INFORMATION TO USERS

This material was produced from a microfilm copy of the original document. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the original submitted.

The following explanation of techniques is provided to help you understand markings or patterns which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting thru an image and duplicating adjacent pages to insure you complete continuity.

2. When an image on the film is obliterated with a large round black mark, it is an indication that the photographer suspected that the copy may have moved during exposure and thus cause a blurred image. You will find a good image of the page in the adjacent frame.

3. When a map, drawing or chart, etc., was part of the material being photographed the photographer followed a definite method in "sectioning" the material. It is customary to begin photoing at the upper left hand corner of a large sheet and to continue photoing from left to right in equal sections with a small overlap. If necessary, sectioning is continued again — beginning below the first row and continuing on until complete.

4. The majority of users indicate that the textual content is of greatest value, however, a somewhat higher quality reproduction could be made from "photographs" if essential to the understanding of the dissertation. Silver prints of "photographs" may be ordered at additional charge by writing the Order Department, giving the catalog number, title, author and specific pages you wish reproduced.

5. PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

Xerox University Microfilms
300 North Zeeb Road
Ann Arbor, Michigan 48106

74-28,306

KOMNENICH, Pauline, 1937-
HORMONAL INFLUENCES IN VERBAL BEHAVIOR
IN WOMEN.

The University of Arizona, Ph.D., 1974
Psychology, experimental

University Microfilms, A XEROX Company, Ann Arbor, Michigan

THIS DISSERTATION HAS BEEN MICROFILMED EXACTLY AS RECEIVED.

HORMONAL INFLUENCES IN VERBAL BEHAVIOR IN WOMEN

by

Pauline Komnenich

A Dissertation Submitted to the Faculty of the

COMMITTEE ON LINGUISTICS

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 7 4

THE UNIVERSITY OF ARIZONA

GRADUATE COLLEGE

I hereby recommend that this dissertation prepared under my direction by Pauline Komnenich

entitled Hormonal Influences in Verbal Behavior in Women

be accepted as fulfilling the dissertation requirement of the degree of Doctor of Philosophy

Earl A. Rogers — Dissertation Director

7 June 1974 — Date

After inspection of the final copy of the dissertation, the following members of the Final Examination Committee concur in its approval and recommend its acceptance:*

Robert D. Hubbell — June 7, 1974

*This approval and acceptance is contingent on the candidate's adequate performance and defense of this dissertation at the final oral examination. The inclusion of this sheet bound into the library copy of the dissertation is evidence of satisfactory performance at the final examination.

STATEMENT BY AUTHOR

This dissertation has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this dissertation are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: Pauline Tomonaka

ACKNOWLEDGMENTS

The author is grateful to Dr. Cecil A. Rogers, Jr., major professor, for his aid and encouragement during the planning and completion of this research. The contributions of Drs. Paul R. Turner and Robert D. Hubbell are gratefully acknowledged. A special acknowledgment and thanks are extended to my father, Dushan T. Komnenich, for his patience and understanding throughout the course of this study. In addition, the author wishes to express her appreciation to Dr. Janelle C. Krueger, Director of the Nurse Scientist Program, for her continued support; to Drs. Edward H. Spicer and Keith H. Basso, members of the minor committee; and to Dr. Wayne M. Heine for his help in implementation of the research.

This research was aided by the U. S. Department of Health, Education, and Welfare Public Health Service multidisciplinary grant Number 5T01-NU-5009-07 for the behavioral and biological sciences awarded through the Nurse Scientist Program at The University of Arizona. Support, in part, was also received from the Veterans Administration.

TABLE OF CONTENTS

ABSTRACT

The present experiment was proposed to explore in greater detail the relationship between specified aspects of verbal behavior and cyclical fluctuations in physiological variables which occur during the female sexual cycle. Four females with no known physical or psychological anomalies and no history of menstrual disorder served as subjects. These subjects had regular monthly periods and were not using oral contraceptives. Cycle phase along with temperature and estriol levels were examined as they related to verbal behavior. Verbal material was obtained through tape recordings. Results indicated that a significant increase in speech disfluencies occurred during the menstrual and luteal phases of the sexual cycle. Findings of a significant quadratic component for total words, content words, and speech disfluencies revealed a cyclical trend similar to general biological rhythms. Basal body temperature was positively correlated with speech rate. These findings suggested that speech could be an important behavioral correlate of hormonal influences in women.

INTRODUCTION

One area of particular importance in the specification of physiological processes underlying behavior is that of the neuroendocrine aspects of sexual function. Hormonal effects on behavior can be observed in both men and women but perhaps more readily in women because of the menstrual cycle which is itself hormonally induced. Mood shifts, fluid retention, and a number of physiological and psychological symptoms have been noted in women as manifestations of hormonal activity. The nature and amount of verbal output as a behavioral correlate during the female sexual cycle has not, however, been seriously examined as one of these symptoms. Speech has been recognized as a neurological function with both cognitive and motor characteristics, but not necessarily as hormonally related.

Anecdotal, correlational, and laboratory experiments exist that bear indirectly upon the problem of defining the role of hormones in speech. For example, direct hormonal influences on speech have been observed in conditions of hyperthyroidism and hypothyroidism (Luchsinger, 1965). A particular type of inhibited hyperthyroid speech resembling dysarthria and exhibiting elements of stuttering was reported very early by Segré (1933). This inhibited speech was manifested by "tonic spasm" followed by meaningless filling words or embolophrasias. The disorder was transitory in nature, appearing first in adulthood. It was found to

be resistant to environmental influences such as social context. Therefore, it was distinguished from general stuttering syndromes (Luchsinger, 1965, p. 209).

Disorders of the singing voice during menstruation have been recorded from case studies (Luchsinger, 1965). Observations of sudden vocal cord hemorrhages have been noted in singers who were forced to perform in strenuous roles during menstruation. Common changes in the voice were most apparent in the quality of high tones. In one case of an actress who regularly became hoarse during the days of her menstrual period, laryngoscopic examination revealed swollen vocal cords with a reddish sheen. Symptoms were accompanied by a decreased amount of mucous secretion and a sensation of dryness. These direct influences of hormonal changes on mucous membrane in women have also been observed in menopausal complaints relating to skin dryness and decreased vaginal secretions (Van Keep and Lauritzen, 1973). Occasional virilization during menopause has also been noted as revealed by a masculine harshness of vocal timbre. The latter phenomenon was related to increased adrenocortical activity following the reduction of ovarian estrogens (Luchsinger, 1965).

Pioneer efforts to investigate effects of hormonal influences on psychological affect in women were made by Benedek and Rubenstein (1942) through psychiatric interviews. These investigators found consistent psychological changes related to hormonal phases of the menstrual cycle. For example, passive receptive tendencies were positively correlated with progesterone production, and active heterosexual strivings with estrogen production. Further inquiries by Benedek in 1959 revealed

heightened feelings of anxiety and depression with regard to sexual fantasies and to fear of mutilation and death. Almost no evidence of such feeling was found at the time of ovulation.

More recent inquiries into the nature of premenstrual syndrome using questionnaires and careful documentation of phases of the menstrual cycle add to these pioneer efforts to describe hormonally induced behavioral changes in women. Sutherland and Stewart (1965), for example, submitted questionnaires to 100 female students and 50 registered nurses. These researchers found that only 3% of the respondents reported no molimina. Symptoms varied from emotional tensions to various physical complaints such as diarrhea, vaginal discharge, and variation in hair and scalp conditions.

Hamburg, Moos, and Yalom (1968) conducted a questionnaire study to determine the extent to which menstrual and premenstrual distress could be conceptualized multidimensionally. Eight symptom groups were identified from information obtained in the questionnaires. These symptom groups were comprised of such components as pain, mental concentration, behavioral change, i.e., action, dizziness, water retention, negative affect, positive arousal, and general somatic complaints such as palpitations, chest pain. Their data indicated that endocrine factors played a more important role in certain types of menstrual symptoms than in others. Definitive statements as to which were more important remained conjectural.

In a subsequent study of a similar nature, Moos, Kopell, Melges, Yalom, Lunde, Clayton, and Hamburg (1969) followed a group of women

identified as having either high or low premenstrual distress. Premenstrual distress was based on menstrual symptoms divided into four general categories: (a) pain, (b) autonomic reactions, (c) water retention, and (d) somatic complaints. Symptoms were characterized by complaints such as cramps, dizziness, weight gain, and palpitations, respectively. In addition to the symptom check list, mood was assessed by the Nowlis Mood Adjective Check List (Nowlis, 1965). Blood was drawn from these women during each of a number of interviews which were spaced over two menstrual cycles. Blood samples were analyzed for corticosteroids and progesterone. Cyclical fluctuations for water retention, pain, anxiety, and aggression were noted to be higher premenstrually and menstrually. According to these researchers, current evidence indicated that a large proportion of women who commit suicide, engage in criminal acts of violence, or have accidents, do so during the menstrual or premenstrual phases of the cycle.

Other studies have also correlated menstrual cycle with changes in affect (Ivey and Bardwick, 1968; Gottschalk, Kaplan, Gleser, and Winget, 1962; Paige, 1971) as well as intellectual function (Sommer, 1972; Graham, 1973). Paige (1971), for example, measured the magnitude of negative affect through content analysis of verbal speech samples collected at four different phases of the menstrual cycle. Results of her study revealed a reduction or absence of affective fluctuations found among users of oral contraceptives. These affective fluctuations were suggested as attributable in part to drug effect on intensity of menstrual flow and in part to the effect of monamine oxidase (MAO)

activity. MAO, which is found premenstrually in the endometrial lining of the uterus and in the brain, increases in the absence of estrogen.

The study by Paige, the above evidence, and other reports as well, tend to show that estrogen and progesterone fluctuations have rather pronounced effects on emotional state and/or intellectual function. Direct effects of estrogen and progesterone as directly evidenced by changes in mucous membrane were also pronounced. Cyclical variations in endocrine function appear to be significant physiological correlates to behavior generally. Although verbal samples have been used to describe changes in emotional state and intellectual function, no attempts have been made to relate hormonal effects to speech per se. Systematic documentation of speech during phases of the female sexual cycle in terms of rate, paralinguistic features, and content analysis may reveal similar effects to those described above. That is, there may be direct hormonal effects either on central processing mechanisms or tissue. Such findings would have implications in studies on sex-related differences in intellectual function and decision making as well as subsequent social and cultural implications. It has been well documented that speech is mediated through higher centers in the brain; a question remains, however, as to how significant hormonal influences might be in this mediation.

The present experiment was proposed to explore in greater detail the relationship between specified aspects of verbal behavior and cyclical fluctuations in physiological variables which occur during the female sexual cycle. A 4 X 3 X 2 within-subjects design using basal body temperature to delineate four phases of the menstrual cycle as an

independent variable was employed. These four phases were defined as menstrual, follicular, ovulatory, and luteal. Spontaneous speech samples collected at the four specified intervals provided verbal data for analysis. The samples were collected over two successive menstrual cycles. Each speech sample was divided into three one-minute segments in order to determine any significant change over time. Speech samples in one-minute segments and replication of the experiment then comprised the two additional independent variables. Following each speech elicitation blood samples were drawn. Results from the analysis of these samples were later correlated with speech rate.

Scoring of verbal data was divided into three categories: (a) nonstimulated word and sentence material, (b) content analysis, and (c) word count. These response measures were subsequently subjected to analysis of variance and appropriate correlational statistics.

METHOD

Subjects

Four females between the ages of 25 and 30 with no known physiological or psychological anomalies and no history of menstrual disorder served as subjects. The subjects were registered nurses currently enrolled as college students. Each had a history of regular monthly periods which varied from 21 to 30 days. None were using oral contraceptives. Each participant was informed as to the nature of the experiment and written consent was received. The four volunteers were given a token payment for participation.

Design

Phase of the menstrual cycle, length of speech sample, and replication were independent variables. The design was a 4 X 3 X 2 (Phase X Minute X Replication) within-subjects design with repeated measures. Data were collected four times during each of two cycles under the same conditions. Phase referred to the time at which each speech sample was elicited. This interval was designated on the basis of basal body temperature and cycle length for the individual subject. The first phase was the menstrual phase and consisted of that time interval between the onset of menstruation through the fifth day. The follicular phase extended from the sixth to the ninth day followed by the ovulatory phase which included days 10 through 17. The luteal phase extended from day

18 through day 24. Length of each speech elicitation was restricted to three minutes.

Since most standardized reading and recitation tasks do not allow for spontaneity in expression and would not reflect natural hesitations in speaking, a method of nonstimulated free association was used. Scoring of spontaneous speech elicitation was divided into three general categories: (a) nonstimulated word and sentence material (Rogers and Sulzer, 1973); (b) content analysis (Gottschalk and Hambidge, 1955); and (c) word count (Bloomfield, 1933; Salzinger and Feldman, 1973). Word as a unit of analysis in the present experiment makes use of Bloomfield's (1933) definition of a word as the minimum free form of speech. For purposes of this study a word was also considered as a recognizable fraction of a minimum free form of speech set off by blank spaces at both ends when in written form. Words or recognizable fractions thereof were considered to be identifiable in a dictionary. Speech rate referred to the number of words per minute.

Word count included total words, content words, function words (Salzinger and Feldman, 1973); speech disfluencies (Broen and Siegel, 1972); pauses, pauses and fills (Goldman-Eisler, 1958; 1968); and verb-adjective ratio (Antosch, 1969). The use of the verb-adjective ratio (VAR) was based on a study in which Antosch (1969) found that the degree of highly involved or detached emotional engagement of a given character's involvement in a dramatic scene is reflected in the character's VAR value for that scene (Antosch, 1969, p. 64).

Operational definitions for the above terminology used in analyzing verbal data are presented in their entirety in the glossary.

Coefficient of reliability for word count was .97. Significance level for verbal analyses was set at .10.

Procedure

Initially, an interview was held with each of the four subjects. Each participant received a basal thermometer and a temperature graph in addition to instructions as to their responsibilities in the study. They were instructed to keep a careful record of body temperature on a daily basis from the end of one menstrual period to the beginning of the next for a total of three months. Each subject was asked to note coitus in addition to any unusual stress or illness (Hamblen, 1945). Basal body temperature during the first cycle provided a baseline temperature for collection of data during the subsequent two cycles. Tape recordings of speech which were taken at mid cycle between the twelfth and the sixteenth days of the first cycle served as baseline recordings. In addition, this initial tape recording of speech served as a pre-experiment effort to acquaint the subject with the procedure. The session provided an opportunity to test the sequence of the procedure for recording verbal material and to eliminate any mechanical problems.

A soundproof room containing three chairs, a lamp, and a Tandberg Model 11 tape recorder with an Electrovoice RE-15 dynamic microphone was used for all recording sessions. Procedures for recording were modeled after those described by Gottschalk and Hambidge (1955) and Gleser, Gottschalk, and Watkins (1959). These investigators gave a set of standardized instructions to each of their subjects. Speech samples were then elicited over a specified period of time.

Following the first session in which the same standardized set of instructions was given to each subject, the procedure outlined below was employed. On entering the room, the subject was seated in the same chair each time and allowed to relax for two to three minutes. She was then asked to express the first word she thought of, followed by a sentence (nonstimulated, free association). On cue she was asked to talk about anything she wished without interruption for three minutes. She was told that the interviewer would be present but would not verbally interact with the subject. Blood collections for hormone assays were drawn prior to or immediately following each tape recording session. Radio-immunoassay techniques used at the Arizona Medical Center were employed for analysis of blood data.

Scoring and Analysis

Each tape recording of the speech samples were transcribed verbatim without punctuation. All minimum free forms were included in the transcripts. Pauses were indicated in terms of length, i.e., one second, two seconds, etc. Laughs, throat clearings, and other sounds were indicated in parentheses. All "um's," "ah's," and "uh's" were also transcribed. Two individuals transcribed the tapes. Transcriptions were done separately, then checked together in order to confirm their accuracy. Once the transcriptions were completed, they were again checked by the investigator against the tapes. The transcripts included the initial word, sentence, an identification letter, and a recording session number. All protocols were read by two psychologists for general mood

and thematic orientations as part of the content analysis. In addition, a tabulation was made of the terms included under content analysis in the glossary.

Word count for total words, content words, and function words was checked for reliability with an uninvolved observer. Content words, function words, pauses and fills were color coded and counted separately. Actual counting of marked words was completed by two individuals. All minimum free speech forms or fractions thereof, with the exception of laughs, sighs, and those interjections defined as fills, were considered as words. Hyphenated words, contractions, plurals, and compound words were counted as one word. In addition, two lexical items when fused were counted as one word, e.g., "coupla" (couple of), "gonna" (going to).

Speech disfluencies and verb-adjective ratio were tallied separately on analysis forms. Speech disfluencies were identified in terms of repetition of sound, syllable, word, or phrase or in terms of interjection of sound, syllable, word, or phrase. Fills such as "um," "ah," "uh" were counted as sounds as were throat clearings. Any speech segment which carried pitch and was expressed as a timed unit was counted as a syllable. Filler expressions such as "I mean," "you know," were regarded as interjections of phrases. Once all counts were completed, the data were subjected to statistical analyses via computer techniques.

RESULTS

Examination of the free association word and sentence data taken at the beginning of each session revealed little except highly variable responses both between and within subjects. These data were examined with respect to sentence structure, verb tense and voice, content, affective tone, and similar measures. The strongest superficial trend noted was variation in adjective selection with regard to color across cycle levels; however, chi-square tests indicated that the effect was not significant.

Data for the complete interviews were then examined. Scoring of these data focused on the content analysis in terms of those operational definitions presented following the discussion and word count, which included total number of words produced per session, content words, function words, pauses, fills, disfluencies and verb-adjective ratio. Content analysis demonstrated highly variable responses both between and within subjects with little significant change in affective tone over cycle levels. Subjects tended to focus on topics either of current interest or specific aspects related to work or domestic life which immediately preceded or followed the interview. For example, the current political controversies, plans for the weekend, work, school, and the like were frequently selected topics for each three-minute discourse The content analysis revealed no consistent pattern.

Analysis of variance (Clifford, 1968) of the defined response measures (total word count, content words, function words, speech disfluencies, pauses, fills, and verb-adjective ratio) revealed a significant phase effect for speech disfluencies $F(3,6) = 2.91$, $p < .10$. A Scheffé test (Edwards, 1972) indicated no differences between the means of the menstrual (13.08) and luteal (13.38) phases, or between the follicular (9.88) and ovulatory (9.92) phases. However, the combined menstrual and luteal mean differed significantly from the follicular and ovulatory mean, $F(1,9) = 8.08$, $p < .025$.

Means for the response measures which were statistically significant are included in Table 1. A plot of the means for total words, content words, and speech disfluencies revealed a U-shaped function where speech rate was higher for data elicited during the menstrual and luteal phases as compared with means for the follicular and ovulatory phases. Trend analyses indicated a significant quadratic component for speech disfluencies, $F(1,9) = 8.08$, $p < .025$; total words, $F(1,9) = 4.55$, $p < .10$; and content words, $F(1,9) = 3.56$, $p < .10$. No significant linear component was found for any of the above measures.

Another main effect noted was a significant minute effect for function words, $F(2,6) = 6.64$, $p < .05$. The highest value occurred during the first minute (36.56) with a consistent decrease over the next two minutes (32.84, 30.06). A significant replication effect appeared for pauses, $F(1,3) = 11.95$, $p < .05$, pauses and fills, $F(1,3) = 39.29$, $p < .01$, and disfluency/total word ratio, $F(1,18) = 18.26$, $p < .05$. All three of these response measures increased during the second replication of the

Table 1. Means for significant response measures.

	Phases			
Response Measure	Menstrual	Follicular	Ovulatory	Luteal
Total Words	160.46	142.63	142.29	159.33
Content Words	125.67	110.67	109.00	124.88
Disfluencies	13.08	9.88	9.92	13.38

experiment. The mean for pauses increased from 14.33 to 17.5 and for pauses and fills from 19.77 to 23.71. The disfluency/total word ratio mean increased from .073 to .079. Minute X Phase X Replication, the only significant three-way interaction which appeared, was for speech disfluencies $F(6,18) = 2.37$, $p < .10$.

Analysis of variance of verb-adjective ratio revealed no statistically significant findings. Correlational tests using Spearman's rho coefficient were significant between temperature and verbal output for total words ($r' = .43$, $df = 24$, $p < .05$) and content words ($r' = .47$, $df = 24$, $p < .05$). Correlational analyses between estriol levels and the response measures were not statistically significant.

DISCUSSION

The significant quadratic trend found in the present experiment provided supportive evidence for cyclical hormonal influences on verbal output during the female sexual cycle. Findings of a significant difference in mean speech rate and speech disfluencies menstrually and premenstrually indicated a curvilinear relationship between speech rate and cycle phase. The peak of the period of increased speech rate occurred during the menstrual phase with the troughs occurring intermenstrually followed by a rise toward the end of the cycle. The pattern resembled that of general biological rhythms described by Luce (1971). It is a trend which corroborates and extends findings of other researchers who examined variables such as water retention, aggression, and anxiety (Moos et al., 1969).

The significant phase effect for speech disfluencies, if substantiated with further research, may be closely related to symptoms of water retention, aggression, and anxiety. The trend noted in speech disfluencies tends to follow the same trend as these variables. Speech disfluencies may occur as behavioral responses related to some of the same physiological mechanisms as other premenstrual symptoms. For example, there were four general areas that were considered in the interpretation of the physiological basis for the changes in verbal behavior noted above. These interpretations included the possibility of: (a) direct hormonal effects of female sex hormones on nervous tissue,

(b) feedback regulation of hypothalamic-pituitary-ovarian secretions which affect specific target organs, (c) feedback regulation of hypothalamic-anterior pituitary-ovarian interactions which affect fluid balance, and (d) direct hormonal effects on temperature regulation.

The specific influences of hormones on nervous tissue have been studied in animals. These studies indicated that there may be brain receptors in various areas of the central nervous system which assimilate female sex steroids (Wooley, Talens, and Saari, 1969; Michael, 1965; Kato and Villee, 1967; Eisenfeld and Axelrod, 1967; and Green, Luttge, and Whalen, 1969). MAO, the substance found premenstrually in the endometrial lining of the uterus and possibly in the brain, is important biochemically in terms of effects on target organs (Paige, 1971). More recently, O'Malley and Means (1974) have reported regulatory effects of female sex steroids on synthesis, activity, and possibly even on the degradation of tissue enzymes and structural enzymes. This information could ultimately elucidate the hormone-receptor complex, which would allow for more precise interpretation of endocrine nervous system interactions. Such findings could support a thesis that speech centers in the brain are susceptible to hormonal influences which would be manifested in verbal behavior.

In contrast with an interpretation of direct effects on nervous tissue, the hypothalamic-adenohypophyseal-ovarian interplay leads to a consideration of cyclical interpretation of hormonal influences in speech based on feedback regulation. Problems of hormone behavior relationships are simultaneously physiological and psychological and cannot

easily be considered independently of each other (Beach, 1948). Hormones are not likely to be secreted exclusively. Their biological state is dependent on the relative ratios of a number of hormones acting together as well as the morphological state of the target organs.

Secretion of follicle stimulating hormone (FSH), for example, is elevated at the beginning of the menstrual phase. FSH levels off about the tenth day of the cycle and peaks again mid cycle along with a surge in the secretion of luteinizing hormone (LH) and an increase in estrogen. Inhibition of FSH and LH during the luteal phase appears to be a function of negative feedback. The decrease in the secretion of these two hormones is thought to be induced by increases in estrogen and progesterone produced by the corpus luteum (Stevens, 1972). Initially, a tentative hypothesis of the current experiment was that estrogen secretion mid cycle might enhance verbal output and that estrogen and progesterone decrease at the end of the cycle might inhibit or negatively affect speech. Such a hypothesis could be supported by a direct effect explanation. The interplay and dependency of estrogen, progesterone, and the hormones FSH and LH secreted from the anterior pituitary, however, make identification of their specific role in speech difficult.

Estrogen has been described as having an excitatory effect in the brain, and progesterone an anesthetic effect (Vernikos-Danellis, 1972). Estrogen increase mid cycle has been associated with a lowering of anxiety. Progesterone increases in the latter part of the menstrual cycle and during pregnancy and diminishes abruptly at the end of the menstrual cycle and at the end of pregnancy. Physiologically,

progesterone is known to enhance sodium, chloride, and water reabsorption from the distal tubules in the kidney. Increased extracellular fluid volume and gain in body weight prior to menstruation and during pregnancy have been noted (Hamburg, Moos, and Yalom, 1968). These changes were attributed to decreased progesterone.

Increases in speech rate and speech disfluencies which occurred during the menstrual phase could also be a manifestation of the effects of progesterone on extracellular fluid volume. Increased extracellular fluid volume may result in changes in plasma electrolytes in such a way as to create excitatory effects in the brain. Studies of adrenocortical hormones have led to conclusions of increased excitability based on changes in plasma electrolytes (Vernikos-Danellis, 1972). Water retention has consistently been identified as a complaint in studies of premenstrual syndrome. Its relationship to behavioral effects cannot be ignored. That interim between peaking of progesterone during the luteal phase and the onset of menstruation appears to be the most critical interval in behavioral changes that take place.

The significant quadratic trend noted in the present experiment appears to reflect the counterbalancing effects of estrogen and progesterone. It is possible, however, that this trend also reflects the cyclical interplay of the hypothalamic-adenohypophyseal-ovarian system. Blood studies of estrogen and progesterone levels done in the current experiment were inconclusive. The interpretation of the cyclical effects of these hormones on speech would be greatly strengthened by complete assays of FSH, LH, estradiol, estrone, estriol, and progesterone.

Administration of Enovid and other oral contraceptives have been found to smooth out and block significant fluctuations in anxiety and hostility (Gottschalk, 1972) and premenstrual symptoms (Hamburg, Moos, and Yalom, 1968). Oral contraceptives are also known to inhibit pituitary gonadotrophins. The stabilizing effects of oral contraceptives may also have significant implications for comparative study of hormonal influences in verbal behavior.

The fourth area of interpretation of physiological bases for changes in verbal behavior noted in the present experiment was related to temperature regulation. A positive correlation of basal body temperature with verbal samples taken at the four phases of the menstrual cycle in the current experiment suggested that verbal output increased as basal body temperature increased. Temperature fluctuations which occur throughout the female sexual cycle could have an effect on verbal output. The most significant temperature change during the menstrual cycle is the slight but consistent rise in basal body temperature which occurs following ovulation (Vernikos-Danellis, 1972). Use of verbal samples to measure anxiety levels in relation to skin temperature was done by Gottschalk (1972). Two corroborative studies demonstrated that a negative correlation exists between anxiety scores and skin temperature. He also noted women as a group show a transitory decrease in anxiety at the time of ovulation. Correlation of speech samples with basal body temperature, skin temperature, and female sex hormones might elucidate the effect temperature has on verbal behavior.

Three additional significant findings in the present experiment which were related to verbal behavior in terms of speech rate and speech disfluencies but which were not of primary interest are discussed below. The significant minute effect for function words indicated practice as an important factor in essentially content-free words. Function words by their nature tend to be less susceptible to external influences than are words which tend to require more thought. The progressive decrease in mean output from the first to the third minute most likely indicated a fatigue effect which became more pronounced from one cycle to the other. This finding suggested that subjects may have expended less effort to insert function words as they became more fatigued.

The significant Phase X Minute interaction for total words and speech disfluencies and the Phase X Minute X Replication interaction may be explained on the basis of combined fatigue and practice effects. Subjects tended to be more fluent in situations they judged to be more important. As subjects became more familiar with the present experiment, less careful monitoring of their own speech could have occurred. It became more apparent as the experiment progressed that subjects were less self conscious and freer to talk. They seemed to consider the task as routine. The significant phase effect was likely obliterated by fatigue and practice as the task became more routine and less important. This finding would support Broen and Siegel's (1972) finding that the greater the importance placed on the task, the fewer the speech disfluencies.

Speech disfluencies are a rather difficult area to assess. Situational factors account for some changes in number of disfluencies as is true in cases of stuttering. However, Broen and Siegel (1972) through a number of experiments have found that defining disfluencies as a response of repetition or interjection of sound, syllable, word or phrase as used in the present experiment, accounts for 85% of all events generally called disfluencies. In addition, this operational definition allows for reliable scoring. Pauses and prolongations could be considered as a part of speech disfluencies in future studies.

In summary, the major conclusion that can be drawn from the results of the data in the experiment is that there appears to be a significant phase effect on rapidity of speech and speech disfluencies as evidenced by trend analyses. The significant differences in mean speech rate menstrually and luteally suggest a positive correlation between follicular development during the menstrual cycle and central nervous system mechanisms related to speech. The decrease in verbal output intermenstrually coincided with the pattern of secretion of estrogen, FSH, and LH at the beginning of the follicular phase. Estrogen reaches one peak at ovulation with simultaneous changes in basal body temperature and surges in follicle stimulating and luteinizing hormones. These changes may be associated with behavioral changes as a result of direct effects on nervous tissue or as a result of feedback regulating functions. An increase in monamine oxidase which is found both in the endometrial lining of the uterus and in the brain at the time of menstruation (Paige, 1971) has also been considered as a biochemical

factor related to behavior. MAO, along with progesterone, may be very important biochemical factors explaining changes menstrually and premenstrually as they relate to verbal behavior.

The possibility exists that the temperature drop at the time of ovulation, with a subsequent rise, affects changes in verbal behavior. Temperature effects of this type could be similar to those effects noted by Gottschalk (1972) in relation to anxiety. Additional investigation of differences between skin and basal body temperature taken at the time verbal samples are elicited could reveal some interesting cyclical relationships.

Implications of this experiment and similar experiments in the future are important both from a treatment and a research perspective. Judgment and decision making fluctuations in women have been attributed to cyclical variations in the female sexual cycle. Often these assumptions are based on sketchy information regarding the relationships between hormones and behavior.

The goal of this experiment was to elucidate areas where hormone behavior relationships might be explored from the perspective of verbal behavior, focusing on spontaneous aspects of speech as indicators of hormonal effects through experimental research. Paige (1973), who attributed many changes that occur during the female sexual cycle to cultural and religious variables, concluded that women learn to sing "the menstrual blues." This suggestion opens another avenue of pursuit to the investigator interested in analyzing hormonal effects in speech in women in terms of cross-cultural comparison. Certainly, if similar

changes occur among different ethnic groups, such findings would increase support for the argument for physiological effects. In contrast, if differences in verbal output were found to occur among members of different religious and ethnic groups during the menstrual cycle, such findings would support Paige's suggestions that behavioral responses are learned. Both of these questions are valuable avenues for further investigation and research.

GLOSSARY

Terms Related to Content Analysis

Feeling: Any words or phrases which refer to emotion, sensation, need for person, object, or activity.

Thought: Any words or phrases which refer to reasoning or reflection about object, person, or activity.

Action: Any words that imply physical action such as run, walk, play, dance, swing.

Self: Any direct reference to self such as I, me, or we.

Other: Any reference to humans outside of self such as they, you, he, people, etc.

Animals: Any form other than human.

Time: Any reference made to actual time in terms of minutes, hours, days, years, etc. These do not include such expressions as "on one occasion," etc.

Measure: Any quantitative assessment of distance, weight, height, temperature, etc. These terms refer to use of specific quantitative terms used to describe a state, condition, person, or situation.

Environment: Any specific reference to living quarters, outdoors, mountains, desert, country.

Work: Any reference to employment or school, domestic tasks, etc.

Negation: Any negative expression such as not, never, no, etc.

Location: Any reference to place, position of person, object, environment.

Disease: Any reference to disease in self or others, description of disease process.

Food: Any reference to preparing, eating, or expressing an attitude to edible items or beverages.

Terms Related to Word Count

Total Words: All minimum free forms of speech or fractions thereof were included in this category with the exception of laughs, sighs, and "um's."

Content Words: All words which carry meaning, i.e., semantic meaning or dictionary entries that are classified as nouns, pronouns, adjectives, verbs, adverbs, or assume these functions.

Function Words: All words which are used to relate or connect one thought with another. Words which serve as connectives but which essentially are content free, e.g., indefinite articles, prepositions, conjunctions, connectives in any form are function words.

Pauses and Fills: These were divided into three separate groups; each group was analyzed separately, then subsequently grouped together and subjected to statistical analysis. (1) Group 1:

fills. Any audible sound that may or may not normally be found in a dictionary or that may not be defined in a standard dictionary but which may carry meaning psychologically, e.g., interjections such as "Oh," "Ah," "um," etc. (2) Group 2: natural pauses. This term refers to a natural break in flow of words by either inspiration or expiration of air of one to two seconds duration. (3) Group 3: deliberate pauses. This term refers to hesitation or breaks between words lasting more than three seconds.

Disfluencies: This term refers to any repetition or interjection of a sound, syllable, word, or phrase (Broen and Siegel, 1972).

Verb-adjective Ratio: This term refers to the number of verbal forms divided by the number of adjectives.

Verbal Forms: These include all verbal forms with the exception of auxiliaries (Antosch, 1969).

Adjectives: All adjectives attributed to a noun and its intensifiers (Antosch, 1969).

The use of the verb-adjective ratio was based on a study in which Antosch found that the degree of highly involved or detached emotional engagement of given characters in a dramatic scene is reflected in the characters' VAR value for that scene. The VAR increased during moments of high emotional involvement (Antosch, 1969, p. 64).

REFERENCES

Antosch, F. The diagnosis of literary style with the verb-adjective ratio. In L. Dolezel and R. W. Bailey (Eds.), Statistics and Style. New York: American Elsevier Publishing Company, Inc., 1969.

Beach, F. A. Hormones and behavior. New York: Harper (Hoeber), 1948.

Benedek, T. and Rubenstein, B. Sexual cycle in women: The relation between ovarian function and psychodynamic processes. Washington, D.C.: National Research Council, 1942.

Benedek, T. Sexual function in women and their disturbance. In S. Arieti (Ed.), American Handbook of Psychiatry. Vol. 1. New York: Basic Books, 1959.

Bloomfield, L. Language. New York: Holt, Rinehart, and Winston, Inc., 1933.

Broen, P. A. and Siegel, G. M. Variations in normal speech disfluencies. Language and Speech, 1972, 15, 219-231.

Clifford, T. Simplified computational programming for analysis of variance designs with correlated observations. Psychological Bulletin, 1968, 69, 439-440.

Edwards, A. L. Experimental design in psychological research. (4th ed.) New York: Holt, Rinehart, and Winston, Inc., 1972.

Eisenfeld, A. J. and Axelrod, J. Evidence for estradiol binding sites in the hypothalamus-effect of drugs. Biochemical Pharmacology, 1967, 16, 1781-1785.

Gleser, G. C., Gottschalk, L. A., and Watkins, J. W. The relationship of sex and intelligence to choice of words: A normative study of verbal behavior. Journal of Clinical Psychology, 1959, 15, 182-191.

Goldman-Eisler, F. Speech analysis and mental processes. Language and Speech, 1958, 1, 59-75.

Goldman-Eisler, F. Psycholinguistics. London: Academic Press, 1968.

Gottschalk, L. A. An objective method of measuring psychological states. Biological Psychiatry, 1972, 4, 33-49.

Gottschalk, L. A. and Hambidge, G., Jr. Verbal behavior analysis: A systematic approach to the problem of quantifying psychologic processes. Journal of Projective Techniques, 1955, 19, 387-409.

Gottschalk, L. A., Kaplan, S. M., Gleser, G. C., and Winget, C. M. Variations in magnitude of emotion: A method applied to anxiety and hostility during phases of the menstrual cycle. Psychomatic Medicine, 1962, 24, 300-311.

Graham, E. A. Cognitive performance and subjective mood change as they relate to phase of cycle and estrogen level: A study of forty-eight young women with normal menstrual cycles. In J. Vian (Ed.), Nursing Research Report. Vol. 8. No. 1. American Nurses' Foundation, Inc., March, 1973. (Abstract)

Green, R., Luttge, W. G., and Whalen, R. E. Uptake and retention of tritated estradiol in brain and peripheral tissues of male, female, and neonatally androgenized female rats. Endocrinology, 1969, 85, 373-378.

Hamblen, E. C. Minimal standards for sterility surveys. Southern Medical Journal, 1945.

Hamburg, D. A., Moos, R. H., and Yalom, I. D. Studies of distress in the menstrual cycle and the post-partum period. In R. P. Michael (Ed.), Endocrinology and human behavior. London: Oxford University Press, 1968.

Ivey, M. E. and Bardwick, J. M. Patterns of affective fluctuation in the menstrual cycle. Psychomatic Medicine, 1968, 30, 336-345.

Kato, J. and Villee, C. A. Preferential uptake of estradiol by the anterior hypothalamus in the rat. Endocrinology, 1967, 80, 567-575.

Luce, G. G. Biological rhythms in human and animal physiology. New York: Dover Publications, Inc., 1971.

Luchsinger, R. Vocal disorders of endocrine origin: Endocrine dysphonia. In R. Luchsinger and G. E. Arnold (Eds.), Voice--Speech--Language. Belmont, California: Wadsworth Publishing Company, Inc., 1965.

Michael, R. P. Oestrogens in the central nervous system. British Medical Bulletin, 1965, 21, 87-90.

Moos, R. D., Kopell, B. S., Melges, F. T., Yalom, I. D., Lunde, D. T., Clayton, R. B., and Hamburg, D. A. Fluctuations in symptoms and moods during the menstrual cycle. Journal of Psychosomatic Research, 1969, 13, 37-44.

Nowlis, V. Research with the mood adjective check list. In S. Tompkins and C. Izard (Eds.), Affect, cognition, and personality. New York: Springer, 1965.

O'Malley, B. W. and Means, A. R. Female steroid hormones and target cell nuclei. Science, 1974, 183, 610-620.

Paige, K. E. Effects of oral contraceptives on affective fluctuations associated with the menstrual cycle. Psychosomatic Medicine, 1971, 33, 515-537.

Paige, K. E. Women learn to sing the menstrual blues. Psychology Today, 1973, 7, 41-46.

Rogers, C. A., Jr. and Sulzer, J. Non-stimulated free association of words and sentences. Department of Psychology, Tulane University, New Orleans, Louisiana. Unpublished, 1973.

Salzinger, K. and Feldman, R. S. (Eds.) Studies in verbal behavior: An empirical approach. New York: Pergamon Press, Inc., 1973.

Segré, R. Les troubles vocaux dans les maladies de Basedow et Addison. Revue française de phoniatrie, 1933, 1, 39.

Sommer, B. Menstrual cycle changes and intellectual performance. Psychosomatic Medicine, 1972, 34, 263-269.

Stevens, V. C. Hypophyseal-ovarian interrelationships in humans: Endocrine aspects. In H. Balin and S. Glasser, Reproductive biology. Amsterdam: Excerpta Medica, 1972.

Sutherland, H. and Stewart, I. A critical analysis of the premenstrual syndrome. The Lancet, 1965, 1180-1183.

Van Keep, P. A. and Lauritzen, C. (Eds.) Aging and estrogens. Vol. 2. Frontiers of hormone research. Paris: M. Marois, 1973.

Vernikos-Danellis, J. Effects of hormones on the central nervous system. In S. Levine (Ed.), Hormones and behavior. New York: Academic Press, 1972.

Wooley, D. E., Talens, G., and Saari, M. Distribution of radioactivity after ^{3}H-testosterone administration in 4-day old female rats. The Physiologist, 1969, 12, 400. (Abstract)