

The Relationship between Fluency-Based Suprasegmentals and
Comprehension in Oral and Silent Reading in Dutch Speakers of English

by

Inge Anema

A dissertation submitted to the Graduate Faculty in Speech, Language, and Hearing
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Date

Loraine K. Obler, Ph.D.
Chair of Examining Committee

Date

Martin Gitterman, Ph.D.
Executive Officer

Eva Fernández, Ph.D.

Mira Goral, Ph.D.

Supervisory Committee

Paola Dussias, Ph.D.

Outside Reader

AbstractTHE RELATIONSHIP BETWEEN FLUENCY-BASED SUPRASEGMENTALS AND
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ENGLISH

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Inge Anema

Advisor: Professor Loraine K. Obler

To further our understanding of second language (L2) reading, this study investigated the use of L2 English suprasegmentals and the possible link to L2 reading in Dutch learners of English. In order to determine whether the use of L2 English suprasegmentals is linked to living in an L1-speaking context or L2-speaking context, 20 Dutch-English bilinguals living in the Netherlands and 20 Dutch-English bilinguals living in the U.S., in addition to native-English-speaking controls, were tested on oral and silent reading tasks. Participants were also tested with three types of syntactically ambiguous sentences to investigate the relationship between suprasegmentals and the processing of ambiguities.

Focusing was on fluency-based suprasegmentals (e.g., reading rate, number of pauses) and their correlation with L2 reading, it was hypothesized that L2 speakers with frequent L2 exposure would demonstrate native L2 suprasegmental use and that number of pauses would be negatively correlated to L2 reading comprehension.

Correlation coefficients were calculated among the measures of fluency and text processing. Significant overall correlations were found for non-native use of suprasegmentals in oral and silent reading but not in the processing of ambiguous

sentences. The performance of bilinguals living in the U.S. resembled the performance of native-English participants closely in oral and silent reading comprehension but not in ambiguity resolution. In ambiguous sentence processing, bilingual participants living in the U.S. and the Netherlands demonstrated similar attachment preferences. The data suggest that fluency-based suprasegmentals are linked to oral and silent reading comprehension, but not to the disambiguation of a subset of ambiguous sentences.

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Chapter I: Introduction

A. Overview

In second language production, late bilinguals (i.e. second language learners who learn their second language during or after adolescence) demonstrate difficulty mastering second language (L2) phonology, which may result in variable degrees of accent and variable degrees of fluency. What is perceived as foreign-accented speech involves both segmental and suprasegmental aspects, but recent research indicates that inaccurate suprasegmental production may be linked more closely to a foreign accent than inaccurate segmental production (Anderson-Hsieh, et al., 1992).

Acquisition of L2 suprasegmentals in bilinguals has been investigated in only a few studies (e.g., Trofimovich & Baker, 2006; 2007). Thus far, variables that influence the acquisition of suprasegmentals have been identified to include experience with L2 linguistic input, use of the first language (L1) in the L2 environment, and age of first extensive L2 exposure. Furthermore, isolated aspects of suprasegmental phonology may be acquired following separate patterns and timelines.

Second language suprasegmental acquisition in early bilinguals appears to follow an L1 acquisition pattern. This L1 suprasegmental acquisition pattern seems to consist of early-acquired melody- or prosody-based suprasegmentals (e.g. peak alignment and stress timing) and later-acquired fluency-based suprasegmentals (e.g. speech rate, frequency and duration of pausing). The suprasegmentals acquired earlier are typically language specific and

characterize the prosodic pattern of a particular language (Botinis, Granstrom, and Mobius, 2001). In addition, these early-acquired suprasegmentals are mastered before grammar, lexicon, or individual speech segments. In contrast, the fluency-based suprasegmentals acquired later, whose development continues into late childhood, may be less specific to a particular language but signal the ease with which a speaker uses the language (Holmes, 1995).

Suprasegmentals not only play a role in language production, they may also be connected to reading comprehension as well. This connection has been demonstrated in various ways in numerous reading studies, such as oral reading studies, subvocalization suppression studies, and ambiguous sentence processing studies. For example, when unskilled readers, such as beginning L1 or L2 readers, are instructed to read aloud, they frequently demonstrate word-by-word processing. The word-by-word reading reduces the amount of prosody achieved and results in poor comprehension (Breznitz, 2006).

The ability to use suprasegmental cues in reading appears to be linked to processing efficiency or automaticity. Processing efficiency is associated with lexical processes, such as word recognition and lexical access. According to the Automaticity Theory (AT), once lexical processes are automatized, processing efficiency increases (Lagerge and Samuels, 1974; Samuels, 1994). In addition, the Verbal Efficiency Theory (VET) argues that readers who have progressed beyond the initial stages of reading acquisition are able to allocate attentional resources to other reading processes besides lexical processes, i.e. post-lexical processes, such as the use of suprasegmental cues (Perfetti, 1985, 1988).

The high level of efficiency in processing enables skilled readers to subconsciously recognize words and maintain a high reading rate. In addition, as Breznitz (2006) points out, the high reading rate of skilled readers enables them to achieve high levels of prosody. Prosody, specifically pausing, is a vehicle for both speakers and readers to “chunk” or divide text into constituents. Skilled readers chunk text in meaningful phrases, keeping important relationships between constituents intact. Additionally, text that is chunked into meaningful phrases is processed more easily in working memory (Kintsch & Van Dijk, 1978). In contrast, unskilled readers demonstrate slow reading which may be partially caused by frequent pauses. These readers chunk text into shorter segments that interrupt important relationships between constituents, arguably decreasing comprehension.

Assuming for now that the acquisition of suprasegmentals is divided over fluency-based and prosody-based suprasegmentals and that fluency-based cues are less language-specific than prosodic-based cues, fluency-based suprasegmental prosody may be one of the phonological aspects that late learners of L2 can attain. Furthermore, bilingual readers who have accurate word recognition skills but read using non-native suprasegmentals (e.g. the reader pauses frequently at intra-sentential locations) may demonstrate poor chunking skills which can reflect an inability to recognize constituent groups. We can ask whether bilinguals with accurate word recognition skills but non-native L2 suprasegmental skills differ in comprehension from those bilinguals with accurate word recognition skills and near-native L2 suprasegmental skills. To investigate this question, two groups of late bilinguals who have progressed beyond the initial stages of reading acquisition are required, namely, L2 readers who are immersed in the L2 environment (second language environment) and L2 readers who have limited exposure to the L2 (foreign language environment).

Thus, the purpose of this dissertation is to investigate the use of L2 English fluency-based suprasegmentals and their link to L2 reading comprehension in Dutch learners of English. Furthermore, we will attempt to assess what connection there is between the language history of Dutch learners of English and their acquisition of L2 fluency-based suprasegmentals.

The rationale for this study is found in the fact that second language reading studies have focused extensively on the debate concerning whether L2 reading depends on transfer of L1 reading skills or on L2 linguistic knowledge. This debate is ongoing and is complicated by the complexity of reading in L2 and the heterogeneity of L2 readers. At this point, many researchers agree that both L1 reading level and L2 linguistic knowledge influence L2 reading, albeit at different levels for various learner cohorts (e.g., second- or foreign language readers). Despite the acknowledged weight of the above mentioned variables, it is estimated that other factors that significantly influence L2 reading have not been accounted for (Bernhardt & Kamil, 1995). Indeed, other variables have been identified as being correlated to L2 reading, such as reader topic interest and background knowledge, which will not be discussed in this dissertation. This warrants continued investigation into factors important to the L2 reading process.

Recent studies in L1 have indicated that fluency, i.e. processing efficiency, in oral reading is correlated with reading comprehension. Three components are generally thought of as constituting oral reading fluency, namely, word recognition accuracy, reading rate, and reading with expression (National Reading Panel, 2000).

One aspect of “reading with expression”, namely prosodic phrasing or ‘chunking,’ has received particular attention recently. For example, pre-phrased reading materials (i.e., students read text pre-marked at phrase boundaries) have been successfully used in reading remediation programs. Students who used the pre-phrased materials showed increased comprehension, whereas students who only increased their vocabulary did not (Kuhn & Stahl, 2003).

Examining the connections between L2 English suprasegmentals and L2 reading will further our knowledge about the L2 reading process. Specifically, the present study attempts to answer four questions. First, are native-like fluency-based suprasegmentals linked to L2 reading comprehension? Second, do late learners of L2 acquire L2 fluency-based suprasegmentals whether they live in a country where L1 or L2 is spoken? Third, when interpreting ambiguous sentences, is the performance of L2 readers associated with nonnative suprasegmental use, individual working memory (WM) capacity, an L1 attachment preference, or some combination of the three? And finally, is there a link between L2 reading skills and other measures of L2 proficiency, i.e. list generation performance, self-rating, or reading rates?

This chapter will discuss the role of fluency-based suprasegmentals in reading, summarize two theoretical models of reading related to fluency, relate suprasegmentals to L2 reading, and review the linguistic and cognitive factors posited to influence fluency in oral and silent reading.

B. Mechanics of Reading

Reading is a complex skill that involves simultaneous coordination of several stages of information processing (Rayner & Pollatsek, 1989). When a reader processes written material, features of the symbols on the page are converted into orthographic and phonological patterns. These patterns, in turn, assist the reader with further language processing until meaning can be extracted.

For the vast majority of children, learning to read follows spoken language acquisition. In normal language acquisition, we know that infants create mental representations of the language they hear which are stored in and can be retrieved from a mental lexicon. These mental representations are believed to be phonological (segmental and suprasegmental) in nature. With the recognition of words (i.e. matching of phonological information that is perceived with stored phonological information), syntactic and semantic information becomes available. When a child first learns to read, the task at hand consists of the recognizing and decoding of orthographic symbols and matching them to phonological representations acquired in spoken language (Hoover & Gough, 1990).

Decoding and matching orthographic symbols to phonological representations is not a natural or automatic process and usually requires formal instruction. Beginning readers start out by mastering lower-order reading processes, such as decoding and word recognition. Until these lower-order reading processes become automatized, comprehension remains effortful (Samuels, 2002). One explanation for this effortful comprehension is a limited WM capacity (Just & Carpenter, 1992; Daneman, 1991; Gathercole & Baddeley, 1993).

Working memory is a cognitive construct that lets listeners and readers to simultaneously process and store a limited amount of incoming information. In Gathercole and Baddeley's WM model, phonological representations are stored in a 'phonological loop'. Once in the phonological loop, the phonological representations can be referenced to representations in long-term memory. When lower-order reading processes are inefficient, slow, and attention demanding, they will occupy all of working memory capacity, inhibiting comprehension, which is associated with higher-order reading skills, such as making use of reading strategies.

Another explanation for the effortful comprehension in beginning readers is slow reading rates, e.g., those due to effortful decoding or slow word recognition (Grabe, 1991). Working memory processes involved in reading facilitate the creation of memory traces. Such memory traces fade quickly, thus, a slow reading rate prevents the reader from holding large units of printed material in WM. To make use of WM capacity most efficiently, some processes must become automatized, which is possible in the case of lower-order processes. Once readers are able to automatize lower-order reading processes, their reading rates become faster and they are on their way to becoming fluent readers.

With respect to second language (L2) readers, one asks to what extent do readers who start reading in a second language use skills that they have already acquired in learning to read in their first language and to what extent do they have to learn new skills?

C. Second Language Reading

From second language reading studies, we have learned that a variety of L1 reading skills are employed in second language reading (e.g., Gamez, 1979; Rigg, 1977; Bernhardt,

2000). These skills, predominantly higher-order reading skills (e.g., applying knowledge about text and genre characteristics) are said to transfer from L1 to L2. According to the Linguistic Interdependence Hypothesis (LIH) or the Transfer Hypothesis, transfer of reading skills from L1 to L2 determines the level of reading in a second language. Proponents of the LIH claim that L2 reading is heavily influenced by the transfer of L1 skills or that good L2 reading can be explained through good L1 reading skills.

The Linguistic Threshold Hypothesis (LTH) was formulated in reaction to the transfer hypothesis (Alderson, 1984; Clarke, 1980). The LTH proposes L2 knowledge, e.g. vocabulary and grammar, as the most important influence on L2 reading. Proponents of the LTH argue that a reader must achieve a critical level of L2 development (independent of L1 proficiency) before a minimal level of L2 reading comprehension can be achieved.

In comparing languages using the same alphabetic system, which will be the case in this study, the critical threshold level, i.e. L2 linguistic knowledge level, may be surpassed at an earlier stage of L2 reading acquisition than when comparing languages that are orthographically further removed, as van Gelderen et al. (2004) propose in their longitudinal study which focused on development of reading comprehension in L1 and L2 (English) of Dutch high school students.

Several second language reading studies suggest that a combination of factors influence L2 reading comprehension. When Carrell (1991) tested bilingual Spanish and English speakers on reading comprehension in both languages, a combination of both L1 reading ability and L2 proficiency were correlated to second language reading. The data demonstrated that L2 reading ability of the Spanish students, who lived in their L2- country,

was more linked to L1 reading ability than to L2 proficiency. In contrast, the reading ability of native-English students, who were exposed to Spanish only during school hours, was more dependent on L2 proficiency than on L1 reading skill.

The fact that both reading ability in L1 and proficiency in L2 influence reading ability in the second language was explored again by Bernhardt and Kamil (1995). They tested English learners of Spanish performing at one of three proficiency levels. To correct several flaws which were present in previously conducted second language reading studies, they used large samples, authentic materials, skilled readers, and equivalent forms in the two languages to be tested. The results indicated that second language proficiency accounted for a greater portion (30%) of the variance, however, first language reading skills contributed significantly (10%) to second language reading scores as well.

To further investigate the relationship between first language reading skills, second language proficiency and second language reading, Bernhardt and Kamil analyzed the reading materials used in the study. They attempted to determine the weight of such skills as performance on inferential and literal questions and performance based on discourse structure. However, the further analysis did not identify any reading sub-skills to account for a significant source of variance. Bernhardt and Kamil concluded that specific sub-skills do not reflect the level of L2 reading and that it has no linear relationship to L1 reading. Moreover, they also pointed to the fact that their data do not account for 35-50 percent of the variance in the second language reading process.

At more advanced stages of L2 reading, an additional factor has been linked to L2 reading skill, namely, automaticity of processing. Automaticity hypotheses stress the

importance of automatized processing of linguistic information for successful reading comprehension in L2 (Favreau & N. Segalowitz, 1983; Koda, 1996; N. Segalowitz, 2000). The automatization of lower order processing (e.g. decoding, word retrieval) is especially important for attaining a level of L2 reading skill comparable with that already attained in L1.

According to N. Segalowitz (2003), automaticity of processing in L2 reading refers to the 'reorganization, routinization, or bypassing of serial execution of component processes'. In this view, fast processing differs from automatization in that fast processing involves speeding up of all components of reading without the benefit of qualitatively changed processing of linguistic information.

Automaticity, which is also known as 'processing efficiency' (N. Segalowitz & Hulstijn, 2005), is a concept related to WM capacity and incorporated by many reading theories (e.g. Rayner & Pollatsek, 1989, Just & Carpenter, 1992). Walter (2004) argues that L2 readers need automaticity of both word recognition and lexical access (recognizing the word so as to find its meaning in memory, and silently activating its pronunciation). Once a word is recognized, processing in the phonological loop of WM is initiated and with it the construction of a mental representation. The faster readers' speed of retrieval from the mental lexicon, which is linked to their level of vocabulary knowledge, the more proficient their reading comprehension will be.

Bilinguals who have received several years of formal L2 instruction and who have reached more advanced levels of L2 reading (e.g., do not read word-by-word) could shed light on the relationship between automatization of L2 lower order processes and L2 reading

level. In the current study such participants, native-Dutch bilinguals, who started to learn and read English as a second language during adolescence while attending Dutch high school, will be tested. These readers will have been exposed to a wide variety of English texts, will have watched many English-language TV programs (Dutch subtitles), and have acquired a substantial L2 vocabulary.

To enable the reader to fully understand the role of processing efficiency in reading comprehension, predominant theories of automaticity will be discussed in the next section.

D. Automaticity and Efficiency of Processing

Skilled L1 readers are able to process words automatically and efficiently; they have automatized the lower-order reading processes of word recognition and lexical access. It is generally understood that when processing of lower-level components becomes automatized, reading rates increase and more attentional resources can be allocated to higher-order comprehension processes.

How is automaticity linked to processing efficiency? Two theories that are instrumental in answering this question are the Automaticity Theory (AT) and the Verbal Efficiency Theory (VET).

The Automaticity Theory (Laufer and Hulstijn, 1994; Laufer, 1994) hypothesizes that a complex skill such as reading requires the organization of many component processes. Limited attentional resources need to be distributed among the component processes which would easily exceed attentional capacity. However, if a subset of component processes become automatized, then the attentional capacity would not be exceeded and the task at hand, e.g. reading, would be performed more successfully. Proponents of AT would further

reason that component processes in reading most likely to be automatized would be non-comprehension processes, i.e. lexical processes.

According to the Verbal Efficiency Theory (Perfetti, 1985, 1988), however, automaticity in lexical processes is not itself sufficient to increase processing efficiency and improve comprehension. Proponents of the VET hypothesize that post-lexical reading processes (i.e., processes after decoding) can be automatized as well, and may play an important role in fluent reading and comprehension. Verbal Efficiency Theory proposes an explanation as to why improved word recognition does not necessarily lead to improved comprehension. In the explanation, good readers with automatized lexical and post-lexical processes are compared with readers who have automatized lexical processes but lack efficient basic comprehension skills (i.e. post-lexical processes). The latter group is not able to use what attentional resources they have been able to free up to facilitate comprehension. Using L2 reading to illustrate, we could imagine an L2 reader who has reached a reading level which includes automatized lexical processes, but must use the freed-up attentional resources e.g. to process non-automatized morphosyntactic information.

One of the post-lexical processes that is considered important in the development of processing efficiency, according to VET, is the ability to phrase or organize text into meaningful units. The resulting 'chunking' or phrasing of written material is a skill that reflects understanding of syntax and semantics (Rasinski, 1999; Schreiber, 1980; Samuels, 2002). Beginning readers with minimal 'chunking' skills may group words in ways that would not occur in overt speech, phrasing the text into inappropriate syntactic and semantic units (Dowhower, 1991). In oral reading, skilled readers demonstrate their ability to phrase

effortlessly by using appropriate stress, appropriate pauses and correct terminal pitch contours while maintaining their reading rate.

How does processing efficiency in second language reading progress?

Automaticity in L2

Comparably to beginning L1 readers, beginning L2 readers tend to read word-by-word, allocating most of their resources to word recognition and lexical access. Skilled L1 readers read at faster rates and demonstrate higher accuracy in reading comprehension than proficient L2 readers. Based on the assumption that L2 readers go through the same cognitive processes that characterize reading in L1 (Alderson & Urquart, 1984; Day & Bamford, 1998), we can ask what variables make L2 processing efficiency lag behind that of L1 readers.

According to the Automaticity Theory, the automatization of lexical processes will result in faster reading rates and more accurate comprehension. Evidence that increased reading rates and reading comprehension are not the result of efficient word recognition and lexical access alone comes from studies in which word recognition skills are trained. In a study by Fukkink, Hulstijn, & Simis (2005), the relationship between word recognition and comprehension was investigated in Dutch-speaking students (grade 8) ranked at an intermediate level of L2 English. They studied the effects of training on word recognition skills, reading rates and comprehension of text. The study demonstrated that the training developed the L2 readers' speed in isolated word recognition skills, however, no transfer of the recognition skills on reading speed or comprehension was evident.

Similarly to the role of lexical processes in L1 reading, automated word recognition skills in L2 reading may not be sufficient for successful reading comprehension. Grabe &

Stoller (2002) suggest that automatized post-lexical processes may be critical in L2 reading. A post-lexical process they argue to be important is fast and automatic phrasing or 'chunking' of text into meaningful units.

The relationship between L2 reading comprehension and L2 was investigated by Johnson and Moore (1997). Phrasing in this study was measured by correct pausing in L2 (English) while reading aloud. The participants, 76 learners of English at either an intermediate level or an advanced level of study, came from 20 different countries and represented ten languages. The subjects were given two tasks; the reading portion of the TOEFL test and a read-aloud task, which was audio-taped. Second language reading ability and non-native pausing pattern in these learners of English showed a moderate but significant correlation. The study did not provide additional information about the participants beyond the first language spoken and the level of English study attained.

Several explanations for the lack of automatized post-lexical processes in L2 readers, such as native-like phrasing, have been suggested. Koda (1996) proposes that L2 readers, unlike English L1 readers, often do not have implicit L2 grammar and vocabulary knowledge before they start learning to read L2. Second language readers do not have a lot of experience or exposure to text in L2 to develop automatic word recognition and some basic post-lexical comprehension skills. Various other factors have been identified that may be linked to the difficulty automatizing post-lexical processes, e.g., working memory capacity (Walter, 2004), reading rate (Rasinski et al., 1994), and living in a foreign language environment (August, 2006).

It remains to be consistently demonstrated in L2 that automated word recognition skills are a sufficient condition (AT) or a necessary, but not sufficient, condition (VET) for successful reading comprehension. Examination of L2 readers' word recognition and phrasing abilities should supply us with evidence supporting a theoretical model of processing efficiency. It could be argued that in oral reading, accuracy and reading rate are linked to word recognition skills, and prosody is linked to the ability to phrase efficiently. If L2 readers demonstrate accurate word recognition, fast reading rates, non-native-like phrasing in L2, and accurate reading comprehension, this would support the Automaticity Theory. However, if L2 readers demonstrate native-like phrasing in addition to accurate word recognition, fast reading rates, and accurate reading comprehension, this would support the Verbal Efficiency Theory. In addition, testing both less proficient and advanced late learners of L2 may clarify whether native-like fluency can be acquired and under which conditions.

One task is particularly useful for observing the above-mentioned processing aspects, namely, oral reading. In the next section, the relationship between oral reading and processing efficiency, i.e. fluency, will be discussed.

E. Reading Fluency

Until recently, the term "reading fluency" referred to silent reading in which it was associated with word recognition speed. Oral reading was considered an unimportant component of the reading process. This changed when a report of the National Reading Panel (2000) underscored the link between oral reading fluency and reading comprehension in children from preschool to grade 12.

In oral reading, the three dimensions of fluency (accuracy, speed, and prosody) can be readily observed. In both oral and silent reading, fluency is positively correlated to reading comprehension, i.e. high levels of fluency are linked to accurate reading comprehension. As Grabe (1991) notes, ‘fluent reading is rapid; the reader needs to maintain the flow of information at a sufficient rate to make connections and inferences vital to comprehension.’

The link between the three components of fluency and comprehension can be illustrated with the oral reading of beginning readers. When beginning readers are instructed to read out loud, they tend to read word-by-word, often repeating or skipping words. Attentional resources are exhausted in decoding words individually. Beginning readers lack the automaticity and accuracy in word recognition of fluent readers. Reading rate, the second component of fluency, is slow as a result of inefficient decoding and frequent pausing. At a slow reading rate connections are not made between words nor does WM function efficiently; memory traces disappear before the information is processed. With respect to the third aspect of fluency, prosody, reading with expression or prosodic reading, beginning readers frequently are not able to add appropriate expressive rhythmic and melodic patterns to their reading because their attention is focused on word recognition. How is prosodic reading with expression or prosodic phrasing related to reading comprehension?

This exact question was investigated in a large (N = 123) study of native English 2nd- and 3rd-grade children (Schwanenflugel et al., 2004). In this study, Schwanenflugel et al. attempted to assess whether prosody actually assists reading comprehension or comprehension of the message enables the reader to read prosodically. In the latter case, prosody should be an indicator that the reader understands what is being read. All participants were tested on word decoding, reading comprehension, and prosodic reading.

Prosodic reading was assessed by measuring sentence-final declination in pitch, general prosodic contour, and inter- and intra-sentential pauses. To assess the development of reading prosody independently from word decoding, the oral reading passage used in this study was easy-to-decode (90% decoding accuracy for all participants) and included a variety of syntactic forms.

Results demonstrated that children with good to excellent decoding skills read with few, brief intra-sentential pauses and clearly marked sentence boundaries with a falling pitch. Furthermore, results neither suggested that prosody assists reading comprehension nor that prosody is an indicator that the reader understands what is being read. Schwanenflugel et al. concluded that prosodic reading and comprehension are not strongly correlated.

Two reasons for the missing relationship between prosodic reading and comprehension in this study may have been the choice of reading passage and the fact that no reading comprehension questions were connected to the passage itself, according to the researchers. For future study, they suggest including a passage that is easy-to-decode but with more challenging content and structure (p.128) and questions directly related to the reading passage.

As a result of the recent interest in fluency and its possible link to reading comprehension (National Reading Panel, 2000), several assessment tools are now available. One of such assessment tools is the Reading Fluency Indicator Test (Williams, 2004), which measures rate, accuracy, prosody, and comprehension. The Reading Fluency Indicator (RFI) test is based on the definition of fluency preferred by the National Reading Panel (2000) which is the ability to read orally with speed, accuracy, and prosody.

The passages that are included in the RFI are graded over ten levels to be used with beginning and fluent readers. Because the purpose of the RFI is to measure a student's ability to read connected text with understanding, each passage is accompanied by four comprehension questions in multiple-choice format. The RFI contains literal and inferential questions with a majority of the questions being literal at lower reading levels and the majority of the questions being inferential at the higher reading levels. Both reading time (RT) and Words Read Correctly per Minute (WCPM) can be calculated. Prosodic skills can be subjectively rated by matching one of four levels of prosodic reading provided by RFI. The four levels of prosodic reading specify the length of phrases, the use of appropriate stress and pitch contours, and the attention given to prosodic cues e.g., commas.

Not only has the influence of prosody on oral reading fluency in assessment received increased attention. Reading studies have investigated whether explicit training in prosodic reading would increase reading comprehension. A study by Kuhn and Stahl (2003) demonstrated that repeated reading as well as pre-parsing texts into phrases with phrase units prosodically marked improved reading comprehension in first and second graders. In contrast, familiarization with lexical items alone did not improve reading comprehension.

Let us now return to the reading comprehension of late bilinguals and whether prosodic reading and comprehension are similarly linked for them. In some respects, non-native readers resemble beginning L1 readers; they are slower in decoding and even at higher L2 proficiency levels demonstrate consistently slower reading rates. What can we learn about L2 prosodic reading and its relation to reading comprehension? In the next section a review of studies investigating various aspects of L2-reading prosody will follow.

Reading Fluency in L2

Few second language (L2) oral reading studies have focused on the relationship between prosodic aspects of L2 and L2 reading comprehension. Even fewer studies have investigated the performance of late bilinguals and prosodic reading. One study is an oral reading study with 11 native-English and 143 native-Turkish (L2=English) late L2 learners (Bada, 2006). Participants were instructed to read an English story aloud and were audio-recorded. The story contained frequent ‘that’-constructions (i.e. complementizers introducing either a relative clause or sentential complements), which in Turkish is regarded as part of the syntactic group it follows and in English as part of the following clause. This study investigated whether the length of a pause preceding “that” differed from a pause following “that” in the oral reading of native-English and Turkish non-native speakers of English. Acoustic measurements of the taped passages demonstrated that native speakers of English produced relatively long pauses preceding ‘that’ in three tested constructions (noun-clauses with ‘that’-complementizers, relative clauses with ‘that’-complementizers acting as subject, and ‘that’- complementizers acting as object). Turkish L1 speakers of English demonstrated a different pausing pattern with ‘that’ constructions from that of native speakers of English. In all but the ‘that’-complementizers acting as object-construction, the Turkish readers used longer pauses following the ‘that’ constructions in English than the native-English participants. Although this study did not investigate reading comprehension, it would be interesting to follow up with comprehension questions. Based on the literature, one would predict that non-native pausing patterns would reflect readers’ problems in grouping syntactic units in text which may negatively impact reading comprehension.

A second study investigating late bilinguals and prosodic reading is a L1-Dutch and L2-Dutch oral reading study (Cucchiaroni et al., 2000). Twenty native-Dutch and 60 non-native-Dutch speakers orally read two different sets of five Dutch sentences over the telephone. The non-native participants in this study were categorized as beginning, intermediate or advanced Dutch speakers. The readings were recorded and rated for fluency by three expert phoneticians and six speech therapists. It was concluded that expert fluency ratings of L2 readers were mainly influenced by rate of speech and number of pauses. Indeed, native-Dutch readers produced on average 1.42 sentence-internal pauses versus non-native-Dutch speakers on average 7.20 sentence-internal pauses. Locations of pauses or pause patterns were not analyzed in this study.

When an L2 reader pauses at non-native L2 locations (e.g. intra-sentential locations) during L2 reading, the image of an unskilled L1 reader comes to mind. In defining fluency in L2 production, Wood (2004) indicates that native speakers and fluent L2 speakers pause at sentence and clause junctures, whereas non-fluent L2 speakers pause both more frequently and at intra-sentential and intra-clausal locations. It can be hypothesized that frequent pausing such as that reported in L2 speakers by Cucchiaroni et al. indicates a proficiency level at which automaticity of L2 pausing patterns has not yet been achieved.

Sentence-level prosody produced by bilingual speakers in a production task was the focus of a study by Fernandez (2005). A group of twelve bilingual participants, who lived in the U.S. and who had learned to speak Spanish from birth and started English from three to 13 years of age, were tested as adults. They were instructed to read three-sentence combinations aloud which they had to organize into a single sentence in a prescribed form. The prescribed form the participants had to use contained a complex noun phrase (NP)

followed by a relative clause (RC). The RC could be considered a modifier of a non-local noun (N1) or a modifier of a local noun (N2). The relative clause in the target sentence was either short (e.g., *who snores*) or long (e.g., *who often unknowingly snores*). Added length at the end of the relative clause increases the likelihood of a prosodic phrasal break in the sentence. In the same materials, the target construction functioned either as a post-verbal direct object, or as a pre-verbal subject in order to test the effect of location within the sentence. All participants read and produced sentences in English at one testing and in Spanish at a second one with a two-week separation. Acoustic analyses of bilingual and monolingual productions were compared for mean duration and pitch movement for the second noun in the complex noun phrase and the RC-final verb.

The prosody produced by bilinguals demonstrated complex and distinct patterns compared to monolinguals for duration and pitch movements. Specifically, the duration data showed that bilinguals prosodically phrase preverbally placed RC attachment constructions (e.g. *the brother of the groom who snores impressed the guest*) differently than from monolinguals, and that the timing of bilingual speech is overall more variable, particularly in Spanish, the L1. One reason for the reported results, according to Fernandez, may have been that pre-verbally placed RC attachment constructions (*the brother of the groom who snores impressed the guest*) may require substantial processing resources. Furthermore, increased reading dysfluencies in the lesser-read language (Spanish) may have played a role in the prosodic production of the ambiguous sentences.

The studies discussed above provide us with insight related to fluency in L2 oral reading, specifically about a prosodic aspect of fluency, namely rhythmic patterns. Pauses in oral reading constitute a measurable unit of prosodic reading. It could be argued that few pauses

in oral reading indicate skilled reading and many pauses indicate unskilled reading. With respect to L2 readers, we can, then, ask whether native-like use of L2 pausing patterns can be acquired by bilinguals and how they relate to L2 reading comprehension.

Trofimovich and Baker (2007) propose an acquisition model differentiating between early-learned language-specific suprasegmentals and later-learned, less language-specific suprasegmentals. This type of model appears to clarify L2 suprasegmental development in L2 speakers.

In the study by Trofimovich and Baker, forty Korean speakers who started speaking English as children ($M = 9.5$ years) participated in a delayed sentence repetition task from which the production of five suprasegmentals was acoustically analyzed. The five suprasegmentals included stress timing, peak alignment, speech rate, pause length, and pause frequency. Both stress timing (the phenomenon that there is a constant amount of time, on average, between two consecutive stressed syllables) and peak alignment (the phenomenon that an F_0 peak associated with a prominent syllable should occur near that syllable) are considered acquired early in L1, language-specific, and prosody-linked (Botinis, Granstrom, and Mobius, 2001). Speech rate, pause length, and pause frequency are not considered to be acquired early, their development continuing into late childhood and are considered less language-specific than prosody-based suprasegmentals (Holmes, 1995).

The results of the study demonstrated that child L2 learners with significant experience in L2 ($M = 11.1$ years) were able, as adults, to produce the five suprasegmentals with near-native accuracy except for 'speech rate' (speech rate is considered a non-language-specific suprasegmental, which may reflect the fluency with which the spoken language is used).

Child L2 learners with limited L2 experience ($M = 1.0$ year) were not able to produce any of the five suprasegmentals with native-like accuracy.

It could be argued that child learners of L2 in this study demonstrated native-like ability to phrase sentences as measured by the frequency of their pauses. The inability of the same participants to employ native-like L2 speech rates appears to parallel results of recent investigations of child L2 learning at the segmental level which documented limits to child L2 learners' ability to perceive and produce L2 segments nearly natively, even despite extended amounts of L2 exposure (e.g., Flege et al., 1999).

It has been suggested that this dissociation between acquisition of prosody-based and fluency-based suprasegmentals in child learners of L2, as in L1 learners, implies different underlying processing mechanisms. From this perspective, the processing and learning of the suprasegmentals characterizing speech prosody may reflect language-specific linguistic knowledge (Botinis et al., 2001), whereas the processing and learning of the suprasegmentals characterizing fluency reflects the rapid and efficient functioning of psycholinguistic mechanisms, such as lexical access (Costa & Santesteban, 2004).

These results also hold promise with respect to investigating whether post-lexical processes, such as the ability to phrase or organize text into meaningful units, can be automatized in L2 processing and possibly support improved L2 reading. To review; Automaticity Theory argues that automatized lexical processes were sufficient for increased reading rate and comprehension. In contrast, Verbal Efficiency Theory argues that lexical processes were not sufficient and that automatized post-lexical processes play a role in higher reading rates and improved reading. The Automaticity Theory and the Verbal Fluency

Theory are based on L1 reading development, however, both theories have been applied to L2 reading. In this context, L2 phrasing skills, as measured by pause frequency, can be used as a measurable quantity to indicate automatization of a post-lexical process in L2 reading.

From several production studies it is known that L2 learners pause more in their L2 compared to their L1 (e.g., Riazantseva, 2001), however, the influence of L2 experience on this process is not clearly understood. A study by Lennon (1990) demonstrated that with an increasing amount of L2 experience, pause frequency and pause duration moderately decreased in L2 speech. In contrast with Lennon's study, another study (Towell, 2002) revealed no change reported in pause duration after three years of a college foreign language program.

Yet another study investigated the relationship between fluency-based suprasegmentals and comprehension. In this study by Johnson & Moore (1997), reading comprehension and non-native pausing patterns were correlated. The participants were 76 learners of English at either an intermediate level or an advanced level of study (the participants came from 20 different countries and, among them, spoke ten languages). The subjects were given two tasks; the reading portion of the TOEFL test and a read-aloud task, which was audio-taped. Second language reading ability and non-native pausing pattern in learners of English showed a moderate but significant correlation, $r = -.349$, $p < .002$. Further analyses showed that non-native readers paused at several non-native locations compared to native readers.

From their study, Johnson and Moore determined six locations from their study at which nonnative readers paused and skilled monolingual readers did not: 1. at the end of a line, 2. between an adjective and the noun it modified, 3. between a preposition and its object, 4.

between a verb and its direct object, 5. between the subject and the verb, and 6. before a prepositional phrase. The effect of each pause location on comprehension could not be calculated because of low incidence of the specific pause-types in the materials.

In summary, suprasegmental phonology seems to be correlated to oral reading fluency and possibly to reading comprehension. Also, the ability to phrase or 'chunk', as measured by frequency of pausing, seems to be linked to skilled reading in L1 which has been demonstrated to be one of the post-lexical processing skills that can be automatized. Non-native readers who demonstrate a native-like pausing pattern in L2 may similarly have automatized post-lexical processes.

To ascertain that prosodic reading is not merely a characteristic of oral reading, but that it may facilitate comprehension in silent reading as well, the next section will review literature related to suprasegmental cues in silent reading.

F. Silent Reading and Suprasegmentals

At first, a role for suprasegmental phonology in silent reading seems counter-intuitive. We associate suprasegmentals with oral reading and production, not with silent reading. However, a series of subvocalization suppression studies (Słowiacek and Clifton, 1980; Levy, 1975; Kleiman, 1975) suggested that suprasegmental phonology facilitates reading comprehension.

Rayner and Pollatsek (1989) argued that similarly to auditory processing, silent readers require intonation contours and sentence rhythms to group words into phrases and focus on important information. It has been suggested that in the absence of such prosodic information, readers reintroduce prosodic structure, which, if prevented (e.g. by asking the

participants to verbalize or count out loud while reading silently), will decrease comprehension.

In subvocalization suppression experiments, participants are instructed to count aloud or verbalize while silently reading, removing the benefit of phonological coding and subvocalization. In a study by Slowiaczek and Clifton (1980), 48 students read four stories and were presented with test sentences that were either paraphrases of or inferences from the stories. Two conditions were tested: silently reading sentences and silently listening to sentences. In both the reading and listening conditions, the participants were either quiet or suppressed subvocalizations by repeating the word 'cola.' The results demonstrated that only in the reading condition, comprehension was decreased when subvocalizations were suppressed. It was argued that prevention of subvocalization or 'inner voice' significantly decreased comprehension of complex sentences but not verbatim recall of the sentences (Slowiaczek and Clifton, 1980).

The negative effect of suppressed vocalization on reading comprehension has not only been explained as a prosodic phenomenon, but as a non-prosodic phenomenon as well. In a memory-based explanation, subvocalization is seen as the phonological coding of a visual input. Speech-based subvocalization interferes with speech-based phonological representations, resulting in an overload in memory capacity. Phonological representations have been closely linked to working memory (WM) and reading comprehension. As was mentioned above, WM is a "mental blackboard" or "temporary workspace" that allows humans to store and manipulate information while performing mental tasks (Gathercole and Baddeley, 1993). Within the WM system, an important role is assigned to one of the two slave systems, the phonological loop. The major role of the phonological loop is in formation

and retention of phonological representations. The superiority of phonological representations stems from the fact that they are more durable than auditory traces.

Slowiaczek and Clifton acknowledge the close connection between prosodic coding and memory in subvocalization, however, they hypothesize the role of prosodic ‘chunking’ as consisting of a restructuring of the memory representation instead of one of assuring durability of the memory representation. The use of prosodic ‘chunking’ as consisting of a restructuring of the memory representation corresponds to the concept of automatization proposed by N. Segalowitz (2003). According to N. Segalowitz, automatization involves qualitatively changed processing of linguistic information. From this perspective, we could speculate that unskilled readers, native or nonnative, may recognize words efficiently and accurately (i.e. automatization at a lexical level), but are not able to efficiently phrase or ‘chunk’ sentences in large, meaningful units (i.e., automatization at a post-lexical level).

The question of durability or restructuring of memory representations was at issue as well in a suppressed subvocalization experiment with Japanese-English bilinguals (Ohno & Abe, 2006). This study demonstrated that the level of subvocalization necessary to cause a given degree of impaired comprehension in L2 may be different from that in L1. It was argued that L2 reading in the case of Japanese speakers of English ‘will not be developed with as much phonological necessity.’ Apparently, many Japanese L2 English learners do not learn to read English via an oral route and this may result in impoverished phonological representations (personal communication: T. Ohno, 2007).

Working memory capacity may be linked to prosodic phrasing and phonological coding. A task frequently used to determine a reader’s WM capacity is the Reading Span Task

(Daneman and Carpenter, 1980). This task was designed to test WM storage and processing simultaneously. In this task participants read sentences aloud and remember the last word of each sentence. The participant is instructed to read an increasing number of sentences and remember the last words of the larger set of sentences. The final score is the maximum number of sentences per set for which the participant can recall all of the final words. Scores, which to date come predominantly from studies with college student participants, range from low (3 or fewer words remembered) to high (4 or more words remembered).

Performance on the Reading Span Task in both L1 and L2 was tested and compared by Christoffels et al. (2004). They demonstrated no significant differences in bilingual adults' performance on a Dutch and an English version. Christoffels et al. concluded that the functional working memory capacity of the Dutch participants appeared equally large in L1 and L2. Harrington and Sawyer (1992) similarly reported no differences between performances on reading span tasks administered in two languages.

In summary, suppressed subvocalization studies provide a link between oral reading studies and silent reading studies with respect to reading comprehension. From such studies, we learn that readers who are prevented from accessing and processing phonological representations may demonstrate reduced sentence processing and reading comprehension. With respect to suprasegmentals, the question remains whether readers make use of suprasegmental cues in silent reading. The difficulty in ascertaining whether readers make use of suprasegmental cues, such as phrasing or 'chunking,' stems from the fact that reading processes are not observable during silent reading. However, event-related potential (ERP) studies have reported the presence of an electrophysiological response related to

‘entlasten’ (to support), is transitive. The preferred reading of this sentence pair would be sentence 1, where the noun phrase ‘Anna’ would be parsed as the indirect object of the preceding verb. In sentence 2, a garden path situation is created, which needs to be revised once the verb ‘entlasten’ is read or heard. The prosodic patterns of these sentences were predicted to differ in number of prosodic boundaries (one boundary in sentence 1 and two boundaries in sentence 2) and therefore differ in number of intonational phrases. The prosodic boundary after the verb ‘verspricht’ in sentence 2 distinguishes it prosodically before the lexical disambiguation with the verb ‘entlasten’. Steinhauer tested whether the prosodic information in sentence 2 prevents the erroneous attachment of ‘Anna’ to the preceding verb. Indeed, the auditory experiment demonstrated that prosodic boundaries guided parsing decisions.

The influence of the prosodic boundaries could be monitored on-line with event-related potentials (ERPs). ERP data demonstrated that a reliable electrophysiological response was elicited at speech boundaries. This electrophysiological response labeled the closure positive shift (CPS) is predominantly related to prosodic cues. Additional analysis of the CPS in the Steinhauer study proved that the response occurs at the phonological level (speech boundaries) of prosodic processing, independent of its acoustical realization, e.g., boundary tones, pause insertion.

When the same sentence materials of the auditory experiments were used in a reading experiment, a similar although smaller CPS was present. Steinhauer hypothesized that the reduction of the CPS may be accounted for by the lesser degree of activation of phonological representation during silent reading.

In the visually presented sentences of Steinhauer's experiment (2003), commas were inserted at acceptable and non-acceptable prosodic boundaries. To determine why commas evoked a CPS that was reduced in amplitude and duration, an experiment using de-lexicalized prosodic patterns was designed. In this experiment, participants were instructed to replicate a previously heard prosodic pattern during reading. Participants first listened to a pure 'sentence melody' that was stripped of any lexical information with a special filtering procedure leaving suprasegmental information related to pitch, amplitude, and rhythm intact. Half of these prosodic patterns contained an additional prosodic boundary. Subjects were instructed to replicate this melody during the silent reading of a visually presented (word-by-word) sentence without punctuation. Although the written word sequence always allowed this sentence-prosody pattern, the syntactic structure of the sentence was either compatible or incompatible with the number of prosodic boundaries.

While the participants were listening to the pure melody and during the silent reading task, CPS-like ERP components were elicited at the prosodic boundaries and the replicated boundaries. The participants who demonstrated the most reduction in amplitude and duration of the CPS, performed worse in the comprehension task and on the Reading Span Task (Daneman and Carpenter, 1980). Steinhauer concluded that the CPS appears to be an on-line reflection of both overt and covert phonological prosodic phrasing independent of the input modality.

In these ERP studies, a CPS was elicited whenever listeners or readers segmented a sentence in prosodic phrases and its amplitude was consistently larger in auditory than visual language presentation. Furthermore, a link between readers with the most reduced CPS and sentence comprehension seems to reflect the difficulty poor readers have in activating

phonological representations including suprasegmentals. In the study discussed above, Steinhauer suggests that syntactically ambiguous sentences can be disambiguated by pauses or breaks at phrase boundaries.

Assuming, then, that suprasegmental cues stem from the same cognitive mechanism, we now turn to studies that may help us understand what the introduction of prosodic structure in silent reading entails and its link to the processing of ambiguous sentences.

Ambiguous Sentence Processing and Suprasegmentals

Whereas in spoken language the effectiveness of a prosodic boundary can depend on factors such as its acoustic robustness (pitch and duration cues) or the phonological category it belongs to (Carlson, Clifton, and Frazier, 2001), in visual processing, we know that individual reading skills and activation of phonological representations mainly influence introduction of prosodic structure.

One way to investigate the relationship between prosodic structure and the processing of ambiguous sentences while reading them silently is to investigate phrasing preferences among readers. One particular parsing model, proposed in the Prosodic Visibility Hypothesis (Schafer, 1997), may shed light on prosodic phrasing of ambiguous sentences by readers. Schafer suggests that listeners are guided by the number of a speaker's prosodic boundaries with respect to disambiguation. She uses the following sentence to illustrate her hypothesis:

1. The bus driver angered the rider with the mean look.

Sentence 1. ends in a prepositional phrase (PP), *with the mean look*, which can be either attached to the immediately preceding NP (*the rider*) or to the VP headed by the verb *angered*. Disambiguation was tested under the following conditions:

1a. [The bus driver angered the rider] [with the mean look].

1b. [the bus driver angered] [the rider with the mean look].

1c. [The bus driver angered the rider with the mean look].

1d. [The bus driver] [angered] [the rider] [with the mean look].

Within the Prosodic Visibility Hypothesis, Schafer argues that attachment of the PP, *with the mean look*, to the NP is preferred in 1b., because the PP and the NP are ‘packaged’ within the same prosodic phrase. In sentence 1c. both the NP and VP are packaged in the same phrase as the PP and therefore attachment should be more evenly split between the two sites. Similarly, in 1a., both the NP and VP are separated from the PP equally, resulting in attachment distributed more evenly over both sites. In sentence 1d. the verb is separated by two phrases while the NP by only one. In this case Schafer hypothesizes that the frequency of NP modification is intermediate between the choices for sentences 1b and 1a/1c.

Listening studies corroborated the fact that with the presence of a prosodic boundary following the verb and adding a prosodic boundary before the PP (in French sentences) the preference for NP attachment was eliminated (Pynte & Prieur, 1996). Schafer concluded that interpretation of a prosodic boundary depends on other boundaries in the sentence.

Despite the fact that the Prosodic Visibility Hypothesis was based on auditory processing of suprasegmentals, the underlying premise is relevant for visual processing as well. Remember that Steinhauer et al. concluded that in silent reading, individual reading skills and ability to activate phonological representations determined sensitivity to suprasegmental cues. We could imagine that readers introduce different level of prosodic cues during reading.

Let us look more closely at sentence 1d. This type of phrasing, with many prosodic boundaries, could reflect the skill level of a beginning L1 reader. If the prosodic boundaries were located not only inter-phrasally but also intra-phrasally (e.g. a boundary between ‘bus’ and ‘driver’ in sentence 1d.), it could reflect the skill level of an L2 reader. Depending on the number of prosodic boundaries, ambiguous sentences may be disambiguated depending on the attachment preference indicated in the Prosodic Visibility Hypothesis.

The possibility of investigating the role of prosodic phrasing in the processing of ambiguous sentences by bilinguals presents itself in the case of the relative clause ambiguities. The relative clause ambiguity is unique in that attachment preference, and with its interpretation, seems to differ across languages.

Relative Clause Ambiguities and Suprasegmentals

A case in which suprasegmentals may play a role in disambiguation of structurally ambiguous sentences is of the following kind:

Peter fell in love with the daughter of the psychologist who studies in California

NP1

NP2

Relative Clause

This sentence consists of a complex noun phrase (NP) followed by a relative clause (RC). The complex NP includes two simple NP's, 'the daughter' (N1) and 'the psychologist' (N2). The RC "who studies in California" can be considered a modifier of 'daughter' or a modifier of 'psychologist'. In a study by Cuetos and Mitchell (1988), Spanish readers preferred to attach the RC to NP1 in Spanish sentences, whereas studies with English readers demonstrated a preference to attach the RC to NP2 in comparable English sentences. This difference in preferred interpretation has been replicated with readers of other languages, where some tested languages seem to resemble Spanish interpretation and a few other tested languages seem to resemble English interpretation.

Two studies specifically relevant to Dutch in respect to attachment preference are by Brysbaert and Mitchell (1996) and Wijnen (2003). The study by Brysbaert and Mitchell consisted of a questionnaire and two on-line experiments. First, the questionnaire, a translation of the Cuetos and Mitchell questionnaire, demonstrated that Dutch speakers (N=100) select N1 attachments (i.e., the relative clause modifies the first N in the complex noun phrase) with a mean of 6.2 out of 11 sentences (human nouns) and 8.7 out of 13 sentences (non-human nouns). The high (or N1) attachment preferences by the Dutch participants was less marked than the attachment preferences present with Spanish participants, and in general can be considered small. In addition, individual differences in the direction and strengths of biases of attachment preferences were present in the data.

Data from the first on-line experiment (N = 48 Dutch monolingual participants) confirmed the high-attachment bias from the questionnaire task only with complete sentence presentation (i.e., word-by-word presentation did not elicit the high-attachment bias) and immediate disambiguation (by means of two Dutch relative pronouns 'die' and 'dat'). In the

second on-line experiment, an eye-tracking study, 30 participants read complete sentences only and demonstrated once more that sentences in which late closure (i.e., N2 or low attachment) is forced are more difficult to process (i.e. longer response latencies).

Brybaert and Mitchell discuss their data in light of the Construal Theory (Frazier and Clifton, 1996). Construal Theory, which can be considered an extension of the garden-path model, states that attachment of relative clauses, as in the structures discussed here, is not considered to be guided by primary relations, i.e. arguments of the main predicate and its dependents. Instead, attachment of relative clauses is the result of a broader or construal process which makes use of e.g. discourse information. Frazier and Clifton (1996) argued that the Construal Theory could explain the high-attachment preference of the Dutch readers, a preference that previously was thought to be restricted to languages in which adjectives predominantly follow nouns (Dutch is a pre-nominal language). Brybaert and Mitchell conclude that the data from their study is best explained by the Linguistic Tuning Hypothesis (e.g., Mitchell, 1994). The Tuning model states that initial parsing preferences in syntactically ambiguous sentences are determined by people's previous exposure to similar structures.

An alternative explanation for crosslinguistic differences in relative clause attachment preference is provided by Janet Fodor (1998, 2002). Fodor proposed that readers project a default prosodic contour (possibly a language-specific prosodic contour) during reading comprehension and then treat this implicitly created prosody as if it were part of the stimulus, so that it influences syntactic processing as 'real' prosody does when we listen to speech. This proposal is known as the Implicit Prosody Hypothesis (IPH). Support of the IPH can be found in crosslinguistic data, but also from studies that examine how attachment preference

can shift within a language, based on manipulations (e.g. length of constituents) of the materials.

Implicit prosody was concluded to play a role, and therefore seems to support the Implicit Prosody Hypothesis, in a second Dutch study (Wijnen, 2003) that investigated attachment preferences. This study made use of Jabberwocky materials (i.e. nonsense language with grammatical order and morphological markers intact e.g., ‘All mimsy were the borogoves’). The motivation for the use of Jabberwocky was to eliminate semantic influences and focus on prosodic effects only. Wijnen argued that phonological length (or weight) influences ‘prosodic packaging’ which can alter the position of prosodic boundaries. In the study, in two questionnaire tasks completed by electronic mail, Dutch participants (22 and 18 subjects, respectively) were asked to indicate whether a relative clause in NP1-preposition-NP2-Relative Clause sentence-fragments modified the first or the second noun. In the first task, the length of the nouns was varied systematically, resulting in four conditions (long-long, short-short, long- short, and short-long). In the second task, a prepositional phrase was added to the relative clause in addition to varying the length of the nouns.

Specifically in the first task, in the short NP1-long NP2 condition, high attachment preferences were twice as high compared to the long NP1-short NP2 condition, which was predicted by the Implicit Prosody Hypothesis. The length of the relative clause in the second task forced a prosodic break before the relative clause, resulting in an increase in NP1 attachments regardless of length of N1 or N2. In the third task of the study, participants were instructed to read Jabberwocky materials (identical to the first task) from a computer screen. The materials were presented in fragments and participants were to judge whether

continuation of the previous material was acceptable or not. Non-significant results demonstrated that it was easier to accept NP2 disambiguation when NP1 is long and NP2 is short than when NP1 is shorter than NP2.

In summary, the attachment preferences across the three tasks show great variability which, according to Wijnen, can be partially attributed to the complexity of processing Jabberwocky.

Additional support for the IPH comes from a study investigating the relationship between prosodic phrasing, working memory (WM) and attachment preference i.e. ambiguous sentence interpretation (Swets, Desmet, Hambrick, & Ferreira, 2007). Swets et al. report on preferred interpretations in Dutch and English readers. In this study, Dutch readers processed ambiguous Dutch sentences and English readers processed equivalent ambiguous English sentences. Results demonstrated that, in addition to a general tendency by Dutch readers to attach high and English readers to attach low, limited WM capacity readers, in both languages, preferred to attach high, whereas high span readers, in both languages, attached locally or low (i.e., N2 is modified). The researchers argue that, possibly, high capacity readers are able to prosodically chunk large groups of words together. This would eliminate the pause, which functions as a prosodic cue, before the relative clause.

Recall that pausing before a clause influences phrasing and attachment. Limited capacity readers would prosodically chunk the sentence into smaller groups, necessitated by their smaller capacity. This type of 'chunking' is the process stipulated by the IPH. As Swets et al. point out; the IPH may be able to explain individual parsing differences beyond the original cross-linguistic parsing differences.

One further methodological point regarding the Relative Clause Ambiguities bears mention: in the study of Swets et al., the experimental sentences were of the format “NP-of-NP Relative Clause”, where the relative clause was placed preverbally:

The brother of the groom who snores impressed the guest
 NP1 NP2 RC Verb phrase

Sentences of this format sentence were found to produce more variable prosody in bilinguals when reading aloud than sentences where the relative clause was placed post-verbally (Fernandez, 2005). Fernandez hypothesized that the prosodic variety was possibly the effect of disfluency in the lesser read language (Spanish) and heavier WM load for preverbally placed RC attachment constructions in that language.

In summary, off-line studies demonstrate that RC attachment preferences may depend on language-specific parsing strategies, possibly a language’s default prosody (Fodor, 2002). Speakers of some languages, e.g., Dutch, whose default prosody places a major prosodic boundary before the RC will prefer N1 attachment, whereas speakers of languages whose default prosody imposes no such boundary, generally prefer N2 attachment

Relative Clause Ambiguities and Second Language Processing

If in fact, the proposed influence of prosody is a primary source of cross-linguistic variation in RC attachment preferences, RC attachment ambiguities could serve as a vehicle to investigate a possible link between L2 fluency-based suprasegmentals and L2 reading comprehension. A discussion of studies investigating L2 RC attachment resolution is to follow.

Relative clause attachment ambiguities, the structures that were discussed in the previous section, were presented to 31 L1 Spanish-L2 English and 32 L1 English-L2 Spanish speakers in a bilingual reading study (Dussias, 2003). The participants read sentences in their L1 and L2 of the following kind (note that the RC is part of the object):

1. The president scolded the secretary of the manager who was very busy.

Two control groups, monolingual English and monolingual Spanish speakers, served as the basis for comparison. Overall, it was concluded that both bilingual participant groups did not follow L1 or L2 disambiguation preferences. Two experiments, a questionnaire and a self-paced reading task, resulted in an N2 attachment preference (i.e., ‘who was very busy’ modifies ‘the manager’ in the above sentence) in both languages for the Spanish and English bilingual participant groups. Dussias hypothesized that this N2 attachment preference is related to the bilingual language processor having to manage two language systems which will more easily create processing delays for the bilingual processor. The processor may employ processing strategies, such as the Late Closure strategy, which assigns incoming material immediately to the clause last worked on, to minimize delays. Employing the Late Closure strategy, which integrates new material with prior material, prevents exceeding memory capacity. A similar link between processing and memory was the subject of investigation of the crosslinguistic study by Swets et al. (2007).

An alternative explanation for the results is offered by Dussias, one that relates to the notion of language environment. She points out that testing of both groups of bilinguals took place in the U.S., which may have played a role in the attachment preferences. The L1 Spanish-L2 English participants studied English on average eleven years before moving to

the U.S. and had resided in the U.S. on average seven years. This group of readers may have been able to prosodically phrase in larger units. Their resemblance to a skilled L1 reader may be linked to more frequent exposure to spoken L2 and reading it more, processing efficiency in L2 or a combination of the two.

In a subsequent eye-tracking experiment, 24 Spanish-English participants with limited L2 exposure (on average 8.5 months) and 20 Spanish-English bilinguals with extensive L2 exposure (on average 7.1 years) were tested with temporarily ambiguous sentences in Spanish (Dussias and Sagarra, 2007). The participants with limited L2 exposure were tested in Spain and were speaking English as a foreign language; the participants with extensive L2 exposure were tested in the U.S. and were speaking English as a second language. In the study, two ways to determine whether the two participant groups were comparable in terms of L2 proficiency were used. First, self-rating scores showed that the two groups differed significantly in speaking and reading. Secondly, reading times for 114 filler items and comprehension scores on the same filler items were compared and no significant differences were found between the two participant groups. Based on the latter results, the two participant groups were concluded to be comparable in L2 English proficiency.

The study by Dussias and Sagarra demonstrated that, comparable to monolingual Spanish speakers, the bilingual group with limited L2 exposure demonstrated a high attachment strategy. The Spanish-English bilinguals with extensive exposure to L2 attached the relative clause to the second noun, i.e., low attachment. The authors conclude that processing strategies from L1 are transferred to L2, e.g., maintaining high attachment preferences in reading L2 English relative clause ambiguities, but, similarly, L2 can influence L1 processing strategies as well.

In the present study, ambiguities in which the RC is either part of the subject or the object of the sentence are included. If ambiguity resolution is mainly linked to prosodic manipulation, we expect comparable attachment preferences for both sentence types. If other variables were similarly linked to RC ambiguity resolution, such as WM capacity or syntactic knowledge, the two sentence types may be disambiguated according to a different pattern.

Even though the relative clause ambiguity attachment preferences have been investigated extensively, the variety in participants, languages studied, attribute variables etc. varies widely. However, a set of additional structures in which suprasegmental aspects appear to contribute to disambiguation, to be discussed next, would corroborate a link of suprasegmentals with text processing.

Other Ambiguous Structures and Suprasegmentals

Directly relevant for this dissertation is a study investigating pauses in both auditory and visually presented ambiguous sentences. This study (Kang & Speer, 2004) required participants to both read and listen to ambiguous particle constructions, for example:

Aaron followed a poor guy drinking his soda.

Participants (N=114) in the experiments answered comprehension questions (e.g. “Who was drinking the soda?”) with five response choices:

1. definitely Aaron
2. more likely Aaron
3. either Aaron or the poor guy
4. more likely the poor guy

5. definitely the poor guy

Kang and Speer argued that the ‘either Aaron or the poor guy’ response reflects ‘the indeterminacy of interpretation in these constructions’.

Participants in the Kang and Speer study were also asked to rate acceptability of the two interpretations of the same sentence. Results from the reading experiment indicated a trend towards low-attachment preference (i.e., where ‘drinking his soda’ seems to modify ‘a poor guy’). Results from the listening experiment clearly indicated that sentences with an intonational phrase break before the ambiguous constituent was interpreted as the main subject (‘Aaron’) performing the action (‘drinking his soda’) and with an intonation phrase break somewhere else in the sentence, the ambiguous phrase (‘drinking his soda’) would be grouped with the immediately preceding noun (‘guy’).

These auditory and reading results correspond to the ERP-study results of Steinhauer (2003), discussed above. The closure positive shift (CPS), which was the result of prosodic cues in a listening study and the result of reconstructed prosodic cues in a reading study, was more robust in the listening comprehension study than in the reading study. In addition, Kang and Speer, like Steinhauer, point out the large individual differences in processing and reconstructing of prosodic cues.

One other study indirectly presents the opportunity to assess a possible role for suprasegmentals in the disambiguation of an ambiguous sentence. The relationship between pauses and auditory processed ambiguous sentences was investigated by Price et al. (1991). Importantly, Price et al. concluded that ‘different types of word strings with two competing

syntactic structures differ in the degree to which they can be disambiguated by prosodic cues' (p. 2956).

In this study, participants listened to structurally ambiguous sentence pairs with their disambiguating contexts written out on an answer sheet. The sentence pairs were recorded by four professional FM public radio newscasters and manifested seven types of structural ambiguities. Participants were instructed to mark the context that they thought best matched the sentence they heard. Overall, participants marked the matching disambiguating context with 84% accuracy with a range of 71-95%. Price et al. found that large prosodic breaks occurred at large syntactic boundaries. Those items that had been most successfully disambiguated by naive listeners displayed the largest durational and intonational differences between the two structures at points of syntactic ambiguity. In the acoustic analysis, using duration and fundamental frequency (F0) measures, again, the greatest amount of lengthening occurred at the largest syntactic boundaries.

In the Price et al. study, sentences recorded with the largest prosodic break before the phrase to be attached to a far site were perceived with the correct disambiguating context by listeners 78% of the time. Sentences recorded without a large prosodic break were perceived with the correct disambiguating context 69% of the time. One of structural ambiguities used in the Price et al. study, the 'far versus near attachment of final phrase' ambiguity (e.g. 'I read a review of nasality in German'), could be used in a visually presented study as well. No other ambiguous structures employed in this study could be modified for a visual presentation because the sentence pairs were differentiated by changes in spelling or punctuation.

G. Summary

As is apparent from the literature reviewed above, reading is a complex phenomenon. This complexity only increases in L2 reading, simply because two languages are involved. Some skills related to L2 reading have been identified, such as L1 reading skill and L2 linguistic knowledge. A third skill, processing automaticity (also called processing efficiency or fluency), is often associated with reading beyond the lower reading levels. First language reading studies have demonstrated several stages of processing automaticity by assessing component operations, such as word recognition, reading rate and phrasing. Beginning L1 readers often demonstrate poor word recognition, which results in slower reading rates. The majority of cognitive resources are spent on lower-order reading components which are word-based, not comprehension-based. This often results in limited availability of resources for higher-order post-lexical reading processes, e.g., phrasing.

One model of processing automaticity, the Automaticity Theory, hypothesizes that readers mainly automatize lower-order reading skills; a second model, the Verbal Efficiency Theory, argues that both lexical and post-lexical processes can be automatized.

The literature review also indicated that L1 reading studies that investigated the 'prosody'-component of the oral reading fluency model demonstrated mixed results. Some studies indicated no relationship between prosodic reading and reading comprehension, other reported a more pronounced relationship between prosody and reading comprehension than between word recognition and reading comprehension.

One aspect of prosodic reading that separates skilled from unskilled readers, in L1 and L2, is the frequency of pausing during oral reading. Skilled readers pause at phrase- and

sentence boundaries, demonstrating knowledge and understanding of syntax and semantics. Unskilled readers not only pause more frequently, but also at locations where no pauses are indicated.

The literature suggests that phrasing, as a result of pauses, stems from a cognitive mechanism that serves both oral and silent reading. Event-related potential studies investigating the role of prosody in the disambiguation of sentences demonstrated participants were sensitive to prosody in both auditory and visually presented ambiguous sentences. However, prosodic cues used in silent reading, as evidenced by subvocalization suppression studies and ERP studies, appeared less robust than prosodic cues used during auditory presented materials. It was suggested that the difference could possibly be explained by a lesser degree of activation of phonological representations during silent reading than auditory presented sentences. Furthermore, individual differences, possibly related to WM capacity, were reported in several of the reading studies reviewed above. In addition to the individual differences reported, sentence types used across studies varied greatly which complicated comparison.

With respect to L2 reading, studies have investigated separate components of L2 reading fluency, such as word recognition, reading rates, and prosodic reading, however, interactions between component operations are complex and the relationship with reading comprehension is unclear. Specifically related to prosodic reading, late bilingual readers demonstrate variability to phrase L2 text appropriately reflected by frequent and inappropriate pausing. Some L2 research suggests a link between non-native phrasing and reading comprehension.

H. Research Questions

A review of the pertinent literature and consideration of L1 reading fluency models, then, led to a pilot study intended to explore the relationship between L2 prosodic reading, specifically pausing patterns, and L2 reading comprehension. This study, using eight bilingual (Dutch-English) readers and four native-English readers, examined the relationship between L2 fluency-based suprasegmental use in L2 oral reading and L2 reading comprehension in oral and silent reading. Indeed, the pilot data on the bilingual readers suggested that L2 phrasing is linked to L2 reading comprehension. Language history, as well (i.e., second-language or foreign-language environment) appeared linked to L2 fluency-based suprasegmental acquisition. The dissertation study reported here was intended to further clarify the link between L2 suprasegmental use and reading comprehension and find significant factors related to L2 comprehension. The following research questions were asked:

Research question 1

Are native-like fluency-based suprasegmentals linked to accurate L2 reading comprehension?

Prediction

It is expected that accurate reading comprehension is linked to native-like prosodic oral reading skills (e.g. fewer and more native-like pauses). This is expected based on pilot data and previous reports in the literature providing evidence that readers who use fluent prosodic phrasing demonstrate an understanding of syntax and semantics, which is linked to accurate

reading comprehension. Overall number of pauses will be higher and reading comprehension scores will be lower for learners of English in the Netherlands than learners of English in the U.S. This will be the result of non-automatized lower order reading skills (i.e., L2 prosodic phrasing) for learners of English in the Netherlands. In addition, learners of English in the Netherlands will pause more frequently and at nonnative-like locations.

Research question 2

Do late learners of L2 acquire L2 fluency-based suprasegmentals whether or not they live in a country where L1 or L2 is spoken?

Prediction

There will be a relation between pausing patterns and living in an L2 environment such that bilingual participants who live in the U.S. will show pausing patterns that are similar to native English speakers. This is expected based on the assumption that pausing patterns rely on the activation and development of suprasegmental phonological representations, which, the literature shows, can better develop in an L2 environment.

Furthermore, it would be expected that Dutch-English bilinguals in the Netherlands spend the least amount of time in a L2 environment and therefore demonstrate the least developed oral reading skills compared to the Dutch-English bilinguals in the US and native-English participants. Oral reading skills of Dutch-English bilinguals in the Netherlands may more closely resemble those of a beginning L1 reader, i.e. reading with frequent pauses and lacking of intuitive constituent knowledge.

Research question 3

When interpreting ambiguous sentences, is the performance of L2 readers associated with nonnative suprasegmental use, individual WM capacity, an L1 attachment preference, or some combination of the three?

Prediction

It is expected that L2 speakers will demonstrate a L1 attachment preference in the processing of ambiguous sentences. This is expected based on results of the pilot testing. Furthermore, it is hypothesized that ambiguity resolution and WM will be correlated for bilinguals in the Netherlands. This is based on previous research, which demonstrated that certain syntactic structures may result in heavier WM loads than other structures.. It is hypothesized that between-subjects analysis may reflect a correlation for WM capacity in the L2 processing of L2 ambiguous sentences.

Research question 4

Is there a link between L2 oral reading skills and other measures of L2 proficiency, e.g., list-generation performance, self-rating, or L1 and L2 reading rate comparison?

Prediction

It is expected that L2 reading skills and measures of L2 proficiency are linked. Based on pilot data and the fact that the three proficiency measures are related to reading fluency, it is expected that the three measures are linked with oral and silent reading comprehension.

Furthermore, it is expected that the proficiency measures correlate to the individual oral fluency measures and will help verify potential components of a L2 fluency models.

Chapter II: Method

Recall that the purpose of this study was to investigate the use of L2 English fluency-based suprasegmentals and their relation with L2 reading comprehension in Dutch learners of English. As was learned from the literature reviewed above, suprasegmentals are linked to oral and silent reading, as well as reading of ambiguous sentences. However, individual sensitivity to prosodic cues, possibly related to WM, and residence in an L1- or L2-speaking country appear to influence the link of suprasegmentals with comprehension.

Therefore, the first research question concerns the link between the use of native-like L2 suprasegmentals and comprehension. By including reading comprehension measures related to oral and silent reading, possible differences or similarities may be established for both types of reading. Furthermore, three types of ambiguous sentences will be included to investigate the possible relationship between ambiguous sentence interpretation and the use of native-like suprasegmentals.

The second research question directs our attention to the fact that L2 exposure may influence the acquisition of L2 suprasegmentals; do late learners of L2 acquire L2 fluency-based suprasegmentals? By including two groups of bilinguals, from a foreign language or a second language environment, who formally started to learn L2 at a comparable age, we hope to clarify the process of fluency-based suprasegmental acquisition as it relates to language environment.

In the third research question we specifically address the interaction of fluency-based suprasegmentals, WM and ambiguous sentences: When interpreting ambiguous sentences, is

the performance of L2 readers associated with nonnative suprasegmental use, individual WM capacity, an L1 attachment preference, or some combination of the three? As previously reviewed research studies indicate, the role prosody and WM play in the processing of ambiguous sentences is complex. In the proposed study three types of ambiguous sentences which previously have been investigated with respect to prosodic disambiguation are included, as well as a WM capacity measure.

Lastly, we are interested in the interface of L2 prosodic reading skills and proficiency related variables, specifically accuracy and L1 and L2 reading rates. Recall that reading fluency is currently thought to include word reading accuracy, reading rate, and prosodic reading. Other proficiency related measures, such as a list-generation task and a comparison of L1 and L2 reading rates may further clarify L2 reading fluency and reading skills.

A. Participants

For the current study, three groups of participants were recruited: two groups of Dutch-English bilingual participants and one group of monolingual native-English participants. The three groups of participants were matched for education, in that all participants had attended college between two and four years. Participants reported normal speech, language and hearing, no known neurological deficits, and normal or corrected vision. All participants were right-handed, except for one native-English speaker and one native-Dutch speakers. Participants were between 18 and 40 years old.

Bilingual participants

In order to determine differences between the non-native speakers with frequent L2 exposure (second language environment) and limited L2 exposure (foreign language

environment), both Dutch speakers of English living in the U.S. (from now on: BUS) and Dutch speakers of English living in the Netherlands (from now on: BNL) were recruited. Age of L2 acquisition was controlled in that both groups of bilinguals had started to learn English formally at the start of high school (11-13 years of age). One group of bilingual participants (N=20) had learned English as a second language in Dutch schools and are residents of the Netherlands (henceforth BNL). The second group of participants (N=20) had learned English in Dutch schools as well. However, they had moved to the U.S. for at least one year (henceforth BUS), i.e. at least one year prior to testing. Participants were bilingual Dutch-English speakers without being highly proficient in a third language.

The bilingual participants filled out a questionnaire related to their language and reading background. BUS participants filled out a questionnaire focusing on their use of Dutch and English in the U.S. (Appendix 1) and BNL participants filled out a questionnaire focusing on their use of Dutch and English in the Netherlands (Appendix 2). These questionnaires provided the examiner with information about language history, self-assessed reading background and current self-assessed reading and language proficiency. The language and reading questionnaires were administered in Dutch for the participants in the Netherlands and in Dutch or English, as they choose, for the participants in the U.S.

Bilingual Participants in the Netherlands (BNL)

The 20 BNL participants were recruited at the School for Facility Management, Hanzehogeschool Groningen, the Netherlands and were either students or professionals there. The average age of the participants was 24.6 years (range 18-40). They received eight to nine years of formal instruction in English as a second language for about three to four hours a

week, starting approximately at the age of twelve. They were exposed informally to English via film, television, and music, in their daily lives. None of the BNL participants lived abroad (outside the Netherlands) for more than 3 months. The language and reading history questionnaires indicated that the L1 of BNL participants' primary caretakers (parents or others) was Dutch. The BNL participants had taken French or German classes in high school; however, they rated their proficiency in those languages as poor.

Bilingual Participants in the US (BUS)

The 20 BUS participants were working professionals in the U.S. where they were tested. The average age of the BUS participants was 29.3 years (range 20-36). These participants also received eight to nine years of formal instruction in English as a second language for about three to four hours a week, starting approximately at the age of twelve. Subsequently, they moved to the US in their early adulthood, i.e. at least one year prior to testing. The responses obtained from the BUS participants on the language and reading history questionnaires closely resembled those obtained from the BNL participants. The responses indicated that the L1 of BUS participants' primary caretakers was Dutch. They also had taken classes in French, German, and Italian; however, their proficiency in these languages was rated fair to poor by the participants. While residents of the Netherlands, none of the participants spent more than two months at the time outside the Netherlands for purposes other than vacationing.

Native-English Participants (MUS)

The 20 MUS participants were college students and working professionals with an average age of 24.5 years (range 21-38). The language and reading history questionnaires

indicated that the MUS participants grew up in English-speaking households with English as native language for parents or other primary caretakers. Similarly to the L2 participants, the MUS participants had taken classes in Spanish or French in high school, but they did not consider themselves proficient in those languages.

B. Materials

Materials discussed below were selected based on pilot study data to assess oral and silent reading, as well as reading ambiguous sentences. Additionally, materials to assess language proficiency and WM were used.

Oral Reading

Oral reading in English and Dutch were assessed. Oral reading in English was assessed using the Reading Fluency Indicator Test (Williams, 2004), which is a measure of rate, accuracy, and comprehension. The Reading Fluency Indicator (RFI) employs a four-point prosody rating scale to identify readers at various points in a prosody proficiency continuum; readers at the lowest point on the scale read word-by-word without attention to phrasing or prosodic cues (e.g. commas, periods) and without meaningful variation in pitch, stress, or duration. Passages of the RFI consist of three paragraphs and are followed by a set of four reading comprehension questions in a multiple-choice format.

Selection of the passage (Appendix 3) for this study was based on the fact that no reference to American geography or history was made, which could complicate reading for non-native readers. Two native-Dutch raters screened the passage and verified that it contained no confusing words or concepts.

Oral reading in Dutch was assessed using a passage from “Samen Lezen”, a Dutch reading assessment tool (Appendix 4). Both English and Dutch passages were comparable in topic (a kitchen setting in which a young adolescent is dealing with a unique event), level (highest level of test used with grades 9 through 12) and linguistic content (e.g., presence of a question, a command, an embedded sentence, and an extended sentence).

Oral reading was digitally tape recorded (SONY DAT-tape recorder TCD-D8) and converted to WAV files. To examine the readers’ most fluent reading, only the middle paragraph (English, N= 89 words, Dutch, N=103 words) was analyzed using the speech analysis program Speech Analyzer 2.7.

As was discussed above, a recent definition of reading fluency includes accuracy, reading rate, and prosody. Four measures related to fluency were obtained from these passages: (1) reading accuracy, (2) reading rate, (3) number of pauses, and (4) pauses at non-native locations (English passage only).

Reading accuracy was calculated noting the following error categories: (1) word repetitions (e.g. “mindless...mindless”), (2) word additions (e.g. “what one more time’ for “one more time”), (3) word omissions (e.g. “that, he would” for “that, yes, he would”), and (4) misread words (e.g. “and” for “any”). In order to calculate reading rate, words read correctly per minute (WCPM) was determined. Words correct per minute (WCPM) was calculated based on total words read (n=89) minus the sum of all errors in the categories just mentioned.

To measure the effect of reading accuracy in contrast with the effect of number of pauses, the total number of reading errors was registered as a separate measure. To calculate

pauses in oral reading that were not the effect of unfamiliarity with the L2, only those pauses that were produced separately from disfluencies were scored. Any pauses produced before (e.g., ...**pause**...refri....refrigerator), during (e.g., ...mind...**pause**...less) or after (e.g., ...asked...eh...door...**pause**) a disfluency were excluded from the calculations. The first measure, number of pauses, reflects total number of pauses and includes the second measure, number of pauses at non-native locations.

The number of pauses in oral reading was calculated as follows. Flat waveforms lasting 0.35 seconds or longer on the spectrograph were labeled as pauses (based on average pauses of unskilled L1 readers in Grades 1-3; Taylor, 2006). A random subset of 15% of the total number of oral readings by all three participant groups was also analyzed by a second rater to assess reliability in calculating number of pauses. Interjudge agreement was 89% for judgments of pauses.

To calculate the number of pauses occurring at non-native locations, all pauses were highlighted in the text and classified as nonnative if they occurred at one of the following locations (based on Johnson & Moore, 1997): (1) at the end of a line, (2) between a pronominal and the noun it modifies, (3) between a preposition and its object, (4) between a verb and its direct object, (5) between the subject and the verb, and (6) before a prepositional phrase. A random subset of 15% of the total number of oral readings by all three participant groups was also analyzed by a second rater to assess reliability in calculating the nonnative location of pauses. Interjudge agreement was 91% for judging the nonnative location of pauses.

2003; Fernandez, 2005) different constructs of animate and inanimate nouns have been employed. Both RC-S and RC-O structures were included in the study to investigate the possible link with WM capacity or fluency-based suprasegmentals, as well as to compare those links in both the RC-S and RC-O structures.

The second type of experimental sentence used in the study is the participle construction ambiguity sentence. This type of ambiguous structure was used by Kang and Speer (2004), who reported a non-significant low attachment preference in native-English participants. An example of this structure is:

3. *Laura ran away with the man wearing a robe.*

In the current study, this type of structure was presented in a short version (e.g., wearing a robe) and a long version (e.g., wearing a robe with the hood) to investigate the introduction of a possible prosodic break in the longer constructions and to compare monolingual and bilingual processing of this structure.

The third type of experimental sentence used in this study is the ‘far versus near attachment of final phrase’ ambiguity sentence (Price et al., 1991), e.g.:

4. *The reporter defended the report on the web.*

Price et al. presented this sentence type auditorily with two possible contexts. No data is available on the attachment preference of non-native-English speakers.

A set of 38 experimental items was constructed (Appendix 4) which were presented interleaved with a set of 77 fillers (distributed pseudo-randomly) in two separate versions. The two versions were crossed for the variables Placement (post-verbal and pre-verbal

relative clause) in the relative clause ambiguous sentences and Length (short versus long) in the participle construction ambiguous sentences.

Reading Comprehension

Two measures of reading comprehension were included in this study. The first measure consisted of four multiple choice questions following the oral reading passage. The second comprehension measure consisted of 77 sentences previously used as fillers with relative clause ambiguity sentences (Fernandez et al., 2005). The sentence-question items were constructed to have one unambiguously correct answer. The set of 77 sentence-question items were identical for the two versions of the experiment. Two Dutch-English bilinguals living in the Netherlands selected 80 items (which were reduced to 77 after pilot data became available) based on them not containing confusing lexical material.

The sentence-question items were presented interleaved with the ambiguous experimental sentences and consisted of a sentence followed on the same line by a question and its five answer alternatives, as used by Kang and Speer (2004), for example:

Our puppy slept so much today that he stayed up all night playing.

When did the puppy sleep?

- a. definitely during the day
- b. more likely during the day
- c. either during the day or at night
- d. more likely at night
- e. definitely at night

The presentation of the sentence-question items was identical as that for the ambiguous sentences.

Using a system of five answer alternatives for the experimental and the comprehension sentences was done for two reasons. First, by including an ‘either-or’ answer, responses may be sensitive to the indeterminacy of interpretation of the ambiguous construction and possible implicit prosodic cues (Kang & Speer, 2004). Price et al. (1991) observe that ‘different types of word strings with two competing syntactic structures differ in the degree to which they can be disambiguated by prosodic cues’ (p. 2956). Second, using the 5-point rating scale with an ‘either-or’ answer may reflect individual attachment preference patterns which may not follow language-specific preference patterns, i.e. overall preference for low- or high attachment.

Working Memory Capacity

From studies investigating L1 and L2 WM capacity (Christoffels et al., 2003; Harrington & Sawyer, 1992), it was concluded that functional working memory capacity appeared equally large in L1 and L2. Results were based on performance by college students. Participants in the proposed study were comparable to the cohorts in the aforementioned studies, permitting the inclusion of a reading span task in English only. An identical presentation format compared to that of Christoffels et al. was used in the current study. In this task the participants read an increasing number of sentences and are instructed to remember the last word of each sentence. The task consisted of three sets each of two, three, four, and five sentences. Sentences were presented as whole sentences on a computer screen, and participants could pace themselves through each set. The final score of each participant

is the maximum number of sentences per set for which the participant can recall all the final words written down in the right order on designated lines of a score sheet. The maximum score for this task is 42 points.

Second Language Measures

Additional proficiency measures in the interface of L2 prosodic reading skills and fluency related variables, specifically accuracy, a comparison of L1 and L2 reading rates, and a list generation task, were included. Recall that oral reading fluency is currently thought to include word reading accuracy, reading rate, and prosodic reading. Other proficiency measures possibly related to reading fluency, such as listed above, may provide important information about fluency aspects and reading skills.

To examine the link of second language proficiency with prosody and reading comprehension, three language measures were included. The participants filled out a language and reading questionnaire. Secondly, the participants completed a list-generation task. For this test, the participants were instructed to generate a list of words beginning with the letters F, A, S (as many as possible in 60 seconds for each letter). The score was the total number of words generated divided across the three trials. Native-English speakers were tested with the same procedure by Brickman et al. (2005). In the age range of 21-30 years, Brickman and colleagues' native-English participants generated 15-16 per 60 seconds averaged over the categories F, A, S.

Thirdly, oral reading rates of passages in English and Dutch (comparable reading level from "The Reading Fluency Indicator" and "Samen Lezen") were calculated and compared.

In addition, measures of disfluencies and pausing from the Dutch oral reading passage were included.

C. Procedure

All participants were tested individually in a quiet room. Dutch was used to test the BNL and BUS participants. Short breaks were allowed, as needed, in between the separate tasks. After filling out an informed consent form, participants were instructed to fill out a language and reading questionnaire. Both consent forms and language questionnaires were available in Dutch and English. After completion of the questionnaire, participants received an answer sheet for the Reading Span Task. Both the answer sheet and the task were explained. Before starting the Reading Span Task, two practice sets were completed (one set of two sentences and one set of three sentences).

Following the Reading Span Task, in order to obtain Dutch fluency data, the bilingual participants were instructed to read a Dutch passage out loud. Next, all participants, monolingual and bilingual, were instructed to read the RFI passage out loud (English oral reading). Participants answered the four multiple choice questions following the passage. The reading of both passages was recorded digitally for subsequent analysis.

The next task was the list-generating task in English to measure L2 proficiency. For this test, the participants were instructed to generate a list of words beginning with the letters F, A, S (as many as possible in 60 seconds for each letter). Participants were instructed that proper nouns do not count and that the 60 seconds would start with the naming of the first word. The examiner timed 60 seconds using a stopwatch.

The last task consisted of the experimental sentences, which were presented in the form of a paper and pencil task. Participants were instructed to finish a sentence and answer pair before moving on to a next sentence. They were instructed to circle the letter (a, b, c, d, or e) matching their answer.

Chapter III: Results

A. Oral Reading Measures

The first of the four research questions was whether native-like fluency-based suprasegmentals are linked to L2 reading comprehension. Fluency-based suprasegmentals included such cues as speech rate and frequency of pausing. In order to determine native-like use of suprasegmentals, four oral reading measures were collected: reading rate in L2, reading disfluencies in L2, number of pauses in L2, and number of pauses at non-native locations.

All four oral reading measures were calculated from recordings of a reading passage (Appendix 3) from The Reading Fluency Indicator Test (Williams, 2004). These measures are presented in Table 1.

Table 1 Oral Reading scores for MUS, BUS, and BNL participants

	MUS	BUS	BNL
English Oral Reading			
WCPM (SD)	171.95 (24.16)	164.87 (20.79)	119.86 (22.33)
Reading Disfluencies (SD)	1.00 (1.03)	1.40 (1.47)	3.10 (1.15)
Number of Pauses (SD)	8.80 (2.03)	9.40 (2.23)	14.20 (4.44)
Number of Non-native Pauses (SD)	0.25 (0.55)	0.45 (0.60)	3.65 (2.94)

Note: WCPM = words correct per minute

BUS and BNL participants were also tested on Dutch oral reading for which Dutch reading rates, disfluencies, and frequency and location of pauses are reported (“Samen Lezen”, Appendix 4) in a later section.

Reading Rate (English)

Reading rate was calculated as words correct per minute (WCPM). WCPM was derived by determining the number of words correctly read in the passage by each participant and dividing that number by the time it took (seconds) an individual to complete the passage. The following errors were considered in this analysis: (1) word repetitions (e.g. “mindless...mindless”), (2) word additions (e.g. “what one more time’ for “one more time”), (3) word omissions (e.g. “that, he would” for “that, yes, he would”), and (4) misread words (e.g. “and” for “any”).

English reading rates ranged from 113-211 (mean = 171.95, SD= 24.16) for the MUS group, 114-203 (mean = 164.87, SD = 20.79) for the BUS group, and 77-154 (mean = 119.86, SD = 22.33) for the BNL group. The participants varied widely in their reading rates with the MUS and BUS groups resembling each other most closely and the BNL group being considerably slower.

Means for reading rates among the three participant groups, MUS, BUS, and BNL, were significantly different, $F(2, 57) = 31.62, p < .0001$. On average, BNL participants produced 52 fewer correct words per minute than MUS participants, $t(39) = 7.26, p < .001$, and 45 fewer correct words per minute than BUS participants, $t(39) = 6.78, p < .001$. The difference in correct words produced per minute by BUS participants compared to MUS participants was not significant, $t(39) = 1.42, p = .16$. Follow-up Bonferroni tests (with $\alpha = .016$ to adjust for

three pair-wise comparisons in this and all subsequent analyses) indicated that reading rates differed significantly between BNL participants and MUS participants, as well as between BNL and BUS participants ($p < .001$).

Disfluencies (English)

To obtain a measure of reading accuracy, which defines reading fluency together with reading rate and prosodic reading, disfluencies in oral reading were calculated. Accuracy of reading the passage, as measured by the number of disfluencies listed above, ranged from 95% to 100%. The mean accuracy of oral reading across the three participant groups was 98%, suggesting that this passage contained words that were generally familiar to the participants and could be considered easy text. Seven of the 20 BNL participants produced two or fewer disfluencies in the English reading passage, performing similarly to BUS participants.

The means for disfluencies produced among the three groups differed significantly, $F(2, 57) = 13.29$, $p < .0001$. The results for number of disfluencies produced among the three groups showed a pattern similar to the results for reading rate, namely, BNL participants demonstrated three times more disfluencies than MUS participants, $t(39) = 5.25$, $p < .001$, and two times more disfluencies than BUS participants, $t(39) = 3.79$, $p < .001$. Again, the difference in disfluencies was non-significant between MUS and BUS groups here, too, $t(39) = 1.43$, $p = .16$. Follow-up Bonferroni tests indicated that number of disfluencies differed significantly between BNL participants and MUS participants, as well as BNL and BUS participants ($p < .001$).

Pauses (English)

To calculate pauses in oral reading that were not the effect of unfamiliarity with the L2, as indicated in Chapter II, only those pauses that were produced separately from disfluencies were scored. The two types of measures related to pauses were number of pauses, which reflects total number of pauses and number of pauses at non-native locations.

BNL participants produced, on average, 14 pauses located anywhere in the sentence, compared to MUS participants, who produced close to 9 pauses and BUS participants, who produced over 9 pauses on average. Means for total number of pauses produced differed significantly for the three participant groups, $F(2, 57) = 17.99, p < .0001$. Once again, differences were significant between BNL and MUS, $t(39) = 5.10, p < .001$, and BNL and BUS, $t(39) = 4.53, p < .001$, but differences between BUS and MUS were not, $t(39) = 1.27, p = .21$. Follow-up Bonferroni tests indicated that number of pauses differed significantly between BNL participants and MUS participants, as well as between BNL and BUS participants ($p < .001$).

The second type of pauses measured were pauses at non-native locations based on the six non-native locations tested in the pilot study. Average number of pauses produced at nonnative locations among the three participant groups differed significantly, $F(2, 57) = 23.41, p < .0001$. As with the previous fluency measures results, pauses at nonnative locations showed the same pattern of BNL participants producing significantly more pauses at nonnative location than BUS participants, $t(39) = 4.97, p < .001$, and MUS participants, $t(39) = 5.10, p < .001$, but where the number of pauses produced at nonnative locations did not differ significantly between MUS and BUS groups, $t(39) = 1.50, p < .14$. When we calculated the

percent of pauses produced at non-native locations, it became apparent that for the BNL group 26% of all pauses are pauses at non-native locations, for the MUS group 3%, and for the BUS group 5%. The BNL group did not only, on average, produce significantly more pauses than the other two groups, but produced them at non-native locations more often.

Across the three groups, average reading rate was, not surprisingly, negatively correlated with disfluencies, pauses, and non-native pauses (Table 3). In the data reported here, a link was demonstrated between fast reading rate, few disfluencies, and few pauses.

When we summarize the performance of the three participant groups across the four oral reading measures, a distinct pattern emerges. On all four measures, BUS participants demonstrate native-like performance, whereas BNL participants demonstrated a significant difference in performance on all four measures as compared to MUS and BUS participants.

B. Reading Comprehension

To test whether native-like use of L2 suprasegmentals is related to reading comprehension, two reading comprehension measures were examined. The first comprehension measure consisted of four multiple choice questions that followed the English oral reading passage, including one literal and three inferential questions.

BNL participants exhibit overall less accuracy than MUS participants and BUS participants and oral reading comprehension performance reflected the pattern of the oral reading measures discussed above. Means for oral reading comprehension differed significantly, $F(2, 57) = 18.08, p < .0001$. On average, BNL participants answered 2.9 questions correctly out of 4 ($SD = 0.67$), significantly lower than the 3.9 score for MUS participants ($SD = 0.37$), $t(39) = 6.04, p < .001$, and the 3.7 score for BUS participants ($SD =$

0.59), $t(39) = 4.23$, $p < .001$. Average oral reading comprehension scores of BUS and MUS participants were not reliably different, $t(39)=1.67$, $p = .10$.

The second reading comprehension measure consisted of 77 comprehension (filler) questions interleaved with the ambiguous sentences from the ambiguity resolution measure. These sentences were constructed to have one unambiguously correct answer and were presented in multiple choice format with five answer alternatives.

Means and standard deviations for this reading comprehension measure were comparable to the oral reading comprehension scores, replicating once more the pattern where performance of BUS participants closely resembled that of MUS participants but not that of BNL participants. Means for silent reading comprehension among the three participant groups differed significantly, $F(2, 57) = 7.65$, $p < .002$. On average, BNL participants answered 67 questions correctly ($SD = 7.37$) compared to 72 by MUS participants ($SD = 2.25$). A t-test comparison showed a significant difference between the two groups, $t(39) = 2.99$, $p < .005$. On average, BUS participants answered 72 questions correctly out of 77 ($SD = 2.72$), performance that was also significantly different from that of the BNL participants, $t(39) = 3.29$, $p < .002$. A t-test comparison of average silent reading comprehension scores of the BUS participants and MUS did not reach significance, $t(39)=1.28$, $p = .20$. Analysis of variance was significant in the subject-based analysis, $F1(2, 57)=2.57$, $p < .002$), and in the item-based analysis, $F2(2, 152)= 30.06$, $p < .001$.

C. Reading Comprehension, Age, and L2 Age of Acquisition

Since the average age of the participants (Table 2) differed significantly, $F(2, 57)= 5.56$, $p < .006$, correlation coefficients were calculated between age and reading comprehension. A

t-test comparison showed a significant difference in age between the BUS and MUS groups, $t(39) = 3.29$, $p < .002$, and the BUS and BNL groups, $t(39) = 3.07$, $p < .004$, but not between the MUS and BNL groups, $t(39) = 0.70$, $p < .48$. There were no significant correlations found between age and oral reading comprehension, $r = .028$, $p > .05$ or age and silent reading comprehension, $r = .13$, $p > .05$.

For the BUS and BNL groups, average age of L2 acquisition did not differ significantly, $t(39) = 0.11$, $p > .05$.

Table 2. Participants' key biographical information and language history

	MUS	BUS	BNL
Age (SD)	24.55 (4.98)	29.35 (5.00)	24.60 (5.68)
Years of College Education (SD)	3.50 (0.51)	3.50 (0.51)	3.40 (0.79)
Age of L2 Acquisition (SD)		11.79 (0.95)	11.35 (0.71)
Years in the US (SD)		3.65 (3.20)	

D. Relation between Reading Comprehension and Oral Reading Fluency

Measures

As was indicated in L1 reading studies, reading fluency is currently defined as including word accuracy, reading rate, and prosodic reading. To investigate whether reading is linked to oral reading measures correlation coefficients were calculated. Correlations were calculated between the two measure of comprehension (N=4 representing oral reading comprehension, and N=77 representing silent reading comprehension) and the oral reading

measures: rate, disfluencies, number of pauses, and number of pauses at non-native locations.

The correlations are presented in Table 3.

Table 3. Correlations between the performance on two comprehension measures and four oral reading measures; accuracy, rate, and prosody (here: number of pauses, and non-native location)

	1	2	3	4	5	6	7
1. Group	1						
2. WCPM-EN	-0.669**	1					
3. Disfluencies-EN	0.531**	-0.735**	1				
4. Pauses-E	0.566**	-0.769**	0.562**	1			
5. Non-native Pauses-EN	0.598**	-0.729**	0.559**	0.818**	1		
6. Oral Reading Comprehension	-0.589**	0.625**	-0.573**	-0.548**	-0.551**	1	
7. Silent Reading Comprehension	-0.370*	0.564**	-0.528**	-0.480**	-0.627**	0.598**	1

* $p < .05$, ** $p < .02$

Oral and silent reading are significantly correlated with each other, indicating that the two reading comprehension tasks used were similar measures of comprehension performance. This similarity was also reflected in the pattern of correlations between the two comprehension measures and the fluency measures in oral and silent reading. Table 3. shows that, in our data set, number of disfluencies, reading rate, pausing, and non-native pausing are strongly correlated with reading comprehension. For all three groups, the ability to read with a limited number of disfluencies, at a fast rate or with few pauses (either number of pauses or pauses at non-native locations) seems linked to more accurate reading comprehension.

In order to determine which fluency factors contribute to comprehension, a regression analysis for each participant group was performed. Oral reading comprehension and silent

reading comprehension were used as dependent variables in separate analyses. Four variables associated with fluency (disfluencies, reading rate, pausing, and pausing at non-native locations) were entered into the equation as predictors. The fluency variables were entered into the equation in the following order: non-native pausing, disfluencies, pausing, and reading rate.

As the resulting regression model shows (see Table 4), disfluency accounted for 18.9% of the variance in silent reading comprehension measures for MUS participants ($R^2_{\text{change}} = .189$, $\beta = -.435$, $p = .055$), but not in oral reading. Non-native pausing, pausing, and reading rate did not account for any unique variance to comprehension. Disfluency accounted for 14.5% of the variance in oral reading and 32.7% in silent reading for BUS participants (oral reading: $R^2_{\text{change}} = .145$, $\beta = -.438$, $p = .109$; silent reading: $R^2_{\text{change}} = .327$, $\beta = -.660$, $p = .009$). Whereas the contribution of disfluencies was significant in silent reading comprehension, it was not significant in oral reading comprehension for BUS participants. For BNL participants, the strongest predictor of variance in oral and silent reading was number of non-native pauses. The other three fluency variables did not account for any unique variance in comprehension. Non-native pauses accounted for 12.1% of the variance in oral reading and 27.5 % in silent reading (oral reading: $R^2_{\text{change}} = .121$, $\beta = .050$, $p = .033$; silent reading: $R^2_{\text{change}} = .275$, $\beta = -.525$, $p = .018$).

Table 4. Regression analysis with the interaction terms entered in order 1, 2, 3, 4 and oral reading and silent reading as the dependent variable for MUS participants

	Oral reading					Silent reading				
	B	β	R ²	R ² Change	Sig.	B	β	R ²	R ² Change	Sig.
1. Non-native Pauses	-.043	-.065	.004	.004	.784	.073	.033	.001	.001	.885
2. Disfluencies	-.047	-.132	.020	.016	.604	-1.783	-.435	.190	.189	.055
3. Pauses	-.038	-.182	.059	.038	.403	.204	.184	.219	.029	.454
4. WCPM	-.002	-.164	.071	.012	.661	.018	.195	.237	.018	.565

Regression analysis with the interaction terms entered in order 1, 2, 3, 4 and oral reading and silent reading as the dependent variables for BUS participants.

	Oral reading					Silent Reading				
	B	β	R ²	R ² Change	Sig.	B	β	R ²	R ² Change	Sig.
1. Non-native Pauses	.022	.022	.000	.000	.926	-.820	-.183	.033	.033	.441
2. Disfluencies	-.176	-.438	.145	.144	.109	-1.224	-.660	.361	.327	.009*
3. Pauses	-.013	-.048	.147	.002	.853	.314	.258	.415	.054	.241
4. WCPM	.010	.354	.180	.033	.449	.064	.047	.479	.064	.195

Regression analysis with the interaction terms entered in order 1, 2, 3, 4 and Oral Reading and Silent Reading as the dependent variables for BNL participants.

	Oral reading					Silent reading				
	B	β	R ²	R ² Change	Sig.	B	β	R ²	R ² Change	Sig.
1. Non-native Pauses	-.079	.050	.121	.121	.033*	-1.315	-.525	.275	.275	.018*
2. Disfluencies	-.157	.363	.237	.116	.126	-1.307	-.275	.342	.067	.206
3. Pauses	-.011	-.074	.239	.002	.852	.431	.260	.363	.021	.478
4. WCPM	.015	.507	.318	.079	.208	.090	.272	.386	.023	.469

E. Language Environment and Suprasegmentals

Recall that the second research question in this investigation is related to fluency-based suprasegmentals from the perspective of L2 acquisition; do late learners of L2 acquire L2 fluency-based suprasegmentals whether they live in a country where L1 or L2 is spoken? In order to answer that question, we assume a fluency acquisition model in which lower-order processes (i.e. lexical processes), like word recognition, have to be automatized before higher-order processes (i.e. comprehension or post-lexical processes), like phrasing or ‘chunking,’ can be attended to (The National Reading Panel, 2000; Grabe, 1991).

Disfluency is arguably induced by breakdown in lexical processing, while pausing (i.e. number of pauses and non-native pauses) might be more directly linked to the ability to phrase appropriately, which would be considered a post-lexical process. As is shown in Table 3, disfluency and pausing are significantly correlated ($r = .559$, $p < 0.001$). An indication of automatized word recognition would be a low number of disfluencies, whereas an indication of native-like, automatized phrasing would be a low number of pauses (i.e., text is chunked in units that reflect understanding of syntax and semantics).

With an average of 1.4 disfluencies in the oral reading passage, the BUS data suggests native-like word recognition, especially compared to the average of 1 disfluency by MUS participants. In contrast, the BNL group produced 3.1 disfluencies in the oral reading passage. This suggests that BNL participants recognized words less accurately than BUS participants and may not have been able to free up resources for processes such as phrasing, which may be reflected by both number of pausing and pauses at non-native locations. The

BNL participants paused on average 14.2 times, the BUS participants pause on average 9.4 times, $t(39) = 4.53$, $p < .000$. In addition, on average, 3.7 of the pauses of the BNL group were at non-native locations (versus 0.5 pauses for the BUS group) which reflect non-native use of L2 suprasegmentals.

In summary, BNL participants demonstrate L2 reading skills that seemed different from BUS participants and from MUS participants across both lexical and post-lexical processes.

F. Ambiguous Sentence Processing

As discussed at length in Chapter 1 above, several studies have investigated how implicit prosodic representations might influence syntactic decisions, specifically about ambiguity. A variety of factors appear to be associated with syntactic decisions in ambiguous sentences, including WM, L2 exposure, and structure of the ambiguous sentence (e.g. length, location of RC).

To investigate the role of possible implicit fluency-based suprasegmental cues in processing ambiguous sentences, this dissertation examines a third research question: When interpreting ambiguous sentences, are L2 readers affected by L2 fluency-based suprasegmentals, by individual variation in WM capacity, by L1 attachment preferences, or by some combination of these three variables?

Specific to this study is the possible relationship between fluency-based suprasegmentals and the processing of three types of ambiguous sentences. The three sentence types were relative clause ambiguities, participle construction sentences, and ‘near versus far’ constructions.

Recall from the Method section that participants answered questions about the ambiguous sentences by using a 5-point answer scale, where ‘1’ indicates a N1 (or high) attachment preference.

Mean scores and standard deviations for ambiguous materials in the reading comprehension questionnaire are shown in Table 5.

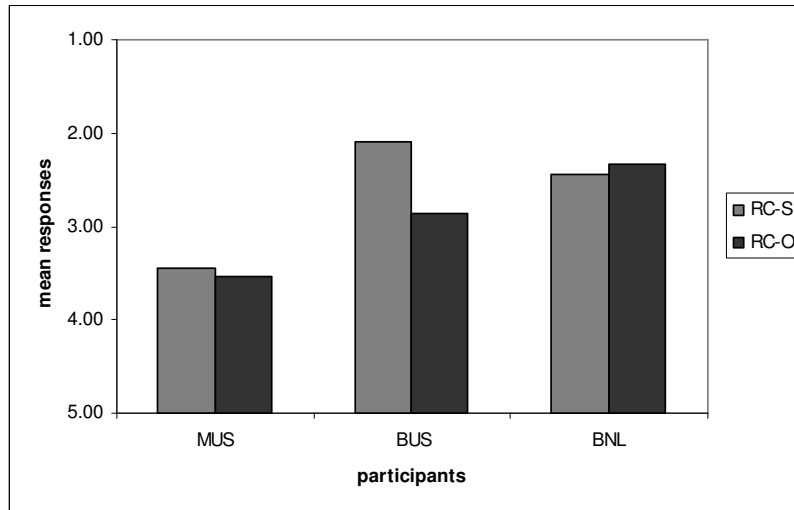
Table 5 Average distribution of ambiguous sentence responses for MUS, BUS, and BNL participants.

Sentence Type	Participants		
	MUS	BUS	BNL
RC ambiguities- subject position (SD)	3.45 (0.72)	2.10 (0.61)	2.45 (0.83)
RC ambiguities- object position (SD)	3.54 (0.61)	2.87 (0.79)	2.33 (0.71)
Participle construction- short (SD)	4.19 (0.54)	3.69 (0.80)	3.40 (1.03)
Participle construction- long (SD)	4.10 (0.62)	3.18 (1.01)	2.93 (0.88)
Near vs. far construction (SD)	3.53 (0.83)	2.93 (0.72)	3.01 (0.54)

Note: items were scored on a 5-point answer scale, where ‘1’ corresponds with N1 (or high) attachment and ‘5’ corresponds with N2 (or low) attachment).

Summary statistics indicate that BUS and BNL groups demonstrate that the cross-linguistic differences in attachment preferences between English and Dutch reported in previous studies also held for our samples: BUS and BNL participants tended to attach more often to N1 than MUS participants did.

Figure 1. Mean responses for MUS, BUS, BNL participants for the RC attachment ambiguities



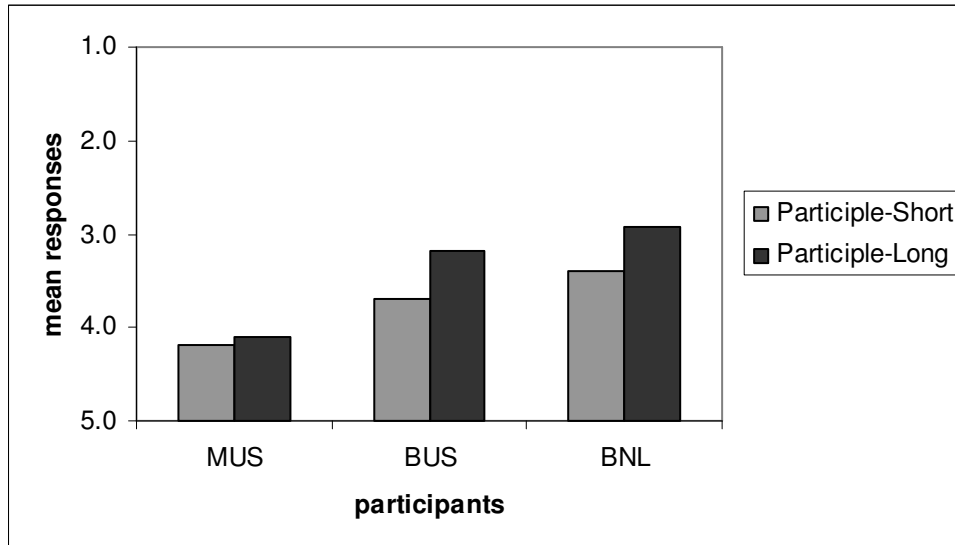
Note: RC-S = relative clause part of subject, RC-O = relative clause part of object

As Figure 1 demonstrates, BUS and BNL participants more frequently interpreted that N1 was modified by the RC in RC-S and RC-O sentences than the MUS participants. A 3 (Language History: MUS, BUS, BNL) x 2 (Test Version: A or B) x 2 (RC Placement: subject-position vs. object position) ANOVA of the relative clause ambiguities was conducted. The analyses yielded a reliable main effect of language history, $F_1(2, 54) = 20.54$, $p < .01$, $F_2(1, 24) = 13.10$, $p < .001$, and RC placement, $F_1(1, 54) = 6.19$, $p = .016$. A significant two-way interaction of Language History and RC Placement was present, $F_1(2, 54) = 7.34$, $p < .005$, $F_2(2, 24) = 4.40$, $p < .025$.

Group comparisons produced the following results. Averages differed significantly in ambiguity resolution of RC subject-position sentences for MUS and BUS groups,

$t_1(39)=7.67$, $p<.0001$, $t_2(9)=6.17$, $p<.01$, MUS and BNL groups, $t_1(39)=5.20$, $p<.001$, $t_2(9)=7.74$, $p<.01$, but not BUS and BNL groups, $t_1(39)=-1.64$, $p>.10$, $t_2(9)=-1.74$, $p>.10$. Therefore, in the case of RC-S sentences, BUS and BNL participants demonstrated a comparable high attachment preference, significantly higher than the MUS group. This was expected based on previous cross-linguistic studies, in which Dutch participants consistently demonstrated a high attachment preference and native-English participants demonstrated a low attachment preference. The results were different for the RC-O sentences, in that, averages differed significantly for all group comparisons: MUS and BUS groups, , $t_1(39)=2.68$, $p=.01$, $t_2(9)=2.41$, $P<.05$, MUS and BNL groups, $t_1(39)=5.46$, $p<.001$, $t_2(9)=6.73$, $p<.01$, and BUS and BNL groups, $t_1(39)=2.89$, $p=.009$, $t_2(9)=2.39$, $p<.05$. These results demonstrate that in the RC-O sentences, the BUS and BNL participants did attach higher than the MUS group, but as well, that the BUS group attached significantly lower than the BNL group. Thus in this sample, the attachment preference of the BUS group is influenced by position of the relative clause.

Figure 2. Mean responses for MUS, BUS and BNL participants for the participle construction ambiguities



The results for the participle construction ambiguities demonstrated that the BUS and BNL groups prefer to attach higher than the MUS group (Figure 2). This was predicted based on previous studies with RC attachment ambiguities. Dutch belongs to a group of languages that presumably places a major prosodic boundary directly before the RC. However, the participle construction ambiguities have not been tested cross-linguistically or with bilingual participants.

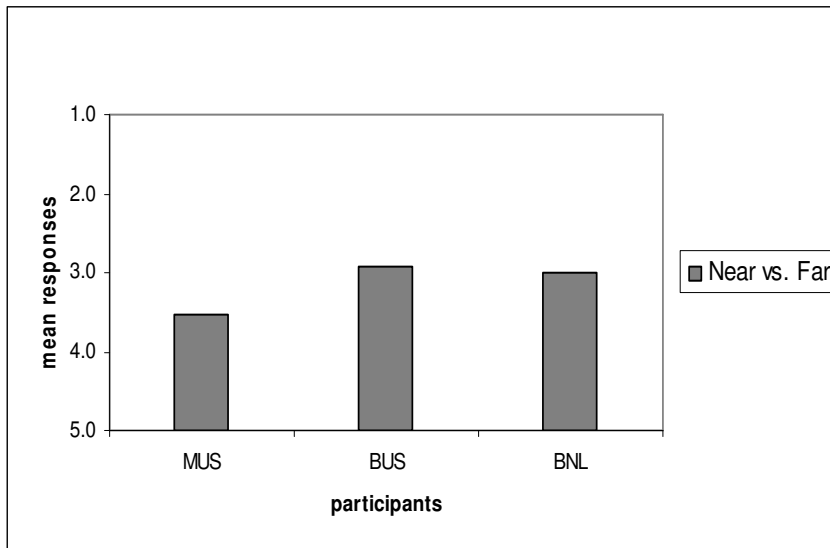
A 3 (Language History: MUS, BUS, BNL) x 2 (List Version: A or B) x 2 (Length: short or long) ANOVA of the participle construction ambiguities was conducted. The analyses yielded a significant main effect of Length by subjects only, $F(1,54)= 6.44$, $p < .05$, $F(1,8)=1.24$, $p = .29$, and Language History, $F(2,54)= 14.22$, $p < .001$, $F(1,8)= 35.93$, $p < .001$. No interaction effect was present.

Comparing averages for ambiguity resolution in participle constructions produced the following results. Averages differed significantly in the processing of the short participle constructions for MUS and BUS groups, $t(39)=2.24$, $p<.05$, $t(5)=-.01$, $p>.90$, MUS and BNL groups, $t(39)=3.01$, $p<.007$, $t(5)=-1.54$, $p>.15$, but not BUS and BNL groups, $t(39)=-.95$, $p=.35$, $t(5)=2.12$, $p>.05$. The results of the long participle constructions are as follows. Averages differed significantly in the processing of the long participle constructions for MUS and BUS groups, $t(39)=3.67$, $p<.001$, $t(5)=-1.83$, $p>.05$, MUS and BNL groups, $t(39)=4.80$, $p<.001$, $t(5)=-0.95$, $p>.15$, but not BUS and BNL groups, $t(39)=-.85$, $p=.40$, $t(5)=2.35$, $p>.05$.

These data indicate that BUS and BNL participants consistently attach higher when the participle phrase is long than when the participle phrase is short. This is consistent with previously reported RC attachment data; long RCs, compared to short ones, are more likely to be preceded by a phrasal break. This phenomenon is present in ambiguity resolution with native-English participants as well, however, the native-English participants in this study did not demonstrate a higher attachment preference in long participle constructions than in short participle constructions.

The last type of ambiguous construction used in this study was the near vs. far construction. A similar pattern as in the RC ambiguities and the participle construction ambiguities emerged, both BUS and BNL groups attached higher in the near vs. far constructions than the MUS group (Figure 3).

Figure 3. Mean responses for the MUS, BUS, and BNL participants for the near vs. far construction ambiguities.



An ANOVA for near vs. far sentences yielded a significant effect for Language History in the subject-based analysis, $F(2, 57) = 4.21, p < .020$), but not in the item-based analysis, $F(2, 15) = 1.23, p = .32$).

Averages differed significantly in the processing of the near vs. far constructions for MUS and BUS groups by subjects only, $t(39) = 2.29, p = .033, t(5) = -2.14, p > .08$, MUS and BNL groups, $t(39) = 2.39, p < .001, t(5) = 12.46, p > .05$, but not BUS and BNL groups, $t(39) = 0.42, p = .67, t(5) = 0.19, p > .85$.

In order to determine whether fluency-based suprasegmentals were linked to the attachment patterns produced by the participants, correlation coefficients were calculated for the three participant groups. As table 6 indicates, significant correlations between number of

pauses and ambiguity resolution were obtained for the BUS participants in both RC-S and RC-O sentences and MUS participants in near vs. far construction sentences.

Table 6. Correlation between ambiguous sentences and fluency measures for MUS, BUS, and BNL groups

MUS	1	2	3	4
1. WCPM	1			
2. Disfluencies	-0.329	1		
3. Pauses	-0.566*	-0.126	1	
4. Non-Native Pauses	-0.517*	0.280	0.318	1
5. Relative Clause, Subj.	0.164	-0.300	0.157	0.153
6. Relative Clause, Obj.	0.125	0.117	-0.405	-0.109
7. Part. Construction, short	-0.140	0.258	0.253	0.263
8. Part. Construction, long	0.267	0.174	-0.214	0.248
9. Near/Far Constructions	-0.097	0.000	0.468*	-.281

BUS	1	2	3	4
1. WCPM	1			
2. Disfluencies	-0.653*	1		
3. Pauses	-0.713*	0.334	1	
4. Non-Native Pauses	-0.614*	0.499*	0.405	1
5. Relative Clause, Subj.	0.208	-0.118	-0.054	-0.613*
6. Relative Clause, Obj.	0.218	-0.354	0.163	-0.490*
7. Part. Construction, short	0.301	-0.120	-0.205	-0.148
8. Part. Construction, long	0.180	0.206	-0.104	-0.175
9. Near/Far Constructions	-0.218	0.324	0.173	0.299

BNL	1	2	3	4
1. WCPM	1			
2. Disfluencies	-0.720*	1		
3. Pauses	-0.629*	0.485*	1	
4. Non-Native Pauses	-0.640*	0.342	0.798*	1
5. Relative Clause, Subj.	0.287	-0.126	0.017	-0.108
6. Relative Clause, Obj.	-0.107	-0.012	0.411	0.365
7. Part. Construction, short	0.004	0.160	-0.160	-0.166
8. Part. Construction, long	0.113	-0.279	0.125	0.147
9. Near/Far Constructions	-0.019	-0.229	-0.189	0.068

Note WCPM= words correct per minute, * $p < .05$, ** $p < .02$, *** $p < .01$

In order to determine whether fluency-based suprasegmentals were linked to the attachment patterns produced by the participants, correlation coefficients were calculated for the three participant groups. As Table 6 indicates, significant correlations between number of pauses and ambiguity resolution were obtained for BUS participants in both RC-subject and RC-object sentences and MUS participants in Near/Far construction sentences only.

Based on the significant correlations between relative clause ambiguities and non-native pauses in the case of BUS participants, a regression analysis was performed to determine the amount of variance accounted for by non-native pauses in the processing of ambiguous sentences by BUS participants. The fluency variables were entered into the equation in the following order: non-native pausing, disfluencies, pausing, and reading rate. Non-native pauses accounted for 37.6% of the variance in RC-S ambiguities and 27.5 % in RC-O ambiguities (RC-S sentences: $R^2_{\text{change}} = .376$, $\beta = -.613$, $p = .004$; RC-O sentences: $R^2_{\text{change}} = .240$, $\beta = -.490$, $p = .028$). The other three fluency variables did not account for any unique variance to attachment preferences of BUS participants in relative clause ambiguities.

When attachment preferences for the ambiguous sentences were examined, the distribution of the 5-point answer choices was as follows (see Figure 4).

Figure 4. Five-point answer averages for MUS, BUS, and BNL participants across three ambiguous sentence types.

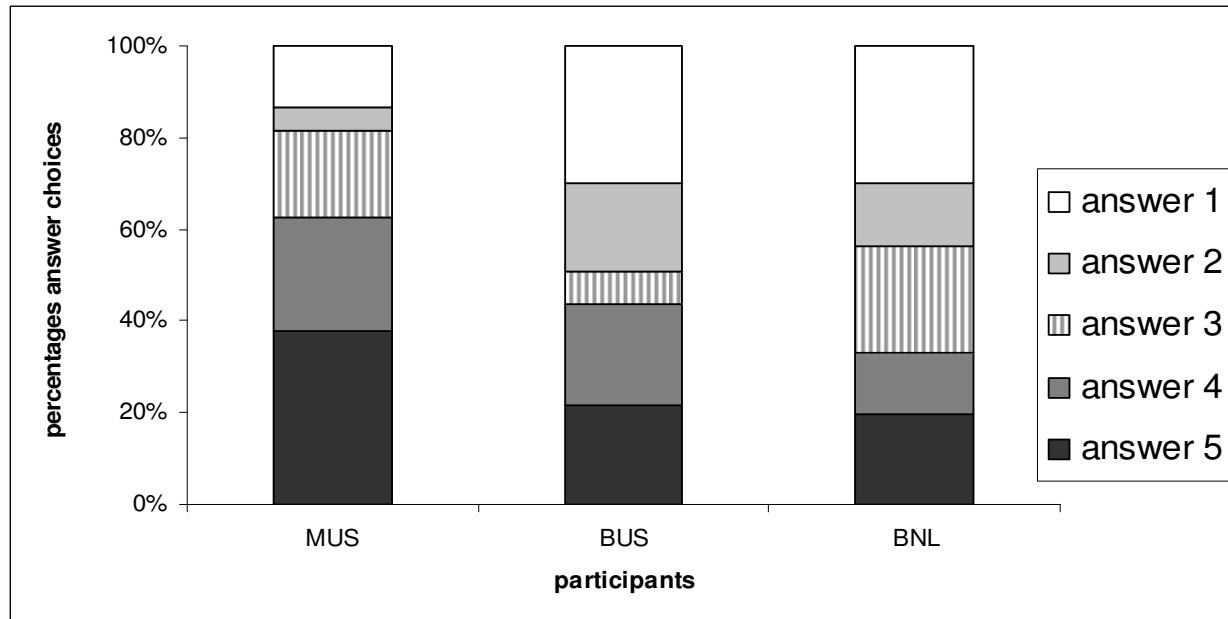


Figure 4 illustrates the infrequent use of answer choice ‘3’ by the BUS participants (7% across all possible answer choices versus 19% by MUS participants and 23% by BNL participants).

In the data obtained from ambiguous sentence reading, a pattern emerges that differs significantly from the pattern in reading rates, disfluencies, pauses, pauses at nonnative locations, oral reading comprehension and silent reading comprehension. With respect to ambiguity resolution, BUS and BNL groups prefer to attach to N1 (or high) across the three sentence types, whereas MUS participants prefer to attach to N2 (or low). Furthermore, BUS and BNL participants demonstrate similar patterns for answer choices ‘1’, ‘2’, ‘4’, and ‘5’, however, quite a different pattern for answer choice ‘3.’

This differs from what we saw earlier, when examining oral reading and reading comprehension data, where the MUS and BUS participants were similar in their behavior.

The remaining variable that has been associated with attachment preferences, in addition to reading comprehension and fluency, is WM capacity, to which we now turn.

G. Working Memory

In Chapter I the relation between WM, fluency, and reading comprehension was discussed. In this study, WM capacity was measured by administering a reading span task. Reading span scores were correlated to both oral reading comprehension, $r = .349$, $p < .01$, and silent reading comprehension, $r = .323$, $p < .02$. For MUS and BUS groups, silent reading comprehension and reading span were significantly correlated, MUS: $r = .646$, $p < .01$, BUS: $r = .489$, $p < .05$, but oral reading comprehension and reading span were not, MUS: $r = .135$, $p > .05$, BUS: $r = .307$, $p > .05$. For the BNL group, oral reading comprehension and reading span were significantly correlated, $r = .457$, $p < .05$, but silent reading comprehension and reading span were not, $r = .252$, $p > .05$.

Group means and standard deviations for the reading span task are as follows: out of 42, MUS participants scored 36 (SD=5), BUS participants scored 34 (SD=5), and BNL participants scored 33 (SD= 6). The group means on the reading span task were not significant for the three participant groups, $F(2,57) = 1.50$, $p = .22$). Performance on the reading span task was not found to correlate with attachment preference of the ambiguous sentences (see Table 7). Therefore it appears that WM span did not play a significant role in the processing tasks of this study.

Table 7. Correlations between reading span and attachment preferences across three ambiguous sentence types for MUS, BUS and BNL groups.

	RC-S	RC-O	Participle-short	Participle-long	Near vs. Far
Span	0.07	0.03	0.22	0.11	0.17

Note RC-S = relative clause, subject position, and RC-O=relative clause, object position

H. Proficiency Measures

The final question in this study asked whether there is a link between L2 reading skills and other measures of L2 proficiency: list generation task, proficiency self-rating, or reading rates. The language proficiency measures were included to assess L2 reading components and their possible application to a L2 reading fluency model. Scores of those three proficiency measures are reported in this section. We also compared scores from the list generation task, English and Dutch reading rates, and self-ratings of English and Dutch proficiency in speaking, understanding, reading and writing.

In the list generation task, the participants were asked to generate a list of words beginning with the letters ‘F’, ‘A’, or ‘S,’ as many as possible in 60 seconds. The score was the total number of words generated divided across the three trials. The MUS participants listed 17 words on average (SD=4), the BUS participants listed 14 words on average (SD=4), and the BNL participants listed 11 words on average (SD=3), with the means showing significant differences across the three groups, $F(2,57)=132.63$, $p < .001$. A t-test comparison showed a significant difference between the BUS and BNL groups, $t(39)=2.12$, $p = .04$, the

MUS and BNL groups, $t(39)=4.89$, $p<.001$, and the MUS and BUS groups, $t(39)=2.53$, $p<.04$.

The list generation task is believed to be closely related to vocabulary size and lexical access. Indeed, number of L2 oral reading disfluencies (a reading accuracy measure) was correlated with the list generation score ($r=-.395$, $p<.05$). List generation scores were significantly correlated with oral reading comprehension ($r=.349$, $p<.05$) and silent reading comprehension ($r=.35$, $p<.05$), but not with the interpretation of the ambiguous sentences.

The second fluency measure consisted of a comparison between L1 reading rate (Dutch) and L2 reading rate (English). Reading rates in L1 and L2 were correlated significantly ($r=.65$, $p<.001$). Means of reading rates for BUS and BNL groups were significantly different between the two groups in both Dutch, $t(39)=2.15$, $p<.05$, and English, $t(39)=6.78$, $p<.001$. Reading results from this study indicated that BUS readers read faster than BNL readers in both L1 and L2. The Dutch-English reading rate ratio, i.e. how much faster did the participants read in Dutch than in English indicated that BNL readers read the Dutch passage 14.4% faster than the English passage on average, and the BUS readers read the Dutch passage 11.2% faster than the English passage on average. The English-Dutch reading rate ratio shows a much larger difference on average, the BNL readers read the English passage 29.3% slower than the Dutch passage, and the BUS readers read the English passage 9.2% slower than the Dutch passage. The English-Dutch reading ratio was significantly correlated with oral reading comprehension, $r=-.553$, $p<.001$, and silent reading comprehension, $r=-.573$, $p<.001$, but not with the processing of the ambiguous sentences, RC-S: $r=.026$, $p>.05$, RC-O: $r=.149$, $p>.05$, Participle-short: $r=.103$, $p>.05$, Participle-long: $r=.186$, $p>.05$, and near vs. far: $r=-.114$, $p>.05$.

Table 8. Average scores on Dutch fluency measures for BUS and BNL participants

Dutch oral reading	BUS	BNL
Reading Disfluencies (SD)	1.55 (1.99)	1.90 (1.48)
Number of Pauses (SD)	11.50 (2.65)	10.35 (2.39)
WCPM (SD)	183.96 (29.48)	169.47 (19.72)
For comparison (from Table 1)		
WCPM-English (SD)	164.87 (20.79)	119.86 (22.33)
Reading Disfluencies (SD)	1.40 (1.47)	3.10 (1.15)
Number of Pauses	9.40 (2.23)	14.20 (4.44)
Dutch-English reading ratio	11.2%	14.4%
English-Dutch reading ratio	9.2%	29.3%

In summary, BUS and BNL participants are comparable readers in Dutch with respect to number of disfluencies and pausing. With respect to reading rate, BUS participants were faster readers in Dutch, however, it was a subset of the BUS participants (the younger participants that have resided in the US fewer than 2.5 years) who were faster Dutch readers than the BNL participants.

The third proficiency measure reported on in this study is based on proficiency self-rating scores. Participants rated their speaking, listening, reading, and writing skills as part of the language and reading background questionnaire (Appendices 1 and 2) using a 5-point scale, where 1= “very poor” and 5 = “very good”. Average differences between the four modality scores for Dutch and English were calculated and reported in Table 9.

Table 9. Summary data on bilinguals' self-assessed proficiency when listening, speaking, reading, and writing

	Language	Listening	Speaking	Reading	Writing
BNL participants	Dutch	4.55	4.65	4.55	4.55
	English	3.80	3.45	3.75	3.50
	Δ D-E ¹	0.75	1.20	0.80	1.05
BUS participants	Dutch	4.95	5.00	4.95	4.90
	English	4.70	4.65	4.70	4.60
	Δ D-E	0.25	0.35	0.25	0.30

Note: responses for these questions were made on a five-point scale, where 1="very poor" and 5= "very good"

¹ Δ D-E indicates the difference in scores between Dutch and English

Both BUS and BNL participants rated their Dutch skills higher than their English skills; however, BUS participants rated their English and Dutch language skills as being more equal than BNL participants. The variation between L1 and L2 skills as reported by the participants showed significant differences for speaking, $t(39)=4.34$, $p= .003$, comprehension, $t(39)=2.70$, $p= .014$, reading, $t(39)=2.77$, $p= .012$, and writing, $t(39)= 3.13$, $p= .005$. Average differences between the four modality scores for Dutch and English correlated significantly with fluency measures (disfluencies, pauses and non-native pauses), oral and silent reading comprehension, but not significantly with the processing of ambiguous sentences; see Table 10.

Table 10. Correlations of average differences of four modality scores for Dutch and English, fluency measures, oral and silent reading comprehension, and ambiguity resolution.

	Speaking	Listening	Reading	Writing
Disfluencies	.350*	.521***	.646***	.373*
Pauses	.389**	.303	.484***	.318*
Non-native pauses	.415***	.363*	.574***	.367*
Oral Reading comprehension	-.459***	-.431***	-.553***	-.272
Silent reading comprehension	-.345*	-.527***	-.623***	-.126
Relative clause-subject	.201	-.059	-.128	.160
Relative clause-object	-.062	-.101	-.172	.027
Participle construction-short	-.319*	-.137	-.175	-.302
Participle construction-long	-.312	-.276	-.305	-.120
Near vs. Far constructions	-.142	.051	.093	.026

*** $p < .01$, ** $p < .02$, * $p < .05$

I. Summary of Major Findings

In summary, we have been able to report two different patterns. The first pattern was related to the English oral reading fluency measures of disfluencies, reading rate, pauses, and pauses at non-native locations. With respect to this pattern, MUS and BUS participants demonstrated a comparable number of disfluencies, pauses and pauses at non-native locations, in addition to comparable reading rates. BNL participants produced significantly more disfluencies, pauses and pauses at non-native locations than the MUS and BUS group, in addition to significantly slower reading rates. All four fluency measures were correlated to both oral and silent reading comprehension.

The second pattern reported was related to the interpretation of syntactically ambiguous sentences. With respect to this pattern, BUS and BNL groups demonstrated a preference to attach high when interpreting ambiguous sentences which is consistent with data reported in previous studies investigating native Dutch attachment preferences. The MUS group demonstrated a preference of low attachment which is also consistent with previous data.

Futhermore, WM capacity was linked to oral and silent reading comprehension measures, but not to oral reading with respect to the four oral reading fluency measures or the processing of the three ambiguous sentence types.

Despite the emergence of the two clear patterns, the BUS group demonstrated characteristics on various measures that make them dissimilar from both MUS and BNL groups. In Chapter IV, a discussion of the research questions will follow, in addition to a detailed analysis of the two patterns and exceptions to the patterns.

Chapter IV: Discussion

The purpose of this study was to investigate L2 suprasegmental use in relation to L2 reading comprehension. Specifically, the use of L2 fluency-based suprasegmentals by late bilinguals was the focus in the present dissertation.

It is well known that late bilinguals demonstrate difficulty mastering both segmental and suprasegmental aspects of L2 phonology. With respect to suprasegmental phonology, this may be evident in slower L2 speech rates or persistent accents in L2, for example. First language production studies indicate that prosody-based suprasegmentals (peak alignment and stress timing) tend to be language-specific and acquired early, whereas fluency-based suprasegmentals (speech rate and frequency of pausing) are not as language specific and acquired over a longer period of time.

As discussed in Chapter I, suprasegmentals are linked to oral reading comprehension, silent reading comprehension and ambiguity resolution. However, the strength of the interaction between suprasegmentals and the different types of reading appears to change depending on the task at hand. For example, during silent reading of ambiguous sentences, less robust electrophysiological responses are elicited at speech boundaries than with auditory presentations of the same ambiguous sentences (Karsteiner, 2003).

We hypothesized that if fluency-based suprasegmentals were less language-specific and learned later, then late bilinguals would be able to acquire and improve in the use of L2 fluency-based suprasegmentals, more so than in the use of L2 prosody-based suprasegmentals. It was further hypothesized that bilingual participants who live in the U.S.

(BUS) would show native-like pausing patterns. This was expected on the assumption that pausing patterns are based on the activation and development of suprasegmental phonological representations.

The following sections frame answers to the following research questions:

1. Are native-like fluency-based suprasegmentals linked to L2 reading comprehension?
2. Do late learners of L2 acquire L2 fluency-based suprasegmentals regardless whether they live in a country where L1 or L2 is spoken?
3. When interpreting ambiguous sentences, is the performance of L2 readers associated with nonnative suprasegmental use, individual WM capacity, a L1 attachment preference, or some combination of the three?
4. Is there a link between L2 reading skills and other measures of L2 proficiency, i.e., list generation task, self-rating, or L1 and L2 reading rate comparison?

In addition to addressing the research questions, we will attempt to relate L2 oral reading fluency and the use of L2 fluency-based suprasegmentals to automaticity in L2 reading. Recall that skilled L1 readers are able to process words automatically. For those readers, the lower-order components of word recognition and lexical access are automatized and more attentional resources are available for higher-order comprehension processes. Proponent of the Automaticity Theory (Laufer & Samuels, 1974; Samuels, 1994) reasoned that lexical processes would be automatized in the more advanced reader, whereas proponents of the Verbal Efficiency Theory (Perfetti, 1985; 1998) considered it likely that post-lexical reading processes, such as phrasing, could become automatized as well.

A. Second Language Reading Comprehension and Suprasegmentals

As Bernhardt and Kamil (1995) note, L2 reading seems largely influenced by L1 reading level and L2 linguistic knowledge. However, these two variables consistently fail to predict L2 reading comprehension accurately.

First language reading studies demonstrate a link between oral reading fluency and reading comprehension where fluency is defined as a composite of accuracy, rate, and reading with rhythm and intonation (The National Reading Panel, 2000; Grabe, 1991). Oral reading fluency and comprehension are correlated in the current study, in that our data show that various aspects of L2 fluency are linked to oral and silent reading comprehension. The ability to phrase or chunk text into appropriate syntactic and semantic units is directly related to the frequency and location of pauses.

As was reported in Chapter I, beginning and poor readers may demonstrate minimal skills in grouping words in appropriate units, and we argue that this often results in poor comprehension. Similarly, second language readers lacked the skills to phrase text in a native-like manner, as evidenced by their frequent intra-sentential pausing. We predicted that native use of fluency-based suprasegmentals, such as pausing at phrase boundaries, would be linked to accurate reading comprehension. Indeed, bilingual participants who demonstrated similar L2 pausing patterns as the native-English speaking participants (few pauses and at phrase boundaries) demonstrated more accurate reading comprehension. This finding of an association between pausing and comprehension is consistent with studies examining such an association in the L1 (Rasinski, 1999; Schreiber, 1980; Samuels, 2002; Dowhower, 1991)

and corroborates the assumption that phrasing is an important variable in L2 comprehension (Johnson & Moore, 1997).

B. Pausing and Pausing at Non-native Locations

Not all bilingual participants were able to read using native-like phrasing in oral reading. The BNL participants read significantly more slowly, produced more disfluencies and paused more frequently. The BUS participants, the bilinguals who reside in the U.S., read as fast, with as few disfluencies and with a comparable number of pauses as the MUS participants did.

In effect, the data seems to reflect a pattern where late bilinguals who are immersed in L2 (in this study, the BUS participants) are able to use L2 fluency-based suprasegmentals, i.e., frequency of pausing, in a native-like manner. In contrast, late bilinguals who are less frequently exposed to L2 and speak L2 as a foreign language (in this study, the BNL participants) do not seem to acquire the aspects of L2 suprasegmental phonology related to fluency-based suprasegmentals.

However, the pattern observed, that is BUS participants, but not BNL participants, use L2 suprasegmentals native-like and demonstrate accurate L2 comprehension, did not exclusively relate just to overall amount of pausing. In fact, the other two measured aspects of reading fluency, number of disfluencies and reading rate, produced this pattern as well. Recall that L1 reading comprehension was closely linked to L1 reading fluency (Schwanenflugel, 2004) and that an updated L1 reading fluency model included accuracy, rate and prosody (The National Reading Panel, 2000; Grabe, 1991). Correlation data reported in Chapter III show that fluency measures were equally linked to oral and silent reading

comprehension for all three participant groups. However, regression data show that pausing at non-native locations predicts reading robustly for the BNL group, whereas this is not the case for MUS and BUS participants. Number of pauses did not seem to account for any unique variance in oral or silent reading comprehension for MUS, BUS or BNL participants. This seems to indicate that pausing at non-native locations distinguishes the BNL group from the MUS and BUS groups in both oral and silent reading, whereas disfluencies, rate and pausing distinguish the BNL group from the MUS and BUS group only in oral reading.

Because reading is a complex skill and reading processes do not operate in isolation, other variables related to reading comprehension need to be discussed in relation to L2 suprasegmental use. As was discussed in Chapter I, WM capacity is often associated with reading comprehension (Just & Carpenter, 1992; Daneman, 1991; Gathercole & Baddeley, 1993). This association was corroborated in the present study. However, did BUS participants benefit from larger WM capacities and therefore demonstrate increased accuracy in L2 reading comprehension? Working memory scores for the three participant groups were comparable, and a link between WM capacity and L2 suprasegmental use was not suggested.

First language skills have been linked to L2 reading comprehension as well (e.g., Rigg, 1977; Bernhardt, 2000). Were better L1 reading skills linked to increased L2 reading comprehension? In the present study, three L1 reading measures were collected: number of L1 disfluencies, L1 reading rate, and number of pauses produced in L1. Number of disfluencies and number of pauses produced were comparable for the BUS and BNL groups. The BUS participants were faster readers in Dutch than the BNL participants, however, when the BUS group was rank-ordered according to age and years of residency in the U.S., it was

the younger cohort with fewer years of residency in the U.S. that read faster in Dutch than the older BUS cohort.

As stated in Chapter II, both age of L2 acquisition, for the bilingual participants, and years of education, for all the participants, were controlled in this study. Bilingual participants reported an average age of 11.5 years for L2 acquisition. All groups had attended college between two and four years, with the BUS and BNL groups attending college in the Netherlands.

One more variable that is frequently associated with L2 reading comprehension is L2 linguistic knowledge (Alderson, 1984; Clarke, 1980). Alderson referred specifically to vocabulary and grammar with respect to L2 linguistic knowledge. Recent research (Barnett, 1986, Shiotsu & Weir, 2007) points to the relative superiority of syntactic knowledge over vocabulary knowledge in reading comprehension. Similarly, Fukkink et al. (2005) demonstrate that isolated word recognition training in bilinguals did not improve reading comprehension. Did immersion in L2 enable the BUS participants to improve upon their vocabulary and grammar knowledge and as a result evidenced higher L2 proficiency?

Recall that, in order to investigate L2 proficiency, participants were asked to self-rate their speaking, listening, reading and writing skills in both Dutch and English. In general, previous research suggests that self-reported language measures are indicative of linguistic ability (e.g., Marian et al., 2007). Marian et al. (2007) found that self-reported proficiency in L1 reading was a reliable predictor of performance on L1 language tasks and self-reported proficiency in speaking L2 was a reliable predictor of language ability in L2. The higher accuracy of self-rating L1 language abilities versus L2 language abilities is an issue

researchers are continuing to investigate (Delgado et al, 1999). The data reported in Chapter III indicate that BUS participants were more proficient in L2. Furthermore, BUS and BNL participants rated their English skills lower than their Dutch skills, however, BUS participants rated their English and Dutch skills as being more equal than BNL participants. As for what knowledge the BUS participants possessed more of, vocabulary or grammar, is unclear. It is conceivable that some of the results reported here such as overall number of pauses derived not from automatized post-lexical processes but from the overall better proficiency of the BUS group. Recall that the participants in this dissertation study all started reading in their L2 around 11.5 years of age. At that age and at that level of L2 proficiency, late bilingual readers often do not possess implicit grammar knowledge (Koda, 1996) and lack knowledge of L2 constituent grammar (Radford, 1981). However, while living in the U.S., the BUS participants may have honed their L2 syntactic skills which could facilitate L2 processing as intuitive L2 knowledge might.

To measure vocabulary size, the list generation task (Controlled Oral Word Association Test, COWAT), a measure believed to be closely related to vocabulary size and lexical access, was used to attest the relationship between accuracy and L2 text processing. List generation scores of the two bilingual participant groups were linked to oral and silent reading comprehension. No specific grammar or syntax measure was included in the present study, however, several researchers consider syntactic knowledge pertinent to phrase or chunk text appropriately. For example, Johnson and Moore (1997) pointed out that late bilinguals, in general, do not possess intuitive knowledge about L2 syntax and therefore do not know the relationships between the parts of a sentence.

Further investigation is warranted in order to determine the relative importance of vocabulary size and grammar knowledge with respect to L2 reading comprehension in populations like those in the current study.

In answering research questions 1, whether fluency-based suprasegmental use is linked to L2 reading comprehension and 2, whether late learners of L2 acquire those fluency-based suprasegmentals regardless of context of acquisition, we can summarize that the BUS participants, but not the BNL participants, use L2 fluency-based suprasegmentals in a native-like manner. The data suggest that this is linked to more accurate reading comprehension. Of the three reading fluency measures tested in this study, pausing at non-native locations stands out in differentiating BUS and BNL participants' L2 reading skills. This finding of a link between pausing at non-native locations and L2 reading skill is consistent with data of Johnson and Moore (1997), which showed that the use of non-native pausing patterns is linked to less accurate reading comprehension.

The unique relationship that seems to exist between L2 suprasegmental use and L2 comprehension can be further explored with respect to automaticity or fluency of processing.

C. Automaticity

Recall that the Automaticity Theory (Laufer and Hulstijn, 1994; Laufer, 1994) hypothesized that a complex skill such as reading requires the organization of many component processes. Limited attentional resources need to be distributed among the component processes which would easily exceed attentional capacity. However, if a subset of component processes were automatized, then the attentional capacity would not be exceeded and the task at hand, e.g. reading, would be performed successfully. Proponents of the

Automaticity Theory would further reason that component processes in reading most likely to be automatized would be non-comprehension processes, i.e., lexical processes.

Alternately, the Verbal Efficiency Theory (Perfetti, 1985, 1988) stipulates that automaticity in lexical processes is not itself sufficient to increase processing efficiency and improve comprehension. Proponents of the Verbal Efficiency Theory hypothesize that post-lexical reading processes (i.e. processes beyond decoding) can be automatized as well, and may play an important role in fluent reading and comprehension.

Both LaBerge and Samuels's Automaticity Theory (1974) and Perfetti's Verbal Efficiency Theory (1985) suggest that once words are processed fluently and automatically, resources become available for readers to engage in the additional processing of text.

Recall that in Chapter I, automatization was referred to as "reorganization, routinization, or bypassing of serial execution of component processes" (N. Segalowitz, 2003). In this view, fast processing differs from automatization in that fast processing involves speeding up of all components of reading without the benefit of qualitatively changed processing of linguistic information. Our findings suggest that BUS and BNL participants, who evidenced comparable L2 WM capacities, seem to allocate WM resources qualitatively differently. Seven of the 20 BNL readers recognized words efficiently and accurately (i.e. automatized at the word level), but did not seem able to efficiently phrase or 'chunk' sentences in large, meaningful units (automatization at a post-lexical level). In contrast, the BUS participants demonstrate efficient and accurate word recognition in addition to native-like phrasing of sentences. This contrast between the BNL and BUS participants as it relates to phrasing of sentences without differences in WM capacity is consistent with the findings of Slowiaczek

and Clifton (1980) who hypothesized that the role of prosodic ‘chunking’ consisted of a restructuring of the memory representation instead of one of aiding in durability of the memory representation.

It was hypothesized that examination of L2 readers’ word recognition and phrasing abilities should supply us with evidence supporting a theoretical model of processing efficiency. It was further hypothesized that in oral reading, disfluencies and reading rate are linked to processing at a lexical level, and pausing, which is linked to the ability to phrase efficiently, is linked to processing at a post-lexical level. If L2 readers were to demonstrate few disfluencies and fast reading rates, non-native-like L2 phrasing (as reflected by many pauses and pauses at non-native locations), and accurate L2 reading comprehension, this would support Automaticity Theory, because automatized lexical processes would increase reading rate and reading comprehension. However, if L2 readers were to use native-like L2 phrasing (as reflected by few pauses) in addition to few disfluencies, fast reading rates, and accurate reading comprehension, this would support the Verbal Efficiency Theory.

The data reported in Chapter III suggests two arguments to support the Verbal Efficiency Theory, specifically its stipulation that skilled readers utilize automatized reading processes beyond the lexical level.

First, seven of the BNL participants (out of 20) demonstrated relatively high accuracy in reading out loud in L2 (only one disfluency in the English oral reading passage) with slow reading rates. These readers may reduce their reading rates in order to correctly access words and avoid making reading errors. As Koda (1996) pointed out, such L2 readers may not have developed automatic word recognition, and still need to focus most of their processing

resources at the word level. The BUS participants demonstrate that they are skilled readers in L1 and L2. Their fluent reading is associated with automatized word recognition, faster reading rates and automatized post-lexical comprehension skills, reflected by phrasing in larger and appropriate syntactic chunks.

The second argument supporting the Verbal Efficiency Theory relates to the BUS participants who demonstrated near-native accuracy skills and reading rates. The Verbal Efficiency Theory proposed that freed-up attentional resources can be allocated to post-lexical processes to facilitate comprehension. The BUS participants appear to have reached a reading level which includes automatized lexical processes, increased reading rates which have enabled them to acquire or hone, among other skills, the use of native-like L2 fluency-based suprasegmentals, and increase accuracy in reading comprehension.

In summary, the data presented here strongly suggest that late bilinguals who are immersed in an L2 environment are able to use L2 fluency-based suprasegmentals in native-like way. For them, one could conclude, automatization at a post-lexical access level may have taken place.

Thus far, the data has been used to answer the first two research questions, namely whether fluency-based suprasegmentals were linked to L2 comprehension and whether late learners of L2 acquire those fluency-based suprasegmentals regardless of context of acquisition. The next section provides an answer to the third research question, which asked about a possible link between ambiguous sentences, suprasegmental use, language history and WM capacity.

D. Ambiguous Sentence Processing

In the current study, three types of ambiguous sentences were tested. The types of sentences included relative clause (RC) attachment ambiguities with the complex NP in either subject position or object position, participle construction ambiguities either short or long in length, and ‘near vs. far’ ambiguities. Recall that Dutch readers in earlier studies have been found to demonstrate a high (N1) attachment preference in RC ambiguities, whereas English readers demonstrate a low (N2) attachment preference (Brysbaert & Mitchell, 1996; Swets et al., 2007). Of the three types of sentences examined in this study, only RC attachment ambiguities have been tested with bilingual speakers.

The reported cross-linguistic differences in attachment preferences between English and Dutch readers also held for our samples. Across the three ambiguous sentence types, BUS and BNL participants demonstrated a high-attachment preference whereas MUS participants did not. Furthermore, L2 oral reading fluency, as measured by disfluencies, rate, pauses, and pauses at non-native locations, which was correlated to both oral and silent reading comprehension, was not correlated to ambiguity resolution.

As discussed in Chapter I, Trofimovich and Baker (2007) distinguished between early-learned, language-specific prosody-based suprasegmentals and later-learned, less language-specific fluency-based suprasegmentals. Botinis et al. (2001) pointed out that the disassociation between the acquisitions of these suprasegmental subsystems may imply different underlying processing mechanisms. The processing of the suprasegmentals characterizing speech prosody was thought to reflect language-specific linguistic knowledge, whereas the fluency-based suprasegmentals may reflect the rapid and efficient functioning of

psycholinguistic mechanisms, such as lexical access (Costa & Santesteban, 2004). From the previous sections, it has become clear that fluency-based suprasegmentals are closely linked with oral and silent reading comprehension. It could be hypothesized that skilled levels of L2 oral and silent reading (of non-ambiguous sentences) are reflected by native-use of fluency-based suprasegmentals. Processing ambiguous sentences, using L2 fluency-based suprasegmentals in a native-like way did not seem to predict sentence interpretation. Despite the fact that BUS participants used L2 fluency-based suprasegmentals in a native-like way, their attachment preferences reflected a L1 pattern. The data reported in Chapter III suggest that if the interpretation of syntactically ambiguous sentences is related to suprasegmental use, it would be linked to L1 suprasegmental use, not to L2 suprasegmental use. Following this line of reasoning, the interpretation of the L2 ambiguous sentences by the BUS and BNL participants seemed to follow a L1 phrasing pattern with pauses introduced before the RC, resulting in N1 attachments. Alternatively, it could be hypothesized that ambiguity resolution of syntactically ambiguous sentences is based on a combination of prosody-based and fluency-based suprasegmental cues. Since prosody-based suprasegmentals were not investigated in this particular study, teasing apart these alternatives is not possible at this time. These data are consistent with the report that the dominant language predicts attachment preference (Fernandez, 2005). In the present study, the bilingual participants all rated their dominant language to be Dutch.

A third explanation of the data may be that ambiguity resolution is not linked to prosody at all. The L1 Dutch background of both BUS and BNL participants may have provided processing strategies other than prosodic cues resulting in L1 attachment preferences.

Despite a high-attachment preference by both BUS and BNL groups, the BUS participants, who use L2 suprasegmentals in a native-like manner, display a different attachment pattern than the BNL participants, who do not use L2 suprasegmentals in a native-like manner. The data presented in Chapter III indicate two instances of this different attachment pattern

First, the different pattern becomes apparent when looking at the responses, consisting of five alternative choices, indicating a low or high attachment preference. BUS and BNL participants demonstrated similar patterns for answer choices '1','2','4', and '5', however, quite a different pattern for answer choice '3.' Recall that the five answer alternatives were included for two reasons. First, the 'either-or' answer (answer choice '3') could introduce sensitivity to the indeterminacy of interpretation of the ambiguous construction and the possible implicit prosodic cues. Secondly, using the 5-point scale with an 'either-or' answer may reflect individual attachment preference patterns which may not follow language-specific preference patterns.

When interpreting the three types of ambiguous sentences, BUS participants chose lower-numbered answers (1 and 2) indicating a high (N1) attachment preference or higher-numbered answers (4 and 5) indicating low (N2) attachment preference, but the neutral 'either-or' (3) answer infrequently. In contrast, the BNL participants, as well as the MUS participants, chose the 'either-or' (3) answer significantly more times than the BUS group.

By choosing low-numbered answers, indicating a high-attachment preference, equally often as the BNL participants and choosing the 'either-or' answer far less frequently than the

BNL participants, the BUS participants demonstrate a more frequent low (N2) attachment preference than their BNL counterparts. Several interpretations of the data are possible.

First, if the interpretation of L2 ambiguous sentences is linked to suprasegmental use then the fact that the BUS participants having been frequently exposed to L2 versus the BNL participants having been infrequently exposed to L2 may have enabled the BUS group to acquire a L2 processing strategy in the form of native-like L2 fluency-based suprasegmentals. The attachment preferences of the BUS participants demonstrate the use of both L1 and L2 reading strategies. This interpretation would be consistent with Trofimovich and Baker (2007) who documented that late bilinguals are able to acquire certain L2 fluency-based suprasegmentals. Likewise, it corroborates the data from Dussias and Sagarra (2007), who concluded that processing strategies from L1 are transferred to L2 and , similarly, L2 can influence L1 processing strategies as well. Nevertheless, it remains difficult to explain why the L2 attachment preference would be transferred inconsistently.

A second interpretation may be related to the reading style of the BUS participants. The infrequent choice of the 'either-or' answer by the BUS participants may reflect their confidence as readers. Recall that the BUS participants were somewhat older than the MUS and BNL participants and that the older cohort of the BUS participants read slower and with more pauses. Furthermore, the BUS participants were mainly working professionals, whereas the majority of MUS and BNL participants were students.

A third explanation of the data may be that ambiguity resolution is not linked to prosody at all. The fact that BUS participants use L2 suprasegmentals in a native-like manner, but

demonstrate L1 attachment preferences may indicate that other variables are important in ambiguity resolution.

This may indicate that BUS participants' ambiguity resolution may be linked to both an L1 and L2 pattern, whereas BNL demonstrate a more predictable L1 pattern. This interpretation corroborates the data from Dussias and Sagarra (2007), who concluded that processing strategies from L1 are transferred to L2 and, similarly, L2 can influence L1 processing strategies as well. Further research is required to identify whether one of these processing strategies is related to the mastering of an L2 pausing pattern.

A possible second instance indicating a difference in ambiguity resolution between the two bilingual groups can be found in the interpretation of RC attachment ambiguities. Recall that two types of RC attachment ambiguities were included in the present study, with the RC either part of the subject (RC-S) or part of the object (RC-O). We included both types of RC sentences, as well as short and long participle construction ambiguities, to verify whether language-specific prosody was linked to attachment preferences or other aspects of sentence processing.

The BUS participants demonstrated significantly different attachment preferences across the RC-S and RC-O sentences. Group comparisons indicated that the BUS participants attached significantly lower than the BNL participants in interpreting the RC-O sentences, but not significantly higher than the BNL participants in interpreting the RC-S sentences. The BUS group attached significantly different in both the RC-O and RC-S sentences from the MUS group. As a group, the BUS participants demonstrated an attachment pattern that seemed responsive to the placement of the complex NP (including the RC), a pattern we had

not predicted. We had predicted that suprasegmental use was linked to the interpretation of syntactically ambiguous sentences, not the placement of the complex NP-RC construction. For the BNL participants no such pattern was observed, they demonstrated a comparable level of high attachment across the RC-O and RC-S sentences. At this time we can only speculate about the BUS participants' sensitivity to placement. One possible explanation is that BUS participants are indeed more confident readers, as was alluded to before. Their choosing more '1', '2', '4', and '5' answers may be linked to the particular attachment demonstrated by the BUS group. Another possible explanation is because of their frequent L2 language exposure, the attachment preference demonstrated by the BUS participants is neither like the attachment pattern of L1 and L2. Additional research is required in order to further investigate the relationship between bilingual attachment preferences.

A strong interrelation between WM and 'chunking' has been indicated in ambiguity resolution studies as well. Particularly, Swets et al. (2007) interpreted the low attachment preference of Dutch and English high span readers, in addition to the general tendency by Dutch readers to attach high and English readers to attach low, to mean that high capacity readers are able to 'chunk' large groups of words together, eliminating the need to pause.

In the present study, reading span scores were not related to attachment preferences for any of the three types of ambiguous sentences. This is in contradiction to the findings of Swets et al. (2007), who concluded that the link between WM capacity and attachment preferences was stronger than that between language history and attachment preferences. Furthermore, high reading span scores for BNL and BUS participants were not correlated to fewer pauses. The data presented here strongly suggest that when interpreting ambiguous sentences, L2 readers' performance seemed more linked to L1 attachment preferences rather

than to nonnative fluency-based suprasegmentals or WM capacity. Recall that in this study, the Reading Span task was only administered in L2 (English). Christoffels et al. (2003) demonstrated that more proficient L2 speakers have comparable WM capacity in L1 and L2 and that speakers who are less proficient in L2 consume extra WM resources in L2 sentence processing tasks. In the present study this finding was corroborated; the two bilingual groups were considered moderate to very proficient L2 speakers with comparable L2 WM capacity.

In summary, when interpreting ambiguous sentences, bilinguals seem to be influenced by L1 attachment patterns. Late bilinguals in a second-language environment (in this study, BUS participants) do demonstrate differences in attachment preferences in comparison with BNL participants, namely, BUS attachment preferences seem to be more clearly divided between very high or very low attachment answers. In contrast, BNL participants, as well as the MUS participants, seem to prefer the ‘either or’-answer. To answer the third research question, BUS and BNL participants demonstrated a L1 attachment preference in L2 ambiguity resolution, whereas WM capacity and L2 suprasegmental use did not seem linked to L2 ambiguity resolution. We can only speculate whether the attachment preferences of the BUS participants demonstrate a possible combination of L1- and L2- attachment preferences. Future research that involves a production study in which bilingual participants read attachment ambiguities out loud may provide additional information to clarify this situation.

E. Differences between L1 and L2 Reading Fluency Models

With the fourth research question, which asked whether there is a link between L2 reading skills and L2 proficiency measures, we are trying to verify whether the L1 fluency model is relevant to L2 reading. Recall that fluency in L1 reading is a good indicator of

overall competence in reading and that the fluency measures used in the current study, reading accuracy, reading rate, and reading prosody, are components of a L1 reading fluency model (The National Reading Panel, 2000; Grabe, 1991). Proponents of this model have argued that when processing of lower-level components, such as word recognition, becomes automatized, reading rate increases and more attentional resources can be allocated to higher-order comprehension processes. How does this model hold up with respect to L2 reading fluency and were any differences in reading fluency acquisition apparent?

The first component of the reading fluency model to be considered is reading accuracy. In the present study, reading accuracy was linked to number of disfluencies during English oral reading, as they were seen as a breakdown in lexical processing. To assess the relationship between accuracy and L2 text processing, the list generation task (Controlled Oral Word Association Test, COWAT), a measure believed to be closely related to vocabulary size and lexical access, was used. Not only were disfluencies and list generation task scores correlated, both measures were correlated to oral and silent reading comprehension.

The next aspect of the reading fluency model to be examined is reading rate. Recall that L1 reading studies (e.g., Walter, 2000; Grabe, 1991) demonstrated a strong link between accuracy and reading rate. It was argued that skilled L1 readers are able to read at fast rates as a result of automatized word recognition. A similar link between accuracy and reading rate was not apparent in the present study as a number of BNL participants (seven out of 20) demonstrated slow reading rates despite high accuracy. This is consistent with L2 reading studies which demonstrate that efficient word recognition alone does not improve reading rate or reading comprehension (Fukkink et al., 2005; Grabe & Stoller, 2002).

The link between accuracy and reading rate reported in L1 reading studies was different in the L2 sample of the current experiment. As several BNL participants demonstrated, accurate L2 reading was not consistently associated with fast reading rates. This is consistent with L2 reading studies which demonstrate that efficient word recognition alone does not improve reading rate or reading comprehension (Fukkink et al., 2005; Grabe & Stoller, 2002). Two reasons that may explain the difference between the relationship of reading accuracy and reading rate in L1 and L2 readers are identified by Schwartz and Kroll (2006). First, word recognition processes may be slowed down due to reduced familiarity and frequency of use of the L2. Second, bilinguals are not able to selectively turn off one of their languages during comprehension.

To verify that reading rate in L2 (English) would be an admissible component of an L2 reading fluency model, reading rates in L1 and L2 were compared. What can a comparison ratio between reading rates of L1 and L2 tell us? First, it can help researchers determine how balanced participant groups are. In our case, BUS participants were faster readers in English and Dutch in addition to being older than BNL and MUS participants. When the BUS group was rank-ordered according to age and years of residency in the US, it was the younger BUS cohort that read faster in both English and Dutch than the older cohort. Secondly, it has been used to measure the balance among languages of L2 speakers (Flege et al., 2002). We can imagine a large difference between reading rates of L1 and L2 to indicate a non-balanced L2 speaker. The BNL participants read the English passage on average 29% slower than the Dutch passage, whereas the BUS participants read the English passage on average 9% slower than the Dutch one. The data in this study are consistent with the notion that slow reading rates are associated with effortful comprehension (Grabe, 1991) and with disfluent reading

(Koda, 2004). With respect to disfluent reading, i.e., pausing frequently which results in phrases that do not demonstrate syntactic and semantic knowledge, it was argued that the disfluent reader is not able to maintain the flow of information at a sufficient rate to make connections and inferences vital to comprehension.

The main purpose for including a comparison ratio between L1 and L2 reading rates in this study was to verify a probable inclusion of L2 reading rate in an L2 reading fluency model. The L1/L2 ratio was strongly related to L2 reading rate and also to oral and silent reading comprehension, but not to ambiguous sentence processing.

The last component of the reading fluency model to be discussed is prosodic reading. In the present study, prosodic reading was assessed by number and location of pauses produced. The data strongly suggest that for bilingual frequently exposed to L2, accurate reading and fast reading are linked to more native-like L2 prosodic reading with respect to fluency-based suprasegmentals. For bilinguals with limited exposure to L2, accurate reading may not lead to faster reading rates and is not linked to native-like L2 prosodic reading as related to fluency-based suprasegmentals.

Are these the only differences to be considered in contemplating a L2 fluency model? Levasseur et al. (2006) concluded that in unskilled L1 readers various aspects of reading, e.g., accuracy, rate, and prosody, emerge separately and converge later on. To illustrate, they cited the example of the less skilled L1, who may read relatively fast, but with poor phrasing or unnatural prosody. In contrast, skilled L1 readers, in general, demonstrate not only a strong relation between reading accuracy and rate, but also between accuracy, rate, and prosodic reading. In the case of a L2 reading fluency model, the components making up the

model may be similar to the components of a L1 reading fluency model, however, the emergence of the components may follow a different timeline and, in addition, may be influenced by frequent or limited L2 exposure. This reasoning would be consistent with the findings of Bernhardt and Kamil (1995), who concluded that specific reading sub-skills do not reflect the level of L2 reading and that it has no linear relationship to L1 reading.

In summary, by using additional measures independent of the oral fluency measures included in the current study, we were able to investigate potential components of a L2 reading fluency model. These additional measures are especially important in substantiating perspectives in which L1 has been used as a point of departure to further pursue issues in L2.

Chapter V: Conclusion

Generally speaking, late bilinguals in this study who had lived in the U.S. for at least a year were able to use L2 fluency-based suprasegmentals in a native-like manner.

Furthermore, the more native-like use of fluency-based suprasegmentals was linked to both oral and silent reading comprehension. However, no link was apparent between pausing at non-native locations and the interpretation of ambiguous sentences.

In addition, this study provides data suggesting that native-like use of fluency-based suprasegmentals by bilinguals maybe linked to automatized processing of text at a post-lexical level. The evidence suggests that automatized processes at a post-lexical level that are the hallmark of L1 skilled readers may also differentiate bilinguals in a second-language environment from bilinguals in a foreign-language environment. How could these data be used in L2 classrooms?

Once the orthography-sound rules are established, second language reading instruction is often based on vocabulary expansion and silent reading. Since reading comprehension is correlated with the native-like use of L2 fluency-based suprasegmentals, it could be argued that explicit instruction in oral reading with a focus on L2 phrasing would be an important inclusion to the L2 teaching curriculum. Especially, beginning to moderate non-native readers, who have little to no exposure to native L2 suprasegmental phonology and cannot

make use of intuitive L2 linguistic knowledge, would benefit from additional support to attain their optimal L2 reading level.

As to future research, this study has investigated the relationship of fluency-based suprasegmentals to reading comprehension in different reading tasks. As this work progresses, it would be useful to add data stemming from the use of prosody-based suprasegmentals, particularly to interpret ambiguity resolution more accurately. One aspect of prosody that may be involved in ambiguity resolution is the lengthening of constituents preceding the intonation phrase boundary. With respect to the sentence accent position, both pitch contour and amplitude measures may be linked to ambiguity resolution as well.

To address the question whether native-like use of suprasegmentals is not only linked to L2 reading comprehension, but influences it as well, a longitudinal experiment may shed light on this relationship. In such an experiment, one group of bilingual readers living in the U.S. could be taught L2 prosodic principles and their reading comprehension could be assessed before and after mastering this L2 prosodic knowledge. In addition, comprehension scores of participants that did not receive specific instruction in such L2 prosodic principles could be compared with the former group. With respect to the participants, bilingual and monolingual, this study was comprised of volunteers who all reported two to four years of college education. Even though this provided much needed control within this cohort, performance of beginning L2 readers from the Netherlands and moderate to advanced L2 readers living in the U.S. who had fewer years of education would provide a broader understanding of the developmental patterns. Had participants been recruited based on language proficiency level (e.g., TOEFL scores), the data might have revealed more about the L2 reading acquisition continuum. Furthermore, future research that would include oral

and silent reading across more varied complexity levels would provide raw data to compare the link between suprasegmental and reading skill in more detail.

How do you rate your speaking?

In English:	very good	good	fair	poor	very poor
In Dutch:	very good	good	fair	poor	very poor

How do you rate your reading comprehension?

In English:	very good	good	fair	poor	very poor
In Dutch:	very good	good	fair	poor	very poor

How do you rate your writing:

In English:	very good	good	fair	poor	very poor
In Dutch:	very good	good	fair	poor	very poor

8. What was your favorite subject in school?.....
9. What was your best subject at school?
10. Did you find it hard to learn to read in Dutch and English?
11. Were there particular parts of learning to read in Dutch that were harder, e.g. reading out loud?
12. Do you remember whether it was hard to learn a foreign language?
13. Were any of your English teachers native-English speakers?
14. Did you find it hard to learn to spell in English?
15. Can you spell well in English?
16. What do you read?

	Yes	No
Work related reading:
School related reading:
Newspapers:
Leisure reading:

17. How old were you when you moved to the US?
18. How many years have you lived in the US?
19. Has your stay in the US been interrupted?

If yes, how often and for how long?

20. Do you live in the US with Dutch relatives or friends?

If yes, what is your relationship with them?

21. How often do you speak Dutch in the US? (circle one)

Daily Most days of the week 1 or 2 times a week Never
22. Whom do you speak Dutch with in the US? (circle as many as apply)

Colleagues

Family
Children
Adults

Friends

23. Which languages do you hear most during the day?

English

Dutch

Other

Which ones? _____

24. What do you consider your dominant language at this moment? _____

Appendix 2

Questionnaire
First and Second Language Reading Comprehension

This information will not be disclosed.

Age:

Sex: M / F

Identification number:

Place of birth (city/town):.....

Occupation:.....

1. Was Dutch the first language of your parents or caregivers?

If not, was his/her/their first language?.....

2. At what age did you learn to speak English?.....

3. Do you speak more languages in addition to Dutch and English?.....

4. Did you spend extensive periods abroad?

If yes, where and for how long?

5. Are you right- or left-handed?

Languages and Education:

6. What language was your primary and secondary education in?

In primary school	-Dutch	-English	-other language: _____
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In secondary school	-Dutch	-English	-other language: _____
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In college	-Dutch	-English	-other language: _____
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7. How do you rate your language knowledge (circle 1 per line):

How do you rate your listening comprehension?

In English:	very good	good	fair	poor	very poor
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In Dutch:	very good	good	fair	poor	very poor
-----------	-----------	------	------	------	-----------

How do you rate your speaking?

In English:	very good	good	fair	poor	very poor
-------------	-----------	------	------	------	-----------

In Dutch:	very good	good	fair	poor	very poor
-----------	-----------	------	------	------	-----------

How do you rate your reading comprehension?

In English:	very good	good	fair	poor	very poor
In Dutch:	very good	good	fair	poor	very poor

How do you rate your writing:

In English:	very good	good	fair	poor	very poor
In Dutch:	very good	good	fair	poor	very poor

8. What was your favorite subject in school?.....
9. What was your best subject at school?
10. Did you find it hard to learn to read in Dutch or English?
11. Were there particular parts of learning to read in Dutch or English that were harder, e.g. reading out loud?
12. Do you remember whether it was hard to learn a foreign language?
13. Were any of your English teachers native-English speakers?
14. Did you find it hard to learn to spell in English?
15. Can you spell well in English?
16. What do you read?

	Dutch	English
Work related reading		
School related reading		
Newspapers		
Leisure reading		

Appendix 3

English Oral Reading

Tyrone flopped down on the couch. He reached for the phone, hoping his friend Luis might be home – but he wasn't. Too bad! Next, Tyrone flipped impatiently through the television channels. Finding nothing of interest, he turned off the TV and headed for the kitchen.

Tyrone opened the refrigerator and mindlessly surveyed its contents. Finding nothing that interested him, he closed the refrigerator door and looked at the clock – 12:45. How could that be? It seemed much more than fifteen minutes ago when his parents and sisters had left for the beach. Tyrone had waved goodbye, assuring his mom one more time that, yes, he would be fine by himself. No, he would not use the stove. Yes, he would write down any phone messages. No, he did not want to go with them.

Once in his room, Tyrone lay across his bed. A distant rumble of thunder drew his attention out the window, where the sky was clouding up. The thought embarrassed him, but he hoped his family's beach outing would be cut short by rain.

Appendix 4

Dutch Oral Reading

Een scooter scheurt over het plein, ons huis voorbij. Het gebrom verdwijnt naar de andere kant van het dorp, als een hommelmot naar een andere kamer. Mijn moeder legt haar vork op haar bord en maakt haar rug recht. Ze knijpt haar lippen op elkaar, en kijkt me aan.

Buiten kwetteren mussen. De hitte zoemt. Het gebrom dat eerst nog dat van een verre tractor op het land lijkt, wordt langzaam harder, komt dichterbij, gaat anders klinken, verandert weer in het lawaai van een scooter, die tenslotte het plein op rijdt en daar ergens blijft staan mopperen.

Mijn moeder schuift haar stoel naar achteren, en aarzelt. Ze kijkt van haar bord naar het raam. De luiken zijn dicht tegen de hitte van de middagzon. 'Wie is dat?' zegt ze.

Ik kom overeind, maar mijn moeder schudt haar hoofd, tikt met haar vork op de tafel en zegt: 'Blijf zitten. Eet verder.'

Ik zak zuchtend terug op mijn stoel, en laat die met een krassend geluid over de tegels schuiven.

Translation

A scooter tears through the square, past our house. The buzzing disappears to another side of the village, like a fly to another room. My mother puts her fork on her plate and straightens her back. She purses her lips and looks at me. Outside the birds sing. The heat hums. The buzzing that first seems to belong to a tractor becomes slowly louder, approaches, starts sounding different, changes into the noise of a scooter again, which finally enters the square where it stays with a running engine. My mother moves her chair back, and hesitates. She

looks from her plate to the window. The blinds are drawn against the heat of the afternoon sun. 'Who is that?' she asks. I get up from my chair, but my mother shakes her head, taps with her fork on the table and says: 'Sit down. Finish eating.' With a sigh, I sit down on my chair again, and make the chair screech across the kitchen tiles.

Appendix 5

Experimental sentences

a-sentences: Relative clause in subject position

b-sentences: Relative clause in object position

1a. The companion of the salesman who amused himself quite a bit wrote a letter to
the editor.

1b. The editor wrote a letter to the companion of the salesman who amused himself quite a
bit.

2a. The nephew of the bishop who injured himself last summer attracted the attention of the
local police.

2b. The local police attracted the attention of the nephew of the bishop who injured himself
last summer.

3a. The brother of the mayor who complimented himself constantly bothered the
reporter.

3b. The reporter bothered the brother of the mayor who complimented himself constantly.

4a. The niece of the waitress who hurt herself on the broken glass shocked the shop owner.

4b. The shop owner shocked the niece of the waitress who hurt herself on the broken glass.

5a. The color of the fabric that was selected for the sofas by the client matched the drapes.

5b. The drapes matched the color of the fabric that was selected for the sofas by the client.

6a. The bodyguard of the ambassador who hunts gorillas for sport cornered the activists.

6b.. The activists cornered the bodyguard of the ambassador who hunts gorillas for sport

7a. The aunt of the nun who leads the book group startled the butler.

7b. The butler startled the aunt of the nun who leads the book group.

8a The daughter of the seamstress who plays solitaire most evenings read a book to Laura.

8b. Laura read a book to the daughter of the seamstress who plays solitaire most evenings

9a. The classmate of the pianist who composes operas as a hobby wrote to a
wealthy uncle.

9b. A wealthy uncle wrote to the classmate of the pianist who composes operas as a hobby.

10a. The secretary of the manager who talks continually at work adores the new
employee.

10b. The new employee adores the secretary of the manager who talks continually at work.

Participle construction ambiguous sentences- Short

1. Susan ran into the woman carrying groceries.

2. Laura ran away with the man wearing a robe.

3. Chris spied on the man eating a hamburger.

4. Jessica searched for the young girl carrying an umbrella.

5. The bagwoman repulsed the businessman walking in the park.

6. The pilot scared the technician looking out of the window.

Participle construction ambiguous sentences –Long

1. Susan ran into the woman carrying groceries in a crate.
2. Laura ran away with the man wearing a robe with a hood.
3. Chris spied on the man eating a hamburger on a bun.
4. Jessica searched for the young girl carrying an umbrella with white stripes.
5. The bagwoman repulsed the businessman walking in the park late at night.
6. The pilot scared the technician looking out of the window of the plane.

'Far versus near' attachment of final phrase ambiguity sentences

1. The university students read an article on the subway.
2. The chauffeur annoyed the man with the cigar.
3. The lifeguard rescued the swimmer with no clothes on.
4. The fireman smashed the door with the rusty bar
5. The reporter defended the report on the web
6. Jason murdered the man with the gun.

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