



HOW DO LEVELS OF DEPRESSION AND ANXIETY AS SYMPTOMS IN MENSTRUAL CYCLE AFFECTS VOICE SIGNALS?¹

Dilek FİDAN

Kocaeli University, Faculty of Education,

Department of Social Science and Turkish Education

41380 Kocaeli

dilekfidan@yahoo.com

Abstract

In the present study, the aim is to determine the affects of emotional shifts in the voice signals in women who diagnosed with PMS (premenstrual syndrome). To this end, voice records of a total 30 women diagnosed with PMS positive (+) and negative (-) have been taken, prior to and after menstrual period, and they have been described in terms of pitch and intensity patterns. Since PMS (+) women have depression and anxiety symptoms in the premenstrual phase, prior to each record, depression and anxiety levels of subjects have been measured. A total of 1406 minutes database was obtained. There is a significant difference between the two subject groups, with positive (N=15) and negative (N=15) PMS, in the minimum and maximum values of the frequency and intensity (F_{0min} , F_{0max} , I_{min} , I_{max}) assumed by F_0 ($p<0.05$).

Keywords: *voice signals, pitch, intensity, emotional speech, PMS, mood, depression, anxiety*

Özet

Bu çalışmanın amacı, adet öncesi sendrom (AÖS; premenstrual syndrome) tanısı almış kadınlardaki duygudurum değişimlerinin, ses sinyallerine etkilerini araştırmaktır. Bu amaçla toplam 30 kadından (15 AÖS [+] ve 15 AÖS [-]) adet öncesi (luteal faz) ve adet sonrası (foliküler faz) dönemlerde ses kayıtları alınmıştır. AÖS (+) kadınlarda adet öncesi dönemde depresyon ve anksiyete puanları yükseldiğinden hem AÖS (+), hem de AÖS (-) deneklerin tüm kayıtları öncesinde depresyon ve anksiyete puanları da ölçülmüştür. Elde edilen 1406 dakikalık ses sinyali veri tabanı, perde

¹ This paper is based on the doctoral thesis of Dilek Fidan called “Türkçe Ezgi Örüntülerinde Duygudurum ve Söz Edimi Görünümleri” (Aspects of Mood and Speech Act in Turkish Intonation Patterns).



yüksekliği (pitch) ve şiddet (intensity) örüntüleri açısından çözümlenmiştir. Statistica 6.0 yazılımıyla yapılan t-testinde AÖB (+) ve AÖB (-) gruplar arasında istatistiksel olarak anlamlı bir fark varken; hem AÖB (+) hem de AÖB (-) deneklerde foliküler ve luteal fazlarda klinik tablo olarak anlamlılık olsa da istatistiksel olarak anlamlı bir farklılık görülmemiştir.

Anahtar Sözcükler: *ses sinyali, perde yüksekliği/pitch, şiddet/intensity, duygudurum, depresyon, anksiyete, adet şncesi belirtiler/AÖB*

1. Introduction

Emotions are expressed by verbal and/or nonverbal communication cues. A speaker can implicate his/her emotions with gestures, mimics, body postures...etc. in nonverbal communication, and she/he can express her/his emotions verbally with prosodic patterns and words (e.g., using the words “I am *happy, unhappy, tense, angry,..etc.*”). A listener can understand the speaker's emotional state from these verbal and/or nonverbal behaviors. In other words, in verbal communication the usage of prosodic patterns with emotional words or only usage of intonation make listeners to infer the speaker's implications and his/her emotive states (Fidan, 2007). It is known that intonation is mostly effected by emotion. Gumperz (1998) states that more can be learned from intonation counters than from pure lexical data. As a result, an evaluation of a language without paralinguistic patterns will be incomplete.

The aim of this study is to investigate what differences occur in the voice signals in the basis of emotional shifts. For this end, voice records of women whose native language is Turkish, diagnosed with premenstrual syndrome positive (PMS +) and PMS negative have been taken prior to and after menstrual phases. Prior to each record, a psychologist has measured depression and anxiety levels of all subjects by Beck Depression (APA, 1994; Hisli, 1988), Beck Anxiety (Beck et al, 1998; Ulusoy et al, 1998), Hamilton Anxiety [Hamilton, 1959, Yazıcı, 1998), and Hamilton Depression scales (Williams, 1978, Akdemir et al, 1996). A database with a total of 2286 utterances (1239 utterance from PMS (+) subjects and 1047 utterance from PMS (-) subjects) has been obtained. Every utterances have been measured in terms of minimum and maximum fundamental frequency ($F_{0min.}$, $F_{0max.}$) levels, and the acoustic correlate of loudness with minimum and maximum intensity levels ($I_{min.}$, $I_{max.}$).

In the following parts of this paper, an overview emotional speech researches; the description of PMS and the information and the reason why PMS is selected as a working topic; materials and procedures; results from the analysis, and conclusion with a discussion will be provided.

2. An Overview of Emotional Speech Researches

In the late 90's, emotion-speech based works increased with technological developments. Objectively analyzed, described, and labeled (named) emotions from speech data provide development not only for linguistics (e.g. discourse analysis, second language acquisition teaching methods, detailing the phonetic and phonologic knowledge of the language, ...etc.) but also for engineering (e.g. automatic speech, speaker and language recognition, etc.), for medicine (e.g. new therapy techniques for people who suffer from weak or lost speech/communication abilities, ...etc.) and for criminology (e.g. adding new methods on speaker recognition/identification) studies as well.

It is observed that the studies (such as Bosch, 2003; Kang et al, 2000; Iida, 2003; Meurer 2004; Meral et al, 2003; Huber et al, 2000), which are focused on the relationship between speech and emotions, emphasis different states and numbers of target emotions, and they entitle emotions differently. In other words, describing emotions, collecting emotional data (acted, non-acted, with one speaker or more speaker, in an isolated or non-isolated place), making a decision about the target emotion/s (two or more emotions or only one emotion which is controlling if that signal is the target emotion or not), and making a decision about the linguistic items that will be studied (word/s, sentence/s, utterance/s or text/s) is the general outline of these studies. One of the most crucial and problematic step in the beginning of an emotional speech research is making a decision about which emotion/s will be evaluated in the study Iida et al (2003) reports a similar circumstance: Anger, rage, disgust, unwillingness, gratitude, joy, pleasantness, elation, sadness, disconsolation were the target emotions for their study, but preparing a database for all of these emotions was difficult, so grouping and sub-categorization solved the problem. Table 1 shows the main emotional groups and including emotions (sub-category).

Table 1. The categorization of emotions in Iida et al (2003).

| GROUPS | INCLUDING EMOTIONS |
|---------------------------------|--|
| 1. Group (Anger Group) | anger, rage, disgust, unwillingness |
| 2. Group (Joy Group) | joy, gratitude, happiness, pleasantness |
| 3. Group (Sadness Group) | sadness, disconsolation, loneliness, anxiety |

As can be seen from Table 1, there are three major emotion categories (anger, joy, sadness) in Iida et al (2003) and every category includes other emotions which are close to each other and can be classified in the same category.

Douglas-Cowie et al (2003) highlights the importance of development of an appropriate database in person-computer based studies. They emphasize that four main topics (scope, naturalness, context and descriptors) should be present in person-computer based studies. a detailed list that has example studies about the scope, naturalness, context and descriptors was presented in Douglas-Cowie et al (2003). Another important point in emotional speech studies is to decide which linguistic items (such as sound, word, sentences, etc.) will be studied. In some works (Chae et al, 2001; Peevy and Davis, 2005; Whiteside et al, 2004) only sounds of the language, in other work only words (Kang, 2000); sentences (Meurer et al, 2004; Meral et al, 2003) or texts (Iida et al, 2003) have been studied.

Acoustic parameters, which will be evaluated is another question in emotional speech studies. The most common studied acoustic parameters are fundamental frequency, duration, energy, spectral characteristics and voice source parameters. In addition to these parameters, speech rate [Meurer et al, 2004; Darby, 1984), voice onset time (VOT) [Whiteside et al, 2004) jitter and shimmer [Peevy and Davis, 2005; Chae et al, 2001) are studied.

3. Premenstrual Syndrome (PMS)

Premenstrual syndrome (PMS) is a term that indicates the emotional, behavioral and/or physical syndromes, which start 7-10 days before the menstruation, repeats almost every cycle and finally, when menstruation starts PMS symptoms begin to relieve and disappear (Dickerson, 2003; Freeman and Sondheimer, 2003; Karadağ, 2001; Kocatepe, 2005). PMS is a cyclic syndrome that appears with the behavioral disorders, which effect the interpersonal communication and regular daily activities; includes physical and psychological findings, and appears in every premenstrual cycle (Acar, 1996).

There are about 150-300 symptoms that have been defined in the PMS literature (Karadağ, 2001; Dickerson et al, 2003; Halbreich, 2003). According to (Connoly, 2001), 85% of women population has one or more symptoms before menstruation starts; but 2-10% of these women report that they suffer from functional disabling and incapacitating symptoms.

According to Erdem (2006) a woman can be diagnosed as PMS (+) if:

- The mood shifts and the behavioral syndromes occur before cycle,
- These symptoms distract her professional and social functions,
- The symptoms disappear in a few days after the bleeding starts.

The most common syndromes observed are shown in Table 2. As can be seen from the Table 2, PMS has physical, behavioral, and emotional syndromes.

² In this study two kinds of sentences have been studied; one has a meaning and the other one has no meaning.

Table 2. The most common syndromes of PMS (adapted from Freeman and Sondheimer, 2003)

| Physical | Behavioral | Emotional |
|-------------------|--------------------|------------------------|
| Swelling | Sleep disturbances | Irritability |
| Breast tenderness | Appetite changes | Mood swings |
| Aches | Poor concentration | Anxiety/tension |
| Headache | Decreased interest | Depression |
| Bloating/weight | Social withdrawal | Feeling out of control |

As it is stated in the previous chapter, making a decision about which and how many emotions will be studied is one of the most important steps in emotional speech studies. On the other hand, describing and labeling the emotions from a psychological perspective is more problematic; because there are several reasons for the emotion shifts. The depression and anxiety levels of PMS (+) women increase before menstruation and decrease after bleeding starts.

The specific emotions sensed dominantly for a long time (hours, days, months) is called “mood” (Öztürk, 2001). Symptoms, which appear in women with PMS, continue a few days not a single day or moment. So that in the present study, it is preferred to use the “mood” term to make clear the emotional and behavioral state of the subject instead of using the term “emotion”.

4 Materials and Procedures

4.1 Subjects

A group of thirty volunteer females from which 15 were diagnosed with PMS(+) and 15 diagnosed with PMS(-) participated in the present study. All participants had the characteristics listed bellow:

- Age between 18-35,
- Never taken diction course/s,
- Not wearing any prosthesis teeth,
- Experiencing regular menstrual cycles in the last 6 months,
- Not having a serious medical illness in the last 6 months,
- Not taking any psychiatric pills and have not used oral contraceptive in the last 6 months.

4.2 Procedures

Before starting to collect the data, ethical committee report has been obtained from Ankara University Medical School³. All subjects read and signed “Informed Voluntary Form” before starting any procedures.

All subjects filled a “Daily Record of Severity of Problems”⁴ (Endicott, 2006) chart everyday for two months. At the end of two months, charts filled by subjects have been evaluated by a psychiatrist and those identified subjects invited for clinical interviews. Up on completion of these evaluations and clinical interviews, those subjects classified as PMS (+) or PMS (-). According to DSM-IV (APA, 1994) diagnosis criteria and according to “Structured Clinical Interview for DSM-IV Axis I Disorders) (SCID-I)” subject showing no psychiatric pathology were accepted to study [First et al, 1996; Çorapçioğlu, 1996).

Following clinical interviews, work schedules developed for selected subjects upon their last menstrual dates. According to these calendars, the initial day of the menstrual period is accepted as the first day, then identified 7th, 8th, and 9th days as follicular phase, and 22nd, 23rd and 24th days as luteal phase. These two phases accepted as ‘interview protocol’ and two voice recordings were made in one of these days; one is in follicular phase and the second is in luteal phase. The reasons these phases are selected is that in average 7-10 days before menstrual period, PMS syndromes appears and then completely disappears few days after menstrual period begins. In addition to this, the depression and anxiety levels of women with PMS (+) are expected to be increased in luteal phase, and decreasing in follicular phase.

On the protocol day for voice recording, a psychiatrist interviewed the subject to evaluate whether she has clinical depression or anxiety. Their levels of anxiety and depression were measured based on the Beck Depression [Beck 1961; Hisli, 1988), Beck Anxiety (Beck et al, 1998; Ulusoy, 1998) and Hamilton Anxiety (Hamilton, 1959; Yazıcı et al, 1998), and Hamilton Depression scales [Williams, 1978; Akdemir et al, 1996).

After determining the level of anxiety and depression levels of these subjects recording of their voices commenced with a Sony MD-Recorder MZ-R700 digital device (<http://www.sony.com/index.php>) used in “mono” mode and auto gain unit left out. During the recording, in order not to limit subject’s movements and maintain same distance to the microphone, the microphone component was eliminated of an “earphone and microphone combination” unit. Instead, a Sennheiser ME 102 type lapel microphone (<http://www.sennheiser.com>) placed on the microphone part of the earphone-microphone combination unit. The subjects wore this device by

³ Document’s date and the number is 17.11.2005-34540.

⁴ This form clarifies the information of a subject’s monthly mood shifts and degree, and shows the dates of her menstrual cycle.

keeping the microphone on either side of right or left. In order to eliminate the noise factor, which was very important for the phonetic analysis, mentioned recording tools were selected and all the recordings have been taken in a semi-isolated room as well. Subjects kept in the same place with the same microphone in all recordings, in addition all the other conditions kept the same with the previous recording.

Before commencing the recording session, to comfort the subject and adjust her to the recording environment, every subject encouraged to talk 10 minutes about daily topics (such as their hometown, school they are attending or graduated, their occupation, members of their family and their transportation method to school or work, etc.). Then questions are asked. These questions selected from topics included but not limited to their family, their pre and postmenstrual period experiences, their eating habits, outfits, books, cinema, and music, which usually accepted in general and considered certain importance for the data base building. Efforts were made to ensure illocutionary uniformity of the environment during the recording of the interviews for each subject. To do this “question-answer” the researcher created illocutionary act pairs.

Data was recorded as mono in 44.100 Hz. and 16 bit sampling rate, and then dumped into the computer in Windows PCM.waw format as analog with the Cool Edit Pro 2.0 Software (http://www.adobe.com/?ogn=EN_US-gn_home). Before analysis every first 10-155 minutes of the interview were erased and not included to database. The remaining 1406 minutes interview examples using Cool Edit Pro 2.0 Editor segmented manually. During segmentation, some of the segments were deleted: if subject’s voice overlapped with background noise or with the researcher. However hesitation of subjects, giggling, and pauses were saved as it occurred. After these determined 15 PMS (+) cases with 1239 utterance, and 15 PMS(-) cases with 1047 utterances, a total of 2286 utterance data was obtained. The total of 2286 utterance for the values of $F_{min.}$, $F_{max.}$, $I_{min.}$ ve $I_{max.}$ were measured with Praat 4.6.01 speech analysis software (Boersma, P., D. Weenink, 1999).

5. Results, Conclusion and Discussions

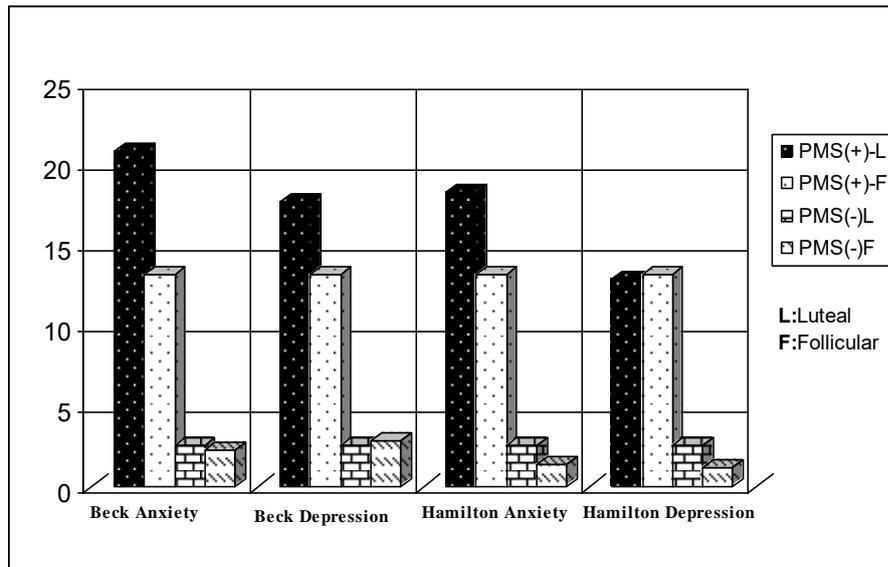
The aim of this study is to observe the effects of mood shifts over the voice signals. In other words, it was aimed to see whether the levels of depression and anxiety as syndromes in PMS make any differences on voice signals or not. The female subjects participated to present study are diagnosed as PMS (+) and PMS (-) by a psychiatrist. The reason why PMS subjects were chosen is the increase of depression and anxiety levels of PMS (+) subjects in luteal phase (before menstruation) and decrease of these levels in follicular phase (after menstruation). Among others, this is the first

⁵ Erased parts of the speech were belonging to question-answer illocutionary acts that are asked to make the subjects feel comfortable.

study, which identifies voice signal changes on the basis of mood shifts of Turkish native speakers in a natural speech environment.

Voice records were collected in follicular and luteal phases of thirty women with PMS (15 PMS [+]) and 15 PMS [-]). Depression and anxiety levels of all subjects were measured before voice records. The average values of depression and anxiety levels of PMS women according to Beck anxiety, Beck depression, Hamilton anxiety, and Hamilton depression tests are shown in Table 3.

Table 3. Depression and anxiety levels of PMS (+) and PMS (-) subjects.



As can be seen in Table 3, the average depression and anxiety levels of PMS (+) group is higher than PMS (-) group. While depression and anxiety levels for PMS (-) group is not clinically significant before or after menstrual period, same levels of PMS (+) group showed clinically significant increase before menstrual period. On the other hand, when the overall levels of depression and anxiety levels are compared between PMS (+) and PMS (-) groups, the depression and anxiety levels of PMS (+) subjects in follicular and luteal phases are higher than PMS (-) subjects.

Present data has been analyzed with STATISTICA 6.0 (STATSOFT Inc., 2001). The statistical significant differences were controlled with t-test and independent variables ($p < 0,05$). The two groups (positive and negative) were compared for the values of F_{min} , F_{max} , I_{min} , and I_{max} . ($p < 0,05$). At the end of this analysis, there was a significant differences between PMS (+) and PMS (-) groups for the values of F_{min} . ($p=0,000086$), F_{max} . ($p=0,000554$), I_{min} . ($P=0,002303$), and I_{max} . ($p=0,001279$). The results are shown in Table 4.

Table 4. The change of voice parameters between PMS (+) and PMS (-) subjects

| | PMS(+) | PMS(-) | Std.Dev. | Std.Dev. | t-value | p |
|--------------|----------|----------|----------|----------|---------|-----------|
| | Group | Group | 1 | 2 | | |
| F min | 111,3848 | 103,8927 | 10,06363 | 10,10712 | 4,06885 | 0,000086* |
| F max | 386,8712 | 413,2932 | 38,67857 | 42,75154 | 3,55000 | 0,000554* |
| I min | 32,6040 | 30,9503 | 2,93866 | 2,87465 | 3,11592 | 0,002303* |
| I max | 78,5785 | 76,6327 | 2,55309 | 3,78713 | 3,29989 | 0,001279* |

As can be seen Table 4, there is a differences between PMS (+) and PMS (-) groups. This means that PMS (+) and PMS (-) groups' F_{min} , F_{max} , I_{min} and I_{max} values are not similar. In other words, PMS symptoms cause changes in pitch and intensity patterns between groups.

Each group controlled if there is a statistical significant differences for the values of F_{min} , F_{max} , I_{min} and I_{max} between follicular and luteal phases ($p < 0.05$), even there was not a statistically significant differences between follicular and luteal phases; there was clinically significance between phases. Chae (2001) stated that because of the hormonal changes in luteal phase, the volume of the vocal cords increases, so that vocal cords may produce lowering of fundamental frequency. The existence of significant differences between groups and non-existence of significant differences within the group in the present study might be an indication that depression and anxiety make changes in vocal cords, voice quality, throat...etc. It would be better if future studies are conducted with a larger interdisciplinary researcher group which consist of linguists, psychiatrists, psychologists, otorhinolaryngologists, speech therapists/pathologist...etc. In addition to measure depression and anxiety levels, making a laryngeal examination will empower the results. In the present study, subject's experience of depression and anxiety were only the syndromes of menstrual cycle, not the syndromes of disorder. That is why, it would be valuable to compare the results of women who have clinical depression and/or anxiety with PMS and who do not have a psychiatric pathology (as the ones in the current study).

Voice quality becomes a primary issue in speech processing studies because it reflects individuals' glottal and subglottal characteristics during their speech (Keller, 2005). In this study voice recordings collected in two different moods and all the other conditions kept same with the previous recording. For this reason, comparing the two phases and the two groups with each other will provide directions to future studies if the evaluation of the database made by means of a voice quality analysis.

Other characteristic of the study is that results are gathered from only 30 female subjects. In fact, further speech-emotion based studies would be better if include male subjects so as to reach more covering conclusions related to emotion-based speech.

Another topic that was observed and planned to perform as a further study is making analyses on the basis of the “contents” of the questions. In other words, categorizing the utterances on the basis of the conversation topics and then analyzing the data of every topic separately for pitch, for intensity and for spectrum patterns and finally, comparing the results between groups and between phases (follicular-luteal) would provide more detailed information. The answers of questions related to PMS that subjects are experiencing and the questions about their family showed a higher sensitivity; however they were more comfortable with the other questions related to cinema, outfits, music...etc. The increased sensitivity about family and PMS related issues might be interpreted as a cultural issue. Marván and Escobedo (1999) reported similar results; they observed Mexican females and reported that it is not a very common issue among Mexican women to talk about their menstrual periods, either. Therefore it would be helpful for future studies if an additional acoustic analysis's is performed on the database, according to the distribution of speech topics.

In the present study, it is aimed to collect natural speech samples. This is why; subjects were not limited with time, were not interfered while answering the questions, and this freedom caused long utterances. Therefore it would be helpful to be careful in such studies if the utterance length is an important issue.

Some research questions are listed below for the researches that will focus on emotional speech and will be similar to the present study.

- Which strategies do the subjects use in turn takings or before starting an utterance? What are the functions of these strategies? Are there any strategies about the duration of starting an utterance?
- What are the stylistics differences of the subjects in two different phases or in different moods?
- What are the contextual, functional and acoustic differences when the same topic is given to the subjects in different moods in discourse?

As a result, it is revealed with this study that mood shifts effect the speech outputs. Supporting this result, significant differences were observed when the speech outputs of two different groups of Turkish speaking females (PMS-positive and PMS-negative) analyzed on the basis of pitch and intensity. The results will be generalized when the number of studies increases in the field.

Acknowledgments

This study has been supported by Ankara University Scientific Researches Projects (Ankara Üniversitesi Bilimsel Araştırma Projeleri -BAP) with the project number: 2005-09-01-022. I would like to thank my adviser İclâl Ergenç, Ph.D for her kind helps for my researches and education. I would like to thank psychologist Zeynep Gülçat, Ph.D who applied the scales, psychiatrist Murat Erdem, MD who interviewed with the subjects and psychiatrist Hamdullah Aydın, MD whom I have been taught in his lectures; electric electronic engineer Tolga Çiloğlu, PhD who supported me about every kind of speech engineering information. Yalçın Coşkuner Ph.D who helped me for the statistical analysis. My special thanks go to Lorena Munoz and Güven Yalçıntaş Ph.D. for reading my translation several times and patiently working with me. Other my special thanks go to Anna Esposito for her kindest helps and patience to me. Finally, I would like to thank my brother Levent Fidan for his encouragements.

REFERENCES

- ACAR, B. (1996). Premenstruel Sendrom (Premenstrual Syndrom). *Temel Kadın Hastalıkları ve Doğum Bilgisi (Basic Gynaecological Diseases and Childbirth Delivery Information)* H.A. Kişnişçi., Gökşin, E., Durukan, T. et al. (eds.) Güneş Press, Ankara. 810–822.
- AKDEMİR, A., Örsel, S., Dağ, İ. (1996). Hamilton Depresyon Derecelendirme Ölçeğinin Geçerliliği, Güvenilirliği ve Klinikte Kullanımı. *3P Dergisi*. 4. 251–259.
- American Psychiatric Association (APA), Committee on Nomenclature and Statistics. (1994). *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*. (4. Ed.). Washington D.C. American Psychiatric Press.
- BECK, A. T. (1961). An Inventory for Measuring Depression. *Arch Gen Psychiatry*. Vol. 4. 561–571.
- BECK, A. T., EPSTEİN, N., BROWN, G., STEER, R.A. (1998). An Inventory for Measuring Clinical Anxiety: Psychometric Properties. *Journal of Consulting and Clinical Psychology*. 56:6. 893-897.
- BOERSMA, P., D. Weenink. (1999). Praat, a system for doing phonetics by computer. *Institute of Phonetic Sciences of the University of Amsterdam*. 132-182.
- BOSCH, L.T. (2003). Emotions, Speech and the ASR Framework. *Speech Communication*. 40. 213–225.
- CHAE, S.W., CHOİ, G., KANG, H.J., CHOİ, J.O., JİN, S.M. (2001). Clinical Analysis of Voice Changes as a Parameter of Premenstrual Syndrome. *The Journal of Voice*. 15 (2). 278–283.



- CONNOLLY, M. (2001). Premenstruel Syndrome: An Update on Definitions, Diagnosis and Management. *Advances in Psychiatric Treatment*. 7. 469–477.
- ÇORAPÇIOĞLU, A., AYDEMİR, Ö., YILDIZ, M., ESEN, A., KÖROĞLU, E. (1999). *SCID'in Türkiye İçin Uyarılama ve Güvenirlilik Çalışması*. Hekimler Press Society, Ankara.
- DARBY, J. K., SİMMONS, N., BERGER, P.A. (1984). Speech and Voice Parameters of Depression: A Pilot Study. *Journal of Communication Disorder*. 17. 75–85.
- DİCKERSON, L. M., MAZYCK, P.J., HUNTER, M.H. (2003). Premenstrual Syndrome. *Am Fam Physician*. 67. 1743–1752.
- DOUGLAS-COWİE, E., CAMPBELL, N., COWİE, R., ROACH, R. (2003). Emotional Speech: Towards a New Generation of Databases. *Speech Communication*. 40. 33–60.
- ENDICOTT, J., HARRISON, W., NEEL, J. (2006). Daily Record of Severity of Problems (DRSP): Reliability and Validity. *Arch Womens Ment Health*, 9. 41–49.
- ERDEM, M. (2006). Âdet Öncesi Disforik Bozuklukta Trombosit Serotonin Düzeyi (The Thrombocyte and Serotonin Levels in Premenstrual Dysphoric Disorder). GATA Military Medical School. Unpublished MD Dissertation.
- FIDAN, D. (2007). *Türkçe Ezgi Örüntüsünde Duygudurum ve Söz Edimi Görünümleri*. Unpublished Ph.D. Thesis, Ankara University.
- FİRST, M.B., Spitzer, R.L., Gibbon, M., Williams, J.B.W. (1996). Structured Clinical Interview for DSM-IV (SCID)", American Psychiatric Association. Washington DC.
- FREEMAN, E.W., Sondheimer, S.J. (2003). Premenstrual Dysphoric Disorder: Recognition and Treatment. *Prim. Care Companion J. Clin. Psychiatry*. 5. 30–39.
- GUMPERZ, J.J. (1998). *Discourse Strategies*. Cambridge University Press, Cambridge.
- HALBREICH, U. (2003). The Etiology, Biology, and Evolving Pathology of Premenstrual Syndromes. *Psychoneuroendocrinology*. 28. 55–99.
- HAMILTON, M. (1959). The Assessment of Anxiety States by Rating. *Br J Med Psychol*. 32. 50–55.
- HİSLİ, N. (1988). Beck Depresyon Envanteri'nin Geçerliği Üzerine Bir Çalışma. *Psikoloji Dergisi*. VI/ 22. 118–126.
- http://www.adobe.com/?ogn=EN_US-gn_home Homepage for the Cool Edit Pro software.
- <http://www.sennheiser.com> Homepage for the lapel microphone

<http://www.sony.com/index.php> Homepage for the Sony recorder

HUBER, R., BATLINER, A., BUCKOW, J., NÖTH, E., WARNKE, V., NIEMANN, H. (2000). Recognition of Emotion in a Realistic Dialogue Scenario *In ICSLP-2000*. 1. 665–668.

IIDA, A., CAMPBELL, N., HIGUCHI, F., YASUMURA M. (2003). A Corpus Based Speech Synthesis System with Emotion. *Speech Communication*. 40. 161–187.

KANG, B.S., HAN, C.H., LEE, S.T., YOUN, D.H., LEE, C. (2000). Speaker Dependent Emotion Recognition Using Speech Signals.” *In ICSLP-2000*. 2. 383–386.

KARADAĞ, F. (2001). Adet Öncesi Disforik Bozukluk (Premenstrual Dysphoric Disorder). *Journal of Psikiyatri Dünyası* 5. 11–14.

KELLER, E. (2005). The Analysis of Voice Quality in Speech Processing. *Nonlinear Speech Modelling and Applications*. (eds.) Chollet, G., Esposito, A., Faundez-Zanuy, M., Marinaro, M. Springer, Germany. 54–73.

KOCATEPE, K. (2005) www.jinekoloji.net access date: 01.09.2004.

MARVÁN, L., ESCOBEDO, C. (1999). Premenstrual Symptomatology: Role of Prior Knowledge About Premenstrual Syndrome. *Psychosomatic Medicine*. 61. 163–167.

MERAL, H. M., EKENEL, H. K., ÖZSOY, A.S. (2003). Türkçede Duygu Çözümlemesi. <http://www.linguistics.boun.edu.tr/bildiri.pdf> access date: 06.06.2007.

MEURER, E.M., WENDER, M.C.O., CORLETA, H., VON E., CAPP, E. (2004). Female Suprasegmental Speech Parameters in Reproductive Age and Postmenopause. *Maturitas The European Menopause Journal*. 48. 71–77.

ÖZTÜRK, O. (2001). *Ruh Sağlığı ve Bozuklukları*. (Renewed 8. Press, 1. Press 1988). Nobel Tıp Presses, Ankara.

PEEVY, C., DAVIS, L. (2005). The interaction of age, vocal training, and hormonal factors on selected vocal parameters. http://convention.asha.org/2005/handouts/293_Davis_Lori_073698_110905104224.doc access date: 25.02.2007.

STATSOFT Inc. (2001). STATISTICA (Data Analysis Software System). Version 6.0, www.statsoft.com

ULUSOY, M., ERKMEN, H., ŞAHİN, N. (1998). Turkish Version of the Beck Anxiety Inventory: *Psychometric Properties*. *J Cog Psychother*. 12. 163–172.



WHITESIDE, S.P., HANSON, A., COWELL, P.E. (2004). Hormones and Temporal Components of Speech: Sex Differences and Effects of Menstrual Cyclicity on Speech. *Neuroscience Letters*. 367. 44–47.

WILLIAMS, B. W. A. (1978). Structured Interview Guide for Hamilton Depression Rating Scale. *Arch Gen Psychiatry*. 45. 742–747.

YAZICI, M. K., DEMİR, B., TANRIVERDİ, N., KARAOĞLU, E., YOLAÇ, P. (1998). Hamilton Anksiyete Değerlendirme Ölçeği: Değerlendiriciler Arası Güvenirlilik ve Geçerlik Çalışması. *Türk Psikiyatri Dergisi*. 9. 114–117.