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Intonation And Reading Skills In Fourth-Grade Students

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DEDICATION

This work is dedicated to my husband, Murray, who has been a constant source of support. It is also dedicated to my children, Kiera and Ben: I hope that you will learn from my mistakes and be daring enough to make your own. Finally, this work is dedicated to my parents Rose and Ted Green in acknowledgement of their immeasurable gifts: knowledge of the love of God; their continuous love; and, the encouragement to dream. I owe them a debt I can never repay.

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CHAPTER 1

INTRODUCTION

Research has documented the relationship between oral language skills and reading skills (e.g., Catts, Fey, Zhang, & Tomblin, 1999). It has been shown that various language skills contribute to reading development (Vellutino, Tunmer, Jaccard, & Chen, 2007), that individual language skills may play a more or less important role at different stages of reading development (Adlof, Catts, & Little, 2006), and that oral language skills may ultimately constrain reading skills (Adlof et al.). The primary purpose of this study was to examine the role of one language skill, intonation, in the reading comprehension of elementary school students.

Intonation is one of the prosodic components of language and it has been characterized as the 'music' or 'tune' of speech. It is formed by changes in fundamental frequency (f0) across speech units and it is recognized perceptually as changes in pitch. Crystal (1986) described intonation as "…the most complex of all the prosodic systems …" (p. 175). It may also be one of the early connections between language form and language function (Flax, Lahey, Harris & Boothroyd, 1991). Prosodic features, including intonation, can serve several functions in communication: grammatical, semantic, attitudinal, psychological, and social (Crystal). Specifically, intonation: (1) gives speech its emotional quality, conveying meaning; (2) communicates the pragmatic and grammatical content of speech (Balog & Snow, 2007); and, (3) delineates units of speech (Snow, 1998). One way prosody functions in a grammatical role is when prosodic features serve to indicate a contrast such as that between a statement and a question (Crystal). The ability to use prosody, specifically intonation, to distinguish this statement/question contrast in both oral and literate language was one of the skills that was used to assess intonation in the current study.

Not only does intonation serve a number of functions in communication, it is also an early emerging component of language. Infants have been shown to demonstrate a preference for intonation patterns they have heard prenatally (DeCasper & Spence, 1986) and have demonstrated discrimination of intonation contour direction within days after birth (Nazzi, T., Floccia, C., & Bertoncini, J., 1998). Comprehension of intonation continues to develop during the preschool and early elementary school years with some skills developing beyond this age. (Wells, Peppé, & Goulandris, 2004). Finally, fMRI studies have confirmed a developmental progression in comprehension of intonation (Plante, Holland, & Schmithorst, 2006).

Later developments in children's comprehension of intonation appear to occur in line with other aspects of receptive and expressive language development. Wells et al. (2004) reported that children's intonation skills, particularly on the Input tasks of the Profiling Elements of Prosodic Systems-Child assessment procedure (PEPS-C; Peppé & McCann, 2003), were positively correlated with children's sentence level comprehension on the Test for the Reception of Grammar (TROG; Bishop, 2003) and their sentence level production on the Clinical Evaluation of Language Fundamentals-Revised (CELF-R, Semil, Wiig, & Secord, 1987). This suggested that children's skills, particularly in comprehension of intonation, may parallel other receptive and expressive language development (Wells et al.). Stojanovik, Setter, and Ewijk (2007) also reported a correlation between typically developing children's intonation skills on the PEPS-C and their receptive and expressive language development (as indicated by performance on the TROG and performance on the Syntactic Formulation subtest of the Assessment of Comprehension and Expression battery (ACE; Adams, Cooke, Crutchley, Hesketh, & Reeves, 2001). Finally, later oral language and intonation development also coincides with the period when children are beginning formal reading instruction. All of these were important considerations for the current study. As children are developing their reading skills, these skills are supported by oral language skills that are continuing to develop. Intonation skills also continue to develop during this period, and it has been noted that children may rely on intonation for comprehension to a greater extent than adults (Read & Schreiber, 1982). In light of these considerations, this study questioned whether a relationship would be demonstrated between children's intonation skills, their linguistic comprehension, and their reading comprehension.

Skills in production of intonation have also been shown to follow a developmental pattern of growth beginning in early infancy. The intonation contours of the cries of young infants have been reported to reflect the contours of the language to which the infant has been exposed (Mampe, Friederici, Christophe, & Wermke, 2009). Similarly, infants have been observed to use prosody that is characteristic of their native language during the period of transition from babbling to single-word production (Hallé, Boysson-Bardies, & Vihman, 1991). Development in ability to produce intonation has been reported across the preschool to school- age range (van der Meulen, Janssen, & den Os, 1997; Wells et al., 2004); however, preschool children have been observed to have greater difficulty producing rising contours than falling contours (Snow, 1998; Wells et al.). The ability to produce various intonation contours plays a role in reading when intonation skills are used to read aloud with expression. Thus, children's skills in production of intonation and the development of these skills across the school-age years were of interest in this study.

In summary, intonation is an early component of language and children produce the intonation contours of their native language from a very young age; both perception and production of intonation have been shown to follow a developmental pattern of growth (i.e., Wells et al., 2004); intonation skills continue to develop during the elementary school years; and, there is some evidence that intonation supports language comprehension in children. Because intonation is an early feature of language that may support linguistic comprehension and because skills in production of intonation are employed during fluent or expressive reading, this study questioned whether overall intonation ability (i.e., both perception and production of intonation) may represent a language skill that contributes to reading comprehension.

Because the aim of this study was to examine the role of intonation as a language skill in reading comprehension, a model of reading was required that would capture the relationship between oral language and reading. Stage models of reading such as those described by Frith (1985), Chall (1983), and Ehri and McCormick (1998) provide one perspective on reading development. These models document attainment of reading skills in relation to academic grades and are familiar in educational settings. For example, although development of word recognition or decoding skills is the key reading milestone in the early elementary grades, the emphasis shifts to development of reading comprehension skills around the fourth grade, the period of interest in this study. At this point, children are no longer learning to read or decode the words but rather, are "… reading to learn …" (Chall, p. 26). Stage models of reading were employed in this study to provide landmarks with respect to attainment of reading skills by typically developing children; however, these models were not designed to provide information regarding the component skills required for reading. Therefore, a model was necessary that would address these skills.

The Simple View of Reading (SVR), a theory of reading that is primarily associated with the work of Gough and Tunmer (1986) and Hoover and Gough (1990), reduces reading to its primary components and highlights the role of oral language in reading. It has been widely adopted as a framework for reading research across various disciplines. The premise of the SVR is that reading comprehension is the ultimate goal of reading and it is the product of decoding and linguistic comprehension. Gough and Tunmer and Hoover and Gough asserted that reading comprehension should be represented as the product of decoding and linguistic comprehension (i.e., a multiplicative operation) because each element is of equal importance: If one of these primary components is lacking, reading comprehension is reduced or absent (i.e., a product of zero). Finally, Hoover and Gough emphasized that although the SVR is a minimalist model of reading it does not deny the complexity of reading. Rather, within the framework of the SVR, factors affecting reading comprehension may do so by exerting their influence on decoding and linguistic comprehension.

Indeed, reading researchers have investigated the relationship between reading comprehension and a number of linguistic skills. Studies have examined skills at the word level such as semantic processing (Nation & Snowling, 1998), semantic skills (Vellutino, 2007), morphological awareness (Nagy, Berninger, & Abbott, 2006), and vocabulary (Oakhill, Cain, & Bryant, 2003; Cromley & Azevedo, 2007). At the sentence level, the relationship between reading comprehension and skills such as syntactic awareness (Nation & Snowling, 2000), morphosyntactic (Nation, Clarke, Marshall, & Durand, 2004) and syntactic skills (Catts, Adlof, & Weismer, 2006), have been investigated. Finally, at the discourse level, investigators have examined the relationship between reading comprehension and metacognitive skills (Oakhill et al., 2003), use of context (Cain & Oakhill, 2007), comprehension monitoring (Oakhill, Hartt, Samols, 2005), knowledge of text structure (Oakhill et al, 2003; Oakhill & Cain, 2007; Snyder & Downey, 1991), and inference making, cohesive devices, and integration (Cain, Oakhill, & Elbro, 2003; Catts et al., 2006; Cromley & Azevedo, 2007; Oakhill et al., 2003; Oakhill & Cain, 2007; Snyder & Downey, 1991). Of particular interest to this study, are a number of investigations that have examined the role of prosody and intonation in reading comprehension. This research has yielded varying results.

Whalley and Hansen (2006) reported that prosodic sensitivity at the phrasal level was found to contribute to reading comprehension in fourth-grade students and Ravid and Mashraki, (2007) identified a relationship between prosody and reading comprehension that is mediated by morphology. Schwanenflugel, Hamilton, Kuhn, Wisenbaker & Stahl (2004) found an association between prosodic reading and faster decoding speed but identified only a weak link between prosodic reading and reading comprehension. Nevertheless, Miller and Schwanenflugel (2006) reported that children who produced wide final falling contours at the ends of declarative sentences and wide final rising contours at the ends of yes-no questions exhibited greater reading comprehension. In a subsequent study, the same researchers also reported that first- and second-grade children who produced adult-like intonation contours during oral reading demonstrated increased reading fluency in third grade and those who demonstrated adult-like intonation contour production in first grade evidenced greater reading comprehension in the third grade (Miller & Schwanenflugel, 2008).

Some of the variability in the results obtained from research on prosody and reading comprehension may be related to the aspect of prosody assessed and the way in which it was measured. Whalley and Hansen (2006) examined perception of intonation whereas Schwanenflugel et al. (2004), Miller and Schwanenflugel (2006, 2008) and Ravid and Mashraki (2007) measured production of various prosodic components, including intonation. Ravid and Mashraki assessed production of intonation by comparing children's use of prosody during passage reading to adult use of prosody in the same passage. The reading passage was marked at points where adult readers employed prosodic features and the children's readings were compared with this adult template. Schwanenflugel et al. and Miller and Schwanenflugel (2006, 2008), however, used acoustic analysis to describe children's use of prosody, including intonation. None of these studies examined the contribution of overall intonation skill (i.e., both perception and production) to reading comprehension.

Additional variability in this body of research may be related to the underlying theories in each study about reading and about the role of intonation in reading. Intonation has been examined as a "… partial mediator between decoding speed and reading comprehension." (Schwanenflugel, et al., 2004, p. 124), an outcome of good reading comprehension (Schwanenflugel et al,), an indicator of automaticity in reading (Miller & Schwanenflugel, 2006), and a contributor to both decoding and reading comprehension (Miller & Schwanenflugel, 2008). Most importantly, although all of these studies evaluated various reading skills (i.e., reading speed, reading accuracy, reading comprehension), none of these studies approached reading from the perspective of the SVR. Although decoding skills were typically measured, (i.e., thus providing information regarding this component of the SVR), the contribution of children's underlying oral language skills was not taken into account. Therefore, there was no measure of linguistic comprehension, the other primary contributor to reading comprehension in the SVR. This leaves unaccounted for many linguistic variables, including intonation, which may also have influenced reading comprehension and also leaves unaccounted for the potential influence of intonation on reading comprehension through oral language comprehension.

One study that did assess a more comprehensive set of prosodic skills and oral language skills was completed by Marshall, Harcourt-Brown, Ramus and van der Lely (2009). They investigated the relationship between prosodic skills (as assessed with the PEPS-C) and language skills in children with specific language impairment and/or dyslexia. Although they did assess various language skills, they did not evaluate all aspects of reading: They assessed only regular and irregular word reading and single word spelling and did not assess reading comprehension. Marshall et al.'s results did not support a strong relationship between prosody and language and literacy skills. It should be noted also, however, that their participant groups were small and their standardized assessments (i.e., of language and literacy skills) were completed two years before administration of the PEPS-C. Moreover, they did not utilize the SVR as their framework and did not address all SVR components (i.e., decoding, linguistic comprehension, and reading comprehension) in their research.

In summary, most children learn to decode words, read fluently, and begin to use reading as a tool to access the academic curriculum within the first few years of their elementary education (see Chall, 1983). From the perspective of the SVR, these children have adequate skills in decoding and linguistic comprehension to support reading comprehension. The contribution of various language skills to each of these components of the SVR has been examined and, although a large body of research has focused on language skills related to decoding, attention has shifted to consideration of language skills (including prosodic skills) that contribute to reading comprehension.

Researchers have investigated the relationship between prosody and reading skills and a relationship between intonation and reading comprehension has been reported. Intonation is one of the earliest developing language skills and children may rely on intonation to support oral language comprehension more than adults. Intonation skills develop throughout childhood and this development spans the period in which children are learning to read; however, some intonation skills may not be achieved by all individuals (see Wells et al., 2004). Skills in both perception and production of intonation are employed in reading: Intonation is used to convey expressiveness when reading aloud and knowledge of intonation is required to interpret the writer's intended intonation in a passage as conveyed by punctuation.

Although research has evaluated the relationship between intonation and reading comprehension, there are many gaps in the current literature. Similar studies of intonation and reading have not used the SVR to frame their examination of reading comprehension and have not examined linguistic comprehension in conjunction with assessment of reading skills. Furthermore, the potential contribution of overall intonation skill (i.e., both perception and production of intonation) to reading comprehension has not been evaluated. It was the goal of this study to assess the role of intonation in this context. Miller and Schwanenflugel (2006) reported that children who produced more adult-like final intonation contours demonstrated greater reading comprehension. The first aim of this study was to determine whether Miller and Schwanenflugel's observations would be borne out with a different population sample and a larger body of data. It was hypothesized that Miller and Schwanenflugel's observations would be upheld and that children with more adult-like final intonation contours would also demonstrate better reading comprehension. The second aim of this study was to examine various aspects of intonation skills development in fourth-grade students and determine the relationships among intonation skills, listening comprehension skills, and reading comprehension skills. It was hypothesized that there would be a positive correlation between intonation skills and listening comprehension skills and between intonation skills and reading comprehension skills. The third aim of this study was to examine these relationships within the framework of the SVR. It was hypothesized that intonation would contribute to variance in reading comprehension either indirectly through linguistic comprehension or directly as a potential 'third component' within the SVR. Finally, the fourth aim of this study was to determine whether the PEPS-C provided information regarding intonation skills that would aid in the prediction of reading comprehension. Specifically, this study asked:

1. Do children who produce more adult-like final contours at the ends of declarative sentences (i.e., falling contours) and declarative or yes-no questions (i.e., rising contours) demonstrate greater reading comprehension than children whose final contours do not resemble adult contours?
2. Do children who produce wider final contours at the ends of declarative sentences (i.e., falling contours) and declarative or yes-no questions (i.e., rising contours) demonstrate greater reading comprehension than children who produce narrower final contours?
3. Does the inclusion of measures of intonation in the SVR provide better prediction of reading comprehension than the traditional simple view?
4. If intonation improves the prediction of reading comprehension in the SVR, what specific measures of intonation are better predictors of reading comprehension?
5. Does the PEPS-C add to the prediction of reading comprehension? If so, are some subtests of the PEPS-C more predictive than others?

CHAPTER 2

Review of Literature

This research study examined the relationship between intonation and reading comprehension within the context of the SVR, a model of reading that emphasizes the relationship between linguistic comprehension and reading comprehension. The SVR includes three components: decoding, linguistic comprehension, and reading comprehension. In the following review of literature, the first section defines reading, examines various models of reading, and introduces the SVR as the model that was adopted in this study. The second section examines research on language skills related to reading comprehension. The third section of the review discusses the development of both perception and production of intonation and considers literature that has examined the course of this development from infancy through the elementary school years. Finally, the fourth section examines research that has addressed the role of prosody and intonation in reading.

Reading

The relationship between oral and literate language. Reading can be defined or described from a number of different perspectives. The most basic description of reading is that it is a language-based skill. As such, it requires proficiency in all of the component skills of oral language: syntax, semantics, phonology, morphology, and pragmatics. However, there are two very significant distinctions that must be made between literate language (reading) and oral language (spoken language). The first distinction lies in the development of each of these forms of linguistic expression. Wolf (2008) points out that, although children are born with a genetic capacity for oral language, there is no similar genetic predisposition for reading: Reading must be learned by each successive generation. This learning may begin as early as the first year of life in language- and literacy-enriched homes and, some would argue, this learning continues throughout the lifetime of the individual. However, by about the fourth grade, most typically developing readers have acquired reading skills that allow them, not only to read, but to begin employing reading as a tool to access the rest of the academic curriculum (Chall, 1983).

The second distinction between oral language and literate language is that the sensory system conveying linguistic information via reading differs from the sensory system conveying oral language information. Although oral language involves the perception and production of language via auditory signals (i.e., signals that are heard), reading involves the perception of language via visual signals (i.e., signals that are seen). This differentiation between the auditory and visual modalities results in different constraints and affordances for the oral versus the literate language user. The primary advantage available to the reader or literate language user is that the written word is permanent and it can be reviewed to increase comprehension of the message. In contrast, the auditory message is transient: Once it is spoken, it cannot be retrieved. During conversation, however, the listener can observe the speaker's facial expressions, gestures, and posture for cues regarding the spoken message. The listener can also listen to changes in the pitch of the speaker's voice, the intensity of voicing, and pausing (i.e., the speech prosody) and use this prosodic information to refine interpretation of the message. These cues are not available to the reader of the written message. Perfetti (1985) observed that the oral message is defined and constrained by the interaction of the speaker and listener but the written message is determined by the writer. Therefore, the reader has only punctuation as a limited guide to prosody and must rely on linguistic knowledge and experience to interpret the writer's message. Perfetti also pointed out that oral language occurs in a social context whereas reading typically occurs in isolation. The context of oral communication is shared by the speaker and listener whereas the meaning of the written message may be more subjective.

In summary, reading and oral language share many similar features. Their greatest similarity stems from the fact that reading skills are built on an oral language foundation. However, there are significant differences between them. Reading presumes that many of the required oral language skills have been mastered and then layers the additional demands of visual recognition and processing onto this oral language foundation. Moreover, reading does not allow the same access to the prosodic (i.e., intonation) and paralinguistic cues (ie., gestures) that are present in speech. This results in different challenges in interpretation of the linguistic signal between the auditory and the visual modalities. The distinctions between oral and literate language were important considerations in the current study. One of the aims of the study was to examine elementary school-age students' ability to produce appropriate prosodic contrasts in their oral reading, thereby signaling comprehension of the intended prosody of the writer as conveyed by punctuation. The current study also questioned whether this ability would be correlated with measures of overall intonation skills development, language comprehension, and reading comprehension.

What is reading? Two different perspectives on what it means to read are the *narrow view* and the *broad view* of reading. Some have argued that reading is described by the ability to decode or recognize words. This *narrow view of reading* maintains that reading should be defined only by the act of decoding (see Kahmi, 2007, 2009) and that reading comprehension involves other cognitive and linguistic activity that goes beyond decoding. Others (e.g., Gough & Tunmer, 1986; Hoover & Gough, 1990) have maintained that reading is the ability to decode words *in order to understand or comprehend* the message intended by the writer. In other words, reading is a purposive activity and comprehension of the written message is the desired goal (see Rose, 2006). From this perspective, decoding without comprehension is not reading (Gough & Tunmer; Hoover & Gough; Catts & Kamhi, 2005). This broad view of reading, one that considers the relevance of both decoding and comprehension was the view that was adopted in this research.

Models of reading.

Stage models of reading. In addition to the complexity of the task itself, reading research is further complicated by the fact that there are various perspectives and models from which any discussion of reading can be initiated. Some researchers have examined stages of reading development (i.e., Frith, 1985; Chall, 1983; Ehri & McCormick, 1998) and for the most part, these stages relate to development of word recognition skills. Stage models of reading provide a useful framework for discussion of reading development because they describe attainment of specific reading skills and thus, can be readily applied in educational settings to students' progress in reading skills development.

Ehri and McCormick (1998) proposed a stage model of reading development which they described as five phases of word learning: *pre-alphabetic phase*, *partial-alphabetic phase*, *full-alphabetic phase*, *consolidated alphabetic phase*, and the *automatic phase*. The pre-alphabetic phase is characterized by lack of knowledge of the *alphabetic principle* (i.e., knowledge that individual sounds within spoken words are represented by graphemes in written words). Ehri and McCormick observed that this phase is observed typically in preschool and kindergarten level students. Although, some 'pretend' reading may be observed (i.e., reading familiar trade logos and symbols, reading a rehearsed or memorized story), students in this phase are not using phonological knowledge to decode words because they have not yet developed awareness of the alphabetic principle. In the partial-alphabetic phase, (typically at the kindergarten and first grade level), students begin to use some knowledge of sound-symbol matching. At this level, students may recognize some letters within a word and attempt to read the word based on this sound-letter knowledge; however, this knowledge is still rudimentary at this stage and may not include sounds produced by digraphs or alternate sounds for consonants. At the full-alphabetic phase of word reading, students have almost mastered the alphabetic system and Ehri and McCormick noted that the full-alphabetic phase is a crucial stage in reading development which must be attained in order for students to progress toward reading proficiency. The fourth phase in word reading, according to Ehri and McCormick, is the consolidated- alphabetic phase. The authors noted that this phase actually begins during the full-alphabetic phase, is typically observed in second grade, and is characterized by the ability to recognize chunks of letters (i.e., root words, syllables). This ability affords the opportunity for faster decoding and increased learning of sight words. Finally, in the automatic phase, students read words without effort and can employ multiple strategies to read unfamiliar words (Ehri & McCormick).

Frith (1985) also proposed a stage model of reading. Frith's model includes three phases that describe the initial development of reading: the logographic phase, the alphabetic phase, and the orthographic phase. In the logographic phase, Frith proposed that children use visual recognition to identify words. In this phase, phonological skills are not used to identify the individual sounds in the word and children recognize familiar words from visual memory and recognition. In the alphabetic phase, however, phonological skills are employed as children demonstrate awareness that graphemes represent specific sounds in words and use this knowledge to decode unfamiliar words. Finally, in the orthographic phase children demonstrate the ability to recognize strings of graphemes (i.e., morphemes) without applying phonological analysis to the string. In this way, children can identify words with facility without having to laboriously decode each grapheme.

The stage models proposed by Ehri and McCormick (1998) and Frith (1985) describe stages related to development of word recognition skills. Chall (1983), however, described a stage model that goes beyond word recognition. This model includes a prereading stage and five stages of reading development: three that relate to literacy development during the elementary school years and two that describe literacy development during the secondary school years and beyond. According to Chall's stages, typically developing children progress from prereading during the period between birth and six years of age (Stage 0), to learning to decode in the first and second grades (Stage 1), increasing reading fluency in the second- and third-grade (Stage 2) and finally, beginning to read to learn in the fourth- to eighth- or ninth-grade (Stage 3). Stage 4 represents the period of the secondary school years and it is characterized by development of the ability to consider multiple points of view. "Generally, Stage 5 means that one has the ability to construct knowledge on a high level of abstraction and generality and to create one's own 'truth' from the 'truths' of others" (Chall, p. 24). This latter stage is the level of reading that generally develops in post-secondary education and thus, not all adults reach this level. These latter stages distinguish Chall's model from the other developmental models that have been reviewed. Although all three models describe significant achievements in initial reading development, only Chall's model suggests that this development continues throughout elementary and secondary education and into the post-secondary years. In fact, it has been suggested that Chall's latter two stages may describe stages of cognitive development rather than reading development alone (Kahmi & Catts, 1989).

From the perspective of these stage models, it was anticipated that the fourth-grade students in the current study would display reading skills typical of Ehri and McCormick's (1998) *automatic phase*, Frith's (1985) *orthographic phase*, and Chall's (1983) *Stage 2* or *Stage 3*. In other words, it was expected that these fourth-graders had reached a level of reading proficiency that would allow them to read fluently without effort so that they could begin using reading as a tool to access new information (i.e., to read to learn). The current study was interested in the role of intonation at this level of reading development and the potential contribution of intonation to reading comprehension at a point when word recognition had become more automatic.

Stage models provide a useful approach to reading development that can be readily related to concomitant academic development; however, Catts and Kahmi (2005) described flaws that have been identified in these models. First, stage models focus on the skills or knowledge required at each stage and not on the processes that underpin reading at each level. Second, these models portray discrete stages whereas the characteristics of reading in one stage may actually overlap other stages. Third, stage models do not address how students' level of knowledge changes across stages. Finally, individual differences in reading acquisition are not addressed (Catts & Kahmi).

***Cognitive processing/component skills models of reading*.** Stage models of reading development describe the developmental acquisition of specific reading skills; however, others (e.g., Perfetti, 1985; Stanovich, 1985; Hoover & Gough, 1990; Kintsch, 1998; Vellutino, Tunmer, Jaccard, & Chen, 2007) have investigated the cognitive processes and/or component skills involved in reading. The literature related to these investigations represent an evolution in the research from a period in which reading and reading comprehension were viewed as a separate skills independent of linguistic ability (Berger, 1978) to the current period in which oral language and reading are subsumed within the more global category of language.

Perfetti (1985) described two levels of processing involved in reading comprehension. The first level, *local processing*, consists of activities that occur as the reader constructs meaning from a sentence. These activities include processes related to semantic and propositional encoding as well as integration of successive propositions. Perfetti defined *propositions* as " …abstract, elementary meaning units that comprise the meaning of a sentence." (p. 37). Perfetti also proposed a second level of processing that he termed *text modeling*. This was defined as the integration of higher-level processes (i.e., knowledge and inferencing) with meaning obtained from the first level (i.e., local processing), to develop text meaning.

Stanovich (1985) summarized the results of previous research with respect to four areas of processing which had been thought to relate to variance in reading ability: visual processes; phonological and naming processes; use of context; and memory and comprehension strategies. According to Stanovich, the research suggested that phonological awareness skills rather than visual processing appeared to account for decoding difficulties in poor readers. He noted that poor readers did use context to facilitate word recognition; however, he also observed that over-reliance on context could reduce processing capacity for comprehension. Finally, Stanovich noted that depressed short-term memory skills in poor readers may be related both to decreased phonological awareness and decreased use of strategies such as imagery, elaboration, and rehearsal.

Kintsch (1998) stated that ability in decoding skills, language skills, and domain knowledge determines the skill level of the reader; however, he pointed out that the interactions of these skills may contribute to different functional reading levels depending on the reading situation. For example, a high level of domain knowledge on a particular reading task may allow a less-skilled reader to perform better than a more skilled reader with less domain knowledge. Kintsch noted that domain knowledge allows readers to understand and remember texts such that domain knowledge may compensate for "… low IQ, low verbal ability, or low reading ability" (p. 287). He also described how decoding proficiency not only "… frees up resources for higher-level processing …" (p. 283) but also fosters vocabulary and semantic growth (i.e., the act of reading then feeds back to facilitate language skills development). Nevertheless, citing Stanovich (1985), Kintsch observed that poor decoders may use higher order processes such as use of context to ameliorate decoding weaknesses. Finally, the ability to determine the propositional elements of text and organize them to create text representations are the language skills that Kintsch described as involved in comprehension.

Vellutino, Tunmer, Jaccard, and Chen (2007) proposed an elaborate model of reading that contained variables identified in previous research as components in children's reading skills. The variables included visual coding, phonological coding, visual analysis, phonological awareness, semantic knowledge, syntactic knowledge, phonological decoding, and spelling. These contributed directly or indirectly to context free word identification and/or language comprehension. Context free word identification and language comprehension then contributed to reading comprehension. Vellutino et al. applied this model to data obtained from two groups of children: a group of 297 students in Grades 2 and 3 (the "Younger" group) and a group of 171 students in Grades 6 and 7 (the "Older" group). Vellutino et al. reported that their model was a good fit for the data obtained from both the Younger and Older participant groups. They also noted that the relationship between word recognition and reading comprehension was stronger in the Younger readers and that the relationship between linguistic comprehension and reading comprehension was stronger in the Older readers. Vellutino et al. observed that vocabulary and semantic knowledge contributed significantly to language and reading comprehension in both Younger and Older readers although the relationship was stronger in the Older readers. Syntactic knowledge, however, did not contribute significantly to reading comprehension in either group. The authors noted that the lack of effect found for syntactic knowledge may have been related to shared variance with semantic knowledge and language comprehension.

In contrast to the complex model of reading comprehension proposed by Vellutino et al. (2007), Hoover and Gough (1990) presented a more parsimonious model that focused on the primary skills underpinning reading comprehension. This model, known as the Simple View of Reading (SVR), was chosen as the framework for reading comprehension in the current study.

The Simple View of Reading. The SVR is a broad view of reading that is currently employed in reading research across disciplines around the world. The Rose Review, a study commissioned by the government of the United Kingdom recommended the SVR as the framework for the teaching of reading in schools in those countries (see Rose, 2006). This model is appealing for several reasons: 1) it reduces the complexities inherit in the reading process to its key features; 2) it provides a framework that both researchers and clinicians/educators can utilize (Rose); and, 3) it acknowledges the role of oral language in reading. Each of these features, and particularly the latter, made the SVR a practical choice for the current study.

The SVR as described by Gough and Tunmer (1986) and Hoover and Gough (1990) reduces reading to a multiplicative operation described by $R = D \times L$ in which reading comprehension is the product of decoding (D) and linguistic comprehension (L). Hoover and Gough defined decoding as “efficient word recognition” (p.130); linguistic comprehension as “the ability to take lexical information (i.e., semantic information at the word level) and derive sentence and discourse interpretations" (p.131); and reading comprehension as the ability to generate sentence and discourse level interpretations from lexical information that is presented graphically (i.e., in print). Thus, skills in both decoding and linguistic comprehension are required for skilled reading because weakness in either component would result in a product of zero reading comprehension. Hoover and Gough emphasized that although this is a minimalist model of reading, it does not deny the complexity of the reading process. Rather, they asserted that all other components that could impinge on reading success (i.e., background knowledge, vocabulary) exert their effect through their influence on decoding and linguistic comprehension. Moreover, the SVR does not imply that the relationships among decoding, linguistic comprehension, and reading comprehension are static. The relative contributions of decoding and linguistic comprehension to reading comprehension change over time: Word recognition exerts a greater effect on reading comprehension in the early elementary grades than in later grades and linguistic comprehension has a greater effect on reading comprehension in the later grades (Hoover & Gough, Adlof et al., 2006).

Support for the Simple View of Reading. Empirical support has been shown for the following features of the SVR: 1) children's decoding and comprehension skills are separable skills (i.e., a child may demonstrate good decoding skills yet poor comprehension skills); 2) skill levels in both decoding and comprehension are correlated with reading comprehension skills; and, 3) during the early years of reading development, the SVR has been shown to predict future reading comprehension (Kirby & Savage, 2008).

Researchers (e.g., Aaron, Joshi, & Williams, 1999; Leach et al., 2003; Oakhill, Cain, & Bryant, 2003; Catts et al., 2006) have demonstrated that the SVR's two fundamental components, decoding and linguistic comprehension, are separable and that weaknesses in either one or both components produce different types of reading impairments. In their study of 4th and 5th-grade students, Leach et al. classified students according to three patterns of late-emerging reading difficulty: difficulty with reading comprehension only; difficulty with word-level processes only (i.e., a *dyslexic* profile of phonological, decoding, and spelling difficulty); and, mixed deficits (i.e., deficits in both word-level and higher-order reading skills). Similarly, Catts et al. (2006) examined the reading skills of eighth-grade students and retrospectively analyzed their language comprehension and phonological skills in earlier grades (i.e., kindergarten, second grade, and fourth grade). They also reported patterns of reading difficulty that supported the dissociation between decoding and linguistic comprehension predicted by the SVR. Catts et al. summarized these patterns in a four-by-four classification matrix with language comprehension and word recognition as the delineating factors. Of the four groups generated by this matrix, two groups of students with comprehension weaknesses were described: students who exhibited poor word recognition skills and poor language comprehension skills and thus, displayed a mixed deficit; and, students who exhibited good word recognition skills and poor language comprehension skills, and thus, displayed a specific comprehension deficit. Finally, the independence of decoding and linguistic comprehension has also been reported in older (i.e., teenaged) poor readers (Savage, 2006).

The ability of the SVR to predict future reading comprehension has also been demonstrated. Catts et al. (2006) demonstrated that eighth grade students who exhibited reading comprehension difficulty had also displayed weaknesses in language comprehension in earlier grades. Catts et al. (2003) also observed consistency in the word recognition and listening comprehension skills of poor readers between the second and fourth grades.

Potential weaknesses in the Simple View of Reading. Although acknowledging that a large portion of the variance in reading comprehension is accounted for by decoding and linguistic comprehension, Conners (2009) indicated that there may be weaknesses in the SVR. These include: 1) the apparent independence of decoding and linguistic comprehension in the model; 2) the implication of unidirectionality in the model; 3) the possibility that the model may not describe the reading process in the same way for typical and atypical readers; and, 4) the fact that not all of the variance in reading comprehension is accounted for by decoding and linguistic comprehension (Conners).

These potential weaknesses in the SVR have been examined by various researchers. For example, Kirby and Savage (2008) investigated whether decoding and linguistic comprehension are indeed independent components in the SVR. They observed that semantic features (i.e., related to context, morphology, and word meaning) influence decoding. They reported that this suggested that decoding and linguistic comprehension may not be entirely independent factors (Kirby & Savage). The perceived implication of unidirectionality in the SVR has been challenged by research that has shown that, at least for some factors (i.e., vocabulary), the relationship appears to be bidirectional (see Oakhill & Cain, 2007). Others have examined the ability of the SVR to predict reading comprehension in atypical readers (e.g., Catts et al., 2003; Savage, 2006). In a study of the SVR with older poor readers, Savage reported that: 1) for teenaged poor readers, an *additive* model of the SVR (i.e., D+LC) best predicted reading comprehension; 2) no significant negative correlation between decoding and linguistic comprehension was found; and, 3) decoding and linguistic comprehension best predicted reading comprehension when a nonword reading task was used to measure decoding. Alternatively, when decoding was evaluated using text reading, Savage noted that decoding and "verbal cognitive ability" (p. 143) predicted reading comprehension better than decoding and linguistic comprehension. However, Catts et al. (2003) reported that a component model such as the SVR (i.e., a model using decoding and linguistic comprehension as predictive variables) accurately classified poor readers in the second and fourth grades.

Finally, researchers have attempted to account for more of the variance in reading comprehension by adding variables to the SVR. For example, Adlof et al. (2006) questioned whether the SVR should include a fluency component. Adlof et al. used structural equation modeling to evaluate the relationships among word recognition, fluency, listening comprehension, and reading comprehension in a large sample of language-impaired and typically developing children in second, fourth, and eighth grades. Adlof et al. reported that fluency did not account for any unique variance in reading comprehension in either the concurrent or prospective models that were evaluated; however, it is of particular interest to the current study that Adlof included measures of reading speed and accuracy as indicators of fluency but did not include a measure of the expressiveness component of fluency.

Cutting and Scarborough (2006) also questioned whether additional components should be added to the SVR. They examined various measures of reading comprehension in a study of 97 children in Grades 1.5 to 10.8. They questioned whether, reading speed, verbal working memory, serial naming speed, attention or IQ were additional variables that might contribute to reading comprehension beyond decoding and linguistic comprehension. Cutting and Scarborough reported that reading speed (as measured by the Rate subtest from the *GORT-3)* was the only feature that improved the prediction of reading comprehension in the SVR.

Johnson and Kirby (2006) investigated the contribution of naming speed to the SVR after accounting for decoding and linguistic comprehension. Naming speed in this study was measured by a picture naming task. Johnson and Kirby found that naming speed accounted for a small amount of unique variance in reading comprehension and that naming speed showed the greatest effect in less-skilled readers. Johnson and Kirby also illustrated the importance of defining the decoding component of the SVR. They assessed the impact of naming speed on reading comprehension in two versions of the SVR: one version with the decoding component represented by pseudoword decoding and a second version with the decoding component represented by word recognition. They reported that the product of the SVR components when word recognition represented the decoding component accounted for greater variance in reading comprehension than the product produced when the decoding component was represented by pseudoword decoding. Adlof et al. (2006) addressed this difference by including both real word and nonword reading tasks in the decoding tasks in their study and this methodology was adopted for the assessment of decoding skills in the current study.

In summary, the SVR, as described by Hoover and Gough (1990), is a model that reduces reading to its key features: decoding and linguistic comprehension. The model does not deny the complexity of reading: rather, it suggests that the many variables that have been shown to influence reading comprehension do so through their effects on decoding and linguistic comprehension. As Kirby and Savage (2008) pointed out, although Gough and Tunmer (1986) and Hoover and Gough may have described a simple view of reading, the component skills supporting that simple view involve complex cognitive processes. Moreover, it may be most appropriate to view the SVR as a model of reading in evolution as researchers continue to investigate factors that may contribute to reading development (Kirby & Savage). Nevertheless, although some weaknesses in the model have been described, the utility of the model is acknowledged by researchers, teachers, and clinicians around the world.

Language Skills Related to Reading Comprehension

A large proportion of early reading research investigated factors contributing to the decoding component of the SVR. It has been shown that word recognition or decoding skill presumes underlying knowledge not only of phonological awareness skills (Oakhill et al., 2003; Justice, 2008) but also other oral language skills (Catts, Fey, Zhang, & Tomblin, 1999). It has been reported, however, that a different set of skills underlies linguistic comprehension (Oakhill et al., 2003). Although many studies have examined aspects of decoding and word recognition, fewer studies have explored the relationship between oral language skills and later reading comprehension (Oakhill & Cain, 2007) or late-emerging reading difficulty. Nevertheless, there is a growing body of work that has focused attention on the linguistic factors underlying reading comprehension. The following is a review of a portion of this research and a discussion of some of the factors that may contribute to reading difficulties beyond the level of decoding. This review focuses on research related to the comprehension components of the SVR because the participants in the current study were fourth-grade students who had reached an academic level at which most students have mastered decoding. Therefore, the object of this study was to examine the relationships among intonation, listening comprehension, decoding and reading comprehension at a point in reading development when it was anticipated that decoding skills would be generally well developed.

Word-level skills. Various studies have examined the relationship between word level skills (i.e. phonological processing, word reading, semantic processing, and morphological awareness) and reading comprehension (Catts et al., 2006, Kelso, Fletcher, & Lee, 2007; Nation et al., 2004; Nation & Snowling, 1998; Nagy et al., 2006). It has been reported that children with depressed reading comprehension skills but intact word reading skills did not differ significantly from typical readers on measures of phonological awareness (Catts et al.; Kelso et al.; Nation, et al.; Nation & Snowling). Indeed, children with poor comprehension skills were distinguished from students with poor decoding skills by the intact phonological awareness skills of the students with poor comprehension (Catts et al.).

With respect to word reading, some research has described word reading skill as an area of relative strength in children with specific reading comprehension deficits (Catts et al., 2006; Leach et al., 2003); however, Snyder and Downey (1991) found significant differences in word reading skill between 8- to 14-year-old typical readers and children with reading disabilities. Furthermore, Nation and Snowling (1998) found that children with poor comprehension skills experienced greater difficulty than a control group (matched for decoding and nonverbal ability) reading infrequently occurring words and words with irregular spelling patterns. Nation and Snowling suggested that this weakness was evidence of semantic processing difficulty in the children with poor comprehension skills. Finally, at least one model (i.e., the direct and inferential mediation model) of reading comprehension in high school students showed that word reading continued to exert a small but significant direct effect on reading comprehension in ninth-grade students (Cromley & Azevedo, 2007).

Nagy et al. (2006) examined the role of morphology in reading comprehension, vocabulary, spelling, reading rate, and reading accuracy in students in the fourth to ninth grades. In this study, morphological awareness made a unique contribution to reading comprehension in all grades with much of its effect due to its impact on vocabulary growth; however, morphological awareness contributed to reading comprehension beyond vocabulary. Nagy et al. also reported that morphological awareness facilitated decoding of morphologically complex words thereby contributing to reading comprehension and played a role in “syntactic parsing” (i.e. syntactic analysis) which in turn also enhanced reading comprehension. Furthermore, the RAND report stated that there appears to be a relation between some components of syntactic parsing and reading comprehension (RAND Reading Study Group, 2002).

Finally, although vocabulary is a skill that has been examined extensively with respect to emergent literacy, its role in later literacy development must be considered because some children with poor comprehension skills have weaker receptive vocabulary skills than typical readers (Catts et al., 2006). Oakhill et al. (2003) found that vocabulary and verbal IQ as general measures of verbal skill accounted for variance in reading comprehension. Furthermore, Cain and Oakhill (2006) reported that 8-year-olds with good comprehension skills obtained significantly higher receptive vocabulary scores and slightly better verbal IQ scores on the WISC-III than children of the same age with poor comprehension skills. Also, reading vocabulary was found to have a significant direct effect on reading comprehension and a smaller indirect effect on reading comprehension via its effect on inferencing skills in a sample of ninth-grade students (Cromley & Azevedo, 2007). Finally, it may be appropriate to distinguish between vocabulary and broader semantic skills. Semantic skills (vocabulary and semantic knowledge) have been found to influence the oral and reading comprehension of both younger (second- and third-grade students) and older (sixth and seventh grade) students, with a somewhat greater effect seen in older students (Vellutino et al., 2007). Vellutino et al. also found that semantic skills contributed to word reading as well as language comprehension. Finally, Ouellette (2006) distinguished between vocabulary depth and breadth. He then examined the relationships between vocabulary depth and breadth, word reading, and reading comprehension. Ouellette reported that “oral vocabulary is related to word recognition through phonology and semantic representation and is further related to reading comprehension through depth of semantic knowledge” (p. 563).

Sentence-level skills. Research has examined sentence level factors such as semantic/syntactic knowledge and syntactic awareness that can affect reading comprehension (Catts et al., 2006; Nation & Snowling, 2000; Nation et al. 2004; Snyder & Downey, 1991). Snyder and Downey reported that by third grade, as they progress from decoding to fluent reading, children demonstrate increased reliance on sentence and discourse level skills in reading. In younger (8- to 11-years) typically developing readers, sentence completion accounted for a proportion of the variance in reading comprehension; however, in children of the same age with reading disabilities, both sentence completion as well as naming speed and accuracy accounted for variance in reading comprehension (Snyder & Downey).

Nation and Snowling (2000) investigated syntactic awareness skills in children with typical reading skills and in children who exhibited poor comprehension skills, in two experimental tasks. One task required the children to rearrange words in scrambled sentences to produce either an active or passive sentence form. The second task required the children to reorder words in scrambled dative sentences. The two groups were matched for "decoding skill, chronological age (approximately 9 years), and nonverbal ability" (p. 232). The children with poor reading comprehension exhibited syntactic awareness deficits that Nation and Snowling contended could not be explained by phonological weaknesses or by limitations in working memory and instead, reflected developmental delays in syntactic awareness skills in comparison with their typically developing peers.

Catts et al. (2006) also observed syntactic weaknesses in children with poor comprehension and Nation et al. (2004) reported relative weaknesses in morphosyntactic skills among children with poor comprehension along with a number of other oral language deficits. Conversely, Cain and Oakhill (2006) found no significant differences in syntactic skills between typical readers and those with poor comprehension skills at 8 years of age. Finally, Vellutino, et al. (2007) reported that syntactic knowledge did not make a significant contribution to listening or reading comprehension in either early primary (Grades 2 and 3) or middle school (Grades 6 and 7) readers.

Discourse-level skills. Kelso et al. (2007) examined reading skills in children (ages 7;7 to 9;5) with specific language impairment (SLI). In contrast to children with SLI and generally poor reading skills, children with SLI and poor comprehension skills displayed significant increasing oral comprehension difficulty from the word, to the sentence, to the paragraph level. The distinguishing language criteria for the two groups were stronger phonological skills and poorer listening comprehension skills at the paragraph level, on the part of those in the poor reading comprehension group (Kelso et al.).

Overall, the following discourse-level skills have been related to reading comprehension: inference making, cohesive devices, and integration (Cain, 2010; Cain et al., 2003; Catts et al., 2006; Cromley & Azevedo, 2007; Oakhill et al., 2003; Oakhill & Cain, 2007; Snyder & Downey, 1991); world knowledge (Cain, 2010; Cromley & Azevedo, 2007); metacognitive skills (Oakhill et al., 2003); use of context (Cain & Oakhill, 2007); comprehension monitoring (Cain, 2010; Oakhill, Hartt, & Samols, 2005); knowledge of text structure (Cain, 2010; Oakhill et al, 2003; Oakhill & Cain, 2007; Snyder & Downey, 1991); and working memory (Johnston et al., 2008; Oakhill et al., 2003; Oakhill et al., 2005). The relative importance assigned to these factors varies across the research.

Cromley and Azevedo (2007) found that "background knowledge and reading vocabulary make a larger contribution, and inference, strategies, and word reading make a smaller contribution" (p. 319) to reading comprehension. Similarly, Oakhill and Cain (2007) observed that early reading comprehension and verbal skills as indicated by vocabulary and verbal IQ were predictors of later comprehension skills; however, apart from these they found three other predictors: "answering inferential questions", monitoring comprehension, and understanding story structure" (p.7). Johnston et al. (2008) noted that "difficulties in inference-making and the use of context are the most consistently reported findings in studies of individual differences in comprehension" (p.127). Finally, these observations were supported by Snyder and Downey's (1991) study of reading skills in 8- to 14-year-old typical readers and children with reading disabilities which found that for older children (ages 11-14) with reading disabilities, the linguistic skills contributing to variance in reading comprehension scores were inferencing ability and the ability to answer questions about stories. Nevertheless, Catts et al. (2006) reported that although their findings suggested that children with comprehension difficulty displayed inferencing weaknesses, possible limitations in working memory may have contributed to this result.

In summary, various linguistic factors have been shown to contribute to reading comprehension. These factors exert their effect at different linguistic levels (e.g., word, sentence, and discourse) and their influence may vary with age and stage of reading development. The presence of numerous variables affecting reading comprehension highlights the complexity of reading but does not detract from the validity of the SVR model. From the perspective of the SVR, all of these factors may contribute to reading comprehension through their effect on one of the variables (i.e., decoding and linguistic comprehension) within the model. In the current study, measures of linguistic comprehension and word recognition/decoding were made at various levels to address some of the issues raised in previous research. Linguistic comprehension was assessed at the word, sentence, and discourse levels; both vocabulary (depth) and semantic knowledge (breadth) were evaluated; and, word recognition/decoding skills were measured in both real word reading and pseudoword reading tasks.

Methodological Issues in Reading Comprehension Research

There are many factors that make research on children's reading comprehension particularly difficult. First, students with late-emerging reading difficulties do not appear to be a homogeneous group and this compounds methodological issues in research on reading comprehension (Catts et al., 2006; Leach, Scarborough, & Rescorla, 2003; Nation et al., 2004). Reading difficulty beyond the early primary years may be related to residual decoding/word recognition skills, comprehension deficits, or a combination of each of these factors (Catts et al., 2006; Leach et al., 2003)

Second, the large number of linguistic and other variables that have been reported to contribute to reading comprehension increases the challenges of research in this area. Recall the many features of oral language that have been reported to play a role in reading comprehension (i.e., vocabulary, syntax, morphology, narrative skills and others). Recall also, that these features will then be conveyed via a visual modality that will impose new demands on the novice reader. It is apparent that it becomes very difficult to account for the number of potential variables in order to conduct a manageable yet valid study of reading comprehension.

Third, it is difficult to reduce a multitude of potential variables to a simple model that is representative of reading comprehension. Johnston et al. (2008) highlighted the challenges of constructing a representative model of reading comprehension from a limited set of variables given the complexity of reading comprehension. This difficulty is exacerbated by the fact that the relative contribution of component skills to reading comprehension has been reported to change with reading development (Adlof et al., 2006; Johnson et al., 2008). Kahmi (2009a) also pointed out that there is an inherent weakness in a broad view of reading (like the SVR) that combines the two very different skills of word recognition and comprehension. Kahmi observed that, although word recognition is an easily defined and highly measurable skill, comprehension is much more ambiguous. Comparing word recognition and comprehension, Kahmi stated, "Comprehension, in contrast, is not a skill with a well-defined scope of knowledge; it is a complex of higher level mental processes that includes thinking, reasoning, imagining, and interpreting" (p. 175). Kahmi pointed out that comprehension can occur on many levels and that comprehension is closely linked to prior knowledge of the content area. In contrast, most standardized tests of comprehension test global comprehension skills and are "domain general" (Kahmi, p.175). This raises concerns regarding the validity of these tests.

Finally, Kahmi's (2009a) concerns regarding "domain-general" (p. 175) tests of comprehension appear to have been substantiated by research that has found that different assessment instruments employed in reading comprehension research may not measure the same cognitive skills (Cutting & Scarborough, 2006; Keenan, Betjemann, & Olson, 2008; Nation & Snowling, 1997). Nation and Snowling compared the performance of 107 Year 3 (ages 7-8 years) and 77 Year 4 (ages 8-9 years) students on several tests of reading skills. They reported that scores on the two tests of reading comprehension used in this study, the Suffolk Reading Scale and the Neale Analysis of Reading Ability, were predicted by different reading skills. Although word recognition skills predicted scores on the Suffolk Reading Scale, listening comprehension skills predicted scores on the Neale Analysis of Reading Ability (Nation & Snowling).

A later study by Cutting & Scarborough (2006) raised similar concerns regarding differences in measures of reading comprehension. They employed three different measures of reading comprehension in a study of the roles of word recognition, language skills, and other cognitive skills in prediction of reading comprehension in children in Grades 1 through 10. Reading comprehension was evaluated using three frequently used instruments: the Gates-MacGinitie Reading Test-Revised (G-M); the Gray Oral Reading Test-Third Edition (GORT-3); and the Wechsler Individual Achievement Test (WIAT). Cutting and Scarborough noted that comprehension is assessed on the G-M by the student's ability to read a passage silently and then respond to multiple choice questions about the passage. The student is permitted to look back at the passage in order to respond. On the GORT-3, comprehension is evaluated as the student's ability to read a passage aloud and respond orally to questions about what has been read without referring back to the passage. On the WIAT, comprehension is determined by the student's ability to read passages silently and respond to oral questions about the passage while the passage is in view. These instruments also differed in other ways: the G-M has a time limit whereas the GORT-3 and the WIAT do not; the instruments vary in number of sentences in each passage; and, the comprehension questions asked on the G-M and the GORT-3 are multiple choice whereas the questions posed on the WIAT are open-ended. Cutting and Scarborough reported that these reading comprehension measures differed in their identification of component skills of reading comprehension and in their ability to identify reading comprehension deficits.

Finally, Keenan, Betjemann, and Olson (2008) extended this research on measures of reading comprehension in a study that compared the GORT, the Qualitative Reading Inventory (QRI), the Woodcock-Johnson Passage Comprehension subtest (WJPC), and the Peabody Individual Achievement Test (PIAT) Reading Comprehension test. The authors found that these tests varied significantly in the amount of variance in reading comprehension attributed to decoding and linguistic comprehension at different developmental and reading skill levels. These differences were most pronounced with younger or less skilled readers. Moreover, not only were the tests not always evaluating the same things but Keenan et al. also found "… that the very same test, particularly the PIAT and the WJPC, can measure different skills depending on developmental level" (Keenan et al., p. 295).

Summary of Language Skills and Reading Comprehension Research

Typically developing readers progress from learning to read (i.e., learning to decode) to reading to learn (i.e., reading comprehension) in the course of their early elementary school years. It has been shown that the two primary processes underlying this development, decoding and linguistic comprehension, are distinct components (Oakhill et al., 2003). Moreover, if efficient decoding has been achieved, the primary constraint on reading comprehension is level of linguistic comprehension. (Hoover & Gough, 1990).

Various linguistic factors have been discussed that may contribute to reading comprehension. The research to date has identified that: 1) numerous language components can contribute to reading comprehension; 2) one factor or a highly individualized interaction of these factors may be responsible for the reading comprehension difficulties experienced by a single child; and, 3) the factor or factors responsible for reading comprehension difficulties for any given individual may exert a different degree of influence at different stages of linguistic and/or literacy development. Although some skills may contribute to both components (i.e., decoding and linguistic comprehension), for the most part, different skills contribute to each (see Oakhill et al., 2003).

Failure to develop adequately in either component area (i.e., decoding or linguistic comprehension) results in impaired reading comprehension. It has been shown, however, that identifying weaknesses in reading comprehension can be problematic. Frequently used measures of reading comprehension do not always tap the same skills and the identification of a reading comprehension deficit may vary from one reading comprehension test to another. Moreover, reading comprehension in the classroom is tied to each academic content area; yet, children's reading comprehension is usually assessed using standardized measures of comprehension that evaluate global content areas rather than classroom content areas. Thus, a valid measure of comprehension "in-situ" may not be obtained.

Intonation Development

Intonation is the prosodic component of speech production that is formed by changes in fundamental frequency (f_0) across speech units. As is characteristic of all of the prosodic components, intonation is described as suprasegmental because it is applied across entire speech segments. Perceptually, intonation is recognized by changes in pitch in the speech stream and it is often described as the musical aspect of speech. Intonation can convey grammatical, pragmatic, attitudinal, psychological, or semantic information (Crystal, 1986) and thus, it communicates meaning beyond the meaning of the words themselves. Intonation skills begin to develop at a very young age; however, intonation development continues for a prolonged period throughout the elementary school years. The following review of the literature presents research highlighting this developmental progression in both perception and perception of intonation. The participants in the current study were fourth-grade students; therefore, aspects of intonation development during the period encompassing the preschool and elementary school years were of greatest interest. Nevertheless, a brief description of development of intonation skills during infancy has been included in this review to provide a more complete perspective of intonation development.

Perception of intonation.

Infants. Research has demonstrated that fetuses who have heard their mother's voice producing the same intonation patterns repeatedly (i.e., reciting daily the same passage) during the last 6 weeks of gestation will prefer those patterns postnatally (DeCasper & Spence, 1986). Thus, there is evidence that even before birth, infants perceive intonation patterns and at a very early time postnatally, they can recall and recognize those intonation patterns.

Various research studies have investigated the ability of young infants to discriminate intonation (Cooper & Aslin, 1994; Fernald, 1993; Karzon, 1985; Morse, 1972; Nazzi, Floccia, & Bertoncini, 1998; Singh, Morgan, & Best, 2002). This research documents the ability of very young infants to discriminate intonation contours. For example, Cooper and Aslin reported that 1-month-old infants were able to discriminate infant-directed from adult-directed filtered speech; Morse found that 40- to 54-day-old infants demonstrated the ability to discriminate intonation and variations in the transitions of the second and third formants that provide the acoustic cues for place of articulation; and, Nazzi et al. demonstrated that infants from French-speaking homes (mean age = 68 hours) could discriminate bisyllabic words in a foreign language (i.e., Japanese) that differed in the direction of the intonation contour.

Preschool- to school-age children. Several studies have examined the development of perception of intonation in preschool and school-age children (Aguert, Laval, Bigot, & Bernicot, 2010; Laval & Bert-Erboul, 2005; Paul, Augustyn, Klin, & Volkmar, 2005; Stojanovik, Setter, & Ewijk, 2007; van der Meulen, Janssen, & den Os, 1997; Wells, Peppé, & Goulandris, 2004). Laval and Bert-Erboul examined the roles of intonation and context in the development of comprehension of sarcasm by French-speaking children between the ages of 3- and 7-years. The 3-year-old children were unable to respond reliably and the experimental task was deemed too difficult for them; however, Laval and Bert-Erboul reported that 5-year-old children demonstrated comprehension of sarcasm but only when a sarcastic voice (i.e., with higher pitch and a rising intonation contour than the neutral voice) was used. The 7-year-old children displayed the ability to use context to identify sarcasm and did not rely only on intonation to make this discrimination. Thus, the younger children relied on intonation to support comprehension when the meaning of the utterance was not stated directly.

Similarly, Aguert et al (2010) investigated children's (5- to 9-year-olds) use of prosody to disambiguate the speaker's intention under four conditions: positive and negative prosody and positive and negative context. Their intent was to determine the most salient cue guiding children's interpretations of expressive utterances (Aguert et al). They reported that, in the absence of lexical information, 5- to 7-year-olds relied on "situational context" (Aguert et al, p. 1629) to a greater extent than prosody for interpretation of the speaker's intention. Nine-year-olds relied on both context and prosody to determine the speaker's intention. Adults, however, relied on prosody to a greater extent to make this distinction. When the situational context was removed, 5-year-olds were able to use prosody to determine the speaker's intent only in utterances conveying negative prosody; however, 7- and 9-year-olds were able to use prosody to determine intention in both conditions (i.e., positive or negative prosody). The authors observed that until the age of 9 years, children appear to turn to lexical information to guide interpretation of utterances when there is incongruence between lexical and prosodic information.

van der Meulen et al. (1997) also found a developmental progression in comprehension of prosody in 4- to 6-year-old children with typical and atypical language development. They noted a developmental progression in children's identification of the affective meanings conveyed by sentence prosody between the ages of 4- and 6-years; however, they did not find a significant difference between children with specific language impairment and typically developing children in ability to identify these affective meanings (van der Meulen et al.).

Wells et al. (2004) investigated the development of both perception and production of intonation in typically developing children between the ages of 5 and 14 years. This study evaluated children's receptive and expressive intonation skills using the Profiling Elements of Prosodic Systems-Child (PEPS-C). The PEPS-C examines intonation skills within four different tasks: *Chunking* (using intonation to distinguish number of items in a list), *Affect* (using intonation to convey like or dislike of an item), *Interaction* (using intonation to confirm or question) and, *Focus* (using intonation to highlight information) (Wells et al.). With respect to development of children's comprehension of intonation, Wells et al. found that the 5-year-olds had not reached the passing criterion of 75% accuracy on the receptive components of the *Interaction* and *Focus* tasks. Moreover, on the receptive component of the *Focus* task, only the thirteen-year-olds reached this criterion (Wells et al.). Wells et al. observed that developments in comprehension of intonation occurred between the ages of 5- and 9-years, with some skills developing beyond this age; however, they noted that there was considerable variability among the scores of the children in their study and the authors speculated whether some aspects of intonation are ever acquired by some individuals. Generally, it was found that children's comprehension of intonation developed in line with receptive and expressive language development (Wells et al.). This finding was supported by the data from typically developing children (between the ages of 4;3 and 12;4) who formed the control groups in Stojanovik et al.'s (2007) study of intonation skills in children with William's syndrome. Stojanovik et al. noted that intonation development and language development were highly correlated in the typically developing children.

Finally, in a study of individuals between 14- and 21-years with autism spectrum disorders that included typically developing individuals (ages 13- to 20.4-years) in a control group, Paul et al. (2005) employed 12 experimental tasks to examine perception and production of grammatical and pragmatic/affective functions of prosody. Two of these tasks examined grammatical perception and production of intonation (i.e. distinguishing between and producing declarative sentences and declarative questions) and two examined pragmatic perception and production of prosody (i.e. distinguishing between and producing typical intonation and motherese). The typically developing participants in the control group attained almost 100% accuracy on the grammatical and pragmatic perception of intonation tasks.

Production of intonation.

Infants to preschool-age children. Studies of the production of intonation by young children vary significantly with respect to the aims of the research, the context in which observations of intonation were made, the acoustical analysis of children's utterances, and the aspect of intonation under investigation. Early studies (Flax, Lahey, Harris, & Boothroyd (1991); Galligan (1987); Hallé, Boysson-Bardies, & Vihman (1991); and, Marcos (1987) focused on the *communicative function* of intonation in children's early vocalizations. Most later studies examined the *acoustic characteristics* or *form* of intonation contours produced by typically developing children from infancy to school-age (Loeb & Allen, 1993; Snow, 1998, 2002, 2006; and, Wells et al., 2004) or the form of intonation contours produced by children who display atypical patterns of speech-language development (Paul et al., 2005; Stojanovik et al., 2007; and van der Meulen et al., 1997). In general, these early studies of production of intonation provided data on very small samples of children and acoustic analysis of utterances was limited.

A different aspect of intonation development was investigated by Hallé et al. (1991) who examined intonation and duration in disyllabic vocalizations (babbling and single words) of French and Japanese children (beginning at 10 months of age and continuing until they were about 18-months-old). The researchers found that at the period of transition from babbling to single word use, both French- and Japanese-speaking children exhibited the general prosodic characteristics of their respective language.

Snow (2006) studied intonation development in 10 children (five boys and five girls) in each of six age groups: 6-8 months; 9-11 months; 12-14 months; 15-17 months; 18-20 months; and 21-23 months. Snow observed a decrease in accent range at 9 months that was matched by an equal increase in accent range between 18 and 20 months. Snow posited that this U-shaped pattern of development may reflect growth from the prelinguistic to the linguistic level of function because discontinuities in intonation development appeared related to other events in language development: The onset of regression occurred when intentionality typically emerges (around 10 months) and the production of a more mature accent range (around 18 months) occurred when two-word utterances begin to be produced. These latter two examples have been presented to illustrate the relationship between intonation development and other linguistic development from a very early point in children's development.

Preschool- and school-age children. Both Snow (1998) and Loeb and Allen (1993) examined preschool children's imitations of adult final intonation contours. Snow found that 4-year-old children were unable to imitate final rising contours as accurately as they imitated final falling contours. Furthermore, when the children did imitate the final rising contours, they produced longer mean word durations and narrower accent ranges than the adult models (Snow). These characteristics (i.e., longer mean word duration and narrower accent range) were not observed in children's imitations of final falling contours (Snow). Loeb and Allen also observed a difference between younger (3-year-olds) and older (5-year-olds) children's imitations of rising final contours. They found that the 3-year-olds in their study were *perceived* to imitate final rising contours less accurately than 5-year-olds; however, *acoustic analysis* revealed no difference in contour imitation by age. Development in contour production across these ages is supported by the findings of van der Meulen et al. (1997) who reported development in ability to imitate intonation in sentences between the ages of 4- and 6-years. Finally, Stojanovik et al. (2007) noted that skill level on some aspects of intonation was related to corresponding development in other language areas for typically developing children (CA = 4;3-12;4).

As noted previously, Wells et al. (2004) assessed intonation development in children between the ages of 5 and 13 years. They found that by 5 years most children demonstrated a functional use of intonation; however, more difficult contrasts (i.e., producing two words in one intonational phrase (e.g., coffeecake) or using intonation to convey meaning (e.g., liking vs. disliking) were not mastered until beyond this age. Wells et al. did note that: 1) there was variation among children with respect to intonation development; 2) some aspects of intonation of intonation continue to develop into the school years; and 3) some individuals may never develop all aspects of intonation. In support of Snow's (1998) findings that rising intonation contours were produced less accurately than falling contours by preschool children (4-year-olds), Wells et al. found evidence that some of the 5-year-olds in their study had not mastered functional use of rising contours.

Finally, as noted in the previous section, Paul et al. (2005) included 13 typically developing subjects (CA = 13-20.4) in their study of perception and production of intonation by individuals with autism spectrum disorders. Two experimental tasks evaluated production of intonation: Grammatical production of intonation (i.e. reading sentences alternatively as statements or as declarative questions) and Pragmatic/affective production of intonation (i.e., reading sentences with typical intonation or with an intonation pattern characteristic of motherese). The typically developing subjects reached a ceiling level of greater than 90% accuracy on the Grammatical production task and a level of approximately 87% on the Pragmatic/affective production task (Paul et al.). Paul et al. noted that the teenaged subjects may have been embarrassed by the Pragmatic/affective production task and this response may have resulted in a decreased score.

The grammatical production of intonation task in Paul et al.'s (2005) study parallels the experimental tasks in the current study; however, the participants in Paul et al.'s study read sentences and in the current study the participants imitated sentences and read a short paragraph. As noted previously, even the youngest participants in Paul et al.'s study (i.e., at age 13) had mastered the grammatical production task.

Summary of Intonation Development

Research has shown that children may begin to perceive intonation contours before birth (DeCasper & Spence, 1986), discriminate between contours shortly after birth (Nazzi et al., 1998), and produce contours before they produce their first word (Snow, 2006). Furthermore, there is a progression in development of perception and production of intonation that may be related to co-occurring linguistic developments (Snow, 2006; Stojanovik et al., 2007; Wells et al., 2004). Although mastery of some skills by adolescence has been demonstrated (Paul et al., 2005), it has been questioned whether some intonation skills are mastered by all individuals (Wells et al., 2004). Because intonation development has been related to development in other areas of language, it was of interest to the current study whether level of development of intonation skills parallels level of development of oral and literate language skills, particularly development of language comprehension skills.

Prosody/Intonation and Comprehension

Numerous studies of language skills related to reading comprehension have been reviewed previously in this paper. What is striking in the large body of literature that examines language and reading skills is the relatively small amount of research that discusses the relationship between the suprasegmental and prosodic components of language and reading skills. There are several reasons why research in this area may provide additional information regarding language and reading skills. It has been shown that the prosodic components of language are early developing features of language (e.g., DeCasper & Spence, 1986; Snow, 2006) and that these prosodic cues can support language comprehension (Read & Schreiber, 1982). Prosodic cues segment spoken language into meaningful units, provide information regarding grammatical structure, and indicate emphasized components of the speech stream (Cutler, Dahan, & van Donselaar, 1997; Whalley & Hansen, 2006). Finally, prosody can play various roles in oral language and research has demonstrated various interactions between oral language skills and reading skills (Catts, Fey, Tomblin, & Zhang, 2002; Catts et al., 2006).

Prosody and oral language comprehension. In a series of experiments designed to assess the importance of various cues to recognition of sentence structure by children and adults, Read and Schreiber (1982) observed that children had greater difficulty than adults identifying the subject in sentences in which all the words in the sentences were read with a 'list-reading' intonation (i.e., each word was produced with a rising intonation). They also had greater difficulty identifying the subject in these sentences than they did in sentences with normal intonation. In a different task, Reid and Schreiber found that when the prosody of the sentence did not match the sentence structure (i.e., the prosody of one sentence form was applied to a different sentence form) the children experienced even greater difficulty. Overall, Read and Schreiber indicated that their results may reflect children's greater reliance on prosodic cues than adults. Finally, Read and Schreiber reviewed their data on first grade students to determine whether there was a relationship between prosody and reading comprehension. In the absence of standardized measures of the children's reading comprehension, they asked the children's classroom teachers to rank the children's reading ability and two groups resulted: average readers and good readers. Read and Schreiber found that the average readers experienced significantly greater difficulty on the mismatched intonation task than good readers.

Friend (2000) distinguished between comprehension of linguistic contrasts (linguistic prosody) and comprehension of affective contrasts (paralanguage). She noted that although infants in the perinatal period are attuned to prosodic cues in the speech of their caregivers, young children, on the other hand, demonstrate a bias for linguistic information. She observed that:

> Variations in F_0, intensity, and duration facilitate attention to these lexical items. Once attention is directed to lexical meaning, resource limitations may insure that paralanguage becomes, in effect, a subordinate function of nonlinguistic, acoustic variation in speech. In early childhood, paralanguage may augment linguistic meaning, but not disconfirm or supplant it (p. 150).

Both Wells and Peppé (2003) and Marshall et al. (2009) used the PEPS-C to assess intonation skills in elementary school-age children. Wells and Peppé investigated intonation skills in 18 children with speech and language impairments (LI), 28 typically developing children matched for chronological age (CA), and 18 children matched for language comprehension skills (LC). They reported that there were no significant differences between the LI and LC groups in performance on any of the PEPS-C subtests. Nevertheless, they did observe that there were significant differences in the performances of the LI and the CA groups on five of the PEPS-C subtests: Chunking Input; Chunking Output; Focus Input; Interaction Input; and Interaction Output. Wells and Peppé suggested that these differences may indicate weaknesses in prosodic memory and in comprehension of pragmatic applications of intonation in the LI group. It should be noted, however, that the sample sizes in this study were small and the LI group was comprised of children with various areas of speech-language difficulty and concomitant diagnoses such as hearing impairment and attention deficit disorder.

Marshall et al. (2009) examined the prosodic skills of typically developing elementary school-age children, children with specific language impairment (SLI), children with dyslexia and children with SLI and dyslexia using the receptive and expressive chunking and focus tasks of the PEPS-C. They observed that children with SLI and/or dyslexia had greater comprehension difficulty than language-matched or age- matched controls when prosody interacted with syntax and pragmatics. However, different weaknesses were present in the SLI and dyslexia groups and overall, there was only a very weak correlation between prosody (as measured by the PEPS-C) and language and literacy skills in both the control and clinical groups. It should be noted that the participants in this study by Marshal et al were older elementary school age students between 10 and 14 years of age and there was a two year lag between administration of language and literacy measures and administration of the PEPS-C.

Prosody and comprehension of literate language. In a comparison of reading and listening skills in average and skilled middle school- (sixth-eighth grade) and college-age readers, Townsend et al. (1987) found that skilled and average readers displayed differences in reading and listening skills that were similar across both modalities. The authors noted that their results suggested that these skills are related and that reading and listening make use of similar strategies. Townsend et al. observed that in both reading and listening tasks, average middle-school readers are 'word-callers', processing both oral and written linguistic information word by word. Thus, less-skilled middle-school readers demonstrated less segmentation of linguistic material into units of meaning during both listening and reading tasks. Furthermore, Townsend et al. reported that the greater ability of the older average readers to chunk material into meaningful segments was the feature that distinguished the younger and older average readers. Based on their findings, the authors recommended that:

> Unskilled readers at the school level need to be more aware of phrase structure groupings of words and of sentences as units of meaning, and how within-sentence groupings of words relate to the meaning of a sentence. Attention to the intonation patterns of spoken language, practice in reading phrases rather than individual words, listening to skilled readers imposing intonation on printed language would all be helpful in increasing proposition perception processes at this level (p. 237).

Schwanenflugel et al. (2004) examined the relationships among decoding, reading comprehension, and various aspects of prosody in 120 second- and third-grade students. Prosodic measures included measures of mean pause length between sentences, variance in pause length between sentences, mean pause length within sentences, difference between child and adult F_0 within sentences, and width of final falling contours (as measured on five sentences for each participant). Decoding was assessed using two subtests of the Gray Oral Reading Test, Third Edition (GORT); however, reading comprehension was evaluated with only one measure, the WIAT-Reading Comprehension subtest. No measures were obtained of the students' oral language skills.

In one model, Schwanenflugel et al. (2004) examined whether prosody played a mediating role in the relationship between decoding speed and reading comprehension. Although they reported that children who were faster decoders were more likely to read expressively, they did not find a strong relationship between prosodic reading and reading comprehension in this model. Schwanenflugel et al. reported that prosodic reading was associated with faster decoding speed but only a weak link was found between reading comprehension and reading prosody. In a second model, Schwanenflugel et al. investigated the prediction of reading prosody by reading comprehension and decoding. They reported that there was a decreased relationship between decoding and reading prosody and again, they did not find a significant relationship between reading prosody and reading comprehension.

Nevertheless, other research has documented support for the role of specific prosodic components in reading comprehension (Miller & Schwanenflugel, 2006; Whalley & Hansen, 2006; Ravid and Mashraki, 2007). Ravid and Mashraki (2007) in a study of 51, Hebrew-speaking, fourth-graders found that reading comprehension, morphological knowledge, and prosodic reading were highly correlated with each other. The authors reported that the relationship of this correlation was such that "… the relationship between reading comprehension and prosodic reading is moderated by morphology, so that the higher the morphological score, the more positive this relationship" (Ravid & Mashraki, p. 150).

Whalley and Hansen (2006) examined the relationships among prosodic skills, phonological skills, and reading skills (accuracy of word and nonword reading and reading comprehension) in a study of 84 fourth-grade children. The prosodic tasks used in this study were the DEEdee task which evaluated prosodic skill at the phrase level and a compound nouns task which evaluated prosodic skill at the word level. According to the authors, the DEEdee task is a prosodic task in which each syllable in a phrase is replaced by the syllable *dee*. Thus, the phonemic information is removed from the phrase while retaining the original prosodic information (i.e., stress, rhythm, and intonation). One of the subtests of the compound nouns tasks was taken from the PEPS-C Chunking Input task. The children were required to listen to a phrase and determine whether two or three items were indicated by the speaker. The second compound nouns subtest required the children to identify whether an item in a sentence represented a noun phrase or a compound noun. Whalley and Hansen reported that the compound nouns task accounted for unique variance in word reading and the DEEdee task accounted for unique variance in reading comprehension. The authors observed that although prosody contributed to reading comprehension in this study, listening comprehension was not addressed in this research. Therefore, it could not be determined whether prosody contributed uniquely to reading comprehension beyond its indirect contribution through linguistic comprehension.

Miller and Schwanenflugel (2006) investigated prosody in the oral reading of 80 third-grade students. The students completed standardized assessments of word reading, fluency, and reading comprehension. The students and a comparison group of 29 adults also read a passage containing three examples of six different syntactic structures. Pause duration and pitch change were measured for each of the syntactic structures. Structures that were not produced with consistent prosody by the adults were not included in the analysis of the children's reading prosody. Miller and Schwanenflugel reported that skilled readers made shorter pauses while reading. They also observed that children whose final intonation contours during reading tasks more closely matched adult contours tended to demonstrate greater reading comprehension. Moreover, Miller and Schwanenflugel did find that prosody made a unique contribution to reading comprehension; however, this was only true for final falling intonation contours at the ends of declarative sentences and for final rising intonation contours following yes-no questions. They concluded that pitch change did play a role in prediction of reading comprehension. Like Whalley and Hansen (2006), Miller and Schwanenflugel did not include measures of listening comprehension in their study; therefore, the role of pitch changes in the prediction of reading comprehension independent of listening comprehension was not determined.

Miller and Schwanenflugel (2008) examined the development of reading prosody as well as the relationship between reading prosody and decoding development between first and second grade on reading fluency and comprehension in the third grade. Children completed measures of real word reading, reading fluency, and reading comprehension. Measures of pause duration, pausal intrusions, sentence-final pitch declination, and intonation contour were completed on the reading passages of a subgroup of 30 participants. From these measures, the authors determined that the largest effect sizes between first and second grades were shown by the measures of pausal intrusions and F_0 match. Therefore, these features were chosen as measures of reading prosody. The authors then tested two models: one with oral reading fluency as the outcome and one with reading comprehension as the outcome. In their evaluation of the first model (i.e., with oral reading fluency as the outcome measure), Miller and Schwanenflugel reported that although first and second grade word reading were strong predictors of third grade reading fluency, intonation contour measures were an additional predictor of word reading beyond the word reading measures. They also reported that first grade intonation contour measures were related to third grade reading comprehension.

Klauda and Guthrie (2008) investigated the relationship between components of reading fluency and reading comprehension in 278 fifth-grade students. The authors were particularly interested in reading fluency at various text levels (i.e., word reading, sentence reading, and passage reading). They evaluated fluency by measuring speed and accuracy of word reading; speed, accuracy, and phrasing in sentence reading; and, expressiveness in passage reading. Klauda and Guthrie reported that each measure of reading fluency (i.e., word, sentence, and passage level) correlated significantly with fifth-graders' performance on the reading comprehension measure. They also observed that increased rate and accuracy of reading at the word level was correlated with higher reading comprehension scores, thus supporting the premise of LaBerge and Samuel's (1974) automaticity theory. The central tenet of that theory is that increased reading rate and accuracy (i.e., automaticity in reading) frees cognitive resources to be used in reading comprehension. Finally, Klauda and Guthrie observed that children who demonstrated greater expressiveness during passage reading also demonstrated greater reading comprehension. Expressiveness was defined as appropriate use of pause, rhythm, stress, and pitch to convey the author's meaning.

Summary of Literature Review

From the perspective of the SVR, reading comprehension is the product of decoding and linguistic comprehension. In absolute terms, absence of skill in either component area results in lack of reading comprehension. It appears to be more often the case that there is weakness in the skills underpinning decoding or linguistic comprehension and thus, there is weakness in one of these two core reading components. This review has examined previous research that has highlighted a variety of linguistic factors that may contribute to deficits in reading comprehension. Moreover, the research cited has demonstrated that prosodic skills and in particular, intonation skills, are some of the most rudimentary features of linguistic production and comprehension. Not only are children at the elementary school level still in the process of developing these skills, they may also be more dependent than adults on these skills for language comprehension. There is an increasing body of research regarding the role of intonation in the reading process. This research has typically addressed one of two areas: prosody (including intonation) as the *expressiveness* component in reading fluency, or intonation as an *indicator* of reading comprehension. The current study, although acknowledging the role of intonation in these two areas, questions whether there is a more fundamental role of prosody/intonation in comprehension, contributing to both linguistic and reading comprehension. Of particular interest is Whalley and Hansen's (2006) assertion that:

> Prosody is critically interwoven with other aspects of spoken language, such as semantics and syntax, and is thus necessary for oral language comprehension. It is posited that normally developing children use their sensitivity to prosody to acquire and master spoken language and, in turn, use this linguistic skill to aid indirectly the comprehension of written text (p. 298).

Finally, Chafe (1988) noted that "both writers and readers experience auditory imagery of intonations, accents, and hesitations in written language." (p. 423). Perhaps when children do not develop the necessary prosodic skills, their level of function is compromised not only in oral language but also in linguistic environments (such as written text) in which the prosodic cues are more abstract.

The current study: 1) examined the final rising and falling intonation contours produced by fourth-grade students during reading and sentence imitation tasks; 2) compared the direction and accent range of these intonation contours with the mean contours produced by adult participants on the same tasks; and, 3) evaluated the relationships among intonation, decoding, linguistic comprehension, and reading comprehension in fourth-grade readers to determine whether inclusion of intonation in the simple view increased prediction of reading comprehension.

CHAPTER 3

METHODOLOGY

Participants

Participants were 137 (72 female, 65 male) fourth-grade students who were recruited from 13 elementary schools within the Windsor-Essex Catholic District School Board in Ontario, Canada. Student participants were recruited by means of information packets that were sent home from the fourth-grade classrooms. Each information packet contained an introductory letter, a parent consent form, a consent form for audio-taping, and a participant questionnaire. Because the primary investigator is an employee of the school board who may have been known to children and families participating in the study, the introductory letter was written by a superintendent of the school board in order to reduce the risk of perceived coercion to participate. Initially, there was a quasi-random selection of participants with distribution of information packets to every other student on each class list; however, insufficient participant numbers were obtained using this selection method so information packets were then sent home to every student in each fourth-grade class.

Participant Screening Measures

When the signed consent forms and participant questionnaires were returned to the school, the questionnaires were reviewed and students who did not meet the study criteria were removed from further participation in the study. The screening of participants was designed so that extraneous variables and possible sources of error such as differing ages of participants, gender, cognitive differences, and, physical or psychological differences were controlled as much as possible. This was accomplished by selecting the sample so that no students who had been identified as having learning exceptionalities and no students who had been diagnosed with behavioral/learning differences (e.g., autism spectrum disorder, attention deficit/attention deficit hyperactivity disorder) that could affect their ability to complete study tasks were included as participants. Previous speech-language intervention was reported by seven children. Articulation difficulty was reported as the reason for intervention for all seven children. None of these children was excluded from participation in the study. Possible effects related to differing ages (i.e., as a result of students who began school at a later age or who had not passed a grade) were controlled by selecting only those participants who were born in the year 2000. Potential effects related to gender were reduced by ensuring that both male and female participants were represented in the study sample. Finally, participants were not eligible for inclusion in this study if they had been diagnosed with a hearing impairment; if they had an uncorrected visual impairment; if their first language was not English; or if another language than English was the primary language of their home or the language of frequent caregivers. Eleven students whose first language or whose language of the home or frequent caregivers was not English, six students who reported a history of attention deficit/attention deficit hyperactivity disorder, two students who reported a hearing impairment/central auditory processing difficulty, and one student who required but did not have glasses were excluded from further participation. Additionally, one student refused to provide assent to participate, one student withdrew assent, and one student refused to be audio-recorded and these students were also removed from further study participation.

Adult Comparison Group

Twenty-two adult participants were also recruited from employees of the Windsor-Essex Catholic District School Board. These adult participants completed Experimental Task One (passage reading) and Experimental Task Two (sentence imitation) only. The measures of adult intonation obtained from these tasks formed a baseline with which the children's intonation samples were compared. The adult sample included 10 male and 12 female speakers between the ages of 25 and 40 years who lived in Essex County, Ontario. The adult participants identified English as their first language and had no hearing disability. Data from two female participants were not retained because of technical difficulties with data recording.

General Procedures

Data collection from adult participants was completed in a quiet room at a Windsor-Essex Catholic District School Board worksite. As noted previously, initial child participant information was collected with the questionnaire that was completed by each participant's parent/guardian (see Appendix A). The children also completed assessment measures of oral language comprehension, reading comprehension, word reading/decoding, and intonation skills. All assessment measures were administered by the author and standardized assessment instruments were administered and scored by the author as directed in the test manual for each test instrument.

All child assessment tasks were administered in a private room in the child's school by the author and most children were assessed during three assessment sessions. Each assessment session was scheduled during one class period (approximately 40 minutes) and most children completed these sessions on three consecutive days. The class periods were randomized so that most children completed the assessment batteries during different class periods on each of the three assessment days (i.e., No child completed all assessment sessions during the last period of the day when children are frequently tired). If a child was absent for an assessment session or sessions, the sessions were completed within a period of no more than two weeks. Data from two students who were absent for assessment sessions and were unable to complete testing within two weeks were excluded from further analysis.

Assessments and Measures

Assessments of oral language comprehension. The children's single word vocabulary comprehension was evaluated with the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007). The PPVT-4 requires examinees to listen to a stimulus word presented by the examiner and then choose the pictured item from a group of four pictures that represents that stimulus. The standard scores from the PPVT-4 were used as one indicator of comprehension at the word level. The Word Classes-Receptive subtest of the Clinical Evaluation of Language Fundamentals-4 (CELF-4; Semel, Wiig, & Secord, 2003) was used as a measure of children's semantic knowledge at the word level. This subtest requires children to listen to lists of four words and choose the two words that share some semantic relationship. The children are then asked to state how the words are related. Scaled scores from this subtest were used as the second measure of comprehension at the word level.

The Concepts and Directions subtest of the CELF-4 requires students to follow oral directions that increase in length and complexity. The scaled scores from this subtest were used as a measure of the children's listening comprehension skills at the sentence level. Finally, the Understanding Spoken Paragraphs subtest of the CELF-4 was used to evaluate the children's listening comprehension at the paragraph level. This subtest requires students to listen to paragraphs and then respond orally to questions about the paragraph.

Assessments of word reading/decoding. The children's word reading/decoding skills were evaluated with the Word Reading and Pseudoword Decoding subtests of the Wechsler Individual Achievement Test, Second Edition Canadian (WIAT-II Can*;* Wechsler, 2003). The

WIAT-II was chosen as the primary measure of reading skills because it has been used in similar research (see Miller & Schwanenflugel, 2008) and because it provides normative data based on a sample of 865 Canadian children between the ages of 5 and 19 years (Wechsler). The Word Reading subtest assesses children's ability to read words of increasing difficulty from a word list. The total number of words read correctly provides a Word Reading score and this raw score was used to indicate the level of each child's word reading skill. The Pseudoword Decoding subtest requires children to read from a list of pseudowords. The total number of pseudowords read correctly provides a Pseudoword Decoding score and this raw score was used as the second measure of word reading/decoding skill.

Assessments of reading comprehension. The Reading Comprehension subtest of the WIAT-II was chosen as one measure of reading comprehension. This instrument assesses reading comprehension at the sentence and paragraph levels. The children began this subtest at their grade level. They were required to read a series of short paragraphs, either aloud or silently, before responding to oral questions about the passages. This manner of reading comprehension assessment is analogous to informal assessments that may be completed by classroom teachers in the classroom. The children were able to view the passage that had been read while the comprehension questions were posed to them and thus, they had the opportunity to 'look back' if they chose. The children were also required to read sentence sets containing one to three sentences each and respond to comprehension questions about those sentences. If children did not meet a baseline level of accuracy at their grade level, a baseline was obtained at a lower grade level as directed in the test manual. Because this reversal method was used to obtain a baseline measure for some children, the children's raw scores were converted to weighted raw scores and these were used as a measure of reading comprehension. The Reading Comprehension subtest also obtains measures of children's reading speed and accuracy; however, these were not included in the reading measures for this study.

The Qualitative Reading Inventory-4 (QRI-4; Leslie & Caldwell, 2006) was used as a second measure of reading comprehension. Unlike the WIAT-II, the QRI-4 does not provide normative data for Canadian children; however, it does assess reading comprehension at the paragraph level. The children read *Tomie de Paola*, a Level Four passage from the QRI-4, and then responded orally to oral questions about what they had read. The children were not allowed to look back at the passage as they responded to the questions. The total number of correct responses yielded a raw score which was converted to a percentage score to provide the second measure of reading comprehension.

Assessments of perception and production of intonation. Intonation was evaluated using three measures: the PEPS-C, a sentence imitation task, and a reading task. The PEPS-C is a computerized assessment of children's perception and production of intonation; however, only the perception data was used in this study. Although normative data for this test is available for Scottish children, no normative data for North American children has been compiled. Nevertheless, this instrument was used because of the information it yielded regarding children's perception of various prosodic components. The examiner and each child listened to the items presented by the computer without headphones. The child indicated a response and the response was entered by the examiner. All subtests were scored automatically by the program. The PEPS-C perception subtests that were administered included Short Item Discrimination (SID), Turn-End Type Reception (TER), Affect Reception (AR), Long Item Discrimination (LID), Chunking Reception (CR), and Contrastive Stress Reception (CSR).

The PEPS-C Short Item Discrimination subtest evaluates the ability to detect intonation differences in short sound segments of one to two syllables. It requires the child to listen to two noises and determine whether the noises they heard were the same or different. The Turn-End Type Reception subtest evaluates the child's ability to label spoken sentences as telling (i.e., statements) or asking (i.e., declarative questions). The Affect Reception evaluates the child's ability to identify affect signaled by intonation. The subtest requires the child to listen to single word utterances (food items) and state whether the speaker likes or dislikes the food. The Long Item Discrimination subtest is similar to the Short Item Discrimination subtest; however, the sound segments are increased to six to seven syllables in length in the former. The Chunking Reception subtest evaluates the child's ability to use prosody to distinguish ambiguous phrasal meaning: The child must point to the picture that matches the phrase that was presented. Finally, the Contrastive Stress Reception subtest is a measure of the child's ability to discriminate contrastive stress and point to the stressed item. Repetitions of items were not encouraged but if there was an increased amount of background noise or if the child had not heard a stimulus presentation, the item was repeated. This occurred infrequently. Occasionally, the computer program did not keep pace with a child's responses and froze on a stimulus item. On those occasions, the subtest was restarted from that point and, if necessary, the item was repeated.

Each child also completed two experimental tasks in which intonation was evaluated: Experimental Task One, a reading task and Experimental Task Two, a sentence-imitation task. In Experimental Task One, both adult and child participants read a brief third-grade reading passage from the QRI-4 that had been adapted so that it included 13 declarative sentences and 10 yes-no questions (see Appendix B). The passage was printed on white paper in Calibri typeface (16-font) and laminated. Both the adult and child participants were instructed to read the passage silently one time in order to familiarize themselves with the passage. All participants were then instructed to, “Read the passage out loud and I will record your voice on the computer. Read it as if you are reading it out loud to your class”. No additional instructions regarding reading style were given. Each participant’s passage reading was recorded directly onto a Toshiba Satellite laptop computer using a Dynex headset with a boom microphone. Children who did not read the passage with 90% accuracy were removed from further participation in the study. The criterion level of 90% was adopted by Miller and Schwanenflugel (2006) and it was retained in this study because the purpose of this task was to record the participant’s use of intonation during reading. If students struggled to decode the passage, the measures of intonation would have been compromised. For this reason, a third-grade reading passage was chosen as the basis for the experimental task so that decoding skills would not be challenged but a suitable level of complexity in sentence structure within the passage would be retained. Nevertheless, eight children did not meet the 90% criterion for reading accuracy and they were excluded from further participation in the study.

During Experimental Task Two, each adult and child participant completed the sentence imitation task (see Appendix C). The stimuli for this task consisted of 10 utterance pairs. One sentence of the pair was produced with a rising final intonation (i.e., as a declarative question) and the other sentence was produced with a falling intonation (i.e., as a statement). The sentences contained vocabulary that was believed to be familiar to fourth-grade students. The stimuli for the experimental tasks were recorded by a native adult female speaker of Canadian English who lives in Essex County. The speaker read each utterance pair aloud and the utterances were recorded onto a Toshiba Satellite laptop computer using a Dynex headset with a boom microphone. The stimuli were randomized with respect to order of question and statement forms. The sentences were also randomized so that alternate forms of the same utterance were not presented sequentially. Both child and adult participants listened to the sentences through headphones. The participants were instructed to imitate the sentences they heard and their utterances were recorded with the boom microphone directly onto the laptop computer.

On Assessment Day One, a child assent script was read to each of the children and their assent to participate was obtained prior to completion of any study tasks. Then, each participant completed Experimental Task One. Reading accuracy for the passage was computed and any participants who did not reach the specified criterion of 90% accuracy were excluded from further participation in the study. The remaining participants completed Experimental Task Two, followed by the Concepts and Following Directions subtest of the CELF-4, the Reading Comprehension task from the QRI-4 and the Word Classes-Receptive subtest of the CELF-4 . The tasks on Assessment Day Two included the PPVT-4, the Understanding Spoken Paragraphs subtest of the CELF-4, and the Pseudoword Decoding and Reading Comprehension subtests of the WIAT-II . Assessment Day 3 tasks included the Word Reading subtest of the WIAT-II and the PEPS-C. Completion of the Assessment Day 2 and Assessment Day 3 batteries was counterbalanced to reduce the possibility of an order effect in battery administration. Half of the participants completed Assessment Day 1 tasks followed by Assessment Day 2 tasks and then Assessment Day 3 tasks. The other half of the participants completed Assessment Day 1 tasks followed by Assessment Day 3 tasks and then Assessment Day 2 tasks.

Acoustic Analyses

The participants' intonation contours produced during Experimental Tasks One and Two were recorded digitally and analyzed with Praat Version 4508 (Boersma & Weenink, 2006), a software program for analysis of acoustic data. The direction and minimum and maximum fundamental frequencies of the final pitch change of the intonation contours were recorded. The methodology employed by Miller and Schwanenflugel (2006) was used to determine the endpoints of this pitch change. That is, the final pitch change was measured from the final pitch peak (b) to the final pitch trough (a) for falling contours.

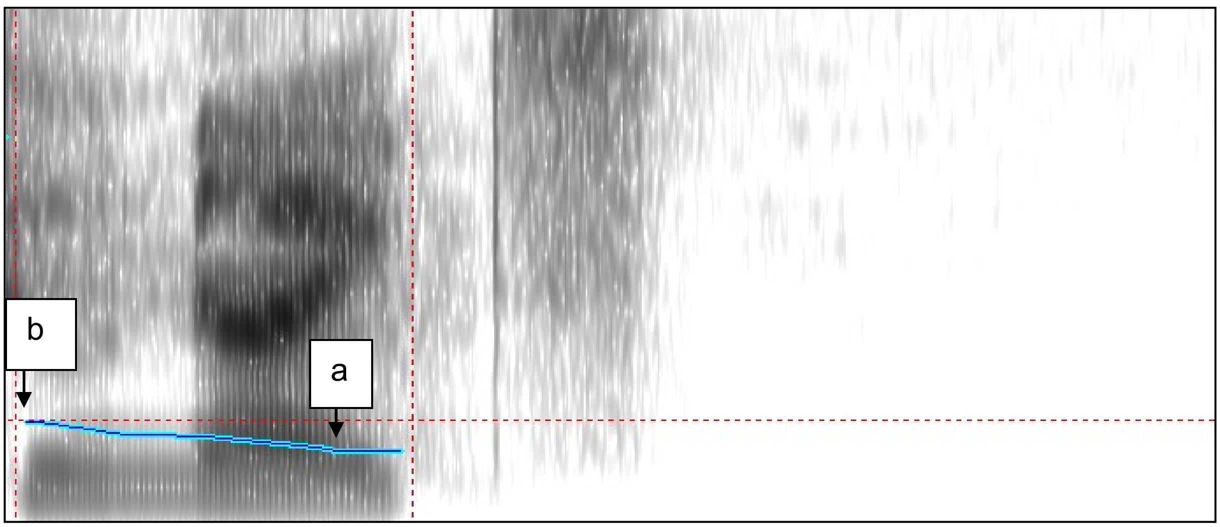

Figure 1. Spectrogram and falling final pitch contour measured on *two nights*.

For rising contours (see Figure 2), pitch change was measured from the final pitch trough (a) to the final pitch peak (b).

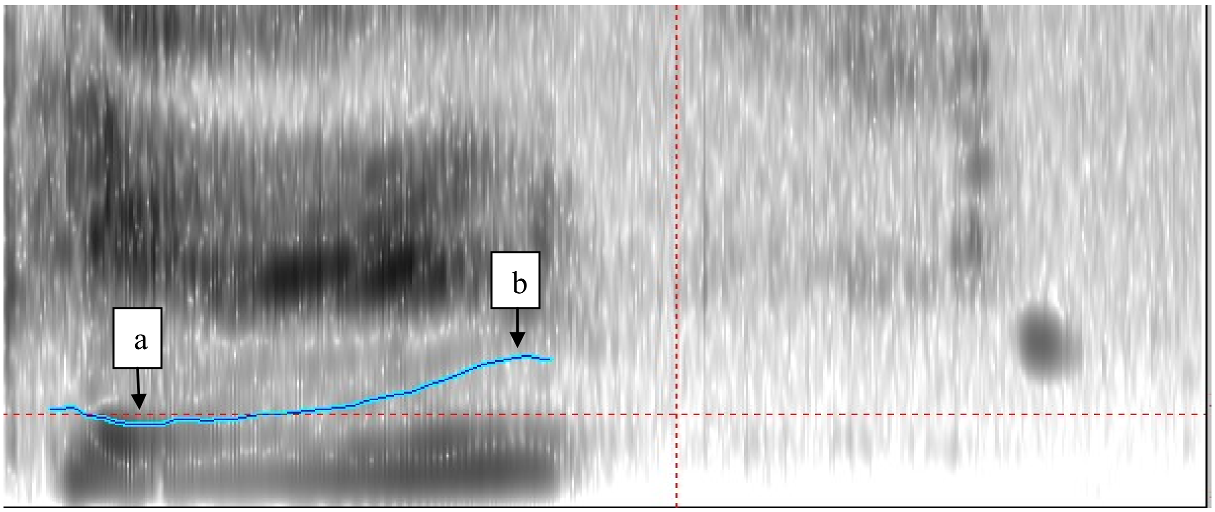

Figure 2. Spectrogram and rising final pitch contour measured on *parents*.

In many cases, this resulted in a final measurement that extended over more than one word. If there was uncertainty in the trace, measures were made on the final word. If the speaker misspoke or misread the final word, the error was accepted if it contained the same number of syllables as the target word. If the error did not contain the same number of syllables as the intended word, the utterance was discarded. Utterances were not retained if the final pitch contour contained speech production that was considered atypical (e.g., laughter during utterance production or significant vocal fry). When voicing dropped off at the end of a falling contour, a measure was made at the end of the curve as long as most of word was represented (i.e., not just the first syllable).

Portions of some final contours, particularly falling final contours, were not analyzed by Praat. These contours were reanalyzed using TF32 (Milenkovic & Read, 1992) to determine whether contour measurements could be determined. If these measures were not obtained using either Praat or TF32, the utterance was not retained for further analysis. When minimum and maximum pitch measures had been recorded for all analyzable utterances, the pitch range (i.e., the difference between the maximum and minimum fundamental frequencies) of the final intonation contour was calculated for each utterance and converted to semitones using the formula: ([12/log (2)] * [log (max f0/min f0)]) (Burns & Ward, 1982).

The same preliminary criteria (i.e., with respect to treatment of data containing word production errors and atypical speech production) were applied to the adult data and utterances that did not meet these criteria were not included in further analyses. The direction, minimum and maximum fundamental frequencies, and the pitch range of the final intonation contours were recorded for the adult data in the same manner that they were calculated for the child data. Fitzsimons, Sheahan, and Staunton (2001) reported significant differences in production of prosodic cues by adult male and adult female speakers' during a sentence reading task and cautioned that gender must be considered in research evaluating production of prosody. Therefore, the adult data in the current study were examined to determine whether there was a significant difference between male and female pitch range in the experimental tasks. The mean adult female and mean adult male pitch ranges were calculated for each imitated sentence with a final rising contour (10 declarative questions) and each imitated sentence with a final falling contour (10 statements). Similarly, the mean adult female and mean adult male final contour pitch ranges were calculated for each yes-no question read and each statement read in Experimental Task Two. If the intended contour was not produced (e.g. if a declarative question was produced as a statement) or when the utterance could not be analyzed acoustically using either Praat or TF32, data from that utterance was not retained for further analysis. If more than 50% of the data points were present for an utterance (e.g., measures for at least 5 adult female or 5 adult male speakers) that utterance was retained for further analysis. Independent samples t-tests were then completed to determine whether there were significant gender-related differences in the adult data. The t-tests indicated that there were significant differences in the amount of pitch change produced by adult male and adult female speakers in rising contours in the imitated sentences task ($t(18) = -3.273$, $p < .05$); however, there were no significant gender-related differences in production of rising contours in the passage reading task ($t(18) = -.992$, $p > .05$). Therefore, because there were differences between male and female speakers in production of the rising pitch contours and because the pitch range of the female speakers was more similar to the pitch range of the children, the data from the adult female speakers only were chosen as the comparison measures for the child data.

Measures of Reliability

Although errors may occur in administration and scoring of standardized tests, the language and reading measures employed in this research require objective scoring procedures. Therefore, the risk of error is less than the risk of error with instruments which rely on subjective measures. Furthermore, the possibility of error was reduced by having all test administration and scoring completed by the author. Thus, the greatest potential source of measurement error was in the measurement of the intonation contours. Therefore, two trained research assistants recalculated the acoustic measurements for 20% of the utterances as a measure of inter-rater reliability. The mean differences between these reliability measures and the measures calculated by the primary investigator were 0.91 and 2.24 semitones for the child utterances and 2.40 and 2.06 semitones for the adult utterances.

CHAPTER 4

RESULTS

Descriptive statistics were generated for all oral language, reading, and acoustic variables. Although acoustic measures were made of both falling and rising final contours in adult and child utterances, a significant percentage of falling contours could not be analyzed and therefore, only the data for the rising contours were retained for analysis. Incomplete cases (i.e., cases with any missing data) were also removed from further analysis. This resulted in a final sample size of N = 81. Again, most of this attrition was due to difficulty with acoustic measurement of utterances. The sample size, mean, and standard deviation for each variable are shown in Table 1.

Before any analyses were completed the data were converted to z-scores and inspected for outliers. Five data points fell more than three standard deviations from the mean: one highly discrepant score on the WIAT2 Word Reading subtest (WIAT2WR), three scores on the Contour Direction in Spoken Sentences (CNTRDIRS), and one score on the Contour Direction in Read Sentences (CNTRDRDG). Because most of the variables were not normally distributed, a log transformation was completed on the data from both normally and non-normally distributed variables (see Field, 2005); however, transformation failed to normalize the distributions. Therefore, each score that fell more than three standard deviations from the mean was truncated to three standard deviations (see Field, 2005; Miller and Schwanenflugel, 2008) and a non-parametric test of correlation, Kendall’s tau, was used to determine initial correlations between all variables. Kendall’s tau correlations for all variables are shown in Table 2.

Table 1

Descriptive Statistics for Study Variables

Variable	n	M	SD
CELF4RL	81	104.17	14.79
CELF4LP	81	9.49	2.33
PPVT4	81	108.63	12.39
WIAT2WR	81	100.78	12.37
WIAT2PD	81	37.36	9.17
WIAT2RC	81	122.60	12.69
QRI4	81	42.85	22.40
PEPSCR	81	85.51	5.82
CNTRDIRS	81	91.68	9.40
CNTRDRDG	81	91.43	9.65
MRO	81	7.17	2.93
DRO	81	2.75	1.71
MRR	81	5.87	2.31
DRR	81	4.70	1.82

Note. CELF4-RL = CELF-4 Receptive Language Index Score; CELF4-LP = CELF4 Understanding Spoken Paragraphs scaled score; PPVT-4 = PPVT-4 standard score; WIAT2WR = WIAT II Word Reading; WIAT 2 PD = WIAT II Pseudoword Decoding; WIAT 2RC = WIAT II Reading Comprehension; QRI4 = QRI4 Reading comprehension raw score; PEPSCR = PEPS-C reception score; CNTRDIRS = accuracy of contour direction in sentence imitation; CNTRDRDG = accuracy of contour direction in reading; MRO = mean width of rising contours in sentence imitation; DRO = difference between children’s mean width of rising contours in sentence imitation and adult mean width of rising contours; MRR = children’s mean width of rising contours in reading; and, DRR = difference between children’s mean width of rising contours in reading and adult mean contour width in reading.

Table 2

Kendall's Tau Correlations for Observed Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. CELF4-RL	-													
2. CELF4-LP	.26**	-												
3. PPVT-4	.33**	.31**	-											
4. WIAT2WR	.35**	.17*	.29**	-										
5. WIAT2PD	.33**	.17*	.23**	.66**	-									
6. WIAT2RC	.42**	.22**	.39**	.34**	.25**	-								
7. QRI4	.32**	.23**	.27**	.37**	.27**	.33**	-							
8. PEPSCR	.28**	.18*	.15	.39**	.36**	.29**	.37**	-						
9. CNTRDIRS	.08	-.12	.05	.18*	.19*	.07	.09	.03	-					
10.CNTRDRDG	.22**	.16	.09	.39**	.34**	.16*	.30**	.26**	.01	-				
11.MRO	.24**	.14	.13	.31**	.24**	.30**	.16*	.19*	.17*	.19*	-			
12.DRO	-.09	.06	.08	-.13	-.10	-.08	-.06	-.07	-.11	-.09	-.53**	-		
13.MRR	.17*	.19*	.15	.29**	.21**	.12	.14	.07	.08	.25**	.38**	-.14	-	
14.DRR	-.16*	-.18*	-.14	-.28**	-.20**	-.12	-.14	-.06	-.09	-.25**	-.37**	.14	-.98**	-

Note. CELF4-RL = CELF-4 Receptive Language Index Score; CELF4-LP = CELF4 Understanding Spoken Paragraphs scaled score; PPVT-4 = PPVT-4 standard score; WIAT2WR = WIAT II Word Reading; WIAT 2 PD = WIAT II Pseudoword Decoding; WIAT 2RC = WIAT II Reading Comprehension; QRI4 = QRI4 Reading comprehension raw score; PEPSCR = PEPS-C reception score; CNTRDIRS = accuracy of contour direction in sentence imitation; CNTRDRDG = accuracy of contour direction in reading; MRO = mean width of rising contours in sentence imitation; DRO = difference between children's mean width of rising contours in sentence imitation and adult mean width of rising contours; MRR = children's mean width of rising contours in reading; and, DRR = difference between children's mean width of rising contours in reading and adult mean contour width in reading.
* $p<0.05$, ** $p<0.01$

In order to determine whether the inclusion of measures of intonation in the SVR provided a more robust measure of reading comprehension than the traditional SVR, three composite scores were created that reflected the components of the SVR. The decoding composite score (D) was created by averaging the *z*-scores for the WIAT-2 Word Reading and Pseudoword Decoding subtests (see similar procedure in Leach et al., 2003). The linguistic comprehension composite (LC) was generated by averaging the *z*-scores for the CELF-4

Receptive Language score, the CELF-4 Listening to Spoken Paragraphs score, and the PPVT-4 score (i.e., listening comprehension at word, sentence, and paragraph level). The reading comprehension composite (RC) was produced by averaging the *z*-scores for the WIAT-2 Reading Comprehension score (WIAT2RC) and the QRI-4 reading comprehension score.

Question 1

The variables DRO and DRR indicate the difference in size between the child final rising contour and the adult female final rising contour in the sentence imitation task and the passage reading task, respectively. The relationships between DRO and DRR and the reading comprehension variables, WIAT2RC, QRI4, and the reading composite measure RC, were examined to determine whether there was a relationship between more adult-like final rising contour production in imitated sentences or read sentences and reading comprehension. Neither DRO nor DRR was significantly correlated with WIAT2RC or the QRI-4 reading comprehension measures and, therefore, not correlated with RC.

Question 2

In order to investigate whether children who produce wider final contours at the ends of declarative sentences and declarative or yes-no questions demonstrate greater reading comprehension than children who produce narrower final rising contours, the initial correlations between final contour size and the reading comprehension measures were examined. Production of wide final rising contours during reading (MRR) was not significantly correlated with the WIAT2RC or the QRI-4 measures. Production of wide final rising contours during sentence imitation (MRO) was significantly correlated with the WIAT2RC score ($r = 0.30$, $p < 0.01$); however, it was not as strongly correlated with the QRI-4 reading comprehension score ($r = 0.16$, $p < 0.05$). MRO was also significantly correlated with overall RC ($r = 0.248$, $p < 0.01$). MRO was entered into a regression analysis to further investigate its relationship with RC and with the other acoustic variables. The results of that analysis are presented in the following section.

Question 3

Table 3.

Summary of Regression Analyses Predicting Reading Comprehension from Decoding, Linguistic Comprehension, and Key Acoustic Variables

Entry of Predictors	Final β's				Summary Statistics			
	D	LC	PEPSCR	CNTRDRDG	R^2	ΔR	ΔF	dfs
D	.537***	-	-	-	.288	.288	31.971***	1, 79
LC	-	.630***	-	-	.397	.397	52.012***	1, 79
D + LC	.325***	.489***	-	-	.483	.483	36.368***	2, 78
D + LC + PEPSCR	.178	.449***	.287 **	-	.537	.054	9.057**	1, 77
D + LC +CNTRDRDG	.224*	.464***	-	.219*	.517	.035	5.535*	1,77

Note. D = decoding; LC = linguistic comprehension; PEPSCR = PEPS-C receptive subtests; CNTRDRDG = accuracy in direction of intonation contour in reading.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Separate regression analyses were completed to determine which predictor variables accounted for variance in reading comprehension. In the first analysis, RC was entered as the outcome variable with D as the predictor variable [1]. D alone accounted for 28.8% of the variance in RC. Next, RC was entered as the outcome variable with LC as the predictor variable. LC alone accounted for 39.7% of the variance in RC. In keeping with the SVR, RC was then entered as the outcome variable with D and LC together as the predictor variables; however, it should be noted that the *product* of D and LC was not entered as dictated by the SVR, rather D and LC were simply entered together into the regression analysis (see similar procedure in Conners, 2009). In this analysis, D and LC together accounted for 48.3% of the variance in RC and the regression coefficients for both D and LC were significant. The decreased association of D with RC after the entry of LC indicated that D shared variance with LC. Nevertheless, D still maintained a significant association of .325 with RC after its association with LC was taken into account.

Next, each of the acoustic variables was entered individually in the next level after D and LC. PEPSCR accounted for approximately 5.4% additional variance in RC and showed a significant relationship with RC. Interestingly, when PEPSCR was entered as a predictor with D and LC, the unique association between D and RC decreased to .178 and the regression coefficient for D was no longer significant ($p < 0.076$). This indicated that D was also associated with the features captured by the PEPSCR.

Note that MRR, DRO, DRR and CNTRDIRS were not significantly correlated with either of the individual reading measures (WIAT2RC and QRI4) and therefore, were not included in the regression analyses. CNTRDRDG, however, was correlated with both of these measures and when it was entered into a regression analysis following D and LC, it accounted for an additional 3.5% of the variance in RC. Again, when CNTRDRDG was added to the regression analysis with D and LC, the regression coefficient for D was significant only at $p < .025$ and the association between D and RC was reduced indicating some shared variance between D and CNTRDRDG also. Finally, MRO was significantly correlated with the individual reading measures (i.e., WIAT-IIRC, QRI4) and with the composite, RC; however, when it was entered into a regression analysis after D and LC, the regression coefficient for MRO was not significant ($p < .281$).

Question 4

The initial regression analyses with the individual intonation predictors indicated that PEPS-C and CNTRDRDG improved prediction of RC. Additional regression analyses were then completed to determine what combinations of variables would best predict RC. In the first regression analysis, LC and D were entered in one block followed by PEPSC in the next block and CNTRDRDG in the last block. L and D accounted for 48.3% of the variance in RC, PEPSC contributed an additional 5.4 % variance and CNTRDRDG accounted for another 2.6% variance in RC. Thus, the intonation variables accounted for an additional 8% additional variance in RC beyond LC and D for a total of 56.3% of the variance in RC.

As noted previously, when PEPSCR was entered as a predictor with D and LC, the unique association between D and RC decreased to .178 and the regression coefficient for D was no longer significant ($p < 0.076$), indicating that D was also associated with the features captured by the PEPSCR. CNTRDRDG accounted for an additional 2.6% of the variance in RC when it was entered into the regression analysis following D and LC, and PEPSCR. Again, when CNTRDRDG was added to the model, the unique association of D with RC decreased further to .101 and the regression coefficient for D was not significant ($p < .331$). Thus, as LC and each intonation variable was entered into the regression equation, the association between D and RC decreased indicating that there was shared variance between D and each of these variables. Furthermore, the regression coefficients for D and CNTRDRDG were not significant in this last model in which both intonation variables (i.e., PEPSC and CNTRDRG) were entered. The summary statistics from these regression analyses are shown in Table 4.

Table 4.

Summary of Regression Analyses Predicting Reading Comprehension from Linguistic and Acoustic Variables

Entry of Predictors	Final β's				Summary Statistics			
	D	LC	PEPSCR	CNTRDRDG	R^2	ΔR	ΔF	dfs
D	.537***	-	-	-	.288	.288	31.971***	1, 79
LC	-	.630***	-	-	.397	.397	52.012***	1, 79
Block 1 D + LC	.325***	.489***	-	-	.483	.483	36.368***	2, 78
Block 1 + Block 2 D + LC + PEPSCR	.178	.449***	.287 **	-	.537	.054	9.057**	1, 77
Block 1 + Block2 + Block 3 D + LC + PEPSCR +CNTRDRDG	.101	.430***	.266**	.191*	.563	.026	4.558*	1,76

Note. D = decoding; LC = linguistic comprehension; PEPSCR = PEPS-C receptive subtests; CNTRDRDG = accuracy in direction of intonation contour in reading.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Because D was no longer a significant predictor of variance in RC when the acoustic variables were added to the model, additional investigations were completed to explore the prediction of RC by LC and the intonation measures alone (see Table 2). LC was entered into the regression analysis in the first block followed by PEPSCR in the second block and CNTRDRDG in the third block. LC alone again accounted for 39.7% of the variance in RC and CNTRDRDG and PEPSCR accounted for an additional 16.1% of the variance for a total of 55.8% of the variance of RC. The values of the regression coefficients of LC, CNTRDRDG, and PEPSCR were all significant for this model.

Table 5.

Summary of Regression Analyses Predicting Reading Comprehension from Listening Comprehension and Acoustic Variables When Decoding Variable Was Removed

Entry of Predictors	β's			Summary Statistics			
	LC	PEPSCR	CNTRDRDG	R^2	ΔR	ΔF	dfs
Block 1							
LC .	.630***			.397	.397	52.012***	1, 79
Block 1 + Block 2							
LC + PEPSCR	.496***	.372***		.518	.121	19.489***	1, 78
Block 1 + Block 2 + Block 3							
LC + PEPSCR + CNTRDRDG	.450***	.304**	.222*	.558	.040	6.992**	1, 77

Note. LC = linguistic comprehension; PEPSCR = PEPS-C receptive subtests; CNTRDRDG = accuracy in direction of intonation contour in reading.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Question 5

The previous analyses demonstrated that the predictor variable, PEPSC, was a significant predictor of RC. Therefore, a final set of analyses was completed to determine whether specific subtests of the PEPS-C were more predictive of reading comprehension than others. Using a larger set of the original data (N = 101), Kendall's tau correlations between individual PEPS-C subtests, LC, and RC were examined (see Table 6). Four of the reception subtests, Turn-End Type Reception (TER), AR (Affect Reception), CR (Chunking Reception), and CSR (Contrastive Stress Reception), were significantly correlated ($p < 0.01$) with RC. CR and CSR were also significantly correlated ($p < 0.01$) with LC.

Simple regressions of each subtest on RC showed that TER accounted for 11.8% of the variance in RC, AR accounted for 13%, CR accounted for 17.2 % and CSR accounted for 21.7%. The regression coefficient for each of these subtests was significant ($p < 0.01$). Similarly, simple regressions of the subtests on LC showed that CR accounted for 16.1% of the variance in LC and

CSR accounted for 9% of the variance. The regression coefficient for each of these subtests was significant ($p < 0.01$).

Table 6

Intercorrelations Between PEPS-C subtests, LC, and RC

Variables	1	2	3	4	5	6	7	8
1. RC	-							
2. LC	.449**	-						
3. SID	.057	.049	-					
4. TER	.307**	.182*	.178	-				
5. AR	.243**	.107	-.047	.190*	-			
6. LID	.176*	.119	.194*	.067	.054	-		
7. CR	.323**	.314**	.035	.325**	.125	-.012	-	
8. CSR	.323**	.188**	.145	.224**	.247**	.208**	.261**	-

Note. RC = reading comprehension; LC = linguistic comprehension; SID = Short Item Discrimination; TER = Turn-End Type Reception; AR = Affect Reception; LID = Long Item Discrimination; CR = Chunking Reception; CSR = Contrastive Stress Reception.
*$p < 0.05$. **$p < 0.01$

CHAPTER 5

DISCUSSION

This study set out to examine the role of intonation skills in the reading comprehension of fourth-grade students from the perspective of the SVR. The roles of prosodic features in general and intonation specifically have not received significant attention in reading research. Although a role for prosody is implied in the National Reading Panel's definition of reading fluency as "…the ability to read a text quickly, accurately, and with proper expression…" (p. 3-5), relatively few studies have investigated the role of prosody and intonation in reading, particularly with respect to reading comprehension. Studies that have examined the relationship between intonation and reading have reported varying results. One notable gap in these studies was the lack of attention to children's underlying language skills and more specifically, intonation as one of those language skills. The current study adopted the view that intonation is one of the many linguistic skills that children bring to the task of reading and attempted to provide additional insight into the role intonation may play in children's reading skills. The current study revisited some of the questions raised in previous research, added additional measures of intonation, and framed these questions within the SVR. The current study also examined additional questions regarding the ability of the PEPS-C to predict reading comprehension within this framework.

The first question posed by this study hinged on the work of Schwanenflugel et al. (2004) who reported a small but significant relationship between second- and third-grade students' approximations of adult F_0 (measured as the average F_0 on all words across three declarative sentences) and their reading comprehension. They concluded that their findings did not provide sufficient support for a relationship between prosody and reading comprehension. The current study compared adult and child F_0 in final rising pitch contours in both oral and literate language contexts. The current study did not find a significant relationship between children's reading comprehension and their approximations of adult final rising contours in sentence imitation or in passage reading. It is of interest that Miller and Schwanenflugel (2008) observed that first-grade students who produced more adult-like final intonation contours demonstrated greater reading comprehension in third grade; however, students' development of more adult-like final intonation contours by second grade did not predict third grade reading comprehension. It may be that the fourth-grade students in the current study were beyond this apparent window of development and therefore, a relationship between more adult-like final contour production and reading comprehension was not supported.

The second question posed by this study was derived from the findings of Miller and Schwanenflugel (2006) who reported that children who produced wider final pitch contours (either falling or rising) during reading demonstrated greater reading comprehension. The current study examined only final rising pitch contours and found that production of wide final rising contours during reading was not correlated with reading comprehension. Production of wide final rising contours during sentence imitation was positively correlated with reading comprehension; however, when it was entered into a regression equation with decoding and listening comprehension, the regression coefficient was not significant.

The current study also examined children's ability to imitate appropriate direction of pitch change and to accurately interpret punctuation during reading to produce the indicated direction of pitch change. Accuracy in imitation of contour direction during sentence imitation was not significantly correlated with reading comprehension; however, accurately producing the appropriate contour direction as conveyed by punctuation in print was significantly correlated with reading comprehension and accounted for 3.4% (see Table 1) variance in reading comprehension after decoding and listening comprehension.

Finally, the current study examined the contribution of additional measures of intonation and prosody to reading comprehension. The initial regression analyses indicated that the PEPS-C and accuracy in direction of the intonation contour in reading (i.e., producing a rising contour in response to seeing a question mark) accounted for the most variance in reading comprehension after decoding and listening comprehension had been entered, accounting for 5.4% and 3.5% variance, respectively. However, the addition of these intonation variables reduced the significance of decoding as a predictor of reading comprehension and there was an increase in shared variance between decoding and the other predictor variables.

Therefore, in the second model, listening comprehension and the significant intonation variables only (i.e., PEPS-C, and CNTRDRDG) were entered as predictors of reading comprehension. This model accounted for a very similar amount of variance in reading comprehension as the original model. Moreover, in this second model, listening comprehension, PEPS-C, and accuracy of contour direction in reading were all significant predictors of reading comprehension and there was reduced overlap between the variance proportions of the variables.

Because these results indicated a significant relationship between the PEPS-C and reading comprehension, further analysis was completed to determine which PEPS-C subtests were most highly correlated with reading comprehension. Chunking Reception and Contrastive Stress Reception showed the strongest relationship with both reading comprehension (accounting for 17.2% and 21.7% variance in reading comprehension in simple regressions) and listening comprehension (accounting for 16.1% and 9% variance in listening comprehension in simple regressions). The findings of the current study of apparent overlap between the variance accounted for by PEPS-C and the decoding variable and of the relative strength of the Chunking Reception subtest of the PEPS-C are consistent with the findings of Whalley and Hansen (2006) who reported that their compound nouns task (modeled after the Chunking Reception subtest) accounted for unique variance in word identification skills in fourth-grade students.

Overall, the current study found that in the fourth-grade students in this sample, listening comprehension was the most robust predictor of reading comprehension, individually accounting for 39.7% of the variance. This finding is consistent with previous research that has demonstrated the role of linguistic comprehension in reading comprehension (e.g., Nation & Snowling, 1997) and with research that has shown the that the relative contributions of decoding and linguistic comprehension to reading comprehension in the SVR vary with reading development (e.g, Adlof et al, 2006). Although decoding is typically reported to account for the most variance in reading comprehension in second grade, listening comprehension has been reported to account for the most variance in reading comprehension by the eighth grade (Adlof, 2006). Thus, the fourth-grade students in the current study may have been at the point of transition at which the influence of listening comprehension on reading comprehension takes precedence over the influence previously held by decoding. According to Chall's (1983) stages, these children had reached the point at which they could begin to read to learn. According to Wells et al. (2004), these children were also at the point at which they had developed many skills in perception and production of intonation. Nevertheless, some higher-level intonation skills may have still been in a period of development. Within this developmental context, the children in this study demonstrated that after accounting for the influence of listening comprehension on reading comprehension, the intonation and prosodic features assessed by the PEPS-C and the ability to interpret punctuation to accurately produce the writer's intended intonation contour were the two prosodic variables that accounted for variance in reading comprehension. In fact, the inclusion of these prosodic variables effectively negated the influence of decoding on reading comprehension within a SVR framework.

Constraints on the Study

Issues related to assessment of reading comprehension. Nevertheless, there are weaknesses that may have influenced the results obtained in the current study. First, as discussed in the literature review, many pitfalls can arise in the assessment of children's reading comprehension. In the current study, children's comprehension of the intonation passage itself was not assessed. Reading comprehension was assessed using standardized assessments of reading comprehension and no assessment was made of comprehension of the intonation passage. Therefore, some differences noted in children's use of intonation during passage reading may have been related to difficulty comprehending what they were reading. Furthermore, although all children whose data were included in the study read the passage with at least 90% accuracy, some children may have experienced continued difficulty with decoding that reduced their use of intonation while reading.

Another weakness in assessment of reading comprehension is related to the assessment tools chosen. Kahmi (2009b) indicated that an instrument like the QRI that measures various aspects of comprehension may provide a more representative picture of children's reading comprehension skills than other measures of reading comprehension. Although the QRI was used as one measure of reading comprehension in the current study, only the response to content questions component of the QRI was administered. A more accurate representation of children's reading comprehension may have been obtained if the retelling component of the QRI had also been administered (see Keenan et al, 2008).

Issues related to acoustic measurements. Other factors that may have influenced the results obtained in this study are related to collection of the acoustic data. Technical issues related to data recording affected the amount of data that could be retained in the study. In particular, the very low pitches of some of the adult male participants precluded the retention of this data for analysis. Similarly, the significant drop in pitch at the ends of some utterances by the adult female and child participants resulted in loss of additional data. This loss of data resulted in comparisons of child and adult female acoustic measures on rising contours only.

Future Directions

The findings of this study suggest several recommendations for future research and educational practice. It was observed that during passage reading, the children frequently displayed decreasing vocal clarity as the reading progressed and exhibited vocal fry at the ends of longer sentences. It may be helpful in future research to have lengthy passages broken into shorter paragraphs with a break between the paragraphs. It was also observed that when children made a reading error, they frequently increased rate, paid decreased attention to punctuation and pausing, and exhibited increased vocal fry as they rushed to finish the sentence. These observations are relevant to the classroom and point to the importance of teacher monitoring of children's voicing during reading.

Conclusions

Learning to read is not only a complex task, it may also be the most important achievement in children's academic careers. It has been shown that reading has its foundation in oral language which, in turn, is comprised of various component skills. Weakness in any language component may weaken the foundation that supports later reading skills. Moreover, as children are learning to read, the complexity of the task is increased by the fact that their language skills are also continuing to develop. In other words, reading skills are being built upon a somewhat fluid foundation. Oral and literate language skills are intimately interwoven; however, different oral language skills may play a greater role or have a greater influence on reading at different stages of reading development. The current study provided support for the consideration of intonation as one of the language skills that may influence developing fourth-grade readers and for the inclusion of measures of intonation in an SVR framework to predict reading comprehension. Although this study did not find support for results from other research that indicated that child-adult contour match or width of children's final intonation contours during reading were related to reading comprehension, the current research did find that accurately interpreting punctuation to produce final rising contours and demonstrating greater skills on the receptive subtests of the PEPS-C, did contribute to variance in reading comprehension beyond decoding and listening comprehension. This research also found that the Chunking Reception and Contrastive Stress Reception subtests of the PEPS-C were the most highly correlated with reading comprehension. Furthermore, the current study demonstrated that when these measures of intonation were included within a SVR framework, decoding was no longer a significant predictor of reading comprehension in the fourth-grade students in this study. Future research to corroborate these findings in other groups of children using measures of both falling and rising intonation contours is required. Additionally, longitudinal studies evaluating perception and production of intonation beginning in kindergarten would provide insights into the trajectories of development in intonation, oral language skills, and literate language skills. These could potentially lead to early identification and/or intervention strategies thereby reducing the impact of some reading difficulties.

NOTES

[1] In this study, *outcome variable* describes the variable being predicted and *predictor variable* describes the variable that is affecting the outcome variable. (See Field, 2005).

APPENDIX A

Research Study: Intonation and Reading Skills in Fourth-Grade Students

Participant History

Child's Name: ____

Name of Person Completing Form (please print): ______________________

Relationship to child: ____

Date completed: ____

1. Does your child have difficulty with his/her vision? Yes No

   If 'Yes', does your child wear glasses? Yes No

2. Are there any concerns with your child's hearing? Yes No

3. Has your child had a hearing test? Yes No

   If 'Yes', did the hearing test indicate that your child has difficulty hearing? Yes No

4. Has your child been diagnosed with autism or Asperger's Syndrome? Yes No

5. Has your child been diagnosed with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD)? Yes No

Research Study: Intonation and Reading Skills in Fourth-Grade Students

Participant History (Cont.)

6. Has your child had an assessment of his/her learning skills by a psychologist? Yes No

7. Has your child been identified as exceptional by an Identification, Placement, and Review Committee (IPRC)? Yes No

   If 'Yes', what is your child's learning exceptionality that is indicated on the IPRC? _________________

8. Is English your child's first language? Yes No

9. Is English the language that is spoken most often in the home by family members and by any frequent caregivers of your child (i.e., grandparents, babysitters)? Yes No

10. Has your child received services from a speech-language Pathologist? Yes No

   If 'Yes", what was the nature of the concern (please circle all that apply):

   1) articulation (speech sounds)
   2) stuttering
   3) language comprehension (receptive language)
   4) language use (expressive language)
   5) other (please indicate) __________________________

APPENDIX B

Wool: From Sheep to You

Do you have a sweater? Do you know what it is made from? One fibre used to make sweaters is wool. Do you know where wool comes from? It comes from a sheep. However, many things must be done before the wool on a sheep can be woven or knitted to make clothing for you. Do you know what some of those things are?

First, the wool must be removed from the sheep. Do you know how the wool is removed? People shear the wool off the sheep with electric clippers somewhat like a barber uses when he gives haircuts. Do you know that like our hair, the sheep's wool will grow back again? Do you know that most sheep are shorn only once a year? After the wool is removed, it must be washed very carefully to get out all the dirt. Do you know that when the locks of wool dry, they are combed or carded to make all the fibres lie in the same direction? It is somewhat like combing or brushing your hair. Then the wool is formed into fine strands. These can be spun to make yarn. The yarn is knitted or woven into fabric. The fabric is made into clothing.

Do you know that yarn can also be used to knit sweaters by hand? Sweaters made from wool are very warm. Do you know that they help keep you warm even when they are damp? Just think, the sweater you wear on a winter day may once have been on a sheep.

Adapted from:

Leslie & Caldwell, QUALITATIVE READING INVENTORY-4, "Wool: From Sheep to You," p. 230, 2006. Reprinted by permission of Pearson Education, Inc.

APPENDIX C

Sentence Imitation Task

1. He went home after two nights.
2. He went home after two nights?
3. He bought some hats and coats.
4. He bought some hats and coats?
5. He forgot to take his mitts.
6. He forgot to take his mitts?
7. He bought new balls and bats.
8. He bought new balls and bats?
9. He will play the music for the parents.
10. He will play the music for the parents?
11. He will order the parts.
12. He will order the parts?
13. He made the strawberry tarts.
14. He made the strawberry tarts?
15. He bought three flutes.
16. He bought three flutes?
17. These are my kites.
18. These are my kites?
19. Those are his boats.
20. Those are his boats?

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ABSTRACT

INTONATION AND READING SKILLS IN FOURTH-GRADE STUDENTS

by

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The purpose of the current study was to examine the role of intonation skills in the reading comprehension of fourth-grade students. Although, the National Reading Panel's (2000) definition of reading fluency as "…the ability to read a text quickly, accurately, and with proper expression…" (p. 3-5) suggests a role for prosody and intonation in reading, these features have not figured prominently in reading research and studies that have examined the relationship between intonation and reading have reported varying results. The current study adopted the view that intonation is one of the many linguistic skills that support children's reading skills. From this perspective, the study examined the relationship between intonation and reading comprehension within the framework of the Simple View of Reading (SVR), a model that describes reading comprehension as the product of decoding and linguistic comprehension. Based on previous work by Miller and Schwanenflugel (2006, 2008), the study examined whether children who produced wider or more adult-like final rising intonation contours demonstrated greater reading comprehension than children who produced narrower or less adult-like final rising contours? The current study did not find support for a relationship between children's productions of wider or more adult-like final rising intonation contours and their reading comprehension. The current

study also examined whether inclusion of measures of intonation in the SVR accounted for additional variance in reading comprehension. The results supported inclusion of two intonation variables: 1) accuracy in producing appropriate final intonation contour direction to mark questions when reading; and 2) ability on the receptive subtests of the Profiling Elements of Prosodic Systems-Child assessment procedure (PEPS-C; Peppé & McCann, 2003), a computerized assessment of intonation. Additional statistical analyses indicated that the Chunking Reception and Contrastive Stress Reception subtests of the PEPS-C showed the strongest relationship with reading comprehension. Finally, inclusion of these intonation variables in a SVR framework reduced the significance of the relationship between the decoding and reading comprehension variables.

AUTOBIOGRAPHICAL STATEMENT

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Wanda Kent is an Assistant Professor in the Department of Communication Disorders and Sciences at the State University of New York, College at Cortland. She received her B.Sc. from McMaster University, her B.Sc.N. from the University of Windsor, and her M.A. from Wayne State University. She has over 20 years of clinical experience in speech-language pathology and has provided speech-language services to children in preschool, elementary school, and children's mental health settings. Her research interest is in the area of language, both oral and literate.