This dissertation has been microfilmed exactly as received 66-15,152

WERNER, Marlin Spike, 1927-
ALTERATIONS IN THE DURATION, PITCH, AND INTENSITY OF SPOKEN PASSAGES THROUGH SUCCESSIVELY HEARING AND REPEATING THEM.

The Ohio State University, Ph.D., 1966
Speech Pathology

University Microfilms, Inc., Ann Arbor, Michigan
ALTERATIONS IN THE DURATION, PITCH, AND INTENSITY OF SPOKEN PASSAGES THROUGH SUCCESSIVELY HEARING AND REPEATING THEM

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Marlin Spike Werner, B.A., Sc.M.

* * * * * * *

The Ohio State University
1966

Approved by

[Signature]
Adviser
Department of Speech
PLEASE NOTE:
Not original copy. Several pages in the Appendix have light and indistinct print. Filmed as received.

University Microfilms, Inc.
VITA

August 15, 1927  Born--Portland, Maine

1950  A.B. Sociology and Social Work, University of Missouri, Columbia, Missouri

1950-1951  Director of Sebago Club, Day Camp in Saint Louis, Missouri

1951-1954  Weights Engineer, Glenn L. Martin Aircraft Co., Middle River, Maryland

1957  Sc.M., Audiology and Speech, School of Hygiene and Public Health of Johns Hopkins University

1958-1960  Audiologist, Chattanooga-Hamilton County Speech and Hearing Center; and Instructor in Audiology and Speech, University of Chattanooga, Chattanooga, Tennessee

1960-1964  Director, Speech and Hearing Center, Asheville Orthopedic Hospital, Asheville, North Carolina; Consultant in Speech Pathology, Veteran's Administration Hospital, Oteen, North Carolina

1960-1965  Abstracter, Deafness, Speech, and Hearing Abstracts--Spanish

1964-1966  Communications Scholar, Ohio State University, Columbus, Ohio

1966-  Associate Professor of Speech and Director of the Speech and Hearing Center, Western Carolina College, Cullowhee, North Carolina
# CONTENTS

<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>VITA</td>
<td>ii</td>
</tr>
<tr>
<td>TABLES</td>
<td>v</td>
</tr>
<tr>
<td>ILLUSTRATIONS</td>
<td>vii</td>
</tr>
</tbody>
</table>

## CHAPTER

### I. INTRODUCTION

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Origin of Language</td>
<td>1</td>
</tr>
<tr>
<td>The Problem</td>
<td>4</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>4</td>
</tr>
<tr>
<td>Organization of the Dissertation</td>
<td>5</td>
</tr>
</tbody>
</table>

### II. REVIEW OF THE LITERATURE

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of Speech Output</td>
<td>7</td>
</tr>
<tr>
<td>Psychophysical Method</td>
<td>9</td>
</tr>
<tr>
<td>Oral Repetition of Heard Phrases</td>
<td>10</td>
</tr>
<tr>
<td>Physical Analysis of Speech</td>
<td>12</td>
</tr>
<tr>
<td>Summary</td>
<td>14</td>
</tr>
</tbody>
</table>

### III. EXPERIMENTAL PROCEDURE

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Design</td>
<td>16</td>
</tr>
<tr>
<td>Recording Schedule</td>
<td>17</td>
</tr>
<tr>
<td>Instructions to Subjects</td>
<td>19</td>
</tr>
<tr>
<td>Equipment</td>
<td>20</td>
</tr>
<tr>
<td>Procedures</td>
<td>25</td>
</tr>
<tr>
<td>Statistical Treatment</td>
<td>29</td>
</tr>
<tr>
<td>Summary</td>
<td>29</td>
</tr>
</tbody>
</table>

### IV. EXPERIMENTAL RESULTS

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Hypotheses</td>
<td>31</td>
</tr>
<tr>
<td>Duration of Speech Output</td>
<td>32</td>
</tr>
<tr>
<td>Duration of Voicing</td>
<td>33</td>
</tr>
<tr>
<td>Range of Vocal Pitch</td>
<td>39</td>
</tr>
<tr>
<td>Mean Intensity</td>
<td>47</td>
</tr>
<tr>
<td>Summary of Profiles of Intensity</td>
<td>51</td>
</tr>
<tr>
<td>Summary</td>
<td>51</td>
</tr>
</tbody>
</table>
# CHAPTER

V. SUMMARY AND CONCLUSIONS ............................. 53

The Experiment ............................................ 53
The Measurements ........................................... 53
Other Sources of Variation ................................. 54
Limitations of the Study .................................... 56
Future Studies ................................................ 60
Summary ......................................................... 62

## APPENDIX

A. Work sheets carrying the record of changes which resulted in the elimination of passages from the study ............... 63

B. Analyses of variance and derivative tables and figures for sound-pressure level measurements I, II, III, and IV for the experimental passages ................................. 84

C. Table and figures representing interactions encountered between lists and between subjects for the criterion measures .................................................. 104

BIBLIOGRAPHY .................................................. 111
TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Means of the phrase duration in seconds for 56 phrases which were read aloud and then successively heard and repeated three times</td>
<td>34</td>
</tr>
<tr>
<td>2.</td>
<td>Summary of analysis of variance (Lindquist, Mixed Design, Type II) of durations of phrases when read aloud and subsequently heard and repeated three times (treatments)</td>
<td>36</td>
</tr>
<tr>
<td>3.</td>
<td>Comparison of observed and expected frequencies of upward and downward changes of durations of phrases when read aloud and subsequently heard and repeated three times</td>
<td>37</td>
</tr>
<tr>
<td>4.</td>
<td>Mean durations in seconds of four experimental ten-syllable passages which were first read aloud and subsequently heard and then repeated three times</td>
<td>40</td>
</tr>
<tr>
<td>5.</td>
<td>Summary of analysis of variance (Lindquist, Mixed Design, Type II) of duration of voicing in seconds of phrases which were read aloud and subsequently heard and repeated three times (treatments)</td>
<td>41</td>
</tr>
<tr>
<td>6.</td>
<td>Mean values in seconds of duration of voicing for ten-syllable passages read aloud and subsequently heard and repeated three times (treatments)</td>
<td>43</td>
</tr>
<tr>
<td>7.</td>
<td>One dimensional critical difference table for the effect upon voice duration when phrases were read aloud and subsequently heard and repeated three times (treatments)</td>
<td>44</td>
</tr>
</tbody>
</table>
Table

8. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of range of pitch of phrases which were read aloud and subsequently heard and repeated three times (treatments) ..................

9. Means of ranges of pitch (Hz) by treatments arranged by lists and by order of subjects when passages were read aloud and subsequently successively heard and repeated three times (treatments) ..........

10. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of the means of four sound pressure level measurements per phrase when phrases were read aloud and subsequently heard and repeated three times ..............................
# ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mean syllable duration plotted with the corresponding number of syllables in the phrase including poetry, prose, narrative, sports casting, conversation, and children's speech (after Fonagy and Maddics)</td>
<td>8</td>
</tr>
<tr>
<td>2. Diagram of subjects, lists, sub-lists, and recordings (treatments) in a study of the effect upon duration of speech output, range of pitch, intensity in dB, and duration of voicing of successive oral repetitions of heard phrases</td>
<td>18</td>
</tr>
<tr>
<td>3. Representation of a Tektronix Type 162 waveform generator and interval timer, and a Tektronix 160-A power amplifier</td>
<td>21</td>
</tr>
<tr>
<td>4. Representation of tape recorders and subject in heard, repeated mode</td>
<td>22</td>
</tr>
<tr>
<td>5. Representation of the face of Tektronix Type 564 storage oscilloscope</td>
<td>26</td>
</tr>
<tr>
<td>6. Representation of calibrated overlay for measuring the length of phrases</td>
<td>27</td>
</tr>
<tr>
<td>7. Representation of the passages remaining without word substitutions, omissions, duplications, or audible inspirations in the middle of the phrase after their having been read aloud and then successively heard and repeated three times</td>
<td>30</td>
</tr>
<tr>
<td>8. Plot of the upward trend toward greater duration of speech output in seconds when phrases were read aloud and then successively heard and repeated three times</td>
<td>38</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>9. Plot of the mean values of changes in duration of voicing of 160 ten-syllable phrases which were read aloud and then successively heard and repeated three times</td>
<td>42</td>
</tr>
<tr>
<td>10. Plot of the change in range of pitch of 160 ten-syllable phrases which were read aloud and then successively heard and repeated three times. Pitch range appears to decrease with successive recordings</td>
<td>46</td>
</tr>
<tr>
<td>11. Plot of the shift in mean intensity in dB from one recording to the next when ten-syllable phrases were read aloud, and then successively heard and repeated three times. Most change is shown to be between Recording I and Recording II</td>
<td>50</td>
</tr>
<tr>
<td>12. Plot of the levels representing four successive measurements of intensity from ten-syllable passages which were read aloud and then successively heard and repeated three times</td>
<td>52</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

The origin of language

Phylogenetic approach. It is not known when or how spoken language first appeared. Linguists have been able to make some generalizations from extant languages and from earlier forms which are preserved as writing. From these data and a growing knowledge of how the human infant acquires speech, the origins of language are inferred.

Paget\(^1\) wrote that man is an imitative animal and that all of his arts had their beginning in imitation. He suggested that man's first words began as movements of his tongue in a pantomime of his activity, and that when a primitive man phonated during a tongue-gesture, the activity could be inferred by another man. Paget further suggested that our present spoken language is a consequence of the accumulation and modification of these prototypes. Each generation imitates the pattern of the previous generation.

Ontogenetic approach. de Laguna\textsuperscript{1} wrote about

\textsuperscript{1}Grace Andrus de Laguna. *Speech, its function and development*. Yale University Press, New Haven, 1927.

two approaches to the origin of language, the phylogenetic and the ontogenetic. She suggested that the infant's predisposition to oral play and the mouth-pleasure associated with oral play are the sustaining motivations for the oral imitation of speech. Mowrer\textsuperscript{2} enlarged upon


the topic of oral repetition of heard phrases. In his statement of an autistic theory of speech learning, he postulated (1) that the child obtains immediate pleasure from oral play and its associated acoustic events, and (2) that these sounds come to serve as a substitute for the love-object which inspired them. Mowrer suggested that the similarities between babble and speech are accidental at first but because they tend to arouse an image of the mother, the oral acts which most closely approximate speech are re-enforced. These observations suggest that the child learns to imitate as he learns to speak.

The concensus of scholars who have written on the transmission of spoken language from generation to
generation is that this transmission depends upon imitation of the adult speech pattern by the infant. Therapy for the habilitation of defective speech exploits visual and acoustic imitation. The imitation of the heard speech pattern is more closely related to the pattern of speech learning by the infant than is either the imitation of visual cues, or the imitation of analogous sounds such as snake hisses for [s]. These may be used, however, during a speech therapy session treating poor production of [s].

In 1960, Black\textsuperscript{1} published a summary of some experimental studies of the psychophysical effects of the oral repetition of heard phrases. He observed that there was a tendency for response phrases to imitate the stimulus phrases in intensity of vocalization, precision of articulation, and in inflection. Other studies have also shown that response phrases are significantly faster and less intense than stimulus phrases. These will be documented in the next chapter.

Until now there have been no studies of changes as they occur when the experimental passages are spoken, heard, and repeated orally, several times in succession.

The problem

Statement of the problem. The purpose of this study was to investigate the effects upon the duration of speech output, the duration of the voicing within that output, the range of vocal pitch, and the intensity of utterance of a succession of oral repetitions of heard ten-syllable passages.

Experimental questions. The experimental questions were stated as follows:

1. Are there differences in the durations of speech output between successive oral copies of heard passages?

2. Are there differences in the durations of voicing between successive oral copies of heard passages?

3. Are there differences in the ranges of pitch between successive oral copies of heard passages?

4. Are there differences in the intensities of utterances of successive oral copies of heard passages?

Definition of terms

Stimulus passage or phrase refers to a recorded passage or phrase used to elicit an oral repetition called the response passage or phrase.

Response passage or phrase refers to the oral copy of a stimulus passage or phrase.

Phrase refers to a word or group of words uttered without perceptible pause, delimited by pauses.
Passage refers to a syntactic series of syllables which may be composed of zero, one, or more phrases.

Length of passage or phrase refers to the number of syllables of which the passage or phrase is composed.

Duration of speech output refers to the time elapsed between the onset and the termination of the speech output of a passage or of a phrase.

Range of pitch refers to the difference between the highest and the lowest fundamental frequencies observed for each phrase. The fundamental frequency was displayed on an oscillograph from which the overtones of the voice were filtered out.

Intensity refers to the magnitude of energy flow acting to produce a soundwave. It is measured in decibels (dB) which can represent a sound-pressure ratio:

\[ \text{decibel} = 20 \log_{10} \frac{P_1}{P_0} \]

where \( P_0 \) is the reference zero of the ratio, .0002 dyne/cm\(^2\), and \( P_1 \) is the measured sound pressure in dyne/cm\(^2\). The sound level meter makes this conversion from sound pressure to intensity automatically.

Organization of the dissertation

In the introduction of this report, the phylogenetic and ontogenetic origins of language were discussed, and the problem and definition of terms were presented. In the second chapter a review of the literature will be presented. The third chapter will include a description
of the design of the experiment, a description of the subjects, the equipment, the procedures of measurement, and the statistical procedures which were employed. The fourth chapter will include the hypotheses, the experimental results, and the statistical evaluation of the results. The fifth chapter will include a summary of the study, with a discussion of the implications of the results, suggestions for future research, and some possible practical applications.
CHAPTER II

REVIEW OF THE LITERATURE

It was the purpose of this study to examine the oral repetitions of heard phrases for differences in duration of speech output, duration of voicing, range of pitch, and intensity of speech output.

Duration of speech output

Fonagy and Maddics\(^1\) studied the speed of utterance in the oral reading of poetry, expository prose, narrative and spontaneous oral sports-casting, conversation, and children's speech. Figure 1 shows their results graphically, specifically the mean duration of syllables as a function of the length of the phrase and the type or mode of speech. The rate of saying syllables increases systematically with an increase in the number of syllables in a phrase up to about ten syllables. Thus the choice of the length of phrases in syllables imposes a set of probabilities upon vocal rate.

Figure 1. Mean syllable duration plotted with the corresponding number of syllables in the phrase. Poetry, prose, narrative, sports casting, conversation, children's speech, and the mean for all speech samples are shown (according to Fonagy and Maddics).
**Psychophysical method**

The experimental procedure was principally the method of reproduction or adjustment. However, the experimental subjects were only instructed to reproduce the words. Nothing was said to them about matching the voice. Of the errors in this type of performance, Koester states:

When an observer in a psychophysical experiment compares two successive stimuli of equal or slightly different magnitude or quality, the second member of the pair is frequently over- or under-estimated with reference to the first, with over-estimation being the more common type of error. Such constant errors in judgement have been commonly referred to as "time errors" and have been designated as positive when the second impression is under-estimated and negative when it is over-estimated.\(^1\)


The observed shortening in duration of speech production and decrease in intensity of speaking referred to in Chapter I may be regarded as constant errors. Because they are adjusted responses, they reflect time errors of the type described by Koester. The terms "positive" and "negative" as used by him refer to the discrepancy after the duration of a response is subtracted from the duration of the stimulus.
The method of adjustment permits the subject to compensate for his perception of the first stimulus. To produce a decrease in duration of speech production he must have perceived the stimulus phrase as being shorter, and in the language of the method of successive stimuli, committed a negative constant error of estimation. Thus, the positive error of approximation reported for duration and for intensity of speech production reflects negative constant errors of estimation.

Oral repetition of heard phrases

Lightfoot\(^1\) studied rate of speaking and compared


the durations and intensities of stimulus and response phrases. He found that the rate of speech output of the response phrase was statistically significantly faster than that of the stimulus phrase, and that the vocal intensity of the response phrase was significantly less than that of the stimulus phrase. His stimulus material was 10 five-syllable phrases.
As noted in Chapter I, Black\(^1\) observed that when a speaker repeated messages he tended to imitate the intensity, inflection, and precision of the articulation which he heard. Subsequently, he observed an increase in vocal rate and a decrease in intensity of the response phrases in a study of "the choral effect."\(^2\) This outcome was observed in connection with the testing of a self-administered procedure for speech improvement. A continuous loop of tape played back a stimulus phrase repetitively. The experimental subject said the phrase as he heard it and attempted to match it in his own voice in matters of rate, intensity, pitch, and enunciation. When he considered himself successful his response was recorded. Atkinson\(^3\) reported a study with this effect in which he compared sonograms for oral copying of the stimulus phrases.


The foregoing procedure was studied again by Black et al., this time comparatively. Both the

stimulus-response (successive) and the choral-response (simultaneous) methods of repeating phrases were used. They found a greater increase in rate of speech production and decrease in intensity when the response phrases were repeated in the choral-response manner than in stimulus-response manner. Throughout, the stimuli were five-syllable phrases except in some materials used by Atkinson.

Physical analysis of speech

To carry out a physical analysis of a sound-vibration it is necessary to be able to convert it from successive waves of compression and rarefaction in air to some form of graphic display such as an oscillating trace from an oscillograph. From such a display, measures of intensity, pitch, and duration can be obtained. Such conversions can be performed by such direct mechanical means as a revolving smoked drum which is inscribed by a sound actuated stylus mounted on a screw that gradually changes the level of the stylus with each rotation of the drum. The short lever of the stylus is affixed to a
sound sensitive tambour which occludes the vertex of an exponential horn, or the end of a sound tube. The changing level of the stylus permits the continuation of a recording period through several rotations of the drum. This apparatus has certain drawbacks: messiness of the soot from the smoked drum, time limitations, calibration difficulties, and sensitivity limitations due to the inertia of the stylus and the friction of the stylus with the smoked drum. Nevertheless, illustrations in Scripture\(^1\) and Miller\(^2\) show that with careful handling importantly contributing measures of speech could be obtained. The photo-phoneloscope of Metfessel\(^3\) solved many difficulties by employing (1) a drum which was many times the diameter of its kymograph predecessor, (2) a very small sound actuated mirror instead of the stylus, and (3) accumulating a photographic film on the recording drum. These innovations resulted in an extension of the


\(^3\)M. Metfessel, "Technique for objective studies of the vocal art." Psychological Monographs, 36:1-40, 1926.
duration of the material recorded, and of the sensitivity of the recordings. Furthermore, the increase in size of the drum permitted the mounting of a phonograph turn-table at the center which rotated synchronously with the drum, and made possible a direct correspondence between the acoustic events and their graphic representation.

Electronic devices are now available to facilitate the physical measurement of speech. The transpitchmeter, cathode-ray oscillograph, and power level recorder perform the functions of the equipment described above, tend to be more compact, and were used in the study reported here.

Summary

Psychophysical measurement of the events related to the oral repetition of heard phrases is relatively new. There is little written on the topic. In summary: the response phrases tend to imitate the stimulus phrases, but exhibit (1) a significantly higher rate, (2) a lower intensity of speech production, and (3) these effects are statistically significantly greater in the choral-mode than in the stimulus-response mode. Studies of these events require the use of appropriate equipment.

The present research deals with the successive oral repetition of heard phrases. The design, equipment,
instructions to the subjects, measurements performed, handling of the data obtained, and statistical tests which were employed in the experimental procedures will be discussed in the next chapter.
CHAPTER III

EXPERIMENTAL PROCEDURE

This is a report of a study of the effects of successive oral repetitions of heard phrases upon duration of speech output, duration of voicing, range of pitch, and intensity of vocalization. Chapter II presented a review of the literature on the rate and intensity of repeated speech, the pertinent psychophysical procedures, and the physical measurement of speech. This chapter will include an explanation of the design, equipment, instructions to subjects, procedures, measurements, and statistical treatment employed in the experiment.

The design

Four sets of experimental recordings were analyzed for changes in duration of speech output, duration of voicing and range of pitch, and level of intensity. The first of these recordings was made by having subjects read lists of test phrases aloud. Each set of response recordings was subsequently used as a set of stimulus recordings. Recordings I, II, and III were employed as stimulus recordings, and Recordings II, III, and IV were regarded as the response recordings.
Phrase lists. Mahaffey\textsuperscript{1} drew upon a list of five-

\textsuperscript{1}The experimental passages were taken from among 212 ten-syllable passages which were assembled to serve as stimulus passages for an experiment with delayed side-tone.

syllable phrases, each of which was syntactic, and had previously been measured in duration and sound pressure level by Walker and Black.\textsuperscript{2} His only criterion for

\textsuperscript{2}Crayton Walker and John W. Black, The Intrinsic Intensity of Oral Phrases. Ohio State University Research Foundation, Columbus, Ohio, Contract N6, May 5, 1950.

pairing of any two phrases was that the combined measured durations be 2.1 seconds.

A total of 160 passages was used. These were randomized and arranged in four lists of forty passages each. Five typewritten copies were made of each list (Appendix A).

Recording schedule

Figure 2 is a diagrammatic representation of the recording schedule. Subjects were recorded in the order of their arrival, and that order was preserved through the remaining recording conditions. To minimize learning, the groups of subjects were staggered in successive recording conditions in such manner that subjects one through five read the passages of list I, and in the next three
Figure 2. Diagrammatic representation of subjects, lists, sub-lists, and recordings (treatments) in a study of the effect upon duration of speech output, range of pitch, and intensity in dB, and duration of voicing of successive oral repetitions of heard phrases. Numbers in the rectangles are the lists (five copies of each), and to the left is the number of the subject who is processing the list for that treatment.
recording conditions heard and repeated respectively the passages of list IV, list III, and list II. Lindquist

\[1\]


describes this arrangement of subjects and material as a 4 x 4 Latin square employed "to control individual differences in evaluating the main effects" of both recording conditions and lists, and refers to it as a Type II Mixed Design.

Instructions to subjects

Two, three-by five-inch note cards were prepared with instructions. The first set of instructions was used only for making the first recordings—the recording of the read passages. The subjects were asked to identify themselves orally at the beginning of each recording:

YOU HAVE BEEN GIVEN A LIST OF PHRASES. YOU ARE REQUESTED TO SPEAK EACH PHRASE IN AS NATURAL A MANNER AS POSSIBLE. AFTER EACH PHRASE, TIME IS TO BE ALLOWED SO AS TO PERMIT A RESPONSE WHEN THE RECORDING IS PLAYED BACK LATER. THEREFORE, YOU ARE TO WAIT UNTIL THE SIGNAL LIGHT FLASHERS BEFORE READING THE NEXT PHRASE.

The second set of instructions was employed only for the conditions employing the oral repetition of heard phrases.

YOU ARE ABOUT TO HEAR A LIST OF RECORDED PHRASES. YOU ARE REQUESTED TO REPEAT EACH
Five sample passages were presented for practice reading. When the subject indicated that he was ready the experimental passages were given to him and recording was begun.

**Equipment**

Figure 3 shows the arrangement whereby a Tektronix Type 162 waveform generator and interval timer and a Tektronix 160-A power amplifier were used to trigger a light which was arranged within the reader's field of peripheral vision. A flash of light signalled him when to begin each phrase. The interval between the flashes was eight seconds.

An Altec M-20 condenser microphone was located one inch from the subject's mouth and slightly to his left out of the path of his breath stream. Each subject was seated in an Industrial Acoustics Company Model 403 audiometric room. The microphone fed into an Ampex PR-10 tape recorder. The subjects listened to the passages by means of one TDH-39 earphone, fitted to the left ear, played back on a Wollensak T-1500 tape recorder (Figure 4). The headset was arranged so that only the left ear received the recorded signal and the right ear remained
Figure 3. Representation of a Tektronix Type 162 waveform generator and interval timer, and a Tektronix 150-A power amplifier. These were used to trigger a light which was arranged within the reader's peripheral visual field and signaled him when to begin each phrase.
Figure 4. Representation of the tape recorders and subject in heard, repeated mode. The subject was seated in an I.A.C. Model 403 sound-treated room. The headphones were fitted to the left ear. The Altec M-20 condenser microphone was located very close to the subject's mouth and slightly to his left. Phrases were played to the subject by a Wollensak T-1500. Response phrases were recorded by the Ampex PR-10 tape recorder.
uncovered, as an attempt to permit more natural side-tone than binaural occlusion by the phone pads would permit.

The experimenter phonated [ɑ] into the condenser microphone under the experimental arrangement and the input gain controls on the Ampex PR-10 were adjusted to -2 VU when the vowel was sustained at 92 dB re .0002 dyne/cm² as registered on a General Radio sound pressure level meter (C-scale) held in a position corresponding to the recording microphone but on the right side. In turn, when the vowel [α] was fed into a General Radio Type 1521-B graphic level recorder, it served as a standard in setting the intensity scale of the recorder. The graphic level recorder was used for analysis of intensity and duration of the speech output of the experimental tape recordings.

The range of pitch and duration of voicing were measured by means of a transpitchmeter and an oscilloscope. The B. Frøkjaer-Jensen transpitchmeter provides a series of low pass filters permitting the selective isolation of the fundamental frequency of the voice, and provides for the representation of that frequency as a function of voltage. The voltage of the battery which powers the transpitchmeter declines sufficiently rapidly to require frequent recalibration. Hence, a Kepco Model FM-36-5M d.c. power supply was attached in parallel with the battery.
The battery in turn served to trap the low-level 60-cycle hum of the power supply. The recordings of the experimental phrases were played through the B. Frøkjaer-Jensen transpitchmeter and displayed on the screen of a Tektronix Type 564 storage oscilloscope.

The cathode-ray tube of this particular storage oscilloscope is equipped with three beams. Two of these maintain the background illumination of the upper and the lower halves of the field of the tube-screen and can be used individually to erase the image from the upper or lower half of the screen. The third beam carries the signal, which can be viewed as on a conventional oscilloscope or can be triggered one sweep at a time with the image stored on the screen for close and prolonged examination. The storing function depends upon a bi-stable phosphor with which the oscilloscope screen is coated. The two field beams maintain this phosphor in a dark green threshold condition. One trace of the third beam across the screen triggers the phosphor particles along its path to a higher energy level and resulting greater brightness, and the field beams impart sufficient additional energy to maintain the triggered phosphors at the higher energy level. Because the sweep-rate can be controlled, as well as the frequency of the sweep, it is possible to display
a two-second passage as modified by the transpitchmeter, with a single sweep of the third beam. The sweep rate chosen for analysis of the test passages was 2 cm per second. This permitted the display of an entire passage across the 10-cm face of the screen. This image could be left on the screen for as long as desired. Thereafter, pitch range and length of voicing were measured directly from the screen of the oscilloscope. Length of voicing (millimeters) was later converted into voice duration (sec). This will be described in the section on measurements.

Procedures

Duration of speech output. Measurements of duration of speech output were obtained from the graphic level recordings by measuring the length of the intensity tracing and converting the measure to time (Figure 5). Measures of the duration of passages were made at the 75 dB level on the chart.

Intensity. Intensity was measured directly from the graphic recording of the power level meter. The recorded vowel, referred to earlier, made it possible to calibrate the chart directly in dB re .0002 dyne/cm². Intensity measurements were made of the four most prominent peaks which appeared to represent the accented syllables
Figure 5. Representation of the face of Tektronix Type 564 storage oscilloscope. The calibrated steps (60, 70, 80, ... 450 Hz) from the Transpitchmeter were drawn upon the screen of the oscilloscope for continued reference. A segment of clear plastic ruler with a mm-scale was used to measure length of voice in mm for later conversion into duration in seconds. A passage displayed on this screen can be measured for both duration of voicing and range of pitch.
Figure 6. Representation of the calibrated overlay for measuring the length of phrases. The overlay is superimposed upon a graphic level recording chart of one of the phrases. The amplitude calibration is on the left. Phrase length was measured at the 75 dB level. On the right is the table used to convert millimeters, length, to seconds, duration.
of the phrase. This procedure required the experimenter to examine and compare the charts of the successive readings of a passage and record the intensities of the four consistently highest peaks in the passages. This involved a subjective evaluation that was not considered to be inappropriate.

**Duration of voicing and range of pitch.** Measurement of range of pitch was discussed in connection with the transpitchmeter and the storage oscilloscope. The duration of voicing was also measured with that equipment, but the measurements had to be converted from total length of voicing per passage in millimeters to duration of voicing in seconds. Breath noises may have contaminated some of the pitch curves. The measurements of duration of voicing should be reliable.

**Elimination of passages.** Some of the passages were eliminated from the study. Of the original lists of forty phrases, Figure 7 shows that after the fourth recording, many had been removed. This was done after completion of the experiment. Those phrases were eliminated from the study in which there were repetitions, substitutions, or omissions of words, or in which the speaker could be heard to break the passage and inspire. These were discarded because they were inappropriate to the
purposes of the study. Errors in the first, or read-
aloud, condition were disregarded if the number of 
syllables was not altered.

The loss of phrases due to alterations is 
schematized in Figure 7. In copy five of list III there 
are only 14 phrases remaining. The dotted vertical line 
indicates that only the data gathered from the phrases to 
the left of the dotted line were used for the statistical 
tests except in one application of the Chi-square test.

**Statistical treatment**

The experiment was designed to yield maximum data 
with a minimum number of subjects. Lindquist\(^1\) refers 


to it as a "Type II Mixed Factorial Design." Its chief 
advantage is that it permits control of individual 
differences in evaluating the main effects of both 
recording conditions I-IV and lists I-IV.

**Summary**

The design, instructions to subjects, equipment, 
procedures, and statistical treatment have been discussed 
in this chapter. Chapter IV presents the experimental 
hypotheses, experimental results, and the statistical 
evaluation of the data.
Figure 7. Representation of the passages remaining without word substitutions, omissions, duplications, or audible inspirations in the middle of the phrase after their having been read aloud and then successively heard and repeated three times.
CHAPTER IV

EXPERIMENTAL RESULTS

The previous chapter described the design of the experiment. Twenty subjects were divided into four groups of five each. One hundred sixty ten-syllable passages were randomized and divided into four lists of which five copies were made. Each member of the first group received a copy of list I; each member of the second group received a copy of list II . . . list IV. Each subject read his copy aloud and the phrases were tape recorded. On successive days, the recordings that had been made previously were rotated in such way that subjects would not hear or say the same passages a second time. After the initial, or "read-aloud" condition, the subsequent three conditions consisted of hearing and repeating a list of the passages which had been recorded by someone else. Recapitulating, of the four experimental conditions, the first involved reading aloud and the last three, successive oral repetitions of ten-syllable passages, which comprised the experimental lists. The recordings obtained from these procedures were analyzed to determine duration
of speech output and level of intensity through the use of a power-level recorder, and the range of vocal pitch and the duration of voicing through the use of a trans-pitchmeter and a storage oscilloscope.

The present chapter includes a statement of the experimental hypotheses and a report of the results obtained under the conditions of the experiment. It covers analyses of duration of speech output, duration of voicing, range of pitch, and level of intensity.

**The hypotheses**

The experimental questions of Chapter I are restated here in the form of null hypotheses.

- There is no difference between mean durations of speech output in successive oral repetitions of heard ten-syllable passages.
- There is no difference between mean durations of voicing in successive oral repetitions of heard ten-syllable passages.
- There is no difference between mean ranges of pitch in successive oral repetitions of heard ten-syllable passages.
- There is no difference between mean intensities in successive oral repetitions of heard ten-syllable passages.
Duration of speech output

The durations in seconds of 56 experimental passages are noted in Table 1. These are passages which did not undergo alterations in wording after the original 160 passages were read aloud and successively heard and repeated the same times. Each entry in the table is a mean of five recordings. The first column represents scores for the "read-aloud" condition. The remaining columns represent comparable scores for the successive oral repetitions of heard passages.

A summary of the analysis of variance of the data relevant to the duration of speech output is shown in Table 2. This analysis did not show the duration of speech output to vary among the four conditions.

The mean values of the duration of speech output in each treatment, based upon the 14-passage data, and arranged by list and by subject, are shown in Tables 3A and 3B. The means of the columns noted at the bottom of Table 4B are plotted in Figure 8, showing the tendency toward an increase in duration with the oral repetition of heard passages.
TABLE 1. Means of phrase duration in seconds for fifty-six phrases which were read aloud and then successively heard and repeated three times. Each mean represents five readings of the phrase under the treatment condition.

<table>
<thead>
<tr>
<th>Phrase</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.16</td>
<td>2.09</td>
<td>2.18</td>
<td>2.37</td>
</tr>
<tr>
<td>2</td>
<td>2.01</td>
<td>1.87</td>
<td>1.94</td>
<td>1.99</td>
</tr>
<tr>
<td>3</td>
<td>1.98</td>
<td>1.99</td>
<td>1.13</td>
<td>2.17</td>
</tr>
<tr>
<td>4</td>
<td>2.03</td>
<td>2.06</td>
<td>2.24</td>
<td>2.22</td>
</tr>
<tr>
<td>5</td>
<td>2.05</td>
<td>2.05</td>
<td>2.24</td>
<td>2.18</td>
</tr>
<tr>
<td>6</td>
<td>2.18</td>
<td>2.06</td>
<td>2.22</td>
<td>2.19</td>
</tr>
<tr>
<td>7</td>
<td>2.15</td>
<td>2.08</td>
<td>2.22</td>
<td>2.41</td>
</tr>
<tr>
<td>8</td>
<td>1.92</td>
<td>1.96</td>
<td>2.05</td>
<td>2.24</td>
</tr>
<tr>
<td>9</td>
<td>2.20</td>
<td>2.17</td>
<td>2.23</td>
<td>2.16</td>
</tr>
<tr>
<td>10</td>
<td>2.01</td>
<td>1.00</td>
<td>2.08</td>
<td>2.17</td>
</tr>
<tr>
<td>11</td>
<td>1.98</td>
<td>1.06</td>
<td>2.14</td>
<td>2.20</td>
</tr>
<tr>
<td>12</td>
<td>2.02</td>
<td>2.14</td>
<td>2.34</td>
<td>2.24</td>
</tr>
<tr>
<td>13</td>
<td>2.04</td>
<td>2.21</td>
<td>2.25</td>
<td>2.39</td>
</tr>
<tr>
<td>14</td>
<td>2.12</td>
<td>2.10</td>
<td>2.09</td>
<td>2.16</td>
</tr>
<tr>
<td>15</td>
<td>2.00</td>
<td>2.09</td>
<td>2.14</td>
<td>1.93</td>
</tr>
<tr>
<td>16</td>
<td>2.20</td>
<td>2.34</td>
<td>2.48</td>
<td>2.36</td>
</tr>
<tr>
<td>17</td>
<td>2.11</td>
<td>2.06</td>
<td>2.14</td>
<td>2.14</td>
</tr>
<tr>
<td>18</td>
<td>2.53</td>
<td>2.23</td>
<td>2.42</td>
<td>2.25</td>
</tr>
<tr>
<td>19</td>
<td>2.21</td>
<td>2.15</td>
<td>2.38</td>
<td>2.27</td>
</tr>
<tr>
<td>20</td>
<td>2.14</td>
<td>2.09</td>
<td>2.21</td>
<td>2.13</td>
</tr>
<tr>
<td>21</td>
<td>2.20</td>
<td>2.27</td>
<td>2.57</td>
<td>2.33</td>
</tr>
<tr>
<td>22</td>
<td>2.10</td>
<td>2.09</td>
<td>2.31</td>
<td>2.16</td>
</tr>
<tr>
<td>23</td>
<td>2.20</td>
<td>2.27</td>
<td>2.20</td>
<td>2.20</td>
</tr>
<tr>
<td>24</td>
<td>2.25</td>
<td>2.32</td>
<td>2.18</td>
<td>2.31</td>
</tr>
<tr>
<td>25</td>
<td>1.97</td>
<td>2.23</td>
<td>2.26</td>
<td>2.05</td>
</tr>
<tr>
<td>26</td>
<td>2.22</td>
<td>2.10</td>
<td>2.26</td>
<td>2.39</td>
</tr>
<tr>
<td>27</td>
<td>2.15</td>
<td>1.05</td>
<td>2.37</td>
<td>2.26</td>
</tr>
<tr>
<td>28</td>
<td>2.22</td>
<td>2.17</td>
<td>2.33</td>
<td>2.25</td>
</tr>
<tr>
<td>Phrase</td>
<td>Recording I</td>
<td>Recording II</td>
<td>Recording III</td>
<td>Recording IV</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>--------------</td>
<td>---------------</td>
<td>--------------</td>
</tr>
<tr>
<td>29</td>
<td>1.95</td>
<td>1.87</td>
<td>1.88</td>
<td>1.83</td>
</tr>
<tr>
<td>30</td>
<td>2.02</td>
<td>2.02</td>
<td>2.18</td>
<td>2.10</td>
</tr>
<tr>
<td>31</td>
<td>2.09</td>
<td>2.18</td>
<td>2.31</td>
<td>2.19</td>
</tr>
<tr>
<td>32</td>
<td>2.27</td>
<td>2.03</td>
<td>2.15</td>
<td>2.04</td>
</tr>
<tr>
<td>33</td>
<td>2.06</td>
<td>2.05</td>
<td>2.06</td>
<td>1.94</td>
</tr>
<tr>
<td>34</td>
<td>2.10</td>
<td>2.14</td>
<td>2.16</td>
<td>2.04</td>
</tr>
<tr>
<td>35</td>
<td>2.09</td>
<td>2.12</td>
<td>2.29</td>
<td>2.03</td>
</tr>
<tr>
<td>36</td>
<td>1.98</td>
<td>2.03</td>
<td>2.06</td>
<td>2.00</td>
</tr>
<tr>
<td>37</td>
<td>2.11</td>
<td>2.09</td>
<td>2.20</td>
<td>2.01</td>
</tr>
<tr>
<td>38</td>
<td>2.03</td>
<td>2.02</td>
<td>2.13</td>
<td>2.06</td>
</tr>
<tr>
<td>39</td>
<td>2.02</td>
<td>2.00</td>
<td>2.17</td>
<td>1.79</td>
</tr>
<tr>
<td>40</td>
<td>2.13</td>
<td>2.01</td>
<td>2.17</td>
<td>2.15</td>
</tr>
<tr>
<td>41</td>
<td>1.87</td>
<td>1.95</td>
<td>1.92</td>
<td>1.79</td>
</tr>
<tr>
<td>42</td>
<td>2.00</td>
<td>2.09</td>
<td>2.26</td>
<td>2.11</td>
</tr>
<tr>
<td>43</td>
<td>1.86</td>
<td>1.93</td>
<td>2.03</td>
<td>2.01</td>
</tr>
<tr>
<td>44</td>
<td>1.83</td>
<td>1.97</td>
<td>2.00</td>
<td>1.93</td>
</tr>
<tr>
<td>45</td>
<td>1.93</td>
<td>2.10</td>
<td>2.18</td>
<td>2.35</td>
</tr>
<tr>
<td>46</td>
<td>1.96</td>
<td>2.24</td>
<td>2.08</td>
<td>2.11</td>
</tr>
<tr>
<td>47</td>
<td>1.88</td>
<td>1.95</td>
<td>2.10</td>
<td>2.15</td>
</tr>
<tr>
<td>48</td>
<td>1.87</td>
<td>2.14</td>
<td>2.34</td>
<td>2.35</td>
</tr>
<tr>
<td>49</td>
<td>2.12</td>
<td>2.30</td>
<td>2.10</td>
<td>2.23</td>
</tr>
<tr>
<td>50</td>
<td>2.10</td>
<td>2.26</td>
<td>2.08</td>
<td>2.18</td>
</tr>
<tr>
<td>51</td>
<td>1.86</td>
<td>2.14</td>
<td>2.22</td>
<td>2.16</td>
</tr>
<tr>
<td>52</td>
<td>1.87</td>
<td>2.17</td>
<td>2.35</td>
<td>2.12</td>
</tr>
<tr>
<td>53</td>
<td>2.00</td>
<td>2.26</td>
<td>2.31</td>
<td>2.28</td>
</tr>
<tr>
<td>54</td>
<td>1.95</td>
<td>2.14</td>
<td>1.18</td>
<td>2.04</td>
</tr>
<tr>
<td>55</td>
<td>2.00</td>
<td>2.21</td>
<td>2.02</td>
<td>2.15</td>
</tr>
<tr>
<td>56</td>
<td>1.78</td>
<td>2.15</td>
<td>2.09</td>
<td>1.93</td>
</tr>
</tbody>
</table>
TABLE 2. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of durations of phrases when read aloud and subsequently heard and repeated three times (treatments). N, readers, 20. Data are in seconds. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL(b)</td>
<td>.25</td>
<td>3</td>
<td>.08</td>
<td>4.00**</td>
</tr>
<tr>
<td>Error(b)</td>
<td>.27</td>
<td>16</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td>2.83</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>.30</td>
<td>3</td>
<td>.10</td>
<td>2.33</td>
</tr>
<tr>
<td>L</td>
<td>.40</td>
<td>3</td>
<td>.13</td>
<td>3.02*</td>
</tr>
<tr>
<td>RL(w)</td>
<td>.06</td>
<td>6</td>
<td>.01</td>
<td>n.s.</td>
</tr>
<tr>
<td>Error(w)</td>
<td>2.07</td>
<td>48</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3.35</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
TABLE 3. Mean durations in seconds of four experimental recordings of ten-syllable passages which were first read aloud and subsequently heard and then repeated three times. These are tabulated by lists in 4(A) and by subjects in 4(B).

<table>
<thead>
<tr>
<th></th>
<th>R₁</th>
<th>HR₂</th>
<th>HR₃</th>
<th>HR₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L₁</td>
<td>2.02</td>
<td>2.03</td>
<td>2.15</td>
<td>2.19</td>
</tr>
<tr>
<td>L₂</td>
<td>2.19</td>
<td>2.18</td>
<td>2.27</td>
<td>2.25</td>
</tr>
<tr>
<td>L₃</td>
<td>2.07</td>
<td>2.06</td>
<td>2.14</td>
<td>2.02</td>
</tr>
<tr>
<td>L₄</td>
<td>1.92</td>
<td>2.13</td>
<td>2.13</td>
<td>2.15</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S₁</td>
<td>2.02</td>
<td>2.05</td>
<td>2.10</td>
<td>2.12</td>
</tr>
<tr>
<td>S₂</td>
<td>2.08</td>
<td>2.12</td>
<td>2.11</td>
<td>2.13</td>
</tr>
<tr>
<td>S₃</td>
<td>2.02</td>
<td>2.11</td>
<td>2.13</td>
<td>2.16</td>
</tr>
<tr>
<td>S₄</td>
<td>2.09</td>
<td>2.11</td>
<td>2.21</td>
<td>2.19</td>
</tr>
<tr>
<td>S₅</td>
<td>2.05</td>
<td>2.11</td>
<td>2.26</td>
<td>2.18</td>
</tr>
<tr>
<td>X_R₁</td>
<td>2.05</td>
<td>2.10</td>
<td>2.17</td>
<td>2.15</td>
</tr>
</tbody>
</table>

R₁ = Read aloud.

HR₂ . . . ₄ = Heard, repeated.

¹A difference between means of .¹⁴ is significant at the .⁰⁵ level. A difference between Xs of .¹⁹ is significant at the .⁰¹ level.
Figure 8. Plot of the upward trend towards greater duration of speech output in seconds when phrases were read aloud and then successively heard and repeated three times.
Duration of voicing

A summary of the analysis of variance of durations of voicing in seconds is shown in Table 4. The associated mean values are plotted treatment by treatment in Figure 9 and are enumerated in Tables 5A and 5B. They increased significantly from treatment to treatment and the corresponding null hypothesis was rejected at the .01 level of confidence. Figure 9 shows that the greatest change in duration of voicing occurred between treatments two and three. The critical differences among the treatments are noted in Table 6.

Range of vocal pitch

A summary of the analysis of variance of the range of pitch data of the test passages is shown in Table 7. The mean values of pitch range are plotted treatment by treatment in Figure 14. The means are shown in Table 8A and 8B.

Values of range-of-pitch were not significant from one treatment to another and the corresponding null hypothesis was not rejected. Figure 10 shows the tendency for range of vocal pitch to become less from treatment to treatment.
TABLE 4. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of duration of voicing in seconds of phrases which were read aloud and subsequently heard and repeated three times (treatments). N, subjects, 20. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td>7.32</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RL(b)</td>
<td>1.05</td>
<td>3</td>
<td>.35 n.s.</td>
</tr>
<tr>
<td></td>
<td>Error(b)</td>
<td>6.27</td>
<td>16</td>
<td>.39</td>
</tr>
<tr>
<td>Within Subjects</td>
<td>39.83</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>18.27</td>
<td>3</td>
<td>6.09</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>5.63</td>
<td>3</td>
<td>1.88</td>
</tr>
<tr>
<td></td>
<td>RL(w)</td>
<td>6.37</td>
<td>6</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>Error(w)</td>
<td>9.55</td>
<td>48</td>
<td>.20</td>
</tr>
<tr>
<td>Total</td>
<td>47.15</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level.

**Significant at the .01 level.
TABLE 5. Mean values in seconds of duration of voicing for ten-syllable passages read aloud and subsequently heard and repeated three times (treatments). \( N \), subjects, 20. Means in \( \delta(A) \) are arranged by lists. Means in \( \delta(B) \) are arranged by subjects. Treatment means are in row \( X_R \).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>( R_1 )</th>
<th>( HR_2 )</th>
<th>( HR_3 )</th>
<th>( HR_4 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( L_1 )</td>
<td>1.65</td>
<td>1.52</td>
<td>1.79</td>
<td>1.95</td>
</tr>
<tr>
<td>( L_2 )</td>
<td>1.53</td>
<td>1.70</td>
<td>1.89</td>
<td>1.83</td>
</tr>
<tr>
<td>( L_3 )</td>
<td>1.70</td>
<td>1.78</td>
<td>1.81</td>
<td>1.81</td>
</tr>
<tr>
<td>( L_4 )</td>
<td>1.53</td>
<td>1.53</td>
<td>1.66</td>
<td>1.79</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( S_1 )</td>
<td>1.64</td>
<td>1.59</td>
<td>1.76</td>
<td>1.81</td>
</tr>
<tr>
<td>( S_2 )</td>
<td>1.61</td>
<td>1.65</td>
<td>1.78</td>
<td>1.83</td>
</tr>
<tr>
<td>( S_3 )</td>
<td>1.63</td>
<td>1.65</td>
<td>1.83</td>
<td>1.90</td>
</tr>
<tr>
<td>( S_4 )</td>
<td>1.51</td>
<td>1.62</td>
<td>1.72</td>
<td>1.83</td>
</tr>
<tr>
<td>( S_5 )</td>
<td>1.60</td>
<td>1.65</td>
<td>1.86</td>
<td>1.86</td>
</tr>
<tr>
<td>( X_R )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R_1 )</td>
<td>1.60</td>
<td>1.63</td>
<td>1.79</td>
<td>1.84</td>
</tr>
</tbody>
</table>

\( R_1 = \) Read aloud.

\( HR_2 \ldots 4 = \) Heard, repeated.

\( ^1 \) A difference between means of .04 is significant at the .05 level and of .12 is significant at the .01 level.
Figure 9. Mean values of changes in duration of voicing of 160 ten-syllable phrases which were read aloud and then successively heard and repeated three times. Data are in seconds.
TABLE 6. One dimensional critical difference table for the effect upon voice duration (in seconds) when phrases were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20.

<table>
<thead>
<tr>
<th>Means</th>
<th>$R_1$</th>
<th>$R_2$</th>
<th>$R_3$</th>
<th>$R_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_1$ = 1.60</td>
<td>$R_1$</td>
<td>.03</td>
<td>.19**</td>
<td>.24**</td>
</tr>
<tr>
<td>$M_2$ = 1.63</td>
<td>$R_2$</td>
<td></td>
<td>.16*</td>
<td>.21**</td>
</tr>
<tr>
<td>$M_3$ = 1.79</td>
<td>$R_3$</td>
<td></td>
<td></td>
<td>.05</td>
</tr>
<tr>
<td>$M_4$ = 1.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
TABLE 7. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of values of range of pitch of phrases which were read aloud and subsequently heard and repeated three times (treatments). N, subjects, 20. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between Subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjects</td>
<td>8133.49</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL(b)</td>
<td>308.31</td>
<td>3</td>
<td>102.77</td>
<td>.21</td>
</tr>
<tr>
<td>Error(b)</td>
<td>7825.18</td>
<td>16</td>
<td>489.07</td>
<td></td>
</tr>
<tr>
<td><strong>Within Subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>1069.28</td>
<td>3</td>
<td>356.43</td>
<td>2.36</td>
</tr>
<tr>
<td>L</td>
<td>1062.75</td>
<td>3</td>
<td>354.25</td>
<td>2.34</td>
</tr>
<tr>
<td>RL(w)</td>
<td>5981.11</td>
<td>6</td>
<td>996.85</td>
<td>6.59**</td>
</tr>
<tr>
<td>Error(w)</td>
<td>7264.71</td>
<td>48</td>
<td>151.35</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20511.34</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.
**Significant at .01 level.
TABLE 8. Means of ranges of pitch (Hz) by treatments arranged (9A) by lists, and (9B) by order of subjects, when passages were read aloud and subsequently successively heard and repeated three times (treatments). N, subjects, 20. Treatment means are listed in row $\bar{X}_R$.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>$R_1$</th>
<th>HR$_2$</th>
<th>HR$_3$</th>
<th>HR$_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$L_1$</td>
<td>47.76</td>
<td>51.86</td>
<td>67.74</td>
<td>57.69</td>
</tr>
<tr>
<td>$L_2$</td>
<td>68.14</td>
<td>76.46</td>
<td>61.36</td>
<td>57.61</td>
</tr>
<tr>
<td>$L_3$</td>
<td>76.60</td>
<td>62.41</td>
<td>56.03</td>
<td>49.14</td>
</tr>
<tr>
<td>$L_4$</td>
<td>78.10</td>
<td>55.59</td>
<td>57.93</td>
<td>65.10</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_1$</td>
<td>82.05</td>
<td>68.43</td>
<td>66.89</td>
<td>58.57</td>
</tr>
<tr>
<td>$S_2$</td>
<td>62.38</td>
<td>63.45</td>
<td>67.29</td>
<td>63.61</td>
</tr>
<tr>
<td>$S_3$</td>
<td>59.36</td>
<td>57.41</td>
<td>57.79</td>
<td>49.61</td>
</tr>
<tr>
<td>$S_4$</td>
<td>59.96</td>
<td>58.52</td>
<td>57.29</td>
<td>55.70</td>
</tr>
<tr>
<td>$S_5$</td>
<td>74.50</td>
<td>60.09</td>
<td>54.57</td>
<td>59.45</td>
</tr>
<tr>
<td>$\bar{X}_R$</td>
<td>67.65</td>
<td>61.58</td>
<td>60.76</td>
<td>57.39$^1$</td>
</tr>
</tbody>
</table>

$R_1$ = Read aloud.

HR$_2$, ..., 4 = Heard, repeated.

$^1$A difference between means 7.36 is needed for .05 level of significance.
Figure 10. Plot of the change in range of pitch of 150 ten-syllable passages which were read aloud and then successively heard and repeated three times. Pitch range appears to decrease with successive recordings.
Mean intensity

The four consistently highest peaks of intensity, from treatment to treatment, were averaged, and subjected to the Lindquist Type II analysis of variance. This is summarized in Table 9. The means of the intensities of the successive recordings are shown by lists and by subjects in Tables 10A and 10B. The means of the intensities are plotted in Figure 11.

Table 9 shows that the mean values of the four treatments were significantly different in intensity; thus, the corresponding null hypothesis was rejected at the .01 level of confidence. Figure 11 shows a decrease in intensity with succeeding repetitions. The differences between the means for the repetition sequence were studied (Table 11). The significance was restricted to the transition from the "read-aloud" condition to the first heard, repeated one. Therefore, despite the rejection of the null hypothesis on the basis of the analysis summarized in Table 9, it cannot be rejected in relation to the singular interest of this study because the significance was restricted to a comparison of conditions which were not included in the hypothesis. As before, the significance noted in Table 9 for within subjects variation between lists and interaction between lists and oral repetitions is considered beyond the scope of this chapter and will be discussed in Chapter V.
TABLE 9. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of the means of four sound pressure level measurements per phrase (re: .0002 dyne/cm²) when phrases were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td>304.10</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL(b)</td>
<td>96.57</td>
<td>3</td>
<td>32.19</td>
<td>2.48</td>
</tr>
<tr>
<td>Error(b)</td>
<td>207.44</td>
<td>16</td>
<td>12.97</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td>662.70</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>122.18</td>
<td>3</td>
<td>40.73</td>
<td>7.25**</td>
</tr>
<tr>
<td>L</td>
<td>69.19</td>
<td>3</td>
<td>23.06</td>
<td>4.10**</td>
</tr>
<tr>
<td>RL(w)</td>
<td>201.55</td>
<td>6</td>
<td>33.59</td>
<td>5.98**</td>
</tr>
<tr>
<td>Error(w)</td>
<td>269.78</td>
<td>48</td>
<td>5.62</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>966.71</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
TABLE 10. Means of mean-of-intensity readings arranged in (A) by lists and in (B) by order of subjects. Data are in dB re: .0002 dyne/cm². Measurements were from ten-syllable passages which were first read aloud and subsequently heard and repeated three times.

<table>
<thead>
<tr>
<th></th>
<th>R₁</th>
<th>HR₂</th>
<th>HR₃</th>
<th>HR₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L₁</td>
<td>93.4</td>
<td>92.3</td>
<td>93.9</td>
<td>91.8</td>
</tr>
<tr>
<td>L₂</td>
<td>95.4</td>
<td>92.7</td>
<td>90.0</td>
<td>90.6</td>
</tr>
<tr>
<td>L₃</td>
<td>95.7</td>
<td>89.0</td>
<td>89.6</td>
<td>85.5</td>
</tr>
<tr>
<td>L₄</td>
<td>90.3</td>
<td>90.6</td>
<td>90.3</td>
<td>94.8</td>
</tr>
<tr>
<td>S₁</td>
<td>94.6</td>
<td>92.0</td>
<td>91.2</td>
<td>92.5</td>
</tr>
<tr>
<td>S₂</td>
<td>92.9</td>
<td>89.9</td>
<td>91.2</td>
<td>91.0</td>
</tr>
<tr>
<td>S₃</td>
<td>92.1</td>
<td>89.7</td>
<td>89.8</td>
<td>88.3</td>
</tr>
<tr>
<td>S₄</td>
<td>94.2</td>
<td>91.8</td>
<td>91.9</td>
<td>90.4</td>
</tr>
<tr>
<td>S₅</td>
<td>95.9</td>
<td>92.4</td>
<td>90.7</td>
<td>91.2</td>
</tr>
<tr>
<td>X¹</td>
<td>94.0</td>
<td>91.1</td>
<td>91.0</td>
<td>90.7</td>
</tr>
</tbody>
</table>

R₁ = Read aloud.

HR₂ . . . ₄ = Heard, repeated.

¹A difference between means 1.52 is significant at the .05 level, and 2.03 is significant at the .01 level.
Figure 11. Plot of the shift in mean intensity in dB (re .0002 dynes/cm$^2$) from one recording to the next when ten-syllable phrases were read aloud, and then successively heard and repeated three times. Most change is shown to be between Recording I and Recording II.
Summary of profiles of intensity

Although no statistical test was made comparing the successive intensity peaks of the recorded messages, the bar-graph of intensities in Figure 12 suggests a systematic reduction of sound pressure throughout a passage. From top to bottom, the bars of Figure 12 represent the succession of the intensity peaks measured from the power level recordings. This reduction in intensity as the passage progresses may reflect a progressive loss of sub-glottic air-pressure from the beginning to the end of the passage.

Summary

The results of this experiment are that successive oral repetitions of heard ten-syllable passages are longer in duration of speech output, have longer durations of voicing, show no significant change in range of pitch, and show a decrease in level of intensity. The decrease in level of intensity was significant only for the read aloud to the first heard repeated comparison.

Chapter V will summarize and treat the limitations and implications of the present study. It will also include suggestions for future research and discuss possible practical applications of the findings.
Figure 12. Plot of the levels representing four successive measurements (shaded) of intensity from ten-syllable passages which were read aloud, and then successively heard and repeated three times. (R₁, HR₂, ..., 4)
CHAPTER V

SUMMARY AND CONCLUSIONS

The experiment

One hundred sixty ten-syllable passages were randomized and divided into four lists of 40 passages each. Five typewritten copies were made of each list. The five copies of list I were given to the first five subjects. The five copies of list II were given to the second five subjects and so on for all 20 subjects. The 20 subjects respectively read their 40 passages aloud. These readings were recorded. Subsequently, these four list-determined groups of five subjects each were rotated in a manner to hear and repeat only passages which had been recorded by one of the other groups. These successive oral repetitions were recorded on tape. This oral processing was carried through three repetitions for a total of four recordings for each list of passages, each by a different five subjects.

The measurements

Measurements were made of the durations of speech output and of voicing, range of pitch, and levels of
Intensity. These were compared, successive recordings, different lists, and different orders. The statistical evaluation of these measurements has been reported in Chapter IV.

In the successive oral repetitions of 160 ten-syllable passages, the durations of speech output and of voicing increased significantly, the range of pitch decreased, and intensity decreased significantly.

Other sources of variation

Sources of variation other than the successive oral repetitions may have been significant.

Durations of passages. There were two F-ratios, one for between-subject interaction and one for between list variation which were significant at the .01 and the .05 levels respectively, in the analysis of durations of speech output.

The between-subject interaction probably resulted from a pooling of the variation between subjects. Each subject mean represented four individuals per treatment and four lists. The significant variation occurred between the five groups because their means failed to approach the collective mean for all 20 subjects.

The significant differences between lists probably reflected subject variability. The mean of each list
represented five different subjects per treatment functioning in different patterns of imitative speech depending upon the initial speaker in each series. List means varied significantly from the mean of the total of all the lists.

**Duration of voicing.** The F-ratios of the variation between lists and the interaction within subjects were both significant at the .01 level.

The variation between lists may be attributable to subject variation as well as to list variation. The randomization of the passages composing the lists makes effects due to lists alone unlikely.

**Range of pitch.** The effect of successive oral repetition was not significant; the within-subjects interaction was. It is probable that the interaction term reflects the lack of reliability of range-of-pitch as a measure in this experiment.

**Mean intensity.** The F-ratios of the variation between lists and the interaction within subjects were both significant at the .01 level. The discussion of similar findings for duration of voicing applies here, too. The experimenter is unable to explain why intensity, contrary to the other three criterion measures, was in accord with the findings for five-syllable phrases, decreasing in intensity with repetition.
Limitations of the study

I. The stimulus passages. In Chapter I, the study by Fonagy and Maddics was cited because it showed that ten-syllable phrases have longer durations of speech production and shorter durations of syllables than do five-syllable phrases. In other words, the phrases of greater syllable-length are spoken with a greater syllable-rate than are phrases of shorter syllable-length, albeit their durations of speech output are longer.

It was also pointed out that the ten-syllable passages composed by Mahaffey were assemblages of pairs of five-syllable phrases. The distinction drawn here between "passage" and "phrase" is deliberate and may be important. Because the Mahaffey passages were assembled with duration as the only criterion for pairing, syntactic relationships of the first and second five-syllable components of a passage could not be depended upon. Moreover, the lack of such continuity was an advantage for him because it tended to reinforce the delayed side-tone-induced cluttering of speech.

In the present instance, as the experiment proceeded through successive recordings the passages underwent some noticeable modifications: pauses for breath somewhere between the first and the tenth syllable, and altered or deleted words, subtle changes in emphasis and brief pauses
which seemed to mark a shift to shorter phrases, in the
direction of plausible syntax. At the conclusion of the
study many of the passages appeared to be composed of two
or more phrases.

According to Black, the response phrases tend to
imitate the stimulus phrases in duration, intensity, and
inflection. In the present study, the listeners
seemingly began by imitating the speech patterns of the
readers. However, there appears to have been some
tendency by each listener-speaker to modify the more
nonsensical of the passages which he heard into somewhat
more sensible ones. He may have done this either by
shifting inflection, changing emphasis, altering the
phrasing, or by converting a word into a different but
similar sounding one which seemed more meaningful. It is
likely that this would not have occurred so markedly had
the stimulus passages been natural phrase units, or had
they been made more nonsensical instead, so that the
subjects might have been less tempted to impose order by
changing the words. The preceding speculation points up
the change in number of phrasal units per passage in the
course of the experiment.

In summary, two five-syllable phrases have a longer
total duration than does one ten-syllable phrase, and five
two-syllable phrases would have a very much longer total duration than one ten-syllable one. Figure 1 shows these differences clearly. A spontaneous subdivision of ten-syllable passages into aggregates of phrases of less than ten syllables will result in a growth in the durations of the passages, and a consequent growth in the durations of the voicing of those passages. Intensity appears to be quite independent of the other variables, but this cannot be said definitely (Table 10). As for range of vocal pitch (Table 8), one can only speculate that treatment effects may be submerged in the interactions, or that the changes in pitch range may be subject to opposing influences from the effects of phrase repetition as one variable, and the effects of the multiplication of subphrase as an opposing variable.

The oral copying of heard phrases, as had been noted before, is attended by a significant imitation of the intensity, duration, inflection, and degree of articulation of the stimulus phrases. This copying imposes a limitation despite its being inherent in the subject of this study. The experiment began with 20 subjects reading four lists aloud in groups of five subjects per list. In subsequent treatments, the subjects heard and repeated the previous recordings of other subjects. The study began with twenty different speech patterns, durations, inflections,
intensities, degrees of articulation, and these were copied through a succession of treatments and emerged as twenty different speech patterns. Despite the assumed normality of the subject sample and the randomization of the stimulus passages, statistical grouping whether by lists or by subjects was likely to reveal significant differences and may have accounted for significant interaction terms and large error terms in the analyses.

II. The subjects. From treatment to treatment subjects had the opportunity to fraternize, become practiced, and become sophisticated with the procedures.

III. The experimenter. There is another limitation to the study. However significant the effects of the lists were or of the order of presentation of the lists to the subjects, it should be borne in mind that the experimenter made the measurements from the recordings in the order in which they were recorded. The data on the duration and intensity of speech production were co-ordinated for all four recording conditions. The measurements were made of passage 1, list 1, Recordings 1, 2, 3, and 4; then measurements were made of passage 2, list I, Recordings 1, 2, 3, and 4... passage 20, list IV, Recordings 1, 2, 3, and 4. Furthermore, the measurement of duration and intensity of speech production occupied the period extending from the middle of December through the end of the month.
of January— a total of one and one-half months. Although the interaction profiles do not indicate any regularity to the differences between list or subject effects which might be attributable to the one and one-half month span of the measurements, the possibility remains that the experimenter may have been an important variable.

Future studies

Future studies should be developed along four lines: (1) correct the present study, (2) isolation, (3) description of corollary events, and (4) development of practical applications of the phenomena.

Correct the present study. The design of present study should be revised to use five-syllable passages, and twenty naive subjects per repetition— eighty subjects, and the original recording of stimulus phrases should be done by one person.

Isolation. It is important to determine whether the observed changes in the passages are a consequence of the subject's monitoring his sidetone while his ears are occluded by headphones— presumably by bone conduction. A study comparing responses with headphones with responses under free-field listening circumstances should be done. Are the observed phenomena related to intensity of the stimulus phrases? A study employing several intensity
levels should be done. Are the phenomena exaggerated by cortical irritants such as lysergic acid di-ethyl amide (LSD), or psilocybin? A double blind study could be done. Because imitation and learning rely heavily upon repetition, another interesting drug study might be done with one of the so-called memory enhancers such as pentylenetetrazol (Metrazol).

Description of the phenomena and their corollaries. The present study examined duration of speech output, duration of voicing, range of pitch, and level of intensity of successive repetitions of heard phrases. Other phenomena might be related to these phenomena. An interesting study might attempt to correlate individual differences in the above criterion variables with suggestibility hypothesizing that there is no correlation between extent of speech modifiability of an individual orally repeating heard phrases and suggestibility. Individual differences might also be related to Intelligence Quotient.

Development of practical applications of the phenomena. Future studies may help to relate the observed phenomena to the development of better teaching machines. Because the phenomena observed occur without the speaker's awareness, they may be used by advertisers to sell products.
Summary

This chapter reviewed the study of previous chapters. The results were summarized and other sources of variation and limitations of the study were discussed and suggestions were made for future studies.
APPENDIX A

Four teams, of five readers each, received four different forty-phrase lists to read aloud. Each team member received his copy of his team's list. During the three subsequent heard-repeated recordings, the experimenter monitored the speaker, keeping a record on the appropriate master sheet.

In the upper right hand corners of the attached sheets are a number and a capital letter, separated by two virgules. An example of this is 1\(\backslash\)A. This translates: "The first member of the team to read list A." Since each list was heard and repeated by four other subjects, it was decided to assign each subject an ordinal position at the beginning. In the upper right hand corner of the page referred to above, it is noted that "list A was first recorded by the first member of the first team and subsequently heard and re-recorded by subjects 6, 11, and 16, in that order."

It will be noted that many of the errors committed by the subjects are inserted between the lines.
The flight manual for the General Radio Type 1521-B lists the following:

- Rating Speed: 20 I.P.S.
- 

1. Little excess if the wind is strong.
   - For the next take-off turn into the wind.
   - When we have enough pressure on the stick.
   - Far enough ahead to hold the nose up.
   - I can make a turn during the spiral.

2. They should be given the first landing shot.
   - Knowing when to land you see what you think.
   - Which we can get back to a full landing.
3. Make a good landing and turn into.
4. The speed of the plane before any spin.
5. With the feeling that you're over the field.
6. Follow the sequence back to level flight.
   - Then we raise the nose in for the landing.
   - We're going to do in their proper place.
7. We've crossed the wind line to circle the field.
8. It's a climbing turn out from the circle.
   - The glide is broken to avoid a skid.
   - Open the throttle as soon as we clear.
9. To start a spiral during the take-off.
10. Keep the heading straight and into the wind.

11. During the take-off reduce the throttle.
12. First spin to the right if you have a great.
13. Sometimes the traffic ahead of the plane.
15. Feeling that he has before the plane leaves.

16. Until we're up to the amount of sky.
17. Quarter of a turn around and below.
   - If power is used in a normal turn.
18. That the student sees any given time.
19. If we do not raise in such a manner that.
20. Normal gliding speed also be given.
21. Keep the wings level to keep the nose.
22. For the same reason speed is kept constant.
23. When you first cross it, we start the landing.
24. We ease back lightly the rudder-alone.

The plane is level to land on the field.

25. Higher than normal wings are kept level.
26. Wind is drifting you in a normal glide.
27. To keep a margin one thousand feet up.
28. To avoid a tree never turn your back.

THE END
A little excess if the wind is strong.

For the next take-off turn into the wind.
When we have enough pressure on the stick.
Far enough ahead to hold the nose up.

I can make a turn during the spiral.

They should be given the first landing shot.
Knowing when to land you see what you think.
Which we can get back to a full landing.

Make a good landing and turn into.

The speed of the plane before any spin.

With the feeling that you're over the field.
Follow the sequence back to level flight.
Then we raise the nose in for the landing.
We're going to do it in their proper place.

We've crossed the wind line to circle the field.

It's a climbing turn out from the circle.

The glide is broken to avoid a skid.
Open the throttle as soon as we clear.
To start a spiral during the take-off.

Keep the heading straight and into the wind.

During the take-off reduce the throttle.

First spin to the right if you have a great.
Sometimes the traffic ahead of the plane.

Show you what I mean by flying down wind.

Feeling that he has before the plane leaves.

Until we're up to the amount of sky.
Quarter of a turn around and below.
If power is used in a normal turn.

That the student sees any given time.

If we do not raise in such a manner that.

Normal gliding speed also be given.
Keep the wings level to keep the nose.

For the same reason speed is kept constant.

When you first cross it, we start the landing.

We ease back lightly the rudder alone.

The plane is level to land on the field.

Higher than normal wings are kept level.

Winds are drifting you in a normal glide.

To keep a margin one thousand feet up.

To avoid a tree never turn your back.

THE END
A little excess if the wind is strong.
For the next take-off turn into the wind.
When we have enough pressure on the stick.
Far enough ahead to hold the nose up.
I can make a turn during the spiral.

They should be given the first landing shot.
Knowing when to land you see what you think.
Which we can get back to a full landing.
Make a good landing and turn into.

The speed of the plane before any spin.
With the feeling that you're over the field.
Follow the sequence back to level flight.
Then we raise the nose in for the landing.
We're going to do it in their proper place.

We've crossed the wind line to circle the field.

It's a climbing turn out from the circle.
The glide is broken to avoid a skid.
Open the throttle as soon as we clear.
To start a spiral during the take-off.
Keep the heading straight and into the wind.

During the take-off reduce the throttle.
First spin to the right if you have a great.
Sometimes the traffic ahead of the plane.
Show you what I mean by flying down wind.

 Feeling that he has before the plane leaves.

Until we're up to the amount of sky.
Quarter of a turn around and below.
If power is used in a normal turn.
That the student sees are given.

If we do not raise in such a manner that.

Normal gliding speed also be given.
Keep the wings level to keep the nose.
For the same reason speed is kept constant.
When we first cross it, we start the landing.

We ease back lightly the rudder alone.

The plane is level to land on the field.
Higher than normal wings are kept level.
Wind is drifting you in a normal glide.
To keep a margin one thousand feet up.

To avoid a tree never turn your back.

THE END
X A little excess if the wind is strong.
   For the next take-off turn into the wind.
   When we have enough pressure on the stick.
   Far enough ahead to hold the nose up.
5 I can make a turn during the spiral.

They should be given the first landing shot.
Knowing when to land you see what you think.
Which we can get back to a full landing.
Make a good landing and turn into.
10 The speed of the plane before any spin.

With the feeling that you're over the field.
X Follow the sequence back to level flight.
X Then we raise the nose in for the landing.
   We're going to do in their proper place.
15 X We have crossed the wind line to circle the field.

X It's a climbing turn out from the circle.
X The glide is broken to avoid the skid.
   Open the throttle as soon as we clear.
   To start a spiral during the take-off.
20 X Keep the heading straight and into the wind.

During the take-off reduce the throttle.
First spin to the right if you have a great.
X Sometimes the traffic ahead of the plane.
   Show you what I mean by flying down wind.
25 Feeling that he has before the plane leaves.

X Until we're up to the amount of sky.
   Quarter of a turn around and below.
   If power is used in a normal turn.
X That the student sees any given time.
30 If we do not raise in such a manner that.

Normal gliding speed also be given.
X Keep the wings level to keep the nose.
   For the same reason speed is kept constant.
   When you first cross it, we start the landing.
35 X We ease back lightly the rudder alone.

The plane is level to land on the field.
Higher than normal wings are kept level.
X Wind is drifting you in a normal glide.
X To keep a margin one hundred feet up.
40 To avoid a tree never turn your back.

THE END
Little if the wind is strong.
For the next take-off turn into the wind.
When we have enough pressure on the stick.
Far enough ahead to hold the nose up.
I can make a turn during the spiral.

They should be given the first landing shot.
Knowing when to land you see what you think.
Which we can get back to full landing.
Make a good landing and turn into.
The speed of the plane before any spin.

With feeling that you're over the field.
Follow the sequence back to level flight.
Then we raise the nose in for the landing.
We're going to do in their proper place.
We crossed the wind line to circle the field.

It's a climbing turn out from the circle.
The glide is broken to avoid a skid.
Open the throttle as soon as we clear.
To start a spiral during the take-off.
Keep the heading straight and into the wind.

During the take-off reduce the throttle.
First spin to the right if you have a great.
Sometimes the traffic ahead of the plane.
Show you what I mean by flying down wind.

Feeling that he has before the plane leaves.

Until we're up to the amount of sky.
Quarter of a turn around and below.
If power is used in a normal turn.
That the student sees any given time.
If we do not raise in such a manner that.

Normal gliding speed also be given.
Keep the wings level to keep the nose.
For the same reason speed is kept constant.
When you first cross it, we start the landing.
We ease back lightly the rudder alone.

The plane is level to land on the field.
Higher than normal wings are kept level.
Wind is drifting you in a normal glide.
To keep a margin one thousand feet up.
To avoid a tree never turn your back.

THE END
I close the throttle to keep the rudder.
Making safe landings without any turns.
To start to level at a higher speed.

The nose is brought down worse than a good one.
You have the best chance to keep the plane in.

You can follow me for a gliding turn.
Landings are put on the rate of descent.
The controls are used higher than normal.

The plane is level if power is used.
To allow the nose exert back pressure.
I close the throttle to help the rudder.
You'll see what I mean and then turn into.
They should be given back to the wind line.

Along the wind line alone to the field.
That the student sees a normal gliding.
In such a way that you may have to hold.
You must be careful making safe landings.
If you have a great first spin to the right.

Even if you see it is nearly stalled.
In a normal glide first we lower the nose.
As soon as we're back complete the landing.
We start the landing out from the wind line.
We leave the traffic as soon as we clear.

Vary your pattern on the upwind side.
The plane is gliding out of a spiral.
Pattern that allows normal gliding speeds.
We start the nose down when you have a lot.
Keep the heading straight and into the landing.

As the plane levels the turn is started.
Seemed to be about trimming the plane.
With the wings level it is nearly stalled.
Vary your pattern until we're up to.
The correct heading gives you greater speed.

The plane is rolling in such a manner that.
The nose is pointed about this distance.
As the other planes apply to that shot.
Be the correct length about twenty feet.

You may have to hold without any turns.

THE END
LIST II.

I close the throttle to keep the rudder.
Making safe landings without any turns.
To start to level at a higher speed.
The nose is brought down worse than a good one.
You have the best chance to keep the plane in.

You can follow me for a gliding turn.

× Landings are put on the rate of descent.
× The rate of bank is still on the line.
The controls are used higher than normal.

First check the traffic until we're up to.

The plane is level if power is used.
To allow the nose exert back pressure.
× I close the throttle to keep the rudder.
You'll see what I mean and then turn into.
They should be given back to the wind line.

× Along the wind line alone to the field.
× That the student sees is normal gliding.
In such a way that you may have to hold.
× You must be careful making safe landings.

If you have a great first spin to the right.

× Even if you see it is nearly stalled.
In a normal glide first we lower the nose.
As soon as we're back complete the landing.
We start the landing out from the wind line.
We leave the traffic as soon as we clear.

Vary your pattern on the upwind side.
The plane is gliding out of a spiral.
Pattern that allows normal gliding speed.
× We start the nose down when you have a lot.
Keep the heading straight and into the landing.

× As the plane levels the turn is started.
Seemed to be about trimming the plane.
With the wings level it is nearly stalled.
Vary your pattern until we're up to.
The correct heading gives you greater speed.

The plane is rolling in such a manner that.
The nose is pointed about this distance.
As the other planes apply to that shot.
× To be the correct length about twenty feet.

You may have to hold without any turns.

THE END
LIST II.

I close the throttle to keep the rudder.  
Making safe landings without any turns.
To start to level at a higher speed.  
X The nose is brought down worse than a good one.
5 You have the best chance to keep the plane in.

You can follow me for a gliding turn.  
X Loadings are put on the rate of descent.
 X And the rate of bank is still on the line.
 X The controls are used higher than normal.
10 X First check the traffic until we're up.

The plane is level if power is used.
To allow the nose exert back pressure.
I close the throttle to help the rudder.
X You'll see what I mean and then turn into.
15 X That should be given back to the wind line.

X Follow the wind line alone to the field.
X The student sees normal gliding.
 X In such a way that you may have to hold.
 X You must be careful making safe landings.
20 X If you have a great first turn to the right.
 X Even if you see it is nearly stalled.
 X In a normal glide first to lower the nose.
10 X As soon as we're back complete the landing.
 X We start the landing out from the wind line.
25 X We leave the traffic as soon as we clear.

X Vary your pattern on the upwind side.
The plane is gliding out of a spiral.
 Pattern that allows normal gliding speed.
 X We start the nose down when you have a lot.
30 X Keep the heading straight and into the landing.
 X As the plane levels the turn is started.
 X Seemed to be about trimming the plane.
 X With the wings level it is nearly stalled.
 X Vary your pattern until we're up.
35 X The correct heading gives you greater speed.

The plane is rolling in such a manner that.
X The nose is pointed about this distance.
 X As the other planes apply to that shot.
 X Be the correct length about twenty feet.
40 X You may have to hold without any turns.

THE END
LIST II.

I close the throttle to keep the rudder.
Making safe landings without any turns.
To start to level at a higher speed.
The nose is brought down worse than a good one.
You have the best chance to keep the plane in.

You can follow me for a gliding turn.
Loadings are put on the rate of descent.
And the rate of bank is still on the line.
The controls are used higher than normal.
First check the traffic until we're up to.
The plane is level if power is used.
To allow the nose exert back pressure.
I close the throttle to help the rudder.
You'll see what I mean and then turn into.
They should be given back to the wind line.

Along the wind line along to the field.
That the student sees in normal gliding.
In such a way that you may have to hold.
You must be careful making safe landings.
If you have a great first spin to the right.

Even if you see it is nearly stalled.
In a normal glide first we lower the nose.
As soon as we're back complete the landing.
We start the landing out from the wind line.
We leave the traffic as soon as we clear.

Vary your pattern on the upwind side.
The plane is gliding out of a spiral.
Pattern that allows normal gliding speed.
We start the nose down when you have a lot.
Keep the heading straight and into the landing.

As the plane levels the turn is started.
Seemed to be about trimming the plane.
With the wings level it is nearly stalled.
Vary your pattern until we're up to.
The correct heading gives you greater speed.

The plane is rolling in such a manner that.
The nose is pointed about this distance.
As the other planes apply to that shot.
Be the correct length about twenty feet.
You may have to hold without any turns.

THE END
LIST II.

I close the throttle to keep the rudder.
× Making safe landings without any turns.
× To start to level at a higher speed.
× The nose is brought down worse than a good one.

You have the best chance to keep the plane in.
× You can follow me for a gliding turn.
× Steerings are put on the rate of descent.
× The rate of a bank is still on the line.
× The controls are used higher than normal.

First check the traffic until we're up to.
× The plane is level if power is used.
× To allow the nose exert back pressure.
× I close the throttle to help the rudder.
× You see what I mean and then turn into.
× You should be given back to the wind line.

× Along the wind line line to the field.
× That the student sees in normal gliding.

In such a way that you may have to hold.
× You must be careful making safe landings.

× If you have a great first spin to the right.

Even if you see it is nearly stalled.
× In a normal glide first we lower the nose.
× As soon as we're back complete the landing.
× We start the landing off from the wind line.

We leave the traffic as soon as we clear.

× Vary your pattern on the upwind side.
× The plane is gliding out of a spiral.
× Pattern that allows normal gliding speed.
× We start the nose down when you have a lot.

× Keep the heading straight and into the landing.

As the plane levels the turn is started.
× Seemed to be about trimming the plane.
× With the wings level it is nearly stalled.
× Vary your pattern until we're up to.

The correct heading gives you greater speed.
× The plane is rolling in such a manner that.
× The nose is pointed about this distance.

As the other planes apply to that shot.
× Be the correct length about twenty feet.

You may have to hold without any turns.

The End
You can follow me as soon as we're back.
The field is roughly under the wing tip,
during the spiral back pressure is held.
If we are coming the plane starts to climb,
You won't have enough practice these landings.

Notice that glide and rate of bank.
They should be given if the engine fails.
To keep the nose up we're going to.
On the other hand how strong the wind is.
And plan the approach angle of the wing.

You won't have to go even if you see.
Until it becomes about sixty knots.
We correct for this remaining and land.
First lower the nose in order to keep.
Pick up too much speed if there is little.

Power to help you push the stick forward.
Feeling that he has when you're crossing.
Don't look back to a poor surface.
Are seated in at forward of neutral.
First turn to the right into the wind.

Use forward pressure to move the student.
Turn into the wind before the plane lands.
Look at the wing until it comes.
We enter the turn when we're in the air.
We begin a turn before the plane leaves.

We leave the traffic clear of other planes.
To be talked over at the proper time.
As in the approach without any turn.
In order to keep a strong wind take-off.
If power is used in terms of making.

On the upwind side vary your pattern.
Make a landing on runway thirty five.
The glide is broken around and below.
Have to hold enough in a shallow dive.
Always be careful and plan your next move.

Landing is started when as soon as we're back.
The plane is mushing through the shortest arc.
The traffic pattern for the next take-off.
You won't have enough power for entry.

We lower the nose with the power off.

THE END
You can follow me as soon as we're back. The field is roughly under the wing tip. If we are coming the plane starts to decline. You won't have enough practice these landings. Notice that the glide and rate of bank. They should be given if the engine fails. To keep the nose up we're going to. On the other hand how strong the wind is. And plan the approach angle of the wing. You won't have to go even if you see. Until it becomes about sixty knots. We correct for this reaching and landing. First lower the nose in order to keep. Pick up too much speed if there is little. Power to help you push the stick forward. Feeling that he has when you're crossing. Don't look back to a poor surface. Are seated in forward or neutral. First turn to the right into the wind. Use forward pressure to help the student. Turn into the wind before the plane lands. Look at the wing until it becomes. We enter the when we're in the air. We begin a turn before the plane leaves. We leave the traffic clear of other planes. To be talked over at the proper time. As in the approach without any turns. In order to keep a strong wind take-off. If power is used in terms of making. On the upwind side vary your pattern. Make a landing on runway thirty five. The glide is broken around and below. Have to hold enough in a shallow dive. Always be careful and plan your next move. Landing is started when as soon as we're back. The plane is mushing through the shortest arc. The traffic pattern for the next take-off. You won't have enough power for entry. We lower the nose with the power off.

THE END
You can follow me as soon as we're back.
The field is roughly under the wing tip
during the spiral back pressure is held.
If we are coming the plane starts to climb.
You won't have enough practice these landings.

Notice that the glide and rate of bank.
They should be given if the engine fails.
To keep the nose up we're going to.
On the other hand how strong the wind is.
And play the approach angle of the wind.

You won't have to go even if you see.
Until it becomes about sixty knots.
We correct for this reaching and landing.
First lower the nose in order to keep.
Pick up too much speed if there is little.

Power to help you push the stick forward.
Feeling that he has when you're crossing.
Don't look back to a poor surface.
Are seated in it forward of neutral.
First turn to the right into the wind.

Use forward pressure to have the student.
Turn into the wind before the plane lands.
Look at the wing until it becomes.
We enter the turn when we're in the air.
We begin turn before the plane leaves.

We leave the traffic clear of other planes.
To be talked over at the proper time.
As in the approach without any turns.
In order to keep a strong wind take-off.
If power is used in terms of making.

On the upward side vary your pattern.
Make a landing on runway thirty five.
The glide is broken around and below.
Have to hold enough in a shallow dive.
Always be careful and plan your next move.

Landing is started when as soon as we're back.
The plane is mushing through the shortest arc.
The traffic pattern for the next take-off.
You won't have enough power for entry.
We lower the nose with the power off.

THE END
You can follow me as soon as we're back.

The field is roughly under the wing tip
during the spiral back pressure is held.
If we are coming the plane starts to climb.

You won't have enough practice these landings.

Notice that the glide and rate of bank.
They should be given if the engine fails.
To keep the nose up we're going to.
On the other hand how strong the wind is.
And plan the approach angle of the wing.

You won't have to go even if you see.
Until it becomes about sixty knots.
We correct for this reaching and landing.
First lower the nose in order to keep.
Pick up too much speed if there is little.

Power to help you push the stick forward.
Feeling that he has when you're crossing.
Don't look back for a poor surface.
Are seated in it forward of neutral.
First turn to the right into the wind.

Use forward pressure to have the student.
Turn into the wind before the plane lands.
Look at the wing until it becomes.
We enter the turn when we're in the air.
We begin a turn before the plane leaves.

We leave the traffic clear of other planes.
To be talked over at the proper time.
As in the approach without any turns.
In order to keep a strong wind take-off.
If power is used in terms of making.

On the upwing side vary your pattern.
Make a landing on runway thirty five.
The glide is broken around and below.
Have to hold enough in a shallow dive.
Always be careful and plan your next move.

Landing is started when as soon as we're back.
The plane is pushing through the shortest arc.
The traffic pattern for the next take-off.
You won't have enough power for entry.
We lower the nose with the power off.

**THE END**
You can follow me as soon as we're back. The field is roughly under the wing tip. If the spiral back pressure is held, the plane starts to climb. You won't have enough practice these landings.

Notice that the glide and rate of bank. They should be given if the engine fails. To keep the nose up, we're going to. On the other hand, how strong the wind is.

And plan the approach angle of the wing.

You won't have to go even if you see. Until it becomes about sixty knots. If we correct for this and landing. First lower the nose in order to keep. Pick up too much speed if there is little.

Power to help you push the stick forward. The feeling that he has when you're crossing. Don't look back to a poor surface. Are seated in forward or neutral.

First turn to the right into the wind.

Use forward pressure to have the student. Turn into the wind before the plane lands. Look at the wing until it becomes. We enter the turn when we're in the air.

We begin a turn before the plane leaves.

We leave the traffic clear of other planes. To be talked over at the proper time. As in the approach without any turns. In order to keep a strong wind take-off.

If power is used in terms of making.

On the upwind side vary your pattern. Make a landing on runway thirty five. The glide is broken around and below.

Have to hold enough in a shallow dive. Always be careful and plan your next move.

Landing is started when as soon as we're back. The plane is mushing through the shortest arc. The traffic pattern for the next take-off. You won't have enough power for entry.

We lower the nose with the power off.

THE END
LIST IV.

Open the throttle as soon as we clear.
So that you know when you see what I mean.
You have no power lifting up the wing.
The stick and rudder for a normal turn.
Under thirty feet reset the throttle.

To circle the field for the next take-off.
Seemed to be about under the wing-tip.
To adjust the length we reduce the power.
Enough flying speed into the landing.
Serve as a pattern back into the field.

So I'll take over to keep the plane from.
A spin to the right crossing the wind line.
We get out farther with a normal glide.
On the other hand the controls are used.

Start to level out in a sideways motion.
Start to level out so that you can land.
The plane is slipping so that out wind line.
The plane is gliding back into the field.
To start a spiral in for a landing.
Adjust the throttle in normal glide.

During the landing be sure that you have.
Shallow out the bank so that you can land.
This throttle setting should make your landing.
In order to keep landing straight ahead.

Should never carry a length of the wind line.

As the other planes making safe landings.
If we do not raise by a diving turn.
The degree of back entry to the spin.
To have the student straight along the ground.
On the other hand you may have to hold.

Start to level out when we have enough.
Release the pressure increasing the throttle.
Only then can we vary so greatly.
As we get higher it's a climbing turn.
Approach and landing at the proper time.

To keep a margin set to break the glide.
In a normal turn lower the left wing.
First lower the nose in for the landing.
To keep the nose up during the spiral.

We leave the traffic flying other planes.

THE END
LIST IV.

Open the throttle as soon as we clear.
* So that we'll know when you see what I mean.
You have no power lifting up the wing.
The stick and rudder for a normal turn.
Under thirty feet reset the throttle.

To circle the field for the next take-off.
Seemed to be under the wing-tip.
To adjust the length we reduce the power.
Enough flying speed into the landing.
Serve as a pattern back into the field.

So I'll take over to keep the plane from.
* A spin into the right crossing the wind line.
We get out farther with a normal glide.
On the other hand the controls are used.
* Start to level out sideways motion.

* Start to level out so that you can land.
The plane is slipping so that out wind line.
The plane is gliding back into the field.
To start a spiral in for landing.
Adjust the throttle in normal glide.

During the landing be sure that you have.
Shallow out the bank so that you can land.
* This throttle setting should make your landing.
In order to keep landing straight ahead.
* Should never carry length of the wind line.

As the other planes making safe landings.
* If we do not raise by diving turn.
* The degree of back entry to the spin.
* To have the student straight along the ground.
On the other hand you may have to hold.

Start to level out when we have enough.
* Release the pressure increasing the throttle.
Only then can we vary so greatly.
As we get higher it's a climbing turn.
Approach and landing at the proper time.

To keep a margin set to break the glide.
In a normal turn lower the left wing.
First lower the nose in for the landing.
To keep the nose up during the spiral.

We leave the traffic flying other planes.

THE END
Open the throttle as soon as we clear.  
So that we'd know when you see what I mean.  
You have no power lifting up the wing.  
The stick and rudder for a normal turn.  
Under thirty feet reset the throttle  

To circle the field for the next take-off.  
Seemed to be about under the wing-tip.  
To adjust the length we reduce the power.  
Enough flying speed into the landing.  
Serve as a pattern back into the field.  

So I'll take over to keep the plane from.  
A spin into the right, crossing the wind line.  
We get out farther with a normal glide.  
On the other hand the controls are used.  
Start to level out a sideways motion.  

Start to level out so that you can land.  
The plane is slipping so that the plane line.  
The plane is gliding back into the field.  
To start a spiral in for a landing.  
Adjust the throttle in normal line.  

During the landing be sure that you have.  
Shallow out the bank so that you can land.  
The throttle setting should make your landing.  
In order to keep landing straight ahead.  
Should never carry length of the wind line.  

As the other planes making safe landings.  
If we do not raise the diving turn.  
The degree of back entry to the spin.  
To have the student straight along the ground.  
On the other hand you may have to hold.  

Start to level out when we have enough.  
Release the pressure increasing the throttle.  
Only then can we vary so greatly.  
As we get higher it's a climbing turn.  

Approach and landing at the proper time.  

To keep a margin set to break the glide.  
In a normal turn lower the left wing.  
First lower the nose in for the landing.  
To keep the nose up during the spiral.  

Relieve the traffic flying other planes.  

THE END
LIST IV.

Open the throttle as soon as we clear.
X So that we'll know when you see what I mean.
You have no power lifting up the wing.
X The stick and rudder for a normal turn.
Under thirty feet reset the throttle.

To circle the field for the next take-off.
Seemed to be about under the wing-tip.
To adjust the length we reduce the power.
Enough flying speed into the landing.

X So I'll take over to keep the plane.
A spin into the right crossing the wind line.
We get out farther with a normal glide.
On the other hand the controls are used.
Start to level out a sideways motion.

Start to level out so that you can land.
X The plane is slipping so that out wind line.
The plane is gliding back into the field.
To start a spiral in for a landing.
X Adjust the throttle in normal glide.

During the landing be sure that you have.
X Shall low the bank so that you can land.
This throttle setting should make your landing.
In order to keep landing straight ahead.
X Should never carry a length of the wind line.

As the other planes making safe landings.
X If we do not raise by a diving turn.
X The degree of back entry to the spin.
X To have the student straight along the ground.
On the other hand you may have to hold.

X Start to level out when we have enough.
Release the pressure increasing the throttle.
Only then can we vary so greatly.
As we get higher it's a climbing turn.
Approach and landing at the proper time.

X To keep a margin set to break the glide.
X In a normal turn lower the left wing.
First lower the nose in for the landing.
To keep the nose up during the spiral.
X We have the traffic flying other planes.

THE END
LIST IV.

Open the throttle as soon as we clear.
X So that we know when you see what I mean.
You have no power lifting up the wing.
X The stick and rudder for a normal turn.
Under thirty feet reset the throttle

To circle the field for the next take-off.
X Seems to be about under the wing-tip.
To adjust the length to reduce the power.
X Enough flying speed into the landing.
X Seeds a pattern back into the field.

So I'll take over to keep the plane from
A spin to the right crossing the wind line.
X We get out farther with a normal glide.
On the other hand the controls are used.
Start to level out a sideways motion.

X Start to level out so that you can land.
X The plane is slipping so that out wind line.
The plane is gliding back into the field.
X To start a spiral in for a landing.
X Adjust the throttle in normal glide.

X During the landing be sure that you have.
Shallow out the bank so that you can land.
X This throttle setting should make your landing.
In order to keep landing straight ahead.
X Should never carry length of the wind lined

As the other planes making safe landings.
X If we do not raise by diving turn.
X The degree of back entry to the spin.
To have the student straight along the ground.
On the other hand you may have to hold.

Start to level out when we have enough.
Release the pressure increasing the throttle.
X Only then can we vary so greatly.
As we get higher it's a climbing turn.
Approach and landing at the proper time.

X To keep a margin set to break the glide.
In a normal turn lower the left wing.
X First lower the nose in for the landing.
To keep the nose up during the spiral.
X We leave the traffic flying other planes.

THE END

Relax
APPENDIX B

Analyses of variance and derivative tables and figures for sound-pressure level measurements I, II, III, and IV for the experimental passages.
TABLE 11. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of the first of four sound pressure level measurements in dB per phrase (re: .0002 dyne/cm² when phrases were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL (b)</td>
<td>119.42</td>
<td>3</td>
<td>39.80</td>
<td>2.65</td>
</tr>
<tr>
<td>Error (b)</td>
<td>254.76</td>
<td>16</td>
<td>15.92</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>116.25</td>
<td>3</td>
<td>38.75</td>
<td>5.46**</td>
</tr>
<tr>
<td>L</td>
<td>70.03</td>
<td>3</td>
<td>23.34</td>
<td>3.29*</td>
</tr>
<tr>
<td>RL (w)</td>
<td>84.81</td>
<td>6</td>
<td>31.80</td>
<td>4.48**</td>
</tr>
<tr>
<td>Error (w)</td>
<td>446.77</td>
<td>48</td>
<td>7.10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1092.04</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
Figure 13. Change in intensity of the first of four intensity readings from ten-syllable phrases which were read aloud and then successively heard and repeated three times. Data are in dB re: .0002 dyne/cm².
TABLE 12. One dimensional critical difference table for the first of four sound pressure level peak measurements per phrase in dB re: .0002 dyne/cm² when the phrases were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20.

<table>
<thead>
<tr>
<th>Means</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁ = 95.77</td>
<td>R₁</td>
<td>2.71**</td>
<td>2.66**</td>
</tr>
<tr>
<td>M₂ = 93.06</td>
<td>R₂</td>
<td>.05</td>
<td>.44</td>
</tr>
<tr>
<td>M₃ = 93.11</td>
<td>R₃</td>
<td></td>
<td>.49</td>
</tr>
<tr>
<td>M₄ = 92.61</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
TABLE 13. Effect of lists upon the means of the first of four graphic-level readings in dB re: .0002 dyne/cm². Measurements were taken from phrases which were read aloud and subsequently heard and repeated three times. Each entry is the mean of recordings by five subjects.

<table>
<thead>
<tr>
<th></th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>L₁</td>
<td>95.49</td>
<td>94.56</td>
<td>96.31</td>
<td>93.33</td>
</tr>
<tr>
<td>L₂</td>
<td>97.91</td>
<td>94.51</td>
<td>91.60</td>
<td>92.21</td>
</tr>
<tr>
<td>L₃</td>
<td>97.03</td>
<td>90.53</td>
<td>91.83</td>
<td>87.91</td>
</tr>
<tr>
<td>L₄</td>
<td>92.64</td>
<td>92.63</td>
<td>92.67</td>
<td>97.00</td>
</tr>
</tbody>
</table>
Figure 14. Effect upon the first of four intensity readings in dB re .0002 dyne/cm$^2$ of the lists and treatments when 160 ten-syllable phrases were read aloud and then successively heard and repeated three times.
TABLE 14. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of the second of four sound pressure level measurements per phrase in dB (re: .0002 dyne/cm²) when phrases were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL(b)</td>
<td>149.86</td>
<td>3</td>
<td>5.00</td>
<td>.40</td>
</tr>
<tr>
<td>Error(b)</td>
<td>200.57</td>
<td>16</td>
<td>12.54</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>189.78</td>
<td>3</td>
<td>63.26</td>
<td>9.48**</td>
</tr>
<tr>
<td>L</td>
<td>140.33</td>
<td>3</td>
<td>46.78</td>
<td>7.01**</td>
</tr>
<tr>
<td>RL(w)</td>
<td>231.32</td>
<td>6</td>
<td>46.89</td>
<td>7.03**</td>
</tr>
<tr>
<td>Error(w)</td>
<td>319.93</td>
<td>48</td>
<td>6.67</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1281.79</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
Figure 15. Change in intensity of the second of four inflection readings from 10-syllable phrases which were read aloud and then successively heard and repeated three times. Data are in dB re: .0002 dyne/cm².
TABLE 15. One dimensional critical difference table for means of the second of four sound pressure level peak measurements per phrase in dB re: 0.0002 dyne/cm² when the phrases were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20.

<table>
<thead>
<tr>
<th>Means</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁ = 94.66</td>
<td>R₁</td>
<td>.09</td>
<td>3.43**</td>
</tr>
<tr>
<td>M₂ = 94.75</td>
<td>R₂</td>
<td></td>
<td>3.52**</td>
</tr>
<tr>
<td>M₃ = 91.23</td>
<td>R₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M₄ = 94.52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
TABLE 16. Effect of treatments and lists upon the means of the second of four graphic-level readings per phrase and dB re: .0002 dyne/cm² when the phrases were read aloud and subsequently heard and repeated three times (treatments). N, subjects, 20.

<table>
<thead>
<tr>
<th></th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>L₁</td>
<td>94.26</td>
<td>93.29</td>
<td>94.37</td>
<td>92.81</td>
</tr>
<tr>
<td>L₂</td>
<td>96.47</td>
<td>93.33</td>
<td>90.51</td>
<td>90.94</td>
</tr>
<tr>
<td>L₃</td>
<td>97.69</td>
<td>88.86</td>
<td>90.34</td>
<td>85.69</td>
</tr>
<tr>
<td>L₄</td>
<td>91.54</td>
<td>91.80</td>
<td>91.74</td>
<td>95.77</td>
</tr>
</tbody>
</table>
Figure 16. Effect upon the intensity of the second of four inflection readings in dB re: .0002 dyne/cm² by lists and treatments when 160 ten-syllable phrases were read aloud and then successively heard and repeated three times.
TABLE 17. Summary of analysis of variance (Lindquist, Mixed design, Type II) of the third of four sound pressure level measurements per passage in dB (re: .0002 dyne/cm²) when passages were read aloud and subsequently heard and repeated three times (treatments). \( N \), readers, 20. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between Subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>466.64</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL(b)</td>
<td>166.16</td>
<td>3</td>
<td>55.38</td>
<td>2.94</td>
</tr>
<tr>
<td>Error(b)</td>
<td>300.48</td>
<td>16</td>
<td>18.78</td>
<td></td>
</tr>
<tr>
<td><strong>Within Subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>715.39</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>170.26</td>
<td>3</td>
<td>56.75</td>
<td>7.72**</td>
</tr>
<tr>
<td>L</td>
<td>60.53</td>
<td>3</td>
<td>20.17</td>
<td>2.74</td>
</tr>
<tr>
<td>RL(w)</td>
<td>231.43</td>
<td>6</td>
<td>38.57</td>
<td>5.24**</td>
</tr>
<tr>
<td>Error(w)</td>
<td>253.17</td>
<td>48</td>
<td>7.35</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1182.03</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
Figure 17. The downward change in intensity of the third of four intensity readings from ten-syllable phrases which were read aloud and then successively heard and repeated three times. Data are in dB re: .0002 dyn/cm².
TABLE 18. One dimensional critical difference table of treatment means for the third of four sound pressure level peak measurements per passage in dB re: .0002 dyne/cm	extsuperscript{2} when the phrases were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20.

<table>
<thead>
<tr>
<th>Means</th>
<th>$R_2$</th>
<th>$R_3$</th>
<th>$R_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_1 = 93.10$</td>
<td>$R_1$</td>
<td>3.19**</td>
<td>3.29**</td>
</tr>
<tr>
<td>$M_2 = 89.91$</td>
<td>$R_2$</td>
<td>.10</td>
<td>.39</td>
</tr>
<tr>
<td>$M_3 = 89.81$</td>
<td>$R_3$</td>
<td>.29</td>
<td></td>
</tr>
<tr>
<td>$M_4 = 89.52$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 18. Effect upon the intensity of the third of four inflection readings in dB re: .0002 dyne/cm² of the interaction between lists and treatments when 160 ten-syllable passages were read aloud and then successively heard and repeated three times.
TABLE 19. Summary of analysis of variance (Lindquist, Mixed Design, Type II) of the fourth of four sound pressure level measurements per passage in dB (re: .0002 dyne/cm²) when passages were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20. Recordings (R), Lists (L).

<table>
<thead>
<tr>
<th>Sources of Variation</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td>383.32</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL(b)</td>
<td>215.48</td>
<td>3</td>
<td>71.83</td>
<td>6.85**</td>
</tr>
<tr>
<td>Error(b)</td>
<td>167.84</td>
<td>16</td>
<td>10.49</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td>975.32</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>138.54</td>
<td>3</td>
<td>46.18</td>
<td>4.85**</td>
</tr>
<tr>
<td>L</td>
<td>121.56</td>
<td>3</td>
<td>40.52</td>
<td>4.26**</td>
</tr>
<tr>
<td>RL(w)</td>
<td>258.31</td>
<td>6</td>
<td>43.05</td>
<td>4.52**</td>
</tr>
<tr>
<td>Error(w)</td>
<td>456.91</td>
<td>48</td>
<td>9.52</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1258.65</td>
<td>79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
Figure 19. Downward change in intensity of the fourth of four inflection readings from ten-syllable passages which were read aloud and then successively heard and repeated three times. Data are in dB re: .0002 dyne/cm².
TABLE 20. One dimensional critical difference table for means of the fourth of four sound pressure level peak measurements per passage in dB re: .0002 dyne/cm² when the passages were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20.

<table>
<thead>
<tr>
<th>Means</th>
<th>R₁</th>
<th>R₂</th>
<th>R₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁ = 91.71</td>
<td>R₁</td>
<td>2.95**</td>
<td>2.79**</td>
</tr>
<tr>
<td>M₂ = 88.77</td>
<td>R₂</td>
<td>.16</td>
<td>.35</td>
</tr>
<tr>
<td>M₃ = 88.93</td>
<td>R₃</td>
<td>.50</td>
<td></td>
</tr>
<tr>
<td>M₄ = 88.42</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
Figure 20. Effect upon intensity of the fourth of four inflection readings per passage in dB re: .0002 dyne/cm² of subjects and treatments when 160 ten-syllable passages were read aloud and then successively heard and repeated three times.
Figure 21. Effect upon mean intensity of the fourth of four intensity readings per phrase in dB re: .0002 dyne/cm² of lists and treatments when 160 ten-syllable passages were read aloud and then successively heard and repeated three times.
APPENDIX C

Table and figures representing interactions encountered between lists and between subjects for the criterion measures.
Figure 22: Effect upon durations of speech output of the subject levels and recordings of 150 ten-syllable phrases when they were read aloud and then successively heard and repeated three times. The most significant interaction is in Recording 2 for subjects 2 through 5. Subject-order within lists was a significant variable.
Figure 23. Duration of voicing by lists and treatments for passages which were read aloud and subsequently heard and repeated three times. There was a significant difference between lists in their effect upon duration of voicing.
Figure 24. The means of range of pitch by lists and treatments of 160 ten-syllable phrases which were read aloud and then successively heard and repeated three times. The direction of change in pitch range is significantly different from list to list.
TABLE 21. One dimensional critical difference table for treatment differences among means of four readings of intensity in dB (re: .0002 dyne/cm²) per phrase of phrases which were read aloud and subsequently heard and repeated three times (treatments). N, readers, 20.

<table>
<thead>
<tr>
<th>Means</th>
<th>R₂</th>
<th>R₃</th>
<th>R₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁ = 93.54</td>
<td>R₁</td>
<td>2.82**</td>
<td>3.00**</td>
</tr>
<tr>
<td>M₂ = 91.14</td>
<td>R₂</td>
<td>.19</td>
<td>.47</td>
</tr>
<tr>
<td>M₃ = 90.95</td>
<td>R₃</td>
<td>.28</td>
<td></td>
</tr>
<tr>
<td>M₄ = 90.67</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at .05 level.

**Significant at .01 level.
Figure 25. Effect upon mean intensity in dB re: .0002 dynes/cm² of the lists and treatments when 160 ten-syllable phrases were read aloud and then successively heard and repeated three times. Lists differed significantly from one another in their effects upon mean intensity.
Figure 26. Plots of four intensity measures made on ten-syllable phrases which were read aloud, then successively heard and repeated three times (Alternate plot of Figure 17).
BIBLIOGRAPHY


Lightfoot, C. Effects of the mode and levels of transmitting messages upon the relationship between their duration and the duration of their repetition. Kenyon College Technical Report SDC 411-1-5.


Linch, G. A. "Phonophotographic study of trained and untrained voices reading factual and dramatic material." Archives of Speech, 1:1, 1934.


