

Development of laterality, articulation and sentence comprehension in a girl with specific language impairment – a longitudinal case study

(scientific paper)

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Abstract: *The article is about speech and language therapy topic. The aim of the paper was to assess laterality, articulation and sentence comprehension in a girl (Monika) with Specific Language Impairment (SLI). We were interested in finding whether and how the degree of laterality, articulation and sentence comprehension changed within six, seven and three years, respectively. We researched areas with persisting deficits that can be an obstacle in Monika's education, choice of profession and possible career paths. There are specific symptoms in language area of persons with SLI persisting to adulthood, such as deficits in processing and understanding (comprehension) of spoken and written language. These difficulties could be a disadvantage in successful education and choosing the job.*

Key words: *laterality, articulation, developmental phonological disorder, comprehension, specific language impairment.*

1 Introduction

The paper deals with a longitudinal speech therapy case study of a girl, Monika (aged 13 years in 06/2016) who struggled with shortcomings in the reception and expression of speech and language pursuant to a specific language impairment (hereinafter also referred to as SLI), known as developmental dysphasia in the Czech environment. The author of this paper provided speech therapy for the girl over a five-year period (since April 2009, i.e. from the age of 5 years and 10 months to November 2014, i.e. to the age of 11 years and 5 months). Four control speech therapy examinations took place from November 2014 to December 2016, followed by recommendations for intervention. In the 2015/2016 school year, Monika completed the 5th class of a primary school of common type in the Czech Republic, where she was educated according to an individual education plan reserved for impaired communication

abilities in terms of developmental dysphasia. For the 2016/2017 school year, the girl is attending the 6th class at a primary school of common type; she receives support provided by a teaching assistant because of persisting difficulties in the reception and expression of speech and language. The collaboration with the assistant is praised by Monika as well as her mother. We focused our research on monitoring selected areas that experienced evolution and variation but also stabilization and improvement during Monika's schooling. We were interested in finding whether and how the degree of laterality, articulation and sentence comprehension has changed. We researched areas with persisting deficits, which can be an obstacle in Monika's education, choice of profession and possible career paths.

1.1 Data from the girl's personal history

Monika has Czech and Canadian citizenship, Czech and Canadian nationality, and was born in Canada to Czech-speaking parents. She lived with her parents and younger sister in Canada until the age of five years. From two and a half to five years, she attended a kindergarten in Canada together with English-speaking children. Speech development in early and pre-school age did not have a typical course. According to her mother, Monika actively used three Czech words at the age of about two and a half – “*táta, dej, ahoj*” (dad, give, hello). She did not speak English at all, had communication problems in the kindergarten, cried and was disappointed with the fact that children and teachers did not understand her and that she did not understand them. She began to behave aggressively toward other children and her neighbourhood. This reactive behaviour did not recede and it was necessary to change the kindergarten (Mlčáková, 2011). In Canada, she underwent audiology examination at the age of three; at 4 years and 3 months age she was examined by a speech therapist, a psychologist and at the Centre for Autism Research with the conclusion: difficulties in comprehension (receptive language – understanding), production (expressive language – verbal skills), articulation, oral-motor skills and pragmatics; light sensory-neural hearing loss in both ears at high frequencies. As mentioned by Mlčáková (2011), the family lived for about one month in the Czech Republic when the girl was three years old; according to her mother, Monika's vocabulary increased significantly at that time. Two years later, the mother decided to move to the Czech Republic even with the second daughter because she felt that the Czech-speaking environment was more favourable for developing Monika's language skills than the language environment in Canada. The girl's father remained in Canada. Since the age of five years, Monika attended a speech therapy classroom at a kindergarten of conventional type. In addition to this speech therapy care, Monika alternated three more speech therapists during her preschool age. The mother always sought professional help, she wanted to know her daughter's diagnosis, she wanted to

help her daughter, but did not know how to develop her communication skills. More detailed history data is presented by Mlčáková (2015, 2013, 2011, 2010). Based on the recommendation of a speech therapist (author of this article), Monika attended a primary speech therapy school in the Czech Republic for the first three years of schooling. In the third year of the primary speech therapy school, conflicts began to emerge between Monika and her classmates; Monika did not have friends in the classroom. Nevertheless, she wanted to gain them enforcing their attention often by specific manners; consequently, complaints about Monika's behaviour on the part of the class teacher began to multiply. Monika, however, did not understand what she did wrong in her behaviour. According to her mother, Monika had difficulties in developing relationships with her peers because she did not develop "probing with peers" due to difficulties in understanding. As the mother stated, Monika learned from movies. For example, she liked the film *"Ať žijí duchové"* (Long Live Ghosts), and she learned from the film that children behaved to each other in a certain way. Monika did not understand some situations, did not understand some meanings in communication with peers, but felt "confused" even when communicating with teachers. Escalating misunderstanding between the mother and school led her mother to the decision to change the school and move. Due to persistent deficits in comprehension, the speech therapist suggested that Monika would repeat the third year in a common primary school with fewer children in the class, preferably in the country. The mother acceded to this opportunity and Monika repeated the third year in a primary school of ordinary type with very good results. Monika successfully completed the 3rd and 5th year at the common primary school in the country with success and recognition; she again wanted to learn and looked forward to school. The atmosphere of the school and the approach of school personnel toward Monika were very helpful and professional, and Monika felt happy. The school, however, did not have the second level. Therefore, Monika had to change the school for the 6th year. Due to persistent difficulties in reception and expression, Monika is educated through a teacher assistant and is reaching good school results so far. Monika prepares her homework with the help of her mother. The latter provides Monika with consistent and stable support; for example, she creates graphic schemes to the curriculum and often explains seemingly clear ideas in the texts. Currently, Monika has the greatest difficulty in understanding the meaning of adjectives (e.g. hostile, amazing) and subsequently in understanding the context. For Monika, it is difficult to learn English words where the Czech equivalents she does not understand even in her native Czech language, e.g. "amazing". According to her mother, Monika is yet unable to talk equally with peers, is not at their language level, and has difficulty in understanding everyday communication in colloquial language. On the other hand, the mother appreciates that Monika has the opportunity to be educated with children who have no language difficulties since she thus has a good chance to work

on herself and reduce her language shortcomings. *It is necessary to emphasize that the education of children with developmental dysphasia is challenging for all involved, especially for children themselves, due to deficits in language as well as non-language areas including deficits in cognitive functions.*

2 Terminology

Specific language impairment is reflected in the hindered ability or inability to learn to communicate verbally, although the conditions for the development of language (speech) are adequate (Dvořák, 2007, p. 53). According to Mikulajová (2012), it is a neurobiological developmental disorder of speech when children have impaired ability to understand speech and/or express themselves using speech in comparison to their peers.

According to Drnková (1991) the term of **laterality** (from the Latin *latus*, *lateris* = side) means right side (or preference) or left side (or preference). The specific manifestations of laterality are: laterality of the upper extremities, lower extremities laterality, eyes and ears. We find out by laterality tests which hand (foot, eye, ear) the client prefers or whether he is “skillfull” to both hands. Then we talk about the ambidexterity (A) – undefined laterality of the upper extremities. Zelinková (2015) pointed that laterality of the upper extremities stabilizes usually at the age of 10 to 11. Dvořák (2007, p. 109) defines laterality as follows: “asymmetry of the body according to the median plane; shape laterality concerns shape asymmetry, laterality functional (motor and sensory) concerns the half of the function of unpaired organ or the preferential use of one of paired organs (limb, eye, ear). Functional laterality of the upper extremities is expressed by dexterity quotient (DQ).

The ability of humans to produce sounds that are used to convey a message, the act of producing such sounds is identified as **articulation**, and this activity is a major component of speech as distinguished from the term language (Kent, 2013, s. 6). **Developmental phonological disorders** represent a group of language disorders that affect the ability of children (usually around 3 to 4 years of age) to mimic speech patterns of the words of adults; they affect the ability to learn and organize sounds into words. The children feature difficulties in auditory distinguishing and weakening of acoustic feedback; the problem occurs at linguistic level, it does not relate to the creation of sounds by speech organs (Dvořák, 2007).

The concept of **comprehension** (cf. Dvořák, 2007, p. 148; Hartl and Hartlová, 2010, p. 415) can be seen as the understanding of relationship, context, purpose, nature of the problem; as a method of cognition, comprehension is similar to intuition and achieved directly. In connection with the concept of comprehension, Dvořák (2007, p. 148, s. 150) refers to language disorders that represent difficulties in encoding or decoding of the language; language disorders include difficulties in

verbal communication, understanding, reading, writing, problem-solving; language disorders are divided according to processing language symbols into receptive and expressive. Receptive language disorders (RLD) are central auditory processing disorders; the understanding of words or sentences is impaired, the subjects have difficulty in understanding the meaning of words and phrases exposed to them, e.g. when asked to show a named object or image; manipulation according to instructions is more complicated, demandingness increases with the length of sentences, the variety of tasks, with using negatives, etc. An important prerequisite for understanding the language is physiological and clear speech (e.g. the pronunciation, fluency, prosody) of the examiner. Expressive language disorders (ELD) are reflected in difficulties with verbal expression, i.e. difficulties in compiling words to formulate thoughts, difficulties in finding words, naming objects, lack of appropriate vocabulary, difficulties in semantics, phonology, morphology, and syntax shortcomings. Průcha (2011) states that the qualitative aspect of the process of learning the meanings of words, i.e. learning words as semantic categories, are explained much less than the quantitative aspect of learning vocabulary by children. According to Lernerová and Johns (2012), children with difficulties in understanding the language can understand separate simple words, such as “*to sit*”, “*chair*”, “*to eat*” “*biscuit*”, but have difficulties in understanding the sentence in which these words are used, e.g. “*Sit in the chair only after eating the biscuit*”. According to Lorusso, Burigo, Borsa & Molteni (2015), linguistic **impairments** in children with SLI disrupt abstract **language** processing more than visual-motor **impairments** in nonverbal learning disabilities.

3 Research Objectives of the Case Study

- Monitor the development of laterality in the course of six years, i.e. since the age of 6 years 3 months to the age of 12 years 8 months.
- Investigate the development of articulation over a period of seven years, i.e. since the age of 5 years 10 months to the age of 12 years 8 months.
- Evaluate the development of speech comprehension over a period of three years, i.e. since the age of 10 years to the age of 12 years 8 months.

4 Research Methods

Regarding the research methods, we used the laterality test by Matějček and Žlab (1972), the actual examination of articulation of sounds and articulation examination focusing on the symptoms of developmental phonological disorders. Furthermore, we used a sentence comprehension subtest from the Heidelberg Language Development Test H-S-E-T (Grimmová, Schöler, Mikulajová, 1997). Speech examinations of the monitored area were carried out by the author of this article.

4.1 The Laterality Test by Matějček & Žlab (1972)

We re-examined the hand and eye preference for the girl by The test of laterality made by Matějček and Žlab (1972). We did not modify the test. We examined the laterality with the girl aged 6 years 3 months, 7 years 8 months, 9 years 0 months, 10 years 9 months and 12 years 8 months. We investigated the degree of laterality - the degree of preference of the upper extremities. We have calculated the degree of laterality using Dextrity Quotient (DQ):

P... right-handed responses

A... ambidextria responses (client used both hands or alternated them)

n... the sum of all exam tasks for the hands

The result of calculation DQ is a number that varies in the range from 0 to 100 (Table 1). To express the degree of laterality Matějček, Žlab (1972) use 5 levels:

Table 1: The degree of laterality

P	100–90	strict right hand preference
P-	89–75	less strict right hand preference
A	74–50	ambidexterity
L-	49–25	less strict left hand preference
L	24–0	strict left hand preference

Degree of preference of the upper extremities was assessed using 10 exam tasks for the upper extremities. We also investigated the type of laterality - the relationship between laterality of the upper extremities (P, P-, A, L-, L) and laterality of the eye (p, l, a). Eye laterality (p, l, a) was assessed using two tasks for the eyes. In children with developmental dysphasia occurs a higher percentage of children with ambidexterity (A) and with an undetermined type of laterality (A/p, A/l, A/a, P/a, L/a, P-/a and L-/a).

4.2 Assessment of Articulation and Phonological Disorder

Articulation evaluation included a sample of connected speech, production of sounds in spontaneous conversation. We try to observe correctly produced sounds as well as misarticulated phonemes in as „natural“ as possible speaking context. Also the articulation of all Czech phonemes (vowels, diphthongs and consonants) was assessed during repeating words with these phonemes in initial, medial and final position.

Consonants B, V, D, Z, Ž, Ď, G, H were assessed due to their nature only in initial and medial position. Within the examination of articulation of words in terms of phonology, we focused on the detection of developmental phonological disorders at the level of words.

4.3 Sentence Comprehension Test

Monika received a subtest from the Heidelberg Language Development Test H-S-E-T (Grimmová, Schöler, Mikulajová, 1997) called The Sentence Comprehension Test. This test detects the level of language abilities and is designed for children aged 4 to 9 years. Subtests, for example, are aimed at sentence comprehension, the ability to form plurals and singulars, repeating phrases, the ability to form derived words, the ability to form sentences and other language aspects. The examples of ten tasks from the **sentence comprehension** subtest (for children aged five years and older) are the following instructions: “*Little child washes the mum*”, “*A grass-hopper will jump before the dog runs*”. Grimmová, Schöler, Mikulajová (H-S-E-T Handbook 1997) indicate that children will resolve these tasks incorrectly if they insist solely on surface strategies and do not penetrate into the depth of meaning of sentences. Children’s reactions are evaluated as either correct or incorrect. Correct answers are evaluated by one point, incorrect by zero points.

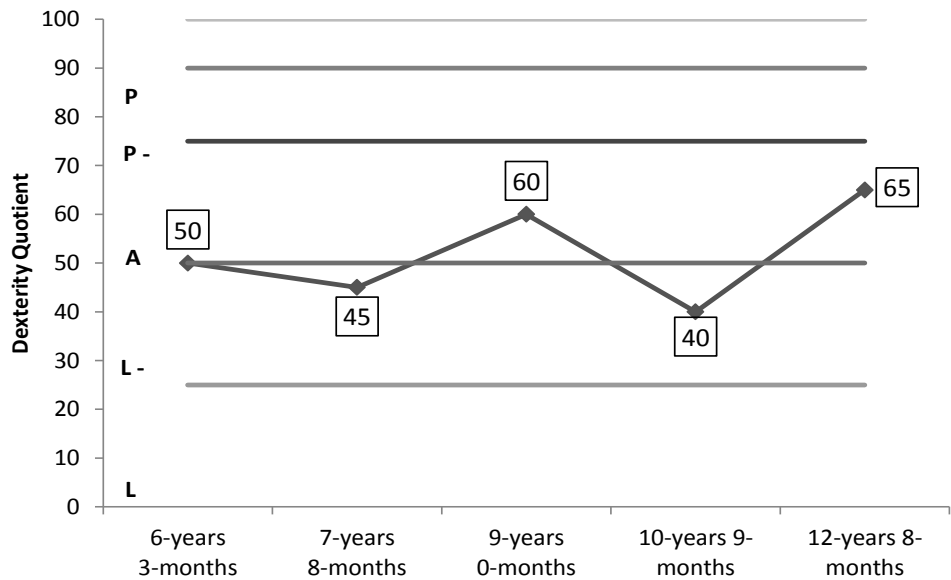
5 Results

As we can see from Table 2 and Figure 1, during five measurements we noticed a change in a girl hand preference, in **degree of laterality and in the type of laterality**. Interestingly, the girl writes and draws by the right hand at school. We recommend leaving the choice of the hand preference to the girl. The change in preference of eyes was not noticed. The girl preferred the left eye during all five measurements. Table 2 demonstrates that the first, the third and the fifth measurement found the type of laterality – undetermined laterality (A/l, ambidexterity of hand and left eye preference). At the second and the fourth measurement we observed a consistent left-sided laterality (L-/l, less strict left hand preference and left eye preference). At the third measurement we found undetermined laterality (A/l, ambidexterity of hand and left eye preference).

Table 2: Results of the test of laterality by Matějček, Žlab (1972)

	Age of the girl				
	6-years 3-months	7-years 8-months	9-years 0-months	10-years 9-months	12-years 8-months
Number of right-handed reactions P	3	2	5	2	4
Number of left-handed reactions L	3	3	3	4	1
Number of reactions rated as ambidextrous A	4	5	2	4	5
Dexterity Quotient $DQ = \frac{p + \frac{A}{2}}{n} \cdot 100$ $DQ = \frac{p + \frac{A}{2}}{n} \cdot 100$ $DQ = \frac{p + \frac{A}{2}}{n} \cdot 100$	50	45	60	40	65
Degree of laterality	A	L-	A	L-	A
Type of laterality (lateral- ity of upper extremities/ laterality of eyes)	A/l	L-/l	A/l	L-/l	A/l

Figure 1: Development of the degree of laterality



When examining **articulation** in April 2009 (at the age of 5 years 8 months), Monika showed mispronunciation of 15 sounds: U, B, D, L, Ř, SZC, ŠŽČ, ŤĎŇ and G. During speech therapy work with the girl, we managed to induce, fix and automate sounds U, B, D, L, Ř, ŠŽČ, ŤĎŇ and G in her spontaneous utterance. At age 12 years and 8 months, sound articulation disorder was still present. **Inconstant irregular pronunciation of SZC consonants** persisted. Failures were caused by irregularities of the teeth and jaws, which gained significance in some co-articulation connections. Correct pronunciation failed to be automated in some co-articulation connections. Phonological representation of words and articulation-motor program allow correct pronunciation of words, including polysyllabic words, words with consonant clusters, composed words, and words containing acoustic or articular similar sounds. Deficiencies in this area may be indicative of developmental phonological disorder at the level of words. In Monika, these problems occurred in spoken, written and read speech till the age of 12 years. In her production, it was possible to observe specific assimilations, transposition of syllables and sounds, elisions of consonant clusters and other changes in the phonetic structure of words. These problems in Monika were successfully corrected; at the age of 12 years and 8 months, the **developmental phonological disorder at the level of words is not present any longer**.

The results of the **sentence comprehension** subtest are given in Table 3. Monika, at the age of 10 years, successfully resolved 50%, i.e. 5 of 10 instructions from the sentence comprehension subtest. She processed 5 instructions incorrectly, failing to handle objects properly in accordance with the instructions. These instructions were as follows: *“The elephant, which is stroking the bunny, will jog the ass”*, *“The giraffe, which was caught by the hare, will bite the duck”*. She misunderstood instructions chronology expressed by the terms: *“before”*, *“after”*. At the age of 12 years and 8 months, Monika successfully resolved 80%, i.e. 8 out of 10 instructions. She processed 2 instructions incorrectly, failing to handle objects properly in accordance with the instructions. These instructions contained temporal relationships expressed by the terms: *“before”*, *“after”*.

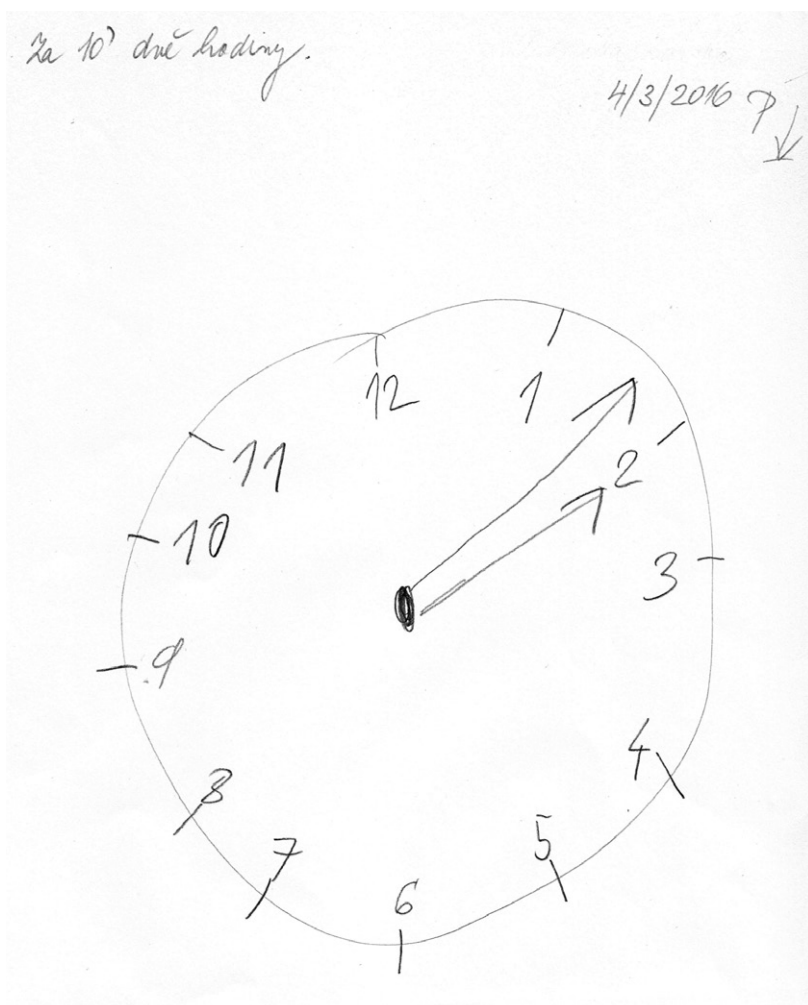
Table 3: Results in Sentence Comprehension Test

Age of the girl	Number of correct responses (n)	Relative number (in %)
10-years	5	50
12-years 8-months	8	80

According to Monika’s mother: “The concept of comprehension is very broad. For example, prefixes in words **“rozrušit”** (excite) and **“narušit”** (disturb) change

the meaning of words. Monika is oriented according to the common root of words and does not understand the literal meaning of the words. Prefixes in the words give Monika other information than we think. We assume that Monika understands the word, sentence and context, but it is not the case. Let's give an example in physics where Monika was to resolve the following task: What should we use to measure a pupils' book? She wondered and asked whether to write meter, millimeter, centimeter? She wrote millimeter.

Figure 1 shows how Monika, at the age of 12 years and 8 months, resolved the instruction: "Draw a clock, draw 10 minutes to two."



Picture 1: "Draw a clock. Draw 10 minutes to two".

Conclusion

During five measurements (age 6-years, 3-months; 7-years, 8-months; 9-years, 0-months; 10-years, 9-months; 12-years, 8-months) we noticed a change in a girl hand preference, in degree of laterality (A, L-, A, L-, A) and in the type of laterality (A/l, L-/l, A/l, L-/l and A/l). Interestingly, the girl writes and draws by the right hand, but the degree of laterality was never right hand preference. The girl preferred the left eye during all five measurements. During the period of 5 years and 8 months to 12 years and 8 months, we managed to adjust Monika's articulation of 12 sounds (U, B, D, L, Ř, ŠŽČ, ŤĎŇ and G). At the age of 12 years and 8 months, however, the sound articulation disorder was still present. Inconstant irregular pronunciation of SZC consonants persisted, mostly due to irregularities of the teeth and jaws. We succeeded in removing the developmental phonological disorder at the level of words, which is not present in her any more. We could notice improvement in the Sentence Comprehension Test, although deficits in receptive language – understanding were proved. Regarding speech comprehension, Monika showed improvements from the age of 10 years to 12 years and 8 months; however, deficiencies in the area of comprehension persisted and constituted a disadvantage in her education. Monika particularly struggled with temporal relationships expressed by the adverbs “before” and “after”, or abstract meanings of adjectives such as “amazing”. Ability to understand the content of the learning presented by the teacher in an ordinary way and with common speed of spoken speech may be endangered. Monika had the support of her family, yet had the motivation to learn and read encyclopaedias about horses; she would like to work with horses and her dream is to become the director of a riding school, horse trainer, assistant teacher, or a teacher in a primary school.

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