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Speech Fluency Disorders – the State of Research and Speech-Language Therapy Practice at the Beginning of the 21st Century

SUMMARY

The article is an attempt to synthesize and organize the most up-to-date data on speech fluency disorders: stuttering and cluttering. The analyzed data come from both scientific research, based on the latest diagnostic techniques (for example: fMRI, PET, audiological research), as well as reflections gathered around the logopedic practice. The factors predisposing, triggering and maintaining the distinguished speech disorders, as well as the methods of determining the goals of therapy of persons with these disorders and ways of its management were taken into account. The conclusions resulting from the meta-analysis of the collected data show significant changes in the theoretical and practical perspective of the perception of stuttering and cluttering.

Key words: logopedic therapy, fluency disorders, stuttering, cluttering

INTRODUCTION

Speech fluency disorders are still a challenge to many speech therapists – both with regard to the knowledge of its causes and mechanisms and regarding the management of an effective therapy of patients suffering from this disorder. The data collected during the last twenty years, which come from scientific research and therapies carried out according to EBP (*Evidence Based Practice*) largely contribute to dispelling many doubts. The synthesis and analysis of data concerning the causes, mechanism, and determinants of speech fluency disorders is espe-

cially important to practicing speech therapists because it allows them to diagnose better, set the aims of the therapy, and determine more effective ways of helping people suffering such disorders.

Stuttering and cluttering are recognized as for speech fluency disorders because it should be assumed that pathological dysfluency that appears in these disorders is diagnostically the most important component. We should also remember that in logopedics, speech dysfluency is a symptom which appears in various speech disorders: in stuttering, cluttering, dysarthria, aphasia, in utterances of people with autism, oligophasia, hearing disorders, and Tourette syndrome. In the above mentioned cases, dysfluency appears as a result of many causes related to the pathology of processes underlying the function of speaking; however it is not the basic problem. Furthermore, speech dysfluency may appear during speech development, occurring with greater intensity in some children, which is called developmental speech dysfluency. Dysfluency also appears sometimes in people who speak fluently. In cases of developmental or situational dysfluency it is probably a signal of temporary difficulties in the processes of planning and coding syntactic utterances. Less fluent speaking occurs because to a speaker in a given situation the utterance is new or atypical – e.g. more emotional. One needs time to build an utterance grammatically correct and appropriate for a situation – it is a normal phenomenon (Woźniak 2012).

As mentioned in the introduction, the situation is different as far as stuttering and cluttering are concerned. In both cases there is pathological speech dysfluency that lasts relatively permanently. Vast information on the subject of dysfluency and assessment of speech fluency is provided by contemporary Polish logopedic literature (Woźniak 2012, Woźniak, Soboń 2015). The interested reader can find the foundations for distinguishing pathological speech dysfluency from a normal one, and also the ways and scales of measuring these phenomena.

In the description of fluency disorders, especially in reference to their etiology, we can distinguish three groups of factors:

1. predisposing,
2. triggering,
3. maintaining speech disorders,

Usually, predisposing factors are of biological character (we will discuss them in greater detail below) and we do not have much influence on them. These factors decide about a predisposition to dysfluent speaking. The triggering and maintaining factors are, from today's perspective, more difficult to determine. They are of psychological and environmental character. They are connected with many variables connected with a person's personality (e.g. tendency to perfectionism – in stuttering, and extrovert behaviors – in cluttering), with his/her temperament (e.g. great emotionality, impulsiveness) as well as with the occurrence of stressing factors in his/her environment (e.g. fears connected with the reactions

of listeners or with anticipated occurrence of dysfluency in defined situations). People around the person with speech fluency disorders and also the person himself/herself may exert influence on these factors.

It has to be admitted that sometimes we can encounter a problem in the discussion on speech fluency disorders, which is caused by the fact that in logopedics there are still two ways, two styles of discourse on speech disorders:

1. Scientific style – formulated on the basis of medical, linguistic, and psycho-pedagogical professional jargon (professiolect);
2. Colloquial style – formulated in relation to practice and based on colloquial Polish.

There is a clear problem of coherence in the description of disorders and the ways of managing the treatment of people suffering from these disorders, which may lead to “communication disturbances” between specialists. The scientific style requires precision, proper terminology, presentation of evidence supporting the formulated theses or suggested ways of conducting treatment. The colloquial style can use general statements not supported by the evidence and leading to “magical” conclusions: “do this and this because it works, no matter why” or presentation of one’s own convictions: “I am convinced that it is so and so”. Utterances formulated in such a discourse cannot be accepted in the logopedics of the 21st century because they can potentially lead to unethical, pseudoscientific solutions that can jeopardize people who undergo therapy or their families.

However, at the start of the 21st century a few important questions should be asked, the answers to which will be of crucial importance to logopedics. In the case of speech fluency disorders, they are as follows:

- What are the interrelationships between biological and psycho-social factors?
- Does neurobiological basis influence the psyche and executive functions and how?
- Do mental states influence somatic functioning and how?
- Can the conclusions be useful in practice?

The answers to these questions would probably contribute to the synthesis of theory and practice in the disorders in question.

STUTTERING – THEORY AND PRACTICE

Theory

Stuttering is the most frequent disorder of speech fluency, it has accompanied our species from the very moment it started speaking. According to numerous sources more or less 1% (precisely 0.76%) of the population stutters (Craig, Tran 2005), the percentage changing from circa 1.5% in childhood to about 0.5% in

adults. The cases of stuttering are described in many historical sources and the Bible. Moses (OT, Ex. 4.10) and many other famous figures known from the history of civilization probably stuttered.

Today a comprehensive character of the disorder is generally accepted i.e. regarded is regarded stuttering as a disorder of speech fluency in which there are symptoms described at various levels: communicative, psychical, and neurophysiological. At the communication level the prevailing symptom is pathological speech dysfluency; it mainly consists in blocking, drawling, and repeating speech sounds. At the psychical level, the awareness of the disorder occurrence attracts attention, the prediction of the occurrence of dysfluency, and the concomitant anxiety reactions of pathological character (logophobia). At the neurophysiological level, the main symptom is increased muscle tension (spasticity) within the speech organs. Although there are feedbacks between these symptoms, a specific pathological speech dysfluency should be regarded as the basic symptom of stuttering (Woźniak 2008a).

In the next part of the article we will examine factors determining this disorder, which mainly comes down to the explanation of the causes of speech fluency disorders.

The analysis of predisposing factors amounts now to examining them at the biological level. Neuroimaging techniques which enabled the study of not only anatomical structures but activities of particular areas of the brain during speaking (position emission tomography - PET, single photon emission computed tomography – SPECT, functional magnetic resonance imaging – fMRI, or architectures and densities of junctions within neuronal tracts neural pathways of the white matter (tractography/diffusion tensor imaging –DTI) are particularly important in determining the origins of stuttering. The studies based on neuroimaging have been conducted since the 1990s and allow scientists to formulate many conclusions on the biological base of stuttering. They are:

1. Neuro-morphological conclusions
2. Neuro-functional conclusions (cf. Neuman, Euler 2010)

Re 1. Neuro-morphological conclusions

K. Neuman and H Euler (2010) summing up numerous works on ongoing structural changes in stuttering people list:

In the case of persistent stuttering:

1. Disturbances of integration of the white matter (substantia alba) concerning:
 - Sensorimotor representation of speech organs such as larynx, throat, tongue in the left area of the Rolandic operculum– adults and children
 - Corticospinal/Corticonuclear tract and supramarginal gyrus (Brodmann area 4) – children

- Primary pre-motor cortex – young people
- 2. Decreased or atypical (right-left) functional asymmetry of the cerebral hemisphere in speech areas – adults
- 3. Enlarged temporal lobe, the right one is larger than the left one – adults
- 4. Dissimilarities in the corrugation of cortex and other anatomical anomalies – adults, young people, children
- 5. Enlargement of grey matter in basal ganglia (nuclei basales) - adults

In the case of those cured from stuttering

- Depletion of the grey matter in the left inferior frontal gyrus (adults and children) and bilaterally in temporal areas regions (children)

Proving the attenuation /diminishment of the number of connections in the white matter in the areas important for the formation of speech is fundamental to the explanation of the origins of dysfluency by referring to neuroanatomy. The studies into people who stutter based on neuroimaging started in the 1990s. The work by M. Sommer et al. (2002) was one of the first studies that changed the perception of the origin of dysfluency. This work proved an almost triple reduction of connections in the white matter near the Rolandic operculum in the left cerebral hemisphere in stuttering adults who had stuttered since their childhood. Such a large reduction of connections significantly distorts the preparation and motor implementation of fluent utterance. However, it could not be resolved whether the observed deficit was the result of long-standing stuttering or its cause. Only studies on children who just started to stutter could answer this question. Recently, the studies by Chang S. Zhu D. (2013) have confirmed this thesis.

These studies show that stuttering children – in comparison to non-stuttering peers – can reveal weakened functional and structural connectivity both in neural networks of auditory-motor regions (responsible for self-control) and in connections of basic nuclei with the corticothalamic regions (responsible for planning the speech “in advance”) first of all in the left cerebral hemisphere. (Chang, Zhu 2013). Moreover, in stuttering children there may be dissimilarity in the organization of the white matter in the brain (structures responsible for connections) particularly in the areas mentioned above but also in other regions of the brain (right cerebral hemisphere and corpus callosum – the structure that joins both hemispheres) which is caused by subtle differences concerning the development of the white matter between 3 and 10 years of life. Furthermore, the depletion of the number of connections between the left putamen and the additional motor cortex and auditory cortex, and better auditory-motor connections

in the left hemisphere in non-stuttering girls, and in the stuttering ones in the right hemisphere was observed (Chang, Zhu, Choo, Anstat 2015).

Summing up, it should be stated that in the light of the most recent knowledge the neuroanatomic differences at the brain level (probably genetically conditioned) are the cause of dysfluency in stuttering in most cases. Anatomical differences concern mainly the depletion of connections in the planning circuits and speech control ones. It may lead to functional disorders: delays in information processing and may involve lateralization disorders concerning the auditory control of speech (using the right hemisphere and left ear to control the speech in right-handed people) (cf. Woźniak 2015).

Re 2. Neuro-functional conclusions

Neuro-anatomical evidence made the researchers formulate conclusions concerning the consequences of the influence of the disordered activity in basic nuclei and the too small function of connections in the circuits planning and controlling speech in the left hemisphere in stuttering people. It concerns mainly connections important in motor preparation of speech (loop I), which includes the following brain structures: the striatum, the globus pallidus, the black matter → → thalamus → → Broca's area → → the motor cortex → → the striatum...., and also processing-controlling connections (of loop II) which comprise such units as: the motor cortex (→ → speech signal) → → → auditory cortex → → Broca's area → → the motor cortex.... Physiological models of the formation of a dysfluent speech point to the phasicity of change in the course of the function that was initially physiologically regular (Giraud et al, 2008). In the case of fluent speakers a simplified physiological course of the formation of speech signal is as follows: activation starts in loop I and it results in the sequential motor activity of the speech organs and formation of a speech signal, after which there are feedback in loop II between the motor cortex, Broca's area, and auditory cortex, whose positive result enables further fluent speech.

In stuttering people there are structural disorders of connections in loop I (mainly in connections between Broca's area and the motor cortex), which causes disorders in functioning in the cortical-striatal loops and eventually means problems with starting speech, the occurrence of blockings, repetitions, attenuation of planning of successive segments of speech disorders, disorders of articulatory and temporal speech patterns - rhythmic implementation disorders (phase I). The next phase is an attempt to compensate for disordered functions through activating analogous areas in the right hemisphere of the brain and to enhance its activity. It leads to a partial improvement but also causes the occurrence of corrections and

delays in speech. Such a state stabilizes stuttering (phase 2). If a stuttering person undergoes a therapy, the areas neighboring on anatomical anomalies are activated and the course of speech functions returns to the left hemisphere while, at the same time, the activity of the right hemisphere diminishes (phase 3). **It means the necessity of using in the treatment of stuttering persons the methods of shaping speech fluency that activate the left-hemisphere centers and diminish the activation of the right hemisphere. This is demonstrated by numerous examinations of people after a successful therapy, conducted based on neuroimaging (Neumann, Euler 2010).**

The over-activation of speech centers of the right cerebral hemisphere is therefore now explained as a compensation for the left hemisphere deficit. In this context, the very interesting observations need to be considered which result from studies on audiogenic determinants of stuttering disorders. 65% of stuttering persons have the advantage of the left ear in auditory self-control (taking into consideration the kind of conduction of speech signal – bone conduction in this case). At the same time, 75% of the examined people showed the dominance of the right ear in understanding speech (Kurkowski 2013). The above conclusions may support the thesis about functional right hemisphere compensation and at the same time explain an increased susceptibility to stress-related disorders of speech preparation: the use of the right hemisphere speech control mechanisms is easier to distort because of negative emotions and, moreover, it requires the inclusion of additional inter-hemisphere connections (corpus callosum) in the process of forming and controlling utterances. Disorders of auditory lateralization may be a factor which intensifies stuttering, operating in the context of other functional and structural deficits of connections in the brain e.g. (in addition to those described earlier) the number of connections in the corpus callosum. It is additionally probable because 17% of the population with speech located in the left-hemisphere have the dominance of the left ear in auditory control (Kurkowski 2013, p. 138) and stuttering is reported in less than 1% of the population, out of whom only 2/3 have left-ear lateralization. It means that it is impossible to recognize audiogenic determinants as the main cause of the emergence of dysfluency. The tendency for left earedness will be regarded rather as a compensation strategy. It does not change the fact that we have to explain the connections between the auditory self-control strategy and environmental factors (e.g. stress) and structural and functional connections in the brain. Future investigations on stuttering people, which include logopedic evaluation, the time when stuttering arose, neuroimaging, tests of auditory processing, and anxiety scales

will probably solve the discussed issues. However, a complete exclusion of emotional factors from the etiology of stuttering and replacing them with anatomical ones seems improbable.

While discussing the issues of emotion, stress, and anxiety reactions that appear in stuttering persons one question should be asked: to what level of the intensification of symptoms can we speak about logophobia as a symptom of stuttering? Shouldn't we treat it, in the case of high intensification of symptoms, as a separate entity, i.e. social phobia? Social phobia is an entity distinguished by modern psychiatry and is characterized by symptoms very similar to those described in the case of anxiety appearing in developed stuttering (however, it does not have to involve speech dysfluency). Social phobia has its indicators at the neurofunctional level (concerning neurotransmission) and is pharmacologically treated.

Taking into account the psychological side of stuttering has a great therapeutic sense, it is one of the bases for diagnosing this disorder. In this context, we should discuss the triggering and maintaining factors of stuttering, which are of psychological and environmental character. A strong environmental phobia is developed in some stuttering patients. Consequently, the resultant is a network of interrelationships between stuttering and social phobia:

1. stuttering without social phobia
2. social phobia without stuttering
3. stuttering co-existing with social phobia:
 - a) mild or moderate social phobia
 - b) severe social phobia.

It can be claimed that social phobia (social anxiety syndrome) and stuttering are phenomena which often merge together. Numerous symptoms of speech dysfluency result from the fear of speaking (logophobia) but at the same time dysfluency leads to logophobia. On the other hand, logophobia, defined as the fear of articulating specific sounds or words, or of speaking in specific circumstances, is one of the symptoms of social phobia. It is not uncommon that despite the effective supportive treatment of speech dysfluency, the symptoms of social phobia persist, later becoming risk factors for a relapse of stuttering and the worsening of other social phobia symptoms.

Therapy

Considerations on the therapy of stuttering persons should start from the description of its aims. Today, it is assumed that there is no obligatory requirement to achieve the patient's constant speech fluency in all communication situations. **The aims of therapy are adjusted to the patient's needs:** from the reduction of dysfluency to an almost zero level of dysfluent syllables (below 2%) lasting

permanently, to the possibility of using the techniques of controlling fluency in situations that need it and stuttering in situations emotionally easy for a patient, to the attitude towards speaking with persistent dysfluency. Various strategies and ways of conducting treatment are adopted depending on the age, kind of stuttering and the patient's expectations. They are, for example, indirect therapy, direct therapy, methods of shaping fluency or modifying dysfluency, psycho-therapeutic and social interactions. The factor of the patient's quality of life, his/her satisfaction, should be regarded as the most important one.

The division of the methods of treatment of stuttering persons by age into three age groups is commonly accepted (McCauley, Guitar 2010):

1. Kindergarten children
2. School children and young people
3. Adults

Re 1. Preschool children

The application of methods of indirect therapy, based on Ch. Van Riper's assumptions (1973) is the most popular method of work with children. It assumes influencing a child through his/her environment: the reduction of punishments, frustration, anxieties connected with dysfluent speaking, acceptance for the child's dysfluencies, reduction of communication stress as well as providing models of correct speaking and formation of self-confidence.

Recently, the application of indirect therapy has become more popular mainly owing to the Lindcombe Program, which is based on the assumptions of behavioral therapy. Its aim is to achieve speech that is free from dysfluency (stage I) and to keep this effect and its stability (stage II). The work under the program is done mainly by parents and consists in the concentration of the child's attention on his/her fluent utterances and on elimination of dysfluent utterances during everyday conversations. The role of a speech therapist is to train parents to react properly to the child's utterances and to measure the intensity of dysfluency and ensure the proper pace of program implementation. During everyday dialogues exchanges in many different situations, in different environment, parents occasionally comment on the child's utterances, both fluent and dysfluent. The task of the speech therapist is to teach parents such a way of commenting as would be pleasant to the child and would not interfere much in the formulation of the utterance itself. A. Packman described the aim of the program as speaking without stuttering in the natural environment despite "rough" daily communication requirements (Onslow et al, 2003, p. 204). The next principle of Lincombe Program is the principle that children should have fun during its implementation. Nobody expects them to understand what is going on; the idea is that they should find pleasure in conversation with parents. If a child, while realizing the program, does not want to

“play” at conversation with parents, it is a clear signal that something is going “wrong” and then a speech therapist or parents must quickly change the way of conducting therapy (Harrison, Onslow 2010), p. 119).

Underlying the preparation of the program was the practical observations, showing that reduction of tension in initial syllables and “the slowing down” of the child’s speech lead to great improvement of fluency. Vast clinical studies, carried out for a long time, taking into consideration the precise measures of the percentage of dysfluent syllables and rigorous statistic evaluation of the results, proved that the improvement of speech fluency appears and remains in children who are praised for moments of fluent, non-tense, slower way of speaking both during therapeutic conversations in direct contact but also in distance communication (telehealth – often used in Australia). Interestingly, despite some doubts expressed by some authors, concerning the emotional safety of children whose attention is drawn to dysfluency, statistical research did not show the increase in fear or anxiety after LP therapy (Harrison, Onslow 2010).

Despite differences in the attitude to stuttering symptoms in the case of various methods of treatment, it is worth to point out similarities present in various forms of work with stuttering children – as in the following programs: the Lincombe Program, the Programs of Ch. Van Riper, I Wygotska (1984), the Palin Parent-Child Interaction Program (Botteril, Kelman 2010). I find as many as seven similarities:

1. All methods underline the necessity of parents’ participation in the therapy, often in one-to-one interactions with a child.
2. All methods underline the necessity of devoting time to “special effects”: plays, relaxation, slower speaking to a child or praising and requesting correction.
3. In each case, exercises are to be a great fun and not a dull duty.
4. All therapeutic approaches emphasize the necessity of building contact with the child that is built on confidence and mutual acceptance and ensuring the child the feeling of safety and self-confidence.
5. The role of a speech therapist is limited, in most cases, to every-week instructions, supporting and controlling the therapy conducted by parents. It is important to raise hope and trust in the success of the therapy in parents, to encourage them to make consistent and long lasting efforts. The liquidation of negative emotions that often appear in parents (connected with stuttering in the child or their sense of guilt) is necessary.
6. The therapy usually lasts minimum three months but it needs prolongation even up to 12 months, with an assumption of a scrupulous and systematic evaluation of progress .
7. The therapies aim at achieving normal speech fluency.

Re 2. School children and young people

In case of school children and young people the combination of methods of shaping speech fluency (techniques of prolonged speaking, delicate start of speech – techniques of rhythmization of speaking) with the training of effective social communication are commonly used.

The current state of knowledge allows us to formulate the thesis that therapy aimed at shaping the fluency of speaking influences the change of the organization of distorted programming and controlling functions of speech in the brain. Data from studies using functional magnetic resonance (fMRI) prove that, as a result of a therapy which shapes fluency, the change of hemisphere activity occurs: an increased correct activity of the left hemisphere of the brain and a simultaneous diminishment of the activity of the left hemisphere is observed. This effect is relatively constant and also lasts during the period of two years after the therapy is over. (Neuman, Euler 2010). This form of therapy should be regarded as a recommended one because its effectiveness has been proved. As far as speech dysfluency in advanced stuttering (which can be spoken of in this age group) is concerned, two different goals are assumed:

- Shaping of speaking fluency
- Modification of dysfluency into its easier form

We do not meet entirely new ways of shaping fluency – in the world-famous centers and in the generally used therapeutic programs techniques are still used, in various proportions, which make use of breath support, delicate start of speech and its slowing down, pausing, rhythmization of speaking, adjunctive equipment, or dysfluency modification based on the principles worked out by Ch. Van Riper. What keeps attention is the precise rules of conducting exercises (frequency, time, the course of exercises), a wide use of computer-assisted, audiovisual techniques and support equipment, constant evaluation of results, and great regularity of performed actions.

In reference to the reduction of logophobia and shaping of the competence of effective social communication the following objectives should be regarded as the main ones:

- Preventing anxiety behaviors
- Acceptance of the occurring dysfluencies and other accompanying symptoms
- Training of self-confidence in all communication situations

These aims are reached mainly by including the family into therapy, through building a communication community (a group), by using reinforcements, the system of rewards and gradation of difficulties: individual training is initially combined with group training, out-of-therapy room tests are gradually introduced in more and more difficult social situations (cf. Yaruss, Pelczarski, Quesel 2010).

Re 3. Adults

It should be pointed out that methods used in young people are generally applied to adults. Taking into consideration the fact that in some adults there is a significant intensification of phobia symptoms occurs which go beyond the speaking related anxiety, the issue of including psychiatrists and pharmacotherapy in the therapy is worth considering. This is certainly not a medicine for speech fluency but for, co-existing with stuttering, social phobia coexistent with stuttering. In such cases, what seems to be the most sensible is to conduct speech therapy supported by pharmacotherapy. So far, such solutions appear more effective than the application of medicines for speech fluency although such attempts are also made. Drugs affecting neurotransmission are tested: mainly from the group of GABA receptors antagonists: gamma-aminobutyric acid (pagoclone) and dopamine (risperidone and olanzapine) Initial results point to the possibility of the reduction of stuttering symptoms but also the application of mixed therapy (logopedic-pharmacological) is suggested (Maguire et al. 2010).

In the case of adults it is possible to use the digital speech aids (DSA). However, in this case it is necessary to answer the question: Should it be giving the patient a “prosthesis or an element of therapy motivation, support in social communication training)? Both solutions are possible – the first one in the case of persistent stuttering that is resistant to therapy is assistance in communication like a hearing aid, the second one, in the training of speech fluency, enables easier introduction of techniques of fluent speaking into out-of-consulting-room situations.

In the general evaluation of all methods of therapy in stuttering persons at the beginning of the 21st century, what draws attention is the common requirement for the evaluation of the effectiveness of methods by means statistical methods and scientific experiments, which in practice means the application of EBP principles and an attempt to pass from “a magical” style to a scientific one in therapeutic discourse

CLUTTERING – THEORY AND PRACTICE

Theory

Cluttering (ICD – 10 F 98.6, ICD – 9.307.0) is a disorder of speech fluency connected with quick and irregular speed of speaking. It often occurs as concomitant with other disorders: difficulties in learning, or ADHD. Symptoms of speech dysfluency in cluttering differ from symptoms in stuttering and mainly consist in non-spastic repetitions, and interjected sounds. These symptoms are accompanied by the general lowering of the precision of utterance articulation. Speech dysfluency co-occurs with symptoms described at the language, psychical, and

neurophysiological level. At the linguistic level it is the decreased grammatical and semantic cohesion of an utterance. At the psychical level: weak concentration, narrow scale of attention, weakened ability to listen, a sea of thoughts, hypersensitivity, unawareness of experienced difficulties. At the neurophysiological level – abnormalities in EEG (Woźniak 2008).

Patients with cluttering do not control their utterance, mainly the speed and articulation, which leads to dysfluency (St. Luis et al, 1985). Early studies already pointed out an organic factor probably exists which determines the underlying causes of this disorder – there was "a hypothesis of central language impairment" which allegedly affects many communication channels and constitutes the underlying cause of cluttering, different from stuttering which was regarded as being of rather functional character (Weiss 1964, after: Tarkowski, Smul 1988).

Recently, Yvone van Zaalen-op't Hof (2009) has presented extensive studies on cluttering. Looking for neurolinguistic differences between the two disorders, she has presented the results of studies, conducted by means of fMRI, on the group of 16 right-handed stuttering and non-cluttering persons and on 14 persons with cluttering (stuttering was excluded). The studies show the initially assumed differences in the pathogenesis of both disorders. In cluttering patients, in comparison with those stuttering, a higher activity in the right precentral gyrus, inferior frontal gyrus and left insula is found. What's interesting, the activity of motor areas gradually increased in cluttering patients while they executed tasks, whereas in stuttering persons it remained relatively stable and concerned other areas – the premotor cortex and temporal lobe. The areas over-activated in the right cerebral hemisphere are probably the results of compensation strategies and point to a deficit of the analogous left hemisphere centers. These areas take part in motor control, planning, and execution of motor behavior (articulation) and require precise integration of information in time.

Other studies point to deficits in the ventromedial-prefrontal cortex which may cause cluttering (Schmolck, Shulz 2010).

In summary, it should be said that the main neuroanatomic deficit underlying cluttering concerns the frontal areas of the left hemisphere responsible for motor planning and behavior control. This may account for the presented symptoms of dysfluency, difficulties in building utterances but also symptoms of irritation, weakened concentration and attention, and antisocial behaviors.

In cluttering, deficits are mainly diagnosed in grammatical coding - both syntactic and phonological - of a sentence, and monitoring of utterance. This causes difficulties in building correct sentence structures in proper time. Research does not confirm problems with planning of utterance content. The described defect does not refer to the problems connected with the motor functions of speech organs (Van Zaalen-op's)>

Therapy

In the logopedic therapy of cluttering patients we cannot report important changes in comparison with the previous years (see Tarkowski, Smul 1988). Logopedic therapy in this case is different from the therapy of stuttering people and, with regard to communication skills, it consists in:

- Slowing the pace of speaking
- Shaping of correct diction
- Exercises in the construction of correct texts
- Correction of difficulties in reading and writing

In reference to psychical symptoms, two basic goals can be distinguished:

- Increasing behavior control
- Increasing the concentration of attention and widening its scope (Woźniak 2008b)

Attention should be paid to the fact that the application of some methods that are effective in the case of stuttering, for example the application of echo correction to improve speech fluency, or of relaxation techniques, is counterproductive in cluttering, and increases cluttering symptoms.

In current literature on the subject there are no reports on the use of drugs in the therapy of cluttering – the only study was written five decades ago (Sedláčková 1970). The author evaluates the studies on patients with cluttering, who were pharmacologically treated, and she confirms the effective action of neuroleptic drugs against cluttering symptoms (cf. Tarkowski, Smul 1988, p. 51).

However, in the case of cluttering we should consider the possibility of applying similar forms of psychotherapy and pharmacotherapy to those applied in ADHD. Perhaps, it will be a therapy supporting the logopedic therapy of people with this disorder. However, this requires further studies.

Summing up, it should be said that cluttering is a disorder to which less attention is devoted than to stuttering. This probably results from the fact that it is less bothersome to patients and is not a lesser social problem. The treatment of cluttering is studied mainly from the perspective of difficulties in learning and in exerting influence on the level of planning and controlling rather than on the level of motor realization of utterances (Van Zaalen-op't 2009).

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