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Methodological considerations in the measurement of reaction time in persons who stutter

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Abstract

This research note describes potential trends in the reaction time (RT) performance of persons who stutter (PWS). The main purpose of this note is to describe these trends to researchers, encourage further research in this area, and alert researchers to possible concerns about the interaction of certain reaction time research procedures and characteristics of PWS. Post hoc analyses and a brief review of selected studies comparing the RT of PWS and PNS revealed three potential trends: (a) PWS show different practice effects relative to fluent speakers (PNS) on RT measures, (b) practice effect differences between PWS and PNS in RT are dependent upon task complexity, and (c) variable foreperiod intervals (VFI) may differentially affect the RT of PWS and PNS.

A 15-item guide is included to aid both clinicians and researchers in the critical review of RT studies and to facilitate planning of future studies incorporating RT as an indicator of potential differences between PWS and PNS.

Educational objectives: As a result of this activity the participant will be able to: (1) Define practice effects as they relate to skill learning (2) Summarize the reviewed literature concerning the performance of PWS on motorically simple and complex RT tasks over practice, and (3) Explain the implications for statistical analysis of a significant relationship between variable foreperiod and RT measures for PWS.

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1. Introduction

1.1. Primary objective

The primary objective of this research note is to describe trends in reviewed reaction time studies suggesting that (a) persons who stutter (PWS) show different practice effects relative to fluent speakers (PNS) on reaction time (RT) measures, (b) practice effect differences between PWS and PNS in RT are task dependent, and (c) variable foreperiod intervals (VFI) may differentially affect the RT of PWS and PNS.

The main purpose of this note is educational and specific to methodology, rather than attempting to review and synthesize the findings of all the RT studies in the area of stuttering. This research note serves the purpose of alerting researchers that these trends may affect the results of reaction time studies and to encourage replication studies in

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Table 1
Reaction time studies that did and did not assess practice effects, and those that found significant practice effects.

Authors	Subjects	Response	Sig. practice effect?
Adams and Hayden (1976)	Adults	Initiation and termination of “ah”	Yes
McFarlane and Prins (1978)	Adults	Lip closure./pæ/./bæ/	N/A ^a
Cross and Luper (1979)	Children 5–9, and adults	“uh”	Yes (trend)
Reich et al. (1981)	Adults	Button press, non-speech phonation, “uh” “upper”	N/A
Borden (1983)	Adults	Finger counting and speech counting	N/A
Cross and Luper (1983)	Children 5–9, and adults	Key press	N/A
Hand and Haynes (1983)	Adults	Key press for nonsense word, “ah” for real word	N/A
Starkweather et al. (1984)	Adults	Button press, “uh”	N/A
Webster (1986)	Adults	Button press sequence	Yes (errors)
Weinstein et al. (1989)	Adults	Saccade sequences	Yes
Peters et al. (1989)	Adults	Words and sentences	N/A
Bishop et al. (1991)	Children 3–10	“ah”, words, finger movements	N/A
Dembowski and Watson (1991)	Adults	“ah”, VCV syllables	N/A
Wijnen and Boers (1994)	Adults	Words	No
van Lieshout et al. (1996)	Adults	Short and long words	N/A
Jones et al. (2002)	Adults	Ballistic arm movement	N/A
Arnold et al. (2005)	Children 3–5	Picture naming	Yes (trend)
Sasisekaran and De Nil (2006)	Adults	Phoneme monitoring while picture naming	N/A
Smits-Bandstra, De Nil, and Saint-Cyr (2006)	Adults	Finger and syllable sequencing	Yes
Smits-Bandstra, De Nil, and Rochon (2006)	Adults	Finger sequencing	Yes
Hennessey et al. (2008)	Adults	Picture naming and reaction time	N/A
Smits-Bandstra and De Nil (2009)	Adults	Syllable sequencing	Yes

^a N/A = not assessed.

this area. A review of several recent RT studies presented in the Journal of Fluency Disorders suggested important trends in those studies which compared the RT of PWS and PNS deserving further investigation. Therefore a selection of the RT studies reviewed in Bloodstein’s most recent “Handbook on Stuttering” (2008; pp. 170–173) was taken to further investigate the existence of these trends. Care was taken to ensure studies from several research groups and several time periods as well as studies both confirming and refuting the existence of the trends proposed by this paper were included. Studies found in the Journal of Fluency Disorders or reviewed by the Handbook were selected because they were conducted in the last 20–30 years, were basically methodologically sound, and were published in accredited, peer-review journals. Studies were also selected based on their accessibility to North American clinicians and researchers. Only those studies published in widely read and widely available journals were included (such as were available online, at the University of Toronto library and the University of McGill library).

2. Practice effects

For the purposes of this paper practice effects were defined as relatively stable (not increasing and then decreasing) improvements in performance (e.g., speed, accuracy, and variability) associated with an increasing number of practice trials over a single session (Schmidt & Wrisberg, 2004). This definition is a global one, wherein improvements could relate to cognitive, linguistic, motor preparation and motor execution processes and even emotional processes. The vast majority of studies reviewed here examine practice effects within a single session. The purpose of this research note is neither to conjecture as to which processes are involved in RT nor to speculate about which processes may or may not be specifically impaired in PWS. This research note presents the observation that the great majority of studies do, in fact, find RT differences between PWS and PNS and furthermore that these groups appear to differ in terms of the rate/amount of RT improvement over practice.

In addition, this research note contends that practice effect differences between PWS and PNS are apparent despite wide variations in methods/paradigms (e.g., choice vs. simple RT paradigms, simple vs. complex motor responses, motor vs. cognitive vs. linguistic tasks). As shown in Table 1, within the sample of reviewed studies, a limited number of studies comparing RT in PWS and PNS have analyzed practice effects (Adams & Hayden, 1976; Arnold, Conture, & Odhe, 2005; Cross & Luper, 1979; Webster, 1986; Weinstein, Caruso, Severing, & VerHoeve, 1989; Wijnen &

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