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# Comparison of /s/ Acquisition Under Block vs. Intermittent Scheduling

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# COMPARISON OF /s/ ACQUISITION UNDER BLOCK VS. INTERMITTENT SCHEDULING

(TITLE)

BY

VICKI TRIPP

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# Chapter I

## Introduction

Accountability is becoming an increasingly important issue in speech therapy services. Implicit in a definition of accountability is the assumption that the "cost" of the product is known. Once the cost of the product is known, the condition of production can be predicted. If the actual cost is greater than the predicted value, then one must account for the excess cost. In the field of speech pathology and audiology this concept of cost accountability calls for more accurate records of client progress and for more efficient use of the clinician's time and skills.

The Code of Ethics adopted by the American Speech and Hearing Association, however, states clearly that no Member should offer a guarantee for speech therapy services. On the other hand, recent advances in educational technology have enabled many educators to develop powerful instructional procedures which allow accurate prediction of success. Within the recent past, several private corporations have offered contracts to public schools guaranteeing the results of their programs ("Jacksonville Contracts Crash Program for First Grade," 1970). Perhaps

the time has come when speech and language clinicians can no longer afford the luxury of offering instructional services that carry no prediction of success.

In order to maintain a high standard of quality in speech therapy services, academic and clinical criteria have been set. As a complement to the Certification of Clinical Competence standards set by the American Speech and Hearing Association, many states are setting licensure standards for speech pathologists and audiologists. One of the most recent licensure bills signed into law is in California. Under the law, speech pathologists and audiologists must be licensed, and special examining committees have been set up. The Bureau of Education for the Handicapped is also expanding its programs to upgrade services and improve the quality and quantity of its services.

Improvement in the quality and quantity of speech, language, and hearing services is made even more importunate by the large numbers of children and adults requiring such services. Estimates of the incidence of speech defects in the general population are few and probably inaccurate. The ASHA Committee on the Midcentury White House Conference (1952) estimated the prevalence of speech disorders among children between the ages of five and twenty-one to be 5.0 percent. The percentages vary from state to state--from 21.4 percent in Fresno, California,

to 1.0 percent in Philadelphia (White House Conference, 1931). Surveys of speech defects in high school and college populations show even wider discrepancies. This is probably due to varying standards as to what constitutes a speech defect at these ages. Carhart (1939), in a survey of 405 Illinois high schools, listed 23.2 percent of the freshmen, 21.0 percent of the sophomores, 20.0 percent of the juniors, and 17.8 percent of the seniors as speech defective. Evan (1938), however, found 1.3 percent of 224 ninth grade students to be speech defective with 43 percent exhibiting "slovenly and inaccurate pronunciation and enunciation." Blanton (1921) reported that personal examination revealed 18.0 percent of 2240 freshmen at the University of Wisconsin "were unable to meet the necessities of English speech." Six percent of these stuttered, while the remaining 12 percent exhibited foreign accent, oral inactivity, rate disorders, voice problems, and misarticulations of /s/ and /z/. Morley (1952), over a ten year period at the University of Michigan, reported an incidence of 3.9 percent of speech defects. Milisen (1971) made the following summary statement which may estimate a median incidence:

| Grade level | Incidence |
|---|---|
| K-4th | 12-15% |
| 5th-8th | 4-5% |
| 8th-up | 4-5% |

Keeping in mind the concept of accountability it becomes necessary to devise new procedures to deal with the large number of people needing speech, hearing, and language therapy. Especially in public school therapy programs there is increasing concern with the mounting case loads. Since the passage of the Illinois Special Education bill requiring the extension of diagnostic and therapy services to children aged three to twenty-one, public school personnel are faced with a methodological and procedural problem of working these children into their case loads and still meeting the needs of those children on their waiting lists.

Scheduling may be a relevant factor in discovering the clinician's most efficient use of time. Ironically, there is relatively little research in the area of scheduling with the exception of some research in the public school. There is no research known to the author that deals with college-age clients, 18-23 years. Clinicians in school programs do not get research help or practical advice to assist them in solving their professional problems. Much of the research material available is academic rather than practical. According to Van Hattum (1966) public schools face a unique problem in the area of research. Research by public school personnel offers no reward such as promotion; no time is alloted for it;

few persons are readily available to write research applications; and Boards of Education are sometimes not supportive of such activities. Some of the research that has been done in the public school has lacked sophistication of design and statistical analysis to render much of the results unreliable.

Van Riper (1955) identified certain features common to public school speech correction programs. Among these are the following:

1. "The case loads are generally excessive for most speech therapy.

2. "Scheduling difficulties prevent the clinician from helping those children who need her most, those requiring more time and more individual attention.

3. "Even slight improvement in the conditions under which the speech clinician operates should do much to solve this problem and reduce case loads to more favorable numbers."

The block system of scheduling has been proposed as a more effective alternative to the intermittent system, the most widely used. A primary purpose in the efficient use of time is to increase overall effectiveness. The most efficient use of time is achieved when the clinician can work on a schedule which allows her skills to be used to their greatest effectiveness. Effectiveness is deter-

mined by progress toward the operational therapy goals. By evaluating the comparative effectiveness of therapy under the block and intermittent systems of scheduling, information on the most efficient use of the clinician's time and skills is obtained. Studies have been done by Van Hattum (1957), Weaver and Wollersheim (1963), and others to investigate the effectiveness of the block and intermittent systems.

Before proceeding further, some explanation of the operational procedures of the two systems is necessary. The following is a brief description of block and intermittent scheduling:

Intermittent

In university clinics and in public schools the intermittent system has been used most generally. Under this system in the public school the clinician is assigned to a certain number of schools. Normally clients are seen two times a week for twenty to thirty-minute periods. A weekly schedule might be as follows:

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| A. M. | School A | School B | School A | School B | School C |
| P. M. | School C | School C | School A | School B | Office |

Block

The block system schedule is constructed in 3-6 full-week blocks of time. Four days a week the clinician works

in the assigned school(s) and the fifth day in the school(s) in the alternate block working with those clients needing additional help. A schedule consisting of four eight-week blocks might be as follows:

| | | | |
|---|---|---|---|
| Blocks 1, 2 . . . . . | 4 days . . . . . | School | A |
| | 5th day . . . . . | | B 3/4 |
| | | | C 1/4 |
| Blocks 3, 4 . . . . . | 4 days . . . . . | School | B 3/4 |
| | | | C 1/4 |
| | 5th day . . . . . | | A |

There are modifications of the block plan, an example being the rotating schedule. For example: Monday a groups would meet at 9:00, Tuesday at 9:30, Wednesday at 10:00, etc., throughout the day.

Undoubtedly both methods have advantages and disadvantages. Chief disadvantages of the intermittent system have been found to be as follows (Goven, 1960; Miller, 1969):

1. Difficulty in establishing frequent and meaningful contact with the regular classroom teachers.

2. Loss of valuable time in traveling between schools.

3. Difficulty in maintaining continuity between lessons.

4. Loss of effective carry-over because of lack of massed practice.

The block system has been proposed to alleviate some of the problems mentioned above. The following advantages of the block system have been hypothesized:

1. Greater retention or carry-over in therapy.

2. More opportunity for teacher-speech correctionist contacts.

3. More accurate evaluation of speech gains utilizing the non-therapy block as a test of carry-over.

4. Reduction of the speech correctionist's immediate case load.

However, it might be argued that the block system has serious deficiencies in that it does not allot enough time in the non-therapy block to those children who need the extra attention; that there may be a regression in learning during the non-therapy block; or that classroom teachers might object to the amount of time that the children may be out of their classes during the block period.

It is generally accepted that intensive therapy is preferable and produces the fastest rate of progress. However, in the block system are the gains made during the therapy block diminished in the non-therapy block to result in a lack of significant difference over the intermittent system?

## Statement of Purpose and Questions

The purpose of this study was to compare the learning curves for the acquisition of the /s/ phoneme in specified phonetic contexts under the intermittent system of scheduling as compared to the block system.

The primary questions to be answered in this study were as follows:

1. Is there a statistically significant difference between the number of responses to criterion (15 consecutive correct responses) for $Block_1$, $Block_2$, and Intermittent in the following context conditions:

| | |
|---|---|
| /sæ/ | I/A |
| /sɪ/ | I/A |
| /st/ | blend I/A |
| /sp/ | blend I/A |
| /ɪs/ | F/A |
| /ɛs/ | F/A |
| /st/ | blend F/A |
| /ns/ | blend F/A |
| /sə/ | I/UA |
| /sɚ/ | I/UA |
| /ɪs/ | F/UA |
| /əs/ | F/UA |
| /ns/ | blend F/UA |
| /st/ | blend F/UA |

2. If there is a statistically significant difference in 1, which scheduling system produced the lowest number of responses?

3. For those contexts where criterion of fifteen consecutive correct responses was not met, is there a statistically significant difference between the percentage

of reinforced responses in the second half as compared to the first half of the trials? In other words, was there a significant improvement in the second half of the trials?

## Chapter II

## Review of the Literature

### Block and Intermittent Systems of Scheduling

In the area of scheduling there is a relative paucity of research available. Many of the studies done in the public school lack not only adequate design and statistical analysis, but often are not published in speech and hearing journals, and so remain relatively obnubilated.

Results of studies comparing the block and intermittent systems have been inconsistent. In a publication of the Ohio State Department of Education (Maclearie and Gross, 1966) experimental studies in Brecksville (1962-63), Cleveland (1964-65), Crawford County (1964-65), Dayton (1961-64) and East Cleveland (1963-64) showed no significant differences between the two systems although the block system did show greater gains, and subjective evaluations by the participants tended to favor the block system. The Brecksville study used 55 experimental subjects matched with 55 control on the basis of grade level, sex, and type and severity of defect determined by Templin-Darley scores. Carryover was checked the year after the conclusion of the study, but no statistical comparisons were made. The Cleveland study used 70 subjects randomly selected and then

grouped in classes by age and severity of defect. The tests used were the Templin-Darley and a seven-point rating scale based on a subjective evaluation by one therapist. The sample size for each class was small and no indication of the rating scale's reliability was included. The Crawford County study used three groups comparing progress with thirty-minute sessions meeting two, three, and four times per week. No significant differences were found, but the type of statistical comparison was not indicated. Thirty subjects were used with controls only for hearing and I. Q. The Dayton study used no standard test; each clinician used her own methods. There was no indication of any tests for carryover of the speech sound after the non-therapy period. The East Cleveland study matched subjects, 16 in the control group and 15 in the experimental group, according to sex, grade level, I. Q., and hearing acuity. No statistical comparisons of results were made. Subjective evaluations of recorded /s/ productions were made by two doctoral candidates is speech pathology rating each production. The reliability of this method was not reported and may be questionable since agreement on recorded /s/ productions is difficult to obtain. In general, these studies lacked adequate design because of small sample size, absence of randomization for the most part, and lack of adequate controls.

Van Hattum (1957) did a four-year study and found that under the block system dismissals rose from 19 percent to 41 percent. This study used no controls and lacked statistical comparisons. No variables were identified, and the only comparison made was that of dismissal rate.

In 1962, Weaver and Wollersheim did a study of the block vs. the intermittent systems using four severity groupings and found a significant difference for all four groups in the rate of improvement for children in the block system. The Templin-Darley and the Illinois Typological Rating Scale 1-4 were used. No measure of judges' reliability using the scale was included. In this study the only variable manipulated was the variable of scheduling in speech therapy. The greater gain made by the children under the block system may be attributable to additional factors other than merely the difference in scheduling. Such factors might include the subjects' sex, age, I. Q., amount of previous therapy, type and severity of speech defect, motivation, the clinician, and groups vs. individual therapy.

Miller (1969) tested the hypothesis that the block system is more effective than the intermittent system using 86 subjects matched for age, grade, sex, I. Q., number of therapy sessions, previous years of therapy, and type of articulation error. A basic criticism of the design is that so many variables were being controlled that some

subcell comparisons had none or only one subject. Improvement in speech was measured by comparing pre and post evaluations on a seven-point rating scale. Since the hypothesis was that the block system is more effective, Miller's own subjective biases might have corrupted the results. From the results Miller suggested support of the hypothesis that children manifesting articulation problems will show greater improvement if speech therapy is conducted under a block system. No statistical analysis for significance of difference was indicated.

Subjective reactions of teachers, parents, and speech clinicians have tended to favor the block system over the intermittent system. Goven (1960) conducted a questionnaire-survey of parents and teachers to obtain their reactions to the use of the block system. Seventeen replies from teachers and seventeen from the parents were returned. The majority of replies from both groups approved the block system. Goven also compared the effectiveness of the two systems using 122 students classified according to age, grade, and type and severity of defect. The same criticisms which were applied to Miller's 1969 study apply here. In some cases there was only one subject per subcell. No statistical test of significance was made.

It might be of interest to note the results of Mrs. Goven's survey of parents and teachers. Following are the trends in attitudes revealed by the questionnaire:

1. The questionnaire presented to the teachers in the experimental schedule was answered in favor of the block by 2/3 of the teachers.

2. A questionnaire to the parents revealed the majority to favor the block schedule.

3. The interest of the children increased (as indicated by the teachers and parents).

4. There were increased opportunities for teacher-therapist contacts (as indicated in the questionnaire).

5. The automatic period away from therapy seemed valuable in a majority of cases for a trial period for the children.

One of the better studies in which block and intermittent schedules were compared was conducted by Diedrich (1972). Three hundred ninety-eight children exhibiting misarticulations of the /s/ phoneme were distributed in therapy sessions meeting once, twice, and four times per week. There was no indication of the length of the block period. Precise measures of correct and incorrect productions were charted at baseline and again every one to four weeks throughout the school year. The statistical analysis of the results revealed that the number of therapy sessions scheduled per week had no affect on the learning of the /s/. However, only three of 32 chinicians performing the therapy worked under the block system. Whether

this might have influenced the results was not considered.

Phonetic Context

Phonetic context has long been a viable tool in speech therapy. Stetson (1951) propounded the concept of speech as an "organized system of skilled . . . articulatory movements." He noted that synchronous changes occur during speech and suggested that movement complexes are important in our systems of phonetic classification. Shohara (1939) stated that many of the muscle movements involved in the articulation of connected speech must occur simultaneously and pointed out that the same consonant at different times is produced by different muscle movements depending on the phonetic context in which it appears.

Stetson showed that the syllable should be considered the basic phonetic unit. The core of every syllable is a vowel or a vocalic sound, and consonants function only within their syllables. Keenan (1961) presented an argument in favor of abandoning the traditional "initial, medial, final" classification of consonants and replacing it with a classification based on the consonant's relationship to its syllable, initial (I) or final (F); and the syllable's position within the word or phrase, accented (A) or unaccented (UA). Consonants, whether singles or

blends, are either prevocalic (CV), preceding the vowel and initiating the syllable, or postvocalic (VC), following a vowel and arresting the syllable.

Coarticulation phenomena can be divided into two general types (Daniloff and Moll, 1968)--backward coarticulation in which an articulatory characteristic of a phone can be observed in later phones in the string, and forward coarticulation in which an articulatory characteristic of a phone is observed during the production of a preceding phone or phones. Daniloff and Moll's cinefluerographic findings indicated that coarticulation of lip protrusion extends over an many as four sequential consonants preceding the rounded vowel /u/. The presence or absence of syllable or word boundaries within the sequence did not appear to affect the starting point of protrusion.

Prior to 1945 several studies had shown inconsistencies in the misarticulation of a given sound for a specific subject. Wellman, Case, Mengert, and Bradbury (1931) found that with an increase in age, there was an apparent increase in the normal production of the consonants accompanied by an increase in inconsistent misarticulation. Nelson (1951), however, found that older-age subjects showed a relatively greater percentage of consistent misarticulations. He explained this by reason that older children may be more strongly conditioned to faulty sound production

after maturation processes are no longer operating. Saylor (1949) found a slight decrease in the mean number of errors from grade seven to ten. Distortions appeared to be the most common type of error in the older group with substitutions and omissions next. Roe and Milisen (1942), Saylor (1949), and Hale (1945) found that certain blends were produced correctly more often than were single consonants making up the blends.

Nelson (1945), Hale (1948), and Buck (1948) attempted to identify variables operating in the inconsistencies in misarticulations. The following observations were made:

1. For all studies, the blends appeared more amenable than singles to normal articulation. In Nelson's study 38.3 percent of the subjects produced the /s/ correctly at least once in a blend and never in a single, but only 2.3 percent produced the /s/ correctly at least once in a single and never in a blend. Similar results were found in the other studies.

2. In each of the studies more than half of the subjects correctly produced the sound in at least one of the phonetic contexts presented.

Some evidence presented by Hale and Buck indicated that the tongue position required for certain adjacent consonants in /s/ and /r/ blends may facilitate correct production. Hale reported finding that the /s/ phoneme in

the /st/ cluster was produced correctly more often than in the /sk/ cluster.

Hale (1948) also noted in Kindergarten children a relationship between correct /s/ production and prominence of the /s/ in particular blends and positions. In accented syllables fewer omissions occurred, and the frequency of errors was generally lower.

It was hypothesized that a misarticulation of a certain phoneme in a particular context might be related to poor sound discrimination of the sound in that context. However, Anderson (1949) found that Kindergarten subjects made discrimination errors about one-third as frequently as they made articulation errors. A relatively higher correlation of .66 between the number of omission type of /s/ articulation errors and the number of discrimination errors in the contexts in which omissions were present, as compared to the correlation of .48 between the number of substitution type of articulation errors and the number of discrimination errors in contexts where substitutions were found. This suggests a relationship between the type of /s/ articulation error a subject tends to produce and his ability to discriminate between a correct and poor /s/ production.

It should be noted that the research dealing with phonetic context used primarily elementary grade subjects, with the exception of Saylor (1949) and Nelson (1951).

Whereas the most common type of articulation errors in young children are omissions and substitutions; older articulatory defective children, grades seven through twelve, tend to produce distortions more frequently (Saylor, 1949; Nelson, 1951). Perhaps then, certain phonetic contexts may have a differential effect on articulatory distortions.

The frequency of occurrence of phonetic contexts and of entire lexical units has been postulated as a relevant factor in articulatory performance (Leonard and Ritterman, 1971). According to Zipf (1935) there is a tendency in our phonemic system to maintain a condition of equilibrium suggesting the existence of an underlying law of economy of effort. Zipf's law states that the shorter the phonemic or lexical unit, the more frequently it will occur in the language.

It has been observed that a sound may be produced correctly in one word and not in another (Van Riper, 1963; Winitz, 1969). Perhaps then, the phonetic context may include whole words. McDonald (1964) has stated that a sound is not only influenced by the sounds immediately surrounding it, but by sounds surrounding the adjacent sounds as well (Daniloff and Moll, 1968). Siegel, Winitz, and Conky (1963) suggested that the frequency of occurrence of the word itself may significantly affect its articulatory

correctness. Accepting frequency of occurrence as a variable, it may be inferred that 1) more frequently occurring clusters and words are discriminated more often, and 2) more frequently occurring clusters and words are uttered or attempted more frequently (Leonard and Ritterman, 1971). Hale (1945) reported that the /s/ phoneme in the /st/ cluster was articulated correctly more often than in the /sk/ cluster. The /st/ cluster occurs more frequently in the initial position than does the /sk/ cluster (Roberts, 1957). Leonard and Ritterman (1971) found significant differences in the articulatory production of /s/ in low and high frequency CCVC and CVCC words, with each word containing a high or low frequency cluster. Schneider (1973) using the most frequently occurring phonetic contexts and words for /s/, /l/, and /r/ found blends to be more facilitating to correct target phoneme production than singles.

From this evidence then, it may be assumed that more frequently occurring phonetic contexts might be an important variable in articulatory performance.

## Charting and Graphing Learning Curves

Defective articulation results from the disruption of the normal learning process (Milisen, 1954). According to Milisen, normal sound learning involves 1) motor sequencing skill, 2) environmental and self reinforcement,

and 3) the ability to imitate new sounds. Any condition which interferes with these also interferes with the learning process.

A fundamental issue in articulation therapy is discrimination. Discrimination is "the process by means of which an organism responds to differences between stimuli" (Fellows, 1968). This process begins when an organism is exposed to a stimulus and ends when the organism makes a proper discriminating response. The organism has to perceive first the differences present and then respond to them. Perception is "the process by means of which an organism receives and analyzes sensory information" (Fellows, 1968). Reception occurs at different levels--auditory, visual, kinesthetic, etc. Analysis involves attention and organization. Learning may then be described as the changing from one systematic, generalized, purposive way of behaving to another and another until the correct response is made.

To record and make visual to some extent the learning process, various methods have been devised for charting and graphing goal-directed behaviors. Diedrich (1972) developed counting and charting procedures to record rate of progress. Measures of articulatory performance were taken periodically using special Sound Production Tasks and TALK Tasks. Both correct and incorrect productions

were charted over time. Studies by Diedrich and Irwin (1970) and Elbert and Arndt (1967) showed sound production tasks similar to that developed by Diedrich to be both sensitive and reliable.

An even more precise indicator of learning was developed by Griffith and Miner (1973). Under this method a learning curve is plotted for only one task using the number of reinforced responses per trial with ten responses constituting one trial. On the graph time is plotted on the abscissa and the percentage of correct responses on the ordinate.

Both methods of graphing learning, either over time or for a single task, appear to be reliable ways of achieving accountability requirements.

# Chapter III

## Methods and Procedures

With the advent of non-parametric statistics, research using a small number of subjects has been facilitated. The present study was designed on a small (n) basis. The design chosen was justified by the need to identify from many variables the way in which scheduling operates in phoneme acquisition. The number of variables would produce great difficulty in controlling extraneous variables in a large randomized design. Sidman (1960) made the following statement concerning the use of non-parametric statistics:

> If there are major undiscovered sources of variability in a given set of data, any attempt to achieve subject or principle generality is likely to fail. Every time we discover and achieve control over a factor, we increase the likelihood that our data will be reproducible.

### Subjects

The ten subjects used in the study were randomly selected from computer listings of university students who had exhibited /s/ errors during the speech and hearing screening required for all freshmen and transfer students. Criterion for inclusion in the study was /s/ errors exhibited on 80 percent of the stimulus words. Since the acquisition rate of the target phoneme was the only variable being considered, the type and severity of the /s/

error was not important in a non-parametric research design. All ten subjects exhibited /s/ distortions with varying degrees of severity ranging from sibilant distortions to lateral distortions of the /s/.

Scheduling

The ten subjects were divided into three groups, two experimental groups (block) and one control group (intermittent). The block and intermittent systems were set up as follows:

| | | |
|---|---|---|
| Intermittent (group of 4) | 8 weeks | meeting twice/week for 20 minutes |
| $Block_1$ (group of 3) | 4 weeks | meeting four days/week for 20 minutes |
| $Block_2$ (group of 3) | 2 weeks | 2 weeks meeting four days/week for 20 minutes |

All group meetings were equal in number and length of the sessions, a total of sixteen twenty-minute sessions.

Item selection

Selection of the stimulus items was based on the frequency of occurrence of phonetic contexts and the 10,000 most frequently occurring words (Thorndike-Lorge, 1944). Keenan (1961) proposed a classification system based on the consonant's relationship to its syllable, initial (I) or final (F), and the syllable's position within the word or phrase, accented (A) or unaccented (UA). On the basis

of Keenan's classification system and the research indicating the importance of coarticulation (McDonald, 1964; Scott and Milisen, 1954; Powell and McReynolds, 1969; and Daniloff and Moll, 1968) the most frequently occurring phonetic contexts were selected as the stimulus items (Thorndike-Lorge, 1944). Assuming the more frequently occurring contexts to be more facilitating to correct production, the order of presentation was from most frequently occurring to least frequently occurring phonetic context as follows:

| Phonetic Context | | Word | Context Frequency |
|---|---|---|---|
| /sɛ/ | I/A | cent<br>center | 89 |
| /sI/ | I/A | sick<br>sing | |
| /st/ | I/A | stick<br>stop | 51 |
| /sp/ | I/A | space<br>speech | |
| /Is/ | F/A | kiss<br>miss | 47 |
| /ɛs/ | F/A | yes<br>question | |
| /st/ | F/A | best<br>east | 41 |
| /ns/ | F/A | dance<br>once | |
| /sə/ | I/UA | person<br>support | 13 |
| /sɚ/ | I/UA | answer<br>excercise | |
| /Is/ | F/UA | office<br>practice | 12 |
| /əs/ | F/UA | various<br>purpose | |
| /ns/ | F/UA | silence<br>distance | 6 |
| /st/ | F/UA | forest<br>interest | |

Context frequency refers to the frequency with which the context occurs in the 1002 most frequently occurring words at Grade Levels One and Two (Griffith and Miner, 1973). For example, there are 161 words in which /s/ is combined with a vowel. Contexts in which a vowel follows the /s/ in an accented syllable occur in 89 out of 161 words.

## Equipment and Procedures

The equipment used in the study was the Bell and Howell Language Master System including the Language Master 717 with the repeat control and the Reinforcer/Counter unit for groups. The Reinforcer/Counter unit included an over-ride switch for the clinician making it possible for the group members' light to be illuminated only if the clinician's light is activated.

Instructions to the subjects were as follows:
(To the responder) "You will be allowed to listen to the stimulus word as many times as you want. When you are ready to respond, attempting to match your production to that of the stimulus, depress the light button in front of you. If, at any time during your responding, you want to hear the stimulus word repeated depress the light button."
(To the members of the group) "You will evaluate the correctness of the response along with the clinician. If you think the response matches the stimulus closely enough

depress the light button in front of you. When your evaluation of a correct response matching the stimulus agrees with the clinician's the light in front of you will be activated.

Shaping procedures were used reinforcing successive approximations. The twenty-eight stimulus items were used as drill material. Each subject in turn was allowed to listen to the stimulus word as many times as he chose and then respond. Criterion for cut-off of responding on one stimulus word was fifteen consecutive correct responses or five minutes. After criterion was reached, the subject proceeded to the next stimulus word, or after five minutes had past the next subject listened to the stimulus and responded. In order to prevent the third and fourth subjects responding during a given session from hearing the stimulus presentations an inordinate number of times while the first two subjects were responding (which might influence the acquisition curves of subjects 3 and 4) the order in which the subjects listened to the stimulus presentations was randomized over the sixteen sessions. The order of word presentation proceeded from those with the most frequently occurring phonetic contexts within the selected contexts to the least frequently occurring

In order to establish examiner reliability a percentage of agreement among six listeners was determined from taped samples of the therapy sessions. The inter-examiner

percentage of agreement was 89% and the intra-examiner percentage of agreement proved to be 93%.

Analysis of Results

The basis of comparison for the statistical analysis was the total number of responses to criterion. The measure was chosen over the number of reinforced responses per trial because the latter may be an indicator of variations in performance and not necessarily improvement. For the purposes of this study a reinforced response was a successive approximation of a correct response toward criterion. The measure is, therefore, an indicator of both variability and improvement. The total number of responses to criterion was computed for each person under each context. The Kruskal-Wallis two way analysis of variance for non-parametric data (Siegel, 1956) was applied to determine if there was any significance of difference. For those contexts in which subjects failed to reach criterion, the Lawshe-Baker Nomograph (Siegel, 1956) for testing the difference between percentages was applied to the percentage of reinforced responses in the first half and second half of the trials for a given context. The rank-ordering of phonetic contexts by correct production was also determined.

# Chapter IV

## Results and Discussion

The total number of responses to criterion for each phonetic context was recorded for every subject in the three groups. In order to answer the questions posed in Chapter I, statistical analyses were made. Comparisons of total number of responses were made among the three groups for each context. For those subjects who did not reach the criterion of fifteen consecutive correct responses, the percentage of reinforced responses in the first half of the response period was compared to the percentage of the second half to determine whether learning occurred. Rank ordering of phonetic context was determined for each group.

### Effect of Scheduling

The results are reported in TABLE 1 for all subjects in the three groups under each phonetic context for /s/. For the purpose of comparing the groups on the basis of learning, only the total responses for those subjects who reached the criterion of fifteen consecutive correct responses were used. See Appendix I, pages 50 and 51, for the distribution of the data. The Kruskal-Wallis two-way analysis for non-parametric data was applied to the totals for each phonetic context.

TABLE 1

INDIVIDUAL NUMBER OF RESPONSES TO CRITERION OF FIFTEEN CONSECUTIVE CORRECT RESPONSES

| Scheduling System | Phonetic Context | | | | |
|---|---|---|---|---|---|
| | /sɛ/ I/A | /sI/ I/A | /st/ I/A | /sp/ I/A | /Is/ F/A |
| $Block_1$ | -- | 36 | 187 | -- | 69 |
| | 220 | 86 | 100 | 132 | -- |
| | -- | 148 | -- | 44 | 62 |
| | -- | 93 | 119 | 186 | 55 |
| $Block_2$ | 83 | 68 | 165 | 168 | 49 |
| | -- | 65 | 148 | 90 | 124 |
| | 178 | 96 | 83 | 142 | 33 |
| Intermittent | 133 | 102 | 186 | 122 | 92 |
| | 248 | 69 | 87 | -- | 41 |
| | -- | -- | -- | 93 | -- |
| | $p>.05$ | $p>.05$ | $p>.05$ | $p>.05$ | $p>.05$ |

| | /ɛs/ F/A | /st/ F/A | /ns/ F/A | /sə/ I/UA | /sɝ/ I/UA |
|---|---|---|---|---|---|
| $Block_1$ | 246 | 95 | -- | 163 | 49 |
| | 76 | 108 | 83 | 113 | 34 |
| | -- | -- | -- | -- | -- |
| | 41 | 104 | 47 | 71 | 36 |
| $Block_2$ | 67 | 82 | 33 | 53 | 85 |
| | 78 | 50 | 78 | 49 | 36 |
| | 68 | 43 | 53 | 50 | 49 |
| Intermittent | 46 | 122 | 217 | 91 | 76 |
| | 76 | 50 | 49 | 57 | 105 |
| | -- | 122 | -- | | |
| | $p>.05$ | $p>.05$ | $p>.05$ | $p>.05$ | $p>.05$ |

TABLE 1--Continued

| Scheduling System | Phonetic Context | | | |
|---|---|---|---|---|
| | /Is/ F/UA | /əs/ F/UA | /ns/ F/UA | /st/ F/UA |
| $Block_1$ | 78 | 50 | 89 | |
| | 130 | 55 | 47 | 86 |
| | 62 | 38 | 104 | 31 |
| $Block_2$ | 33 | 34 | 68 | 63 |
| | 46 | 40 | 43 | 36 |
| | 66 | 34 | 30 | 30 |
| Intermittent | 42 | 54 | 251 | 57 |
| | 108 | 83 | 75 | 104 |
| | $p>.05$ | $p>.05$ | $p>.05$ | $p>.05$ |

As indicated by TABLE 1, there were no significant differences among the two experimental groups and the control group for any phonetic context. Under the conditions set up in the current study, this would indicate that scheduling was not a relevant variable. These results would support the research of Diedrich (1972) who found that the /s/ phoneme was not significantly affected by scheduling using the block and intermittent systems.

From the number of times that subjects were successful in reaching criterion, it can be seen that the block-system groups were slightly better than the intermittent groups in the proportion of contexts in which subjects reached criterion. More specifically, the $Block_1$ group reached criterion 76 percent of the total number of res-

ponses and $Block_2$ 97 percent, while the Intermittent group reached criterion 72 percent of the total. The much higher percentage value for $Block_2$ was most likely due to chance differences among individuals. The individuals in this group exhibited milder /s/ distortions in the experimenter's judgment, and , as a whole, seemed to orient themselves to the relevant aspects of their speech behavior more rapidly than did the members of the two other groups.

For those subjects who did not reach the criterion of fifteen consecutive correct responses, the Lawshe-Baker Nomograph (Siegel, 1956) for testing significant differences between percentages was applied to the percentage of reinforced responses for the first half of the responses as compared to the second.

TABLE 2 lists the first half-second half percentages for each instance where criterion was not reached. In no case was there a significant difference between the percentages. This indicates that during the alloted five-minute response time, learning did not manifest itself for these particular stimulus items. However, in most cases the percentages of reinforced responses were greater for the second half as compared to the first half of the trials. These subjects were reinforced more often during the second half of the trials indicating that some improvement did occur in these instances.

TABLE 2

COMPARISON OF FIRST HALF-SECOND HALF PERCENTAGES
OF REINFORCED RESPONSES

| Scheduling System | Phonetic Context | | | | | | |
|---|---|---|---|---|---|---|---|
| | /sɛ/ I/A | /sI/ I/A | /st/ I/A | /sp/ I/A | /Is/ F/A | /ɛs/ F/A | /ns/ F/A |
| $Block_1$ | 63.3-70.0<br>50.0-66.3 | | 53.3-61.7 | 78.3-70.0<br>62.9-55.7<br>70.0-63.3 | 60.0-75.5<br>51.7-63.3 | | |
| $Block_2$ | 52.5-42.5 | | | | | | |
| Intermittent | 51.4-68.6 | 45.0-45.0 | 67.5-73.8 | 72.9-77.1 | 60.0-50.0<br>50.0-60.0 | 48.6-60.0<br>40.0-34.3 | 40.0-44.0<br>44.3-58.6 |

*no percentage value significant at the .05 level of confidence

Several factors may have caused the response variability--the relatively short response time period, inattention, or fatigue.

The severity of articulation defects has usually been determined by psychological scaling methods. Those studies discussed in Chapter II which attempted to control for severity used scaling techniques (Weaver and Wollersheim, 1963; Miller, 1970). Degree of severity is difficult to determine. The wide variance and disagreement in the reported incidences of speech defects in high school and college populations is likely due to inability to quantify severity, or in other words, "what constitutes a defect."

Charting and graphing of learning curves may well be a way to quantify severity to an extent. With reference to TABLE 1 those subjects who consistently failed to reach criterion were judged by the therapist as exhibiting more severe /s/ distortions. It is suggested, then, that both the percentage of reinforced responses and the number of trials to criterion may be a concrete, objective means of quantifying severity.

Learning Effect

Graphs I, II, and III depict the behavior curves for the /s/ phoneme for the individual groups. Graph IV depicts all three performance curves for a comparison of the three groups.

Figure 1--Performance curve for Block$_1$

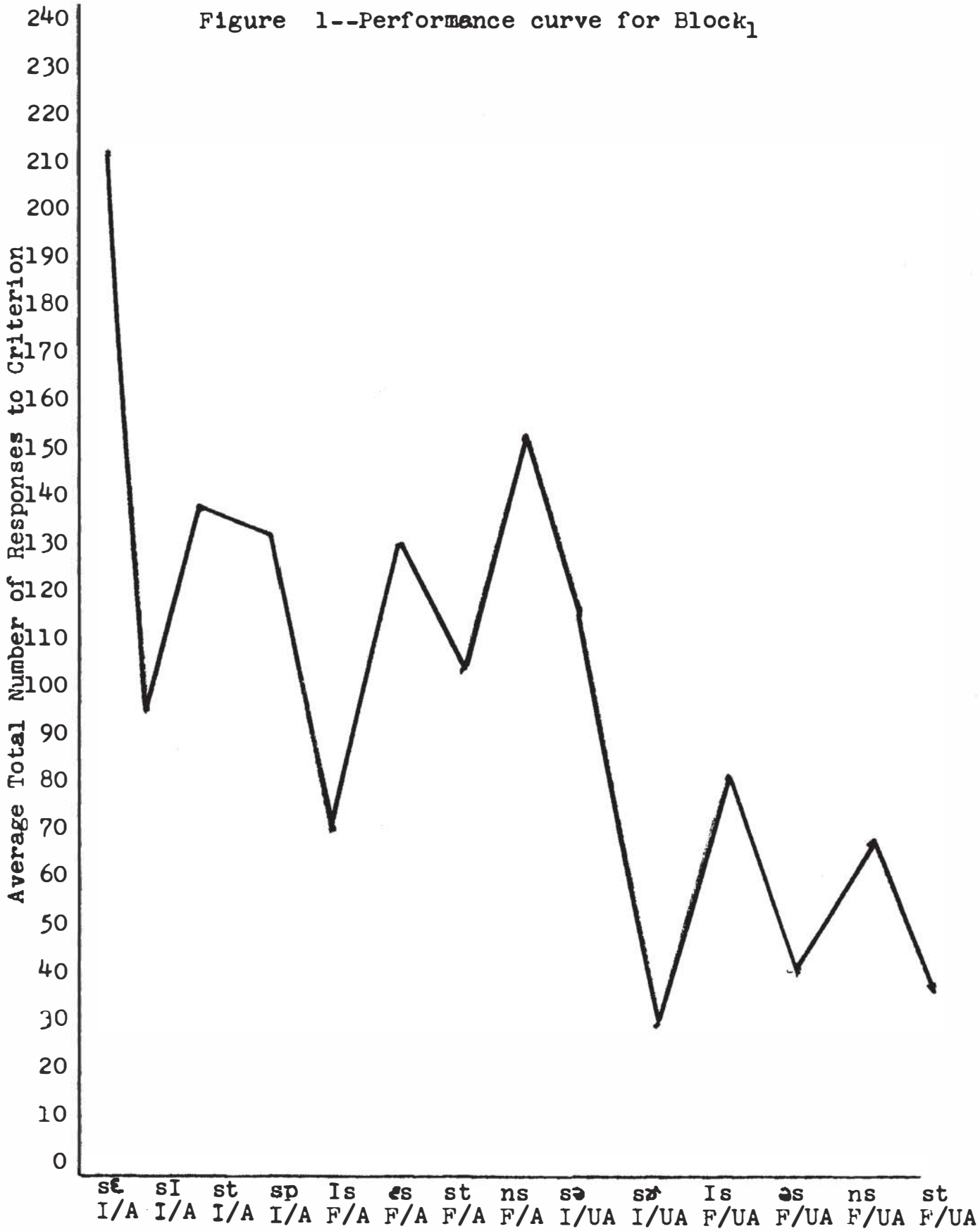


Figure 2--Performance curve for $Block_2$

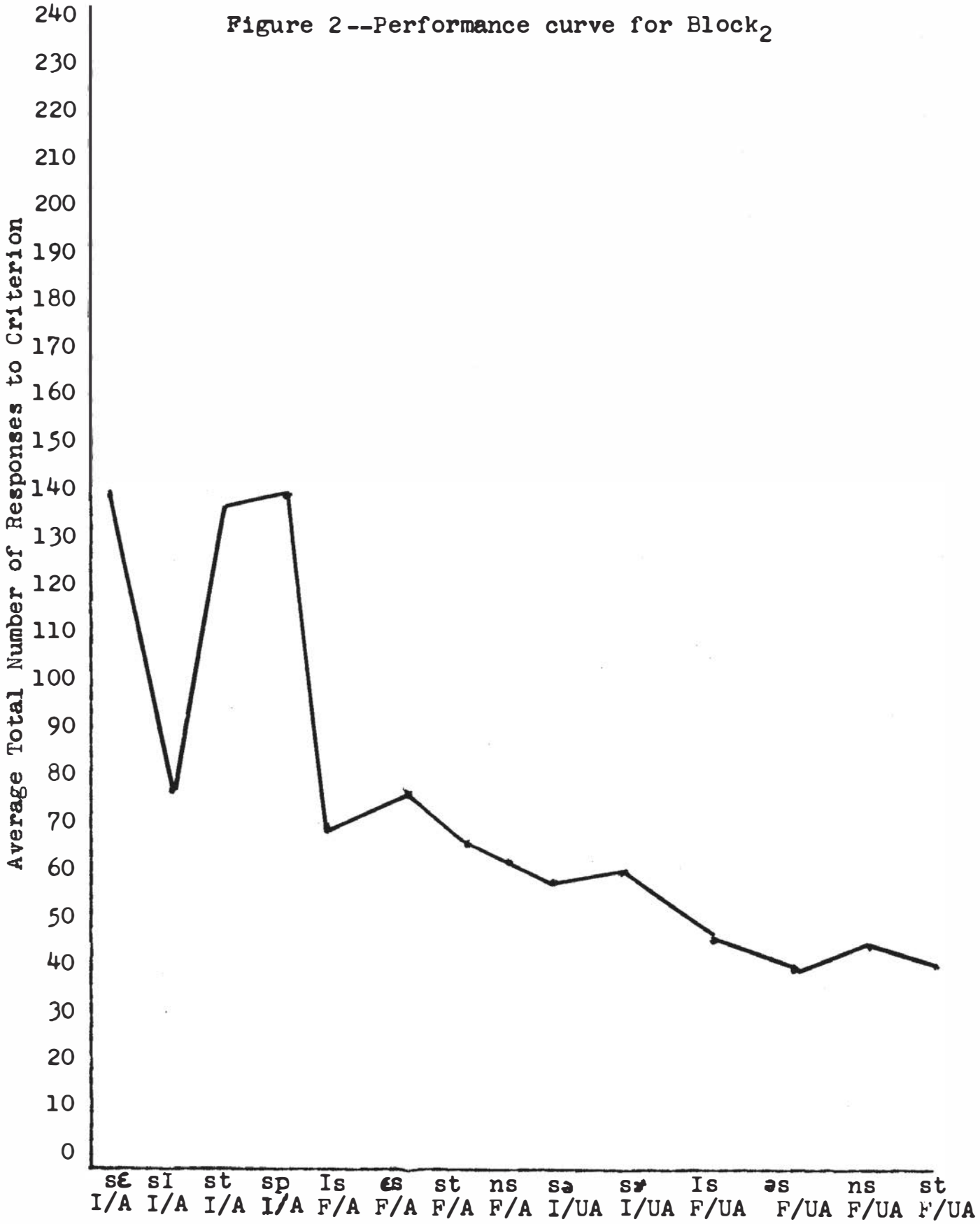


Figure 3--Performance curve for Intermittent

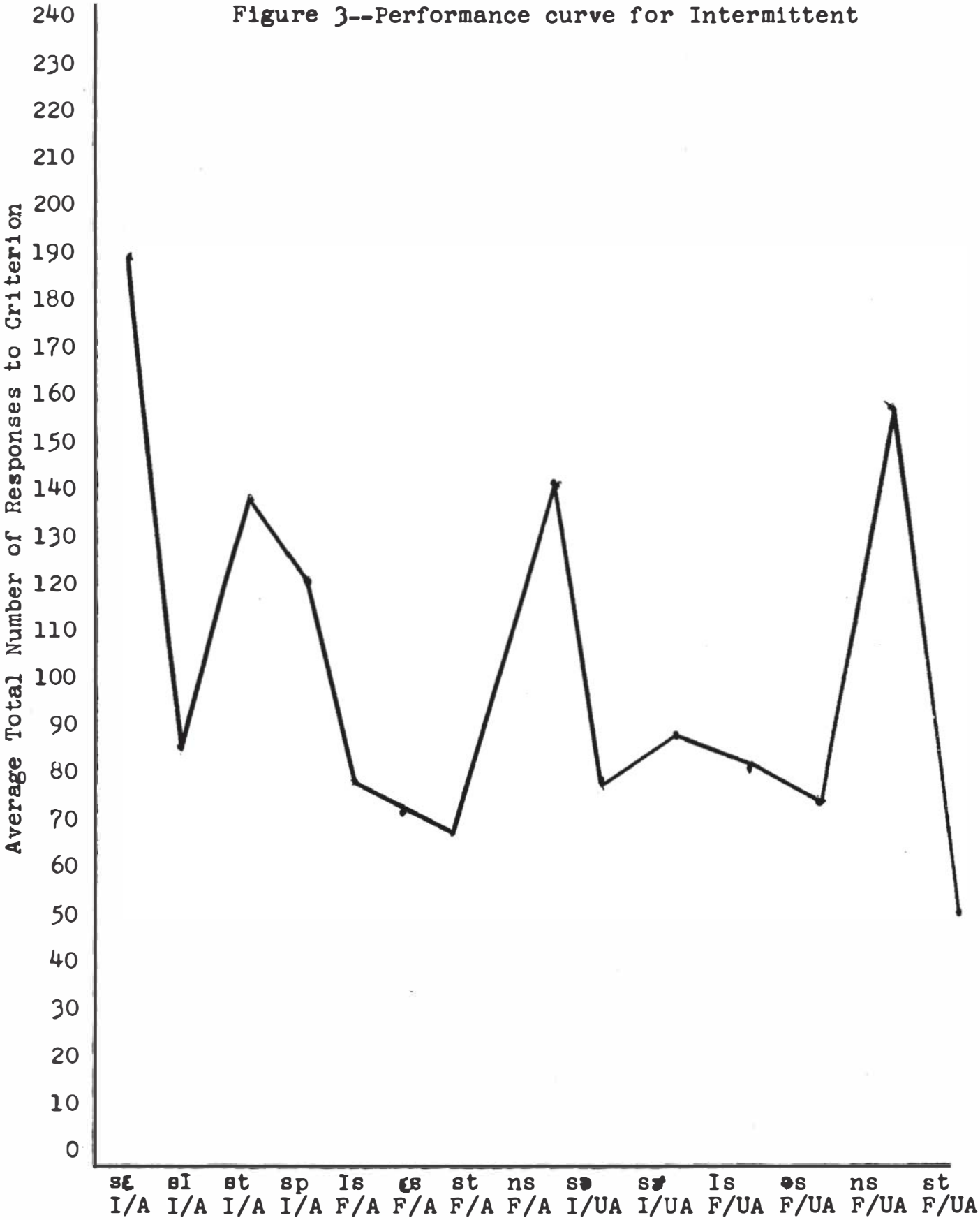
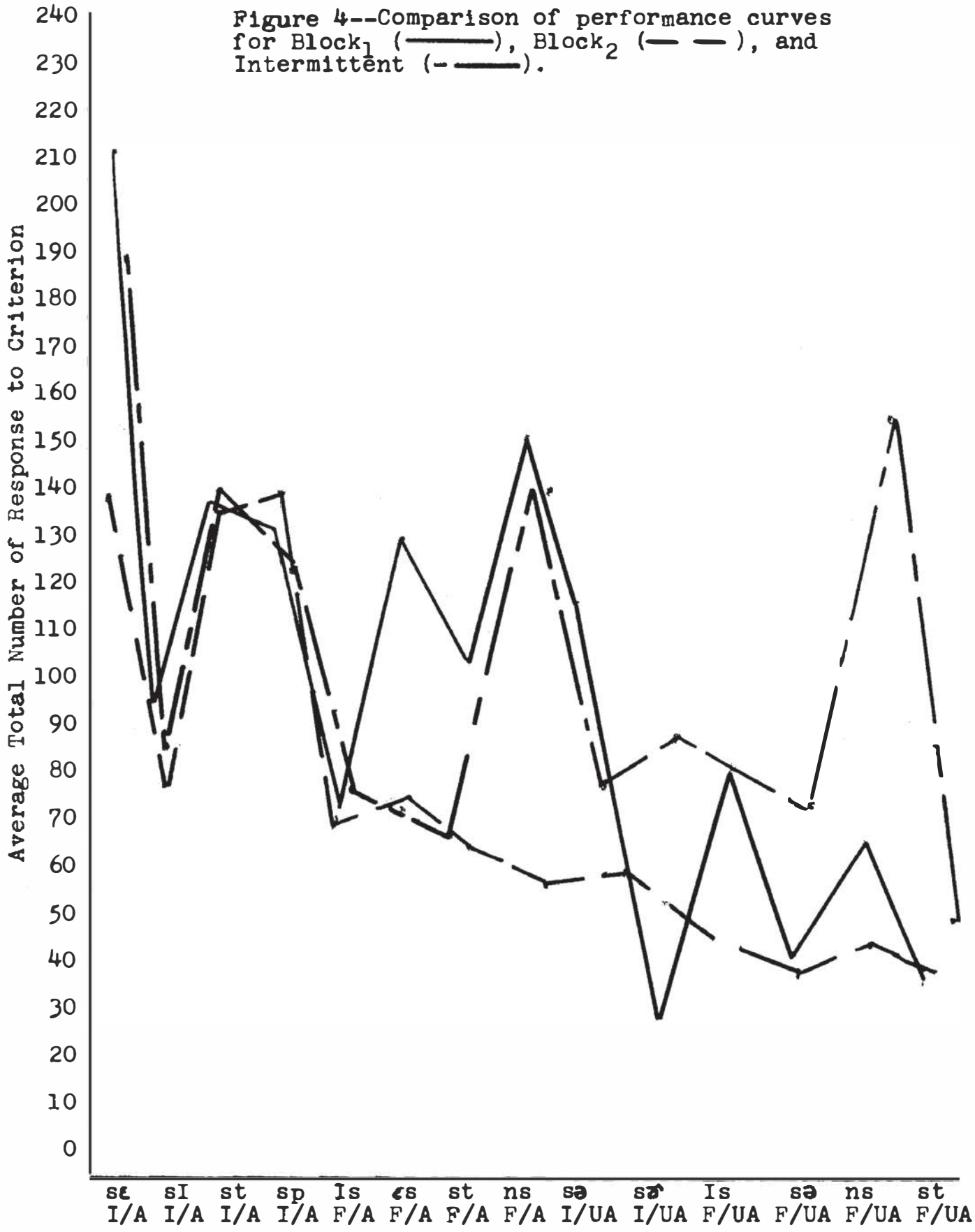


Figure 4--Comparison of performance curves for $Block_1$ (———), $Block_2$ (— —), and Intermittent (- ———).



It is generally apparent from the first three graphs that there was a learning effect as judged by the downward slope of the curves. In all cases the phonetic context /sɛ/ required the greatest number of trials to reach criterion. For all groups the /sɛ/ context was presented first. In most learning situations involving tasks of proportionate difficulty, the initial task is usually the most difficult and requires more trials to achieve criterion than do succeeding tasks. The performance curve for $Block_2$ tends to be more stable and progressively declining in the number of trials necessary to attain the established criterion. This is probably a reflection of the group's general ability to orient themselves to relevant parameters of behavior as was mentioned previously in this chapter. The other two groups show generally more variability in response frequency, however, with a similar downward trend.

In accordance with the generally progressive decline in the number of responses to criterion, the easier phonetic contexts are found toward the end of the phonetic context progression, from most frequently occurring to least frequently occurring, for all three groups. An order effect may be operating. It may be inferred that there is some transfer of learning from one phonetic context to another. However, the variability in the response frequency lends

additional support to the considerable amount of evidence on the influence of phonetic context.

With reference to Graph IV, it can be seen that the acquisition curves for the most part resemble each other. The first five points on the curve approximate each other. This approximation of the first five values may reflect similar baseline behaviors for the three groups. From the sixth point on, $Block_1$ and Intermittent follow parallel curves while $Block_2$ continues on a more steady decline. It is hypothesized that this digression in the curves may be due to a difference in severity of defect.

Rank Ordering of Phonetic Context

The Kendall Coefficient of Concordence: W (Siegel, 1956) was applied to determine the rank order correlation of the phonetic contexts. The resulting value .58 proved to be significant at the .05 level of confidence ($p<.05$). In TABLE 3 are listed the over-all rank ordering of the phonetic contexts progressing from easiest to most difficult.

One of the most important considerations evident in the rank ordering is the relatively greater difficulty of the /s/ blends as compared to the singles. This is in contradiction to the findings of Roe and Milisen (1942), Nelson (1945), Hale (1948), Buck (1948), and Saylor (1949).

TABLE 3

RANK ORDERING OF PHONETIC CONTEXTS

| Phonetic Context | Type | Average Number of Responses to Criterion |
|---|---|---|
| əs | F/UA | 48.50 |
| st | F/UA | 58.14 |
| sɚ | I/UA | 58.75 |
| Is | F/A | 65.63 |
| sI | I/A | 68.33 |
| Is | F/UA | 70.63 |
| ns | F/A | 80.00 |
| sə | I/UA | 80.88 |
| st | F/A | 86.22 |
| ɛs | F/A | 87.25 |
| ns | F/UA | 88.38 |
| sp | I/A | 122.13 |
| st | I/A | 134.38 |
| sɛ | I/A | 172.40 |

Because of the relative consistency among individuals in this investigation with regard to the greater difficulty of the /st/ and /sp/ blends, it is hypothesized that type and severity of misarticulation of the /s/ may have a differential effect with regard to phonetic context. It was reported by Saylor (1949) that older subjects exhibited articulatory distortions more frequently than either omissions or substitutions. The subjects of the present study exhibited /s/ distortions primarily of the sibilant or "whistled" type with a range of severity.

The /s/ phoneme is a voiceless, alveolar fricative. Commonly it is produced with the tip of the tongue raised and placed in contact with the upper teeth and gums at

the sides and against the alveolar ridge in the front except for a narrow central opening through which the breath stream is directed in a continuous stream. Normally it would be thought that the stop plosives /t/ and /p/ might tend to reduce sibilancy since sibilancy is a function of air flow. However, for those contexts used in this study the stop feature did not appear to reduce the sibilancy of the /s/ in the judgment of the examiner. In the case of the contexts used in the present study, the blends involving the /t/, /n/, and /p/ may have tended to increase the sibilant characteristics of the /s/ since the /t/, /n/, and /p/ are frontal consonants, the former two being linguaalveolar and the latter bilabial. The blend /st/ F/UA appears in the rank order position of second. This may, however, reflect the learning effect since this blend was the last context presented.

From the way the contexts rank order themselves, it appears that the contexts involving the lower back vowels facilitate correct production in the case of a sibilant /s/ distortion. In the instances where the relatively low vowel /ɛ/ in combination with /s/ ranks lower than the higher front vowel /I/, the /s/ may have been influenced by other phonemes in the phonetic context of the words. Whereas the stimulus items for /Is/ F/A (miss, kiss), /sI/ I/A (sick, sing), and /Is/ F/UA (office, various) involved

primarily velar or palatal consonants, the /ɛs/ F/A (yes, question) and the /sɛ/ I/A (cent, center) involved post-dental consonants and an anterior palatal consonant /j/.

The /sə/ I/UA appears in a rank ordering slightly lower than might be expected observing the general trends in which the middle vowel contexts required fewer responses to criterion. However, if the entire contexts of the words (person, support) are examined, it may be observed that in both cases most of the consonants are frontal sounds which may facilitate sibilancy. Then, as McDonald (1964) and Daniloff and Moll (1968) found, phoneme production may also be influenced by sounds surrounding immediately adjacent sounds.

In summary it was found that there were no significant differences among the experimental and control groups for any phonetic context. For these subjects scheduling did not appear to be an important variable. For those subjects who did not reach the criterion of fifteen correct responses, no significant learning occurred for the particular contexts on which they failed to reach criterion. The rank ordering of the phonetic contexts indicated that the type and severity of misarticulations may have a differential effect with regard to phonetic context.

# Chapter V

## Summary and Conclusions

The purpose of the present investigation was to compare two types of scheduling systems currently in use and determine if there was any significant difference between the effectiveness of the systems on the basis of learning. Under investigation were the block system and the intermittent system. The block system involved intensive therapy cycled in four to six week "blocks." This way a client would alternately receive intensive therapy for a block of time and be out of therapy for an equal amount of time. In the present study $Block_1$ consisted of therapy for four days per week for four weeks; $Block_2$ consisted of therapy for four days per week for two two-week blocks. The intermittent system involved two therapy sessions per week for eight weeks.

The current study was designed to compare the learning curves for the acquisition of the /s/ phoneme in specified phonetic contexts under the intermittent system as compared to the block system. The primary questions to be answered were as follows:

1. Was there a statistically significant difference between the number of responses to criterion for $Block_1$, $Block_2$, and Intermittent under the specified contexts?

2. If a statistically significant difference was found, which scheduling system produced the lowest number of responses?

3. For those contexts where criterion of fifteen consecutve correct responses was not met, was there a statistically significant difference between the percentage of reinforced responses in the second half as compared to the first half of the trials?

4. How did the phonetic contexts rank order themselves in terms of ease of production and was there a significant correlation among the rank orderings for the three groups?

The total number of responses to criterion for each phonetic context was recorded for every subject in the three groups. In order to answer the above questions statistical analyses were made. Comparisons of total number of responses were made among the three groups for each context. For those subjects who did not reach criterion of fifteen consecutive correct responses, the percentage of reinforced responses in the first half of the response period was compared to the percentage of the second half to determine if learning occurred. Rank ordering of phonetic context was determined for each group.

Conclusions

1. There were no significant differences among the two experimental groups and the control group for any phonetic context. The Kruskal-Wallis two-way analysis of variance was applied to the totals for each phonetic context. Under the conditions of conducting /s/ therapy using college-age subjects, scheduling as varied in this study is not a relevant variable in learning.

2. For those subjects who did not reach the criterion of fifteen consecutve correct responses, no significant learning occurred for the particular contexts during the five-minute response period. The Lawshe-Baker Nomograph for testing the significant difference between percentages was applied to the data. In no instance was there a significant difference between the percentages. This may be attributed to various factors, among them the relatively short response time period, an attention factor, or fatigue.

3. It was suggested by the nature of the data that severity of articulation defects, usually determined by psychological scaling, might to some extent be quantified by charting and graphing learning curves.

4. There was a significant rank ordering of the phonetic contexts according to ease of production. The Kendall Coefficient of Concordence: W was applied to

determine the rank order correlation. The resulting value .58 proved to be significant at the .05 level of confidence ($p < .05$). The rank order of phonetic context is listed in TABLE 3, page 42.

5. The findings of this study indicated that the type and severity of misarticulation of the /s/ may have a differential effect with regard to phonetic context. The subjects of the present study exhibited /s/ distortions primarily of the sibilant type with a range of severity. Contrary to most of the research findings that indicate that blends are more often correct than singles, the findings of this study showed that for sibilant /s/ distortions the /st/, /ns/, and /sp/ blends were more difficult than consonant-vowel combinations. In examining distinctive features in articulatory production and the influence of phonetic context, it can be seen that frontal sounds adjacent to the /s/ may tend, in some cases, to increase sibilancy.

It is necessary to treat the findings of this study with some caution. For the context items and the subjects of this particular study scheduling was not a relevant variable. However, the findings cannot be generalized to other target phonemes, phonetic contexts, or subjects. With the limitations of such a non-parametric design considered, the study was useful in indicating

that scheduling was not an important factor in learning for the particular contexts and subjects involved.

## Implications for Further Research

Some questions that may be of interest for further research are as follows:

1. How does scheduling affect the acquisition of other phonemes--/r/, /l/, etc.?

2. How might an indicator of severity be developed using charting and graphing procedures?

3. How does type and severity of defect affect the rank ordering of phonetic contexts in terms of ease of production?

# APPENDIX I

TABLE 4

TOTAL NUMBER OF RESPONSES TO CRITERION

| Schedule | Phonetic Context | | | | | | |
|---|---|---|---|---|---|---|---|
| $Block_1$ N | sɛ I/A | sI I/A | st I/A | sp I/A | Is F/A | ɛs F/A | st F/A |
| 1 | *136 | 36 | 187 | *120 | 69 | 246 | 95 |
| | 74 | | | *140 | | | |
| 2 | 220 | 86 | 100 | 132 | *140 | 76 | 108 |
| | | | | | *130 | | |
| 3 | *135 | 148 | 66 | 44 | 62 | 55 | 31 |
| | *130 | | *120 | | | *100 | *110 |
| 4 | *150 | 93 | 119 | 186 | 55 | 41 | 104 |
| | *77 | | | | | | |
| $Block_2$ N | | | | | | | |
| 1 | 83 | 68 | 165 | 168 | 49 | 67 | 82 |
| 2 | *83 | 65 | 148 | 90 | 124 | 78 | 50 |
| | 68 | | | | | | |
| 3 | 178 | 96 | 83 | 142 | 33 | 68 | 43 |
| Intermittent N | | | | | | | |
| 1 | 132 | 102 | 186 | 122 | 92 | 46 | 122 |
| 2 | 248 | 69 | 87 | *150 | 41 | 76 | 50 |
| | | | | 59 | | | |
| 3 | *150 | *120 | 101 | 93 | *140 | *150 | 122 |
| | *139 | *160 | *160 | | *126 | *150 | |

*five minute criterion

TABLE 4--Continued

| Block$_1$ N | ns F/A | sə I/UA | sɚ I/UA | Is F/UA | əs F/UA | ns F/UA | st F/UA |
|---|---|---|---|---|---|---|---|
| 1 | *150 *160 | 163 | 49 | 78 | 50 | 89 | |
| 2 | 113 | 34 | 130 | 55 | 47 | 86 | |
| 3 | | | | | | | |
| 4 | 47 | 71 | 36 | 62 | 38 | 104 | 31 |
| **Block$_2$ N** | | | | | | | |
| 1 | 33 | 53 | 85 | 33 | 34 | 68 | 63 |
| 2 | 78 | 49 | 36 | 46 | 40 | 43 | 36 |
| 3 | 53 | 50 | 49 | 66 | 34 | 30 | 30 |
| **Intermittent N** | | | | | | | |
| 1 | 217 | 91 | 76 | 42 | 54 | 251 | 57 |
| 2 | 49 | 57 | 105 | 108 | 83 | 75 | 104 |
| 3 | *101 *150 | | | | | | |

*five minute criterion

# APPENDIX II

Record Sheet

Name:
Date:

Scheduling system:
Context and word:

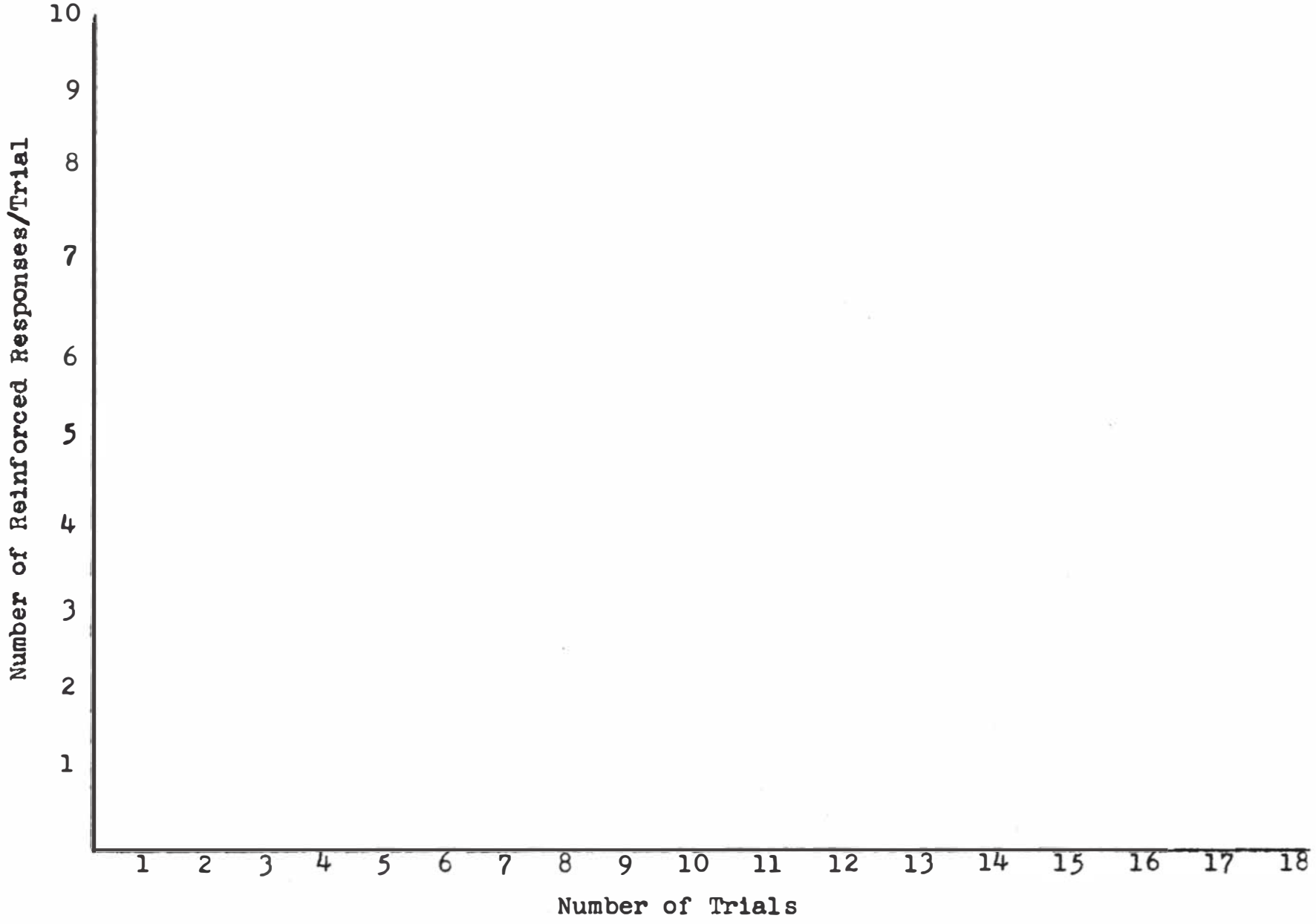
Trials

Responses

| Trials | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |
| 11 | | | | | | | | | | | |
| 12 | | | | | | | | | | | |
| 13 | | | | | | | | | | | |
| 14 | | | | | | | | | | | |
| 15 | | | | | | | | | | | |

Progress Chart

Name_____ Date_____ Context_____ Word_____



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