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Phonological priming in adults who stutter

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ABSTRACT

The purpose of this study was to compare the speed of phonological encoding between adults who stutter (AWS) and adults who do not stutter (ANS). Fifteen male AWS and 15 age- and gender-matched ANS participated in the study. Speech onset latency was obtained for both groups and stuttering frequency was calculated for AWS during three phonological priming tasks: (1) heterogeneous, during which the participants' single-word verbal responses differed phonemically; (2) C-homogeneous, during which the participants' response words shared the initial consonant; and (3) CV-homogeneous, during which the participants' response words shared the initial consonant and vowel. Response words containing the same C and CV patterns in the two homogeneous conditions served as phonological primes for one another, while the response words in the heterogeneous condition did not. During each task, the participants produced a verbal response after being visually presented with a semantically related cue word, with cue-response pairs being learned beforehand. The data showed that AWS had significantly longer speech onset latency when compared to ANS in all priming conditions, priming had a facilitating effect on word retrieval for both groups, and there was no significant change in stuttering frequency across the conditions for AWS. This suggests that phonological encoding may play no role, or only a minor role, in stuttering.

Educational objectives: The reader will be able to: (1) describe previous research paradigms that have been used to assess phonological encoding in adults and children who stutter; (2) explain performance similarities and differences between adults who do and do not stutter during various phonological priming conditions; (3) compare the present findings to past research that examined the relationship between phonological encoding and stuttering.

1. Introduction

The American Speech-Language-Hearing Association (ASHA, 1999) provides a detailed and widely accepted definition of stuttering, which identifies physiological, psychological, motor, linguistic, and/or auditory factors as possibly contributing to its occurrence. Despite extensive research, the impact of these factors on stuttering has yet to be fully explored and understood. Although many explanations have been proposed in relation to its causes, none of the existing theories provides a full account of all aspects of the disorder, which leaves its underlying mechanisms unknown.

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Various theories of stuttering relate this disorder to deficits in linguistic processes, such as semantic encoding (e.g., Bosshardt, Ballmer, & De Nil, 2002; Hennessey, Nang, & Beilby, 2008), grammatical encoding (e.g., Prins, Main, & Wampler, 1997), and phonological encoding (PE) (e.g., Burger & Wijnen, 1999; Hennessey et al., 2008; Sasisekaran & De Nil, 2006). The present study investigated a possible relationship between PE and stuttering, and is therefore concerned with one of the linguistic theories, the Covert Repair Hypothesis (CRH) (Postma & Kolk, 1993).

Postma and Kolk (1993) used Levelt's (1989) model of speech production and Dell's (1986) connectionist model of PE in postulating the CRH, which suggested that stuttering is caused by a disturbance in the formulating component of the speech production system. More specifically, Postma and Kolk (1993) stated that individuals who stutter are slower in PE than individuals who do not stutter. The hypothesis suggests that phonetic plans cannot be completed and sent to the articulatory buffer as quickly as in fluent speakers. This delay is detected by the internal feedback loop as an error that needs correction, and, as a consequence, covert repairs occur. At the same time, the speech articulator overtly compensates for this delay by manifesting different stuttering symptoms including repetitions, audible prolongations, and inaudible prolongations (blocks). If the error is found in the coda of a syllable (e.g., /t/ in *cat*), PE will continue until the correct phoneme is chosen, which will result in overt repetitions of the onset (i.e., initial sound) and nucleus (i.e., vowel) of the syllable (/kæ-kæ-kæ/). If there is an error in the sound following a continuant (e.g., /Λ/ in *luck*), the continuant is audibly prolonged until the phoneme is encoded. Errors in the onset of words or syllables will result in inaudible prolongations. Speech flow will be interrupted for repairs, but the speaker may begin moving the articulators and building up muscle tension, which is recognized as a block. In any of these events, overt speech will contain the primary symptoms of stuttering. Postma and Kolk (1993) view these as adaptation symptoms that represent the articulator's attempts to cope with the impaired system, but which creates an asynchrony between the phonological and the motor systems. To support this notion, the fluency enhancing effect of a slower speech rate on stuttering is used, which, according to Postma and Kolk (1993), comes from the greater amount of time that is provided for PE. By decreasing the speech rate, the articulator works more slowly and is synchronized with the phonological encoder.

There is a growing body of literature that has examined PE in individuals who stutter. Through use of various methodologies, PE has been investigated in both adults who stutter (AWS) and children who stutter (CWS), with each producing variable findings.

1.1. Studies on PE in stuttering

Studies that focused on PE in stuttering have used a variety of paradigms, including phonological priming, nonword repetition, phonological (rhyme and phoneme) monitoring, as well as several others. Phonological priming is the paradigm most frequently used to examine the relationship between PE and stuttered speech. Wijnen and Boers (1994) and Burger and Wijnen (1999) used a phonological priming task, which was developed by Meyer (1990, 1991). This task requires that participants produce a target word after being visually presented with a semantically related cue word, with cue-target word pairs being learned beforehand. Two conditions are created: the homogeneous condition, in which the target words share either the onset (C-prime) or the onset and nucleus (CV-prime), and the heterogeneous condition, in which the target words are phonologically unrelated, that is, they do not share an onset. It is assumed that phonologically related words will prime one another and that the priming effect will increase as the number of shared phonemes increases (Wijnen & Boers, 1994). Therefore, speech onset latencies (SOL) in homogeneous conditions should be shorter than in heterogeneous conditions, and SOL should be shorter in CV-prime when compared to C-prime. Since the CRH suggested that PE is slower in individuals who stutter, and stuttering usually occurs at the beginning of a word (on the first syllable), the predictions were that (a) a C-prime would not decrease SOL in individuals who stutter because the PE of the remaining segments in the syllable could be slower, and (b) a CV-prime should alleviate the PE problem, at least with regard to the initial syllable, which would result in reduced SOL (Wijnen & Boers, 1994). Whether phonological priming is associated with PE or phonetic planning or a combination of both is debatable. However, as postulated by the CRH, stuttering occurs due to the covert repair of errors caused by slower PE but which remain undetected until the phonetic plan is inspected by the internal feedback loop. It may be inferred that, regardless of which of the two processes are facilitated by priming, the presumed culprit of the problem (i.e., the delay in the formation of the phonetic plan) should be eradicated. Wijnen and Boers (1994) reported that adults who do not stutter (ANS) produced significantly different SOL in all three conditions, while AWS produced significantly shorter SOL in the CV- but not in the C-homogeneous condition when compared to the heterogeneous condition. This means to say that the two groups responded differently to phonological priming, as confirmed by a significant group by condition interaction, which was interpreted as supportive of the CRH. Burger and Wijnen (1999), however, found that the priming effect was the same for both groups: the participants produced shorter SOL in homogeneous than heterogeneous conditions, with the CV-homogeneous condition priming significantly better than the C-homogeneous condition. Although AWS were generally slower than ANS in their responses, since the two groups responded to priming in the same way, the findings were interpreted as not supportive of the CRH.

Additional priming studies have used picture naming tasks with phonological primes presented auditorily (Byrd, Conture, & Ohde, 2007; Hennessey et al., 2008; Melnick, Conture, & Ohde, 2003). Melnick et al. (2003) measured the speech response times of CWS and children who do not stutter (CNS) during three types of phonological priming: no prime, related prime, and unrelated prime. In the no prime condition, children were asked to name pictures as quickly as possible following their presentation. In the related prime and unrelated prime conditions, responses were auditorily primed by the initial syllable