Realization of intonation structures in reading attempt and spontaneous speech in the elderly

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Key words: speech intonation structure, speech prosody, speech test program.

Słowa kluczowe: struktura intonacyjna wypowiedzi, prozodia mowy, program do badania mowy.

Abstract

Introduction: The articulation activities of respondents with healthy physiological aging of the brain structures is a significant differentiating factor because slight changes occur on the suprasegmental plane of the language. In the linguistic prosody, the most important elements of the act of utterance emerge in the foreground, which relates to lexical stress (the syllable in a word is stressed), emphatic stress (the word in a sentence is stressed), and intonation (chanting in a sentence, questions, statements). The indicated elements are directed by the part of the right hemisphere of the brain that is responsible for processing and understanding speech prosody, i.e. the posterior cortex in the area of the Sylvius sulcus and the lower part of the right frontal lobe.

Aim of the research: Identifying suprasegmental features of language on the example of selected read texts and spontaneous oral statements.

Material and methods: The study was conducted in a group of healthy seniors attending classes organized by clubs and retirement homes. The spectrographic method was used, including the Praat speech program. The graphic version is presented in the form of intonograms.

Results: Minor disturbances in the rhythmic-intonation structure were found in the subjects without concomitant speech organ dysfunctions and without previous neurological episodes that could affect the implementation of intonation structures.

Conclusions: The realization of particular intonation structures is influenced by the speaker's emotions, intentions, and attitude towards the interlocutor. This means that intonation is of great importance in the process of not only realizing certain levels of language organization, but also in the communicative situation, and thus in the implementation of grammatical and semantic functions.

Streszczenie

Wprowadzenie: W obszarze realizacji czynności artykulacyjnych badanych, u których znaczącym czynnikiem różnicującym jest zdrowe, fizjologiczne starzenie się struktur mózgowych, dochodzi do nikłych zmian na płaszczyźnie suprasegmentalnej języka. W przypadku prozodii językowej (lingwistycznej) wyłaniają się na pierwszy plan nieodzowne elementy aktu wypowiedzi, które dotyczą: akcentu leksykalnego (akcentowana jest sylaba w słowie), akcentu emfatycznego (akcentowane jest słowo w zdaniu) oraz intonacji (intonowanie w zdaniu rozkazu, pytania, twierdzenia). Z badań klinicznych wynika natomiast, że wskazanymi elementami kieruje ta część prawej półkuli mózgu, która odpowiada za przetwarzanie i rozmienienie prozody mowy, tj. tylna kora w okolicy bruzdy Sylwiusza oraz dolna część prawego płata czołowego.

Cel pracy: Wyodrębnienie cech suprasegmentalnych języka na przykładzie wybranych tekstów czytanych i spontanicznych wypowiedzi ustnych.

Streszczenie

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Wnioski: Na realizację poszczególnych struktur intonacyjnych wpływają emocje, intencje mówiącego, a także stosunek do interlokutora. Oznacza to, że intonacja ma ogromne znaczenie w procesie nie tylko realizacji określonych poziomów organizacji język, lecz także w przebiegu sytuacji komunikacyjnej oraz realizowaniu funkcji gramatycznych i semantycznych.
Introduction

The issues presented in this article take into account the description of speech prosody in Polish on the example of the elderly. Prosody is a multidimensional phenomenon that is difficult to analyse. Describing intonation courses is a challenge for contemporary speech therapists dealing with this aspect in the communication process. Prosody includes elements such as accent, intonation, tempo, and rhythm of speech. These are factors necessary in the context of conveying meanings and building consistency of expression. If the researcher undertakes the description of communication behaviours and the diagnosis of prosodic skills (e.g. in the context of future therapeutic activities), it is necessary to refer to all the elements together, because they form a coherent whole dealing with the prosody of human speech.

Aim of the research

The article aims to present the prosodic features of speech characteristics of older people (components of the suprasegmental level of language), which accompany natural organic changes in the respiratory, phonation, and articulation apparatus. Attention was paid mainly to the dependence of the intoned words and phrases at the moment of changing semantic concentration and to the phonation put into the production of a spontaneous utterance and reconstruction of the read text.

Material and methods

This article shows the results of research carried out based on observation of speech performance in the elderly in terms of creating statements, which translates into the receptive aspect (understanding) of the content. The analysis covered selected oral material from 32 Dictaphone recordings of women and men over 60 years of age.

To distinguish the prosodic features of speech, the research material was analysed using the Praat program by Paul Boersma and David Weenink, which was used to analyse speech in terms of phonetics at the segmental and suprasegmental levels. Due to the length of the audio material, only parts of the statements were selected from individual recordings, and then they were described in terms of the following variants, the separation of which was made possible by the program mentioned, i.e. intonation structures (the so-called intonation contour), intensity of speech, and the effort involved in producing sounds. The graphic version is presented in the form of intonograms.

Spectral analysis with the Praat speech test program involved first loading the entire speech (e.g. a 57-minute recording) into the Praat Objects window and using the extract part command to extract the time span of only those issues that were intended for tests. Then, in the Praat Picture window, using the View or View & Edit commands, the speech properties visible on the spectrogram were obtained.

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Table 1. Fragment of text used in an attempted reading

| Chapter III | Rozdział III |
|-------------|--------------|
| AGREEMENT   | UMOWA        |
| – Good morning! – said Jan Dolittle, when he finally got to her. – How perfect and healthy you look, Sarah. – What does it mean, John? – said Sarah sternly. Please tell me, what exactly does it mean you hang around the stage like a clown? Were you not fed up with wasting best medical practice in the entire neighborhood over white mice, frogs, and the like? Have you no shame at all? What are you looking for? – What happened to you, darling? – He asked. – Lancelot, Sarah said weakly – this is my brother, John Dolittle. Janie, this is His Revered, Lancelot Dingle, the parish priest of Grimbeldon, my spouse. Janie, you've never been able to be decent. To join the circus, what a disgrace! You're kidding? And who is this person? – She added, when Mateusz Mugg came up and joined the company. – This is Mateusz Mugg – answered the doctor. – You remember him, don't you? – Pfe! Rat catcher! Sarah exclaimed, and closed her eyes in terror. – Dziś dobry! – powiedział Jan Dolittle, gdy się wreszcie do niej dostali. – Jak doskonale i zdrowo wyglądaś, Saro. – Co to znaczy, Janie? – powiedziała Sara surowo. – Bądź laskaw i powiedz mi, co to właśnie ma znaczyć, że się tutaj walęszasz po scenie jak klown? Czy nie dość ci było, żeś zmarnował najlepszą praktykę lekarską w całej okolicy z powodu białych myszy, żab i tym podobnych stworzeń? Czy wcale nie masz wstydu? Czego tu szukasz? – Co ci się stało, kochanie? – zapytał. – Lancelotie – powiedziała Sara słabym głosem – to jest mój brat, Jan Dolittle. Janie, to jest Jego Wielebność, Lancelot Dingle, proboszcz w Grimbeldon, mój małżonek. Janie, nigdy nie potrafiłeś zachowywać się przyzwoicie. Wstąpić do cyrku, co za hańba! Zartujesz chyba! A coż to za osoba? – dodała, gdy Mateusz Mugg podszedł i przyłączył się do towarzystwa. – To Mateusz Mugg – odpowiedział doktor. – Przypominasz go sobie przecież, prawda? – Pfe! Łapacz szczurów! – zawołała Sara i zamknęła oczy z przerażenia.
Description of the research procedure

Using an original questionnaire, the prosodic-intonation character of the utterance was assessed based on a fragment of a selected reading text (Table 1), and a spontaneous statement in the form of a discussion or response to life values (Table 2) was taken into account.

Symbols of the GAT 2 convention used in the analysis of oral statements

Intonation: [↑] rising intonation (ascending intonation contour/so-called anti-cadence), characteristic of questions requiring longer answers; [↓] falling intonation (falling intonation contour/so-called cadence), characteristic of declarative sentences; [↑↓] intonation

Table 2. Proposed issues for opening the statement, allowing the presupposed views to be expressed

| Issues related to part III: | 1. What do You understand by typical vital values? Please complete the following sentences: |
|----------------------------|---------------------------------------------------------------------------------------------|
|                            | a) Life is for me ...                                                                 |
|                            | My life is as follows ...                                                                  |
|                            | The most important values in life are ...                                                  |
|                            | b) Health means to me ...                                                                  |
|                            | My health condition ...                                                                   |
|                            | c) For me, vital force means ...                                                           |
|                            | I am strong when ...                                                                      |
|                            | I lack strength in situations ...                                                          |
|                            | d) Work was/is for me ...                                                                  |
|                            | At work, I realized myself through...                                                      |
|                            | e) For me, talent means ...                                                                |
|                            | f) Cleverness and resourcefulness mean for me ...                                          |
|                            | Resourcefulness is revealed in situations ...                                              |
|                            | g) Money and property are for me ...                                                       |
|                            | I have experienced career, fame ...                                                       |
|                            | h) I treat power ...                                                                       |
|                            | I have experienced power in circumstances                                                  |
|                            | i) I realize the aspect of fun and joy through ...                                        |
|                            | j) My family ...                                                                           |
|                            | k) Tolerance means to me ...                                                               |
|                            | I tolerate .../ I do not tolerate ...                                                      |
|                            | l) I express patriotism through ...                                                        |
|                            | m) Solidarity means for me ...                                                             |
|                            | 2. What values do you associate with human spirituality? Please complete the sentences:    |
|                            | – God is for me ...                                                                        |
|                            | – I see God in ...                                                                          |
|                            | – Holiness (once and today) means to me - I treat the soul ...                            |
|                            | – I understand salvation by ...                                                            |
|                            | – Good and evil are for me ...                                                              |
|                            | – For me truth and lies mean ...                                                            |

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slightly rising; denotes a slight upward pitch in intonation; intonation rising in expressive accent; intonation falling in a word accent; uniform intonation in the word accent.

Pauses: [-] short pause; [--] medium pause; [] micropause.

Other conventions: h° short exhale; : short vowel extension; ::: extension of vowels with a longer duration (1–2 s); = quick transition to the next notice.

The pace of speech: <[acc]> accelerating (accelerando); <<all>> fast (allegro) <<rall>> slowing down (rallentando).

Results
Reading attempt
In the further part of the article, the material will be presented (Figures 1, 2) showing the semantic inaccuracies concerning particular types of utterances, i.e. the affirmative, interrogative, or imperative (Tables 3, 4).

Characteristic ascending-descending contour (anti-cadence/cadence) for the first sentence. Intonation inaccuracies appear later in the text being read. In places where there should be at least a short pause, either missing or too long (1 second here) was noted, e.g. ‘Pfe (--->) Rat catcher’. There was also a pause of up to two seconds; here marked with the symbol (0.5). However, it appeared in front of the hard-to-pronounce surname ‘Dingle’, and therefore can only testify to the participant’s reflection on how to read this name. In places where an ascending contour should occur (anti-cadence), because the sentence is presented in an ascending intonation, for example: ‘And who is this person?’, the subject uttered the sentence in a descending key.

Characteristic are numerous, short or medium-length pauses appearing in various places of the text being read. There was a break in the continuity of the sentence, for example, ‘This is (--->) my brother’ or there is no break where it should be: ‘Jan, you’ve never been...' "able...’ (no pause). In addition, there was a pause at the intonation point increasing in the exclamation point sentence, i.e. ‘Pfe (-->) rat catcher (-)’. The statement, ‘Join the circus, what a shame!’ ‘You are kidding!’ presents anticadence as the intonation increases, but the subject chants the question instead of the exclamation.

Spontaneous speech attempt
Subsequently, a different character of utterances was analysed, i.e. phrases and sentences uttered in a spontaneous/narrative speech, i.e. emotionally charged by

| Table 3. Graphic description (Figure 1); only places in phrases and utterances where deviations were | Table 4. Graphic description (Figure 2) |
|---------------------------------------------------------------|---------------------------------------------------------------|
| lancelocie (no pause) sara said weakly this is my brother (-) | what happened to you (-) darling asked this is (-) my brother |
| 1 dolittle janie this is his reverence lancelot (0.5) | 1 dolittle janie to jest mój brat (-) jan dolittle janie to jest |
| dingle parish priest in grimblodon my spouse 1 jan | jego wielobrość |
| you have never been able to be decent to join a circus 1 | lancelot (--) dingle (--) |
| a disgrace you’re kidding and who is this person (no pause) | proboszcz w grimblodon mój małżonek |
| she added 1 pfe (--) rat catcher sarah exclaimed and closed | Janie nigdy nie potrafiłeś zachowywać się przyzwoicie |
| her eyes in terror lancelocie (brak pauzy) powiedzi | wstąpić do cyrku co za hańba zartujesz chyba a cďż |
| to jest mój brat (-) jan dolittle janie to jest jego wielobrość | to za osoba (brak pauzy) dodała pfe (--) lapacz szczurów |
| lancelot (0.5) dingle proboszcz w grimblodon mój małżonek | zawołała sara i zamknęła oczy z przerżenia |
| Janie nigdy nie potrafiłeś zachowywać się przyzwoicie | laskellodown mąż podszedł i przyłączył się do towarzystwa |
| wstąpić do cyrku co za hańba zartujesz chyba a cďż | przypomniał go sobie przecież (--) prawda pfe (--) lapacz |
| to za osoba (brak pauzy) dodała pfe (--) lapacz szczurów | szczurów (--) zawołała sara i zamknęła oczy z przerżenia |
assumption, the accent (logical and emphatic) of which may turn out to be variable in terms of semantic concentration. Therefore, the following intonograms provide information on the intonational course of utterances. Similarly, properties such as the intensity of the sounds uttered at each stage of the speech (marked with a yellow line on the oscillogram) and the distribution of formants (red points), i.e. the energy that the examined person puts during the production of phonation, are also taken into account, which is also the result of vibrations generated in various places in the oral cavity (Figure 3).

The utterances were analysed in terms of the intonation contour, the intensity of the spoken sound, i.e. the volume, as well as the variable pace of the spoken words. The participant of the study used micropauses (.) and short pauses (-) before words stressed in even intonation [–ALSO], [–CHILDREN] and [–EVERYTHING], before which the pace of speech slowed down: [<<rall> –ALSO>, <<rall> –EVERYTHING>]. You can see a clear contour falling after the noun ‘health’ (blue line), then, depending on the rate at which the words are pronounced, an ascending-descending contour. The point of intersection of the red lines marks the highest value of the intensity of the sound, which is 70.89 dB and takes place when the conjunction “też” is pronounced. The values of the formants during a recording lasting more than 4 s (4.134221 s) are 1029.147573 Hz (for the first control – F1), 2032.658064 Hz (for the second control – F2), 2951.473680 Hz (for the third formant – F3), and 4342.825825 Hz (for the fourth formant – F4), which means that the energy increases with successively articulated sounds (Figure 4).

Ascending-descending contour. The speech was kept at an unchanged pace, only the Polish word ‘wojennym’ was spoken slower (<<len>>).
a micro pause and an extension of the vowel [o] in the word ‘bronią’, the accent of which was kept in a falling key (‘).

**Discussion**

In linguistic communication, the prosody of speech is considered to be an indispensable, highly significant element for the evaluation of the entire communication process. There is a need to describe prosodic phenomena in the field of speech therapy because of its integral importance for the process of linguistic communication. “Intonational structures can be analysed on several levels: acoustic, acoustophonetic, perceptual-phonetic, and phonological” [1–3]. In the area of articulation activities of the respondents, with healthy, physiological aging of the brain structures is a significant differentiating factor, slight changes occur on the suprasegmental plane of the language.

The intonation reveals the emotional character of the statement, conditioned by the current mental state of the respondent. In this matter, the representation of the so-called emotional speech is related to the activity of the right hemisphere of the brain, and the non-verbal character of the act of communication significantly affects the process of communication [6]. The semantic function, which ultimately determines the consistency of the statement, plays a significant role here. Intonation has an impact on the functional character of the meaning expressed in the sentence, and above all on the logical connection of the topic and the rHEME in the sentence [4, 7]. Therefore, both functionally and structurally, in spontaneous utterances and narrative speech, inductive thinking is preserved in the thematic-rhetematic structure, which on the example of the respondents serves to maintain the conversational character. Emotional utterances are sometimes characterized by a change in semantic concentration in a given phrase, which is related to a changing logical or emphatic accent and a root melody in the phrase [7–12]. “An important aspect of language communication is the control of vocalization processes and the emotional characteristics of voice.” [13].

In the aspect of linguistic prosody, the most important elements of the act of utterance emerge in the foreground, which relates to lexical stress (the syllable in a word is stressed), emphatic stress (the word in a sentence is stressed), and intonation (chanting in a sentence, questions, statements) [14]. However, clinical studies [14] show that the indicated elements are directed by the part of the right hemisphere of the brain that is responsible for processing and understanding speech prosody, i.e. the posterior cortex in the area of the Sylvius sulcus and the lower part of the right frontal lobe.

The analysis of intonation structures has shown that intonation, rhythm, melody, and stress are integral elements of the suprasegmental level of utterance and make up the human prosodic profile. Their implementation is influenced by the emotions, intentions of the speaker, and the attitude towards the interlocutor. This means that intonation is of great importance in the process of not only realizing individual levels of language organization, but also in the course of the communicative situation, and thus in the implementation of grammatical and semantic functions.

The Praat program – mentioned in the Material and methods section – was used for spectrographic analysis. The comprehensive version of the program can be downloaded from the websites [15, 16]. Despite many other, more advanced functions of the program, used, for example, to analyse various phonetic errors and even linguistic behaviour [17–19] – as mentioned previously – the focus was only on showing the properties of the intonation structures of utterances. Wysocka, for example, referred to the issue of intonation in more detail, distinguishing the most important intonation structures in terms of communication, such as a falling contour (cadence) – characteristic, among others for declarative sentences, commands, orders; increasing contour (anti-cadence) – relating, among others, to questions requiring resolution; and a constant contour (progrediance) – assigned to changes in pitch of the voice of fewer than 4 semitones [4, 20–26]. Moreover, the graphic elements of the GAT2 convention, developed in Germany, for the transcription and analysis of speech (German Gesprächsanalytisches Transkriptionssystem), which allows for speech analysis at several levels: minimum, basic, and detailed, were used to record prosodic phenomena. Only the graphical symbols corresponding to the features of the statements found in the presented research material were compared. The symbols were taken from the comparison between Mela and Schulte [27, 28].

In a dozen or so people who agreed to record their statements, differences were noticed at the linguistic level between the implementation of reading statements and spontaneous statements. The subjects tried to recreate the intonation phenomena of the passage being read [29] by putting more energy at the very beginning. In the course of reading, however, their focus shifted to the conscious maintenance of pace and appropriate volume, instead of the meaning aspect. Hence, minor inaccuracies, such as a flat intonation contour in utterances with an ascending intonation course, pauses breaking the contour’s continuity, or lengthening of vowels in words that are difficult to articulate.

Inaccuracies in the linguistic perspective concerning spontaneous utterances on a given topic, when the respondent started and ended his/her thought, e.g. in a questioning way that intuitively requires ending in a falling key, may activate the emotional sphere of an elderly person to such an extent that certain life events will be reported with a feeling of agitation, suffering,
joy, excitement, etc. in a flat or slightly increased tone. Such a topic that evoked various emotions at the outset was the category of a “fulfilled life” activating different reactions, as a result of which statements reported from the perspective of a suffering person in life or the one who, in turn, talked about fulfillment in every sphere of life, showed, for example, a different accent in the structure sentences. A dozen or so recordings of the narrative speech were listened to, in which the emphasis was more concentrated on the terms and objects characterizing the subject him/herself when he/she spoke about sad or very unpleasant things. On the other hand, people reporting from the perspective of the fulfillment of positive events more often emphasized the activities they performed concerning themselves or the environment. Nevertheless, this should not be taken as a rule.

Conclusions
Due to its general nature, the melody turned out to be a significant factor in the statements as regards the gender category. In men it was a melody with a falling structure, so a statement was more matter of fact than effusive with a raised intonation structure. These types of factors significantly affect the course of linguistic communication.

There was a tendency in women’s speech to fluctuate prosody when an emotional factor appeared. At this point, the emphasis was on the lexeme which referred to the raised semantic register.

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Conflict of interest
The authors declare no conflict of interest.

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