THE SECRET LANGUAGE OF TWINS: IMPLICATIONS FOR LANGUAGE DEVELOPMENT

A Thesis by

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The following faculty members have examined the final copy of this thesis for form and content, and recommend that it be accepted in partial fulfillment of the requirement for the degree of Master of Arts with a major in Communication Sciences and Disorders.

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DEDICATION

To my parents, siblings, and my wonderful husband-to-be
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ABSTRACT

Twin language has held much intrigue to both professionals and the public; however, there is continuing debate about the influence of twin language and later language delays. The purpose of this survey study was to determine if there was a relationship between the type of twin (monozygotic or dizygotic) or the gender of the twins and use of twin talk. In the study, results of 55 twin sets (20 monozygotic twins and 35 dizygotic twins) with an age range of 15 months to 55 years were analyzed. The results indicated that neither the type of twin, gender, nor maternal education significantly impacted the use of twin talk. In addition, twin talk did not significantly impact later language or literacy development. Few participants indicated need for speech language services, although of those who did receive services, speech-sound deficits were most common. Twin rates are increasing and speech-language pathologists should understand their language needs.
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CHAPTER I

Introduction

The use of language is a definitive characteristic of being human; it is vital to expressing oneself, conveying messages, and impacting the actions of others. Of course, one is not born with fully developed linguistic abilities; rather, these abilities develop over the course of a person’s life. This development begins once a child is born and tends to follow a linear path. Also, singleton children follow well-researched linguistic developmental patterns, such as speaking their first words around one year and combining words around age two (Rice, 1989). Although twins in general follow the same progression as singletons, there is some controversy concerning differences in the rate of development; one researcher believes that there is no distinct delay in their development (Nan, et al. 2013) while another group believes there is a significant delay (Rutter, Thorpe, Greenwood, Northstone, & Golding, 2003). More research into the development of twins could clarify the topic.

Scientists and lay people alike find it fascinating that two people can share the same genetic makeup in the case of monozygotic twins, and still be individual. Because of the interest, they are often used in studies, but beyond this appeal, twins can offer some valuable information in terms of genetics. Twins offer the scientific community a chance to look at shared genetics, shared environments, and see the outcomes. Studies such as Korah, Prasad, and Sreedevi (2010), that look at twins to see how they develop and interact with each other are also valuable. There is a lack of research about how twin talk develops into later language and literacy skills for twins. By studying both dizygotic and monozygotic twins, the literature becomes more detailed about the norms of twins and what is considered typical. The world’s fascination with twins will only increase, as the population of twins continues to grow (Martin et al., 2015).
There has been a stark increase in the number of twins born in the last decades. According to Martin, Hamilton, Osterman, Curtin, and Mathews (2015), twin rates increased by two percent from 2012 to 2013 and represented 33.7 out of 1000 births. They found that twin rates have risen 76 percent in the last forty years (Martin et al., 2015). A possible reason for this increase in twin births is in-vitro fertilization (IVF) and other forms of assistive reproductive techniques which have become more prevalent. As more women are opting for assistive reproductive techniques, twins are more common because multiple embryos are implanted at one time to increase the effectiveness of the technology. There is a recent increase in the number of twin births, and there is a lack of literature investigating twin language development, particularly as it relates to phonological development and to twin talk.

Twins sometimes make up their own language, and although not as sophisticated as languages such as English or Japanese, languages of this sort are understood by both twins of a set and sometimes by other individuals as well. This phenomenon of twins making up their own language from imitation of speech sounds and gestures and then using it almost exclusively amongst themselves is known as “twin talk.” There is a portion of the twin population that creates their idioglossia (twins’ private language). At 20 months of age, about six percent of twins were using their twin language (Thorpe, Greenwood, Eivers, & Rutter, 2001). Some professionals believe that idioglossia occurs when one twin mirrors back the speech delays and unintelligibility of the other twin, with this delayed and unintelligible speech slowly morphing into a secret language (Korah, Prasad, & Sreedevi, 2010). Furthermore, because twins are able to rely on each other for their needs, they do not use typical children or adults as models as frequently as singletons. Thus, existing delays would compound because, as Rutter and colleagues suggests, twins already develop more slowly than their singleton peers. While many
people are familiar with twin talk, there is much to be learned about how these made up languages can impact language development and literacy later in life.

Although the studies began in the 1960s, the implications of twin talk are not well understood but could be long lasting. Another idea is that the language delay exhibited by twins is caused by twin language. Bishop and Bishop (1998) completed a study that included parent reports of school age twins who had previously used twin talk. The researchers found that there was a correlation between use of twin talk and language difficulty. The research that shows twins are more likely to have a delay in their language acquisition also finds that genetic factors contribute (Stromswold, 2006). The genetic predisposition and environmental contributions, such as the linguistic input the child receives and the development of a twin language, can be used to gauge how well the child will do linguistically later on (Hayashi & Hayakawa, 2004). An early delay in language development can impair the later development of typical communication and literacy skills. Harlaar, Hayiou-Thomas, Dale, and Plomin (2008) state that early language skills are predictive of later literacy ability in twins. Because it is not known if twin talk impairs development of language later on, twins might not have the skills they need if they used twin talk in their toddler and preschool years. The phonological development of twins who used twin talk is of particular interest because it greatly impacts literacy skills.

The purpose of this study is to gain additional information about the influence of twin talk related to gender, type of twin, and histories of speech and language problems. Furthermore, the study seeks to determine whether reading, writing, and spelling skills are connected with the use of twin talk, because language delays have been associated with later literacy. A survey has been developed to most accurately answer the research questions. Results of this study will add to the body of information about twins and language and literacy development.
CHAPTER II

Literature Review

The general development of singleton children tends to follow a linear path with milestones occurring around the same time for each child (Rice, 1989; Walle & Campos, 2014). Children begin to learn and expand upon their language as soon as they are born, as it rapidly develops, and there are well established markers that show the children are reaching commonly agreed upon developmental milestones. Twins also follow this development but there are opposing views about differences in their language and phonological growth, especially if they engaged in twin talk.

In this chapter, relevant motor and hearing development will be summarized followed by language and literacy development, including the oral language, phonological development, reading and spelling of typically developing children and the language differences of late talkers. Similarly, current knowledge related to twins’ growth and motor development, oral language, reading and spelling will follow. Finally, the prevalence, causes, and implications of twin talk will be discussed.

Typical Motor Development

Motor milestones are major markers in a child’s physical development. It is known that there are critical sequential steps of development during infancy and toddlerhood. Sitting up at six months and walking at a year old, are examples. Typically, children begin to walk around 11 to 15 months of age, and this stage has traditionally served as a major milestone of typical development (Lowth, 2014; Walle & Campos, 2014). Walking is a complex process that involves the coordination of several muscle groups including gross and fine motor skills. Walking takes many months to develop to a proficient level, yet children continue to practice
because the benefits (i.e., having increased opportunities to communicate) outweigh the possible costs (i.e., time and effort needed to complete the task) (Adolph & Tamis-LeMonda, 2014). Children are able to see more, interact more, move faster and play in a wider variety of ways with the commencement of walking. Adolph and Tamis-LeMonda also discuss that crawling is not completely abandoned when children begin to walk, the frequency of use just shifts. Adults may still crawl on occasion; however, it is not typical for locomotion.

There has been controversy about whether language development or motor development emerges first. Around a year the child will have a first word and begin walking. Learning to walk affects an infant’s life drastically. He is finally able to explore the world as an adult might: upright and autonomously. Walle and Campos (2014) completed a meta-analysis about how soon language follows after walking commences. It is unclear which one is the predecessor, the language learning before the walking or the walking before the language development.

In addition to motor milestones being connected to language development, they are also connected to social engagement. One study examined the use of social looking (i.e., looking at caregivers) by infants during the transition from crawling to walking (Clearfield, Osborne, & Mullen, 2008). The researchers followed 14 nine-month old children. Each child was observed once a month for six months. The researchers chose that specific age (9 months) because that would mark the beginning of their shift to walking, as all participants were crawling when the study began. The researchers found that more than half of their subjects were walking by twelve months of age, and as they switched to independent walking, they increased their bids for communication through social looking. Learning how to walk can have a social impact as well as a language impact.
Hearing

Recurrent otitis media during infancy and childhood can negatively impact hearing and speech development. Infants demonstrated awareness of the nuances of language before they begin to discern words and speak (Shany, Subbarao & Thushara, 2014). Infections can cause a child’s hearing to fluctuate making it difficult to consistently hear and understand what is being said. Consequently, the child might have trouble reproducing the speech sounds. Peak occurrence for otitis media in children is around 6 to 18 months of age (Winskel, 2006). This age range is a critical time in an infant’s language development.

Winskel (2006) studied 43 children ages 6 to 8 who had recurrent otitis media before age three. They were matched with peers who did not have a history of ear infections. She found that there was a significant difference between the two groups on phonological awareness skills (i.e., rhyming and determining similar initial phonemes). An oral reading test, expressive vocabulary, and word definitions. There were also large gaps in skills between the control group and the otitis media group on the non-word reading, reading fluency and comprehension tests.

Continuing with the research, Shany, Subbarao and Thushara (2014) conducted a study of 36 7-to 10-year olds to determine the effects of recurrent otitis media, before age two, on phonological awareness. Even thought the children had typical hearing after the bouts of ear infections, they continued to score lower on phonological awareness tasks than their age matched peers. The effects of otitis media on language can last years beyond the actual infection.

Language Development

Theories. There are many theories of language development. Two main theories for how language develops were hypothesized by Noam Chomsky and Lev Vygotsky. Chomsky and Vygotsky had opposing viewpoints; Chomsky (1965) theorized that language is inherent and
biological while Vygotsky thought that language developed through social interaction. Chomsky developed the idea of *Universal Grammar*. Chomsky called the *Acquisition Model* for language (the theory that children learn language’s grammar from experiences) inadequate because this does not account for a child’s ability to use sentences he has not experienced. Chomsky posited that if children did not have an innate ability to learn language, their grammar would not be as complex as it is currently. A child does not learn a language’s grammar through inductive inferences; he grasps the understanding of the grammar because of innate ideas and principles he possesses.

Vygotsky contrasted that theory. Vygotsky (1934/1986) proposed that an inherent grammar does not exist; instead children use their motivation to be social to learn language. Children learn language through communications with their family and friends and because they are motivated to engage socially. Because of this, inner language only develops after developing an external language which a child uses for social interactions. Egocentric speech, speech that is used as inner speech in structure, develops first as an external social tool before transforming to an internal instrument. Vygotsky hypothesized that people only use egocentric speech for social reasons. For example, a child will not use it around strangers. Thought and language presuppose the social element and cannot develop without that because it is their direct purpose.

**Oral language.** Much research has been done testing theories concerning stages of typical language development. For instance, typical singleton children speak their first words around one year of age and combine two words at around 18 months (Rice, 1989). Two to three months prior to this stage, children start to use intentional communication (Paul & Norbury, 2012). Examples of intentional communication would include gestures to request items or actions, greetings, or questions. Children are able to do this effortlessly most times and without
instruction from adults. Bates, Camaioni, and Volterra (1975) categorized three stages during language development perlocutionary, illocutionary, and locutionary. Children demonstrating the perlocutionary stage are unintentionally communicating and adults perceive actual communication. Children who are in the illocutionary stage show intentions but more often use gestures and vocables or vocalizations, but not words or typical language to communicate. The final stage occurs around 12 months. In the locutionary stage, children are beginning to use some real words to communicate.

By the time a typically developing singleton child is one year, he will be saying his first word or almost ready to speak. In order for a word to be considered a true word it must meet two criteria. First, the child must be able to produce it multiple times within the same situation (Reed, 2012). Second, the word must be understood phonetically. Pence-Turnbull and Justice (2012) add that typically first words refer to people and objects of everyday life. While the word needs to approximate the adult versions, the child does not, however, need to pronounce the words in the exact same manner an adult might. Ferguson and Farwell (1975) found that pronunciations are often variable during the learning process and progress may be slower. Factors that can contribute to this discrepancy can be the phonetic complexity (e.g., words with more later developing phonemes are often more variable), frequency of word use, and phonological neighborhood density, and the similarity of the speech sounds in words. (Sosa & Stoel-Gammon, 2012). Once a child has learned one word, he continues to discover additional vocabulary at a rapid pace. Rice (1989) stated that children have fast developing language and by 18 months they have a rapid growth in the number of words they understand and use. This is due in part to the pragmatic functions of words. Children who use language intentionally can do so for a variety of functions. Dore (1975) and Halliday (1975) investigated pragmatic intentions for a child. Dore
found that intentions such as labeling, request for action, request for objects, and answering are reasons for using communication, but Halliday describes how well the functions such as personal, instrumental, interactional, or regulatory worked for the child and considered the listener’s response. After developing a corpus of about 50 words, children begin to put two words together to make phrases (Rice, 1989).

The use of two-word phrases by two years of age is another major milestone in a child’s language development. A possible step before having two-word utterances become a single phrase is chained single words (McLaughlin, 2006). He suggested that some children put two single words together but do not mean to combine them. For example, a child may talk about an event and say cookie and all-gone together but not as a single statement or utterance. According to Rescorla, Alley, and Christine (2001), children who are typically developing have at least 120 words by the age of 24 months. This is an increase from the fifty words they have around 18-months of age (Reed, 2012). Although there is some variation in the times when children learn to combine words, language tends to appear around the same age for most children; however, the rate at which children learn language and the type of vocabulary they favor are more flexible. Some children do not develop this basic vocabulary as early, and language can be delayed.

Late Talkers. Late talkers, those who do not verbally express themselves during the typical time frame of around a year, but begin talking after two years, may have ongoing language difficulties. According to Kelly (1998), late talkers are defined as having less than 50 words by 24 months. Most researchers have found that children who are late talkers tend to have an improvement in their language skills during their third and fourth years. They appear to catch up to their typically developing peers but often have trouble with skills that are more complex and require more knowledge. Girolametto, Wiigs, Smyth, Weitzman, and Pearce (2001)
examined 21 children who were late talkers at two years old via parent report and standardized tests. The researchers concluded that their group of late talkers were able to catch up to normal ranges in vocabulary, grammar, pragmatic language, and overall language by the age of five, but they still scored below those children who had typical language development from birth, on language assessments at age five.

In a longitudinal study, Rescorla found similar results (2002, 2005, 2009). Rescorla (2002) began analyzing the progression of language development of 40 participants who were late talking toddlers, ages 24-31 months, as a part of her ongoing longitudinal studies. She compared the late talkers to a control group of 39 typically developing peers. The scores on receptive and expressive language, reading, spelling, and grammar structures were documented at ages 6-, 7-, 8-, and 9-years. Rescorla found that children, who were no more than three months delayed in expressive language, receptive language, or both, appeared to catch up to peers by age eight. They scored within average ranges on test measures but continued to score below their typically developing peers. At age six, late talking toddlers fell below their typical, matched peers in grammar and phonology, but performed similarly on verbal fluency and reading. At age seven, the children were behind on vocabulary, but performed similarly on grammar, phonology, reading, and spelling assessments. The children were beginning to learn how to read at this stage of the study. By age eight, however, the reading and spelling skills began to decline compared with their typically developing peers, and this trend continued through age nine when analyzing decoding, comprehension, spelling, and writing skills.

During a follow up study, Rescorla (2005) studied 28 of the children examined earlier. Reading outcomes at age six predicted the skills of the 13 year-old children. Readers continued to be less skilled as the material became more complex. Rescorla noted that late talkers do not
lack skills uniformly or gain skills uniformly. Rescorla (2009) continued to follow the late talkers at 17 years. They showed that they were fairly evenly matched with their peers at age 17 in nonverbal activities, such as math, but they continued to lag behind in several areas of language. Almost all language abilities were within the normal score range, but were below the scores of their peers. Vocabulary, grammar and verbal memory were among the most poorly performing categories. The researchers found that vocabulary, grammar, reading, and writing scores were predictable from the scores of the children at 13. Those who did better at 13 then continued to do so when they were 17. Late talkers are sometimes missing some foundational knowledge about language which begins with early phonological awareness and manifests in their literacy skills.

**Literacy Development**

**Phonological awareness.** Phonological awareness, realizing that the words in a language are made up of sounds and is officially defined by Gail Gillon in the *ASHA Leader* as “the explicit understanding of a words’ sound structure” (2002, p. 4). Phonological awareness skills include rhyming (i.e., which word rhymes with cat: rat or mouse? ___); syllable manipulations, such as deletions (e.g., *cowboy* minus *cow* is ___) and substitutions (*cowboy* minus *boy* plus *girl* is ___); syllable segmentation; and the blending of words or phonemes. Developing these skills early on, as researchers have recently found, is foundational in learning how to read (Chall, 1983; Harlaar, Hayiou-Thomas, Dale & Plomin, 2008). Typically, phonological awareness is readily learned by preschoolers and elementary school children.

Phonological development is a process that begins early, but helps determine or facilitate a child’s reading ability. Beginning readers need to convert graphemes into a phonological representation to use their knowledge of the word and understand its meaning (Shapiro, Carroll,
& Solity, 2013). They explain there are three main phonological skills that are part of learning to read. First, there is the clear awareness of the phonological information that occurs in words (i.e., phonological awareness). Second, being able to access the lexical form that is stored (i.e., phonological access). Third, recoding the word so it can be managed by the working memory (i.e., phonological short term memory). Children do not move immediately from one step to the next. Shapiro and colleagues investigated the phonological skills involved in learning to read. The participants were 392 children from the United Kingdom with an average age of four years and 6 months during the original study and 348 children with an average age of five years and 2 months during the follow up. During the follow up testing, the children preformed better on the rhyme tasks but overall, they performed poorly on the phonological awareness activities such as letter sound knowledge, phoneme isolation and rapid automatized naming. In general, they found that the phonological skills were challenging for the children not yet reading but predicted later success in reading. Letter sound knowledge, sight words, phoneme isolation, rhyming, awareness of sounds in words correlates to print

**Reading.** Reading has become such a large part of our world that it is connected to everything that we do as a society. Children typically begin to read in kindergarten or first grade with pre-literacy skill starting before that. Because of the early emphasis on reading, it has become especially important for children academically and is considered a marker of success (Stone, 2013). When all the separate skills are layered into this ability, the child is able to read and possibly gain academic success more easily. Reading, learning to read then shifting to reading to learn is a major milestone in children’s development (Chall, 1983). During the reading to learn stage, children must use their new reading abilities to learn new material. Reading development and literacy culminates with the merging of many different skills such as
vocabulary, syntax, and information synthesis. Reading skills can also influence other abilities such as spelling.

Harlaar, Hayiou-Thomas, Dale and Plomin (2008) studied 7179 twin pairs (2496 monozygotic and 4683 dizygotic) to determine whether early language acquisition is correlated with reading development. The children were assessed at 2- and 4-years of age and again at 7-, 9-, and 10- years of age. Per parent and teacher reports, the researchers found that shared environment can have a greater impact on reading ability than genetics, although genetics contributed as well. Overall, beginning reading skills could be predicted from early language skills at ages 2 and 4. Participants were twins; however, results were generalized to singleton populations.

**Shared reading.** Shared book reading can be a powerful experience between a reader and a non reader. The practice can help children learn pre-literacy skills, for example, print awareness. In a nationally representative sample from the United States, 800 children and parent dyads were studied to determine which type of parental talking during shared book reading was the most beneficial. Parental talking included whether they discussed primarily the text, for example, when the parent invited the child to read, or discussed the meaning, for instance having the child predict (Hindman, Skibbe & Foster, 2014). The researchers discovered that most dyads focused on meaning rather than the simple code-based reading strategies such as pointing out rhymes. In fact, 90 percent of the pairs used the meaning parental talking style. Many mothers would direct their children to the pictures in the book and try to engage the child. Demographic factors did not play a role in the determination of the style used.

In addition to the genetic and environmental factors that can impact reading ability, another predictor is how motivated a child is to read. A study completed with 1260 fifth grade
students from Belgium analyzed data to determine how reading motivation affected reading skills (De Naeghel, Van Keer, Vansteenkiste, & Rosseel, 2012). The researchers looked at intrinsic and extrinsic motivations through self report. They then did tests to determine reading self concept (i.e., how the child felt he read), reading engagement, fluency, and performance (i.e., comprehension) for each student. Girls ranked significantly higher on intrinsic motivation in both leisure and academic reading. For controlled motivation, boys and girls were equal. Overall, the students who scored themselves high for self concept participated in more leisure reading and were more engaged in their reading. The more motivated a student was intrinsically, the higher the reading comprehension and engagement.

Another study investigated 208 12-to 14-year old students from the United States and Kenya (Mucherah & Ambrose-Stahl, 2014). The researchers wanted to know if cultural context or other mediating factors such as gender, contributed to motivation to read and reading achievement. Reading efficacy and challenge were positive predictors of reading motivation in the children from the United States. Reading efficacy, i.e., thinking they will do well in reading in the future but not the importance of reading, i.e., viewing reading achievement as more important than other activities, predicts reading ability. The importance of reading was not a significant motivator for achievement. Reading challenging material and reading for compliance was a larger predictor of academic achievement for the children in Kenya. In the study of these two populations, motivation and enjoyment of reading led to higher reading success.

Spelling. Spelling is intertwined with so many other skills such as reading and writing. Spelling is a literacy skill and is highly correlated to other literacy skills such as reading comprehension and word level reading (Apel, Masterson & Brimo, 2012). Students who are better readers are typically better spellers. When learning spelling, there are typically four
foundational skills one must have in place to appropriately use spelling. Phonology, orthography, morphology and semantics knowledge are the building blocks for spelling (Apel & Masterson, 2001). When these skills are efficiently used, they can help develop the decoding ability for reading. There have been several theories about spelling development. Apel, Masterson, and Brimo (2012) explained the stages theory hypothesizing that children learn spelling in a step by step manner. The children would have to use and master one skill (phonology, orthography, and morphology) before moving onto the next. The most current theories surrounding spelling development focus on the foundational knowledge a child must have to be a successful speller. The theories recognize that there are multiple skills involved during each stage of development.

Most researchers have found that spelling develops in stages, although children may spell some words at one stage and other words at a higher stage (Apel, et al). Critten, Pine, and Steffler (2007) studied 23 5:11- 6:11 year olds and 28 6:4-7:4 year olds in two experiments. They suggest that there are three levels of spelling development. At first, children over generalize either the phonological or morphological rules of the language. At the second stage, children have deepened their understanding of the rules, but still make errors. At the third stage, phonological and morphological rules are understood completely. These findings are echoed with a younger population as well. Treiman, Decker, Kessler, and Pollo (2015) studied 58 3-to 5-year olds to determine if pre-phonological children use the same spelling for the same word even if it was spelled incorrectly. The researchers found that pre-phonological children are more likely to use the same spelling of a word twice if both words are the same as opposed to two different words. A child demonstrates adeptness for language when he has mastered spelling rules and can adapt to irregularities and variations of spelling. Whether or not differences exist between the spelling abilities of twins and singletons has not been well documented.
Developmental milestones of typically developing singletons have been discussed in the previous section. These same developmental milestones for twins will be examined beginning with prenatal, perinatal, and postnatal development of infants.

**Twin Development**

People have always had a fascination with twins and their development as compared to singletons. As part of the ongoing nature versus nurture debate, twins, monozygotic twins especially, have provided essential information because their genetic profiles are the same. Twin studies related to language and motor development can help determine which aspects of development might be due to the environment and which parts have a genetic component.

**Prenatal.** In 2014, 1.5 percent of all babies born were born through in-vitro fertilization (IVF) (Christensen, 2014). IVF increases the chance of having twins because multiple embryos are implanted at one time. Artificial reproductive techniques, such as Preimplantation genetic diagnosis (PGD), Preimplantation genetic screening (PGS), Intra-cytoplasmic sperm injection (ICSI), in-vitro maturation (IVM), and IVF, have been found to have a limited impact on a child's development as compared with children who were conceived naturally (Zhan et al, 2013; Nekkebroeck, Van den Broeck, Desmytter, Ponjaert-Kristoffersen, & Bonduelle, 2012). Zhan and colleagues compiled a meta-analysis of 21 studies from 1995 to 2012 with participants ranging in age from newborn to 18 years of age. These studies looked at children who were conceived from the artificial reproductive techniques described above. The researchers did not find any significant differences, except for a possible mild motor delay in early childhood, which they attributed to more premature births. Nekkebroeck, and colleagues (2012) confirm these conclusions as they also found no significant differences in language, motor, socio-emotional, and mental development for their 16 pairs of 2-year-old twins.
**Perinatal.** In general, the previous research demonstrates that twins are not more likely to display a delay in their language acquisition; however, Stromswold (2006) found that there may be genetic factors that contribute to delays. During pregnancy many different factors can cause twins to have complications. Sharing a placenta is one example. What is the result of shared placenta? Twins are statistically more likely to be born premature and/or have a low birth weight (Lung, Shu, Chiang, & Lin, 2009). Placental and amniotic complications are more likely to occur in twins and there is a higher incidence of intrauterine infections. Mothers giving birth to twins also had more labor and delivery complications including hypoxia. These risk factors are perinatal environmental factors, which mean they take place directly before and after birth.

Another factor that people often believe is the cause of the difference between singletons’ and twins’ development is that full term twins are typically smaller than full term singletons, so even when some studies investigate the difference in twins and singletons, they might not have included term lengths and birth size. Mahurin Smith, DeThorne, Logan, Channell, and Petrill (2014) studied language development of pre-and full-term twins. They found no discernible difference between neurologically typical twins born after 27 weeks and their full term peers by school age.

Another way that twins were disproportionately affected by perinatal factors as compared with singletons was that they tend to spend more time in the Neonatal Intensive Care Unit (NICU) so their exposure to a high sensory environment is increased. Stromswold (2006) states that the average noise level in the NICU was between 60 and 90 decibels and lights are brighter than they were used to. Children born prematurely are not ready for that type of environment and it may hinder their development. The equipment often gives off high frequency sounds which can compromise the babies’ hearing very early on. Any factor that affects infants who are
premature and born at a low birth weight will disproportionately affect twins, because their rates of prematurity and low birth weight are higher than singletons. The perinatal factors can adversely affect the brain development of a child, and then possibly impact the child’s ability to learn language.

**Postnatal.** Nan, and colleagues (2013) studied 152 twin pairs in the United Kingdom. The authors analyzed data of 27 monozygotic twins and 48 dizygotic twins; in addition, there were two dizygotic twins who did not have a twin pair. The study utilized the *Ages and Stages Questionaire-3* (Squires & Bricker, 2009), *Wechsler Intelligence Scales for Children* (Wechsler, 2003), *Griffiths Mental Development Scales* (Griffiths, 1996), and the *Bayley Scales of Infant Development* (Bayley, 2005) to determine developmental markers for the children. Additionally, information about the mother’s background information was identified (i.e., employment status, socio-economic status, and age) and Apgar scores after five minutes were recorded for each child. According to these results, there was no difference in developmental skills between monozygotic and dizygotic pairs or within twin pairs. However, the study found a significant difference between the twins and singletons on gross motor, problem solving and personal-social scores but only until nine months. After nine months, they found no significant differences. Individuals who scored a point higher on their Apgar test (five minutes after birth) had increased motor skills at 18 and 24 months. Older maternal age also impacted communication scores, a one-year increase in age lowered scores at 9 and 12 months. These results from the Nan and colleagues study contrast with the results compiled by Datar and Jacknowitz (2009) and Rutter, Thorpe, Greenwood, Northstone, and Golding (2003). The latter studies found a difference in low birth weight and development. Rutter and colleagues followed twins’ language development at 20 months and followed up at 36 months and had a different outcome. The Preschool
Language Scales (Zimmerman, Steiner, & Pond, 1992) and the McCarthy Scales of Children’s Abilities (McCarthy, 1972) were used to determine language skills. They found that twins did lag behind their singleton counterparts in a two tier cohort study design. The study looked at twins and singletons with a closely aged sibling, from a larger UK longitudinal study. The participants included 76 twin pairs (24 monozygotic twins and 52 dizygotic twin pairs) and 80 singleton pairs (where the younger sibling was born within the same time frame as the twins and the older sibling was not more than thirty months older). The research indicated that even when twins were age matched with singletons and all handicaps and prematurity were taken into account, the twins were still behind, up to three months, in their language development. While the two studies both looked at twin development, Nan and colleagues (2013) focused on language development and continued until age two and Rutter and colleagues (2003) continued until age three.

**Growth and Motor Development**

When examining motor milestones, twins, both monozygotic and dizygotic appear to follow the same steps on roughly the same timeline as singletons. Datar and Jacknowitz studied motor and physical development in monozygotic and dizygotic twins as well as singletons. The researchers studied 6750 singletons, 525 dizygotic twin pairs, 100 monozygotic twin pairs, and 50 individual twins. The researchers controlled for maternal, environmental and genetic factors as much as possible and found that there was little difference between the singleton population and the twins. The twins showed a slight motor delay when they were born with very low birth weights, but it was not significant by two years of age. They did discover, however, that physical growth was greatly impacted by the moderately low or very low birth weights, and the researchers did not find evidence that the twins caught up by two years of age, as they did with the motor development.
Ooki (2006) compiled a survey for Japanese mothers of twins. There were 1131 in the first group (mean age 12) centering around the Tokyo area and 951 in the second group (mean age 6) throughout Japan. The questionnaire focused on motor development milestones such as sitting up without support, pulling oneself to standing, and walking without support. Ooki’s research corroborates previous research; weight at birth and gestational age were significant determining factors of motor performance for the milestones. This effect was more apparent with the monozygotic twins because they are typically smaller, but the effect vanished by one year of age. Twins overall were behind singletons on sitting without support, pulling up to standing, and walking without support, skills that occur within the first year of life.

While studying growth rates for twins, Buckler and Green (2007) reported measurements for 1533 twins across the United Kingdom. The participants were between 2 and 9 years old with an average age of 4.03 years. The study found that the twins were slightly shorter than their singleton peers which corroborates previous research. Monozygotic boy twins were the slowest growing group; girls, no matter the twin type, grew faster than their male counterparts.

**Oral Language**

Some studies have shown that twins have complex language that tends to differ from singletons while other studies do not. According to Bishop and Bishop (1998), there has been evidence to show that language and phonological development of twins is typically slower than that of a singleton’s, however, there has been little research about the reason for these language and phonological delays. Rutter and colleagues (2003) declared that the twins who were typically developing in their study were behind by three months at three years of age. Reasons for the results are still unclear. Gucyyener and colleagues (2011) studied a large cohort and discovered that twin boys fell behind singleton boys in language development, but twin girls had the same
development as singleton girls. This may demonstrate that gender can have an impact on language development. These studies show that there are delays, but there are not any known causes for the outcomes.

Conversely, a national birth cohort study done in Taiwan with 21,648 infants, showed that twins who were not born prematurely or at a low birth weight did not demonstrate any differences in their fine motor, gross motor, language development, and social development from six months to 18 months (Lung, Shu, Chiang & Lin, 2009). The researchers discovered that children born full term at a typical birth weight, whose mothers were higher educated and had a better income, had higher language development at six and 18 months. Girl infants also showed higher language development at 18 months.

Lung, and colleagues also found that boys tended to develop faster with their gross motor skills while the girls tended to have better fine motor movement. This study was randomized and looked at factors that could be influential on development in twins and singletons such as socio-demographics and birth weights. The authors found that if parental income or maternal education were lower, those factors could adversely affect the child’s development, regardless of the twinning of the child. These contrasting studies reveal that there is much disagreement about twin development especially language development or could be possibly a difference in societal values. More research needs to be conducted.

Stromswold (2006) argues that her research is more valid than others. She stipulates that those who did not use twins who were premature in their studies, did not look at the full spectrum of factors that could be influencing the twins’ development. Because of this, she says that the perinatal factors are more important than postnatal factors. The other studies, specifically Rutter and colleagues (2003) argued that postnatal development was more important. According
to Stromswold’s (2006) study, genetics, epigenetics, and perinatal environmental factors affects language development much more than postnatal factors. It is important to keep in mind that many children who are from a multiple set are delayed in language development. Rice, Zubrick, Taylor, Gayan, and Bontempo (2014) state that a twinning effect on language could include vocabulary and grammar delays. This could possibly continue to hinder their achievement in later language skills on into adulthood. Multiple factors can contribute to language delays and all need to be taken into consideration.

**Literacy Development**

**Reading.** The genetic and environmental influences that encourage reading development at the most basic level have yet to be thoroughly discovered. A cross sectional study of 2370 twins both dizygotic and monozygotic completed in Florida, showed that there are general genetic influences that can spur reading development in early childhood (Hart et al., 2013). The most correlative of these markers was general cognitive ability.

Typically, children are taught reading skills at home and in schools, but also may have a genetic predisposition to attain certain skills. Byrne and colleagues (2006) researched the genetic and environmental influences that may mold early literacy skills. Byrne and colleagues discussed that it was important to look at this because reading skills may have a genetic basis. They studied 627 preschool twin pairs from three geographical regions (United States, Australia, and Scandinavia) and in total they had 312 monozygotic twin pairs and 315 dizygotic twin pairs. The researchers found that some skills had a definite genetic basis while others were more influenced by the environment. They found that phonological awareness, rapid naming and verbal short term memory have a definite genetic basis, while vocabulary is more influenced by the environment. The study discovered that by the end of the first year in school, reading ability is
shaped by the genetic background that also determines understanding of phonological structure and verbal fluency.

Genetic factors of twins continue to be studied. Harlaar and colleagues (2010) determined potential predictors of reading comprehension skills. The researchers tested the word decoding (i.e., phonological decoding and word recognition), listening comprehension, vocabulary and reading comprehension of 89 monozygotic and 131 dizygotic twins. They found that word decoding and oral language (i.e., listening comprehension and vocabulary) skills together constituted a factor predictive of reading comprehension ability and that oral language skills, independent of decoding skills, constituted a second, unique predictive factor. In addition, phonological decoding did not have shared environmental influences with word recognition and the oral language skill. Certain skills are closely linked through genetics while others are bonded through a shared environment; however, several skills involved in language and reading are irrevocably linked together such as word decoding.

**Spelling.** Twin studies in spelling have often looked for a genetic link that determines a person’s skills in the area of orthography and how it relates to reading. A longitudinal study of 225 monozygotic twins and 214 dizygotic twins from the United States and Australia, completed by Byrne, and colleagues (2008), concluded that orthographic learning (how a child remembers spelling patterns so that they can be retrieved automatically rather than sounded-out each time), spelling and decoding are all subject to genetic influences. For example, learning how to determine the spelling patterns in novel words depends on all three skills: orthographic learning, previous spelling achievement, and decoding which are all linked to the same genetic factors. Also, they noted that these findings were not connected to IQ level; genes that affect spelling, decoding and orthographic learning are not all the same genes that impact IQ.
Another study of 541 twin pairs (both monozygotic and dizygotic) with an average age of 18.5 years, showed that several aspects of spelling, especially irregular word reading, regular word reading, and non word reading, are highly heritable (Bates, et al., 2004). The spelling heritability corresponded with reading heritability for all the factors. This shows that there possibly is a common link between spelling and reading genetically.

Sebastian, Chengappa, and Ballraj (2012) showed that when monozygotic twins had misarticulations they were more likely to misspell words. The writing errors followed what the child misarticulated. For instance, if the child was missing sibilants or stridents, the child might write *microcope* for *microscope*. The children in the study demonstrated trouble spelling non-words and had sequencing errors of letters. The research concludes that children must learn how to speak a word before they can spell it.

People in communities tend to develop slang and mold language to fit their needs. Similarly, twins can sometimes develop a language between themselves to help them communicate and adapt to the world around them. Although the sound of the language varies, the prevalence, cause and implications are more thoroughly researched.

**Twin Language**

The idea that twins can create their own language when they are developing is a concept that has intrigued researchers and inspired several studies. Twin talk is often defined as a private language that occurs almost exclusively between twins or other sets of multiples which is also known as idioglossia (Hayashi & Hayakawa, 2004). The private language can occur with other members of the family, particularly a closely aged sibling.

**Cause.** Possible reasons for the development of twin talk include the fact that twins model for one another and can become accustomed to each individual’s sounds. Korah, Prasad,
and Sreedevi (2010) studied a case of 5:6 monozygotic twin boys whose primary language was Kannada. The children showed several phonological deviations which lead to the family not being able to understand the twins. Each twin would repeat his phonological errors because his twin would model it back. They hypothesized that twin talk may be attributed to twins mirroring each other and copying phonological deviations, rather than a real language that is developed between the two children.

Also there was a higher frequency of twin talk among those who had more incidence of non-verbal play (e.g., building with blocks or drawing) as it shows good communication between the siblings (Hayashi & Hayakawa, 2004). Thorpe, Greenwood, Eivers, and Rutter (2001) examined twin talk, private language of twins, in 76 twin pairs and 80 singleton pairs, as a potential cause of these language delays. When the twins stopped using twin talk by 20 months, children tended to develop typically. Those who were exclusively using twin talk at 36 months had lower vocabulary at 20 months and were behind by six months in comprehension, expression, perception, and short term memory as compared with the twins who did not use twin talk.

Bishop and Bishop (1998) found a correlation between use of twin talk and later language difficulties in children. They studied the effects of twin talk on language and factors that might cause language impairment. They discovered that twins who have a family history of language delay are more at risk when they have a closely aged sibling or a twin, though twinning should not be considered the sole reason for the differences later.

**Prevalence.** Hayashi and Hayakawa (2004) also studied the ages at which twin talk appears most frequently. The answer they found was that most twin talk developed by twenty months and had disappeared by thirty-six months. This means that although twins do not
typically use their twin talk very long, it could still have lasting effects. Bishop and Bishop (1998) found that about 7 percent of their twin pairs had a twin language that was unintelligible and about 3 percent used concurrent typical language. Six percent of twins had a private language at 20 months in the Thorpe, Greenwood, Eivers, and Rutter (2001) study. Hayashi and Hayakawa (2004) researched the diversity involved in twin talk. They found that dizygotic males used twin talk at about 40% and dizygotic females at about 39%. Monozygotic twins, however, had a twin talk prevalence of 48% for male/male pairs and about 48% for female/female pairs. Making their prevalence slightly higher than dizygotic twins. This did not separate same gender dizygotic twins with different gender pairs.

**Impact.** The type of twin talk that the twins used such as jargon or their own private language was an indicator of later language problems with the use of jargon being highly associated with delays. When twins used their own vocabulary mixed with their family’s native language, there was no indicator for delays. The idea that twin talk could be a cause of language delays or is associated with language delays in some way is widely accepted. This correlation is echoed in a study by Hayashi and Hayakawa who hypothesized that early use of twin language may be a predictor of later language delays (2004). There is a dearth of research on whether dizygotic or monozygotic twins are more likely to use twin talk. In addition, little is known about gender differences, use of twin talk, and effect on phonological development.

**Monozygotic and Dizygotic Twin Differences**

There are a few noted differences between dizygotic and monozygotic twins. Rice, Zubrick, Taylor, Gayan, and Bontempo (2014) state that dizygotic twins are usually born longer and heavier than their monozygotic twin counterparts. The researchers posit that monozygotic twins could be more affected by prematurity and lower birth weights than their dizygotic peers.
Harlaar and colleagues (2010) found that monozygotic twins have a more similar shared environment than dizygotic twins. They attributed this to the possibility that shared genetics make them act in more similar ways and attract more similar types of people. They also discovered that monozygotic twins scored higher than dizygotic twins on scores for reading comprehension except for the Test of Word Reading Efficiency (Torgesen, Wagner, & Rashotte, 2012) and the Test of Narrative Language (Gillam & Pearson, 2004). However, they did note that they had a small sample size. The minute differences between dizygotic and monozygotic twins are continuing to be explored by researchers.

**Statement of the Purpose**

Studies have shown that there are apparent differences between twins and singletons in terms of their development rates. Language development in twins as opposed to singletons is an area that needs to be more thoroughly researched, especially the area of idioglossia, because not much is known about the causes, prevalence, and impact of such a unique feature of twins. Early use of twin talk could contribute to language delays in twins and affect literacy as they age. The purpose of this study will be to answer the following questions.

**Research Questions**

1. Is there a difference in use of twin talk between monozygotic and dizygotic twins?
   
   a. Hypothesis: Monozygotic twins will have a higher incidence of twin talk than dizygotic twins.
   
   b. Rationale: Previous studies have not separated dizygotic and monozygotic twins or only used monozygotic twins. Monozygotic twins are more commonly portrayed as closer which might help create a twin talk.
2. Is there a difference in use of twin talk between same and different gender pairs?
   a. Hypothesis: Same gender pairs will have a higher incidence of twin talk than different gender pairs.
   b. Rationale: Same gendered pairs might be closer to each other and rely on each other more as communication partners. This can be due to parents encouraging the same activities.

3. Is there a relationship between language development and use of twin talk?
   a. Hypothesis: There will be a negative relationship between twin talk and language development.
   b. Rationale: Some studies have suggested that twins who use twin talk have delays in their language leading up to and during school age.

4. Does the use of twin talk within twin pairs have an impact on later literacy skills?
   a. Hypothesis: There will be a negative relationship between twin talk and literacy skills.
   b. Rationale: Twin talk may reduce the amount of phonological awareness that the twins are learning in their family language during the foundational years because they are not using the language, which could impair language and literacy skills later.

5. Is there a relationship between low birth weight and incidence of twin talk?
   a. Hypothesis: Twins who are born at a low birth weight will have a higher incidence of twin talk.
   b. Rationale: Babies who are premature and have a low birth weight often have more language difficulties.
6. Is there a relationship between maternal education and incidence of twin talk?
   a. Hypothesis: Lower maternal education will result in higher use of twin talk.
   b. Rationale: Some studies have suggested that a lower maternal education could result in higher use of twin talk.

7. Does a history (familial and personal) of speech-language delays affect incidence of twin talk?
   a. Hypothesis: Twins with a family history of speech and language delays will have a higher incidence of twin talk.
   b. Rationale: A twin who has a family history of speech and language delays might be more likely to mispronounce sounds or words and then use them with his conversation partner, his fellow twin.

8. Does twin talk usage lead to a higher incidence of speech language services?
   a. Hypothesis: Twin talk usage will increase the incidence of twin talk.
   b. Rationale: One explanation of twin talk is that twins are mirroring incorrect speech sounds. A twin talk would exacerbate speech sounds which would require treatment.
CHAPTER III

Methodology

The research was conducted in order to gain a better understanding about any differences in language and phonology development in twins, both monozygotic and dizygotic particularly in relationship to the use of twin talk amongst twins. The participant selection, research instrument, and procedure are explained in this chapter.

Participants

Participants for this study were monozygotic and dizygotic twins of all ages or a parent. The research took a sample of convenience and gather participants through the snowball effect. The study will recruit people who speak English as their primary language. Twins under the age of eighteen needed a parent fill out the questionnaire.

Research Instrument

This survey was adapted from the surveys done by Bishop and Bishop (1998); Lung, Shu, Chiang and Lin (2009); and Ooki (2006) for parents of twins or the adult twins themselves. (See Appendix A). The participants answered 37 questions about themselves and their twin or their children. The survey also considered the language ability of any siblings to determine if there are variables in their environment that would affect all the children in the family and not just the twins.

The categories of the survey include:

Background information (thirteen questions) (e.g., Do twins run in your family?)

Language milestones (four questions) (e.g., Did one or both twins use recognizable words by their first birthday?)

Motor milestones (one question) (e.g., How old were the twins when they first learned to walk?)
Use of twin talk (four questions) (e.g., When they were young, did they use a twin talk?)
Reading and writing (five questions) (e.g., Is reading or looking at books considered fun?)
Hearing (two questions) (e.g., Did they have any ear infections when developing?)
Siblings’ development (two questions)
Foil questions (two questions) (e.g., Do they have neat penmanship?)

**Procedure**

**Obtaining participants.** Twins or families of twins were identified through personal contacts by the investigators and by flyers posted around the WSU campus and local community (See Appendix B). The survey will be online and the link will be sent to participants through email. The recruitment method for this study will be by word of mouth.

**Informed consent.** The first question on the survey was for Informed Consent (See Appendix C). Completing and submitting demonstrates consent to participate in the survey and have their information analyzed.

**Survey process.** Participants contacted the faculty investigator via email. She forwarded the email to the primary investigator, who distributed the electronic survey link to the twin or family member using email. Answers were either in a checkbox format (e.g., Type of twin: dizygotic or monozygotic) or open ended (e.g., What did the twin talk sound like?) so the participant could add their input or descriptions. Though email addresses were used for distribution purposes, they were not collected or saved. The survey was submitted anonymously. The investigators categorized the results by topic.

**Analysis**

The primary investigator tabulated results of monozygotic and dizygotic twins separately for statistical analysis of the research questions.
CHAPTER IV

Results

This chapter is organized according to the seven research questions. These questions were constructed to determine any possible relationship between use of twin talk and twin sets, gender pairs, language development, literacy development, birth weight, maternal education, and familial history.

Survey Participants

A total of 55 participants took this survey; 27 of the respondents were the parents, 17 were the older twin and 11 were the younger twin. There were nine surveys which were not used because they were submitted incomplete. There were 20 monozygotic twins and 35 dizygotic twin pairs represented. There were 22 female/female pairs, 19 male/male pairs, and 14 male/female pairs regardless of type of twin. Twins ranged in age from 15 months to 55 years of age with the mean age of 22 years among the participants, with a mode of 39.

Research Question 1: Is there a difference in use of twin talk between monozygotic and dizygotic twins? Twin talk was used by 62% of dizygotic and 72% of monozygotic twins used a twin talk. A chi-square test for independence indicated no significant association between the use of twin talk and the type of twins, \( \chi^2 (1, n = 50) = 0.49, p = .486 \) (See Table 1). Five respondents did not answer if the twins participated in twin talk, or they were too young to be analyzed. Type of twin did not have an influence on the type of twin talk used (comprehensible, jargon, reduplication, private, or selective mutism). Dizygotic twins reported 30% using a comprehensible twin talk, 10% using reduplication, 35% using jargon, and 25% using a private twin talk. There were no reported incidences of selective mutism with the dizygotic twins.
Monozygotic twins reported 18% using a comprehensible twin talk, 9% using reduplication, 27% using jargon, 36 using private twin talks, and 9% using selective mutism. Overall, for both dizygotic and monozygotic twins with 68% and 77% respectively, the twins only used their twin talk within their twin pair. They did not share their language with another family member.

**TABLE 1**

**TYPE OF TWIN AND TWIN TALK**

<table>
<thead>
<tr>
<th>Type of Twins</th>
<th>Twin talk usage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Used</td>
<td>Didn't use</td>
</tr>
<tr>
<td>Dizygotic</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>Monozygotic</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>17</td>
</tr>
</tbody>
</table>

**Research Question 2:** Is there a difference in use of twin talk between same and different gender pairs? The same gender pairs (male/male and female/female) used twin talk with an incidence of 72% in the sample provided. A chi-square test for independence indicated no significant association between the use of twin talk and the gender combination of twins, \( \chi^2 (1, n = 50) = 2.65, p = .103 \) (See Table 2). Different gendered pairs used twin talk in about 45% of cases. Five respondents did not answer the question.

The current study analyzed type of twin talk and gender of twin as well as when the twin talk ceased to determine any trends. Male/male gender pairs responded that 23%, used comprehensible twin talk. Jargon was used by 62% of pairs and private twin talk was used by 30% of pairs. Selective mutism was the least common with 7% of pairs using that form of twin talk.
talk. Overall, the male/male pairs had 67% of participants stopping twin talk before age 3, 11% stopping by age 4, 11% by age 5, and 11% continuing after age 6.

For female/female gender pairs 25% used a comprehensible twin talk, about 13% used a reduplication twin talk, 38% used a jargon, and 25% used a private twin talk. Female/female twin pairs used twin talk slightly longer. Before the age of 3, 31% of pairs had discontinued their twin talk. By age 3 7% stopped, and by age 4, 54% had ceased in using their twin talk. There were 7% of participants that continued with their twin talk past the age of 6.

| TABLE 2 |
| GENDER AND TWIN TALK |

<table>
<thead>
<tr>
<th>Twin talk usage</th>
<th>Used</th>
<th>Didn't use</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same</td>
<td>28</td>
<td>11</td>
<td>39</td>
</tr>
<tr>
<td>Different</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>17</td>
<td>50</td>
</tr>
</tbody>
</table>

Research Question 3: **Is there a relationship between language development and use of twin talk?** Language development was determined by the age of the first word, age at which the children put two words together, having 50 words by two years. These were determined to be major milestones in learning language and easy to remember by respondents. Fisher’s Exact Probability Test indicated no significant association between the use of twin talk and the use of recognizable words by the first birthday, $p = .595$. (See Table 3). Thirteen participants did not remember the answer and 3 respondents skipped the question for the first correlation. Most of
the twins and their parents reported that both twins had at least one word by 12 months, with less than 15% of overall participants reporting that neither twin had one word by their first birthday.

Chi-square tests for independence indicated no significant associations between the use of twin talk and the use of short sentences by two years, \( \chi^2 (2, n = 43) = 0.21, p = .899 \). See Table 4. Six participants did not remember the answer, three participants skipped the question and two respondents were not old enough at the time of the study to answer the question for the second correlation. Most of respondents (93%) reported that the twins were using short two-word sentences by age two without regard to use of twin talk.

Another chi-square test was completed to determine whether twin talk impacted late talking of one or both twins, \( \chi^2 (2, n = 39) = 0.52, p = .772 \). See Table 5. Late talkers were defined as having at least a 50 word vocabulary by age two. Nine respondents did not remember enough information to answer this question, five participants skipped the question, and two sets of twins were not old enough at the time of the survey to answer the question.

<table>
<thead>
<tr>
<th>Twin talk usage</th>
<th>Some recognizable words by 1st birthday</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Both</td>
<td>Neither</td>
</tr>
<tr>
<td>Twin talk usage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Didn't use</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>3</td>
</tr>
</tbody>
</table>

**TABLE 3**

FIRST WORD BY FIRST BIRTHDAY AND TWIN TALK
TABLE 4
SHORT SENTENCES BY TWO AND TWIN TALK

<table>
<thead>
<tr>
<th>Twin talk usage</th>
<th>Did the twins use short sentences by 2 years?</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes, mostly</td>
<td>Yes, but rarely</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>23</td>
<td>4</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Didn’t use</td>
<td>12</td>
<td>2</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>6</td>
<td>2</td>
<td>43</td>
</tr>
</tbody>
</table>

TABLE 5
LATE TALKERS AND TWIN TALK

<table>
<thead>
<tr>
<th>Twin talk usage</th>
<th>Was either twin a late talker?</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Both</td>
<td>One</td>
<td>Neither</td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>6</td>
<td>1</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>Didn’t use</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>2</td>
<td>29</td>
<td>39</td>
</tr>
</tbody>
</table>

Research Question 4: Does the use of twin talk within twin pairs have an impact on later literacy skills? Literacy skills were determined by asking four questions: reading at grade level, if reading was considered fun, if the twin ever read with parents or sibling, and if either twin is a good speller. The results were split between older twin and younger twin to test trends between the two.
**Older Twin**

Fisher’s Exact Probability Test indicated no significant association between the use of twin talk and an inability to read at grade level, \( p = .999 \). Chi-square tests for independence indicated no significant associations between the use of twin talk and whether the older twin considered reading fun, \( \chi^2 (2, n = 48) = 2.35, p = .310 \), whether the older twin enjoyed reading with a sibling or a parent, \( \chi^2 (2, n = 48) = 1.22, p = .544 \), or whether the older twin was a good speller, \( \chi^2 (2, n = 40) = 2.81, p = .246 \).

**Younger Twin**

Fisher’s Exact Probability Test indicated no significant association between the use of twin talk and an inability to read at grade level, \( p = .413 \). Chi-square tests for independence indicated no significant associations between the use of twin talk and whether the younger twin considered reading fun, \( \chi^2 (2, n = 50) = 1.29, p = .524 \), whether the younger twin enjoyed reading with a sibling or a parent, \( \chi^2 (2, n = 48) = 1.63, p = .444 \), or whether the younger twin was a good speller, \( \chi^2 (2, n = 41) = 0.66, p = .720 \).

**Research Question 5:** Is there a relationship between low birth weight and incidence of twin talk? A preterm birth was defined by the World Health Organization (2016) standards as a baby born before 37 weeks’ gestation. A chi-square test for independence indicated no significant association between the use of twin talk and whether the twins were premature, \( \chi^2 (1, n = 43) = 0.35, p = .555 \). A chi-square test for independence indicated; however, a significant association between the use of twin talk and the birth weight of the twins, \( \chi^2 (2, n = 49) = 6.16, p = .046 \). Among the twins who did not use twin talk, 50% \( n = 8 \) were identified as having been
low in birth weight, whereas 64% ($n = 21$) of those who did use twin talk were identified as having been average in birth weight (See Figures 1 and 2).

![Graph showing prematurity and twin talk](image-url)
Research Question 6: Is there a relationship between maternal education and incidence of twin talk? A chi-square test for independence indicated no significant association between the use of twin talk and the mother’s level of education, $\chi^2 (5, n = 50) = 3.89, p = .565$. In the current study, 29% of mothers had a high school education or less, about 45% had some college or a bachelor’s degree, and 25% had received a graduate degree. There was no trend in mother’s education and use of twin talk (See Figure 3).
Research Question 7: Does a history (familial and personal) of speech-language delays affect incidence of twin talk? Fisher’s Exact Probability Test indicated no significant association between the use of twin talk and familial history of speech-language delays, $p = .999$. Most respondents (53) reported no family history of speech-language delays.

Research Question 8: Does twin talk usage lead to a higher incidence of speech language services? Chi-square tests for independence indicated no significant associations between the use of twin talk and whether one or both twins received speech language therapy for either dizygotic twins, $\chi^2 (3, n = 32) = 3.39, p = .335$, or monozygotic twins, $\chi^2 (2, n = 15) = 0.31, p = .855$. However, each twin who noted a need for services marked speech sounds as the area of delay.
CHAPTER V
Discussion

Research Question 1:

Is there a difference in use of twin talk between monozygotic and dizygotic twins?

There were higher numbers overall that used twin talk in the current sample. The Hayashi and Hayakawa sampling had roughly 43% of participants using a twin talk. The current study had about 66% showing a large increase from previous research.

The hypothesis was that monozygotic twins would have a higher incidence of twin talk than dizygotic twins. The current study determined that there was no significant difference between use of twin talk and type of twin. Dizygotic twins and monozygotic twins were not represented equally in this study with 20 monozygotic twins and 35 dizygotic twins. Although 66% of all participants used twin talk, 13 of the 20 monozygotic twins used a twin talk. Research shows that closely aged siblings can be involved in the twin talk which suggests that twinning may be less of a factor in the development of a twin talk, but rather closeness in age and relationship might have more impact on use of twin talk (Hayashi & Hayakawa, 2004). Hayashi and Hayakawa found that dizygotic males used twin talk at about 40% and dizygotic females at about 39%. Monozygotic twins, however had a twin talk prevalence of 48% for male/male pairs and about 48% for female/female pairs. The current study showed 62% of dizygotic twins used a twin talk and 72% of identical twins used a twin talk.

Harlaar and colleagues (2010) stated that monozygotic twins have an environment that is more similar than dizygotic twins. There is also the genetic link that could predispose monozygotic twins to use twin talk with a higher frequency. Previous studies either did not differentiate between use of twin talk in dizygotic and monozygotic twins or only used
monozygotic twins. Monozygotic twins are more commonly portrayed as closer which might foster the development of a twin talk.

**Research Question 2:**

*Is there a difference in use of twin talk between same and different gender pairs?* The hypothesis was that same gender pairs would have a higher incidence of twin talk than different gender pair with the rationale that same gendered pairs might be closer to each other and rely on each other more as communication partners. Previous research found that about 50% of same gender pairs used twin talk and 40% of different gender pairs used a twin talk (Hayashi & Hayakawa, 2004).

The present findings did not show a significant difference in use of twin talk and the gender of the twins. The present research showed 72% of same gender twins using a twin talk, an increase from the previous literature, and 45% of different gender pairs using a twin talk, about the same as previous research. Although gender might not be a primary factor in the frequency of twin talk, the data from the current study did show a slight trend for the same gender pairs using a twin talk more frequently. A larger sample of participants might show a stronger relationship. Consideration should be given to the fact that the twins of the same gender are placed together more often, giving them more opportunities, while male/female twins might be encouraged to pursue different activities even starting at a young age, as hypothesized.

Another way to investigate the use of gender with twin talk is to look at which genders might use twin talk more frequently. Females are often considered the talkers in the family and it is often thought by society and the public that they will be the ones to learn language sooner and use it more often. When speaking of twin talk, however, twin girls used twin talk at about the
same frequency as twin boys (76% for the former and 67% for the latter). In general, previous research states that twins who have good communication between them, have higher frequency of twin talk (Hayashi & Hayakawa, 2004).

**Research Question 3:**

*Is there a relationship between language development and use of twin talk?* The hypothesis was that there will be a negative relationship between twin talk and language development. The rationale behind the thought was that some studies have suggested that twins who use twin talk have delays in their language leading up to and during school age (Hayashi & Hayakawa, 2004; Thorpe, Greenwood, Eivers & Rutter, 2001). There has been debate over whether twin talk may affect language development later on. Previous research studied any impacts twin talk might have. Thorpe, Greenwood, Eivers, and Rutter (2001) found that using twin talk for a longer period of time could lead to challenges in vocabulary, comprehension, expression and perception. Hayashi and Hayakawa (2004) showed that most twins stopped their twin talk by 36 months which is corroborated by these data. Although the sample size is small, of the same gendered pairs, girls used twin talk slightly longer than the boy pairs with 54% stopping before or by age 3 and 38% stopping by age 5. The boy pairs had 63% stopping before or by age 3 and 27% stopping by age 5. Each group had one pair that continued beyond age 6. This could have a greater impact on language.

In contrast to those results, the survey did not find a significant difference for language development. As measured by major milestones surrounding expressive language. In fact, most respondents did not list any differences. Only 13% of participants, who responded to the question, replied that the twins did not have their first word by their first birthday, regardless of
use of twin talk. Similarly, only about 5% of participants marked the negative answer that the twins were not using any short sentences by two years, while about 26% reported that one or both twins was a late talker. These results do not suggest that use of twin talk puts twins at higher risk for language deficits.

Other researchers who found a difference in use of twin talk and later language delay did not have a concrete explanation for the delay, so it is possible that it could be contributed to confounding variables and not be an issue for twins as the current study suggests. This may be a limitation of an anonymous survey to assess such specific information. However, because this study had a large age range, memory of past events in toddlerhood and early elementary might have contributed to these results.

Research Question 4:

Does the use of twin talk within twin pairs have an impact on later literacy skills? The hypothesis was that there will be a negative relationship between twin talk and literacy skills. The hypothesis was developed because twin talk shows a relationship with language development in some research as previously stated, so it could follow that it also showed a relationship with literacy development because those influence each other.

Twin talk may reduce the amount of phonological awareness that the twins are learning in their family language during the foundational years because they are not using the language, which could impair language and literacy skills later. Harlaar and colleagues (2010) studied predictors of reading comprehension skills focusing on phonological and phonemic awareness. Some of the factors had genetic links while others were more closely influenced by environment. In the current study there was no significant findings for an influence of twin talk on literacy
skills as measured by inability to read at grade level, whether reading was considered fun, the
twin enjoyed reading with a sibling or patent or if the twin was a good speller. Each twin was
studied individually to see if there were any correlations between the older twin or younger twin
and literacy development. There was no correlation for either twin group.

**Research Question 5:**

*Is there a relationship between low birth weight and incidence of twin talk?* The
hypothesis was that twins who are born at a low birth weight would have a higher incidence of
twin talk. Babies who are premature and have a low birth weight often have more language
difficulties because they are behind developmentally. However, the current research found that
twins with lower birth weights were less likely to use twin talk than those at average birth
weights. It is possible that twins who are born at an average birth weight are able to produce
sounds earlier than premature twins. This may cause an increase in the speech sound errors
produced by average weight twins which are then modeled back to each twin.

**Research Question 6:**

*Is there a relationship between maternal education and incidence of twin talk?* The
hypothesis was that lower maternal education would result in higher use of twin talk. A previous
study suggested that a lower maternal education could result in higher use of twin talk. The
previous study (Lung et al., 2009) found that maternal education could have an impact on
communication and language skills. The respondents in the current study were more highly
educated and may have contributed to these results.
Research Question 7:

Does a history (familial and personal) of speech-language delays affect incidence of twin talk? The hypothesis was that twins with a family history of speech and language delays will have a higher incidence of twin talk. The rationale behind the hypothesis was that many disorders run in families. A twin who has a family history of speech and language delays might be more likely to mispronounce sounds or words and then use them with his conversation partner, his fellow twin. The current study did not find significant difference; however, family members might not have been aware of a family history. In the general population about 6% of people have language disorders and about 8-9% of young children have speech disorders. That percentage lowers to about 5% by the time children reach first grade (National Institute of Deafness and other Communication Disorders, 2010). The current study population showed a prevalence of about 4% for both speech and language disorders.

Research Question 8:

Does twin talk usage lead to a higher incidence of speech language services? The hypothesis was that twins who used twin talk would be more likely to need services for speech and language. Previous research on the cause of twin talk found that it could be caused by the twins mirroring each other (Korah, 2010). The finding for the present research was not significant. Twins using twin talk did not receive speech or language services with a higher frequency than those in the general population. About 30% of twin pairs or individual twins who used a twin talk did require services. However, when looking at general statistics, less than 10% of the overall population need speech or language services (National Institute of Deafness and other Communication Disorders, 2010). Specifically, only about 8-9% of young children have
speech disorders and that number reduced further to about 5% when children reach about age 6. There was a trend for twins who used twin talk to receive services at a higher frequency. Also, it should be noted that of those twins who used twin talk and needed services, each stated that they required speech sound services. Four participants received additional services. Having so many twins need only speech sound therapy corroborates the theory that twin language is an exacerbation each twins’ speech sound errors.

Limitations and Future Research

The study, like all studies relying on surveys, was limited by missing data. The format of gathering information, a survey, involved self reporting and in some cases remembering past events. An, “I don’t remember” option was provided given for most questions to reduce guessing. This caused some questions to lack sufficient data due to the large population of older adult twins completing the survey.

In addition, self reporting could lead to less objective data and scores being inflated or misremembered to suit the participant. Only one twin was required to fill out the survey, so s/he might not have had a clear understanding of his/her twin’s abilities or remembered as clearly as a parent might, because certain events on the survey took place early in childhood. If any of the questions was confusing to the readers, they could not ask for clarification during the survey due to the online nature of the study. Also, the rating scale used in the last series of questions was subjective leaving room for interpretation on the part of the participant. No definitive criteria were given for some categories. For example, one survey question asked, “Did the twins have a large vocabulary?” and the options were yes, somewhat, and no. There is no strict definition for what defines a large vocabulary.
The participants were collected as a sample of convenience which may have inadvertentely biased the sample with people who were more similar. Overall, the number of school age participants, whose parents would possibly have more recent recollection, was low.

In future studies, obtaining younger, school age participants would be beneficial to gain a more complete understanding of literacy at school age. Future research could explore a larger sample size of younger twins to develop more fully the implications of twin talk for school age. Researchers could interview parents in person to reduce ambiguity and limited answer choices. The study could focus on more direct questions of how twin talk might affect literacy development. Another study could also research participants who received speech language services to determine if those twins used twin talk.

Clinical Implications

The current study aimed to provide professionals and families with twins an understanding of the differences twins might face when learning language and literacy as an effect of the use of twin talk. The study was created to help narrow down possible correlations for differences that had been previously found. The current study found that there were no significant differences in use of twin talk of dizygotic and monozygotic twins. This will help speech pathologists and parents know to look for twin talk in dizygotic twins as well as monozygotic twins instead of overlooking the former. There was also the result that babies born at average birth weights were more likely to use a twin talk. Many clinicians would automatically pay extra attention to the premature babies in terms of twin talk usage, but might not be expecting twin talk in the average weight twins. Twins who required services for twin talk (30%) was higher than the overall incidence of speech disorders in the general population (8-9%
before 1\textsuperscript{st} grade). All of the twins who needed services were recommended for speech sound disorders. This is important for a speech pathologist to be aware of and inform parents about the possible delays in the area of speech sounds.
CHAPTER VI

Conclusion

The possible implications of the effects of twin talk are not yet completely understood. The current study contradicted previous research in a few key aspects. More twins used twin talk (66% of those reporting on use of twin talk) than previously described by Bishop and Bishop (1998) and Thorpe, Greenwood, Eivers, and Rutter (2001) who both reported twin talk percentages under 10%. They did not, however, look at dizygotic versus monozygotic twins. Same gender twins had a higher incidence of twin talk than previously reported. This area is not highly studied, but Hayashi and Hayakawa (2004) reported about 50% of same gender twins using a twin talk while the current study had 72% of same gender twins reporting using a twin talk. The current study found no significant difference between twin talk and type of twin, gender pairs, using recognizable words by 1, using short sentences by 2, and being a late talker. This study found no relationship between maternal education, family history of speech language delays, or literacy development. Although there were no significant findings for prematurity and use of twin talk, a twin born at average birth weight was significantly more likely to use a twin talk than those at a low or very low birth weight. A more in-depth analysis of the topic might find nuances that the current study could not detect. An expanded study might show significance where the current study could only show trends.
REFERENCES
REFERENCES


APPENDIX A

Purpose: You are invited to participate in the study, Twin Language: A Preliminary Study. As a result of this study, we hope to learn more about speech and language development of identical and fraternal twins.

Participant Selection: You were selected as a possible participant in this study because you are a twin or you are the parent of twins. In this current study, we hope to survey 50 individuals.

Explanation of Procedure: If you decide to participate, you will complete the survey on Survey Monkey, an anonymous on-line survey tool. Potential participants will email Dr. Strattman. Co-researchers will send this Informed Consent form with the Survey Monkey link. There are 23 questions to answer either by yes/no (e.g., did either twin use twin talk), short answer completion (at what age did they stop using twin talk) or a ranking from “very accurate” to “not at all true” (e.g., did speech sounds develop easily). The entire survey should only take about 10 minutes to complete.

Discomfort/Risks: There are no known or expected risks associated with answering these survey questions. If you feel uncomfortable answering any question/s, you may skip it and you can finish the rest of the survey.

Benefits: Multiple births appear to be increasing for a variety of reasons. In this study, we hope to learn more about early speech and language development of twins, both identical and fraternal. Answering questions on this survey will give important new insights about early
speech and language development to prepare future speech-language pathologists to meet the needs of these children and their families.

Confidentiality: Involvement in this research is completely voluntary. The results of this study will only be used for scholarly purposes. No identifying information will be saved by the researchers or Survey Monkey.

Refusal/Withdrawal: Participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your future relations with Wichita State University. If you agree to participate, you may withdraw from the study at any time without penalty.

Contact: If you have questions regarding this study, you may contact me at: Dr. Kathy Strattman, Department of Communication Sciences and Disorders, by telephone (316)978-6356 or email at Kathy.strattman@wichita.edu. If you have questions regarding your rights as a participant in research projects, you may contact the Office of Research and Technology Transfer at Wichita State University, Wichita, KS 67260-0007, telephone (316) 978-3285.

By submitting the survey, you are giving your consent to participate. You are under no obligation; however, if you do, you may save or download this form for your records.
APPENDIX B

The Wichita State CSD department is asking for participants for a survey to look at twins’ language when they were developing.

- Short 15 minute online survey, 38 questions
- Participants can be any age
- Fraternal or identical
- Only one twin or parents need to participate
- Parent must fill out if twin is under 18
- If you are interested or know someone who might be, please contact Dr. Strattman at Kathy.Strattman@wichita.edu

Dr. Kathy Statman
Kathy.Strattman@wichita.edu
APPENDIX C

1. Purpose: You are invited to participate in the study, The Secret Language of Twins. As a result of this study, we hope to learn more about speech and language development of identical and fraternal twins.

Participant Selection: You were selected as a possible participant in this study because you are a twin or you are the parent of twins. In this current study, we hope to survey 50 individuals.

Explanation of Procedure: If you decide to participate, you will complete the survey on Survey Monkey, an anonymous on-line survey tool. Potential participants will email Dr. Strattman. Co-researchers will send this Informed Consent form with the Survey Monkey link. There are 37 questions to answer either by yes/no (e.g., did either twin use twin talk), short answer completion (at what age did they stop using twin talk) The entire survey should only take about 15 minutes to complete.

Discomfort/Risks: There are no known or expected risks associated with answering these survey questions. If you feel uncomfortable answering any question/s, you may skip it and you can finish the rest of the survey.

Benefits: Multiple births appear to be increasing for a variety of reasons. In this study, we hope to learn more about early speech and language development of twins, both identical and fraternal. Answering questions on this survey will give important new insights about early speech and language development to prepare future speech-language pathologists to meet the needs of these children and their families.

Confidentiality: Involvement in this research is completely voluntary. The results of this study will only be used for scholarly purposes. No identifying information will be saved by the researchers or Survey Monkey.

Refusal/Withdrawal: Participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your future relations with Wichita State University. If you agree to participate, you may withdraw from the study at any time without penalty.
Contact: If you have questions regarding this study, you may contact me at: Dr. Kathy Strattman, Department of Communication Sciences and Disorders, by telephone (316)978-6356 or email at Kathy.strattman@wichita.edu. If you have questions regarding your rights as a participant in research projects, you may contact the Office of Research and Technology Transfer at Wichita State University, Wichita, KS 67260-0007, telephone (316) 978-3285.

By submitting the survey, you are giving your consent to participate. You are under no obligation. You may save or download this form for your records.

☐ Agree
☐ Disagree

2. Who is completing this survey?
☐ Parent of Twin
☐ Older Twin
☐ Younger Twin

3. Gender of twins (Choose both boxes if applicable):
☐ Male
☐ Female

4. Type of twins:
☐ Fraternal
☐ Identical

5. Age of twins now?

6. Do twins run in your family?
☐ Yes, on both sides
☐ Yes, on the paternal side
☐ Yes, on the maternal side
☐ No, artificial reproduction methods were used
☐ No, and no artificial reproduction methods were used

7. Do language or speech disorders run in your family?
8. What is the highest level of school the mother completed or the highest degree she received?

- Less than high school degree
- High school degree or equivalent (e.g., GED)
- Some college but no degree
- Associate degree
- Bachelor degree
- Graduate degree
- Other (please specify)

9. What is the highest level of school the father completed or the highest degree he received?

- Less than high school degree
- High school degree or equivalent (e.g., GED)
- Some college but no degree
- Associate degree
- Bachelor degree
- Graduate degree
- Other (please specify)

10. Were the twins premature? If yes, how long were they in the Neonatal Intensive Care Unit (NICU)?

11. What was the twins' birth weight?

- Very low birth weight (below 3 pounds)
- Low birth weight (three to five pounds)
- Average birth weight (five to nine pounds)
- Heavy birth weight (nine pounds and above)
12. How old were the twins when they first learned to walk?
- Under 1 year
- 1 year
- over 1 year
- I don't remember

13. How old were the twins when they got their first tooth?

<table>
<thead>
<tr>
<th>Older twin</th>
<th>Younger twin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. How old were the twins when they started eating solid food?

<table>
<thead>
<tr>
<th>Older twin</th>
<th>Younger twin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. Did one or both twins use some recognizable words by their first birthday?
- Both
- One
- Neither
- I don't remember

16. Did the twins use short sentences by 2 years (i.e., 2 words together)?
- Yes, mostly
- Yes, but rarely
- No
- I don't remember

17. Were the twins late talkers (i.e., having less than 50 words by 2 years)?
- Neither
- One
- Both
- I don't remember

18. When they were young, did they use typical words and vocabulary when communicating with others?
19. When they were young, did they use a twin talk with each other?

- Yes
- No
- I don't remember

20. If so, did they use the twin talk with other family members?

- Yes
- No
- I don't remember

21. What did it sound like? (Mark all that apply)

- Jargon (strings of fluent utterances that sounded like sentences, but were not understood by anyone else)
- Reduplication (repeating syllables as words such as baba or gaga)
- Comprehensible (language that is understood by at least one other family members, but not strangers)
- Private (twins switch between normal language and their twin language)
- Selective mutism (one or both twins only talk to each other and not other people)
- Other (please specify)

22. If so, when did they stop using it?

- Before age 3
- By age 3
- By age 4
- By age 5
- By age 6
- After age 6
- Still using
- I don't remember

23. Did either twin receive speech or language services?
24. What was the speech or language therapy for?

☐ Speech Sounds
☐ Vocabulary
☐ Fluency
☐ Sentence Length
☐ Reading
☐ Spelling
☐ Other
☐ Not applicable

25. If twin(s) received speech or language service, during what age (in years) were these services used? If twins received services at different times, please specify older twin or younger twin.

From: __________________________
To: __________________________

26. Have you ever been told that either twin was not reading at his/her grade level?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>I don’t remember</th>
</tr>
</thead>
<tbody>
<tr>
<td>Older Twin</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Younger Twin</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
27. Is reading (or looking at books) considered fun?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Somewhat</th>
<th>No</th>
<th>I don't remember</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old Twin</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
</tr>
<tr>
<td>Younger Twin</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
</tr>
</tbody>
</table>

28. Did they enjoy reading with a sibling or parent?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Somewhat</th>
<th>No</th>
<th>I don't remember</th>
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</thead>
<tbody>
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<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☐</td>
</tr>
</tbody>
</table>

29. Do they have neat penmanship?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Somewhat</th>
<th>No</th>
<th>I don't know</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Younger Twin</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

30. Did they enjoy using pencils, pens, and colors?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Somewhat</th>
<th>No</th>
<th>I don't remember</th>
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<td>☐</td>
<td>☐</td>
<td>☒</td>
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</tr>
</tbody>
</table>

31. Are they good spellers?
### 32. Did they enjoy playing word sound games, like rhyming and alliteration (first sound manipulation games: Andy Pandy, Jim Pim)?

<table>
<thead>
<tr>
<th>Older Twin</th>
<th>Yes</th>
<th>Somewhat</th>
<th>No</th>
<th>I don't know</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Younger Twin</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### 33. Did the twins have a large vocabulary?

<table>
<thead>
<tr>
<th>Older Twin</th>
<th>Yes</th>
<th>Somewhat</th>
<th>No</th>
<th>I don't remember</th>
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</tbody>
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<table>
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<tr>
<th>Older twin</th>
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<td></td>
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</tr>
<tr>
<td>Younger twin</td>
<td></td>
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</tr>
</tbody>
</table>

### 34. Did they have any problems with their ears or hearing as they grew up?

<table>
<thead>
<tr>
<th>Older Twin</th>
<th>Frequently</th>
<th>Occasionally</th>
<th>No</th>
<th>I don't remember</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Younger Twin</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Younger Twin</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### 35. Did they have any ear infections when developing?

<table>
<thead>
<tr>
<th>Older Twin</th>
<th>Frequently</th>
<th>Occasionally</th>
<th>No</th>
<th>I don't remember</th>
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<tbody>
<tr>
<td></td>
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</table>
Sibling Information

The following questions are about the siblings of the twins.

36. Age of Siblings (not including twins) (separate ages with commas):

37. Did any siblings have any delays in learning to: (please specify number of siblings)

<table>
<thead>
<tr>
<th></th>
<th>Talk?</th>
<th>Producing speech sounds?</th>
<th>Read?</th>
<th>Write</th>
<th>Spell?</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any older siblings</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Any younger siblings</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tbody>
</table>

Number of siblings (not including twins)