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ENERGETIC INTERACTION OF VERBAL AND NON-VERBAL MEANS IN ADOLESCENTS' SUGGESTIVE SPEECH: METHODOLOGY FOR THE EXPERIMENTAL STUDY

Метою теоретичної розробки є обґрунтування узагальненої програми й методики експериментального дослідження системи енергетичної взаємодії вербальних та невербальних засобів сугестивного мовлення підлітків. Теоретичною основою обрано системну методологічну концепцію й основні елементи комплексної методики дослідження енергетичної взаємодії вербальних і невербальних засобів у комунікативній поведінці людини загалом та мовленнєвій комунікації зокрема, викладені українською авторкою нової енергетичної теорії мови й мовлення А.А. Калитою. Для досягнення зазначеної мети виникла необхідність послідовного розв'язання таких *завдань* теоретичного дослідження, а саме: з'ясування логіки та особливостей побудови програми й методики експериментального дослідження енергетичної взаємодії вербальних і невербальних засобів у сугестивному мовленні підлітків та наведення узагальненого прикладу реалізації методології розробки програми та обґрунтування методики низки досліджень енергетичної взаємодії вербальних та невербальних засобів у сугестивному мовленні підлітків. *Методи* дослідження – формалізація, абстрагування, моделювання, а також описовий, системний методи та метод теоретичного аналізу. Показано, що елементи класифікації універсальних ознак сугестивного мовлення підлітка доцільно диференціювати за сімома ієрархічними рівнями: види комунікації, оточення мовця, комунікативний статус мовця, тип темпераменту мовця, його гендерна приналежність, вік мовця та період чи фаза його розвитку, емоційно-прагматичних потенціалів реалізації актів комунікативної поведінки підлітка. Розглянуто чотири системи взаємопов'язаних чинників: 1 – соціально-політичну, 2 – ситуативно-комунікативну, 3 – психічно-генетичну, 4 – фізіологічно-станову. За результатами обґрунтування сформовано модель впливу системи зазначених чинників на психічні механізми актуалізації сугестивної комунікативної поведінки підлітка, яка зароджується у системі його духовного буття, диференційованій на три автономні сфери: екзистенціальну, ментальну та трансцендентну. Модель супервентної взаємодії вербальних та невербальних засобів комунікативної поведінки підлітка віддзеркалює механізм породження альтернатив смислів висловлень, які підліток актуалізує через концепти-поняття та концепти-дії, сформовані в його пам'яті на основі попереднього комунікативного та соціального досвіду.

У висновках зазначено, що узагальнення програми і методики експериментального дослідження системи енергетичної взаємодії вербальних та невербальних засобів сугестивного мовлення підлітків може слугувати методологічним дороговказом для зіставлення, перевірки й узагальнення результатів різноаспектних досліджень комунікативної поведінки.

Ключові слова: програма й методика експериментального дослідження, психо-енергограма, вербальні та невербальні засоби, сугестивне мовлення підлітків.

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Introduction

The problem we are considering in the article is undoubtedly of an interdisciplinary nature, since the results of its study should be based at least on the classical knowledge of linguistics and psychology [Burns, 1991], with additional consideration of certain aspects of sociology [Gorenc, 2022], physiology [Lieberman, Blumstein, 1988], physics [Shione, Wakabayashi, Kitaoka, 2023], and others.

Thus, the *topicality* of the undertaken study is conditioned not only by the demands of linguistics, but also by the present-day tendency to grasp the problem itself within the theoretical paradigm of modern speech energetics theory that allows us, on the one hand, to make sure of the systemic nature and sufficient completeness of the theory itself, and, on the other hand, it shows the need for additional development of a number of partial methodological provisions and procedures aimed directly at the substantiation of the generalized program and methodology for the experimental research of the energy interaction between verbal and non-verbal means of adolescents' suggestive speech.

The systematic methodological concept and the main elements of a comprehensive methodology for studying the energy interaction of verbal and non-verbal means in human communicative behavior in general, and speech communication in particular are outlined by the Ukrainian author of a new speech energetics theory, the head of Kyiv School of Phonetics, Professor Alla Kalyta, in her fundamental scientific works [Kalyta, 2016; Kalyta, Klymeniuk, 2022].

However, any substantiated methodology in each case of its working out by a researcher for the experimental actions aimed at obtaining scientific knowledge of a particular object, requires, as it is well known, additional development of an original methodology on its basis that can ensure the fulfilment of the program and *objectives* of the research itself.

Therefore, the *aim* of this theoretical inquiry, grounded in methodological ideas and axiomatic provisions of speech energetics theory, is to substantiate a generalized program and methodology for the experimental study of the system of the energetic interaction between verbal and non-verbal means in adolescents' suggestive speech.

Taking into account the objective posed in this study, we intend to consistently address the following theoretical research *issues*:

a) to clarify the logic and specific features necessary to form the program and methodology for experimental research of verbal and non-verbal means' energy interaction in adolescents' suggestive speech;

b) to offer a generalized example illustrating implementation of the research methodology and substantiate the methods for a number of studies of verbal and non-verbal means' energetic interaction in the adolescents' suggestive speech.

To achieve the aim, we employed the *research methods* of generalization, formalization, abstraction, modeling, as well as the methods of descriptive, systematic and theoretical analyses.

The technological features of the lingual-energetic research presuppose that we should obtain the most comprehensive scientific understanding of the interaction of verbal and non-verbal means in the adolescents' suggestive speech to be interpreted graphically in the form of qualitatively and quantitatively defined dynamic patterns depicting the course of this interaction throughout time. In view of this, on the basis of the generalized algorithmic technology for developing a program and methodology of scientific experimental research, presented in the classic scientific research [Klymeniuk, 2006, pp. 214–235], we have conducted a systematic substantiation of the program and a comprehensive methodology for interdisciplinary research of the energy interaction of verbal and non-verbal means in the adolescents' suggestive speech, outlined below.

Theoretical and methodological basis for the development of a generalized methodology for lingual-energetic research

In order to develop a generalized methodology for a series of interdisciplinary studies of adolescents' suggestive communicative and speech behavior, we have substantiated [Burka, 2022, p. 12] the universal classification of the leading features, based on the following criteria: 1. Types of communication (1.1 – formal, 1.2 – informal); 2. The speaker's surroundings (2.1 – micro society, 2.2 – macro society, 2.3 – individual communication); 3. The speaker's

communicative status (3.1 – high, 3.2 – medium, 3.3 – low); 4. The speaker's temperament type (4.1 – choleric, 4.2 – sanguine, 4.3 – melancholic, 4.4 – phlegmatic); 5. The speaker's gender (5.1 – female, 5.2 – male); 6. The speaker's age and developmental period or phase (6.1 – (11–14 years old) a period of adaptation to the adolescent crisis, 6.2 – (14–15 years old) a stable period of adolescence, 6.3 – (15–16 years old) pre-critical phase of adolescence, 6.4 – (16–17 years old) phase of transition to adolescence); 7. Emotional and pragmatic potential of speech behavior (7.1 – high, 7.2 – medium, 7.3 – low). We believe this minimum is necessary for the scientific description of the results of almost any experimental study of the phenomenon of suggestion.

This classification has a high level of abstraction of the concepts introduced into it. However, in order to obtain an objective view of the rational limits of application of the system of universal situational and communicative features of adolescents' suggestive speech, which has been formed in this way, we should not forget that any classification should be created for a specific purpose.

Therefore, it is clear that in other specific cases, the researcher, based on the aim of the study, has the opportunity to additionally refer to the following situational and communicative features of suggestive speech, namely: prepared/unprepared, sociable/unsociable, classroom/out-of-classroom, personal/non-personal, etc., as well as introduce other additional partial features at certain hierarchical levels. It is obvious that in this case the description of the results of the experimental search for patterns of energy interaction of the complexes of verbal and non-verbal means in adolescents' suggestive speech should be carried out in their clear correlation with the features of the outlined classification [Burka, 2022, p. 12]. For this purpose, only examples of adolescents' suggestive speech realized in the following communication conditions should be considered for the corpus of experimental material: 1.1 – formal or 1.2 – informal and occurring in the conditions of 2.1 – micro-society, 2.2 – macrosociety, 2.3 – individual communication.

However, if it is necessary to consider other aspects of the course of adolescents' suggestive communicative and speech behavior, the researcher can choose any features of communicative conditions out of their existing set, the fragment of this model being shown in Fig. 1.

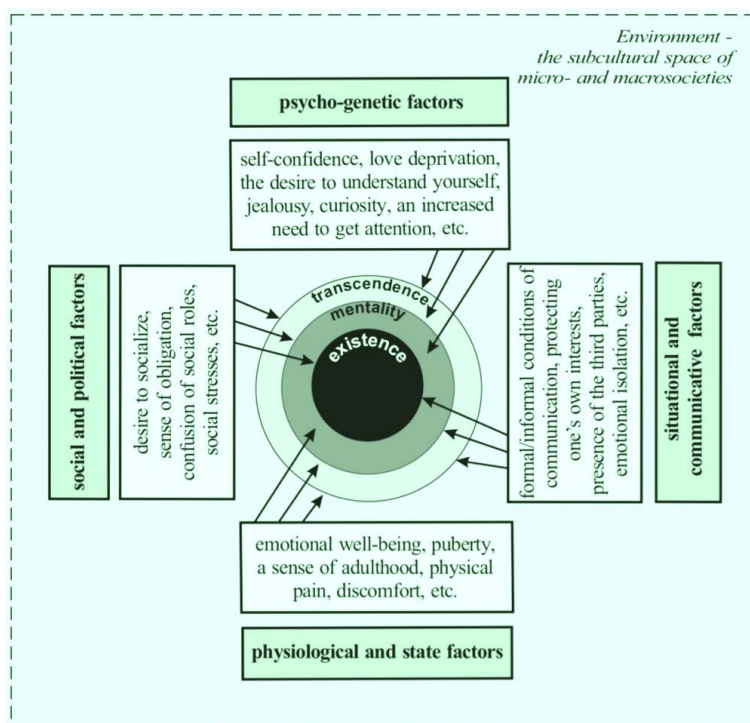


Fig. 1. Model of the influence of the system of factors on the mental mechanisms of actualization of adolescent's suggestive speech behavior

The model shows that in the system of factors of real human communicative behavior, there can be four large classes of factors, most of which we usually consider as conditions of communication and believe that certain combinations of these factors can influence the patterns of functioning of mental mechanisms of actualization of adolescent suggestive speech behavior. These classes of the system include all the factors-feelings, conditionally differentiated in our work as follows.

1. External factors-feelings:

1.1 – situational and communicative (1.1.1 – formal communication, 1.1.2 – informal communication, 1.1.3 – communication with an audience, 1.1.4 – communication with a group of people, 1.1.5 – presence of third parties in communication, 1.1.6 – private communication, etc.);

1.2 – social and political (1.2.1 – feeling of redundancy, 1.2.2 – social stress, 1.2.3 – need for communication, etc.);

2. Internal factors - feelings/sensations:

2.1 – psycho-genetic (2.1.1 – confidence, 2.1.2 – curiosity, 2.1.3 – need for attention, etc.);

2.2 – emotional well-being (2.2.1 – indifference, 2.2.2 – devastation, 2.2.3 – emotional stress, etc.);

2.3 – physiological state (2.3.1 – vigor, 2.3.2 – suspended fatigue, 2.3.3 – physical discomfort, etc.);

2.4 – physical and sensory (2.4.1 – physical pain, 2.4.2 – reduced tone, 2.4.3 – physical weakness, etc.).

When describing the results of an experimental interdisciplinary study of autonomous systems of factors, it is important to understand the essence of their conditional division by the nature of generation. Thus, if the communicative reactions of an adolescent to the stimuli that create separate subsystems of external factors (1.1.1 – social and political, 1.1.2 – situational and communicative, 1.1.3 – psycho-genetic) are acquired throughout the entire period of his/her socialization and stored in memory as its specific concepts, then in contrast, the generation of internal factors, which we have grouped into the corresponding subsystems (1. 2.1 – physiological and state, 1.2.2 – emotional and self-awareness, 1.2.3 – physical and sensory), occurs spontaneously and is strictly related to the psycho-physiological state of the individual's organism. It should not be forgotten that the role of the environment, which surrounds the supersystem of factors and exchanges information with it, is always played by the subcultural space of micro- and microsocieties, in which adolescents communicate.

Returning to the universal classification outlined in the paper [Burka, 2022, p. 12], let us pay attention to the sixth hierarchical level of the features of adolescents' suggestive communicative and speech behavior covered by it. We will see that at this level the age of adolescents is divided into four classical phases or periods of their development. This is certainly necessary for in-depth psycho-physiological research. However, for most interdisciplinary cognitive studies, it is sufficient to limit ourselves to considering the communicative and speech behavior of adolescents in the age range of 12–19 years, which, regardless of the socio-economic and cultural conditions of growing up, inevitably covers the basic and final periods of their self-development as a result of transitional and crisis states of the human psyche. The classification is completed by quantitative features of the degree of actualization of the emotional and pragmatic potential of adolescents' suggestive communicative and speech behavior to the interpretation of which we will turn below.

The next important point in the development of methodological prerequisites and methods of interdisciplinary lingual-energy research of adolescents' communicative behavior is the need for a clear understanding of the complex supervening cause-and-effect interaction of complexes of conditions of suggestive communication and means of its actualization, which inevitably takes place in the cognitive sphere during human thinking-and-acting activities. To explain this phenomenon, let us refer to the generalized model of the system of supervenient interaction of communicative means in the cognitive processes of actualization and decoding of the meaning of speech as is shown in Fig. 2.

We emphasize here that this interaction has a supervenient character, as a result of which certain complexes of factors-causers of suggestive communication lead to the selection by the adolescent of appropriate complexes of means of its implementation.

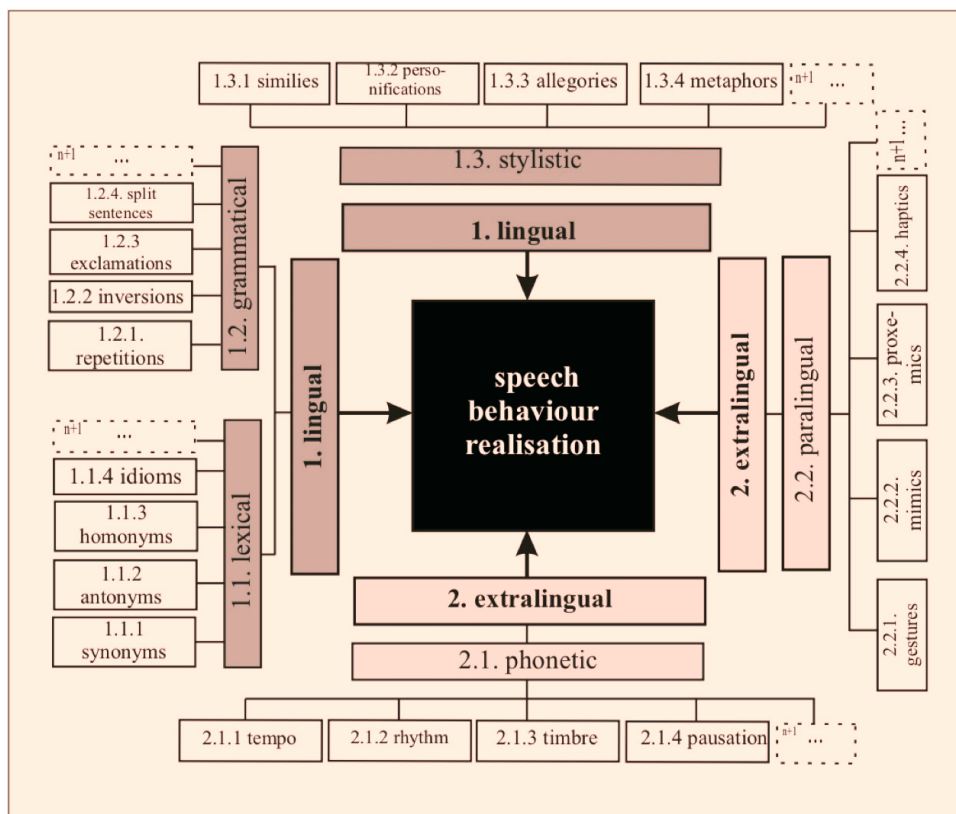


Fig. 2. A generalized model of the system of supervenient interaction of communicative means in the cognitive processes of actualization and decoding of speech meaning

That is, the cause-and-effect mechanism of communication is characterized by the fact that it requires the scientific description of at least three leading factors that influence in each case the result of the adolescent's selection of an appropriate set of verbal and non-verbal means of speech behavior, which are typical for the subcultural space of micro- and macrosocieties in which communication takes place.

The logic of describing the results of theoretical or experimental linguistic and cognitive studies based on the conceptual model thus formed allows us to consider the supervening influence of the factors of adolescent speech behavior indicated through the mental mechanisms of actualizing the peculiarities of his/her suggestive speech.

From the mentioned above it becomes clear that the methodological potential of the classification substantiated in the paper [Burka, 2022, p. 12] and verbal-and-graphic models (Figs. 1, 2) makes it possible to effectively use in the scope of many interdisciplinary linguistic and cognitive searches similar to ours, the well-tested in practice classical and modern knowledge of linguistics, psychology, physiology and sociology.

Therefore, focusing on the fundamental theoretical principle by A. Kalyta – the principle of preserving the utterance emotional and pragmatic potential [Kalyta, 2007, pp. 5–14] and the specifics of the interaction and relationship between the sound and meaning of the word, carefully described in her works [Kalyta, 2016; Kalyta, 2001], we get the opportunity to provide a meaningful example of the implementation of direct procedures that should be performed by the researcher when justifying the program and methodology of any specific study of the peculiarities of the energy interaction of verbal and non-verbal means in adolescents' suggestive speech.

Thus, the article presents a generalized example of a program and methodology for the experimental study of the specificities of energetic interaction of verbal and non-verbal means

in the adolescents' suggestive speech. The purpose of the experimental lingual-energetic research is to test theoretical and methodological prerequisites developed by us for the scientific description of the features and invariant models of energetic interaction of verbal and non-verbal means complexes in the adolescents' suggestive speech.

The results of the experimental search should be presented in a clear correlation with the universal classification advanced in the paper [Burka, 2022, p. 12].

1. Program of interdisciplinary experimental study

1.1. Selection of the English-language experimental material.

1.2. Auditory analysis of the prosodic (temporal, dynamic, and tonal) characteristics of experimental realization of adolescents' suggestive speech.

1.3. Acoustic analysis of prosodic characteristics in experimental realization of adolescents' suggestive speech.

1.4. Audiovisual analysis of the perceptual characteristics in the experimental realization of adolescents' suggestive speech.

1.5. Linguistic interpretation and generalization of the results from the experimental lingual-energetic research.

2. Methodology of interdisciplinary experimental linguistic and energy research

The methodology of the experimental study includes the selection and compilation of the corpus of experimental material, auditory and audiovisual analyses, electroacoustic analysis, and linguistic interpretation of the results, as well as the conditions of their statistical processing.

2.1 Selection and compilation of the experimental material corpus.

The experimental identification of general regularities and specific features of the interaction between verbal and non-verbal means in adolescents' suggestive speech is carried out in accordance with the objectives of the scientific research on the basis of the communication features given in the classification [Burka, 2022, p. 12]. The analyzed fragments of monologues and dialogues in adolescents' suggestive communication are systematized by the conditions of communicative (formal, informal), subject matter, and characteristic features of the verbal means of their actualization.

The text of each experimental fragment was transcribed in writing and placed on a separate card, with digital indexing of its linguistic features in the upper right corner according to the classification [Ibid.]. This indexing of features (in our case, from 1.1 and 1.2 to 6.1, 6.2, 6.3, and 6.4) is used to divide the cards of the studied fragments of the experimental material into the following two enlarged classes according to the criterion of communication types: 1.1 formal, 1.2 informal. Further, within each enlarged class, the cards-fragments of the experimental material are differentiated according to the criterion of the speaker's environment into their separate classes: 2.1 – macrosociety, 2.2 – microsociety, 2.3 – individual communication. Each set of cards-fragments of each class is divided according to the criterion of the speaker's communicative status into: 3.1 – high, 3.2 – medium, 3.3 – low.

Further stratification of the cards should cover the main psycho-physiological characteristics of the adolescent speaker and differentiate them into: groups 4 – types of temperament, subgroups 5 – gender, and subgroups by age 6 – characteristics.

In addition, each card should have a label on it, where auditor-phoneticians should indicate the level (low, medium, high) of emotional and pragmatic potential (hereinafter referred to as EPP) of the linguistic actualization of the indicated communicative fragment and separately record the levels of emotional (EP) and pragmatic (PP) potentials of this communicative fragment. The indexing described above is necessary for the quick selection of cards with fragments of adolescents' suggestive communication when preparing experimental material to solve each specific research objective. Fragments of adolescents' suggestive communication are selected from English-language films, e.g., 'Work it', etc.

2.2 Auditory Analysis of Prosodic Characteristics of Fragments of Adolescent Suggestive Speech.

Auditory analysis is carried out to establish typical patterns of adolescents' use of intonation in suggestive speech and to select appropriate experimental material for selective control of these patterns through instrumental analysis.

The analysis is carried out by two groups of auditors. The first group consists of native English speakers with a philological background and practical listening skills. The second group includes professional phonetic auditors with experience in conducting experimental phonetic research.

At the first stage of the auditory analysis, native English speakers listen to all the experimental material to determine: the naturalness of its sound, the correspondence of the intonation of the recorded fragments to the conditions of communication and to the pronunciation norms of the English language. The auditors record the course of the auditory analysis in protocols.

At the second stage, professional phoneticians describe changes in the prosodic parameters of the experimental fragments at the levels of: 1) melodic component (type of pre-head, terminal tone, scale, pitch range, pitch levels of the beginning and end of the fragment, pitch interval of the junction of adjacent intonation groups and sections of the intonation contour; 2) temporal characteristics (total duration of the speech fragment, type and duration of pauses); 3) distribution of utterance stress, 4) rhythmic structure of the fragment; 5) loudness within the fragment. They also graphically depict the direction of pitch movement within all parts of the rhythmic and melodic structure of the intonation groups of the analyzed fragments and provide additional information on the peculiarities of the functioning of segmental units in these fragments.

To describe the above parameters, phoneticians use the following scales of the complex of perceptual gradations given in the source [Kalyta, 2021]: 1) type of intonation scale; 2) type of terminal tone (taking into account its beginning and end); 3) degree of syllable prominence (unstressed, partially stressed, stressed); 4) pitch level of the beginning and end of the studied descriptions (extra-high, high, medium, low, extra-low); 5) pitch interval at the junctions and between the sections of their intonation contour (positive or negative: wide, widened, medium, narrow, zero); 6) pitch range (narrow, medium, widened, wide); 7) tempo (slow, moderate, accelerated, fast); 8) pauses (short, medium, long; perceptual, intrasyntagmatic); 9) rhythm (simple, complex, mixed); and 10) volume (low, reduced, moderate, increased, high).

2.3 Acoustic analysis of prosodic characteristics of fragments of adolescent suggestive speech

The acoustic analysis is based on typical samples of adolescent suggestive speech fragments selected in the course of the auditory analysis provided that there are significant differences in the auditors' assessment of prosodic parameters of the actualized utterances. The selected fragments are recorded in the form of Windows PCM (*.wav) sound files on an electronic disc. The obtained recordings are subject to acoustic processing on a personal computer using WaveLab (Version 2.1) [Goutier, 1995–1998], SpectraLAB (Version 4.3213) [Sound technology, 1997], CoolEditPro (Version 1.2) [Johnson, 1996], Praat (Version 5.4.04) [Boersma, Weenink, 1991].

Fragments of the spoken texts of suggestive speech are divided into segments, within which the frequency of the main tone, intensity and duration are measured and recorded using the above computer programs.

The sequence of studying the spectral characteristics of fragments of spoken texts of adolescents' suggestive speech should, in accordance with the recommendations of the source [Humeniuk, 2017], consist of the following procedures: 1) preparing the spoken texts of adolescents' suggestive speech for processing on the spectrum analyzer (1.1. installing recordings of the studied fragment in accordance with the logic of the experiment sequence; 1.2. setting the recording to the beginning of the analyzed sound segment); 2) recording the sound segment into the computer memory (2.1. controlling listening and defining the beginning and end of the segment, 2.2. recording and viewing the audio program on the monitor in real time; 2.3. entering the information obtained into the computer data file); 3) selection of the spectrogram for the analysis (3.1. selection of options for graphical interpretation of the dependencies of amplitude on sounding time, amplitude on frequency, phase on frequency, spectrum with a selected amplitude on time, etc. in plane coordinates, 3.2. selection of the most adequate three-dimensional image of the frequency spectrum distribution over time); 4) formation of coordinates of graphical dependencies and scaling of their axes (4.1. choosing the option of representing amplitude graphs in logarithmic or linear scales, 4.2. determining the appropriate scales and positions of the axes of graphs, 4.3. choosing the optimal angle of view for a three-dimensional

image of the distribution of frequency spectra); 5) analysis and registration of data of statistical processing of indicators of intonation characteristics (5.1. analysis of statistical indicators of intonation characteristics of the sound segments under study, 5.2. refinement and verification of statistical indicators values at extreme points of graphical dependencies); 6) printing of acoustic analysis results.

Quantitative indicators of the acoustic parameters of tonal, temporal and dynamic features of the studied fragments of adolescent speech are determined by calculating the average maximum range of fluctuations of the digital values of the studied parameter. The indicator of the average maximum range of each individual parameter is obtained by correlating its average maximum and minimum values. Further, the average maximum range, which reflects the maximum value of the analyzed parameter, is equated to 100% and conditionally segmented into zones of its acoustic realization for correlation with the relevant data of the auditory analysis. On the basis of the described division of the averaged tonal range, scales of tonal, temporal and dynamic indicators of the analyzed utterances are created.

In studying the tonal characteristics of fragments of adolescent suggestive speech fragments, the following prosodic features of their speech are taken into account at the acoustic level in accordance with the recommendations [Andruschenko, 2019, pp. 76–79].

The frequency range of the intonation group, which is measured by the ratio of acoustic indicators of the maximum and minimum levels of the fundamental frequency with the correlating conversion of the obtained data into semitones using the appropriate tables. The conversion of the digital range indicator in halftone to a percentage value is carried out in accordance with the percentage value of one halftone, based on the speaker's average maximum range. The average maximum range of frequency fluctuations in a speaker's communicative fragments is conditionally divided into five zones: narrow (0-20%), narrowed (21-40%), medium (41-60%), widened (61-80%) and wide (81-100%).

The value of the tonal maximum, which is measured by the ratio of the maximum value of the utterance (syntagm) to the average minimum level of the speaker's fundamental frequency.

Tonal maximum localization is defined according to the intonation group structural elements: pre-head, head, second and third rhythmic groups, nucleus, and tail.

The rate of the fundamental frequency change in the terminal rhythm group, being defined by the following formula:

$$S = \frac{i \cdot \tau}{\Delta t},$$

where S is the speed of the change fundamental frequency; i is the interval between the maximum and minimum values of the fundamental frequency; τ is a time scale equal to 1000 m/s; Δt is the duration of the fundamental frequency section in m/s. The gradations of the rate of the fundamental frequency change are qualified in the following terms: zero, small, medium, large, maximum.

The pitch value at the beginning of the intonation group, which is measured by the ratio of a specific value of the fundamental frequency to the average minimum level of the speaker's fundamental frequency.

The dynamic characteristics of the intonation model of adolescents' suggestive speech utterances actualized by different types of speech accentuators are evaluated by the following prosodic features:

The maximum intensity and its localization in the utterances of adolescents' suggestive speech; the following contrasts of the maximum intensity are differentiated as follows: minimal (0-20%), small (21-40%), medium (41-60%), large (61-80%), and maximum (81-100%).

The range of intensity of adolescents' suggestive speech is determined by the difference between its maximum and minimum levels. This range is differentiated according to the following scales: narrow (0-20%), narrowed (21-40%), medium (41-60%), extended (61-80%), and wide (81-100%).

The temporal characteristics of adolescents' suggestive speech utterances, shaped by different types of linguistic accentuators, are determined by the following features:

The duration of pauses in adolescents' suggestive speech utterances are actualized by different types of linguistic accentuators: minimal (0-20%), short (21-40%), medium (41-60%), increased (61-80%), maximum (81-100%).

The indicators of the emotional-and-pragmatic potential (EPP) level of the statements within the fragments of adolescents' suggestive speech are calculated by the formula of the quantitative K-criterion of Kalyta-Taranenko [Kalyta, 2016, p. 144], which is as follows:

$$K = \frac{F_0 \times t \times I_0}{1000 \times I_3},$$

where: K is the criterion of the level of the utterance emotional-and-pragmatic potential actualization; F_0 is the fundamental frequency (Hz = 1/s); t is the duration of the syllable (ms); I_0 is the intensity of F_0 (dB = erg/m²s); I_3 is the intensity of F_3 (dB = erg/m²s); 1000 is the conversion factor of milliseconds to seconds.

The results of the auditory and acoustic analyses are recorded in the computer's memory in the form of spreadsheets of quantitative values of the obtained parameters.

2.4. Statistical processing of quantitative research results

The data obtained from the results of the auditory analysis and acoustic measurements are processed using established methods of probability theory and mathematical statistics. The calculation of statistical indicators of the results of the experimental study is carried out [Klymeniuk, 2007, p. 121] in the following sequence.

1. On the basis of the results of individual measurements of the evaluated parameter entered in the table, its average value is determined as follows:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i,$$

where \bar{x} – is the arithmetic mean value of the measured parameter; x_i – is the value of a particular measurement; n – is the number of measurements taken.

2. The absolute errors of individual measurements are calculated using the formula:

$$\Delta x_i = x_i - \bar{x},$$

where: Δx_i – an absolute error of an individual measurement; x_i – value of a specific measurement; \bar{x} – arithmetic mean value of the measured parameter.

3. The standard deviation of the mean result is determined as follows:

$$S(\bar{x}) = \sqrt{\frac{\sum_{i=1}^n (\Delta x_i)^2}{n(n-1)}},$$

where: $S(\bar{x})$ – standard deviation of the mean result; $(\Delta x_i)^2$ – sum of squared absolute errors; n – number of measurements

4. The value of the actual Student's criterion is calculated:

$$t_{\phi} = \frac{x - \bar{x}}{S(\bar{x})},$$

where: t_{ϕ} – Student's actual criterion value; x_i – value of a particular measurement; \bar{x} – arithmetic mean of the measured parameter; $S(\bar{x})$ – standard deviation of the average result.

5. The actual and tabulated Student's criteria are compared. The tabular Student's criterion is determined by the number of measurements of the evaluated parameter with a confidence level of $\alpha = 0.95$. In the case of $>$, the gross error is removed, and the remaining values were re-processed. If $t_{\phi} \leq t_T$, then the calculation is continued, and the error of the average result is determined:

$$\varepsilon_{\alpha} = t_{\phi} S(\bar{x}),$$

where: ε_{α} – error of the average result; t_{δ} – actual Student's criterion; $S(\bar{x})$ – standard deviation of the average result.

6. The confidence interval is calculated as follows:

$$x \pm \varepsilon_{\alpha}.$$

7. The relative measurement error is defined as follows:

$$\Delta x = \frac{\varepsilon_{\alpha}}{x} 100\%,$$

where: Δx – relative measurement error; ε_{α} – error of the average result; \bar{x} – arithmetic average value of the measured parameter.

The values of the random error of the intra-zone measurements obtained in this way are given by the confidence interval and confidence probability. Other results obtained in the course of the experimental-phonetic study and the dependencies between them are presented in the form of intonograms and tables.

The course of the experimental-phonetic study of prosodic actualization of adolescents' suggestive speech fragments is accompanied by the preparation of working protocols and tables with the experimental data.

2.5. Presenting the results of interdisciplinary linguistic and energy research

To visualize the results of interdisciplinary lingual-energetic research, we use the relevant psycho-energy-grams, substantiated in the paper [Kalyta, Klymeniuk, 2022, pp. 543–552, 603–620], which allow us to record simultaneously quantitative characteristics of the levels of production/perception by communicators of emotional and pragmatic potentials of the utterance or text segment.

The meaningful forms of these verbal and graphic psycho-energy-grams can be of two main types. The template of the first type of psycho-energy-gram is shown in Fig. 3.

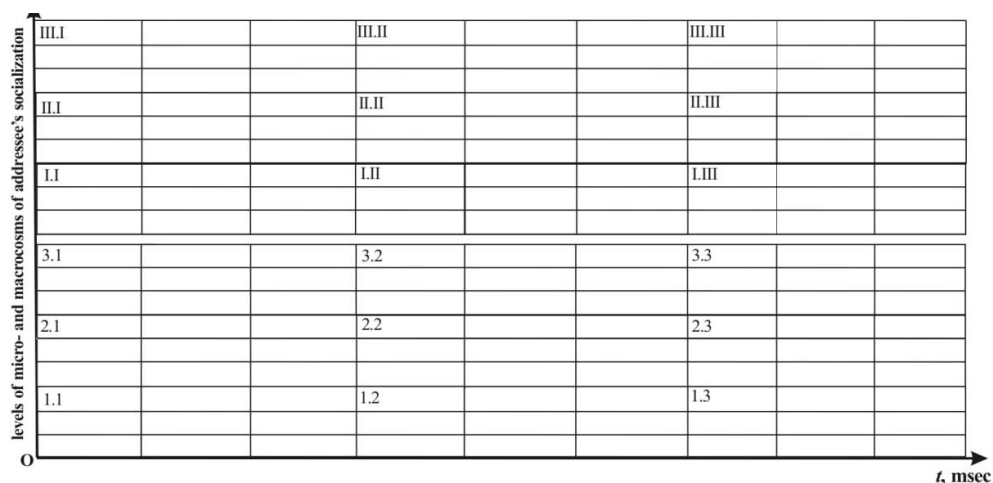


Fig. 3. Matrix template for constructing psycho-energy-grams depicting self-developing processes of an individual's thinking and speaking activities [Kalyta, Klymeniuk, 2022, p. 606]

We quote verbatim [Kalyta, Klymeniuk, 2022, p. 606]: as can be seen from the figure, the matrix covers the content of the universal model of the semantic division of the system of the individual's thesauri and the spheres of the space of their communication [Ibid., p. 604], which is a complex multi-level system of complex factors-causes that can influence the complex of results of human cognitive self-developing processes in communication. By its functional essence, this system is a multilevel classification of scientific terms of different degrees of abstraction designed to provide an unambiguous description of complexes of factors-causes supervening on the complex results of cognitive processes occurring in the existence of the communicator.

At the first hierarchical level, the system distinguishes two autonomous subsystems: the microcosm and macrocosm of the communication space. The microcosm contains the thesauri of factors internal to the communicator, which are basically determined by the level of their personal speech and thought culture. The macrocosm, on the other hand, covers the subsystem of spaces of influence on the individual's speech and thought of external factors-causes generated by the requirements and traditions of society.

At the second level of classification, there are elements of the macrocosm subsystem that relate to: I. – the sphere of education, II. – the sphere of social culture, III. – the space of real communication situations. The autonomous subsystem of the microcosm of the causes of an individual's speech behavior includes at this level 1. ego-thesaurus, 2. socio-thesaurus, and 3. universal-thesaurus.

At the third hierarchical level of the system under consideration, within its subsystems (micro- and macrosocieties), the complexes of causal factors included in them are differentiated into the following groups:

In the microcosm subsystem we can trace the following:

1. – Ego thesaurus (1.1 – idealistic, 1.2 – materialistic, 1.3 – rationalistic).
2. – Socio-thesaurus (2.1 – I-thesaurus, 2.2 – We-thesaurus, 2.3 – They-thesaurus).
3. – Universal thesaurus (3.1 – dogmatic, 3.2 – pragmatic, 3.3 – dialectical).

In the macrocosm subsystem there are:

- I. – Spheres of education of the macrocosm (I.I. – humanitarian, I.II. – natural science, I.III. – functional and practical).
- II. – Spheres of society culture (II.I. – authoritarian, II.II. – transitional, II.III. – democratic).
- III. – The space of real communication situations (III.I. – dominance of the status of the sender of information, III.II. – equality of statuses of communicants, III.III. – dominance of the status of the receiver of information).

The source cited above also provides an example (Fig. 4) of building a corresponding psycho-energy-gram in these coordinates.

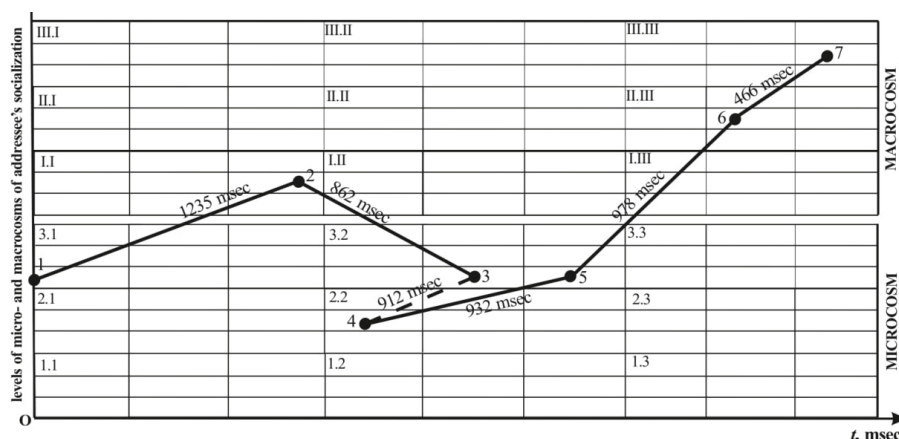


Fig. 4. An example of constructing a psycho-energy-gram of self-developing process of the speaker's choice of lexical means of communication
[Kalyta, Klymeniuk, 2022, p. 607]

It should be noted here that each cell of the subsystems of micro- and macrocosms is divided vertically into three rectangles with three planes from the bottom to the top marking the low, medium and high levels of emotional and pragmatic potentials of utterances actualization by the speaker. At the same time, if necessary, these same planes make it possible to simultaneously mark the levels of actualization of the bifurcation points of both emotional and pragmatic potentials of two or more structures-attractors of self-development of any cognitive processes and phenomena. In turn, bold black dots indicate the points of bifurcation of synergistic self-development of attractor structures of cognitive processes of speaking and thinking activities in the speaker's mental sphere. Above each partial attractor, the time of its self-development is indicated in milliseconds.

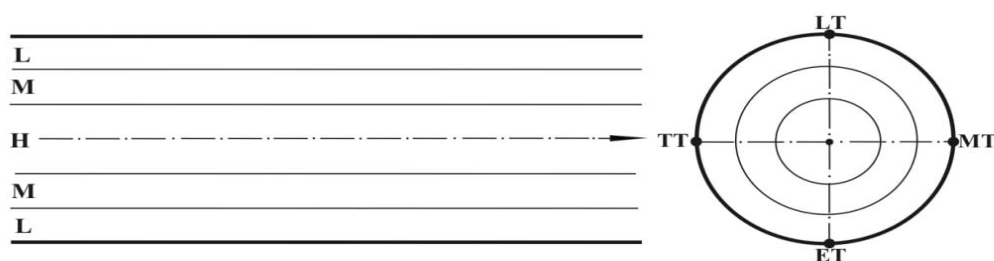


Fig. 5. The structure of the space for modelling the self-development of the human thought flow [Kalyta, Klymeniuk, 2022, p. 402]

The figure shows that the cross-section of the model space (the left part of the model) is divided into three zones of levels (L – low, S – medium, H – high) of actualization of the emotional and pragmatic potential of the statements or actions under analysis. The boundaries of these zones are projected onto the right side of the model as corresponding circles. The shell of the transverse-axial section of the model space on its right projection is bounded by a bold circle, at the opposite ends of the axes of which black dots indicate the poles of concentration of psycho-energetic taboos in the self-development of human thinking and speaking processes and actions. These poles as the points of concentration of the maximum energy of the taboo potentials of the individual's psyche are marked as follows: LT – logical taboo, MT – mental taboo, ET – existential taboo. Due to this, the model shows the space of self-development of cognitive processes and phenomena within the coordinates LT – ET, TT – MT and the time axis (horizontal axis B in the left part of Fig. 5), marked in milliseconds.

In [Kalyta, Klymeniuk, 2022, pp. 403–408], it is clearly stated that the logical tabulation sector (see the upper half of the right part of Fig. 6) is covered by the TT-LT-MT curve, the existential tabulation sector by the TT-ET-MT curve, the transcendental tabulation sector by the ET-TT-LT curve, and the mental tabulation sector by the LT-MT-ET curve. It is also emphasized that the localization of most endpoints of the structures-attractors of self-development of an individual's thinking and speaking activities becomes an experimental artefact, which testifies to the existence of certain types of human thinking, which include their vector-directed varieties: existential (existential-transcendental, transcendental-existential, existential-mental, mental-existential); mental (mental-existential, existential-mental, mental-logical, logical-mental); transcendental (transcendental-existential, existential-transcendental, transcendental-logical, logical-transcendental). It is emphasized that all 12 types of the aforementioned vector orientations in self-development of individual thinking are realized with relatively low expenditure of human psycho-physiological energy.

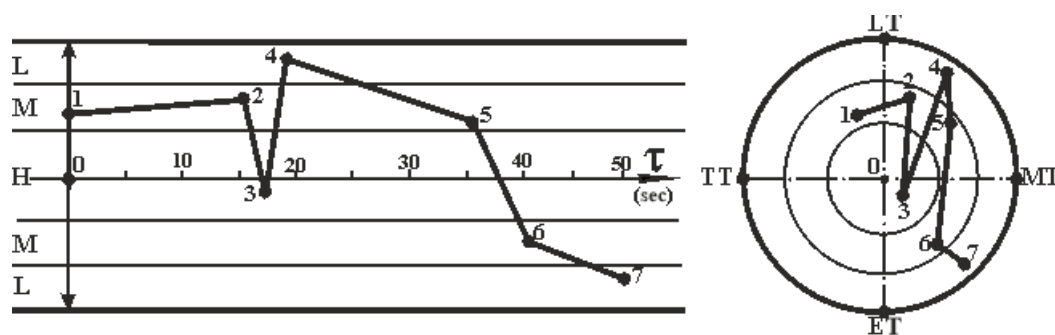


Fig. 6. An example of constructing a psycho-energy-gram of the speech segment self-development in an individual's stream of thinking [Kalyta, Klymeniuk, 2022, p. 587]

By supplementing the qualitative depiction of the individual's thinking process presented in this way with numerical data on the levels of emotional-and-pragmatic potential (EPP) of each thought actualization (see attractors 1-2, 2-3, 3-4, etc.), we obtain a comprehensive qualitative and quantitative description of the patterns of fluctuations of the psychophysiological energy of self-development of the individual's thought flow.

Let us also remind that, if necessary, the researcher may differentiate EPP into its components: emotional (EP) and pragmatic (PP) potentials, to track and evaluate the quantitative redistribution of these potentials or EP in general between verbal and non-verbal means of communication, to establish the pause-drop of EP at the junctions of thought segments, to determine the indicators of EP related to the time of actualization of any segment of the individual's thought flow or their materialization in statements, etc.

Conclusions

This article, based on the theoretical generalization of various interdisciplinary studies and partial methodological provisions and procedures, presents a generalized program and methodology for the experimental study of the system of energy interaction between verbal and non-verbal means in adolescents' suggestive speech. It is shown that the elements of the classification of universal features characterizing adolescent suggestive speech can be differentiated into seven hierarchical levels, namely: types of communication, speaker's environment, speaker's communicative status, speaker's type of temperament, gender, speaker's age and period or phase of development, emotional and pragmatic potentials of the acts of speech behavior. Four systems of interrelated factors are considered as follows: 1 – social and political, 2 – situational and communicative, 3 – psycho-genetic, 4 – physiological and state. Considering this, the article advances a model that depicts the influence of the system of these factors on psychic mechanisms underlying the actualization of the adolescent's suggestive speech behavior, which emerges in the system of his/her spiritual being. The model is differentiated into three autonomous spheres: existential, mental and transcendental. The indicators of the emotional-and-pragmatic potential (EPP) level of the statements within the fragments of adolescents' suggestive speech are calculated by the formula of the quantitative *K*-criterion of Kalyta-Taranenko. The model of a supervenient interaction of verbal and non-verbal means of adolescent's communicative behavior reflects the mechanism generating the utterances meanings' alternatives, being actualized by the adolescent through concepts-notions and concepts-actions acquired by his/her memory due to previous communicative and social experience. The results of the auditory and acoustic analyses are recorded in the computer's memory in the form of spreadsheets of quantitative values of the obtained parameters. It is hoped that the above justification of the generalized program and methodology of the experimental study of the system of energy interaction of linguistic and non-linguistic means of adolescents' suggestive speech can serve as methodological guidelines for comparing, verifying and generalizing the results of multidimensional studies aimed at understanding the specifics of the processes of adolescents' implementation of suggestive behavior in general and speech in particular, as well as contribute to increasing the reliability of statistical estimates of the phenomena under consideration.

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ENERGETIC INTERACTION OF VERBAL AND NON-VERBAL MEANS IN ADOLESCENTS' SUGGESTIVE SPEECH: METHODOLOGY FOR THE EXPERIMENTAL STUDY

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Key words: program and methodology of experimental research, psycho-energy-grams, verbal and non-verbal means, adolescents' suggestive speech.

The article presents a generalized program and methodology for the experimental study of the energy interaction system between verbal and non-verbal means of adolescents' suggestive speech. The study is conducted within the framework of Speech Energetics Theory and employs its idea of emotional-and-pragmatic potential, which is believed to accurately convey the idea of adolescents' suggestive speech and therefore further facilitate successful interaction of its verbal and non-verbal means.

The *relevance* of the study is defined by general scarcity of current enquiries highlighting the necessity of the additional development of partial methodological provisions and procedures directly aimed at substantiation of the generalized program and methodology of experimental research on verbal and non-verbal means' interaction in adolescents' suggestive speech.

The article theoretical basis is a systematic methodological concept that serves as the main elements of a comprehensive methodology for studying psycho-energetic interaction of verbal and non-verbal means in human communicative behavior in general and speech communication in particular, set out by the Ukrainian author of a new speech energetics theory, Professor Alla Kalyta.

The *research methods* employed in the article are generalization, formalization, abstraction, modeling, as well as descriptive, systematic, and theoretical analyses.

The study demonstrates that the elements of the classification of universal features characterizing adolescent suggestive speech can be differentiated into seven hierarchical levels, namely: types of communication, speaker's environment, speaker's communicative status, speaker's type of temperament,

gender, speaker's age and period or phase of development, emotional and pragmatic potentials of the acts of speech behavior. Four systems of interrelated factors are considered as follows: 1 – social and political, 2 – situational and communicative, 3 – psycho-genetic, 4 – physiological and state. Considering this, the article advances a model that depicts the influence of the system of these factors on psychic mechanisms underlying actualization of the adolescent's suggestive speech behavior, emerging in the system of their spiritual being. The model is differentiated into three autonomous spheres: existential, mental, and transcendental. The model of a supervenient interaction of verbal and non-verbal means of adolescent's communicative behavior reflects the mechanism generating the alternative utterance meanings, being actualized by the adolescent through concepts-notions and concepts-actions acquired by their memory due to previous communicative and social experience.

The *results* demonstrate that the program and methodology of the experimental study of the interaction between verbal and non-verbal means in adolescents' suggestive speech can serve as methodological guidelines for comparing, verifying, and generalizing the results of various studies on communicative behavior.