additional prompt. The use of fading and shaping procedures in conjunction with the time delay was observed in most of these studies.

Halle, Marshall, and Spradlin (1979) used a delayed stimulus to teach institutionalized retarded adults to ask for their food trays while in a cafeteria line. The neutral stimulus (S_1) was a plate of food held by the attendant. After a 15 second delay, the attendant prompted the client by saying, "Tray, please" if the client had not requested the food. Cuvo (1973, 1978) taught mildly retarded adults indoor maintenance skills by introducing a prompting hierarchy that ranged from verbal cues to physical assistance. The neutral stimuli (S_1) were the materials themselves. For example, a client would be told to clean a bathroom. Being in the bathroom was to have acted as the stimulus for engaging in the first cleaning step (e.g., getting the appropriate cleaning materials). If the client had not engaged in the appropriate response after a five second delay, a series of progressively more intrusive prompts was given, until the client responded.

The majority of the studies reporting the use of a delayed

stimulus to enhance learning were rather nonsystematic. Delay lengths were often arbitrarily chosen and applied (for example, procedural descriptions might simply read, "Wait a few seconds".) and delays were often combined with fading and/or shaping procedures which varied the strength of the conditioned stimuli. Another area of variation was in the use of conditioned stimuli. Some investigators used no conditioned stimuli at all, but simply withheld reinforcement following the presentation of the neutral stimulus contingent upon a response. Other studies utilized a hierarchy of conditioned stimuli, indicating that stimulus control had not been reliably established with any one stimulus. This lack of stimulus control often resulted in relatively high error rates. Additionally, an operational definition of the conditioned stimulus was not always clearly specified; whatever prompt elicited a correct response was often considered appropriate. Finally, it should be noted that investigators were generally interested in increasing rates of appropriate responding; a delay was used as one of a number of methods to meet this goal.

As early as 1971, however, more systematic and refined work with the stimulus delay procedure had been conducted. Touchette (1971) applied the concept of the delay in a laboratory setting as a means of measuring the exact moment of transfer of stimulus control. In his study, retarded adolescents were taught discrimination tasks. The subjects were seated before a pair of illuminated keys and were taught to press whichever key was illuminated with the color red (versus white). Two different figures were then illuminated on the keys (one on each key) and the figure to be taught was then illuminated

with the color red and touched by the subject. Then, a gradual delay was introduced between the figure presentation (the neutral stimulus) and the onset of the background color red (the conditioned stimulus). Touchette found that the subjects quickly learned to pick out the correct figure prior to the onset of the red background color.

Touchette's stimulus delay procedure differed from most of the previously discussed studies utilizing delays in the following ways: the delay was precisely measured; the delay was gradually introduced and systematically increased in length; the neutral and conditioned stimuli were clearly specified and remained at a constant strength throughout the procedure; no fading or shaping procedures were used; the procedure was errorless; and dependent measures included the number of trials to acquisition, latency of response, number of anticipated responses, and the apparent moment of transfer of stimulus control, rather than the rate of responding.

The studies which are based upon this laboratory work are characterized by the same factors. Investigators have followed Touchette's procedures and taught handicapped children and adults a wide range of skills including expressive and receptive sign language (Smeets and Striefel, 1976a, 1976b; Stremel-Campbell, Cantrell and Halle, 1977), direction following (Striefel, Bryon, and Aikins, 1974; Striefel, Wetherby, and Karlan, 1976) identifying the appropriate object, picture, number, or word from an array of stimuli when a particular stimulus is named by the instructor (Moon and Geelen,¹ Solot,²) and choosing the appropriate object (from an array of objects) when shown a corresponding picture (Spellman, DeBriere,

Jarboe, Campbell and Harris, 1976).

While each of these studies based on Touchette's (1971) work have closely paralleled his original methodology, there have been some interesting variations and additions to the procedure. One such variation has been the use of a wait training procedure (Johnson, 1977, Solot,²). This involves teaching subjects to wait for the presentation of the conditioned stimulus (S_2) prior to responding. Johnson (1977) pre-trained his subject to wait for up to 4 seconds before responding. This involved presenting an impossible discrimination (2 blank cards) and asking the subject to point to the correct one. The delay between this prompt (S_1) and the experimenter's pointing to one of the cards (S_2) was gradually increased (errorlessly) from one to four seconds. When other stimuli were presented, the subject continued to wait if he did not know the answer and to anticipate if he knew the answer.

Solot² similarly pre-trained her subject by a three step method: 1) wait training with an unfamiliar task (e.g., matching printed numbers to number names dictated in Portuguese), 2) anticipation training on a task already learned (e.g., matching printed numbers to number names dictated in English), and 3) a mixed task consisting of stimuli both familiar and unfamiliar (e.g., stimuli whose names are dictated in both Portuguese and English). However, Solot's method is only feasible with clients who have some reliable matching or discrimination skills to use in the anticipation training step. With severely retarded clients who frequently have neither matching skills nor waiting behavior, it would seem that Solot's

procedure would be more difficult to implement.

A second variation in Touchette's (1971) original procedure involves the addition of stimulus rehearsal to the stimulus delay procedure by having the client repeat the neutral stimulus given by the experimenter prior to responding. A number of studies have indicated that a direct relationship exists between the amount of "observing behavior" a subject is required to emit and the rate of response acquisition. In their work with pigeons, both Lydersen, Perkins, and Chaires (1977) and Sacks, Kamil and Mack (1972) observed increases in acquisition rates and improved accuracy when the required number of sample key responses were increased. Lydersen et al (1977) worked with a delayed oddity task while Sacks et al (1972) used both a simultaneous and delayed match to sample task.

Solot,² however, suggests that pecking in pigeons may not serve the same function as pointing in humans. Corey and Shamow (1972) did not find any effects on performance when they required that children point at words during oral reading. While pigeons may peck in order to discriminate food from other items on the ground, pointing by human subjects may simply indicate that a stimulus has been presented but not that the subject has discriminated the stimulus from others. One way to further assist a subject to discriminate among stimuli is to require a differential response such as naming the stimulus. Both Constantine and Sidman (1975) and Solot² found that severely and moderately retarded subjects who had done poorly using the stimulus delay procedure increased the rate of task acquisition once they were instructed to name each stimulus prior to pointing to or matching to the stimulus sample.

Finally, most of the stimulus delay studies patterned after Touchette's methodology implemented the following three step sequence with the delay procedure:

- 1) Demonstration of control by the conditioned stimulus.
- 2) Demonstration of control during simultaneous trials in which S_1 and S_2 are paired together.
- 3) Implementation of delay trials in which S_1 and S_2 are serially presented.

Steps 1 and 2 are seen as prerequisites to the implementation of a delay.

In three studies (Johnson, 1977; Smeets & Striefel, 1976a; and Striefel, Bryan & Aikins, 1974) the implementation of a short delay in which the subject was allowed to respond (anticipate) resulted in acquisition. Therefore, the delay procedure may have simply acted as a probe which indicated that learning had occurred. Simultaneous exposure, rather than being a pre-requisite step to the implementation of a delay (step #2), may actually have been the step where much or all of the learning occurred. Even in those studies in which learning was only evident following a number of delay trials, it is possible that the same results would have been produced by a similar number of simultaneous trials (Smeets & Striefel, 1976b). If this is the case, the only obvious advantage to stimulus delay would be its function as a measure of the exact moment of acquisition. Simultaneous presentation, which does not provide the subject an opportunity to respond without the presence of the conditioned stimulus, would require a probe phase to test for acquisition. Therefore, it remains

to be seen whether the stimulus delay procedure results in more rapid acquisition than the simultaneous presentation of paired stimuli.

The present study was designed to compare the effectiveness of the stimulus delay and simultaneous presentation procedures.

Method

Subjects.

Two autistic children were selected to participate in the study: one 16 year old female and one 10 year old male. Both functioned in the severe range of retardation. The two subjects demonstrated the following skills: 1) ability to sit with hands in lap until given directions, 2) ability to make eye contact with task, 3) ability to respond to pointing cue, and 4) ability to match to sample with six basic colors. They were not able to identify colors consistently.

Setting.

The study was conducted in the subjects' classroom in a partitioned area in the corner of the room. Each subject sat across from the experimenter at a small table. Sessions were conducted for each subject three days a week, with two morning and two afternoon sessions each day. Only one subject and experimenter were present in the area during training sessions.

Materials.

Materials included seven different colored plastic tokens made

by American Guidance Service (grey, blue, pink, brown, yellow, white, and black), one styrofoam cup, a set of fourteen 3 x 5 inch file cards which indicated the random order or placement and naming of the colors, data sheets, a 3 x 5 foot rectangular table with two chairs, and a 1/100 second time clock with a large sweeping hand.

Four of the tokens were divided into two paired sets of colors (blue/grey, yellow/white). A fifth black token was included as a distractor with the yellow/white pair and a sixth pink token was included as a distractor with the blue/grey pair. This was done in order to increase the difficulty of the tasks and to provide a finer measurement for acquisition (i.e., a two color discrimination could result in 50% correct responding due to guessing, while the third distractor color would drop this to 33% correct responding by chance). This also provided a way to observe more gradual progress.

Pre-Training Procedures.

Baseline/Pre-Test.

Both sets of colors were tested during each baseline session by having the subjects point to the colored tokens as they were named by the experimenter. Sessions involved six consecutive trials per color set with three trials for each color (the distractor was not tested). While color placement order was randomly determined, every color was tested in each of the three positions (left, middle, and right), also using a random sequence. The tokens were placed (from left to right) in front of the subject with about 2 inches of space between adjacent tokens. A total of seven pre-test sessions was given for S1 and six pre-test sessions for S2 for each set of colors over a 2-3 day period.

Pre-test trials were conducted using extinction.

Wait Training Procedure.

The wait training program was based on a variation of both the Johnson (1977) and Solot² procedures. The procedure involved placing two brown plastic tokens in front of the subject and having him/her place hands in the lap. The 1/100 second time clock was placed facing the experimenter in order to keep an accurate count of the delay periods. The subject was then told to wait until the experimenter pointed. The word "brown" was said as the experimenter pointed to one of the two tokens. The subject was then reinforced for giving the experimenter the designated token. Trials were run in blocks of five. Five trials of correct responding (within a given block of trials) resulted in the addition of a 1/2 second delay between the naming of the color brown and pointing by the experimenter. Five additional correct trials (within a block of trials) resulted in an increase in the delay to one second, then two seconds, etc. until a five second delay had been taught. One or two errors in a block of trials resulted in keeping the delay the same during the next five trials, while more than two errors resulted in a decrease to the previously longest delay length. Errors were defined as: 1) giving the experimenter one of the tokens prior to the pointing prompt, 2) the subject's moving his/her hands to respond prior to the experimenter's cues, or 3) the subject's giving the experimenter the wrong token even after the pointing cue had been given.

Following the cue, "brown", if the subject attempted to anticipate (either #1 or #2 above) s/he was told, "No, you have to wait" and hands were placed back in the lap. The word, "brown" was then repeated

while the experimenter held the client's hands in his/her lap until the delay period was over. Appropriate responding was then reinforced, but this correction procedure did not count as a trial. In the event that this correction procedure did not result in waiting behavior during subsequent trials, the present procedure being used was temporarily suspended and a fading procedure implemented. This involved holding the subject's hands down and then gradually eliminating the assistance as the subject waited for the pointing cue before responding. Other prompts which were used with the subjects included: 1) reminding subjects prior to the trial that they must wait and having them verbally say, "wait" in response to the experimenter's asking them what they must do, 2) using the experimenter's upraised index finger as a visual cue for waiting (when it is held up, the subject waits; when it points to a token, the subject gives that token to the experimenter). Once these additional cues were gradually faded, the subjects were again run through the procedure as previously described.

Choosing the incorrect token following the experimenter's pointing cue resulted in the following correction procedure: 1) experimenter said, "No" to client, 2) experimenter told client to place hands in lap and said the word, "brown", again, 3) experimenter held client's hands in lap until the end of the delay period and then physically guided client's hands to choose the correct token (as the experimenter simultaneously pointed to the correct choice with his other hand). Appropriate responding was reinforced, but this correction procedure did not count as a trial.

Once a subject had met the criterion of waiting for 5 seconds during two consecutive 5-trial blocks, the waiting baseline training

was terminated. The anticipation baseline was then introduced in which the subject was told to place hands in the lap while one styrofoam cup and one brown token were placed in front of the subject (the subjects were able to identify the cup). The experimenter then said, "cup" and gave the client 5 seconds to respond. If there was no response within this period, the subject was given a verbal cue to give the experimenter the cup (or physical cue if necessary) and then reinforced for complying. If the subject chose the brown token instead of the cup, s/he was told, "No" and the following correction procedure was then conducted: 1) experimenter told client to place hands in lap and repeated the word "cup", 2) experimenter provided immediate physical assistance to insure that client chose the cup (the experimenter did not simultaneously point to the cup with his other hand). Appropriate responding was reinforced, but this correction procedure was not counted as a trial. Criterion was met when the subject responded by pointing to the cup (within 5 seconds) without additional prompts (i.e., only following the experimenter's saying, "cup") for two consecutive 5-trial blocks.

A mixed baseline was then introduced in which the subject placed his/her hands in the lap and the two brown tokens and one cup were placed before him/her. Both placement order and object to be named were randomly determined for each trial. When the experimenter said, "brown", the subject was reinforced for waiting 5 seconds and then responding to the pointing cue. Anticipations resulted in being told, "No, you have to wait" and having the subject's hands placed back in his/her lap. This was scored as an error. A correction procedure

then followed in which the word, "brown" was repeated while the experimenter held the subject's hands in his/her lap until the 5 second delay was over and the pointing cue was provided. Reinforcement followed, but this was not scored as a separate trial. When the experimenter said, "cup", correct responses (within 5 seconds) were reinforced. If no response occurred within 5 seconds, the subject was again told to point to the cup, followed by a physical prompt if no response was forthcoming. While such correct responding following the additional cues was reinforced, it was counted as an error. If the subject chose one of the two objects not pointed to by the experimenter, the correction procedure for "Choosing the incorrect token following the experimenter's pointing cue" (p. 12) was implemented. If the subject chose one of the tokens when the experimenter said, "cup", the correction procedure for "If the subject chooses the brown token instead of the cup" (p. 13) was implemented.

Criterion was met when the subject anticipated and waited appropriately during two consecutive 5-trial blocks. Subjects worked with the experimenter for two 10 minute sessions a day in which as many trials as possible were run.

Intervention Procedure.

Each color set was assigned to one of two conditions; stimulus delay - a progressive increase in time between presentation of the S_1 (neutral stimulus) and S_2 (conditioned stimulus), or simultaneous stimulus presentation - the simultaneous paired presentation of S_1 and S_2 . The color sets were counterbalanced across subjects. When

criterion was met by one of the tasks, the remaining task was to be reassigned to that teaching procedure which had proven more effective. Probes and training sessions were to be continued until criterion had been met by both tasks.

Four daily sessions (one session for each color set) were held involving 18 training trials per session. Two sessions were held in the morning and two in the afternoon. The 18 training trials were broken into three blocks of six trials each. A set of 18 index cards, each depicting one of the six possible placement configurations, were shuffled and placed in a pile to the experimenter's right. There were three cards for each configuration. In addition, a set of six cards, three with the number "one" and three with the number "two" written on them were used. The two numbers corresponded to the two colors to be taught in each set (e.g., #1 stood for either yellow or blue while #2 stood for either white or grey). These cards, as well, were shuffled and placed on the experimenter's right. A color order card and corresponding color number card were drawn for each trial. Therefore, each session involved 18 training trials with a total of 9 trials per color. Sessions were preceded by a 6 trial probe. The order of the two daily sessions was randomly determined, with each session lasting approximately 15 minutes.

Pre-Training Probes.

Six probe trials preceded each session under all conditions. These were extinction probes in which each color was tested three times in random order. The subject was told to point to the color named.

If the subject did not respond, s/he was verbally prompted until a response was made. Each color was tested once in each of the three positions (in random order) and overall array configurations were also randomly determined (the same cards described previously were used to determine array configuration and color to be named). Two consecutive probe sessions with 100% correct responding were defined as acquisition.

Mixed Baseline Priming.

In order to assist the subjects to discriminate between probe trials in which they were told to point, and training trials in which they were reinforced for waiting for a pointing cue, a short mixed baseline training period preceded all training trials (under both conditions). As in the wait training, this involved using the two brown tokens and one cup. The same procedure was used as in wait training with five consecutive correct trials acting as criterion for moving to the training trials (however, trials were continuous and not in blocks of five). In a pilot study, this was successful in priming the subjects to wait. While potentially confusing for the subjects, the nature of the study required probe trials and this was seen as the best way to help subjects with minimal language skills to discriminate between the contingencies operating under probe and training sessions.

Training Conditions.

Stimulus Delay.

The delay condition began with a 1/2 second delay between naming the appropriate color (S_1) and pointing to it

(S₂). Waiting for the pointing cue (before making a correct response) as well as making a correct anticipation were scored as correct and reinforced with praise (CRF) and other appropriate reinforcers (see Reinforcement Section). Incorrect anticipations or giving the experimenter the incorrect color following the pointing cue were scored as an error and elicited a reminder from the experimenter to wait. The name of the color was given again while the experimenter held the client's hands in his/her lap until the delay period was over. The experimenter then pointed to the correct token and appropriate responding by the subject was reinforced. The correction procedure did not count as a trial.

Incorrect responding following the pointing cue resulted in the experimenter implementing the correction procedure for "Choosing the incorrect token following the experimenter's pointing cue" (see above).

Five or six correct responses in a block of six trials resulted in an increase to a one second delay. Similar results during following sessions added an additional one second increase to the delay up to a seven second ceiling. Three or four correct responses during a block of six trials kept the delay at its present length, while less than three correct responses resulted in a decrease to the previously longest delay length.

Simultaneous Stimulus Presentation.

This condition involved the experimenter naming and pointing to the appropriate color simultaneously. Pointing to the color designated by the experimenter was then reinforced. Errors (pointing to the wrong

color) were consequence by the experimenter saying, "No" and implementing the following correction procedure: 1) telling client to place hands in lap, 2) saying the name of the color again and simultaneously pointed to the appropriate token, 3) providing immediate physical assistance to insure that client chose the correct token. Appropriate responding was reinforced, but this correction procedure did not count as a trial.

Reinforcement.

Reinforcement was given in a manner consistent with that provided during the subjects' regular program. Staff assisted the experimenter in determining the most appropriate schedule and type of reinforcer required for each subject, given the nature of the task. Reinforcers included praise (CRF) and food (potato sticks, Mountain Dew, crackers, lemonade) given on a variable ratio schedule of three (VR3). In addition, the experimenter continued to implement individual behavior management programs designed by the school for each of the clients (e.g., a verbal reprimand program for decreasing self-stimulatory behavior).

Additional Manipulation.

A second experimental manipulation was conducted following an examination of the results of the initial 10 training sessions for S1 and the initial 14 training sessions for S2. This involved the addition of a stimulus rehearsal procedure (Constantine and Sidman, 1975; Solot,²) to the stimulus delay and simultaneous stimulus

presentation conditions. Both subjects were taught to repeat the name of the desired color in response to the experimenter's naming of the color. Immediately after naming the desired color, the experimenter would point twice to the subject who repeated the name of the color following each point. The timing of the delay (under the stimulus delay condition) or the experimenter's pointing to the correct color (under the simultaneous stimulus presentation condition) occurred immediately following the subject's second repetition of the color name. The procedure, otherwise, remained the same as that previously outlined for the stimulus delay and simultaneous stimulus presentation conditions.

Results

Reliability.

Reliability checks were conducted with each color set during every phase of training for both subjects. These checks involved assessing the accuracy of both the recorded data and the implementation of the experimental procedures (e.g., appropriate use of correction procedures, correct delay length, correct order of stimulus presentation). Six reliability checks were made during sessions with S1 with inter-observer agreement ranging from 97% to 100% and averaging 99%. Eight reliability checks were conducted during sessions with S2, ranging from 97% to 100% and averaging 99%. Additionally, it was found that the experimenter followed the procedure as written during all but two trials in which reliability was taken.

Wait Training.

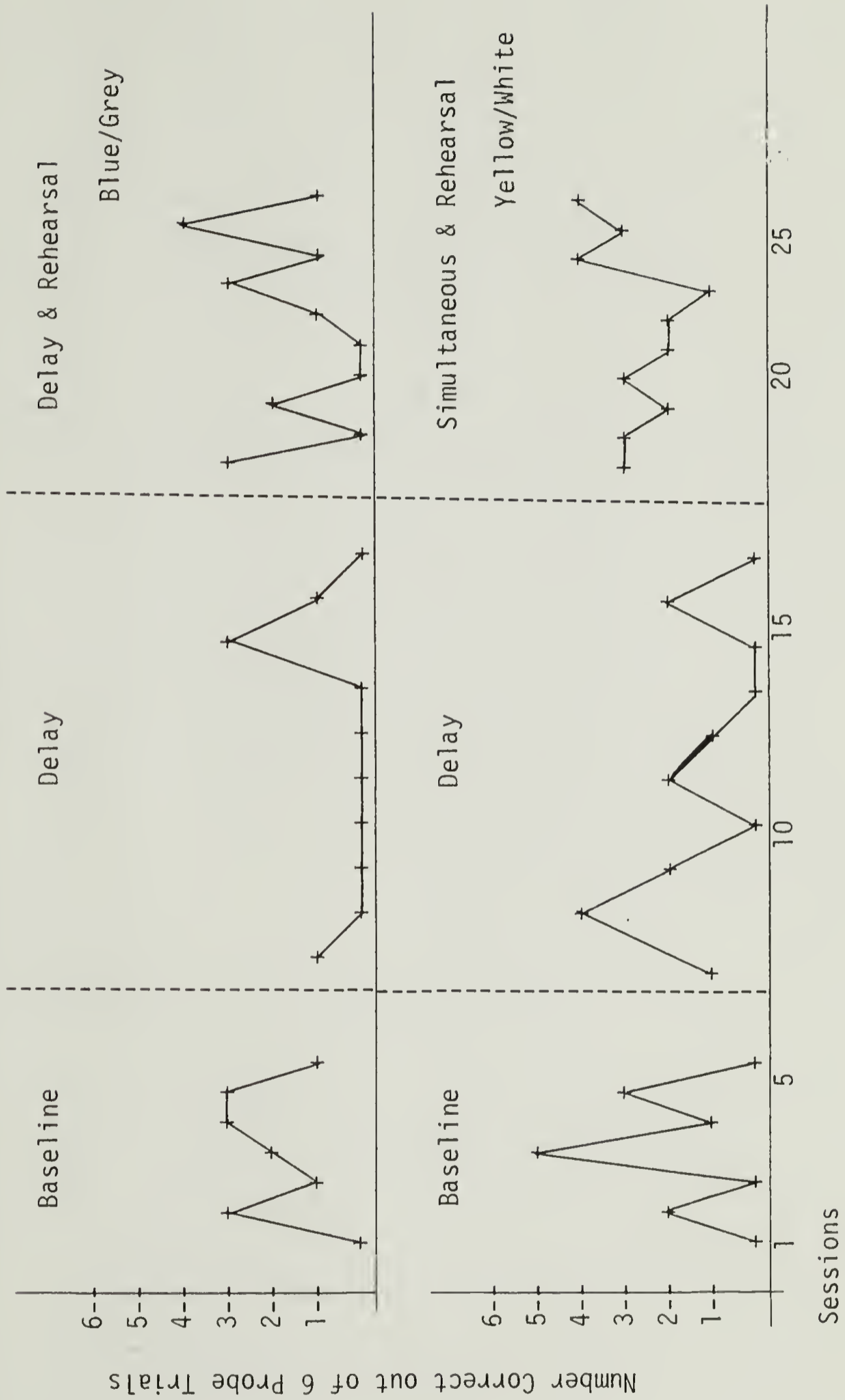
Wait training was accomplished within two sessions for both subjects. Both initially required holding down their hands during the delay period. This assistance was gradually faded and training proceeded as outlined in the Methods Section. The mixed baseline trials which preceded training sessions for both conditions were usually conducted with one or fewer incorrect responses.

Subject 1.

The results of color acquisition for S1 appear in Figure 1. The data indicate an erratic pattern during baseline for both color sets, ranging from zero to five correct (out of six trials) for the Yellow/White/Black set and zero to three correct (out of six trials) for the Blue/Grey/Pink set. Mean number correct for both sets (1.6 and 1.9 respectively) was slightly below chance levels of responding (two correct out of six). Following 180 Training trials (10 sessions) for each condition, neither the simultaneous stimulus presentation procedure nor the stimulus delay procedure resulted in the acquisition of color identification. Mean number of correct responses in probes over the 10 training sessions was 1.2 (out of six trials) for the simultaneous stimulus presentation condition. Under the stimulus delay condition, the mean number of correct responses was .5 (out of six trials).

Following the addition of the stimulus rehearsal procedure, the subsequent 10 sessions resulted in an increase in correct responding

Figure 1



during probes to a mean of 2.7 for simultaneous stimulus presentation and 1.5 for stimulus delay. While simultaneous stimulus presentation plus rehearsal yielded a slightly higher mean number correct during probes, neither condition could be said to be superior.

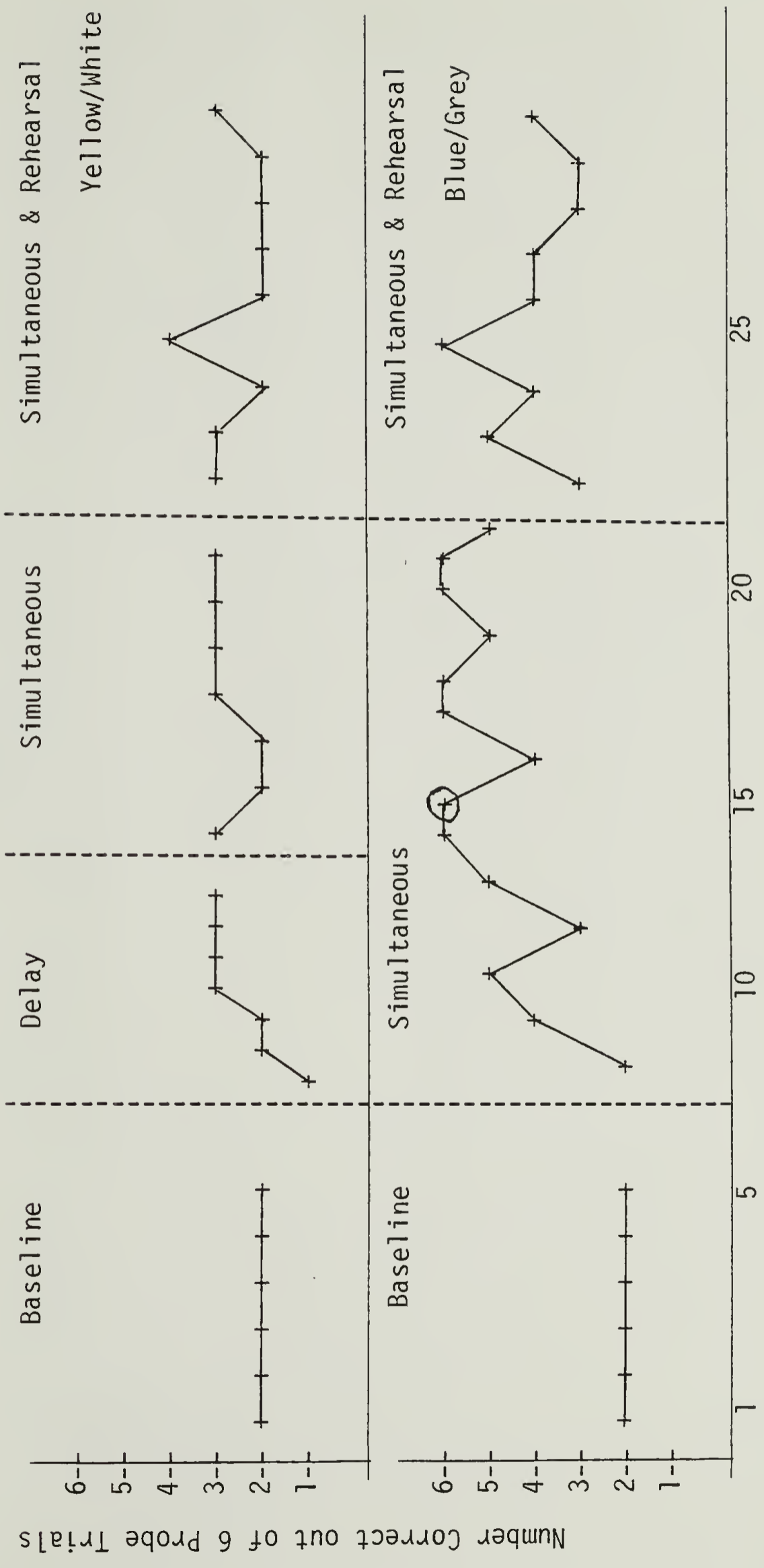
Of 360 training trials, 15 involved anticipated responses; 10 were correctly anticipated and five were not. It was interesting to note that of the final 11 anticipated responses, 10 were correct. However, these responses were widely distributed among the last 255 trials with no indication of any generalization to the probe trials.

Due to the ending of the school term, the study was terminated before either condition resulted in skill acquisition.

Subject 2.

The results for S2 appear in Figure 2. The data indicate that during the baseline period the subject consistently chose the middle of the three presented stimuli for both color sets. This resulted in two out of six correct responses during all six baseline sessions under both conditions. The use of simultaneous stimulus presentation resulted in the meeting of criterion (six out of six correct on two consecutive probes) within seven sessions (126 trials) for the Blue/Grey/Pink color identification task. Following 126 trials of the delay procedure for the Yellow/White/Black color identification task, responding had stabilized at three out of six correct during probes. The subject had begun to perseverate on the yellow stimulus, choosing it over the other two stimuli regardless of which color was requested. Changing the stimulus delay condition to simultaneous stimulus presentation

Figure 2



Sessions

○ - Criterion met

yielded no change in subject responding during probes over the subsequent seven sessions. Meanwhile, continued maintenance training with the Blue/Grey/Pink color set resulted in some fluctuations in responding, but a mean correct of 5.4 (out of six) over the next seven sessions. The addition of the stimulus rehearsal procedure at session 21, similarly, did not lead to an increase in correct responding for the Yellow/White/Black color identification task, and actually resulted in a decrease in correct responding for the Blue/Grey/Pink color identification task.

Of 126 training trials under the delay condition, only seven involved anticipatory responding; three of these were correctly anticipated while four were not. The anticipated responses were interspersed throughout the 126 trials and were not indicative of any trend toward acquisition.

The study was terminated due to the ending of the school term, before acquisition could be met with the Yellow/White/Black color set.

Individual Response Strategies.

Both subjects demonstrated some unusual response strategies. Tables 1 and 2 provide positional and color response preferences during probe trials for both subjects. Subject 1 achieved zero correct in seven out of ten probe sessions during the delay training phase for the Blue/Grey/Pink color identification task (Figure 1). The expected correct rate would be two out of six with random responding. According to Table 1, S1 may have associated the word "grey" with the color "blue". This is indicated by 24 out of 30 blue responses when grey was requested during the Delay Condition, as opposed to near random responding (8 out

Table 1

Probe Trial Positional and Color Response Preferences:

S1 Blue/Grey/Pink			
Response	Experimental Condition		
	Baseline	Delay	Delay plus Rehearsal
Positional Preferences			
Position 1	7	16	11
Position 2	22	21	24
Position 3	13	23	25
Total	42	60	60
Blue Token Requested			
Blue	5	2	7
Grey	8	14	8
Pink	8	14	15
Total	21	30	30
Grey Token Requested			
Blue	8	24	12
Grey	8	3	8
Pink	5	3	10
Total	21	30	30

Table 2

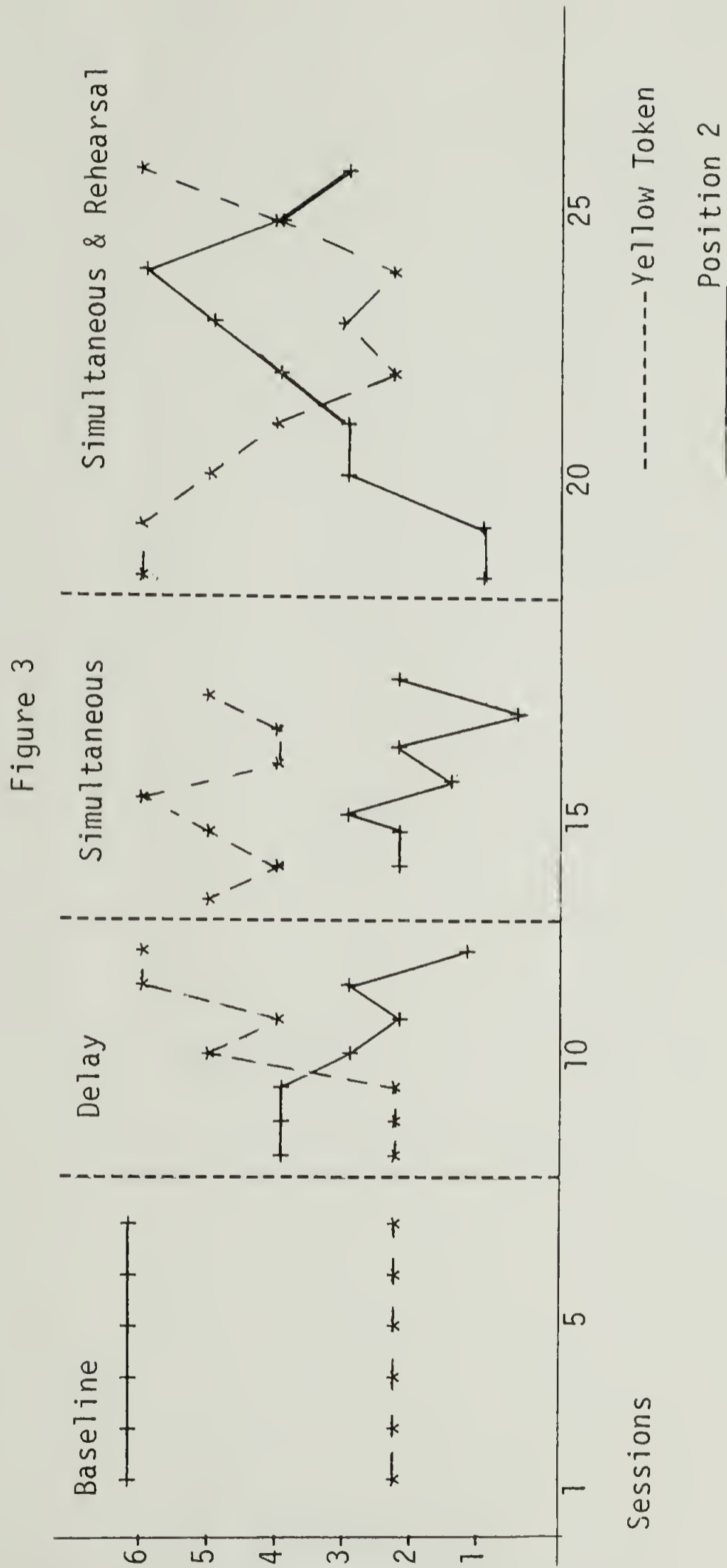
Probe Trial Positional and Color Response Preferences:

S2 Yellow/White/Black				
Experimental Condition				
Response	Baseline	Delay	Simultaneous	Simult. & Rehers.
Positional Preferences				
Position 1	0	7	10	11
Position 2	36	21	13	30
Position 3	0	14	19	13
Total	<u>36</u>	<u>42</u>	<u>42</u>	<u>54</u>
Yellow Token Requested				
Yellow	12	15	17	19
White	12	2	3	2
Black	12	4	1	6
Total	<u>36</u>	<u>21</u>	<u>21</u>	<u>27</u>
White Token Requested				
Yellow	12	12	16	19
White	12	2	2	4
Black	12	7	3	4
Total	<u>36</u>	<u>21</u>	<u>21</u>	<u>27</u>

of 21 requested) during Baseline. When the color blue was subsequently requested, the blue token was not available (since the subject already associated the blue token with the word, "grey"). Responses were, therefore, evenly distributed between grey and pink with blue chosen only two out of 30 times when requested. This response strategy apparently changed by session 15, with subsequent responding at about chance levels. Apparently, while the word, "grey" and the color blue were no longer associated, the subject developed no new strategy that was evident (as indicated by positional and color preferences under the delay and rehearsal condition).

Subject 2 demonstrated some interesting response strategies with the Yellow/White/Black color identification task. According to Table 2, the subject responded by consistently choosing the middle token (position 2) during baseline (36 out of 36 trials). As training progressed, responses continued to be stereotyped, but the subject chose the color yellow during most probe trials (as evidenced by the high frequency of yellow responses when both yellow and white were requested under all three training conditions). Figure 3 illustrates the contrast between S2's positional and color responses strategies. While initial baseline responses were according to position (position 2 favored), subsequent responding favored the color yellow with little regard to position. Finally, there was a brief switch to the middle positional preference during the simultaneous and rehearsal condition, with a subsequent return once again to yellow.

Number of Times Position 2 or Yellow Token Chosen During Probes (out of 6 trials)



Discussion

A comparison of stimulus delay and simultaneous stimulus presentation procedures was conducted by teaching two subjects a set of parallel tasks. Each task was taught by one of the two training procedures. In one case (S2), simultaneous stimulus presentation resulted in more rapid skill acquisition of one color combination than the stimulus delay method. In the second case (S1), neither training procedure was effective in teaching the task. In neither case was the use of the stimulus delay procedure effective in producing skill acquisition. The addition of a stimulus rehearsal procedure to both stimulus delay and simultaneous stimulus presentation methods did not result in an increase in performance.

These data are not consistent with previous findings which indicate that the stimulus delay procedure is a rapid method for teaching discrimination tasks (e.g., Smeets & Striefel, 1976a; Striefel, Bryan & Aikins, 1974). However, there were some differences between the previous studies and the present one. Many of the prior studies taught only one new stimulus at a time, whereas the present study involved the teaching of two stimuli concurrently. Of those previous studies that did involve the concurrent teaching of more than one stimulus, most resulted in less rapid skill acquisition. For example, in the Smeets & Striefel (1976a) and Striefel, Bryan & Aikins (1974) studies in which one new stimulus was taught at a time, 90-100% correct responding during post-tests (random sequences) was observed following only one training session for each stimulus taught. In contrast, Johnson (1977), who taught as many as six stimuli simultaneously,

took up to 264 trials per stimulus (33 training sessions) to meet criterion. Solot² similarly conducted three experiments in which a subject learned to identify two out of five stimuli. The first two experiments involved up to 218 trials, and neither experiment resulted in skill acquisition. A third experiment involved 358 stimulus delay trials before criterion was met. Solot also reported that the addition of stimulus rehearsal resulted in more rapid acquisition. In the present study, however, significant increases in performance were not achieved with stimulus delay alone or when combined with stimulus rehearsal.

Since the number of trials conducted in the present study were fewer than those in the Solot study (126 and 180 compared to 218), it is possible that additional trials would have resulted in skill acquisition. However, in Solot's first experiment, 60% of the trials to criterion involved correct anticipatory responses, which indicated that the subject was learning the discrimination. In the present study, subject 1 and 2 had 5% and 2% correctly anticipated responses respectively.

The fact that the delay procedure was unsuccessful remains puzzling in view of the previous research supporting this technique (Moon & Geelen¹; Smeets and Striefel, 1976a, 1976b; Solot²; Spellman, DeBriere, Jarboe, Campbell & Harris, 1976; Stremel-Campbell, Cantrell & Halle, 1977; Striefel, Bryan & Aikins, 1974; and Striefel, Wetherby & Karlan, 1976). One possible problem was with the choice of neutral and conditioned stimuli. Touchette's 1971 study used a mechanical device to supply both neutral and conditioned stimuli. The neutral stimuli to be discriminated were projected onto two Plexiglas keys and the

conditioned stimulus, a red overlay, was similarly projected. In the present study, the neutral stimuli were three colored tokens placed before the subject, while the conditioned stimulus (a pointing cue) was provided by the experimenter. One might assume that in order for stimulus transfer to occur, subjects must attend to the stimuli for the length of the delay. While this was so in Touchette's (1971) study, due to the inherent nature of the presentation of the stimuli, the choice of stimuli used in the present study may have resulted in the inadvertent reinforcement of the subjects for attending to the experimenter rather than the neutral stimuli. Consistent with this hypothesis is the observation that during the seven second delay, most of the time was spent with the subjects' watching the experimenter. It is possible that the seven second delay length was too long a period to expect the subjects to continuously attend to the neutral stimuli.

Most studies also used conditioned stimuli supplied by the experimenter, yet, the subjects in the majority of studies were reported to transfer stimulus control within relatively few trials. The fact that delay lengths remained very short (usually under two seconds) may have alleviated the problem of the subject's attending to the experimenter. Additionally, all of the previously discussed studies which were specifically based upon Touchette's (1971) methodology used mentally retarded subjects. It is possible that the autistic subjects used in the present study were differentially attending to the cues provided by the experimenter. The implementation of a differential response such as stimulus rehearsal (Solot²) was one attempt to increase subject attention to stimuli. However, this

rehearsal procedure did not result in increased correct responding in the present study and the subjects still continued to attend to the experimenter for the duration of the delay period rather than to the stimuli placed before them. Interestingly, this was not a problem with the simultaneous stimulus presentation condition and may account for the fact that subject 2 successfully learned the color identification task with this procedure.

Another possible reason for the failure of the stimulus delay condition involves the inclusion of the wait training procedure. It is possible that the subjects were inadvertently trained not to anticipate. This may have been due to the fact that wait training involved teaching the subjects to both wait and anticipate. While waiting behavior was reinforced, it was also assumed that the reinforcement of anticipating the experimenter's pointing to the cup (during wait training) would generalize to anticipatory pointing to colors that would be learned (during stimulus delay training). The possibility should not be ruled out that pointing to the color brown, which was punished during wait training, may have caused confusion on the part of the subject or even resulted in a hesitency to point to any colored tokens during training sessions in which the stimulus delay procedure was used. However, it is assumed that if this were the case, learning would have been demonstrated on the forced choice probe trials preceding each stimulus delay session. Such learning was not evident and so the advantages and disadvantages of wait training cannot be assessed at present. Additional research in this area is required.

Finally, it is possible that the variable ratio schedule of primary reinforcement (VR3) inadvertently shaped incorrect associations and/or stereotyped responding. Howard (1978) found acquisition rates using the stimulus delay procedure to co-vary with changes in the reinforcement schedule (denser schedules for correct anticipated responses resulted in higher rates of skill acquisition). Therefore, future studies with the stimulus delay procedure might involve a continuous schedule of reinforcement to enhance learning and to avoid the possible shaping of incorrect responses.

Both subjects apparently developed a number of consistent response strategies. While learning, in the sense of making "correct" responses, occurred only with one subject and one color identification task, learning was also taking place in that consistent patterns of incorrect responding may have been shaped as a result of the training procedure. Whether these were superstitious responses or artifacts from previous teaching experiences is not known. What caused the subjects to change response strategies when they did is also puzzling, although some of the changes appear to be closely related to phase changes in the training procedures. It also does not appear that such response strategies are limited to one particular training procedure, but occur under a variety of experimental conditions.

The present study raises a number of questions regarding the use of the stimulus delay procedure. While the question of its comparative effectiveness remains, the results of this study would suggest that it is no better than simple paired stimulus presentation. Certainly, the stimulus delay procedure did not prove to be the rapid

training procedure so frequently described in the literature. Questions regarding its use with autistic children, the necessity and role of wait training, the effects of the stimulus rehearsal procedure, as well as its overall effect as a training procedure remain unanswered and must be addressed by future research.

Footnotes

1. Moon, M. & Geelen, K.E. Use of a delayed cue procedure to teach auditory-visual number matching: a multiple baseline analysis.
Paper presented at the meeting of the Association of Behavior Analysis, Dearborn, Michigan, May, 1980.
2. Solot, R. The use of an overt differential response to facilitate transfer of stimulus control in the delayed-cue procedure.
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