Phonological knowledge and the role of accuracy and error consistency in speech sound acquisition following intervention

Jessica Barlow, San Diego State University
Philip Combiths, San Diego State University / University of California, San Diego

Children exhibit individual differences in acquisition of phonology, and this is likewise apparent in learning that occurs for children with speech sound disorder (SSD) following treatment. Such differences are attributed in part to pretreatment phonological knowledge. Children show higher accuracy on treated sounds following treatment if they have some degree of knowledge of those sounds prior to treatment (Dinnsen & Elbert 1984; Rvachew & Nowak 2001). However, generalization to untreated sounds may show the reverse pattern, with treatment on unknown sounds leading to greater gains system-wide as compared to treatment on known sounds (e.g. Gierut 1992; Gierut et al. 1987; Williams, 1991; cf. Rvachew & Nowak 2001).

Productive phonological knowledge is often based on presence versus absence of sounds in the child's phonetic or phonemic inventory; however, consistency in errors has been proposed as a more nuanced way to characterize phonological knowledge for sounds excluded from the phonetic inventory (Barlow 1996; Rice & Avery 1995). Given two target sounds, both of which are absent from the child's inventory, the sound that is produced with a consistent substitute is assumed to be more known by the child than the sound produced with inconsistent substitutes (i.e. a variety of different substitutes). Children with SSD who exhibit consistent errors on treatment targets show greater improvement in accuracy to those targets posttreatment, generalizing across word positions, whereas those with inconsistent substitution patterns do not show such gains (Forrest et al. 1997, 2000). Gains following treatment are also reflected in increased consistency in errors on the treated target (Cummings & Barlow 2011; Tyler et al. 2002). What is unclear is whether treatment on targets that are produced consistently prior to treatment leads to lesser or greater *overall* gains in the sound system posttreatment.

To address this gap, we evaluated data drawn from the archives of the Learnability Project (Gierut 2017)[1] to evaluate pre- and posttreatment sound systems of 96 monolingual English-speaking children with SSD (mean age 52 mos.; range: 36-72) who were trained on singleton targets that varied by pretreatment accuracy and error consistency. The children had reduced phonemic inventories and scores >1 SD below the normative mean on a standardized articulation test (Goldman & Fristoe 1986). They performed within normal limits on hearing, cognition, oral-motor structure/function, and motor-speech measures. Each child was trained on one target phoneme (of /k g f θ s ʃ ʧ l ɹ/), for 1-hour sessions, three times per week, for a mean of 13 sessions (range 5-19). Pretreatment and immediate posttreatment single-word speech samples that included an average of 736 consonants for each child (range: 726-756) were analyzed, using Phon (Hedlund & Rose 2016), for the following: Percent Consonants Correct-Revised (PCC-R; Shriberg et al. 1997), accuracy of treatment target, and number of unique substitutes for the treatment target (collapsed across word positions).

Results of regression analyses showed that children with higher pretreatment accuracy on the

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[1] Archival data were retrieved from the Gierut / Learnability Project collection of the IUScholarWorks repository at https://scholarworks.iu.edu/dspace/handle/2022/20061. The archival data were original to the Learnability Project and supported by grants from the National Institutes of Health to Indiana University (DC00433, RR7031K, DC00076, DC001694; PI: Gierut). The views expressed herein do not represent those of the National Institutes of Health, Indiana University, or the Learnability Project. The authors assume sole responsibility for any errors, modifications, misapplications, or misinterpretations that may have been introduced in extraction or use of the archival data.

treated target showed greater gains in target accuracy posttreatment than those with lower pretreatment accuracy ($p < .01$). For PCC-R, the opposite was true: Those with 0% accuracy on the treated target pretreatment showed greater gains in PCC-R posttreatment than those with greater than 0% accuracy, though this effect was only marginally significant. Moreover, the number of unique target substitutes did not impact posttreatment change in target accuracy or overall PCC-R ($p > .05$). More nuanced relationships were revealed when considering treated manner and untreated sounds with 0% accuracy prior to treatment.

Consistent with prior research, we found that greater *local* gains occur on treated sounds with higher pretreatment accuracy, and that, in contrast, greater *global* gains may occur following treatment on sounds with 0% accuracy. Contrary to prior research, pretreatment target error consistency did not impact gains in target accuracy following treatment; however, its effects on untreated sounds was dependent on the treated manner class. Clinical implications for treatment target selection and theoretical implications for error consistency and phonological knowledge will be discussed.

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