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How do children with phonological impairment respond to requests for clarification containing polysyllables?

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Abstract
Accurate production of polysyllables (words of three or more syllables) can be challenging for children with phonological impairment. Research with typically developing children has suggested that children can improve their polysyllable productions in response to requests for clarification containing an incorrect model of a target word (Gozzard et al., 2008). This study extends the work of Gozzard et al. (2008) by determining whether accuracy can improve in response to requests for clarification containing a correct (e.g. 'did you say elephant?') versus an incorrect (e.g. 'did you say eresemp?') model. Four children with phonological impairment (aged 3;10, 3;11, 4;3 and 5;4) had segmental and structural difficulties with polysyllables, in both single word and connected speech contexts. All participants revised their productions following requests for clarification containing the incorrect production, with 75.8% of suprasegmental and phonological revisions demonstrating increased accuracy. No phonological or suprasegmental revisions occurred following requests for clarification containing the correct model. The findings suggest that role of communication breakdown and repair in intervention targeting children's polysyllable difficulties needs to be better understood.

Keywords
Phonological impairment, polysyllables, requests for clarification, speech, stress

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I Introduction

Children who have a phonological impairment can be difficult to understand. They experience breakdowns in communication significantly more frequently than their typically developing peers (Gardner, 1989; Yont et al., 2002). One source of breakdown for these children can be their inaccurate production of polysyllables, which are words comprising three or more syllables (Baker and McCabe, 2010). Communication breakdowns are typically signalled by a request for clarification (RQCL) from the listener. In this article we explore the effect of two different types of RQCL on the repair responses by children with phonological impairment to incorrect productions of polysyllables. In our review of the literature we consider previous research on the ability of children with phonological impairment to repair breakdowns in communication, in addition to the effect of different types of RQCL on children's repair responses. We also outline why we have focused specifically on children's productions of polysyllables.

1 Communication breakdown and repair

Breakdowns in communication are studied in the context of contingent query sequences:

- speakers' problematic utterances;
- listeners' signals that the speakers' utterance have not been understood; and
- speakers' repairs of problematic utterances (Yont et al., 2002).

Utterances can be problematic for a number of reasons, such as unintelligible speech, inappropriate loudness, incomplete utterances, utterance complexity, inappropriateness, relevance of an utterance and uncooperative communication partners (Roth and Spekman, 1984).

Listeners' RQCLs can take a number of forms. Based on the coding system described by Yont et al. (2000) they can include:

- nonspecific or neutral requests for repetition (NRR) (e.g. 'what?' or 'pardon?');
- specific requests for confirmation (SRC) that may be accompanied by a rising intonation, repetition or reduction of the speaker's utterance (e.g. 'found a mouse?');
- specific requests for repetition (SRR) that contain both a *wh*-question and a repetition of part of the speaker's utterance (e.g. 'you saw a what at the park?');
- specific requests for specification (SRS) that invite the speaker to provide more information to clarify a misunderstanding, such as 'you played with Matthew at the park? Who is Matthew?'; and
- nonverbal requests (NVB), such as a confused facial expression.

Speakers' repair responses can also take a number of forms such as a simple confirmation (C) (e.g. 'yes' or 'no'), a repetition (R) where the speaker repeats his or her utterance exactly, no response (NR), an irrelevant response (IR) and a revision (R+) (Gozzard et al., 2008). Revised utterances may contain a phonological, phonetic, suprasegmental, syntactical or semantic change (Gardner, 1989; Gozzard et al., 2008; McCartney, 1981).

Typically developing children have been reported to respond to RQCL from the age of 1;8 years (Anselmi et al., 1986). These children tend to use simple repair strategies such as repeating their original utterance, making suprasegmental changes, using gesture, and revising the word phonetically or phonologically (e.g. Anselmi et al., 1986; Gallagher, 1977; Schwartz et al., 1983). As children get older, they develop a wider variety of repair strategies, and show greater linguistic sophistication in their attempts to repair breakdowns in communication (Brinton et al., 1986; Gallagher, 1977).

2 Communication breakdown and repair in children with phonological impairment

Research on communication breakdown in children with phonological impairment has considered the frequency and source of communication breakdown, the types of responses children use when trying to repair breakdowns, and the effect of different types of RQCL on children's repair responses.

First, with regards to the frequency and source of communication breakdown, Yont et al. (2002) reported that 12 children (mean age 4;1 years) with concomitant speech and language impairment experienced significantly more breakdown in communication (368 instances) than a similarly aged group of 12 typically developing peers (97 instances). Of the instances of communication breakdown, most were associated with either phonological (125) or pragmatic (112) errors by the children with concomitant speech and language impairment. The proportion of polysyllables involved in the instances of phonologically-based communication breakdown was not reported. In the typically developing group, there were relatively few breakdowns due to phonological errors (6 instances). These results point to reduced speech intelligibility as an importance source of breakdown in communication.

In a study of the naturally occurring instances of communication repair during interactions between children and their mothers, Gardner (1989) found that children with phonological impairment (aged 3;6–5;1 years) experienced more episodes of communication repair (7.8%) than a group of age- and language-matched peers (3.2%). The frequency of repair episodes was more similar to a younger group of typically developing children (aged 2;0–2;11 years) (10.2%). Gardner (1989) further reported that the children with phonological impairment used more semantic/syntactic (50.0%) than phonetic revisions (33.9%) to repair breakdowns in communication. While these results suggest that children with phonological impairment tend to rely on language-based rather than speech-based revisions to repair breakdowns, the results also indicate that children with phonological impairment can revise their speech in an effort to repair a breakdown in communication. McCartney (1981) reported a similar observation. In a study of conversational interactions between three boys (aged 5;0, 5;1 and 6;9 years) and their mothers, a peer and another unfamiliar adult, McCartney noted a small number of instances where the boys changed their speech (sometimes an improvement) in a repair response. If children can improve their speech when responding to a RQCL, does the type of request influence the type of repair response by children with phonological impairment? Data from a small number of studies suggest it does.

When McCartney (1981) examined the relatively small number of speech repair responses produced by the three boys in her study, she noticed the responses followed a request for confirmation containing a model of the target word. McCartney (1981: 156) speculated that 'the three children studied may have required a model of the correct phonetic form to help them change their speech patterns.' The effect of incorrect (or partially incorrect) models on the children's speech was not considered. By contrast, in a study of 15 children (aged 3;1–5;6), Weiner and Ostrowski (1979) reported that the accuracy of the children's production of monosyllabic words improved the most following a RCQL (specifically, a request for confirmation) containing an incorrect model of the target word, relative to a correct model, and an incorrect model identical to the child's attempt. Based on the information available in their study, it was unclear whether the children had typical or impaired speech. More recently, Gozzard et al. (2008) extended the work of

Weiner and Ostrowski (1979), specifically focusing on polysyllables. They reported that young children with typically developing speech improved their production of polysyllables given a RQCL containing an incorrect model. In an exploratory single-case study, Baker and McCabe (2010) trialled the use of an incorrect model with a RQCL in a pragmatically valid play context in an effort to find a strategy that would help a young child (4;6 years) improve his production of polysyllables. The RQCLs used in this study contained prosodically correct, yet segmentally inaccurate pronunciations of the child's intended words (e.g. for the target word 'elephant', the RQCL was 'did you say eresemp' following the child's incorrect production 'efent') (Baker and McCabe, 2010). It was reported that this type of RQCL improved the child's polysyllable production accuracy; however, it was unknown whether it was simply the experience of being misunderstood that prompted the child to improve the accuracy of his productions of polysyllables, or whether it was the incorrect model containing the correct word shape and stress pattern within the RQCL that prompted the revision.

Pragmatically, a clear misunderstanding occurs when an incorrect model is used within a RQCL: the speaker knows that his or her message has been unsuccessful and he or she has reason to do something about it. Presumably, if speakers receive RQCLs from listeners which indicate that they have been completely misunderstood then they may be particularly motivated to provide repairs that are successful. Clinically, however, it seems counterintuitive to provide a child with an incorrect auditory model of a target word within a RQCL to improve speech. Such a behaviour ignores the importance of using accurate spoken models to help children develop their acoustic-phonetic representations (Rvachew and Brosseau-Lapré, 2012). The conflicting evidence does however beg the question: Which is better: a RQCL containing a correct model (in keeping with the findings of McCartney, 1981) or a RQCL containing an incorrect model (in keeping with Baker and McCabe, 2010; Gozzard et al., 2008; Weiner and Ostrowski, 1979)? This question is difficult to answer, because the studies advocating a particular type of model (correct or incorrect) in a RQCL do not always compare the other type of RQCL. To better understand the importance of pragmatics in facilitating phonological change, there is a need to compare the effect of the two different types of RQCL (one containing a correct model and another containing an incorrect model) on children's speech production accuracy. To conduct such a study, it is important to study a similar phonological difficulty across children. One such area of difficulty for children is the accurate production of polysyllables.

3 *Children's productions of polysyllables*

Children learn to produce polysyllables gradually and over time (James et al., 2008a). In fact, it is not until the later school years that children learn to master adult-like polysyllable timing (Ballard et al., 2012). However, according to Kehoe (2001), the deletion of stressed syllables in multisyllabic words (words comprising two or more syllables) is relatively infrequent after 2 years, with the deletion of unstressed or weak syllables relatively infrequent after 3 years, with high truncation or deletion rates in children aged 3;6 years and older considered 'diagnostic of prosodic difficulties' (p. 291).

Accurate production of polysyllables can be difficult for a few reasons. Relative to monosyllables, polysyllables contain more consonants and vowels to be articulated. They require careful sequencing of syllables according to the lexical stress pattern of the word. They also require more effort to process phonologically: more information needs to be stored in phonological working memory when the word is first heard, and more information needs to be encoded, stored and retrieved in the form of an underlying phonological representation. It is not surprising then that difficulty with the accurate production of polysyllables in children with phonological impairment has been linked with phonological processing (including phonological awareness) and literacy difficulties (e.g. Larrivee and Catts, 1999). Thus, it makes sense to identify strategies that would help young children with phonological impairment improve their production of such challenging words.

4 Study aim

Therefore, the purpose of this study was to examine the effect of two types of RQCL on children's polysyllable productions. One RQCL contained an incorrect model that was prosodically correct yet segmentally inaccurate (e.g. 'did you say eresemp'; hereafter referred to as RQCL-IM), and the second RQCL contained a correct model of a child's target word (e.g. 'did you say elephant'; hereafter referred to as RQCL-CM). Based on previous research (e.g. Gozzard et al., 2008; Weiner and Ostrowski, 1979), it was hypothesized that the RQCL-IM would prompt genuine communication breakdown and increase revisions. It was also predicted that the children's revisions following a RQCL would increase in accuracy in both weak-onset and strong-onset 3-syllable words.

II Method

This was a preliminary and descriptive study, designed as a series of single case studies. The Human Research Ethics Committee at The University of Sydney, Australia, approved this research (approval number 12259).

1 Participants

The participants were recruited through a university clinic and preschools in Sydney, Australia. Potential participants, who were on the waiting list for an assessment at the university clinic were contacted via email or mail and invited to participate. Advertisement flyers were also sent to 140 privately run preschools in western Sydney and emailed to Australian speech pathologists who were members of a paediatric speech pathologist email distribution list.

Five families responded to the advertisement. From these, four children (aged 3;10–5;4) were eligible to participate based on the following inclusion criteria: a mild–moderate or moderate–severe phonological impairment characterized by, but not limited to, difficulty with the accurate production of polysyllables, typical oral structure and function, and no reported parental concerns regarding hearing. The children's receptive language score was not an inclusion criterion; however, the range in these scores is noted (see Table 1). All children spoke Australian English. None of the children had a reported history of otitis media. The eligible children completed assessment tasks to evaluate their speech, language, oro-muscular and phonological processing skills (including nonword repetition, digit and word memory). These tasks were also completed to determine eligibility for participation. Table 1 provides a summary of the participants' presenting characteristics.

2 Materials and procedure

a Assessment tasks. The children's speech, language, oro-musculature and phonological processing skills were assessed using a range of standardized and informal assessment tools. Speech was initially assessed using the Phonology Assessment of the Diagnostic Evaluation of Articulation and Phonology (DEAP; Dodd et al., 2002). Additional speech samples targeting the children's productions of polysyllables were gathered as part of the experimental task, as described in the next section.

Table 1. Participant characteristics.

	Ben*	Molly*	Claire*	William*
Age (years;months)	3;10	3;11	4;3	5;4
Gender	M	F	F	M
PCC (percentile rank)[a]	66.7 (2)	51% (1)	45% (1)	41% (1)
Core language percentile rank[b]	75	25	75	12
Receptive vocabulary percentile rank[c]	86	19	79	7
Digit memory percentile rank[d]	1	< 1	5	9
Word memory percentile rank[d]	9	< 1	9	25
Nonword repetition PCC (percentile)[e]	60.3 (< 10)	38.9 (< 10)	48 (< 10)	34.4 (< 10)
Previous speech therapy	nil	nil	nil	fortnightly for 3 months prior to starting school; concluded 8 months before participation

Notes. *pseudonym; PCC = percentage consonants correct; [a]Phonology Assessment of the Diagnostic Evaluation of Articulation and Phonology (DEAP) (Dodd et al., 2002); [b]Clinical Evaluation of Language Fundamentals Preschool – 2nd edition, Australian and New Zealand – standardized edition (CELF P-2 Australian and New Zealand) Core Language Score (Semel et al., 2006); [c]Peabody Picture Vocabulary Test – 4th edition (PPVT-4) (Dunn and Dunn, 2007); [d]Test of Auditory Processing – 3rd edition (TAPS-3) (Martin and Brownell, 2005); [e]Children's Test of Nonword Repetition (CNRep) (Gathercole and Baddeley, 1996).

Language skills were assessed using the subtests of the Clinical Evaluation of Language Fundamentals Preschool – 2nd edition, Australian and New Zealand – standardized edition (CELF P-2, Australian and New Zealand), which comprise the Core Language Score (Semel et al., 2006). Receptive vocabulary was assessed using the Peabody Picture Vocabulary Test – 4th edition (PPVT-4; Dunn and Dunn, 2007). Observations of oro-muscular structure and function were completed using protocol adapted from Robbins and Klee (1987).

A sub-set of phonological processing skills were also assessed. Each of the children completed the Children's Test of Nonword Repetition (CNRep; Gathercole and Baddeley, 1996). The children also completed digit and word memory tasks from the Test of Auditory Processing – 3rd edition (TAPS-3; Martin and Brownell, 2005) in which the children were required to repeat a series of digits, or words, of increasing length and complexity.

b Polysyllable baseline tasks. Three speech sampling tasks were used to elicit the children's baseline polysyllable productions. If prompting was required, two cues were presented in order; a semantic cue and then a binary choice with a semantically unrelated word (as described by McLeod, 1997). The speech sampling tasks were as follows:

- A single word picture naming task designed to sample 49 polysyllables of varied stress and syllable patterns. This task included 3-, 4- and 5-syllable words, of which 13 have a weak-onset stress pattern (Gozzard et al., 2006).
- A single word picture naming task designed to sample an additional 12 selected polysyllables; six 3-syllable weak-onset words and six 3-syllable strong-onset words (see Appendix

Table 2. Polysyllable baseline and experimental data collection schedule.

Purpose	Task	Session 1	Session 2
Baseline	Gozzard et al. (2006) single word picture naming task sampling 49 polysyllables.	Administered once	Administered at the beginning and then immediately before experimental tasks.
	Twelve polysyllables (6 weak-onset, 6 strong-onset), in SW picture naming task	Administered twice (not in succession)	Administered twice (once before then after experimental tasks)
	Twelve polysyllables (as used in SW task), in CS play context	Administered once	Administered once (before experimental tasks)
Experimental	Experimental RQCL task (SW), containing same twelve polysyllables used in the baseline task	Not administered	Administered twice
	Experimental RQCL task (CS), containing the same twelve polysyllables used in the baseline task.	Not administered	Administered twice

Notes. CS = connected speech; RQCL = request for clarification; SW = single word.

1). The words were selected from the Australian English Developmental Vocabulary Inventory OZI (Schwarz and Burnham, 2006) so that they would be known by Australian-English speaking 3–5 year olds. Baseline measures were completed three times, in keeping with recommendations by Tate et al. (2008).

- A connected speech task designed to sample the 12 selected polysyllables. The words were elicited in conversation during one of two play conditions (Play-Doh™ or a tea party) in keeping with Gozzard et al. (2006).

c Data collection procedure. Each child attended two sessions with the first author at the university clinic. The first session involved administration of assessment tasks to determine eligibility for the study and the collection of the polysyllable baseline data. Children who met the eligibility criteria attended a second session. During the second session additional polysyllable baseline data were gathered, and RQCL experimental tasks (described in the next section) were conducted in single word and connected speech contexts. Table 2 provides a summary of the polysyllable data collection. All participants completed all baseline tasks and did not appear to fatigue during repeated production of the same words. Each child's polysyllable productions were transcribed online using broad phonemic transcription. All sessions were recorded using an Olympus VN-5500PC digital voice recorder and a Canon MV 630iE digital video camera.

d Experimental request for clarification tasks. The children completed two experimental connected speech tasks and two experimental single word tasks. The 12 selected polysyllables used in the baseline sampling were the target words for all experimental tasks. During each task, the children were presented with one of two types of RQCL: RQCL-CM or RQCL-IM (see Appendix 1).

The children were randomly allocated to one of two conditions using a computer-generated randomization list. A child's allocated condition determined the order of RQCL presentation across the four experimental tasks (see Table 3). The presentation of tasks was balanced across

Table 3. Order of presentation of stimuli, during experimental tasks.

Experimental tasks	Condition 1 (Molly, William)	Condition 2 (Claire, Ben)
Single word task 1	RQCL-IM	RQCL-CM
Connected speech task 1	RQCL-CM	RQCL-IM
Connected speech task 2	RQCL-IM	RQCL-CM
Single word task 2	RQCL-CM	RQCL-IM

Notes. RQCL-IM = a request for clarification which contained an incorrect model; RQCL-CM = a request for clarification which contained a correct model.

the children to ensure alternating presentation of RQCL stimuli. During each experimental task, the children interacted with a blind-folded puppet. The puppet, controlled by the first author, presented the required order of RQCLs. When a child produced one of the 12 selected words incorrectly, the 'puppet' provided the RQCL in accordance with the child's allocated condition. The single word experimental tasks were picture naming tasks. For the connected speech experimental task the children created one of four 'silly scenes' (shopping, camping, picnic, and under the sea) using MagneTalk™ backgrounds (Goodwin and Prince, 2006) and magnetic coloured pictures of the polysyllables. The first author helped the children create each silly scene while the puppet remained blind-folded. The child then told the puppet how to create an identical picture.

Incorrect models of each the 12 selected polysyllables were created (See Appendix 1). The incorrect models aimed to meet the following criteria as closely as feasible; 1) permissible phoneme combinations in Australian English, 2) non-developmentally predicted phoneme substitutions, 3) the phoneme substitutions did not constitute a phonological pattern, 4) place of production only was altered (no change in manner or voicing). Each incorrect model contained the same word shape, stress pattern and sonority as the target and was unlikely to be spontaneously produced by the children (James et al., 2008b). The RQCL were presented in the same manner for each task, '*did you say (incorrect or correct model)?*'

e Intra- and inter-judge transcription reliability. Inter and intra-judge point-by-point reliability, based on a randomly selected 10% sample of the recorded single word and connected speech samples for each child was determined. Based on 894 data points, intra-judge agreement for broad phonetic transcription was 93% and inter-judge agreement was 85%.

f Procedural fidelity. Fidelity calculations were based on a sample of 24% of the single word and connected speech experimental tasks for each child. An independent observer viewed eight randomly-selected interactions between the researcher and the child. A checklist determined if the experimental tasks were completed as described. Based on 96 data points, procedural fidelity for the experimental tasks was 97%.

3 Data analysis

The assessment data was analysed in accordance with test developers' instructions. Percent consonants correct (PCC) was calculated on the assessment speech samples (including Dodd et al., 2002; Gathercole and Baddeley, 1996), using the PROPH module of Computerized Profiling v 9.7.0 (Long et al., 2006)

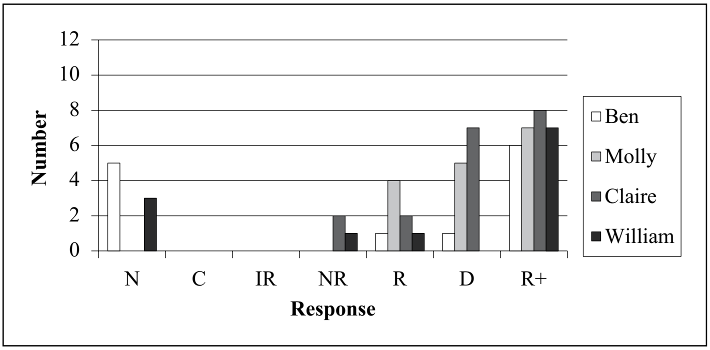

Figure 1. Responses of all participants after 'request for clarification – incorrect model' (RQCL-IM) in single word tasks.
Notes. N = no request was given as it was not required, C = confirmation, IR = irrelevant response, NR = no response, R = repetition, D = disagreement, R+ = revision.

The children's productions of polysyllables during the baseline and experimental tasks were phonetically transcribed and then visually inspected with respect to accuracy; change was then pragmatically categorized. Specifically, the children's responses to the RQCL-IM and RQCL-CM were categorized as: verbal confirmations (C, e.g. 'yes'); repetitions (R, e.g. when the child repeated his or her initial, incorrect production); no response (NR), irrelevant responses (IR), verbal disagreements (D, e.g. 'no'); or revisions (R+, when the child changed his or her production after the request for clarification), based on Gozzard et al. (2008). If the child said a polysyllable correctly and did not require a RQCL, the interaction was categorized accordingly (N). Revisions (R+) were further categorized as phonological (PL), suprasegmental (SU) and/or syntactic (SY). Phonological and suprasegmental revisions were further categorized with respect to increased (e.g. butterfly: /bʌdəfaɪ/ → /bʌdəflaɪ/) or decreased (e.g. /bʌdəfaɪ/ → /dʌpəfaɪ/) accuracy, in keeping with McCartney (1981). Responses were categorized as showing increased accuracy if one or more phonological elements in the word (consonant, vowel, stress pattern, word shape, or syllable shape) were more accurate relative to the child's initial attempt that prompted the RQCL. For instance, in /bʌdəfaɪ/ → /bʌdəflaɪ/ the child's production of the cluster has increased in accuracy from one cluster element to both cluster elements being present in the revision. Decreases in accuracy were categorized as such if one or more phonological elements were less accurate relative to the child's initial polysyllable attempt.

Due to the descriptive nature the case studies, the relative small number of polysyllables produced, and the variability of responses following the RQCL tasks, statistical analysis was not completed. Measures of effect size in single case design studies are highly variable and 'dependent on the particular statistical test used' (Brossart et al., 2006: 558) and therefore not presented herein.

III Results

1 Responses to requests for clarification

The children's responses were categorized according to response type. Responses to RQCLs in single word tasks are presented in Figures 1 and 2. Responses to RQCLs in connected speech tasks are presented in Figures 3 and 4. Children's responses could be coded to more than one category (e.g. disagreement and revision). Therefore, the totals do not equal 100%.

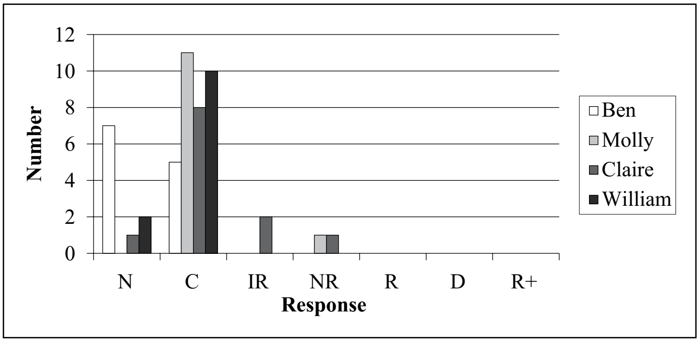

Figure 2. Responses of all participants after 'request for clarification – correct model' (RQCL-CM) in single word tasks.
Notes. N = no request was given as it was not required, C = confirmation, IR = irrelevant response, NR = no response, R = repetition, D = disagreement, R+ = revision.

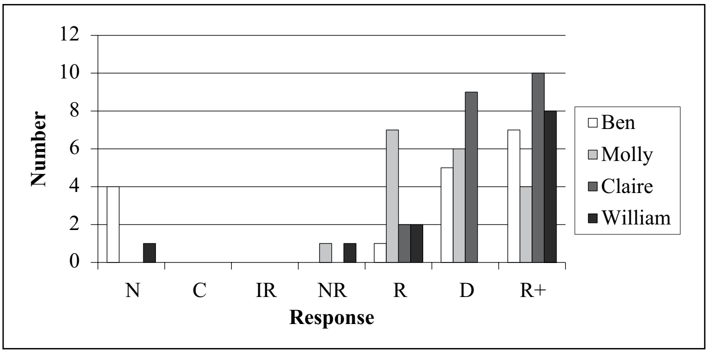

Figure 3. Responses of all participants after 'request for clarification – incorrect model' (RQCL-IM) in connected speech tasks.
Notes. N = no request was given as it was not required, C = confirmation, IR = irrelevant response, NR = no response, R = repetition, D = disagreement, R+ = revision.

Following a RQCL-IM, 69.5% of responses included a revision. Following a RQCL-CM, only 3.7% of responses included a revision. Ben made the fewest errors and was presented with the fewest RQCLs. Following a RQCL-IM, Ben revised his production on seven occasions in the connected speech task (Figure 3) and six occasions in the single word task (Figure 1). Claire and William also followed this pattern (see Figures 1 and 3).

Molly's responses to RQCL-IM are also shown in Figures 1 and 3. Molly had the lowest number of revisions (n = 4) but the highest number of repetitions (n = 7) during the connected speech RQCL-IM task (see Figure 3). Molly also made three syntactic revisions following RQCL-CM in the connected speech task (Figure 4).

Ben, Claire and Molly frequently paired disagreement responses with revision responses following a RQCL-IM, and this occurred more often in connected speech tasks. Ben responded with a disagreement plus revision on five occasions during the connected speech task (Figure 3) but only once during the single word task (Figure 1). William did not pair his revision responses with a disagreement in any of the RQCL-IM tasks (see Figure 1 and 3). However, William was the only child who produced a disagreement after a RQCL-CM (n = 1) (see Figure 4).

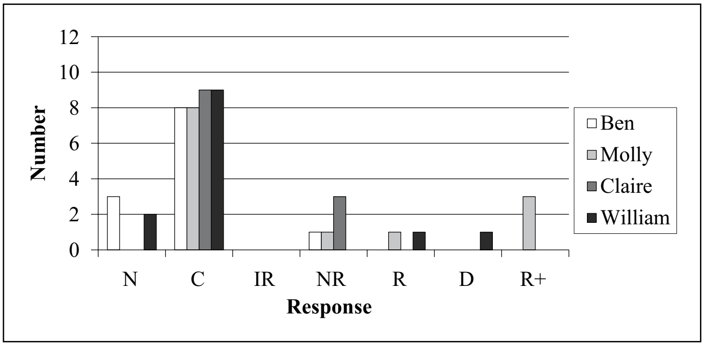

Figure 4. Responses of all participants after 'request for clarification – correct model' (RQCL-CM) in connected speech tasks.
Notes. N = no request was given as it was not required, C = confirmation, IR = irrelevant response, NR = no response, R = repetition, D = disagreement, R+ = revision.

William, Claire and Ben revised their productions on more occasions following a RQCL-IM than following a RQCL-CM (see Figures 1–4). Molly was the only child who had a higher number of repetitions than revisions during a RQCL-IM task. Molly's most common response following a RQCL-CM was to say 'yeah' (confirmation) with no revision.

2 Revision behaviours

Each of the children made both phonological and suprasegmental revisions of increased and decreased accuracy (see Table 4). Each revision was classified as either being closer to (increased accuracy) or further away from (decreased accuracy) the adult target based on McCartney's (1981) definitions.

In total, across the children, there were 44/70 phonological revisions, 18/70 were categorized as suprasegmental revisions and 8/70 syntactic revisions during the experimental tasks. Of the 44 phonological revisions, 36 were categorized as showing an increase in accuracy, while 8 were categorized as a decrease in accuracy. Suprasegmental revisions were also categorized as either increases in accuracy (n = 11) or decreases in accuracy (n = 7).

a Phonological revisions. Each of the children made phonological revisions of both increased and decreased accuracy in speech segments and/or word shapes and/or stress patterns. Ben's production of *kangaroo* in the connected speech task exemplifies an occasion when he revised and improved his production through segmental change (albeit still not matching the adult production):

Ben : /tændəwu/ (target *kangaroo*)
Researcher : did you say /tæmbəlu/?
Ben : no, /kæŋgəwu/

Phonological revisions involving the addition or deletion of syllables also occurred in response to RQCL-IMs. For example, Claire's production of *potato* during the RQCL-IM connected speech task increased in accuracy due to revision of phonological features. Despite this, Claire's production was still incorrect:

Table 4. Comparison of the total revisions for each child: Total revisions for experimental RQCL tasks (connected speech and single word).

	Increased accuracy			Decreased accuracy		
	Phonological revision	Suprasegmental revision	Total	Phonological revision	Suprasegmental revision	Total
Ben	9	3	12	1	1	2
Molly	4	3	7	3	1	4
Claire	12	3	15	3	2	5
William	11	2	13	1	3	4
Total	36	11	47	8	7	15

Claire : /peɪdoʊ/ (target *potato*)
Researcher : did you say /təkeɪpoʊ/?
Claire : no, /əteɪtoʊ/

This suggests that phonological accuracy (word shape) increased during the experimental RQCL-IM tasks. Two interactions with Claire and one interaction with Molly did not follow this trend (3/8 phonological revisions of decreased accuracy). For example, Molly reduced the syllable-initial weak-onset of *vanilla* after a RQCL-IM:

Molly : /ənɪlə/ (target *vanilla*)
Researcher : did you say /zəmɪwə/?
Molly : /nɪlə/

b Suprasegmental revisions. Each of the children made suprasegmental revisions of both increased and decreased accuracy. Many of these revisions co-occurred with phonological revisions. For example, William revised suprasegmental and phonological features of the target word, *vegemite*, following a RQCL-IM:

William : /bɛʤʌmaɪt/ [*emphasized*] (target *vegemite*)
Researcher : did you say /zɛʧənaɪk/?
William : /vɛʤəmaɪt/

Overall, the RQCL-IM prompted revisions in words with both weak- (29/62: 47%) and strong-onsets (33/62: 53%).

IV Discussion

The main purpose of this study was to examine the effect of two types of request for clarification (RQCL) on children's polysyllable productions. The predictions about the effect of RQCL-IM and RQCL-CM on children's polysyllable production were confirmed. When presented with a RQCL-CM, children with phonological impairment were most likely to agree with the researcher and not attempt to revise their production. The RQCL-IM was more successful in prompting the children to revise their response. The exception to this trend was Molly who typically repeated her original pronunciation of the target polysyllable.

We also predicted that the revisions following a RQCL would be more accurate relative to the children's production prior to the RQCL. This prediction was confirmed. All the children made suprasegmental and phonological revisions, which increased the accuracy of a polysyllable following a RQCL-IM (Table 4). There was little difference between words with weak onset and words with strong onset in terms of the frequency of phonological and suprasegmental revisions. Although these findings are limited due to the small sample size, these results could be interpreted as having possible therapeutic applications.

There have been confusing and contradictory findings in previous research about the most effective use of RQCLs to prompt changes in speech production in typically developing children (Gozzard et al., 2008) and children with phonological impairment (McCartney, 1981). In this study, one RQCL (RQCL-CM) included all the phonological information children require to change their speech (McCartney, 1981). The alternate RQCL (RQCL-IM) utilized genuine communication breakdown. The children were required to identify the source of the breakdown and formulate a repair strategy (Gozzard et al., 2008). The most noticeable trend in this study was that each child attempted to revise his or her production following an RQCL-IM. This supports the earlier findings of Baker and McCabe (2010), Gozzard et al. (2008) and Weiner and Ostrowski (1979). This may have been due to the genuine communication breakdown generated by this type of request and the child's motivation to be understood. The RQCL-CM appears not to indicate communication breakdown and thus may not have created sufficient motivation for change. Perhaps the greater rate of revisions in the connected speech task occurred because effective communication was required to complete the task.

Alternately, the maintenance of the suprasegmental properties of the target word in the RQCL-IM stimuli (see Appendix 1) may have assisted the children to revise their productions. Through providing a correct suprasegmental model within a RQCL, the children may have used it as a scaffold to attempt a revision. This occurred within the context of true communication breakdown, but increased available phonological information.

The difference in revision response between three of the children (Ben, Claire and William) and Molly was interesting. This difference raises a need to consider the underlying cognitive processes involved in polysyllable production. Theories of speech production hypothesize that a child's speech output is only as good as his or her underlying phonological representation of the word (e.g. Stackhouse and Wells, 1997). However, the results of the current research suggest that a child's speech output is not always a clear reflection of his or her underlying representation. Three of the children in this study improved their productions when presented with a RQCL-IM. This suggests that these children may have had a better phonological representation of polysyllables than they initially produced. This is also supported by the variability of each child's polysyllable production. Thus, even if children have poorly specified underlying phonological representations (Elbro et al., 1998), they may use these representations to a greater or lesser extent. One suggestion is that children use their available cognitive resources as economically as possible to communicate the intended message (Baker and McCabe, 2010). When communication breaks down, children may re-evaluate the amount of effort required and retrieve more phonological information than in the preceding utterance. Thus, the extent to which their representations are accessed may depend on the success of their communication. In this respect, William, Claire and Ben may have been motivated to change their speech and were able to improve their productions because they retrieved more information from their stored representations than initially accessed. The variability in receptive language ability among the children made this observation particularly interesting. Although William demonstrated the poorest receptive language skills, he responded to the RQCL stimuli in the same way as Claire and Ben. This suggests that in these children, receptive language may not have been a mediating variable associated with responsiveness to the RQCL.

In contrast, Molly made little change in her polysyllable productions following the RQCL-IM. This suggests that Molly may have had less specified underlying representations of the target words. Molly may have initially used her best possible production but, once communication broke down, she did not have any additional information to access. Thus, her surface representation may have matched the underlying representation of the words. Alternately, she may not have had sufficient working memory to access additional information when challenged to repair a breakdown in communication. This is supported by her relatively poorer performance on the working memory assessment tasks.

We suggest that children who can improve their polysyllable productions following a RQCL-IM may benefit from a polysyllable-based intervention that harnesses this conversation-based technique. Children who are less responsive to this type of communication breakdown may require an alternative intervention strategy for polysyllables. The relationship between child responsiveness and the effect of this technique warrants further investigation.

1 Limitations

As a preliminary descriptive case study, the sample size of participants and the number of selected polysyllables was small. Consequently, statistical analysis was not completed (Kratochwill et al., 2010). This study controlled for word length and variations in word shape through the inclusion of 3-syllable words with either weak- or strong-onset pattern, which allowed for direct comparisons between data and clear interpretation of results. However, no comment can be made about how children would respond to RQCLs when they produced even longer words (4–5 syllables) incorrectly.

The children's phonological processing skills were assessed in the initial phase of this research. However, the nonword repetition task and digit span tasks selected did not appear sensitive enough to capture subtle variations in phonological working memory skills of the children with phonological impairment in this study. All children demonstrated near ceiling performance on these tasks during their initial assessments.

2 Recommendations

There is a need for an effective intervention to target children's polysyllable productions. In light of the results from the present study, further research is required to determine whether an intervention based on RQCL-IM with weak- and strong-onset targets is viable. Such an intervention may assist children to access their phonological representations more effectively. It may also help children with phonological impairment to better specify their underlying representations of polysyllables. This could be an interesting line of inquiry given the links between phonological impairment, poor polysyllable production and literacy difficulties (Lewis et al., 2002).

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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Appendix 1

Experimental single word list, phonetic transcription, RQCL-CM and RQCL-IM used during the experimental tasks.

Experimental-Single Word	Transcription	RQCL-CM	RQCL-IM
		'Did you say …'	'Did you say …'
Strong onset:			
butterfly	bʌtəflaɪ	bʌtəflaɪ	dʌpəslaɪ
elephant	ɛləfənt	ɛləfənt	ɛrəsəmp
kangaroo	kæŋgəru	kæŋgəru	tæmbəlu
crocodile	krɒkədaɪl	krɒkədaɪl	plɒtəgaɪ
vegemite	vɛʤəmaɪt	vɛʤəmaɪt	zɛʧənaɪk
radio	reɪdijoʊ	reɪdijoʊ	leɪbiroʊ
Weak onset:			
koala	kəwalʌ	kəwalʌ	pəjawʌ
potato	pəteɪtoʊ	pəteɪtoʊ	təkeɪpoʊ
vanilla	vənɪlə	vənɪlə	zəmɪwə
banana	bənanə	bənanə	dəmaŋə
computer	kəmpjutə	kəmpjutə	tənkrupə
tomato	təmatoʊ	təmatoʊ	kənapoʊ

Notes. RQCL-IM = a request for clarification which contained an incorrect model; RQCL-CM = a request for clarification which contained a correct model.