Chapter #13

SPEECH AND LANGUAGE SOFTWARE IN THE INTERVENTION OF ORAL MOTOR FUNCTIONS IN AUTISM SPECTRUM DISORDERS

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ABSTRACT
Aim and objectives: The research focused on the analysis of speech (oral) motor abilities of children with autism spectrum disorder (ASD) using the special speech and language therapy (SLT) software. The relations to dyspraxia, as well as the early educational correlations with the development of speech, and early speech vocalization including complex motor difficulties, are mentioned. The grounds stemmed from our wider focus on the assessment of pragmatic language level, since the ability of facial expression gestures represents one of the most important pragmatic, nonverbal communication activities. Methodology: We mapped the oral motor abilities of children with ASD in the initial and final stages of the examination, applying the software programme FONO 2, a multimedia programme intended for individuals with impaired communication ability. We used the observational numerical scale evaluation followed by comparison of the inter-stage differences within longitudinal observation. Conclusions: The results show that it is possible to achieve positive outcomes by applying a systematic SLT approach based on using the SLT software in the intervention focused on the development of the oral-motor activities in children with ASD. We put forward a discussion on the possible exploitation of the results for assessment in the sphere SLT intervention.

Keywords: autism spectrum disorder, oral motor praxis, speech and language therapy, assessment, technology, pragmatic communication.

1. INTRODUCTION

For diagnostic as well as therapeutic activities, modern speech and language therapy (SLT) use not only a variety of equipment but also technology comprising specifically designed software applications. The latter enables strengthening or even direct compensation of limited or deformed information coming from sensory-perceptual system, which, otherwise, results in insufficient feedback about an activity conducted by the person (Vitásková, 2013). Better feedback from the performed motor activities, including oral motor activities, is then ensured, above all, by means of visualization (or visual biofeedback). The substance of this influence is a reciprocal connection between the skills to recognize (gnosis) and the skills to carry out purposeful movements (praxis) or, at qualitative level, between perception and motor activity. Among the motor activities we can include those associated with speech production, non-verbal communication and co-verbal behavior. The non-verbal component of communication that is, for the most part, formed by facial expressions, gesticulation and prosody, is the very basis of pragmatic value of communication, i.e. for functional use of speech in every-day social contact. It forms the so-called communication competence that crucially determines understanding the contents of information conveyed by the surroundings of the speaker because it can complement, alter or even negate the formal component of the message (Vitásková & Říhová, 2013).

In addition and in relation to the education process, it is necessary to highlight that, according to Samfira, and Fārāgāu-Dragos (2014), the majority of school communication is conducted by means of non-verbal communication. Therefore we assume that it is necessary to regard the possible deviations, which can be primarily caused also by the differences in oral motor activities, as significant (with secondary consequences observed e.g. in facial expressions). They can cause false understanding of the communication behavior of a pupil whose form of spoken utterance can differ significantly from his/her communication intention or intended contents of the verbal utterance (see Vitásková & Lechta, 2014). This can, however, be caused by the inability, or limited ability, to produce or adequately flexibly and functionally adapt the pragmatic components of communication, based on disordered oral motor movements.

2. BACKGROUND

Oral motor skills and, consequently acquired and mastered motor skills, are the predictors of speech ontogenesis (individual development of speech) and, naturally, determine the development and quality of communication skills. Oral motor movements are enabled by the neuromuscular set up of the oral-facial system. They can be defined as motor gestures executed by one's jaw, lips and tongue. Autism spectrum disorders, within the context of oral motor movements, comprise many inhibiting factors, such as more frequent comorbidity with dyspraxia or apraxia, which represent reduced or totally absent skills to produce targeted, learned and accurate movements, which can be connected both with non-disturbed and, on the contrary, with a priori definitive gnosis (recognition) (Belmonte et al., 2013; Dewey, Cantell, Crawford, 2007; Mitchell et al., 2006; Winder, Wozniak, Parladé, & Iverson, 2013; Warreyn, & Roeyers, 2014.). Miller, Chukoskie, Zinni, Townsend, & Trauner (2014) suggest that the etiological ground of dyspraxia in ASD children relate to control and integration activities of the brain responsible for praxis executed by cerebellar and cortical mechanisms. The substance of the disturbance is also problematic imitation of movements or their performance based on exposed verbal instructions. According to Biscaldi et al. (2014) the imitation deficits are cognitively based, and the most disturbed activities in ASD are significant in timed motor performance and the quality of the movement. As autism spectrum disorders are, a priori, disorders of communication, we consider a speech and language therapist (SLT) as a key member of an interdisciplinary or transdisciplinary team interested in the diagnosis and complex intervention of persons with ASD (more, e.g. Vitásková & Říhová, 2012; 2014). The objective of this chapter is to draw attention to the possibilities of application of a special speech-therapeutic software program utilized originally for different types of diagnoses associated with communication disorders, in speech-therapeutic diagnosis determination and in the intervention of individuals with autism spectrum disorder.

3. OBJECTIVES, RESEARCH DESIGN AND METHODOLOGY

The principal objective of the research investigation was to analyze the oral motor skills in selected persons with autism spectrum disorder, divided into the following two partial goals:

- To assess oral motor skills in children with ASD in the initial and final phases of the investigation by means of the software programme FONO 2, unit Warm-up, and by the created evaluation numerical scale.
- To compare the differences in the results between the initial phase of the oral motor

activities in children with ASD and the respective final conditions.

The principal, as well as the partial objectives, were shaped as three major research questions:

- What is the condition of the oral motor skills in children with ASD in the initial phase of the investigation?
- What is the condition of the oral motor skills in children with ASD in the final phase of the investigation?
- Are there differences in the oral motor skills evaluation in the initial and final phases of the investigation?

The fundamental research tool was the speech-therapeutic multimedia programme software FONO 2, which was originally designed for the diagnosis and therapy of people with disturbed communication skills. It comprises 5 basic types of exercises – sections Warm-up, Associations, Phonemic hearing, Reading and repeating dactyl signs (Čo je Fono, 2014). For the purposes of this part of the research we focused on oral motor skills in the monitored people with ASD, we selected a team called Warm-up with 37 activities. For the research activities, we selected 13 tasks and adjusted the recommended utilization of the programme. Our selection included the following isolated and sequential oral motor, or oral-facial, activities: 1. Smile but do not show your teeth. 2. Smile and show your teeth. 3. Pout your lips. 4. Bite your lower lip. 5. Bite your upper lip. 6. Open and close your mouth. 7. Move your jaw left and right. 8. Chomp. 9. Whistle. 10. Try to imitate chewing. 11. Blow into your cheeks and do puuuu… 12. Stick out your tongue between upper and lower teeth, keep it straight and stretch at the tip. 13. Touch the middle of your upper lip with your tongue. The personal motor activity of a person is accompanied and supported by the programme by presenting a visual model (a face performing the required movement appears on the screen), which provides the person with ASD visual facilitation of the movement imitation. The sample oral motor gesture is accompanied with verbal instruction (recorded human voice specifying the movement) and the final option, very important in our opinion, comprising visual feedback in the form of the performed motor activity of the person visually compared with the example demonstration (on the right part of the screen). It is also possible to record the movement for more detailed analysis. The main method applied was longitudinal extrospective monitoring conducted in the period of 4 months. The monitored areas were determined and the evaluation items, accompanied by graphical visualization produced by the applied software, were conceived. The evaluation scale was divided into three main areas shown in Table 1.

Table 1. Evaluation scale for assessment of oral motor movements within the programme "Warm-up" for persons with ASD.

Initiation of the activity	Assistance	Accuracy of performance of the given exercise
0 – does not initiate the activity	0 – requires full assistance in performing the activity	0 – performs the exercise completely wrong
1 – initiates the activity following our assistance	1 – requires partial assistance in performing the activity	1 – performs the exercise wrongly but after our correction, he/she is able to perform the exercise correctly, at least partially
2 – initiates the activity after verbal request	2 – does not require any assistance in performing the activity	2 – performs the exercise wrongly but after our correction, he/she is able to perform the exercise completely and correctly
3 – initiates the activity himself/herself		3 – performs the exercise completely and correctly

In the successive steps, we conducted evaluation of the initial and final phases of the SLT, using the above-mentioned software in three persons with ASD at infant or adolescent age. The SLT had to be, in order to maintain the principles of beneficence (see Vitásková, 2013), interlinked also with further complex development of the persons with ASD.

4. RESULTS

For the purpose of this chapter, we present an example of the changing oral motor conditions in a girl M. and a boy P. Within the time span of 4 months, 11 speech therapies were conducted applying the above-stated unit "Warm-up" of the FONO 2 program. Other areas of focus of the SLT included gross and fine motor skills, comprehension, active and passive vocabulary and the practice of social situations comprising non-verbal communication. The visualization of the oral motor movements were accompanied by an analysis and ended with comparing the monitored areas within the given time span. We observed whether there are, in the monitored activities and within the given time span, positive or negative changes or stagnation. We also focused on tasks that showed significant positive changes as well as on tasks that were more demanding and challenging.

The comparison of M. is described in Table 2. At the time of investigation, M. was 6 years old, diagnosed with atypical autism with mild intellectual disability (according to ICD 10., WHO).

Table 2. Evaluated areas of the monitored activities and corresponding numeric scales with results in girl M.

	Activity	Initiation	Assistance	Accuracy		Activity	Assistance	Accuracy	Initiation
Initial evaluation	1	2	1	2	Final evaluation	1	2	2	1
	2	2	1	2		2	2	2	3
	3	1	1	1		3	2	1	2
	4	2	1	2		4	2	2	2
	5	2	1	2		5	3	2	3
	6	2	2	1		6	3	1	2
	7	0	0	1		7	1	0	2
	8	3	2	2		8	3	2	2
	9	0	0	0		9	1	1	1
	10	2	2	2		10	3	2	2
	11	0	0	1		11	1	0	1
	12	0	0	0		12	0	0	0
	13	0	0	0		13	1	1	1
	Stagnation				Σ	N= 16 (41.03 %) [I=4, D=6, S=6]			
	Positive change					N= 21 (53.85 %) [I=8, D=6, S=7]			
	Negative change					N= 2 (5.13 %) [I=1, D=1, S=0]			

From the results presented in Table 2, it follows that positive changes occurred in 21 monitored activities within 13 given tasks. The working majority of tasks (53.58 %) showed a positive change in the field of initialization (N=8), assistance (N=6) as well as accuracy of the performed motor task (N=7). In all instances, this was a shift upwards by one evaluating scale – e.g. in activities No. 3 "Pout your lips", activity No. 5 "Bite your upper lip" and activity No. 10 "Try to imitate chewing". Further, also in the field of assistance with the given activity in activity No. 1 "Smile but do not show your teeth", activity No. 4 "Bite your lower lip" and activity No. 9 "Whistle". Positive changes were

also apparent in the accuracy of performing individual activities, e.g. task No. 2 “Smile and show your teeth”, No. 6 “Open and close your mouth” and task No. 13 “Touch the middle of your upper lip with your tongue”. Less frequent in the evaluation result, implying stagnation of the skills, with 41.03 % (N=16) included activities such as initiating activities No. 2, 4 and 12, assistance in activities No. 3, 7 and 8, and performance accuracy in activities No. 1, 8 and 10; we did not record in the final evaluation any positive changes when compared with the initiation phase of the evaluation. Negative changes acquired the lowest percentage 5.13 % (N=2) in terms of quality of evaluated activities, which was recorded in two instances - activity No. 1 “Smile but do not show your teeth” in its initialization and activity No. 6 “Open and close your mouth” in its assistance (2→1).

The second person who underwent the analysis of oral motor skills is a boy P. At the time of the research examination, he was 6 years old and diagnosed with atypical autism with attention disorder and hyperactivity (according to ICF 10., WHO). As is obvious from Table 3, all evaluating scale values are present for P. – value No. 0 up to value No. 3. The lowest evaluating category (value 0), which represents severe difficulties in initialization and execution of a given activity and which, at the same time, requires a higher rate of support, occurs 12 times. In combination with other evaluating values (prevailingly with value 1), value 0 is present, e.g., in activity No. 1 “Smile but do not show your teeth”, activity No. 3 “Pout your lips”, activity No. 4 “Bite your lower lip”, as well as in activity No. 7 “Move your jaw left and right”, activity No. 9 “Whistle”, activity No. 11 “Blow your cheeks and blow out with “phuuuu” and activity No. 12 “Stick out your tongue between the lower and upper teeth, hold it straight and stretch the tip of the tongue“. Value No. 0 is detected both in the category of initialization, and support and accuracy of execution of the given activity. The highest frequency is with value No. 1, which also represents problems in initialization (initialization only after our support), partial facilitation with execution of the activity and the ability of partial execution which is, however, preceded by significant correction. This evaluating value occurs fifteen times, most often (twice) in activity No. 2 “Smile and show your teeth”, activity No. 5 “Bite your upper lip” activity No. 7 “Move your jaw left and right” and activity No. 13 “Touch the middle of the upper lip with your tongue”.

Table 3. Comparison of the observed oral motor activities in person P.

	Activity	Initiation	Support	Accuracy		Activity	Initiation	Support	Accuracy
Initial evaluation	1	0	0	2	Final evaluation	1	1	1	2
	2	1	1	2		2	1	2	3
	3	0	1	2		3	0	1	3
	4	0	0	1		4	1	2	1
	5	1	2	1		5	1	2	2
	6	3	2	1		6	2	2	3
	7	1	0	1		7	1	1	2
	8	3	2	3		8	3	1	2
	9	1	0	0		9	2	1	2
	10	2	1	2		10	2	2	3
	11	0	0	1		11	1	0	1
	12	0	0	1		12	0	0	1
	13	1	1	2		13	0	1	2
	Stagnation				Σ	N= 18 (46.15 %) [I=7, D=6, S=5]			
	Positive outcome					N= 17 (43.59 %) [I=4, D=6, S=7]			
	Negative outcome					N= 4 (10.26 %) [I=2, D=1, S=1]			

The representation is 17 areas (43.59 %) in the stage of initialization (N=4), support (N=6) as well as accuracy of the execution of the given activity (N=7). Positive changes refer, in three instances, to increase by two evaluating scales; in other instances by one evaluating scale. Significant changes, as stated right now, are practically touching the activities No. 4 "Bite your lower lip" (support 0→2), activity No. 6 "Open and close your mouth" (accuracy 1→3) and activity No. 9 "Whistle" (accuracy 0→2). We can, therefore, state that we have recorded the most positive changes in these activities during the speech-therapeutic intervention.

As it is evident from Table 3, even the category of negative balance is not missing in P. – i.e. regression in the final evaluation compared with the initial evaluation. Such results were recorded in 10.26 % (N=4) and present in all three monitored areas – initialization (N=2), support (N=1) and accuracy in the execution (N=1). This relates to activity No. 6 "Open and close your mouth" (initialization 3→2), activity No. 13 "Touch the middle of the upper lip with your tongue" (initialization 1→0), activity No. 8 "Click one's tongues" (support 2→1) and also activity No. 8 "Click one's tongue" (accuracy 3→2). It is then obvious that activity No. 8 showed negative decrease in two partial activities.

5. FUTURE RESEARCH DIRECTIONS

The research investigation is, naturally, also limited and influenced by factors determining the course of the investigation. These are, above all, momentary physical and mental conditions of the child, and the impact of external environment (such as noise, heat or, on the contrary, cold). With respect to the importance placed on the diagnosis and significant deficiencies not only in communication skills, the 4-month duration of the research investigation cannot be considered as sufficient for obtaining key results and, above all, to speak about the authenticity of the positive results. Despite the mentioned circumstances and limitations, we attempted to create suitable conditions for materializing the given investigation.

Further monitoring shall be oriented on the application of the acquired findings on oro-facial sensitivity on the one hand and in the diagnosis of pragmatic aspects in communication in relation to facial expressions on the other. We believe that one of the neglected areas that should be involved in the diagnosis of pragmatic communication skills of persons with ASD is the area of oral motor skill. The influence of oral motor skills in children with ASD on the quality of their production and perception of pragmatic representatives of communication should be examined from a specific SLT point of view, which is able to synthesize both contextual as well as the formal aspects of speech (compare Vitásková & Říhová, 2012). The resulting findings will serve SLT diagnosis and intervention in persons with ASD more effectively and also may increase the quality of the education process that is, for the most part, conducted, evaluated and controlled by means of communication processes.

6. CONCLUSION AND DISCUSSION

From the comparative results above it can be inferred that the conducted intervention targeted at the development of oral motor activities resulted in positive outcomes, which is especially reflected in the prevalence of positive results (53.85 %) over the negative (5.13 %) in M. This finding is in relative compliance with the Biscaldi et al. (2014) results confirming improvement of some of the motor, including facial (oral) motor, performance in ASD.

The presented results must be perceived as very encouraging, especially concerning activities involving sequence of movements. This is plausible especially in terms of the activities "Smile but do not show your teeth" and "Touch the middle of your upper lip with your tongue". The execution of such activities, in their entirety, is rather difficult and in persons with ASD this aspect should even be more pronounced as they have difficulties with serializing and sequencing. The value representing stagnation of the child's skills (41.03 %) also showed significant frequency, which indicates that the results are not fully positive in such a relatively short span.

In the second comparison, in case of P, we can state that a dominant position in the evaluation was occupied by stagnation of the evaluated categories. On the other hand, this category is quantitatively close to the second category representing positive balance. The difference is only 2.56 %, which can be perceived as almost irrelevant. We also recorded negative balance, which is represented by 10.26 % and this also cannot be taken as insignificant. It is, however, necessary to take into account the possible factors (immediate physical or mental conditions of the child, the environment, etc.) affecting the entire examination that can, to a certain extent, influence the evaluation.

In conclusion, we can state that according to the oral motor skills analysis carried out on a person with ASD by means of the speech-therapeutic software program FONO 2, its partial section Warm-up and our own evaluating scale, it is obvious to state the possibility of, through systematic SLT intervention focused on the development of mobility in the oral facial area, achieving positive results. It is, logically, not possible to generalize these results. That is why it would be suitable to carry out further, more detailed and longitudinal investigation in this field.

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