PHONOLOGICAL PROCESSES IN FIRST AND SECOND LANGUAGE IN AN ADOLESCENT MODERATE-FUNCTIONING AUSTICTIC INDIVIDUAL

Karolina Grzeszkowiak & Monika Połczyńska

Adam Mickiewicz University, Poland
karolina.grzeszkowiak@gmail.com; plmonik@ifa.amu.edu.pl

ABSTRACT

Autism may lead to distorted speech production. Studies on clinical populations investigating phonological processes in first (L1) and second (L2) language indicate that a higher number of processes is applied in L2 because L2 is a more difficult linguistic context. We investigated phonological processes in a Polish speaking adolescent with moderate-functioning autism who had intermediate proficiency level in English. The subject performed L1 and L2 clinical speech tests. The recordings were transcribed phonetically and analyzed acoustically with *Praat*. We found that in a spontaneous speech task, there were significantly more processes in L1 (14 processes per 100 phonemes) than in L2 (0,88 processes per 100 phonemes). More errors in L1 speech might have been caused by a faster speech tempo and longer phoneme sequences that resulted in a decreased articulatory precision. Our study indicates that faster speech rate might be associated with more speech errors in moderate-functioning autism.

Keywords: autism, speech production, phonological processes, speech rate

1. INTRODUCTION

Autism is a neurodevelopmental disorder which typically influences a person's social development and communication skills [17]. Impaired language function is common among autistic individuals [2]. Even though some children with autism develop language skills, they are usually applied one-sidedly, are not reciprocal, and are used as an instrument and not as a means of social communication [3, 13]. Some autistic individuals suffer from impaired phonological processing [5].

According to Natural Phonology (e.g., [14]) and Phonology as Human Behavior (e.g., [16]) there are three types of phonological processes: (1) substitutions (e.g., gliding), (2) assimilations (e.g., prevocalic voicing), and (3) changes in syllable structure (e.g., unstressed vowel deletion). Substitutions and assimilations have stronger communicative force and changes in syllable structure have weak communicative force, i.e., are more radical [10, 16].

Studies on various clinical populations show that application of phonological processes in first (L1) and second (L2) language may differ in individuals with lower L2 proficiency. For example, dysarthric individuals with severe traumatic brain injury employ significantly more processes in L2 than in L1. The processes are also more radical in L2 [6, 10]. One plausible explanation might be that L2 is a more difficult and less exercized linguistic context [10]. L1 speech production is more automatic in nature, whereas in L2 the speaker needs to pay more attention to all language components, including lexical search, or proper grammar [7]. This was evidenced in a neuroimaging study by Halsband [4] in which motor patterns of L1 phoneme sequences were shown to be more automatic and overlearnt, i.e., easier to produce. In clinical populations this extra cognitive load may result in a higher number of processes as well as more radical processes in production of L2 phoneme sequences [10].

According to our knowledge, the majority of studies investigating speech production in autism have been conducted on older and/or high functioning individuals [8]. Also, application of phonological processes by autistic individuals appears underresearched. One of the few studies [18] investigated four autistic siblings. The youngest child was two years old and the oldest was nine. The authors found that the most frequent processes applied by the children were spirantization of stops, velarization, consonant deletion, consonant cluster reduction and deaffrication.

This paper aims to analyze phonological processes in L1 (Polish) and L2 (English) speech

production of an adolescent autistic female individual with moderate L2 proficiency. Based on results from the previous studies on clinical populations with lower L2 proficiency levels, we hypothesize that there will be more phonological processes in L2 than in L1 and that the processes in L2 will be more radical.

2. METHODS

2.1. The subject

Our subject was a 16-year-old, moderate-functioning autistic female, KD, whose L1 was Polish and L2 was English. KD always experienced difficulties in physiological and psychological development. She exhibited problems with articulating particular words, mimicking and gesturing, which resulted in limited interpersonal contacts. To communicate KD used simple words and gestures and had problems understanding questions and instructions. In the recent years, her language skills improved to a certain degree. She spoke grammatically, with only minor mistakes. However, her ability to classify ideas, apply metaphors, comparisons and to verbalize thoughts was still impaired. Her articulation was rather intelligible, yet phonemes appeared blurred when KD talked about her interests.

2.2. Procedure

The recordings were made during two one-hour-meetings. KD performed the *Polish Dysarthria Test* [12]. For assessment of L2 we chose the *English as the Second Language Test in Dysarthria* [9]. The tests comprise a range of tasks that include, e.g., repetitions of single phonemes, words, and short sentences, reading, and spontaneous speech. Both the tests have been used in clinical studies comparing and contrasting phonological processes in L1 and L2 (e.g., [6, 9]).

We assessed KD's L2 proficiency level with the *Clinical Test of Language Proficiency in English as the Second Language* [11]. The test evaluates major L2 components: lexicon, grammar (including syntax), pronunciation and comprehension. It consists of 20 questions that increase in complexity as the test progresses.

The recordings were made and analyzed with *Praat* [1]. Acoustic analysis was carried out in order to maximize the precision of phonetic transcription of KD's speech. Since phonological processes were observed only in more complex tasks – reading and spontaneous speech – we analyzed 400 phonemes in L1 and L2 reading and 800 phonemes in L1 and L2 spontaneous speech. We measured how many types of processes occurred in each language. We analyzed the total number of occurrences of all phonological processes in L1 and L2. Here we also applied a measure of an average number of processes applied per 100 phonemes (x/100phs). Next, we analyzed frequency of occurrence of each phonological process (x%) in relation to the total number of processes applied in each language (100%).

We measured L1 and L2 speech rate in spontaneous speech and we calculated speech versus silence ratio. By silence, we understood pauses, breathing, hesitations and other non/para-linguistic signals. Within the speech signal, we analyzed the average number of syllables per second, and average duration of an uninterrupted articulation (produced without pauses lasting more than 0,4 seconds).

3. RESULTS

According to the *Clinical Test of Language Proficiency in English as the Second Language* [12], KD had intermediate L2 proficiency: she scored 56 out 80 points.

KD applied phonological processes only in reading and spontaneous speech (i.e., no processes were found in the repetition tasks). The subject was fluent in both the tasks, with no instances of phoneme or phrase repetitions common in autism.

3.1. Spontaneous speech

We found that the speech-silence ratio was 69,06-30,94% in L1 and 43,2-56,8% in L2.

KD produced 0,18 syllables per sec. in L1 and 0,33 syllables per sec. in L2. The average duration of an uninterrupted articulation was 1,4 sec. in L1 and 1 sec. in L2. The longest uninterrupted sequence of articulation was 5,76 sec. in L1 and 2,5 sec. in L2.

In the 800 phonemes analyzed in each language, KD applied 13 types of processes in L1 and five in L2. In L1, the subject employed 112 processes with the average of 14/100phs. Vowel centralizations constituted 73,3% of all the processes applied (81 vowel centralizations in total). Other frequent processes were: denasalization (5,4%), consonant deletion (4,46%) and gliding (3,57%). The majority of phonological processes were applied in word medial position (see Table 1).

Table 1: Phonological processes in L1 and L2 spontaneous speech (per 800 phonemes). S: substitutions, A: assimilations, U: underarticulations, C: changes in syllable structure.

	TYPE	INI-TIAL	MED-IAL	FIN-AL	TO-TAL
L1 – POLISH					
S	Gliding		4		4
	Denasalization		5	1	6
	Spirantization of stops		1		1
	Vowel lowering		2		2
	Sibilant imprecision		3		3
A	Devoicing	1	1		2
U	Vowel centralization	2	59	20	81
C	Consonant deletion		2	3	5
	Unstressed syll. deletion		1	1	2
	Cons. cluster reduction		1		1
	Unstressed vow. deletion			2	2
	Consonant epenthesis		2		2
	Vowel epenthesis		1		1
	total	**3**	**82**	**27**	**112**
L2 – ENGLISH					
S	Gliding			1	1
	Denasalization		1		1
A	Devoicing	1			1
C	Consonant deletion			3	3
	Unstressed syll. deletion			1	1
	total	**1**	**1**	**5**	**7**

In L2, the subject employed only seven processes (0,88/100phs). There were two substitutions, one assimilation and four syllable structure changes. KD employed five subtypes of processes, among which consonant deletion occurred three times and the remaining processes occurred only once each. The majority of the processes were applied in word final position (see Table 1).

3.2. Reading

In the reading task, in the 400 phonemes analyzed in each language, KD applied 10 types of processes in L1 and five in L2. In L1 the subject employed the total of 51 processes (12,75/100phs). Similarly to the spontaneous speech task, the most prevailing process was vowel centralization (49% of all the processes applied), followed by devoicing (13,7%) and vowel fronting (11,8%). The majority of processes in L1 were again applied in word medial position.

In L2, the number of phonological processes was considerably smaller. The subject applied only 12 processes per 400 phonemes (3/100phs), among which 58,3% were consonant deletions. We found 83,3% processes in word final position (see Table 2).

Table 2: Phonological processes in L1 and L2 reading task (per 400 phonemes).

	TYPE	INI-TIAL	MED-IAL	FIN-AL	TOT-AL
L1 – POLISH					
S	Vowel fronting	1	5		6
	Sibilant imprecision		1		1
	Consonant devoicing		7		7
C	Consonant deletion		2	1	3
	Cons. cluster reduction		1		1
	Unstressed vow. deletion		1	3	4
	Consonant epenthesis	1			1
	Vowel epenthesis		1		1
U	ICC		2		2
	Vowel centralization	2	14	9	25
	total	**4**	**34**	**13**	**51**
L2 – ENGLISH					
S	Spirantization of stops		1		1
C	Consonant deletion			7	7
	Unstressed vow. deletion	1			1
	Consonant epenthesis			2	2
	Vowel epenthesis			1	1
	total	**1**	**1**	**10**	**12**

4. DISCUSSION

Our autistic subject applied significantly more processes in L1 than in L2. Thus, our hypothesis was not confirmed. This finding is also contrary to the previous studies. Połczyńska [10] showed that dysarthric TBI patients with moderate L2 proficiency applied 40% more types of processes in L2 than in L1. Moreover, processes found in L2 were more radical. Similarly, Marecka and Połczyńska [6], who investigated a group of individuals with sensorineural hearing loss, also found that more phonological processes were employed in L2 than in L1. As mentioned, for less proficient users L2 is a more demanding linguistic context [7, 10]. What may have caused this unexpected result was faster speech tempo and longer uninterrupted duration of articulation in L1. Syllable duration in L1 was shorter and the mean duration of uninterrupted articulation was 28,6% longer. More rapid phoneme production in longer articulatory chunks might have caused more phonological processes, therefore, L1 speech was less intelligible. At the same time, this result applied only to L1 reading and spontaneous speech. In the remaining tasks (e.g., repetition), KD did not employ any processes both in her L1 and L2. This might indicate that (1) more complex tasks required extra cognitive load and resulted in more processes in general, (2) slower articulation in L2 minimized the number of phonological

processes applied, thus overriding the aspect of L2 being a more difficult linguistic context.

The most frequent process applied by KD was vowel centralization. This process constituted nearly three-fourth of all the phonological processes employed by the subject in spontaneous speech, and a half of all the processes in the reading task. Previous studies investigating phonological processes in the autistic population (e.g., [18]) do not report vowel centralization as a frequent speech production error. This may stem from the fact that Polish does not allow for vowel reduction. Hence, vowel centralization in adolescents/adults occurs only in clinical speech.

The majority of phonological processes were applied in word-medial position in L1 and word-final position in L2. Both positions have a considerably weaker communicative force than word initial position [16]. Previous studies on clinical populations also showed that the number of processes word-initially is the lowest (e.g., [10]).

To conclude, our study showed that autistic deficits may lead to distorted speech production. Although L1 articulatory patterns are easier to produce, our subject applied more phonological processes in L1 than in L2 in the spontaneous speech and reading tasks. This might have been caused by the fact that the subject had a faster speech tempo and longer phoneme sequences in L1, which resulted in a decreased articulatory precision. Our study indicates that faster speech rate might be associated with more speech errors in moderate-functioning autism.

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