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ORIGINAL PAPER

A Study of Strategies for Treating Compensatory Articulation in Patients with Cleft Palate

Ma Carmen Pamplona · Antonio Ysunza · Katia Chavelas · Esperanza Arámburu · Carmeluza Patiño · Fernanda Martí · Santiago Morales

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Abstract
Introduction Patients with cleft palate (PCP) frequently show compensatory articulation disorder (CAD). Compensatory errors require a prolonged period of speech intervention. Scaffolding strategies are used for correcting placement and manner of articulation.
Objective To study whether some strategies commonly used in speech therapy for correcting compensatory articulation errors, can be more effective depending on severity of CAD in PCP.
Materials and Methods Fifty PCP were studied. All patients showed velopharyngeal insufficiency (VPI) and CAD. Transcriptions of speech therapy sessions were revised in order to quantify positive changes in articulation. Correlation between effectiveness of each strategy and degree of severity of CAD was assessed. Also, different strategies were compared in order to determine whether some strategies were more appropriate for specific levels of severity of CAD.
Results There was a significant relationship between the success of some strategies, as measured by the number of positive changes in articulation, and the degree of severity of CAD in PCP.
Conclusion There seems to be a relationship between effectiveness of some speech therapy strategies for correcting compensatory articulation errors and severity of CAD. Assessment of severity of CAD appears to be useful for planning speech intervention in PCP. Selected speech therapy strategies could be used according to severity of CAD.

Keywords Cleft palate · Language · Speech · Therapy

Introduction

Patients with cleft palate (PCP) may have an articulation disorder. Certain articulation disorders are generally regarded as compensatory behaviors secondary to velopharyngeal insufficiency (VPI). These errors include dysfunction not only of the velopharyngeal sphincter, but also of the entire vocal tract and higher levels of articulation control in the central nervous system [1, 2]. For example, plosive sounds such as/p/ or /k/might be attempted by substituting a glottal stop. These abnormal articulation patterns are usually referred as compensatory articulation disorder (CAD). CAD severely affects intelligibility and usually requires a prolonged period of speech therapy [3, 4].

Several authors have described speech disorders in PCP. Some of these articulation impairments are associated with the structural deviations associated with clefting [5–7]. It has been suggested that these impairments also involve higher levels of language organization [8–10].

Speech disorders in PCP, such as CAD, may initially occur as a consequence of the cleft. Over time, these errors become incorporated into the child's developing rule system of articulation [8].

When intervention is based on these principles, some implications for the assessment and management of PCP may be assumed, including analysis of phonologic processes in addition to phonetic analysis. For speech intervention in these children, some scaffolding strategies have

M. C. Pamplona (✉) · A. Ysunza · K. Chavelas · E. Arámburu · C. Patiño · F. Martí · S. Morales
Cleft Palate Clinic, Hospital Gea González, Mexico City, Mexico
e-mail: macamenpamplona@hotmail.com

been described. These strategies are aimed to modify the articulation system of each child.

The use of these strategies is useful for scaffolding the child's communicative turns in order to increase the child's speech and language performance [11].

These strategies are helpful for assisting the child in formulating messages with greater complexity, specificity of meaning, accuracy, and clarity of expression.

Scaffolding strategies include various types of prompts, questions, information, restatements, and other procedures, which provide support to the child as he/she is actively engaged in the process of communicating a message [12].

Many authors have described scaffolding strategies for facilitating a better way to communicate and/or articulate the sounds of speech [9, 13]. However, it is important to study the possible relationship between different stages of speech development or severity of articulation impairment, and effectiveness of these strategies. Some commonly used strategies include the following: Modeling [11, 14], Phonemic Cues [12], Minimal Pairs [13, 15], Cycles [9], Imitation and drills [16], Requests for clarifications [17], Phonetic changes [12], and Expansions [11], among others.

Speech acquisition is gradual [18]. It is a process. Also, correction of compensatory articulation errors has diverse stages. In our center, a clinical scale of severity of CAD in PCP had been used for determining the stage of the process of correcting CAD in each patient [19]. That is, the degree of severity of CAD in each child. The scale mentioned herein is described as follows:

- *Appropriate articulation. (First category)* The patient is able to produce adequate placement and manner of articulation during spontaneous speech, including non-present situations.
- *Inconsistent articulation. (Second category)* The patient shows compensatory articulation errors inconsistently during spontaneous speech. Intelligibility is not significantly affected.
- *Articulation within context. (Third category)* The patient self-corrects articulation when using speech within a specific context. For example during telling a story from a story book which the patient already knows well. Nonetheless he shows frequent compensatory errors during spontaneous speech, and this may affect intelligibility.
- *Articulation with strategies. (Fourth category)* The patient can correct articulation during isolated words or selected short phrases, only when the clinician uses specific instructions on articulation. Intelligibility is affected.
- *Articulation of isolated phonemes. (Fifth category)* The patient is able to correct articulation only in isolated phonemes through direct instruction. Intelligibility is severely affected.
- *Constant CAD. (Sixth category)* The patient is not able to correct articulation not even in isolated phonemes and despite direct instruction. Intelligibility is severely affected.

The aim of this study is to study whether some of the scaffolding strategies commonly used in speech therapy for correcting compensatory articulation errors, can be more appropriate, depending on the degree of severity of CAD in cleft palate children.

Materials and Methods

This study was carried out at the cleft palate clinic of the Hospital Gea Gonzalez in Mexico City. The Bioethics and Research Committees of the Hospital approved the protocol and the study had been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki's and its later amendments. Before the inclusion of each patient into the study group, the parents or legal guardians were carefully explained about the procedures and the methodology of the protocol. All parents of the patients included in the study group, agreed to participate in the study and gave their informed consent prior to the inclusion of the study.

Sample size was calculated for a one-sample study. An Alfa of 95% confidence interval and a Beta power of 80% were used. The distribution of the severity of CAD mentioned herein, in the children with cleft palate assessed at our center, during the last 2 years was considered. The aim was to detect a difference of at least 10% between categories. According to these calculations, a minimum of 11 patients classified in each of four categories of the scale should be included in the study. Thus, the minimum number of patients in the sample should be 44. It should be pointed out, that in this study only patients with compensatory articulation errors were included. By this token, PCP without compensatory errors, which are classified in the 1st category of the scale, were excluded from the study group for this paper.

Patients with constant compensatory errors, who are not able to correct articulation not even in isolated phonemes and despite direct instruction on placement and manner of articulation, were also excluded from the study group for this paper. The reason for the exclusion of these patients was that the number of patients classified in this category was quite reduced (4 patients) and it was difficult to find the required number for this study. It is necessary to emphasize that although these patients were excluded from the study group, they were not excluded from receiving

speech therapy. These patients continued receiving speech therapy on a regular basis. Hence, for this study, only patients classified into the second to fifth categories were included.

The age of the patients ranged from 4 years and 4 months to 10 years and 11 months. The median age was 5 years.

Two independent examiners made all the evaluations. When they revised the videotaped phoniatric clinical evaluations for classifying patients according to the clinical scale for the severity of CAD, they agreed in 95% of the cases. When the transcriptions were analyzed for detecting which strategy was being used during each interaction, both examiners agreed in 95% of the cases. Finally, as far as the quantification of positive changes in articulation with the use of each strategy, during the videotaped therapy sessions, the examiners were in agreement in 98% of the cases. In any case of disagreement, a consensus was reached after reviewing the videotape for a second time.

Patients

The recruitment of patients was carried out prospectively. All patients at the cleft palate clinic from January 2008 to June 2009 were assessed. A total of 152 patients were evaluated. To qualify for the study group for this paper, the patients had to meet the following criteria:

(a) Unilateral, complete cleft of primary and secondary palate (UCLP) [20]
(b) No known neurological or genetic syndromes
(c) No identified severe language disorders according to the SDS-model evaluation practiced in our clinic routinely and reported previously [21].
(d) Palatal repair of the UCLP performed according to the surgical routine of the cleft palate clinic. This routine includes: surgical repair of the lip and primary palate between 1 and 3 months and surgical repair of the secondary palate, including first palate and velum between 4 and 8 months with a minimal incision palatopharyngoplasty [22]. That is, hard and soft palate are repaired simultaneously.
(e) VPI after palatal repair demonstrated by clinical assessment, videonasopharyngoscopy and multi-view videofluoroscopy.
(f) CAD in association with VPI, had to be demonstrated during a complete phoniatric clinical evaluation.
(g) Absence of postoperative fistulae
(h) No further velopharyngeal surgery (pharyngeal flap or sphincter pharyngoplasty) other than palatal repair when they were assessed for the study.
(i) Chronological age between 4 and 11 years of age at the time of selection for the study group.
(j) Normal hearing demonstrated by conventional pure-tone audiometry.

Patients were selected, keeping in mind that it was necessary to include a minimum of 11 patients, classified in each of the four categories of the articulation scale used for this paper. The patients were classified according to the clinical evaluation of articulation.

Patients recruited for this study, were referred to the Phoniatrics department for a speech evaluation by the cleft palate clinic. All these patients were subjected to a complete clinical phoniatric evaluation including all aspects of language, voice and speech. A complete clinical phoniatric evaluation is the gold standard for the diagnosis of compensatory articulation disorder. It should be pointed out that compensatory articulation errors are associated with velopharyngeal insufficiency, which occurs during phonological development, as in cases of cleft palate. Prevalence of compensatory articulation disorder in patients with cleft palate and residual velopharyngeal insufficiency varies from 33 to 70%, depending on several factors including language development, educational level of parents, socio-economical aspects, etc. [19, 21]. Detection of compensatory articulation disorder is extremely important for the cleft palate team since it requires specific speech therapy. Furthermore, even a successful surgical correction of velopharyngeal insufficiency does not eliminate compensatory articulation errors. Thus, detection of this disorder is essential for effective treatment planning.

All patients were assessed at the onset and at the end of the study in order to identify the phonological rules present in the phonological system of each child with special attention in compensatory articulation patterns. For this purpose, children were videotaped interacting with a trained speech pathologist during free play and storytelling for 30 min. A 15 min segment was selected where a high level of verbal interaction occurred. The 15 min of interaction were transcribed verbatim to analyze the child's phonological system, as well as the presence and severity of compensatory articulation. All speech pathologists participating in this study had been performing phonological transcriptions of cleft palate children for at least 5 years.

For assessing the reliability of the evaluation of CAD severity, as expressed by the scale used in our center, a blind procedure was utilized, whereby all analysis were independently conducted by two trained speech pathologists. Whenever there was a disagreement, each case was discussed until a consensus was reached.

A total of 52 patients were recruited. Eleven patients showed inconstant compensatory articulation; 14 patients were able to articulate correctly within context: 14 patients showed appropriate articulation in words and short phrases

only with the use of strategies; 11 patients were able to articulate correctly only isolated phonemes.

Strategies

The following strategies were used during speech therapy sessions:

(A) *Modeling:* Modeling is one of the most frequently reported strategies. The speech pathologist models the speech and/or language behavior that the child is to learn. Some clinicians found that children respond spontaneously if the language behaviors being stressed are at the child's level. Thus, they model the behavior but do not normally request for formal elicitation. Modeling approaches the normal conditions of language learning more closely than the elicited imitation procedure [14]. Example: Child: "_all he_ (call her)". Clinician: "Yes, call her". This strategy has been often described as useful for language development, but it is also proposed as a strategy for children with articulation impairment. Hoffman states that the models of appropriate articulated words in context are thought to help stimulate appropriate syllabic and phonemic organization [11]. The clinician has the opportunity to model and talk about the structure of words within an overall communicative context [23].

(B) *Modeling with stress:* With this strategy, the speech pathologist models targeted sounds of speech, but includes a brief pause before the sound and also, a stress on the sounds (phonemes) the clinician wants to model. For example, during a play situation in which a cake is being cut, the child says "_ut the _ae_ (cut the cake); The clinician can respond "yes, (pause)….cut the (pause)…cake. I will (pause)…cut the (pause)…cake and give you a (pause)…piece", stressing the targeted phonemes for the purpose of making them more easily audible and facilitating focusing attention in those specific sounds.

(C) *Cloze procedure with phonemic cues*: With this strategy, the clinician prompts the child's communicative turn by supplying part of the utterance and letting the child fill the rest [24]. If necessary, the clinician can provide the selected sound of the target word [12]. For example, when reading a storybook, the clinician can say: "Yes, she was hungry, and she found three bowls of ____(soup) on the t t ____(table)". The idea is that sharing the responsibility of telling the story and letting fill in the blank space, the children can focus on the specific words and the targeted sounds. Also, using phonemic cues by providing the initial sound or syllable the child can direct his/her attention to the targeted sound and the distinctive features of it.

(D) *Phonetic changes:* The speech pathologist indicates that the message would be more easily interpreted with a modification in speech production [12]. For example, when the child says "the _en (the pen)" reading a storybook in which there are different objects, the clinician says: "the pen". Remember to put your lips together and make an explosion: p p pen". With this strategy, the information would directly contribute to refining the phonemic distinction being articulated.

(E) *Think aloud in phonemic awareness:* Originally, this is a metacognitive strategy where the speech pathologist verbalizes thoughts while reading a selection, thus modeling the process of comprehension [25]. This strategy enables to demonstrate the patient how to select an appropriate articulation process at a specific point in a particular communicative message. The clinician verbalizes specific think-aloud about different levels of language organization including information about the sounds of speech. For example, before reading a storybook, the clinician says: "Let us think which sounds we will be focusing on. We have to consider that some sounds are short and explosive like/k/, /p/, /t/. I will write these letters for reminding us to use them while we refer to the ideas and words of the book. Besides, we have other sounds that are long and continuous:/s/ or /f/. I will write these letters in this other paper. While looking at the storybook, the clinician is focusing on the target sounds and explaining the characteristics of each phoneme and how changing the sound can change the characteristics of the word increasing intelligibility. Also, the clinician gives specific instructions about how to produce sounds correctly.

It is important to emphasize, that strategies, which include modeling such as modeling with stress, do not involve direct instruction, but they establish an appropriate context for focusing on the sounds of speech while receiving the correct model of articulation of the targeted sounds. In contrast, the rest of the strategies provide information for managing the sounds of speech. For this reason, we will consider them as strategies that involve direct instruction.

Speech Therapy Sessions

All patients were recorded on videotape during speech therapy sessions. All speech therapy sessions were

recorded during the 2008 and 2009 speech summer camps. The patients included in the study group were recorded with only four selected speech pathologists, with a minimum of 5 years experience working with PCP and CAD, and with experience using the strategies mentioned herein. However, previous to this study, all of them received training for identifying and using the strategies used during speech therapy sessions.

The speech summer camps were done for a period of 4 weeks each year. In these camps, PCP attended daily, 4 h. During the summer camps, the methodology followed is called "narrative-centered themes" [26]. This procedure serves as a means for addressing children's language and articulation in an integrated manner. Thus, articulation goals were always present in an organized whole. Most activities were realized as event representations such as play or storybook reading. These were the contexts for videotaping the speech therapy sessions. The reason for this is that these contexts provides more structure and allows videotaping all children in a more controlled way.

Children were divided in small groups depending on the age, linguistic development, and cognitive level.

All strategies were used within structured activities to provide children with contextually appropriate opportunities to use language and focus on articulation. The clinician could choose either to expand an expression or refine upon an expressed idea by giving specific information.

Clinicians also used verbal expansions to provide children with information about higher levels of language organization. This type of interaction has been shown to increase the semantic and syntactic complexity of children's utterances, and may have similar effects on articulation [11].

The speech pathologists made sure that all strategies under study were used with each patient during the sessions. For this purpose, after each session, the speech pathologist reviewed the used strategies in order to plan the next session and make sure all strategies were used in each patient everyday.

All interactions were video recorded for later transcription analysis. All videotaped interactions were transcribed verbatim, including the conversational turns of the examiner and the child. The four examiners were trained in the procedures of transcribing, using and identifying the strategies under study. They transcribed the samples, which were randomly assigned to an examiner. The examiners revised the transcriptions, detecting which strategy was being used during each turn of interaction. Also, the examiners quantified the positive changes in articulation elicited by the use of each strategy. Positives changes were considered as the conditions in which the patients were able to consistently approximate or correct appropriate placement or manner of articulation of the phonemes being used. Each transcription was then checked against the videotape by a researcher that had not done the original transcription along with a second examiner for accuracy. If either of these two judges differed from the transcription, the videotape was analyzed again until a consensus was reached. All videotapes for all children were verified for accuracy in this manner.

The possible relationship between the effectiveness of each strategy, measured as the frequency of consistent positive changes in articulation and the level of severity of CAD was assessed using a chi square. Also, using a chi square, the different strategies were compared in order to determine whether some strategies were more adequate for specific levels of severity of CAD. A 99% confidence interval ($P < 0.001$) was selected for considering chi square values as significant.

Results

A chi-square demonstrated a significant relationship ($P < 0.05$) between effectiveness of all strategies and degree of severity of CAD in children with cleft palate. Effectiveness was measured as the number of positive changes in articulation, as a result of the use of each of the strategies. That is, all the strategies yielded a significantly higher number of positive modifications in articulation in patients classified in the milder levels of the scale, including patients with inconsistent compensatory errors during spontaneous speech, and patients who were able to correct articulation within a familiar linguistic context. Moreover, there were a reduced number of positive changes in patients classified in the more severe levels, including patients who were able to correct compensatory errors during the production of words or short sentences, when they were being provided with specific instructions on placement and manner of articulation and patients who were able to correct compensatory errors only during the production of isolated phonemes, through direct instructions.

Table 1 shows distribution of percentages of positive changes in articulation, obtained with each of the strategies used for this paper, according to the severity level of CAD.

Table 2 shows the comparison of all strategies used for this paper. A chi square was used for determining which differences were significant ($P < 0.01$).

When modeling was compared versus, the other four strategies: Modeling with Stress (MS); Cloze Procedure with Phonemic Cues (CPPC), Phonemic Changes (PC) and Think Aloud in Phonemic Awareness (TAPA), the results showed that all five strategies yielded similar percentages of positive changes in articulation in patients classified as the mildest level of severity of CAD ("Inconsistent"). (See

Table 1 Distribution of percentage of positive changes in articulation across all the strategies used

Severity of CAD	M (%)	MS (%)	PC (%)	TAPA (%)	CPPC (%)	
Inconsistent	94	90	94	90	94	%
Only within context	42	94	94	90	90	OF
Only with strategies	13	54	90	94	94	P C A
Only isolated phonemes	9	33	90	90	86	

CAD Compensatory articulation disorder, *M* modeling, *MS* modeling with stress, *PC* phonetic changes, *TAPA* think aloud in phonemic awareness, *CPPC* cloze procedure with phonemic cues, *% PCA* percentage of positive changes in articulation

Table 2 Probability values (*P*) obtained by the comparison of all strategies using a chi test

M versus MS[a]	($P < 0.001$)
M versus CPPC[a]	($P < 0.001$)
M versus PC[a]	($P < 0.001$)
M versus TAPA[a]	($P < 0.001$)
MS versus CPPC[a]	($P < 0.001$)
MS versus PC[a]	($P < 0.001$)
MS versus TAPA[a]	($P < 0.001$)
CPPC versus PC	($P = 1.0$)
CPPC versus TAPA	($P = 1.0$)
PC versus TAPA	($P = 1.0$)

M Modeling, *MS* modeling with stress, *PC* phonetic changes, *TAPA* think aloud in phonemic awareness, *CPPC* cloze procedures with phonemic cues

[a] Increased percentages in positive changes in articulation

Table 1). In contrast, the other four strategies produced increased percentages of changes than modeling in the remaining patients included within the other three levels of severity. A chi square test demonstrated that these increases were statistically significant ($P < 0.001$). (See Table 2).

From the comparison of Modeling with Stress (MS) with the other three strategies (CPPC; PC and TAPA), it was evident that all four strategies yielded similar percentages of positive changes in articulation in patients classified within the milder levels of severity of CAD ("inconsistent" and "appropriate within context"). In the remaining patients, included in the other two levels of severity, the three strategies (CPPC; PC and TAPA) produced increased percentages of changes than MS (See Table 1). A chi square test demonstrated that these increases were significant ($P < 0.001$) (See Table 2).

When Cloze Procedure with Phonemic Cues (CPPC), Phonemic Changes (PC) and Think Aloud in Phonemic Awareness (TAPA), were compared among themselves, the results showed that all strategies had elicited similar percentages of changes in articulation (See Table 1). Non-significant differences were demonstrated between all percentages, regardless of the severity of CAD. (See Table 2).

Discussion

The purpose of this paper was to study some of the strategies frequently used in speech therapy for correcting CAD. It was proposed, that the use of scaffolding strategies might be more appropriate depending on the degree of severity of CAD. The results of this study seem to support this statement.

All the strategies used in this study promoted positive changes in the articulation of the patients. Moreover, a significant relationship between effectiveness of all strategies and degree of severity of CAD in these patients was demonstrated. It should be pointed out that the significant relationship between effectiveness of specific strategies with severity of CAD, detected in this study, was independent of the age of the patients. Severity of CAD was not related with age of the patients. Moreover, effectiveness of the different strategies did not significantly correlate with age of the patients.

Strategies that include direct instruction such as phonetic change, cloze procedure with phonemic cues, and/or think aloud in phonemic awareness, appeared to be more appropriate for promoting positive changes in articulation in patients who were in the higher levels of severity of CAD, such as those who can only articulate correctly isolated phonemes or used them in words or short phrases with constant support of the clinician. When these strategies were compared with those that do not include direct instruction such as modeling or modeling with stress, a significant difference was observed. However, these last two strategies showed similar effectiveness in the lowest level of severity of articulation (inconsistent). In this level, children are more aware of the use of speech sounds, and show confidence for producing these sounds during a more structured discourse.

It is important to emphasize that modeling is one of the most frequent strategies described [11, 12, 14]. Also, the two strategies that include modeling, i. e. modeling and modeling with stress, were the most common strategies used by the speech pathologists in this study. The results show that these strategies do not seem to be as appropriate as the ones that include direct instruction when they are used in children with higher levels of severity of CAD.

This finding has important implications for speech intervention. The clinician should consider the characteristics and level of severity of articulation impairment before deciding which strategy should be used. These strategies can be used at any time during the intervention period. Furthermore, no additional procedures or studies are necessary for incorporating their use during routine speech therapy sessions.

There are other strategies, which are frequently used for providing speech therapy in PCP. Moreover, specific methodologies and procedures have been described in the related scientific literature, reporting successful outcomes. Good results have been reported using drills with a focus on frequent and rapid repetition, frequency of therapy and frequently reinforcement at home several times a day [27, 28].

As mentioned herein, in our center, we provide speech therapy addressing articulation directly but within linguistic context. About our position regarding speech therapy, it is necessary to consider that most of the patients receiving attention at the Hospital Gea González, come from families with extremely low educational level and severe social and economical limitations. It has been reported that besides the expected speech disorders in PCP, some of these patients can show language impairment. It has also been reported that low educational level of parents and limited social and economical resources are related with an increased frequency of language impairment [29, 30].

For the speech intervention, during the Summer Camp, different activities were structured in order to facilitate changes in the articulatory system of each child. Some of them had a structured context such as storybook reading/telling where the text or illustrations provide concrete information with visual cues to refer to. Also, talking about a graphic organizer can be considered a structured and present context. In contrast, communicating during symbolic play situations in which the context or situation for playing has to be created with words, or talking about a non-present situation, are considered less structured linguistic contexts or events, since there are no visual cues supporting communication. In these instances, the individual has to create the whole context through language (decontextualized situation). When the positive changes in articulation elicited by the use of the strategies mentioned herein, were compared in more structured and less structured contexts, there seemed to be similar positive changes in both situations. Nonetheless, when the strategies that do not include direct instruction on articulation such as modeling, or modeling with stress were being assessed, there seemed to be a tendency for more positive changes when the strategies were being used in more structured contexts, such as storybook reading/telling. This finding can be explained since these structured situations can provide more contextual or concrete support for communication. This can be especially relevant for the higher levels of severity of CAD, and speech pathologists can consider this when planning an intervention. Moreover, when children with articulation errors are treated, providing visual support is valuable tool for scaffolding.

The speech pathologist has to have clear goals for each patient for optimizing speech intervention. Considering which strategy could be more appropriate for each patient depending on their specific needs, such as the severity of CAD, can improve the results of intervention. Moreover, improving speech outcome is extremely relevant for the child's integral development and final result.

This is a preliminary attempt to study some strategies commonly used during speech interventions in patients with cleft palate. Although, the reduced and homogenized number of patients included in this study, precludes obtaining definite results, the conclusions of this paper seem useful and promising. It will be necessary to study larger numbers of patients in different situations, as well as include more strategies in the study. However, from the results of this paper, it can be concluded that considering which strategy could be more effective for each patient depending on his or her specific needs, such as the severity of the articulation disorder, could be a valuable procedure for improving outcome in speech therapy sessions.

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