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The phonic substance of utterances in dysarthria cases in infantile cerebral palsy

SUMMARY

The article presents the results of studies conducted in a group of 36 children aged 6–15 years, diagnosed with dysarthria in the infantile cerebral palsy syndrome. The experimental group was divided into two equinumerous subgroups: 1) intellectually normal children, 2) mentally retarded children. The main diagnostic technique used in investigations was the *Dysarthria Scale. Children's version*. The presented experiments concern one of the problems examined as part of the project "Segmental and Suprasegmental Specificity of the Phonic Sequence and the Intelligibility of Utterances in Dysarthria Cases in Infantile Cerebral Palsy."

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Keywords: dysarthria, infantile cerebral palsy (ICP).

Dysarthria, apart from oligophasia, is one of the most frequently reported units of speech pathology in infantile cerebral palsy (Mirecka, Gustaw 2005), and because of its neuromotor character it can be recognized as a speech impairment specific to ICP. Neurological injuries that cause the motor disorder of speech mechanism at the executive level manifest themselves in dysfunctions in the respiratory, phonatory and articulatory apparatus, thus resulting in distortions of the phonic substance of utterances at the segmental and suprasegmental level. Dysarthric disorders have different ranges and intensity (in extreme cases they consist in the inability to produce speech sounds) while a large group of patients suffering from them have to cope with the serious problem which is the limited intelligibility of their pronunciation, making it difficult or impossible to pass information through the articulatory-auditory channel.

OWN INVESTIGATIONS

The article presents the distortions of the phonic substance in utterances of dysarthric patients with ICP, diagnosed under the postdoctoral-degree project (NN 106 268538 “Segmental and Suprasegmental Specificity of the Phonic Sequence and the Intelligibility of Utterances in Dysarthria Cases in Infantile Cerebral Palsy” – 38th competition of the Ministry of Science and Higher Education) (Mirecka 2013b). The population investigated from 2010 to 2011 consisted of children aged 6 to 15 years, who attended classes conducted at rehabilitation and therapy centers and in education centers located in towns in the Lublin Province. The main diagnostic tool utilized in the investigations in question was the *Dysarthria Scale. Children’s Version* (Mirecka, Gustaw 2006; Mirecka 2012a), a type of estimation scales based on observation of how a patient performs particular tasks involving the speech apparatus, and grounded on perception assessment in analyzing the utterances of the patient investigated. During individual investigations, observations were gathered concerning the verbal behaviors of children (in particular their interactions skills, dialogue skills, and social language skills), their phonological (phonemic and prosodic) hearing was also checked (to that end, experimental diagnostic tests developed by the author were applied) (Mirecka 2012c), as well as the body posture and the anatomical state of the speech apparatus (including dental and occlusal conditions) were assessed. The available medical, psychological, pedagogical, rehabilitation, and speech therapy documents of each of the diagnosed children were analyzed in order to obtain information essential for the undertaken studies, which was important at the stage of forming experimental groups and the stage of analysis of investigation materials and interpretations of results. The experimental group consisting of 36 children was divided into two equinumerous subgroups: 1) dysarthric children, 2) dysarthric children with concurrent oligophasia; in the investigations in question the subgroups are identical with the groups: 1) intellectually normal children (seven children with average intelligence, eleven children with below-average intelligence) 2) mentally retarded children (nine children with a mild degree of mental retardation, and nine children with a moderate degree). The dysarthria diagnosed in the children investigated had a differentiated clinical form and different degree of intensity. The most frequent dysarthria type was spastic dysarthria (17 cases), then mixed spastic-kinetic dysarthria (12 cases), dyskinetic dysarthria (four cases), ataxic dysarthria (two cases), and mixed ataxic-dyskinetic dysarthria (one case). 19 cases of mild dysarthria were found, eight moderate cases, eight severe cases, and one case of profound dysarthria¹. In nine cases, dysglossia was also

¹ Diagnosis of dysarthria types was based, according to the guidelines for the speech therapy management standard (Mirecka 2008), on the symptomatology of dysarthric dis-

diagnosed, determined by dental-occlusal anomalies, and by the highly shortened tongue frenulum (one case). The foregoing speech disorders were often accompanied by dysphagia (25 cases).

DISORDERS AT THE SEGMENTAL LEVEL OF THE PHONIC SEQUENCE

The assessment of the segmental level of the phonic sequence studied as part of sphere III. ARTICULATION of the *Dysarthria Scale* in six tasks covered tests involving repetition of words and sentences, and the patient's free utterances. Realization at the segmental level of the phonic sequences in both subgroups was assessed as having the same degree (intergroup comparisons showed no statistically significant differences between the results in tasks of sphere III. ARTICULATION, *Dysarthria Scale*) (Mirecka 2013b).

The order of the description of segmental disorders is determined by their typology used in the analysis: a linguistic classification developed by J. T. Kania (1982), which comprises paradigmatic disorders (which affect the phoneme/sound inventory) and syntagmatic disorders (affecting the phonemic/phonic structure of the word).

Paradigmatic disorders

The paradigmatic disorders recorded in the analyzed investigation material included all the types distinguished by J. T. Kania: elisions, distortions and substitutions of sounds, the dominant type being distortions, both of vowel phonemes and consonant ones. The following significant phenomena can be indicated:

- 1) distortions affected all phonemes (except /ń/, /k/, /g/, /x/),
- 2) distortions occurred in the pronunciation of most children (this applies in particular to distortions of consonant phonemes),
- 3) the degree of distortions of individual sounds varied: from slight distortions of sounding and anomalies in the articulatory apparatus to very high divergences from normative pronunciation that resulted in the impossibility of identifying a phoneme,
- 4) distortion of vowel phonemes consisted most often in articulating a sound in between two similar phonemes because of the arrangement of the speech organs (mainly the tongue mass),

orders taking into account the results of specialist medical examinations showing the location of damage to the nervous system and/or dominant neurological symptoms. Analysis covered both pathological phenomena (symptomatic of particular disorder forms) manifesting themselves at the segmental and suprasegmental levels of the phonic sequence, and disturbances of functions assessed in respiratory, phonatory, and motor tests.

5) substitutions affected most consonant phonemes (except /i/, /u/, /m/, /f/, /x/, /p/, /t/) and two vowel phonemes (/e/ and /o/),

6) substitutions occurred in the pronunciation of the minority of children (less than half of the group tested),

7) the most often distorted and substituted phonemes were dentalized and alveolar sonorant consonants,

8) many phonemes had common realization – both in the form of a correctly produced sound and a distorted one,

9) apart from evident distortions, reduced clarity of pronunciation was observed in most children, sometimes highly reduced – so-called blurred articulation, the blurring of differences in vowel color,

10) in some of the children investigated a certain articulation variability was observable, becoming part of the continuum from distorted to correct pronunciation,

11) elision (total, covering all phonemes) was found in the child with profound dysarthria.

Paradigmatic disorders in the pronunciation of the studied children consist in the “use non-normal facultative variants of phonemes” that often also function as phoneme substitutions, and in the reduction (as a result of substitution) of the phoneme inventory in the “sending system”²; in the case of the child in whom elision was found, the phoneme inventory of Polish exists only in the child’s mind: the phonemes are not produced in the sending system. Distortions and substitutions of consonants are connected first of all with the limitations and reduced accuracy of tongue and lip movements (often accompanied by incorrect muscular tone within the articulatory apparatus) which prevent correct phoneme realizations on account of such articulation features as, first of all, the place of articulation, and then the degree of closeness of the speech organs. Motor dysfunctions of the mandible and malocclusion should also be taken into account as the cause of difficulties in dentalization and in obtaining the right arrangement of articulation organs for a sound, in the proper distance between them (for example when articulating bilabial sounds). The distortions of sounds in children with dysphagia were caused to some extent by their problems with swallowing saliva while speaking (saliva accumulated in the mouth or flowing from it). Apart from the dysfunctions found in the kinesthetic-motor sphere of the articulation apparatus, the cause of incorrect phonemic realizations may have also been disorders in auditory-kinesthetic-motor integration and, in the case of two children, disorders of phonemic hearing.

² Formulations by J. T. Kania (1982, 15), which he used while describing paradigmatic disorders in patients with dyslalia: non-normal facultative variants occur with distortions, while the phoneme inventory is reduced in the sending system in the case of elision and substitution.

Syntagmatic disorders

Changes in word structures recorded in the analyzed empirical material were primary and secondary. Primary syntagmatic disorders included almost all their types specified in J. T. Kania's classification: quantitative and qualitative deformations, changes in the linear sequence of phonemes in the word, and combined changes. The following is the most important information on the irregularities in the phonemic structure of the word found in the pronunciations of the children investigated:

- 1) reductions in the word structure consisted mainly in simplification of consonant groups,
- 2) reduction of consonant phonemes outside of consonantal combinations occurred more often in the final rather than in the initial position in words,
- 3) reduction of syllables and epenthesis of phonemes were a marginal phenomenon,
- 4) the limiting of the number of phonemes in a word (resulting from simplification of consonant groups and reduction of consonant phonemes outside of consonantal combinations) was usually due to the change of a closed syllable into an open one CVC>CV and the change of the type CCV into CV,
- 5) mildly intense changes in the linear sequence of word constituents affected first of all phonemes (syllable metatheses were sporadic),
- 6) qualitative deformations consisted mainly in sound assimilations and covered first of all consonant phonemes (vowel assimilations were sporadic),
- 7) assimilations occurred first of all in terms of the articulation place, and then in terms of the degree of closeness of the speech organs,
- 8) cases of sound dissimilation were sporadic,
- 9) combined changes, producing considerable deformations of the word structure that most often consisted in its shortening and in the wrong composition and arrangement of its constituent phonemes, usually occurred in polysyllabic words with a more complicated phonetic structure and lower frequency in texts,
- 10) secondary quantitative changes resulting from phoneme substitution consisted in the reduction of phonemes within consonant groups: simplification of geminates (formed from the substituted phoneme and its substitute, and from phonemes having the same substitute), and also simplification of consonant combinations not typical of Polish,
- 11) secondary qualitative syntagmatic changes consisted in the formation of new phonemic combinations of the type CV: /ti/, /ʉi/.

The foregoing quantitative changes, qualitative changes, and changes in the linear sequence of phonemes co-occurred in most cases with paradigmatic disorders in the form of distortions and substitutions of phonemes. The observed syn-

tagmatic disorders can be related to dysfunctions in the kinesthetic-motor sphere of the articulation apparatus and to disorders in auditory-kinesthetic-motor integration.

DISORDERS AT THE SUPRASEGMENTAL LEVEL OF THE PHONIC SEQUENCE

In the studies presented here the analysis of the suprasegmental level of the phonic sequence covered intonation, word and sentence stress, rhythm of utterances, rate of speech, phrase length, respiratory-phonatory-articulatory synchronization, nasal resonance, and voice quality; these phenomena were assessed in the tasks in the following spheres of the *Dysarthria Scale*: IV. RESONANCE, V. PROSODY, and VI. PHONATION. Realization at the suprasegmental level of the phonic sequence in both subgroups was generally assessed as having the same degree (intergroup comparisons showed no statistically significant differences between the results of tasks in the *Dysarthria Scale*'s sphere IV. RESONANCE and most of tasks in sphere V. PROSODY and VI. PHONATION – except tests for changes of vocal pitch and volume, speech rate, stress realizations, and prolongation of phonation, with which children with mental retardation had significantly greater difficulties) (Mirecka 2013b).

Pathological phenomena most often affected voice, resonance, phrase length, and respiratory-phonatory-articulatory synchronization. The following anomalies found in the children investigated should be listed here:

1) voice disorders arising first of all from the improper functioning of the larynx caused by damaged neural controlling and from improper cooperation with the phonatory organ of the respiratory apparatus and the resonating cavities (laryngeal vestibule, pharynx, oral and nasal cavities):

– reduced voice quality: first of all, hypophonia, hoarse voice and tense voice, less often – weakened sonority, breaks in phonation, and loss of voice;

– fatigability of the phonatory organ co-occurring with anomalies of vocal attack (hard or breathy);

– problems with the volume of voice: constantly low or unstable loudness of utterances, difficulties in intentional differentiation of voice volume;

– problems with vocal pitch: unstable pitch or too low voice, difficulties in intentional differentiation of voice pitch;

2) disorders of nasal resonance conditioned by the palatopharyngeal dysfunction manifested mainly in hypernasality and unstable resonance;

3) disorders of respiratory-phonatory-articulatory synchronization manifested as speaking on residual air and on inhalation;

4) incorrect segmentation of utterances into phrases, consequent primarily upon respiratory dysfunctions, slowed articulation, and respiratory-phonatory discoordination:

- too short phrases (small number of syllables pronounced in a phrase);
- wrongly placed respiratory pauses (not motivated by the semantic/syntactic structure of an utterance or by rules of the prosodic organization of an utterance);

5) intonation disorders conditioned by phonatory and respiratory dysfunctions, manifesting themselves chiefly as monotonous intonation, less often as unstable intonation;

6) disorders of speech rhythm as a result of phonatory and respiratory dysfunctions and respiratory-phonatory-articulatory discoordination:

- reduction of sentence and word stress;
- prolongation of sounds;
- in single cases – scanning (pronouncing words with a noticeable tendency to divide them into syllables spoken with different intensity) and *staccato* (lack of fluency in passing from one articulation to the next, stronger pronunciation of some sounds);

7) disorders of speech rate (too slow or unstable rate) arising from slowed articulation, drawling of sounds, increased number of respiratory pauses, and from fatigability of the speech apparatus.

We should emphasize that many of the foregoing pathological phenomena co-occur and determine one another: changes in one sphere result in changes in other spheres, which was pointed out in the descriptions of disorders in the prosodic organization of utterances of dysarthric patients.

DISCUSSION

In cases of infantile cerebral palsy, problems in speech therapy diagnosis may result from the fact of overlapping potential causes of various speech disorders: intellectual, auditory, or motor or other dysfunctions, which, consequently, produces a complex picture of symptoms associated both with the sphere of competences (linguistic, communicative, cultural) and with realization abilities. The occurrence of more than one speech disorder in a patient (as is the case with the studies in question: co-occurrence of dysarthria and oligophasia, and dysarthria and dysglossia, as well as dysarthria, oligophasia and dysglossia) often produces difficulties with classifying a phenomenon, whether segmental or suprasegmental, as a symptom of dysarthria/ oligophasia/ dysglossia, and sometimes, because of the multi-etiological character of some symptoms, it is impossible. An example is the defective articulation of dentalized sounds in children with dental-occlusal defects which, like dysphagia and salivation may be the result of muscular paraly-

sis in the articulatory apparatus³, but they can obviously occur independently of this condition.

Disorders of the phonic sequence significant from the perspective of speech therapy diagnosis should be assessed and analyzed in the context of such difficulties of the dysarthric patient as: respiratory dysfunctions (abnormal respiratory pattern, shorter exhalation phase, weaker control of the strength of exhaled air), phonatory dysfunctions (e.g. weaker control of vocal pitch and volume), and motor dysfunctions (in isolated and alternating movements of the articulatory organs). The analysis of the phonic level of utterances, oriented towards identifying the types of anomalies in their segmental structure (paradigmatic and syntagmatic disorders) and in the prosodic organization (disturbances of speech rhythm, intonation, phrasing of intonation, and others), should be compared with the results of the intelligibility assessment of the patient's utterances.

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³ Morphological/functional changes in the masticatory organ of patients with ICP are associated by dental surgeons (Jankowska, Kaczmarek 2012) with lowered muscle tone, anomalies in the motor activity of the tongue and articulation, lowered chewing ability, hypertrophy of the orbicular muscle of the mouth, abnormal respiratory pattern and type of swallowing, while the outflow of saliva (with its normal secretion) is associated with muscular hypotonia which causes inability to close the mouth, with the open bite, and dysphagia. In the children investigated under this project, salivation also occurred in cases of posterior occlusion and with spastic hypertonia. It should be also stressed that interdental speech impediments usually co-occurring with the infantile type of swallowing may have contributed to the rise of or increase in dental-occlusal defects.

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