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Text memory as a category of logopedic diagnosis

SUMMARY

The article seeks to define the concept of text memory, which is a new one used in the assessment of human language abilities. The introduction of the category of text memory of stems from studies on narrative in schizophrenia and is based on the neuronetwork narrative theory formulated by the author. In relation to psychological models of memory, the text memory is a function of working memory which uses language for remembering, storing and retrieving information organized in a narrative way. The author then discusses preliminary studies on the text memory in the speech norm and speech pathology to pass on to the instruments for diagnosing this phenomenon.

Key words: working memory, narrative, schizophrenia, speech disorders

1. DEFINITION

The article aims at introducing the concept of text memory as a category which can be used in determining the degree of the mastery of speech, as well as in diagnosing speech disorders. In a longer perspective the category of text memory may constitute the basis for developing standardized diagnostic tools and new methods of therapeutic intervention.

Text memory is a function of working memory, using language for remembering, storing and recalling information, organized in a narrative way. I derive the concept of text memory directly from the research on narrative (Woźniak, 2005). Clearly, the concept of text memory is associated with an extensive psy-

chological and neuroanatomical discussion on memory processes, which will only be briefly summarized.

Memory is one of the bases of building the identity of man and his cognitive functioning. Numerous theories of memory do not form disjoint sets, but rather complementary models, divisions intersecting with one another, describing ways to fix, store and recall information acquired in different sensory modalities.

For example, in respect of the form of data storage and mechanisms of accessing data, declarative and nondeclarative memory are distinguished; in respect of the nature of the stored information semantic and episodic memory are singled out; in respect of the degree of conscious involvement in remembering information, explicit and implicit memory are distinguished. In addition, regarding the duration of the memory processes (storage of information) the following types of memory are distinguished:

Immediate memory (sensory); information storage time 1-2 sec.

Short-term memory; information storage time 15-30 sec.

Long-term memory

The inclusion of the mode of action of the individual "subsystems" of memory has led to the emergence of the concept of working memory (Baddeley, Hitch, 1974, Kurcz, 1995, Szepietowska, 2006).

In contemporary approaches treating memory as a system of systems dominates, where the term "system" is used in a general and working sense, i.e. as the ability to perform certain mnestic tasks, activate specific operations, as well as for identifying the type of stored information. Systems have a distinct neural substrate, they are defined as independent, which means that a disruption of one will not break the others ("logic of dissociation") (Szepietowska, 2006).

Text memory belongs to conscious memory, its elements are contained in both episodic memory (record of personal experience, structured according to temporal and spatial sequences), but also in semantic memory (comprising general knowledge about the world, abstracted from individual experience) (see Chlewinski , Hankała et al., 1997), but I would seek its characteristics in the mode of action. Therefore, to understand the basics of its operation, it is necessary to refer to the concept of working memory. Working memory remains active for a short time, it is engaged in retaining and processing newly acquired information and in manipulating it. The predominant modes of acquiring information are the modalities: auditory (the phonological loop is at work here, where acoustic information is processed in 1-2 sec.) and visual (where visuospatial sketchpad is at work). Superior to the functioning of working memory is the attention system (regulation of the resources of the phonological loop and the visuo-spatial sketchpad), which sends information to long-term memory. The current version of a working memory model encloses the episodic buffer, which collects informa-

tion in a multi-dimensional code. The episodic buffer acts as a temporary interface between the phonological loop, visuo-spatial sketchbook and long-term episodic memory and is controlled by a central unit which creates coherent fragments by combining information from different sources. Long-term episodic memory uses the resources of information stored in visual semantic memory, or from data created with the help of language (Baddeley, 2000). We can now indicate a fairly exact anatomical location of the described functions. They are associated primarily with the activities of the dorsolateral prefrontal cortex, which has connections with: posterior parietal cortex, lower part of the temporal cortex, callosal gyrus and the hippocampus (Goldman-Rakic P.S., 1999).

The model described above corresponds to the understanding of memory functioning described in the neuronetwork narrative theory (Wozniak, 2005). Memory works ‘’in the background” of all the narrative processes and, as such, is an active element of the construction of the whole narrative discourse. It should be assumed that this is so for all other types of discourse as well.

The neuronetwork narrative theory comes down to the statement saying that narrative, understood as a procedure for interpreting the world through language, works as processes in a neural network.

The neural network operation involves, firstly, the existence of specific input information, but the system can handle multiple inputs. Secondly, the network processes the data in a nonlinear way, performing a number of parallel operations between the mutually connecting groups and maps of neurons. Thirdly, the result of the network’s ‘output’ operation is the creation of a functional circuit (with strengthened synapses), which become the foundations for categories based on values.

The model of narrative interpreted in that way is presented in Diagram 1.

Diagram 1. The model of narrative in the neuronetwork narrative theory.

Input:

I [1]
(The world of consciousness: values, statements, qualia, emotions)

NON - I [2]
(the sensually perceived world)

Processing:

NARRATIVE PICTURE [3]
NARRATIVE SEQUENCE [4]
MEMORY [7]
NARRATIVE SCENE [5]
NARRATIVE WORLD [6]

Output:

Narrative discourse [8]

The presented model of narrative functions in accordance with the requirements applicable to neural networks, i.e. input – processing – output. Inputs to the model are:

1. Categorizations of the world of consciousness, i.e. statements, subjective beliefs and feelings (qualia), emotions. Emotions are the most complex of mental processes.

Additionally, thanks to feedback connections with memory [7], recategorizations of memory traces, the previously fixed categorizations of narrative units, enter processing through the world of consciousness. The anatomical locations of these phenomena are mainly the frontal, temporal and parietal lobes.

2. Perceptual categorizations of the objects and phenomena of the world perceived sensually [2], in all sensory modalities: visual, auditory, tactile, olfactory, gustatory and proprioceptive (responsible for deep sensibility). The anatomical location of those phenomena is primary and secondary cortex of mainly the occipital, temporal and parietal lobes.

The input data are processed with the help of language. The anatomical location of these processes is Broca's and Wernicke's area. The processing consists of several parallel levels:

3. Creation of narrative images [3], which are linguistic categorizations of input data, binary units consisting of a theme and a rheme. We can distinguish three types of narrative images: images of the external world, images of the world of consciousness and images of memory traces.

Narrative images form narrative sequences [4], consisting of a minimum of two images, linked by a common theme. Narrative sequences are ordered by time, space or concept.

Creating a narrative scene [5] is another level of processing. A narrative scene is a collection of images and sequences produced intentionally and subjectively by the narrator, it is a unit distinguished on the basis of a global intention.

4. Correlated combinations of narrative scenes, connected through feedback by memory [7] form a world of narrative[6]. The world of narrative is the most complete unit which is a linguistic interpretation of reality. It is usually realized in more complex narrative utterances of the same narrator.

5. All narrative units connect with each other via feedback on the basis of current projections, and by memory [7]. **Memory is a property of the whole system and is the most important guarantor of the coherent functioning of the whole, and the internal cohesion of units. Thanks to the feedback connections of memory, all units refer to the whole, which they form in syntactic, semantic and pragmatic dimensions.** The working of all levels of processing and feedback-connected memories results in a coherent narrative discourse [8].

The narrative discourse [8] is placed at the "output" of this narrative model. It becomes the basis for further categorizations of the narrator's awareness processes [1], through feedback connections may be fixed in memory [7]. It also becomes the object of the world perceived sensually [2] by the narrator and by other people. As such, it may become the basis for subsequent narrative processes. In that way the loop in the model closes, the loop which allows for theoretically infinite possibilities of creating narrative worlds and the relationships between them.

The above presented approach to memory within the neuronetwork narrative theory, supplemented by the model of working memory, is essentially a description of the activity of text memory. Therefore we should assume as the introduction that text memory is a function of working memory, using language to remember, store and recall information organized in a narrative way. Such an assumption implies a mandatory presumption of understanding the text that has been remembered. The text stored in a mechanical, phonographic way does not meet the definition of text memory because the remembered information is not a text for the person involved (it does not have a denotative character). In the light of the above-presented models of memory and narrative, the assumption that text memory is closely related to working memory remains non-contradictory with the assumption of using long-term memory for handling texts. A "store" of text patterns is located in long-term memory, and becomes the basis for the narrative world, global understanding of the world, as well as for creating new texts.

2. TEXT MEMORY IN STANDARD SPEECH AND SPEECH DISORDERS

The high usefulness of text memory for assessing language and communication skills was observed by the founders of Heidelberger Sprachentwicklungstest (HSET), [Heidelberg Test of Language Development], H. Grimm and H. Schöler (1978): the HSET's point A2 tests the imitation of forms of grammatical structures is studied, while point F tests the degree of integration of the levels of language mastery and communication at the level of reconstruction of a text recounted earlier. In particular, the task of memory reconstruction of a text recounted earlier proved to be one of the most trustworthy. The text (in this case a modified fairy tale) was divided into units of meaning, each of which being scored in the response. Eight- and nine-years old achieve results of approximately 60% in this test (Wojtowicz, 1993).

The issue of text memory is becoming one of the key questions in the study of speech pathology in schizophrenia. Many years of research on narrative in schizophrenia indicate a close link between the working of memory and creation of a narrative text. Memory is fundamental for creating a coherent text, implementing the narrative model (Woźniak, 2005).

In patients with schizophrenia, narrative disorders and memory deficits appear. The thesis of the connection between text memory and the activity of working memory is also confirmed. Moreover, the very well-documented working memory deficit in schizophrenic patients correlates with the lateral prefrontal cortex dysfunction (Callicott et al, 2003).

In the light of the research on schizophasia the following question should be asked: what is the situation with other disorders, if functional and neuroanatomical connections between speech and memory disorders are so close?

An attempt to answer that question has become a task for a team of researchers led by me. Initial reports on auditory text memory show its significant impairment in children with schizophrenia and ADHD (Rogala, Szabelska 2008), as well as in cluttering, autism, and oligophasia (in my own research). Comparison of the functioning of text memory in normal and pathological cases is becoming an interesting research task. Our research includes not only the reconstruction of "units of meaning", relevant information, but also the realization of a narrative model, repeating events in their order (the narrative line). In the study, nine-years-old normal children reconstruct 75.9% of the remembered information from the recounted text and in 81.25% the correct narrative line. On the other hand, in children with schizophrenia the patients reconstruct 25.28% of the information from the recounted text and in 11.1% the correct narrative line (on average 16 years of age.). In ADHD, (in 10-years-old patients on average) 39.7% of the information from the recounted text was reconstructed and in 18.7% the correct narrative line (Rogala, Szabelska 2008). The observation of so significant differences was certainly not accidental and coincides with the findings from the study of speech disorders in children with schizophrenia (Kaczyńska-Haładyj, Woźniak, 2003, Woźniak, 2005).

The observed differences warrant further reflection on the relevance of text memory as a category of description and diagnosis of linguistic and communication skills of humans.

First of all, the results provide an incentive to use the text memory test as a diagnostic category for most speech disorders.

The next key task is to develop developmental standards for text memory (taking into account the auditory and visual modalities). We should be aware of the consequences of the adoption of the text memory category in the proposed approach.

Firstly, phonological memory (as part of text memory) is the basis for the mastery of vocabulary. It is due to this specifically human capacity to remember speech sounds in their temporal order that it is possible to learn words. Although a similar ability can be observed in some birds, this is only a global imitation of the signal, without the possibility to regard its denotative nature and the possible segmental analysis.

A similar memory effect in relation to linguistic information obtained through auditory channel can be found in the case of information perceived through visual modality (taking into account visual semantic memory).

Secondly, text memory is necessary to imitate the forms of grammatical structures, and thus to learn syntactic rules. Man masters basic syntactic patterns by recognizing them in the statements of others, gathering them in memory and building new utterances on that basis. This view is accepted by all approaches describing the acquisition of speech - even nativist theories acknowledge that surface structures must appear before the deep ones. In a longer perspective, memory of the context of speech usage (as a component of episodic memory) should also be taken into account. As such, text memory is an obligatory basis for learning interactive behaviors, basic dialogue initiations and responses.

And thirdly, text memory is essential to learn the narrative, which happens after mastering the basics of language. At the same the narrative must be understood not only as the ability to build a text, but as a procedure for interpreting the world through language, as I mentioned earlier (Woźniak 2005).

3. A DESIGN OF A TOOL FOR ASSESSING AUDITORY TEXT MEMORY

The foundations for theoretical studies of text memory seem clear, but the problem of its adequate assessment remains an issue not yet realized. During the studies of text memory in speech disorders, conducted at the UMCS Department of Logopedics and Applied Linguistics, the idea to develop a test for assessing auditory text memory arose. A design was developed that has become the basis for the preparation of a standardized version. Below I will present the main assumptions of this proposal.

Firstly, the test takes into account two age levels:

- Children and schoolchildren (5-16 years of age)
- Adolescents and adults (over 16 years of age).

The division results from the observation of acquisition of the skills at remembering texts. Man learns narrative behaviors after having mastered the basics of language, i.e. from the fourth year of life. It can therefore be assumed that at the age of five text memory is already functioning in the majority of normal children. The smooth functioning of text memory develops and is strengthened by school education, reading different kinds of texts, and by development of abstract thinking. These skills stabilize after puberty, which in the present generation takes place usually between 12 and 16 years of age. Achieving sexual maturity is usually related to the reconstruction of connections in the brain, particularly with the frontal area. The achieved level of functioning usually lasts until old age when the ability to remember text can be affected by dementia.

The test introduces the following assessment categories:

1. Repetition of words (phonological memory test, recreating the structure of a word with a growing number of syllables: 3, 5, 7, 9, and 11). This subtest will enable determination of the limits of the system concerning the mastery of vocabulary.

Repetition of sentences (recreating the syntactic structure of an utterance). This subtest takes into account the increasing number of words in the utterance and the complexity of its structure. As material for repetition simple sentences are used, as well as complex coordinate and subordinate two-component sentences and extensive coordinate - subordinate four component structures.

The assessment of remembering words which do not form coherent structures (repeating three unrelated words).

The assessment of the memory of a text read. As has been mentioned earlier, this task is similar to the task in HSET and is highly diagnostic when it comes to the assessment of the integration of the processes of understanding, remembering and recalling coherent text data. Unlike HSET the test does not contain pictures supporting the recall of text; additionally, the degree of recreation of the narrative line (besides the assessment of the degree of relevant information repetition) is assessed.

The assessment of the memory of movement sequences of the facial muscles, tongue and hands. It is a non-linguistic task, which is a pause between reading the text and its repetition; we repeat a sequence: 4, 6, 8 movements. The temporary switching of the attention system (for about 60 seconds) allows us to assess whether the text has been fixed in long-term memory. Irrespective of that aim, the relationship between motor memory and language skills is an interesting issue. It is, however, a separate problem.

The assessment of a text remembered before the test – telling a story. The tested person is asked to tell a familiar tale. In that subtest we cannot be certain about the modalities of remembering the text, but we study the functioning of the recall of the text activated from the long-term memory resources. We assess among others: giving the title, narrative efficiency (semantic coherence, narrative complexity, and narrative pattern implementation), the vocabulary and grammar of a narrative utterance - cohesion of the text.

In conclusion I want to express my conviction that the adoption of the text memory category in logopedic diagnosis will help to create new diagnostic tools and, subsequently, it will permit speedy and accurate assessment of the patients' linguistic abilities without burdening them.

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