Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Research in Autism Spectrum Disorders 2 (2008) 110–124
Research in Autism Spectrum Disorders
http://ees.elsevier.com/RASD/default.asp

Production of syllable stress in speakers with autism spectrum disorders

Rhea Paul [a,b,*], Nancy Bianchi [c], Amy Augustyn [d], Ami Klin [a], Fred R. Volkmar [a]

[a] *Yale Child Study Center, United States*
[b] *Southern Connecticut State University, United States*
[c] *West Haven Public Schools, United States*
[d] *Florida State University, United States*

Received 8 March 2007; received in revised form 27 March 2007; accepted 9 April 2007

Abstract

This paper reports a study of the ability to reproduce stress in a nonsense syllable imitation task by adolescent speakers with autism spectrum disorders (ASD), as compared to typically developing (TD) age-mates. Results are reported for both raters' judgments of the subjects' stress production, as well as acoustic measures of pitch range and duration during stressed and unstressed syllable production. Results reveal small but significant differences between speakers with ASD and typical speakers in both perceptual ratings of stress and instrumental measures of duration of syllables. The implications of these findings for understanding prosodic deficits in ASD are discussed.

Keywords: Syllable stress; Prosody; Autism

Autism spectrum disorders (ASDs) are a group of severe neuropsychiatric conditions characterized by disturbances in social, cognitive, and communicative function that are not fully explained by developmental level. Although most of these disorders are associated with depressed cognitive and language functioning, an estimated 20–40% of individuals with these syndromes function within the normal range on IQ testing (APA, 1994; Klin and Volkmar, 1997). These individuals demonstrate large spoken vocabularies and apparently intact formal language skills. Individuals at this level of functioning may, according to the Diagnostic and

* Corresponding author at: Yale Child Study Center, 40 Temple St # 6B, New Haven, CT 06510, United States. Tel.: +1 203 785 3388; fax: +1 203 785 3705.
E-mail address: rhea.paul@yale.edu (R. Paul).

1750-9467/$ – see front matter
doi:10.1016/j.rasd.2007.04.001

Statistical manual of Mental Disorders-4th Ed.-TR (APA, 2000), receive one of three diagnoses within the autism spectrum: high functioining autism (ASD), in which there is a history of language delay and symptoms in all three areas that characterize the syndrome (severe deficits in socialization, communication and stereotyped, repetitive or ritualistic behaviors); Asperger syndrome (AS) in which there is no history of language delay, the presence of significant social and communicative disability and an obsessive interest in circumscribed topics; and PDD-NOS in which social, communicative and/or stereotypic behaviors are present, but do not reach criteria for autism. The most prominent communication deficits in these disorders in higher functioning individuals are in the areas of pragmatics and social communication (Ramberg, Ehlers, Nyden, Johansson, & Gillberg, 1996; Tager-Flusberg, 1995). Another area in which communicative difficulties are frequently reported for speakers with ASD is *prosody* (McCann & Peppe, 2003).The term *prosody* refers to the suprasegmental aspects of speech production; those properties of the speech signal that extend beyond phonemic segments to modulate and enhance its meaning (Crystal, 1969; Couper-Kuhlen, 1986; Kent & Read, 1992; Merewether & Alpert, 1990; Panagos & Prelock, 1997). The term *prosody* is typically used to refer to:

(1) the assignment of relative prominence or *stress* to various units within the signal;
(2) changes in pitch of the speech sound wave over time that make up its *intonation contour*;
(3) the rhythm and timing patterns that make up the *phrasing* of the utterance; expressed through *rate*, *duration* and *pauses* within speech events (Shriberg, Kwiatkowski, & Rasmussen, 1990).

Acoustically, prosody is a composite of pitch (fundamental frequency), intensity (amplitude), and duration, as well as the co-variation of these variables (Stephens, Nickerson, & Rollins, 1983).

Since the first delineation of the autistic syndrome (Kanner, 1943), abnormal prosody has been frequently identified as a core feature of the syndrome for individuals with autism who speak (Baltaxe & Simmons, 1987, 1992; Fay & Schuler, 1980; Ornitz & Ritvo, 1976; Paul, 1987; Pronovost, Wakstein, & Wakstein, 1966; Rutter & Lockyer, 1967; Tager-Flusberg, 1981). Paul and Shriberg, et al. (2005) reported abnormal prosody in 47% of the speakers with ASD studied. These abnormalities have been reported anecdotally to include monotonic or machine-like intonation, deficits in the use of pitch and control of volume, deficiencies in vocal quality, and use of aberrant stress patterns.

Shriberg et al. (2001) reported on a range of suprasegmental characteristics of continuous speech in speakers with ASD, using a standard assessment method, the Prosody-Voice Screening Profile (PVSP; Shriberg et al., 1990). This study found significant prosodic differences between speakers with ASD and typical speakers. However, differences were not wide-spread, but focused in a few areas; most notably in speech phrasing or fluency, the presence of hypernasal voice quality, and in the use of stress.

Stress, or the highlighting of particular words or syllables with increased duration, pitch changes, and amplitude (volume), is used for a variety of purposes in speech. In English, one function of stress is to distinguish grammatical class in some disyllabic words. For example in the word *present*, pronunciation with stress on the first syllable denotes a noun (*pre*' sent), while stress on the second denotes a verb (pre *sent*'). This function would generally be considered a grammatical usage of stress, since the prosodic change is employed to signal a change in grammatical class (Quirk, Greenbaum, Leech, & Svartvik, 1990). Another function that can be served by stress is the contrastive or emphatic function. This usage of stress involves highlighting