

Supplemental Material S2

Details of Multiple Oppositions Intervention Provided in This Study

These supplemental materials provide details about the multiple oppositions intervention approach and how it was delivered in this study. More information about multiple oppositions is available from the following resources:

- Williams, A. L. (2000a). Multiple oppositions: Case studies of variables in phonological intervention. *American Journal of Speech-Language Pathology*, 9, 289-299.
- Williams, A. L. (2000b). Multiple oppositions: Theoretical foundations for an alternative contrastive intervention approach. *American Journal of Speech-Language Pathology*, 9(4), 282.
- Williams, A. L. (2003). *Speech Disorders Resource Guide for Preschool Children*. Clifton Park, NY: Thomson Delmar Learning.
- Williams, A. L. (2010). Multiple oppositions intervention. In A. L. Williams, S. McLeod, & R. J. McCauley (Eds.), *Interventions for Speech Sound Disorders in Children* (pp. 73-94). Baltimore, Maryland: Paul H. Brookes Publishing Co.

Glossary of Terms Related to Multiple Oppositions

Collapse of contrast	Collapses of contrast occur when a child produces multiple adult phonemes as a single sound. This results in widespread homonymy in a child's speech, which can significantly reduce intelligibility. An example is shown in Williams (2000a, p. 293), in which a child collapses voiceless non-labial obstruents to [t], resulting in the following 1:10 collapse: [t] ~ /t, k, tʃ, s, ʃ, st, sk, tɪ, kɪ, kl/. A child with this collapse would say the words tip, kip, chip, sip, ship, [stɪp], skip, trip, /kɪp/ and clip all as [tɪp].
Default	The error sound resulting from a collapse of contrast. In the example from Williams (2000a, p. 293), the default sound is [t].
Maximal classification	The principle of maximal classification is considered when selecting targets for intervention. It refers to selecting targets that are representative of the child's phoneme collapse in that they, where possible, come from different manner classes and have different places of production, voicing characteristics and/or structures (e.g., singletons or clusters) in order to enlarge the frame of learning.
Maximal distinction	The principle of maximal distinction is considered in target selection. Targets are chosen so that they are, where possible, maximally distinct in terms of place, voice and manner from the child's default sound.

Phases	Multiple oppositions comprises 4 phases. In Phase 1, the goal is for children to become familiar with the rule that is being trained (that is, the specific phoneme collapse), the target sounds, and the pictured stimuli, vocabulary and gestures. Phase 2 “emphasizes the phonetic aspects of sound learning” (Williams, 2010, p. 87) and comprises two steps. In Step 1, children imitate productions of the target word, which is paired with the default word (for example the target word <i>gain</i> , <i>Shane</i> or <i>stain</i> paired with the default word <i>Dane</i>); in Step 2, children spontaneously produce these paired productions. The later phases of intervention (Phases 3 and 4) “place more emphasis on the contrastive function of the target sounds within communicative and conversational contexts” (Williams, 2010, p. 87). Naturalistic play using toys containing the child’s targets is also included within the approach, to provide opportunities for practice of speech targets in conversation. Children must meet pre-determined criteria to move between phases and between the steps in Phase 2 (see Figure 1 in Williams, 2000a).
Targets	The targets are the sounds to be targeted in intervention. In the multiple oppositions intervention approach, 2 to 4 targets from a child’s phoneme collapse are selected to treat in therapy. These targets are selected according to the principles of <i>maximal classification</i> and <i>maximal distinction</i> .
Teaching moment	Teaching moments involve behaviour principles, and include an antecedent event, a response, and a consequent event. McLeod and Baker (2017, p. 413) describe these moments as “the intervention agent... providing an antecedent instruction (i.e., saying and/or doing something), the child responding, and then the intervention agent providing consequent feedback”. An example of a teaching moment for Phase 2 of multiple oppositions is described in Figure S1, below.
Treatment set	In multiple oppositions intervention, a treatment set consists of 20 to 50 productions of the target words, depending on the number of contrasts being trained and the number of word sets used (Williams, 2000a). In this study, all children had 3 to 4 targets which were trained using 5 word sets. A drill-play activity incorporated all 5 word sets, for a total of 15 to 20 productions of the target words per activity (i.e., 3 targets × 5 word sets totalling 15 productions, or 4 targets × 5 word sets totalling 20 productions). Thus, two activities—together comprising 30 to 40 productions—were conducted in part (3) and (4) of each clinic-based session to meet the aforementioned definition of a treatment set. As the criteria to move between phases in multiple oppositions intervention requires a benchmark performance across two treatment sets, each clinic-

based session comprised a minimum of two treatment sets. To ensure that children with different numbers of targets received a similar dose per session, we aimed to complete 5 activities (or 2.5 treatment sets, for a total dose of 75) for children with 3 targets and 4 activities (equaling 2 treatment sets) for children with 4 targets (for a total dose of 80) in a clinic-based session.

Word set In multiple oppositions, several word sets are developed for a child’s collapse. Word sets comprise a set of rhyming words that contain the child’s target and/or default phonemes in the relevant word position. Non-words can be used when necessary. In this study, 5 word sets were developed for each child (all five word sets for Thomas are shown below).

Date ~ gate, /dʒæt/, state

Dane ~ gain, Jane, stain

Deep ~ /gi:p/, Jeep, steep

Deer ~ gear, jeer, steer

Dot ~ got, jot, /stɒt/

An example word set for the other participants is shown in Table 1 of the manuscript.

Adaptations of Multiple Oppositions Made in this Study for Delivery by Trained Parents

In order to reduce the time commitment for parents, home-based sessions were designed to contain fewer activities than clinic-based sessions: parents were asked to complete 1.5 treatment sets (comprising 45 to 60 productions over 3 drill-play activities) in each of the two home-based sessions, for a total of 3 treatment sets per week (comprising a total 90 to 120 productions over 6 drill-play activities, depending on each child’s number of targets). This contrasts to the clinic-based sessions, in which 2 or 2.5 treatment sets were provided per session (depending on the number of targets; more information provided in the glossary above).

In addition to structured activities using the word sets, parents were asked to complete naturalistic play activities in the form of shared book reading with their child on at least two occasions throughout the week. Parents were asked to emphasize and discuss words starting with their child’s target sounds.

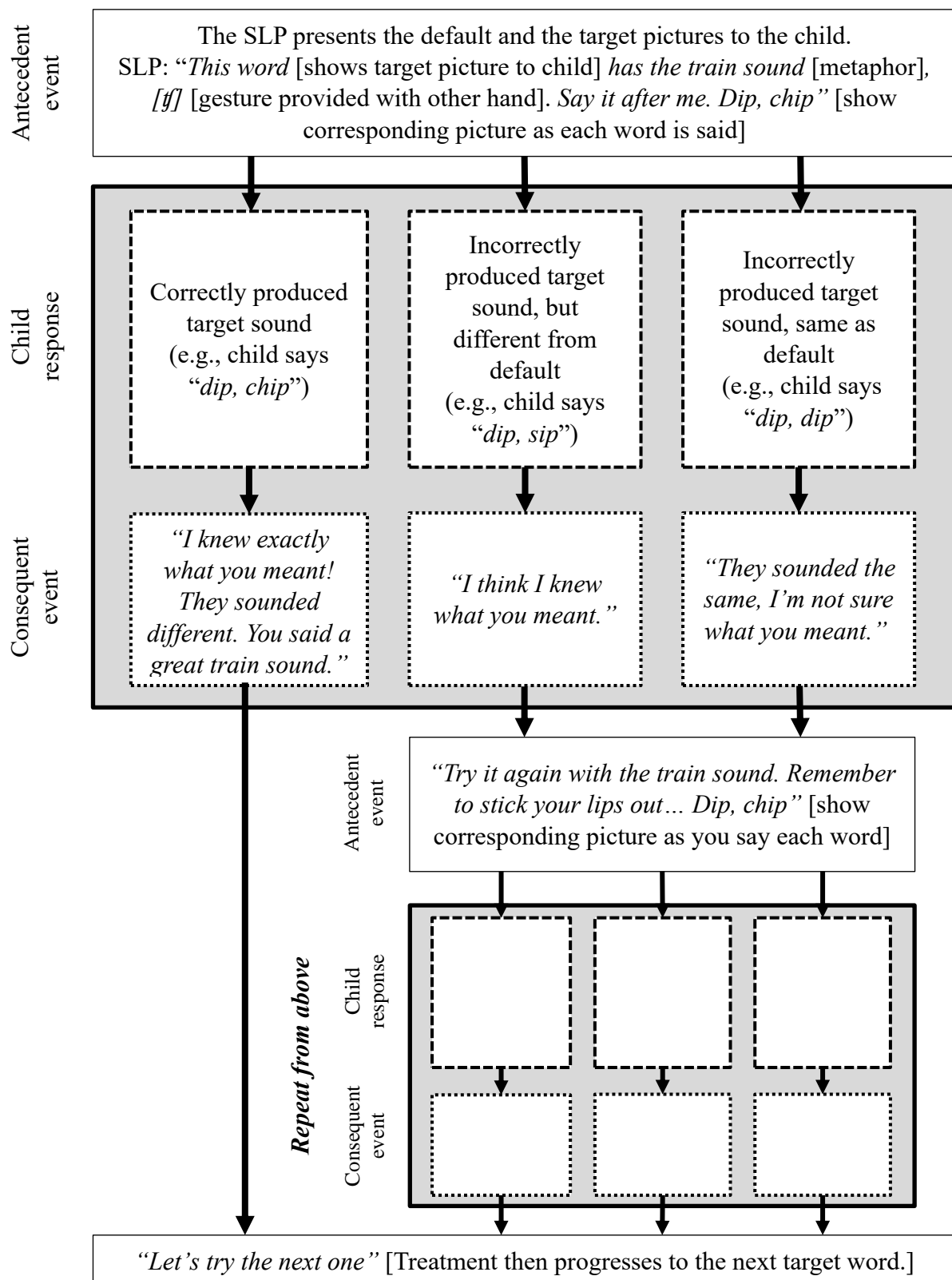
Example Teaching Moment for Phase 2, Step 1 of Multiple Oppositions as Provided in this Study

Figure S1 presents an example of a teaching moment for a child in the initial stages of parent and SLP-delivered multiple oppositions intervention (in Phase 2, Step 1). In this phase, the child is learning the articulatory requirements for the target sound and produces all targets in imitation.

In this example, the child’s target sounds are [d] ~ [tʃ, k, sl]. An example word set is *dip* ~ *chip*, *kip*, *slip*. The example teaching moment depicted in Figure S1 focuses on one target from this word set [target word: *chip*, default word: *dip*]. Once the child has attempted this target word, as outlined below, the other targets from the same word set (i.e. *kip*, *slip*) are presented, using the same teaching strategies and script. After all targets from this word set are complete, intervention progresses to the second word set.

In this study, children were provided with an initial attempt to produce the target. If their production was incorrect, the child was provided with a second attempt to produce the target (as depicted in the smaller grey box in Figure S1). In this way, each teaching moment may have involved more than one opportunity (or trial) for a child to produce the target word.

Figure S1. Teaching Moment for Phase 2, Step 1 of Parent and SLP-delivered Multiple Oppositions Intervention.



Note: the presentation order of target and default words within the antecedent event is randomized across trials. Figure S1 Copyright © 2017 by Eleanor Sugden, Elise Baker, A. Lynn Williams, Natalie Munro, and Carol M. Trivette. Used with permission from the authors.