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Stuttering in adults: The acoustic startle response, temperamental traits, and biological factors

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Abstract

The purpose of this study was to investigate the relation between stuttering and a range of variables of possible relevance, with the main focus on neuromuscular reactivity, and anxiety. The explorative analysis also included temperament, biochemical variables, heredity, preonset lesions, and altered auditory feedback (AAF). An increased level of neuromuscular reactivity in stuttering adults has previously been reported by [Guitar, B. (2003). Acoustic startle responses and temperament in individuals who stutter. *Journal of Speech Language and Hearing Research, 46*, 233–240], also indicating a link to anxiety and temperament. The present study included a large number of variables in order to enable analysis of subgroups and relations between variables. Totally 32 stuttering adults were compared with nonstuttering controls. The acoustic startle eyeblink response was used as a measure of neuromuscular reactivity. No significant group difference was found regarding startle, and startle was not significantly correlated with trait anxiety, stuttering severity, or AAF. Startle was mainly related to calcium and prolactin. The stuttering group had significantly higher scores for anxiety and childhood ADHD. Two subgroups of stuttering were found, with high versus low traits of childhood ADHD, characterized by indications of preonset lesions versus heredity for stuttering. The study does not support the view that excessive reactivity is a typical characteristic of stuttering. The increased anxiety is suggested to mainly be an effect of experiences of stuttering.

Learning outcomes: As a result of reading this article, the reader will be able to: (a) critically discuss the literature regarding stuttering in relation to acoustic startle, anxiety, and temperament; (b) describe the effect of calcium on neuromuscular reactivity; (c) discuss findings supporting the

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importance of early neurological incidents in some cases of stuttering, and the relation between such incidents and traits of ADHD or ADD; and (d) discuss the role of genetics in stuttering.

1. Introduction

1.1. Overview

Stuttering is a frequent speech disorder which, if persistent, often has far-reaching psychological and social effects for the affected persons. The etiological mechanisms are still unclear, though research has shown the influence of genetical factors in many cases (Ambrose, Cox, & Yairi, 1997; Riaz et al., 2005; Shugart et al., 2004; Viswanath, Lee, & Chakraborty, 2004; Yairi & Ambrose, 2005). There are also indications of non-genetic influence. The nature of such non-genetic factors is not clear, but various types of neurological incidents are likely contributors (Böhme, 1968; Poulos & Webster, 1991; Segalowitz & Brown, 1991; West, Nelson, & Berry, 1939).

The possible roles of psychological factors, such as anxiety and a "sensitive" temperament, are matters of debate (Alm, 2004b; Craig, Hancock, Tran, & Craig, 2003; Ezrati-Vinacour & Levin, 2004; Guitar, 2003; Oyler, 1994). One possible link between temperament and stuttering is that stuttering persons tend to have an increased level of neuromuscular reactivity, resulting in exaggerated muscular reflexes and difficulties to regulate force and speed when talking. This possibility is supported by a recent report of increased "acoustic startle" in stuttering persons, i.e., increased blink reflexes in response to a surprising loud sound (Guitar, 2003).

A physiological factor known to affect the level of neuromuscular reactivity is calcium: the excitability of the nervous system is directly related to the level of calcium in the blood, so that low calcium can lead to tetany (Guyton & Hall, 1996). It is therefore of interest that Costa, Antoniac, Berghianu, and Marinescu (1986) reported low levels of calcium in stuttering children and adults.

Another trace in the search of the causes of stuttering has lead to the neural transmitter *dopamine*. Wu et al. (1997) reported about 3-times higher cerebral uptake of a precursor of dopamine, in a study of three stuttering adults. Dopamine receptor blockers is the type of medication that has shown the best documented effect on stuttering (Brady, 1991). The level of dopamine in the pituitary serves as the main regulator of the release of the hormone *prolactin* into the peripheral blood stream (Ben Jonathan & Hnasko, 2001). With this background the plasma level of prolactin has been suggested to be an index of cerebral dopamine activation (Appelberg et al., 2000). As far as we know the level of prolactin has not been investigated in persons who stutter.

A striking aspect of stuttering is the often dramatic improvement of fluency shown during *altered auditory feedback* (AAF), like *frequency altered feedback* (FAF) or *delayed auditory feedback* (DAF) (Kalinowski, Armson, Roland-Mieszkowski, Stuart, & Gracco, 1993). However, the mechanism behind this effect is not well understood. One hypothesis might be that the auditory feedback is too strong in some stuttering persons.