

Pennington L.

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Cerebral palsy and communication

Lindsay Pennington, PhD
Clinical Medical Sciences (Child Health)
Newcastle University
Sir James Spence Institute
Royal Victoria Infirmary
Newcastle upon Tyne
NE1 4LP

Tel: 0191 202 3006

Fax: 0191 202 3060

Email: lindsay.pennington@ncl.ac.uk

Abstract

Children with cerebral palsy often experience problems in developing clear, intelligible communication, due to difficulties producing speech, gesture and body language, and language delay. Motor, sensory and cognitive impairments underlie children's communication problems. This paper describes the communication disorders commonly experienced by children who have cerebral palsy. Assessment procedures used by speech and language therapists are described, along with descriptions of interventions used to address the disorders.

Key words:

Cerebral palsy; children; speech; child language; communication; nonverbal communication; communication aids for disabled; reading; dyslexia; parents; speech therapy; speech-language pathology

Communication

Communication is the transfer of information from one person to another, and depends on both communicators being able to send and receive messages. Messages may be conveyed using a variety of methods / communication modes:

- Vocalisation: sounds produced by the vocal tract that are not words;
- Speech: sounds produced by the vocal tract that are recognisable words;
- Gestures: recognisable movements that are symbols representing words or concepts, e.g. shrugging shoulder to indicate “I don’t know”, raising eye brows to indicate surprise;
- Body movement
- Writing

Requests relating to objects within the immediate environment and yes/no answers can be communicated by simple movements or vocalisation, but language (i.e. the expression of meaning through words) is needed to communicate more complex information. Language can be conveyed through speech (spoken language) or writing (written language). To receive messages and decode information, skills are needed in visual perception, speech perception and understand spoken and written language.

In addition to the ability to send and receive messages, for face to face communication to occur successfully communicators must also obey the rules of interpersonal interaction. These rules include: conveying messages succinctly, in a way that will be understood by the listener; responding to a speaker without delay; and not speaking or conveying a message when someone else is doing so. It takes time for children to learn these rules, but by 3 years of age children usually take an equal role in interaction, taking as many turns as adults, initiating conversations and responding to those started by others. At 3 years children following the typical pattern of development have also learned to use communication to express all types of intentions commonly found in adult conversation. These intentions are called communication functions and include: requesting joint attention, requesting information, requesting objects and actions, providing information, asking for clarification when a speaker’s message has not been heard or understood, repeating or revising messages when they have not been heard; and the simple skills of responding to questions with yes/no answers, protesting and greeting. To take part fully in interaction, children need to be able to start conversations, respond to those of others and express all the functions listed above.

Cerebral palsy

“Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behaviour, by epilepsy, and by secondary musculoskeletal problems”¹.

Children with CP may have difficulties in communication acting as a sender and/or a receiver of messages as a result of the impairments arising from damage to their neurological systems. Motor impairments can limit the intelligibility of speech and

gesture and the ability to write using either a pen or a computer. Cognitive impairments can cause delayed spoken and written language development. Visual impairments can affect language development and interpersonal interaction. Hearing impairments affect speech development, and spoken and written language. Epilepsy may be associated with language disorder. Communication development may also be affected by reduced experience of the world and limitations in activity imposed by the impairments above. This paper will describe the common communication difficulties associated with the movement and cognitive disturbances of CP, the assessment procedures used to assess their severity and interventions used to reduce their impact on children's development. The information will be pertinent to children with mild-moderate sensory impairments; however, readers are directed to literature on visual impairment and deafness for information on the development of communication by children with severe sensory impairments.

Communication difficulties associated with CP

Speech

Speech production relies on the function of several subsystems: respiration, phonation, nasality (controlled by velopharyngeal movement to close off the nasal passages during speech) and articulation. Motor speech disorders are classed as dysarthria and can reduce control of any or all of these subsystems and their coordination. Dysarthric speech is characterised by shallow, irregular breathing with children speaking on small, residual pockets of air; low pitched, harsh sounding voice; hyper-nasal speech with audible escape of air through the nose during speech; and poor articulation. Disorders can range from mild, with slight slurring of words and breathy voice, to profound with an inability to produce any recognisable words. Dysarthria can be associated with all types of CP⁴, difficulties are more often reported in children with dyskinetic than spastic types, and in children with spastic type CP difficulties are more often observed in children with wider distributions of motor impairment^{4,5}. However, associations between speech disorder and motor impairment distribution are not clear cut.

Children with cerebral palsy may also experience phonological delay or disorder, or dyspraxia (in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits). However, with the exception of children with Worster Drought, these disorders are not a direct result of CP and increases in prevalence of speech disorders other than dysarthria have not been noted for children with CP in research to date.

Language

Children with CP may experience delayed language development as part of their cognitive disturbance, or as a result of their lack of interaction with their world and reduced world experience. Language disorder has not been associated with CP in research to date.

Communication

The motor disorders of CP can affect children's production of speech, facial expressions, gestures and body movements and reduce their ability to act as effective senders of communication signals. Children may have difficulty in initiating movements and movements may be inconsistent, varying in speed, range and strength. The signals may be produced too late in conversation, may vary from one occasion to

the next, and may look and sound different to those produced by children without motor disorders. As these differences make children's communication difficult to interpret parents may arrange their own communication around the few signals they can understand. Parents of children with motor disorders often lead conversation, and children adopt a respondent role. A pattern of conversation is often observed in which repeated short exchanges occur: parents ask questions or request children to perform activities; children respond; parents follow up the responses with a brief acknowledgement and then ask another question or make another request. Children rarely make requests of their own and take very little control over conversation. With such patterns of conversation children with motor disorders are at risk of becoming passive communicators and often fail to develop a full range of communication skills. As active and enquiring communication is needed to engage fully in social and education activities, children with motor and communication disorders are also at risk of exclusion.

Reading and spelling

Some children with motor speech disorders have been found to have severe difficulties in learning to read and spell. Research currently suggests that difficulties may be due to problems in covertly manipulating letter sounds, in working memory, to decode (read) and form (spell) words. However, research to date has involved small groups and many potentially confounding variables have not been investigated. Further research is needed to determine the potentially multiple causes of children's literacy problems and to develop possible subgroups of children who have written language difficulties.

Prevalence

Research shows that CP affects approximately every 2/1000 live births.² However, there is a dearth of information about communication development in children with CP. We know that about 40-45% of children with CP have been observed to have speech/communication difficulties at 8-13 years.³ However, it is not clear whether difficulties relate to speech, language and/or communication. Current understanding does not allow us to predict either which children will have speech / communication disorder or children's speech intelligibility. Severity of speech disorder is rated in only one study to date, several studies conflate speech, language and communication and all are single observations of children in middle childhood^{4,6}. Further research is currently needed to show the prevalence of speech, language and communication disorders in children with CP and to investigate the characteristics of children with persisting communication disorders.

Assessment and diagnosis

If children's speech, language and/or communication do not appear to be in line with their cognitive and motor skills referral should be made to a speech and language therapist (SLTs), who can diagnose type and severity of disorders and recommend tailored intervention. Assessment will depend on children's age, type of communication disorder and the severity of their motor, cognitive and sensory impairments. For most children with CP some assessment of their oro-motor function, their ability to produce speech, their understanding and use of spoken language (receptive and expressive language skills) will be undertaken. Ability to communicate needs and ideas will also be investigated for younger children and those with severe speech disorder. Older children's ability to read and spell may also be investigated.

Oro-motor function

In children below two years of age oro-motor function is difficult to assess, except in relation to eating and drinking, which is beyond the scope of this paper. In older children oro-motor investigations can differently diagnose dysarthria and dyspraxia, and can help determine the severity of these disorders. Assessment may be informal or follow a standard protocol, such as in the Verbal Motor Production Assessment for Children⁷. In the assessments children are asked to produce movements of body parts used in speech (mandible, facial muscles, lips, tongue) in single and coordinated movements. The range, speed and consistency of movements are observed. General motor control of the respiratory and oral tracts is observed, and the presence of oral reflexes is tested.

Speech

The aim of oro-motor assessment is to diagnose the presence and type of dysarthria and the presence of dyspraxia. However, there is no direct relation between ability to produce oral movements in isolation and the ability to produce intelligible speech⁸. Of maximum importance for children and their families is children's ability to produce clear speech that others can understand. Therefore, emphasis is placed on examination of children's speech production in any assessment.

As speech production relies on the function several subsystems (respiration, phonation, nasality, articulation) assessment of children's usual performance and capacity to control each speech subsystem in speech is undertaken. Assessment involves the examination of the function of each subsystem individually, and the coordination of these subsystems for the production of continuous speech. For example: as part of the assessment the child might be observed at rest to examine their breathing pattern, and asked to control their breathing to make their exhalations longer; they might then be asked to say 'ahhhh...' to observe if they can coordinate respiration and phonation; to say 'ah' louder to observe if they can coordinate phonation with increased respiratory pressure; to say 'ah' repeatedly, to test if they can combine respiration with on and off phonation; to say 'ah' with rising or decreasing pitch, to assess the coordination of respiration and changing laryngeal height in phonation; to say 'far' and 'car' to observe effect of increased articulatory movement; and to say words containing 'ah' in sentences of different length and intonation to assess the effect of increased length and complexity of utterance.

Unfortunately, at present there is no published reliable and valid paediatric dysarthria assessment protocol, and investigations are informal and differ between therapists and the children they see. However, a wide array of published assessments are available determine the range of speech sounds (phonemes) that children can produce in single words and continuous speech, allowing the articulation part of the assessment to be replicated.

In addition to examining the control and coordination of speech production subsystems, and system as a whole, assessment should also include investigation of the function of the system with an evaluation of intelligibility. Intelligibility can be measured objectively using published protocols, such as the Children's Speech Intelligibility Measure⁹. In such protocols children are recorded saying single words and sentences, recordings are played to listeners who write down the words they hear,

and percentage intelligibility is calculated from the words perceived correctly. Alternatively, subjective ratings of intelligibility (ability to understand more than 75% of a child's speech, between 50 – 75%) can be made. However, although these methods are quicker than objective measures, they are less reliable and may be less useful in evaluations of therapy success.

Language

In many cases standardised assessments of receptive language can be used to test the development of children with CP, especially for older children. For some children administration of tests may need to be modified, to accommodate activity limitations. For example, in a test demanding the child to point to one of four pictures, children may respond to items by the clinician scanning the pictures in a clockwise fashion and the child indicating 'yes' when the clinician reaches the target picture. However, when modifications to tests are used the impact of the increased cognitive load involved should be considered. In the modification above, in addition to scanning the pictures, comparing them with the test item, and making their choice as other children do, the child will also have to keep concentrating on the target and control their body movements to indicate 'yes' at the correct point. With such adaptations test scores must be interpreted with caution and standardised scores cannot be used.

For children with mild speech disorders any test of expressive language may be used. For children with more severe speech disorders expressive language testing, other than calculating the mean length of utterances in words, may not be possible. Children may speak in shortened sentences and omit grammatical markers, either as a strategy to increase intelligibility or because phonetic contrasts cannot be produced.

Communication

As communication involves the sharing of thoughts, feeling and ideas between at least two people it is essential that assessment of children's communication considers not only how and what the children are communicating, but also what opportunities they have to communicate, and investigates the factors in children's environments which might limit their communication activity. For children with severe motor disorders and/or cognitive impairments, whose communication is often nonverbal, sometimes pre-intentional, and usually idiosyncratic, assessment will involve detailed observation of the children in their usual activities, to investigate the methods children are using to communicate, what prompts them to do so and what responses to communication they receive. Children's acquisition of communication skills not observed in everyday conversation can be directly tested by clinicians offering children opportunities/temptations to use target communication skills in play situations (REFS). Parents' and teachers' views on children's communication skills can be elicited through interview and use of protocols such as the Pre Verbal Communication Schedule. Using a combination of observation, interviews and direct testing clinicians can examine children's usual communication performance and their capacity, and observe the impact on the communication environment on children's performance.

Reading and spelling

Children's reading and spelling, and the neuropsychological processing underlying these activities, can be assessed using neuropsychological and traditional literacy

tests, many of which can be adapted for children who are functionally nonspeaking. Tests of reading and spelling must be accompanied by assessments of children's nonverbal and language processing, and assessment of their visual processing. Hence, assessments relating to literacy may be carried out by a number of different professionals. The aim of testing is to ascertain whether the child has a specific difficulty in reading and spelling, and to examine the profile of strengths and difficulties in cognitive processing for reading and spelling.

Intervention

The aims of speech and language therapy for children with cerebral palsy are to maximise children's intelligibility and to help them to take a full and active role in communication. Many children with cerebral palsy will use multiple methods to communicate: speech, vocalisation, gesture and body language, and perhaps augmentative and alternative communication (AAC) systems and/or written language. For most children a 'total communication approach', in which any intelligible communication is accepted, is advised. To ensure that each method of communication is maximally intelligible intervention may address speech, language, interaction patterns (Communication, below) and/or reading and spelling. Therapy to foster the development of receptive and expressive spoken language follows the same principles and practice as therapy for children without motor disorders and is discussed in this paper only in relation to AAC.

Speech

Therapy to reduce motor speech impairments experienced by children with CP, and the intelligibility limitations these impairments impose, has been advocated in dysarthria texts. A whole system approach that targets breathing, phonation, nasal resonance, articulation and pitch control is commonly described, and is similar to intervention for adults with acquired dysarthria. Treatment aims to help children control their breathing and maintain adequate air pressure to sustain speech across a phrase. This may, for example, involve teaching children how to start to speak at the beginning of exhalation and how to split utterances into smaller phases in which they can maintain adequate volume. Intervention also involves slowing children's speech rate and increasing background effort, to allow larger and more precise, definite movement of muscles in the oral tract. Treatment for articulation is only advised when other aspects of speech production have been/are being addressed. Imprecision of speech sounds, perceived as an articulation problem, is often due to lack of air pressure to make the sounds audible, movements being made too quickly when children are speaking on residual air, and insufficient muscular effort to maintain clear articulation across an utterance. Thus, more precise articulation and improved intelligibility is achieved through developing control of breathing for speech, maintaining background effort and slowing speech rate.

Although the approaches to dysarthria treatment for children with CP have been well documented there is a dearth of evidence of their effectiveness. Two small scale studies by researchers in the UK and US, using the approaches described above, have recently been published and have shown promising results with increases in intelligibility and sound pressure level (volume) of speech. A further pilot study is currently underway. Large-scale, definitive trials of the interventions are needed to demonstrate their generalised effectiveness for children with dysarthria. Outcomes must be evaluated not only in terms of relative increased intelligibility and speech

volume, but also in regard to their impact on children's communication activity and participation.

Communication

Intervention to promote the communication development of children with CP starts early in children's lives. It aims to establish positive communication for parents and children, in which both expect to send and receive messages, and which can be used as a basis from which children can be taught further communication skills.

Intervention often focuses on the child and their parents as a unit. Parents are taught to look for children's communication signals and to determine their meaning by considering actions that preceded the child's behaviours. Parents are also taught about the potential impact of their own actions on their child; for example, how asking lots of questions when they do not understand their child may preclude the child from communicating spontaneously; and how to engineer conversation to prompt their child to use all of the communication signals they have available, as often as possible.

A further aim of intervention is to teach children to use a wide a range of communication functions as possible, using their natural methods of communication. This can involve operant techniques, and may be carried out by a therapist or assistant or by training parents to carry out the teaching. Often the first skill to be taught is the ability to request objects in the immediate environment, for example by vocalisation, eye pointing or leaning towards a favourite toy when a small selection of objects is placed in view of the child. Using such requests is cognitively simple and brings instant reward. They also help children to become more active and independent in conversation.

AAC (heading c)

For children whose intelligibility is severely limited as a result dysarthria augmentative and alternative communication, to supplement their natural modes of communication, should be considered. For children unable to produce many recognisable words AAC may be their only chance to produce expressive language, and communicate ideas, feelings and thoughts other than basic requests for objects in their immediate environment and responses to others' questions. The choice of system introduced depends on children's motor, cognitive and visual skills. Simple systems involve small number of photographs of objects within the child's home; more complex symbol systems represent not only objects, but also actions, and more abstract concepts such as feelings and descriptions.

AAC systems are provided to supplement, rather than replace, children's natural modes of communication. They enable children to express the same functions of communication as through their natural communication modes, but extend the range topics. For example, using an AAC system a child may be able to request items that they cannot see and to which they cannot gesture. AAC systems also provide the means to express new communication functions, such as repairing conversation by giving a message in a different way, using new vocabulary. They also allow children to express longer messages, combining words and using grammar if appropriate. However, children need to be taught how to use new vocabulary and communication functions via AAC. And, as communication partners influence children's engagement and activity in communication they should be taught how the AAC system works and how the child can use it to take an active part in conversation.

Using AAC systems can be cognitively complex. Symbol books and voice output aids require children to remember where items are stored and how to access these items. This can involve turning a page in a communication book, or moving between screens on a digital device. Children who use switches to operate their communication aid, or use an assistant to turn the pages of a communication book, have additional cognitive requirements to access the items in their AAC systems.

The teaching of communication skills is a team endeavour, and is usually undertaken by speech and language therapists, with parents, early interventionists, teachers and education assistants. The introduction of AAC also relies on this team, but will also include occupational therapists to advise on the positioning of AAC equipment and the best method of access.

Reading and spelling

Expected level of literacy development will depend on cognitive and sensory processing. Children may be expected to learn to “read” using the symbols of their AAC system, to have a small sight vocabulary, which they learn through operant teaching, or to decode letter sounds from printed words. As discussed above, some children with CP have specific problems in processing text for reading and spelling. There is currently debate regarding the best way to teach these children to read and spell.

Key Learning Points

- **Children’s speech, language, communication, and reading and spelling can be affected by cerebral palsy.**
- **Children with communication problems are at risk of social exclusion.**
- **Intervention aims to foster independent, active communication.**
- **Augmentative and alternative communication (AAC) systems can supplement natural modes of communication, increasing children’s access to language**
- **Effective communication via AAC can be complex, involve significant cognitive load, and takes considerable time to learn.**