

# Disordered Prosody in the Speech of Autistic Individuals

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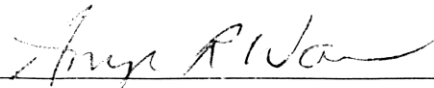
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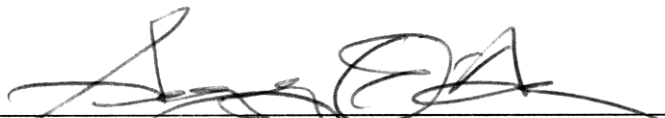
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Running head: PROSODY IN AUTISM

Disordered Prosody in the Speech of Autistic Individuals

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### Abstract

Prosody of speech includes many voice qualities such as stress, inflection, intonation, and resonance. While there is not a significant body of research discussing prosody in autistic individuals, the available literature suggests that many autistic individuals have disordered prosody. Examples of disordered prosody include erratic stress patterns, flat affect, and a significant nasal resonance. The current literature tends to use control groups which have disorders other than autism as opposed to typical individuals. Age ranges for experimental and control group subjects are quite large in the majority of the literature. The current pilot study attempted to examine prosody and autism using neurotypical controls and autistic preschoolers.

### Disordered Prosody in the Speech of Autistic Individuals

The development of language follows a typical progression for children across cultures. Around 6 months of age, children begin to identify the specific flow of their native language which is evidenced by their babble. Children have a tendency to omit the subtleties between phonemes which their native language does not recognize and they also show a preference for stress patterns used by their native language (Gray, 2002). For most children, this is the beginning of the use of prosody. Prosody includes the use of stress, voice inflection, and several other voice qualities. While these elements of language develop naturally and with relative ease in the majority of children, for some groups of children, the rules of prosody prove to be very challenging and nearly impossible to learn. Autistic individuals comprise one such group. After reviewing the literature on autism and language, Bloch-Rosen (1999) reports that language delays are typical for autistic children. In fact, language delays are one diagnostic criterion. She claims that, "During the preschool years...language may be delayed, precocious, or otherwise highly idiosyncratic." She also points out the tendency for the inflection and intonation of autistic individuals to be rather rigid and monotone. Along the same lines, Lord and Paul (1997) claim that "odd intonation patterns associated with autism seem to be among the most immediately recognizable aspects of the disorder" (p. 209). Specifically, they give the examples of pitch and stress patterns. Shriberg, Paul, McSweeney, Klin, Cohen, and Vokmar (2001) state that some differences between autistic children and neurotypical children are autistic children's use of "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.” Although recognized as a problem, there is minimal research pertaining directly to autistic children’s problems with prosody and even less discussing the implications of deviant prosody.

### Elements of Prosody

The term *prosody* encompasses a variety of elements involved in spoken language. In order to form a working definition, it is helpful to look at possible deviations from normal speech. Fox (1978) draws a distinction between vocal dysfunction and speech/language disorders. He claims that the truly defective voice has abnormal “pitch, loudness, timing, or quality.” Although he classifies vocal dysfunction as primarily physical, resulting from problems such as deformation of the vocal apparatus, swelling, infection, hormones, or brain abnormalities, he also notes that psychological stress can cause the same problems. While vocal dysfunction can be as mild as hoarseness, which affects up to 7% of all children, it can also be as severe as cleft-palate. He cites stuttering and abnormal articulation as examples of speech and language disorders, but he does not focus on them further. In another book, Van Riper (1947) goes so far as to say that “speech is defective when it deviates so far from the speech of other people that it calls attention to itself, interferes with communication, or causes its possessor to be maladjusted” (p. 15). Therefore, variations of speech are acceptable when they fall within an appropriate range; defining these parameters often becomes difficult to quantify. Instead, determining problems with the voice is often primarily a qualitative judgment. Even

though the boundary separating normal from abnormal speech is not always clear, Van Riper (1947) suggests that speech becomes truly defective at the point that it deviates so much from that norm that it becomes socially conspicuous.

Gerken and McGregor (1994) describe prosody as “a general term used to refer to three types of language phenomena, phrasal stress, boundary cues, and meter” (p. 38). Along these same lines, Hargrove (1997) states that prosody includes “tempo, intonation, stress, and rhythm” as well as, “pitch, loudness, duration, and pause.” These definitions are primarily concerned with airflow and how it affects the sound of speech when the airflow changes in intensity, speed, and timing. Fitch (1973), however, focuses a great deal of attention on. This definition suggests that prosody is not only affected by airflow, but is also affected by the formation of the tongue and lips. While prosody can be manipulated by constricting airflow and changing the position of the mouth, it is also highly influenced by the brain and cognitive factors.

In order for a speaker to effectively convey information to the listener, the speaker must have a basic understanding, at least subconsciously, of the rules of prosody. Even if the vocal apparatus is not defective, prosody will be affected if there is damage to certain brain areas. Whereas different areas of the brain are responsible for various elements of prosody, several studies indicate that neurological mechanisms for prosody are present in both the left and right hemispheres of the brain (Merewether & Alpert, 1990). Along these same lines, Shriberg et al. (2001) draw a distinction between grammatical, pragmatic, and affective prosody. Each type of

prosody serves a different purpose yet each is dependent upon the subject's use of stress and modal register. Therefore, it would be possible to lose one type of prosody due to brain damage without losing the others even though they all rely on the same speech mechanism. Panagos and Prelock (1997) state, "Neurological conditions impair prosody production, and psychiatric conditions yield highly variable prosody." Prosody is therefore a multi-faceted phenomenon involving the coordination of the vocal apparatus, mouth, and brain.

Some authors discuss prosody as a component of speech on the same level as voice elements and quality while other authors use the term prosody as an umbrella term which includes all of the aforementioned elements. For this paper, the term prosody will be used as a comprehensive term to include all possible elements of the voice during speech. Examples include volume, pitch, and quality of the voice as well as syntactic elements such as stress, phrasing and rate of speech. Elements such as articulation, voice inflection, and intonation will also be included. Abnormal elements of speech, such as hoarseness, nasal quality, and flat inflection, will also be considered in the discussion.

### Stress

As previously stated, autistic children have markedly different speech patterns than their neurotypical peers. As indicated in the research, one prosodic element that autistic individuals use abnormally is stress. Proper use of stress typically places emphasis on the word that conveys new information to the listener (Gerken et al., 1994). However, erratic stress patterns are meaningless to the listener because key

words are left unstressed while “grammatical filler” words are emphasized. In one study, Fine, Bartolucci, Ginsberg and Szatmari (1991) found that the stress patterns of autistic individuals were, in fact, abnormal when compared with the control groups.

The diagnosis for subjects used in this study fell within three distinct groups:

Asperger’s syndrome (AS), high-functioning autism (HFA, i.e., autistic children who are not mentally retarded), and children and adolescents with non-specific social deficits (OPC). For the AS condition, 25 subjects, ages 8-18 years, were selected from referrals made by child psychiatrists and developmental pediatricians to the study. Referrals were based upon descriptions of odd and eccentric behavior sent to the doctors prior to referrals by the researchers. Subjects were then identified as having AS using multiple methods. In the HFA condition, 25 subjects were recruited from two separate sources. Of the 25 subjects, 19 met the DSM-III criteria for autism and had a full-scale IQ (FSIQ) higher than 70 on the WISC-R making them eligible for the study. The age range for the HFA group was 7-32 years. The authors made a point to note that both groups (AS and HFA) were chosen based on criteria other than language in order to avoid bias. The third category, out-patient controls (OPC), was also selected from referrals and was comprised of 36 children, ranging in age from 7 to 18 years. Children in the OPC condition were diagnosed with psychiatric disorders such as attention deficit disorder and conduct disorder and also had a diagnosis of social deficits.

The three groups were tested to identify how they made use of the prosodic element of stress. In the English language, there are two distinct stress patterns,

marked and unmarked. The pattern of marked stress can be further divided into 5 subgroups (labeled type A-E for the purpose of this study) creating a total of six groups. These labels described the type of word receiving stress (content or function word) and the location in the sentence that the stress occurred (final or non-final). These subgroups of marked stress are important because new information is identified by the location in the sentence. In order to determine the appropriateness of each subject's use of stress, a speech sample was first taken. To obtain the speech sample for each subject, a 10-minute interview was conducted by a research assistant and audio recorded for analysis purposes. Based on these audiotapes of each subject, a professional phonetician marked each tone unit as defined by an intonation boundary, and a second research assistant coded the boundary as occurring at an appropriate or inappropriate time. Both the phonetician and research assistant were blind to the nature of the study which helped to prevent bias. However, there were no reliability checks done to ensure the accuracy of the coding. The researchers explained this discrepancy by stating that, "This coding involved no judgment and was completely determinate" (p. 775). No other explanation or support was offered, nor did they take into account human error. Once the speech patterns were divided into tone units and each tone unit coded as either unmarked stress or one of the five types of marked stress, researchers were able to determine what percentage of the time each subject used the various stress patterns.

Autistic subjects differed significantly from the other two groups on Type A stress and Type C stress. The differences between the HFA, AS, and OPC groups on

unmarked stress, Type B, D, and E stress, however, were not significant. The Type A stress pattern referred to stress placed on a non-final content word. Autistic subjects exhibited significantly less of this type of stress than either of the other two groups. On the other hand, Type C referred to stress placed on a final function word. Autistic subjects used this stress pattern significantly more than the other two groups. The authors noted that autistic subjects made greater use of Type B stress (content word, non-final, two stresses) than AS subjects, but not more than OPC subjects. These differences, however, do not appear to be significant.

These results suggest that high-functioning autistic individuals might not have stress patterns contributing to functional prosody. Although HFA individuals are capable of varying their intonation patterns, it is not in a way that is helpful to the listener. Stress is typically used to single out words which the speaker believes to be new to the listener (Type A), autistic individuals did not use this type of stress in a consistent or predictable manner. In contrast, the stress patterns which were more prevalent in the HFA group play a smaller role in normal speech. As stated by the authors, “the HFA *less* often employ a functionally useful intonation pattern (Type A) and *more* often employ non-useful patterns (Types B and C).”

These results are reasonable in light of findings by other authors who claim that autistic individuals tend to use language for entertainment, or at the very least do not have purposeful communication (Bloch-Rosen, 1999). It is unclear, however, if autistic individuals have erratic stress patterns because they do not understand how to use stress to communicate or if they are simply oblivious to the fact that language is

for communication. Several studies have suggested that autistic individuals lack theory of mind (Merewether & Alpert, 1990, Tanguay, Robertson, & Derrick, 1998) which could suggest that autistic individuals do not use appropriate stress patterns to indicate new information to the listener because they are unaware that the listener is a thinking human being. If others are not perceived to have thoughts, then the autistic individual surely would not feel a need to distinguish between new and old information.

In the previously discussed study, Fine et al. (1991) successfully avoided several potential areas of bias. The subjects were selected based upon characteristics typical of either AS or HFA (depending on which group they were in) but not characteristics directly related to language. This control prevented subjects from being chosen because they appeared to have deviant stress patterns which the authors hoped to find strongly correlated to the other characteristics, therefore making the groups more representative of the population. The study did not mention, however, whether or not the persons making the referrals were aware of the study's hypothesis. It would be most beneficial to the study if they were blind to the nature as well, so that they would be certain to make the referrals based on neutral characteristics as opposed to those being tested.

Unfortunately, the subjects were unable to be randomly selected due to the nature of the experimental groups, but they were recruited from more than one source. This could be an issue if all the subjects were referred by a professional who

specialized in deviant language patterns, but the subjects were referred by a couple of different professionals (a pediatrician and child psychologist).

A potential source of error could be that each subject was only recorded for 10 minutes, and the interview was conducted by an unfamiliar person. Although the authors claim that this was an adequate speech sample, the study could only benefit from a larger speech sample (e.g., three, 10-minute interviews spread 1 or 2 weeks apart). The study indicates that the interview consisted of topics such as school, family, and vacation and was conducted by a research assistant who was blind to the nature of the study, but it does not specify where the recordings took place or how familiar the subjects were with the interviewer. Ideally, the researchers could have kept one parent (or primary care provider) blind to the nature of the study (with the informed parent giving consent) and asked the uninformed parent to audiotape several conversations with the child in the home environment. The researchers could have ruled out any differences in prosody due to the experimenter or the research environment if the results from the highly controlled environment were strongly correlated to the results from the more familiar home environment.

Another potential problem is the age range of the subjects (7-32 years). The majority of the subjects were males, but the authors did not offer any evidence that young boys prior to puberty and adult men use the same stress patterns. Although stress may be an aspect of language that can be accurately compared across age groups, there are certainly qualitative differences that one would expect to find

between boys and adult men. This point warranted comment by the authors, but no discussion was offered.

As acknowledged by the authors, this study is limited in that it only assesses deviant placement of stress. It does not address the direction of stress or other elements of prosody such as articulation or pitch. However, it is very beneficial in that it suggests that there is a significant difference in the way that autistic individuals use stress compared to other pervasive developmental disorder (PDD) subgroups (AS) and the control group (OPC).

A study conducted by Shriberg et al. (2001) also examined the use of stress by autistic individuals. The study had two experimental groups, one consisting of 15 males with HFA and the other consisting of 15 males with AS. The subjects' ages ranged from 10 to 49 years. All of the subjects were recruited from the Developmental Disabilities Section of the Yale Child Study Center and the diagnoses were confirmed independently by two clinicians, using several different diagnostic scales. It is important that the clinicians were blind to the nature of the study to ensure that language delays were taken into account when diagnosing each subject, but this information is not provided by the authors. The control group for this study was created by compiling audiotapes used for other studies from two different data bases. This group consisted of 53 males ranging in age from 10 to 30 years. These subjects on these audiotapes were given a speech status classification of Normal Speech Acquisition (NSA) and met certain protocols for the previous study, such as normal cognitive, sensory-motor, and psychosocial function, but little else is known about

this group. It is unclear where the controls were originally selected from or whether or not they were randomly selected. IQ scores along with several verbal behavior ratings were reported for the experimental groups, but these scores were not available for the control groups.

The speech sample for each subject in the experimental group was taken from a 30-minute interview. These interviews were videotaped and used by an experienced research transcriber for phonetic transcription and prosody-voice coding. It is unclear, however, if the audio recordings of the control group were transcribed at the same time, or by another transcriber for a different study. In order to establish reliability for the present study, six speech samples were transcribed twice and software was used to identify the intrajudge reliability for the six samples. While most of the elements transcribed had high intrajudge reliability (85-100%) some elements did not appear to be reliable (14-73%). The authors explain this apparent lack of reliability by stating that the more general aspects are very reliable and it is only the minor, seldom-used elements which lack reliability.

The use of stress is one of the prosody-voice elements tested in this study. (Other elements will be discussed later.) Results drawn from these data suggest that autistic individuals have significantly abnormal stress placement when compared with controls. It appears that these deficits concern pragmatic or emphatic stress as opposed to grammatical or lexical stress, meaning that it is stress placement within the sentence that is abnormal as opposed to stress within multi-syllable words. The authors note that the misuse of contrastive stress is small but significant.

This study could have been greatly improved by a few simple changes. First, the age range for this study is very broad. As in the last study, it may be unreasonable to test subjects prior to and long after their voices' change, particularly when testing all male subjects. Secondly, the study does not indicate if the person conducting the interviews was part of the research team or blind to the nature of the study. The authors also exclude information about the relationship of the subjects to the interviewer and specific qualities of the interview environment, including whether or not the individuals knew they were being videotaped. This aspect of the study could be improved in a similar fashion as the previous study. Thirdly, it is questionable practice for one of the authors to also be the transcriber despite her credentials. The transcriber should have been blind to the nature of the study so as to avoid experimenter bias.

These studies indicate that autistic individuals do in fact use abnormal stress patterns in some instances. Even though the discrepancies are small, they are still significant. It is possible that the differences would have been even larger had different control groups been used.

#### Inflection

Several studies indicate that autistic children have problems with intonation and inflection causing their speech to be rigid and monotone (Bloch-Rosen, 1999, Fine et al., 1991, Lord et al., 1997, Pronovost, Wakstein & Wakstein, 1966, Shriberg et al., 2001), also known as flat affect. While Hargrove (1997) does not comment specifically about autistic children, she does discuss prosodic disability in children

with specific language impairment. In her description she shows that a “staccato sound” is produced when the child inserts too many linguistic boundaries. This is partly caused by stressing the final word instead of the informative word in each statement. Based on this information, however, autistic individuals should not have significant problems with monotone because a previous study conducted by Fine et al. (1991) indicates that autistic individuals break information into similar tone units as controls instead of producing excessive tone units which would give the speech a monotonous sound. Nonetheless, the literature is overwhelmingly in agreement that at least some autistic children have difficulty producing inflections, thereby preventing their speech from having a natural flow and interesting sound (Van Riper 1947).

#### Articulation

Van Riper (1947) offers a useful definition of articulation. He states that, “Under disorders of articulation we include all those disorders characterized by the substitution, omission, addition, and distortion of the speech sounds” (p. 20). He goes on to note that the most significant problems with articulation are those in which the sounds produced are defective or incorrect. The literature is unclear, however, regarding the appropriateness of articulation use in autistic children.

One study conducted by Boucher (1976) suggests that autistic children do not have impaired articulation when compared with control groups. In her study, three groups of children are described, yet the tables showing the results indicate that four groups were used. The first experimental group consisted of 31 autistic children

ranging in age from 6 to 16 years. Using the Peabody Picture Vocabulary Test (PPVT), the autistic subjects averaged 58 verbal quotient points. The first control group also consisted of 31 subjects and was individually matched to the experimental group for chronological age and verbal comprehension. The second experimental group, labeled *more able autistic children* consisted of 11 subjects ranging in age from 6 to 12 years. The average PPVT verbal quotient for this group was 68.5. It is unclear, however, if this group consisted of the top 11 subjects from the first experimental group or 11 different subjects. It is this group that is unaccounted for in the description but present on the various tables. The second control group consisted of 11 receptive dysphasic children ranging in age from 7 to 11 years. The average PPVT verbal quotient for this group was 78.1. All but six of the children (2 in the first control group and 4 in the second control group) attended schools for children with special needs.

The Edinburgh Articulation Test (EAT) was individually administered to each subject by a qualified speech therapist. In this test, subjects were shown 41 pictures of common objects and asked to give the name for each picture. Prompts were avoided as much as possible because the researchers were most interested in spontaneous language as opposed to imitation. Of the 41 words, 68 single-consonant phonemes or consonant blends were identified. Scores for each subject were determined by how many phonemes were pronounced correctly.

The results for this study were summarized in a table but not elaborated on in the text. The researchers used two t-tests to analyze the data. The first was significant

and appears to have been between the autistic group and age matched controls. The second t-test was also significant and appears to be between the more able autistic children and dysphasic children. The standard deviation for all four groups was quite high (13.4-14.4) which shows a high variability within groups. The author concludes that autistic children have better articulation than subnormal controls and dysphasic children. She also suggests that IQ scores may influence articulation, but she makes this conclusion based on the assumption that the experimental group had the highest IQ.

There are several problems with this study. For example, the test used is not normed for children over the age of four. The subjects in this study, however, ranged in age from 6 to 15 years. Although this test was used so that the language would be easy and articulation could be studied independent of language acquisition, the author should have included a group of randomly-selected, typical subjects within the age range of the experimental group. This data would not be sufficient enough to provide norms for the older children, but it would provide a frame of reference. In order to make generalizations about autistic children, data must also be presented about typical children of the same age, whether it is in the form of norms or a separate control group. While data on subnormal controls and receptive dysphasic children is interesting and helps interpret the reasons for differences between the autistic and other atypical groups, it is not sufficient enough to draw conclusions about the articulation of autistic individuals in general.

A strong aspect of this study is the author's ability to measure the data in a quantitative way. It is clear that an experienced speech therapist conducted the interviews, but it is unclear whether or not the speech therapist was privy to the nature of the study. It is also unclear who scored each subject's responses. Ideally, a second speech therapist should have scored the responses from an audiotape. This would prevent bias based on which children were the most outgoing or physically attractive. In addition, both speech therapists should have been blind to the nature of the study. Although quantitative data helps create a strong study, this study could have benefited from additional data based on spontaneous conversation. It is possible that the subjects had clearer articulation on the test because they were required to say one word at a time in response to visual stimuli. If the children's spontaneous conversation had been analyzed, where the focus was on communication as opposed to the words themselves, the results may have been very different.

In this study, Boucher (1976) draws conclusions which contradict the assertions made by other authors. For example, Lord et al. (1997) cites a study in which the researchers found articulation development in autistic children to be delayed when compared to language-level-matched controls with severe receptive-expressive delays. In another study cited in the same article, ten autistic children were compared to mentally-handicapped children and to typical children matched for non-verbal mental age. The results of this study indicate that there is not a significant difference between the articulation of autistic children and the articulation of IQ-matched, mentally-handicapped individuals. In assessing these results, Lord et al. (1997)

comments that the similarities between the autistic group and mentally-handicapped group do “not mean that autistic children have no articulation difficulties. Even if they are not specifically related to autism, articulation difficulties can have very serious ramifications for the autistic child’s ability to communicate effectively” (p. 205).

Based on the literature it is not possible to say whether or not autistic individuals have problems with articulation. It is plausible that autistic individuals, particularly those with a lower IQ, do have difficulty with articulation. This is evidenced by the fact that mentally-retarded individuals tend to have more difficulties than controls.

#### Resonance

In a study previously discussed, autistic subjects were found to have an inappropriately high percentage of nasal resonance (Shriberg et al., 2001). Whereas 1.9% of utterances were inappropriate in the control group, 23.1% were coded as inappropriate in the autistic group. In agreement with these findings, several other authors suggest that autistic children have a tendency toward hyper/hyponasality (Gretz et al., nd.) as well as hoarseness (Lord et al., 1997). According to Van Riper (1947) a hyper nasal voice has the potential to sound whiny. He also indicates that hoarseness is related to breath expenditure and muscle strain. He states that it is not uncommon for boys’ voices to become hoarse during the few years prior to voice change. This factor was not, however, taken into account by the authors claiming that autistic children’s voices tended to be hoarser than normal children. Boys during voice change should have been omitted or comprised a second group. It is interesting

to note that hoarseness is perhaps the most frequently occurring voice disorder in children and therefore certainly not exclusive to autism (Fox, 1978).

### Implications

These studies suggest that there is a difference between the speech of autistic individuals and control groups, although there are disagreements about the direction of the difference and the extent. Of all the studies on prosody with autistic individuals, however, the majority have an extremely small sample size (<30) and broad age ranges which are too broad for drawing conclusions. No studies have been done using strictly autistic children prior to adolescence. This point is important because children, especially boys, have voice changes during adolescence and early adulthood which introduce confounding variables.

Secondly, the majority of studies lack appropriate control groups. Many of the control groups for these studies are not neurotypical peers. Instead, many studies use subjects with Asperger's Syndrome (AS) as a control group because AS is also categorized as a pervasive developmental disorder (PDD) similar to autism. While information obtained from such a control group is beneficial when comparing PDD subtypes, it is inadequate for making generalizations about autism as a whole. Other commonly used control groups are children with language delays or social delays. This information is also interesting because there is a debate in the literature about whether language delays cause the social delays in children with autism or vice versa (Lord et al., 1997). Therefore, the differences between these two control groups when compared to autistic groups provides potentially useful information, but once

again this information is not adequate for making generalizations about autism as a whole, only autism in relation to other disorders. In order for a study to truly capture the differences of autism, at least one of the control groups must be typical peers. It could be argued that the “peers” should be matched by mental age (MA) or language age (LA) as opposed to chronological age (CA), regardless, however, the peer group should be a random sample composed of typically developing children within the same age range (MA or CA) of the experimental group.

Another defect of the current studies on prosody with autistic individuals involves the use of only high-functioning autistic individuals. As stated previously, there are recognizable reasons for using a strictly HFA group, but again, this prevents the results from being generalized to the entire autistic population.

Ideally, studies should include autistic individuals with a wide range of IQ scores but a relatively narrow range of ages (preadolescence or post adolescence). Likewise, control groups should consist of typical individuals within a similar age range and IQ range. It may, however, be necessary to analyze the scores to see if the element being measured is affected by IQ in both groups or just the autistic group.

#### Future Research

Assuming that the experimental and control groups are adequate, some areas for future research include the pitch of autistic subjects’ language and voice quality. Some research has been done on these two elements, but very little. In a study described above, Shriberg et al. (2001) reports that autistic individuals tend to have slightly higher pitched voices than controls but these differences do not appear to be

significant. Likewise, in the same study autistic subjects had slightly lower ratings on quality than controls, but these differences were not significant either. It is possible, however, that the differences would have been significant given a more appropriate control group. Although many studies mention pitch or quality as a characteristic of prosody, or at the very least an element of speech (Hargrove 1997, Lord et al., 1997, Merewether et al., 1990, Panagos et al., 1997, Pronovost et al., 1966, Shriberg et al., 2001, Van Riper, 1947), little research has been done relating these elements to autism. Other elements worthy of study include volume and the rate of speech for autistic children when compared to appropriate controls.

## Method

### *Participants*

The subjects in this study included four, Caucasian males ages 2 to 5 years. Young males were selected so that the voices could be compared without the confounding variables of gender and age. Two of the children, ranging in age from 27 to 49 months, comprised the experimental group, selected because they had both been diagnosed previously with developmental delay and likely diagnosis of autism. The experimenter was currently or had previously been employed as an applied behavior analysis therapist by the parents of the children in the experimental group. She therefore had a rapport with the children and routinely recorded the verbalizations of the children.

The remaining two children comprised the control group and ranged in from 52 to 60 months of age. The controls were not diagnosed as having any developmental delay and were recruited because they were involved in a play group designed to foster social interaction for one of the autistic children. The controls were selected because they were the youngest, male subjects that were available for testing and they were accustomed to participating in academic activities during play group.

A parent of each child signed an informed consent form that insured confidentiality and acknowledged that the child could withdraw from the study at any time for any reason. Parents were also told how to receive their child's results. Neither the subjects nor their parents received any payment for participation in this

study although the children were given a sticker and a cookie after completing the interview. In order to be included in the study, subjects had to be able to produce a spontaneous 10-20 word sample. All subjects met this criterion therefore no scores were dropped for this reason from the final results. A 5<sup>th</sup> child, the 6 year old brother of one of the autistic subjects, was recorded as a potential control subject. Although he produced a spontaneous 15-word sample, his vocalizations were not used in the final report. The scores were omitted because only two control subjects were needed and he was the oldest. Thus the scores from the two younger control subjects were kept because they more closely represented the age of the experimental subjects.

#### *Apparatus*

Two testing instruments were used in this study, The Peabody Picture Vocabulary Test—Third Edition (PPVT-III) and A Voice Protocol Assessment for Children and Adults (VAP). The PPVT-III is an individually administered, untimed test designed to measure verbal ability and receptive language skills in persons 2 ½- to 90+ years of age. The test makers claim that this test is reliable and effective even when used with preschoolers and states specifically that it can be used with autistic subjects (Dunn & Dunn, 1997). The test consists of 204 PicturePlates divided into 17 groups of 12 plates each. Each PicturePlate includes four black-and-white drawings, the target which is identifiable by the stimulus word and three distractors.

The stimulus words for the original PPVT were chosen from a pool of 3,000+ words taken from the 1953 edition of *Webster's New Collegiate Dictionary*. The current version used many of the same words and also added some new words taken

from several recent dictionaries. These words were selected because they were words that could easily be illustrated using a simple black-and-white drawing. The current version also makes use of more action words and drawings that involve people than previous editions. The distractors were chosen because they contained similar subject matter as the target picture and contained the same amount of visual complexity.

The PPVT-III was primarily used in this study to identify each subject's receptive language age equivalent. Although this test is not designed to be used as an expressive measure, for the purposes of this test, it was also used to obtain voice samples. For three of the subjects, voice samples were captured via a digital video camera and then transferred to a laptop. The recordings were made with the lens cap on so as to capture only the voices and not the faces of the subjects. A microcassette recorder was used to obtain the voice sample for the fourth subject and then the sample was transferred to the laptop. The experimenter then made a CD containing a 15-word sample from each subject. While viewing the CD a written form of the word appeared on the screen while each word was spoken by the subjects. The word sample for three of the subjects came straight from the pictures on the PPVT-III but the words differed for the fourth subject because he was unable to identify the pictures. Instead a sample of his spontaneous language was used. The sample included letters and numbers as well as pictures of foods and animals from books and Baby Einstein flashcards. Two copies of the CD were made for two local speech therapists to analyze.

Thus, because the PPVT-III was not designed to be used as an expressive measure, there are no statistics regarding the reliability or validity of this use. There were, however, elaborate measures taken to ensure that the PPVT-III was reliable and valid when testing receptive language skills. The test was standardized nationally on a sample of 2,725 children and adults so that all raw scores can be changed into normative scores. Reliability was verified using alternate forms reliability, test-retest reliability, alpha reliability coefficients, and split-half reliability coefficients. Although a confidence level can easily be set, the test makers state that the obtained score is likely to be the best and most accurate indicator of achievement.

Not only is the PPVT-III a reliable instrument, it is also a valid instrument. It has been shown to have content validity, as all the stimulus words come from the dictionary. Historically, vocabulary tests have been accepted as a good measure of intelligence, therefore making the PPVT-III an acceptable measure of achievement in the area of receptive language. Thus, this test also has construct validity. The test has internal validity which is indicated by the fact that the percentage of correct responses positively increases across age groups. Also, the test makers show how the PPVT-III is associated with crystallized intelligence indicating it has criterion validity.

The second instrument used, the VAP, measures five voice parameters including pitch, loudness, breath features, quality and rate/rhythm (Pindzola 1987). This assessment was used to assess the prosody of the subjects' speech. Although it is difficult to quantify elements of speech, the VAP serves as a tool designed to aid

speech therapists in making more objective diagnostic decisions and provide confidence in those decisions.

Ideally, an extensive voice sample and specific knowledge of the subjects is needed in order to administer the VAP. Raters need to know the child's age, height, and weight as well as be able to observe the child speak and walk among other motor skills. An appropriate voice sample consists of a conversation involving a spontaneous exchange between the therapist and the client, phoneme prolongation, reading, purposeful changes in loudness and singing the scale. Unfortunately, due to the language abilities of the subjects in this study, such an elaborate voice sample was not able to be obtained. Instead, a spontaneous 15-word sample was used.

The first parameter measured by the VAP is pitch. Using the form provided, speech therapists rate seven variables of pitch. The form is laid out in a question answer format. For some of the questions a blank is provided for the therapist to fill in the appropriate answer and for other questions the therapist is instructed to discriminate between the answers provided and circle the answer which most closely pertains to the subject's speech. Using the tape provided by the test's author, each subject's habitual pitch, optimal pitch and pitch range is measured in hertz and the musical note of the pitch is identified using a chart on the form. There are specified blanks on the form for this information to be documented. The other five variables require the therapist to determine the "best fit" response. When asked if pitch breaks occur in the child's speech, the therapist chooses either "yes" or "no, normal." If yes, discrimination is then made between "upward" and "downward." Therapists have to

make similar discriminations when asked if diplophonia (two or more simultaneous pitches) is present and whether or not the pitch is appropriate for the subject's size, sex, and age. Finally, the therapist determines whether the speech is monotone, has normal inflection, or has excessive variation.

The second voice parameter assessed is loudness. This form contains six "best fit" questions and two "fill in the blank" questions. The therapist assesses variables such as the typical level of loudness for the context the child is in, degree of effort exerted by the subject, variability, and loudness breaks. Other elements include the range of loudness and situations in which loudness abuse may occur during daily life.

Voice quality is the third parameter assessed. All the questions on this form contain "best fit" answers which form a Likert scale ranging from "severe and distracting" to "not present, normal." In this section, therapists are instructed to identify tonal deviations related to breathiness, harshness, hoarseness, and glottal attacks (amount of tension in the vocal folds). A resonance flow chart is also used to help identify hyponasality and hypernasality.

Breath features are considered next. Variables such as whether or not sounds are heard during breathing and the average number of words per breath are measured using the "best fit" method of answering. Therapists also watch to see what part of the child's body is used for breathing (chest or abdomen) and measure the length of time the child can prolong various sounds.

Finally, rate is assessed. The number of words and syllables used per minute and the time needed to repeat syllables is measured using a “best fit” method indicating normality.

The test writer does not provide any information on the reliability and validity of the test. In a review published in the *Mental Measurements Yearbook*, however, Maynard D. Filter (1992) suggests that it would be very difficult to establish reliability and validity since the elements tested are subjective measurements by their very nature. He also criticizes the test writer for not providing more thorough instructions in the examiner’s handbook.

#### *Procedure*

The subjects were first assessed using the PPVT-III. Three of the subjects sat at a table with the PPVT-III materials in front of him; the fourth was unable to sit at the table so we attempted to do the test on the floor. Each was told to point to one of the four pictures indicated by the stimulus word. Several test trials were done to ensure that the subject felt comfortable with the procedure. At least two correct responses on the trial questions, as stated in the examiner’s handbook, were required before moving on. The subjects in the control group met this criteria, but the subjects in the experimental group were unable to identify two consecutive pictures, therefore they were deemed *untestable*. For the two control subjects, the basal set was set one and set three respectively. The experimenter proceeded through the materials until each subject missed eight or more target pictures out of 12 reached ceiling. The stimulus words were repeated if it was needed by the subject but no other coaching or

rephrasing was used. The last set of pictures used was identified as the ceiling set and the last picture in the ceiling set used became the ceiling item, which differed between the subjects.

After the ceiling item was identified, the experimenter started over and asked the subjects to name the pictures. The process was also followed after attempting to administer the test to the experimental subjects. Pictures used for this purpose were those on the PicturePlates but some of them were target pictures and others were distractors. The test took approximately 15-20 minutes to administer, but one subject required a break during the test due to fidgeting.

Once the test had been administered, the experimenter scored all the results. This was done using the Performance Record provided in the test kit. The raw score was obtained by subtracting the number of errors the subject made from the ceiling item. This score was used to find the receptive language age equivalent in Table 3 of the Norms Booklet. Although the purpose for obtaining the age equivalent was to see how much the two groups differed receptively, this information was not able to be identified since neither of the experimental subjects was testable.

After all the subjects were recorded, the experimenter made a CD containing the voices of all four children. Each child was identified on the CD by a code (e.g. AS01) instead of by name. Two identical CDs were burned and given to two local speech and language therapists who then rated the samples using the VAP. Both therapists are licensed and certified and therefore qualified to administer the test; the first rater has practiced for 30 years and the second rater has practiced for 8 years.

Two raters were used so that inter-rater reliability could be determined. Each rater was aware of the nature of the study but blind to the ages and diagnoses (or lack thereof) of the children on the CD. The speech therapists rated the children using the five worksheets provided with the test. Each worksheet corresponded to one of the voice parameters discussed previously. Several of the parameters were not able to be measured due to the inadequate voice sample. For a complete list of the parameters that were used, see Appendix 1.

## Results

After subjects were tested with the PPVT-III, their scores were calculated. For the control group, the receptive language age equivalent ranged from 5-years-3-months to 6-years-3-months. Although this data was collected to ensure that the control group was appropriate for the experimental group, this comparison could not be made because the experimental group was untestable according to the criteria set by the authors of the PPVT-III.

Subjects were also tested using the VAP by two separate raters. According to the results obtained by the first rater, the experimental and control groups only differed with regard to harshness. As can be seen in Appendix 1, the control group did not appear to exhibit any harshness but the experimental subjects had *slight* harshness. With the exception of slight harshness, the pitch, loudness, and quality of speech appeared normal for all the subjects. All subjects displayed adequate pitch variability and did not exhibit diplophonia or pitch breaks. Likewise, the loudness level was appropriate for the situation in all subjects, and none of the subjects exhibited an uncomfortable amount of effort. None of the subjects' utterances trailed off at the end or showed signs of phonation breaks. Loudness range and variability appeared normal in all subjects except for two subject's whose voice sample was inadequate to make that comparison. Breathiness and hoarseness was not evident in any of the subjects, nor did any of the subjects have glottal attacks. Furthermore, all the subjects appeared to have normal resonance.

The second rater, however, made a different assessment in several cases. For example, there were several elements pertaining to loudness that she did not feel comfortable scoring based on the voice sample given. These items are scored as NA in Appendix 1. She also rated one of the experimental subjects as exhibiting tension, whereas the first rater rated all the subjects as exhibiting a comfortable level of effort. With regard to voice quality, the second rater scored the experimental subjects as having more breathiness and hoarseness than the first rater, but agreed that the experimental subjects exhibited slight harshness. She also rated the experimental subjects as having slight to moderate glottal attacks and one of the experimental subjects as having slightly nasal resonance. Both raters agreed that the subject's were not testable with regard to rate or breathing variables.

The two raters had 87% agreement. This percentage is based on the number of variables in which the raters agreed (94) divided by the total number of variables (108). Percentages were calculated similarly for each group. There was 100% agreement on all the variables involving pitch, breathing, and rate. The only areas of difference were loudness and quality. As seen in Appendix 2, there was 71% agreement with regard to loudness and 65% agreement with regard to quality.

## Discussion

These results suggest that autistic children may have slightly abnormal prosody even with one word utterances, but they are far from conclusive. Although these results are inadequate for making generalizations they do warrant further research especially in the areas of loudness and voice quality. It is unclear why there was so much discrepancy between the two raters with regard to voice quality. This discrepancy would certainly need to be addressed in future research. There were several limitations of this study which could have contributed to the lack of overwhelming findings supporting the hypothesis that prosody is deficient in autistic children.

The first limitation of this study was the sample. Along with the extremely small sample size, the subjects in the experimental group were not capable of producing the necessary voice sample for the VAP. Ideally, the subjects should have been able to engage in a conversation, sing notes on the scale, and vary their loudness from very soft to very loud. The subjects in this study were not able to do this. Both of the subjects were only able to say one word at a time and neither subject was able to fully articulate each word. Not only is the more thorough voice sample necessary for the test used in this study, Gleason (2001) suggests that people use different prosody in conversational speech than they do when reading lists of words. If that is true, it certainly could have affected the study. This voice sample prevented the raters from being able to judge the voices as accurately as possible. Several of the variables listed on the test were not testable given the voice sample and even the ones that

could be tested posed a problem for the raters. Next to several of the questions the one of the raters commented that her judgments were not absolute indicators of the children's capabilities but rather her best estimate based on the limited voice sample. It is possible that if the raters had been supplied with more thorough voice samples there would have been greater variance between the two groups.

The second major limitation of this study was the test that was used to assess the children's prosody. Due to the qualitative nature of the construct being measured, there was not a wide variety of tests to choose from. The *Voice Assessment Protocol* was found through an internet search and it appeared to measure most accurately the parameters that this study was designed to measure. Although the review of the assessment by Maynard D. Filter (1992) criticized the test for being vague and possibly unreliable, it still appeared to be the best assessment for this study. In hindsight, however, the VAP was not a very useful test. The test publishers claimed that the assessment utilized a Likert type scale, but the test did not measure prosody on a continuum from *more normal* to *less normal*, instead it merely asked if the subject exhibited a specified problem and gave choices such as "yes" or "no, normal." While this type of assessment might be beneficial for clinical purposes, it was inadequate for research purposes.

Despite its limitations, this study did have several strengths. Heretofore, researchers have focused their research on older children and adults. Primarily with males, research which utilizes both pre-puberty and post-puberty subjects in the same sample could have serious confounding variables when voice elements are the subject

of research, but these problems have not been addressed in the literature. This study made a point to address such issues which is why young subjects (>5 years) were chosen. It is certainly possible, however, that past researchers have not used such a young sample due to the complications in obtaining an adequate voice sample for analysis purposes. Nonetheless, the present study did attempt to test a group of individuals which had not been previously tested in the literature.

Another strength of the present study was the use of inter-rater reliability. Even though the assessment used was more qualitative than quantitative, the use of inter-rater reliability aided in controlling for error. By obtaining 87% overall agreement between raters, the experimenter was able to insure that the results were as valid as possible which is very important considering the qualitative nature of the test and the minimal voice sample posed a greater chance for error.

The construct researched in this study is an important one. Individuals use prosody to communicate meaning and intention to others. Prosody also helps to build social ties because people who lack inflection in their voices tend to have a monotonous sound which can be very irritating to those listening and hence make social relationships more difficult. By the very definition of autism, autistic individuals tend to have difficulty with social skills. Thus, if they also have abnormal prosody, that could interfere further with their social development. Therefore, it would be beneficial if this study was replicated with a larger, more capable subject group utilizing a more detailed test. The study could also benefit from a second control group with flat affect but typically developing cognition. If more extensive

research finds that autistic individuals do lack normal prosody, as many other studies have suggested, the next step would be to design a treatment program to help these individuals learn how to make use of prosodic elements. Regardless, much more research is needed in this area.

## References

- Bloch-Rosen, S. (1999). *Asperger's syndrome, high functioning autism, and disorders of the autistic continuum*. Retrieved October 20, 2002 from <http://www.autismsocietyofberks.org/pages/articles/aspie.html>
- Boucher, J. (1976). Articulation in early childhood autism. *Journal of Autism and Childhood Schizophrenia*, 6(4). 297-302.
- Dunn, L. M., & Dunn, L. M. (1997). *Examiner's manual for the peabody picture vocabulary test third edition*. Circle Pines, MN: American Guidance Service.
- Filter, M. D. (1992). A voice assessment protocol for children and adults. In J. J. Kramer & J. C. Conoley (Eds.), *The eleventh mental measurements yearbook (pp. 1007-1008)*. Lincoln, NB: The Burros Institute of Mental Measurement of The University of Nebraska-Lincoln.
- Fine, J., Bartolucci, G., Ginsberg, G., & Szatmari, P. (1991). The use of intonation to communicate in pervasive developmental disorders. *Journal of Child Psychology*, 32(5), 771-781.
- Fitch, J. L. (1973). Voice and articulation. In B. B. Lahey (Ed.), *The Modification of language behavior (pp. 130-177)*. Springfield, IL: Charles C. Thomas Publisher.
- Fox, D. R. (1978). Evaluation of voice disorders. In S. Singh, & J. Lynch (Eds.), *Diagnostic Procedures in Hearing, Language, and Speech (pp. 495-527)*. Baltimore, MD: University Park Press.

- Gerken, L., & McGregor, K. (1994). An overview of prosody and its role in normal and disordered child language. *American Journal of Speech-Language pathology, 7*. 38-49.
- Gleason, J. B. (2001). *The development of language* (5<sup>th</sup> ed.). Boston: Allyn and Bacon Publishers.
- Gray, P. (2002). *Psychology* (4<sup>th</sup> ed.). Boston: Worth Publishers.
- Gretz, S. (nd.). *Other concerns regarding speech, communication, and children with autism*. Retrieved October 20, 2002 from <http://www.apraxia-kids.org/assessment/autism.html>
- Hargrove, P. M. (1997). Prosodic aspects of language impairment in children. *Topics in Language Disorders, 17*(4). 76-83.
- Lord, C., & Paul, R. (1997). Language and communication in autism. In D. J. Cohen, & F. R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (2<sup>nd</sup> ed.), (pp. 195-225). New York, NY: Publisher unknown.
- Merewether, F. C., & Alpert, M. (1990). The components and neuroanatomic bases of prosody. *Journal of Communication Disorders, 23*. 325-336.
- Panagos, J. M., & Prelock, P. A. (1997). Prosodic analysis of child speech. *Topics in Language Disorders 17*(4). 1-10.
- Pindzola, R. H. (1987). *A voice assessment protocol for children and adults manual*. AL: Auburn University.

- Pronovost, W., Wakstein, M. P., & Wakstein, D. J. (1966). A longitudinal study of speech behavior and language comprehension in fourteen children diagnosed as atypical or autistic. *Exceptional Children, 33*. 19-26.
- Tanguay, P. E., Robertson, J., & Derrick, A. (1998). A dimensional classification of autism spectrum disorder by social communication domains. *Journal of American Academy of Child and Adolescent Psychiatry, 37*(3). 271-277.
- Shriberg, L. D., Paul, R., McSweeney, J., L., Klin, A., Cohen, D. J., & Volkmar, F. R. (2001). Speech and prosody characteristics of adolescents and adults with high-functioning autism and Asperger's syndrome. *Journal of Speech, Language, and Hearing Research, 44*. 1097-1115.
- Van Riper, C. (1947). The disorders of speech. In *Speech Corrections: Principles and Methods* (pp. 15-28). New York, NY: Prentice-Hall, Inc.

## Appendix 1

| <b>Variables</b>             | <b>Experimental</b> | <b>Control</b>  | <b>Experimental</b>    | <b>Control</b> |
|------------------------------|---------------------|-----------------|------------------------|----------------|
| <b>Pitch</b>                 |                     |                 |                        |                |
| Habitual Pitch               | NA                  | NA              | NA                     | NA             |
| Pitch Appropriateness        | NA                  | NA              | NA                     | NA             |
| Pitch Range                  | NA                  | NA              | NA                     | NA             |
| Optimal Pitch                | NA                  | NA              | NA                     | NA             |
| Pitch Variability            | Normal              | Normal          | Normal                 | Normal         |
| Diplophonia                  | Normal              | Normal          | Normal                 | Normal         |
| Pitch Breaks                 | Normal              | Normal          | Normal                 | Normal         |
| Direction of Pitch Breaks    | NA                  | NA              | NA                     | NA             |
| <b>Loudness</b>              |                     |                 |                        |                |
| Loudness Level               | Appropriate         | Appropriate     | NA/Appropriate         | Appropriate    |
| Degree of Effort             | Normal              | Normal          | Tension/Normal         | Normal         |
| Trail-off at the End         | Normal              | Normal          | NA/Normal              | Normal         |
| Phonation Breaks             | Normal              | Normal          | NA/Normal              | Normal         |
| Loudness Variability         | Normal              | Normal          | NA/Normal              | Normal         |
| Loudness Range               | Normal/Probably     | Normal/Probably | NA/Normal              | Normal         |
| <b>Quality</b>               |                     |                 |                        |                |
| Breathiness                  | Normal              | Normal          | Moderate/Slight        | Normal         |
| Harshness                    | Slight              | Normal          | Slight                 | Normal         |
| Hoarseness                   | Normal              | Normal          | Moderate/Slight        | Normal         |
| Glottal Attacks              | Normal              | Normal          | Weak/Moderate          | Normal         |
| Resonance                    | Normal              | Normal          | Normal/Slight Nasality | Normal         |
| <b>Breathing</b>             |                     |                 |                        |                |
| Breathing Region             | NA                  | NA              | NA                     | NA             |
| Sounds During Breathing      | NA                  | NA              | NA                     | NA             |
| Average Words Per Breat      | NA                  | NA              | NA                     | NA             |
| Maximum duration of /a/      | NA                  | NA              | NA                     | NA             |
| SZ Ratio                     | NA                  | NA              | NA                     | NA             |
| <b>Rate</b>                  |                     |                 |                        |                |
| Rate of Speech               | NA                  | NA              | NA                     | NA             |
| Repetition of 20 Syllables   | NA                  | NA              | NA                     | NA             |
| Repetition of 10 Trisyllable | NA                  | NA              | NA                     | NA             |

## Appendix 2

|                               |             |
|-------------------------------|-------------|
| <b>Pitch</b>                  |             |
| Habitual Pitch                | 1.00        |
| Pitch Appropriateness         | 1.00        |
| Pitch Range                   | 1.00        |
| Optimal Pitch                 | 1.00        |
| Pitch Variability             | 1.00        |
| Diplophonia                   | 1.00        |
| Pitch Breaks                  | 1.00        |
| Direction of Pitch Breaks     | 1.00        |
|                               | <b>100%</b> |
| <b>Loudness</b>               |             |
| Loudness Level                | 0.75        |
| Degree of Effort              | 0.75        |
| Trail-off at the End          | 0.75        |
| Phonation Breaks              | 0.75        |
| Loudness Variability          | 0.75        |
| Loudness Range                | 0.50        |
|                               | <b>71%</b>  |
| <b>Quality</b>                |             |
| Breathiness                   | 0.50        |
| Harshness                     | 1.00        |
| Hoarseness                    | 0.50        |
| Glottal Attacks               | 0.50        |
| Resonance                     | 0.75        |
|                               | <b>65%</b>  |
| <b>Breathing</b>              |             |
| Breathing Region              | 1.00        |
| Sounds During Breathing       | 1.00        |
| Average Words Per Breath      | 1.00        |
| Maximum duration of /a/       | 1.00        |
| SZ Ratio                      | 1.00        |
|                               | <b>100%</b> |
| <b>Rate</b>                   |             |
| Rate of Speech                | 1.00        |
| Repetition of 20 Syllables    | 1.00        |
| Repetition of 10 Trisyllables | 1.00        |
|                               | <b>100%</b> |
|                               |             |
| <b>Total Reliability</b>      | <b>87%</b>  |

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