LANGUAGE DEVELOPMENT OF SAME-SEX MULTIPLE-BIRTH SIBLINGS:

A RETROSPECTIVE NATURE/NURTURE STUDY

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Linda W. Holladay

Certificate of Approval:

____
Thomas E. Nunnally
Associate Professor
English

____
Robin Sabino, Chair
Associate Professor
English

____
Elaina M. Frieda
Assistant Professor
Communications

____
Joe F. Pittman
Interim Dean
Graduate School

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A RETROSPECTIVE NATURE/NURTURE STUDY

Linda W Holladay

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LANGUAGE DEVELOPMENT IN MULTIPLE-BIRTH, SAME-SEX SIBLINGS:

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Linda W. Holladay

Signature of Author

Date of Graduation

VITA

Linda Holladay is a graduate of Spearfish High School in Spearfish, South Dakota. She received her Master's from the University of Nebraska, Omaha, and entered the Ph.D program at Auburn University, Alabama, in 1996. She is married to retired Air Force Colonel Cecil Holladay and has two sons, Andrew and Matthew. She currently teaches linguistics and composition at Alabama State University in Montgomery, Alabama.

DISSERTATION ABSTRACT

LANGUAGE DEVELOPMENT IN SAME-SEX MULTIPLE-BIRTH SIBLINGS:

A RETROSPECTIVE NATURE/NURTURE STUDY

Linda W. Holladay

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This retrospective study considers the extent to which nature and nurture influence early first language acquisition. Data sets that address rate of grammatical acquisition, acquisition of regional dialect features, and temperament are examined.

The subject population consists of four multiple-birth, same-sex siblings born to a European-American, college-educated couple living in the South. Two of the siblings are monozygotic (identical DNA), and the other two are dyzygotic (at least 50% shared DNA).

Pre-existing audio tapes recorded when the children were ages 2 through 6 were examined using Mean Length of Utterance (Brown, 1973) and Developmental Sentence Structure (Lee, 1974) to determine grammatical development. Tapes also were examined for acquisition of two regional phonological features: monophthongization of /ai/ and variants of (ing), and two lexico-syntactic features, *yall* and *fixin to*. Carey Temperament Scales, completed by the parents, were used as a third estimate of similarity or difference.

Although the retrospective nature of the study limits the data available for analysis, results show that the monozygotic siblings are more similar to one another in both grammatical acquisition and regional forms than are the dyzygotic siblings. Acquisitional differences appear more pronounced at earlier ages, indicating that genetics may be more influential in earlier years.

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CHAPTER 1

INTRODUCTION

Nurture vs nature is a central issue among linguists, who often disagree as to the relative contributions of genetics and environment to the acquisition of language. Nurturists argue from the perspective of the Vygotskyan theory that language acquisition is largely a product of social interaction, and that the environment of the learner is of more importance than heredity. Nurturists accept the premise that heredity may provide cognitively healthy children with an ability to produce language, but do not believe children are genetically endowed with a cognitive structure dedicated solely to the acquisition of language. From the nurturist perspective, linguistic behavior, modeled by the speech community, provides adequate linguistic input. As children interact with their speech communities, they produce increasingly complex linguistic structures. Therefore, the linguistic environment in which a child is socialized is the prime impetus for language acquisition. From this perspective, children learn not only linguistic functions, but also social norms and language values.

The naturist theory, in contrast, derives from Chomskian theory which holds that the ability to learn language is biologically innate; all healthy individuals have the ability to learn language since the brain is genetically encoded to acquire language. According to naturist thought, the environment surrounding the child merely produces the necessary data that the language acquisition device uses to set language parameters. As evidence for their position, naturists point to the fact that children produce constructions to which they have not been exposed, such as overregularization of past tense morphemes (*I runned fast*). Naturists argue that children create a complex system of rules despite the poverty of the input. This biological approach explains the universal nature of language acquisition.

Although many first language acquisition researchers reject the nativist position, they nevertheless agree that child language acquisition shows remarkable cross-linguistic similarity. All children, regardless of language, learn first utterances at about one year of age with grammar emerging similarly across languages. Moreover, despite the seeming polarity of views, neither naturists nor nurturists contend that language acquisition occurs in a vacuum. The debate centers on predominance of domain and which specific aspects of language are affected by either nature or nurture and to what degree.

Two problems have been encountered by researchers when attempting to determine the effects of nature or nurture on the acquisition of language. Studies using controlled environments do not account for possible genetic differences, and studies using children with different genetic codes do not account for differences in environments. A controlled environment and a subject data set which contains both children with identical genetic structures and children with non-identical genetic structures is necessary to determine which influence predominates. Such a controlled environment has been difficult to find.

No child is born into exactly the same environment as any other child. A first-born child is born into a pre-existing family of two parents. A second-born child, although born to the same parents, will be born into a different environment, one consisting of two parents and an older sibling. The two environments share some but not all characteristics. In addition, the genetic make-up of two such siblings differs, making it impossible to determine whether the different environments or the different gene structures are the predominant influences on the acquisition of language.

Identical twins solve the problem of identical genetic structure, but since identical twins are also born into an identical familial relationship, it is difficult to tell whether the identical genetic structure or the similar environment most affects language acquisition. An additional set of siblings with non-identical genetic make-up (fraternal twins) who are born into the same family at the same time would provide a comparison to the set of identical twins. One possible data set, therefore, would be a corpus produced by a set of same-sex quadruplets consisting of one set of identical twins and one set of fraternal twins.

This study examines the language acquisition of just such a data set, a corpus produced by four, multiple-birth, same-sex siblings consisting of one set of identical twins and one set of fraternal twins. Linguistic features of particular interest to this study are rate of language acquisition and acquisition of regional dialect features. In addition to analysis of the language data, this study considers genetic temperament characteristics as a possible explanation for language similarities and/or differences.

CHAPTER 2

REVIEW OF THE LITERATURE

2.0. Introduction

The review of the literature for this study address both non-linguistic and linguistic variables. Studies of non-linguistic variables are those examining external factors such as the environmental and genetic impact on the rate of child-language development. Studies of linguistic variables will include those examining the phonological and syntactic conditioning of regional dialect forms. Much work has been done concerning the rate of child language acquisition, and these studies can often shed light on the nurture/nature debate. Very little, however, has been studied concerning the extent to which regional dialect features are affected by either nurture or nature. The review of the literature will look at twin studies with implications for either nature or nurture, temperament studies with implications for language development, studies on the rate of child language development, and studies on acquisition of Southern monophthongization of /ai/, variable (ing) and lexico-syntactic features *yall* and *fixin to*.

2.1. Twin Studies with implications for the effect of nurture and nature on language acquisition

Researchers seeking to resolve the nature/nurture debate have studied the language development of twins as a means of examining the relative contributions of genetics and environment. Comparing sets of twins or comparing twins with singletons has allowed researchers to identify differences between identical twins (referred to in this study as monozygotic, or MZ) who share 100% of their genetic make-up, and fraternal twins (referred to in this study as dyzygotic, or DZ) who share at least 50% (Dale, Eley, & Plomin, p. 622). Since the twin environment is largely equivalent, differences in language acquisition have been attributed to the different genetics of the twin sets.

Many of these studies concentrate on the divided attention situation endemic to the twin situation (Conway, Lytton & Pysh, 1980; Stafford, 1987; Tomasello, Mannle & Kruger, 1986). That is, while a mother of a singleton can direct all her attention to one child, a mother of twins must direct attention to two. This diminished individual attention has been considered a cause of slower language development in twins.

Conway, Lytton, and Pysh (1980) studied 12 sets of twins and 24 singletons, age 2:6, from similar socioeconomic backgrounds.[1] A two-hour spontaneous speech session was taped for each twin set. The study reports that the amount of the mother's speech to the child was the most important predictor of the child's language performance. Children from singleton/mother dyads verbalized more; children from twin and mother triads verbalized less. The authors interpreted their results as indicating that the environmental factors surrounding the singleton/mother dyads encouraged verbalization.

Tomasello, Mannle, and Kruger (1986) observed six twin pairs and 12 singletons, all white, middle class children, at age 15 months and again at 21 months. The results of their study were similar those of Conway, Lytton and Pysh (1980) in that twins scored

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[1] Specific socioeconomic information was not given.

lower than singletons on all measures of language development; however, the amount of verbalization in the environment was not found to be a mitigating factor in this study. Rather, Tomasello et al. report that although mothers of twins spoke as much as mothers of singletons, twin children had less speech directed to them individually, a difference that developed from the triadic situation itself.

Stafford (1987) monitored the conversational characteristics of college-educated mothers and 24-36 month-old twins and singletons. This study included 22 mothers of twins and 22 mothers of singletons, all from middle-class families. As with previous studies, twins scored significantly lower than singletons on tests involving language expression and comprehension. There was also a correlation between both the qualitative and the quantitative maternal input and the children's test scores. Stafford reports that twins received less responsive, conversation-eliciting, maternal speech than did singletons.

Although the above studies are useful in identifying contrasts between twins and singletons that may indicate an environmental impact, they have not addressed the question of nature. Studies which compare MZ and DZ twins do indicate a genetic effect on language acquisition.

Matheny and Bruggemann (1972) tested the articulatory development of 263 twins and 94 singletons from families of twins. Subjects ranged from three years to eight years old and were from a range of socioeconomic backgrounds. Using the *Templin-Darly Screening Test of Articulation,* Matheny and Bruggemann found that the mean scores of twins were significantly below the standard norms. Additionally, they found greater similarity in articulation between MZ twins than between DZ twins. Since siblings within the same family group share much of their environment, Matheny and Bruggeman attributed the difference in articulation to genetics.[2]

Locke and Mather (1989) analyzed speech samples from 26 pairs of 4-year-old MZ and DZ twins from white, middle-class Midwestern backgrounds, and found that MZ twins were more likely to produce substitutions, omissions or distortions for the same sounds on an articulation test than were DZ twins, whose utterances were judged to be similar to unrelated children. Pollack and Keiser (1990) also report that a set of identical twins patterned closely in vowel error production.

More recent studies, such as Ganger's (1998) dissertation, show a genetic influence in acquisition of lexicon and inflectional morphology. Her case study of 43 MZ and 33 same-sex DZ twins shows that MZ twins have similar rates of vocabulary growth and similar acquisition of grammatical categories, whereas DZ twins show greater divergence from one another. Ganger, Wexler and Soderstrom (1998) studied an optional infinitive[3] stage of language acquisition in five pairs of MZ and four pairs of DZ twins. The twins were studied longitudinally from age 1:7 to 3:10. They report that for the children studied, the optional infinitive stage was more similar in MZ twins than in DZ twins and interpret their findings as indicating a possible genetically-driven stage of acquisition.

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[2] Their study indicates that birth position in the family and socioeconomic status can also affect articulation in both twins and singletons.

[3] Defined as "a period in early child language during which children know the properties of tense and agreement but do not treat the use of these features as obligatory" (224).

2.2. Temperament studies with implications for language development

A second domain of interest to this study concerns personality and the effects of temperament on language development. Temperament differences, such as shyness and persistence, are thought to be genetically influenced (Wilson & Matheny, 1986; Martin, Drew, Gaddis & Moseley, 1988; Plomin, 1994; Dale & Goodman, 2005), and correspond to the ways a child responds to situations, such as curiously or fearfully, being easily distracted or able to focus attention well. Thus a temperament effect on language development represents a possible genetic influence, and as such, is relevant to the nature/nurture debate.

Questions regarding language, personality development, and motivation have been explored with studies on referential and expressive learning styles. Haynes and Shulman (2000) reference studies by Katherine Nelson in 1973 which first showed that children can be roughly divided into what she referred to as two learning tracks: referential learners, whose early vocabulary includes relatively more nominals, and expressive learners, whose vocabulary includes relatively more personal/social words.[4] Studies by Dellacorte, Benedict, and Klein (1983) confirmed Nelson's findings and went on to connect the expressive style of the mother with the learning style of the child. In the Dellacorte et al. study, in-home recordings of 60 mothers were used to classify maternal utterances according to communicative intent, focus of attention and evaluation.

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[4] Other researchers, e.g. Bretherton, 1983; Dellacorte, Benedict and Klein, 1983, maintain that children are not easily defined by tracks. They report that most children use a fairly balanced approach and that there is no indication of an advantage of one track over another.

They found that mothers of referential children produced a greater number of utterances, and those utterances were more descriptive and less prescriptive than the utterances of mothers of expressive children. Although the study can be interpreted as demonstrating an environmental link to the tracking style of the child, there was no control in the study to preclude a genetic connection.

A possible genetic connection to language development may have been documented by Bretherton, McNew, Snyder and Bates (1983) who tested the vocabularies of 30 children at 20 months and again at 28 months. They found that expressive learners produce more pronomials in early vocabulary (first 50 words), are more physical, have more activity-oriented words, and are predominately male. Maleness, however, must not be automatically associated with a genetic link. Although a sex differentiation indicates a genetic influence, a gender difference reflecting different social expectations indicates an environmental influence.

Other researchers have identified a genetic influence on language development (e.g. Martin and Holbrook, 1985; Martin, Drew, Gaddis, and Moseley, 1988; and Plomin, 1994). Martin and Holbrook found significant correlation between the behavior characteristics of persistence, activity level, adaptability, and approach/withdrawal and 104 first graders' reading scores on both classroom and standardized achievement tests. In three separate studies reported in Martin et al., distractibility, persistence, and activity level were reported to have the highest degree of correlation to standardized test scores in 243 kindergarten through second graders. These researchers indicate that behavioral characteristics (i.e. temperament) are inherited. Plomin argues that such characteristics are instrumental in creating a learning environment. He maintains, "People to some extent choose their environments; the environments chosen are influenced by, not 'determined by,' the genotypes of those who choose" (p. 2).

Shyness has also been argued to impact language development. Wong-Fillmore (1979) observed the social interaction of five Spanish children, age 6 to14, while they learned English as a second language. Although she did not quantify the data, her observations indicated that the child who was most outgoing and who produced language without regard for correctness learned English more quickly. Those who were less outgoing produced less language and took longer to learn. Wong-Fillmore hypothesized that the risk-taking personality socializes more easily and that greater socialization accelerates language learning. Although socialization may allow for the input needed for language development, in Wong-Fillmore's study it is the risk-taking temperament which creates the environment that accelerates the process.

Goldfield and Snow (1989) came to similar conclusions concerning risk taking and first language acquisition. They found that shy children make fewer errors, but that they talk less and produce less complex speech. Faster learners talk more, make more errors, but seem to learn from those errors and achieve greater fluency.

Paul and Kellogg (1997) report a relationship between shyness and slower rates of acquisition. Twenty-eight children who had been identified by parents and clinicians as delayed in language development[5] were rated according to approach/withdrawal

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[5] Fewer than 50 words at 20 months

behavior. The children's behavioral measure positively correlated with mean length of utterance (MLU). In addition, Paul and Kellogg found a positive correlation between physical activity and language development. They suggested that the results were due to the same basic source: shyness resulted in lower motivation to initiate conversation, which, in turn, resulted in less communication. High physical activity resulted in less time to communicate.

Other correlations between language acquisition and personality are reported by Dixon and Smith (2000). *Toddler Temperament Scales* were completed on 40 toddlers at age 13 months. This was followed by the *Communicative Development Inventory* at 20 months. Positive correlations were found to exist between stable emotional temperaments at 13 months and later language development at 20 months. Dixon and Smith suggested that children with more stable temperaments are better able to focus attention, allowing faster acquisition. The authors theorized that focused attention allowed the child to initiate more mother-child interaction, facilitating acquisition.

Although the studies discussed here on rate of acquisition show a connection between language learning and personality, they generalize among genetically unlike subject pools. Thus questions concerning the effects of nature or nurture remain. It is possible, for example, that risk-taking is a learned trait rather than an inherited one, or that temperament shapes mother/child interaction. What is needed is study on genetically similar subjects from socially similar environments.

2.3. Assessment of language development

A number of instruments have been used to assess child language development. Two of interest to this study are Mean Length of Utterance (MLU) and Developmental Sentence Scoring (DSS).

MLU, developed by Brown in 1973 as a diagnostic tool to assess child language acquisition, determines the average number of morphemes a child speaks per speech episode.[6] Brown considered evaluation of MLU a valid measure of morphemic and syntactic level up to age 4. However, this widely used measure of language development is not without critics. Although Brown gives fairly comprehensive guidelines for computing MLU, Crystal (1974) criticizes Brown's guidelines as incomplete. Klee and Fitzgerald (1985) studied 18 normally developing two and three-year-old, white children from English-speaking homes to determine if MLU alone was a valid indicator of syntactic development. Excluding single-word morphemes (e.g. *yes*, *no*, etc.), Klee and Fitzgerald report that MLU increases predictably as a child ages, but that the results were not consistent across an age range. They argue that there is no predictable relationship between MLU in the 24 -48 month range and suggested that MLU is of limited value beyond Brown's stage II (age 2.0-2.5).

Using a larger sample, Blake, Quartaro and Onorati (1993) refuted Klee and Fitzgerald's results. Recording spontaneous speech samples from 87 English-speaking children, Blake et al. found an age correlation through age 4.5, reporting, "The measure

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[6] An episode is the approximate equivalent of a sentence. (See appendix A).

of syntactic complexity was not found to have a ceiling in terms of reflecting clausal complexity; and thus, it is a promising measure of grammatical complexity which is also relatively easy to apply to spontaneous speech samples" (151). High correlations between age and MLU are also reported by Miller and Chapman (1981) and Rondal, Ghiotto, Bredart, and Bachelet (1987). Interestingly, Miller and Chapman's results with 123 children validated MLU through age 5, although they reduced the number of utterances by half observing that "a minimum of 50 intelligible utterances or 20 minutes of conversation was required" (156). In spite of some criticism, then, MLU has become a standard measurement of child language development, as witnessed by its use in the studies of Conway, Lytton and Pysh (1980), Paul and Kellogg (1997), Roberts (1994), Shatz (1994) and others.

A second highly respected and widely used assessment tool of child grammatical development, normed on a group of 200 normally developing children, is Developmental Sentence Scoring (DSS) (Lee, 1974). Larsen (1975) of the University of Texas, Austin, describes the DSS as "a significant work on assessing children's use of grammatical rules in Standard English, and is useful to any professional working with children with language disorders" (467). However, although DSS is used by clinicians to diagnose language delay and acceleration, Lee, the creator of the testing measure, does not limit DSS to that purpose. She writes, "Developmental Sentence Analysis is a method for making a detailed, readily quantified and scored evaluation of a child's use of standard English grammatical rules from a tape-recorded sample of his spontaneous speech in conversation with an adult" (xix).

Although to date, DSS has not been used in twin studies, it has been used to assess normal children in conversation and picture-description experiments (Haynes, Purcell, & Haynes, 1979). It was also used in Paul and Kellogg's (1997) study of "Temperament in Late Talkers" as one means of establishing level of language development.

2.4. Temperament assessment

Many of the studies referenced in section 2.4 are based on categories established by the *New York Longitudinal Study* (NYLS) of Thomas, Chess, Birch, Hertzig and Korn (1963). This seminal work (Wilson & Matheny, 1986) is no longer available. However, the *Carey Temperament Scale* (CTS), which is highly correlated with the NYLS (*Carey Temperament Scale*, 1996-2000) and which has been adapted for use on children from one month to 12 years of age, is available. CTS uses parental input to obtain data, a technique increasingly accepted as providing valid data on language and child development. According to Dale and Goodman (2005), "One of the most striking developments in the study of child language, and indeed developmental psychology more generally over the past 20 years, is the revival of parent report as a trustworthy, and trusted, research technique" (42).

2.5. Acquisition of regional dialect features

Acquisition of child language has generally been studied by considering groups of children acquiring Standard English forms; little has been done on the acquisition of regional dialect features since these have generally been seen as affected solely by environmental constraints (i.e. nurture). However, within the limited dialect acquisition literature, no studies have been conducted which attempt to separate environmental from genetic impact. The possibility of a genetic component, such as temperament, that affects the acquisition of dialect cannot logically be ruled out.

Among the studies relating dialect choices to social influences are Labov (1972a), Jorgenson (1998) and Berthele (2002), who describe language as an instrument of prestige and belonging. Labov's study on Martha's Vineyard shows the local population's use of vowel centralization as a form of identity marking. His study of New York department stores (1972a) shows a correlation between socio-economic status and the perceived prestige of postvocalic [ɹ] usage. His work among inner city youth (1972b) demonstrates how group members use language to establish and enforce group boundaries.

Jorgensen's (1998) study of taped conversations of Turkish immigrant teens in Denmark reported situational code-switching when the teens spoke to Danish adults as opposed to Turkish adults. He reports dialect forms when the Turkish teens are speaking to Turks that are not used in conversations with Danes and interprets his results to mean that speakers choose a linguistic code based on issues of power and solidarity.

Berthele (2002) reports similar findings in his study of idiolectal dissonance. He observes that speakers' choices of linguistic form negotiate social roles and power. Berthele showed, in his study of, 9-year old Swiss, elementary school children acquiring a second dialect (N=14), that accommodation to a second dialect serves to mark identity in a group of peers. He interviewed the children and then taped them in their social classroom setting to discover if there was a target variety and in what contexts it occurred. Berthele indicates that even in same situations, the choice of variety depends on (1) individual psychological disposition, (2) age, (3) social style and (4) personality traits. He suggests that the degree to which an individual acquires a target dialect depends on how much the individual sees himself as part of the target group, and on the group's acceptance of him/her. As with Labov's studies of inner city youth, sociograms (analysis of social status within groups) showed greater accommodation to the dialect where there was greater peer acceptance of the child.

The question of a target dialect was also addressed by Deser (1989) in a study of six Detroit families with children ranging from 9 to 20 years of age. All were born in Detroit but had family members who had relocated to Detroit from the South. Individuals were assessed for degree of southern dialect retention. Within the same family unit, some children acquired Detroit speech while others acquired Southern dialect features. Although there were no clear patterns of parent/child modeling, Deser reports that the kinds of dialect models the child is exposed to—especially in school—have a great impact on the dialect choice. Her evidence also indicated that in some cases dialect ties are stronger than family ties.

Similar to Deser (1989), Starks and Bayard's (2002) study of acquisition of postvocalic /r/ in four pre-school children in New Zealand found parental modeling to be of limited value in the acquisition of New Zealand dialect forms. They studied four children of rhotic parents ([r] producing) and found that three of the four exhibited little or no postvocalic [r] in spite of parental modeling of the form.

The above studies on the acquisition of a regional or ethnic dialect concentrate on older speakers or second language learners. Few researchers, however, address early learners and their perceptions of a target language.

Cole's (1980) dissertation on the development of dialect features indicates that the impact of dialect choice appears over time and that some dialect features are not produced by young learners. She studied 3 to 5-year-old (N=60) children of speakers who exhibited what she identified as "moderate Black English" (BE). She found only eight of 19 BE forms to be present in pre-schoolers, but additional forms were found in older children. She concluded that children do not initially exhibit ethnic dialect forms, but produce forms found in Standard English until the age of three or four, at which time dialect forms may emerge. The findings seem to indicate that more than parental modeling is involved in the process of acquisition and dialect choice.

Harris' (2004) study of 60 speakers of African American English (AAE) from age 4 to 15 helps to illuminate Cole's finding. Harris found that although pre-school European American (EA) and African American (AA) children develop the same phonological, morphological and syntactic features, AA speakers retain features longer if the features are also found in AAE dialects.

Roberts (1994), who studied pre-school children in Philadelphia, shows that for t/d deletion (as in contractions with *n't* or past tense verbs such as *passed*) and the variation between the velar and alveolar nasal (e.g. *running* vs *runnin*), children create their own rules before acquiring those modeled by parents. She studied daycare children (N=17), age 3-5, in South Philadelphia and found that 3 and 4-year-old subjects exhibit t/d deletion and /ing/ in contexts different from adult usage and subject to different phonological and grammatical constraints. They were, she concluded, constructing variable rules and linguistic constraints of their own.

In contrast to the above studies, in a study of 108 children in Philadelphia, Payne (1980) showed parental modeling, hence environment, was essential in acquiring Philadelphia short /a/. Only those children in her study whose parents were locally born and raised could affectively produce the complex Philadelphia short /a/ pattern. Even those children who were born and raised in Philadelphia, but whose parents were non-local, were unable to completely acquire the phonological form.

The above research shows that when several alternatives are available in the environment, dialect acquisition seems to be a matter of choice to some degree. However, some dialect features have been found to be so pervasive in certain regional dialects (Bailey and Tillery, 1996; Bernstein, 2003; Hay, Jannedy, and Mendoza-Denton, 1999; Maynor, 1996) that it is likely the features will be found when studying the acquisition of child language within that region. The monophthongization of /ai/, the use of alveolar nasal [n] rather than veolar nasal [ŋ] in nouns as well as in verbs, and the use of *yall* and *fixin to* are all well-researched indicators of Southern American English (Bailey and Tillery, 1996) and were thus considered to be of interest to this study.

2.5.1. Phonological development of /ai/

Although there are several studies of children with phonological disorders, little research has been done concerning normal acquisition of English vowel forms. Even less has been done concerning the monophthongization of an existing diphthong. Fikkert (in press) holds that a child's vowel system is not fundamentally different from that of an adult's. She sees the developing system as not allowing for all the contrasts in adult speech. Rather, children tend to produce sounds which are easier to articulate. Otomo and Stoel-Gammon's (1992) study of four normally developing children ages 22-30 months found that two of the earliest vowels to develop are [a] and [i]. Kehoe and Stoel-Gammon's (1999) studies of 14 English-speaking children ages 1 to 3 found early development not only of [a] and [i], but also of the central lax vowel /ʌ/. Diphthong development has been shown to follow initial monophthong development in studies by Bernhardt and Stemberger (1998). Thus, the development of [a] and [i] precedes the development of /ai/. They also found that diphthong production in closed syllables (those containing a final consonant sound) was difficult for children, and one child in their study produced no diphthongs until after age 2.5. Otomo and Stoel-Gammon (1992) found that substitutions of /ai/ for monophthongs were rare in young children.

Pollack and Keiser (1990) studied phonological disorders in vowel production, but cite studies on normally developing children as well. Their findings based on 15 children, ages 3.8 to 6.4, studied for vowel production errors show that vowel reduction errors were more common than diphthongization. Pollack and Keiser also cite an older study by Wellman (1931) which indicates that diphthong errors typically involve the substitution of a monophthong for a diphthong, and that monophthongization is a common vowel production error in children.

The above studies agree that ease of production is involved in early vowel development, that the low and mid-central vowels [a] and [ʌ] appear early, and that children are likely to substitute a monophthong for a diphthong, especially in closed syllables.

2.5.2. Acoustic analysis of /ai/

Anticipating that spectrographic analysis might be useful in distinguishing monophthongal vowels from diphthongal vowels, several sources were consulted for conventions regarding formant analysis: Borden, Harris, and Raphael, 1994; Kent and Read, (1992); Ladefoged, Peter, 1996; and Carnell, 1997. According to Carnell, an adult southern monophthongal [a:] is indicated by F1 around 710 and an F2 around 1100 Hz. Diphthongal /ai/ is indicated by F1 around 640 Hz and F2 around 1190 Hz with marked movement toward 2250. Anderson's (2002) formant analysis of monophthongization in African-American Detroiters found similar Hz levels. Anderson defined an upward movement of greater than 250 Hz as indicating a strong diphthongal vowel.

2.5.3. Southern monophthongization of /ai/

In adults, Southern monophthongization of /ai/ has been shown to be conditioned by social and stylistic factors such as such as sex, age, socio-economic status (SES) (Head, 2003), social attitudes (Bailey and Tillery, 1996), ethnicity of speaker (Hay, Jannedy & Mendoza-Denton, 1999), and peer and caregiver influence (Starks & Bayard, 2002). Monophthongization of /ai/ has been shown to be influenced by internal factors as well. Bailey and Bernstein (1989), Hazen (2000), Bowie (2000), Head (2003), and Fridland (2003) have reported several internal variables, including following phonologival environment, part of speech, and word frequency as correlating with the production of monophthongal [a:]. Of those factors, following environment has received the most attention with a few researchers reporting the effects of part of speech (Bowie, 2001), or word frequency (Hay, Jannedy & Mendoza-Denton, 1999).

Research indicates that monophthongization is highly influenced by the sonority[7] of the following sounds. The greater the sonority of the following segment, the higher the probability that the second element of the diphthong will be weakened. Fridland's (2003) study of 30 adult European-American (EA) and African-American Vernacular English (AAVE) speakers in Memphis shows that glide weakening, or a decrease in the diphthong /ai/, is increasing in the South and most likely to be found before voiced obstruents, nasals, and in word final, or open, position. Hazen (2000) also reports that syllable position of the following sound affects monophthongization of /ai/ as much as sonority. Monophthongs in his data set were more likely to be produced in multisyllable words if the vowel and the following obstruent shared a common syllable, such as *lightning (la:t ·niŋ)*. When the following sound appeared in the onset of the following syllable, for example *lighting (laj · tiŋ)*, monophthong production was less likely. He hypothesized that when the following sonorant and the coda share the same syllable, the sonorant had greater impact on the vowel, thus increasing sonority. Hazen's findings of greater sonority in closed syllables are in contrast with Fridland's findings of greater sonority in word final position.

Hazen (2000) also reports a hierarchy of following environmental factors which influence monophthongization of /ai/ in West Virginia and North Carolina: liquids >

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[7] Sonorance refers to the free passage of air through either the oral or nasal cavity.

nasals > voiced obstruents > voiceless obstruents.[8] His results are similar to findings by Bailey and Bernstein (1989), Labov and Ash (1997), Bowie (2001), and Anderson (2002). Head (2003) expands Hazen's hierarchy to include glides, vowels and word boundary, and reports a hierarchy in Elba, Alabama, of glides > liquids > word boundary > voiced obstruents > nasals > voiceless obstruents > vowels. In adult speech, both Hazen and Head found that following liquids were more likely to produce monophthongization than other following environments such as nasals, or voiced and unvoiced obstruents. All of the researchers above found greater monophthongization of /ai/ preceding voiced obstruents than preceding voiceless obstruents.

Bowie (2001) indicates that word class has an effect on monophthongization. Nouns, especially non-subject nouns, adverbs, and verbs are more likely to be monophthongal than adjectives and other syntactic categories, including prepositions and determiners.

Hay, Jannedy and Mendoza-Denton (1999) found that lexical frequency, defined by them as five or more occurrences in the corpus of their study, was an indicator of monophthongization. They suggested that frequent production led to "semantic bleaching, phonological reduction" (n.p.).

Some studies indicate possible changes in progress in traditional Southern English, some toward expanded monophthongization and some toward reduced monophthongization. Comparing data from 1996-2001 to data in the *Linguistic Atlas of*

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[8] English liquids include [l][and [r]; nasals include [m] [n] [ŋ]; voiced obstruents include [b] [d] [g], voiceless obstruents include [p] [t] [k].

the Gulf States which shows no pre-voiceless glide weakening from speakers in Memphis, TN in the early 70's, Fridland (2003) suggests that monophthongization in pre-voiceless contexts is increasing. Thomas's (1997) evidence from the Phonological Survey of Texas indicates a split in the monophthongization patterns among Texas Anglos with urban areas showing less /ai/ monophthongization than rural areas. Bowie (2001) found a similar decrease in monophthongization in his study of 25 white, middle-class speakers in Southern Maryland.

2.5.4. The variable (ing)

A phonological variant with wide-spread English distribution is the alternation of alveolar [n] and velar [ŋ], particularly in the present participle morpheme (ing) (Wald and Shopen, 1985). Labov (1972) and Shuy, Wolfram and Riley (1968) show that the [n] variant is often seen as less prestigious than [ŋ], with many people not admitting to using the [n] variant at all. In non-Southern speech, greater use of the [n] variant has been documented in lower social classes, in younger speakers, and in informal situations. It is interesting to note, however, that Southern speech allows for the use of alveolar variant in formal situations as well. The variant has been noticed in State of the Union speeches by Presidents Clinton and Bush.[9] Shuy, Wolfram and Riley (1968) show that production of [ŋ] may also be influenced by phonological conditions such as preceding and following sounds. Preceding alveolar stops (t,d) favor the [ŋ] variant, while preceding velar stops (k,g) favor [n]. Following velar stops favor the [ŋ] variant, while following alveolar stops

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[9] R. Sabino, personal conversation, August 24, 2006

favor [n]. Wald and Shopen's (1985) article on the factors surrounding (ing) indicates that, in addition to sociolinguistic variables of gender, class and formality, grammatical category can affect [n] production. In most dialects of English, verbs are the most likely grammatical category to contain the [n] variant, followed by the pronouns *something*, *nothing*, and *anything*. Frequency of production also influences the production of the alveolar [n] form.

Although little research into monopthongization has been conducted on child speakers, some researchers have studied (ing) in children. Fisher's early (1958) study of (ing) in New England included an equal number of boys and girls (N=24), age 3-10, divided equally into two groups by age. His findings are similar to Labov's, (1972a) that [n] was more likely to be produced by boys, by children from lower socio-economic groups, and in less formal situations. According to Roberts' (1994) study, 3 and 4 year olds acquire grammatical and phonological constraints before social constraints. Grammatically, the Philadelphia children whom she studied were more likely to use [n] in verbs/complement structures[10] and less likely to use [n] in subject forms.

2.5.5. *Yall* and *fixin to*

Two lexico-syntatic features readily associated with Southern American English that have received the attention of researchers are *yall* and *fixin to*. In fact, according to Bernstein (2003), "No feature has been more closely identified with southern speech than the use of yall" (p. 107). Studies by Tillery, Wikle and Bailey (2000) and Maynor (1996)

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[10] Roberts found no significant difference in (ing) variation between verbs and complements, and differentiates between nouns, adjectives, and subject complements.

indicate that *yall* is beginning to lose its Southerness based on evidence from the Southern Focus Polls and *Linguistic Atlas of the Gulf States* showing that the feature is diffusing to speakers in northern and western states in spite of the stigma usually attached to Southern speech. Tillery, Wikle and Bailey (2000) report that over 40% of non-Southerners surveyed, even those with no apparent Southern roots, admit to using *yall*.

All the above researchers report that *yall* is widely preferred over *you all* among younger users. Maynor (1996) reports that age is of more importance than race, gender, or SES in determining which variant is used.

Although not as widely recognized as Southern outside the region, anecdotal evidence suggests the inchoative aspect marker *fixin to* is a feature often acquired in common with a positive orientation to the South.[11] It is now a common feature of Southern speech (Bailey and Tillery, 1996). Ching's (1987) study of 104 students and faculty at the University of Memphis indicates that agreement varies on a firm definition of *fixin to,* but the core meaning contains elements of priority of action, a slight delay, and anticipated preparatory action.

2.6. Summary

The research discussed above addresses the various questions that are of concern in this study which attempts to shed light on the nature/nurture debate in first language acquisition. Twin studies showing the effects of divided attention, both qualitatively and quantitatively, argue for the effects of nurture, while those twin studies that show the

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[11] R. Sabino, personal communication, August 24, 2006.

similarity of articulatory development and rate of acquisition of MZ twins give evidence consistent with a greater effect of nature. Inherited temperament characteristics such as shyness, persistence, willingness to approach new situations, and activity level have all been shown to correlate with language acquisition. Shy children do not interact as frequently as more curious counterparts, and children with high activity levels appear to expend energy on physical rather than verbal activities. Children who are curious and persistent appear to acquire language more quickly.

Because most of the above nature/nurture studies have been conducted on middle-class children, they represent the acquisition of Standardized English. Although studies have been conducted to ascertain the conditioning of dialect forms, studies of monophthongization in young children focus on errors, rather than the acquisition of dialect forms. Studies of adult monophthongization indicate several external and internal conditioning factors: topic, age, gender, ethnicity, peer influence, following sound, word class, stress, and word frequency. Other studies indicate that acquisition of a standardized or regional dialect reflects some level of choice. Some studies (Roberts, 1997) indicate that children construct their own rules for certain variables, others indicate that parental modeling is necessary (Payne, 1980).

To date, researchers have provided results that indicate the effects of both nurture and nature. However, they do not effectively speak to the relative effects of these factors due to the genetically and/or environmentally dissimilar subject pools from which they draw. A subject pool consisting of both genetically like subjects and genetically unlike subjects raised within the same environment is necessary to control for the effects of both nurture and nature. Siblings in larger multiple-birth groupings are born at the same time and share their environment, effectively eliminating environmental differences. When two or more multiple-birth siblings are MZ, genetic differences are also eliminated. When the multiple-birth group contains both MZ and DZ siblings, the circumstances are ideal for testing the effects of nature vs nurture. The study that follows analyzes retrospective data from such a subject pool, 2 MZ and 2 DZ same-sex, multiple- birth siblings.

CHAPTER 3

METHODOLOGY

3.0. Introduction

The purpose of this retrospective longitudinal study is to determine the relative contributions of nature and nurture to the language development of four multiple-birth, same-sex siblings. The study looks at two monozygotic (MZ) siblings and two dyzygotic (DZ) siblings raised in the same home to determine the degree to which the children are developing language similarly.

Language data was available from the four siblings from age 2 to age 6. The data were analyzed by several methods. Mean Length of Utterance (MLU) and Developmental Sentence Scores (DSS) were used to determine the rate of grammatical acquisition. Quantitative analysis was used to determine relevant linguistic conditioning for two regional phonological features, the monophthongization of /ai/ and the variable (ing). The lexico-syntactic features *yall* and *fixin to* were also examined. A *Carey Temperament Scale* (1996-2000) analysis, which measures nine personality characteristics, was obtained as an additional means of assessing the impact of nature and nurture on language development. This chapter discusses the selection of the subjects and the procedures and the instruments used to collect and analyze the data. In all cases, the null hypothesis, that there is no difference in the language development among the siblings on any of the measures, is tested.

3.1. Selection of Subjects

The subject population for this study consists of four members of a group of multiple-birth, same-sex siblings born to European American, college-educated parents living in the South. Two of the siblings are MZ (with identical DNA), and two are DZ (with at least 50% identical DNA). The DZ twins are identified as D1 and D2; the MZ twins are identified as M1 and M2. All children are developing normally with no reported speech, hearing, intellectual, or medical deficiencies. From birth, all of the siblings were tended by multiple caregivers who assisted with feeding, bathing, changing, and nurturing. In the first few months, tasks were shared equally by caregivers and parents. No caregiver was assigned an individual child; each assisted with the child who needed attention at a given time. Therefore, it is not likely that particular caregivers unduly influenced any of the children in the sibling group. An assumption of the study is that the sibling environment is more consistent than environments reported in previous twin studies.

The parents are acquaintances of the researcher and her family, and the researcher has known the siblings from their birth. Because the sibling group contains both MZ and DZ subjects, the children constitute an excellent subject pool to study the nature/nurture aspects of language development.

3.2. Data Collection

Data used for this study were taken from pre-existing audio tapes which were created by the parents and one of the caregivers during the natural course of the children's development between the years of two and six. The tapes are composed of child-directed conversations in the course of the siblings' play activities. Because the audio tapes were not created with this study in mind, the conversation is not controlled in terms of subject matter, type of interaction, location, privacy of conversations, or amount of data.

During the taping, the siblings were not aware that they were being recorded: the recording device was not visible, and the siblings were not wearing microphones. Enthusiastic parental consent was obtained to use the data on the audio tapes in this research study.

All data were collected from tapes which fell within two weeks of the siblings' second birthday and within two weeks of subsequent six-month intervals with the exception of the period between age 4.5 and 6 when no tapes were available for study. Thus, all utterances examined for each six-month interval fall within a thirty-day period.

3.3. Transcription

The researcher transcribed all available audiotapes which fell within the designated time frame using an Olympus Pearlcorder micro-mini transcriber. Transcription was enhanced by parental input in instances where utterances or speaker identification was not clear to the researcher. Unintelligible utterances were discarded, as were utterances which could not be positively ascribed to a specific sibling. All useable utterances were then listed by speaker and age on separate worksheets using standard English orthography. Variants of /ai/ were coded as [ʌ], [a] or [ai]. Variants for the variable (ing) were coded as [n] or [ŋ]. The lexico-syntactic tokens were listed.

3.4. Analysis of grammatical development

3.4.1. Mean Length of Utterance (MLU)

As discussed in the Section 2.3, despite some criticism (Crystal, 1974; Klee & Fitzgerald, 1985) MLU has become a standard measurement of child language development (Blake, 1993; Genesee, Nicoladis & Paradis, 1994; Roberts, 1994; Shatz, 1994). Using this widely accepted measure of early language development, this study hypothesizes that there will be no difference in MLU scores of the siblings at the 6 ages for which data has been transcribed.

Due to the nature of the pre-recorded data, the number of utterances available for analysis differs across the siblings. The 100 utterances for each child recommended by Brown (1973) were not obtainable at any of the ages studied. However, Miller and Chapman (1981) validated Brown's correlations in their study of 123 children using only 50 utterances to determine MLU; therefore, the current study is comfortable with a level of 50 utterances per sibling.

With the exception of the number of utterances per child, Brown's guidelines were followed in calculating MLU. Only fully transcribed utterances were used and doubtful transcriptions were eliminated. Inflectional and derivational affixes were counted as single morphemes. Lexical items considered as one morpheme were proper names, compound words (doghouse), diminutive words (*choo-choo*), irregular past tense verbs (*ran, went*), auxiliaries, and catenatives (*gonna, wanna*) because evidence indicates that these words operate as single morphemes for young children (Brown, 1973). The following utterance

What are we gonna do with the Blues Clues book? (D2 age 4.5)
1 2 3 4 5 6 7 8 9

would consist of nine morphemes with the catenative *gonna* and the proper name *Blues Clues* counting as single morphemes. Since the auxiliary is separated from the main verb, it is considered to be operating as a separate morpheme.

Data at age 2 did not contain enough tokens for MLU measurement. Thus, MLU for each subject was calculated at ages 3, 3.5, 4, 4.5, and 6 by dividing the total number of morphemes found per child by the total number of utterances available for that child. (See Appendix A for a fuller explanation of Brown's guidelines.)

SPSS 13.0 for Windows was used to perform a two-tailed t-test to determine if significant differences existed between the siblings' MLU scores. A value of $p<.05$ is interpreted to indicate significant difference for a pair of siblings.

3.4.2. Developmental Sentence Scores (DSS) and Developmental Sentence Type (DST)

Developmental Sentence Scores (DSS) was used in this study as a second measure of the children's language development. Although DSS is not as widely used by first language acquisition researchers as Brown's MLU, DSS is recognized as valid for assessing language development of both normally developing children and those with language deficits (Haynes, Purcell, & Haynes, 1979; Haynes & Shulman 1998; Pierce & Bartolucci, 1976; Cole, 1980).

DSS assesses sentences by assigning a weighted value to eight different categories of grammatical forms as the child develops their use. Nouns, pronouns, main verbs, secondary verbs, negatives, conjunctions, interrogative reversals and wh-questions are ranked by progressively more advanced usage. Structures which develop early are given lower point values than those which develop later. The points assigned to each sentence at each age for each child for the eight grammatical forms were totaled and then divided by the number of sentences assessed to obtain a mean sentence score.

The most recent version of Lee's *Developmental Sentence Analysis* (1974) was used to describe the siblings' sentence structure development.[12] Until a child's utterances consist of clausal structures, either dependent or independent, regardless of whether or not the utterances are deemed correct by adult standards, DSS is not considered a valid measure. Thus, in order to compute a DSS score, it must first be established that the child is producing such utterances. Consistent with Lee's instructions, Developmental Sentence Types (DST) analysis was performed in order to determine at what age to begin DSS scoring.

For each age, each child's usable utterances were separated into single-word constructions, two-word constructions, phrases of three or more words, and clausal constructions. The percent of clausal constructions per sibling was calculated. When DST

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[12] The problems encountered with insufficient data in the MLU analysis also present themselves in relation to computing DST and DSS scores, though to a lesser degree. Lee (1974) recommends a corpus of 100 utterances to compute the initial DST; however, fewer than 100 utterances can be used to estimate a child's grammatical ability.

indicated that more than half of the child's utterances were composed of clausal constructions, the child was determined to be ready for DSS testing. A secondary indication of readiness for DSS consists of 1) a decline across data points in the proportion of single-word and two-word constructions and 2) a concomitant increase in the proportion of phrases and sentences. The proportion of increase or decrease in these constructions was compared at ages at ages 3, 3.5, 4, and in one case, 4.5 until readiness was determined.

For the DSS, Lee (1974) recommends a corpus of 50 unique clausal constructions in order to accurately assess grammatical development, with scores from fewer than 50 sentences considered an estimate of a child's grammatical ability. DSS scoring was computed with the utterances available for each child.

To compute the DSS, repetitions were removed from the data sets, leaving only the unique utterances for each sibling beyond the age at which previous analysis determined DSS could be used. These utterances were listed for each child on the Excel spreadsheets. Utterances were assigned a score according to the scoring instrument developed by Lee (1974) shown as Appendix B.[13] Personal and indefinite pronouns are assigned one point; negatives, modals and interrogative reversals are assigned more points, depending on which grammatical structures they combine with. An extra point is assigned for a complete sentence structure. For example, the utterance *Can you do this and this?* (D2, age 3) is scored as follows:

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[13] Complete scoring instructions are found in *Developmental Sentence Analysis* (Lee, 1974)

Table 3.1. DSS computation of *Can you do this and this?*

word	structure	points
this x 2	indefinite pronoun	1x2=2
you	personal pronoun	1
can do	modal + main verb	4
and	conjunction	3
	interrogative reversal of modal	6
	complete sentence structure	1
Total points for utterance		**17**

Scores for all sentence structures for each child at each age were totaled and checked by the researcher. For each child at each age, the total score was divided by the total number of sentences per child to achieve an individual DSS score for each of the age ranges.

SPSS 13.0 for Windows was used to perform a two-tailed t-test to determine if significant differences existed between the siblings' DSS scores. An alpha value of $p<.05$ was selected as the criterion for significant difference.

3.5. Analysis of regional dialect features

Because the siblings reside in the South and some of the caregivers use regional dialect features, it was decided to analyze the siblings' speech for production of features which linguists have noted as being particularly prevalent in the Southern United States.

In the South, the phoneme /ai/ have two allophones, [ai] and [a:], each conditioned by phonological and social factors. Transcripts from ages 2 to 6 were searched for lexical items containing /ai/ in adult standardized English, such as *mine*, *diaper*, and *right* to test for alternation between the allophones. The pronunciation of the vowel was coded as monophthong or dipthong. Examination of the monophthongs revealed an unanticipated mid-central variant [ʌ]. A second feature associated with Southern speech is the widespread substitution of [n] for [ŋ] in nouns, adjectives and adverbs as well as in verbs. Since variants of (ing) are limited to multi-syllable words, the tapes were examined for multi-syllable lexical items containing the variable (ing). Pronunciation was coded as velar [ŋ] or alveolar [n]. The tapes were also examined for instances of *fixin to* and *yall*.

3.5.1 Analysis of variable /ai/

The literature (Bernhardt & Stemberger, 1998; Kehoe & Stoel-Gammon, 1999) indicates that monophthongs are acquired before diphthongs. The percent of diphthong use was found for each sibling by dividing the number of /ai/ found at each age by the total number of tokens at the same age. For the purpose of this study, the diphthong was determined to be fully acquired when a sibling's diphthong usage was at the unambiguous 80% level.

In order to determine a possible difference between pre-monothongal [a] and later [a:] constrained by Southern conditioning, tokens of /ai/ acquired before the diphthong was fully acquired were classified as pre-diphthongal. Tokens of /ai/ acquired after were classified as post-diphthongal. JMP IN 4.0 was used to compute multivariate analysis on the lexical items containing [a].

Although many quantitative studies (e.g. Bowie, 2001; Head, 2003) exclude nearly categorical types, in the sibling data, *I* and *my* are so prevalent (N=202) that limiting the number would reduce the number of tokens per child to numbers too small for valid analysis. All the *I* and *my* tokens, therefore, were retained for this study.

The vowel sounds were classified as monophthongs or diphthongs impressionistically by repeated listening to the audio tapes. Items that were difficult to classify impressionistically were examined acoustically with Speech Analyzer 2.6 for Windows and a Pearlcorder Micro/mini transcriber connected to a Dell Inspiron 1100 laptop computer running Windows XP. A Y-split audio cable was connected though the headphone jack of the transcriber to the audio-in port of the computer allowing the researcher to hear the segments as they were being recorded by Speech Analyzer 2.6.

Questionable items were categorized by comparing the F1 and F2 of the vowel segment to a mean F1 and F2 found for the siblings. To perform the formant analysis, the word containing the vowel was digitized. The segment of interest was isolated on the spectrograph by repeated listening. Individual segments within words were isolated by setting boundary markers outside the target segment and gradually moving in to isolate the vowel sound.

To determine mean F1 and F2 formants for the siblings, five tokens of [ai] and five tokens of [a:] were taken from each child at each age and plotted on the spectrograph. The mean for the F1 and F2 formants was calculated for each of the 40 tokens.

Once the mean values were established, the questionable tokens were examined for evidence of an offset drop of the first formant and an offset rise of the second formant, indicating the pattern of the diphthongal [ai]. Vowel segments which could not be categorized were discarded.

Each identifiable /ai/ token was coded for child, age, following phonological environment, part of speech, syllable stress, and word frequency. Following phonological environment was coded as pause, voiced obstruent (i.e., /b/, /d/, /g/), unvoiced obstruent (i.e., /p/, /t/, /k/), nasal (e.g. /m/, /n/, /ŋ/), liquid (i.e., /r/, /l/) glide (i.e., /w/, /y/), or vowel. Multivariate analysis was used to determine if the siblings differed along this dimension and the degree to which phonological conditioning matched that reported for adults.

Word class was operationalized as noun, pronouns including contractions of *I* (e.g. *I'll, I've* and *I'm*), verb, adjective, adverb, and other. Each token was classified as belonging to one of these classes. Multivariate analysis determined if sibling monophthongization was following adult patterning reported in the literature.

Syllable stress was determined by listening for word stress and categorizing each token as occurring in either a stressed or unstressed syllable. Following Hazen (2000) and Bowie (2001), multisyllable words with monophthongal vowels were analyzed for secondary stress patterns by breaking the words into subsyllabic units consisting of onset, nucleus and coda to see whether or not following sound shared a common syllable with the /ai/ vowel or if it occurred in the onset of the following syllable. For example, the word *dinosaur* has an initial stressed syllable, /dai/ with a following nasal occurring in the onset of the following syllable, /nə/.

Words containing /ai/ were also analyzed for word frequency. For this study, word frequency was considered the frequency of use of a word within the corpus of the siblings as a whole as found on the transcribed tapes. Lexical items with five or more occurrences within the sibling data base were analyzed to see if there was significantly more monophthongization with those forms than with words with fewer than five occurrences. Because of the high occurrence of *I* in the sibling lexicon (175) compared to other words, *I* was analyzed for frequency separately from other parts of speech. *I'm, I'll* and *I've* were retained with the rest of the data.

As the analysis proceeded, when two factors within a factor group were linguistically similar and factor distributions were non-significant, the factors were collapsed. The Chi-Square web calculator (http://www.georgetown.edu/faculty/ballc/webtools/web_chi.html) was used to test for significant differences between the factors.

3.5.2. Analysis of variable (ing)

Variation of (ing) as an alternation between velar [ŋ] and alveolar [n] occurs only in multisyllable words. In monosyllables, [n] and [ŋ] are contrastive, as in *sing* vs *sin*, or *thing* vs *thin.* The tapes at age 2, 3, 3.5, 4, 4.5 and 6 were examined for multisyllable words containing /iŋ/ in adult speech. The items were examined by repeated listening by the researcher for phonetic realization of the nasal segment. Tokens which could not be positively identified as either a velar nasal or an alveolar nasal were discarded. Remaining items were placed on a JNP IN 4 worksheet and coded by speaker, age, word class and following phonological environment. Word class was coded as noun, adjective,

adjective in complement structure, pronoun, and verb. Following phonological environment was coded as glide, liquid, nasal, unvoiced obstruent, voiced obstruent, vowel, and pause. Totals were tabulated for each category. Bivariate analysis was used to determine if the siblings differed along this dimension and whether their phonological conditioning patterned similarly to Southern adult patterning.

The research on phonological development indicates that [n] is acquired prior to [ŋ]; therefore variants for each child were analyzed only after the velar nasal had been acquired. For the purpose of this study, the velar nasal was determined to have been acquired when it first appeared in the transcripts of the audiotapes. When Chi-Square analysis found the distribution between two factors within a factor group to be non-significant, the factors were collapsed. Chi-Square web calculator (http://www.georgetown.edu/faculty/ballc/webtools/web_chi.html) was used to test for significant differences between the factors.

3.5.3. *Yall* and *fixin to*

All tapes were examined for instances of the Southern features *yall* and *fixin to*. Only two examples of *yall* were found. There were no instances of *fixin to*. Thus, no analysis was possible.

3.6. Temperament Analysis

In contrast to the linguistic data collected from pre-existing audiotapes, the temperament assessment was done at the time of the current study. Parents were asked to complete the Carey Temperament Scale (CTS) which assesses the following nine temperament characteristics, as defined in the Carey Temperament Scales Test Manual (1996-2000):

1. RYTHMICITY—the predictability of routine
2. SENSORY REACTIVITY—the amount of stimulation necessary to evoke a response
3. PERSISTENCE—the length of time activities are pursued
4. DISTRACTIBILITY—the effectiveness of extraneous stimuli in interfering with behavior
5. INTENSITY—the energy level of responses
6. MOOD—the amount of pleasant or unpleasant behavior in various situations
7. APPROACH—the nature of initial responses to new situations
8. ADAPTABILITY—the ease or difficulty with which reactions can be modified in a desired way
9. ACTIVITY—the amount of physical motion during activities

CTS questionnaires created for ages 3-7 were completed for each sibling. Each questionnaire consisted of 110 items concerning behavioral characteristics which were rated on a six point scale. Computer analysis using Quickscore V4.2P, provided by the CTS publishers, was used to create behavioral profiles showing the siblings' temperament characteristics in the nine areas.

The scores provided by the Quickscore V4.2P were placed on an Excel worksheet and graphed. Graphs were than compared to determine if the MZs had similar profiles, and whether they differed from those of the DZs. The siblings were ranked in the areas of ACTIVITY level, PERSISTENCE, SENSORY/reactivity and willingness to APPROACH new situations, since these areas were seen in the literature review as impacting language acquisition.

3.7. Comparison of language development

Temperament profiles of the siblings were compared to the MLU, DSS, grammatical development scores, and results of the [a:] and [ŋ] analyses.

The MLU and DSS scores were ranked for each sibling at each age. The siblings were also ranked at each age for degree of monophthongization of /ai/ and use of the [n] variant of (ing). The ranks were then compared to determine if there was a relationship between MLU and DSS scores and production of Southern regional forms. The temperament characteristics of ACTIVITY, SENSORY, APPROACHABILITY and PERSISTENCE were ranked for each sibling in the same fashion, and the temperament rankings were compared with the rankings of MLU, DSS, and Southern regional forms to see which temperament characteristics, if any, could be correlated with language development.

CHAPTER 4

RESULTS: GRAMMATICAL DEVELOPMENT

4.0. Introduction

This chapter reports the results of the analysis of Mean Length of Utterance (MLU) and Developmental Sentence Structure (DSS). The purpose of the two assessments of grammatical development was to determine if there were similarities in the language development of the MZ siblings and if that development differed from the development of the DZ siblings. The null hypothesis is that no difference will be found.

4.1. MLU Results

MLU was computed from guidelines set by Brown (1973) using the data transcribed from audiotapes for ages 3, 3.5, 4, 4.5 and 6. Data from age 2 contained too few utterances to be analyzed for MLU and DSS. For each age, the total number of morphemes in all utterances was divided by the number of utterances to ascertain MLU for each child. Following the findings of Miller and Chapman (1981), 50 morphemes per child were considered reliable for this study. Reliable numbers to compute MLU scores were not available for each sibling at each age. The number of utterances available for each child is seen in the table 4.1 below, with unreliable numbers of utterances indicated in parentheses.

Table 4.1. Number of utterances for each child at each age

	3	3.5	4	4.5	6
D1	66	57	51	51	(49)
D2	64	76	71	(49)	64
M1	62	51	(38)	(47)	80
M2	68	(44)	63	(26)	51

Table 4.2 shows the results of the calculations for MLU for each subject at each age based on the available number of utterances given in Table 4.1. The 49 utterances produced by D1 at age 6 and D2 at age 4.5 are considered an estimated MLU and appear in parentheses. Cells with unreliable data are left blank.

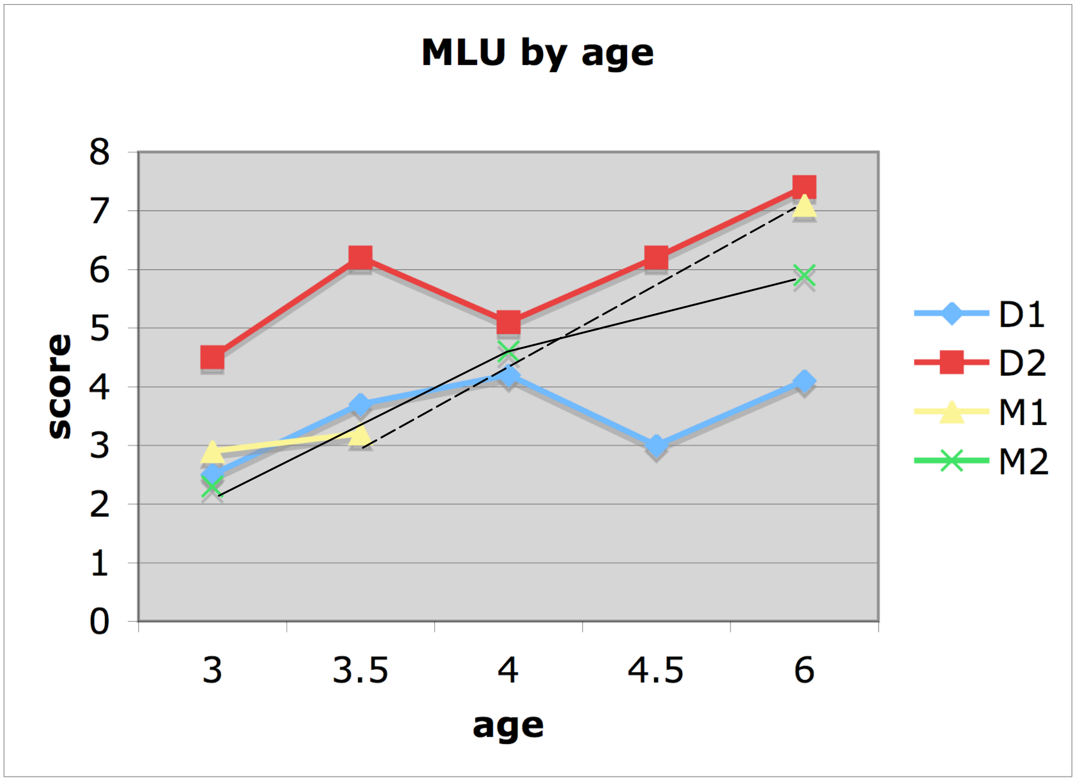
Table 4.2. MLU for each subject at each age

	3	3.5	4	4.5	6
D1	2.5	3.7	4.2	3	(4.1)
D2	4.5	6.2	5.1	(6.2)	7.4
M1	2.9	3.2			7.1
M2	2.3		4.6		5.9

The data is sufficient to evaluate the hypothesis for the MZs only at ages 3 and 6 and for the DZs only at ages 3, 3.5 and 4.

Figure 4.1, based on the data in Table 4.2, shows the comparative progression of the siblings based on MLU from age 3 through age 6 with estimates from D1 and D2 included.

Figure 4.1. MLU progression by age



The figure indicates that D2's MLU is higher than that of the other siblings at every age, differing least at age 4. The MZs and D1 show a pattern of similar development until age 4.5, when the MZs show a greater resemblance to D2. At all ages, the MZs pattern more similarly to each other than to the either of the DZs. Figures 4.2 and 4.3, which separate the data for the MZs and the DZs, reveal their comparative development more clearly.

Figure 4.2. MZ MLU pattern

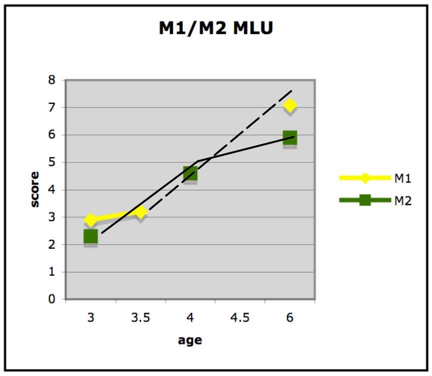
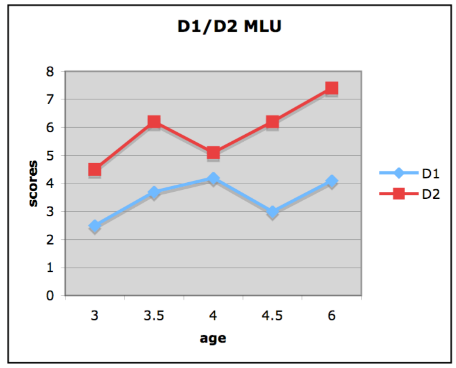


Figure 4.3. DZ MLU pattern



To determine if the differences shown in Tables 4.1-4.3 were statistically significant, t-tests were computed on the MLU scores of the siblings. Results of the t-test are given in Table 4.3 below. Differences were considered to be significant at the $p<.05$ level. Cells with unreliable data have been left blank. Results based on less reliable MLU scores are indicated in parentheses.

Table 4.3. T-test results of MLU scores

	3	3.5	4	4.5	6
M1/M2	.010				ns
D1/D2	.000	.000	ns	(.000)	(.000)
M1/D1	ns	ns			(.001)
M1/D2	.002	. 000			ns
M2/D1	ns		ns		(.048)
M2/D2	.000		ns		ns

The data are insufficient to evaluate the hypothesis fully; however, they indicate that an initial significant difference between M1 and M2 has disappeared by age 6. The difference between M1 and D2 persists through age 3.5. D1 and D2 are significantly different at ages 3 and 3.5, and significant differences based on estimated MLU also appear at ages 4.5 and 6. At age 6 there is no difference between M1 and D2 or between

M2 and D2. Estimated MLU also indicates that D1, who developed similarly with the MZs at early ages is significantly different by age 6. It appears that, with the exception of D1, the children are more different at age 3 and less different at age 6.

Based on the visual similarity of the MZs for age 3.5, 4.0 and 4.5 in Figure 4.1, and because of the gaps in the data, it was decided to pool the MZs and run a second t-test for significant differences between the MZ group and D2, the DZ sibling who produced the most utterances.

The pooled data includes no fewer than 73 tokens at any age for the monozygots, more than the 50 tokens considered reliable for this study. Table 4.4, which compares the pooled MZs with D2, shows a significant difference between the MZs and D2 at 3.5 and 4.5.

Table 4.4. T-test results on MLU for the pooled MZs and D2

	age 3.5	age 4.5	age 6
M/D2	.000	.000	.412

T-test results suggest that by age 3.5, the MZs can be distinguished from their DZ siblings on the basis of MLU, but, as seen on Table 4.3 on page 46, the statistical differences disappear by age six.

4.2. DSS Results

Two additional measures of syntactic development, the Developmental Sentence Types (DST) and Developmental Sentence Scoring (DSS), are based upon the same corpus of utterances that were used for MLU scoring.[14] DST is an initial analysis of the number of sentence structures within a child's corpus and is conducted before DSS scoring to determine if there are enough sentence structures within a child's corpus to advance to the more detailed analysis of the grammatical structures in the DSS scoring.

4.2.1. DST scores

Table 4.5 shows the total utterances, including repetitions and non-clause constructions, as well as the number of unique utterances used for DST scoring found in the corpus from age 3 through age 6.

Table 4.5. Total utterances and usable utterances for DST and DSS scoring

	3		**3.5**		**4**		**4.5**		**6**	
	Total	**Usable**	**Total**	**Usable**	**Total**	**Usable**	**Total**	**Usable**	**Total**	**Usable**
D1	85	50	69	52	56	49	52	48	53	44
D2	80	64	106	90	90	82	56	55	71	66
M1	68	52	63	52	42	31	49	44	101	97
M2	78	57	50	34	75	54	26	25	74	52

DST scores are the percentage of sentence structures in each child's corpus of unique utterances. Because the numbers of unique utterances for some of the siblings were low, DST scores were computed for each child with the intention of comparing the results to a gradual increase in the complexity of phrasal constructions (shown in Tables

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[14] Since DST scores are based upon subject/verb relationships rather than speech episodes, the number of utterances used to compute DST differs from that used to compute MLU. For example, the complex sentence *Put the puzzle in there and I can doos it.* (D1/3.0) consists of one utterance for the purposes of MLU scoring, but two utterances for DST scoring because of the two clauses with subject and verb in subject/predicate position. Similarly, *No want.* (M2/3.0) consists of two morphemes for MLU scoring, but is not acceptable for DST or DSS because no subject is present. Refer to Appendix B for a full DSS scoring chart.

4.8-4.10 below) as a secondary measure to further validate readiness for DSS scoring. Table 4.6 shows the number of sentence structures (SS) that were extracted from each child's usable utterances (UU) and the resultant DST percentage score.

Table 4.6. Sentence structures (SS), unique utterances (UU), and DST scores

	3		**3.5**		**4**		**4.5**		**6**	
	SS/UU	**DST**	**SS/UU**	**DST**	**SS/UU**	**DST**	**SS/UU**	**DST**	**SS/UU**	**DST**
D1	17/50	34	28/52	**54**	31/49	63	23/48	48	24/44	55
D2	45/64	**70**	64/90	71	62/82	76	41/55	75	50/66	76
M1	22/52	42	25/52	48	14/31	47	27/44	**64**	50/87	52
M2	17/57	30	18/34	**53**	47/54	**87**	10/25	40	41/52	79

Scores which indicate a readiness for DSS testing are shown in bold.

Chi-Square analysis was then computed on the DST scores to determine if the siblings were producing sentence structures at a similar rate. Results are shown in Table 4.7 below.

Table 4.7. Chi-Square analysis of paired DST scores

	3	**3.5**	**4**	**4.5**	**6**
M1/M2	ns	ns	.001	ns	.025
D1/D2	.001	.05	ns	.01	.025
M1/D1	ns	ns	ns	ns	ns
M1/D2	.01	.01	ns	ns	.025
M2/D1	ns	ns	.01	ns	.025
M2/D2	.001	ns	ns	.01	ns

A comparison of the sibling group as a whole shows a significant difference of $p<.001$ at ages 3, 4, 4.5 and 6, and a difference of $p<.05$ at age 3.5. Individual comparisons indicate that the MZs are similar at ages 3, 3.5, and 4.5, while the DZs differ significantly at these same three points. M2 is significantly different from each of the other siblings at two points: from M1 and D1 at ages 4 and 6, and from D2 at ages 3 and 4.5. Results show no significant difference between D1 and M1 at any age, indicating that they are developing more similarly than the other siblings. D1 and D2 differ at every age with the exception of age 4. Although MLU results indicated differences disappearing at age 6, DST results are opposite, finding the most difference at age 6, with similarity crossing zygotic lines: M1 = D1, M2 = D2.

When a child's corpus consists of at least 50% sentences, the utterances are ready for DSS scoring, which considers the grammatical complexity of the utterance. Data obtained from D2 at age three shows 45 sentence structures out of a possible 64 unique utterances, a DST score of 70%, well above the 50% suggested for subsequent DSS scoring. The other three siblings, however, had less than 50% usable utterances at age 3. D1 and M2 show readiness for DSS scoring at age 3.5. M1 shows readiness at age 4.5.

Because the low number of utterances available for three of the siblings allowed for only an estimate of readiness for DSS, a secondary measure was used to enhance reliability. Lee (1974) suggests that a decrease in one and two-word constructions and an increase in the number of phrases (non-sentences of three or more words) and sentences indicates readiness for DSS scoring. Tables 4.8-4.10 show the pre-sentence constructions produced by D1, M1, and M2 until the age when lower percentages of one and two word constructions occur concurrently with an increase in phrases and sentences. (D2's constructions were not analyzed since readiness for DSS scoring had been evidenced by age 3, as noted above.)

Table 4.8. D1's pre-sentence constructions

D1	**3**		**3.5**		**4**	
	N	%	N	%	N	%
One-word	17	43	11	21	6	12
Two-word	10	20	6	12	4	8
phrases	6	12	7	13	8	16
sentences	**17**	**34**	**28**	**54**	**31**	**63**
total UU	50		52		49	

D1's production of sentences increased from 34% at age 3 to 54% at age 3.5, while during the same period production of single-word utterances decreased from 34% to 21%. This progression shows an increase in higher grammatical structures and confirms the readiness for DSS scoring at age 3.5 as indicated by the DST scoring.

Table 4.9. M1's pre-sentence constructions

M1	**3**		**3.5**		**4**		**4.5**	
	N	%	N	%	N	%	N	%
One-word	11	21	15	29	10	32	9	21
Two-word	11	21	5	10	5	16	4	9
phrases	8	15	7	13	2	6	2	5
sentences	**22**	42	**25**	48	**14**	45	**27**	64
total UU	52		52		31		42	

M1's production is difficult to assess. The percent of two-word utterances showed an expected decrease from age 3 to 3.5, but one-word utterances showed a continuing increase through age 4. The percent of sentence constructions (phrases containing a subject and a verb in subject/predicate relationship) increased at age 3.5 but dropped at age 4. DST was computed for M1 at age 4.5, and, although M1 still showed a low number of utterances with a tendency to speak in one and two word constructions, at this age, total UU increased to 42 with 64% sentence construction, indicating M1's readiness for DSS scoring at age 4.5, validating the DST score of 64 in Table 4.6.

Table 4.10. M2's pre-sentence constructions

M2	**3**		**3.5**		**4**	
	N	%	N	%	N	%
One-word	20	35	9	26	6	10
Two-word	11	19	1	3	6	10
phrases	8	14	6	19	0	0
sentences	**5**	**9**	**18**	**53**	**47**	**80**
total UU	57		34		59	

At age 3.5 M2 shows a decrease in one and two-word utterances and a slight increase in phrase constructions of three words or more. This patterns with M2's percent of usable utterances (53% at age 3.5, and 47 out of 54 usable utterances (87%) at age 4.0 and confirms the readiness estimate of 53 at age 3.5 seen in Table 4.6.

This patterning of phrasal development shows a similar development for M2 and D1 for whom Chi-Square difference was not significant at ages 3 and 3.5. The phrasal development pattern is quite different for D1 and M1. D1 shows DSS readiness at age 3.5 while M1 does not indicate readiness until age 4.5. However, Chi-Square results for D1 and M1 show no significant difference at any age, indicating that their phrasal development is essentially the same.

4.2.2. DSS Scores

Having met Lee's secondary criteria of an increase in the number of sentences and phrases and a decrease in the number of one and two word constructions, DSS scores were compiled for D1, D2 and M2 beginning at age 3.5 and for M1 at age 4.5.

DSS was computed for the siblings based on Lee's rubric for assigning higher scores for more complex grammatical structures (See Appendix B). Table 4.11 shows reliable DSS scores for each of the siblings at each age. However, as Table 4.6 above indicates, the number of sentences available for analysis did not meet Lee's primary criteria at all ages. Cells with less reliable data have been left blank.

Table 4.11. Reliable DSS scores for each child at each age

	3.5	**4**	**4.5**	**6**
D1				
D2	7.58	7.8		10.06
M1				7.02
M2				

Table 4.11 does not allow for comparisons except at age 6, which shows that D2's scores are higher than at least one of the monozygots. T-test analysis shows a significant difference of $p<.003$ between M1 and D2, indicating a difference which falls along zygotic lines at age 6.

4.3. Summary

The purpose of the MLU and DST/DSS measurements was to determine if the genetically identical MZs were exhibiting similar grammatical development to one another and to the DZs who are less genetically similar. All three measures provide evidence that grammatical development between the MZs, as well as between the MZs and DZs is dissimilar at some points. The null hypothesis of no difference between the siblings does not hold, as T-test analysis for MLU indicates that at age 3, the monozygots and D2 are developing differently from each other.

Results from the MLU and DSS assessments disagree as to the ages at which similarities are seen among the siblings. Although Chi-Square analysis on the DST scores indicates that MI and M2 are developing similarly at age 3, the more widely used MLU measurement shows dissimilarities at age three. For this study, MLU is the more valid analysis as the DST scores indicate only a ratio of the number of sentences produced, while MLU indicates increased grammatical development. The visual similarity of MLU scores shown on Figure 4.1 also suggests that the MZs are developing more similarly to each other than to either of the DZs. There are more differences among all the siblings' MLU scores at earlier ages; however, by age 6 differences seem to disappear with the exception of D1 and D2 who remain significantly different. Both MLU and DSS indicate dissimilarities in the siblings' development; therefore the null hypothesis of no difference is not supported.

CHAPTER 5

RESULTS: REGIONAL DIALECT FORMS

5.0. Introduction

A well-described feature of adult Southern English, the monophthongization of /ai/, has received little attention in the literature on first language acquisition. In fact, the acquisition of diphthongs in general has received little attention. The present study provides an opportunity to address both of these issues as it explores the relativity of the roles of nature and nurture in first language acquisition.

This chapter approaches the siblings' acquisition of Southern English /ai/ both qualitatively and quantitatively, first discussing the three variants produced by the siblings. The quantitative analysis explores the frequency of the variants at ages two years through six years. The linguistic conditioning of monophthongization is also explored.

This chapter also discusses the two variants of (ing), the alveolar nasal, [n], and the velar nasal, [ŋ], from ages two through six, as well as factors that condition these variants. Although variation of (ing) occurs in Northern American English, British, and New Zealand English (Wald and Shopen, 1985), Southerners in the U.S. use the alveolar variant in a wider range of styles and in more word classes than Northerners.

5.1. Description of /ai/ variants

Four hundred and fifty tokens of /ai/ were located in the sibling data set from ages two through six.[15] Data from the earliest audio tapes shows production of three variants: a mid-central monophthong [ʌ], a low central monophthong [a], and a diphthong [ai]. The [ʌ] tokens (N=14) all occur in 1st person constructions, such as [ʌ] *got*, and [ʌ] *think*. Eighty-six percent of the [ʌ] tokens from age 2 through 4 were produced as [ʌ] *know* '*I don't know'* in contrast with [ai] *know* '*I know'* As Table 5.1 below shows, not all the siblings produce tokens of [ʌ]. Moreover, [ʌ] does not appear in the data after age 4, suggesting this is the earliest of the three forms.

Table 5.1. Monophthong production at age 2

	[ʌ]	N	%	[a]	N	%	[ai]	N	%
D1	*I*	2	33	*I*	2	33	*right*	2	33
D2		0		*I*	15	37.5	*right* (2) *night*(1) *rice* (3) *bite* (5) *light* (1) *mine* (3) *I* (11)	26	62.5
M1	*I*	2	25	*I*	2	25	*tiger* (2) I (2)	4	50
M2	*I*	2	28.5	*I*	2	28.5	*I* (1) *eyes* (1)	2	43

Table 5.1 shows the distribution of variants of /ai/ at age 2. Table 5.2 shows the gradual decline of [ʌ] until it disappears after age four.

[15] Only those containing /ai/ in adult Standard English were considered in the analysis.

Table 5.2. [ʌ] production at ages 3 and 4

Sibling	age 3	age 3.5	age 4
D1	25% (N=2)	0	0
M1	11%(N=2)	0	25% (N=2)
M2	31% (N=4)	0	5% (N=1)

The full set also provides the strongest evidence for an order of acquisition: early monophthongal [ʌ] is followed by the monophthong [a]. Next, the diphthong [ai] is acquired, and last to appear is [a:] constrained by the phonological and social conditioning of adult Southern speech. As Table 5.1 indicates, several variants may appear at the same age.

The small number of [ʌ] tokens makes it difficult to draw conclusions about the phonologies of the siblings at age 2-4; however, the difference between D2 and the other siblings is not consistent with the hypothesis that no differences will be found for the language development of the four siblings.

By age 6, all siblings produce the variant [a:] to some extent, with one of the siblings developing a preference for the monophthong. The data for this child also reveal the emergence of some phonological conditioning.

An attempt to determine at what point [a:] was acquired by differentiating the early monophthongal forms by duration proved unsuccessful as length seemed conditioned by situation, mood, and topic. Since the published research indicates that the earliest vowels to appear are the mid-vowels, [ʌ] and [a] with diphthongs appearing later (Bernhardt & Stemberger, 1998; Kehoe & Stoel-Gammon, 1999), it was decided to separate the data into two categories, pre-diphthongal and post-diphthongal, and to analyze each category according to the internal constraints of following phonological environment, word class, stress, and word frequency. A level of 80% diphthongal use was defined as indicating acquisition of the diphthong. Table 5.3 shows the percentage of diphthong use for each sibling. The ages at which the diphthong appears to be fully acquired is marked in bold.

Table 5.3. Percent of diphthong use for each sibling at each age

age	**2**	**3**	**3.5**	**4**	**4.5**	**6**
D1	33% (N2)	37% (N3)	46% (N6)	71% (N10)	**90% (N9)**	73% (N12)
D2	38% (N25)	**91%(N10)**	61% (N20)	63% (N22)	36% (N8)	12% (N3)
M1	43% (N4)	68% (N13)	**82% (N13)**	75% (N6)	100% (N19)	96% (N52)
M2	43% (N3)	21% (N3)	**100% (N6)**	77% (N17)	100% (N3)	65% (N25)

In view of the null hypothesis of no difference, it is interesting to note that both MZ's acquire the diphthong at age 3.5, while D2 acquires it at 3 years and D1 acquires it at 4.5. This is similar to findings of Matheny and Bruggeman (1972) and Locke and Mather (1989) who reported more similarity of articulation between MZ twins than between DZ twins.

5.2. Analysis of /ai/ variation

5.2.1. Pre-diphthongal analysis

Tokens produced by each sibling before diphthongs had been fully established at the 80% criterion were analyzed for conditioning factors. D1's tokens prior to age 4.5, D2's prior to age 3 and the MZ's prior to age 3.5 were classified as pre-diphthongal and placed on a JMP IN 4.0 spreadsheet. These tokens were coded for following phonological environment, word class, stress, and word frequency. One hundred and twenty-eight tokens were classified as pre-diphthongal. Table 5.4 shows the initial distribution by following environment for pre-diphthongal tokens.

Table 5.4. Pre-diphthongal analysis of /ai/ variation by following phonological environment

Count Row %	[ai]	[a]	
glide	3 42.86	4 57.14	7
liquid	1 50.00	1 50.00	2
nasal	12 41.38	17 58.62	29
-v obst	33 66.00	17 34.00	50
+v obst	16 45.71	19 54.29	35
vowel	1 50.00	1 50.00	2
pause	3 100.00	0 0.00	3
total	69	59	128

While following vowels and liquids do not impact the alternation, the direction of the effect of voiced and unvoiced obstruents is consistent with the adult Southern pattern. Unvoiced obstruents are negatively correlated with the [a:] variant; voiced obstruents are positively correlated with it. Although the numbers are small, it appears that the siblings are treating glides and nasals similarly to voiced obstruents.

Chi-Square was used to determine if these distinctions were significant. Where no significant difference existed between categories, the categories were collapsed. Pause, having only three tokens and categorically producing a preceding diphthong, was omitted from analysis. Because Chi-Square analysis indicated no significant difference between glides, liquids, and vowels, these categories were collapsed. Finding no subsequent significant difference between the collapsed category (glides liquids, vowels) and nasals or voiced obstruents, all categories except unvoiced obstruents were collapsed, leaving two categories: unvoiced obstruents and other. A significant difference of $p < .01$ was found between unvoiced obstruents and all other categories, indicating that the primary indicator of diphthongal [ai] in sibling pre-diphthongal speech is a following unvoiced obstruent.

Bowie (2001) indicates that nouns, adjectives, and adverbs are more likely to be monophthongized (/ai/ realized as [a:]) by adults than are other word classes. Head (2003) found that pronouns, verbs and adjectives were more likely to be monophthongized. To see if the siblings behave as the adults in either Bowie's or Head's sample, the tokens were coded for word class , operationalized as adverb, adjective, verb, noun, pronoun, and other. Table 5.5 shows the initial distribution of pre-diphthongal monophthongization according to word class.

Table 5.5. Pre-diphthongal analysis of /ai/ variation by word class

Count Row %	[ai]	[a]	
adj	1 25.00	3 75.00	4
adv	8 72.73	3 27.27	11
noun	20 100.00	0 0.00	20
other	5 71.43	2 28.57	7
pronoun	32 39.02	50 60.98	82
verb	3 75.00	1 25.00	4
Total	69	59	128

Pronoun, the largest category (N=82), contained diphthongs 39% of the time. Nouns, which were categorically diphthongal, were excluded from analysis. Because Chi-Square analysis showed no significant difference among the categories of verb, adverb, and other, these were collapsed, as were the categories of adjective and pronoun. Analysis of the resulting three categories shows a sibling pre-diphthongal hierarchy for [a] as pronoun/adjective>adverb/verb/other>noun.

Although Hazen (2000) and Bowie (2001) indicate that a monophthong is more likely to occur in syllables which contain both the vowel and a following sonorant, none of the pre-diphthongal data contained multi-syllable words with this pattern. Results on single syllable words show 84 which are less stressed within the context of a sentence. These produced a monophthong 43% of the time (N=36). The 44 fully stressed words produced a monophthong 75% of the time (N=33), but Chi-Square analysis did not find the difference to be significant.

Hay, Jannedy and Mendoza-Denton (1999) found word frequency to be a significant predictor of monophthongization, defining *frequency* as occurring five or more times within the corpus. Word frequency analysis of sibling pre-diphthongal data shows that in, general, words occurring five or more times in the corpus, (e.g. *I*, *my*, *right*, *I'm*, *like*, and *right*) were monophthongized, but at 51% the difference was not significant. Less frequently appearing words were all diphthongized with the exceptions of *white* (N=3) and *I'm* (N=3) which were both categorically monophthongized. It would appear that in the pre-diphthong database, neither stress nor word frequency plays a significant role.

The pre-diphthongal sibling' corpus exhibits some evidence of the adult conditioning in monophthongization. A tendency to suppress monophthongization before voiceless obstruents may be emerging, but is not significant at early ages. Adult patterning of /ai/ as [a:] regarding word class indicates a hierarchy of nouns> adverbs/verbs> adjectives (Bowie, 2001) or pronoun>verb>adj>noun >adv>prep> conjunction according to Head (2003). The sibling patterning shows the pronoun *I* is frequently monophthongal, as in adult speech. However, the remaining word classes show either Hazen's or Head's pattern:

adjective >adverb/verb/other >noun.

5.2.2. Post-diphthongal analysis

The post-diphthongal analysis contained 322 tokens produced after each sibling had demonstrated acquisition of the diphthong at the 80% criterion. These include tokens from D2 beginning at age 3, the MZs beginning at age 3.5, and D1 beginning at age 4.5 Table 5.6 shows the results of the analysis for following phonological environment.

Table 5.6. Post-diphthongal analysis of /ai/ variation by following phonological environment

Count Row %	[ai]	[a:]	
glide	14 70.00	6 30.00	20
liquid	7 43.75	9 56.25	16
nasal	51 55.43	41 44.57	92
- obst	94 78.33	26 21.67	120
+ obst	41 78.85	11 21.15	52
vowel	8 100.00	0 0.00	8
pause	11 78.57	3 21.43	14
Total	226	96	322

The analysis shows that the siblings continue to avoid the monophthong when the vowel is followed by a voiceless obstruent. However, voiced obstruents and pause also strongly favor the diphthong. Following vowels, which categorically produced diphthongs, were removed from analysis. Chi-Square analysis showed no significant difference between the categories of voiced and unvoiced obstruents, pause, and glide. These categories were collapsed.

Although the pre-diphthongal analysis shows liquids as having no impact on monophthongization, the post-diphthongal analysis identifies liquids as the only environment favoring the monophthong. Although liquids and nasals appear to have a different effect, liquids favoring [a:] and nasals favoring [ai], the distribution of tokens is not significantly different, thus the categories were collapsed. The resultant categories showed a post-diphthongal hierarchy (/ai/ realized as [a:]) of nasal/liquid>everything else. These categories are significantly different at $p<.0001$.

Table 5.7 Shows the different hierarchies associated with following sounds. Sounds on the left of the implicational hierarchy favor monophthongization.

Table 5.7. Comparison of hierarchies of following phonological environment

Source	Hierarchy (/ai/as [a:])
Hazen (2000)	liquids>nasals>voiced obstruents>voiceless obstruents
Head (2003)	liquids>voiced obstruents>nasals>voiceless obstruents
Fridland (2003)	voiced obstruents>voiceless obstruents
Bailey and Bernstein (1989)	voiced obstruents>voiceless obstruents
Bowie (2001)	voiced obstruents>voiceless obstruents
siblings pre-diphthongal	other>voiceless obstruents
siblings post-diphthongal	nasal/liquid>other

Results for the analysis of word class were similar to that found for the pre-diphthongal data. Table 5.8 shows post-diphthongal analysis of /ai/ realized as [a:] by word class.

Table 5.8. post-diphthongal analysis of /ai/ variation by word class

Count Row %	[ai]	[a:]	
adj	11 73.33	4 26.67	15
advb	15 68.18	7 31.82	22
noun	35 89.74	4 10.26	39
other	12 63.16	7 36.84	19
pronoun	135 66.18	69 33.82	204
verb	18 78.26	5 21.74	23
Total	226	96	322

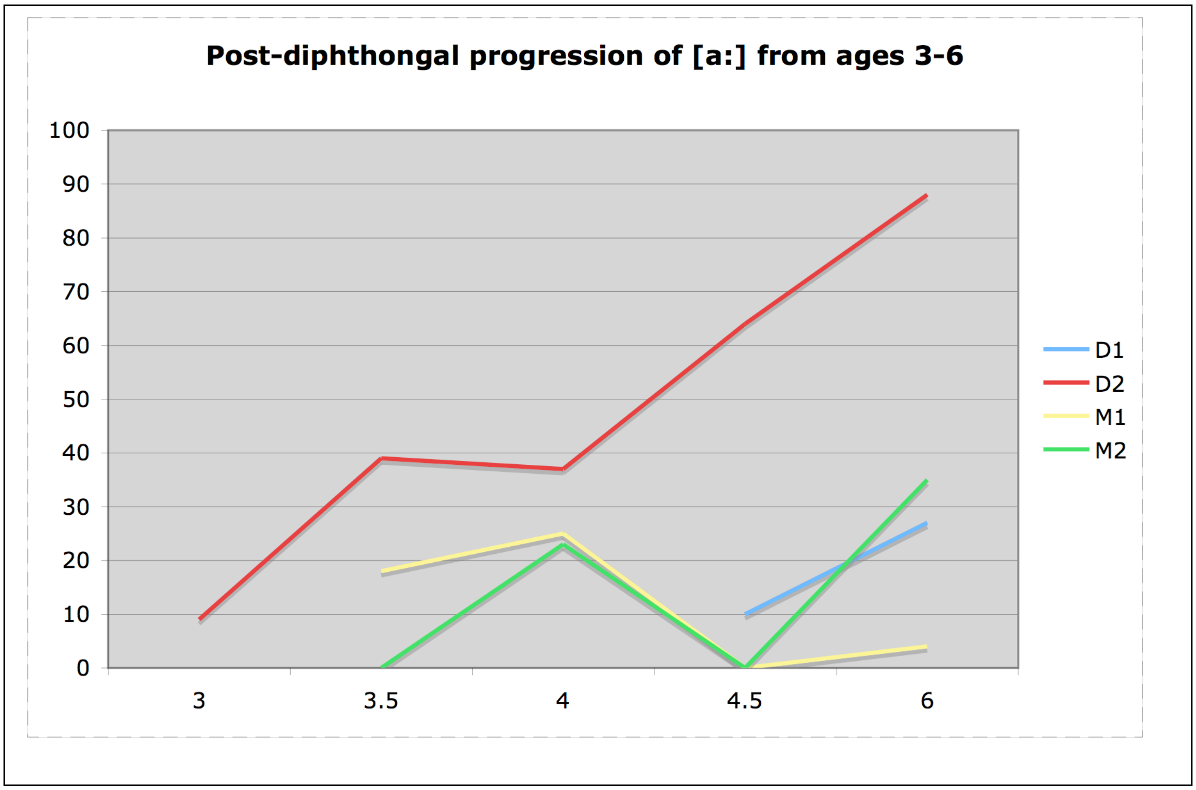
Pronouns (N=204) again comprised the greatest number of tokens (63%). Chi-Square analysis showing no significant differences, the categories of pronoun, other, verb, adjective, and adverb were collapsed, leaving a post-diphthongal hierarchy ([ai] realized as [a:]) of other>noun significant at p<.01.

While all word classes in post-diphthongal analysis are more likely to contain diphthongs than monophthongs, nouns are least likely to be monophthongized. As with the pre-diphthongal analysis, this pattern is in contrast to adult patterning where nouns, adverbs and verbs are more likely to be monophthongized than other word classes.

Multivariate analysis showed no significant difference in the effects of word stress or word frequency for the post-diphthongal data. Twenty-two of the multi-syllable tokens in the post diphthong data contained /ai/ in open syllables. Four of these were monophthongized (18%). Twelve tokens contained /ai/ in closed syllables. Only one of these (8%) was monophthongized. Although not consistent with Hazen's (2000) report that adults in West Virginia and North Carolina are more likely to monophthongize in closed syllables in multi-syllable words, this may be due to the small number of tokens available for analysis.

Figure 5.1 shows the post-diphthongal sibling pattern of acquisition of monophthongal [a:] from age 2 to age 6.

Figure 5.1. Acquisition of Southern /ai/ monophthongization



The figure shows that the sibling who acquired the diphthong earliest also produced the greatest amount of [a:], with 89% acquisition at age 6. Slightly less than half (41%) of the total tokens were produced by this sibling. To test whether adult conditioning was acquired by this child, these tokens (N=133) were analyzed for the full set of factors. D2's [a:] production was like that of the sibling set with the exception of word class. For this factor group, there was a significant difference for pronouns ($p<.001$) and verbs ($p<.05$). Both categories were more likely to be monophthongized by D2 than by the siblings as a whole. Additionally, all of the monophthongized adjectives (N=4) in the sibling data were produced by this sibling.

5.2.3. Comparison of post-diphthongal /ai/

Comparing the siblings who produced the most tokens reveals that of M1's 95 post-diphthongal tokens, only 5 are monophthongs, while D2 shows a growing pattern of monophthongal acquisition, becoming 89% monophthongized at age 6. Although neither M1 nor D2 shows significant differences in stress or word frequency, it is apparent that the null hypothesis of no difference among the siblings in the rate of acquisition of Southern monophthongized [a:] is not supported.

5.3. The variable (ing)

O'Grady, Aronoff and Rees-Miller (2005) show that the alveolar nasal appears around age 2 and the velar nasal around age 3 or 4. Haynes and Shulman's (1998) discussion of morphological and phonological development in children indicates that the present progressive form {-ing} begins to emerge between 2 and 3 years, although early pronunciation may not include the velar nasal until around age 3. Both these sources indicate that the alveolar nasal is developmentally prior to the velar nasal. The sibling data are generally consistent with those sources. For the siblings, [ŋ] appears first in the data of D2 at the age of 2.5, and for the other siblings at age 3.

The variable (ing) occurs only in multi-syllable contexts. Since [n] appears developmentally before [ŋ], only multi-syllable words were analyzed, and only after [ŋ] appeared in the sibling's data. Sixty-seven words containing (ing) in multi-syllablic contexts were located over the six age groups. These are shown in Table 5.9.

Table 5.9. Velar and alveolar variants of (ing) for ages 2-6

	[n]	**[ŋ]**	**% [n]**
D1	5	6	55%
D2	15	17	53%
M1	4	10	72%
M2	4	6	64%

The table shows that all siblings prefer the [n] variant. Chi-Square analysis shows no significant difference among the four siblings or between the DZs or between the MZs. It is interesting to note that the sibling producing the greatest percent of Southern monophthongization is not the sibling producing the greatest percent of [n]. In fact, D2 shows the lowest percent of the alveolar variant of the four siblings.

Since there were no significant differences among the siblings, their data were pooled. Using guidelines from Wald and Shopen (1983) and Roberts (1994), who show wide distribution of variable (ing) across standard varieties of English, the (ing) tokens were coded for word class. The analysis considered adjective, the pronouns *something*, *nothing*, and *anything*, and verbs. Based on Roberts (1994), the data were also coded for verbs in complement structures, such as *I saw the leaves turning yellow* (D2, age 6). Although an informal survey by students in an undergraduate linguistics class at Auburn University found about one-third of their [n] tokens were noun forms. such as *meeting* [mi tən] or *Birmingham* [bɚ mIn hæm] (R. Sabino, personal communication, July 13, 2006), no nouns containing (ing) were contained in the sibling data set. Table 5.10 shows the distribution of (ing) tokens by parts of speech.

Table 5.10. Distribution of (ing) variation by word class

Count Row %	[ŋ]	[n]	total
adj	1 100.00	0	1
compl	6 66.67	3 33.33	9
pron	4 50.00	4 50.00	8
verb	17 36.95	29 63.04	46
Nouns	0	0	0
Total	28	36	64

Forty-six of the 67 sibling (ing) tokens were verbs, and 63% of those contained the alveolar variant [n]. Three tokens could not be categorized by word class: *That's a winkin,* and *That's a layin down winkin*. (D1 age 4).

Roberts' (1994) data showed an average of 82% [n] in verbs in complement structures for the 17 children in her study, with no child producing less than 67%. However, the data for this study shows only 33% [n] use in verb complement structures, suggesting that the Southern siblings may not be acquiring the Northern verb-complement pattern found by Roberts in Philadelphia. More data is needed to determine whether or not this is a regional difference.

Chi-Square analysis of the factor groups shows no significant difference across grammatical categories.

5.4. *Yall* and *fixin to*

Yall has been identified by Bernstein (2003) as the dialect form most identified with Southern speech. Anecdotal evidence shows Southern children as young as five using the form.[16] During the course of this study, D2 at age 6 was heard by the researcher to produce *yall* several times; however, only two instances of *yall* were found in the sibling data set, both produced by D2 at age 6.

Sabino (personal communication, July 13, 2006) reports hearing a neighbor child age 3 using *fixin to*. However, no instances of *fixin to* appeared in the sibling data, and none of the subjects was heard to use the form during the period of the research.

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[16] Heard by the researcher in a 5-year-old Sunday School class 6/21/06

CHAPTER 6

RESULTS: TEMPERAMENT ANALYSIS

6.0. Introduction

Since temperament is thought to be hereditary (Wilson and Matheny, 1986, Martin et al., 1988, Plomin, 1994, Dale and Goodman, 2005), the children's temperaments were analyzed to determine if the behavioral profiles of the two MZs were similar or dissimilar to each other and similar or dissimilar to those of the DZs. As described in Chapter 3, at the time of this study, the parents completed 110 questions regarding aspects of the siblings' behavior. The siblings were 6 years old at the time the questionnaire was completed. This chapter reports the results of the temperament assessment for each of the siblings.

6.1. Scoring

Quickscore V4.2P assigned each sibling a raw score in each temperament category from -1 to +2.5. The program then plotted the raw scores on a graph, with 0 considered a mean score for a child between 3-6, the age range of the questionnaire. Raw scores for the four siblings are shown in Table 6.1.

Table 6.1. Raw scores for temperament characteristics

Characteristic	D1	D2	M1	M2
ACTIVITY	1.1	0.07	-0.3	-0.34
ADAPTABILITY	-0.07	-0.76	-0.42	0.51
APPROACH	2.02	-0.47	-0.38	-0.09
MOOD	1.19	0.28	-0.58	0.77
INTENSITY	0.48	-0.16	-0.03	0.99
DISTRACTIBILITY	0.88	0.88	0.38	-0.48
PERSISTENCE	1.93	0.33	1.64	1.2
SENSORY/REACTIVITY	1.09	0.03	-0.72	-0.27
RYTHMICITY	2.49	-0.12	1.67	0.69

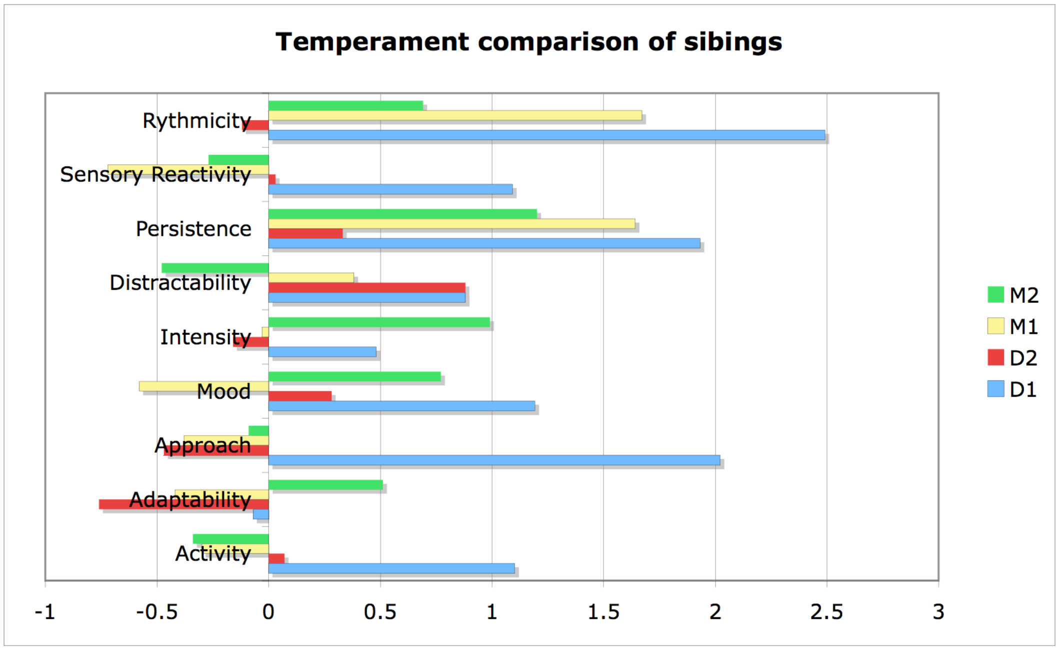
Characteristics with minus scores are not considered negative traits; they are traits which the creators of CTS consider easier to manage than characteristics receiving a plus score. For example, a plus APPROACH score would indicate a more curious child, while a minus approach score would indicate a less curious child. Interpretations of the nine temperament characteristics in terms of the siblings' plus and minus scores are given in Table 6.2. Characteristics are shown in terms of + or – increments from 0.

Table 6.2. Interpretation of individual temperament scores

Characteristic	D1	D2	M1	M2
ACTIVITY	+++active	+active	-inactive	-inactive
ADAPTABILITY	-quick	--quick	-quick	+gradual
APPROACH	++++cautious	-approaching	-approaching	-approaching
MOOD	+++negative	+negative	--positive	++negative
INTENSITY	+intense	-mild	-mild	++intense
DISTRACTIBILITY	++often	++often	+often	-rarely
PERSISTENCE	++++rarely	+rarely	++++rarely	+++rarely
SENSORY/REACTIVITY	+++reactive	+reactive	--nonreactive	-nonreactive
RYTHMICITY	+++++irregular	-regular	++++irregular	++irregular

Quickscore V4.2P also produces a visual representation of the siblings temperament characteristics which is shown in Figure 6.1.

Figure 6.1. Comparison of the sibling temperament scores



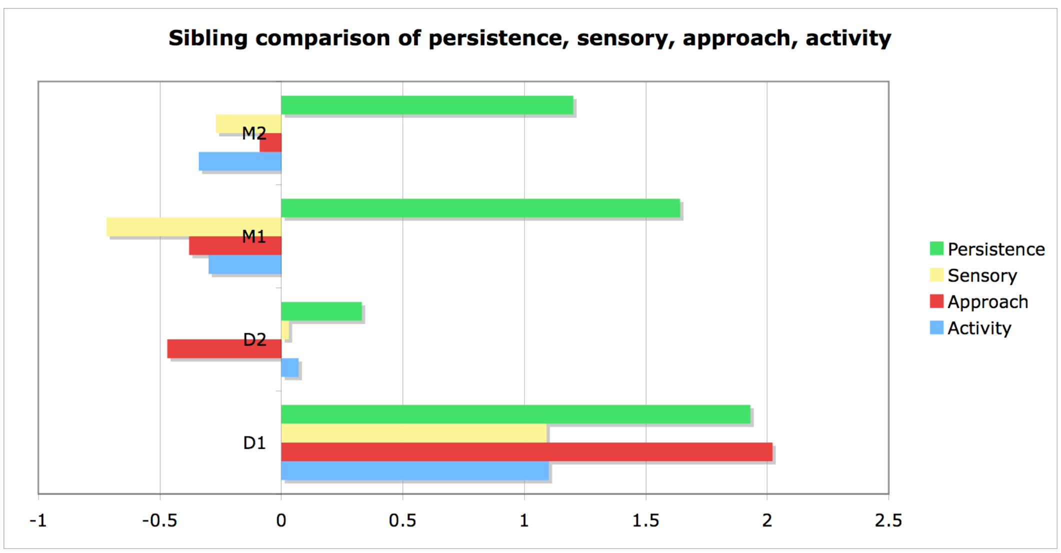
6.2. Temperament Profile Analysis

Previous studies in the area of language acquisition have shown that four characteristics are likely to influence rate of language acquisition: risk-taking (Wong-Fillmore 1979), shyness (Paul & Kellogg, 1997), activity level (Paul & Kellogg, 1997), and attentionality (Dixon & Smith, 2000). ACTIVITY level is measured by the CTS and defined by them as "the amount of physical motion during sleep, eating, play, dressing, bathing." Although the remaining three characteristics do not map directly on to the CTS categories, they are equivalent to CTS categories. Risk-taking and shyness are equivalent to the CTS category of APPROACH, "the nature of initial responses to new stimuli—people, situations, places foods, toys, procedures." Attentionality is similar to the CTS categories of PERSISTENCE, "the length of time particular activities are pursued by the child with or without obstacles" and SENSORY, "the amount of stimulation, such as sounds, light, taste, smell or feel, necessary to evoke discernable responses in the child."[17] Because the studies mentioned above indicated a connection between these four temperament characteristics and language acquisition, the CTS categories can be used to assess the null hypothesis of no difference among the siblings. In Table 6.3 and Figure 6.2, the siblings were compared specifically in the areas of PERSISTENCE, SENSORY, APPROACH and ACTIVITY.

Table 6.3. Temperament scores for PERSISTENCE, SENSORY, APPROACH and ACTIVITY

	D1	D2	M1	M2
PERSISTENCE	1.93	0.33	1.64	1.2
SENSORY	1.09	0.03	-0.72	-0.27
APPROACH	2.02	-0.47	-0.38	-0.09
ACTIVITY	1.1	0.07	-0.3	-0.34

Figure 6.2. Temperament comparison for PERSISTENCE, SENSORY, APPROACH, and ACTIVITY



[17] Carey Temperament Scales Test Manual and User's Guide, 1996-2000.

CTS assessment indicates that the MZ siblings are more similar to each other than to their DZ siblings in all four characteristics. The MZs are most similar in the traits of PERSISTENCE, APPROACH, and ACTIVITY: Their raw scores in these areas are within one standard deviation from each other. Their APPROACH scores show a difference of .29 points, PERSISTENCE .44 points, and ACTIVITY only .04 points. Their scores on SENSORY REACTIVITY show a difference of .65 points, just over one standard deviation. In addition, these traits graph similarly as plus or minus characteristics. Their PERSISTENCE scores are both on the right, or plus, side of the chart and their SENSORY, APPROACH and ACTIVITY scores are all on the left, or minus, side of the chart, indicating that the MZs are similar in their activity levels, their approach to new situations, their persistence in staying on-task, and the amount of sensory input needed to elicit a response to a situation. In comparison, D2 and D1 are dissimilar to each other in all four characteristics. Their raw scores are more than one standard deviation from each other in all four areas. D1 is within one standard deviation to M1 in the area of PERSISTENCE, D2 is within one standard deviation of M2 in the area of SENSORY, and within one standard deviation of both M1 and M2 in APPROACH and ACTIVITY.

Table 6.3 ranks the four siblings according to the degree of each characteristic they exhibit. Rank order is determined by how much of a characteristic each sibling exhibits, minus raw scores generally indicating less of a characteristic than plus scores. The MZs consistently rank next to each other in each of the four characteristics.

Table 6.4. Ranking of raw scores on temperament characteristics

	D1	D2	M1	M2
PERSISTENCE	4	1	**3**	**2**
SENSORY	1	2	**4**	**3**
APPROACH	4	1	**2**	**3**
ACTIVITY	1	2	**3**	**3**

A summary of temperament characteristics indicates the following:

- D1 is the least persistent, the most active, the most cautious in approaching new situations, and requires the least stimulation to evoke a response.
- D2 is the most persistent and the most curious in approaching new situations. D2 is also seen as having scores closest to the mean, an indication of stable temperament according to CTS (1996-2000).
- M1 and M2 track similarly and are indicated as having low persistence, a moderately low activity level, are mildly curious in approaching new situations and are less sensitive to outside stimulation than the DZs.

6.3. Comparison of temperament characteristics and language acquisition scores

Temperament links to language acquisition are illustrated by comparing the temperament characteristics of the siblings to their rates of language acquisition according to their DSS and MLU scores. Although DSS data was too low to provide meaningful statistical analysis, the DSS rankings of the siblings when the unreliable data is included is consistent with the rankings of temperament characteristics of the siblings. D2 has the highest DSS score at each age, followed by M1 or M2 and then D1, with the exception of age 4 where D1's score is higher than the MZs.

MLU scores do not show as neat a parallel with temperament scores as DSS scores do. Tables 6.5 and 6.6 show the MLU, DSS, acquisition of monophthongal [a:], and CTS rankings of the siblings when using raw scores. CTS rank remains the same over the five data points as the behavioral profile assesses temperament from age 3 to age 6. Post-diphthongal acquisition of [a:] differs for each sibling and reflects the age at which the diphthong /ai/ was fully acquired.

Table 6.5. MLU DSS, acquisition of [a:], and CTS rankings of the DZ siblings

Ages	D1							D2						
	MLU	DSS	[a:]	CST				MLU	DSS	[a:]	CST			
				persistence	Sensory	Approach	activity				Persistence	Sensory	Approach	activity
3	3			4	1	4	1	1	1	1	1	2	1	2
3.5	2	4		4	1	4	1	1	1	1	1	2	1	2
4	3	2		4	1	4	1	1	1	1	1	2	1	2
4.5	3	4	2	4	1	4	1	1	1	1	1	2	1	2
6	4	4	3	4	1	4	1	1	1	1	1	2	1	2

Table 6.6. MLU, DSS, acquisition of [a:], and CTS rankings of the MZ siblings

Ages	M1							M2						
	MLU	DSS	[a:]	CST				MLU	DSS	[a:]	CST			
				persistence	Sensory	Approach	activity				Persistence	Sensory	Approach	activity
3	2			3	4	2	3	4			2	3	3	3
3.5	3	3	2	3	4	2	3	2	2	3	2	3	3	3
4	4	3	2	3	4	2	3	2	4	2	2	3	3	3
4.5	2	2	3	3	4	2	3	4	3	3	2	3	3	3
6	2	2	4	3	4	2	3	3	3	2	2	3	3	3

The temperament ranking of the siblings in the areas of persistence and approach show the same hierarchy as the DSS scores, that D2 is most persistent, most approaching, followed by the monozygots and then D1. The areas of SENSORY REACTIVITY and activity level differ slightly in the hierarchy, showing that D1 is most active and needs the most sensory input, followed by D2 and then the MZs. The results would seem to indicate that persistence and willingness to approach a new situation may have a greater bearing on language acquisition than activity level.

Although D2's MLU scores rank the same as the DST scores, the only age which follows the temperament ranking of D2, M1, M2 and D1 is age 6. Although the table shows D1's MLU score ranking between the MZs , it must be remembered that T-test showed no significant difference between the MZs and D1 at most ages. More importantly, the MZs show a similar development to each other while the DZs show a dissimilar development from each other and, for DSS, from the MZs.

Interestingly, the rankings for acquisition of monophthongal [a:] at age 6 show D1 ranking between the MZs. Although the MZs are nearly identical at ages 4 and 4.5, Chi-Square analysis shows no significant difference between the MZs and D1 at age 4.5 or between M2 and D1 at age 6, indicating that, as with MLU and DST, the MZs and D1 are developing similarly while D2 is dissimilar.

Although the remaining areas of temperament have not been studied as to their influence on language acquisition, it interesting to note that the MZs appear to be less distractible than the DZs, who are nearly tied in their raw scores on DISTRACTIBILITY, "the effectiveness of extraneous environmental stimuli in interfering with ongoing behaviors" (CTS, p. 24). Additionally, the MZs rank 2 and 4 in the area of INTENSITY, "the energy level of responses regardless of quality or direction" (CTS, p. 24).

CHAPTER 7

DISCUSSION

7.0. Introduction

The purpose of this retrospective study of first language acquisition was to determine if biologically identical children and biologically non-identical children acquire language similarly when they are raised in a similar environment. A second research question was whether differences in temperament could help to explain any differentiation. A null hypothesis of no difference between the siblings was tested for both these questions.

Data from two DZ and two MZ same-sex siblings were examined for this study. Previously recorded audiotapes of the siblings from ages 2 to 6 were analyzed for evidence of acquisition of grammatical structure and dialect features. Parental assessment of the siblings' temperament characteristics was used to elucidate acquisition results.

The study finds that despite a similar environment for all siblings, they are not developing similarly, either grammatically or phonologically. Rather, the linguistic data and temperament measures pattern to some extent along zygotic lines. Results also suggest that the temperament traits of PERSISTENCE and APPROACH may be more important than the traits of ACTIVITY or SENSORY/reactivity.

7.1. Grammatical development

This study evaluates grammatical development in four ways: 1) MLU, the average number of morphemes per utterance, 2) DST, the development of sentence structures in readiness for DSS testing, 3) phrasal development, the increase in longer phrases and clauses and the decrease in one and two-word phrases 4) DSS, the development of grammatical structures within sentences, such as complements, *wh* questions, and negative reversals. Grammatical analysis of MLU and phrasal development indicate that differences in language development tend to disappear as siblings age. In contrast, DST shows differences increasing with age. The DSS analysis was inconclusive due to the retrospective nature of the study. All measures indicate differences in grammatical development among the siblings; thus the null hypothesis of no difference is not supported.

7.1.1. MLU analysis[18]

MLU results, which did not support the null hypothesis of no difference between the siblings, indicated that at least two of the siblings, D1 and D2, are not developing similarly. Results for the group as a whole indicate that the siblings are more different at earlier ages, but that differences are non-significant by age 6. At the ages where reliable data exists (3, 3.5 and 4), no significant difference is found between D1 and either M1 or M2. Although D1 is similar to the MZs at early ages and D2 is similar to them at later

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[18] Because of the retrospective nature of the study, 50 utterances were not available for all of the siblings at all of the data points. Two MLU scores based on 49 utterances were used to estimate MLU and are indicated as such on the tables in the previous chapters. Scores lower than 49 were considered unreliable and were not used to test for statistical differences.

ages, similarity between the MZs themselves cannot be determined as reliable data for the pair is found only at age 3, when they show a significant difference, and at age 6, when no significant differences are found.

Thus, the MLU results from this study are neither consistent nor inconsistent with the findings of Ganger (1998) who reports similar development in MZ twins at ages 1-3. Although data for M1 and M2 was inconclusive, the differences between D1 and D2 indicate that the null hypothesis is not supported by MLU testing.

7.1.2. DST and DSS analysis

Developmental Sentence Structure (DSS), a measure used to determine children's grammatical development, was determined using Lee's (1974) guidelines for scoring advanced grammatical structures (Appendix B). Scores computed on fewer than Lee's suggested 50 utterances were considered unreliable and were not used for statistical analysis. Although it was not possible to use the DSS measurement to fully test the null hypothesis due to gaps in the data, significant differences in DST scores and scores of phrasal development indicate that the null hypothesis of no difference is not supported by these testing measures.

DST, designed to indicate readiness for analysis of grammatical development, has not previously been used to characterize development itself. However, although the results cannot be claimed to be definitive, the data provides some counter evidence to the null hypothesis, due to the similarities between M1, M2, and D1 at earlier ages and significant differences between D2 and the other siblings at all ages except age 4. Interestingly, the analysis of DST scores, which represent the percent of sentence structures in each child's corpus of utterances, reveals a pattern different from the MLU results. According to DST, there is less difference at earlier ages and more at age 6. For example, D1 and M1 are not significantly different across the five data points, and both are different from M2 only at ages 4.5 and 6, indicating that D1 and M1, siblings who share at least 50% of their DNA, are patterning similarly. At age six, however, differences appear between M1/M2, M1/D2, M2/D1 and D1/D2.

A secondary analysis of the siblings' corpora for phrasal development, done to determine readiness for DSS scoring, shows D2 ready at age 3, D1 and M2 ready at age 3.5, and M1 ready at age 4.5. Although the MZs and D1show readiness at different times, Chi-Square testing showed the difference between the three was not significant. Thus, similar to the DST analysis, which shows early similarity and later divergence, this analysis shows three of the siblings developing similarly up to age 4.5 when D1 diverges. D2's readiness at age 3 and D1's divergence at 4.5 indicates the siblings phrasal development is not similar; thus the null hypothesis is not supported.

Because of the retrospective nature of the study and the rigor of Lee's protocol, it was possible to reliably compare the siblings' DSS scores only for M1 and D2 at age 6. Although only this one comparison is available, it is interesting to note that, at this age, there is a significant difference between the two siblings at the level of $p < .003$.

7.1.3. Comparison of MLU and DST/DSS scores

It is also interesting to note that unanticipated decreases in MLU scores occur as the siblings age. D1 and D2 are the only siblings with valid, or nearly valid, MLU data across all ages, and both show a drop in MLU score—D2 at age 4 and D1 at age 4.5. Lee

(1974) assumes that children cannot speak better than their grammatical ability allows, but they may choose not to use certain constructions (p. 67).

While this may be an artifact of the study's reliance on retrospective data, nonetheless, it is of interest that these unexpected results appear around age 4. One explanation is that age four may be a pivotal age in child cognitive processes. The findings in this study in regard to MLU coincide with the cognitive studies of Bloomquist (2003) and Wellman (1990) who show divergent results at this age. Although cognitive processes are beyond the scope of this study, it is possible that the MLU results document a pivotal process in language acquisition which co-occurs with other changes in cognitive processing.

7.2. Regional dialect forms

Speakers of Southern English variably monophthongize /ai/ to [a:] and use the alveolar nasal in nouns, as in [a:m let tə ðə mitn] '*I'm late to the meeting.*' To test the null hypotheses for the acquisition of these Southern dialect features, tokens were counted for variants of /ai/ and (ing) after the acquisition of the diphthong [ai] and the velar nasal [ŋ] was established. Tokens for both phonological variables were analyzed by following sound, part of speech, word frequency and word stress. The acquisitional patterns of the siblings were also compared to descriptions of Southern adult patterning.

The corpora indicated that the MZs acquired the diphthong [ai] similarly, at age 3.5. Chi-Square analysis of the rate of diphthongization showed no significant difference between the MZs except at age 3 ($p<.025$). These siblings differed from both D2 who acquired the diphthong at age 3.0 and from D1 who did not demonstrate diphthong use until age 4.5. Chi-Square analysis showed a significant difference between D1 and D2 of $p<.025$ at age 3.5 and $p<.001$ at ages 4.5 and 6. The data are inconsistent with the null hypothesis, suggesting that M1 and M2 are developing similarly while D1 and D2 are not.

For both acquisition of Southern monophthong [a:] and alveolar variant [n], the siblings were found to be developing a pattern unlike adult modeling, a finding in keeping with Roberts (1994) and Cole (1980).

7.2.1. Analysis of monophthongization

Although there were not enough tokens of /ai/ to allow for the testing of the hypothesis for the conditioning of this phonological alternation, analysis of the pooled data revealed that following liquids and nasals were more likely to be associated with a preceding monophthong than all other categories. Several researchers (Bailey & Bernstein, 1989; Hazen, 2000; Head, 2003; Fridland, 2003) have reported monophthongs associated with voiced obstruents>voiceless obstruents in producing a preceding monophthong. However, the sibling data showed obstruent voicing not to be a conditioning factor. It is interesting to note that D2, who produced more tokens than the other siblings, shows an emerging tendency to produce monophthongs preceding unvoiced obstruents and glides as well as before nasals and liquids, showing a possible emerging Southern pattern similar to that found by Fridland (2003).

Fridland (2003) and Head (2003) found that for Southern adults, word boundary, which is equivalent to open syllables, was associated with preceding monophthongization. Hazen (2000), however, although he did not specifically address word boundary, indicates that closed syllables were associated with increased monophthong production in multi-syllable words. The present study did not specifically address word boundary; however, in light of these studies, the results for pause, which is equivalent to open syllables, in both the pre and post-diphthongal sibling data are interesting. Pre-diphthongal results (N=3) show no monophthongization in pre-pause contexts. Post dipthongal results (N=14) show 21% monophthongization associated with following pause. Whether the pre-diphthongal data indicate a phonological difficulty or the post-diphthongal data indicate the emergence of a pattern is difficult to determine.

In contrast to Southern adults, the sibling group as a whole produced more diphthongal [ai] than monophthongal [a:] in every speech category. However, as with Head's (2003) adults and children, the pronoun *I* was more frequently monophthongized than other lexical items. Only 10% (N=4) of nouns contained a monophthong, indicating a pattern unlike Southern adult patterning reported by Bowie (2001) in which nouns were commonly monophthongized. Three of the four monophthongized nouns produced by the siblings were from the data of D2, who, with a monophthongization rate of 89% at age 6, shows a possible emerging pattern in keeping with the adult pattern. It may be that the low rate of monophthongization for M1, M2 and D1 reflect the cross-generational decrease in monophthongization reported by Thomas (1997) and Bowie (2001) for Texas and Maryland respectively. If this is the case, three of the siblings may be acquiring an emerging Southern pattern, with the fourth showing greater evidence of the more traditional pattern.

7.2.2. Analysis of (ing)

The variant [ŋ] first appears for D2 at age 2.5 and for the other siblings at age 3. The siblings produced a total of 67 (ing) tokens across all five ages, a number too low to reliably test the null hypothesis. All used 53% to 72% alveolar variant [n] across the age range. This is somewhat lower than the rate Roberts (1994) finds for 3 and 4 year-olds in Philadelphia, but may indicate that a high percentage of alveolar [n] is a common element of early childhood phonological development. The sibling pattern in the pooled data appears to mirror adult patterning (Wald and Shopen, 1983) insofar as pronouns (*something, nothing*) and verbs are most likely to contain the alveolar variant. However, no noun forms with alveolar [n] were found in the sibling data, although anecdotal evidence (Sabino personal conversation, 7/13/06) indicates Southerners commonly produce alveolar [n] rather than velar [ŋ] in noun forms

7.2.3. Analysis of y'all and fixin' to

Due to insufficient data, the null hypothesis could not be tested for either *fixin to* or *y'all.*

7.2.4. Acquisition of regional dialect forms

The siblings are developing similar patterns of monophthongization, but at different rates. A Chi-Square analysis of the siblings' monophthongization of /ai/ revealed significant differences between D1 and D2 at ages 3, 4.5 and 6. No differences were found between the M1 and M2 across the five age groups, indicating that the MZs are developing along similar lines while the DZs are not. Since D2 was found to develop [ŋ] by age 2.5 and the others at age 3, the null hypothesis is not supported for acquisition of either /ai/ or (ing).

The results also indicate that the siblings are not yet approximating adult speech. This finding is consistent with Cole's (1980) and Roberts' (2000) hypotheses that children construct dialect rules of their own at this level of phonology.

7.3. Temperament analysis

Carey Temperament Scale questionnaires (1996) completed by the parents assessed sibling temperament in nine areas. Four of these, because of previous research in language acquisition, were of interest to this study: PERSISTENCE, SENSORY/REACTIVITY, APPROACH TO NEW SITUATIONS, and ACTIVITY LEVEL. Although different pairs of the siblings show similarities in one or two characteristics, the MZ siblings' scores in these four areas are much closer to each other than to their DZ siblings. M1 and M2 differ less than one standard deviation in all four characteristics; D1 and D2 show differences of more than one standard deviation in all four characteristics. Moreover, when the siblings are ranked according to the degree of each characteristic that each manifests, the MZs are ranked next to each other in every category. In the areas of PERSISTENCE, APPROACH, and ACTIVITY level, the MZs rank between D1 and D2, indicating that although M1 is similar to M2, D1 is not similar to D2.

Previous studies (Paul & Kellogg, 1997) have suggested that more active children acquire language more slowly than their less active counterparts. This finding is consistent with data produced by D1 whose ACTIVITY score is much higher than those of the other siblings, and whose language development is progressing more slowly.

However, the MZs scored lowest in ACTIVITY level, yet showed lower MLU than the more active D2. The sibling results for PERSISTENCE and APPROACH are similar to Martin and Holbrook's (1985) correlation between those characteristics and first grade reading scores. D1 ranks lowest in both PERSISTENCE and APPROACH and also ranks lowest in MLU and DSS at age 6. D2, who is acquiring language most quickly, scored higher than the others in both PERSISTENCE and willingness to APPROACH new situations, and it may be that these characteristics have greater weight than ACTIVITY level regarding the acquisition of language. This is in keeping with the findings of Paul and Kellogg (1997) who found a high correlation between willingness to approach new situations and higher MLU scores.

7.4. Limitations of the study

The primary limitation of the study was its retrospective nature. This resulted in insufficient data at several points. Although the study followed Miller and Chapman (1981) in using 50 utterances in place of Brown's recommendation of 100 utterances, the prerecorded tapes did not contain 50 utterances for all of the siblings at all five ages. As a result, reliable comparisons could not be made for the MZs except at ages 3 and 6. The available evidence, however, does not support the null hypothesis of no difference between the siblings grammatical development.

A similar limitation existed in the case of DST and DSS data. 100 unique utterances were not available at all ages to determine DST scores, resulting in the necessity of a secondary test for DSS readiness, an increase in phrasal complexity. Even using both DST and phrasal complexity as readiness indicators for DSS, some of the results can only be considered an estimate of readiness. In addition, the 50 unique clausal structures necessary for DSS analysis were not available for all siblings at all ages. As a result, a comparison was possible only for D2 and M1 at age 6. As with the MLU, available results do not support the null hypothesis of no difference.

Pooled tokens of /ai/ for the siblings totaled 450 over the 5 ages. More tokens from each sibling would have resulted in greater accuracy in determining the siblings' pattern. In addition, existing studies concentrate on adult acquisition of regional dialect features. Few studies address child acquisition of dialect forms.

The recordings contained a mid-central allophone of /ai/ not previously reported in the acquisition literature. This variant emerged early and disappeared by age 4.5. The order of acquisition suggests [ʌ] is acquired before [a:] constrained by Southern phonological conditioning. It is unfortunate that [ʌ] tokens accounted for only 13% (N=17) of the pre-diphthongal tokens, and, thus, did not allow for a full analysis of the variant in child language development.

Pooled tokens of (ing) yeilded only 67 across the five ages, allowing for only a speculative analysis of child variation. Also disappointing to the study is the lack of evidence of lexico-syntactic features *yall* and *fixin to*. Although anecdotal evidence indicates use of *yall* by at least one sibling, only two examples of *yall* were available on the tapes.

The instruments used to assess grammatical development appear also to be a limiting factor. Unexpectedly, MLU and DST results differ. Although this difference may reflect the gaps in the data, it is possible that since MLU measures acquisition of morphemes and DSS measures grammatical complexity, the two assessment tools are actually measuring different types of development. It is unknown which one best measures acquisition of grammar.

MZ twins share 100% of their DNA while DZ twins share at least 50% of their DNA. Full interpretation of the relationship between D1 and D2 was limited because no effort was made to determine the amount of DNA they shared. Thus, it is possible that the similarities in MLU scores and phrasal development between D1 and the MZs are a result of a substantially greater amount of shared DNA.

7.5. Implications for future research

Because it is unknown whether the differences found between MLU results and DSS results reflect the gaps in the data or differences in the testing measures themselves, more research is needed on these and other instruments used to assess grammatical development so that the best measurement tools can be used for future investigators.

This study found a pre-diphthongal allophone of /ai/ which has not been reported in previous studies on child language acquisition. Tokens of [ʌ] were too few to make a detailed analysis of its acquisition, and no studies were available for reference. Child acquisition of this variant bears further study to determine the full pattern of monophthong acquisition and its possible impact on the acquisition of Southern speech.

Future nature/nurture studies in the area of language development would benefit from biological measurements which can determine levels of shared DNA among DZ siblings. Knowing the degree to which DZ siblings share inherited traits would more fully explain the effects of genetics on child language development.

7.6. Conclusions

If language acquisition were due only to environmental influences, the results of this study would support the null hypothesis of no difference by indicating similarities among all four siblings, due to their consistent environment. On the other hand, if acquisition were due only to biological influences, the results would indicate MZ similarity and DZ dissimilarity across all five data points. In fact, the results are mixed. MLU results show some dissimilarity between the MZs at earlier ages along with some similarity between the MZs and D1.

Although occasional gaps in the data exist because of the retrospective nature of the study, the sibling data are inconsistent with the null hypothesis of no difference at several points. On the one hand, although the monozygotic siblings share 100% of their genetic make-up, differences can be seen in their language development and aspects of their temperament. The DZs show significant differences from each other in every area: MLU, DST, DSS, acquisition of regional forms, and temperament. The study also indicates greater similarity between the MZs than between DZs in MLU scores, DST scores, phrasal development, and acquisition of regional forms. Results also indicate greater similarity between the MZs twins in areas of temperament (ACTIVITY level, SENSORY/REACTIVITY, PERSISTENCE and APPROACH) that previous studies (Dixon & Smith, 1997; Paul & Kellogg, 1977; Wong-Fillmore, 1979) have shown to impact language acquisition.

These results suggest that despite an environment that is more consistent than has been reported in previous twin studies, biologically identical children do not develop language identically. The results also suggest that biologically similar children diverge to an even greater extent. At least part of the explanation for the acquisitional differences may lie in inherited temperament traits; that the combination of willingness to APPROACH new situations and PERSISTENCE may be of more importance, especially in language development, than either ACTIVITY level or SENSORY/REACTIVITY.

The present study was possible because of the presence of same-sex MZ and DZ siblings within a familial environment that controlled for both nature and nurture. Although similar data sets are rare, multiple-birth siblings are becoming more common due to recent advances in fertility techniques, increasing the possibility of similar sets of multiple-birth, same-sex siblings. Future studies of these subjects would provide additional information to the growing body of research on the effects of nature and nurture on the acquisition of child language.

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APPENDIX A

Computation of MLU

Guidelines from Brown (1973) pg 55.

Morphemes in 100 utterances are counted for each child. The total is then divided by 100.

How to determine utterances:

1. Start with second page of the transcription unless that page involves a recitation of some kind. In this latter case, start with the first recitation-free stretch. Count the first 100 utterances satisfying the following rules.

2. Only fully transcribed utterances are used, none with blanks. Enter portions of utterances in () to indicate doubtful transcription is used.

3. Include all exact utterance repetitions. Stuttering is marked as repeated efforts at a single word; count the word once in the most complete form produced. In the few cases where a word is produced for emphasis or the lie, (*no no no*) count each occurrence.

4. Do not count such fillers as *mm* or *oh*, but do count *no*, *yeah*, and *hi*

5. All compound words (two or more free morphemes), proper names and ritualized reduplications count as single words. Examples: *birthday, rackety-boom, choo-choo, night-night, see saw*). Justification is that there is no evidence that the constituent morphemes function as such for these children, but are seen as one morpheme.

6. Count as one morpheme all irregular pasts of the verb *(got, did went, saw*)

Justification is that there is no evidence that the child relates these to present forms.

7. Count as one morpheme all diminutives (*doggie, mommie*) because these children at least do not seem to use the suffix productively. Diminutives are the standard forms used by the child.

8. Count as separate morphemes all auxiliaries, (*is, have, will, can, must, would*) Also all catenatives: *gonna, wanna, hafta*, These latter counted as single morphemes rather than as *going to* or *want to* because evidence is that they function so for the children.

9. Count as separate morphemes all inflections; for example, possessives, third person singular -s, regular past -ed, progressive -ing, plural -s,

APPENDIX B

Developmental Sentence Scoring Rubric (DSS)

Score	Ind pronoun or noun modifiers		Main verbs	Secondary Verbs	Negatives	Conjunctions	Interrogative reversals	Wh-questions
1	Is, this, that	1^{st} and 2^{nd} person	A. uninflected verbs B. copula is or ‘s C. is+verb+ing		Copula or auxilary reversal+not		Copula reversal	
2		3^{rd} person	A. Regular inflected verbs, B. irregular past C. Copula am, are, was, were D. auxiliary am, are, was were	Early infinitives Lemme, wanna, gotta				Who, what, what+noun B. Where, how many
3	No, some, more, all lot(s), one(s), other, another	Plurals, we, us, our, these, those		Non-complementing infinitives: I stopped to play, I’m afraid to look		and		
4			A .Can, will, may+verb B. Obligatory do+verb C. Emphatic do+verb	Participle, present or past	Can’t don’t		Reversal of auxiliary be	

5		Reflexives: myself, himself, etc		A. Infinitival complements B. obligatory deletions: make it [to] go. C. Infinitive with wh-word	Isn't won't	But, so, and so, so that, or, if		When, how, how+adj How do you do it?
6		Wh-pronouns: who, which, whose, whom	Could, would, should,might+verb B. obligatory does, did+verb C. emphatic does, did+verb			because	Obligatory do, does, did: Do they run? Didn't it hurt B. reversal of modal C. tag question	
7	A. Any, anything B. everybody, everyone C. both, few, most, next, first etc.	His own, oneself, whichever, whatever	A, passive with get B. must, shall+verb C. have+verb+en D. have got	A. Passive infinitival with get: I have to get dressed. B. with be: I wanna be pulled.	All other negatives			Why, what if, how come+gerund Why are you crying?
8			A, have been+verb+ing B. modal+have+verb +en C. other auxiliary combinations: should have been sleeping	Gerund		Where, when, how, while + adjective+as if,m like, that, B. obligatory deletions: I run faster than you [run] C. wh-words+infinitive: I know how to do it.	Reversal of auxiliary have: has he seen you? B. Reversal with two or three auxiliaries" Could he have been crying?	Whose, which, which+noun Whose car is that?