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Case Study

Parent Implemented Language Intervention through Bluetooth Enabled Device: A Preliminary Investigation in Three Pediatric Patients

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Abstract

Over the past decades, language intervention programs have undergone several alterations as a result of changing demands and technological advancements, and rightfully so. With documented evidence suggesting success when parents take the lead in facilitating speech and language development, the aim of this study was to observe changes in parent interaction skills and communicative behaviours of children when a Bluetooth enabled mobile phone was used to deliver a parent-implemented language intervention. If effective, the Bluetooth-enabled method would eliminate the need for a speech-language pathologist's physical presence or interference during sessions. Three parent-child dyads participated in this descriptive case study. Each child was diagnosed with a pre-existing language disorder (with or without comorbid conditions). After detailed language assessment of the child and rating the parent skills using the Parent Rating Scale, each dyad underwent a training procedure for 3-5 sessions. The mothers were taught to modify their interaction through "PRIDE" skills. Post training, the dyads were observed and differences in parent interaction skills and child communicative behaviors were noted. Parents reported improved practice of the prescribed behaviours after Parent-Child Interaction Therapy sessions, indicating positive outcomes in all dyads. PCIT had a favorable impact on all three participants, as evidenced by improvements in verbal imitation, spontaneous verbal utterances, pragmatic skills, and behaviour regulation. This study's findings contribute to the expanding body of evidence that supports the use of PCIT in a variety of therapeutic settings. Focusing on parent abilities as key language stimulator can help with manpower concerns. Future research should focus on the generalization and maintenance of learnt behaviours and skills. The efficacy of the study protocol must be tested particularly for tele-therapy practices which will be useful in challenging times like the COVID-19 pandemic.

Keywords: PCIT; Parent-Child Interaction Therapy; Speech Therapy; Developmental Delays; Bluetooth Device; Pediatric Patients

Abbreviations

PCIT: Parent-Child Interaction Therapy; MLU: Mean Length of Utterance

Introduction

Language disorder is defined as "persistent difficulties in the acquisition and use of language across modalities (i.e., spoken, written, sign language, or other) due to deficits in comprehension or production, and language abilities that are "substantially and quantifiably" below age expectations as per the Diagnostic and Statistical Manual of Mental Disorders [1]. Shanbal and Reddy reported that around 11.5% of school-aged children had some form of communication disorders [2]. Among these, the distribution of language disorders (7.4%) was in more significant proportion as compared to speech disorders (3.8%) and multiple disorders (0.2%). Child language disorders often co-occur in association with neurodevelopmental disorders like Autism Spectrum Disorders, Learning Disabilities, Cerebral Palsy, Intellectual Disabilities, etc. and sensory deficits such as Hearing Loss. Arora and colleagues found 475 of 3,964 children (between the ages of 2 and 9 years) had at least one neurodevelopmental disorder (12.0%) [3]. Intervention for children with language disorders (with or without comorbid conditions) can be carried out using various approaches designed to focus on building language mediated through a speech-language pathologist. These approaches can be clinician-directed approaches, child-centred approaches, or hybrid approaches carried out in various setups (home, clinic, school, etc.) Traditionally, the clinician played a primary role in the therapy session, while the parent was expected to observe and replicate the same at home. It is not easy for parents to learn the language stimulation strategies by mere observation of therapy sessions.

Training parents to provide chances for their children to acquire novel language skills in everyday routines help the children practice language skills in relevant contexts [4] resulting in global expressive and receptive language improvement [5]. Such language interventions are referred to as "parent-implemented interventions". Heidlage and others indicated that parent-implemented language interventions might have positive effects on linguistic outcomes for young children with or at-risk for language impairment [5].

With the advent of technology, it is possible for speech-language pathologists to train parents without interfering in the therapy session. Hence, the present study aimed to observe the changes in verbal and non-verbal behaviour of children when parent implemented language intervention was provided using a Bluetooth enabled mobile phone.

Objectives of the study

- To compare changes in parent interaction skills using 'PRIDE' skills framework before and after parent training using Bluetooth enabled devices.
- To compare changes in communicative behaviours in children before and after language intervention through parent training using Bluetooth enabled devices.

Method

Participants

The study included three children who presented with a language disorder (with or without comorbid conditions). All child participants were accompanied by their mothers who were within the mean age range of 30 to 41 years. The demographic details of the children are given in table 1.

	Child 1	Child 2	Child 3
Age	3.11 years	4.7 years	6.11 years
Sex	Male	Male	Female
Medical diagnosis	Cerebral palsy	Nil	Idiopathic congenital hearing impairment
Developmental Motor Milestones	Delayed milestones along with weakness of lower limbs	No reported delay in milestones	Delayed milestones with muscle weakness.
Audiological findings	Right ear: Slight low-frequency hearing loss Left ear: Slight hearing loss with rising configuration	Bilateral hearing sensitivity within normal limits	Bilateral profound hearing loss

Psychological findings	Developmental delay	Average Intelligence	Mild intellectual deficits
Receptive language skills (REELS)	18 - 20 months	27 - 30 months	08 - 09 months
Expressive language skills (REELS)	09 - 10 months	27 - 30 months	08 - 09 months

Table 1: Demographic details of the patients.

The consenting dyads were included in the study; there were varied motivating factors for every dyad, for example, inability to commute, interest in trying a newer approach, perceived need for training for stimulation across settings.

Measures

The children in every dyad underwent a detailed assessment for communicative behaviors and the parental interaction skills were evaluated using the Parent Rating Scale [6]. The Parent Rating Scale is a four-point rating scale with ratings "never", "sometimes", "often" and "always" was used (see Table 2).

Does the parent	Never	Sometimes	Often	Always
Allow the child to choose toys.				
Follow what the child wants to do.				
Play down at child's level				
Wait for child to start the talk-with words, sounds, gestures or eye contact				
Give him/her extra time to talk				
Show that I am listening by repeating or answering him/her				
Commenting on what the child is doing, seeing, hearing				
Not asking questions				
Give verbal praise				
Talking slowly so your child can understand				

Table 2: Parent Rating Scale.

Training procedure

All three mother-child dyads underwent 3-5 training sessions in a clinical setup where the child and the parent were seated beside each other in a sound-treated room with a glass window through which the interaction was monitored by the therapist. A Redmi wireless Bluetooth headset, connected to Huawei Honor 5x mobile phone, was used by the parent to listen to the instructions from the clinician on the other side of a one-way mirror. The audio and video samples were recorded on separate devices (Samsung and Redmi HM 2LTE-IN mobiles, respectively). The therapy room had materials (storybooks, kitchen set, colouring book, clay, fishing and boating set and so on) selected based on the interest of the child. These materials were placed on a table at the corner of the room. A phone was placed inside the room for obtaining the audio sample for analysis. The mothers were taught to modify their interaction through "PRIDE" skills [7] as listed in Table 3. The clinician explained the rationale behind every strategy and its usefulness in increasing expected behaviours and reducing undesired behaviours.

	Strategies	Rationale of strategy
Praise	Praising your child	Increase confidence in communication skills. Positive reinforcement of verbal output is achieved.
Reflection	Commenting on what your child is doing.	Gives child access to contingent language input Accurate language model for children. Decrease pressure on child to speak
	Showing your child you are listening by repeating or answering.	Encourages interaction Confirm child's output- increases confidence in communicative ability. Greater enjoyment of interaction

Imitation	Following what your child wants to do with the toy.	Increases a child's attention and focus on play. Shares own focus with parents. Develops the sequence of play. Orders thoughts for re-play and language output.
	Showing your child you are listening by repeating or answering.	Encourages interaction Confirm child's output- increases confidence in communicative ability. Greater enjoyment of interaction
Description	Commenting on what your child is doing.	Gives child access to contingent language input Accurate language model for children. Decrease pressure on child to speak
	Talking slowly so your child understands	Increase processing time.
Enjoyment	Praising your child	Increase confidence in communication skills. Positive reinforcement of verbal output is achieved.

Table 3: Table of strategies and their rationale.

Note: The strategies and their rationale were adopted from the article with the permission of the authors "Assessing the effectiveness of parent-child interaction therapy with language delayed children: A clinical investigation. [6]"

The mothers were instructed to allow free play before implementing the instructions given by the clinician. Later on, mothers were allowed to freely implement the strategy that they learnt. In case of incorrect use of strategies, the clinician provided real-time feedback for modifications and reinforced the mothers for correct implementation through the Bluetooth enabled device. The mothers were counselled to practice the interaction at home and provide video samples for analysis. Over the sessions the therapist gradually reduced the amount of feedback given, expecting the parent to self-monitor.

Procedure and data analysis

Parent rating scale was administered once before the procedure began and once after completion of training. The audio and video recordings merged using the software - Adobe Premiere Pro. for analysis of mother-child interaction. These interactions were used to enumerate intentional communicative behaviours pre-training (first session) and post-training (last session).

The recorded videos were reviewed to find out changes in intentional communication behaviours (verbal and non-verbal).

Results

The following results were noted in the PRIDE skills (see Table 4). Based on the findings obtained from the Parent Rating Scale, the parents were noted to have significant reduction in their non-preferred language stimulation which mainly included questioning, commanding, and negative reinforcement. Now, with precise understanding and appropriate usage of the strategies, there were child specific positive changes noted in their interaction skills where they show increased willingness in following their child's intention and giving them time to express themselves. Along with this, description, imitation and dominance of positive reinforcement were noted which lead to better verbal output from their child.

	Dyad 1		**Dyad 2**		**Dyad 3**	
	Pre	Post	Pre	Post	Pre	Post
Allow the child to choose toys	Always	Always	Always	Often	Always	Always
Follow what the child wants to do	Often	Always	Always	Always	Often	Often
Play down at child's level	Always	Always	Never	Sometimes	Sometimes	Always
Wait for child to start the talk-with words, sounds, gestures or eye contact	Often	Often	Always	Often	Often	Always

Give him/her extra time to talk	Often	Often	Always	Often	Always	Always
Show that I am listening by repeating or answering him/her	Always	Always	Always	Always	Always	Always
Commenting on what the child is doing, seeing, hearing	Often	Often	Often	Often	Always	Always
Not asking questions	Sometimes	Often	Never	Often	Sometimes	Often
Give verbal praise	Always	Always	Often	Always	Always	Always
Talking slowly so your child can understand	Always	Often	Never	Always	Often	Always

Table 4: Parent Rating Scale Pre- and Post- Findings.

The changes observed in intentional communicative behaviors (see Table 5) were quantified based on the number of verbal and non-verbal behaviors depicted in Figure 1. Use of vocalizations, protowords, true words, and phrases were considered verbal communicative behaviors while the facial expressions, gestures, and use of manual signs were categorized as non-verbal communicative behaviors. For Child 1, an overall increase in communicative behaviors was noted with an exceptional increase in use of verbal utterances. Child 2 exhibited significant increase in verbal output as well as a more diverse range of pragmatic functions at the end of 5 sessions. In case of child 3, there was a quantitative decline in non-verbal communicative behaviors with the frequency verbal communicative skills remaining constant compared to the pre-training session. The possible reasons for this decline will be discussed in the next section.

		Child 1				**Child 2**			**Child 3**			
		Pre		**Post**		**Pre**	**Post**		**Pre**		**Post**	
Pragmatic functions	Mode	Frequency	MLU	Frequency	MLU	MLU	Frequency	MLU	Frequency	MLU	Fre-quency	MLU
Protesting	Early sounds	3		4								
	Screams and whines											
Demand to continue an action	Facial expression & smile	5		7								
	Squeal, coo and fuss			31								
	Vocalisa-tions			41								
Request more of an action	Facial expression & smile											
	Squeal, coo and fuss											
	Early sounds											
	Verbally-Word/ Phrase	6	1									

Refuses or rejects something	Body movements						1		5		1	
	Simple gestures											
	Conventional gestures						1					
	Verbally-Word/ Phrase											
Requests more of an object	Body movements											
	Gestures											
	One word utterance											
	Phrases					2	2	2				
Makes choices	Gestures								1		2	
	One word utterance											
	Phrases					2.0-4.0						
Requests a new object	Gestures											
	One word utterance						1					
	Phrases					3	1	2				
Requests attention	Gestures											
	One word utterance											
	Phrases					2						
Directs adult attention to something	Conventional gestures								15		8	
	Abstract symbols						3					
	Verbally-Word/ Phrase											
Labelling	Mimics sound of object						7					
	Gestures								3			
	Pantomiming actions								2			
	Rote learnt utterances											
	Spoken word						20				14	
	Phrases					2.0-3.0	3	2				

Offers things or shares	Gestures											
	One word utterance						1	1				
	Phrases											
Asks question	Gestures											
	One word utterance											
	Phrases						2	2.0-4.0				
Answers yes/no questions	Body movements											
	Simple gestures											
	Manual sign								1			
	Conventional gestures								3		1	
	Verbally-Word/ Phrase											
Makes comments	Gestures								20		2	
	Pantomiming actions								14			
	Mimics sound								1			
	Spoken word						3		12			
	Phrases						15	2.0-3.0				

Table 5: Intentional Communicative Behaviors Pre- and Post- Training.

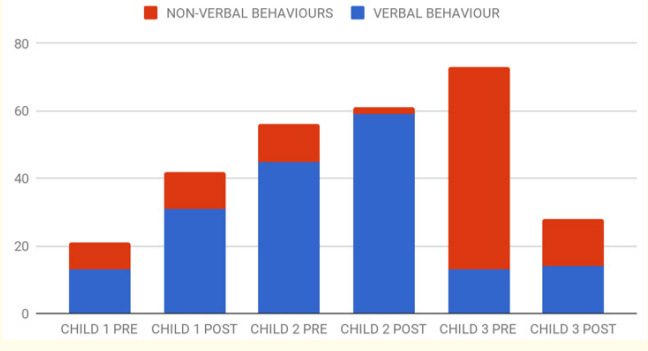

Figure 1: Verbal and Non-verbal Behaviors Pre- and Post- Findings.

Discussion

Three clinically distinct children and their parents were considered for this study. The aim was to check for effect of parent interaction training on child's language behaviors using PRIDE skills through counseling and real time-feedback from the clinician.

Parent-child interaction skills

The following as reported based on the Parent Rating Scale findings (see Table 4).

Parent 1

Pre-training report

The parent was observed to use an indirect method of interaction; need for modification was identified with respect to relying

on use of too many questions, speaking at a slower pace for better understandability at all times and infrequency in following the child's lead during play.

Post-training report

There was a positive increase in having the child lead interactive activities. The parent was observed to use description (extension and expansion) and commands along with relevant requests for information, without excessive questioning, in a well-balanced proportion. The parent also provided increased waiting time for the child to respond and used positive reinforcement strategies.

Parent 2

Pre-training report

It was inferred that the parent was overly dependent on the child to initiate interactions with objects/activities of his interest. The parent seemed to wait and give the child extra time to talk with no prompting or perlocutionary responses. The parent did not modify the setting or behavior for better interaction with the child (i.e., speaks slowly, play down at the child's level). Reinforcement was done in the form of verbal praise.

Post-training report

The parent had begun to initiate more structured forms of interactions at the child's level while choosing some activities themselves, speaking slowly and prompting for responses when needed more frequently. There was a drastic decrease reported in using questions for facilitation of a response. Positive reinforcement strategies were also reported to be used consistently.

Parent 3

Pre-training report

The parent reported to play down at the child's level only sometimes. Asking for information was the primary strategy to create opportunities for the child to communicate. The parent-child interactions were mostly initiated by the parent and no communication strategies to enhance comprehension were used.

Post-training report

Post training the parent reported that there was an increase in interactive activities at the child's level and rate of speech was altered for ease of comprehension. The parent was able to use more descriptive modeling strategies instead of use of questions to increase opportunities for the child to communicate. It was also reported that the parent waited for the child to initiate interaction when there was an obvious need to do so.

Intentional Communicative Behaviors (refer Table 5)

Child 1

Pre-training observations

The 3 years 11-month-old male, was diagnosed with a receptive and expressive language delay associated with cerebral palsy. On assessment, it was found that he could comprehend simple one-step commands, identify family members, a few body parts, most commonly used objects like spoon, plate, glass, etc. along with their use.

On pre-training observation of the child, it was noted that the child used a combination of both verbal and non-verbal modes to protest, demand continuation of an activity and request more of an action. The verbal behaviour was limited to naming parents while the non-verbal behaviours were basic, primitive acts. It was evident that it was a need-based form of communication.

Post-training observations

The child showed overall qualitative improvement in pre-linguistic behaviours. Verbal imitation of parent utterances emerged. Gradual increase in sitting tolerance, task compliance, and increased attention and concentration span was present.

The above-mentioned changes were a result of a three-day intensive in-session and post-session coaching. The carryover of these skills was planned to be monitored through tele-mode since the dyad was unable to continue the regular sessions due to personal reasons.

When the pre- and post- training recordings were compared for pragmatic functions, the child was found to have increased frequency of both verbal and non-verbal communicative behaviours. The verbal form of indication to continue an action increased from 13 to 31 instances, this could be as a result of the child's increased compliance to overall exploration and play.

Child 2

Pre-training observations

The 4 year and 7-month-old male was diagnosed with receptive and expressive language delay associated with no comorbidities.

He was able to follow two step commands, identify common lexical items under categories such as animals, vegetables, fruits, body parts, and most commonly used objects along with their use. He was also able to identify colours.

He was able to request attention and more of an object/new object, make choices, refuse, direct adult's attention, label objects in immediate environment and recite part rote learnt verbal utterances (alphabets and numbers). He used 2.0 - 4.0 mean length of utterance (MLU) to do so. He was predominantly a verbal communicator.

Post-training observations

There was an increased duration of sitting tolerance with improved attention and concentration skills over the five days of training. The parent interaction was modified by recommending strategies relevant to the dyad, i.e., imitation, description and positive reinforcement while maintaining frequency of use of commands and questions.

On analysing the post-training session, pragmatic functions - refusal or rejection, directing adult's attention to something, offering things or sharing, asking for information and making comments were found to be present. The child also used newly emerged exclamations like 'wow' and 'ahha'. Overall increase in frequency of verbal utterances was also noted with similar MLU as in pre-training. Use of strategies that the parent was trained for had a higher influence on the child's communicative function compared to other dyads. This might be attributed to absence of comorbidities.

Child 3

Pre-training observations

The 6 year and 11-month-old female was diagnosed with receptive and expressive language delay associated with congenital hearing impairment and mild intellectual deficits. She could follow simple one step commands with gestural instruction, identify family members, body parts, and commonly used objects along with their use. She communicated through instrumental use of caregivers, pointing, and vocalizations.

The child used non-verbal mode of communication for refusal/rejection, to direct others' attention, to label, answer yes/no questions and make comments. The non-verbal communicative behaviours were in the form of body movements, conventional gestures, pantomiming actions and rare instances of use of manual signs. Occasional use of single word utterances were also noted to make comments.

Post-training observations

There was an overall improvement in pre-linguistic behaviours over the sessions. The parent was able to facilitate use of communicative behaviours as guided by the clinician. The parent's interaction skills were modified so as to facilitate verbal communicative behaviours through imitation, description, and reinforcement while continuing to ask questions and give commands.

The child showed almost equal number of verbal utterances pre-training. The frequency of intentional communicative behaviours was found to be reduced in the fifth session owing to inconsistency of communicative behaviours of the child over the training period. One of the reasons why post-training communicative behaviours in general might have reduced is due to the parent's choice to focus on labelling skills as the child showed promising one-word responses verbally, though the child could elaborate gestures and the same could be modified for even complex communication. This reinforces the need to consider the communicative performance across settings to decipher the true effectiveness of PCIT.

When parents opt to follow their child's lead, children with developmental delays, behavioural disorders, and communication difficulties improve their language abilities specifically: "verbal initiations, MLU and the proportion of child-to-parent utterances" [8,9]. We found that short term intervention resulted in significant communicative progress of the dyad. PCIT is known to increase parent knowledge about the role of language input [8], particularly their language stimulation methods and interactive skills as evident from our observation of the PRIDE skills. Parent-Child Interaction Therapy has been documented to be effective in increasing reported daily practice of special play time in as few as 5 sessions [10] and improved parents' abilities to change their linguistic behaviours in a short period of time i.e., during the intervention [11] as noted for Dyad 2 in this study.

The parents reported increased practice of the suggested behaviors post PCIT sessions. PCIT had a positive effect on all three participants, evidently on parameters: verbal imitation, increased spontaneous verbal utterances, improved pragmatic skills and behavior regulation. These findings are consistent with other studies

that report improvements in the children's mean length of utterance, the ratio of time of child to parent speech were found after the therapy [12,13].

Klatte and Roulstone reported that PCIT is applied in a range of methods by speech and language pathologists (SLPs) depending on "organizational constraints, family needs and practicalities" [14]. PCIT is valued by SLPs, yet it is difficult to implement. Lim and colleagues investigated challenges in service delivery in the area of speech language pathology across Australia and Canada [15]. The challenges reported were disparity in SLP demand and availability, and poor involvement of the caregivers. Likewise in India, issues regarding awareness, accessibility, availability, and affordability of the rehabilitation services have been documented in states like Goa, Kerala and Rajasthan [16-18]. Through internet-based PCIT, speech-language pathologists can overcome these challenges.

Conclusion

The findings of this study add to the literature supporting use of PCIT to diverse clinical population. Adequate modifications can be made to the protocol to suit the needs of every caregiver-child dyad aiding in increasing efficiency of speech-language intervention services in a country such as India. Issues regarding accessibility to services and availability of manpower can be overcome by rationing the intervention session and capitalizing on parent skills as primary language stimulators.

The study needs to be replicated with higher number of participants and varying clinical profiles. Future studies must investigate generalization and maintenance of learned behaviours and skills. The effectiveness of the protocol used in the study must be tested when applied to tele-therapy.

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