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A Study of Certain Effects of Local and Topical Anesthetics on the Speech of Stutterers

Charles Michael Gross

A STUDY OF CERTAIN EFFECTS OF LOCAL AND TOPICAL ANESTHETICS ON THE SPEECH OF STUTTERERS

by

Charles Michael Gross

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CHAPTER I

INTRODUCTION

Introductory Statement

The ability to monitor one's own vocal output is essential if one is to produce and maintain normal speech. Speech would become progressively defective if one were unable to detect errors in voice, articulation, or rate. The preservation and maintenance of speech require the coordination of several automatic systems in the human body. One of these systems includes the tactual-kinesthetic purpose of defining the tactual-kinesthetic role and its relation to feedback cues in the production of speech.

Since speech is controlled by more than one automatic feedback system, it is essential that an investigation of these channels be explored thoroughly in order that their relative contribution be established. Speech is a complex process. Therefore, information leading to a better understanding of this process will aid in explaining how man is able to control his vocal output and maintain normal speech.

The importance of the role of the kinesthetic sense in speech is recognized by Patton who states:

> Without the kinesthetic sense the conditioned reflex

> of speech could probably never be established nor maintained. There must be a memory whether it is a conscious or unconscious, of the series of motor acts involved in the necessary respiration, of the series of motor acts involved in the necessary respiration, phonation, resonation, and articulation before a sound or group of sounds can be reproduced. In babbling the infant repeats random sounds he makes accidently at first. The stimulus for repetition at this time is probably almost entirely kinesthetic, though after a few repititions the auditory sense may aid in this stimulation. When the adult repeats these random sounds made by the infant and applies them to objects, the kinesthetic image becomes conditioned to the auditory image and to the visual image so that either may with practice evoke the sound originally made by the child. However, until a sound or group of sounds has been repeated a sufficient number of times to create a kinesthetic memory, it cannot be reproduced at will. Thus the kinesthetic sense is basically important in the first stages of speech. (21, p. 305)

Van Riper and Irwin believe that the kinesthetic and tactual patterns develop, become more vivid and important as one matures from infancy, soon becoming sufficiently stabilized to serve as the dominant control for speech; all auditory cues, heretofore of primary importance in the largest phases of speech development, slowly being relegated to a secondary role. (28, p. 10)

Gray and Wise relate speech to conditioning of kinesthetic sensibility. "The ability to speak, then, is based upon the possession of innumerable neurograms, which resulted from conditioning the musculature of the speech organs to respond to inadequate stimuli." (29, p. 278)

The tactual and kinesthetic circuits are but a part of the automatic control system which monitors our speech.

by both auditory and non-auditory circuits; b) to compare and measure speech with a master pre-set reference pattern, and c) to alter output deviating from this pre-set pattern so that it more closely approximates the standard pattern. Ringel (23) in his study concluded that:

> ...articulatory errors under conditions of feedback alteration...are a result of the speech system's inability to match its output to the reference master pattern which exists in each phoneme. Specifically, precise feedback to the effector regarding the error extent of the fine articulator adjustment is necessary for accurate speech. The effector must receive information regarding the extent of the error if it is to bring about the correct output level under conditions of altered feedback. However, the effector unit is rendered incapable of functioning at its maximum level. In other words, it is theorized that altered feedback interferes with the proper comparison of output to input and therefore places severe restrictions upon the system's power to resolve errors within the usual time limits. (23, pp. 90, 91)

Articulation errors are not the only type of disruptions observed in the speech of a person whose monitoring system has been interrupted. Behavior resembling stuttering has been observed when auditory feedback is delayed. (8) Observations of the different varieties of speech disturbances which accompany feedback disturbances has led some speech pathologists to speculate about a relationship between stuttering and disruption or synchronym of the feedback mechanism.

SELECTION OF PROBLEM

Very little research has been carried out with respect to non-auditory feedback cues and normal speech. Complete data regarding non-auditory feedback cues and their importance in stutterers is virtually nonexistent. If any relationship between stuttering and feedback disfunctions is to be investigated, it is imperative first that data be accumulated with respect to the reaction of stutterers as well as of normal speakers to disrupted non-auditory cues.

The present study was designed to explore the extent to which non-auditory feedback cues affect the speech rate, articulation, and the number of stuttering blocks of stutterers.

CHAPTER II

RELATED STUDIES

McCroskey (18) using nonstuttering subjects, studied the effects of anesthetization of the lower lip, cheek, buccal and lingual gingivie, anterior two thirds of the tongue, entire alvelous and teeth under conditions of normal and delayed auditory side-tone. Each of the six subjects read three word lists under four experimental conditions: first, normal side-tone; second, delayed (0.18 second) air-borne side-tone; third, anesthetized articulators; and fourth, delayed side-tone plus anesthesia. The third experimental condition was produced in the following manner.

> Bilateral mandobular blocks of the inferior alveolar nerves at the mandibular foramen were performed. (A total of approximately 4 cc of 2 percent Xylocaine with 1:50,000 Epinephrine was used for each subject). The lingual and buccal nerves were anesthetized with the same injection at different levels of needle insertion. Anesthesia of these three pairs of nerves eliminated sensor innervation of the lower lip, and cheek, buccal and lingual gingivie, and the anterior two-thirds of the tongue as well as the entire alveolus and teeth. The lip was anesthetized by inraorbital foramen injections from an intraorol approach. As far as it was possible to ascertain, there was no interference with the motor pathways due to the injections. (18, pp 1,2)

McCroskey (18) found that the rate of progress of speech did not differ significantly between the normal and the anesthetic conditions; i.e., subjects were able to read aloud just as rapidly with an anesthetized lower lip, tongue and cheek as without. He also reported significantly fewer words were correctly articulated when tactile cues were interfered with than under either normal or delayed side-tone conditions; that when tactual cues were disrupted speech was judged significantly less intelligible than either conditions of normal or delayed side-tone. There was no significant difference in the number of words correctly articulated between anesthesia alone and the conditions in which the delay was combined with anesthesia.

In a study to determine the effect of high level masking and anesthetization of the lips, tongue, cheeks, and lower jaw upon articulatory proficiency and certain voice characteristics of normal adult speakers, Weber (29) attempted to eliminate the auditory and non-auditory feedback cues of normal speakers. Four experimental conditions were used: normal, masked, anesthetized, and combined. No disruption in feedback was carried out in the normal condition. The masked condition consisted of air and bone conduction masking. The non-auditory masking condition consisted of four injections of an anesthetic into the sensory nerves of the lips, tongue, cheeks and lower jaw. The combined condition consisted of a combination of the masked and anesthetized conditions. Results of the study indicated that there were significantly more articulation errors in the two conditions containing disruption of the non-auditory channel (anesthetized and combined) than in the normal condition; the masked condition not being significantly different in numbers of errors from the normal condition. He also reported that various differences in the types of articulation errors were caused when auditory and non-auditory feedback channels were disrupted.

"In the normal and masked conditions, the errors were about two-thirds distortions, one third omissions, and very few substitutions. In the anesthetized and combined conditions the errors were about one half distortions, three-eights substitutions, and one-eighth omissions." (29, p. 59)

Weber concluded that non-auditory feedback cues seem to be of greater importance to the correctness of articulation than do auditory feedback cues and that different types of errors of articulation result from disruptions of auditory and non-auditory feedback channels. Pitch and loudness were affected by auditory feedback cues more than by non-auditory feedback cues thus suggesting that the former monitoring channel was dominant in this instance.

Ringel (23) studied the effects on speech output when the oral region's tactile and auditory sensorium information was altered. Thirteen females majoring in speech pathology and audiology served as subjects. Each subject read a standard passage under six randomly administered conditions: 1) control (absence of both anesthetic or masking); 2) binaural masking (94 db SPL white noise); 3) anaesthetization of the lower lip, cheek, buccal and lingual gingivie and the anterior two-thirds of the tongue by topical application of Xylocaine

HCL four percent; 4) local anesthetization of the oral region by bilateral mandibular block and infraorbital nerve block technique employing Xylocaine HCL two percent; 5) simultaneous use of binaural masking and anesthetization of the oral region by topical application of Xylocaine HCL four percent. 6) simultaneous use of binaural masking and local anesthetization of the oral region by bilateral mandibular and infraorbital nerve block technique employing Xylocaine HCL two percent.

Ringel found that speech rate is retarded in the presence of masking noise and local anesthesia; articulation accuracy is seriously impaired by the use of local anesthesia; the most common type of articulation error under altered tactual sense conditions is phonemic distortion.

Guttman (10) attempted to eliminate both auditory and non-auditory feedback cues when he sought to define the role of each in the speech control system. Six subjects were instructed to read a passage aloud under six conditions: normal reading, reading with thermal noise and reading with delayed auditory feedback of two tenth seconds at a level thirty decibels over normal conversational loudness. The three conditions were repeated with anesthetization of the oral cavity. Masking was by means of thermal noise delivered by earphones at a sensation level of eighty decibels. The noise spectrum was essentially flat from 100 - 7,000 cycles per second. Xylocaine HCL was used in the anesthetized condition.

Elimination of the non-auditory cues was carried out by means of a bilateral nerve block of the inferior portion of the fifth cranial nerve, including the alveolar, lingual, and mandibular branches.

"The anesthetic agent was two cc of two percent Lidocaine solution, 1:50,000 parts adrenalin. The injections, bilaterally administered, was into the medial surface of the mandible in the region of the mandibular foramen." (10, p. 321)

He reported significant differences at the .05 level of confidence with reference to the number of correctly articulated words under local anesthesia. The mean number of correctly articulated words was 50.7 from a possible fifty-five for the normal reading, and for anesthesia alone 40.8. Notice should be given that in this study slightly fewer words were correctly articulated under anesthesia alone than under combined anesthetization and masking. The subjects, who were all enrolled in a college public speaking course at the time of this study, took an average of 20.0 seconds to read the passage under the combination of anesthesia and masking, 19.0 seconds for anesthesia alone, 18.6 for masking alone, and 17.3 seconds to read the passage under normal conditions. These differences, however, were not significant.

Guttman's results were similiar to those of McCroskey in that anesthesia caused fewer words to be correctly articulated. They also agreed that the anesthesia caused no significant difference between reading rate means of the conditions anesthesia and normal.

Only two relevant investigations of cues other than auditory and dealing with stuttering have been reported.

Both involved the alteration of the tactile feedback channel by means of sprayed or injected anesthetics. Desai (5) in an effort to study the effects of reduced auditory and tactile feedback on the speech of stutterers, applied Xylocaine anesthetic spray to the lips, tongue, and buccal cavity of twenty-four adult stutterers. Each subject read three 250-word reading passages of factual material under six experimental conditions: I, no noise, no spray (control); II, Xylocaine (applied by atomizer into the subject's oral cavity); III, placebo (applied with atomizer); IV, noise with no spray; V, noise with Xylocaine; and VI, noise with placebo. The order of presentation was counterbalanced for the twenty-four subjects.

During condition II, in which the Xylocaine solution was liberally sprayed by atomizer into the subject's oral cavity, the subjects were instructed to hold the spray in their mouths for sixty seconds, then spit it out or swallow it. The swallowed solution was considered to have been diluted enough by the saliva to have lost its anesthetizing effect. This spray-wait procedure was repeated twice so that there was a total of three sprayings, each followed by a sixty second wait. A total of five cc of Xylocaine was required for the three sprayings. Subjects proceeded with the reading of the test passage at the end of the sixty second wait after the third spray. Desai reported that several of the subjects showed a strong gag reflex due to the bitter taste of the Xylocaine and spontaneously spit out the liquid. In such cases subjects were sprayed again. This second spray was then regarded as the initial spray for the condition.

Noise was fed to each subject binaurally. The intensity was increased in steps until a ninety-five decibel level was reached. The subjects were instructed to read all passages aloud in his normal manner without either trying to control or modify stuttering patterns.

Results of the Desai study indicate that under conditions IV, V, and VI; the noise conditions, stuttering was found to be less severe than under conditions I, II, and III; the no-noise conditions. The mean severity for the placebo condition was the lowest of the mean for the three no-noise conditions as well as for the three noise conditions. On the other hand, mean judged seventy was higher for the Xylocaine condition both in the noise and no-noise series. In terms of the frequency of stuttered words, more stuttering was observed under the anesthetic condition during both the noise and no-noise series.

Although judges were not asked to rate speech quality, Desai reported that some deterioration in speech quality with masking noise, and even more with Xylocaine anesthetic was evident.

> ...with the Xylocaine spray, subjects seemed to speak with more nasality, some slurring of speech, and with lowered pitch level. Several subjects reported difficulty in articulating in the Xylocaine spray conditions. (5, p. 8)

Hejna (12) used eight college students, who were judged moderate to severe stutterers, in an effort to determine whether frequency of stuttering during oral reading and spontaneous speech of stutterers would be altered when tactual feedback was reduced. Subjects first read a prepared passage of material and then spoke spontaneously using informal conversation for a five minute period. This was tape recorded using an Ampex 620 recorder. Subjects were then given a twenty minute rest period. Next topical Xylocaine was applied to the lips and tongue of each subject. After a three minute waiting period, subjects repeated the reading of the passage and again spoke spontaneously for a five minute period. This was also tape recorded. A frequency count of stuttering blocks for each subject, under each condition, was carried out, and statistical comparisons made. Results failed to reach the five percent level of significance. Hejna concluded that:

> Cues afforded by superficial kinesthetic contacts during the act of speaking, play no significant role in triggering stuttering blocks. However, since the topical anesthetic affects only the mucous membrance of the tongue and lips, it is still possible that underlying structures, such as articulatory musculaturl, or proprioceptive nerve impulses leading to such muscles might play a part in affording kinesthetic or tactile feed-back so as to trigger stuttering blocks. (12, p. 4)

Statement of the Problem

It is generally conceded that tactual-kinesthetic cues play an important tole in speech. Previous research had indicated that the tactual-kinesthetic sense both in stutterers and non-stutterers may play an integral part in the formulation of speech patterns. In essence, past investigators have reported that the tactual-kinesthetic sense plays an insignificant role in the speech rate of normal speakers (10,18) but that it plays a major role in articulation patterns of normal speakers (18,23,29) and stutterers.

With respect to stutterers, Hejna reported that under topical anesthetic no significant increases in the frequency of stuttering blocks were observed. Desai found that under topical anesthesia the mean number of stuttering blocks was slightly higher than control conditions, although his results were not significant at the five percent level of confidence. In addition, Desai noted a tendency for the articulation of stutterers to become less accurate under anesthetic conditions.

The purpose of this experiment was to study the effect of two types of anesthetics, in various combinations, upon the articulation, number of stuttering blocks and speech rate of stutterers.

Expressed in more specific terms, the purpose of the present study was to test the following null hypothesis:

HYPOTHESIS I. THE ORAL READING RATE OF STUTTERERS UNDER VARIOUS CONDITIONS OF ANESTHESIA DOES NOT DIFFER FROM THE ORAL READING RATE OF STUTTERERS UNDER NORMAL CONDITIONS.

So far there has been little or no experimental investigation of the speech rate of stutterers under the influence of anesthetics. This hypothesis is devised to determine if such a difference exists.

<u>HYPOTHESIS II.</u> THE NUMBER OF STUTTERING BLOCKS OF STUTTERERS UNDER VARIOUS CONDITIONS OF ANESTHESIA DOES NOT DIFFER FROM THE NUMBER OF STUTTERING BLOCKS OF STUTTERERS WHEN UNDER NORMAL CONDITIONS.

So far there has been little or no experimental investigation of the frequency of stuttering blocks under various conditions of anesthetics. This hypothesis is devised to determine if such a difference exists.

<u>HYPOTHESIS III.</u> THE NUMBER OF CORRECTLY ARTICULATED WORDS OF STUTTERERS UNDER VARIOUS CONDITIONS OF ANESTHESIA DOES NOT DIFFER FROM THE NUMBER OF CORRECTLY ARTICULATED WORDS OF STUTTERERS UNDER NORMAL CONDITIONS.

Some research has indicated that under the influence of an anesthetic a stutterers capacity to articulate correctly is impaired. This hypothesis was designed to investigate more carefully the subjective observations of previous investigations.

CHAPTER III

PROCEDURES

Selection of Subjects

Six male adult stutterers served as subjects for this investigation. All were between the ages of twenty and twenty-seven years of age. The mean age was 23.3. Although all subjects had previous experience with anesthetics, none had experience with them as they were administered in this investigation. (See administration of local, topical, and local-topical anesthetic). Five of the subjects had received speech therapy at Western Michigan University. One subject was receiving speech therapy at the Michigan Rehabilitation Institute during the time of this study. All subjects considered themselves stutterers and were considered stutterers by the investigator.

Selection of Anesthetic

Xylocaine (HCL) two percent with epinepherin was selected as the anesthetic agent for this investigation as experience has established that the anesthesia is rapid in onset, and highly predictable with respect to duration, extent, and depth. Because of its potency it is clinically effective in low concentrations, a factor which renders this drug particularly suitable to a wide spectrum of local and topical anesthesia procedures. Research (5)(12)(18)(23)(29) also indicates that Xylocaine has met similar cuteria in previous investigations. Since the extent and speed of drug diffusion throughout the tissues in the oral region. Xylocaine with epinepherin was selected as the latter agent restricts diffusion of the drug into other areas.

Administration of Local Anesthesia

Subjects were seated in a dental chair and given a brief oral examination. Each subject reported that he had never experienced any ill effects with topical or local anesthetics of any kind previous to this investigation.

The local anesthetic was administered[1] by means of a Cook-Waite asperating syringe using a #25 guage needle. The injection procedure was as follows:

> The retromolar notch in the asceding ramus of the mandoble was palpated with the index finger. At its deepest point the needle was inserted in the pteragal-temporal space and advanced medial to the inner surface of the mandoble to a depth halfway to the anterior and posterior boarders of the ascending ramus. At this point .6 cc of Xylocaine (2%) solution was deposited and the needle removed. This procedure was carried out bilaterally.

After the injection each subject waited approximately three minutes for the anesthetic to take effect. The dentist then tested the subject's oral cavity at various points with a pointed metal dental explorer for pain and pressure to make certain that no other structures but the anterior two-thirds of the tongue, floor of the mouth and the mucosal of the inside of the lower jaw were anesthetized. Structures

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[1] All experimental conditions involving the drug Xylocaine were administered by Dr. Michael Steinberg DDS.

were considered anesthetized when a subject could feel neither pain nor pressure when stroked with the pointed end of the metal explorer. As far as it was possible to ascertain there was no interference with motor pathways due to the injections.

Application of Topical Anesthetic

The second method of anesthetizing the tongue was that of topical anesthesia. The tongue tip was grasped between two sterile gauze pads by the dentist. Each subject's tongue was then swabbed dry with another gauze pad. The entire anterior two-thirds of the tongue, was then coated with a five percent topical ointment by means of a cotton swab. Surface anesthesia was achieved within three to five minutes.

Application of Local and Topical Anesthetic

This procedure was carried out in exactly the same manner as the individual conditions I and II except that after the local anesthetic was injected and the tongue, floor of the mouth, and the inside of the lower jaw tested with the explorer, the topical anesthetic was applied in the same manner as condition II.

Instructions

Instructions used during this experiment were similar to those used by Desai (5) They were as follows: "Please read the passage before you aloud in your normal or usual manner without trying to control or to fake stuttering."

A signal was agreed upon by which the experimenter would inform the subject if he was too close or too far away from the microphone thus causing the distortion light on the tape recording machine to flicker. The signal was never used during the readings. The subjects were not told the purpose of the experiment until after the last condition. Each subject was cautioned not to speak after each anesthetization unless he was answering questions from either the dentist or the experimenter.

Experimental Task

The experimental task consisted of reading 133 words of mimeographed material (see Appendix) under four conditions. The stimulus material consisted of the 133-word "My Grandfather" passage. The passage contained all the sounds found in the English language and was not considered to be difficult reading as far as word recognition was concerned. All conditions in the sequence were presented at approximately the same time of the day for any given subject. At least twenty-four hours separated each condition.

The same room was used for all recording. This room was across the hall from the room in which each anesthetic condition was administered, only the experimenter and one subject were in the room at one time during testing. The subject was seated in a chair. A tape recorder was placed in front of him. A mimeographed copy of the material to be read was placed face down in front of each subject. Upon signal from the experimenter, each subject turned the reading material over and read into a microphone.

The Criterion Measures

Reading rates were judged with a stop watch by the investigator, and were expressed simply in terms of the total time required for each reading task. All timing was made from the tapes of the subjects. Only the passage was timed; the title was not included in timing but was used as a "signal" for the investigator that the subject was about to begin reading the passage.

The ability of the investigator to make reliable measures was established by having a graduate student in speech pathology at Western Michigan University rejudge eight of the experimental tapes. Four of the tapes were judged for stuttering blocks and four for articulation errors and the agreement between judges was computed.

An error in articulation was judged to have occurred during the reading of the test passage under the following conditions: 1) when there was an addition or intrusion of additional phonemic elements within a word during the reading of the test passage; 2) when there was a substitution of an inappropriate vowel or consonant within a word; 3) when there was an omission of any sound(s) from a word during the reading of the test passage was considered an articulation error; 4) when there was distortion of any sound in a word.

A stuttering block was judged to have occurred: 1) when there was a repetition of a word, i.e. if the word itself was pronounced more than once during the reading of the test passage; 2) when there was a repetition of a sound within a word; 3) when there was a prolongation of a sound within a word or if the word itself was judged by the experimenter as drawing attention to itself because of the time involved to pronounce it on the part of the speaker; or 4) when there were unusual hesitations before a word or the inclusion of starting devices such as the clearing of the throat, an unusual sound, or coughing in order that the speaker gain time to better prepare himself before attempting to speak.

When one or more of the above conditions occurred, during a word, it was counted as one stuttering block. Therefore, if more than one of the conditions occurred in a word, it was still considered as only one block.

CHAPTER IV

RESULTS AND DISCUSSION

The investigator and the graduate student judge agreed ninety-three percent of the time in judging the occurence of stuttering blocks. With respect to correctly articulated words, the agreement was ninety percent. These figures were judged to be sufficiently high to establish the investigators reliability on making these criterion measures.

The significance of the differences among the group mean of the four experimental conditions was tested separately for each of the three criterion measures.

A Lindquist (16, p. 156) treatment by subject design was employed in this study in order to eliminate inter-subject differences as a source of error.

HYPOTHESIS I: THE ORAL READING RATE OF STUTTERERS UNDER VARIOUS CONDITIONS OF ANESTHESIA DOES NOT DIFFER FROM THE ORAL READING RATE OF STUTTERERS UNDER NORMAL CONDITIONS.

The mean reading times of the six subjects for the four conditions are listed in TABLE I and are represented graphically in FIGURE I.

As shown in TABLE I, the mean reading time for the control condition was 92.6 seconds. Only the second condition,

TABLE I: THE MEANS OF THE READING TIMES, IN SECONDS, FOR SIX SUBJECTS

Conditions	Mean
Control	92.6
Local Anesthetic	97.2
Local-Topical Anesthetic	84.3
Topical Anesthetic	79.5

local anesthetic, showed an increase in the mean reading time for the six subjects. The other two conditions, local-topical, and topical anesthetic alone showed a decrease in mean reading time of 84.3 and 79.5 respectively. In an analysis of variance using the Lindquist treatment by subject design formula, an F value of 1.080 was obtained. As shown in TABLE II this value is not significant at the five percent level of confidence.

TABLE II: SUMMARY OF ANALYSIS OF VARIANCE FOR THE READING TIME, IN SECONDS, FOR SIX SUBJECTS

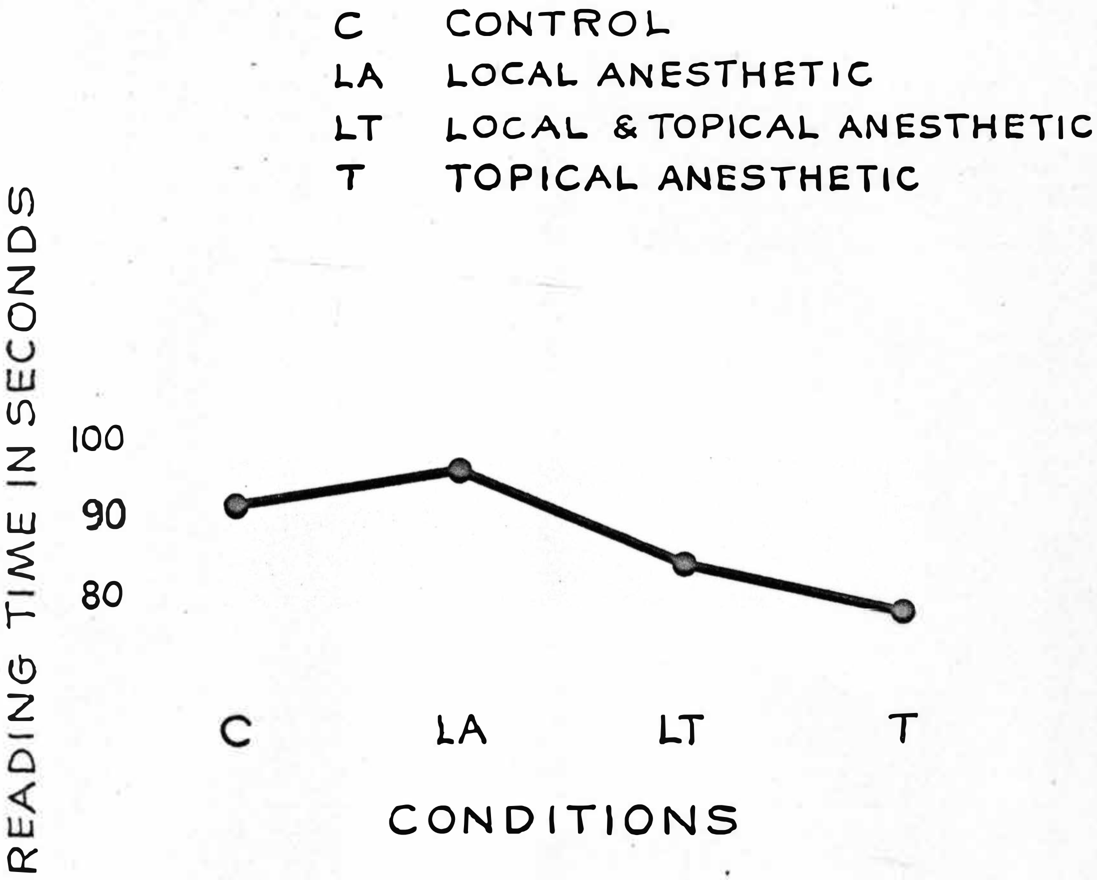
Source	df	ss	ms	F*
Treatments (A)	3	3206.240	1068.746	1.808**
Subjects (S)	5	59596.298	11919.259	
Treatments x Subjects (AS)	15	14839.662	989.310	
Total	23	77642.200		

$*F = MS_A / MS_{AS}$

$**F_{05\ (df = 3,15)} = 3.29$

FIGURE I

THE MEANS OF THE READING TIMES, IN SECONDS, FOR SIX SUBJECTS



Thus the null hupothesis that there is no difference in the reading times of stutterers under various conditions of anesthesia cannot be rejected at the five percent level of confidence. However, individual differences were apparent, as noted by the raw scores listed in TABLE III and shown in FIGURE II.

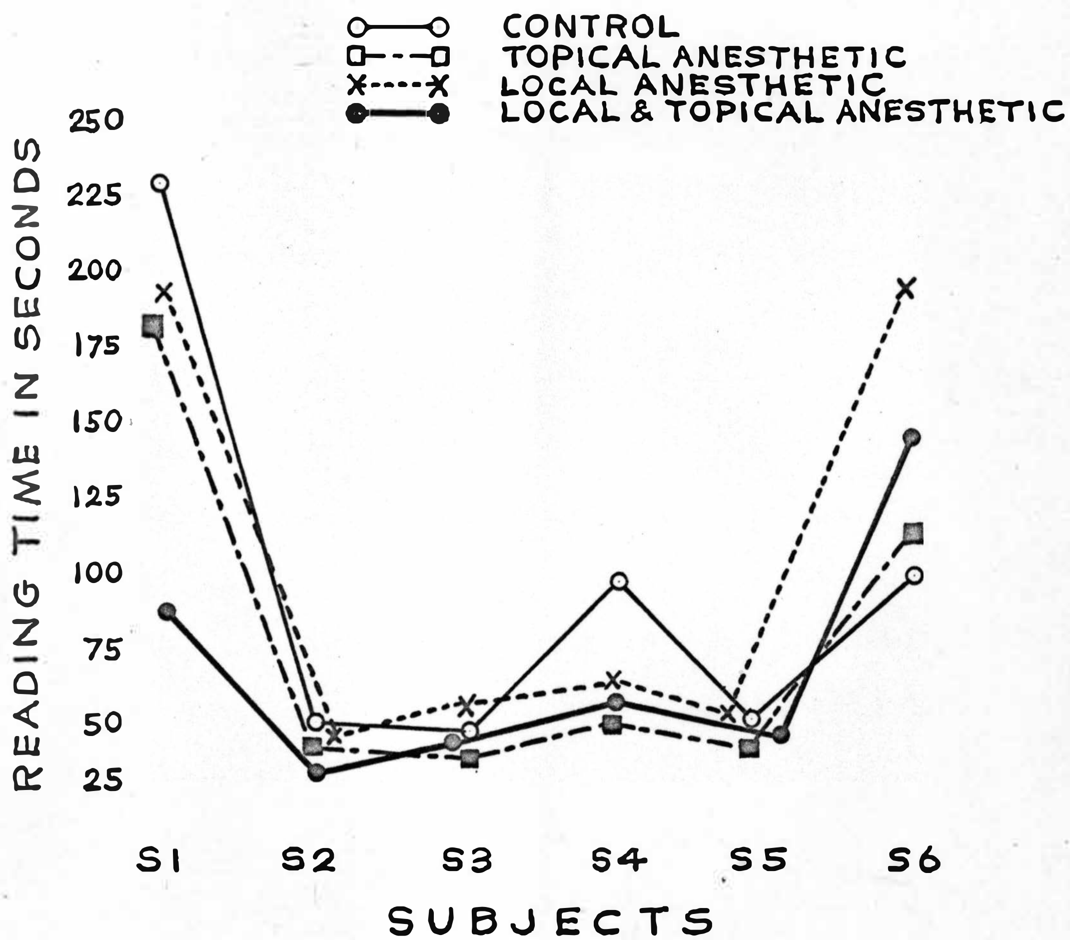
TABLE III: RAW SCORES OF THE READING TIMES, IN SECONDS FOR SIX SUBJECTS

Subject	Control	Local	Local & Topical	Topical
S_1	222.6	188.4	80.8	183.6
S_2	52.2	51.9	47.8	46.0
S_3	42.7	46.2	41.6	41.0
S_4	97.0	61.0	54.4	51.0
S_5	46.0	42.5	40.4	40.2
S_6	95.3	193.2	141.2	115.6

Although group mean reading times were not significantly different, there was a general trend for the raw scores of individual reading times to decrease under conditions of local, topical, and combination local-topical anesthetics. Two subjects (S_3, S_6), however, evidenced an increase in reading time under local anesthetic. Only one subject (S_6) showed an increase in reading time under the combination of local-topical anesthetics. This same subject also evidenced an increase in reading rate raw score under topical anesthetic.

FIGURE II

TOTAL READING TIMES FOR SIX SUBJECTS



Results of this part of the study confirm those of McCrosky (18) who found that the rate of progress of speech does not differ significantly between normal and anesthetic conditions. The present study indicates that under topical anesthesia the mean reading rate was reduced but that the figures are not significant. According to Guttman, under topical anesthetic there was an increase in mean reading time although, as in the present study, his results were not significant. These two studies taken together suggest that local anesthesia does not significantly affect reading time, with either stutterers or nonstutterers. McCrosky's subjects were able to read just as rapidly with an anesthetized lower lip, tongue, and cheek under normal conditions. Guttman's subjects were able to read more rapidly with anesthetized lips, tongue and cheek than under normal conditions. In the present study, in general, the six stutterers were able to read faster under the influences of various combinations of anesthetics but, as in the McCrosky study, this trend did not produce differences of sufficient magnitude to be significant at the five percent level of confidence.

The possibility that reading rate and frequency of stuttering blocks were differentially affected by local anesthesia is suggested by the fact that under local anesthesia the number of stuttering blocks observed was less than that observed in the control condition; on the other hand, the reading time was greater in the control condition than in the local anesthesia condition. The present study, of course, provides no direct basis for discussing the effect of local anesthesia on perceived severity of stuttering.

HYPOTHESIS II: THE NUMBER OF STUTTERING BLOCKS OF STUTTERERS UNDER VARIOUS CONDITIONS OF ANESTHESIA DOES NOT DIFFER FROM THE NUMBER OF STUTTERING BLOCKS WHEN UNDER NORMAL CONDITIONS.

The means of the number of stuttering blocks of the six subjects for the four conditions are listed in TABLE IV. These same means are represented graphically in FIGURE III.

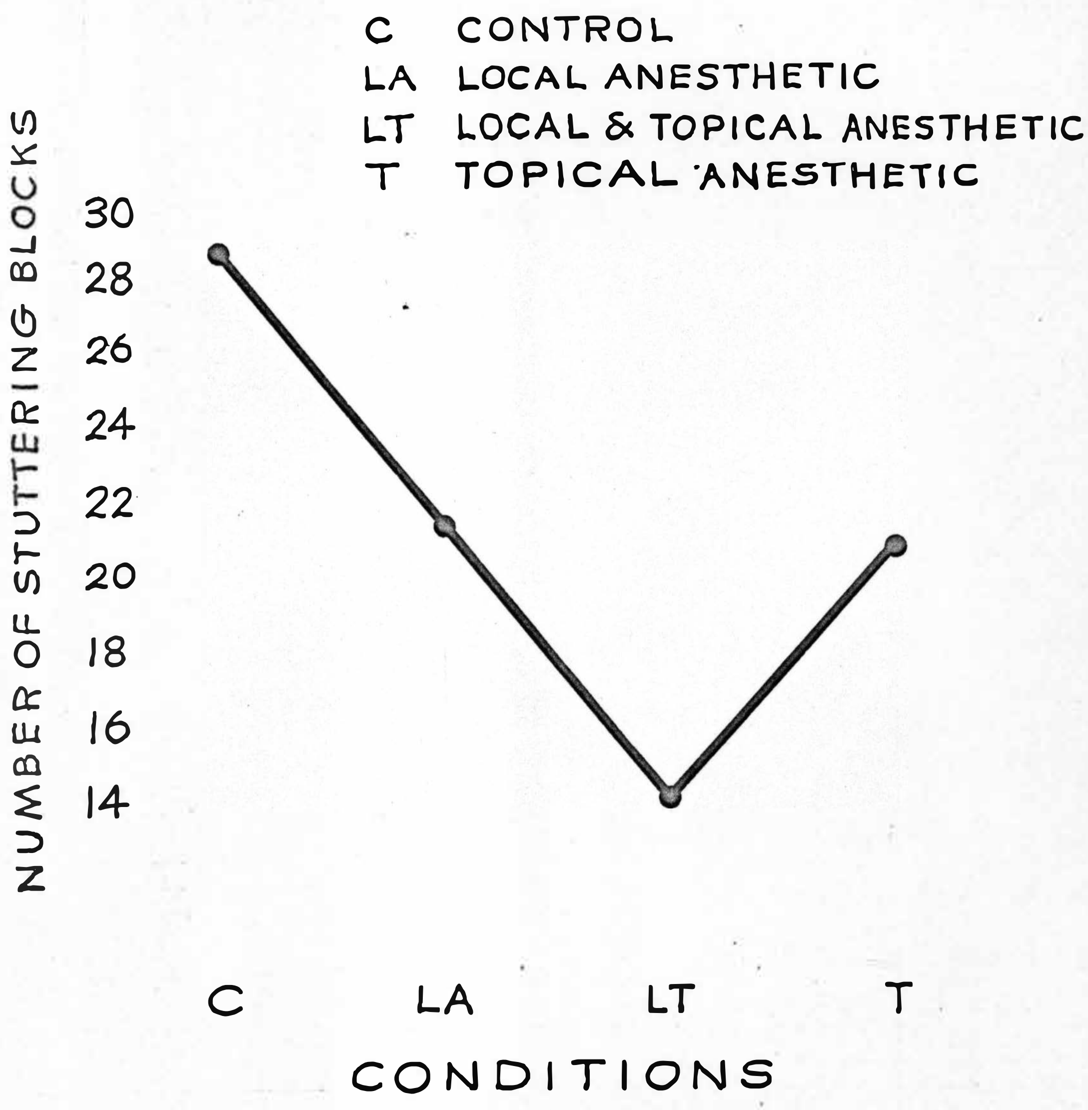
TABLE IV. THE MEANS OF THE NUMBER OF STUTTERING BLOCKS FOR SIX SUBJECTS

Conditions	Mean
Control	28.3
Local Anesthetic	21.1
Local & Topical Anesthetic	14.0
Topical Anesthetic	20.8

As shown in TABLE IV and FIGURE III there was a decrease in the mean number of stuttering blocks under all conditions involving the use of anesthetics. The mean number of stuttering blocks in the control condition was 28.3. The mean number of stuttering blocks for local anesthetic, local-topical combination, and topical anesthetic alone were 21.1, 14.0 and 20.8 respectively.

FIGURE III

THE MEANS OF THE NUMBER OF STUTTERING BLOCKS
FOR SIX SUBJECTS



As can be seen in TABLE V and FIGURE IV, all but two of the subjects did evidence a reduction in the number of stuttering blocks for all anesthetic conditions.

TABLE V: RAW SCORES OF THE NUMBER OF STUTTERING BLOCKS FOR SIX SUBJECTS

Subject	Control	Local	Local & Topical	Topical
S_1	78	72	26	71
S_2	6	4	1	3
S_3	1	1	0	1
S_4	42	9	5	5
S_5	4	1	2	1
S_6	39	40	50	44

Of the two exceptions, one (S_3) had the same number of blocks in the local and topical conditions as he had in the control condition. The other subject (S_6) showed an increase in stuttering blocks under the influence of all anesthetic conditions. The raw scores for this individual increased from thirty-nine stuttering blocks in the control condition to forty blocks under local anesthetic, to forty-four blocks under topical anesthetic and to fifty blocks under the influence of a combination of local-topical anesthetics. As shown in TABLE VI an F value of 1.42 was obtained in an analysis of variance using the Lindquist treatment by subjects design formula. This value is not significant at the five percent level of confidence.

FIGURE IV

NUMBER OF STUTTERING BLOCKS FOR SIX SUBJECTS

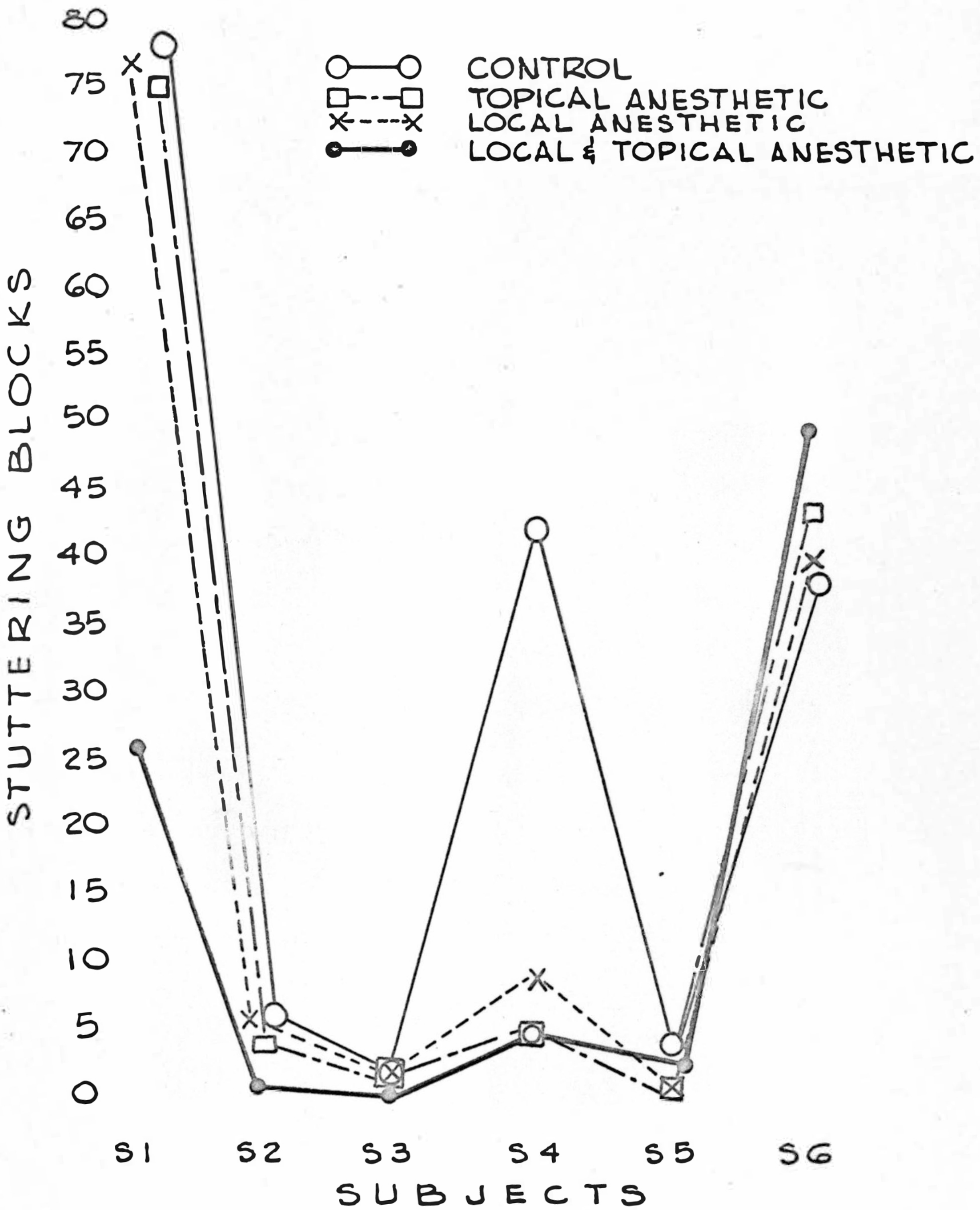


TABLE VI. SUMMARY OF ANALYSIS OF VARIANCE FOR THE NUMBER OF STUTTERING BLOCKS FOR SIX SUBJECTS

Source	df	ss	ms	F*
Treatments	3	616.83	205.61	1.42**
Subjects	5	13063.83	2612.77	
Treatments X Subjects	15	2175.167	145.01	
Total	23	15855.83		

$*F = MS_A / MS_{AS}$

$**F_{.05\ (df\ =\ 3,15)} = 3.29$

Thus the null hypothesis that there is no significant difference in the number of stuttering blocks of stutterers under various conditions of anesthesia cannot be rejected. Results of this part of the study were similar to those of Hejna (12) who tried to determine whether altered tactual feedback would reduce the frequency of stuttering blocks. Both the Hejna study and the present study failed to produce results which were significant at the five percent level of confidence when only topical anesthetics were involved. In addition, the present study failed to produce significant differences at the five percent level of confidence for conditions involving local anesthetic, or for the combination of local-topical anesthetics.

HYPOTHESIS III: THE NUMBER OF CORRECTLY ARTICULATED WORDS OF STUTTERERS UNDER VARIOUS CONDITIONS OF ANESTHESIA DOES NOT DIFFER FROM THE NUMBER OF CORRECTLY ARTICULATED WORDS OF STUTTERERS UNDER NORMAL CONDITIONS.

The means of the number of correctly articulated words for six subjects under the four conditions are listed in TABLE VII and shown graphically in FIGURE V.

TABLE VII: THE MEANS OF THE NUMBER OF CORRECTLY ARTICULATED WORDS FOR SIX SUBJECTS

Conditions	Mean
Control	132.5
Local Anesthetic	125.3
Local & Topical Anesthetic	128.1
Topical Anesthetic	131.3

As shown in TABLE VII the mean for the correctly articulated words for the control condition was 132.5. The maximum being 133. The means for correctly articulated words for local anesthetic alone, the combination local-topical anesthetics, and topical anesthetic were 125.3, 128.1 and 131.3 respectively. Thus, the mean number of correctly articulated words for the six subjects was reduced in all anesthetic conditions. In an analysis of variance using the Lindquist treatment by subject design formula, however, an F value of 2.186 was obtained; and, as shown in TABLE VIII, this value is not significant at the five percent level of confidence.

FIGURE V

THE MEANS OF THE NUMBER OF CORRECTLY ARTICULATED WORDS FOR SIX SUBJECTS

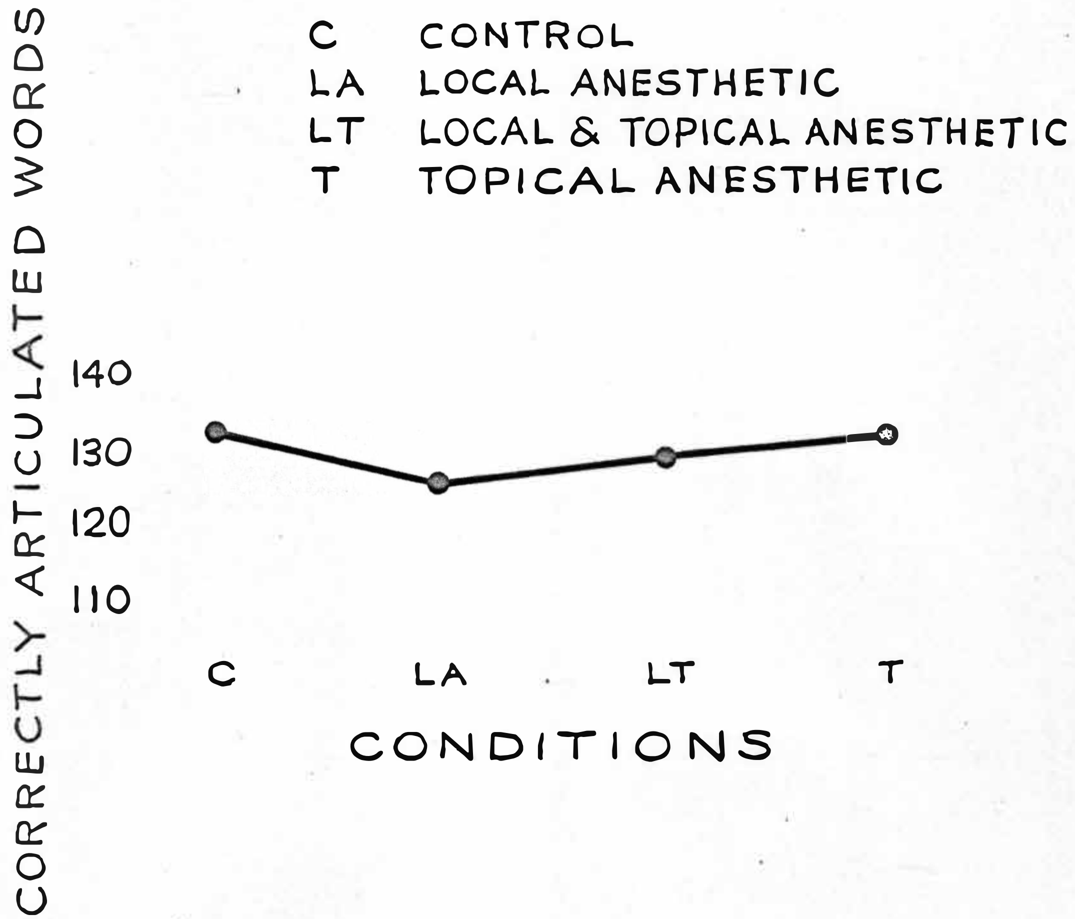


TABLE VIII: SUMMARY OF ANALYSIS OF VARIANCE FOR THE NUMBER OF CORRECTLY ARTICULATED WORDS FOR SIX SUBJECTS

Source	df	ss	ss	F*
Treatments (A)	3	188.326	62.775	2.186**
Subjects (S)	5	110.340	22.068	
Treatments x Subjects (AS)	15	430.674	28.711	
Total	23	729.340		

$*F = MS_A / MS_{AS}$

$**F_{.05\ (df = 3,15)} = 3.29$

Thus the null hypothesis that there is no difference in the number of correctly articulated words of stutterers under various conditions of anesthesia cannot be rejected at the five percent level of confidence. However, individual differences were apparent as noted by the raw scores listed in TABLE IX and as shown in FIGURE VI.

Four subjects correctly articulated all words in the reading passage under the control conditions. Two of these subjects articulated fewer words correctly when under the influence of the three anesthetic conditions than the control condition. One subject (S_1) correctly articulated all words during the control, topical and local anesthetic conditions; showing a reduction in correctly articulated words only when the combination local-topical anesthetics were employed. One subject (S_3) correctly articulated all words during the control, topical and combination local-topical conditions; showing a reduction of correctly articulated words only under the influence of local anesthetic. One subject (S_2) misarticulated one word during the control condition. His raw score indicates that for two conditions, local and topical anesthetic combined and topical alone he misarticulated the same number of words. In addition, this subject did the poorest job of articulation when under the influence of both local and topical anesthetics. Subject five (S_5) correctly articulated all words in the reading passage under the topical-local anesthetic and local anesthetic alone whereas he mispronounced two words during the control condition. Under topical anesthetic alone this subject misarticulated three words. (In addition, this subject had one more misarticulation under the combination local-topical anesthetic than under the control condition).

TABLE IX: THE RAW SCORES OF THE NUMBER OF CORRECTLY ARTICULATED WORDS FOR SIX SUBJECTS

Subject	Control	Local	Local & Topical	Topical
S_1	133	133	133	128
S_2	132	128	128	118
S_3	133	133	111	133
S_4	133	131	128	131
S_5	131	133	133	130
S_6	133	130	119	129

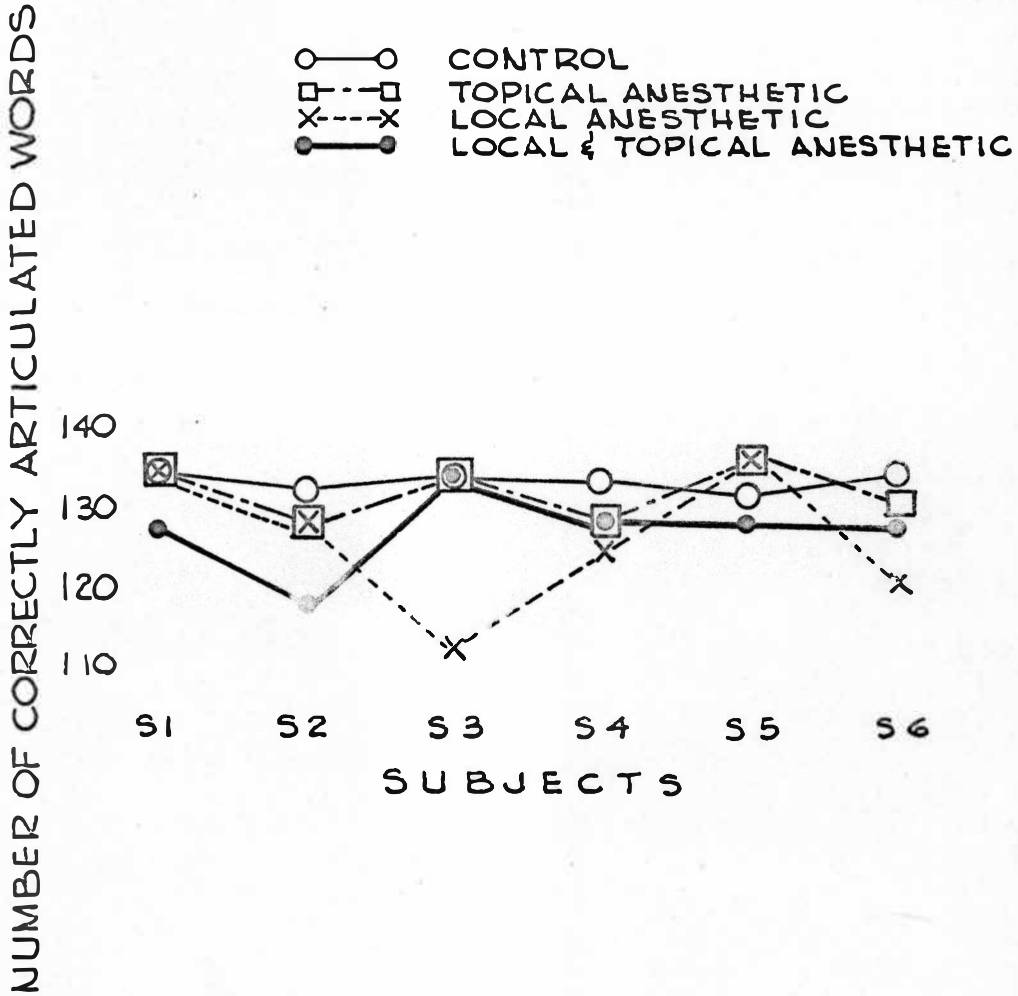
Results of this study do not confirm those of McCrosky (<u>18</u>), or Guttman (<u>10</u>), who found that in non-stuttering subjects anesthesia caused significantly fewer words to be correctly articulated than under normal conditions.

Six male stutterers tape recorded an oral reading passage, under four conditions: control, local anesthetic, topical anesthetic, and a combination local-topical anesthetic. Observed differences in reading time, number of stuttering blocks, and number of articulation errors were analyzed statistically.

The results indicated that under the conditions studied: 1) there were no significant differences in the oral reading times of stutterers; 2) there were no significant differences in the number of stuttering blocks experienced; and 3) there were no significant differences in the number of correctly articulated words.

FIGURE VI

NUMBER OF CORRECTLY ARTICULATED WORDS FOR SIX SUBJECTS, THE MEANS OF THE NUMBER OF STUTTERING BLOCKS FOR SIX SUBJECTS



CHAPTER V

SUMMARY AND CONCLUSIONS

Although no significant differences were obtained statistically, the results of this study generally agree with certain trends observed by other investigators who used speakers. it was, observed that the reading rate of stutterers behaved in a similar manner to those of normal speakers reported in other investigations.

Guttman (10) and Ringel (23) both observed that normal speaker's articulation accuracy was reduced when the lips, jaws, tongues, and cheeks of their subjects were anesthetized by a local anesthetic. Ringel noted that the mean number of articulation errors increased under local anesthesia, and Guttman also noted a decrease in the mean number of correctly articulated words. The present investigation also noted the trend for subjects to have a reduced number of correctly articulated words under the influence of local anesthetic. However, this trend was not great enough to produce statistically significant differences.

The present investigation does not confirm the trend reported by Desai that under topical anesthetic there is an increase in the number of judged disfluent words. The present study indicates that the trend is for subjects to have a reduced number of stuttering blocks.

Also noted in the present investigation was the non-homogeneity of the stuttering group. It was obvious that large individual differences in one individual in a small group will influence the outcome to a greater extent than if the entire group tends to behave similarly. Future investigators should select homogeneous groups of stutterers for subjects for research of this kind.

It is possible that differences between findings of the present study and other studies reviewed may have resulted from differences in procedures.

Theoretically, under the influence of the various combinations of anesthetics the sensory abilities of the tongue were affected in two ways. First, under topical anesthetic only the tactual cues were eliminated. Only the mucosa of the tongue was anethetized. As a result, each subject may have been able to place his tongue with relative accuracy even though he didn't receive all of the usual tactual cues when his tongue made contact with other parts of his mouth. Second, during local anesthetic, both the tactual and the kinesthetic cues were eliminated. As a result, in addition to not receiving tactual feedback, cues afforded by the deep musculatures of the tongue as to its position were also eliminated.

If it is true that stutterers utilize non-auditory feedback cues differently than do normal speakers, this difference should be apparent in the results. This possibility is supported by the observation that a combination of local and topical anesthetics had more of an effect on the articulation accuracy than did local or topical anesthetic administered alone. However, very little is known about these effects on normal speech.

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APPENDIX I

MY GRANDFATHER

YOU WISHED TO KNOW ALL ABOUT MY GRANDFATHER. WELL, HE IS NEARLY NINETY-THREE YEARS OLD; HE DRESSES HIMSELF IN AN ANCIENT BLACK COAT, USUALLY MINUS SEVERAL BUTTONS; YET HE STILL THINKS AS SWIFTLY AS EVER. A LONG, FLOWING BEARD CLINGS TO HIS CHIN, GIVING THOSE WHO OBSERVE HIM A PRONOUNCED FEELING OF THE UTMOST RESPECT. WHEN HE SPEAKS, HIS VOICE IS JUST A BIT CRACKED AND QUIVERS A TRIFLE. TWICE EACH DAY HE PLAYS SKILLFULLY AND WITH ZEST UPON OUR SMALL ORGAN. EXCEPT IN THE WINTER WHEN THE OOZE OR SNOW OR ICE PREVENTS, HE SLOWLY TAKES A SHORT WALK IN THE OPEN AIR EACH DAY. WE HAVE OFTEN URGED HIM TO WALK MORE AND SMOKE LESS, BUT HE ALWAYS ANSWERS, "BANANA OIL!" GRANDFATHER LIKES TO BE MODERN IN HIS LANGUAGE.