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Nasal voice in boys with high-functioning autism spectrum disorder

Audrey M. Smerbeck *

Rochester Institute of Technology, 2388 Eastman Hall, 18 Lomb Memorial Drive, Rochester, NY 14623, United States

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ABSTRACT

This study compared speech samples of 29 boys aged 6–13 with high-functioning autism spectrum disorder (HFASD) to those of 29 typically developing (TD) boys matched on age and ethnicity. Ten listeners blind to speakers' diagnoses rated speech samples for nasality and reported their perceptions of the speaker on a 6-point Likert-type scale. Results indicated significantly greater listener-perceived nasality in the HFASD than the TD group. Listeners rated the HFASD group significantly higher than the TD group on negative socially relevant adjectives, a finding which was mediated by nasality. In addition, compared to TD speakers, speakers with HFASD were rated lower on dominance and perceived age, as well as higher on perceived disability.

1. Introduction

Autism spectrum disorder (ASD) is primarily characterized by two groups of symptoms: social-communicative impairment and a pattern of restricted, repetitive, and stereotyped behaviors, activities and interests (American Psychiatric Association [APA], 2013). While some individuals with ASD have intellectual disability and/or severe deficits in verbal communication, others display normal intelligence and fluent speech. The latter group generally encompasses cases previously diagnosed as having Asperger's disorder and is often described as "high-functioning" (e.g., see Mayes et al., 2009; Volker et al., 2010).

Although the two core domains of impairment define high-functioning autism spectrum disorder (HFASD), additional associated features have been frequently observed. For example, children with HFASD suffer high rates of bullying and ostracism by age mates, which are in turn associated with mood and anxiety disorders (Asperger, 1944; Green, Gilchrist, Burton, & Cox, 2000; Lopata et al., 2010). Similarly, fine and gross motor impairments have frequently been observed (e.g., see Dowell, Mahone, & Mostofsky, 2009; Ghaziuddin, Butler, Tsai, & Ghaziuddin, 1994; Green et al., 2009; Ming, Brimacombe, & Wagner, 2007; Staples & Reid, 2010). This report proposes an additional associated feature: nasal voice. Unspecified or varied abnormalities in voice have previously been described in this population. In fact, one of Asperger's original case studies, Ernst, was noted to have a voice which was "high, slightly nasal and drawn out" (Asperger, 1944). Since then, the research literature has occasionally mentioned voice abnormalities in individuals with HFASD – sometimes with specific mention of, but never with a focus on, nasality (Baltaxe, Simmons, & Zee, 1984; Fine, Bartolucci, Ginsberg, & Szatmari, 1991; Paccia & Curcio, 1982; Provonost, Wakstein, & Wakstein, 1966; Shriberg et al., 2001).

* Tel.: +1 585 475 3953.
E-mail address: amsgss@rit.edu

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1.1. Mechanics of speech production

Human speech is produced by using the organs of the vocal tract, such as larynx, tongue, and lips, to shape and control the flow of air as it exits the lungs (Ladefoged & Maddieson, 1996). During non-speech exhalation, air flows freely up the throat. It passes the pharynges and the velum, which are relaxed and lie separated, and exits via the nasal cavity. During production of many speech sounds, however, the velum and pharynges move toward one another, sealing off the nasal cavity and diverting airflow to the oral cavity, where the tongue and lips can create the majority of English phonemes by varying position and pressure. From a developmental perspective, it is important to note that the "path of least resistance" for exhaled air is through the nasal cavity; newborns produce only nasal exhalation (for both breathing and vocalization) until approximately three months of age, when some capacity to close the velopharyngeal apparatus is achieved (Netsell, 1981).

The majority of English consonants are produced with little or no nasal resonance, requiring the speaker to close the velopharyngeal apparatus (Ladefoged & Maddieson, 1996). All vowels include a mixture of oral and nasal resonance, but in American English nasal resonance is minimal except when the speaker is using prosodic features to convey displeasure (i.e., whining tone; Kummer & Lee, 1994). An exception occurs when vowels are produced immediately before or after a nasal consonant [/m/, /n/, and /ŋ/]. These vowels assimilate to the features of the nasal consonant and have increased nasal resonance in normal speakers (Ladefoged & Maddieson, 1996).

It is common to refer to voice and prosody as if they were interchangeable, but in actuality they refer to separate, though highly interrelated, facets of communication. Prosody refers to the manipulation of stress, pitch, volume, rate, duration, and timbre to emphasize or modify the grammatical, pragmatic, or affective message conveyed by a spoken utterance (Paul, Augustyn, Klin, & Volkmar, 2005). Voice is the vehicle through which prosody is conveyed in spoken languages, but it also has its own independent, baseline features. Nasality is a feature of voice, generally produced consistently by an individual, independent of communicative intent (Kummer & Lee, 1994). However, nasality can be prosodically manipulated within an utterance to add communicative features, specifically to convey a sense of dissatisfaction. Thus, while all speakers will increase nasality for prosodic purposes, some may have chronically high or low levels of nasal voice. While the ratio of nasal to oral exhalation can be measured (a variable known as *nasalance*), this value is only moderately correlated with listener perceptions of nasality, just as amplitude is only moderately correlated with listener perceptions of loudness (see Sweeney & Sell, 2008 for a more detailed treatment). The impairment associated with nasal voice is the result of listener judgments, rather than the specific path of air movement. Thus, listener-perceived nasality, rather than mechanically measured nasalance, is considered the 'gold standard' for research which examines the social consequences of nasal speech (Kuehn & Moller, 2000).

1.2. Social consequences of nasal voice

The psychosocial consequences of persistently nasal speech are significant and well established. Early pediatric research demonstrated that children expressed increased willingness to avoid or exclude peers with highly nasal speech (Blood & Hyman, 1977). Further research with adults demonstrated that listeners rated highly nasal speakers as less pleasant, less kind, and even less physically attractive (Blood, Mahan, & Hyman, 1979). Later studies replicated these findings with child and adolescent speakers and also reported a tendency for listeners to rate nasal speakers as less intelligent, less confident, and less honest (Lass, Ruscello, Harkins-Bradshaw, & Blankenship, 1991; Lass, Ruscello, Stout, & Hoffman, 1991; Ruscello, Lass, & Podbesek, 1988). A study of Australian adults found vocal nasality to be negatively correlated with persuasiveness, social status, and solidarity (Pittam, 1990). Proposing a possible mediator for negative listener ratings, McKinnon, Hess, and Landry (1986) found that listeners reported increased anxiety when listening to nasal speech. A more recent investigation sought listener ratings on a variety of semantic differential items (e.g., confident/unsure, beautiful/ugly, graceful/awkward, etc.) and found that highly nasal speakers were not only rated significantly more negatively than normal control speakers, but also more negatively than speakers with other voice disorders (Lallh & Rochet, 2000). In addition, these researchers provided a subgroup of listeners with information about voice disorders before the listeners began the rating task, but found no significant differences between the opinions of raters who received stigma-reducing education those who received neutral control information. This is consistent with McKinnon et al.'s finding that listeners' negative reaction to nasal voice may be affectively, rather than cognitively, mediated.

Negative listener reaction to nasality has even been found in listeners' reactions to infants' pre-speech vocalizations. For example, both Canadian and Japanese mothers responded less frequently to nasal infant vocalizations, perceiving them as less communicative than non-nasal infant vocalizations (Masataka & Bloom, 1994). When undergraduates rated infants on a variety of social favorability criteria based on their vocalizations, nasality was associated with significantly lower ratings for boys, though not for girls (Bloom, Moore-Schoenmakers, & Masataka, 1999). Bloom, Zajac, and Titus (1999) published results that further elaborated on the relationship between nasality and gender. They asked listeners to rate male and female speakers varying in nasality on adjectives reflecting positive female stereotypes (e.g., sensitive, helpful, etc.), negative female stereotypes (e.g., whiny, weak, etc.), positive male stereotypes (e.g., assertive, competent, etc.), and negative male stereotypes (e.g., boastful, hostile, etc.). Bloom et al. found that a highly nasal voice was most strongly associated with an increase in ratings for negative stereotypically female traits across speakers of both sexes, and a decrease in ratings for positive male traits. The latter finding yielded a significant nasality by sex interaction, indicating that highly nasal male speakers were penalized more harshly than highly nasal female speakers on ratings of positive masculine traits.