Phonological Encoding in Children with Stuttering

by Sangeetha Mahesh

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Project Proposal

Part-A

1.0 Title of the project: Phonological Encoding in Children with Stuttering

Area of Research: a) Speech, Language, Hearing

1.1 Principal Investigator: Ms. Sangeetha Mahesh

1.2 Principal Co-Investigator: Ms. Geetha. M.P.

1.3 Collaborating Institute: Nil

1.4 Total Grants Required: 4, 42,000, Four lakhs and forty two thousand only

1.5 Duration of the project: 1 Year

2.0 Project Summary:

In the present study 30 children with stuttering (CWS) and 30 children with no stuttering (CWNS) in the age range of 8-12 years with stuttering severity of moderate and above degree would be selected. The main aim of the experiment will be to check the difference in phonological encoding using phoneme monitoring in silent naming task and to compare between children with stuttering and without stuttering. The study will further aim to check simple motor task, picture familiarization and naming and auditory tone monitoring between CWS and CWNS. The experiment will be carried out in 4 tasks, (1) simple motor task, (2) picture familiarization and naming (3) phoneme monitoring in silent naming and (4) auditory tone monitoring. For phoneme monitoring task, trisyllabic nouns would be prepared using target phonemes in all positions (initial, medial and final). The target phonemes are based on the "mean percentage of highly dysfluent phonemes" (Sangeetha & Geetha, 2015). Appropriate white and black line drawing pictures will be selected for target words in all positions. Prepared stimulus will be counterbalanced and presented using DMDX software. For auditory tone task, 1 KHz (target tone) and 0.5 KHz pure tone will be used. Using this pure tone, four tone sequences would be prepared. The number of four sequence pure tones will be equal to number of target words. The participants will be instructed to respond whether target phoneme and/or target four sequence tone is present or not by pressing the button. The results will be compared using appropriate statistical procedures.

Introduction

3.1 Definition of the problem

Since decades stuttering is considered to entail both linguistic and motoric deficits. According to Bloodstein in 2002, stuttering is a disorder of language development. There are many evidences that Persons with Stuttering (PWS) would exhibit language deficits like lexical retrieval and phonological encoding. Phonological encoding is defined as the process involved in

retrieving or building a phonetic or articulatory plan from each word or the utterance as a whole. Literature also supports the idea of phonological encoding deficits in adults and children with stuttering. Various paradigms have been used to study the phonological encoding deficits however, results are inconclusive. None of these paradigms pin pointed the presence of phonological deficits as the cause of stuttering but rather identified phonological encoding to be one among various other factors contributing towards stuttering. Most of the paradigms used to study the phonological encoding are indirect. However, one of the paradigms is phoneme monitoring which tries to specifically target the phonological encoding deficits.

3.2 Objectives

The main aim of the experiment will be to check difference in phonological encoding using phoneme monitoring in silent naming task and to compare between children with stuttering and children with no stuttering. The specific objectives are:

- Is there any difference in speed of phoneme monitoring (reaction time) between CWS and CWNS
- Is there any difference in percentage of error response in phoneme monitoring between CWS and CWNS
- Is there any difference between CWS and CWNS in auditory tone monitoring task
- Is there any difference between CWS and CWNS in picture naming and simple motor task

3.3 Review of literature

Phonological encoding is defined as the process involved in retrieving or building a phonetic or articulatory plan from each word or the utterance as a whole. It constitutes of three components; (1) Generation of segments that constitutes words, (2) Integration of sound segments with word frames, and (3) Assignment of appropriate syllable stress. This phonological encoding process constitutes interlink between lexical processing and motor speech production (Levelt, 1989).

Several psycho-linguistic theories explain the process of phonological encoding. Among them, Levelt (1989), explained the psycho-linguistic model of language comprehension and production. The language production constitutes of three components; (1) Conceptualize (2) Formulator and (3) Articulator. The conceptualize has an access to the intention of the speaker, world knowledge, physical and social context, and current state of the discourse. In other words, has an access to pre-verbal message. The formulator uses pre-verbal message to construct sentence representation, which is further divided into two subcomponents; i) Grammatical encoding and ii) Phonological encoding. Grammatical encoding is responsible for selecting words from mental lexicon and assigning grammatical rules to these words and construct phrasal representation in a linear order. The phonological encoding is responsible for determining

prosody of the sentence, spelling out the phonological segments and metrical structure of the word. The articulator helps in motor programming and execution. On the other hand, auditory processing and speech comprehension is responsible for word recognition, syntactic analysis and mapping of syntactic representation onto meaning.

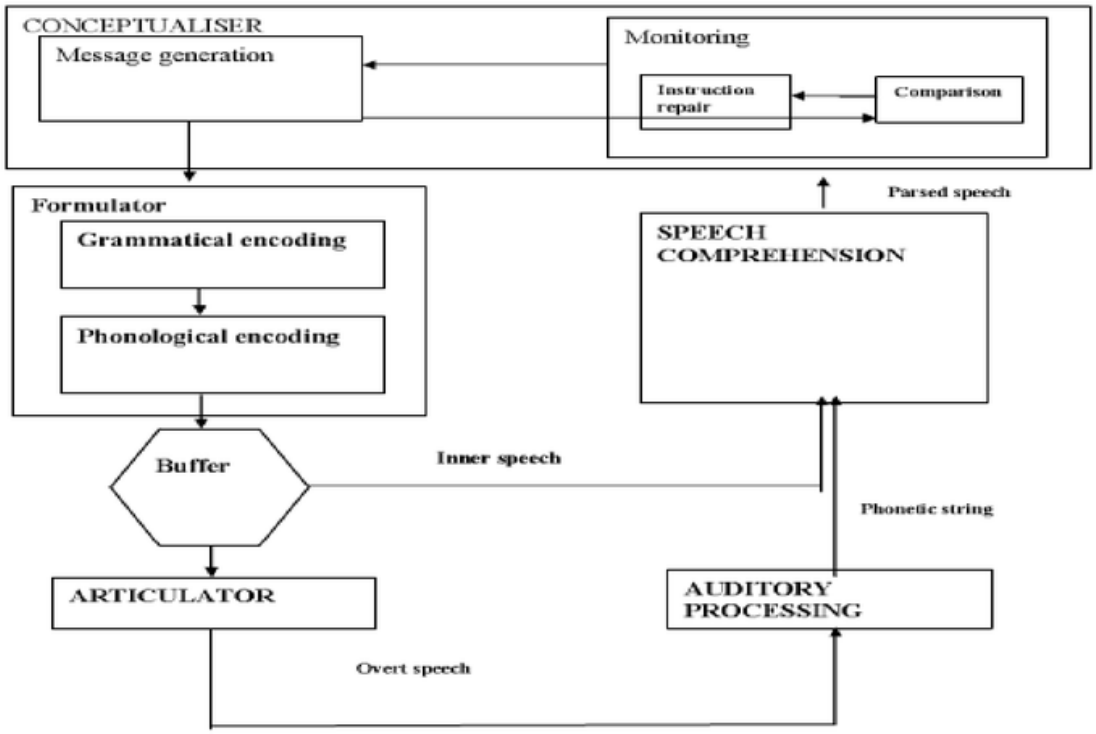

Figure 1. Levelt's model of speech production (Source: Phonological encoding & monitoring in normal & pathological speech. Psychology Press)

Theories on phonological encoding and stuttering

Some theories have explained the relation between stuttering and phonological encoding. In the year 1988, Wingate proposed Fault Line Hypothesis, which highlights delay in the retrieval and encoding of a syllable rhyme during speech production, fault line occurs at the point of integration of the syllable onset and its rhyme in PWS. Further, Postma and Kolk (1993) proposed Covert Repair Hypothesis addresses that stuttering occurs because of delay in the process of selection and retrieval of speech sounds from speech plan and also in case of errors covert corrections takes place. According to EXPLAN theory, stuttering occurs due to difficulty in temporal asynchrony between linguistic planning and speech execution (Howell, 2004).

The investigations on phonological encoding are performed in several ways. The tasks included non word repetition (to check phonological memory), sound matching, phoneme blending, phoneme segmentation and phoneme elision task (to check phonological awareness) and Rapid Automatized Naming (RAN), which refers to the ability of the individual to retrieve the phonetic information rapidly by converting the orthographic symbols or the pictures into a meaningful string of phonemes. Along with these tasks phoneme monitoring is also considered to be effective to investigate the phonological encoding. Phoneme monitoring paradigm is a dual task paradigm which is mostly used to study the attentional processes. Eg. If the person is doing dual tasks such as reading and listening to a tone, it indicates that both tasks draw same cognitive resources.

Studies on phoneme monitoring and stuttering

In phoneme monitoring task participants have to monitor the certain target phoneme in the words or sentences, when it is presented auditorily. During this task person is comprehending words/sentences and then detecting the presence or absence of a target phoneme by pressing a button which requires performance of a dual task.

Sasisekaran and De Nil in 2006, conducted a study on 10 PWS and age-gender matched PNS in the age range of 18 to 48 years. The experiment included three tasks such as; familiarization task, phoneme monitoring in silent naming and phoneme monitoring in auditory perception. They found that PWS were significantly slower in phoneme monitoring in silent naming compared to PNS. But there were no such group differences in phoneme monitoring in auditory perception. It was concluded that PWS were slower in segmental and phonological units during silent naming, where as difficulty in auditory perception rule out the general monitoring skills. It shows that phonological encoding and/or monitoring is a causal variable in stuttering.

On the similar lines a study was conducted in Indian context by Darshini (2015) on 12 adults with the stuttering (11 males and 1 female) and age-gender matched 12 adults with no stuttering in the age range of 18 to 25 years. The main aim of the study was to investigate phonological encoding in adults using phoneme monitoring paradigm in silent naming and in auditory perception. The study further aimed to check the influence of position of the target phonemes (initial, medial and final position) in trisyllabic words. She found that PWS showed significantly poorer performance in silent naming and in auditory perception with respect to reaction time. PWS were also less accurate in phoneme monitoring in silent naming compared to PWNS. However, PWS were accurate as PWNS in phoneme monitoring in auditory perception. PWS were significantly poorer in monitoring the phonemes in all positions in silent naming with respect to reaction time but with respect to accuracy measures, poorer performance was present in medial and final position when compared to PWNS. In auditory perception task, PWS were poorer in phoneme monitoring in medial position only and reaction time was comparable between the groups in other positions. Overall, phoneme monitoring was comparatively better for initial position with respect to reaction time as well as accuracy measures.

In accordance with the observation of studies on phonological encoding in children with stuttering only few studies have been noted. Sasisekaran and Byrd in 2013, conducted a study on 9 children with stuttering (8 males and 1 female) and age-gender matched children with no stuttering in the age range of 7-13 years. The experiment was divided into four tasks. i) picture naming ii) phoneme monitoring task iii) rhyme monitoring and iv) tone sequencing monitoring. They found that there was slow monitoring for consonant clusters in CWS compared to CWNS. It was concluded that there was no difficulty in terms of segmentation or rhyming abilities in CWS though there was some preliminary evidence of segmentation difficulties with increasing phonological complexity.

Similar to the previous experiment, Sasisekaran, Brady and Stein in 2013, conducted a study on 9 children with stuttering and age-gender matched children with no stuttering in the age range of 10-14 years. The experiment was divided into four tasks. i) simple motor task ii) picture familiarization, iii) phoneme monitoring and iv) auditory tone monitoring. They found that CWS were significantly slower in the reaction time as compared to CWNS in phoneme monitoring task. But there was no difference between CWS and CWNS in simple motor task and auditory tone monitoring task. They concluded that CWS exhibit temporal asynchronies in one or more processing leading to phoneme monitoring.

Need for the study (Importance of the proposed project in the context of current status)

In summary, it is evident that there is relationship between language and stuttering. Literature also supports the idea of phonological encoding deficits in adults and children with stuttering. Various paradigms have been used to study the phonological encoding deficits however, results are inconclusive. None of these paradigms pin pointed the presence of phonological deficits as the cause of stuttering but rather identified phonological encoding to be one among various other factors contributing towards stuttering. Most of the paradigms used to study the phonological encoding are indirect. However, one of the paradigm is phoneme monitoring which tries to specifically target the phonological encoding deficits. To our knowledge, there are no studies performed on children with respect to Indian context in general and Kannada speakers in particular. English is stress timed and Kannada is syllable timed and results cannot be generalized to other languages. Hence the present study has been taken up.

4.0 Work Plan

4.1 Method

Participants: 30 children with stuttering (CWS) and age-gender matched 30 children with no stuttering (CWNS) in the age range of 8 to 12 years would be selected for the study. All children will be ruled out for neurological deficits, speech-language, hearing difficulties and for any other related medical problems except stuttering.

Inclusion criteria

- Mother tongue should be Kannada Language
- Right handed
- Diagnosed as having moderate and above degree of stuttering by qualified Speech-Language Pathologist.
- Moderate to high socio economic status
- Vocabulary, Short term memory Articulation and Phoneme awareness
  - To check vocabulary in both groups semantic section from Linguistic profile Test (LPT) by Karanth, Ahuja, Nagaraja, Pandit, and Shivashankar (1991) would be used. To investigate articulation abilities of the children Kannada Articulation Test by Babu, Rathna and Bettagiri (1972) would be administered. To check both auditory and visual memory Cognitive Linguistic Assessment Protocol for Children (CLAP-C) by Anuroopa (2006) will be used. To check the phoneme awareness subsection of metaphonological from RAP-K by Prema (1997) would be administered. Children who pass these tests would be considered for the study.

Materials Used

Materials used for selection of participants

a. NIMH Socioeconomic Status Scale (Venkatesan, 2006)
b. Linguistic Profile Test- LPT (Karanth, Ahuja, Nagaraja, Pandit, & Shivashankar, 1991)
c. Stuttering Severity Instrument – 3 (Riley, 1994)
d. Kannada Articulation Test-KAT (Babu, Rathna & Bettagiri, 1972)
e. Cognitive Linguistic Assessment Protocol for Children (CLAP-C) (Anuroopa, 2006)
f. Reading Acquisition Profile in Kannada- RAP-K (Prema,. 1997)

Materials used for data collection

a. Laptop with Headphone
b. DMDX software
c. PRAAT software
d. White and black line drawing pictures

Procedure

The experiment would include four tasks in the present study, they are Simple motor task, Picture familiarization and naming, Phoneme monitoring in silent naming and Auditory tone monitoring. The picture familiarization task would be presented prior to phoneme monitoring task for familiarization purpose for the participants. Other three tasks would be randomized and presented.

1. ***Simple motor task:*** The purpose of this task would be to check time taken to execute simple manual response by the participants. For this purpose 500 Hz pure tone would be used for a duration of 550 ms. The participants would be instructed to respond onset of the target tone as quickly as possible by pressing the button. 26 trials of 500 Hz tone of duration 500ms would be prepared using DMDX software and it would be presented to the participants with inters stimulus interval varying between 700ms, 1400ms, 2100ms. The inter stimulus interval would be varied to reduce anticipatory button press from participants. 3-5 trials would be given for practice purpose.

2. ***Picture familiarization and naming:***

   Stimulus preparation: For picture familiarization task stimulus or the target words for the study will be prepared. The phonemes would be selected based on the "mean percentage of highly dysfluent phonemes" (Sangeetha & Geetha, 2015). For these phonemes nouns would be selected in such a way that target phoneme would be presented in initial, medial and final positions. Pictures in black and white drawings representing the target words would be selected. These words and pictures will be given to 5 SLP's for validity check on the basis of naturalness, size and representation with respect to children. Three point rating scale would be used in which '0' represents no similarity of the picture with target word, i.e. unnatural and inappropriate size and ''2'' represents complete similarity with target word, i.e. very natural and of appropriate size. If any changes suggested by SLPs' will be incorporated.
   Familiarization and naming: The purpose of this task is to familiarize participants with the target words. These pictures will be presented to participants to name the target word. In case of any errors by the participants a corrective feedback will be provided.

3. ***Phoneme monitoring in silent naming***
   The same stimuli prepared for familiarization would be used in this task. The purpose of this task is to measure participant's response time in ms and accuracy in monitoring the presence or absence of target phonemes during silent picture naming.
   Task would be presented in following steps
   - Opening screen for 700ms followed by auditory presentation of a pre recorded target phoneme

- Varying inter stimulus interval (ISI) between hearing the target phoneme and seeing the target picture. ISI would be varied between 700ms, 1400ms, 2100ms, to reduce anticipatory button press.
- Target picture would be presented for 3s and response time would be measured
- The same pictures will be presented to participants and will be asked them to name the picture aloud. This would be done to determine if a child was thinking of the target word as opposed to another word when responding to the monitoring task. Presentation of the next trial in the sequence would be initiated automatically after 3s in case of no response.

Instruction: In this task you will hear a sound e.g. /ta/ or /pa/ and this will be followed by one of the picture that you named earlier. You are required to name the sound whether it is present or absent in the picture and press the 0 button if no and 1 if yes. The sound could be present either at the beginning, middle or end of the target picture name. You will see the same picture another time after you press the button and this time you have to name the picture aloud. Wait after you name the picture aloud for next sound and picture. 3-5 trials would be given for practice purpose.

4. ***Auditory tone monitoring:*** The purpose of this task is to check general auditory tone monitoring skills.

   Stimulus preparation: For this task 1KHz and 0.5 KHz pure tone would be used. To consider length of the tone, average length of the trisyllabic words would be calculated and considered. Once the length of the tone calculated, this will be made to four pure tone sequence with a gap of 50ms. Care would be taken that the total number of tone stimulus would match total number of target words. Here the target tone would be 1 KHz.

   Task would be presented in following steps

   - Opening screen for 700ms followed by auditory presentation of a pre recorded target tone (1 KHZ)
   - Varying inter stimulus interval (ISI) between hearing the target tone and subsequent four tone sequence. ISI would be varied between 700ms, 1400ms, 2100ms, to reduce anticipatory button press.
   - Response time would be measured from the onset of the tone sequence and till participants press the button
   - Presentation of the next trial in the sequence would be initiated automatically after 3s in case of no response.

Data collection: will be done in recording room with adequate lighting using Laptop with Headphone

Scoring

- Mean reaction time and accuracy of the responses between CWS and CWNS would be scored using DMDX software and will be compared

Relaibility *:*

30% of the randomly sampled participants will be subjected to re-administration of the experiment, post 1 week of initial administration.

Data Analysis: Appropriate statistical procedures will be adopted for the analysis of the data.

6.0 Clinical Implications

The outcome of the current study will help the Speech Language Pathologists to enhance and update the knowledge on phonological encoding in children with stuttering in Indian context especially in Kannada speakers. Further the professionals would have better, global and comprehensive understanding of the fluency disorder. It might be useful in making the persons with stuttering much more aware of their problems and sensitize them towards understanding the nature of occurrence of stuttering. Considering the phonological encoding in children with stuttering during the assessment and management may be necessitated depending on the results of the study.

7.0 Ethics protocol

During all the phases of research ethical considerations/practices will be rigorously respected and scrupulously followed. Information gathered from all the files will be kept confidential. Written consent regarding participation in the study will be obtained from the participants/parents.

Phonological Encoding in Children with Stuttering

ORIGINALITY REPORT

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PRIMARY SOURCES

1	www.slp.utoronto.ca Internet Source	9%
2	Sasisekaran, Jayanthi, Alison Brady, and Jillian Stein. "A preliminary investigation of phonological encoding skills in children who stutter", Journal of Fluency Disorders, 2013. Publication	4%
3	Sasisekaran, J.. "Phoneme monitoring in silent naming and perception in adults who stutter", Journal of Fluency Disorders, 2006 Publication	2%
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6	Vandana, V. P.; Shyamala, K. C. and Jahan, Shafna. "Adaptation and Standardisation of Cognitive Linguistic Quick Test in Kannada	1%

(CLQT-K): Comparison between Monolinguals (Kannada) and bilinguals (Kannada-English)", Language in India, 2013.

Publication

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