Chapter 5.11

Synthetic Speech Perception in Individuals with Intellectual and Communicative Disabilities

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ABSTRACT

The purpose of this chapter is to review research conducted over the past two decades on the perception of synthetic speech by individuals with intellectual, language, and hearing impairments. Many individuals with little or no functional speech as a result of intellectual, language, physical, or multiple disabilities rely on non-speech communication systems to augment or replace natural speech. These systems include Speech Generating Devices (SGDs) that produce synthetic speech upon activation. Based on this review, the two main conclusions are evident. The first is that persons with intellectual and/or language impairment demonstrate greater difficulties in processing synthetic speech than their typical matched peers. The second conclusion is that repeated exposure to synthetic speech allows individuals with intellectual and/or language disabilities to identify synthetic speech with increased accuracy and speed. This finding is of clinical significance as it indicates that individuals who use SGDs become more proficient at understanding synthetic speech over a period of time.

INTRODUCTION

One of the most significant advances in enhancing the communicative abilities of individuals with severe communication impairment has been the development of Speech Generating Devices (SGDs). The use of SGDs for interpersonal communication by individuals with severe communication impairment has increased substantially over the past two decades (Koul, 2003). This increase in the use of SGDs is primarily a result of technological advances in the area of synthetic speech. Most high-end SGDs use text-to-speech synthesis in which graphic symbols, alphabets, words, and digits are entered from an input device, such as touch screen/keyboard/switch/infrared eye tracking technique, and are converted into a speech waveform using a set of mathematical rules. This chapter has three general aims. The first aim is to review the literature on the perception of synthetic speech by individuals with language, intellectual, and hearing impairments. The second aim is to use that review to understand the effects of degraded acoustic input on the synthetic speech perception by individuals with developmental communicative and intellectual impairments. The final aim is to present the research on effects of synthetic speech output on acquisition of graphic symbols by individuals with developmental disabilities.

PERCEPTION OF SYNTHETIC SPEECH BY PERSONS WITH INTELLECTUAL DISABILITIES

Data from the United States, Department of Education (2002) indicate that 18.7% of the children ages 6 through 21 who receive services under the Individuals with Disabilities Education Act have a diagnosed speech and/or language impairment and 9.9% have a diagnosed intellectual impairment. Further, about 3.5% and 1.0% of individuals with intellectual impairment fall in the categories of severe and profound impairment respectively

(Rosenberg & Abbeduto, 1993). Many individuals with severe-to-profound intellectual disabilities and severe communication impairments are potential candidates for SGDs. Thus, it is critical to investigate the factors that influence synthetic speech perception in individuals with intellectual impairment. Unlike non-electronic communication books and boards, SGDs provide speech output (synthetic or digitized) to the individual user and the communication partner (Church & Glennen, 1992). A retrospective study conducted by Mirenda, Wilk, & Carson, (2000) on the use of assistive technology by individuals with autism and intellectual impairment indicated that 63.6% of the students with severe intellectual impairment used SGDs to augment their communication.

Although substantial research exists on the perception of synthetic speech systems by typical individuals (e.g., Duffy & Pisoni, 1992; Higginbotham & Baird, 1995; Koul & Allen, 1993; Logan, Greene, & Pisoni, 1989; Mirenda & Beukelman, 1987, 1990), limited data are available about the intelligibility and comprehension of synthetic speech by individuals with intellectual disabilities (Koul & Hester, 2006; Koul & Clapsaddle, 2006; Koul & Hanners, 1997; Willis, Koul, & Paschall, 2000). Further, there are differences in aspects of natural language comprehension and information-processing between individuals with intellectual disabilities and mental-age matched typical peers (e.g., Abbeduto, Furman, & Davies, 1989; Abbdeduto & Nuccio, 1991; Berry, 1972; Kail, 1992; Merrill & Jackson, 1992; Rosenberg, 1982; Taylor, Sternberg, & Richards, 1995). Individuals with intellectual disabilities have receptive language delays that exceed their cognitive delays (Abbeduto et al., 1989) and they demonstrate difficulty understanding linguistic information that requires extensive analysis of the acoustic-phonetic aspects of the speaker's words (Abbeduto & Rosenberg, 1992). These differences in language and cognitive domains between typical individuals and individuals with intellectual impairments make it difficult to generalize find-

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