



# The effect of single syllable silent reading and pantomime speech in varied syllable positions on stuttering frequency throughout utterance productions

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Received 18 February 2015; received in revised form 9 September 2015; accepted 28 September 2015

Available online 9 October 2015

## Abstract

**Background:** Stuttering is an overt speech disorder with the majority of disruptions occurring during phrase and sentence initiations. Recent theories and models of stuttering often describe deficits in neuromotor processes for planning motor speech movements, especially those involved during motor initiation. Interestingly, stuttering-like behaviors are reduced by approximately by nearly 100% during silent articulations (i.e., pantomime speech). If stuttering is primarily a deficit in neuromotor planning for speech actions, disfluent behaviors should be significantly reduced throughout an utterance when people who stutter employ silent reading or pantomime strategies on one syllable of an audibly produced utterance.

**Aims and scope:** The aim of the first study was to examine stuttering frequency during oral reading as participants who stutter produced the initial syllable under silent reading (SR), pantomime (P), and redacted (R) speech conditions. Similarly, the second study examined stuttering frequency during oral reading as a unique set of participants who stutter employed SR or P strategies on single syllable productions in initial, middle, and final syllable positions of an utterance.

**Methods and procedures:** Two unique sets of participants who stutter audibly read sentences under baseline and experimental conditions. Experimental conditions for the first study consisted of (1) SR, (2) P, and (3) R on the initial syllable of audibly produced utterances. Experimental conditions for the second study consisted of participants performing SR and P on single syllables in initial, middle, and final syllable positions throughout an audibly produced utterance.

**Results:** Stuttering was significantly reduced during all experimental conditions in the first study. All experimental conditions differed from all others in the first study with P, SR, and R progressing from most to least effective. Results from the second study revealed differences from both SR and P to baseline and differences in both the initial and final syllable positions to baseline, but not the middle position to others, which approached statistical significance ( $p = 0.1$ ). In the second experiment, post hoc comparisons revealed that P in the initial position was the most effective and that P was significantly more effective than SR in both the initial and final positions, which supports the findings from the first study.

**Conclusions and implications:** Results from the current studies demonstrate a reduction of stuttering throughout an utterance when participants employed SR and P strategies on single syllables within an utterance. The greatest reduction in stuttering frequency occurred when silent motor plans were enacted and not just read or omitted (i.e., during P conditions). Supporting current feed-forward models of

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stuttering, strategies were most effective when employed in initial syllable positions. It can be hypothesized that behavioral strategies such as SR and P speech alter predictive neuromotor planning via feedback mechanisms or enhancing output gain of neuromotor planning regions.

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*Keywords:* Stutter; Fluency; Pantomime; Silent reading; Models of speech; Feed-forward

## 1. Background

Stuttering is a fluency disorder in which a majority of the speech disruptions occur during phrase and sentence initiation (Bloodstein and Bernstein-Ratner, 2007). Interestingly, stuttering has also been shown to exhibit a marked reduction during whispered speech, and most germane to this paper, a near elimination during silently articulated pantomime speech (P) (Brenner et al., 1972; Commodore, 1980; Commodore and Cooper, 1978; Perkins et al., 1976). Researchers typically report 80–90% reductions in stuttering frequency during whispering (Brenner et al., 1972; Commodore, 1980; Commodore and Cooper, 1978; Perkins et al., 1976; Rami et al., 2005) and nearly 100% fluent speech productions during P (Commodore, 1980; Commodore and Cooper, 1978; Perkins et al., 1976).<sup>1</sup> It should be noted that due to participants using whispered and P strategies throughout the entirety of the passages, Commodore (1980), Commodore and Cooper (1978), and Perkins et al. (1976) used visual-only presentations of client recordings during analysis of stuttering. This was done to maintain consistency across all conditions (control, whispered, and P). Type and frequency of stuttering was therefore classified using visually evident behaviors only.

Pantomiming procedures in relation to studies in fluency disorders have primarily been utilized to test hypotheses regarding hierarchical discoordination speech systems in people who stutter (PWS) (Commodore, 1980; Commodore and Cooper, 1978; Perkins et al., 1976) and to examine the adaptation effect (i.e., reduction in stuttering after repeated productions of the same content) (Brenner et al., 1972). More specifically, a contribution from many of these studies was initial support for what became known as the “discoordination hypothesis”. This suggested that simplifying the speech process contributes to an easier and more efficient coordination of the articulatory system, and hence, increased fluency. For example, Commodore (1980) and Commodore and Cooper (1978) required participants who stutter to read passages during

voiced (i.e., baseline), whispered, and silently articulated (i.e., P) stressed and non-stressed conditions. Results from these studies indicated differences in stuttering frequency between stressed (i.e., visible video recording) to non-stressed conditions (i.e., hidden camera). More relevant to the current manuscript, differences were found between whispered and silently articulated experimental conditions to baseline. Significantly less stuttering was reported during speech that was whispered and silently articulated compared to during baseline. No differences were reported between the two experimental speech conditions. Similarly, in testing theoretical notions of fluency enhancements being caused by a slowed speech rate, Perkins et al. (1976) analyzed speech characteristics of participants who stutter that verbally read under voiced (i.e., baseline), whispered, and pantomimed conditions. Stuttering was reduced during experimental conditions with pantomime, whispered, and voiced progressing from greatest reduction to least. They also reported that as the speech hierarchy was reduced (i.e., reducing voicing, then airflow components) participants increased articulatory rate.

Lastly, researchers have also utilized whispering, P, and silent reading (SR) procedures to examine the adaptation effect in stuttering. Brenner et al. (1972) had participants read the same passage three times during silent rehearsal (i.e., silent reading “SR”), silent rehearsal with lip movement (i.e., P), whispered rehearsal, aloud rehearsal (i.e., audible production), and no rehearsal conditions before audibly reading the passage a fourth time during which stuttering was analyzed. Results revealed that stuttering frequency was only significantly reduced during the audible rehearsal condition. Although previous studies of the P and SR effect on stuttering frequency have demonstrated that the two conditions reliably reduced stuttering frequency, all of the aforementioned studies employed fluency enhancing strategies (P and SR) throughout the productions. As recent theoretical frameworks posit that stuttering is most likely to occur on the initial sound or syllable, it may be important to examine how P and SR strategies reduce stuttering frequency when only implemented on single syllables within sentence productions.

In summary, in all of these previously described studies researchers had participants use P and SR throughout the entirety of the passage then per the observed results, inferred about theoretical notions of hierarchies in the speech production systems of PWS. Given recent advances in neuro-based theories and models of stuttering and

<sup>1</sup> These findings are consistently reported, with the exception of Van Riper (1971) who reports that Deal (1982) presented a case study of a client that had attempted suicide and did not exhibit benefit from many well-known fluency enhancing conditions (e.g., choral speech, signing, pantomiming, or whispering). This is also true for participants who have had laryngectomies and produce alaryngeal speech, as reported in Van Riper (1971). Use of an electrolarynx, essentially pantomime speech, maintains similar fluency enhancements, as reported in Van Riper (1971).

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