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Phonological encoding of young children who stutter

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ABSTRACT

Purpose: Several empirical studies suggest that children who stutter, when compared to typically fluent peers, demonstrate relatively subtle, yet robust differences in phonological encoding. Phonological encoding can be measured through the use of tasks that reflect the underlying mechanisms of phonological processing, such as phonological awareness. This study investigated the phonological encoding abilities of five- and six-year old children who stutter.
Methods: Young children who stutter were paired according to language ability, maternal education, and sex to their typically fluent peers. Participants completed multiple measures of phonological awareness abilities (i.e., sound matching, phoneme blending, elision), as well as measures of expressive and receptive vocabulary and articulation.
Results: Young children who stutter performed significantly less well than nonstuttering peers on tasks of elision and sound blending. No between-group differences were found in sound matching abilities or in any of the background language measures.
Conclusions: Results suggest that young children who stutter have subtle, yet robust, linguistic differences in certain aspects of phonological encoding that may contribute to an unstable language planning system in young children who stutter.

Educational Objectives: The reader will be able to: (a) describe how phonological awareness can inform our understanding of phonological encoding; (b) summarize the findings of previously published studies that examined some aspects of phonological awareness in children who do and do not stutter; and (c) compare the results of the current study with other investigations of phonological awareness skills in children who stutter and their typically fluent peers.

1. Introduction

1.1. Phonological awareness and phonological encoding

Some theorists posit that one contributing factor in the production of disfluencies is a difficulty with the underlying selection and preparation of the sounds that form the words in a speaker's message (Howell & Au-Yeung, 2002; Kolk & Postma, 1997; Perkins, Kent, & Curlee, 1991; Wingate, 1988). Although details of the psycholinguistic theories of stuttering vary, they all hypothesize that a delay or breakdown occurs when phonological words are constructed from individual phonemes, that is, during the process of phonological encoding (Howell & Au-Yeung, 2002; Kolk & Postma, 1997; Perkins et al., 1991; Wingate, 1988). The theoretical construct of phonological encoding has been conceptualized differently in

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various models of typical language formation. Some models, such as the Gestural Linguistic Model (Browman & Goldstein, 1992, 1997; Saltzman & Munhall, 1989), suggest that the process of phonological encoding is closely related to speech motor production. Other models, such as WEAVER++ (Levelt, 1989; Levelt, Roelofs, & Meyer, 1999; Roelofs, 2004), posit that phonological encoding is a process that occurs before the speech motor system is activated. Both of these models include a process of phonological encoding, but the execution of this process is envisioned in different ways. The impetus for this current line of research has its basis in psycholinguistic theories of stuttering, thus, this article uses the definition of phonological encoding as forwarded by WEAVER++ (Levelt et al., 1999; Roelofs, 2004). WEAVER++ defines phonological encoding as the process by which the phonological code (i.e., phonemes or syllables) of a word is retrieved and reassembled in an incremental, just-in-time manner to allow for efficient construction of phonological words.

The process of phonological encoding is one that is obscured from direct observation because it is deeply embedded in the process of language formulation (Coles, Smid, Scheffers, & Otten, 1995; Meyer, 1992) and must therefore be explored through alternate processes that reflect its incremental nature. One aspect of phonological encoding that can be observed is the process of *phonological awareness*, which is an individual's ability to identify, isolate, and manipulate various-sized segments of speech such as words, syllables, onsets/rimes, and individual phonemes. Phonological awareness skills begin to stabilize around age five, allowing for exploration of the phonological encoding abilities of young children who stutter as close to the onset of stuttering as possible once phonological awareness skills are established. Performance on phonological awareness tasks also parallel the processes that occur during phonological encoding, thus providing a valuable research tool in this empirical investigation of the phonological encoding skills of children who stutter.

1.2. Phonological awareness

Phonological awareness tasks are well understood and frequently used with preschool and school-age children (see reviews in Gillon, 2004; Sodoro, Allinder, & Rankin-Erickson, 2002; Troia, 1999). These abilities progress along a developmental continuum from less-to-more complex. Rhyming, sound matching, and phoneme blending abilities develop first, followed by later developing skills such as phoneme segmentation, elision and phoneme reversal (Adams, 1990; Gillon, 2004; Schuele & Boudreau 2008). *Rhyming* involves the determination of whether two words rhyme (e.g., "Which word rhymes with *cat*? *Cake, tin*, or *mat*?"). *Sound matching* tasks measure whether the child can identify individual phonemes and match the occurrence of those phonemes in sets of words (e.g., "Which word starts with the same sound as *pen*? *Pot, hat*, or *cane*?") *Phoneme blending* requires an individual to hear syllables or individual phonemes and blend them together to create a word (e.g., "What word do these sounds make? *pa–per*"). *Phoneme segmentation* measures an individual's ability to break apart the phonetic code of a word to identify and produce the constituent phonemes of that word (e.g., "Say the word *dog* one sound at a time. *d-o-g*"). *Elision* is the ability to remove a phonetic segment from a given word to create a brand new word. This requires the individual to not only break apart the phonemes of a given word, but also blend the remaining phonemes together to make a new word (e.g., "Say *plants* without saying/*l*/. *pants*"). Finally, *phoneme reversal* is a task that asks the individual to hear a word and then break apart the phonetic code so it can be reassembled in the reverse order, creating an entirely new word (e.g., "Say/*tif*/backwards. *feet*"). Five- and six-year old children are capable of completing tasks like rhyming, sound matching, and phoneme blending that use earlier-developing skills, while tasks like phoneme segmentation and phoneme reversal are typically established later (Gillon, 2004). Where a child falls along the developmental continuum should be considered when administering phonological awareness tasks to prevent inadvertent skewing of the outcomes due to developmentally inappropriate tasks.

Just as phonological awareness abilities emerge in a sequence from less-to-more complex, the stimuli used in each phonological awareness task can also be manipulated in terms of complexity. A less complex task such as phoneme blending can include stimuli that range from simple (e.g., "blend/*k-æ-t*/ → cat") to more complex (e.g., "blend/*i-m-ɜ-ʤ-ɛ-n-s-i*/ → emergency"). This is accomplished through the modification of the number of phonemes or syllables as well as the presence or absence of consonant clusters. Tasks containing more phonemes and syllables are more difficult to complete as there are more phonemes to identify, sort, or blend and must be held in working memory (Sevald, Dell, & Cole, 1995). The level of phonological complexity of the stimulus items will increase in difficulty with the presence of consonant clusters (Sasisekaran & Weber-Fox, 2012), as well as the inclusion of later developing phonemes (Moore, Tompkins, & Dollaghan, 2010; Storkel, 2001). Thus, both task and stimuli complexity should be considered when assessing phonological awareness abilities.

1.3. Phonological representations

Phonological representations in young preschool children are initially stored in holistic form, that is, "without detailed phonological segmentation" (Brooks & MacWhinney, 2000, p. 337). They then gradually undergo a developmental shift toward incremental representations that support just-in-time phonological encoding (Brooks & MacWhinney, 2000; Jusczyk, 1997; Metsala, 1999; Walley, 1993). The shift of phonological representations from holistic to incremental representations begins around age five and continues to refine until approximately age eleven (Brooks & MacWhinney, 2000). This growth occurs at roughly the same time that phonological awareness skills begin to develop and appears to parallel vocabulary growth as well (de Cara & Goswami, 2003; Jusczyk, 1993; Metsala & Walley, 1998; Nittrouer, 1996).