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Speech and nonspeech sequence skill learning in adults who stutter

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Abstract

Two studies compared the speech and nonspeech sequence skill learning of nine persons who stutter (PWS) and nine matched fluent speakers (PNS). Sequence skill learning was defined as a continuing process of stable improvement in speed and/or accuracy of sequencing performance over practice and was measured by comparing PWS's and PNS's performance curves of accuracy, reaction time, and sequence duration, as well as retention and transfer. In experiment one, participants completed a 30-trial finger tapping sequence and in experiment two, a 30-trial read-aloud sequence of nonsense syllables. Significant between-group differences were found in the speed of sequencing performance after practice, and on retention and transfer tests. These results partially supported the inference that PWS demonstrated differences in early stages of sequence skill learning compared to PNS.

Educational objectives: As a result of this activity the participant will be able to: (1) define skill learning and the important indicators of skill learning; (2) summarize the reviewed literature concerning the performance of PWS on speech and nonspeech sequencing tasks over practice; and (3) explain the implication of reaction time differences over practice between PWS and PNS.

Keywords: Skill learning; Practice; Stuttering; Adults; Retention; Transfer; Nonsense syllables; Sequencing; Finger tapping

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1. Introduction

For most children the onset of developmental stuttering (DS) coincides with the development of multiword utterances and rapid expansion of speech and other motor skills. Between the ages of 2 and 4 years, sentences become longer and more complex, speech rate is enhanced and speech rhythm becomes adult-like (Allen & Hawkins, 1980). At the same time, children rapidly acquire advanced fine and gross motor skills such as talking and writing. The ability to learn new motor skills is crucial to this rapid early development.

Children who have difficulty performing complex motor skills (such as talking) may not be learning motor skills effectively. Kalvaram (2001) proposed that DS may evolve as a result of a young child's difficulties with learning to develop adult-like motor speech skill. Similarly, Zelaznik, Smith, Franz, and Ho (1997) proposed that the development of efficient speech/language processing may have been disrupted due to neurophysiological impairment. If present, skill learning differences between people who stutter (PWS) and fluent speakers (PNS) are thought to be relatively subtle and only observable when task complexity and context are manipulated to reflect the demands of speech (Alfonso, 1991; Webster, 1986, 1990).

1.1. Skill learning

Skill learning was defined as a continuing process of stable improvement in speed and/or accuracy of performance over practice. Skill learning is not directly observable and must be inferred from measured changes in variables such as accuracy, reaction time, and sequence duration over practice (performance curves) (Schmidt & Wrisberg, 2004). Likewise, between-group differences in skill learning must be inferred from relative group differences on such measures.

In addition to performance curve measures, measures of retention and transfer are also important indicators of skill learning (Schmidt & Wrisberg, 2004). A retention test consists of a sample of the experimental task. The purpose of a retention test is to determine the amount of performance improvement that is retained after a rest period. Transfer, in turn, is defined as how well performance on a practiced task carries over to a novel, but similar task. The purpose of a transfer task is to evaluate to what extent performance improvement obtained for a practiced sequence is transferred to a new sequence. Retention and transfer tests may be conducted within the same session (Behrman, Cauraugh, & Light, 2000; Smiley-Oyen, Worringham, & Cross, 2003), or after a much longer rest period of months to years (Shadmehr & Brashers-Krug, 1997). Both retention and transfer tests have been used to measure skill learning in healthy subjects (Kilduski & Rice, 2003; Seidler, 2004) and in patients with Parkinson's disease (Behrman et al., 2000; Dominey, Ventre-Dominey, Broussolle, & Jeannerod, 1997). Evidence of between-group differences on retention and transfer tests generally supports the presence of differences in motor learning between patients with Parkinson's disease and age/sex matched control subjects (Behrman et al., 2000; Dominey et al., 1997; Doyon et al., 1997).

1.2. Skill learning in PWS

Practice generally results in an increase of performance speed. Several studies have found PWS to be slower in increasing their speed of performance on speech and nonspeech motor tasks after practice. For instance, Cooper and Allen (1977) asked subjects to increase their rate of speech while repeating sentences and paragraphs up to 110 times. They found that PWS needed more repetitions than PNS to increase their rate of (fluent) speech after practice. In another study,