The potential contribution of communication breakdown and repair in phonological intervention

Contribution potentielle des bris et des réparations de la communication lors de l'intervention en phonologie

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Abstract
This paper explores the potential contribution of communication breakdown and repair sequences in phonological intervention. The paper is divided into two parts. In part one, we examine the inclusion of communication breakdown and repair sequences across three current approaches to phonological intervention. The review of this literature highlights a need for researchers to better document the teaching dialogue used in therapy. In part two of this paper, we consider how a unique type of clarification request containing an incorrect production could be applied in an intervention context. Reasons why such a unique counterintuitive clarification request might help children's speech are considered. The need to better understand the effect of different types of clarification requests on children's speech production skills during phonological intervention is discussed.

Abrégé
Cet article explore la contribution potentielle des séquences de bris et de réparation de la communication lors de l'intervention phonologique. Il est organisé en deux sections. La première examine l'inclusion des séquences de bris et de réparation de la communication dans trois méthodes actuelles d'intervention en phonologie. Cette analyse documentaire met en valeur la nécessité de mieux documenter l'enseignement de dialogues utilisés en thérapie. Dans la deuxième section, un type unique de demande de clarification contenant une production incorrecte pouvant être utilisé dans un contexte d'intervention est proposé. Des raisons sont données expliquant pourquoi une telle demande de clarification contre-intuitive unique pourrait aider la parole des enfants. Le besoin de mieux comprendre les effets de différents types de demandes de clarification sur les habiletés de production de la parole des enfants lors de l'intervention en phonologie est abordé dans la discussion.

Keywords: intervention, phonology, request for clarification, pragmatics, and polysyllables

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Clinician:	*What are you going to put on your pizza?*
Mark:	*White capsicum* [waɪ kæʔtən]
Clinician:	*A what?*"
Mark:	*Capsicum* [kæptən]
Clinician:	*Hmm, I'm not sure what you mean. A captain?*
Mark:	*You know capsicum* [ju noʊ kæptətən]
Clinician:	*Ah! Capsicum.*

Mark is 4 years old and has a phonological impairment. One of the consequences of his impairment is that breakdowns in communication occur. As shown in the above conversation between Mark and his speech-language pathologist (S-LP), breakdowns are signaled when listeners request clarification of speakers' utterances (Fagan, 2008). Requests for clarification (RQCL) are unsolicited queries from listeners inviting speakers to revise or repair their original utterances so that listeners can better understand speakers' originally intended messages (Brinton, Fujuki, Loeb & Winkler, 1986; Yont, Hewitt & Miccio, 2002). RQCL and the ensuing conversational exchanges between speakers and listeners are called repair sequences (Brinton et al., 1986). These sequences need to be resolved so that the topic of conversation can continue (McCartney, 1981). Resolutions may be achieved by speakers successfully revising their original message and/or listeners deducing speakers' intended meaning. As shown in the above example, breakdowns in communication may motivate children to repair their speech in order to be understood. In this paper, we reflect on the potential contribution of communication breakdown and repair sequences in phonological intervention as a pragmatic strategy for promoting speech change. The paper is divided into two parts. In part one, we explore the inclusion of communication breakdown and repair sequences across three approaches to phonological intervention. We consider whether communication breakdown and repair sequences can be evidence-based kernels (Embry & Biglan, 2008) of phonological intervention, that is, whether they are specific and unique teaching procedures shown through experimental manipulation to positively change children's phonological abilities. In part two, we examine the literature on the impact of different types of clarification requests on children's speech. We consider how the findings from this research could be applied to the management of phonological impairment in children, particularly with respect to children's difficulties producing polysyllables.

Part One: Inclusion of Communication Breakdown and Repair Sequences across Current Approaches to Phonological Intervention

Children who have a phonological impairment are thought to have a linguistic difficulty with the organization and use of phonemes to signal meaning (Howell & Dean, 1994). Phonological intervention aims to facilitate the re-organization of children's phonological systems through the careful analysis and strategic selection of intervention targets, with the hope of promoting generalization. Complexity-based approaches to phonological intervention (e.g., maximal oppositions) focus almost exclusively on the role of intervention targets in facilitating widespread change in children's phonological systems (e.g., Gierut, 1992, 2007). While consideration of what to target in intervention is important, S-LPs still need to know how intervention targets are best taught.

Strategies for teaching intervention targets could be divided into one of two types: articulation-based teaching strategies and concept-based teaching strategies. To put it simply, articulation strategies focus on the mouth while conceptual strategies focus on the mind (Grunwell, 1983). Examples of articulation strategies include instructions about tongue-placement (e.g., "*put your tongue behind your teeth when you say [s]*") and imitation of clinicians' models (e.g., "*watch my mouth and say [s] with me*"). Examples of conceptual strategies include using imagery terms to classify sounds according to classes of voice, place or manner characteristics (e.g., Klein, 1996; Howell & Dean, 1994), and using communication breakdown and repair sequences that capitalize on the functional impact of the homonym in children's speech when they attempt to say minimal pair words (e.g., Weiner, 1981). For the practicing S-LP, decisions about which of these teaching strategies to use needs to be guided by research evidence. By this, we do not simply mean evidence in support of a particular intervention approach such as minimal pairs therapy (e.g., Weiner, 1981), but insight into the status of teaching strategies within approaches as evidence-based kernels of intervention (Embry & Biglan, 2008). An evidence-based kernel is "a behaviour–influence procedure shown through experimental analysis to affect a specific behavior and that is indivisible in the sense that removing any of its components would render it inert" (Embry & Biglan, 2008, p. 1). In this section of the paper, we consider whether communication breakdown and repair sequences are evidence-based kernels within three phonological intervention approaches that use minimal pair words.

Communication breakdown and repair sequences have been used as teaching strategies across many (but not all) approaches to phonological intervention. Perhaps the most well-known approach associated with such sequences is the minimal pair approach (e.g., Weiner, 1981). This approach was developed on the assumption that the "the social-communicative basis of the speaker-listener interaction serves as a powerful source of phonological learning" (Weiner, 1982, p. 141). In a review of the evidence base for

this approach, Baker (2010) identified 42 peer reviewed published investigations. A close inspection of this literature showed how the use and timing of communication breakdown and repair sequences had varied. For instance, across the 42 investigations Baker found that 53% explicitly noted using communication breakdown and repair sequences. An additional 7% of studies explicitly stated that they did not induce communication breakdown, while the procedural details regarding the use of communication breakdown and repair sequences was difficult to discern for the remaining 40% of studies. In one of the first studies of the minimal pair approach, Weiner (1981) reported that minimal pair intervention including such sequences was successful at reducing the occurrence of the phonological processes of stopping of fricatives, final consonant deletion and velar fronting in two boys (4;10 and 4;4 years) with a phonological impairment. The exact contribution of this conversational device on the intervention outcomes was unknown because additional teaching strategies were included following participants' unsuccessful attempts to repair episodes of communication breakdown. Specifically, Weiner (1981, p. 98) reported that the clinician said "*You keep saying "bow." If you want me to pick up the boat pictures you must say the /t/ sound at the end. Listen, "boat, boat, boat." You try it. Okay, let's begin again*." In this brief dialogue example, metaphonological instruction is include ("*you must say the /t/ sound at the end*") and auditory models are provided for imitation ("*listen, "boat, boat, boat*"). In one of the few minimal pair investigations to not use communication breakdown and repair sequences, Saben and Costello-Ingham (1991) noted that the results may have been better if communication breakdown had been used. In their study, they attempted to make the participants aware of the homonymy in their speech by having them produce minimal pair words consecutively. They also provided the children with opportunities to imitate spoken models of minimal pair words, and asked them to point to named minimal pair pictures. Although the children learned how to say the treatment words, phonological generalization, described as the suppression of the targeted phonological processes in non-treatment words containing the targeted speech sound and other untreated phonemes affected by the targeted processes, did not occur. They suggested that real communication breakdown may have been needed to evoke phonological generalization. Together, the findings from these two investigations suggest that communication breakdown and repair sequences might be a useful teaching strategy for helping children learn how to use phonemes to signal meaning. Assuming that the strategy is useful, it would be important to know when it might best be used.

Across the evidence-base for the minimal pair approach identified by Baker (2010), 56% of studies using communication breakdown and repair sequences used them only once participants were able to imitate the treatment words, at word level. For example, Tyler, Edwards and Saxman (1987, p. 396) did not use "activities designed to take advantage of the semantic confusion created by an error production," that is, communication breakdowns and repair sequences, until their participants could produce the target sound in words. Tyler et al. (1987) note that "based on previous clinical experience, this was believed necessary in order for the child to experience success" (p. 396). By contrast, other studies of the minimal pair approach (e.g., Baker & McLeod, 2004; Blanche, Parsons & Humphreys, 1981; Crosbie, Holm & Dodd, 2005; Weiner, 1981) indicated that they used such sequences at word level from the outset of intervention. For example, Baker and McLeod (2004) reported saying the target word and minimal pair cognate as part of a RQCL (e.g., "*Do you mean nail or snail? I'm not sure what you mean. Tell me again*") during spontaneous speech production activities at word level. An initial imitation phase was not included in this study. Crosbie, Holm and Dodd (2005) reported using activities that resulted in communication breakdown if the participants did not say the target words correctly, initially in an imitation context at word level. Crosbie et al. (2005, p. 480) exemplified their feedback following error productions as "*I didn't hear a /p/ on the end when you said beep — it sounded like bee to me*." Weiner (1981) used communication breakdown and repair sequences from the outset of intervention based on an assumption that children experience a need to learn to change their speech within the context of such sequences. According to Weiner (1982), breakdown and repair sequences provide children with an opportunity to discover Malinowski's (1949) phenomenon of *word-magic*: successfully communicated words are powerful because they have the potential to cause action during a speaker-listener interaction. When spoken words do not work like magic, Weiner (1982) suggests that the frustration children experience when communication breaks down motivates them to change their phonology so that they can be understood. Inclusion of such breakdown and repair sequences from the outset of intervention prior to any imitation activities presumably ensures that such learning opportunities occur. Although this sounds intuitively appealing, the relative benefits of including communication breakdown and repair sequences from the outset of intervention, or, after imitated-based activities remain to be understood.

Other phonological intervention approaches in which communication breakdown and repair sequences involving minimal pair words have been used include Metaphon (e.g., Dodd & Bradford, 2000; Jarvis, 1989) and Parents And Children Together therapy (PACT; Bowen & Cupples, 1999). Across the evidence on these two approaches, the potential contribution of such sequences was difficult to establish because the sequences were included as one of a number of teaching strategies. For example, in a case study of the PACT approach, Bowen and Cupples (1999) used a variety of strategies such as auditory bombardment, production practice using meaningful minimal pair words, in addition to activities involving communication breakdown and repair sequences. Bowen and Cupples also included metalinguistic talk about 'fixing up' speech errors. Bowen and Cupples (1999, p. 80) commented how Ceri, 4;10 years, said to her mum, "*I fixed that one*

up, didn't I mum?" following a self-correction. Therapy dialogue examples of clarification requests and feedback on error as part of communication breakdown and repair sequences were not provided. The effect of this latter conceptual teaching strategy on Ceri's speech was unclear. Similar comments could be made about a case study of the Metaphon approach. Jarvis (1989) reported using a variety of teaching strategies with Luke, 4;9 years. Some of the strategies included teaching him the difference between noisy and quiet sounds, activities targeting his perception of /p/ and /b/ in sound, syllable and word level contexts, activities using candles, bubbles, and straws to highlight the aspiration involved in producing initial /p/, and, activities in which communication breakdown and repair sequences occurred using the minimal pairs *pear* and *bear* at the single-word level. Although Jarvis noted that Luke successfully repaired his speech following a RQCL during a conversation with a peer in the classroom at school following a block of intervention, examples of teaching dialogue from intervention sessions were not provided.

In summary, although communication breakdown and repair sequences have been used across different contrast approaches to phonological intervention involving minimal pair words, the effect of such sequences as a teaching strategy on treatment outcomes remains to be clearly understood. If we are to determine whether communication breakdown and repair sequences are in fact evidence-based kernels of intervention, we need more carefully controlled efficacy research examining the relative contribution of clearly defined and exemplified episodes of communication breakdown and repair. A first step could be to determine the best type of RQCL that initiates a communication breakdown and repair attempt from children who have a phonological impairment. For instance, it would helpful to understand whether a RQCL containing a target word and minimal pair cognate (e.g., "*Did you say key or tea*?") is more effective than a simple RQCL (e.g., "*What did you say*?"). Part two of this paper reviews the existing literature on the effect of different types of RQCLs on the speech production skills of children with typically developing speech, and children who have a phonological impairment.

Part Two: Children's Responses to Different Types of Clarification Requests

Children's responses to different types of RQCL have been studied for over 30 years (e.g., Brinton et al., 1986; Fagan, 2008; Gallagher, 1977; McCartney, 1981). Yont, Hewitt and Miccio (2000) proposed a helpful system for describing and coding types of RQCL including (a) nonspecific or neutral requests for repetition (NRR), such as "*what*?"; (b) specific requests for confirmation (SRC), such as "*did you mean ring*?"; (c) specific requests for repetition (SRR), such as "*you found a what*?"; (d) specific requests for specification (SRS) that ask the speaker to provide more information to clarify a misunderstanding, such as "*you said you played with Tim*? *Who is Tim*?"); and (e) nonverbal requests (NVB), such as a confused facial expression. Of particular interest to the present paper are the studies that have considered whether children with typically developing speech or phonological impairment could repair their speech in response to different types of RQCL.

In a study of typically developing children's responses to a contrived NRR ("*what*?"), Gallagher (1977) reported a group of 21 children, aged 21-29 months, were more likely to repair their speech rather than repeat or ignore their listener's request. McCartney (1981) examined the effect of various types of RQCLs on the speech production skills of three boys with a severe speech disorder of unknown etiology. She reported that only eight responses to 113 RQCLs contained a speech repair and that the request type associated with such repairs was an SRC containing a model of the target word. For example:

"M. *What's he called?*
NE. *Sheriff* [ˈtɛwɪ]
M. *Sheriff?*
NE. *Yea, the sheriff* [ˈʃɛwɪ]"
McCartney (1981, 156)

Weiner and Ostrowksi (1979) provided 15 children, aged 3;1-5;6 years, with three different types of SRC ("*did you say* ____?"): (a) SRC using correct pronunciation of the target word, (b) SRC using child's pronunciation of the target word, and (c) SRC using an incorrect but novel pronunciation of the target word that differed from the child's incorrect pronunciation. Novel pronunciations were described as misarticulated responses that differed from the participants' responses. No further details were provided as to how or in what ways the misarticulated responses were developed. They described their participants as having misarticulated at least four fricatives or affricates. The status of the participants' speech as typically developing or impaired was not provided, although it was stated that none of the participants had received speech remediation. Confusion about the status of the participants' speech production skills exists in the extant literature, with one study indicating that the participants were typically developing (McCartney, 1981), and another suggesting that the participants had impaired speech (Paul-Brown & Yeni-Komshian, 1988). This issue aside, Weiner and Ostrowski (1979) reported that the children's repair responses following the novel SRC had the fewest speech production errors. They likened this condition to real communication breakdown, suggesting that children may be more motivated to make changes to their speech when they are clearly not understood. This suggestion is of course limited by the ambiguity surrounding the speech status of the children involved in the study. This phenomenon was replicated by Gozzard, Baker, and McCabe (2008) in a study of six typically developing children aged 4;1-4;9 years. In this particular study, the children were able to improve their pronunciation of polysyllabic words in response to a SRC containing an incorrect novel pronunciation in both a single-word context, and during conversational speech. As shown in the following example, Megan

Table 1
Summary of Robbie's language and phonological processing assessment results at age 4;6 years

Assessment tool	Standard Score	90% Confidence interval	Percentile Rank
Clinical Evaluation of Language Fundamentals-Preschool 2 Australian: Expressive Language Score (Wiig, Secord & Semel, 2006)	92	+/- 6	30%
Clinical Evaluation of Language Fundamentals-Preschool 2 Australian: Receptive Language Score (Wiig et al., 2006)	102	+/- 7	55%
Peabody Picture Vocabulary Test 4th Edition (Dunn & Dunn, 2007)	104	+/- 7	61%
Children's Nonword Repetition Test (Gathercole & Baddeley, 1996)	74		<10 %
Preschool and Primary Inventory of Phonological Awareness Subtests (Dodd, Crosbie, McIntosh, Teitzel & Ozanne, 2000)		95 % Confidence interval	
- Syllable segmentation	4	+/- 2.4	2%
- Rhyme awareness	10	+/- 1.9	50%
- Alliteration awareness	8	+/- 2.4	25%
- Phoneme isolation	9	+/- 0.7	37%

successfully repaired a breakdown in communication during conversational speech when the researcher requested clarification using a novel SRC containing a segmentally incorrect yet suprasegmentally correct production of her target word, echidna.

"Megan: *The echidna* [ˈkɪdnə] *has to go here*

Researcher: *Was that an* [əˈbɪdnə]?

Megan: *Echidna* [əˈkɪdnə]"

(Gozzard et al., 2008, p. 256)

In summary, it would seem that children are not only capable of revising their speech in order to repair a breakdown in communication, but, that the type of RQCL used by a listener may influence the extent to which children's speech revisions match the adult target. In light of the findings by Weiner and Ostrowski (1979) and Gozzard et al., (2008) it would seem reasonable to consider whether a SRC containing a novel pronunciation of children's target words could be used as a teaching strategy during phonological intervention with children who struggle to use their own relatively complete phonetic inventories accurately in polysyllables. What follows is a description of a preliminary clinical case in which this novel type of SRC was used. The primary purpose in presenting this clinical example is to illustrate how the novel SRC might be used in an intervention context. Using Fey and Finestack's (2009) five-phase plan for evaluation interventions, the case study merely serves as a pre-trial study to stimulate thought and discussion about the potential contribution of communication breakdown and repair sequences in phonological intervention. The case is not intended to provide empirically robust efficacy data but simply preliminary information that could be used in future evaluations of the efficacy of this conceptual teaching strategy.

Clinical Case Study: Background

Robbie (pseudonym) is the third child of English-speaking parents with no immediate family history of phonological or language impairment, no structural or anatomical cause for his speech impairment and normal hearing. At the age of 4;6 years, he was seen by a speech-language pathologist (second author) for a review speech and language assessment. Prior to this time, he had received blocks of intervention primarily targeting his segmental skills over a two-year period. The focus of this case example is Robbie's speech production skills at 4;6 years.

In summary, Robbie presented with an unusual phonological impairment. Despite having an almost complete phonetic inventory (20 vowels and 23 consonants with the exception of /ɵ/) and a wide range of word shapes, word lengths (up to five syllables) and stress patterns, his percentage of consonants correct (PCC) in a single-word context was 57.9%. Robbie's speech was more accurate in single words than in connected speech, and more accurate in monosyllables than in di- and polysyllables. He also had considerable difficulty with iambic stress. Across a sample of 15 words beginning with weak stress (e.g., *computer, potato*), he frequently omitted the initial weak syllable or changed the syllable stress from weak to strong (e.g., *giraffe* /dʒəˈraf/ was [ˈdɔwaf]). Of the words showing syllable omission, his attempts were either variable (e.g., *echidna* /əkɪdnə/ was [ˈtɪdʌ] and [ˈkɪdnə]) or included segments from the omitted weak syllable (e.g., *spaghetti* /spəˈgɛti/ was [ˈstɛti]) suggesting that he may have had more intact underlying phonological representations than individual surface representations suggested. Robbie was also frequently unable to change or update established productions of polysyllabic words as his phonological system developed. For example, despite being able to articulate word initial

Table 2
Summary of Robbie's phonological skills based on an independent and relational analysis of a single-word sample*

Independent analysis	
Phonetic inventory	Singletons: [p b t d k g m n ŋ h f v s z ʃ ʒ tʃ dʒ l j w r] with one instance of [ð] Consonant clusters: Word-initial [br tr kr bl sp st sn sm sw sl gw bw fw ʃn] and word-final [nt, nd, mp, mt, ns, ndʒ, ŋk, kt, ts, dz, vz, ld] Absent from inventory: [θ], some 2-element clusters /sk, kl, gl, fr, bj, kj, tr, θr/ and 3-element word-initial clusters[b]
Word shape/length inventory:	Monosyllables: $C_{0-2}VC_{0-2}$ e.g., V, CV, VC, CVC, CCV(C), C(C)VCC, Disyllables: $C_{0-2}VC_{0-3}VC_{0-2}$ e.g., CVCV, VCVC(C), CVCVC, CVCCV(C), CCVCV(C), CVCCCVCC Polysyllables: • 3-syllable words: $C_{0-2}VC_{1-2}VC_{1-2}VC_{0-2}$ e.g., C(C)VCVCV, CCVCVCV, CVCCVCVC • 4-syllable words: CVCVCVCV(C) • 5-syllable word *hippopotamus* CVCVCVCVCVC
Stress pattern inventory (S= primary stress, s= secondary stress, w= unstressed)	S, SS, Sw, Sws, Ssw, Sww, Swsw, Sssw, Swssw (once) Absent from inventory: wS, wSw, wSs, wSww
Relational analysis	
Percent Consonants Correct (PCC)	Total PCC = 57.9% PCC Early = 73.8%; PCC Middle = 51.6%; PCC Late = 46.5% PCC stops = 63.1%; PCC nasals = 84.8%; PCC fricatives = 58.9%; PCC affricates = 8.3%; PCC glides = 63.6%; PCC liquids = 58.5% PCC clusters = 31.2%
Percent Vowels Correct (PVC)	Total PVC = 82.7%
Percent Word Shapes Correct	Monosyllables = 73.9% Disyllables = 58% 3-syllables = 28 % 4- and 5-syllable words = 42%
Stress patterns	SS = 100%; Sw = 84%; wS = 0% (all attempts changed to SS) Sws/Sww/SwS = 61% (incorrect productions were either SS or SW) wSw / wSs = 0% (all attempts were changed to SS or Sw) Swsw / Swss/ Swws / Sssw = 36% (incorrect productions typically were the result of weak syllable deletion)

[a]Sample from 138 spontaneous single-word responses from Robbie during DEAP Phonology Assessment (Dodd et al, 2003) and the Gozzard et al., (2006) single-word test of polysyllables.
[b]Sampling constraints meant that some initial 2-element consonant clusters including /dr, pr, gr, ʃr, tw, tj, nj, pj/ were not sampled. The inventory status of these clusters was unknown.

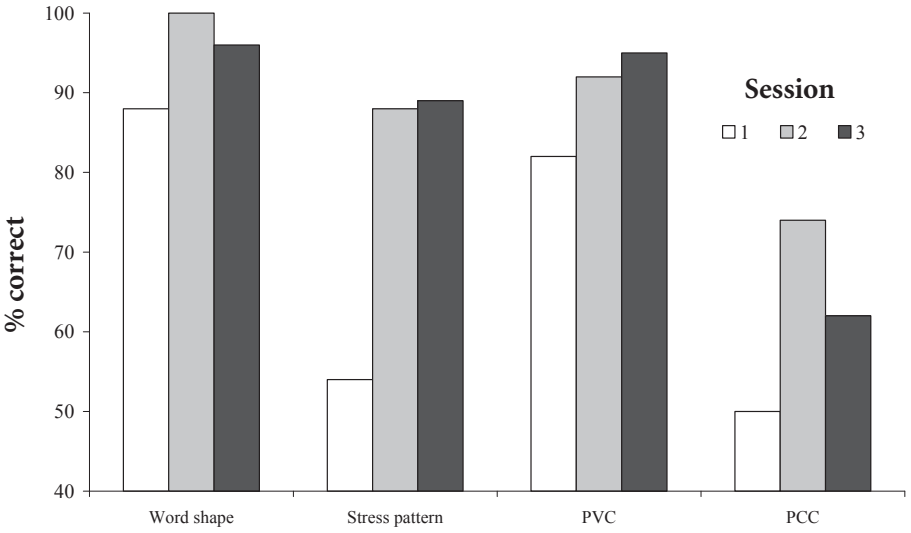
/st/ clusters in single-word and conversational speech contexts at assessment, his production of *stegosaurus* was [ˈtɛgtɔ]. Apparently, he had been using this production for *stegosaurus* since developing a keen interest in dinosaurs as a toddler.

Robbie's language comprehension and production test scores were within the normal range. Measures of his phonological processing ability, including phonological working memory and phonological awareness suggested that he may have had difficulty encoding, storing and/or retrieving phonological information. However, the degree to which his phonotactic constraints influenced his performance on measures of phonological processing was unknown. Tables 1 and 2 provide a summary of Robbie's speech and language assessment results.

During conversational speech, Robbie was responsive to his communication partner's needs. When there was a breakdown in communication, he typically responded by repeating or repairing his original utterance. Using the repair categories described by Gozzard et al., (2008), his repair attempts typically involved semantic, syntactic or suprasegmental revisions. That is, he either changed the word he was trying to say, re-phrased his utterance or spoke louder and with greater emphasis on any

unintelligible words or phrases. Over the three sessions required to conduct the speech and language assessment, Robbie did not use the strategy of revising the phonological or phonetic content of his speech in any repair utterance in response to naturally occurring neutral clarification requests (e.g., "*pardon*?", "*what did you say*?").

Figure 1: Robbie's percentage of word shapes, stress patterns, vowels and consonants correct for target words in response to the clinician's specific request for confirmation (SRC) containing a different incorrect production of the target words, across the three trial sessions.



Clinical Case Study: Methodology

Given that Robbie did not change his speech in response to neutral RQCLs during conversation, and that he seemed to have more detailed underlying phonological representations than his surface representations for individual words suggested, we speculated whether the novel SRC used by Gozzard et al., (2008) with typically developing children might prompt him to repair his speech and use more adult-like productions of polysyllabic words. We conducted a trial of this repair strategy at the beginning of three of Robbie's regular weekly 50-minute intervention sessions. At the time of the trial, his regular intervention sessions focused on his phonemic awareness, letter and sound knowledge, based on Gillon (2005). The trial component within each therapy session lasted approximately 20 minutes. What follows is an overview of the procedure, measurements and outcomes of this preliminary trial.

The trial sessions involving communication breakdown and repair were embedded in a clinician-directed play activity involving a set of 27 felt animals representing nine polysyllabic words and an African landscape scene mat. We limited the target polysyllabic words to the semantic category of African animals in keeping with the theme of the play activity. The novel SCR used to initiate the communication breakdowns contained a repetition of Robbie's incorrect attempt at one of the nine target polysyllabic words; however, the pronunciation was characterized by pre-prepared non-developmental segmental errors dissimilar to his errors with correct (or near correct) word/syllable shape, correct word length and correct stress patterns relative to the Australian English pronunciation. The novel error productions were phonotactically permissible in Australian English and did not contain metathetic errors (see the Appendix for details).

The clinician, Robbie and his mother Lucy (pseudonym) all sat on the floor around the mat while the clinician held the felt animals under a guise of sorting them. Robbie was invited to ask the clinician for the animal he wanted to place on the mat. If Robbie's request contained a phonological error, the clinician signaled a communication breakdown by stating "*Did you want a* (predetermined error production)?", in keeping with Gozzard et al (2008). For example, when he asked for [loʊp] (*antelope*), the clinician responded with a puzzled facial expression and said "*Did you want an [*ˈæskɛdoʊp*]*?" If his repair response matched the adult pronunciation or he changed his production to more closely match the adult pronunciation, the clinician acknowledged that the communication breakdown had been repaired by stating "*Oh an antelope, you want an antelope, now I understand you*". If his repair response did not change, the clinician offered feedback to acknowledge that she had still not understood but that the communication breakdown and repair sequence was completed by stating "*I* ***think*** *this is what you want*". No further breakdown was expressed for that turn. Play then proceeded with Robbie deciding where to put the animal and the participants talking about the developing scene. Over the natural course of this conversation, he was exposed to accurate auditory models of the target words spoken by the clinician and/or Lucy. Lucy also took turns requesting an animal from the clinician. Lucy was instructed to make deliberate mistakes in her production of the polysyllabic words in order to model communication breakdown and repair sequences. This allowed Robbie to observe both the consequence of a speech error and speech repair behavior. No other productions of the target words were requested or reinforced and no other therapy was provided on speech production (e.g., no feedback was given on phonetic errors). The decision to use the novel RQCL during the activity was based on the clinician's correct/incorrect judgment without regard to the type of error Robbie used. No homework was provided involving the novel communication breakdown and repair sequences and Lucy was requested to avoid incidentally using the technique during everyday conversation over the period in which the preliminary trial was conducted. However, Lucy was provided with homework focused

Table 3
Number of Robbie's productions of the trial polysyllabic words following the clinician's SRC showing correct, more accurate and less accurate productions over the three trial sessions

	Session 1 (number of opportunities = 24)	Session 2 (number of opportunities = 24)	Session 3 (number of opportunities = 27)
Correct	0	3	2
More accurate segmental production	11	9	12
More accurate suprasegmental production[a]	6	3	1
More accurate segmental and suprasegmental production	1	1	0
No change	2	5	8
Less accurate segmental production	3	0	0
Less accurate suprasegmental production[b]	1	3	4
Less accurate segmental and suprasegmental production	0	0	0
Imitation of clinician's incorrect production	0	0	0

[a]Suprasegmental includes word shape and/or stress pattern.
[b]Note, although the numbers suggest a decline in Robbie's accuracy overtime, it should be noted that these numbers are relative to his productions prior to the clinician's SRC in the same session. As shown in Figure 1, Robbie's percent correct word shape and stress pattern increased from session one to session two.

on Robbie's phonemic awareness, and letter and sound knowledge to complement the therapy provided in the regular intervention portion of the trial.

Robbie's production of the nine target words before and after each SRC was gathered during each of the three trial sessions. His production of an additional nine words not used in the trial was gathered at the beginning of each session. These nine words were limited to the semantic category of Australian animals in contrast with the African animal names used within the trial sessions, and were used to evaluate any generalized change in his production of polysyllables. The generalization words are listed in the Appendix – some of which may be unfamiliar to readers but are commonly known to Australian children. All of Robbie's productions of the trial and generalization words were phonetically transcribed online, audio- and video-recorded and checked for transcription reliability following the session. Point-by-point intra-rater transcription reliability was 92%.

Clinical Case Study: Results

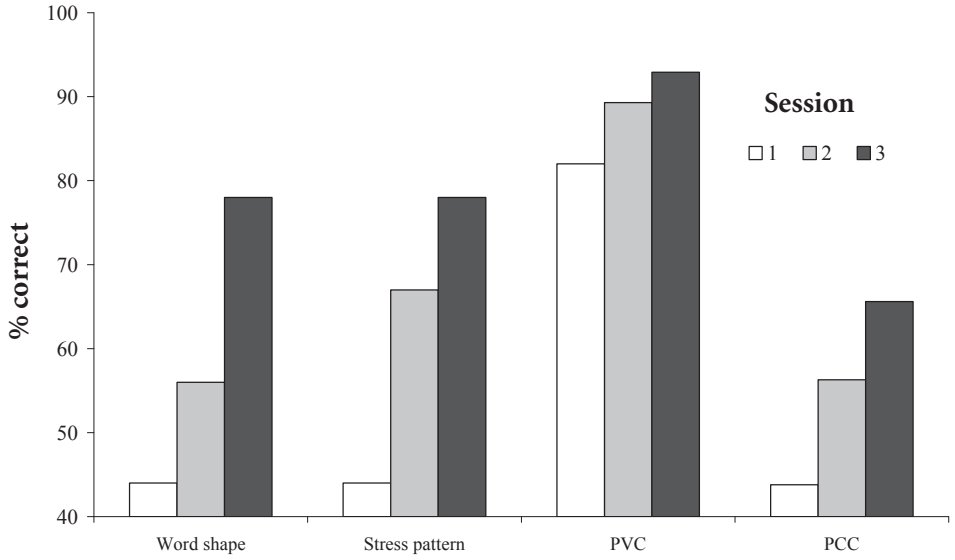
As shown in Figure 1, the percentage of consonants, vowels, word shape, and stress patterns correct for Robbie's production of the trial words following the clinician's SRC steadily improved from session 1 to session 3. The increase in his percentage of stress patterns correct (54% in session 1 to 88% in session 2) shows how this skill improved the most relative to the other measures. The following dialogue sequence from session 1 exemplifies this finding.

Robbie: *Alligator* [ˈdeɪtɔ]
Clinician: *Did you say* [ˈækəˌʃeɪnə] ?
Robbie: *No, alligator* [ælɪdeɪdə]

Also shown in Figure 1, Robbie's percentage of word shapes correct was higher than his percentage of stress patterns correct. This was primarily due to Robbie changing his dominant pattern of weak syllable deletion into syllable-stress alteration with weak syllables becoming strong syllables (i.e., wS > sS or SS). For example gorilla /gəˈrɪlə/ was produced as [dɒrɪlə] following the clinician's SRC. This latter example also highlights how although word shape and stress patterns seemed to improve, Robbie's PCC was relatively lower because he substituted other consonants for the target consonants. It seemed that he prioritized matching the word shape and/or stress pattern over matching the required consonants to the adult pronunciation.

Table 3 provides a quantitative summary of the nature of the changes (or lack thereof) in Robbie's productions of the trial words following the clinician's SRC relative to his production of the same trial words prior to the clinician's SRC. A number of observations were made. First, although the number of productions showing no change in response to a SRC increased from session 1 to session 3, the accuracy of his productions particularly with respect to word shape and stress patterns showed a gradual improvement. This may have meant that he had reached a point in session 3 where relatively fewer revisions were needed because he was producing the necessary syllables in words but that he

Figure 2: Robbie's percentage of word shapes, stress patterns, vowels and consonants correct for the generalization words, across the three trial sessions.



was less able to use all segments needed for an accurate production.

Secondly, although the majority of changes were positive (more accurate word shape, stress pattern and/or segments), only a small number of productions were completely correct (0 in session one, 3/24 in session two and 3/28 in session three). Moreover, some of Robbie's productions were less accurate relative to his production immediately prior to the novel SRC (3/23 in sessions one, 3/24 in session two, and 4/28 in session three). This latter observation was of some concern. Ideally, intervention facilitates progress towards a goal, not away from a goal. If the novel SRC were to be used as a conceptual teaching strategy in phonological intervention, the risks and benefits relative to other teaching strategies would need to be carefully considered. Thirdly, Robbie seemed to have a variety of realizations for the same word, within and across sessions. Finally, at no time did he imitate the clinician's incorrect production in the SRC. The following dialogue sequences from session 1 through 3 illustrate these observations. Prior to the first trial session, Robbie said antelope /æntəloʊp/ as [ænloʊ] and [loʊp].

Session 1

Clinician: *What is it?*
Robbie: *Antelope* [æməloʊ]
Clinician: *You didn't say* [ˈæskədoʊp] did you?
Robbie: *Antelope* [ælələoʊp]

Session 2

Clinician: *What next?*
Robbie: *That one*
Clinician: *Which one?*
Robbie: *Antelope* [ætəloʊt]
Clinician: *Did you just say* [ˈæskədoʊp]?
Robbie: *No antelope* [æmbəloʊt]

Session 3

Clinician: *Which one next?*
Robbie: *Antelope* [æbəloʊp]
Clinician: *Did you say* [ˈæskədoʊp]?
Robbie: *Antelope* [æmpəloʊp]

Similar trends were evident in the generalization words. As shown in Figure 2, there was a gradual increase in the percentages of consonants, vowels, word shapes and stress patterns correct across words from session one through to session three. It seemed that as Robbie included weak syllables and/or improved his production of word shapes, there was a corresponding increase in the percentages of consonants and vowels correct. In contrast with the data for the target words shown in Figure 1, his percentage of word shapes correct was better for the target words than the generalization words. It was difficult to clearly discern why this was the case. In part, it may have been due to the fact that the generalization words contained two instances of weak onsets (*koala, echidna*) in contrast with one instance (*gorilla*) for the target words. Robbie typically omitted the weak onsets in *koala* and *echidna,* thereby altering the word shape. By contrast, he tended to maintain the word shape for *gorilla* while altering the stress pattern from /gəˈrɪlə/ to [dɒrɪlə]. Robbie's difficulty updating earlier established words as his phonological system develop may have also contributed to the difference. Specifically, it may have been that he learned the names for the Australian animals (generalization words) as a young toddler when his word shapes were less well-developed (e.g., *koala* as [ˈwalə]) and continued to use these words shapes, while learning the names for the target words at a later point in time when his word shapes were perhaps better developed. It may also have been that because the word lists were not identical with respect to word shape, word length and stress pattern, that Robbie's performance across the lists was not comparable.

With respect to the nature of the changes (or lack thereof) across the generalization words, 67% (6/9) were more accurate, 22% (2/9) showed no change and 11% (1/9) evidenced a less accurate production. As shown in Table 4, consonant accuracy was more accurate for four of the words (e.g., *rosella* changed from [ɹoʊzɛwə] to [ɹoʊzɛlə]) while consonants, word shape and stress pattern was more accurate for two of the words (e.g., *kookaburra* changed from [tʊbʌwə] to [tʊkəbʌɹə]). The one word to show a less accurate production involved a change in word shape and consonants but not stress, specifically, *platypus* in session one was produced as [pwæwəpʊts] while in session three Robbie said it as [bædəpʊs]. Readers are reminded that these observations are from a non-experimental clinical case and

Table 4
Robbie's production of the generalization words from session one to session three

Generalization word	Session one	Session two	Session three
platypus /ˈplætəˌpʊs/ (Sws)	[pwæwəpʊts]	[fætəpʊs]	[bædəpʊs]
pelican /ˈpɛləkən/ (Sww)	[pɛndɪn]	[pɛndən]	[pɛlətən]
cockatoo /ˈkʰɒkəˌtu/ (Sws)	[tɒgədu]	[dɒkədu]	[tɒkətu]
kangaroo /ˌkʰæŋgəˈɹu/ (swS)	[tæŋgəwu]	[tæŋgəɹu]	[tæŋgəɹu]
rosella /ˌɹoʊˈzɛlə/ (sSw)	[ɹoʊzɛwə]	[toʊdɛlə]	[ɹoʊzɛlə]
goanna /ˌgoʊˈwænə/ (sSw)	[doʊnænə]	[doʊmænə]	[doʊnænə]
echidna /əˈkʰɪdnə/ (wSw)	[tɪdnə]	[tɪn.nə]	[tɪdnə]
koala /kəˈwalə/ (wSw)	[walə]	[walə]	[doʊwalə]
kookaburra /ˈkʰʊkə/ˌbʌɹə/ (Swsw)	[tʊbʌwə]	[tʃʊkəbʌɹə]	[tʊkəbʌɹə]

that is it impossible to determine what in the clinician's interaction with Robbie may have prompted any of the observed positive and/or negative changes in his speech.

How might Communication Breakdown and Repair Sequences Improve Children's Speech Production Skills?

Our anecdotal clinical case in conjunction with the observations from Weiner and Ostrowksi (1979) and Gozzard et al's (2008) study suggests an interesting phenomenon. Typically developing children and at least one child with a phonological impairment seem to be able to improve their speech in response to a unique type of clarification request containing an incorrect production that differs from their own incorrect productions. How might children be able to do this? The very idea of requesting clarification using an incorrect production that differs from children's incorrect productions challenges the established practice of providing children with clear, accurate models of target words as part of phonological intervention. The type of incorrect production used in both Robbie's case and in Gozzard et al (2008) may hold some answers. Perhaps the correct components of the clinician's overall incorrect production inadvertently served as a model. This may have been the case for Robbie, given the improvement in his percentage of word shapes and stress patterns correct relative to measures of his PCC. Perhaps the novel production operated alone in prompting the change or in combination with the correct productions of the target words provided by the clinician and Robbie's mother over the natural course of conversation during the conversation-based play activity. The lack of experimental control in Robbie's case means that little can be said about the causal influence of the novel production on Robbie's production of polysyllables. It would have been interesting to compare his responses following different types of RQCL such as a SRC containing an accurate model of a polysyllable only, a SRC containing a novel production as was used in this investigation, and simply a SRC containing a word completely unrelated to the target word. Greater improvements in all measures given an accurate model would provide evidence against using the novel type of SRC. Equal or greater improvements in all measures given an unrelated word may help isolate the relative contribution of the breakdown in communication (pragmatics) from the relative contribution of the clinician's pronunciation of the target word. Well-controlled experimental studies would be needed to address such speculations.

Using Crystal's (1987) bucket theory of language disability, perhaps the incorrect production may have simply served as an attention device alerting the children to a pragmatic need to allocate more processing resources to the phonology domain so as to repair the breakdown in communication. The children may have been able to make the repair because they had the resources, in the form of more richly specified underlying phonological representations than their habitual or spontaneous use indicated. This may have been the case for Robbie given his surface realizations containing consonants from deleted weak syllables and his variable realizations. The breakdown in communication may have alerted the children to a need to create and execute a better motor plan based on their representations. This idea suggests a parsimony of speech output in which the least effort for effective communication is used as an unconscious default until the strategy is unsuccessful, as indicated by the novel SRC. These ideas are of course speculative and open to alternative theoretical interpretation.

Conclusion and Future Directions

Communication breakdown and repair sequences have been thought to be integral to the success of contrastive approaches to phonological intervention involving minimal pair words (e.g., Weiner, 1981). A review of the evidence across three different approaches suggests that such sequences may be valuable. However, there is insufficient evidence to unequivocally support the statement that they are in fact evidence-based kernels. Four issues need to be addressed in future research to better understand the potential contribution of communication breakdown and repair sequences in phonological intervention. First, the effect of phonological contrast intervention with and without communication breakdown and repair sequences on children's phonological generalization learning needs to be established. Second, there is a need to determine the appropriate timing of the use of communication breakdown and repair sequences. To date, some studies of phonological intervention have used such sequences from the outset of intervention while others have suggested that they are more appropriate following imitation-based activities. Third, there is a need to evaluate the relative benefits of different

types of RQCL on children's phonological abilities, such as SRCs containing correct models, SRCs containing novel productions, and SRCs containing phonologically and semantically unrelated words, in both assessment and intervention contexts. It would be particularly interesting to explore the possibility of a relationship between children's abilities to respond to different types of SRCs prior to intervention and their rates of intervention progress. It may be that those children who do not show any change in their speech following different types of SRCs may benefit from explicit instruction to repair their speech (e.g., "fixed-up-one" routine as described by Bowen & Cupples, 1999). It may be that those children with richer underlying phonological representations relative to their surface representations may benefit from being given a reason to make better use of their underlying representations via breakdowns in communication. Finally, it would be important to examine the impact of communication breakdown and repair on children's overall experience of intervention. If children are frustrated from the outset of intervention, it would be important to gauge the relative benefits and risks of this experience on children's motivation and willingness to participate in future intervention sessions. Some children may simply be disheartened and lose motivation in intervention when faced with repeated episodes of communication breakdown. In such cases, sequences of communication breakdown and repair may need to be avoided. Conversely, if children are unaware of the need to respond to listeners' RQCL, they may benefit from the inclusion of such sequences.

Breakdowns in communication are a daily experience for children with unintelligible speech. It would seem obvious that such experiences be embedded within phonological intervention, so as to help children learn how to cope with and better manage misunderstandings. However, obvious suggestions are not always the best suggestions. Based on our reflection on the use of communication breakdown and repair sequences across three different contrast approaches to phonological intervention, and the literature on children's responses to different types of RQCLs, there is a need to better understand the potential contribution of this pragmatic device on children's phonological abilities.

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Appendix

Target words, pre-prepared error productions and generalization probe words[a]

Word length and stress pattern	Target words	Adult pronunciation and word shape	Pre-prepared error productions	Generalization words	Adult pronunciation and word shape
3-syllable words					
Sww	elephant	[ˈɛləfənt][b] VCVCVCC	[ˈɛgəpət]	pelican	[ˈpʰɛləkən] CVCVCVC
Sws[c]	buffalo	[ˈbʌfəˌloʊ] CVCVCV	[ˈzʌtəˌloʊ]	platypus	[ˈplætəˌpʊs] CCVCVCVC
	antelope	[ˈæntəˌloʊp] VCCVCVC	[ˈæskəˌdoʊp]	cockatoo	[ˈkʰɒkəˌtu] CVCVCV
sSw[c]	hyena	[ˌhaɪˈjɪnʌ] CVCVCV	[ˌgaɪˈjɪmʌ]	rosella	[ˌɹoʊˈzɛlə] CVCVCV
				goanna	[ˌgoʊˈwænə] CVCVCV
swS[c]	chimpanzee	[ˌtʃɪmpænˈzi] CVCCVCCV	[ˌfɪnwænˈsi]	kangaroo	[ˌkʰæŋgəˈɹu] CVCCVCV
wSw	gorilla	[gəˈɹɪlə] CVCVCV	[nəˈvɪlə]	koala	[kʰəˈwalə] CVCVCV
				echidna	[əˈkʰɪdnə] VCVCCV
4-syllable words					
Swsw[c]	alligator	[ˈæləˌgeɪtə] VCVCVCV	[ˈækəˌʃeɪnə]	kookaburra	[ˈkʰʊkəˌbʌɹə] CVCVCVCV
sSww[c]	rhinoceros	[ˌɹaɪˈnɒsərəs] CVCVCVCVC	[ˌʤaɪˈbɒləgəs]		
wSww	chameleon	[kʰəˈmilɪjən] CVCVCVCVC	[səˈbɪligən]		

[a]Words are arranged in the columns according to word length and stress pattern. Given the relatively limited numbers of polysyllables for African animals (target words) and Australian animals (generalization words), word length and stress patterns were a close but not exact match (e.g., there were three 4-syllable target words compared with only one 4-syllable generalization word).
[b] Glottal stops are optional in vowel-initial words and are not included in the transcription.
[c]Syllables that are unreduced are considered to have either primary or secondary stress, depending on degree of prominence.