

Research Article

Effectiveness of Morphosyntactic Treatment on Production in two Children with Hearing Impairment Older than 3 Years

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Abstract

Background: Because hearing loss can lead to linguistic and especially morphosyntactic delay, creating a method for fostering and facilitating morphosyntactic development seems rational. So auditory based (Sayeh Tahbaz Hoseynzadeh) STH-method has been designed. The aim of this article is studying effectiveness of this treatment.

Materials and methods: Two hearing impaired children which used hearing aids, with moderately-severe and severe hearing loss and older than 3 years of age at the time of study, enrolled in STH-method for 24 weeks. Persian Developmental Sentence Scoring (PDSS) was used for analyzing language samples together with some formal and informal assessments which were performed with 12 weeks intervals.

Results: According to PDSS which was used for analyzing spontaneous language samples, score of participant1 changed from 0 to 10.6 and participant2 improved from 5 to 7.4 at final assessment.

Conclusion: The findings showed that STH-method helped to improve morphosyntactic skills of participants.

Keywords: Developmental language disorders, hearing impairment, morphosyntax, (Sayeh Tahbaz Hoseynzadeh) STH-method, Persian language.

1. Introduction

Hearing loss (HL) has negative effects on linguistic and specially morphosyntactic (MS) development (1-15). Also accelerating language development after some delays occurred is more difficult (7), and neuroplasticity of central auditory system decreases gradually (16). So immediate diagnosing and enrolling hearing impaired children (HIC) in suitable auditory/linguistic intervention is crucial.

There are several methods for teaching HIC which some emphasize on verbal communication and others incorporate signs (17). So HL can lead to linguistic problems which probably necessitate linguistic intervention. Fey & Proctor-Williams (2000) summarized some grammar facilitation methods (18). Although good amplification and rich environment are necessary for linguistic development, sometimes linguistic intervention is inevitable specially in challenging conditions e.g. little parent participation (19-21, 4, 12), limited residual hearing (RH) (5, 15, 19) and additional disabilities.

In fact, challenging issues necessitate more systematic intervention. Because HL affects linguistic, cognitive and communicative development, rapid improvement of basic linguistic skills could help therapists cover more aspects of development. Therefore, we created auditory-based STH-method (22, 23) which concentrates primarily on MS development.

Our aim was documentation of MS progress of 2 congenital HIC, older than 3 years at the beginning.

2. Case Description

Participants

Participants were 1 boy and 1 girl with congenital prelingual HL that hadn't additional disorders and were in monolingual Persian environment. Both were enrolled in Newsha Knowledge-Based Foundation (NKF). At first, participant 1 (P1) was 3 years 4 months and participant 2 (P2) 4 years 1 month and had received suitable bilateral amplification. Linguistic, audiologic and cognitive assessments were undertaken in NKF, where children received intervention.

Assessment procedure

Assessments included some formal/informal assessments that examiner performed only through listening in quiet room in 2 sessions and videotaped it. COVID-19 compelled examiner to use 2 multilayer face mask (24), ventilator and open the window which decreased signal-to-noise ratio. Examiner also completed questionnaires of Newsha Developmental Scale (NDS) (25) through parent interviewing and parents completed 1000 words checklist (26) which included receptive and expressive vocabulary. After complete assessment, participants were enrolled in 24 weeks treatment and assessments were repeated at 12 weeks intervals.

Cognitive assessment

Cognitive evaluation were undertaken initially using an informal checklist by the occupational therapist at NKF that included visual processing (attention, memory), problem solving, drawing and copying skills (27). Evaluation showed that none of children had cognitive problem in evaluated fields.

1. Audiological assessment

Audiometry was undertaken to be sure of children's aided/unaided thresholds before assessment. Speech recognition abilities were assessed using Speech Discrimination Score (SDS) that included 50 recorded monosyllabic words at children's mcl (28).

2. Language assessment

2-1: Receptive language (RL)

Comprehension of 1000 words checklist (26) was completed by mothers during a week.

An informal situation (consistent with STH-situations) was used for examining comprehension of "Wh" questions and linguistic abilities. Correct Response (CR), which was extracted from situation evaluated understanding questions and answering. Criterion for correct response was using target in isolation or context.

RL was assessed by The NDS (25) which is for 0-72 months.

Syntax Comprehension test (SCT) (29) was used which measures syntactic structures comprehension in 4-6 years, so wasn't suitable for P1. But it was used because of limited formal Persian test in this age.

2-2: Expressive language (EL)

Mothers completed expression of 1000 words checklist (26).

Complete Linguistic Structure (CLS):that examined correct answer formulation as complete utterance, and formulation of utterances Using Correct Verb (UCV) which related to question tracking and response formulation using suitable verb with correct tense and inflection, were extracted from situation. If a response included the target structure in correct utterance/sentence, CLS is correct (CLS=1). Only correct CR responses, evaluated for UCV and if correct verb is used according to question, UCV is correct (UCV=1).

Story retelling (Three goats), photographic story telling (serial picture story) and spontaneously talking about one topic(park and party) were evaluated. Utterance in our study included one sentence or unit with independent meaning which separated from next unit by pause (30). Total number of utterances including verb was extracted. Also mean length of 5 longest utterances (MLU) in morphemes (m) and words (w) were calculated. Also these utterances were analyzed according to PDSS (31). PDSS is an evaluation tool for syntactic development in 30-66 months. Because of limited spontaneous language, we selected 5 longest utterances from each sample.

EL was assessed using expressive domain of NDS.

Also we used the Photographic Expressive Persian Grammar Test (PEPGT) (32) that is for Persian 4-6 years, for assessment of expressive MS characteristics. Although P1 wasn't in its age range, we used it because of limitation.

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Finally, results of STH-situation were rated by two examiners and inter-rater reliability was calculated.

Treatment procedure

Following assessment, participants enrolled in intervention that included weekly 30 minutes assessment session (AS) and 60 minutes treatment sessions (TS). In ASs therapist evaluated previous and determined new targets. In TSs targets were practiced systematically. Moreover, ½ sessions devoted to speech treatment.

P1 in first 12 weeks had 1 AS and 1 TS weekly. But because ½ sessions presented online and parent was concerned, after week 12th sessions duplicated. He totally had 39 AS and 34 TS .

He also had 45 minutes session weekly that some group session (GS) materials were practiced individually.

But P2, because of poorer prognosis, had 2 ASs and 2 TSs weekly. So P2 totally had 49 AS and 46 TS.

STH-method

STH-method is a systematic step by step procedure for fostering MS development for both challenging and ready-to-learn children. It contains 3 parts: a) direct practice (DP), b) generalization, and c) STH-situations that intermediate between other parts. Therefore, this method supports MS development since eliciting each skill until its generalization to various linguistic contexts (question-answer).

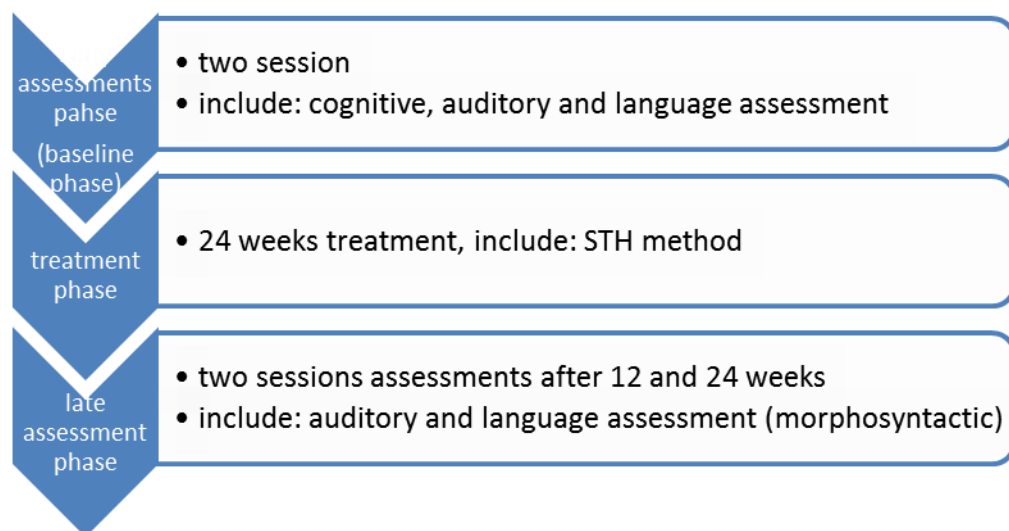
In DP we try to 1) elicit a target in one utterance, 2) stabilize it, 3)improve utterance formulation by several words, 4)accelerate utterance formulation, 5)use utterances quickly as answers to various questions. In first 3 items, if necessary, we use simpler subskills, prerequisites, cues or utterance segmentation to simplify target.

In STH-situations, we put practiced MS targets in meaningful situation as question-answer and primarily use cues and utterance segmentation if necessary.

During generalization, children use learned rules in response to questions in several contexts rapidly.

Some features of STH-method include: 1) natural development and child's readiness determined MS goals, 2) several goals are treated simultaneously. In DP sessions some goals are at elicitation and others at question-answer level. 3) for elicitation, shaping and memorizing one skill, tasks are organized systematically, so one challenging task is central and other tasks are practiced in intervals of returning to it, 4) when new utterances are formulated rapidly using a rule, this rule should be generalized.

In this study, we followed 3 phases which is presented in flowchart:



1-assessment and treatment phases' flowchart

Results:s

P1:

Diagnosing HL and receiving hearing aids (Oticon bte geno1P) was at 3 years 1 month. He had moderately-severe HL according to ABR/audiometry and two of relatives have HL. After birth for 3 minutes he became cyanosis following hypoxia. At the beginning he had 3 years 4 months and until then, had received 12 hours language treatment in NKF.

Auditory skills: Results of SDS showed that his discrimination improved from 60% in first assessment to 68% in second and third assessments.

P2:

In P2, HL was diagnosed at 20 month and receiving first hearing aids was at 2 years 2 months. Because of probability of cochlear implantation, inexpensive poor hearing aids were prescribed. At 3 years more suitable hearing aids (Widex fastion d220) were prescribed. According to ABR/audiometry, she had bilateral severe HL. At the beginning she had 4 years 1 month. Before entering to NKF, she had about 22 SLP sessions, that weren't auditory-based, and after entering NKF, before study, she had 29 hours auditory-based language treatment at NKF. Also one of relatives had HL.

Auditory skills: Initially SDS was 42%. 12 and 24 weeks later increased to 54% and 58%.

Table 1 shows results of RL assessments.

Table 1. Results of receptive language assessments.

	Participant	First assessment	Second assessment(12 th week)	Third assessment(24 th week)
Receptive vocabulary(RV)	P1	40%	57.2%	66.5%
	P2	49%	65%	70.6%
CR	P1	16.6%	45.8%	91.6%
	P2	41.6%	70.8%	100%
Receptive language(NDS)	P1	46%	70%	80%
	P2	49%	57%	64%
SCT	P1	0	0	0
	P2	0	0	4.1%

Results of EL tests exist in table 2.

Table 2. Results of expressive language assessments.

	Participant	First assessment	Second assessment(12 th week)	Third assessment(24 th week)
Expressive vocabulary	P1	28.5%	51.2%	63.3%
	P2	42.5%	62.6%	70.3%
CLS	P1	0	41.6%	79.1%
	P2	8.3%	20.8%	75%
UCV	P1	0	0	70.8%
	P2	0	8.3%	62.5%

Expressive language(NDS)	P1	61%	56%	80%
	P2	49%	57%	53%
PEPGT	P1	0	2.5%	12.5%
	P2	0	15%	12.5%

Table 3 shows the results of analysis of language samples.

Table 3. Results of language sample analysis.

		Participant	First assessment	Second assessment(12 th week)	Third assessment(24 th week)
Story retelling	Number of utterances	P1	3	5	13
		P2	22	26	37
	MLU(w)	P1	1	3.2	6.8
		P2	4	4	4.4
	MLU(m)	P1	2	4.4	9.6
		P2	6	7.2	8.2
	PDSS	P1	5	5.6	9
		P2	6.2	8.2	13
Photographic story telling	Number of utterances	P1	0	0	13
		P2	6	7	12
	MLU(w)	P1	0	0	2.2
		P2	3.2	3	3.6
	MLU(m)	P1	0	0	3.2
		P2	4.8	4.4	6.6
	PDSS	P1	0	0	6
		P2	6.6	5.8	9.2
Spontaneous language sample	Number of utterances	P1	0	0	8
		P2	2	2	18
	MLU(w)	P1	0	0	6.4
		P2	2.5	2.5	3.4
	MLU(m)	P1	0	0	8.6
		P2	3.5	3.5	4.8
	PDSS	P1	0	0	10.6
		P2	5	5	7.2

Inter-rater reliability which was calculated for STH-situation showed more than 80% Agreement between two examiners.

3. Discussion

Since in some HIC, MS development doesn't occur simply during natural development(4, 5), and late diagnosing, limited RH and poor communicative/linguistic environment exacerbate condition, also because usually compensating the language delay is so difficult after it occurred(7), we designed STH-method and in this study tried to show its effectiveness on MS development in 2 congenital HIC.

In Auditory-verbal treatment(AVT)which is an auditory-based approach(33) there wasn't detailed suggestions for fostering and speeding up linguistic and MS development. But STH-method presented a highly systematic, step by step method for linguistic and specially MS development. So this method played an important role in speeding up children's linguistic development, specially those children that were in challenging condition.

Because this treatment is auditory-based, children should primarily learn listening and then use it for language learning.

But because COVID-19 compelled us to use 2 multilayer face mask (24), ventilator and open the window which decreased signal-to-noise ratio, listening would be challenging. Also quarantine led to eliminate GSs, important for generalization, mother education, behavior management, LTL and following directions by children.

Lack of target generalization in GSs, led us to include them in TSs, so treatment slowed down and working on new targets was delayed. Also limited family education decreased effective parent participation. Moreover, because family's poor economic status, cooperation of child psychologist for behavior management wasn't possible. Therefore, in lack of GSs, individual sessions partly devoted to behavior management, so the time of language treatment reduced. Also, LTL for a child with limited RH and reliance on visual inputs, is so difficult. Lack of GSs made this difficult task more challenging. Also, quarantine limited children's communication with their peers, so generalization became so limited. Also, online presentation of many sessions imposed several challenges: unskilled mother, children noncooperation, poor internet and voice quality. Also devotion of at least 50% TSs to speech decreased available language sessions.

Seemingly our emphasis on elicitation one MS target in DP and then its systematic generalization was partly similar to method suggested by Eisenberg (34) which each session included some DP for elicitation target and then entering it into meaningful communication.

Nevertheless, during treatment we improved their listening skills. Finally, improvement was remarkable in the total number of utterances, MLU and PDSS of language samples that clearly indicate MS development. These results were consistent with increasing the use of language in communication, using longer utterances and new/more advanced MS rules.

In addition, CLS improvement showed developing skill in tracking questions, memorizing its structure, and response formulation by similar structure using various words, so answering to similar questions and catching the speaker's talk during communication improved.

Also, improving the UCV score indicated that children formulated their answers using correct verb tense and inflection according to question that improves answering to questions.

According to CR, understanding and answering questions improved finally. Also, receptive and expressive vocabulary improved.

As noted above, poor signal-to-noise ratio, elimination of GSs, and online sessions, made difficult task of LTL more challenging. We should improve children's LTL so well that enables them to use listening for learning new linguistic skills recognize and discriminate words. LTL was more difficult in P2 because of her poor environment, lower RH, reliance on lipreading, and lack of suitable amplification and auditory-based treatment at lower age. It seems that limited auditory familiarity following poor environment and lack of GSs prevented more auditory development.

In addition, although her language target learning in TSs was reasonable, lack of GSs and mother's proficiency led to slow generalization.

P1 who had more RH, richer environment and lower age, succeeded to learn auditory/linguistic skills better, but P2 who had poorer condition, encountered more difficulties.

Because increasing the MS complexity of photographic story telling and spontaneous language sample is more difficult than answering or story retelling, poor results obtained from analyzing these samples in second assessment, may indicate that then, participants didn't achieve necessary skill for using those developing rules in spontaneous language. This results is consistent with our expectations from treatment, because we a) stabilize a target in practice, b) practice it toward automaticity, c) enter it into question-answer, and, after systematic generalization, target gradually enters in spontaneous language. To wit, children's skills should increase more, before changes became observable in spontaneous language. However, finally these scores showed remarkable improvement.

STH-method principally is based on practicing each target toward automaticity and minimal response latency and then systematic generalization. Therefore, this method has some resemblance with the theory that has been proposed by Ling(35). Although speech development and feedforward mechanisms involved in speech is really different from language development, some similarities can be observed between them.

Results of formal assessments didn't show a remarkable, continuous improvement. Although NDS showed relative improvement in RL, SCT showed no improvement and only P2 finally obtained minimal score. Also, although children showed improvement according to PEPGT, EL scores of NDS were fluctuating.

SCT's complexity for HIC and rigid rating, probably led to poor scores, although P1 was younger than test's age.

Deduction of normal range score from child's score led to fluctuating results of NDS.

Therefore, probably in more challenging cases, 24 weeks treatment isn't sufficient for emerging significant changes in these formal tests and some small changes in these tests could better suit them for HIC.

Also, evaluation of imitation accuracy and rate of learning could be useful.

Results of analyzing language samples, CLS and UCV showed that STH-method could improve MS development in these participants. Although MS skills of both children were improved, it seems that existence of all parts of treatment is important for satisfactory improvement specially in challenging children.

Because all of HIC aren't simply ready to acquire language following amplification, we suggest using a systematic procedure for MS treatment. So after an exact evaluation, we determine which skills, and how should be treated and therefore start treatment from suitable skill using suitable method and after generalization, progress toward more advanced skills.

Limitations of study

COVID-19 compelled us to use 2 multilayer face mask (24), ventilator and open the window which decreased signal-to-noise ratio, so difficult task of learning to listen became more challenging.

Ethical Considerations

Compliance with ethical guidelines:

This study has been done with consent of families and NKF.

Authors' contributions

Conceptualization, methodology, supervision, data Analysis, and Writing: Sayeh Tahbaz. Reviewing and editing: Sayeh Tahbaz and Azar Mehri.

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Conflict of interest

The authors declare no conflict of interest.

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