An Investigation of the Extent to Which Two African American Children With Autism Have Developed Social Language Variation

Kiara S. Savage

College of William and Mary

Follow this and additional works at: https://scholarworks.wm.edu/honorstheses

Recommended Citation

https://scholarworks.wm.edu/honorstheses/631

This Honors Thesis is brought to you for free and open access by the Theses, Dissertations, & Master Projects at W&M ScholarWorks. It has been accepted for inclusion in Undergraduate Honors Theses by an authorized administrator of W&M ScholarWorks. For more information, please contact scholarworks@wm.edu.
An Investigation of the Extent to Which Two African American Children With Autism Have Developed The Social Language Variation of Their Parents

Kiara Savage

College of William and Mary, Williamsburg, VA
Abstract

The aim of the current research design is to start to develop an understanding of how autism spectrum disorder affects the ability to acquire social language variation. To narrow the scope, the population selected for this design is African American children with autism, allowing me to focus on a specific variety of English (African American English). In the research design, I consider four factors that could influence how each individual child on the autism spectrum acquires social language variation: 1) level of social interaction, 2) production of autistic speech, 3) ability to joint attend, and 4) ability to attend to speech sounds. The design includes collection of speech samples of an African American triad (mother, child with autism, and sibling) and an African American dyad (mother and child with autism). Matched guise testing targeted special education teachers, student teachers, and experts. The matched guise survey included samples of speech from the members of the triad and dyad and it simply asked the listeners to identify the racial or ethnic background of the speaker. From the phonological analysis for both cases, there was interspeaker variation between the mother, child with autism, and the sibling of the triad case and between the mother and child of the dyad case. This research design provides a framework for future design with the same aim. When speech pathologists understand social language variation acquisition for typically developing individuals and individuals with autism and other developmental disorders, they will be able to provide more comprehensive intervention that will have sociolinguistic and psychological implications.

Keywords: autism spectrum disorder, social language variation, and language development
Acknowledgements

I would like to take the opportunity to thank those who have encouraged and guided me throughout this research process and my college career. First, I must thank God for the many blessings He has afforded me. I would not be here if it were not for His grace and mercy. I must thank my beautiful parents for their unconditional love and support. Thank you to my Granny, who is no longer with us but whose legacy lives in my heart. I thank my main advisor, Dr. Anne Charity Hudley, for being my mentor. She challenged me to write a thesis my freshman year and to consider the larger social implications of my academic work. She is the reason why I decided to study linguistics instead of business. Dr. Anne Charity Hudley has been a constant motivator. I thank Drs. Erin Ament and Janice Zeman for their guidance and for serving on my committee. Lastly, thank you to the College of William and Mary for a wonderful four years that have allowed me to grow personally and academically. Thank you for everything!
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>CHAPTER 1. INTRODUCTION</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>CHAPTER 2. LITERATURE REVIEW</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>2.1</td>
<td>AUTISM DIAGNOSTIC TOOLS AND ASSESSMENTS</td>
<td>13</td>
</tr>
<tr>
<td>2.2</td>
<td>FACTORS INFLUENCE SOCIAL LANGUAGE VARIATION ACQUISITION</td>
<td>14</td>
</tr>
<tr>
<td>2.2.1</td>
<td>Peer versus parent influence</td>
<td>14</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Impairment in social interaction</td>
<td>14</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Joint Attention</td>
<td>15</td>
</tr>
<tr>
<td>2.3</td>
<td>ATTENTION TO SPEECH SOUNDS</td>
<td>17</td>
</tr>
<tr>
<td>2.4</td>
<td>AUTISTIC SPEECH</td>
<td>18</td>
</tr>
<tr>
<td>2.4.1</td>
<td>Monophthongization</td>
<td>29</td>
</tr>
<tr>
<td>2.4.2</td>
<td>Interdental Alternation</td>
<td>30</td>
</tr>
<tr>
<td>2.5</td>
<td>PHONOLOGICAL FEATURE ANALYSIS</td>
<td>31</td>
</tr>
<tr>
<td>2.5.1</td>
<td>Monophthongization Phonological Analysis</td>
<td>31</td>
</tr>
<tr>
<td>2.5.2</td>
<td>Interdental Alternation Phonological Analysis</td>
<td>32</td>
</tr>
<tr>
<td>2.5.3</td>
<td>Matched Guise Testing</td>
<td>33</td>
</tr>
<tr>
<td>CHAPTER 3. DISCUSSION OF HYPOTHESES</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>3.1</td>
<td>SUMMARY OF FACTORS</td>
<td>35</td>
</tr>
<tr>
<td>3.2</td>
<td>HYPOTHESES</td>
<td>37</td>
</tr>
<tr>
<td>CHAPTER 4. METHODOLOGY</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>4.1</td>
<td>PARTICIPANTS</td>
<td>41</td>
</tr>
<tr>
<td>George Family 4.1.1</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Symonds Family 4.1.2</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>4.2</td>
<td>MATERIALS</td>
<td>44</td>
</tr>
<tr>
<td>Praat 4.2.1</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td>Audacity 4.2.2</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Matched Guise Survey 4.2.3</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>4.3</td>
<td>PROCEDURES</td>
<td>45</td>
</tr>
<tr>
<td>Interviews 4.3.1</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Phonological Analysis of Monophthongization 4.3.2</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Phonological Analysis of Interdental Alternation 4.3.3</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Matched Guise Testing 4.3.4</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>CHAPTER 5. RESULTS</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>5.1</td>
<td>GEORGE FAMILY ANALYSIS</td>
<td>48</td>
</tr>
<tr>
<td>George Mother 5.1.1</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>George Sibling 5.1.2</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>
FIGURE 3: GEORGE MOTHER WAVEFORM AND SPECTROGRAM ........................................ 49
FIGURE 4: GEORGE SIBLING WAVEFORM AND SPECTROGRAM .................................... 52
FIGURE 5: GEORGE CHILD WITH AUTISM WAVEFORM AND SPECTROGRAM ................. 54
FIGURE 6: GEORGE AVERAGE CHANGE IN F2-F1 (Hz) ACROSS VOWEL DURATIONS .... 55
FIGURE 7: SYMONDS CHILD WITH AUTISM WAVEFORM AND SPECTROGRAM .............. 61
FIGURE 8: SYMONDS MOTHER WAVEFORM AND SPECTROGRAM ................................ 62
FIGURE 9: SYMONDS AVERAGE CHANGE IN F2-F1 (Hz) ACROSS VOWEL DURATIONS ..... 63
Chapter 1:
Introduction

“Well he’ll go like, ‘Hey, can I play? What’s that? What you doing?’ And as he discovers maybe that he’s not on the same level, he’ll try to stay back. A lot of the time he’s out of the context anyway. ‘Hey, look at that plane.’ They’re like, ‘Dude, what you talking about? We over here chillin’.’ And he is like trying to engage. And he may try a few times and then just stray away if he recognizes that that’s not his group. ‘I don’t fit in there’ kind of thing. But he doesn’t automatically recognize like an average, typical child would recognize up front, ‘that’s not something that I fit in so I’m not going to go over there.’”

- Symonds Mother (personal communication, February 15, 2013)

The excerpt above is from the interview with one of the mother’s of a child with autism whose speech I analyzed in the current study. The mother describes her child with autism and his social interaction. Unlike many children on the autism spectrum (“CDC - Diagnostic Criteria, Autism Spectrum Disorders - NCBDDD,” n.d.), her son readily engages but does not attend to social cues that suggest that he is not being accepted by his typically developing peers (Symonds Mother, personal communication, February 15, 2013).

The aim of the current research design is to start to develop an understanding of how autism spectrum disorder affects the ability to acquire social language variation. To narrow the scope, the population selected for this design is African American children with autism, allowing me to focus on a specific variety of English (African American English). In the research design, I consider four factors that could influence how each individual child on the spectrum acquires social language variation: 1) level of social interaction, 2) production of autistic speech, 3) ability to joint attend, and 4) ability to attend to speech sounds. The design
includes the collection of speech samples from members of an African American triad (mother, child with autism, and sibling) and an African American dyad (mother and child with autism). Matched guise testing targeted special education teachers, student teachers, and those with expertise in special education. The matched guise survey included samples of speech collected from members of the triad and dyad and it asked the student teachers to identify the racial/ethnic background of the speaker. This thesis is the development of a new model of research to study social language variation acquisition among those with developmental disorders like autism spectrum disorder. Extensive literature review serves as the foundation for model development. The potential findings of this design will improve understanding of autism spectrum disorder and language acquisition. Additionally, it will help researchers and practitioners begin to understand how people acquire the phonological features of their dialects. From this research, I hope to draw connections to psychology by asking the question how the ability to acquire social language variation influences identity formation for children.

1.1 Social language variation. Labov (1966) was one of the first linguists to assert the critical relevance of language variation in his study of how variation in use of language reinforced social stratification in New York City. Wolfram (2006) suggests that language variation is socially significant variety in language production within a language, which permeates all domains of language use (e.g., phonology, lexicon, syntax, morphology, etc.). Variation can include different pronunciation, vocabulary, and grammar (Wolfram & Schilling-Estes, 2005). For example, Southern English is a variety spoken in southern states. One feature of Southern English is diphthongization of monophthongs (Wolfram & Schilling-Estes, 2005). African American Vernacular English (AAVE) is another widely
researched speech variety. One feature of AAVE is the pronunciation of the diphthong that glides from \textit{ah}-like vowel to an \textit{ee}-like vowel, as in the words ‘my’ and ‘eye,’ as a monophthong with only the \textit{ah}-like vowel (Rickford & Rickford, 2002). Speakers of AAVE might pronounce ‘my’ like \textit{mah} (Rickford & Rickford, 2002). The social implications of language variation are most relevant to the current study as children with autism have social impairments that affect their language development. I contend that speech pathologists need to understand social language variation and how it is acquired in order to guide their patients with autism to develop a higher level of socially mediated communicative functioning.

1.2 Autism spectrum disorder. I consider the criteria for an autism diagnosis in this research design because I hypothesize that autism specific factors will influence the acquisition and/or production of social language variation. Prior to the development of my hypotheses, however, I reviewed the validity of the diagnostic criteria. Kanner (1943) was the first to describe autism. The diagnostic criteria for autism were not included in the Diagnostic and Statistical Model until its third edition (DSM-III; APA, 1980). The Diagnostic and Statistical Model establishes standardized criteria to help diagnose autism spectrum disorders and other mental health disorders and is widely implemented in the United States among researchers and clinical practitioners (Volkmar, 1996; Widiger, Frances, Pincus, Davis, & First, 1991). Prior to its current edition (DSM-IV; APA, 1994), there was less of a focus on establishing an empirical research basis for the descriptions of disorders (Volkmar, 1996). One of the many changes for the DSM-IV was to be thorough and selective in the literature review (Volkmar, 1996). Volkmar, et al. (1994) conducted a DSM-IV (APA, 1994) field trial aimed to establish clarification for the high rate of false positives in autism diagnoses under the DSM-III (APA, 1980). The field trial tested the
validity and reliability of the third edition by testing the criteria on 977 cases, 454 of which had autism. The raters included 125 individuals with a range of experience in diagnosing autism. While the DSM-III (APA, 1980) had high interrater reliability between raters with similar levels of experience in diagnosing autism, the criteria were not specific enough to avoid false positives (Volkmar et al., 1994). More specific criteria have been established for the DSM-IV (Volkmar et al., 1994). Below is the description of autistic disorder diagnosis criteria as they appear in the DSM-IV (DSM-IV; APA, 1994). The Center for Diseases Control describes the diagnostic criteria for autism based on the DSM–IV (“CDC - Diagnostic Criteria, Autism Spectrum Disorders - NCBDDD,” n.d.). In this early stage in the development of this research model, I consider the full outline of diagnostic criteria for autistic disorder to form hypotheses about the autism specific factors that might influence social language variation. I discuss my hypotheses in Chapter Three.

**Autistic Disorder (299.00 DSM-IV)** (“Autism Society - Diagnostic Classifications,” n.d.)

The central features of Autistic Disorder are the presence of markedly abnormal or impaired development in social interaction and communication, and a markedly restricted repertoire of activity and interest. The manifestations of this disorder vary greatly depending on the developmental level and chronological age of the individual. Autistic Disorder is sometimes referred to as Early Infantile Autism, Childhood Autism, or Kanner's Autism (page 66).

A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):

1. Qualitative impairment in social interaction, as manifested by at least two of the following:
   - Marked impairment in the use of multiple nonverbal behaviors such as eye to-eye gaze, facial expression, body postures, and gestures to regulate social interaction.
   - Failure to develop peer relationships appropriate to developmental level
   - A lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)
   - Lack of social or emotional reciprocity
2. Qualitative impairments in communication as manifested by at least one of the following:
   - Delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gestures or mime)
   - In individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
   - Stereotyped and repetitive use of language or idiosyncratic language
   - Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

3. Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
   - Encompassing preoccupation with one or more stereotyped patterns of interest that is abnormal either in intensity or focus
   - Apparently inflexible adherence to specific, nonfunctional routines or rituals
   - Stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
   - Persistent preoccupation with parts of object

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years:

- Social interaction
- Language as used in social communication
- Symbolic or imaginative play

C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

1.3. Connections to relevant disciplines.

My research question is aptly at the intersection of both of my fields of study—psychology and linguistics. Does autism spectrum disorder affect the ability to acquire and/or produce social language variation? The findings of the current research do not definitively answer this question. This work does, however, provide further insight for future research. In the development of this research model, it has been critical for me to draw connections to psychology and linguistics.

As I will discuss, individuals with autism have difficulty developing peer relationships appropriate for their developmental level (APA, 1994), which is likely
connected to language impairment and aspects of autistic speech (Eigsti, de Marchena, Schuh, & Kelley, 2011). Additionally, individuals with autism have difficulty regulating their emotions and applying emotion display rules (Begeer et al., 2011). The inability to regulate emotion can negatively impact the development of peer relationships (Zeman, Cassano, Perry-Parrish, Stegall, 2006) and possibly affect peer influence on language development (Baron-Cohen & Staunton, 1994).

Linguistics and developmental psychologists study language acquisition, but little is known about the exact mechanisms that mediate the acquisition of social language variation. Findings based on children with autism and other developmental disorders might give insight to those mechanism. Psycholinguists use brain imaging to investigate language processes. Brain imaging might reveal the brain mechanisms that are responsible for the acquisition of social language variation. Also within the realm of psycholinguistics is the concept of bidialectalism. Bidialectalism is salient to African American identity and social functioning, particularly in the United States (Weddington, DeBose, & Keulen, 1998). In the case of African Americans, bidialectalism involves the ability to use Standard American English and African American English when appropriate (Weddington et al., 1998).

As a student of community studies, I have been trained to constantly valuate the social implications of my actions. For this reason, the implications of this research for my future profession as a speech-language pathologist are important to understand. The American Speech and Hearing Association (ASHA) has increased its emphasis on developing culturally competent SLPs who understand concepts of language variation and the difference between cultural difference and disorder (ASHA’s Multicultural Issues Board, 2004). Additionally, it is the goal of SLPs to help patients achieve the highest level of
functioning. Social language variety is relevant to social interaction and thus should be considered when providing services to patients. If SLPs understand how social language variation is acquired, then they can design therapy and interventions that aid in the acquisition and/or production of language variety.

In this research model development, I am incorporating the community-based learning model. Cress, Collier, and Reitenauer (2005) define community-based modeling: “students engage in actively addressing mutually defined community needs as a vehicle for achieving academic goals” (p. 7). I have designed this research to focus on African American children with autism and their families in order to address the disparities in time of diagnosis of autism spectrum disorders relative to the majority population and the disparities in quality of service.

1.4 Overview of thesis. In Chapter Two of this thesis, I review the relevant literature on autism and social language variation. In the Chapter Three, I discuss my use the literature to form hypotheses about social language variation acquisition by children with autism. In the Chapter Four, I describe my methodology. In Chapter Five, I provide the results of my phonological analysis that I conducted on the speech data. In Chapter Six, I provide the results of the matched guise testing. Finally, in Chapter Seven, I discuss the results and limitations, suggest developments for the research design, and share my future plans to continue similar research with a community-based component during graduate study.
Chapter 2:

Literature Review

2.1 Autism diagnostic tools and assessments

Throughout this review of the literature I mention several diagnostic tools and assessments that autism researchers have applied in their study of language development. For the majority of the literature I reviewed, there is a risk for cultural and linguistic biases that could potentially preclude the applicability of these measures and findings to African American children regardless of developmental trajectory. Standardized instruments have historically not included culturally and linguistically diverse populations in representative proportions in their normative testing (Laing & Kamhi, 2003). A widely recognized yet criticized instrument for measuring expressive and reception vocabulary is the Peabody Picture Vocabulary Test (Revised) (Jongsma, 1982). In earlier versions of the Peabody Picture Vocabulary test the proportion of African Americans in the normative sample was not representative and, consequently, 90% of low-income, typically developing African American children performed below the mean (Laing & Kamhi, 2003). More recent versions of the Peabody Picture Vocabulary Test have included proportions of African Americans that resemble the African American population in the United States (Jongsma, 1982; Laing & Kamhi, 2003). At-risk African American preschool children performed within normal standards. Laing and Kamhi (2003) concede, however, that making adjustments to the normative sample to include culturally and linguistically diverse subjects might simply result in the lowering of the mean distribution so that culturally and linguistically diverse subjects perform within normal limits but still below the mean. Diagnostic and assessment instruments need to be considerate of culturally and linguistically diverse populations. With
cultural and linguistic biases in mind, I critically review the literature’s applicability to
African American children with autism.

2.2 Factors Influencing Social Language Variation Acquisition

2.2.1 Peer versus parent influence. Prior to age five, parents or caregivers are the
most influential for child language development (Baron-Cohen & Staunton, 1994; Labov,
1972). When children start school (generally at the age of five), they spend a significant
amount of time with peers, making peers more influential for language development during a
time when language is still developing (Baron-Cohen & Staunton, 1994). Typically
developing children have mastered the phonology of language by age six (Hoff, 2009; Long,
1990) as children have adult-like production of all of the sounds of their first language (L1).
From age 5 to age 12, children are most influenced in their development and use of language
by their peers (Labov, 1970). Payne (1980) conducted a study on families that had
immigrated to Philadelphia and found that the children acquired and regularly produced the
phonological features of the local dialect. Children with parents whose first language is
foreign develop an accent that more closely resembles their peers (Baron-Cohen & Staunton,
1994). This understanding of peer influence, however, is based on the typical development.
The broad question this research design aims to answer is whether these normative
developmental stages can apply to atypical development as seen with children with autism
spectrum disorder. If a child on the autism spectrum has difficulty with social interaction,
will his peers influence his language?

2.2.2 Impairment in social interaction. A consistent characteristic among all levels
of functioning on the autism spectrum is impairment in social interaction (“CDC - Diagnostic
three different types of social interaction styles of children with autism that are still accepted and used in assessments through the Wings Subgroups Questionnaire (Castelloe & Dawson, 1993). Scheeren et al. (2012) employed the Wings Subgroups Questionnaire in their investigation of the relationship between the severity of autism symptoms and the social interaction subgroups. There are three subgroups: aloof, passive, and active-but-odd (Scheeren et al., 2012). The aloof individual does not respond to social interaction; the passive individual does not seek social interaction but responds appropriately; the active-but-odd individual initiates social interaction but conducts himself atypically (Scheeren et al., 2012). One of the children in the present study, referred to as Symonds child with autism, would likely be classified as active-but-odd based on how his mother described his social interaction in the quote in Chapter One of this thesis. He tried to engage with peers but they reject him because of his atypical actions. The distinction between the subgroups was based the full scope of characteristic autistic impairments through measures of communication, social interaction, stereotypic behavior, and temper and aggression (O’Brien, 1996). Scheeren, Koot, and Begeer (2012) employed several parent- and teacher-report questionnaires as well as a theory of mind task and the ADOS-G (as described above). As expected, the researchers found that symptom severity is negatively associated with level of social interaction. Most children on the spectrum experience failure to develop peer relationships that are considered appropriate for their developmental level (“CDC - Diagnostic Criteria, Autism Spectrum Disorders - NCBDDD,” n.d.). If social interaction is impaired to any level of severity, the nature of peer influence on language, and even more broadly, will likely be atypical.
2.2.3 Joint attention. Joint attention is the act of sharing visual focus or attention with another individual (Dawson et al., 2004; Delgado, Mundy, Crowson, Markus, Yale, & Schwartz, 2002; Loveland & Landry, 1986; Mundy et al., 1990; Mundy & Neal, 2000). Early impairment in joint attention for children on the autism spectrum may contribute to latent social and communicative impairments (Mundy & Neal, 2000). Delgado et al. (2002) assert that joint attention ability at an early age is predictive of future language skills for typically developing infants. Delgado et al. (2002) found a significant correlation ($r^2=0.30$, $p<.01$) between expressive language ability and joint attention ability in and outside the visual field combined (Delgado et al., 2002). Their study included 47 healthy, 15 month-old infants. They used the Early Social Communication Scales (ESCS) to determine joint attention ability. This instrument has been used in a number of studies with children with autism (Dawson et al., 2004; Bono, Daley, & Sigman, 2004; Mundy et al., 1990) and typically developing children (Delgado, 2002). When the researchers controlled for the visual field and conducted a partial correlation for outside of the visual field, there remained a significant correlation with expressive language ability. The importance of joint attention for language development is well documented. The question is whether joint attention is related to the acquisition of social language variation.

Dawson et al. (2004) investigated the salience of social attention impairments in the identification of children with and without autism spectrum disorder. The researchers considered three social impairments: social orienting, joint attention, and attention to distress. The participants included children with autism ages three to four, children with developmental delays ages three to four, and typically developing children ages 12 to 46 months. These three groups were matched for mental age. Dawson et al. (2004) used two
different, research-based instruments: the Early Social Communication Scales (as previously discussed) and the Autism Diagnostic Observation Schedule-Generic (ADOS-G). The ADOS-G is a semi-structured assessment tool designed to differentiate between individuals with autism disorder, individuals with Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS), and non-spectrum disorders (Lord et al., 2000). The designers of this instrument took several measures to create an instrument that applied to a range of expressive language ability levels in addition to age levels (child to adult) (Lord et al., 2000). Additionally, the instrument has a standard method of implementation that requires training and yields high inter-rater and test-retest reliability. I question, however, the applicability of this instrument to individuals of diverse backgrounds, such as African American children with autism, as 80% of the subjects used to test this measure were Caucasian (Lord et al., 2000).

Dawson et al. (2004) found that three- to four-year-old (pre-school aged) children with autism are significantly more impaired in social orienting, joint attention, and attention to distress. Further analysis of the relationship between social orienting, joint attention and language ability corroborated previous findings by Sigman (1999). Joint attention seems to have a strong, direct predictive relationship with language ability (Dawson et al., 2004). Social orienting seems to be indirectly predictive through its relationship with joint attention (Dawson et al., 2004). The relationship between social orienting, joint attention, and language ability suggests that social impairment among individuals with autism significantly affects language development, which might also include the acquisition of social language variation.
2.2.4 **Attention to speech sounds.** Attention to speech sounds is a critical consideration because language input is necessary for language acquisition. If a child is not attending to the speech sounds within his environment, his ability to acquire language, let alone social language variation, could be affected. If a communicative child on the autism spectrum shows difficulty in attending to speech sounds and does not produce language variation that is prevalent in his environment, impairment in attending to speech sounds could be the critical factor for the acquisition of social language variation. Whitehouse and Bishop (2008) used brain-imaging techniques to measure event related potentials (ERPs) when children on the spectrum and their typically developing controls were attending passively and actively to speech sounds. The speech-sound stimuli in this study were English vowels (monophthongs). Whitehouse and Bishop (2008) found abnormalities in the encoding of speech sounds when the children with autism in their study attended passively (versus actively) to speech sounds. If a child with autism is not attending to speech sounds, this may affect the quality of processing language input, which could have implications for how a child with autism acquires language in all domains including phonological language variety. The differentiation in the findings between active and passive attention suggests that it might not be enough for a child with autism to be in an environment where there is language input. The child could be around his peers or around his parents who are producing speech and not be attending to it, which again might affect their acquisition of the language varieties that are produced around him.

2.2.5 **Autistic Speech.** Children on the autism spectrum tend to use peculiar phrasing, which is often characterized as “Little Professor” (Eigsti et al., 2011) or pedantic speech (Ghaziuddin, 1996). Pedantic speech includes precise articulation of speech sounds, formal
sentence structure, and relatively erudite vocabulary (Ghaziuddin, 1996). Eigsti et al. (2011) assert that this style of speech might be attributed to little practice speaking with peers, as many children on the spectrum prefer to interact with adults. Communicative children with autism are often described as having speech that sounds different as in robotic and high-pitched (“Autism - Autism Spectrum Disorders,” n.d.). Shriberg, Paul, McSweeny, Klin, Cohen, and Volkmar (2001) describe some individuals with autism to have monotonous voice quality with abnormal use of pitch.

Prosodic aspects of speech include pitch, intonation, rhythm, and stress. Eigsti et al. (2011) note that all studies to date confirm that children with autism have prosodic impairment but also concede that few studies have been conducted on these prosodic impairments. Shriberg, et al. (2001) conducted a study on children with high-function autism and Asperger’s Syndrome with typically developing controls who ranged in age from 10-49 years. The researchers analyzed speech samples of the participants for prosodic elements including phrasing, rate, stress, loudness, pitch, laryngeal quality, and resonance quality. The findings showed that those with autism were significantly less proficient at using prosody to figure out syntactic ambiguity (Shriberg et al, 2011). These features of autistic speech could effectively override the dialectal features that are present in their home or school environments. In this case, it would still be unclear as to whether a perceived lack of social language variation is a processing or acquisition issue or a production issue.

Kjelgaard and Tager-Flusberg (2001) studied language impairment in 89 children with autism between 4 and 14 years of age and reported that children with autism who are communicative have normal or even advanced articulatory development. To arrive at this finding, the researchers employed the Goldman-Fistoe Test of Articulation (GFTA; Goldman
& Fistoe, 1986), a widely used instrument that tests phonological processing via three subtests that assess articulation of sounds-in-words, sounds-in-sentences, and stimulability (Hersen, 2004). Kjelgaard and Tager-Flusberg (2001) solely used the sounds-in-words subtest. Interestingly, however, Shriberg et al. (2001) found that adolescents and adults with high functioning autism and Asperger’s produced speech-sound distortions that were uncommon in the general population. Speech-sounds distortions, as described by Shriberg et al. (2001), involve subphonemic changes in place and manner of articulation. The participants included 15 verbal males with high functioning autism (HFA), and 15 verbal males with Asperger’s syndrome. These diagnostic participants were compared to the profiles 53 typically functioning males. All participants were between ages 10 and 53. The researchers used clinical interview methodology and video recording to collect speech samples that were then coded and assessed via the Prosody-Voice Screening Profile (PSVP) (Shriberg, Kwiatkowski, & Rasmussen, 1990). The researchers collect frequency data for five different categories of errors: consonant, vowel/diphthong, consonant vowel combinations, consonant deletion or substitution, vowel or diphthong deletion or substitution. They also noted the percentage of intelligible words produced.

Shriberg et al. (2001) found that one-third of the Asperger’s and high functioning autism participants produced residual distortion errors on the approximant sounds /l/ and /r/ and the voiceless fricative /s/. The researchers had to exclude more of the utterances produced by high functioning autism participants (42.3%) than the Asperger’s participants (30.9%) due to unintelligibility. Aside from differences in intelligibility percentages, the differences in the prosody-voice profiles between the high functioning autism and Asperger’s participants were minimal despite known differences in their early language histories.
Significant differences were found on the levels of fluency and stress between the diagnostic participants and the profiles of the typically functioning controls. 66.7% of participants with high functioning autism and 40% of participants with Asperger’s produced nonfluent speech in 20% or more of their utterances relative to 26.4% of the controls. 53.3% of participants with high functioning autism and 26.7% of participants Asperger’s produced inappropriate stress in 20% or more of their utterances relative to 5.7% of the controls. High functioning autism and Asperger’s speakers produced more disfluent speech, did not place stress in grammatically appropriate ways, nor stress appropriate syllables within multisyllabic words. Resonance comparisons revealed that high functioning autism and Asperger’s produced significant more nasal utterances relative to typically developing speakers.

Shriberg et al. (2001) raises questions about what these distortions reveal about the phonological development of people on the autism spectrum. The researchers suggest that, speech-sound distortions may be indicative of a speaker’s inability to, “attend to and/or allocate resources for fine-tuning speech production to match the model of the ambient linguistic community” (Shriberg et al., 2001, p.1109). I hypothesize that if a child does not have the ability to attend to the linguistic input and use the input to guide his own speech production, his acquisition or production of social language variation may be affected. Again, this relates to the factor of attention to speech. If the child is not able to attend to the current linguistic environment to match it in his production, then the child likely has difficulty attending to speech, which might affect his acquisition of the language varieties in his environment.

Wolk and Giesen (2000) studied four siblings with autism, each at different levels of severity, and found that severity seemed to play a role in answering the question of delayed
versus disordered development. Child A was 9.0 years old; Child B was 5.9 years old; Child C was 3.9 years old; and Child D was 2.3 years old. The researchers conducted individual phonological investigation for each of the four children via object naming facilitated by the Assessment of Phonological Processes (APP; Hodson, 1990) and spontaneous speech samples. Overall, the results exhibit both normal and deviant patterns among these four siblings on the spectrum. The oldest child with the least severe impairments only displayed mild phonological impairments: in the fricative class her interdental fricatives (/θ/ and /ð/) were absent and her alveolar fricatives (/s/ and /z/) were interdentalized, she slurred, and produced imprecise articulation. Her younger siblings who were more severely impaired displayed more atypical processes such as velarization and liquid frication. Even high functioning individuals on the spectrum, like Child A in the Wolk and Giesen (2000) study, experience phonological impairments that could override some socially salient features of a language variety such as African American English.

Sigman and Mcgovern (2005) hypothesized that gains in cognitive and language ability between preschool and middle childhood would be greater than between middle childhood and adolescence, meaning a slower rate of development. As both of the children with autism in the current study in middle childhood, the trajectory of language gain before and after middle school is relevant to make predictions about delay versus deviance. The participants in Sigman and Mcgovern (2005) included 48 adolescents with a mean age of 19 years. The preschool mean age was three years and the middle childhood mean age was 12 years. The researchers used standardized assessments to determine cognitive abilities, language skills, and non-verbal communication skills. Pretend play skills were assessed at recruitment. The researchers predicted that adolescent intelligence level and language ability
would be reflective of middle childhood ability. Ability was defined by language age based on standardized scores measured via the Reynell Scales of Language Ability (Reynell, 1977) during early childhood and middle childhood and the Clinical Evaluation of Language Fundaments-Revised (CELF-R: Semel, Wiig, & Secord, 1987) during adolescence. Improvement was measured by difference in mental age in months. While there was significant variability in the range of improvements measured among the participants with autism (consistent with the heterogeneous nature of the disorder), the results were consistent with the hypothesis. Additionally, the researchers found that IQ scores, measured via the Stanford-Binet-5 (SB-5; Roid, 2003), were positively associated with gains in language. Lennen, Lamb, Dunagan, and Hall (2010) studied the implications of evaluating autism using SB-5 (Roid, 2003) and further corroborated the association between IQ scores and gains in language. Lennen et al. (2010) found that language ability (both verbal and nonverbal) has a large association with on SB-5 (Roid, 2003) IQ score and that the SB-5 (Roid, 2003) could predict group (with or without autism disorder and with or without mental retardation) membership with 52.9% accuracy (Lennen et al., 2010). Overall, the mean change in language age between middle childhood and adolescence was only half of the mean change between preschool and middle childhood (Sigman & McGovern, 2005). The finding of Sigman and McGovern (2005) asserting that gains in language ability are greater prior to middle school relates to the earlier point that children are most influenced by their peers from ages 5 to 12 years (Labov, 1970). Age twelve is about when many children begin middle school. Around age twelve, then, is a logical period to measure the development of social language variety. According to both Labov (1970) and Sigman and McGovern (2005), a
significant amount of language development has occurred by middle school with the influences of both parents and peers.

2.3 Model Study Baron-Cohen and Staunton (1994)

In my review of the literature, there was a dearth of research that specifically addressed the topic of the acquisition of social language variation by individuals on the autism spectrum. Baron-Cohen and Staunton (1994), however, serves as a model on which this research design aims to build on, as it is one of the only studies in the literature that investigates social language or dialectal acquisition by children with autism through triad comparisons (mother, child with autism, and typically developing sibling). Baron-Cohen and Staunton (1994) predicted that children with autism would sound more like their parents than their typically developing siblings because many children with autism have impaired ‘theory of mind’ (Lombardo & Baron-Cohen, 2011), which, they speculate, is related to a lack of desire to identify with peers. Lombardo and Baron-Cohen (2011) discuss the practice of determining ability to employ theory of mind via fMRI brain imaging while children are playing a game with another person. The Baron-Cohen and Staunton (1994) hypothesis makes logical sense. If a child with autism does not wish to identify with peers they also likely do not wish to interact with peers or sound like them in their speech.

Baron-Cohen and Staunton (1994) found that the children with autism who were raised in England by a non-English mother (with a non-English accent) sounded more like their mother than their sibling despite receiving similar if not the same phonological input. Baron-Cohen and Staunton (1994) did not define what it meant linguistically for a child to sounds like his or her mother, which is a limitation of this study that is addressed in the current research design. The judges were non-linguists and were blind to the hypotheses. The judges
were not given a formal set of acoustic characteristics to guide their judgments. Baron-Cohen and Staunton (1994) asked the judges to make judgments about whether the child sounded English or non-English and whether the child sounded more like the mother or the father. Baron-Cohen and Staunton (1994) rely solely on the perception of non-linguists. The use of non-linguists seems to be a sufficient control for the effects of linguistic knowledge. The use of perception aids external validity because the focus of this research is social identification via language use. In social settings, people do not compare waveforms and spectrograms to determine whether an individual sounds more like his parents or his peers; in the social setting people rely on perception. Waveforms and spectrograms can elucidate more subtle variation in speech sound frequency to provide a more holistic picture. For this reason, waveform and spectrogram analysis, in addition to perception analysis, are components of this current research design. The findings of Baron-Cohen and Staunton (1994) were significant with high inter-rater reliability even after controlling for the effects of autism via the inclusion of an experimental group with children with autism and two English parents.

Baron-Cohen and Staunton (1994) offer a few explanations for their findings including lack of exposure to peers, imitation deficits and a lack of drive to interact and identify with peers. They rule out the first two possible explanations. They state that there is no evidence for the fact that children with autism come into less contact with peers; in fact, it appears that their contact is no different than typically functioning children (Baron-Cohen & Staunton, 1994). Echolalia, which is the behavior of some children with autism which involves the repetition of someone else’s speech often with the same intonation (Tager-Flusberg, Paul, & Lord, 2005), and the results of Baron-Cohen and Staunton (1994) disprove the idea that children are incapable of imitation as the children with autism in this study
sounded like their mothers. It is known, however, that children with autism universally have social deficits, which would explain their lack motivation to identify with peers and thus not speak as their peers do.

The current research design builds on the work of Baron-Cohen and Stauton (1994) albeit with an entirely different demographic. The use of siblings as a point of comparison is a strong component of the research design because it controls for environment and phonological input. If the child with autism and his or her sibling are exposed to the same home environment and social environments (e.g., school), the language input should be similar.

2.4 Autism Among African Americans

Autism occurs in equal proportions across demographic groups (Dyches, Wilder, Sudweeks, Obiakor, & Algozzine, 2004). While research confirms the indiscriminant nature of autism, there are still disparities among different racial and ethnic groups in the age at which children are diagnosed (Mandell, Listerud, Levy, & Pinto-Martin, 2002) as well as the number of children within these groups who have received formal diagnoses (Mandell et al., 2009).

Mandell et al. (2002) investigated racial difference in the age at which children received their diagnosis of autism disorder. The study was conducted in Philadelphia among 406 Medicaid-eligible children. The researchers used Medicaid specialty mental health claims to identify information about the dates of the first mental health visits, date of the autism diagnosis, and the number of visits between those dates. Analysis was conducted based on linear regression models, showing the relationship among race, age at diagnosis of autism, time of treatment, and total visits preceding the diagnosis. The findings show that, on
average, African American children are diagnosed 1.6 years later than white children (Mandell et al., 2002). On average, white children were diagnosed after 4.1 mental health treatments while African American children did not receive diagnoses until after an average of 13 visits (Mandell et al., 2002). These findings suggest a significant disparity in autism spectrum disorder diagnoses between African American and white children. The sample resembled the population of all Medicaid-eligible children and adolescents in Philadelphia on the level of race (Mandell et al., 2002). Inability to gain access to early intervention for developmental disorders results in the necessity for more intense intervention later as in the case for many African American children with autism (Gourdine, Baffour, & Teasley, 2011). More intense interventions are necessary because lack of intervention yielded the persistence of a low level of functioning later into childhood. The persistence of low functioning also means that the child’s language is less likely to be influenced by peers through social interaction for a longer period of time.

Zionts, Zionts, Harrison, and Bellinger (2003) conducted a study to learn about perceptions of urban African American families towards the special education system. The families of 24 African American children with severe emotional or cognitive disabilities (including autism spectrum disorder) were recruited from two large metropolitan areas and a wide range of socioeconomic backgrounds were represented (Zionts et al., 2003). The researchers conducted interviews to obtain information for analysis. Zionts et al. (2003) found that many African Americans have negative or less than ideal experiences with traditional special education services. Parents interviewed in this study reported negative experiences based on lack of respect by school personnel, lack of cultural understanding, and lack of adequate training (Zionts et al., 2003). The themes that emerged from the interviews
Zionts et al. (2003) conducted with African American families with children with developmental disorders revealed that the parents believe that teachers in special education need to better understand the characteristics of the disorders so that they are more adept at determining what is causing the child’s behavior as some behaviors may not be a result of a disorder but of cultural practice. Some culture-based behaviors might be considered disorder-based simply because the behavior deviates from what the educator understands to be normal (Zionts, 2003). These perceptions might contribute to later diagnoses of developmental disabilities like autism spectrum disorder among African Americans.

These disparities need to be addressed; African American children with autism and their families deserve the attention of researchers and intervention specialists. The current research design has the potential to increase understanding of social and language development among African American children. There is no expectation that African American children with autism should acquire social aspects of speech differently than children on the spectrum from different backgrounds. The choice to focus on African American English has motivations in both linguistics and psychology. Mandara, Gaylord-Harden, Richards, and Ragsdale (2009) studied the main effects and interaction effects of racial identity and self-esteem on depressive and anxiety symptoms among 259 African American seventh and eighth graders. Racial identity is important to resilience in dealing with the discrimination that many racial and ethnic minorities face (Mandara et al., 2009). Variation in language has critical social implications because it is one of the main ways people assert their identity (Lippi-Green, 1997). Lippi-Green (1997) articulated the intimacy between language and identity best: “we use variation in language to construct ourselves as social beings, to signal who we are, and who we are not and cannot be” (p. 63). If a child
with autism has social and language impairments, are they able and do they use language to construct themselves a social beings? The current research develops a model that could potentially answer that question.

2.5 African American English

Craig, Thompson, Washington, and Potter (2003) conducted an investigation of the phonological features produced by 64 elementary school-aged (second through fifth grade) African American English speakers. The features that were most widely dispersed among the participants were monophthongization of diphthongs (57%) and interdental alternation (45%) (Craig et al., 2003). The researchers reported high inter-rater reliability: 86% agreement on the presence of variation, 99% agreement on distinctions between African American English variations and non-African American English variations.

Craig et al. (2003)’s finding that monophthongization and interdental alternation were most prevalent among their sample informed the design of the current research design. The prevalence of these features in this study could mean that these features are salient to the variety at this level of development. If monophthongization and interdental alternation are salient to child speakers of African American English, production of these features would have implications for use of the variety as an expression of identity, depending how aware children are of these particular features. The researchers concede that immaturity of the oral motor system might have been a confounding factor in the determination of whether or not features were reflections of acquisition of African American English. The researchers employed the Triangles subtest of the Kaufman Assessment Battery for Children (K-BAC, Kaufman & Kaufman, 1983). Since 1983, researchers have questioned the use of this instrument that the researchers used to test the children to make sure they were typically
developing because of the way the subtest specific variance was determined by its designers (Bracken & Howell, 1989). Additionally, the use of teacher reports to help determine whether the child is typically functioning is questionable, as it invites both cultural and linguistic biases.

The most relevant aspect of the Craig et al. (2003) study to the current research design is the idea that if monophthongization and interdental alternation are present in elementary school, it is likely that they are still present in middle school, which is the main reason I analyzed these features. Both of the children with autism included in the current research are middle school aged.

2.5.1 Monophthongization. Vowels are dynamic. Linguistically, “dynamic” means that a vowel’s formants change in frequency during its duration (Fox & Jacewicz, 2009). Linguists use spectrograms and waveforms to discern the dynamic nature of vowels. A spectrogram analysis gives the frequencies of the first and second formants. Fully articulated diphthongs show a change in the difference between the first and second formants over the course of production. Plots of the first and second formant values allow for inter-speaker comparisons.

Monophthongization of /aɪ/ is a known feature of White Southern speech (Fridland, 2003). This feature, however, has expanded to the African American English variety (Anderson, 2002; Fridland, 2003). In the Southern English and the African American English varieties, monophthongization of /aɪ/ most commonly occurs in the pre-voiced (e.g., the vowel in “tide”) and word final environments (e.g., the vowel in “tie”) (Fox & Jacewicz, 2009).
### 2.5.2 Interdental Alternation

Substitution of t/d and f/v for interdental fricatives /θ/ and /ð/ is a well-known and well-researched feature of African American English (Green, 2002; Thomas & Carter, 2006;). Speakers of African American English replace interdental fricatives with t/d in prevocalic environments (Craig et al., 2003). Speakers of African American English replace interdentals with f/v in intervocalic and postvocalic environments (Craig et al., 2003). Craig et al. (2003) found that 45% of 64 African American elementary school children produced interdental alternation. Labov, Cohen, Robins, and Lewis (1968) studied the process of interdental alternation among African American English speakers in New York and found that interdental alternation occurred more often for the voiced interdental fricative /ð/ than the voiceless /θ/.

### 2.6 Phonological Feature Analysis

#### 2.6.1 Monophthongization phonological analysis

There are at least three measures that quantify diphthong production by speakers: vector length (VL), trajectory length (TL), and spectral rate of change (Fox & Jacewicz, 2009). Fox and Jacewicz (2009) employed vector length, trajectory length, and rate of change in their investigation of dialectal variation in American English vowels at three locations: North Carolina, Ohio, and Wisconsin.

Vector length measures the amount of formant change over the duration of the vowel production (e.g., Fox & Jacewicz, 2009). The vowel is broken into equidistant temporal locations and researchers typically conduct analysis on vowels between the 20% and 80% locations (Fox & Jacewicz, 2009; Hillenbrand, Getty, Clark, & Wheeler, 1995). Starting analysis at 20% and ending at 80% controls for the affects of coarticulation or surrounding consonants (Fox & Jacewicz, 2009; Tasko & Greilick, 2010). In that 20% to 80% temporal space, vector length is a measure of the vector in the F1xF2 plane (Fox & Jacewicz, 2009).
Trajectory length provides a more detailed measure of changes in vowel frequency by tracking frequency change in four sections between the 20% and 80% temporal locations (Fox & Jacewicz, 2009). In the current research I conducted a simplified analysis of diphthongs by measuring the difference between the first and second formants at four equidistant time points—20%, 40%, 60%, 80%.

2.6.2 Interdental alternation phonological analysis. Zhao (2010) describes stop-like modification of interdental fricatives. In his investigation of the acoustic differences, he collected speech samples from the TIMIT corpus. His sampling included 100 tokens of stop-like /ð/ and 102 tokens of /d/ from 59 male and 23 female speakers. From that data he concluded that there are distinct acoustic differences between stop-like /ð/ and /d/ despite their perceptual similarities (Zhao, 2010). Perceptual similarities are most salient when considering the social interpretations of language use and concepts of sounding like a speaker of a particular group. Spectrograms show clear differences between fricative productions and stop productions. Figure 1 includes spectrograms of the word “this” produced as /ðɪs/ in 1a and /dɪs/ in 1b. Figure 1 illustrates how spectrograms can be used to figure out what sound is produced. The darkest sections are vowels and the interdental fricative occurs before the vowel. In Figure 1a, the high frequency spectral activity indicates that a fricative /ð/ was produced before the vowel. In Figure 1b, there is no spectral activity aside from the voicing bar before the onset of the vowel, indicating that the word initial consonant of the word “this” has been produced like a voiced stop /d/. In the current research, I conduct spectrogram analysis of interdental fricative productions.
2.6.3 Matched guise testing.

Matched guise testing is a sociolinguistic experimental design that tests covert values or attitudes that people assign to others based on speech alone (Wodak, Johnstone, & Kerswill, 2010). Lambert, Hodgson, Gardner, and Fillenbaum (1960) created matched guise tests, which are also a measure of perception. Lambert et al. (1960) studied evaluative reactions to English and French speech. The aim was to see if there were differences in how people perceive others as a function of spoken language. How others perceive you could be a measure of successful identity expression.

Purnell, Idsardi, and Baugh (1999) conducted a series of four perceptual and phonetic guise experiments to investigate American English dialect identification. The Purnell et al. (1999) experiments aimed to expand upon previous guise research (Lambert & Tucker, 1972; Tucker & Lambert, 1975) that investigated dialectal attitudes by asking participants to assign
attributes to the speakers of different dialects. Purnell et al. (1999) studied dialectal 
identification on the sentential and single-word levels to isolate the effects of phonetic 
features. Stimuli were drawn from three dialects—African American Vernacular English, 
Chicano English, and Standard American English. Listeners were asked to listen to the 
stimuli and identify the gender and racial background of the speaker based on speech samples 
alone. The listeners correctly identified the racial background of the speakers over 70% of 
the time by just hearing the word “hello.” The findings of Purnell et al. (1999) suggest that 
“microlinguistic” or phonetic features distinguish dialects and listeners can make 
identifications using phonetic features. The current study employed a matched guise test 
using speech samples from the data I collected from the participants for phonological 
analysis. Based on the finding that Purnell et al (1999) that people have the ability to identify 
racial and ethnic background based on speech along, I designed a matched guise to see if 
special educators could correctly identify the racial or ethnic backgrounds of the guises 
created from my data. The matched guise testing is described in Chapter Six.

Chapter 3:
Discussion of Hypotheses

3.1 Summary of factors.
The puzzle piece is a symbol of autism. Figure 2 is the logo for Autism Speaks, one of the world’s largest autism science and advocacy organizations (“Autism Speaks,” 2012). It is a metaphor for the complexity, mysteriousness, and diversity of this spectrum disorder.

Any discussion of autism spectrum disorder and its associated impairments should be prefaced with an acknowledgement of the heterogeneous nature of the disorder. In Chapter Two, I discussed several factors that can influence the acquisition of social language variation by children on the spectrum.

*Figure 2. The symbol for Autism Speaks (“Autism Speaks,” 2012), one of the world’s largest autism science and advocacy organizations*

If children on the autism spectrum do not interact with their peers, the potential for peer influence on language development is likely diminished (Baron-Cohen & Staunton, 1994). If instead they solely interact with adults like their parents, primary caregivers, or intervention service providers, they might continue to sound like those adults with whom they spend the most time. Even still, there is the factor of autistic speech, which might preclude the acquisition or production of social language variation all together.

Impairments in the ability to joint attend and attend to speech sounds are common among those on the autism spectrum. Ultimately, the inability to joint attend or attend to speech sounds could affect the extent to which a child even sounds like the adults he primarily interacts with. I make connections to psychology by considering the implications of an individual speaking and sounding differently from other members in his or her
environment. Sounding differently could affect an individual’s identity expression as language use is often tied to identity (Lippi-Green, 1997). Sounding differently might also affect the development of peer relationships.

Labov (2011) describes internal and external factors that influence language change and language acquisition from one generation to the next. Internal factors are determined by biological, innate factors such as the physical restraints of the oral and nasal cavities or genetics (Yang, 2000). Internal factors dictate the existence of Universal Grammar (UG), a widely understood concept in linguistics that describes the language structure that underlies all languages (Yang, 2000). External factors include all influential aspects of the environment in which language changes or is acquired (Yang, 2000). Social interaction is an external factor. Interestingly, autism spectrum disorders are characterized by impairments that enter the realms of both internal and external factors.

In the formation of my hypotheses, I have grouped a vowel feature (monophthongization of /aɪ/) and a consonant feature (interdental alternation). It is important to consider the possibility that these two features might manifest differently due to possible differences in the internal and external factors that affect the acquisition and/or production of these features. The findings of Craig et al. (2003) suggest, however, that these two features occur with similar frequency among the African American elementary school aged participants in their study, which justifies (in part) the grouping of these two features.

The current study involves an African American triad (a child with autism, his higher functioning sibling, and his mother) and an African American dyad (a child with autism and his mother). I collected speech data from all participants and performed phonological analysis, specifically focusing on monophthongization of /aɪ/ and interdental alternation—one vowel
and one consonant feature respectively. I compared the speech of the children with autism to the speech of their mothers (to the speech of the sibling in the case of the triad). I also conducted a matched guise test to learn what racial or ethnic background a group of listeners perceived the five speakers to be from. The phonological analysis and matched guise testing are discussed in greater detail in the methodology in Chapter Four.

3.2 Hypotheses. There are four factors that I consider in this research design and in the development of my hypotheses.

1. **Social interaction.** Social interaction describes the extent to which the child interacts with peers, parents, and others. Social interaction is a challenge for many individuals with autism (Constantino et al., 2007). Many children with autism experience difficulty developing peer relationships that are appropriate for their developmental level (“CDC - Diagnostic Criteria, Autism Spectrum Disorders - NCBDDD,” n.d.). These children do not as readily engage with their peers and rarely initiate social interaction. If the child is not engaging with peers, then it is likely that he is not actively receiving language input, which could limit the extent to which the child is influenced by peer language. It may also be the case that the child with autism wishes to engage but is rejected by peers for reasons related to autism—repetitive or stereotyped behavior (“CDC - Diagnostic Criteria, Autism Spectrum Disorders - NCBDDD,” n.d.), inability to regulate emotions (Begeer et al., 2011), lack of theory of mind (Lombardo & Baron-Cohen, 2011), etc. The hypothesized effect of difficulty with social interaction is that the child with autism will not acquire and/or produce the social language variety of his peers and sound more like his parents in his speech relative to a higher functioning sibling.
2. **Production of autistic speech.** There are language production features that are specific to autism and characterize autistic speech (Shriberg et al., 2001). Autistic speech is described as monotonous with abnormal pitch (Shriberg et al., 2001). Autistic speech is also described as pedantic (Ghaziuddin, 1996). The mechanisms that cause an individual with autism to produce autistic speech might affect the acquisition and/or production of the ambient social language variety of the child. There could be internal, autism specific factors that preclude the acquisition and/or production of social language variation. The hypothesized effect of autistic speech is that the child will not acquire and/or produce the social language variety of his peers or his parents.

3. **Ability to joint attend.** Joint attention is the act of sharing focus on an object with another person and it is a critical aspect for language development (Baldwin, 1995). Many children with autism lack the ability to joint attend (Dawson et al., 2004; Delgado et al., 2002; Mundy, Sigman, & Kasari, 1990). Early impairment in joint attention for children on the autism spectrum may contribute to latent social and communicative impairments (Mundy & Neal, 2000). The hypothesized effect of the inability to joint attend (assuming this inability is consistent when engaging with both peers and parents) is that the child will not acquire and/or produce the social language variety of his peers or his parents.

4. **Ability to attend to speech.** The ability to attend to speech describes the extent to which an individual actively or passively pays attention to speech sounds, which can affect a child’s language development (Whitehouse & Bishop, 2008). Whitehouse and Bishop (2008) studied how children with autism encode speech sounds via brain imaging and measured differences between attending actively versus passively. The researchers found abnormalities in the encoding of speech sounds when the children with autism attended
passively. The hypothesized effect of abnormal encoding of speech sounds is that the child will not acquire and/or produce the language variety of his peers or parents.

For three of the four factors (production of autistic speech, ability to joint attend, and ability to attend to speech), I predict that a child with autism will not acquire and/or produce the language variety of his peers or his parents. In the case of social interaction, I predicted that a child with autism, who does not as readily engage socially, will not acquire and/or produce the social language variety of his peers but might still acquire and/or produce the variety of his parents. If sibling comparison is applicable, I hypothesize that the child with autism with difficulty interacting socially would sound more like the parent than a higher functioning sibling who successfully engages with peers. Table 1 illustrates my hypotheses based on the four factors previously discussed—social interaction, autistic speech, ability to joint attend, and ability to attend to speech sounds. Note that I did not predict that the child with autism would sound less like the parents and more like the peers for any of the four factors. I would predict, however, that a child with autism would sound more like his peers if he had the ability interact with his peers and actively attend to the language input of his peers.
### Table 1
Hypotheses matrix considering five salient factors

<table>
<thead>
<tr>
<th>Factors</th>
<th>Hypothesis A</th>
<th>Hypothesis B</th>
<th>Hypothesis C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The CWA will sound <em>less</em> like the peers <em>and more</em> like parents (relative to a higher function sibling)</td>
<td>The CWA will sound <em>less</em> like the parents <em>and more</em> like peers (relative to a higher function sibling)</td>
<td>The child will not sound like peers or parents.</td>
</tr>
<tr>
<td>1) Social interaction: The CWA does not readily engage with peers and primarily interacts with parents</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Language: The CWA produces autistic speech</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3) Language development: The CWA does not joint attend</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>4) Language development: The CWA does not attend to speech sounds</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

(CWA) Child with autism

It is likely the case that these four factors interact with each other. Table 1 offers a simple representation of how these factors might affect whether a child with autism will sound more like their parents phonologically relative to a sibling or relative to the extent to which they sound like their peers.
Chapter 4:

Methodology

4.1 Participants

Participants included two communicative, African-American children on the autism spectrum and their families. Families were defined as having at least a mother and a child (a dyad) to facilitate mother-child comparisons. I use pseudonyms for both families in all discussion. The George family was a triad consisting of the child with autism, Anthony (age 12 years), his mother, and his sibling with Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS), Alex (age 11 years). The George family resides in New York City. Additional demographic information could not be accessed about this family despite efforts to initiate contact. I accessed the George family’s speech data via Youtube videos posted by the mother. The Symonds family was a dyad consisting of the child with autism, Keith (age 12 years), and his mother. The Symonds family is located in a county in southern Maryland. The county is 65.4% African American, 26.6% Caucasian, and 8% other (“QuickFacts from the US Census Bureau,” n.d.). The Symonds family was recruited through advertisement on a Facebook page for African American parents with children with autism. I made contact with five other African American families. I was not, however, able to include those five families in my research because their children were not communicative enough to collect analyzable data.

The participants for the matched guise testing included 16 listeners (12 Caucasian, 3 African American, and 1 did not indicate racial/ethnic background). All of the participants were at least 18 years old. Six of the respondents described themselves as having expertise in special education; eight respondents described themselves as being special education
teachers; two described themselves as being special education student teachers; and one did not respond. Of the 16 respondents, 15 had not taken linguistics course and one had taken a linguistics course. The listeners were recruited by sending personalized emails to special education faculty and students at the College of William and Mary’s School of Education and the University of Virginia’s Curry School of Education.

4.1.1 The George family. I gained access to the Youtube videos through a website called Faces of Autism, that was founded by the mother in the triad ("Faces of Autism Organization,” n.d.). The Youtube video from which I extracted the speech data of the children was posted in April 2012. The Youtube video from which I extracted the speech data of the mother was posted in July 2012. There were differences in the amount of speech data that I was able to retrieve from each member of the triad. The mother’s Youtube video included 10 minutes of running speech. In the video, she discussed the purpose of her advocacy organization called For Faces of Autism and talked about her children. From her video, I gained valuable information about Anthony and Alex. The speech data from Anthony and Alex came from the same Youtube video, which only provided approximately 3 minutes of speech data per child. Even still, their speech data was not as fluent as the mother’s. To account for this discrepancy, feature tokens were only taken from the first three minutes of the mother’s speech sample. Despite the limitations of the Youtube data, I chose to include the data because it allowed for sibling comparison and the comparison of different levels of functioning on the autism spectrum (autism versus PDDNOS). As mentioned, Alex has PDDNOS. PDDNOS is a higher functioning disorder on the spectrum and those who experience it have milder symptoms than those diagnosed with autism or Asperger’s syndrome (“CDC - Facts, Autism Spectrum Disorders - NCBDDD,” n.d.). Although the
sibling is on the autism spectrum, there is a clear difference in developmental level that I was able to discern from the Youtube videos. In the portion of the video with the child with autism, the sibling is helping the mother elicit speech from the child. This shows that the sibling is higher functioning both socially and communicatively than the child with autism. The difference in developmental level maintains the element of quasi-experimental control, despite the fact that the sibling is not typically developing. The background music and noise in the videos affected the quality of the speech data, but I was able to clean up some of that noise using Audacity noise removal (Audacity Team, 2012). It is also possible that the videos are not representative the triads natural speech. The mother likely tried to sound professional for the video since it was posted on her Faces of Autism organization page. Throughout the analysis, I refer to Anthony as George child with autism; I refer to his sibling Alex as George sibling; and I refer to his mother as George mother.

4.1.2 The Symonds family. The Symonds family dyad speech data was collected via interview. Keith is in the seventh grade. Both of the Symonds parents are African American. The family also has a 9-month-old daughter. The external factors I learned about through the interview with the mother allowed me to make some inferences about the extent of social language acquisition by Keith. During the school year, Keith interacts most with his mother at home as she is the one who ensures that he is getting his homework and chores done (Symonds mother, personal communication, February 15, 2013). Like the Baron-Cohen and Staunton (1994) study I discussed in Chapter 2, I only compared the child’s speech to one parent’s speech. Because Keith primarily interacts with his mother, I chose to analyze the mother’s speech only. I was not able to gain access to Keith’s peers at school to sample their speech. I did learn, however that Keith has trouble engaging with peers and is often rejected
by his peers because they find him odd (Symonds mother, personal communication, February 15, 2013).

Keith is a student at a predominately African American middle school in southern Maryland. As of the 2011-2012 school year, the student enrollment was 84.8% African American, 1.5% American Indian, 3.5% Asian, and 4.7% White, non-Hispanic, and 5.5% not reported (Covington, Smith, & Moore, 2011). Among the student body, 59% receive free and reduced lunch (Covington et al., 2011). The school includes an autism program (Symonds mother, personal communication, February 15, 2013). Keith is in an inclusion program so he receives help from aids inside a general education classroom. Keith is surrounded by typically developing students (peers) while at school in the general education classroom, which means that he has access to the language input of his typically developing peers. This does not mean, however, that he is acquiring the language variety of his peers. These demographics reveal that the majority of Keith’s classmates are African American so it is likely that many of his peers use features of African American English. I was not, however, able to confirm the language variety of his peers through speech sampling Keith’s primary aid is African American. Despite efforts to make contact with his aid, I was not able to set up an interview to obtain speech data. Throughout the analysis, I refer to Keith as Symonds child with autism and the mother as Symonds mother.

4.2 Materials

4.2.1 Praat. To conduct phonological analysis for monophthongization and interdental alternation, I used Praat (Boersma & Weenink, 2011), software designed for phonetic analysis. The software analyzes speech sounds based on phonetic variables, including pitch and intensity.
4.2.3 Audacity. To clean up background noise and eliminate background music from the Youtube data, I used the Noise Removal command on Audacity (Audacity Team, 2012). One limitation of the noise reduction was that I was not able to completely delete the noise without affecting the voice quality of the samples.

4.2.3 Matched Guise Survey. I created a Qualtrics survey using my William and Mary login credentials for the matched guise testing. The speech samples that I embedded in the survey were linked to a Word Press page that I upgraded the account in order to upload media files (the speech samples).

4.3 Procedures

4.3.1 Interviews. I collected data via the interview method for the Symonds dyad. I used professional quality audio equipment (e.g. Zoom H4n audio recorder) to record the interviews to collect at least 15 minutes of running speech from the parent and the child with autism. Many of the interview questions for both the child and the mother were designed to elicit running speech data from the participants (e.g., What is your favorite childhood memory? What is your typical day like? If you could invent something, what would it be?). I also asked the mother questions to learn about her son with autism and factors that might influence his acquisition of social language variation (e.g., How would you describe your child’s ability to communicate in different settings?). The full list of interview questions for both the Symonds mother and the Symonds child with autism are in Appendix B. The Symonds family interview was conducted in their home in southern Maryland on February 15, 2013.

4.3.2 Phonological analysis of monophthongization. Monophthongization is the process of producing a vowel that canonically has two points of articulation (a diphthong) as
a vowel with one point of articulation. For example, the word “my” sounds like *mah* when it is monophthonized as discussed in Chapter Two. Another example would be the word “tide” pronounced like the word “tad.” In my analysis, I measured the degree of monophthongization. First, I determined the duration of each of the diphthongs I selected for inclusion. The inclusion criteria are discussed in Chapter Five. I divided the duration of the vowels by five to separate them into five equidistant temporal locations yielding four time points: 20%, 40%, 60%, and 80%. This method follows the model of previous research including Fox and Jacewicz (2009) and Hillenbrand, Getty, Clark, and Wheeler (1995). Starting at the 20% point and ending at the 80% point controls for the effects of coarticulation of surrounding consonants (Fox & Jacewicz, 2009; Tasko & Greilick, 2010).

Since F1 correlates with the height of the tongue during speech production and F2 correlates with front/back tongue advancement (Fridland, 2003), measuring the difference in frequency between F1 and F2 at each time point will give a picture of how the diphthong is produced. I also measured the point of transition during the duration of the vowel by my perception and the spectrograms. Transition points are described as the point when the difference between the first and second formants starts to increase more rapidly. I also recorded F2-F1 (Hz) at the point of transition from nucleus to glide for all diphthongs. This measurement helped to determine a degree of monophthongization. Significant differences in the duration of nucleus and glide across a diphthong suggest a higher degree of monophthongization.

**4.3.3 Phonological analysis of interdental alternation.** The spectrograms give pictures of how interdental fricatives are produced as discussed in section 2.5.2. I looked at word initial interdental fricative productions (e.g. “this,” “that,” “those,” “them). I used spectrograms to conform my phonemic transcriptions. If there was spectral activity at high
frequencies (indicative of fricative production), then I marked the token for the speaker as non-interdental alternation. If there was a pause in spectral activity (indicative of a stop closure), I marked the token for the speaker as interdental alternation.

4.3.4 Matched guise testing. I distributed an online survey to special education teachers, student teachers, and experts. I chose special education teachers because they are trained to educate children with special needs, including children with autism spectrum disorder. The survey questions are in the Appendix D. The listeners are asked to identify the racial or ethnic background of the speaker based on their perception. The survey also asked the listeners to describe their level of linguistic knowledge as this could bias their racial/ethnic background identifications. I conducted simple statistical analysis for trends via Microsoft Excel.
Chapter 5:  

Results  

5.1 Phonological Analysis, George Family  

5.1.1 George Mother. I only conducted analysis for monophthongization of /āɪ/ for the George family. I selected the first four of the George mother’s tokens of /āɪ/ in word medial position to match the number of tokens in the George sibling’s (n=3) and George child with autism’s (n=3) speech samples. I was not able to match specific words across all three members of the triad due to the limited amount of speech data from George sibling and George child with autism.  

Table 2 displays the differences between F1 and F2 frequency measurements across the duration of four of the mother’s earliest tokens of the diphthong /āɪ/ in the word medial position. Table 2 also indicates the duration of each diphthong and includes differences between F1 and F2 at four, equidistant time points.  

<table>
<thead>
<tr>
<th></th>
<th>Duration (s)</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>80% - 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>thrive</strong></td>
<td>0.18</td>
<td>211</td>
<td>230</td>
<td>287</td>
<td>421</td>
<td>210</td>
</tr>
<tr>
<td><strong>minds</strong></td>
<td>0.12</td>
<td>268</td>
<td>210</td>
<td>287</td>
<td>401</td>
<td>133</td>
</tr>
<tr>
<td><strong>minds</strong></td>
<td>0.13</td>
<td>114</td>
<td>115</td>
<td>306</td>
<td>363</td>
<td>249</td>
</tr>
<tr>
<td><strong>time</strong></td>
<td>0.16</td>
<td>286</td>
<td>268</td>
<td>229</td>
<td>268</td>
<td>-18</td>
</tr>
</tbody>
</table>
The mother does not fully monophthongize the /æɪ/ diphthong. In two of her four tokens of /æɪ/, the transition from the nucleus of the diphthong to the glide of the diphthong occurs after the 50 % point, which indicates a degree of monophthongization as the nucleus is dominant over the duration of the token. Transition points are described as the point when the difference between the first and second formants starts to increase more rapidly. For the first two vowels in Table 2 (in “thrive” and the first token of “minds”), the largest increase in F2-F1 does not occur until between the 60 % and 80 % time points. The nucleus in these first two token persists until relatively late in the total diphthong production, suggesting a degree of monophthongization for both tokens.

Figure 3. Waveform and spectrogram for the George mother’s first token of the word “minds,” a token of the /æɪ/ diphthong. The thick, vertical line approximates the location of the transition point in the diphthong.

Figure 3 shows the waveforms and spectrograms of the George mother’s first token of “minds.” In the spectrograms of Figure 3, the linear predictive coding (LPC) red dots chart the change in frequency of the formants. The transition point occurs after the 50% time point.
There is variation in the George mother’s tokens of /aɪ/. In a subsequent token of /aɪ/ (the second token of “minds”), the largest increase in the difference between F1 and F2 occurs closer to the middle of the vowel’s duration between the 40% and 60% time points. Adding to the variation, for in the mother’s token of /aɪ/ in “time,” the difference between F1 and F2 decreases consistently from the 20% time point to the 80% time point. This consistent decrease in the difference between F1 and F2 looks more like a diphthong for which there is movement of the tongue from forward to back (e.g., /aʊ/) instead of from low front to high front as it does for /aɪ/. The decrease from the 20% point to the 80% point, as is shown in Table 2, is only minus 18 Hz, which is much smaller of an decrease than would be expected from a canonical /aʊ/ token. While the trend is a decrease in the difference between F1 and F2, this token of /aɪ/ in “time” more closely resembles a monophthong because there is little change in the difference between F1 and F2 overall. Based on the four tokens of the /aɪ/ diphthong that I analyzed, it appears that the mother produces a degree of monophthongization as seen in the persistence of the nucleus or first point of articulation when she produces /aɪ/ for two of her four tokens. While she is capable of producing a degree of monophthongization, none of the tokens were completely monophthongized. Her second token of the word “minds” is more diphthongal as the duration of the nucleus and the glide are about equal with the transition point between the nucleus and the glide occurring at about half of the vowel’s duration. Overall, George mother’s data suggests intraspeaker variation. More tokens of /aɪ/ produced by the George mother are needed to better understand the extent of monophthongization and intraspeaker variation in George mother’s speech.

5.1.2 George Sibling. Table 3 displays the differences between F1 and F2 frequency measurements across the duration of three of the sibling’s tokens of the diphthong /aɪ/ in the
word medial position. In George sibling’s speech sample, there were only three tokens of /æɪ/ in word medial position. Table 3 also indicates the duration of each diphthong and includes differences between F1 and F2 at four, equidistant time points.

Table 3
Differences between formant 1 and formant 2 frequency measurements (Hz) across the duration of George sibling's /æɪ/ diphthong tokens at four time points

<table>
<thead>
<tr>
<th></th>
<th>Duration (s)</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>80%-20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>time</td>
<td>0.09</td>
<td>241</td>
<td>325</td>
<td>440</td>
<td>382</td>
<td>141</td>
</tr>
<tr>
<td>nine</td>
<td>0.1</td>
<td>402</td>
<td>364</td>
<td>612</td>
<td>689</td>
<td>287</td>
</tr>
<tr>
<td>time</td>
<td>0.08</td>
<td>574</td>
<td>727</td>
<td>918</td>
<td>842</td>
<td>268</td>
</tr>
</tbody>
</table>

All three of the siblings tokens of /æɪ/ displayed in Table 3 were word medial and preceded nasal consonants. Consistently across these three /æɪ/ tokens, the transitions from the nucleus to the glide occur between the 40% and 60% time points. The increase in F2-F1 at the point of transition for all three tokens is above 100 Hz and reaches 248 Hz for his production of the word “nine.” Across all three members of the triad, 248 Hz was the greatest increase in F2-F1 between time points. In the George sibling’s second token of “time,” F2-F1 decreases after the 60% point, which might be the effect of coarticulation. Table 3 also shows the change in the difference between the first and second formants from the 20% to the 80% point. In all three of the sibling’s tokens of /æɪ/, the difference between the first and second formants increases. The George sibling’s tokens do not show transition points before the 40% point nor after the 60% point, suggesting relatively equal duration of the nuclei and glides of his diphthong tokens and little to no monophthongization.
Figure 4. Waveform and spectrogram for the George sibling’s token of the word “nine,” a token of the /ɑɪ/ diphthong. The thick, vertical line approximates the location of the transition point in the diphthong.

Figure 4 includes the spectrogram for the George sibling’s token of the word “nine.” In the spectrogram of Figure 4, the LPC red dots chart the change in frequency of the formants. The thick, vertical line marks the location of the point of transition in the diphthong, which is approximately at the mid-point of the vowel’s duration.

5.1.3 George Child With Autism.

Table 4 displays the differences between F1 and F2 frequency measurements across the duration of three of the George child with autism’s tokens of the diphthong /ɑɪ/ in the word medial position. In George child with autism’s speech sample, there were only three tokens of /ɑɪ/ in word medial position. Table 4 also indicates the duration of each diphthong and includes differences between F1 and F2 at four, equidistant time points.
Of the three members in the George triad (George mother, child with autism, and sibling), the child with autism’s tokens of /aɪ/ were the least dynamic and differed most from a canonical diphthong token. In the first token of (in “nice”), F2-F1 increased the most (135 Hz) between the 20% and 40% time points. Between the 40% and 60% time points, F2-F1 decreased by almost half (264 Hz) and then continued to decline more gradually to the 80% time point. The net change in F2-F1 across the duration of this token of was -156 Hz. From the 40% to the 80% time points, this vowel resembles a diphthong produced by the movement of the tongue from front to back as in the diphthong in the word “down” (/ɑʊ/).

This first token of /aɪ/ (in “nice”) was the most dynamic of all of the George child with autism’s /aɪ/ tokens. The George child with autism produced the vowel in the word “like” (his second token of /aɪ/) like a monophthong. While there was slight fluctuation in F2-F1, the change was never more than 66 Hz and there was no consistent increasing or decreasing trend in the difference between the first and second formants. F2-F1 increased between 20% and 40%, then decreased between 40% and 60%, and then increased again between 60% and 80%.

<table>
<thead>
<tr>
<th></th>
<th>Duration (s)</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>80% - 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>nice</td>
<td>0.15</td>
<td>400</td>
<td>535</td>
<td>271</td>
<td>244</td>
<td>-156</td>
</tr>
<tr>
<td>like</td>
<td>0.05</td>
<td>447</td>
<td>500</td>
<td>444</td>
<td>510</td>
<td>63</td>
</tr>
<tr>
<td>side</td>
<td>0.19</td>
<td>357</td>
<td>362</td>
<td>435</td>
<td>403</td>
<td>46</td>
</tr>
</tbody>
</table>
Figure 5. Waveform and spectrogram for the George child with autism’s token of the word “like,” a token of the /au/ diphthong.

Figure 5 is the waveform and spectrogram for George child with autism’s token of the word “like.” In the spectrograms of Figure 5, the LPC red dots chart the change in frequency of the formants. The distance between the first and second formants does not change more than I would have expected to see in a monophthong. Similarly, for the George child with autism’s third token of /əɪ/ (in “side”), the change in F2-F1 is never more than 73 Hz. There is, however, a consistent yet small increase in F2-F1 across the duration of the vowel. I did perceive and transcribe the vowel to be a diphthong, but also noted that there seemed to be a degree of monophthongization because the transition to the glide was not as pronounced as I would perceive a canonical /a/ nucleus to /l/ glide transition to be for /əɪ/.

5.1.4 George Family Comparison
Based on the three tokens of /ɑɪ/ by the George sibling and the three tokens of /ɑɪ/ by the George child with autism, it appears the George sibling is more standard in his production of /ɑɪ/. The George sibling consistently produced both points of articulation of /ɑɪ/, each for about half of the vowel’s duration. The George child with autism, however, did not produce /ɑɪ/ with both points of articulation. The results showed little change in F2-F1 across the duration of all of the George child with autism’s /ɑɪ/ productions, suggesting that he frequently monophthongizes this diphthong. More tokens from both children are necessary to understand the true extent of monophthongization in their speech.

![Figure 6](image-url)

*Figure 6.* The average change in F2-F1 (Hz) across the duration of /au/ tokens for George child with autism (n=3), sibling (n=3), and mother (n=4).
Figure 6 graphically illustrates the average rate of change in F2-F1 for the George mother’s, sibling’s, and child with autism’s productions of the diphthong /āɪ/. Notice that for both the George mother and sibling there is an increasing trend across the duration of their /āɪ/ productions after the 40% point. The George sibling’s rate of change, however, was more rapid than the George mother’s. For the George child with autism, however, there is neither an increasing nor a decreasing trend, which is indicative of monophthongization. Overall, the George child with autism produced monophthongization of /āɪ/ to a greater degree than the George sibling and their mother. Based on this feature and my perception of the harmonic quality of the speech of the members of the George triad, the George child with autism does not phonologically sound like his mother or his sibling. More sampling is necessary, but this finding could have implications for the child’s identity expression through language.
5.2 Phonological Analysis, Symonds Family

5.2.1 Diphthong analysis. Table 5 displays the differences between the F1 and F2 frequency measurements across the duration of 12 of the Symonds child with autism’s tokens of the diphthong /ɑɪ/ in the word medial position.

<table>
<thead>
<tr>
<th>Word</th>
<th>Duration (s)</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>80% - 20%</th>
<th>Transition Time (s)</th>
<th>F2-F1</th>
<th>% Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>outside</td>
<td>0.20</td>
<td>864</td>
<td>891</td>
<td>821</td>
<td>1012</td>
<td>148</td>
<td>0.17</td>
<td>1210</td>
<td>87</td>
</tr>
<tr>
<td>like</td>
<td>0.13</td>
<td>795</td>
<td>993</td>
<td>1256</td>
<td>1436</td>
<td>641</td>
<td>0.11</td>
<td>1414</td>
<td>80</td>
</tr>
<tr>
<td>like</td>
<td>0.13</td>
<td>1047</td>
<td>1148</td>
<td>1379</td>
<td>1425</td>
<td>378</td>
<td>0.04</td>
<td>1215</td>
<td>29</td>
</tr>
<tr>
<td>like</td>
<td>0.11</td>
<td>1099</td>
<td>1295</td>
<td>1361</td>
<td>1523</td>
<td>424</td>
<td>0.05</td>
<td>1306</td>
<td>44</td>
</tr>
<tr>
<td>fight</td>
<td>0.19</td>
<td>937</td>
<td>1230</td>
<td>1751</td>
<td>1777</td>
<td>840</td>
<td>0.07</td>
<td>1181</td>
<td>39</td>
</tr>
<tr>
<td>like</td>
<td>0.11</td>
<td>1144</td>
<td>1276</td>
<td>1479</td>
<td>1543</td>
<td>399</td>
<td>0.06</td>
<td>1364</td>
<td>50</td>
</tr>
<tr>
<td>like</td>
<td>0.14</td>
<td>999</td>
<td>996</td>
<td>1122</td>
<td>1325</td>
<td>326</td>
<td>0.08</td>
<td>1090</td>
<td>59</td>
</tr>
<tr>
<td>right</td>
<td>0.12</td>
<td>889</td>
<td>992</td>
<td>1121</td>
<td>1345</td>
<td>456</td>
<td>0.04</td>
<td>1308</td>
<td>33</td>
</tr>
<tr>
<td>behind</td>
<td>0.10</td>
<td>1183</td>
<td>1400</td>
<td>1656</td>
<td>1507</td>
<td>324</td>
<td>0.04</td>
<td>1315</td>
<td>37</td>
</tr>
<tr>
<td>might</td>
<td>0.14</td>
<td>921</td>
<td>1042</td>
<td>1145</td>
<td>1415</td>
<td>494</td>
<td>0.05</td>
<td>972</td>
<td>39</td>
</tr>
<tr>
<td>five</td>
<td>0.23</td>
<td>638</td>
<td>641</td>
<td>747</td>
<td>892</td>
<td>254</td>
<td>0.19</td>
<td>891</td>
<td>83</td>
</tr>
<tr>
<td>excited</td>
<td>0.11</td>
<td>962</td>
<td>960</td>
<td>1076</td>
<td>1216</td>
<td>254</td>
<td>0.05</td>
<td>1004</td>
<td>48</td>
</tr>
</tbody>
</table>

Transition Time: amount of time elapsed in the duration of the vowel when the transition from nucleus to glide occurs
F2-F1: F2-F1 at transition point
% Point: %age of vowel duration elapsed at point of transition
All of the formant contours of all of the Symonds child with autism’s /aɪ/ tokens showed transitions points from the nucleus to the glide. The points of transition for the Symonds child with autism’s tokens of /aɪ/ were more variable relative to his mother’s tokens. The earliest point of transition among the child with autism’s tokens was in the word “right” at the 33% point and the latest point of transition was in the word “outside” at the 87% point. Conversely, the mother’s earliest point of transition was in the word “right” at the 58% point. The mother’s latest point of transition was in the word “like” at the 80% point.

Table 6 displays the differences between F1 and F2 frequency measurements across the duration of 12 of the mother’s tokens of the diphthong /aɪ/ in the word medial position.

<table>
<thead>
<tr>
<th>Word</th>
<th>Duration (s)</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>80% - 20%</th>
<th>Transition Time</th>
<th>F2-F1</th>
<th>% Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>like</td>
<td>0.07</td>
<td>766</td>
<td>872</td>
<td>1092</td>
<td>1241</td>
<td>475</td>
<td>0.04</td>
<td>1030</td>
<td>57</td>
</tr>
<tr>
<td>right</td>
<td>0.09</td>
<td>1041</td>
<td>1113</td>
<td>1078</td>
<td>1255</td>
<td>214</td>
<td>0.05</td>
<td>1201</td>
<td>58</td>
</tr>
<tr>
<td>like</td>
<td>0.11</td>
<td>937</td>
<td>982</td>
<td>1066</td>
<td>1280</td>
<td>343</td>
<td>0.08</td>
<td>1175</td>
<td>80</td>
</tr>
<tr>
<td>like</td>
<td>0.07</td>
<td>834</td>
<td>900</td>
<td>1021</td>
<td>1037</td>
<td>203</td>
<td>0.06</td>
<td>1052</td>
<td>80</td>
</tr>
<tr>
<td>might</td>
<td>0.11</td>
<td>1117</td>
<td>1150</td>
<td>1309</td>
<td>1204</td>
<td>87</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>like</td>
<td>0.17</td>
<td>661</td>
<td>799</td>
<td>1104</td>
<td>1323</td>
<td>662</td>
<td>0.11</td>
<td>1194</td>
<td>63</td>
</tr>
<tr>
<td>like</td>
<td>0.17</td>
<td>917</td>
<td>1034</td>
<td>1100</td>
<td>1224</td>
<td>307</td>
<td>0.08</td>
<td>1200</td>
<td>78</td>
</tr>
<tr>
<td>behind</td>
<td>0.18</td>
<td>731</td>
<td>723</td>
<td>904</td>
<td>909</td>
<td>178</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fight</td>
<td>0.15</td>
<td>583</td>
<td>740</td>
<td>956</td>
<td>1377</td>
<td>794</td>
<td>0.10</td>
<td>1108</td>
<td>68</td>
</tr>
<tr>
<td>aside</td>
<td>0.16</td>
<td>819</td>
<td>855</td>
<td>829</td>
<td>785</td>
<td>-34</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>behind</td>
<td>0.08</td>
<td>558</td>
<td>557</td>
<td>730</td>
<td>517</td>
<td>-41</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
These 12 tokens were chosen based on the child’s tokens. Since the Symonds child with autism’s speech data was more limited due to his communicative ability, all of the child’s /æʊ/ tokens were used except in the case of unclear tokens. The child produced three unclear /æʊ/ tokens. I chose the mother’s tokens so that the words analyzed were mostly the same as those analyzed for the child to eliminate the confound of word environment. The Symonds mother’s speech data did not include a clear token of the word “five” as the Symonds child with autism’s did so I chose “life” as a substitute because the diphthong precedes the labiodental fricative (/f/) as it does in “five” (/v/). Also, the Symonds mother did not produce the word “excited,” so I chose a second token of the word “behind” for analysis.

In three of the 12 tokens (in the words “might,” “aside,” and both tokens of the word “behind”), there was little change in F2-F1 across the duration of the vowel, which is indicative of monophthongization. The Symonds mother did not consistently monophthongize /æʊ/. The vowel occurs in a different environment for each of these words so environment does not seem to play a role. This inconsistent monophthongization could simply be explained by intraspeaker variation.

The mother showed a smaller range in the point of transition from the nucleus to the glide in her productions of the diphthong /æʊ/ (58% to 80%) than the Symonds child with autism did. For 10 of the 12 Symonds mother tokens, the transition point was after the 60 %
time point. In tokens three and four in Table 6 (both tokens in the word “like”), the transition occurred around the 80% time point, which is relatively late in the duration of the vowel.

Figures 7 and 8 are waveforms, spectrograms, and formant contours—they illustrate the first token of “like” by the child with autism in Table 5 and the fifth token of “like” by the mother in Table 6 respectively. In both Figure 7 and Figure 8, there are easily discernable points of transition on the spectrograms and formant contours; both transition points are around the 80% duration point. Additionally, the duration of the vowels in “like” for these two tokens (one by the Symonds child with autism and one by his mother) were similar (0.13 seconds for the child with autism and 0.17 seconds for his mother’s token). While the Symonds child with autism and his mother produced “like” similarly, there was difference in the amount intraspeaker variability between the Symonds child with autism and his mother and thus yielding interspeaker variability. Table 5 shows the transition points for four other of the child with autism’s tokens of “like.” Among the Symonds child with autism’s “like” tokens, the transition point ranges from the 29% to 80%. Table 6 shows the transition points for four other of the Symonds mother’s tokens of “like.” Among all of the Symonds mother’s “like” tokens, the transition point ranges from 63% to 80%, meaning the nucleus of the diphthong is consistently dominant and that there is some degree of monophthongization. The Symonds child with autism’s speech varied more within itself than the Symonds mother’s did. This finding might simply be associated with the inherent variation that I would find between any two speakers. This finding might also be associated with the fact that the Symonds child with autism’s language is still developing. More speech sampling is necessary to begin to answer whether the difference in variability between the Symonds child with autism and the Symonds mother is associated with autism specific factors.
The shift in the formants is dramatic in Figure 7b. The difference between the first and second formants and the frequency of each formant remains relatively constant through the nucleus and then second formant shifts up and F2-F1 increases, effectively forming the diphthong /aɪ/.

**Figure 7a.** Waveform and spectrogram for the Symonds child with autism’s token of the word “like,” a token of the /aɪ/ diphthong.

**Figure 7b.** Formant contour for the Symonds child with autism’s token of the word “like,” a token of the /aɪ/ diphthong.
Figure 8, the frequency of both the first and second formants increase, as does F2-F1 gradually. The transition point is not as clear as the Symonds child with autism’s transition in Figure 7. The change in F2-F1 is gradual.

Figure 8a. Waveform and spectrogram for the Symonds mother’s token of the word “like,” a token of the /ai/ diphthong.

Figure 8b. Formant contour for the Symonds mother’s token of the word “like,” a token of the /ai/ diphthong.
Figure 9 graphically illustrates the average rate of change in F2-F1 for 24 tokens of /āɪ/ (12 for the child with autism and 12 for the mother). The trends for both the Symonds child with autism and the Symonds mother displayed in Figure 9 are comparable in rate of change in F2-F1. The 119 Hz difference in the y-intercept is indicative of the finding that, for the child with autism, F2-F1 was greater than for the mother overall across the duration of the vowels. The average greater difference in F2-F1 means that the Symonds child with autism’s tongue is more forward in the oral cavity than it is for the Symonds mother as he is producing the diphthong /āɪ/.

![Figure 9](image)

*Figure 9*. The average change in F2-F1 (Hz) across the duration of /au/ tokens for the Symonds child with autism (n=12) and mother (n=12).
5.2.2 Interdental Analysis. To conduct the interdental analysis, I selected all of the Symonds child with autism’s intelligible tokens of word initial interdental fricatives (i.e., demonstratives and the pronoun “they”). There were a total of 11 tokens. The mother had more tokens, but I selected the first 11 tokens.

Tables 7 and 8 describe the interdental fricative tokens by the Symonds child with autism and his mother respectively. In the Tables, “IA” stands for interdental alternation, the linguistic feature described in sections 2.4.2 and 2.5.2. Marks in the “No IA” column mean that the interdental fricative was produced as an interdental fricative. Marks in the “IA” column mean that there was some degree of interdental alternation.

<table>
<thead>
<tr>
<th>Word</th>
<th>No IA</th>
<th>IA</th>
<th>Phonemic Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &quot;the&quot;</td>
<td>x</td>
<td></td>
<td>/tɛs/ (consonant produced as affricate)</td>
</tr>
<tr>
<td>2 &quot;there&quot;</td>
<td>x</td>
<td></td>
<td>/dɛɹ/</td>
</tr>
<tr>
<td>3 &quot;they're&quot;</td>
<td>x</td>
<td></td>
<td>/dɛɹ/</td>
</tr>
<tr>
<td>4 &quot;they&quot;</td>
<td>x</td>
<td></td>
<td>/de/</td>
</tr>
<tr>
<td>5,6 &quot;they..that&quot;</td>
<td>x</td>
<td></td>
<td>/de/ /θɪs/ /θɪs/ /θɛ/</td>
</tr>
<tr>
<td>7 &quot;they&quot;</td>
<td>x</td>
<td></td>
<td>/de/</td>
</tr>
<tr>
<td>8,9,10 &quot;this..this..that&quot;</td>
<td>x</td>
<td></td>
<td>/θɪs/ /θɪs/ /θɛ/</td>
</tr>
<tr>
<td>11 &quot;that's&quot;</td>
<td>x</td>
<td></td>
<td>/θɛ/</td>
</tr>
</tbody>
</table>

No IA: Consonant produced as interdental fricative
IA: Interdental alternation

Table 7 includes the analysis of the 11 interdental tokens of the child with autism that I included in the analysis. Six of the 11 interdental tokens were interdental alternations. All of those six tokens preceded mid-front vowels (/e/ and /ɛ/). In one interesting case, the interdental fricative in the word initial position of “the” was produced as the /t̚s/ affricate.
Table 8
Tokens of interdental fricatives by the Symonds mother

<table>
<thead>
<tr>
<th>Word</th>
<th>No IA</th>
<th>IA</th>
<th>Phonemic Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &quot;then&quot;</td>
<td>x</td>
<td></td>
<td>/ðɛn/</td>
</tr>
<tr>
<td>2 &quot;the&quot;</td>
<td>x</td>
<td></td>
<td>/ðæ/ (some reduction)</td>
</tr>
<tr>
<td>3, 4 &quot;that that&quot;</td>
<td>x</td>
<td>x</td>
<td>/æ/ , /ɛ/</td>
</tr>
<tr>
<td>5 &quot;the&quot;</td>
<td>x</td>
<td></td>
<td>/ðæ/</td>
</tr>
<tr>
<td>6 &quot;this&quot;</td>
<td>x</td>
<td></td>
<td>/θɪs/</td>
</tr>
<tr>
<td>7 &quot;they&quot;</td>
<td></td>
<td>x</td>
<td>/de/</td>
</tr>
<tr>
<td>8, 9 &quot;that…that&quot;</td>
<td></td>
<td></td>
<td>/ðæ/, /ɛt/</td>
</tr>
<tr>
<td>10, 11 &quot;that…this&quot;</td>
<td></td>
<td>x</td>
<td>/ðæ/, /θɪs/</td>
</tr>
</tbody>
</table>

No IA: Consonant produced as interdental fricative
IA: Interdental alternation

Table 8 includes the analysis of the 11 interdental tokens of the Symonds mother. Only two of the Symonds mother’s 11 tokens were interdental alternations. One of those tokens preceded the mid front vowel, as did all of the Symonds child with autism’s. The second token of interdental alternation preceded the low front vowel (/æ/).

5.3 Conclusions

The results for both the analysis of monophthongization of /æɪ/ and interdental alternation suggest differences within the George triad and within the Symonds dyad. For the George family, the George child with autism produced monophthongization of /æɪ/ to a greater degree than his sibling and mother. Secondly, the George sibling was more standard in his production of the diphthong /æɪ/ than the George child with autism and their mother. The most interesting finding was the difference between the George child with autism and the George sibling. Would this finding still occur with more speech sampling? If so, what internal and external factors are mediating the difference despite receiving similar
phonological input? Peer sampling might elucidate the factors that are influencing this difference.

For the Symonds family, there was greater variability in the Symonds child with autism’s diphthong productions than in the Symonds mother’s as measured by a wider range in the points of transition across his 12 tokens of /āu/. Additionally, the Symonds child with autism produced more tokens of interdental alteration. More sampling (including peer sampling) is necessary to understand the mechanisms that are influencing this difference. External, sociolinguistic variables should be considered carefully. Mothers and their male children differ in age and in gender. Age and gender are socially salient factors that mediate language variation (Wolfram, 2006).

People are able to make judgments about others from hearing just few. As Purcell-Gates (2002) describes, as soon as a person opens his or her mouth, we can attribute characteristics related to intelligence, class, and race. According to Purnell et al. (1999), people are capable of identifying the racial background of others based on speech alone. Whether or not a child sounds like the speakers in his or her environment could potentially affect the child’s ability to interact with peers despite the level of communicative ability. If the child sounds odd to peers, the peers might be reluctant to interact with the child, which could affect psychological adjustment (Erdley, Nangle, Newman, & Carpenter, 2001). The Symonds child with autism is in an inclusion classroom with typically developing peers and an aid. If the differences between him and his mother are reflective of differences between him and his typically developing peers, the Symonds child with autism might experience issues with psychological adjustment while at school. Difficult psychological adjustment due to a lack of developmentally appropriate peer relationships is a possibility as the Symonds
mother described the Symonds child with autism’s difficulty successfully initiating interaction with peers. Similarly, if the standard features of the George sibling’s speech contrast with his peers and that contrast is salient, the contrast could affect his psychological adjustment. By salient, I mean that the relevant linguistic features affect the ability of the speaker to identify with other speakers and the extent to which the identification is reciprocal (peers accept the speaker and the speaker believes he or she identifies with peers based on use of language). I suspect that the differences between the George child with autism’s speech, his mother’s speech, and his sibling’s speech are specific to the autism diagnosis and characteristics of autistic speech as discussed earlier. Again, if his speech differs from his peers and the difference is salient, the difference could affect his psychological adjustment.
Chapter 6:

Results: Matched Guise Testing

In Chapter Two, I described matched guise testing as a sociolinguistic experimental design that tests covert values or attitudes that people assign to others based on speech alone (Wodak, Johnstone, & Kerswill, 2010). In the current study, as I describe in this chapter, I conducted matched guise testing to determine what racial and ethnic backgrounds a sample of special education teachers, student teachers, and experts perceive the members of the George triad (George child with autism, sibling, and mother) and the members of the Symonds dyad (Symonds child with autism and mother) to be from.

The guises were generated from the data collected for the phonological analysis discussed in Chapter Five. The guise samples were carefully selected in order to avoid priming the listeners. Each sample was between 15 and 20 seconds of running speech. For three of the guises (the three children), I needed splice sections the speech data to create samples. Most critically, the guises could not include narrative that would implicate the speaker’s racial identity. For example, the speaker in Sample A (George child with autism) referred to his “chocolate arms,” which was his way of referring to himself as African American. The racial background categories included in both Table 9 and Table 10 are based on the responses of the 16 special education teachers, student teachers, and experts.

Guise sample surface transcription:

Sample A—George Child With Autism

“I like my tails because, because they’re nice and I like to put them on the wall because they’re colorful, they’re nice on the wall. I like games—video games, Mario Brothers. Racecar games. I like to draw a lot” (“Faces Of Autism”, 2012).
Sample B—George Sibling With Autism

“If you don’t know your nines times tables, let me teach you by your fingers. You hold up ten fingers. Okay, pretend you didn’t know nine times seven. You put down your seventh finger. Count one—one, two, three, four, five, six” (“Faces Of Autism”, 2012).

Sample C—George Mother

“Faces of Autism definitely was inspired by through my boys and the fact that I—the fact that I lightened up towards their diagnosis” (“Faces Of Autism”, 2012)

Sample D—Symonds Child With Autism

“She was—I think she sang like ten or fifteen songs. And that’s why dad things she did—she cut off all the power. She might cut off all the power. And that program is going to be longer since it’s thirty-four minutes delay—thirty-four minute delay or thirty-five.” (Symonds child with autism, personal communication, February 15, 2013)

Sample E—Symonds Mother

“Typically, I wake at 5:30 and I’m off to work by 6:30 and I’m at work by seven. And then on the reverse I come home by 4:30 and go from professional me to home, mommy me.”

(Symonds mother, personal communication, February 15, 2013)

Table 9 shows the racial identifications by the 16 listeners of the guises based on the George family guises. As previously discussed, all of the guises were African American. Of the 16 listeners, fewer than 50% of them correctly identified the George child with autism as African American. Even fewer of the listeners correctly identified the George sibling as African American (25%). More of the listeners identified the George sibling as Caucasian. Interestingly, however, 68.8% of the listeners correctly identified the George mother as African American.
Table 10 shows the racial identifications of the Symonds family guises. Of the 16 listeners, the majority of them (56.2%) correctly identified the Symonds child with autism as African American. 81.2% of the listeners correctly identified the Symonds mother as African American.

Overall, the matched guise testing revealed that at least the plurality of the listeners correctly identified the racial identity of four of the five guises, excluding the George sibling. These findings fail to support the hypothesis that the listeners would categorize the children with autism as not “sounding African American/black.” The finding that the plurality of listeners identified the George sibling as Caucasian might mean that higher functioning individuals with autism have more difficulty developing the social language variation that is salient to sounding African American. Further investigation is necessary to assess what linguistic features were critical to these correct identifications.
Table 11 shows correct racial/ethnic background identifications by guise and listener. Each listener was given a letter label. Twelve of the listeners were Caucasian/white, so I cannot draw specific conclusions about differences in ability to distinguish dialects based on racial or ethnic background. It is interesting to note, however, that none of the three African American listeners were able to correctly identify the Sample B guise (George sibling with autism). As discussed earlier, the George sibling has Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS). PDDNOS might affect the ability of the child to acquire dialectal features that are salient to the ability of African Americans to correctly identify the racial/ethnic background of other African Americans by speech alone.

<table>
<thead>
<tr>
<th>Listener</th>
<th>Racial/Ethnic Background</th>
<th>Sample A</th>
<th>Sample B</th>
<th>Sample C</th>
<th>Sample D</th>
<th>Sample E</th>
<th>Total Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>African American</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>African American</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>African American</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>Caucasian</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>Caucasian</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>F</td>
<td>Caucasian</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>G</td>
<td>Caucasian</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>5</td>
</tr>
<tr>
<td>H</td>
<td>Caucasian</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>3</td>
</tr>
<tr>
<td>I</td>
<td>Caucasian</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>J</td>
<td>Caucasian</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>K</td>
<td>Caucasian</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>L</td>
<td>Caucasian</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>M</td>
<td>Caucasian</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>3</td>
</tr>
<tr>
<td>N</td>
<td>Caucasian</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>O</td>
<td>Caucasian</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>P</td>
<td>Did not indicate</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>5</td>
</tr>
</tbody>
</table>

$x = $ Correct identification
6.2 Conclusions

In both the George triad and the Symonds dyad, the children were more difficult to identify than the mothers, which may have implications for the ability of the children to assert their racial identity as African Americans. Identity expression, however, is beyond the scope of the current study. A greater sample of African American listeners is necessary to understand the significance of the three African American listeners incorrectly identifying the George sibling with PDDNOS. The fact that 75% of the listeners were not able to correctly identify the George sibling brings up questions about what it means to sound like a member of a racial or ethnic background and what internal and external factors mediate the ability to sound like a member of a racial or ethnic background.
Chapter 7: Discussion

7.1 Discussion

The findings of the current research have allowed me to develop new questions and thus arrive at a new starting point for future research. Developing a more informed starting point and research model was, in fact, the primary aim for this thesis research.

One of the biggest questions relates to isolating autism specific factors from sociolinguistic variables that might affect the acquisition and/or production of social language variation. In addition to autism specific factors, gender and age are sociolinguistic variables that likely contributed to differences between the two children with autism and their mothers in their production of monophthongization of /aɪ/ and interdental alternation. Adults and children and males and females produce social language variation differently (Wolfram, 2006). Inherent variability could also explain differences between the mother and the children. To better understand the role of autism, it is necessary to compare the child’s speech to peers and to a sibling who has lived in the same environment with the same language input.

Even with the potential effects of sociolinguistic factors, the matched guise results suggest that there is something about the speech of the five guises that affected how the listeners identified the guises racial and ethnic backgrounds. As discussed, the listeners had more difficulty correctly identifying all three of the children (George child with autism, George sibling, and Symonds child with autism) than they did with identifying the mothers (George mother and Symonds mother). While this finding might be related to age as a sociolinguistic variable, the finding that 75% of the listeners incorrectly identified the George
sibling raises questions about factors specifically related to Pervasive Developmental Disorder Not Otherwise Specified (PDDNOS). Further investigation is needed to learn how PDDNOS might affect the acquisition or production of features that are salient to the ability of African Americans to identify other African Americans correctly by speech alone, as none of the three African American listeners correctly identified the George child with autism. Further investigation would involve more African American listeners and more guises with PDDNOS.

7.1.1 George family. While I was not able to gather information about the George home environment, I assume that the George child with autism, his sibling, and their mother live together based on narrative by the mother suggesting regular interaction. If this triad does in fact live together or even if the mother is the primary caregiver for her two children, the language environment for the George child with autism and his sibling are likely the same or similar. I am also making the assumption that the mother interacts and communicates with her two children equally. There was no mention of the presence of a father (a potential source of language input). With language environment constant, I can consider other explanations for differences between the George child with autism and his sibling. The fact that the child monophthongized his diphthongs more than his mother and sibling suggests that autism specific factors are influential. More information about the George child with autism’s ability to interact socially, joint attend, and attend to speech sounds would be helpful in drawing conclusions about why there were differences. Based on the fact that the George child with autism was responsive and generated questions in his interaction with his mother and sibling in the Youtube video suggests that he is able to engage in joint attention and social interaction, at least in the familial context. It remains to
be seen if he interacts with his peers. I would hypothesize that mechanisms of autistic speech are overriding the George child with autism’s ability to produce the speech variety of his mother and sibling. The George child with autism’s speech was monotonous by my perception, which is a feature of autistic speech. More speech data would allow for more detailed analysis of qualities and features of autistic speech in the George child with autism’s speech.

7.1.2 Symonds family. The Symonds mother shared that her child with autism does not usually successfully engage with peers, which might suggest that peer influence on his language is relatively limited, regardless of the language variety of his peers. To fully assert that claim, however, I would need to analyze the speech of his peers at his middle school. The high percentage of African Americans at his public school suggests that many of his peers might use some features of African American English.

7.2 Limitations

One of the challenges of my thesis research was finding African American triads. A triad was defined as a child with autism, a sibling, and a mother. Ultimately, I was able to use data from one triad and one dyad. The triad data came from Youtube. A mother with two children (one with autism and one with Pervasive Developmental Disorder Not Otherwise Specified) recorded videos of herself and her boys from which I was able to extract speech data.

It is important to note that several autism studies included small samples. Whalon and Hart (2011) conducted an exploratory study investigating how children with autism in inclusion classrooms experience reading instruction. The participants included three students with autism spectrum disorder. Likewise, Whalon and Hanline (2008) included three students
with autism and nine general education students in their study of the effects of reciprocal questioning on the question formation and responding of children with autism. Wolk and Giesen (2000) studied a single family that included four children with autism. Whalon and Hart (2011), Whalon and Hanline (2008), and Wolk and Giesen (2000) all discuss the implications of their work and suggest future research that will expand on their findings as I do in this current research.

7.2.1 Youtube data. While the Youtube data did not provide a complete picture of the factors that could have potentially influenced the analysis, the use of the Youtube data for a pilot investigation was helpful in the construction of a research model. There are several limitations that informed aspects of the methodology that I plan to employ during future study. The limitations include the inability to gain specific information about the child with autism’s peer and social interactions and a lack of direct observation of the child. Information about the George child with autism’s peer interactions would have allowed me to make specific hypotheses and conduct analysis on the extent to which the child is influenced by peer language variety relative to the mother’s influence. Direct observation would have allowed me to learn of differences in the George child with autism’s and the George sibling’s speech production based on communicative partner and environment. Additionally, from the Youtube data, I was not able to analyze the same words across the members of the George triad because there were no words with /ɑɪ/ in word medial position that were produced by all three member of the triad. Unlike the Symonds dyad, I was not able to control for sound environment. I must consider the possibility that the differences might not have remained if I compared the same words across all three members of the triad. The matched guise testing, however, corroborated differences in the speech of the three members of the triad.
7.2.2 Sibling comparison. A sibling comparison within the Symonds dyad (effectively making it a triad) would have allowed me to determine if the Symonds child with autism’s acquisition of social language variation reflects typical development as well as control for language environment. The demographic data about the Symonds child with autism’s middle school, however, helped me to make inferences about the Symonds child with autism’s level of social language variation acquisition. Even still, these inferences would have been stronger if I had speech data from his peers at his middle school.

7.3 Design of Future Research

Future research investigating the acquisition of social language variation could build on the current design. Major advancements for the current design would include more detailed diagnostic criteria for the children with autism, the collection of speech data in different environments, and the expansion of linguistic features considered in the analysis.

7.3.1 Participants. Complete triads (mother, child with autism, and typically developing sibling) should be recruited in order to control for environment via child-sibling comparisons. The children should be school age and communicative to increase the potential for child-peer interaction. Confirmation of diagnoses from a specialist should be required for inclusion. With this confirmation, the researchers should require a detailed report of all measures used to diagnose the children so that the researcher can have a thorough understanding of the impairments that could potentially influence the acquisition of social language variation. Additional information such as phonological awareness, verbal IQ, and joint attention ability will also be helpful in drawing conclusions beyond the current investigation. Additionally, the study should include more triads than the current study and peer speech sampling.
7.3.2 **Recorded observations.** The researcher should conduct three audio and video recorded dyad observations: 1) mother and child with autism, 2) mother and sibling, and 3) child with autism and sibling. Father’s speech, when applicable, could also be collected and analyzed. This research would then also include either interview questions or a questionnaire to assess the amount of interaction the child with autism and his sibling have with each parent. These observations will give the researcher an idea of variation in language use within the family based on communicative partner. Two researchers should observe and provide narrative analysis for the data without discussing their observations to eliminate bias.

7.3.3 **Feature analysis.** Albeit the speech sampling for the current research was limited, future study should involve broader linguistic analysis to consider non-phonological features as well. I would analyze syntactic or grammatical features. Two examples of grammatical features relevant to African American English would be the use of habitual “be” and copula deletion. I would also explore the salience of the fundament frequency (F0) in order to analyze voice quality and the harmonics of speech, which may contribute to the concept of “sounding African American” or sounding like a member of a racial background. To collect the speech data, I would use elicitation paragraphs for fundamental frequency analysis. If the participants are reading the same paragraph, I can isolate phonology and compare specific words within triads and conduct fundamental frequency analysis. To analyze differences in use of grammar, I would present the participants with videos with an agent engaging in some behavior or activity and ask the participant to orally describe what he or she saw. Oral descriptions would be audio and video recorded. In the case of describing what is happening in videos, the participants are constructing the sentences based on their own syntactic knowledge.
7.3.4 Future directions. The future research design discussed above builds on the design implemented in the current study. From this more comprehensive design, I will be able to get a more complete understanding of the factors that might contribute to how each child with autism develops or does not develop social language variation. As discussed, the extent of social language variation can have implications for identity expression and, I speculate, identity formation. I can further expand on this design to gain insight on identity formation for children with autism. Considering the literature and the limited understanding of the extent to which African American children with autism acquire social language variation, this design has the potential to answer critical questions at the intersection of developmental psychology, linguistics, Africana studies, and community studies.

7.3.5 Community-based model. In this research model development, I will incorporate the community-based learning model. Cress, Collier, and Reitenauer (2005) define community-based engagement: “students engage in actively addressing mutually defined community needs as a vehicle for achieving academic goals” (p. 7). There is a need for more culturally and linguistically informed interventions and services (ASHA’s Multicultural Issues Board, 2004). Through this research, I will also interview African American families about their concerns about speech services. I will use my findings to develop culturally and linguistically informed speech interventions for children with autism for pilot testing among African American families. In the more distal future, I will expand the model to other minority backgrounds. Additionally, I want study the diagnostic and assessment tools used for autism and evaluate their representativeness and applicability to racial and ethnic minorities. My aim is to work towards eliminating the discrepancies in the
age of autism diagnoses and the quality of services received between majority and minority
groups.

In fall 2013, I will begin graduate study at Vanderbilt University to pursue a Master
of Science in Speech-Language Pathology. With access to resources in the Vanderbilt
University Peabody College of Education and Human Development and the Vanderbilt
University School of Medicine, I will continue to investigate the social language acquisition
of African American children with autism through work on a master’s thesis. This current
research serves as a field study to further develop the model of investigating social language
acquisition by children with autism and other developmental disorders. At Vanderbilt, I will
investigate the same research questions. To what extent do African American children with
autism acquire and/or produce social language variation? And what factors mediate
acquisition and/or production of social language variation?
References


Constantino, J. N., Yang, D., Gray, T. L., Gross, M. M., Abbacchi, A. M., Smith, S. C.,


Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Leventhal, B. L., DiLavore, P. C., … Rutter,


Thomas, M. S. C., Annaz, D., Ansari, D., Scerif, G., Jarrold, C., & Karmiloff-Smith, A.


Appendix A: Pre-Interview Consent Form

Dear Parent,

My name is Kiara Savage and I am a student at the College of William and Mary studying linguistics and psychology. As a part of my honors thesis work, I am conducting a research study to examine the effect of autism spectrum disorder on child acquisition of parent speech variety. The families I have selected for participation have an African American child with autism spectrum disorder. This research is case study based. The results of this study will be synthesized into an honors thesis research paper and presented to a committee of faculty members at the College of William Mary in April 2013. Publication of the results will not be pursued until I obtain your consent. There are no plans for specific publication to date.

You and your child will be asked a series of questions via interview. The interviews will be conducted only with your permission and your child’s assent. I will be conducting the interviews. I would ask that you (as the parent or guardian) are present during my interview with your child. Prior to both my interview with you and my interview with your child I will provide a complete list of the questions to be asked for your review. Please see this list of questions on the following page. The interviews will be audio recorded only with your permission as well. You may at any time ask to review the audio files and edit them in order to delete any material you do not want in those files. You may also turn the audio recorder off at any time during the conversation.

The manner in which a person speaks may vary on levels of pronunciation, grammar, and vocabulary. Differences in the way people speak naturally arise because language is always
changing (Charity Hudley and Mallinson, 2011). The primary purpose of recording the
interviews is to have speech samples to analyze for distinct ways in which you speak English
in an informal setting relative to people of different speech communities.

During the interview I will ask you questions about your background as it relates to your
speech variety. I will also ask you to describe your child’s ability to communicate as well as
any interesting or noteworthy aspects about how your child communicates in different
settings and with different people. The content of your answers will allow me to get an
understanding of your child prior to conducting the interview with your child. The interview
with your child will primarily be used for speech sampling and analysis. Additionally, I will
observe an interaction between you and your child. This observation will last thirty minutes
and will be audio and video recorded with your permission only. The interaction should be
something that is a part of your daily routine with your child. I will ask you to decide the
activity I will observe.

There are no risks associated with participation in this study nor are there direct benefits.
However, by participating and allowing your child to participate you will be contributing to
understanding about the language acquisition of children with autism spectrum disorder. You
will be compensated for your participation with a $30 Target gift.

Confidentiality

All identifying information about you and your child or children will be disassociated with
the recording and kept strictly confidential. If any publications result from this research, you
nor your child or children will be identified by name. You and your child’s or children’s participation in this study is completely voluntary and you may withdraw at any time.

Disclaimer/Withdrawal:
You and your child are not required to enter this research study and your agreement to participate in this study is completely voluntary. You and your child are free to withdraw from this study at any time without penalty or prejudice and, if you wish, all data that has been collected will be destroyed at your request.

Offer to Answer Questions:
As principal investigator, I will answer any questions you have at any point in this process. If you have any additional questions or concerns, please contact my advisor Dr. Anne Charity Hudley via email at ahchar@wm.edu or the Chair of PHSC, Dr. Lee Kirkpatrick (7572213997, consent@wm.edu). You may also contact me via my cellphone number 7038617721 or via email at kssavage@email.wm.edu.

Please read the list of interview questions below prior to signing this form.

I, _________________________________________, have read the interview questions and do agree to participate in the project described above.

I do grant permission for my child, ________________________________________, to participate in this project.
Child Assent Script

Title: Assessing the Prevalence of the Acquisition of Parent Language Variation Among Their Children with Autism Spectrum Disorder

Hello, _________________________ my name is Kiara. How are you doing today? I would like your help with a study. I would like to interview you about your interests and daily routine. The plan is to audio and video record the interview so that I can go back and listen to our session together. While reviewing the files, I will be listening to see if there are similarities in the way you and your parent or guardian speak. I will be paying attention to pronunciation, grammar, and vocabulary. You can share as much or as little as you like. My goal is for this interview to feel less structured and more like a conversation. Later I will observe an interaction between you and your parent/guardian. You should pretend like I am not even there. This observation will be audio and video recorded as well.

If you have any questions during the interview or observation session, you can always ask me. Your parents said it was okay for you to talk with me. If you ever feel uncomfortable and don’t want to continue our conversation, just let me know and we can stop at anytime. You won’t get in any trouble, and no one will be mad at you. Okay?

Would you like to participate in an interview with me today?
If yes, great, we will start at ________________.

If no, the child will be free to leave, thanked by the interviewer, and dismissed from the study.
Appendix B: Interview Questions

Parent Interview Questions:

1. Where are you from?
2. Where have you lived?
3. With whom have you lived?
4. Which of the these social details (those referenced and discussed in the previous questions) do you think may have influenced the way you speak? Are there other social details that you think are important?
5. What is your favorite childhood memory?
6. Please describe a typical day for your family.
7. Please describe a typical day for your child with autism.
8. With whom does your child interact most during a typical week?
9. Does your child with autism have any special interests? If so, could you describe how he or she acts on his or her interest(s)?
10. How would you describe your child’s ability to communicate in different settings (home, school, etc.)?
11. How would you describe your child’s speech?

Child Interview Questions:

1. Could you tell me about some of your interests?
2. What is your favorite thing to do?
3. What is your average day like?
4. Where is one place you would like to visit?
5. Where is your favorite place to be?
6. What is your favorite childhood memory?

7. If you could invent something, what would it be?

8. If you could have one superpower, what would it be and why?
Appendix C: Pre-Survey Consent Form

Title of Project: Assessing the Perception of the Racial and/or Ethnic Background of Five Speakers Based on Speech Samples

Researcher: Kiara Savage (kssavage@email.wm.edu)

I understand the general nature of this study entitled, “Assessing the Perception of the Racial and/or Ethnic Background of Five Speakers Based on Speech Samples” conducted by Kiara Savage. I understand that I will be asked to respond to ten questions. The survey will include links to five speech samples that are no longer than 20 seconds. Immediately following the end of the sample, I will be asked to identify what I perceive the racial or ethnic background of the speaker to be. There are no risks or benefits associated with my participation. This survey should take no more than 10 minutes to complete. I understand that my responses will be confidential and that my name will not be associated with any results of this study. I know that I may refuse to answer any question asked and that I may discontinue participation at any time. I am aware that I may report dissatisfaction(s) with any aspect of this experiment to the Chair of the Student IRB, Dr. Monica Griffin, 1-855-800-7187 (toll free), or consent@wm.edu. I am aware that I must be at least 18 years of age to participate. My signature below signifies my voluntary participation in this project and that I have received a copy of this consent form.
If study subject has any questions in regard this project, please contact the principal researcher directly:

Kiara Savage (kssavage@email.edu)

Dr. Anne Charity Hudley (achar@wm.edu)

THIS PROJECT WAS FOUND TO COMPLY WITH THE APPROPRIATE ETHICAL STANDARDS AND WAS EXAMPTED FROM THE NEED FOR FORMAL REVIEW BY THE COLLEGE OF WILLIAM AND MARY STUDENT IRB (Phone: 757-221-3966) ON [03-25-2013]

Signature (please type your initials in the text box below to provide consent)
Appendix D: Matched Guise Testing Questions

This survey targets special education teachers, special education student teachers, and those with expertise in special education. Do one of these categories describe you?

- Yes
- No

If yes, which category best describes you?

- Special education teacher
- Special education student teacher
- Someone with expertise in special education

Each of the next five questions will include a link to a short (less than 20 seconds) speech sample. Please click on the link and listen to the speech sample. One you are done listening, you can close the window with the speech sample and answer the question. Thank you for your participation!

Click here: Sample A

From what racial or ethnic background do you perceive the person in Sample A to be? Please type your response.

Click here: Sample B
From what racial or ethnic background do you perceive the person in Sample B to be? Please type your response.

Please click on the link and listen to the speech sample. Once you are done listening, please close the window with the speech sample and answer the question.

Click here: Sample C

From what racial or ethnic background do you perceive the person in Sample C to be? Please type your response.

Please click on the link and listen to the speech sample. Once you are done listening, please close the window with the speech sample and answer the question.

Click here: Sample D

From what racial or ethnic background do you perceive the person in Sample D to be? Please type your response.

Please click on the link and listen to the speech sample. Once you are done listening, please close the window with the speech sample and answer the question.

Click here: Sample E

From what racial or ethnic background do you perceive the person in Sample E to be? Please type your response.

Have you heard any of these speech samples before?

- Yes
- No
Have you even taken a linguistics course?

- Yes
- No

What racial or ethnic background do you identify with? Please type your response.

PAGE BREAK

Debrief

The survey you just completed was a matched guised survey. Sociolinguists use the matched guise technique to measure language attitudes (Gaies & Beebe, 1991). The aim of this study is to see how a specified group of non-linguists perceive five speakers based on speech samples alone. The survey aims to supplement concurrent honors thesis research. The honors thesis is an investigation of the extent to which two children with autism are able to acquire social language variation.

If you have any questions in regard to this project, please contact the principal researchers directly:

Kiara Savage (kssavage@email.wm.edu)

Dr. Anne Charity Hudley (ahchar@wm.edu)
Appendix D: Spectrogram Pictures

George Mother

Figure 9. Waveform and spectrogram for the George mother’s production of the word “thrive,” a token of the /aI/ diphthong.
Figure 10. Waveform and spectrogram for the George mother’s second production of the word “minds” a token of the /aI/ diphthong.

Figure 11 Waveform and spectrogram for the George mother’s production of the word “time,” a token of the /aI/ diphthong.
**George Sibling**

Figure 12. Waveform and spectrogram for the George sibling’s second production of the word “time,” a token of the /aI/ diphthong.

Figure 13. Waveform and spectrogram for the George sibling’s production of the word “time,” a token of the /aI/ diphthong.
George Child With Autism

Figure 14. Waveform and spectrogram for the George child with autism’s production of the word “nice,” a token of the /aI/ diphthong.

Figure 15. Waveform and spectrogram for the George child with autism’s production of the word “side,” a token of the /aI/ diphthong.
Symonds Child With Autism

Figure 16a. Waveform and spectrogram for the Symonds child with autism’s production of the word “outside,” a token of the /ai/ diphthong.

Figure 16b. Formant contour for the Symonds child with autism’s production of the word “outside” a token of the /ai/ diphthong.
Figure 17a. Formant contour for the Symonds child with autism’s production of the word “like” a token of the /aI/ diphthong.
Figure 18a. Waveform and spectrogram for the Symonds child with autism’s production of the word “like” a token of the /al/ diphthong.

Figure 18b. Formant contour for the Symonds child with autism’s production of the word “like” a token of the /al/ diphthong.
Figure 19a. Waveform and spectrogram for the Symonds child with autism’s production of the word “fight” a token of the /al/ diphthong.

Figure 19b. Formant contour for the Symonds child with autism’s production of the word “fight” a token of the /al/ diphthong.
Figure 20a. Waveform and spectrogram for the Symonds child with autism’s production of the word “like” a token of the /aI/ diphthong.

Figure 20b. Formant contour for the Symonds child with autism’s production of the word “like” a token of the /aI/ diphthong.
Figure 21a. Waveform and spectrogram for the Symonds child with autism’s production of the word “like” a token of the /aI/ diphthong.

Figure 21b. Formant contour for the Symonds child with autism’s production of the word “like” a token of the /aI/ diphthong.
Figure 22a. Formant contour for the Symonds child with autism’s production of the word “right” a token of the /ai/ diphthong.
Figure 23a. Waveform and spectrogram for the Symonds child with autism’s production of the word “might” a token of the /al/ diphthong.

Figure 23b. Formant contour for the Symonds child with autism’s production of the word “right” a token of the /al/ diphthong.
Figure 24a. Waveform and spectrogram for the Symonds child with autism’s production of the word “behind” a token of the /al/ diphthong._behind_9_.

Figure 24b. Formant contour for the Symonds child with autism’s production of the word “behind” a token of the /al/ diphthong.
Figure 25a. Waveform and spectrogram for the Symonds child with autism’s production of the word “might” a token of the /aI/ diphthong.

Figure 25b. Formant contour for the Symonds child with autism’s production of the word “might” a token of the /aI/ diphthong.
Figure 26a. Waveform and spectrogram for the Symonds child with autism’s production of the word “five” a token of the /aI/ diphthong.

Figure 26b. Formant contour for the Symonds child with autism’s production of the word “fight” a token of the /aI/ diphthong.
Figure 27a. Waveform and spectrogram for the Symonds child with autism’s production of the word “excited” a token of the /aI/ diphthong.

Figure 27b. Formant contour for the Symonds child with autism’s production of the word “excited” a token of the /aI/ diphthong.
Figure 28a. Waveform and spectrogram for the Symonds mother’s production of the word “like” a token of the /al/ diphthong.
Figure 29a. Waveform and spectrogram for the Symonds mother’s production of the word “right” a token of the /aI/ diphthong.

Figure 29b. Formant contour for the Symonds mother’s production of the word “right” a token of the /aI/ diphthong.
Figure 30a. Waveform and spectrogram for the Symonds mother’s production of the word “like” a token of the /aI/ diphthong.

Figure 30b. Formant contour for the Symonds mother’s production of the word “like” a token of the /aI/ diphthong.
Figure 31b. Formant contour for the Symonds mother’s production of the word “like,” a token of the /ai/ diphthong.
Figure 32a. Waveform and spectrogram for the Symonds mother’s production of the word “might” a token of the /aI/ diphthong.

Figure 32b. Formant contour for the Symonds mother’s production of the word “might” a token of the /aI/ diphthong.
Figure 33a. Waveform and spectrogram for the Symonds mother’s production of the word “like” a token of the /al/ diphthong.

Figure 33b. Formant contour for the Symonds mother’s production of the word “like” a token of the /al/ diphthong.
Figure 34a. Waveform and spectrogram for the Symonds mother’s production of the word “behind” a token of the /al/ diphthong.

Figure 34b. Formant contour for the Symonds mother’s production of the word “behind” a token of the /al/ diphthong.
Figure 35a. Waveform and spectrogram for the Symonds mother’s production of the word “fight”, a token of the /aI/ diphthong.

Figure 35b. Formant contour for the Symonds mother’s production of the word “fight” a token of the /aI/ diphthong.
Figure 36a. Waveform and spectrogram for the Symonds mother’s production of the word “aside” a token of the /aI/ diphthong.

Figure 36b. Formant contour for the Symonds mother’s production of the word “aside” a token of the /aI/ diphthong.
Figure 37a. Waveform and spectrogram for the Symonds mother’s production of the word “behind” a token of the /aI/ diphthong.

Figure 37b. Formant contour for the Symonds mother’s production of the word “behind” a token of the /aI/ diphthong.
Figure 38a. Waveform and spectrogram for the Symonds mother’s production of the word “life” a token of the /aI/ diphthong.

Figure 38b. Formant contour for the Symonds mother’s production of the word “life” a token of the /aI/ diphthong.