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# Evaluation of Core Vocabulary intervention for treatment of inconsistent phonological disorder: Three treatment case studies

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## Abstract

*Children with unintelligible speech differ in severity, underlying deficit, type of surface error patterns and response to treatment. Detailed treatment case studies, evaluating specific intervention protocols for particular diagnostic groups, can identify best practice for children with speech disorder. Three treatment case studies evaluated the efficacy of Core Vocabulary intervention for three boys with inconsistent speech disorder. The cases examined the effects of previous intervention, use of default preferred word plans and behaviour disorder on intervention outcome. Inconsistent speech disorder was diagnosed after Diagnostic Evaluation of Articulation and Phonology assessment. A Core Vocabulary approach to intervention was selected to focus on planning whole word production rather than surface error patterns or specific sound features. Individual differences between cases led to different amounts of intervention and the number of words taught during intervention. All three boys showed gains in intelligibility, accuracy and consistency of word production. Core Vocabulary intervention was shown to be appropriate for all three children, although their individual differences required clinical adaptation of the approach.*

Assessment of children with unintelligible speech involves description of the characteristics of their speech errors, their other language abilities, the family and educational context, medical and social history. This information is evaluated to deduce causal and maintaining factors of the disorder and determine

whether intervention is indicated. If therapy is offered, then clinicians make a series of decisions about diagnosis, setting goals for the child and carers, planning how to implement intervention and monitor its effectiveness. Here we describe the clinical management of three boys with unintelligible speech. They were diagnosed with inconsistent phonological disorder and received Core Vocabulary intervention.

## Inconsistent phonological disorder

Typically developing children exhibit some phonological variability in their speech (Grunwell, 1981). Normal variability can be due to a number of different factors such as misperception, developing oro-motor skills or communicative context (Holm, Crosbie and Dodd, 2005). Kenney and Prather (1986) described variability associated with phonetic context (e.g. /ʃ/ is more accurate word initially than finally). Alternatively, variability may signal a transitional period as more mature realizations of words develop (Grunwell, 1981; Dodd and Bradford, 2000; Forrest, Elbert and Dinnsen, 2000). Leonard, Schwartz, Morris, and Chapman (1981) reported a 'trade-off' between production of the appropriate consonants and maintenance of the word shape that led to variability in successive attempts at new vocabulary items.

Younger children are reported to be particularly variable in the production of their first 50 words (Teitzel and Ozanne, 1999; Menn and Stoel-Gammon, 1995; Vihman, 1993). Although Hewett (2002) claimed that variability is characteristic of typical development beyond the 50-word stage, the available evidence suggests that variability decreases with age. (Burt, Holm and Dodd, 1999; Williams and Stackhouse, 2000). A recent large scale study of three- to six-year-old children's consistency of production of words in the same linguistic context indicated that even the youngest demonstrated variability below 13% (Holm, Crosbie and Dodd, 2007).

These data allow identification of a subgroup of children with speech disorder whose errors are characterized by inconsistency. There is a difference between variability in typical development and the inconsistent productions associated with highly unintelligible speech (Holm *et al*., 2005). Variability is defined as productions that differ, but can be attributed to factors described in normal acquisition and use of speech. Inconsistency is speech characterized by a high proportion of differing repeated productions with multiple error types, that include errors at both the phonemic (e.g. fronting of velars, /h/ deletes word initially) and syllable level (e.g. syllable deletion or addition; final consonant deletion).

Inconsistency is characterized by the unpredictable use of a relatively large number of phonemes. Grunwell (1981) and Williams and Stackhouse (2000) argued that such an unstable phonological system indicates pervasive speech-processing difficulties. Children with inconsistent speech disorder produce the same words or phonological features inconsistently not only from context to context, but also within the same context (McCormack and Dodd, 1996; Holm and Dodd, 1999; Dodd and Bradford, 2000). In other words, they may pronounce the same word differently each time they say it.

Forrest, Elbert and Dinnsen (2000) suggested that inconsistency 'will have a negative impact on phonological acquisition and may contribute to a profile that characterizes children with persistent phonological disorders' (p. 530). Assessment is problematic because describing and analysing inconsistent surface error patterns in terms of phonological error patterns is not useful for deciding the focus of therapy (Dodd and Bradford, 2000). Forrest *et al*. (2000) stated that 'it is difficult to …[treat] these children, because one may not know the appropriate sound to use in contrast to the error. This may mean that children with a variable substitution will fare worse in treatment than other children because the available protocols for this population are not as effective as other procedures' (p. 529).

Psycholinguistic approaches to speech disorders propose models of the mental processes involved in the speech processing chain (e.g. Stackhouse and Wells, 1997). The theoretical orientation of each model reflects different mental processes. One model (Dodd and McCormack, 1995) was based on experimental data that led to the hypothesis that inconsistent speech disorder reflected an underlying deficit in phonological assembly of the sequence of phonemes that make up a specific word.

While deficits in phonological assembly are assumed to underlie inconsistent phonology in aphasia (e.g. Berndt and Mitchum, 1994), inconsistency as a type of developmental speech disorder has only recently been accepted (Forrest, Elbert and Dinnsen, 2000). Velleman and Vihman (2002) argued for a word 'template' that contains the phonological specifications for word production – a phonological plan. Both phonological assembly and phonological planning refer to a blueprint that does not involve the motor-speech system. Children whose speech is characterized by inconsistent errors may have difficulty in selecting and sequencing phonemes (i.e. in assembling a phonological template for production of an utterance).

This deficit differs from that usually associated with childhood apraxia of speech (CAS). Ozanne (2005) concluded that recent research supports Stackhouse's (1992) suggestion that CAS is a multi-deficit motor-speech disorder with impairments in phonological planning; phonetic programming; and
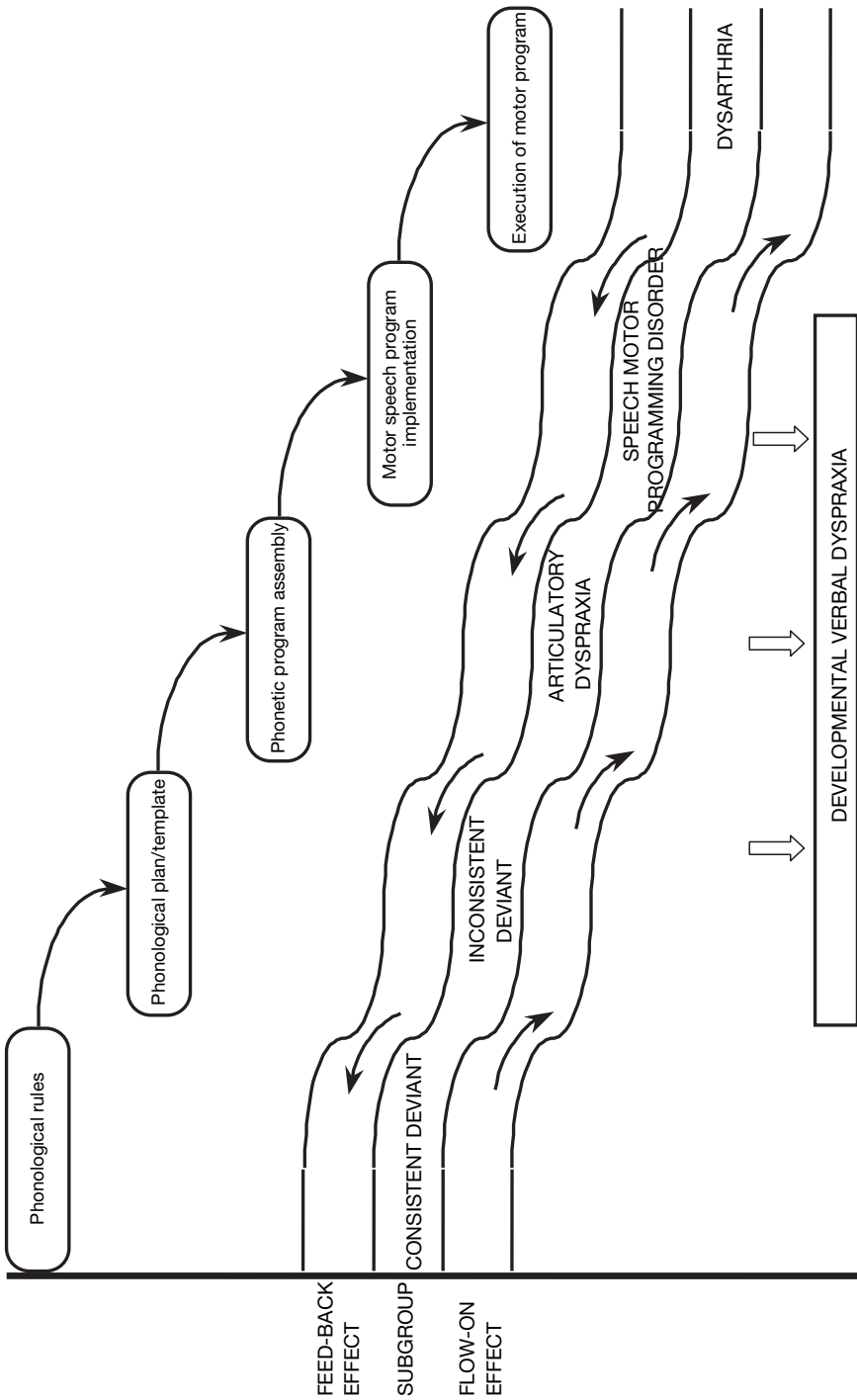
**Figure 1**   Ozanne's (2005) Cascade model of speech output processing

motor-program implementation (see Figure 1). Multiple deficits may interact to 'sabotage' remediation strategies designed for a single specific deficit. For example, Moriarty and Gillon (2006) attributed their successful intervention for CAS to targeting both accurate pronunciation and the intactness of the phonological representation using phonological awareness. Similarly, the use of the PROMPT (Prompts for Restructuring Oral Muscular Phonetic Targets) approach to intervention for children with CAS may be successful because it targets two levels in the speech processing chain: phonetic programming and motor speech implementation (Chumpelik, 1984; Square-Storer and Hayden, 1989).

In contrast, intervention for children with inconsistent speech would need to target phonological assembly. Their reading, awareness of phonological legality and onset-rime is reported to be intact, their imitated word production has fewer errors than their spontaneous production and there are no oro-motor symptoms like groping or poor diadochokinetic skills (for a summary, see Holm, Crosbie and Dodd, 2005). These findings suggest that unlike children with CAS, children with inconsistent speech disorder, have intact phonological representation, phonetic planning and motor-speech implementation.

## Core Vocabulary intervention

The initial goal of therapy for children who make inconsistent errors is to establish consistent (as opposed to correct) production in single words and spontaneous speech. Two frequently used intervention approaches can be rejected on theoretical grounds. Intervention that contrasts phonemes using minimally or maximally paired targets is designed to enhance children's understanding of the phonological system's constraints and contrasts. Since children who make inconsistent errors perform like typically developing controls on tasks requiring phonological legality judgements and reading, they would be unlikely to have a deficit in phonological knowledge. Teaching articulation of individual speech sounds in isolation, using motor cues would only have value if a child was unable to produce a phoneme considered essential for intelligibility. Most children with inconsistent speech disorder have been reported to have no difficulty articulating speech sounds at a level appropriate for their age (Holm *et al*., 2005).

In contrast, Core Vocabulary intervention teaches children how to assemble word phonology on line, first in single words and then in connected speech (Dodd and Iacono, 1989; Holm, Crosbie and Dodd, 2005). Therapy provides information about the phonological plan without giving a model for imitation;

eliciting best productions (i.e. inaccurate productions are accepted if they are typical developmental errors) and, drilling the specified production until it is produced consistently. The methodology section includes a detailed description of how Core Vocabulary intervention is implemented.

**Research goals**

Data presented here describe the course of Core Vocabulary intervention for three boys. They were selected for study because each was problematic. Andrew had a previous history of intervention that had failed to improve intelligibility but had consequences for later differential diagnosis. Ben's word production evidenced a strong tendency to use a default word plan. Cameron's unintelligible inconsistent speech was associated with a behaviour disorder. Three intervention case studies describe the boys' response to a core vocabulary approach to intervention. It was hypothesized that Core Vocabulary intervention would remediate inconsistency in all three children.

## Justification of research methodology

One problem with randomized control trials in speech-language pathology is that they often fail to adequately specify the population or the intervention approach used (Pring, 2004). Pring (2004) concluded that current efforts to develop evidence based practice in speech-language pathology using randomized controlled designs are premature and can lead to misleading results. He cites the WHO (1975) guidelines, arguing that development of evidence based practice in health care, including speech-language pathology, consists of a series of phases. Each phase must be successfully completed before researchers move on to the next step of the process.

Robey and Schultz (1998) identify clinical reports and case studies of a treatment as the first steps in research on clinical outcomes. These studies can evaluate a treatment's potential and ensure it has no harmful side effects. Multiple single case studies allow precise definition of the treatment and the population the treatment will benefit. Such studies can determine the amount of therapy likely to be required and the type of service delivery that provides most benefit. Appropriate outcome measures can be identified. These basic studies should precede large-scale, efficacy-randomized control trials in clinical services. Similarly, Garrett and Thomas (2006) and Reilly, Douglas and Oates (2004) stress that systematic reviews of evidence-based practice in speech-language pathology should include studies using qualitative methods.

Howard (1986) argued that intervention case studies provide precise information about the nature of the individual, the disorder, the intervention, and outcomes in terms of acquisition, generalization and maintenance. Case studies allow more in-depth assessment and can provide more detailed information about the course of intervention and the clinical decisions made. Multiple single case study designs add reliability and validity. They provide a perspective on individual differences in symptomatology and varying response to therapy.

## Method

### Participants

*Child 1*:  Andrew is the older of two children in his family. He was initially assessed by a speech pathologist when he was 3;0. Speech therapy intervention was recommended and Andrew attended 10 weekly therapy sessions focusing on articulation of individual speech sounds. His parents were then advised that further therapy was necessary as he had made little progress. Andrew's mother sought a second opinion regarding her son's speech difficulty from the first author when he was 3;8.

Andrew's level of inconsistency was difficult to determine because his speech errors may have reflected previous intervention, with /s/ sometimes used intrusively (e.g. [sːdɪdə] scissors [sːhɪθɪn] fishing) and as a substitution for many consonants (ɪ,ʃ,θ,ð,tʃ,f,v,z). Although he pronounced 7 of 10 words inconsistently on repeated productions on the DEAP Diagnostic Screener, four of these were due to his inconsistent use of /s/, suggesting the score was inflated by the influence of previous intervention.

Andrew was offered 10 sessions of therapy in a clinical research study comparing the use of minimal and maximal pairs for children with speech disorder (Holm *et al*., 2008). Post-therapy testing indicated, however, that minimal pairs intervention had little impact on his speech production. His percent consonants correct score pre-treatment was 44 and post-treatment only 46. The DEAP Inconsistency assessment was administered and Andrew produced 14 out of 25 words differently (56 %), supporting a diagnosis of inconsistent speech disorder.

According to the case history, pregnancy was full term with no birth complications. Despite milestones for first words and sentence development being within normal limits, Andrew's mother reported that his speech was difficult to understand, not only by naive listeners but also all family members. Apart from five episodes of otitis media, which were treated with antibiotics only, there

was no other significant medical history. One cousin was reported to have a speech and or language difficulty and one uncle had a learning difficulty. The family rated their income as high and the mother had tertiary qualifications.

*Child 2*:   Ben, aged 3;9, was referred by his mother. While she usually under-stood him, other family members, friends and his kindergarten teacher had great difficulty. Ben's word production evidenced a strong tendency to use a default word plan: most words contained at least two syllables; word final con-sonants were deleted and most words ended with /ə/ e.g. [fɪiə] fishing, [kɪjiə] kitchen, [ʃiə] ship, [bʊə] book, [ʃuə] juice, [tʊiə] sausage. Nevertheless, his errors were inconsistent (e.g. parrot: [kætoʊə] [kadɔwə][koutuə]; elephant [hɜwiə], [ɛwiə]).

   Ben, the second of two children, was born full term with no birth compli-cations. His speech and language milestones were within the normal range and there were no reports of any middle ear infections. There is however a history of gastric reflux and asthma which are under medical treatment. Ben's sister had attended speech therapy for intervention with language comprehension, but her speech skills were age appropriate. Household income was reported as high and Ben's mother completed 12 years of education.

*Child 3*:   Cameron, aged 4;2 at assessment, was referred by his mother because his speech was very difficult to understand. He was on a 12–18-month waiting list for speech therapy services with the local health department, but had not been assessed. Cameron was born at 38 weeks without any complica-tions, the second of two children. His milestones were normal and there were no reports of otitis media; no significant medical problems or family history of speech and or language or learning difficulties.

   Household income was not disclosed. Cameron's mother left school after year 10.

   Cameron's intelligibility was poor and his mother reported his frustration at being unable to communicate. He was often reluctant to try new words that he thought might be difficult during therapy sessions. He used a number of methods to avoid cooperating (e.g. hiding under the table, sitting on the cards, saying 'no', pouting and refusing to talk, and running away). Similar behav-iour was common at home, particularly when daily practice was required.

**Assessment**
All three boys performed within normal limits on the Quick Test of Language (McIntosh and Liddy, 2006). The results of assessment using the DEAP (Dodd, Zhu, Crosbie, Holm and Ozanne, 2002) are presented below (see Table 1).

**The Diagnostic Screener** takes about five minutes to administer and requires children to name 10 pictures twice, with a speech sound stimulability task separating the two trials. If a child fails to imitate sounds that 90% of children of the same age group are able to say according to normative data, then the Articulation and Oro-Motor sections of the DEAP should be administered. However, if the child is able to imitate the sounds that they produced incorrectly in single words, then the Phonology section is administered. Finally, an inconsistency rating is calculated by comparing the word productions on the two trials. If 50% or more of the 10 words are produced differently then the Inconsistency assessment and the Oro-Motor assessment are administered, the latter being used to screen for childhood apraxia of speech (CAS).

All three boys were easily able to name the 10 pictures and were stimulable for the sounds produced incorrectly in their spontaneous productions. Ben and Cameron both attained a score of 50% inconsistency on the screener while Andrew's score was 80%. Because they all scored at 50% or greater for inconsistency, the Inconsistency assessment and the Oro-Motor assessment were administered.

**The Oro-Motor Assessment** required the children to produce repeated sequences of 'pat-a-cake' five times, to demonstrate isolated tongue and lip movements (e.g. tester says 'Can you put your tongue up to the top of your mouth like this?) and sequences of tongue and lip movements (e.g. the tester says 'Do what I do. Blow and put your tongue up.'). Andrew and Ben were able to perform the diadochokinetic and isolated and sequenced oro-motor movements appropriately for their age. Cameron also performed the isolated and sequenced movements well but refused to complete the DDK task.

**The Inconsistency Assessment** of the DEAP allows the tester to identify those children who have atypical speech that is characterized by multiple error forms in the production of single words. If the child produces 40% (10 out of 25) or more of words differently over the three trials then the child is deemed to have an inconsistent speech disorder.

Cameron and Ben both produced 16 out of 25 words differently giving them an inconsistency score of 64%, while Andrew produced 14 words differently (56%), supporting a diagnosis of inconsistent speech disorder.

**The Phonology Assessment** was administered to gain a speech sample that would allow quantitative analyses for comparison with normative data. This assessment involves the children naming 50 pictures followed by a description of three 'funny' pictures in which 14 of the words in the picture naming task are elicited in a connected speech sample. Word productions are transcribed phonetically, then error patterns identified and compared to aged norms.

Quantitative analysis allows the tester to calculate Percent Consonants Correct (PCC), Percent Vowels Correct (PVC), Percent Phonemes Correct (PPC) and Single Words versus Connected Speech Agreement (SvsC). Table 1 shows the percentage correct for consonants, vowels and all phonemes as well as the single word versus connected speech agreement at pre-therapy baseline.

## Core Vocabulary intervention

Before the first therapy session, the parents of the three boys were asked to provide a list of 50 words (minimum) that were frequently part of their child's functional vocabulary. These words were then used as the basis for their therapy sessions. The most common words that the parents included in their lists were names of family, friends and teachers, places, foods, favourite toys or movie characters and functional words like please, thank you, finished and sorry. The words were not selected according to word shape or segments. They were chosen because intelligible use of these functionally powerful words would motivate the use of consistent productions. It was emphasized to the three mothers that the primary target of the intervention was to make sure their child said a word exactly the same way each time they attempted to say it, not necessarily an error-free production.

*Establishing best production*    The boys were seen twice weekly for approximately 30 to 40 minutes per session with their mothers present and in the case of Andrew, his younger sibling. The first session was devoted to teaching the selected treatment words aiming at best production. The number of words targeted depended on the child's ability to achieve the best possible word production. Andrew achieved best production on five words for the first session while Ben and Cameron both achieved four words. However once their ability to target accurate production improved so did the number of words per session. This eventually varied between 10 and 12 for Andrew, eight and 11 for Ben and six and 12 for Cameron.

In order to teach the words the clinician used a variety of cues, teaching sound by sound, breaking words into syllables and sometimes using Cued Articulation (Passey, 1990). When teaching Cameron the word 'water' the

**Table 1**    Quantitative analysis: DEAP pre-therapy assessment

| Child (CA) | PCC (SS) | PVC (SS) | PPC (SS) | Inconsistency | SvsC Agreement |
|---|---|---|---|---|---|
| Andrew (4;3) | 44 (3) | 88 (3) | 60 (3) | 56 | 58 (7) |
| Ben (3;9) | 34 (3) | 78 (3) | 50 (3) | 64 | 67 (8) |
| Cameron (4;2) | 22 (3) | 53 (3) | 31 (3) | 64 | 43 (5) |

SvsC Agreement: agreement ratio between single words and continuous speech
Core Vocabulary intervention

clinician explained that water had two parts, where the first part had two sounds /w/ (first sound) and /ɔ/ (second sound) and the second part also two sounds /t/ and /ə/. It was easier for Cameron to practice the first and second syllables separately and then join the two together to produce the entire word.

*Drill*   The second session each week focused on a high number of productions of the newly learned words in order to monitor production. The aim of this session was for the boys to produce each word 20 times during the session. As this session was primarily drills of sets of five trials of the same word, games were used as the reward for correct production. Ben and Cameron liked the 'Mr Potato Head' game. Each time they completed a set of drills for a particular word they were able to spin for a body part or item of clothing and when all parts had been obtained, they were allowed to complete Mr Potato Head. During this session both verbal and visual feedback was given. Ticks and crosses on a page next to the target word proved most effective in giving immediate feedback as to the correct or incorrect production of the word. A cross often resulted in self correction. At the end of this session, the boys were asked to say each of the target words for that session three more times. If the words were produced consistently a sticker was put next to the word on their personal word chart or the card was placed in the 'finished' bag. Words that were not consistent were placed back in the target pile and carried over to the next session.

Parents were an integral part of the therapy programme. They would observe the therapy session and then supervise daily practice of the words at home. Their feedback was invaluable as it often influenced the content of the therapy session (e.g. words or phrases needing additional teaching, new words to target). To monitor generalization, a set of unrelated items (10 words) was administered after each eight-session block. Post-therapy assessment and follow up involved re-administering the Phonology and Inconsistency subtests of the DEAP (Dodd *et al.*, 2002).

Table 2 shows the total number of therapy sessions for each boy, the total number of words targeted in those sessions and the average number of words per week. The boys were seen for therapy at the Royal Brisbane and Women's Hospital in a room that was relatively free of distractions. An appropriately sized table and chair was provided.

**Table 2**   Therapy sessions summary

|  | Andrew | Ben | Cameron |
|---|---|---|---|
| Total number of words used | 53 | 86 | 106 |
| Total number of therapy sessions | 12 | 27 | 38 |
| Average number of | 8.8 | 6.4 | 7 |
| words per week (Range) | (5–12) | (4–10) | (1–12) |

## Results

Andrew, who had the highest baseline PCC took only 12 sessions and 53 words to achieve consistent speech production. He averaged nine new words per week and enjoyed therapy sessions. It was possible to elicit accurate production of new words after only two attempts. He was attentive and motivated by his success. Andrew's inconsistency at week nine showed 10% of probe words produced inconsistently; however, his mother wanted to continue until the 50 words had been reached, so therapy continued for a further three sessions. Table 3 shows consistency of production on untreated probes for all three children.

Table 4 shows the results of the post-therapy assessment. Andrew's PCC had increased by 34% and inconsistency was down to 12%. A maintenance assessment eight weeks later revealed further improvement and Andrew's PCC was now up a further 14% to 94. His single word versus connected speech agreement was 100%. Andrew was discharged after his maintenance assessment.

Ben, with a PCC of 34, worked through 86 words over 27 sessions. Progress was slow over the first 10 sessions (32 words). At first Ben produced all new words with a schwa at the end (e.g. [puə] push and [boʊə] boat). He was

**Table 3**   Inconsistency efficacy on untreated probes

| Efficacy assessment | Andrew | Ben | Cameron |
|---|---|---|---|
| Session 1 | 70% | 50% | 40% |
| Session 5 | 40% | 40% | 40% |
| Session 9 | 10% | 40% | 40% |
| Session 13 | | 40% | refused |
| Session 15 | | | 40% |
| Session 19 | | 30% | refused |
| Session 23 | | | 40% |
| Session 27 | | 20% | 30% |
| Session 30 | | | refused |

**Table 4**   Comparison of baseline, post-therapy and maintenance assessments

| | Andrew | | | | | Ben | | | | | Cameron | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PCC | PVC | PPC | SC | I | PCC | PVC | PPC | SC | I | PCC | PVC | PPC | SC | I |
| Baseline | 46 | 94 | 62 | 58 | 56 | 34 | 78 | 50 | 67 | 64 | 22 | 53 | 30 | 43 | 64 |
| Post-therapy | 80 | 99 | 86 | 62 | 12 | 63 | 91 | 73 | 80 | 32 | 44 | 85 | 58 | – | 48 |
| Maintenance | 94 | 99 | 95 | 100 | 10 | 69 | 95 | 78 | 75 | 10 | 52 | 86 | 64 | 75 | 40 |

PCC = Percentage Consonants Correct; PVC = Percentage Vowels Correct; PPC = Percentage Phonemes Correct; SC = Single word versus Continued speech; I = Percentage Inconsistency

reluctant to try new words saying 'No, can't' and resisted attempting any words with a CVC syllable structure. He had limited attention and required longer breaks between drill sets than Andrew.

In order to 'break' the pattern of a schwa as the default word ending, the clinician, in consultation with mother, reshaped the word structure; for example good became [gudi]; shop became [ʃɒpɪŋ]; big became [bɪgə] and point became [pɔɪntɪŋ]. Once Ben had mastered these words, it was easy for him to reduce them to a single syllable word with a consonant ending. It was at this point that Ben became more confident in his own word productions and he began to progress rapidly.

At session 27 the number of words said inconsistently on the efficacy probe assessment of untreated words was reduced to 20% (see Table 3). A full reassessment was indicated. Ben had progressed from 34% PCC to 63% PCC. His inconsistency score changed from 64% to 32%. A maintenance assessment 3 months later indicated a small increase in PCC to 69% but a decrease in inconsistency down to 10% (see Table 4). His single word to connected speech agreement ratio improved from 67% to 75%. Ben's speech at this stage was characterized by developmental errors of gliding and reduction of /s/ clusters and he was therefore discharged. If no further spontaneous improvement occurs he will be reassessed once he begins school.

Therapy with Cameron proved to be the most challenging of the three boys. Appendix 1 shows a comparison of the word productions of the three boys. Cameron's speech to the naive listener and his family was highly unintelligible. He presented with more unusual word productions than the other two (e.g. /wʌkipik/ for elephant; /waipa/ for helicopter and /waɪəbɔ/ for ladybird). Cameron appeared to have two major default patterns for his word production. He often began words with /w/ and used a velar plosive or the syllable /pɪk/ or /wak/ word finally (e.g. [wʌguə] apple, [wɒkwɔ] orange, [wawak] lighthouse, [wɒg] watch, [pɪk] swing, [bɪkwak] giraffe).

During the first therapy session only four words were attempted, these were 'water, bag, hat and bike'. The word 'hat' proved to be the most difficult and Cameron did not master this word until session eleven, when it was reintroduced as a target. Words mastered early were those with a CV syllable structure (e.g. motor, funny, dinner, banana, potato). Once these were established, CVC words emerged.

A total of 81 words over 23 sessions resulted in a decrease in inconsistency from 64% to 48% and an increase in PCC from 22% to 44%. Most sessions however involved considerable time spent on behaviour management. Cameron sometimes refused to complete the required task, although at other times he was cooperative and appeared motivated by his progress. Table 4

shows Cameron's maintenance assessment results, four months post-therapy, increasing to 52% PCC and decreasing to 40% inconsistency. His agreement ratio between single words and connected improved from 43% to 75%. Although Cameron's speech is still inconsistent, his mother finds him more intelligible and has learned strategies for establishing consistent word production. Now that Cameron has started school, he has been referred to the school speech-language therapy service.

## Discussion

Treatment case studies of three boys with inconsistent phonological disorder were described. The children received between 12 and 38 sessions that were about 30 minutes long, twice weekly. Outcome was positive for all three children although the rate of progress varied. Andrew's intervention, 12 30-minute sessions over six weeks, led to a decrease in inconsistency from 56% to 10% and an increase in PCC from 46% to 95%. Ben's intervention, 27 30-minute sessions over 14 weeks, led to a decrease in inconsistency from 64% to 10% and an increase in PCC from 34% to 69%. Cameron's intervention, 38 30-minute sessions over 19 therapy weeks (with breaks), led to a decrease in inconsistency from 64% to 40% and an increase in PCC from 22% to 52%.The children were chosen in order to examine factors that might influence response to Core Vocabulary intervention: previous therapy, use of a pervasive default word plan and behaviour difficulties.

Andrew's previous lack of progress in intervention for his speech disorder reflects research findings that children with inconsistent speech disorder are resistant to phonological contrast (Crosbie, Holm and Dodd, 2005; Forrest, Dinnsen and Elbert, 1997) or traditional articulation therapy (van Riper, 1963). Crosbie *et al*. (2005) evaluated 10 children with inconsistent speech disorder and eight children with consistent phonological disorder. Children received two blocks of eight hours of twice weekly therapy: one block of core vocabulary intervention and one of phonological contrast therapy. Half the children with each diagnosis first received Core Vocabulary intervention. The results were clear-cut. Children with inconsistent phonological disorder made greatest improvement when they received Core Vocabulary intervention and children with consistent phonological disorder made greatest progress when they received phonological contrast therapy.

A retrospective *post hoc* analysis of 14 children with speech disorder (Forrest *et al*., 2000) compared children who made consistent sound substitutions for sounds not present in their inventories (e.g. /k/ always produced as

[t]), those who had inconsistent sound substitutions across word positions (e.g. /v/ substituted by [b] word initially, but [f] word finally), and those that used a different sound substitution within (word initial /s/ being substituted by /v, f, d, b/) and across word positions. The three groups were matched for severity of phonological impairment and all received phonological contrast therapy targeting a single error in a single word position. The children with consistent sound substitutions learned the sound and generalized to other word positions. The children with inconsistent sound substitutions across word positions learned the sound but only in the treated position. The children with variable sound substitutions within and across word positions did not learn the sound in the treated or untreated word position.

These findings suggest that choice of therapy approach is crucial for the remediation of inconsistent phonological disorder. Targeting phonological contrasts or articulation of individual speech sounds, results in little change in the number or type of speech errors and inconsistency persists. Successful intervention for speech disorders needs to target the deficit underlying the type of disorder. Inconsistent errors in the absence of CAS require intervention that targets planning of the sequencing of phonemes in whole words.

Andrew's case study suggests that while previous episodes of therapy do not preclude successful intervention using a core vocabulary approach, it may make identification of inconsistency problematic. His inconsistent use of /s/ as an intrusive consonant and substitute for a range of other sounds obscured the nature of his speech disorder. Since Andrew's response to core vocabulary was rapid and highly cost-effective (a total of six hours of therapy), it might be argued that his two previous episodes of care focusing on articulation of /s/ and phonological contrast using minimal pairs were influential in preparing him to respond positively to Core Vocabulary intervention. This seems unlikely given results of Crosbie *et al*. (2005) showing that those children who had first received intervention focusing on phonological contrasts made no greater progress than those who received the Core Vocabulary intervention first.

Ben used a 'default' word plan that deleted word final consonants and added a schwa (e.g. [bʊə] for book). This preferred word shape proved difficult to suppress, but progress was rapid once this had been achieved by an intermediary step of accepting /CVCə/ and /CVCɪn/ word templates as accurate. Diversifying 'allowable' word plans was also problematic for Cameron. Duggirala and Dodd (1991) argued that children's first words demonstrate the use of a basic word plan, often /$C_1VC_1$i/, that gives rise to productions like [mʌmi], [dædi], [næni], [keɪki] and [teɪti] for Katie. Only after children have acquired the ability to plan whole words, and use a range of different word plans, does their speech production begin to provide evidence of a

phonological system characterized by consistent phonological error patterns affecting intra-word segments. Ben's disorder seemed to involve the use of a preferred word plan /CVə/ indicating an impaired ability to assemble phonology.

Cameron's phonology was highly unintelligible, even to his mother. He preferred to use /w/ word initially, and end words with a syllable containing [p/b] plus a vowel and often [k/g] finally. Since his default word plans were usually unrelated to the targets, he often seemed to be producing jargon. The severity of his disorder had a major influence on the outcomes of intervention. Cameron's progress was dependent upon a greater amount of intervention and this might be attributed to undetected deficits in phonological awareness. Alternatively, Cameron's lack of intelligibility may have led to behavioural difficulties which reduced productive clinical time and home practice, which led to persisting unintelligibility and increased intervention time.

It is not surprising that Cameron's lack of intelligibility was associated with behaviour difficulties. Emerson (1995) said that those with severe communication difficulties, irrespective of whether they are expressive or receptive, are more likely to exhibit challenging behaviours. The course of Cameron's therapy was lengthened by his avoidance strategies that slowed progress because of the reduced time for drilling words in a session. Elbert, Powell and Swartzlander (1991) suggest a child should produce approximately 100 responses in 30 minutes. Cameron often failed to meet that criterion in therapy sessions and his mother reported difficulties in home practice. Core Vocabulary intervention relies on children's carers practising the target words daily outside the clinic as well as receiving feedback on those words in everyday communication situations.

The study reported had a number of limitations. One issue is the lack of planned baseline data, although some baseline data were available. Andrew had previously received two 10-week blocks of therapy first targeting individual speech sounds and then phonological contrasts. Neither approach proved successful in terms of intelligibility or PCC measures. Cameron's mother's concern had led her to refer him for assessment of unintelligible speech at 3;0. He had been on a speech-language therapy waiting list at his local health centre for 14 months before being assessed by the current study. Given that his PCC at assessment was 22 and that it more than doubled to 52% during intervention, it is unlikely that the progress made can be attributed to maturation.

Two of the cases reported received a greater amount of therapy than would normally be provided in most speech and language therapy services, making this an efficacy (research) rather than an efficiency (measurement typical of service provision) study. While Andrew received only six hours of intervention, Ben received 13.5 hours and Cameron 19 hours. Crosbie *et al*.'s (2005) group

intervention study indicated that considerable progress was made by children with inconsistent speech disorder receiving eight hours of Core Vocabulary intervention. Dosage in speech-language therapy is an issue requiring further research. It seems obvious, however, that not all children require the same amount of intervention.

## Conclusion

Clinicians select intervention approaches that best suit a child's profile of abilities. Children with speech disorder are often considered to be homogeneous, so that all receive the same basic approach to therapy, whether it be phonological awareness training (Gillon, 2004), traditional articulation therapy (van Riper, 1963) or phonological contrast therapy (Gierut, 1991). It is now well established, however, that children with speech difficulties are a heterogeneous population (Shriberg, 1994). Given the complexity of the speech processing chain (e.g. Stackhouse and Wells, 1997), the notion that different deficits can give rise to errors in speech production is logically imperative.

The case studies presented here focus on children with inconsistent phonological disorder who appear to have a deficit in phonological assembly. A Core Vocabulary approach to intervention that focuses on planning of whole-words was shown to remediate the speech of three children, both in terms of accuracy and consistency. Individual differences between children were explored to evaluate the influence of previous intervention, default preferred word plans and behaviour difficulties. While the latter two factors influenced the amount of intervention and the course of therapy, the approach was shown to be appropriate for all three children.

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## Appendix: Comparison of Andrew, Ben and Cameron target words

| Target | Andrew | Ben | Cameron |
|---|---|---|---|
| shark | s:ak; ʃ:ak | tʃa; ʃa | tak; kak |
| boat | bɒt; boʊt | boʊ | boʊg; bʌg |
| elephant | ɛsdɛnt; ɛsədɛnt; ɛlsədɛnt | ɛwiə; hɜwi; ɛwi | wʌkipik; ɛwɛipɪk |
| kangaroo | kæŋawu; tæŋgawu; tækawu | kæwʌ; hæwu; kæwu | tæau; tæiwuə; tʌwu |
| umbrella | bʌnə; ʌbʌnə | bwʌdə; brɛjə; bwɛdə | ɛwatɒk; bɪbʌi |
| helicopter | hɛnədʊtə; hʌndʊtə hɛdidɒktə | kɒiə; kadʌ· kaə | waipa; |
| thank you | tæŋku; dæŋkju | æŋju; æu; æŋku | tɒkuə; tʌku; tʌkuə |
| ladybird | nerdibidəl | weribiə; weɪbʌ | waɪəbɔ; warbɔ |