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Oral Sensation And Related Vocal Parameters As A Function Of Age

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ORAL SENSATION AND RELATED VOCAL PARAMETERS AS A FUNCTION OF AGE

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ABSTRACT OF THESIS

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Previous research has established relationships between chronological age and performance on an oral stereognostic task and between chronological age and perceived age estimates. Based on these findings, it is plausible that a relationship may exist between perceived age estimates and performance on an oral stereognostic task.

The present study was designed to investigate the relationship, if any, between perceived age estimates and oral stereognostic performance. In addition, as all previous research in these two areas had utilized male subjects only, male vs. female performance on oral stereognosis was also examined. To substantiate previous findings, the relationship between perceived age estimates and chronological age was also studied.

Twenty-eight male and 29 female subjects between 30 and 80 years of age were voluntary participants in the study. Subjects were required to record a reading passage for later use as a voice sample for age estimates. In addition, all subjects made same-different judgments for 36 pairs of oral forms. Perceived age estimates in years, based on the recorded voice samples, were made by a total of 37 listeners in two different listening conditions (i.e., listeners aware or unaware of age range of speakers).

Pearson product-moment correlations were utilized to investigate relationships between the four variables (i.e., chronological age, mean perceived age estimates conditions I and II, and number of errors on the oral stereognostic task). Two-way analysis of variance was also employed to study the effects of sex, age, and their interaction on oral stereognostic performance. In addition, the significance of differences between perceived age estimates for male vs. female subjects of equivalent chronological age was determined using t-tests. Intra- and inter-examiner reliability of listeners' judgments was also established using Pearson product-moment correlations.

The results of the present study may be summarized as follows:

1. There was no relationship between perceived age and number of errors on the oral stereognostic task for female subjects. For male subjects, there was a suggestion of a relationship between perceived age and oral stereognostic performance, although the correlation coefficients were slightly below the .05 level of significance.

2. There was no significant difference between overall male and female performance on the oral stereognostic task.

3. There was a relationship between perceived age and chronological age for both sexes.

4. There was no significant difference between perceived age estimates for male and female subjects of equivalent chronological age.

5. Perceived age judgments did not vary significantly regardless of whether the listeners were aware or unaware of the age range of the speakers.

In light of the present findings, the necessity of further research on randomized groups of aged subjects to clarify the effects of aging on oral sensory-perceptual abilities and the relationship of such abilities to vocal output becomes clear. The previously established relationship between chronological and perceived age was supported by the present findings. This finding indicates that a reduction in oral sensory-perceptual ability was not a necessary accompaniment of characteristic voice changes with advancing age.

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CHAPTER I

INTRODUCTION

Studies Concerning Oral Sensory Perception and Articulation

Numerous studies have been done to investigate the nature of the relationship between oral sensory-perceptual ability and its effect on articulation. Where individuals with reduced oral sensory perception were not available for research, decreased oral sensation has been induced through various methods of anesthetization. Various observable articulatory and acoustical deviations have been correlated with a reduction in oral sensation.

Mandibular kinesthesia (sense of weight, position, and movement of the mandible) was studied in light of its relationship to speech production by Saxman, Ringel, and Brooks, in 1967. They concluded that sensory information from jaw movements may be an important factor in controlling the speech production process. The same year, Ringel and Fletcher sought to determine the ability of normal subjects to orally discriminate different textures. The authors felt that texture discrimination was related to articulation. In addition, they hypothesized that information about the spatio-temporal movements of the articulatory structures was a prerequisite for the development and maintenance of correct articulation. Their data indicated that neural abilities of the structure involved and physical characteristics of the stimuli were related to the sensations evoked.

These researchers also felt a more accurate representation of the sensory abilities of a given structure could be obtained using a broad range of tactile stimuli.

Other studies involving normal subjects included Locke's investigation (1972) of the relationship between short-term auditory memory span, oral perception, and experimental sound learning in children. Locke found that children with higher scores on oral stereognosis were significantly better at imitating two non-English sounds than those with lower scores. Therefore, he felt that oral stereognosis was related to articulatory abilities.

The ability to discriminate object size was studied by Dellow, et al., in 1970. These investigators felt that similar structures were used for determining object size and producing certain consonantal sounds. It was concluded that the ability to orally assess object size may be a measure of sensory systems controlling consonantal speech.

In several other studies, the abilities of sensory- and motor-deprived individuals on oral stereognosis were investigated. In 1973, Darley, Wertz, and Rosenbek compared oral sensation and perception in apraxics, aphasics, and normals. Their results indicated a definite deficiency in oral sensory perception in the more severe apraxics. This finding was unexpected, as apraxia had always been considered a motor disorder. Based on these results, these investigators suggested that both motor and sensory involvement may occur in moderate to severe apraxia.

A study involving normal and dysarthric adults was performed by Creech, Wertz, and Rosenbek (1973). The oral sensory-perceptual abilities of these two groups were measured by means of oral form identification, two-point discrimination, and mandibular kinesthesia. The dysarthric subjects performed significantly poorer than normal subjects on all three tasks of oral sensation and perception. However, speech intelligibility and severity of dysarthria could not be related to oral sensory-perceptual performance.

Bishop, Ringel, and House (1973), in their study on oral sensory perception, speech production, and deafness, felt that non-use of the oral mechanism may cause poor oroperceptual performance. These investigators found that deaf individuals trained by oral methods performed better on oral stereognosis than deaf subjects restricted to manual communication. It was reasoned that the integration of orosensory and oromotor input, important for oral stereognosis, and likewise for speech production, was facilitated by speech practice.

Oral sensory deprivation has been temporarily induced in many subjects with anesthetics. One such study, performed by Scott and Ringel (1971), concentrated on the effect of reduced oral sensation on articulation. Their results indicated a tendency to undershoot the desired place of articulation or a reduced amplitude of articulatory movement in subjects with induced oral sensory deprivation. In addition, they contributed efficient speech production to a combined open and closed loop control system. However, these researchers felt the neural mechanisms utilized for oral stereognosis were different from those functioning automatically in normal speech.

Putnam and Ringel (1972) induced labial sensory deprivation and studied articulation. In this condition, they found the subjects were still capable of producing intelligible speech. However, the degree of lip rounding was affected, and more difficulty was demonstrated with complex consonant clusters. Subjects tended to produce bilabials by movement of the lower lip only, but this had no significant effect on intelligibility.

Using the same speaker for normal and sensory-deprived conditions, Horii, et al., (1973) found a higher fundamental frequency, reduction in high frequency components affecting fricatives, and some temporal disorganization in the sensory-deprived condition. These authors felt the maintenance of speech intelligibility under conditions of oral sensory deprivation may be attributed to listener adaptability and the selective effect of deprivation on certain speech sounds.

Similar results were found by Gammon, et al., (1971). Fricatives and affricates were identified as most frequently misarticulated sounds by subjects under oral anesthetization. This was believed due to the precision required for the production of these classes of sounds. This study indicated approximately 20% of the consonants were affected by oral anesthetization. Additional differences were noted in voice quality and rhythm. The suggestion that articulatory units may become somewhat self-perpetuating through learning could be a possible explanation for the maintenance of speech intelligibility despite oral sensory deprivation.

Studies Concerning Aging

The previous studies cited have primarily investigated the relationship between oral sensory perception and articulation. However, along somewhat different lines, McDonald and Aungst (1967) investigated oral stereognosis in relation to aging. Results indicated an increase in performance on oral stereognosis through the midteens, with a marked decrease in performance of the geriatric subjects. This decreased performance exhibited by aged subjects may be due to reduced perceptual ability with age or simply an artifact of the study. However, several studies have indicated the presence of characteristic voice changes with advancing age, which may include articulatory and acoustical changes related to reduced oral sensory perception.

In a study by Ptacek, *et al*., (1966), performance of a younger adult group (under 40) was compared with that of a geriatric group (over 65) on several voice-related parameters. When compared with younger subjects, the geriatric group exhibited reduced scores on the following tasks: (a) maximum pitch range, (b) diadochokinesis, (c) maximum vowel intensity, (d) maximum vowel duration, (e) maximum intraoral breath pressure, and (f) vital capacity. These authors felt the clear difference between younger and geriatric subjects could not be solely attributed to changes in the laryngeal mechanism.

Ptacek and Sander (1966) found that listeners could distinguish younger (under 35) from older (over 65) subjects with impressive accuracy. Apparently acoustic cues were present in the voice which indicated age change. The listeners were able to identify age correctly based on (a) vowel prolongations - 78% of the time, (b) backward speech - 87% of the time, and (c) forward speech - 99% of the time. Reportedly, the listeners based their judgments on (a) rate of reading, (b) hesitancy, (c) quality differences, (d) pitch differences, and (e) vitality or intensity.

In 1969, Shipp and Hollien investigated the aging effect on male voices. The age range of subjects studied was 20 to 89 years of age. Perceptual judgments of age based on voice samples were made by naive listeners. It was found that there was a significant relationship between chronological and perceived age. Therefore, the authors conceded the existence of some perceptually identifiable parameter(s) affecting age judgment in the speech samples.

Ryan and Burk (1974) studied perceptual and acoustical correlates of aging in the male voice. Adult males from 40 to 80 years of age served as subjects. Untrained listeners made direct age estimates for these subjects. Forty subjects, whose perceived age estimations were in close agreement, were selected for further study. Ten voice characteristics were identified by trained listeners in the voices of these selected subjects. The five following voice characteristics were identified as most useful in predicting age: (a) air loss, (b) voice tremor, (c) laryngeal tension, (d) imprecise consonants, and (e) slow rate of articulation. In addition, the following acoustic information was gathered on the 40 speech samples: (a) mean dB SPL, (b) words/minute rate, (c) words/minute/sentence, (d) mean fundamental frequency, and (e) standard deviation of the fundamental frequency. However, it was determined that these acoustic parameters were of little use in predicting age, and that the voice characteristics were much more valuable in age perception. It was speculated that these changing voice characteristics with advancing age may have resulted from the aging effect on higher control centers.

The relationship between fundamental frequency and chronological age was investigated by Hollien and Shipp (1972). The subjects were males from 20 to 89 years of age. It was determined that a male's speaking fundamental frequency lowers from 20 to 40 years of age, followed by a rise in speaking fundamental frequency from 60 through 89 years of age. This rise in fundamental frequency in aging males may be associated with the typical senescent changes in body structures.

A relationship between perceived age estimates for male speakers and their fundamental frequencies was also demonstrated by Horii and Ryan (1974). Age estimates were obtained for 57 male speakers between 40 and 80 years of age. Analyses revealed that those speakers judged to be younger by the listeners exhibited lower mean fundamental frequencies than did those speakers judged to be aged. A stronger relationship was found between perceived age and mean fundamental frequency than between chronological age and mean fundamental frequency.

Another study by Ryan (1972) sought to describe certain acoustic characteristics of aging males (40 to 80 years of age). The mean vocal intensity, the over-all rate in words/minute, and the average rate of words/minute/sentence both in reading and impromptu speaking were measured. Results of this study indicated a significant increase in mean vocal intensity in the oldest group only, and a decrease in wpm/s rate in the oldest group. In addition, there was a significant difference in wpm/s between 60 and 40 year old subjects.

A study on voice characteristics in aging women was performed by McGlone and Hollien (1963). Data indicated no significant variation in pitch level associated with aging in women, in contrast to the higher pitch observed in aging men (Hollien and Shipp, 1972). The presence or absence of a "senile" voice described by Bach, et al., as a flat, monotonous, and shrill voice quality, was also investigated. These researchers found no indication of "senile" voice in their female subjects.

Summary

In light of the literature reviewed, the plausibility of a relationship between oral sensory-perceptual ability and perceived age is obvious. The previous study by McDonald and Aungst (1967) revealed a significant relationship between chronological age and performance on oral stereognosis. Other studies have enumerated various acoustical and perceptual voice characteristics subject to change with advancing age, while a strong relationship between chronological and perceived age has been reported by a number of investigators.

Statement of the Problem

The existence of a relationship between oral sensory-perceptual ability and perceived age seems plausible. Due to a paucity of research literature in this area, a detailed analysis of the relationships between oral sensory performance, perceived age, chronological age, and sex of the subject is in order.

The major purpose of this study was to investigate the relationship between perceived age and performance on an oral stereognostic task. Additional comparisons were made between performances of male and female subjects on an oral sensory-perceptual task, in addition to assessing the relationship between perceived age and chronological age.

Specifically, the following research questions were proposed:

(1) Is there a relationship between perceived age and performance on an oral stereognostic task?

(2) Are there differences between male and female performances on an oral stereognostic task?

(3) Is there a relationship between perceived age and chronological age?

CHAPTER II

METHOD

Subject Selection

The subjects for the study were volunteers between 30 and 80 years of age. Twelve subjects for each age decade between 30 and 60 years of age were used, with the experimenter attempting to secure a spread of subjects' ages in each decade. Of these 12 subjects per decade, six were female and six male. Eleven subjects between 60 and 70 years of age were used with six being female and five male. Five female and five male subjects between 70 and 80 years of age also participated, for a total of 57 subjects.

Participants were required to come to the University of New Mexico Communicative Disorders Unit, where the audiometric and recording booths were located. Therefore, accessibility and mobility of the individuals affected subject-selection. The only requirements for participants, other than the age and sex stipulations, were useable hearing and oral reading abilities. Useable hearing was considered to be a pure tone average in the better ear of 45 dB or better (without aid) and a speech discrimination score in the better ear of 84% or better. Due to the nature of the procedures undertaken, all subjects were volunteers; a fact which made random-sampling procedures impossible.

Procedure

Each subject was required to submit a brief case history and sign a release form. The release form provided a brief written outline of the procedures to be undertaken.

Each subject was given a pure tone audiometric examination and a speech discrimination test utilizing recorded "W-22 PB Word Lists 2A and 3A". These audiometric tests were administered with a Grason-Stadler 1701 Diagnostic Audiometer.

Following the audiometric tests, the subject was required to make a tape-recording of Fairbanks' (1937) "Rainbow Passage". These recordings were made with a high quality recording system in an IAC booth. The subject was instructed to read through the passage, signal the experimenter when he was done, and then read the passage for taping. This recorded passage was later used as a voice sample for direct age estimations.

The subject was then required to make same-different judgments for 36 pairs of pre-sterilized oral forms. Verbal instructions for this task were the following:

> "There are eight forms here. There are different shapes and different sizes of the same shape. I am going to put one form in your mouth, leave it for three seconds, take it out, and put it or another form in your mouth for three seconds. Then I will take it out and ask you to tell me if the two forms are the same or different. Each form will be paired with itself and with every other form, so there will be 36 pairs of forms. If you think the two forms are different in any way, say they are 'different', because as I said, there are different sizes of the same shape. You have to distinguish the forms by manipulating them in your

> mouth, so you'll have to keep your eyes closed. Let's try one pair (trial). Are they the same or different? Yes, they're different. Would you like to look at them? One is a cross, and one is a circle. The rest of these won't have such gross differences, so you'll have to feel very carefully. Ready? Close your eyes."

The oral forms used were a modified version of the NIDR oral forms and are schematically represented in Appendix A. The final order of pair presentations was randomized (See Appendix B). Each oral form was paired with itself and with the seven other forms as either the initial or the final stimulus. Each form was placed in the oral cavity for three seconds, followed by a three-second interval prior to introduction of the second member of the pair. Five-second intervals separated the presentation of pairs of stimuli.

The recorded speech samples of the 57 speakers were played for 37 listeners under two different conditions. In condition I, the speech samples were played for 17 members, eleven females and six males, of a college undergraduate class in the Department of Communicative Disorders. These listeners were given the following instructions:

> "You are going to hear a tape. On the tape are speech samples of 57 adult speakers of both sexes. Each speaker will read one paragraph. On this sheet there is a space for each speaker. You are to estimate the speaker's age in years, based on his or her speech sample, and write it in the space provided."

In condition II, 20 members, eighteen females and two males, from the same college class were participants. These listeners were given the following instructions:

"You are going to hear a tape. On the tape are speech samples of 57 speakers of both sexes. The speakers range in age from 30 to 80 years. All speakers are randomized on the tape according to age and sex. Each speaker will read one paragraph. On this sheet there is a space for each speaker. You are to estimate the speaker's age in years, based on his or her speech sample, and write it in the space provided."

To assess inter- and intra-judge reliability, 11 of the 37 listeners, five from condition I and six from condition II, also made second age-estimates for 20 of the speakers approximately one month following the original estimate. Listeners from the two experimental conditions received the same instructions as originally.

Data Reduction and Analysis

The following scores were obtained for each subject:

1. chronological age (C.A.)
2. mean perceived age estimate - condition I (P.A.I)
3. mean perceived age estimate - condition II (P.A.II)
4. number of errors on the oral stereognostic task (E.O.S.).

These and audiometric data for each subject are presented in Appendix C.

Conventional measures of central tendency and variability were calculated for each age-sex group for the four variables, namely chronological age, mean perceived age estimate condition I, mean perceived age estimate condition II, and number of errors on the oral stereognostic task. Pearson product-moment correlations were used to investigate the relationships between the four variables for all males (N=28) and all females (N=29). In addition, two-way analysis of variance procedures were utilized to further study the relationships between chronological age, sex, and number of errors on the oral stereognostic task. The significance of differences between perceived age estimates for male and female subjects of equivalent chronological age was also investigated using t-tests. Test-retest reliability of listeners' age estimates was then examined using Pearson product-moment correlations.

CHAPTER III

RESULTS

Results of the present investigation are presented in the following order: (a) the relationship between perceived age and performance on the oral stereognostic task, (b) male vs. female performance on the oral stereognostic task, and (c) the relationship between perceived age and chronological age.

<u>Perceived Age and Performance on the Oral Stereognostic Task</u>

The mean chronological age, mean perceived age (conditions I and II), mean number of errors on the oral stereognostic task, and the standard deviation of each measure are presented in Table 1 for each age group and both sexes.

Pearson product-moment correlations between the two mean perceived age estimates and the number of errors on the oral stereognostic task were computed. The correlation for all males (N=28) for perceived age condition I was 0.33 and 0.37 for perceived age condition II, suggesting a relationship between perceived age estimates and oral stereognostic performance in males, although the correlation coefficients were non-significant. For all females (N=29), however, the correlation for perceived age condition I was 0.02 and for perceived age condition II, 0.01, indicating no relationship between perceived age estimates and oral stereognostic performance in females.

TABLE 1

A COMPARISON OF MEAN CHRONOLOGICAL AGE (C.A.), MEAN PERCEIVED AGE CONDITION I (P.A.I), MEAN PERCEIVED AGE CONDITION II (P.A.II), AND MEAN NUMBER OF ERRORS ON THE ORAL STEREOGNOSTIC TASK (E.O.S.) FOR AGE-GROUPS OF MALES (N=28) AND FEMALES (N=29) BETWEEN 30 AND 80 YEARS OF AGE

Chronological Age Group	C.A.	S.D.	No. of Subjects	P.A.I.	S.D.	P.A.II	S.D.	E.O.S.	S.D.
30-40									
Males	34.68	3.58	6	35.33	7.97	42.45	6.55	5.17	2.23
Females	34.87	1.91	6	33.60	7.07	40.55	6.68	4.17	1.60
40-50									
Males	45.55	3.01	6	48.52	5.05	54.90	5.40	4.17	1.83
Females	46.93	2.23	6	42.85	12.06	47.58	11.90	7.67	2.50
50-60									
Males	54.07	1.97	6	50.77	6.18	56.35	7.04	5.17	2.14
Females	54.37	2.86	6	53.13	13.85	56.68	12.52	7.67	3.72
60-70									
Males	64.52	3.48	5	55.58	7.59	62.34	5.54	7.40	4.04
Females	66.45	4.00	6	56.92	13.67	60.47	10.98	5.83	2.14
70-80									
Males	72.22	1.17	5	65.58	5.60	71.30	4.38	6.20	2.95
Females	70.96	0.85	5	60.50	2.99	64.14	3.43	5.60	2.19

Male vs. Female Performance on the Oral Stereognostic Task

Following testing using Bartlett's test for homogeneity of variance indicating the variances were homogeneous, a two-way analysis of variance was employed to study the relationship between age, sex, and performance on the oral stereognostic task. As can be seen in the analysis of variance summary table (Table 2), no significant differences were found between the age and sex of 57 subjects, and the number of errors made by them on the oral stereognostic task.

TABLE 2

THE EFFECTS OF SEX, AGE, AND THE SEX-AGE INTERACTION ON ORAL STEREOGNOSTIC PERFORMANCE

Source	df	SS	MS	F
A (Sex)	1	4.53	4.53	.67
B (Age)	4	25.98	6.50	.95
A X B	4	58.65	14.66	2.15
Error	47	32.15	6.81	

F .95 (1,4) = 7.71

Chronological Age and Perceived Age

Pearson product-moment correlations for chronological and perceived age were computed. For all males (N=28) the correlation for perceived age condition I and chronological age was 0.80, and for perceived age condition II and chronological age, 0.82, which indicates a relationship does exist between chronological and perceived age in male subjects. The correlations for chronological age and perceived age estimates for all females (N=29) were 0.73 for condition I and 0.72 for condition II. These values indicate there is also a relationship between chronological and perceived age in female subjects, although this relationship is not as strong as for male subjects.

Testing of the significance of differences between the two perceived age estimates (i.e., listeners unaware of age range vs. listeners aware of age range) indicated that the differences between mean perceived age estimates in the two conditions were not significant. As can be seen in Table 3, there was also no significant difference between perceived age estimates for male vs. female subjects in each age group. As the differences between mean perceived age estimates in conditions I and II were previously shown to be non-significant, mean perceived age estimates for condition I only were used in the t-tests.

<u>Test-Retest Reliability of Listener Judgments</u>

Pearson product-moment correlations were obtained for 11 listeners making test-retest age estimates for 20 speakers. Correlations for intra-judge reliability ranged from 0.86 to 0.93 for the 11 judges. Inter-judge reliability, also determined by Pearson product-moment correlations, ranged from 0.65 to 0.92 in condition I (listeners unaware of age range). In condition II (listeners aware of age range), the correlations for inter-judge reliability ranged from

0.79 to 0.93. It was felt that the overall intra- and inter-judge reliabilities were sufficient for the purposes of this experiment.

TABLE 3

A COMPARISON OF MEAN DIFFERENCES BETWEEN PERCEIVED AGE ESTIMATES (CONDITION I) FOR MALES (N=28) AND FEMALES (N=29) IN FIVE AGE GROUPS

Age Group	Sex	$\bar{X}$	SD	$\bar{X}$ Diff.	t
30-40	Male	35.33	7.97	1.73	.398 N.S.
	Female	33.60	7.07		
40-50	Male	48.52	5.05	5.67	1.062 N.S.
	Female	42.85	12.06		
50-60	Male	50.77	6.18	2.36	.381 N.S.
	Female	53.13	13.85		
60-70	Male	55.58	7.59	1.34	.206 N.S.
	Female	56.92	13.67		
70-80	Male	65.58	5.60	5.08	1.789 N.S.
	Female	60.50	2.99		

CHAPTER IV

DISCUSSION

Briefly, the results of the present study may be summarized as follows:

1. There was no relationship between perceived age and number of errors on the oral stereognostic task for female subjects. For male subjects, however, there was a suggestion of a relationship between perceived age and oral stereognostic performance, although the correlation coefficients were slightly below the .05 level of significance.

2. There was no significant difference between overall male and female performance on the oral stereognostic task.

3. There was a relationship between perceived age and chronological age for both sexes.

4. There were no significant differences between mean perceived age estimates for male vs. female subjects of equivalent chronological age.

5. Perceived age judgments did not vary significantly regardless of whether the listeners were aware or unaware of the age range of the speakers.

Based on previous research relating both chronological and perceived age (Ptacek and Sander, 1966, Shipp and Hollien, 1969) and chronological age and oral stereognostic performance (McDonald and Aungst, 1967), it was hypothesized that a relationship may exist between perceived age and oral stereognostic performance (i.e., poorer performance on the oral stereognostic task positively related to older perceived age judgments). No such relationship was found to exist, however, between perceived age and oral stereognostic performance in female subjects. In male subjects, there was suggestion of a relationship between perceived age and oral stereognostic performance, although the correlation coefficients were not significant. This demonstrated lack of a significant relationship no doubt reflected the co-existing lack of a significant relationship between chronological age and performance on the oral stereognostic task, in the present study.

As previously mentioned, no relationship was found to exist between chronological age and number of errors on the oral stereognostic task. This finding was in contradiction to that of the McDonald and Aungst study (1967), in which chronological age and performance on an oral stereognostic task were highly correlated, with older subjects doing poorer on oral stereognosis. An explanation for those contradictory findings may be the fact that aged subjects in the McDonald and Aungst study (1967) were in a residential home, whereas the aged subjects in the present study were willing volunteers who were able to come to the University of New Mexico Communicative Disorders Unit to participate. There were undoubtedly biological differences between aged subjects in the two studies necessitating residential care for those in the previous study and not for subjects in the present study. Performance on an oral stereognostic task, as a measure of oral sensory-perceptual abilities, may reflect the biological differences between the two groups of subjects.

Perceived age judgments were positively correlated with chronological age for both male and female subjects in the present study. The finding for male subjects supported previous research (Ptacek and Sander, 1966, Shipp and Hollien, 1969), and a higher correlation was obtained for males as compared to females. This discrepancy by sex in perceived age judgments may be due to the fact that acoustical and characteristic vocal parameters affecting age judgments were more identifiable in the voices of male subjects than in female subjects. Changes in the physical structures as a function of aging have previously been correlated with observable changes in the voices of male subjects (Ryan and Burk, 1974, Hollien and Shipp, 1972, Horii and Ryan, 1974, and Ryan, 1972). No such observable differences have been found in the voices of female subjects (McGlone and Hollien, 1963). Apparently, the physical changes resulting from aging are not as pronounced in females as in males. Assuming the validity of the proposed relationships between senescent changes in the body structure and characteristics of vocal output, it would seem reasonable to assume that perceived age estimates would be more accurate for geriatric males than for geriatric females, in whom senescent changes were less pronounced. Although correlations between chronological and perceived age estimates were higher for male subjects overall, however, no significant differences were found between perceived age estimates for male and female subjects of equivalent chronological age. The lack of a significant difference between perceived age estimates for aged male and female subjects may reflect the biological superiority of the subjects in the present study, as compared with subjects in the McDonald and Aungst study (1967). Likewise, results of the present study also showed no difference between male and female performance on the oral stereognostic task, which was a novel finding as none of the previous studies utilizing oral stereognostic procedures involved female subjects. Again, the biological superiority of the subjects in the present study probably lessened the observable effects of aging on both male and female subjects. Therefore, if a discrepancy in oral stereognostic performance due to sex or the sex-age interaction did occur, it may have been masked by the biological status of the subjects participating.

The ability of listeners to estimate speakers' ages based on voice samples was comparable in the two listening conditions provided in the present study. Non-significant differences were obtained between perceived age estimations made when the listeners were aware of the age range and when the listeners were unaware of the age range. Based on these results, either method of obtaining perceived age estimations would seem equally appropriate.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Previous research has shown relationships between performance on an oral stereognostic task and chronological age (McDonald and Aungst, 1967) and between chronological age and perceived age estimates (Ptacek and Sander, 1966, Shipp and Hollien, 1969). It would seem plausible, therefore, that a relationship might exist between perceived age estimates and performance on an oral stereognostic task. The primary purpose of this study was to determine if such a relationship did indeed exist. Secondly, subject selection procedures were broadened to also include female subjects; a fact unique to the present study in both areas (i.e., perceived age estimates and oral stereognostic performance). Additional investigation of the relationship between chronological and perceived age was included to further substantiate previous findings. Two variations in the listening conditions, under which perceived age judgments were made, were also studied in light of their effect on perceived age estimations.

Twenty-eight male and 29 female subjects between 30 and 80 years of age were participants in the study. All subjects had useable hearing and oral reading abilities. Following audiometric testing, each subject orally read Fairbanks' (1937) "Rainbow Passage" for recording. Each participant was also required to make same-different judgments for 36 pairs of oral forms.

The recorded speech samples of the 57 speakers were then played for a total of 37 listeners in two listening conditions (i.e., condition I - listeners unaware of age range of speakers, condition II - listeners aware of age range of speakers). All listeners were required to make age estimates in years for each speaker, based on the recorded speech samples.

Chronological age, mean perceived age estimate condition I, mean perceived age estimate condition II, and number of errors on the oral stereognostic task were available for each of the 57 subjects, in addition to audiometric data. Pearson product-moment correlations were computed to study the relationships between the four variables (i.e., chronological age, mean perceived age condition I, mean perceived age condition II, and number of errors on the oral stereognostic task). Two-way analysis of variance was also employed to further study the differences between the number of errors on the oral stereognostic task as a function of the age of the subject, sex of the subject, and the interaction of the two. T-tests were also utilized to determine the significance of differences between mean perceived age estimates for male and female subjects of equivalent chronological age.

Results of the present study may be summarized as follows:

1. There was no relationship between perceived age and number of errors on the oral stereognostic task for female subjects. For male subjects, however, there was a suggestion of a relationship between perceived age and oral stereognostic performance, although the correlation coefficients were slightly below the .05 level of significance.

2. There was no significant difference between overall male and female performance on the oral stereognostic task.

3. There was a relationship between perceived age and chronological age for both sexes.

4. There were no significant differences between mean perceived age estimates for male vs. female subjects of equivalent chronological age.

5. Perceived age judgments did not vary significantly regardless of whether the listeners were aware or unaware of the age range of the speakers.

Conclusions

Findings of the present investigation indicate no superiority of either male or female subjects in performance on the oral stereognostic task. Perceived age estimates for male subjects were more highly correlated, however, with their chronological ages than for female subjects. In addition, there was a suggestion of a relationship between perceived age estimates and oral stereognostic performance in male subjects, but not in female subjects.

All findings for female subjects were novel, as no previous studies concerning either oral stereognosis or perceived age estimates had involved female subjects. Results contradictory to a previous study (McDonald and Aungst, 1967) were obtained, however, for chronological age and oral stereognostic performance in males. The biological status of subjects in the two comparable studies may be responsible for this discrepancy in results. Apparently, the biological age rather than the chronological age of subjects determines the degree of oral sensory-perceptual abilities retained.

Biological changes reflecting aging have also been previously correlated with characteristic changes in vocal output for male subjects (Ryan and Burk, 1974, Hollien and Shipp, 1972, Horii and Ryan, 1974, and Ryan, 1972). No such pronounced changes as a result of aging have previously been identified, however, in female subjects (McGlone and Hollien, 1963). In the present study, there were no significant differences between perceived age estimates for male and female subjects of equivalent chronological age. Therefore, one would assume no significant difference in the biological age of male vs. female subjects, which would affect vocal output and moreover be reflected in perceived age estimates.

The lack of effect of different listening conditions on listeners' age judgments was also a finding of the present study. Differences between the mean perceived age estimates in the two listening conditions were not significant in spite of the fact that listeners in condition I did not know the age range of speakers, while listeners in condition II did know the age range. It would seem, therefore, that the vocal characteristics, used by listeners as a basis for age judgments, were obvious enough to result in comparable age estimates, whether the listeners were aware of the age range of the speakers or not.

Suggestions for Future Research

Based on findings of the present study, the following areas are suggested for future research:

1. Replication of the present study using a larger number of subjects in each age group.

2. Replication of the present study utilizing random sampling techniques for subject selection.

3. Use of different speech samples (i.e., oral reading vs. conversational speech) to further investigate the intra-examiner reliability of listeners' perceived age estimates.

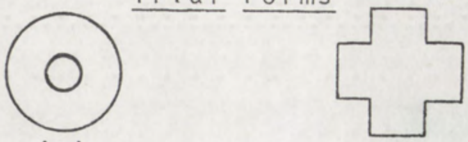
4. Test-retest measurement of oral sensory-perceptual abilities to assess the reliability of oral stereognostic performance.

APPENDICES

APPENDIX A

SCHEMATIC REPRESENTATION OF ORAL FORMS

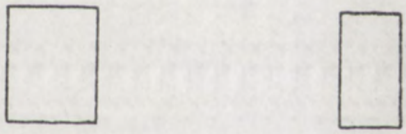
Trial Forms



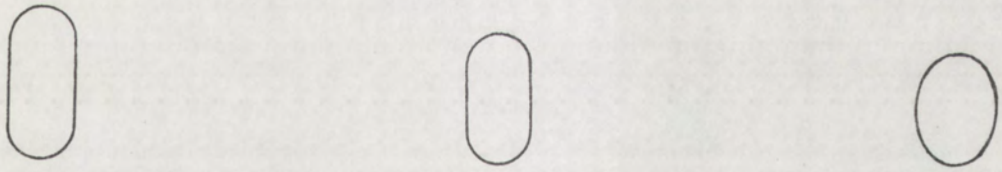
(A) (B)

Test Forms

(1) (2) (3)



(4) (5)



(6) (7) (8)

APPENDIX B

RANDOMIZATION OF ORAL FORM PAIRS

1. 1-5
2. 5-5
3. 4-7
4. 2-3
5. 3-3
6. 1-4
7. 4-8
8. 1-6
9. 1-7
10. 5-6
11. 5-8
12. 1-3
13. 3-6
14. 7-8
15. 6-6
16. 7-7
17. 5-7
18. 6-8
19. 2-8
20. 1-8
21. 4-4
22. 6-7
23. 3-8
24. 3-4
25. 2-6
26. 4-6
27. 2-5
28. 1-1
29. 2-7
30. 2-4
31. 2-2
32. 1-2
33. 4-5
34. 8-8
35. 3-7
36. 3-5

APPENDIX C

RAW SCORES FOR INDIVIDUAL SUBJECTS

Subject #	C.A.	P.A.I	P.A.II	E.O.S.	P.T.A. Right	P.T.A. Left	Spch. Disc. Right	Spch. Disc. Left
MALES								
1	30.83	42.29	48.35	2	7dB	10dB	98%	100%
2	30.92	24.41	35.10	7	7dB	25dB	100%	100%
3	34.33	27.47	35.60	3	2dB	5dB	98%	90%
4	34.83	43.12	47.80	7	10dB	10dB	96%	96%
5	37.42	34.18	38.80	5	8dB	10dB	98%	98%
6	39.92	40.47	49.00	7	--	--	--	--
7	41.33	56.82	63.35	5	5dB	23dB	96%	92%
8	43.92	50.12	56.80	3	10dB	12dB	92%	100%
9	44.42	48.29	50.55	2	15dB	25dB	96%	98%
10	46.33	47.47	57.10	7	3dB	8dB	96%	96%
11	47.50	47.18	53.15	5	--	--	--	--
12	49.92	41.24	48.30	3	15dB	10dB	88%	96%
13	50.83	51.76	52.40	3	5dB	0dB	100%	96%
14	52.83	42.71	47.95	5	13dB	27dB	90%	92%
15	54.17	57.00	63.80	9	7dB	13dB	96%	94%
16	55.00	58.29	65.75	4	8dB	23dB	96%	94%
17	55.50	49.18	55.90	6	17dB	15dB	92%	92%
18	56.08	45.59	52.20	4	23dB	23dB	90%	92%
19	60.67	51.06	57.80	3	20dB	27dB	98%	100%
20	61.67	66.00	69.55	10	30dB	17dB	82%	84%

APPENDIX C
(Continued)

Subject #	C.A.	P.A.I	P.A.II	E.O.S.	P.T.A. Right	P.T.A. Left	Spch. Disc. Right	Spch. Disc. Left
21	64.25	60.29	66.75	13	17dB	13dB	96%	92%
22	66.92	53.59	60.10	5	13dB	25dB	98%	96%
23	69.00	46.88	57.40	6	33dB	37dB	78%	94%
24	71.17	66.24	74.10	6	42dB	8dB	76%	98%
25	71.42	63.41	68.75	5	37dB	35dB	90%	80%
26	71.67	64.82	69.65	11	37dB	32dB	80%	86%
27	72.83	59.12	66.45	3	23dB	15dB	92%	88%
28	74.00	74.41	77.40	6	38dB	53dB	92%	66%
FEMALES								
29	31.75	25.41	34.25	3	0dB	0dB	98%	98%
30	34.33	39.47	46.45	4	3dB	3dB	100%	94%
31	34.67	43.06	49.20	3	0dB	0dB	100%	98%
32	35.17	28.41	33.00	7	0dB	0dB	98%	100%
33	35.50	36.41	43.00	3	0dB	0dB	94%	98%
34	37.67	28.82	37.30	5	0dB	7dB	98%	98%
35	43.17	34.88	40.00	8	5dB	10dB	98%	96%
36	45.83	30.59	36.05	5	0dB	3dB	98%	96%
37	46.75	30.94	35.05	7	8dB	40dB	100%	94%
38	48.00	57.35	62.60	10	12dB	3dB	92%	94%
39	48.25	50.12	55.35	11	12dB	17dB	100%	100%

APPENDIX C
(Continued)

Subject #	C.A.	P.A.I	P.A.II	E.O.S.	P.T.A. Right	P.T.A. Left	Spch. Disc. Right	Spch. Disc. Left
40	49.50	53.18	56.30	5	17dB	12dB	98%	100%
41	51.25	53.59	55.40	4	30dB	28dB	100%	96%
42	52.83	34.71	39.75	11	7dB	13dB	96%	96%
43	53.17	47.88	52.60	13	13dB	18dB	92%	92%
44	54.50	67.41	70.90	6	12dB	13dB	100%	98%
45	54.83	44.35	49.60	8	3dB	0dB	96%	96%
46	59.58	70.82	71.80	4	62dB	35dB	0%	90%
47	60.00	49.47	56.75	7	5dB	7dB	100%	98%
48	62.92	56.41	60.60	8	12dB	18dB	98%	98%
49	68.50	55.53	59.40	7	2dB	5dB	98%	96%
50	68.58	62.29	62.30	5	28dB	25dB	86%	90%
51	69.08	79.35	78.90	6	18dB	43dB	100%	94%
52	69.58	38.44	44.80	2	8dB	28dB	96%	92%
53	70.67	59.18	60.05	9	42dB	48dB	80%	90%
54	70.00	57.41	62.85	6	12dB	15dB	96%	98%
55	70.42	58.53	62.80	5	3dB	8dB	98%	96%
56	71.75	63.71	65.80	3	17dB	18dB	96%	98%
57	71.92	63.65	69.10	5	32dB	18dB	88%	86%

C.A. = Chronological Age
P.A.I = Perceived Age Estimate Condition I
P.A.II - Perceived Age Estimate Condition II
E.O.S. = Errors on Oral Stereognostic Task

P.T.A. = Pure Tone Average
Spch. Disc. = Speech Discrimination Score

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