CHAPTER 29

Executive Function, Cognitive Control, and Sequence Learning in Deaf Children with Cochlear Implants

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Abstract

Clinical research on deaf children with cochlear implants has been intellectually isolated from the mainstream of current research and theory in neuroscience, cognitive psychology, and developmental neuropsychology. As a consequence, the major clinical research problems have been narrowly focused on studies of speech and language outcomes and the efficacy of cochlear implantation as a medical treatment for profound hearing loss. As noted in both of the National Institutes of Health (NIH) consensus statements on cochlear implants in 1988 and 1995 (NIDCD, 1988, 1995), little, if any, research has investigated the underlying psychological and neurocognitive factors that are responsible for the enormous individual differences and variability in the effectiveness of cochlear implants. In this chapter, we report some new research findings on executive function, sequence memory, and cognitive control in prelingually deaf children who have received cochlear implants. Our results demonstrate that several domain-general neurocognitive processes related to executive function and cognitive control processes, such as working memory capacity, fluency-speed, inhibition, and organization-integration sequencing skills, are strongly associated with traditional clinical speech and language outcome measures. These specific neurocognitive processes reflect the global coordination, integration, and functional connectivity of multiple underlying brain systems used in speech perception, production, and spoken language processing. We argue that these executive function and organization-integration processes contribute an additional unique source of variance to speech and language outcomes above and beyond the conventional demographic, medical, and educational factors. Understanding the neurocognitive processes responsible for variability in spoken language processing will help both clinicians and researchers explain and predict individual differences in speech and language outcomes following cochlear implantation. Moreover, our results also have direct application to improving the diagnosis, treatment, and early identification of young deaf children who may be at high risk for poor outcomes following cochlear implantation.

Keywords: cochlear implant, executive function, deaf, children, memory, speech perception, language

Our long-term goal is to understand and predict the enormous variability in speech and language outcomes in deaf children who have received cochlear implants as a treatment for profound deafness. As noted in both of the National Institute on Deafness and Other Communication Disorders (NIDCD) consensus statements on cochlear implants in 1988 and 1995, individual differences and variability in speech and language outcomes are significant clinical problems that have not been addressed adequately in the past. Little, if any, progress has been made in understanding the neurobiological mechanisms and neurocognitive processes that are responsible for the variability observed in speech and language outcomes following cochlear implantation.

Most of the past work on cochlear implants has been concerned primarily with documenting the "efficacy" of cochlear implantation as a medical treatment