

Institution: Newcastle University		
Unit of Assessment: UoA 4		
Title of case study: A motor learning approach to speech therapy for children with cerebral palsy underpinned UK guidance and international teaching practice		
Period when the underpinning research was undertaken: 2006-2015		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Dr Lindsay Pennington	Reader in Communication Disorders	2008-present
Professor Nick Miller	Professor of Motor Speech Disorders	1994-2018
Professor Luke Vale	Professor of Health Economics	2011-present
Ms Denise Howel	Medical Statistician	1992-present
Dr Nick Steen	Medical Statistician	1994-2018
Ms Elaine Stamp	Medical Statistician	2006-2018
Ms Sheila Robson	Research Associate	2010-2015
Ms Ella Roelant	Research Associate	2010-2012
Ms Vicki Thompson	Research Associate	2012-2013
Ms Rose Mary Watson	Research Associate	2010-2020
Period when the claimed impact occurred: 2017-present		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact		
Over 10,500 children in the UK with cerebral palsy are affected by dysarthria, a group of speech disorders that result from poor control of muscles of the chest, throat, face and mouth. Newcastle research investigated the benefits of intensive speech therapy, based on motor learning theory, which focused on breath control. Significant increases were found in children's intelligibility, increasing their confidence and improving participation in communicative interactions. This research informed UK NICE guidelines and has already started to change practice to focus on effective therapies. In addition, the research has underpinned international undergraduate teaching and a widely-used textbook.		
2. Underpinning research		
<u>Background</u>		
Dysarthria refers to a group of speech disorders resulting from abnormalities in the strength, speed, range, steadiness, tone or accuracy of movements required for control of the respiratory, phonatory and articulatory aspects of speech production¹. It is commonly seen in children with cerebral palsy (CP): of the 30,000 young people in the UK with CP², around 35% (10,500) are affected by dysarthria arising from their motor disorders (R4). However, at the outset of research there was little evidence of the effectiveness of therapy for dysarthria and little guidance on therapies that were effective.		
<u>Newcastle research into breath control for improved intelligibility in children with dysarthria</u>		
Newcastle therefore investigated the effectiveness of therapy that focuses on improving breath control, since this is the foundation of speech. The research used a Speech Systems Approach underpinned by motor learning theory, where improvement in motor ability is due to repetition and experience. The therapy does not propose a cure or aim to change the underlying impairment: rather, it offers strategies to improve speech quality in children with dysarthria. The novelty of the research was to build on knowledge of a therapy designed for dysarthria acquired in adulthood to childhood dysarthria for the first time.		

¹Motor Speech Disorders - E-Book: Substrates, Differential Diagnosis, and Management. Duffy, 2013, page 4.

²<https://thepacecentre.org/information-centre/stats-facts/>

The initial paper (R1) studied the effect of intensive therapy to increase breath support in six young people with CP, and found improved intelligibility at the single word level. This success led to a later study (R2), which investigated a Systems Approach to controlling breath support, phonation (vibration of the vocal folds to create voice) and speech rate in 16 children aged 12-18 years. Children received 18 sessions of individual therapy, which focussed on 1) practising coordinating the onset of speech with the beginning of exhalation, 2) maintaining breath support to produce a clear voice, and 3) maintaining a steady rate whilst speaking to allow accurate articulation. The study found that intelligibility generally increased for most children, and that changes were maintained throughout the six-week follow-up. The increase in intelligibility was seen in both single words and across connected phrases, and for listeners both familiar and unfamiliar with each child's speech. In addition, therapy was found to be acceptable to the children, and 14/16 rated therapy as "definitely helpful". The next study (R3) investigated this therapy in 15 younger children aged 5-11 years following the same protocol and motor learning basis. Overall, intelligibility increased for both single words and connected speech, and this improvement was maintained for 12 weeks without further therapy. In this group, intelligibility increased in all children for familiar listeners, and in some children for unfamiliar listeners. Parents were asked to rate the effectiveness, and all 12 who responded rated the therapy as effective. A further finding was that, after therapy, children participated in more communicative interactions and required less help to do so.

Despite the clear benefit of therapy for dysarthria, a survey of current practice (R4) found that the assessment and management of dysarthria associated with childhood CP varied widely across the UK. In response, Newcastle researchers worked with a range of bodies to include this new knowledge in textbooks, guidelines and teaching syllabuses: the impact of this is described below.

3. References to the research

SciVal field-weighted citation impact (FWCI) as of December 2020. Newcastle researchers in **bold**.

- R1. **Pennington L, Smallman C, Farrier F.** (2006) Intensive dysarthria therapy for older children with cerebral palsy: Findings from six cases. *Child Language Teaching and Therapy*. 22(3):255–73. DOI: 10.1191/0265659006ct307xx. FWCI: 0.26.
- R2. **Pennington L, Miller N, Robson S, Steen N.** (2010) Intensive speech and language therapy for older children with cerebral palsy: a systems approach. *Developmental Medicine and Child Neurology*. 52(4):337-44. DOI: 10.1111/j.1469-8749.2009.03366.x. FWCI: 1.61.
- R3. **Pennington L, Roelant E, Thomson V, Robson S, Steen N, Miller N.** (2013) Intensive dysarthria therapy for younger children with cerebral palsy. *Developmental Medicine and Child Neurology*. 55(5):464-71. DOI: 10.1111/dmcn.12098. FWCI: 2.56.
- R4. **Watson RM, Pennington L.** (2015) Assessment and management of the communication difficulties of children with cerebral palsy: a UK survey of SLT practice. *International Journal of Language and Communication Disorders*. 50(2):241-59. DOI: 10.1111/1460-6984.12138. FWCI: 2.17.

4. Details of the impact

Newcastle research found a substantial benefit of breath control therapy on the intelligibility of young people with CP affected by dysarthria. Since breath control is fundamental to clear, intelligible speech, Newcastle recommended this as the first line of therapy before, for example, improving articulation.

Impact on NICE guidance

At the outset of research, there was little guidance on effective therapies. Newcastle research underpinned the chapter on improving speech intelligibility in the January 2017 full NICE guideline NG62 (EV1). For example, R2 and R3 are cited on pages 232-5 as the only studies that investigated improvement of speech production and intelligibility for both single words and connected speech when rated by both familiar and unfamiliar listeners. The guideline also highlighted the finding of R3 that treatment improved children's communicative participation in

interactions at home and school. This evidence led to the following recommendation in the accompanying concise guideline on assessment and management (EV2, page 20):

1.9.6: “Offer interventions to improve speech intelligibility, for example targeting posture, breath control, voice production and rate of speech, to children and young people with cerebral palsy...”

Impact on practice

In 2019, a survey was distributed via the Royal College of Speech and Language Therapists with the same question set as the initial survey (R4, carried out in 2012) to assess change in practice (EV3). Overall, the results suggest a reduction in provision of two types of therapy that Newcastle found to be ineffective or inappropriate (R1-3). The first type is non-speech oromotor interventions (e.g. blowing, moving the tongue in different directions on command); since neural control is specific, this therapy should not improve speech production. The second is articulation therapy, which can only be provided once breath control is sufficient to support speech. Specifically, there was a significant reduction in the proportion of therapists providing these interventions compared to 2012: from 70% to 43% for non-speech oromotor interventions and from 87% to 77% for articulation interventions, indicating a reduction in the use of interventions with limited effectiveness. The proportion of therapists stating that they targeted the speech functions specified by NICE was over 90% in both 2012 and 2019, indicating that therapists now focus their limited time on more effective methods.

In addition, the therapy has been found to improve children’s confidence, allowing them to have more successful conversations, with a wider range of partners in more environments, thereby increasing their social participation (EV4).

Impact on Australian online guidance

In June 2016, the Australian Cerebral Palsy Alliance included R1-3 as evidence on their webpage “Speech therapy for children with dysarthria” (EV5), which has around 250 hits/month, with the recommendation:

“Intensive dysarthria therapy appears to be effective for children with cerebral palsy... the studies concluded that these children’s speech was easier to understand after the therapy.”

Impact on textbook resources

Newcastle research (R1-3) extensively informed the widely-used 2016 textbook “Children’s Speech: An Evidence-Based Approach to Assessment and Intervention” by McLeod and Baker. As of July 2020, this had Amazon sales rankings in the top 5% across Anatomy, Pre-clinical Medicine and Family, and Lifestyle Paediatrics; and sales of over 800 in Europe and over 3,500 in the US (EV6). Citations of Newcastle work include:

- Page 379 “[R2] found that intensive intervention... using the systems approach... was associated with improvements in speech intelligibility for older children with cerebral palsy and dysarthria.”
- Page 514 “Across the evidence on a systems approach to intervention, procedures involving practice of a particular motor skill are usually based on principles of motor learning e.g.... [R2, R3].
- Page 515: “[R2] reported that... intervention sessions 3 times per week for 6 weeks resulted in improvements in both word level and conversational speech intelligibility in children aged 12 to 18 years. A similar finding was reported for younger children aged 5 to 11 years [R3].

Impact on undergraduate teaching

The research (particularly R1-4) has informed national and international university speech therapy courses. For example, at Manchester Metropolitan University the research was crucial in developing their courses and has been adopted on publication into undergraduate teaching to 50 students per year since 2015 (EV7). The University of Strathclyde has included the research into

undergraduate teaching since 2017, and R4 is compulsory reading for all 35 students as preparation for class-based discussion (EV8).

Internationally, the University of Sydney confirmed (EV9) that undergraduate teaching has included R1-4 as they have been published since 2014, including specific reference to the systems approach. The course is undertaken by around 90 students per year. At the University of Melbourne, R1-4 were crucial to developing the course, which is undertaken by up to 90 students per year (EV10). The papers also informed a two-year Masters of Speech Pathology degree. Finally, Radboud University Medical Center (Netherlands) confirmed that R1-4 have been included into their undergraduate teaching to 50 students a year since 2013 (EV11).

In summary, Newcastle research found a substantial effect of breath control therapy on the intelligibility of children with CP who are affected by dysarthria. The results informed UK guidance, worldwide use in textbooks and international teaching practice.

5. Sources to corroborate the impact

EV1. NICE January 2017 full guideline NG62: Cerebral palsy in under 25s: assessment and management. <https://www.nice.org.uk/guidance/ng62/resources/cerebral-palsy-in-under-25s-assessment-and-management-pdf-1837570402501>

EV2. NICE January 2017 concise guideline NG62. <https://www.nice.org.uk/guidance/ng62>

EV3. Results in press in *Bulletin* as of March 2021. Available on request.

EV4. Pennington *et al.* 2020: Views of children with cerebral palsy and their parents on the effectiveness and acceptability of intensive speech therapy.

<https://doi.org/10.1080/09638288.2019.1577504>

EV5. Webpage from the Cerebral Palsy Alliance. <https://cerebralpalsy.org.au/our-research/about-cerebral-palsy/interventions-and-therapies/speech-therapy-for-children-with-dysarthria/#1465876304355-1a006462-4442>

EV6. Figures provided by publisher, letter to confirm available on request.

EV7. Letter from Manchester Metropolitan University.

EV8. Letter from the University of Strathclyde.

EV9. Letter from the University of Sydney.

EV10. Letter from the University of Melbourne.

EV11. Letter from Radboud University Medical Center.