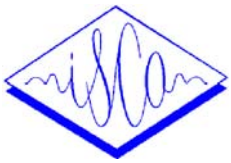

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THE CONTROVERSIAL CONNECTION BETWEEN SPEECH PRODUCTION AND PERCEPTION: THEORIES VS. FACTS

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ABSTRACT

Neurolinguistic investigations support the dissociation between speech production and speech perception in the case of aphasia. This means that an aphasic patient may be able to understand words and sentences while he is not able to produce them or, he may be able to produce certain linguistic forms properly while he is not able to detect the semantics of verbal utterances. Empirical data, however, seem to contradict the supposed excellent co-operation of speaking and perceiving in normal subjects as well. Various phenomena such as slips of the ear, violations of co-operation strategy of communication as well as the controversial connections of speech production and perception during language acquisition show dissociations of the two mechanisms. The question is how the properly working speech production co-occurs with inappropriate speech perception and what is the strategy where appropriate speech perception is escorted by inappropriate speech production.

Keywords: perception, production, dissociation, language acquisition

INTRODUCTION

Wolfgang von Kempelen made some statements concerning speech production and speech perception 200 years ago that have been experimentally confirmed since. Kempelen, the Hungarian nobleman who created the first speaking machine in the world, proved that speech was imitable which was a great step ahead not only in phonetics but also concerning the concept of the world at that time [7]. Without computers and synthesizers it took him 14 years to produce the first sentences by the machine. The only human factor in these sentences was his working brain controlling his hands and legs but articulation was performed only by the machine. Kempelen's first moment of success appeared when his wife and children came from a distant room to him asking about the language they had heard being spoken. In fact, they heard the speaking machine. In other words, artificial sentences were accepted as natural speech.

Trying to produce artificial speech, Kempelen realized that (i) people are able to discriminate speech sounds more easily than they able to identify them, (ii) context influences the recognizability of speech sounds, (iii) the 'minor parts' between speech sounds are of crucial importance for perception; if they are too long, one perceives them as pauses, (iv) visual perception contributes to verbal speech perception, and (v) „human ears" are uncertain in the sense that people tend to recognize words despite proper speech sound identification.

The core of these statements can be found in some modern theories like the motor theory of speech perception [10] or the model of analysis by synthesis [2], the theories on the controversies of speech perception by ear and eye [9], the realization of transient phases in the acoustics of speech sounds, the theories of the problem of invariance [12], the hypotheses on acoustic vs. semantic advantages in speech perception, etc.

Kempelen's facts clearly point to questioning the 'harmony' of speech production and speech perception. Because language is a complex of functions, everybody accepts that appropriate speech perception presupposes appropriate speech production and vice versa. No one thinks of inappropriate speech production if speech perception works properly. The only exception is aphasia. Traditionally, aphasia has been defined as the impairment of central language abilities in the speech modality following brain damage [3]. We should note that the impairment may be more or less complete, may involve more or fewer subprocesses of speech production and perception. According to Lurija [8] a dissociation occurs if one process is disturbed but a related process is left intact.

There is no problem with accepting aphasia as a syndrome where either speech production processes or speech perception processes are more involved in the impairment. Empirical data have proved that Broca's aphasics are unable to articulate sounds or words properly, their spontaneous speech is non-fluent, dysprosodic and agrammatic while their auditory comprehension is usually reported to be much better than their speech output.

Wernicke's aphasics, on the contrary, speak fluently (sometimes with abnormally high speech tempo), their grammatical structure may appear normal but their auditory comprehension shows a severe loss. There is a clear asymmetry in these cases between speaking and understanding independently of the organic reason behind the syndrome.

During normal communication no one expects that a speaker/listener would consciously violate the so-called co-operation strategy. We do not produce utterances that cannot be perceived or comprehended like the famous, old phrase of the psycholinguist George Miller: "Colourless green ideas sleep furiously" [11]. Similarly, we do not intend to misperceive or miscomprehend what we have been told. If we analyze spontaneous speech it seems that there is some magic trick on the part of the listener who is able to understand what was said to him. The most interesting situation is, however, if a dissociation exists within one person who poorly perceives speech without a speech production deficit or, if his articulatory gestures are inappropriate despite his excellent perception.

1. MOMENTARY DISSOCIATIONS: SLIPS OF THE EAR

Slips of the ear may remain hidden since the speech decoding mechanism is extremely fast in correcting them. Sometimes the listener is not even aware of the self-correction. What kind of mechanism brings about these errors of speech perception? What are the reasons for this phenomenon? What processes are at work in the background? How can slips of the ear be explained within the perception mechanism that is built on well-structured and well-operating subprocesses? Are slips of the ear results of failures in subprocesses, e.g. acoustic-phonetic identification or, are they consequences of false interrelations among the subprocesses?

The speaker's articulatory gestures are extremely „overcoded" in order to ensure the listener's safe speech perception and comprehension. The results of this „overcoding" are as follows: (i) a very complex mechanism of the continuous articulatory gestures, (ii) a very complex acoustic structure of time, frequency and intensity, and (iii) a very specific and complex perceptual mechanism that is able to identify the original linguistic message. The acoustic waveform of the speech events produced by the articulatory gestures contain a lot of redundant patterns that might take over the function of the basic patterns in cases when something goes wrong with them. The acoustic waveform contains the linguistic message that will be transformed several times from thought to thought through articulation, acoustics, decoding processes of the ear, central hearing, i.e. speech perception, and finally comprehension.

There are many cases when the decoding mechanism is successful in recovering the original message, and the listener is not aware of the momentary „gaps" of his perception/comprehension. However, there are some cases when there is no opportunity for correction and the listener realizes his gaps. These phenomena are called „slips of the ear". In other words: listeners identify sound sequences or words that were not uttered or, they understand sentences (questions, statements, instructions) that were not said.

Three main categories of reasons have been defined according to the nature of the 'slip of the ear': (i) misidentification of one or more speech sounds, (ii) segmentation failure, i.e. misidentification of a word boundary, (iii) false prediction. A slip-of-the-ear phenomenon is frequently escorted by some specific communication situation which contributes to its occurrence.

(i) Since the listener is generally unconscious of the operations of the so-called lower perception processes because of their highly autonomous working [4], failures at these levels are more frequent than at all the others. Misperception may apply to one or more sounds of the utterance. Examples (bold letters indicate the places of perception failures):

1. Original utterance: „ne menj a **h**ázához" ('do not go to his house')

Slip of the ear: „nem menj a **v**ázához" ('do not go to the vase')

Specific situation contribut to misidentification of the consonant [h]: two people were chatting at a table on which there was a big vase with flowers in it.

2. Original utterance: „Jó ez az **i**ll**a**t." ('This is a fine smell.')

Slip of the ear: „Jó ez az **él**e**t**." ('Life is good.')

3. Original utterance: „Láttad már a **V**incét?" ('Have you seen *Vince* /name/?')

Slip of the ear: „Láttad már a **p**incét?" ('Have you seen the cellar?')

The listener wanted to visit the cellar and was thinking of this fact (though he knew the person called *Vince* who was working in that cellar).

(ii) Phonetic research has confirmed that the speaker's articulation rarely helps the listener's perception to define correctly the word boundaries in spontaneous speech. This means that global speech perception is needed to comprehend spoken utterances. Examples (bold letters indicate the places of perception failures):

1. Original utterance: „Tegnap óta **ittál**?" ('Have you drunk since yesterday?')

Slip of the ear: „Tegnap óta **itt áll**?" ('Has this been standing here since yesterday?')

Specific situation: The converstaion took place in the kitchen early in the morning. The husband asked the question referring to a glass of milk standing on the fridge.

The wife, however, misperceived the word boundaries and the morning time supported the possibility of the question.
2. Original utterance: „Nézd, leszedték **az árakat**!" ('Look, the removed the prices!')
Slip of the ear: „Nézd, leszedték **a zárakat**!" ('Look, they removed the locks!')
Two persons were standing in front of a shop. Removing the locks were much more likely for the listener than the originally uttered noun.
3. Original utterance: „felment a **tej ára**" ('The price of milk has been increased')
Slip of the ear: „felment a [**tejára**]" ('/he/ has climbed up to the tea')
The message was heard from the radio, this time no supporting situation could help to avoid the funny comprehension.
(iii) False predictions are based on real-time operations of the comprehension mechanism. More specifically, they are based on several factors like communication situation, the listener's assumption about the speaker's intention, the listener's insertion of known information into the comprehension process, various kinds of association, etc. Predictions can be so strong that they block the possibility for correction. This is the type of situation when utterances like „I could not really understand" are often heard. Examples:
1. Original utterance: „Nem volt rajta**m** semmi, amikor benyi**tott**." ('I had no clothes on me when he entered.')
Slip of the ear: „Nem volt rajt**a** semmi, amikor benyitott**am**." ('He had no clothes on him when I entered') – exchange of participants by changing the suffixes
Another slip of the ear: „Nem volt rajta**m** semmi, amikor benyitot**tál**." ('I had no clothes on when you entered.') – changing one participant by changing the suffix
Some psychic reason is supposed to play a role in these misperceptions.
2. Original utterance: „anya és lánya jódlizik" ('mother and daughter are yodelling')
Slip of the ear: „anya és lánya jógázik" ('mother and daughter are practising the yoga')
The two acoustically similar and also equally rare words might be close to each other in the listener's mental lexicon. The listener's prediction was the verb *yodel* which she thought more likely in the situation than the phrase *practise the yoga*.
One of the most interesting examples in this category is the following:
3. Original utterance: „Lemosta az autót?" ('Did you wash the car?')
Slip of the ear: „Lefestette az autót?" ('Did you paint the car?')
The listener's background train of thoughts was that the car is so beautiful and bright as if it had been freshly painted. So, he answered: „No, it was washed". The situation explains even more: the car was stopped by a policeman who asked the driver.
In everyday communication the slip-of-the-ear phenomenon rarely appears in simple forms. Frequently, two or more reasons together lead to misperception or to miscomprehension. Shattuck-Hufnagel and Klatt suggest that this phenomenon is the result of speech perception being (unlike speech production) essentially a matter of hypothesis testing, with bias as one of the means of generating hypothesis about what has been heard [13].
Misidentification of speech sounds can be mixed with segmentation failure or false prediction or, segmentation failure can co-occur with false prediction. Examples (bold letters indicate the places of perception failures):
1. Original utterance: „**két ember** hazudik" ('two men are lying')
Slip of the ear: „**képembe** hazudik" ('he is lying directly to me')
2. Original utterance: „kérlek, **negyedeld**!" ('please, split it in four')
Slip of the ear: „kérlek, **ne egyed**" ('please, do not eat it')
Activating another lexical item in the mental lexicon that is different from the speaker's intended one or being unable to find the appropriate meaningful word might cause serious comprehension problems. The slips-of-the-ear phenomenon is well-known in psycholinguistics. In the present author's interpretation slips of the ear are signs of momentary disharmony between speech production and speech perception since the person's speech production works well while his perception does not.
The next paragraphs deal with permanent production/perception dissociation within the same speaker/listener: the case of dysphasia, speech defects and perception problems. In all cases the same methodology was used based on the GMP test-package for the evaluation of speech perception and comprehension of Hungarian-speaking children [5].

2. DEVELOPMENTAL DYSPHASIA

The term 'developmental dysphasia' is applied to children's language development where starting to speak is delayed beyond the normal range. Evidence suggests that such children are particularly impaired in acquiring correct pronunciation and syntactic and morphological rules. A series of experiments has been carried out in order to check the possible dissociation between the speech production and perception abilities of 100 young dysphasic children [6]. Their mean age was 3;0 and varied between 2;10 and 3;2 (68 boys and 32 girls). Beside their age the following criteria had been used in order to select them for the experiment: (i) normal birth circumstances, (ii) normal IQ, (iii) no neurological problem reported, (iv) no autistic features detected, (v) no previous treatment by speech

therapist. All these children were in the 'holophrasic' phase of first language acquisition. They expressed their wishes by non-verbal gestures but they were able to decode adults' verbal utterances to a certain degree. The same children were been retested 5 years later, at the age of 8.

Three-year-old children's sentence comprehension showed enormous individual differences. The standard performance of the sentence comprehension test at the age of three is 70%, i.e. the children should comprehend 7 sentences out of 10 correctly. The mean result of our dysphasic children's correct responses is 39.4%, the range is 0-80%. The dysphasic children performed significantly poorer than their normally developed controls. However, there were 9 children among them who understood the sentences at the same level and 2 children even slightly better than normally developed children do. The majority of the tested children were able to understand 3 sentences correctly. Without appropriate speech production these children were able to decode complex sound-sequences, their lexical access was successful and they decoded the rich Hungarian morphology and syntactic structures of the sentences appropriately. How can this be explained? What sort of dissociation exists between production and perception in these children? They may have more relatively complex language knowledge than it is supposed and/or their decoding processes may work more autonomously from the production mechanism than it is supposed. There is an increasing body of research indicating that children become aware of the linguistic aspects of language at a very young age, including evidence for an understanding of language-specific syntactic patterns by 20 months. In this sense children learn to use their language, a notion that includes (i) making predictions, (ii) identifying causes, and (iii) justifying a response [6]. On the basis of these acquired operations the child will be able to comprehend not only words and word combinations but also shorter and then longer utterances.

Evaluation of these children's text comprehension (in a playing situation) showed that they all comprehended those complex utterances that had been told them. The question arises: how are the children able to identify morphology, syntax and their interrelations if their mental lexicon contains not more than 10 content words. Is it likely that their language awareness meets their age and cognitive developmental level, however, their verbal speech production is substituted somehow by natural sign language? If so, it could be supposed that at the beginning of language acquisition (sometimes) there might be a more emphasized interrelation between the Wernicke's area and some other parts of the hemisphere but not the Broca's area. This assumption is supported for example by the following series of concepts a dysphasic child produced using signs: *„Mother, this woman will not give me an injection, will she*?"

The results of retesting the dysphasic children showed that their 'language dissociation', unfortunately, had not disappeared. At the age of 8 their speech production showed no deficits; however, their speech perception and comprehension performances were extremely poor. At the beginning there was a dissociation which could be characterized by more developed speech perception and significantly underdeveloped speech production. The development shows a specific change of the dissociation: speech production is good but speech perception shows enormous deficits. The 8-year-old children's correct acoustic-phonetic perception was 71.2%, their mean serial perception was 53.9%, their transformational perception reached the level of 79.5% instead of 100% in all subprocesses. Their speech sound discrimination ability showed difficulties not only with the quantity of vowels and consonants but also with the voicing character of the consonants. Their sentence comprehension was significantly better than their text comprehension – the mean value for sentence comprehension was 78.5% and for text comprehension only 47.3% instead of 100% in both cases. All the data show a significantly poorer performance compared to that of normally developed children of the same ages ($p<0.0001$). (To test statistical significance, variance measures were conducted: two-tailed student-t test). On the basis of these data we can state that there is a complex breakdown of the decoding mechanism of these children whose speech production in all areas show normal operations. **Dysphasic children show enormous dissociation between all subprocesses of speech production and perception.**

3. LANGUAGE IMPAIRED CHILDREN

A series of experiments has been carried out with the participation of 550 Hungarian-speaking children (420 boys and 130 girls). The criteria for choosing the children for the experiments were as follows: (i) normal IQ, (ii) normal hearing, (iii) normally developed grammatical and syntactic structures, (iv) starting of speech around the age of one, (v) severe articulation defects concerning the following Hungarian consonants: voiced and voiceless spirants, affricates, palatal stops and nasals, and [r]. Five subprocesses of the speech perception mechanism were tested by means of the GMP standardized diagnostic procedure. The tested subprocesses were: acoustic-phonetic perception, serial perception, transformational perception, speech sound discrimination, and text comprehension. All children had been tested first at the age of five while they were re-tested 3 years later at the age of 8.

Table 1 summarizes the perceptual performance of the tested children (LI) and that of the normally developed

children without any speech defects (ND) at the ages of 5 and 8.
The tested children show severe deficits at the age of 8 in all perceptual subprocesses. Their performance is extremely poor in acoustic-phonetic and serial perception which will seriously affect their reading and writing acquisition [14].

Table 1: Speech perception performances of normally developed and language impaired children (a-ph.p.= acoustic-phonetic perception, d.=discrimination, s.p.= serial perception, t.p.=transformational perception)

Perceptual subprocesses	Correct responses (mean in %)			
	5-year-olds		8-year-olds	
	LI	ND	LI	ND
a-ph. p.	37.2	85	62.5	100
d.	39.4	90	78.7	100
s. p.	46.9	90	63.6	100
t. p.	65.2	75	82.7	100

Figure 1 illustrates the development of the tested children's sentence and text comprehension. Their performance shows a severe disorder in both processes at the age of 5 since instead of 100% of correct answers their mean performance is 30 and 40% less than that. As opposed to the speech perception processes, the LI children's sentence and text comprehension perfomrance shows the expected level for normally developed 8-year-old children.

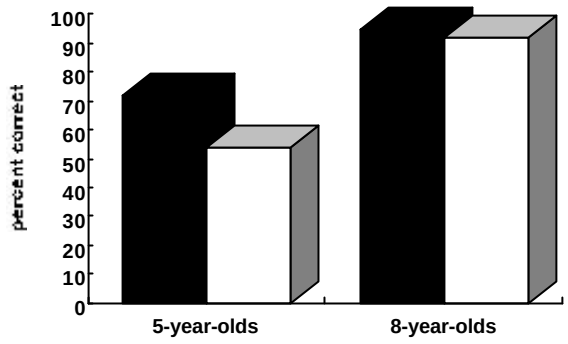

Figure 1
Sentence (black coloumns) and text comprehension (white coloumns) of language impaired children tested at the age of 5 and 8

The results of the first experiment confirmed our hypothesis: disordered articulation was found to co-occur with heavily disordered perception processes, particularly in the domain of serial perception and sound discrimination. Not a single child was found with normally developed speech perception. However, the results of the second part of the experiments (3 years later) contradicted our hypothesis in the sense that the tested children with normal articulation still suffered from disordered speech perception processes. This means that (i) severe articulation deficits predict perceptual deficits as well, (ii) corrected articulation gestures do not entail the automatic correction of speech perception processes. **Language impaired children show dissociation between their articulation and speech perception but do not show dissociation between their speech production and comprehension.**

4. READING DISABLED CHILDREN

Speech production failures can easily be detected by simply listening to the child's utterances irrespective of the nature of the shortcomings (e.g. articulation defects, mistakes in word usage, or syntactic problems if any). Difficulties of speech decoding, however, might be hidden because of children's compensation strategies. Frequently, it is only after starting school that it becomes obvious that the child is not fully able to follow verbal messages.
Children with reading difficulties show severe delays and/or disorders in their speech perception and comprehension processes [15]. The speech perception and comprehension performance of 450 reading disabled children (360 boys and 90 girls) was tested using the same GMP test-package as in the previous experiments. There was no report on delay in starting to speak or on language impairment with these children. They had normal IQ as well. Their ages ranged from 7 to 10. Their speech production was normal in all respects. Their speech perception processes showed disorders (Table 2) (age-required level in all subprocesses is 100%).
The speech perception processes develop gradually with these children, the nature of the dissociation shows a slight but well detectable change across ages. By the age of 10 the children's acoustic-phonetic and transformational perception is close to the acceptable level; however, their serial perception still shows severe deficits. The dissociation between speech production and perception shows a narrowing tendency.
During text comprehension, linguistic and extra-linguistic knowledge systems must be combined for an adequate interpretation of concepts, propositions, utterances and macrostructures. Since language is more than just grammar and abstract linguistic principles, there is a need for a specialized capability that is associated with the affective and social aspects of language as well. If there had been any lack in the developmental process or misleading operations or strategies had existed and they could not be discontinued or cancelled, the child's comprehension process would not work properly.

Table 2: Speech perception performance of children with reading difficulties (a-ph.p.=acoustic-phonetic perception, t.p.= transformational perception, s.p.=serial perception)

Test groups	Correct identification (%)		
	a-ph. p.	t. p.	s. p.
7-year-olds	67.8	73.5	46.5
8-year-olds	72.8	79.4	58.9
9-year-olds	86.2	91.6	79.2
10-year-olds	91.3	95.8	81.3

Age-required speech perception mechanism, successful lexical access, correct identification of morphological and syntactic structures are supposed to take place together with the proper activation of phenomena, experiences and knowledge stored earlier at the level of associations in order to result in appropriate text comprehension. Any lack of items or subprocesses or any failure of operations within the mechanism will restrict the child in achieving actual comprehension, i.e. to realize the necessary interrelations of the verbally heard message.

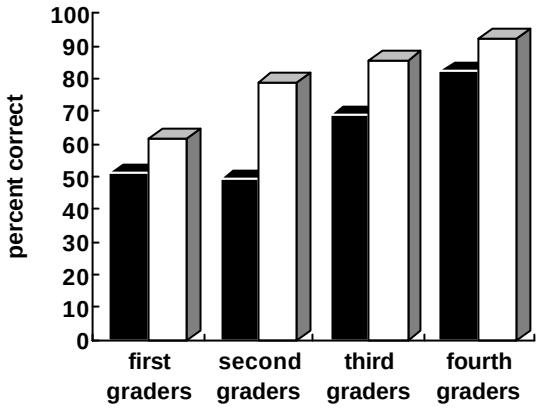

Figure 2
Sentence (white coloumns) and text comprehension (black coloumns) performance of reading disabled children

The majority of the tested children's sentence comprehension was better than their text comprehension on average but all the data obtained show a significantly poorer performance compared to those of normally developed children of the same ages ($p<0.0001$). Children with poorer sentence comprehension than text comprehension had problems in decoding short messages, verbal or written descriptions of various tasks (Figure 2).

All tested children show a dissociation between speech production and comprehension but the majority of them have a more severe dissociation between production and text comprehension than production and sentence production.

5. CHILDREN WITH LEARNING DIFFICULTIES

214 children (162 boys and 52 girls) with learning problems (ages from 8 to 13) were tested on the basis of either the teachers' or the parents' impression. All children's IQ fell in the normal range and no child was reported to have hearing deficits, or any kind of speech disorders, or reading disability. The tested children's speech perception processes were perfect as well as their sentence comprehension. Our hypothesis was then that these children should have text comprehension problems. Verbal comprehension is based on various factors and processes. These provide the listener with an opportunity to understand the details and the main ideas of the text, in other words the interrelations among characters, events, places, times as well as to comprehend the reasons and consequences of the happenings. Factors like an appropriately developed mental lexicon, well-acquired morphological and syntactic structures, good short-term, long-term and working memories, age-required attention, age-specific comprehension strategies play an important role in decoding verbal messages together with working processes like good lexical access, gathering semantic information, and finding and embedding the stored knowledge. If not, learning difficulty, as a consequence, is expected to exist. Table 3 shows the schoolchildren's data (using the GMP-procedure again).

Table 3: Schoolchildren's text comprehension results (standard level is 100% in all ages)

Ages	Correct answers (%)	
	Average	Range
8	50.9	0-70
9	57	40-80
10	60	20-90
11	63.7	50-80
12	82.5	60-90
13	80	40-90

The most striking feature of these data is the lack of or very slight development across age groups. There is a tendency of gradual development of the schoolchildren that can be explained either by their cognitive development or by the effect of actual teaching at school. Not a single child was found to reach age-specific requirements, i.e. the age-specific text comprehension level. Although some of the older children (ages 12 and 13) answered only one question incorrectly, the backwardness is relatively high since being unable to answer one question means that they show a

poorer comprehension than it is required at the age of seven. Two children were found among the 8-year-olds to be completely unable to comprehend the text, they could answer not a single question correctly. Unfortunately, a large number of children showed a low level of comprehension with the older students as well, performing according to the age-requirements of 3- or 4- or 5-year-old kindergarten children. The tested schoolchildren had in fact less problems with the identification of the main idea of the heard text; however, different details seem to be unanswerable for them.

On the basis of the data five types of reasons of children's comprehension difficulties can be hypothesized: (i) momentary speech perception disorder, (ii) problems of lexical access, (iii) uncertainty of syntactic decoding, (iv) working memory problems, and (v) disorder at the level of associations.

(i) Momentary speech perception disorder means that the child's higher level operations fail because of the misleading results of the lowel level operations. In other words, if the child misperceives some parts of the utterance it may affect his lexical access and may result in mistakes of the higher processes. Examples: missing the second syllable of the word *tejföl* ('sour cream') at the speech perception level the child will identify the word *tej* ('milk') in his mental lexicon. Serial perception disorder results in the word *lakoma* ('feast') instead of the original word *lakodalom* ('wedding feast'). Phonetic perception disorder caused the identification of *hentes* ('butcher') instead of *boltos* ('shopkeeper'). The results of all these false lexical access processes could have been logically correct answers to the questions.

(ii) Problems of lexical access may arise from the lack of the item in the mental lexicon, or from the semantic uncertainty of the given word form. Examples: the word *bajusz* ('whiskers') may be unfamiliar to the child but on the basis of the context he identifies this word by some close semantic association as *orr* or *száj* ('nose, lips'); similar process happens to the word *galuska* ('dumplings') and the result is the word *tészta* ('pasta'). However, careful experiments have proved that only half of the children with comprehension deficits show disability also in word identification [14].

(iii) The uncertainty of syntactic decoding should be explained by underdeveloped syntactic and morphological systems which cannot be traced in the children's speech production. Example: the identification of the structure "*the cat had been sipping the sour cream until he drank it completely*" had been uncertain for some children.

(iv) Memory deficiencies are supposed to occur accidentally because no other possible explanations could be found in some cases as the sources of the incorrect answers.

(v) Disorder at the level of associations means that the child is not able to identify the interrelations within the heard story. Comprehension of the main idea of the text caused problems in 48% of all 8-year-olds, in 46% of all 9-year-olds, in 37.6% of all 10-year-olds, in 35% of all 11-year-olds and in 21.9% of all 12-year-olds. No problems were found with that with older children in this test.

The incorrect answers – independently of the ages – have been analysed and certain types of the failures could be defined. (i) The answer refers to another detail of the story. (ii) The answer is based on the child's experience and either his fantasy or his logic dominates in his response. (iii) Generalization. The child's answer does not mark the actual place or time or subject but makes some generalization. (iv) Simple repetition of the question. The different types of the children's answers show the way they unconsciously try to solve their comprehension problems. The more intelligent the child is the more he insists on his experiences stored in his memory. These experiences can be the memories of his own life, or events that happened to him or were heard or seen by him.

Those children whose verbal memory is good can use it when answering some details of the story; however, these very children are unable to answer correctly the main idea questions. It is relatively easy to detect this „memory strategy" since these children recall some parts of the story word by word as an answer to the question. There are a great many children whose strategy is to speak fluently about anything instead of answering the question in order to hide the comprehension difficulty.

Children with learning difficulty show dissociation between (i) their speech production (in all areas) and their text comprehension, (ii) their speech perception (in all subprocesses) and their text comprehension, as well as (iii) their sentence comprehension and text comprehension.

6. CONCLUSIONS

The results obtained suggest that the tested children's various surface problems are all consequences of some dissociation between the various processes of speech. Due to communicative experience, good logic, intelligence and various compensatory strategies, these children are usually able to hide their difficulties. The nature of this dissociation is complex in the sense that the dissociation might arise in diverse forms. These findings suggest that language skill may be related to the functional organization and not just to the structural organization of the brain. Dissociation phenomena support the claim that language is modular, that is, compartmentalized into separate systems [1].

The more we learn about the false tracks of childrens' comprehension processing, the better we will understand the sources of their deficits. More knowledge on the brain

structure and brain operations in normal subjects as well as a careful analysis of the experimental data will lead to modelling the disordered mechanism.

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