

JOLANTA PANASIUK

Maria Curie-Skłodowska University in Lublin,
Department of Logopedics and Applied Linguistics

ORCID ID: <https://orcid.org/0000-0002-5666-4899>

Neurobiological Mechanisms of Emotional and Volitional Behaviors *vis-à-vis* Strategies for Logopedic Therapy

*Tell me and I will forget,
show me and I may remember
involve me and I will understand.*

Confucius

SUMMARY

It should be assumed that human linguistic and intellectual capabilities are gradable, which follows from both the laws of evolution of the human species and from developmental stages of each individual. The order of succession of the stages in the process of formation of mental functions is determined by the principle: from the most primitive to the increasingly complex. This hierarchy is based on neurobiological determinants: all the levels of the brain organization participate in the processes of forming and receiving utterances, from the oldest or the brain stem, which is connected with the readiness to speak and automation of vocal sequences, to the limbic level, which regulates the emotional and motor aspect of utterances, to the youngest or cortical level, which is responsible for language planning. The paper presents strategies that should be adopted to stimulate, shape and rebuild linguistic behaviors of children and adults with neurologically-based speech disorders. These strategies stem from the evolutionary and ontogenetic laws of the development and functioning of the human nervous system.

Key words: speech phylogenesis, speech ontogenesis, pragmatic functions of utterances, speech disorders, speech therapy management

INTENTIONALITY OF HUMAN BEHAVIORS

An inherent feature of the human species is the ability to acquire speech. In order to explain the essence of speech, the category of intentionality is of key importance. Intention (intent, desire), in any case, underlies all complex human activities. According to John R. Searle (1995) the intentionality of action is immanent in action itself and is characterized by three features:

- 1) it contains some content,
- 2) it is to satisfy some conditions,
- 3) it generally has its causal power.

Searle explains the essence of intentional human behaviors saying that intentionality is the trait of the mind, owing to which it creates internal representations of objects and states of affairs in the world. However, our minds are at the same time in constant causal contact with the world. When we see objects, they produce visual sensations. When we remember events from the past, they evoke our present recollections. When we intend to make a movement, the intention causes our body to move. In each case we are dealing both with a causal and intentional element. In order that intentionality functioned and we survived, it is necessary that the mind's ability to create representations and causal relationships interconnect in some regular way. This is effected in the form of an intentional causal relationship. In this case, cause and effect work the way they do because either the cause represents the effect or the effect represents the cause (cf. Searle 1999, 167–170).

According to Searle, the basis of action is always specific causes, but when intentional behavior comes into play, its explanation has to refer to neurobiological and content factors at the same time. This relationship is not deterministic because the intentional cause alone does not imply that action must be completed. In other words, intentional causes are not a sufficient condition for action, like neuronal¹ factors that are linked with them.

According to the assumptions of interaction theory, the planning and implementation of an individual's actions is always carried out in a social context. Action within a social group consists in the mutual adjustment of individual actions, when individual persons adjust their activities to the activities of others, based on the recognition of the actual or intended behaviors of the latter. In this way, a person enters "the role of others", both in the role of a specific person and a group ("generalized others") (Mead 1975, Blumer 1969, Hałas 2006).

¹ John R Searle thus comments on it: When I explain my own behavior by stating that my convictions and desires made me act, I usually do not suggest that I could not have done otherwise. Usually, when I conclude from my convictions and desires about what I should do, a certain gap appears between the causes of my decision (in the form of convictions and desires) and my actual decision, and another gap between the decision and performance of an action. These gaps appear because the intentional causes of behavior are not enough to determine the behavior (cf. Searle 1999, 171–172).

The problem of intentionality² of human behaviors in social relationships acquires special significance in describing speech disorders, when, because of biological limitations, a person performs behaviors that do not satisfy the intentionality criterion or do not conform to the rules adopted by a group. What is meant are actions that are characteristic of either the early stages of human development or that result from disorders of cerebral processes induced by neuropsychiatric diseases.

The causes of those limitations may lie in different phases of the communication process, which was pointed out *inter alia* by Roman Jakobson arguing that the analysis of speech convincingly indicates the significance of studying and correlation of various phases in the whole act of speech, from its source to the listener: intention, nervous stimulation, gradual producing of transmission, hearing, perceiving, and understanding. Numerous examples of isolationist restrictions of research to one particular phase of this process without taking into consideration the next phases or cases when subsequent phases mix, affected the analyses and deprived them of effective classification criteria. The situation of each phase in the whole speech process requires careful explanation (Cf. Jakobson 1989, part 1, 137).

The criterion for the intentionality of behaviors can be found in the concept of mental product and acts initiated in 1912 by one of the founders of Polish psychology Kazimierz Twardowski (1965). The psychological phenomena, according to this theory, are expressed in a durable or non-durable psychophysical product, which is observable, repeatable and meaningful³. The role of a researcher is to

² Intentionality is one of the basic notions of 20th century philosophy, vastly discussed in Edmund Husserl's phenomenology. Husserl took the category of intentionality over from Franz Brentano, who in his treatise *Psychology from an Empirical Standpoint* revived this notion of scholastic origin and made it a discriminant of mental states. For F. Brentano each mental event was characterized by intentionality, which was characteristic of human mind only. In Husserl's thought intentionality refers to consciousness and means that it is always the consciousness of something. Consciousness means simultaneously comprehending an object, thinking about it and giving a sense to it, because an object is revealed exclusively through the intentional project of consciousness directed at it. In the analytical philosophy of John R. Searle and in psychology, intentionality is a feature of a conscious and intentional act, state or action (Searle, 1995).

³ Kazimierz Twardowski became part of the methodological discussion on the range of physiological and psychological research. It was about the status of such physiological responses of the organism as e.g. getting pale, mimic expressions connected with a certain configuration of facial muscles, trembling of the hands etc. Making a distinction between acts (e.g. *to cry*, *to think*, *to speak*) and the products (e.g. *a cry*, *a thought*, *a speech*) he divided them into durable and non-durable. Kazimierz Twardowski ascribed the feature of durability to products and physical acts, distinguishing a specific kind among them – psychophysical acts and products that can, but do not have to be durable. The psychophysical products are created “thanks to a psychophysical act, i.e. such a physical act that is accompanied by a psychological (mental) act that impacts the course of the physical act and thereby the product that is being created thanks to that act.” (Twardowski 1965, s. 230).

open the meaning of a mental state on the basis of a symptom (indication) or sign. In this psycho-semiotic interpretation which, to a significant degree, utilized the achievements of the humanities, no strict distinction has been made so far between a symptom (indication) and a signal of psychophysical products.

The theory was applied by Twardowski's disciple – Władysław Witwicki, who distinguished between symptoms (indications) and bits of information (signs) concerning mental and especially emotional life. He included into the interpretable products all the intended signs of psychical facts, which are directed at another person in their intent “[...] to make someone aware of a certain status or a certain disposition” (Witwicki, 1963, 25). The division of psychophysical products suggested by Witwicki is based on the criterion of “intentionality – absence of intentionality”. The basis of communication in light of the theoretical assumptions thus formulated is interpretation, i.e. seeking the meaning of observed facts in the course of social interactions.

There is a special type of interaction between people: it results from the fact that people do not respond in a simple way to their actions but mutually interpret or “define” them. Human interaction takes place through symbols, through ascribing meaning to the behavior of others – between stimulus and response there is the process of interpretation (Blumer 1969, Grabias 2007; Panasiuk 2012)⁴.

According to Stanisław Grabias's sociolinguistic theory (1997) a person reveals two categories of phenomena in speech: 1) his/her emotional experiences and 2) his/her volition acts. The author believes that the status of emotional experiences is unclear and requires distinction into: a) emotions i.e. manifestation of emotional processes, and b) language expression, or the process of the sender manifesting him/herself in an utterance. The emotional function of utterances involves the expression of attitude towards the surrounding reality, and defines the sender's personality traits. The use of expressive means is subject to social and situational determinants. In interpersonal communication, the sender's emotional states may manifest themselves, may be expressed or communicated as well. Each technique is endowed with different means of expression and different rules of their use. In volition acts, “the sender transmits “wants/wishings” consisting in: 1) informing the receiver about the state of affairs, 2) persuading/inducing the receiver (or oneself) to start and perform an act, and 3) imparting information on his/her (=sender's) attitude towards reality

⁴ The idea of society as a symbolic interaction, though often recalled, has seldom been systematically formulated. Partial, usually fragmentary assumptions that social reality emerges from interactions are recalled in the works by numerous sociologists, first of all by Charles Horton Cooley, William I. Thomas, Robert E. Park, Ernest W. Burgess, Florian Znaniecki, Ellsworth Faris, or James Mickel Williams.

The information function is executed when the sender announces information about states of affairs, denies or confirms the interlocutor's announcements, asks for complementing information or for deciding an alternative. The action function involves a verbal behavior when the sender, estimating the receiver's actual abilities, wants the receiver: to take action (request), abandon action (prohibition, ban) or not to take action (refusal to permit action). The receiver may take action or refuse to do so, whereas the sender may or may not have sanctions to compel the sender to act. Sanctions may be legal or moral and are strictly connected with the social roles performed by the interlocutors. The termination of action may benefit the sender, the receiver, or both. The modal function of an utterance concerns the speaker's attitude to the manner of the duration of states of affairs and of occurring processes. Modality is usually measured in terms of certainty, presumption, doubt, and exclusion (Grabias, 1997, 322).

Man – *homo loquens* – manifests him/herself through verbal (linguistic) behaviors – for an individual, language performs an existential function. In the case of speech disorders, the accomplishment of intentions is impeded. A speech disorder always involves the internally determined need to behave in a particular way and the lack of ability to behave differently (Grabias, 2001). Persons who have problems accomplishing their intentions due to developmental abnormalities or acquired diseases function in society and communicate with the environment in a specific way⁵. This specificity is caused either by difficulties in programming their behaviors or limitations in ascribing meaning to the behaviors of other people. The category of intentionality is therefore crucial to explaining human behavior. The interpretation by a researcher describing speech disorders has at the same time to refer to neurobiological determinants and interaction categories.

From the standpoint of logopedics, one more aspect of intentional behaviors is significant: in what order it is necessary to release and shape behaviors with a specific communicative intent (pragmatic function) when programming a logopedic therapy for children with speech development disorders and for persons in whom there was a disintegration of previously acquired language and communication skills. In view of the urgent need to develop optimal methods of logopedic therapy, which is expected to result in the efficient use of language in its communicative and cognitive functions, this problem requires solutions.

NEUROBIOLOGICAL FOUNDATIONS OF EMOTIONAL AND VOLITIONAL BEHAVIORS

The brain organization of human behaviors is hierarchical, being defined by the laws of the evolution of the nervous system. According to Gerald M. Edel-

⁵ When one person communicates with the other, this other person always more or less understands what the first person's message meant (cf. Fiske, 1999, 59).

man's theory of neuronal group selection – (TNGS) (1998), being part of the current of Darwinian evolutionism, the development of the brain occurred because of the need for adaptation, thus enabling the individual and the species to survive in the environment.

The basic reactions of the organism that are the basis of life functions (breathing, heart beating, primary reflexes, and the like) are innate and non-intentional. The organ that is evolutionarily responsible for them is the oldest part of the brain (the spinal cord and its extension – the brain stem, which comprises the medulla, the pons, and the mesencephalon), sometimes called the “reptilian brain”, in which only biological processes are regulated, e.g. the reticular formation within it controls the state of mental excitation, waking and consciousness, whereas the hypothalamus cooperates with the autonomous nervous system, regulating the biological homeostasis of the organism: thermoregulation, biological rhythms, and sensations of thirst and hunger. Above the mesencephalon is the diencephalon – its largest part, thalamus, mediates information transmission from the lower levels of the brain stem to both hemispheres of the cerebral cortex: the telencephalon (Fix, 1997).

A separate functional system, developed late in the evolutionary process, is the limbic (marginal) system situated in the evolutionarily older part of the brain, and first called rhinencephalon. It is poorly developed in reptilians, and well developed in mammals. This system is responsible for regulating patterns of instinctive and emotional behaviors, and for memory consolidation (Fix, 1997; Martin, 2001). The limbic system consists of many structures that determine human gestural and mimic behaviors, and maintain the state of readiness to utter sounds that organize voice in terms of rhythm and intonation, and thereby determining the expression of the emotional component in verbal utterances. The role of the limbic system also manifests in the selection of words in respect of their expressive markedness, which impacts the stylistic differentiation of utterances.

An important aspect of language communication is the control of vocalization processes and the emotional characteristics of voice. For these abilities, the tertiary cortical areas are responsible, especially the prefrontal region, which is controlled by the parbasal part of the frontal lobes that jointly make up the limbic system. This structure controls the non-verbal and unconscious aspects of utterances: gestures, facial expressions, and also influences its emotional character, which is also reflected in intonation, voice and the choice of words.

The organization of intentional (free) behaviors is far more complex⁶. They are the responsibility of the cerebral cortex divided into two hemispheres, and into

⁶ The knowledge about the environment, which shapes human behaviors, is created and modified by cognitive processes or the processes of information processing. They take place in the nervous system and consist in receiving information from the environment, in storing and transforming, and then in applying it in specific behaviors (Maruszewski, 1996; Materska, Tyszka, 1997).

four lobes (frontal, temporal, parietal, and occipital) in either. The cerebral cortex constitutes the highest level of information processing: it is ultimately the part that the signals initiated in the sensory organs arrive at, and it is from it that neural impulses sent to muscles come from. Most behaviors controlled by the cortex are connected with the integrated effect of its different areas. In other words, the cortical functions are organized into dispersed systems. An example could be the analysis of visual observation, which involves the areas in the occipital, parietal and temporal lobes. The areas of the cerebral cortex that are not directly involved in sensory or motor processing are called association areas. These areas became the most enlarged in the human species, which made human cognitive abilities go beyond sensory experiences and introduced man into the world of notions and conceptual language. The organization of higher mental functions involves all types of cytoarchitectonic (cortical) areas, with special emphasis being laid on the importance of the tertiary, ideational areas of the cerebral cortex, which is most developed in people (Kaczmarek, 1995).

Human abilities are, however, something far more than merely an epiphenomenon of the nervous system. According to Humberto Maturamy and Francisco J. Vareli (1980) the mind manifests itself in acting: it is a product that is active by its nature. The history of the development of human culture and evolution, as well as studies into the child's ontogeny show the significance of the process of language socialization and the upbringing environment in the socialization of individual experience and knowledge building. Only a child who lives and develops in the optimal environmental conditions and in good contact first with mother and then with both parents, and receives positive emotional stimuli, has conditions satisfied for normal development in psychomotor terms (Gerhard, 2010; Ruszel, 2011).

SPEECH DEVELOPMENT

The nativist view holds that a healthy infant is able to learn any of the world's existing languages (Chomsky, 1957). The signs of the humans as a species innately programmed for the speech function are adaptation: morphological (the properties of the structure of some organs like the teeth, mouth, tongue, larynx, lungs and the brain) and physiological (the functions of internal organs: the automatic coordination of nerve and muscle actions and respiratory rhythm during speaking). According to Eric Lennenberg (1967), speech is a biologically determined behavior, which means that:

- it develops before it becomes useful or indispensable for biological functioning;
- it does not result from an individual's conscious decision;
- it is not triggered by some specific external events;

- it proceeds in accordance with specific developmental stages;
- there is a critical period conducive to the acquisition of such behavior (from the age of 2. do 14);
- no external events can accelerate its emergence, nor do they determine the omission of any of its development stages.

The process of speech development does not proceed identically in all children because individual anatomical-physiological characteristics of the child's organism as well as different environmental determinants, including the kind of linguistic socialization, may produce differences in the pace and ways of language acquisition.

Studies by neurophysiologists on the structure and functioning of the central nervous system show that language played a crucial role in man's gaining the awareness of him/herself and in undertaking a specific activity based on it⁷ (Edelman, 1998). The regularities of language development in the evolution of the *Homo sapiens* species (phylogeny) are reflected in the course of the individual development of a child's speech (ontogeny). Phylogenetic development resulted in the formation of a neuroanatomical structure, characteristic of the contemporary human at the microscope level.

As early as 2 million years ago, as has been proved by geneticists, the gene FOXP2 responsible for speech development began to mutate in the human genome. It was language that was the product of evolution that determined the special development of the human species and made it possible to pass on the whole store of experiences and accumulated knowledge to successive generations. Further development of human mental abilities is linked to gene **miR-941** (microcephalin), which was formed with the appearance of art, music and tools (ca. 37 thousand years ago) and the gene ASPM, which arose with the emergence of dialects, agriculture, and towns (ca. 6 thousand years ago) (Khaitovich, Enard, Lachmann, 2006; Wit, Linse, Cuppen Berezikov, 2009; Gilad, Oshlack, Smith et al., 2006; Somel, Liu, Tang et al., 2011).

The genetic code does not, however, provide an exact diagram of functional connections between neurons; it only defines the rules restricting the process of selection within the neural network, which causes groups of neurons in each individual's brain to form individualized networks of neural connections. In accor-

⁷ Gerald M. Edelman's theory is based on neural models, which explain how consciousness emerges in the evolutionary process based on natural selection and in the process of individual development. Edelman refers to the principles of evolutionary morphology and selection, categorically rejecting the view that a syntactic description of mental operations and representations is sufficient to explain the mind. This is the first theory that tries to combine embryological, morphological, physiological and psychological data. Many other studies published in the 1990s emphasize the role of language in the development of *homo sapiens* and treat the emergence of language as an outcome of purely mechanical evolution and at the same time as the original cause of the development of human culture (Edelman, 1998).

dance with the principles of evolution, the process that organizes the development of an organism is selection – this mechanism guarantees the similarity of forms within a species but it also results in individual diversity at the level of the detailed structure of the neural network. In the responding organism, synaptic connections are selectively strengthened or weakened by the operation of specific biochemical processes, hence even genetically identical individuals do not have the same neuronal networks – selection is an epigenetic process. The existence of this diversity at the level of individuals appears to be the most important feature of the brain morphology: it can be the basis of the development of language and the mind (Edelman, 1998), and determine individualization in comprehending the phenomena of reality⁸.

As a result of millions of years of development, evolutionary adaptive processes enabling survival in changing, unfavorable conditions, the contemporary human was molded as a speaking being. The factor most closely connected with the structure of the human brain and human language abilities is the complexity of social groups in which the human species evolved and in which each human individual developed. Social life, maintaining relationships in a group, and the need to process information connected with the functioning of a group determined the direction of the development of the nervous system (Dunbar, 2014).

According to G. Edelman, in the evolution of the human species, the first to develop was primary consciousness, which was made up of internal sensations, and which, limited to the present, was not accessible to intro- and retrospection. During the next stages of evolution, based on primary consciousness, higher-order consciousness was able to form, connected with the development of semantic abilities, for which language became indispensable. Language made it possible to give accounts of the subject's internal conditions, and the second-order consciousness developed together with language. Man's linguistic brain can use neural systems for introspection, to explain human behaviors and understand the behaviors of others.

The evolution of human linguistic capabilities took place with the development of the cerebral structures at many levels of their inner organization. Although it is difficult to definitively determine the number of these levels, they should certainly include the molecular, cellular, and structural-functional levels in the brain

⁸ The factors that are believed to influence the individualization of an individual's language development are intelligence, the level of special abilities connected with speech and its development, directions of the child's activity that are characteristic of individual subjects, and sex (Jurkowski, 1986). In girls, speech develops faster because of the greater pace of general physical development, including the anatomical-functional development of the articulatory organs. Sex also involves socio-educational determinants – the child's different situation in the family and forms of emotional influence in daughter/mother, and son/mother relationships. In the development of an individual, two preferred directions of activity are distinguished influencing different developmental achievements: the first takes into account the dominance of the need to get to know, the other – dominance of the need to express (Matczak, 1982).

but in the context of the whole human organism. The uniquely complex structure of the nervous system was formed during the developmental stages of the organism, the activity of the brain resulting both from its “self-organization” and the environmental impacts (Edelman, 1998).

The universal and complete model of human phylo- and ontogeny should be adopted as a perspective that organizes the knowledge on the neurobiological determinants of the human ability to speak. The underlying principle of the functioning of living organisms is economy of effort, which means, in reference to human speech, that this process proceeds from the comprehensive marking of a situation by specific acoustic signals to articulated speech, in which individual elements (segmental and suprasegmental) impact the content of a message although they themselves are devoid of meaning (Aitchison, 1991, 1999; Diamond, 1998).

It is assumed that in the process of phylogeny the first and most basic function of sound signals was to communicate the necessary needs and basic threats to a group of kindred members: hunger, fear, anger (Zwoliński, 2003). The primal messages were intended to trigger a response of the environment, thereby performing the expressive and impressive functions: they expressed emotions and needs, and were expected to persuade the people in the environment to take specific action (Diamond, 1998). Daniel Goleman (2007, 26) even writes about infecting with emotions in interpersonal contacts, saying that this kind of contagion is the main transaction in emotional economy, a mutual exchange of feelings that accompanies any contact we make with another person, regardless of about what apparent matter we contact him/her. As the human socialization developed, so did intentional signs, the earliest concerning, first of all, emotional content.

A higher and phylogenetically later form of communication was descriptions detached in their content from the currently experienced emotions and needs. In order to produce them, it was necessary to create a distance from reality. It might be presumed that primal descriptions were signals referring to the whole of the phenomena described, and their subject might have been the experiences important for the survival of the species and activities that required communication between individuals within the group. Description made it possible to use the knowledge contained in it in future situations and to develop a particular way of responding to certain types of circumstances in the social structure (Aitchison, 1999; Zwoliński, 2003).

The next stage of development involved the need to increase the information content of description by diversifying sound signals. Developing the abilities of his/her organism, man modulated the original, more general voice signal by producing short and diversified phonetic phenomena relating to definite elements of the world (Aitchison, 1991; Diamond, 1998). The underlying principle of the functioning of living organisms is economy of effort, which means – in reference to speech phylogeny - that development proceeded from the comprehensive

marking of a situation by specific acoustic signals to articulated speech, in which individual sounds make it possible to produce messages with detailed content although they themselves are devoid of meaning of (Aitchison, 1999).

The primal sound signals referred to concrete phenomena - their task was, by means of memory and imagination processes, to only recall appropriate associations and to expand the picture of reality being created. At the next stage of phylogenetic development there arose the need to lend credence to this picture, thereby developing the ways of substantiating judgments about the world. This fact impacted the fundamental change in human thinking ability. The conscious improvement in the accuracy of description required analyzing the text, governing its structure, distinguishing its parts, and controlling them. Image thinking evolved towards discursive thinking: acceptance of a vision of the world allowed the regulation and standardization of behaviors within a social group.

In discursive thinking the basic whole is not a picture but a sentence. What become essential are different types of relationships between sentences whereby the structure of message acquires the form of the model: proposition and its substantiation. The detachment of concepts from particular reality and the ability to combine them into propositions according to logical criteria gave rise to man's mental abilities to create possible worlds, independent of the situation of the utterances and experiences of the speakers (Zwoliński, 2003).

Table 1. Stages of language development in phylogeny

Stage	Circumstances	Mechanisms	Functions	Effects
I.	messages connected with currently experienced needs	hunger, fear, anger	express emotions, release reactions of the environment	communication of indispensable needs and basic dangers
II.	the content of messages detached from currently experienced needs	developed ways of responding in given circumstances	utilize knowledge in new situations	distance from the reality experienced
III.	the need to increase the information content of description	diversity of sound signals, development of articulatory abilities	substantiate and lend credence to judgments about the world	lending credence to and substantiations of judgments about the world
IV.	the need to control the structure of an utterance, to distinguish its parts and to consciously steer them	development of metalinguistic abilities	create possible worlds	the utterances and experiences of speakers become independent of situations

Source: own study after: Zwoliński A. (2003). *Słowo w relacjach społecznych*. Warszawa: WAM.

The order of language development in ontogeny is documented by neurophysiological data. First, in the periaqueductal gray of the brain stem the system of endogenous opioids has its source, which determine the reaction of attachment⁹ and further on, the regions of the limbic system with the amygdaloid nucleus and the temporal insula (Fix, 1997) enable the recognition of the emotional content in social behaviors, and it is only the cortical structures in the region of the upper temporal sulcus and the medial part of temporal lobes that make it possible to control emotional behaviors, i.e. to rationalize them through awareness and linguistification, thus determining man's cognitive abilities.

HIERARCHIZATION OF LANGUAGE BEHAVIORS

Contrary to former behavioral interpretations, each human behavior, including verbal (or linguistic) functions is understood by contemporary psychology as hierarchized behaviors that become organized at the same time at levels of different degree of complexity. In each function, a significant role is played by the maintenance of the appropriate order of particular stage of its course, and the preservation of their proper hierarchy (Tomaszewski, 1969).

Phylogenetically earlier processes became the basis for functions formed later in the development of the human species. Speech centers in the brain that mediate in the creation of linguistic engrams serving symbolic thinking cooperate with the evolutionarily earlier brain areas. The stage-based model of human phylo- and ontogeny became the perspective for describing the neurobiological foundations of speech, the most human ability. The laws of biology defined human language capabilities, while the evolution of the human species determined their hierarchy. This holistic perspective of interpreting the brain mechanisms of speech reflects the parallel between the evolutionary development of the nervous system and the evolution of the human species and natural languages¹⁰.

The production and perception of messages therefore involves all the levels of brain organization:

1. the stem level (involving the readiness and automation of voice contours).
2. the limbic level (involving the emotional aspect of utterances);
3. the cortical level (involving linguistic planning);

⁹ Studies on animals showed the significant role of mother in the development of offspring; the most important was to ensure tactile contact (Bajek, Rzempowska, Gawłowicz et al. 2014).

¹⁰ The general principle of the neurobiological organization of the neurobiological foundations of linguistic communication is not contradicted by many attempts made to determine the biological correlates of individual language skills.

Processes regulating social, including linguistic, behaviors are integrated both at the level of connections between the cortical centers and in the hierarchical and bidirectional systems: "top – bottom" and "bottom – top", which formed in the course of human evolution from the brain structures at the lowest level associated with the regulation of physiological functions, to the subcortical structures of the limbic system, associated with the regulation of socio-emotional behaviors, then to the specialized cortical centers associated with the regulation of cognitive functions, and finally to the most cytoarchitecturally diversified and functionally complex associative parts of the cerebral cortex, responsible for the planning and controlling processes.

Individual levels cooperate with one another based on feedback, regulating different forms of speech:

1. limbic speech (the oldest level of communication associated with the operation of the deep cerebral structures, at which spontaneous, reactive vocal and gestural behaviors are organized),
2. verbal speech (abilities to speak and understand verbal structures connected with activity of the cortical centers of utterance production and perception, located within the "speech region"),
3. internal speech (the ability closely connected with linguistic planning and thinking, which ability expresses the individual character of each person by using virtual images, short cuts and associations, and is regulated by the prefrontal structures) (Mazur, Klimarczyk, Rudy and Nyka, 2006).

The phylogenetically earlier processes – automatic and unconscious – are thus the basis for intentional, conscious, planned and controlled functions, which emerged as the latest in the development of the human species. In neuropsychology, emotional reactions are treated as instinctive, reactive, automatic, uncontrolled and stereotyped, whereas volitional behaviors are interpreted as free, intentional, controlled, and symbolic (cf. Panasiuk 2012). The status of the two types of behaviors is closely associated with man's biological properties and the structure of the human brain.

As early as the second half of the 19th century, neurologist John Hughlings Jackson said that any function, including speech, has two levels of its brain organization: 1) logical (intellectual) and 2) emotional, the highest level being disturbed in the case of brain injuries. At the intellectual level, the human expresses what s/he is thinking, and at the emotional level – what s/he is feeling. Speech disorders after brain injuries are characterized by the fact that the most susceptible to disorders is the level of intellectual speech, i.e. the ability to use language most freely, while emotional speech, i.e. unintentional, is more accessible¹¹. Under-

¹¹ John Hughlings Jackson's proposition that due to brain injuries there arise first of all disorders of "intellectual speech" and the ability to construct sentences rather than the loss of words or

standing linguistic behaviors in the context of a continuum from simple to complex ones is supported by many proponents¹².

STRATEGIES FOR LOGOPEDIC THERAPY IN LIGHT OF DEVELOPMENTAL LAWS

Jason W. Brown's microgenetic conception (2015) assumes that the direction of cognitive processes always successively involves all the neuroanatomical structures of the brain, from the oldest to the youngest, the oldest being the brain stem and the mesencephalon with the limbic system, and the youngest – the cerebral cortex. One function turns into another in a continuing way. Man's ontogenetically earliest, instinctive behaviors are regulated by the lowest brain structures, which also decide the course of vegetative functions, thus enabling the biological balance of the organism; then come the interactive, non-verbal behaviors regulated by the limbic system; next in line are volitional behaviors for which the cortical structures are responsible, and it is only at the last stage of development that metacognitive and metalinguistic abilities develop, their course being associated with the operation of the prefrontal structures. The order in the development of successive mental functions is thus determined by the principle: from the most primal to the more and more complex (Domańska, Borkowska 2008; Pąchalska, 2007).

In the logopedic treatment of children with language acquisition disorders, as well as in restoring and stabilizing language skills in persons with acquired brain injuries, it is necessary to obey the biological laws of evolution and language development. Language derives from action. Every human brain develops through dynamic interaction with the environment. When little children interact with the world of people and objects, their brains become so organized as to enable adaptation in the environment (Tarnawska 2018). In accordance with sociolinguistic conceptions it is assumed that language is learned during the interaction process (Grabias 2003, Dryll 2003), while the speech directed to infants and children is a special kind of discourse that serves emotional expression (Milewski 2004). Interiorization of the rules of language use takes place through participation in different communication situations, the occurrence of specific conditions being conducive to their actualization in social interactions¹³.

linguistic abilities as such produced important consequences for logopedic description of aphasia in terms of linguistic competences and language skills (Grabias, 1997b; Panasiuk, 1999, 2012).

¹² For example, Joseph M. Wepman, like Goldstein, associates the highest level of use with the abstract attitude – (Wepman, 1951), William M. Kogan - with the categorizing function of language, the system of “linguistic generalizations” (Kogan, 1962), and Diana van Lancker - with freely taking account of the context when producing utterances (Herzyk, 2000).

¹³ In psycholinguistic studies two mechanisms of the child's cognitive development are

The most fundamental carrier of interaction is signs. Signs that a person sends (produces), interprets, perceives and responds to are symbolic: they are cultural signs. The human process of cognition of the world occurs through categories contained in language; owing to language a person detaches him/herself from the biological way – characteristic of other living beings – of finding his/her bearings in reality (Grabias, 2001) and adopts the intersubjective picture of the world. In its description of speech disorders, linguistic methodology more and more frequently gives up the atomistic understanding of language and the description of its relationships with extralinguistic reality, and increasingly often focuses on its functioning in social relations and in the cultural context¹⁴. An inherent feature of a human being is after all to strive to have contact with other members of a community, the wish to impart information about him/herself and the world. The desire to exist in social environment and the wish to express oneself go hand in hand with the need to perceive the reactions of the environment. From this point of view, verbal behaviors are treated as an element of man's global social behaviors, the direction of their development being universal.

It should be assumed that if communication is a purposeful interaction taking place in a socially defined context, in which social norms are actualized and its participants perform mutual roles (Russell, Kreuz 1998), the development of interactive skills in the process of logopedic therapy has to take this socio-cultural context into account. The contextuality of communication acts and the rules of their interpretation determined by socio-cultural norms are highlighted by Michael Halliday's conception (1980), which emphasizes the order of acquisition of communication functions by the child by 24 months of age.

This order is as follows:

- a) instrumental function realized by the child through:
 - protesting;
 - demanding an object and action at the same time;
 - demanding attention;
- b) regulatory function realized by the child through:
 - demanding objects;
 - demanding action;

named: 1) "cognitive custom" i.e. the fact that when accompanying adults, human infants and children perform the same actions that they observe in the former, and 2) "active instruction", i.e. the participation of adults in the development of their children by guiding and stimulating their activity in specific areas (Tomasello 2002, 108–111).

¹⁴ Tomasello says that at nine months the infants start to display many behaviors associated with attention-sharing. This may show the development of understanding other people as intentional agents like me, whose relations with external objects can be followed, channeled or adapted to (Tomasello 2002, 85).

- c) interactive function realized by the child through:
 - showing interest and feelings;
 - calling, greeting;
 - limited repetition;
- d) information function realized by the child through:
 - answering questions ;
 - telling, describing ;
- e) personal function realized by the child through:
 - naming his/her own action;
 - commenting ;
- f) imaginative function realized by the child through:
 - playing with meanings and pretending;
- g) heuristic function realized by the child through:
 - asking questions;
 - obtaining information.

Developing pragmatic functions produces a conviction that it is through words or other signs, e.g. gestures or symbols, that the feeling of agency can be achieved, and different needs can be satisfied. With neurobiological determinants taken into account, individual pragmatic functions – presented in Grabias's typology (1997) – develop in the order determined by the laws of human phylo- and ontogeny. The earliest are behaviors representing the emotional function, when the sender reveals his/her emotional state (speech-therapy exercises should comprise ways of expressing emotional states by nonverbal and verbal means). Then the action function manifests itself, when the sender wants the receiver to take specific actions, and s/he her/himself can also show interest in action (speech therapy exercises should be oriented towards developing speech acts: request, ban, demand, consent to action, or refusal). The next to develop is the information function, when the sender wants to inform the receiver, ask him about something, as well as deny or confirm the truth of some information (speech-therapy exercises serve to develop the following speech acts: declaration, denial or confirmation of the interlocutor's declaration, supplement of information or settling of an alternative, and also questions). The last to form is the modal function, when the sender expresses his/her attitude to reality and estimates the likelihood of the occurrence of states of affairs (speech therapy exercises should pertain to the following speech acts: expression of certainty, presumption, exclusion, doubt, and modal indeterminacy).

Logopedic therapy seeks to cause the patient to master and develop sufficient pragmatic skills to effectively communicate to the best of his/her biological abilities. The achievement of these objectives requires the inclusion of his/her family and closest milieu in the patient's therapy. While recording, describing and interpreting linguistic behaviors, the logopedist gains data necessary for preparing

a therapy program tailored to the patient's biological capabilities, the role of the family being to consciously initiate daily interactions, verbalize daily actions and events, to build and enhance the patient's motivation to interact, stimulate his/her joy of speaking, organize and use daily communicative situations to make him/her interested in speech, as well as to evoke a sense of agency and to convince the patient of his/her rightful role of partner in interaction.

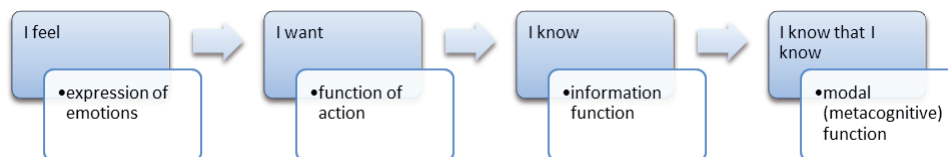


Fig. 1. The order of development and release of pragmatic functions in logopedic therapy

From the pragmatic perspective, therapy focuses not only on language understood as code but on communicative activity¹⁵. Owing to the working of the brain, characteristic of the human species, a person is able to ascribe collectively negotiated meanings to literally all human actions: to speech, facial expressions, gestures, body postures, distances s/he keeps from others, or to the style of dressing. The ability to read symbolic signs permits a person to enter a role or assume someone else's role¹⁶. By observing the behaviors of other people, a person can imagine him/herself in their position, can adopt their point of view, and predict what they will do¹⁷.

Stanisław Grabias (1997) has adopted a thesis that the rules that determine social behaviors also define the form of linguistic behaviors, but speech acts take place according to autogenous principles characteristic only of themselves. A person knows the world through the senses: these provide him/her with subjective,

¹⁵ Linguistic action is a being, inherent in every individual, embedded in the structure of the picture of the world - in the spirit of Jürgen Habermas's philosophy (1999); it is the forming and maintaining of the shared, subjective world for various individuals who interact with one another in many ways - as interpreted in Alfred Schütz's phenomenological sociology (1984), it is cooperation of two communicating consciousnesses as a result of which the intersubjective "unity of sense" emerges - in Jan Patočka's approach (1993).

¹⁶ A social role is a set of expectations towards an individual, associated with having a specific social status as well as a set of rights and duties consequent upon the social position held. Each role has its imperatives and prohibitions - it defines the margin of freedom. In the interpretivist approach, a role is freer - it determines both a set of expectation and the interactive participant's creative contribution to creating it. In contemporary society, each individual plays several social roles. Each social role determines next roles, but social roles are organized in relation to the crucial one. Roles, like social statuses, may have the ascribed and the achieved character (Hałas, 2006).

¹⁷ In symbolic interactionism the term translatability of perspectives was introduced, which means that a participant in an interaction puts him/herself in the situation of another individual with whom s/he interacts and is able to understand the sense of the latter's action (Blumer, 1969).

unique knowledge inaccessible to other individuals. The senses of every person operate within the biological determinants of the species while sense experiences provide individual data that determine the diversity and uniqueness of human experiences. However, language organizes these sensations within intersubjective, common structures within social groups and intellectualizes cognition, transforming biological, sensory orientation in reality into a mental view.

The consequence of the fact that a person intellectualizes his/her cognition via language is that his/her activity is not merely the triggering of reaction but it can be planned, channeled, and controlled. When starting communicative actions, the intentional person has to define what s/he wants to do and how s/he is going to accomplish it, s/he has to be aware of different circumstances that may turn out to be conducive to these actions, as well as the ones that can prevent them; s/he has to take account of demands, expectations, bans and hazards that may arise in the situation s/he acts in. By observing the behaviors of other people, a person can imagine himself in their place, may adopt their point of view, recognize their emotions, and predict what they will do. To others and to him/herself, s/he can explain the reasons for his/her actions to and define emotions that drive him/her. Owing to these skills, the intentional person joins in culture, adopting specific values, molding his/her convictions and learning the binding norms. The interaction theory opens a new perspective before logopedics, in the center of which there is a person rather than a speech-disorder entity assigned to him/her. The human-oriented logopedic therapy is becoming both a challenge and obligation to every logopedist.

BIBLIOGRAPHY

- Aitchison J., 1999, *Ziarna mowy. Początki i rozwój języka*. Przeł. M. Sykurska-Derwojed, Warszawa: PIW.
- Bajek A., Rzepowska J., Gawłowicz K., Galewska I., Chochowska M., Marcinkowski J., 2014, *Znaczenie dotyku dla prawidłowego rozwoju kręgowców wyższych*, *Hygeia Public Health*, 49 (3), 421–424.
- Brown J. W., 2015, *Microgenetic Theory and Process Thought Reflections and prospects*. Imprint Academic.
- Chomsky N., 1957, *Syntactic Structures*, Hague: Mouton.
- de Wit E., Linsen S.E., Cuppen E., Berezikov E., 2009, *Repertoire and evolution of miRNA genes in four divergent nematode species*, *Genome Research* 19: s. 2064–2074.
- Diamond J., 1998, *Trzeci szympan. Ewolucja i przyszłość zwierzęcia zwanego człowiekiem*, przeł. J. Weiner, Warszawa.
- Domańska Ł., Borkowska A.R., red., 2008, *Podstawy neuropsychologii klinicznej*, Lublin.
- Dryll E., 2003, *Interakcja wychowawcza w relacji matka – dziecko*, [w:] *Z zagadnień współczesnej psychologii wychowawczej*, red. A. Jurkowski, Warszawa, 131–162.

- Dunbar R.I.M., 1998, *The social brain hypothesis*. *Evolutionary Anthropology: Issues, News, and Reviews* 6, 5, 178–190.
- Dunbar R., 2014, *Nowa historia ewolucji człowieka*, przeł. B. Kucharzyk, Kraków: Copernicus Center Press.
- Edelman G.M., 1998, *Przenikliwe powietrze, jasny ogień. O materii umysłu*, przeł. J. Rączaszek. Warszawa, Państwowy Instytut Wydawniczy.
- Fiske J., 1999/2003, *Wprowadzenie do badań nad komunikowaniem*, przeł. A. Gierczak. Wrocław: Astrum.
- Fix J.D., 1997, *Neuroanatomia*. Przeł. i oprac. J. Moryś, Wrocław: Urban and Partner.
- Gerhardt S., 2010, *Znaczenie emocji. Jak emocje wpływają na rozwój mózgu*, przeł. B. Radwan, Kraków: Wydawnictwo Uniwersytetu Jagiellońskiego.
- Gilad Y., Oshlack A., Smyth G.K., Speed T.P., White K.P., 2006, *Expression profiling in primates reveals a rapid evolution of human transcription factors*, *Nature* 440, 242–245.
- Goleman D., 1997, *Inteligencja emocjonalna*, przeł. A. Jankowski. Poznań: Media Rodzina.
- Grabias S., 1997a, *Język w zachowaniach społecznych*, Lublin.
- Grabias S., 2001, *Perspektywy opisu zaburzeń mowy*, [w:] *Zaburzenia mowy*, red. S. Grabias, t. 1, s. 11–43, Lublin.
- Herzyk A., 2000, *Afazja: mechanizmy mózgowe i symptomatologia*, *Logopedia*, 27, 23–54.
- Herzyk A., 2005, *Wprowadzenie do neuropsychologii klinicznej*, Warszawa.
- Jakobson R., 1989, *W poszukiwaniu istoty języka*, t. 1–2, przeł. M. R. Mayenowa, Warszawa.
- Jurkowski A., 1975, *Ontogeneza mowy i myślenia*, Warszawa: WSiP.
- Kaczmarek B.L.J., 1995, *Mózgowa organizacja mowy*, Lublin.
- Khaitovich P., Enard W., Lachmann M., Paabo S., 2006, *Evolution of primate gene expression*, *Nature Reviews Genetics* 7, 693–702.
- Kogan W.M., 1962, *Wosstanowlenije rieczii pri afaziji*, Moskwa, Izdatielstwo CIETIN.
- Lenneberg E.H., 1967, *Biological Foundations of Language*, New York, NY: John Wiley and Sons.
- Martin G.N., 2001, *Neuropsychologia*, przeł. J. Gielecki, Warszawa: PZWL.
- Maruszewski T., 1996, *Psychologia poznawcza*, Warszawa: Znak – Język – Rzeczywistość, Polskie Towarzystwo Semiotyczne.
- Matczak A., 1982, *Style poznawcze*. Warszawa: PWN.
- Materska M., Tyszką T. (red.), 1997, *Psychologia i poznanie*. Warszawa: PWN.
- Maturana H., Varela F., 1998, *The Free of Knowledge. The Biological Roots of Human Understanding*. Boston, MA – London: Shambhala.
- Mazur R., Klimarczyk M., Rudy J., Nyka W., 2006, *Wielopiętrowość zaburzeń mowy w praktyce lekarskiej*, *Psychiatria*, 3(3), 112–117.
- Milewski S., 2004, *Mowa dorosłych kierowana do niemowląt*, Gdańsk.
- Panasiuk J., 1999, *Zaburzenia języka a komunikacja w przypadkach afazji*, [w:] *Beiträge der Europäischen Slavistischen Linguistik (POLYSLAV)*, red. K. Böttger, M. Giger, B. Wiemer, t. 2, 213–222, München: Verlag Otto Sanger.
- Panasiuk J., 2013, *Afazja a interakcja. TEKST – metaTEKST – konTEKST*, Lublin.
- Panasiuk J., 2016, *Mózgowa organizacja procesu mówienia*, [w:] *Logopedia artystyczna*, red. B. Kamińska, S. Milewski, Gdańsk: Wydawnictwo Harmonia Universalis, 288–311.
- Panasiuk J., 2016a, *Neurologiczne uwarunkowania rozwoju mowy*, [w:] *Wczesna interwencja logopedyczna*, red. K. Kaczorowska-Bray, S. Milewski, Gdańsk, Wydawnictwo Harmonia Universalis, 36–53.
- Pąchalska M., 2007, *Neuropsychologia kliniczna. Uraz mózgu*, t. 1, Procesy poznawcze i emocjonalne. Warszawa.
- Ruszel M.E., 2011, *Sieroctwo duchowe dziecka*, *Studia Gdańskie*, XXVIII, 151–157.
- Searle J.R., 1995, *Umysł, mózg i nauka*. Przeł. J. Bobryk, Warszawa.

- Smyczek A., 2007, *Wspomaganie rozwoju komunikacji i języka dzieci niepełnosprawnych od 1-go do 6-go roku życia*, [w:] *Możliwości diagnostyki i terapii dzieci z wczesnym uszkodzeniem mózgu w wieku od 0 do 6-go roku życia i wsparcia ich rodzin*, red. M. Król, J. Kryszczyńska, J. Taczała, Stowarzyszenie Pomocy Dzieciom Niepełnosprawnym „Krok za krokiem”, Zamłość, 91–103.
- Somel M., Liu X., Tang L., Yan Z., Hu H., Guo S., Jiang X., Zhang X., Xu G., Xie G., Li N., Hu Y., Chen W., Pääbo S., Khaitovich P., 2011, *MicroRNA-Driven Developmental Remodeling in the Brain Distinguishes Humans from Other Primates*, PLoS Biology 9(12): e1001214
- Tomaszewski T., 1963/1969, *Wstęp do psychologii*, wyd. 1, wyd. 3, Warszawa.
- Twardowski K., 1965, *O czynnościach i wytworach. Kilka uwag z pogranicza psychologii, gramatyki i logiki*, [w:] *Wybrane prace filozoficzne*, K. Twardowski, 222–240, Wybór i oprac. T. Rzeppa. Warszawa.
- Wepman J.M., 1951, *Recovery from Aphasia*. New York, NY: Ronald Press.
- Wytwicki W., 1963, *Psychologia* (t. 2). Warszawa.
- Zwoliński A., 2003, *Słowo w relacjach społecznych*, Warszawa.