2003

The Effect of Digitally Shortening and Lengthening Pauses on Listening Comprehension

Ronald Gregory Reid

THE FLORIDA STATE UNIVERSITY

SCHOOL OF INFORMATION STUDIES

THE EFFECT OF DIGITALLY SHORTENING AND LENGTHENING PAUSES ON LISTENING COMPREHENSION

By

RONALD GREGORY REID

A Dissertation submitted to the
School of Information Studies
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Degree Awarded:
Spring Semester, 2003

The members of the Committee approve the dissertation of Ronald Gregory Reid

defended on 3 March 2003.

Marcella D. Genz
Professor Directing Dissertation

Michelle S. Bourgeois
Outside Committee Member

Benjamin Keith Belton
Committee Member

Charles Wm. Conaway
Committee Member

Approved:

Jane B. Robbins, Dean, School of Information Studies

The Office of Graduate Studies has verified and approved the above
named committee members

ACKNOWLEDGMENTS

The researcher wishes to especially express his gratitude to Dr. Charles Wm. Conaway. Dr. Conaway served as my advisor throughout my advanced graduate work in Information Studies at Florida State University. In addition, until his retirement in December 2002, Dr. Conaway served as chairperson of my doctoral committee up through the time of my dissertation proposal defense. His help, advice, guidance, and friendship are gratefully appreciated and are acknowledged.

Special acknowledgment is also due to Dr. Marcella Genz. Dr. Genz graciously assumed the chairpersonship of my doctoral committee at the time of Dr. Conaway's retirement. Her willingness to assume the additional responsibility is acknowledged and appreciated.

Also, acknowledgment is due to doctoral committee members Dr. Keith Belton of Information Studies and Dr. Michelle Bourgeois of Communication Disorders for devoting their time and energies and providing professional advice and guidance.

For their advice and technical assistance, Janie Humphries, Fred Gissoni, and Larry Skutchan at the American Printing House for the Blind are acknowledged.

To my parents, who provided help and encouragement through all my years of education, goes my sincere appreciation.

Other contributions are not noted individually, but are recognized and appreciated.

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ABSTRACT

The purpose of the study was to determine the effect of digitally shortening and lengthening pauses on listening comprehension. Using digital audio software, pauses within the Brown, Carlsen, Carstens (BCC) Listening Comprehension Test were modified to create a control group version (unaltered) and three experimental versions: pauses lengthened by 300 msec; pauses shortened by 150 msec; and, pauses shortened by 300 msec. Effects of these pause length treatments on listening comprehension were measured for each of the five individual BCC sections and for composite scores. Subjects were 144 college students enrolled in undergraduate psychology classes. Means of numbers of incorrect responses were used in analysis of variance and Kruskal-Wallis calculations. Results demonstrated statistical significance for two BCC test sections, Section C (Recognizing Transitions) and Section D (Recognizing Word Meanings). For Section C, lengthening pauses by 300 msec yielded a significant difference between mean numbers of incorrect responses at the .05 level. For Section D, the control group condition (with unaltered original pause lengths) yielded a significant difference between mean numbers of incorrect responses at the .10 level. For certain sections of the test, it was concluded that that presentation rate could be increased (via pause length shortening) without loss of comprehension—in other words, that listening efficiency could be increased. Designated as primary beneficiaries of the research were clients of the National Library Service (the producers of "Talking Books") and distance learners using audio-enhanced web-based materials. Recommended were further studies involving different pause lengths, subjects and stimulus materials, as well as the development of software that allows users to select from a variety of offered pause lengths.

CHAPTER 1

INTRODUCTION

Recently developed software has made it possible to shorten and lengthen pauses in audio text without removing phonemes in the text. In the context of information studies, it is of interest to study the effects of digitally shortening and lengthening of pauses on listening comprehension; this kind of study relates how to more effectively tailor audio information to the needs and preferences of the user, rather than forcing the user to adapt to a rate of presentation that may not be ideal. This study has particular relevance for two groups: (1) blind and visually impaired persons, and (2) users of web-based learning materials that incorporate digital audio technology.

Comprehension is essential to acquiring an education, finding a successful career, and participating in a full and productive life. Blind and visually impaired persons have immediate needs to increase time efficiency in learning. Braille has limitations. While a 90 wpm reading rate is attained by practiced Braille users, less-experienced users of Braille average only 40-50 wpm (Foulke, 1964). Both figures are well below the 300-350 wpm average reading speed of sighted high school graduates (Carver, 1990). It stands to reason that for purposes of learning, the importance of audio material is heightened for those who have print-related disabilities. It would seem the discovery and use of optimal pause lengths within listening material for blind and visually impaired persons may indeed increase listening comprehension for the members of these groups. Indeed, the American Federation for the Blind (2001) reports that for those with visual impairments, literacy can be attained through the use of software that incorporates human-like voice. It is hoped the present study will aid in the discovery of optimal pause lengths for increasing listening comprehension for blind and visually impaired persons.

Students and others who use (or will use) digital audio incorporated into web-based learning materials also need to find ways of increasing comprehension. Frequently the audio portion of web-based materials accompanies the visual portion and explains the processes and interrelationships shown in the visual portion. The inclusion of pause lengths that permit optimal mental processing time may eliminate much of the need for re-viewing and re-listening to all or portions of a web-based presentation (especially if its default presentation rate is less than ideal for a given user) in order to comprehend the content. Discovery of optimal pause lengths for listening by students therefore could result in more efficient use of student study time.

For blind and visually impaired persons, the amount of usage of audio materials is reported by the National Library Service for the Blind and Physically Handicapped (NLS, a division of the Library of Congress). Service to more than 765,000 persons and a yearly circulation of approximately 23 million audio books and magazines accounts for an average circulation of more than 30 items per person each year ("Digital audio future for blind Library patrons," 2000). The Talking Books program is administered by the NLS, which focuses on recorded materials intended for "pleasure reading" (listening) purposes (fiction, etc.). NLS contends that the advantages of digital audio offerings to its clients are superior sound quality and the capability of listening to a book in its recorded entirety without the necessity of physically manipulating the cassette (e.g. inserting the cassette, removing and flipping over cassettes, reinserting an analog cassette) (Kearns, 2001). Recording for the Blind and Dyslexic (RFB&D) is a New Jersey-based non-profit organization specializing in production and recording of audio educational materials. RFB&D reports 2001 book distribution of more than 243,000 items and an active membership of more than 100,000. A total of 2.43 items per person is the circulation average (Recording for the Blind and Dyslexic, 2002). Presently, NLS engineers are in the process of converting its materials from analog to digital format, and has targeted April 2008 for initiation of its digital offerings (Cylke, 2002; Korman, 2002). The design of a user-friendly, software-based player is already in progress (Kearns, 2001), and prototypes have already been unveiled. Standards for the design and production of digital audio materials for the NLS have been established by the National Information Standards Organization (NISO), building upon similar work done by the DAISY Consortium

(Digital Accessible Information System).

Distance learning applications of today include digital audio-enhanced PowerPoint presentations (Van Horn, 2001). Digital shortening or lengthening of pauses might bring about better listening comprehension for users of PowerPoint presentations, and for other users as well. During the last few years, some university libraries have increased digital services to instructors. For example, the library division at the University of Tennessee has taken initiative by offering to digitize audio (among other) resources for instructors, which in turn will be accessed by students as reserve materials (Bayne & Hodge, 2001). Other universities have constructed special libraries for digital listening materials. For example, Maple and Henderson (2000) reported on the construction of a digital music library at Pennsylvania State University. This music library allows for incorporation of textual information such as instructor annotations to the music material. Such a project facilitates the offering of music-related distance education courses.

The study of temporal components within audio materials is also of interest to researchers in the realms of memory (Jarrold & Hughes, 2000) and stuttering (Kent, 1984).

In summary, this study is to examine the effects of digitally decreasing and increasing pause lengths on listening comprehension. It has particular relevance to two groups: (1) blind and visually impaired persons, and (2) users of audio-enhanced, web-based instructional materials such as distance learners. Table 1 summarizes the study:

Table 1

Study Summary

Problem	The effect of digitally shortening and lengthening pauses on listening comprehension
Technologies	Software permitting ready, inexpensive shortening and lengthening of pauses within digital sound files
Primary Beneficiaries	1) NLS/RFB&D clients who use audio materials for learning and for entertainment; 2) Distance learning students who utilize audio enhanced text presentations

Nature of the Problem

The purpose of this study is to determine the effect of digitally shortening and lengthening pauses on listening comprehension.

Listening ability in humans varies. In general, however, we remember only about 25% of what we hear (Boyd, 2001; Blanchard 1992). This inefficiency is due to many factors. Early work by Nichols (1948a), as well as Nichols and Stevens (1957), indicated that the disparity between speech production and speech processing is striking. Indeed, according to Boyd (2001), people can think much faster than they speak, with thought roughly four times faster than speech. The average speed of human speech is approximately 120 words-per-minute (Friedman, 1978). At the same time, audible words in sequence can be thoroughly comprehended at speeds up to 250-300 wpm (Williams, Moore & Sewell, 1983-84). The result can be inefficient use of time in the listening process. This time may be used by the listener in furthering comprehension, or, unfortunately, in completely unrelated activities such as daydreaming (Blanchard, 1992; Junor, 1992; Robertson, 1991; Friedman, 1978). Blanchard adds that "noises" such as uncomfortable physical environments (excessive heat, cold, etc.) and personal distractions (problems yet to be resolved, etc.) interfere with effective listening. Because of the disparity between narration rates and comprehension rates, it appears logical that shortening or lengthening of pauses within audio materials may be of some assistance in eliminating at least some distractions that occur in listening to them, by making audio materials more easily comprehended. Insofar as is possible, the present study will control for factors such as discomfort and distraction by having the subjects take the test within their regular classrooms, during their regularly scheduled class periods, with instructors present at all times.

More issues involving listeners exist with listening comprehension. For example, limited vocabulary can impede and even prevent listening comprehension. According to Noblitt (1995), listening comprehension is a mental process of translating sounds into visual images in the mind. According to Lingren (1997), comprehension is necessary for mental growth and productivity, evidenced in part by knowledge and enjoyment gained by listening effectively. Clearly, listeners must be mentally capable of associating words and other aural stimuli with pictures in the mind. Learning to associate aural stimuli with mental pictures begins very early in life. Tomatis (1997) claims that in the womb, a fetus, by listening to its mother's voice, undergoes the earliest stages of developing language. By practicing the things they hear, children learn speech (the oral form of language), how words are made, how punctuation rules signal meaning, and how to form combinations of words to meet situational needs (ASHA, 2000; ASHA, 2002). Storytelling can contribute to vocabulary growth by helping children learn to create mental pictures associated with the symbolism and metaphor of spoken words through questions and discussions about what was heard (Gillard, 1996). Effective storytelling, however, is not an easy process. Oral presentation often proceeds in a linear fashion (DiVecchio, 1998) and is not under the direct control of the listener. Because oral communication is more additive, aggregative and situational than text (Ong, 1982), getting and sustaining listener attention are critical. The opening may be and often is important enough to influence listener attitude toward the rest of the presentation (Goldbart, 2002). The opening itself should strongly seize the attention of the listener (Morgan, 1996). McHugh (2001) advocates that narrators begin a story with action, even with a pre-configured climax. Strong openings can take various forms with various consequences: startling openings attract attention; negative openings raise anticipation; comparison/contrast openings induce critical thought, writes Goldbart. Narrators have a lot to do with the expression and energy of stories ("Voiceover forecasts," 2000). Little variety in narration (monotone) significantly compromises effectiveness (Timpson & Tobin, 1982) (a part of transforming words into story are inflections of tone and pace variations, with such adjustments of presentation serving as markers of pace, mood, and emotion (Hearne, 2000)). That the left and right sides of the brain are both used in comprehension of material such as stories (Woodard, 2002) points to the importance of story presentation in the process.

Another kind of problem with listening to audio material is the sound quality (fidelity), which varies from recording to recording. According to Junor (1992), sound quality affects comprehension. A third problem is that speaking rates of narrators vary from recording to recording, and even within recordings. Inconsistent sound quality (volume, clarity, etc.) in narrated presentations can be especially frustrating for persons who need to have information presented aurally (Hansen, Lee, & Forer, 2002); furthermore, such users often must rely on sequential learning processes (Bigelow, 1996). A fourth problem is that some listeners may experience adjustment problems if reading habits include jumping from place to place, rereading portions, or often changing their reading rates. This problem can be lessened somewhat in listening presentations by adding more examples related to the subjects, and repeating use of new vocabulary terms in the context of information being presented. Again, decreases or increases in pause lengths may offer at least some assistance to increasing listening comprehension, particularly in instructional materials for blind and visually impaired persons as well as for students and others using web-based learning materials (especially when such materials are recorded at a fixed rate that may or may not coincide with the optimal audio information processing rate for a given individual). Unfortunately, there do not appear to be narration rate standards for audio materials.

Increasing listening comprehension is a goal that has been pursued by various means, including the use of popular music as a cloze procedure stimulus (Kanel, 1997). In a cloze procedure a test subject is usually prompted to provide a word that was procedurally deleted from some form of text (Manning, 1999; Abraham & Chapelle, 1992). Effects of presentation rate on comprehension of listening stimuli have been investigated for decades, generally with the goal of increasing efficiency in information acquisition (Jonassen, 1996). At first, researchers tried simply playing back audio at faster rates. Higher words-per-minute (wpm) rates were found to be uncomfortable for listeners, because words became less intelligible as rates increased. Jonassen (1996) called into question the findings of these early studies. Later, researchers such as Miller and Lichlinder (1950) experimented with a technique called tape-sampling, where a switch was used to turn off the speech signal from time to time, thereby deleting portions of the speech (a technique which proved distracting to some). Garvey (1953) cut out segments of tape and spliced the remaining ends together, a process that proved to be too labor-intensive for widespread production of materials. During the 1950s and 60s, a piece of equipment known as a speech compressor produced what is called compressed speech, which enabled researchers to present intact listening stimuli to subjects at different wpm rates, by cutting out tiny portions of tape randomly. Today speed-related pitch distortion is somewhat controlled through the use of commercially-produced, variable speed cassette players with a sliding lever to decrease or increase listening rates. One example is the four-track players produced by NLS. Even with the variable pitch controls on these machines, however, sound distortion continues at some of the higher and lower playback speeds. The addition of digital controls to add pause length shortening and lengthening capability appears to be desirable for achieving better sound quality delivery and (possibly) for achieving higher degrees of listening comprehension.

There is evidence that rate of information acquisition is important to listeners. Zhao (1997) found that listening comprehension by subjects improved in student subjects that were given control over playback speed. Junor (1992) reports that students who were able to adjust their own rate of listening will do so, amounting to having saved 15 minutes per hour of listening time. Of curiosity to the researcher is if people indeed prefer a higher rate of information acquisition, and, if higher information rates can be more productive, why is there such inconsistency of comprehension results in compressed speech studies? In the opinion of the researcher, studies attempting to increase learning efficiency by means of compressed speech (which has produced disparate results) may have used an approach that was too broad. For example, investigations using increments of 100, 200 and 300 WPM rates do not consider that optimal listening rates could be in between any two of the three wpm rates used in the investigation or beyond lower and higher wpm limits. For the present study, the researcher chooses to select one rate of spoken word delivery while decreasing or increasing pause lengths of a presentation by milliseconds only. Another difference between this study and compressed speech studies is that many of the latter involved removing both phonemic and non-phonemic portions of the speech signal. The present study shortens or lengthens (only) the pauses of the speech signal. Perhaps by holding the rates of the spoken words constant while shortening or lengthening only the pauses within an audio presentation a way to increase listening and learning effectiveness may be found.

Research Objectives and Hypothesis

Overall objective: the purpose of this study is to investigate the effects of digital shortening or lengthening of pauses on listening comprehension.

Sub-objectives of the study are:

1. to determine if digitally shortening or lengthening of pauses affects subjects' immediate recall of unrelated words presented in sequence
2. to determine if digitally shortening or lengthening of pauses affects the ability of subjects to follow spoken directions
3. to determine if digitally shortening or lengthening of pauses affects subjects' ability to recognize word meanings
4. to determine if digitally shortening or lengthening of pauses affects subjects' ability to recognize transitions
5. to determine if digitally shortening or lengthening of pauses affects subjects' ability to comprehend lectures
6. to determine if digitally shortening or lengthening of pauses affects subjects' overall performance on a standardized test of listening comprehension (sum of sub-objectives 1-5)

Each of the first five objectives corresponds to a section of the standardized listening test used in the study. The objectives are measured by determining and analyzing the means of incorrect responses given by subjects on each test section. The sixth objective is measured by determining and analyzing means of total numbers of incorrect responses given by subjects on the entire test. The null hypothesis is there are no differences of statistical significance between the (mean) numbers of incorrect responses on each section of the test as well as on the entire test. The alternative hypothesis is there are differences of statistical significance between the (mean) numbers of incorrect responses of each section of the test as well as on the entire test.

Definitions

Listening is defined as a process of sensing, interpreting, and evaluating aural stimuli (Steil, Barker, & Watson, 1983), most often measured by recall of content or meaning (Thomas & Levine, 1994).

Listening comprehension, according to Lingren (1997), is a mental process that involves (1) receiving sound stimuli; (2) the creation of mental images (visual representations of the sound stimuli); (3) the mental association of the sound stimuli with the visual representation of the sound. It is an ongoing process. Comprehension is necessary for mental growth and productivity, evidenced in part by knowledge and enjoyment gained by listening effectively (Lingren).

Digital sound is sound which has been converted to bits (binary digits) that represent information in the form of 0s and 1s (Teachout, 2002; Burdick, 1997). Pause is defined as "…a silent segment bound by vocalizations" (Breznitz, 1990, p. 155). An altered pause is one wherein the length of the pause has been either shortened or lengthened.

Compressed speech, according to Foulke and Sticht (1969), is listening material that is either (1) speeded up, or (2) has undergone mechanical pause removal of small segments (as opposed to compressed audio, the removal of redundant portions of sound files by an encoder (Heffernan, 1999)).

Time expanded speech (the opposite of compressed speech) is speech presented at a slower rate than originally recorded.

Time-scale modification (TSM), according to Hamdy (2000), is the manipulation of an audio signal by deletion or repetition of certain signal components. TSM as a concept applies to both compressed and expanded speech.

Assumptions

One assumption of the study was that the test used in this study, the Brown, Carlsen, Carstens (BCC) Listening Test, indeed serves as a valid and reliable test of listening comprehension, as is asserted in the literature. A second assumption was that subjects execute the BCC test to the best of their abilities (e.g., responses were honest and reflected the true comprehension skills of the subjects). A third assumption was that there was no communication of test questions and/or responses among subjects who took the test at different times (i.e., no subject taking the test had prior knowledge of any specific, question-related test material).

Limitations of the Study

One limitation of the study is that only a small segment of the general population, namely college-level students, were utilized as subjects. Another limitation is the relatively small size of the sample, within which the potential exists for hearing difficulties and differences in cognitive abilities to have an oversized share of influence on the results. A third limitation is that the testing utilized only listening material contained in the BCC test (revised). Some forms of information are less conducive to aural consumption than are questions on a standardized listening test. A fourth limitation is that the experimental test materials, while using digital software, were recorded on software using input from an analog (cassette) original. Any sound imperfections associated with the analog-recorded original were then transferred to the digitally changed copy. A fifth limitation is that only 3 pause lengths (for the experimental groups) were considered, to ensure that a relatively large number of subjects took each pause length version in this study. It is likely a number of additional and different pause lengths will need to be investigated—again with large numbers of subjects--before optimal pause lengths can be discovered. A sixth limitation is that testing was conducted en masse, with college students together inside regular classrooms, within full view and earshot of each other while the recording is presented (ways to alleviate the problem in future research are explained in the Discussion section). This study did not attempt to examine the effects of speeding up or slowing down the words in the audio text.

Summary

Two defined groups stand to gain the most from the results of this research: (1) clients of bodies such as the NLS and RFB&D (especially blind and visually impaired persons); (2) students using distance learning applications including voiceover presentations. As sources such as NLS and RFB&D move to downloadable digital audio format for new materials, and can readily change lengths of existing pauses in audio text, research on pause lengths can and should assist in determining optimal pause lengths. For distance learning applications, research such as this would be helpful if optimal pause lengths were incorporated into distance learning offerings. Too, the results of pause change studies may call attention to the desirability of having users of audio materials be able to choose their own audio pause lengths within digital audio materials in order to better suit their own information needs and preferences. In general, the results of this research might allow for better fulfillment of a goal held in common by many modern information professionals. The goal, namely, is the fitting of information presentations (in this case, information in audio format) to the needs and preferences of the user, as opposed to requiring user adaptation to a presentation that may be less than ideal. We can think much faster than words are spoken, a phenomenon that allows a number of factors to interfere with our listening comprehension. Listening efficiency seems to be valued, as evidenced by many previous attempts to increase it. Speeding up or slowing down of speech signals has met with mixed results in previous research. Isolating the pause portions of the speech signal may hold one of the keys to increasing listening comprehension.

Related Research and Literature

The related literature for this study includes the following: audio and visual modes of learning; factors that affect listening; theories involving listening; studies using compressed/expanded speech (subjects mostly college age or younger); studies (many compressed speech) with older and/or hearing impaired subjects; studies involving blind/visually impaired persons; compressed speech—evaluations; studies involving pauses; BCC Listening Test; and, motivations for listening.

Audio and Visual Modes of Learning

Distance learners often use materials that incorporate both audio and video. Studies that compare, in isolation, the effects of these two modes have not yielded a consensus. Junor and Junor (1994) is an example. In two forms—print and computer-controlled audio--Junor and Junor presented identical information to 16 undergraduate and 8 graduate students. WPM rate, pause lengths, time intervals between words, and variations between rates of passages, were identical. With both presentation media, results showed a similar performance drop with increase in word display rate. Further studies comparing the effectiveness in isolation of audio instruction and visual instruction were conducted by Toth (1997), Lee-Sing (1996) and Miller (1985), all of whom were unable to find performance-related differences of significance in their respective studies. Comparison studies of reading comprehension and listening comprehension have yielded strong correlations. Carlisle and Felbinger (1991) found that strong correlations exist between scores for listening comprehension and scores for reading comprehension, while earlier such work by Beery (1954) found positive correlations in the .60-.82 range. However, wpm rates for the two modes of learning seem to display differences, as reported in early work by Goldstein (1940), as well as Day and Beach (1950). Goldstein utilized live narration in part to compare reading comprehension with listening comprehension. He found that subjects comprehended more by listening at 100-211 wpm rates, had equal comprehension between 248-285 wpm, and comprehended more by reading at 322 wpm. Day and Beach found that material that is familiar and meaningful is best presented aurally, while less familiar, less meaningful material is best presented visually. Somewhat later, Foulke and Sticht (1969) demonstrated that humans use less effort to learn through use of audio channels than through visual channels. Concurring with Foulke and Sticht were Rubin, Hafer, and Arata (2000), who tested 59 college students. Some subjects listened to, and some read, speeches and articles. These researchers found that while oral discourse yielded the best comprehension, the (higher) concentration level required in reading likely assisted in the yielding of more information acquisition (as opposed to listening) with their student subjects. Despite requiring less expenditure of effort than reading, listening, according to Hatlen (1996), is largely considered inadequate for comprehending mathematical equations, reference materials, charts, tables, and other graphic material.

Audio and visual learning modes seem to demonstrate a positive synergy when coupled, which would seem to be good news for many distance learners. While early work with college students by Travers (1964) found no efficiency differences between audio, visual, and combined presentation modes, Kim (1983), Pinsky and Wipf (2000), and Ginther (2002) found otherwise. Part of Kim's study incorporated extended pauses at sentence boundaries in an attempt to improve comprehension of compressed speech.

Kim also varied the wpm rate of the speech and the nature of pictures that were presented to 120 college students, and found that adding pictures increased comprehension when the audio wpm rate was increased, but that adding time to pauses fostered no comprehension increases with increases in wpm rates. Pinsky and Wipf (2000) also noted that recall and comprehension are increased when audio is incorporated with visual materials in instructional tasks. Ginther, working with the listening comprehension section of the Test of English as a Foreign Language (TOEFL), found that with audio information, complementary visual information enhanced subject performance.

Factors That Affect Listening

Listening is multidimensional and includes physiological, cognitive, and behavioral elements (McKenzie & Clark, 1995), all of which have potential for affecting levels of comprehension. Hearing acuity is a physiological component, with hearing acuity and comprehension related (Schneider & Daneman, 2000). Even those who have no problems with hearing itself often must deal with incomplete auditory stimuli in conversational speech (Helfer, 1997).

The cognitive and behavioral elements of listening include selection, interpretation, and evaluation (Friedman, 1978). Blanchard (1992) contends that our selectivity with listened-to material induces us to retain mostly that which agrees with our own points of view. Level of interest (Bentley, 1998; Alexander, Jetton, & Kulikowich, (1996; Nichols, 1948b)) also relates positively with comprehension, with Machlachlan (1982) adding that listener attitudes toward the speaker are significantly improved when compressed speech is utilized, adding that humans tend to equate knowledge, enthusiasm, and confidence with fast, yet fluent speech. The interpretation process of listening involves both the text itself and the existing knowledge of the recipient (McKenzie & Clark, 1995). Culture may affect interpretation (Kintsch, 1998). Bostrom (1996) writes that one’s interests, motivations, and attitude (the latter corroborated by Strickland (1957)) are all involved in how one evaluates and comprehends listened-to material. Lingren (1997) addressed the issue of attention in listening by blaming the overwhelming quantity of aural stimuli for inducing a lack of listener attention-with 12,500 words spoken daily, on average, by each human being, association with multiple persons at work/home/both can induce a cognitive tuning out process.

Some research has been done on the role of gender in listening comprehension, resulting in no clear consensus. For example, Todd (1992) tested 136 undergraduates for comprehension of material within conversations and found gender to be a non-factor in results. In earlier work by Sewell (1973), however, it was found that men comprehended more than women (to a statistically significant degree) on a 20-question test over speech given to 120+ undergraduates. Women, though, outperformed men in listening comprehension studies done by Dwyer (1980) and Halay and Roberts (1989). Dwyer worked with 157 second grade children from a rural environment. Halay and Roberts utilized a national high school student sample of 397 in comparing scores on the Watson-Barker Listening Test.

Nonverbal aspects are involved in listening and can affect comprehension: examples include pitch, modulation, volume, and tone of the audio signal (Kodish, 1998; Blanchard, 1992), as well as posture and facial expression in face-to-face interactions (Hasan, 2000; McConnell, 2000; Thomas & Levine, 1994).

A landmark article by Nichols (1948b) described some additional factors involved in listening comprehension, based on his study with 200 college freshmen. Among these factors were intelligence, reading comprehension ability, ability to listen to discern main idea, interest in subject, and fatigue. That year, Nichols (1948a) also wrote that gender of listener, susceptibility to distractions, room environment (temperature, ventilation), and speech training in high school also have potential effects on listening comprehension.
In later work, Bentley (1998) reported still more factors, including perceived importance of source (speaker, etc.), effectiveness of the audio source, and perceived consequences of failure to comprehend, relating to the effectiveness of listening. In this research having instructors present for all test administrations, in the rooms where classes are usually held, will act as some control for variables such as room environment and perceived importance of listening. Bostrom and Waldhart (1980) classify listening processes into three categories: (1) “lecture”, or long-term, listening (retention for more than ten minutes); (2) short-term listening (retention for a minute or less); and, (3) rehearsed short-term listening (keeping something in mind by conscious repetition). The

first two categories are tested strongly by the stimulus materials of this study. In summary, factors both within and outside the control of the listener affect his or her comprehension of audio material. As can many other factors, pause lengths can act as positive or negative forces in the pursuit of optimum comprehension. This study seeks to maximize the positive nature and minimize the negative qualities of pause lengths in listening comprehension.

Theories Involving Listening

An audio stimulus acts as a code, of sorts, that triggers imagery in the listener's mind. Royer (2001) built on Johnson-Laird's "Mental Model" theory (1983) in positing that comprehension (of text or of audio) involves a synthesis of the information presented with the existing knowledge of the recipient, the product of which is a mental representation of the stimulus. Related theoretical work consisted of the constructive integration theory, advanced by Kintsch (1988). Kintsch's theory proposes that mental representations have a micro-level and macro-level structure (the former involves meaning of utterances, the latter a bigger picture of understanding up to chapter or book levels). Noblitt (1995) and Gillard (1996) also wrote about the sound-to-image translation that takes places during the listening comprehension process.

Studies Using Compressed/Expanded Speech (Mostly with Subjects College Age or Younger)

Students have been subjects for numerous studies involving compressed speech, which may give credence to the idea that efficiency in listening is important to educators and learners. Even though compressed speech tends to place increased cognitive burden on the message recipient (Weaver, 1972), faster presentation rates seem to be a preference of students. For example, in a study of 75 college students in a first year computer science course, where random rate access to audio from a lecture was granted, Harrigan (1995) found that students liked having the audio played at faster rates. Some years earlier, Short (1977) also worked with college students and found that they preferred listening to tapes of compressed speech over tapes of normal wpm rates.

As often as they have been attempted, studies in compressed speech have failed to yield consistent results with student subjects. Some successes with compressed speech were reported, including Sullivan (1982), who worked with 75 university students in part to improve listening skills. Instructional speech compressed from 150 wpm to 375 wpm over a six-week period was one of the experimental treatments. At the conclusion of the study, those students who underwent this treatment were better able to comprehend audio materials (at normal and speeded rates) than did students who underwent visual-based pacing treatment or no external treatment. In his pretest-posttest procedure, Sullivan used analysis of variance testing on means of dependent variables and found statistical significance for experimental treatments. Fulford (1989) also found success, working with 78 vocational education students to determine if time could be saved while learning objectives were still met, by utilizing: text (by itself); text combined with normal-speed speech (175 wpm); and, text combined with speech that was compressed to 262 wpm. Her results showed that text (by itself) and text combined with 262 wpm speech were equally effective and efficient, and that both were superior to text combined with 175 wpm speech. Subjects saved significant time completing tasks when the compressed speech component was used in combination.

Other researchers found that increasing rates of audio presentation reduced comprehension. For example, Payne (1984) worked with fourth-grade students in a listening comprehension study. He utilized sixteen stories of fourth-grade reading level, and used presentation rates of 87.5, 175 (normal), 262.5, and 350 wpm. Half the subjects took the test in oral form, and half in written form. A 20-question multiple choice test was used for evaluation. Payne's general finding was that comprehension scores improved at the slower presentation rates. Servinsky (1980) had a similar finding with students who had just entered a school for Morse code. Servinsky compared comprehension score means of listening comprehension test recordings at four rates, finding that comprehension decreased with increases in word rate. Finally, Williams (1982) worked with 131 community college students to determine how listening comprehension would be affected by varying compression rates of speech. The highest scores were found to be from speech that was not compressed.

Still other researchers found compressed speech to be a non-factor in comprehension, including Rader (1990). Rader analyzed recall of speech, both at normal speed and expanded at two different rates, with ninety (90) university students in third-quarter Spanish classes. The dependent variable was the percentage of text recalled. Means for the three word rates used showed no differences of significance in analysis of variance. Finding no differences of significance in comprehension is a positive for compressed speech in studies such as Rader's, because it then is demonstrated that the audio material utilized can indeed be speeded without comprehension compromise.

In summary, college students seem to prefer faster rates for presentation of audio materials. Compressed speech studies with this group demonstrate inconsistency in results. Studies involving the use of a standardized listening test are apparently lacking. There seems to be cognitive thresholds for processing of audio, which of course, likely vary by individual. A possible advantage of allowing users to choose rates of audio presentation may be that users can stay under such thresholds while maximizing learning efficiency.

Studies (Many Compressed Speech) with Older and/or Hearing Impaired Subjects

Those who use resources offered by the NLS are often older persons. Evidence indicates that age affects audio information processing negatively with older persons, but that some cognitive plasticity remains. For example, experimental work by Ramsel (1984) compared recall and reading times for younger and older adults. Older persons were found to be adaptive and flexible in their information processing abilities. However, the older adults also displayed, on average, lower recall scores and slower reading times than their younger counterparts in the study. Ramsel posited a slower speed of language processing as a reason why older persons undergo decline in memory. Subsequent work by Gordon-Salant and Fitzgibbons (1995) focused on difficulties older persons have with less-than-ideal audio stimuli. They hypothesized that age increases the hearing difficulties associated with acoustic degradation of speech (which can take the form of distortion, noise, rapid speech, and speech in reverberant environments). Their testing revealed that multiple degradation conditions fostered significant age effects. Previously, Gordon-Salant and Fitzgibbons (1993) found that age and hearing impairment contribute to problems of recognition of speech that is temporally distorted (reverberant speech, interrupted speech, the speech of fast talkers, etc.). Other work stated the facts more bluntly: Wingfield (1996) repeated the findings of Glynn and Muth (1979) and found that in general, older persons have more difficulty than their younger counterparts with comprehension and recall of compressed speech.

Findings of compressed speech studies using older persons as subjects show variation, as do similar studies using student subjects. Most such work with older subjects reflects aforementioned student difficulties with compressed speech. An example is Wingfield, Poon, Lombardi, and Lowe (1985), who found that performance for older adults declined not only with length of audio segment, but also with increasing wpm rates. Similarly, Lund (1996), who worked with 28 adults aged 60+ using auditory tests that included compressed speech, found performance declining with age. Holland and Fletcher (2000) used more older subjects (69 of them, aged 55-83) having each listen to stories at different rates of speech (75, 115, and 175 wpm), then reading a story at his or her own rate. Their results showed recall performances at the two slowest rates of speech bested those of the 175 wpm speech rate and the self-paced rate. Working with older women only, Mourad (1986) divided 50 subjects aged 56 to 95 into four 10-year age intervals, and used word lists compressed 0, 30, 40, 50, and 60% to measure auditory processing in the brain. Among Mourad's findings were significant age-related declines in listening discrimination scores with concomitant increases in compression rates.

Despite a number of studies demonstrating the struggles older persons seem to have with compressed speech, expanded speech failed to serve as a panacea, according to Mehta (2000). Mehta worked with older, hearing-impaired subjects to determine if speech slowed during a digital expansion technique affected their speech processing abilities. The treated speech (expanded at various rates) had a negative effect on subjects' processing; no age effects of significance were found.

Among studies that compared performances of older subjects with those of younger subjects was Wingfield and Ducharme (1999). These researchers used both time-compressed and time-expanded speech with both older and younger adults, allowing all subjects to choose a preferred rate. Part of their procedure was to delete portions of text material and have subjects infer the content of deleted portions (passages regarded as more difficult were those in which such inferences were harder to make). They found that older adults more often preferred slower rates than their younger counterparts, but that most (older and younger) subjects preferred rates faster than that of the original recording. Additionally, all subjects preferred slower rates for more difficult passages. They also found that older persons are able to assess the difficulty level of recorded speech, and thus modify their rate preferences, as well as younger persons, a finding that indicates continued presence of elasticity within the older human brain.

As do comparable studies with student subjects, however, compressed speech studies with older subjects show varied results. Working with 50 adults, Kim (2001) used narratives of synthetic speech, inserting pauses of various lengths therein to obtain five rates of speech ranging from 8.75 to 140 words per minute. It was found that levels of comprehension did not change significantly with rate alterations.

It should be mentioned that many of the compressed/expanded speech studies (with both older and younger subjects) suffered from very small sample sizes and audio materials that were disparate.

Studies Involving Blind/Visually Impaired Persons

Using a reading test, Hensil and Whittaker (2000) found that (older) subjects with low vision can "read" as quickly by listening to speech as their non-impaired counterparts do when reading conventionally. In their study, Hensil and Whittaker used audio played at progressively faster rates, allowing each of 53 subjects to adjust gradually to the rate as it rose to his or her individual limit of comprehension. The two researchers discovered there was resistance on the part of some older subjects to use any kind of magnification means or to use audio literature, due to fears of being labeled "blind." In their results, it was also found that the type of text affected comprehension, depending on subjects' familiarity with the type of text. That is, people generally read fiction more quickly than nonfiction.

Continuing with the theme of cognitive fluidity in processing of audio stimuli, Foulke (1965) sent samples of compressed speech to 100 blind college students enrolled in a blind student assistance program. Asking their preferred rate of presentation for the samples, Foulke reported that 275 wpm was the overall preferred rate, but that students in college the longest preferred rates that were faster, to a 350 wpm maximum.

Demonstrating further the role of audio information delivery in listening comprehension, Luxton (1983) used the STEP Test of Listening Comprehension to compare 30 sighted and 30 blind adults. At identical speeds, the test was recorded on tape in two formats: one utilized a professional reader, the other a Kurzweil Reading Machine. Luxton's hypothesis was that comprehension of the Kurzweil synthesized version would be less than the professionally read version. Analysis of variance and Pearson Product correlation procedures showed differences of significance in favor of the professionally read version.

Subtleties in presentation rate can make for noticeable differences in comprehension, according to Stromer (1974). While reporting that fewer than 3% of Braille readers can match the speed of sighted persons reading aloud (the latter with a 150 wpm average). Stromer also wrote that the nature of some audio materials is such that a reduction of 10% in required time for listening can result in far less frustration. In such instances time saved can be relatively little but the perception may be just right even when a slight adjustment in presentation speed is made.

The theme of studies involving blind/visually impaired persons seems to be that the brain has some pliability as far as processing of heard stimuli is concerned. Speeding up material (within reason) without comprehension loss seems possible in certain instances, with adjustments to quicker presentation also often taking place.

Compressed Speech—Evaluations

Past studies involving compressed speech and/or pauses in audio text provide background information for the present study. In compressed speech a great deal of research has been performed (Jonassen, 1996). Most studies were performed in the 1960s and 1970s. Recent research that deals with compressed speech (Harrigan (2000) is an example) incorporates many references from articles that are decades old. In his overview of the field of compressed speech, Jonassen (1996) cites more than 50 works. Of these, fewer than five were completed since 1980. On this basis, compressed speech can likely be considered a mature field of study. Despite its impressive body of research, however, compressed speech seems not to have been demonstrated to be an efficient means of increasing aural information comprehension. Other researchers seemed to concur on this point. Sticht (1971), for example, found that overall comprehension of audio material was not increased by using speech compression. While subjects indeed saved listening time, they tended to use that time to enhance their learning of certain portions of material, seemingly at the expense of other portions. Schramm (1972) found no differences in learning between subjects that heard the same material once at normal speed and subjects that heard it twice at double the speed. Blau (1990) indicated that results of studies involving effects of speech rate manipulation on listening comprehension have been inconsistent. Jonassen (1996) reported that short-term exposure to compressed speech often fosters increases in listening comprehension, but research has been mostly unsupportive of the idea that compressed speech increases learning efficiency.

Again, the researcher contends that compressed speech, in its modification of the entire speech signal (both phonemes and pauses), may be too broad an approach in attempting to increase listening comprehension.

In summary of previous research, compressed speech—at a minimum in forms that use technologies from previous decades--does not seem to be the answer to modifying aural information presentation for better comprehension.

Studies Involving Pauses

According to many researchers, pauses comprise an important element of audio information processing. According to three researchers (Grosjean, 1980; Siegman, 1978; Goldman-Eisler, 1968) pauses themselves relate to both physiological and cognitive necessities. For speakers, pauses are necessary for breathing, and for listeners, pauses are necessary for purposes of information processing. In fact, in the wake of studying rate-altered speech that only worsened comprehension in older subjects, Mehta (2000) postulated that cues in speech, not speech rate, had the most to do with comprehension. Lengths and frequencies of pauses are determined by both physiological and cognitive components. In related work, Steinhauer, Alter, and Friederici (1999) looked at processing of speech in terms of neurology, indicating that structural elements such as pauses serve to guide initial cognitive analysis of speech, and that unnatural breaks in the audio signal can induce difficulties in processing. In further study, Steinhauer and Friederici (2001) reported that cues such as pauses in audio materials structure information into smaller components, and have considerable affect on how one processes audio information. Earlier work by Bestgen (1998), Chafe (1980), and Lounsbury (1954) had pointed out that in discourse, segment break points such as pauses enhance not only continuity, but also discontinuity (such as change in direction or thought within sentences). More simply, Marcus (2002) wrote that with speech, pauses act as punctuation. Absence of prosodic features such as pauses, wrote Hakulinen, Turunen, and Raiha (1999), creates a monotonous audio presentation often disliked by listeners.

Results of studies involving pause alterations appear to be more promising than those of compressed speech. In some pause studies, adding to existing pause lengths increased comprehension. In other studies, reduction in pause lengths had no significant effect on comprehension, a positive outcome for those who desire increased listening efficiency. Nooteboom (1983), for example, worked with 6 Dutch subjects, asking them to write their understandings and recollections after hearing six 25-word synthetic speech sentences. Some of the sentences had pauses added to them to make the presentation sound more like human speech. Results showed that performance improved with insertion of pauses. Synthetic speech was used also by Pennella (1992) with 16 subjects, using synthetic speech sentences. Pennella varied sentence lengths and pause lengths and tested his subjects for recall of key words. Results showed that recall improved with pause length and declined with increases in sentence length. A similar study was performed by Gutek (1993) using five sentences recorded by speakers with nervous system-related muscle control loss. Sixty subjects transcribed the five sentences. Gutek inserted pauses between words in one version of the recordings and found that intelligibility of the speech (measured in subject scores) improved by 5% with pause insertion.

Adding lengths to pauses, but by differing amounts, was a twist executed by Maddox (1989) who used synthetic speech to test 36 college students. The presentation rate of speech was reduced by creating pauses between the words at various intervals. Maddox's finding was that intelligibility rose dramatically with pause length over the 0-285 millisecond pause range, but that no differences of significance were demonstrated over the corresponding 286-595 millisecond range.

Location within text of lengthened pauses was important in four studies. Blau (1990) worked with 36 Polish and 70 Puerto Rican students in a language laboratory, using text recorded at 3 rates: normal speed, reduced speed, and normal speed with 3-second pauses introduced only at selected text positions. Comprehension scores were by far the best with pause-insertions and were the worst with reduced speed speech. Labelle (1973) worked with 36 children, 18 of whom had a mean age of 3.67 years, and 18 of whom had a mean age of 5.25 years. Labelle inserted pauses at major phrase break points within aural sentences, then tested comprehension effects. Results showed that the younger group of children comprehended more with pauses inserted at break points (such as where a comma would be placed) than with pauses inserted between phrase break points or without any pauses inserted (results with the older group of children showed no differences of significance). Wingfield, Tun, Koh, and Rosen (1999) worked with 18 volunteers aged 64-84 and 18 university students aged 18-28. Subjects listened to identical passages in 4 forms: original 165 wpm rate; time-compressed to 300 wpm; time-compressed with pauses added to restore the presentation to 165 wpm; and time compressed with pauses added to effect a rate of 206 wpm. Two versions of the pauses-added conditions were made: one version had pauses added only at boundaries of syntax, the other had pauses added at other points. Results showed that performances for both age groups improved when listening to the 206 wpm presentations, improving more from having pauses added at boundaries of syntax. Younger subjects recalled almost as much at 206 wpm as at 165 wpm, but older subjects did not. Wingfield, Tun, and Rosen (1995) used both time compression and speech segmentation (adding pauses either at random or between sentence clauses) with young and old adults. Their findings were that increases in rate of speech and in random segmentation of speech resulted in less recall for older adults.

Studies involving reductions in pause length seem to show that comprehension is not compromised significantly by such reductions. For example, a large-scale study was performed by Brown (1973), who utilized 168 college student subjects to determine effects on listening comprehension of pause deleted, time-compressed audio materials. He used an unaltered control group version of audio material and three experimental versions that incorporated pause deletions. Listening comprehension test results revealed no differences of significance among control and experimental versions. Brown replicated the testing with 192 additional college students with like results. With 30 college students, Merlet (2000) also found no comprehension differences of significance in recall testing when pause lengths of audio stimulus materials were reduced.

Breaking with the trend of pause length alterations aiding some way in comprehension/efficiency was a study performed by Uchanski, Choi, Braida, Reed, and Durlach (1996). These researchers altered segments of speech in two ways: by deleting pauses from sentences spoken more clearly than normal, and by inserting pauses into normal speech. After subjects listened to both presentations, identification of key words taken from the sentences was shown to be lower for both versions. Therefore, both lengthening and shortening of pauses were detrimental to comprehension in Uchanski, et. al., a rarity in the context of other similar studies. That both pause lengthening and pause shortening worsened comprehension may indicate that for certain kinds of audio materials, pause lengths must fall within a narrowly-defined range; deviations from such a range result in comprehension loss.

Another rare study in pause length analysis (this time in the context of stimulus material used) was performed by Sheehan and Aseltine (1973), who utilized a standardized listening comprehension test in their work. Specifically, Sheehan and Aseltine used selections of the Sequential Tests of Educational Progress to test 30 aphasics, with half of them under age 50, the other half over age 50. The researchers tried to show that temporal sequence of audio can relate to difficulties in comprehension. For one experimental version the researchers surrounded each phoneme of the selections with 150 msec of silence. For another experimental version the same amount of silence was added after each word. The younger group of subjects (but not the older) benefited comprehension-wise from the silence-surrounded phonemes condition.

Many studies have indeed been performed in the realm of pauses in audio material. Again, however, one can state that the stimulus materials used for these studies were quite disparate, and sample sizes were often small. An apparent literature gap this study fills is that all versions of the audio material used in this study not only retained all pauses in the same text locations as the tried-and-true standardized (control group) version, but also had altered pauses shortened or lengthened by the same amounts (e.g. lengthened by 300 msec in version 2). Relative subtraction/addition of pause lengths was exactly controlled.

An interesting phenomenon with both pause length and compressed speech studies is that much of the research seems to have been performed in relative isolation. Few researchers seem to write multiple articles, let alone build on previous studies of their own or of others.

A possible explanation for the paucity of repetition and follow-up work may be the subject-driven nature of the research. When students are tested within classroom settings, as was the case in this study, permission from instructors must first be secured. Instructors understandably might not be willing to grant such permission on more than one occasion, if at all. A researcher may then be forced to pay student subjects for their time (an expensive proposition for large-scale studies). Even when subjects can easily be obtained in large numbers, compressed speech/pause length research is labor-intensive and time-consuming. In addition, the preparation of stimulus materials and purchasing of equipment may be expensive.

Some compressed speech/pause length researchers, however, have been prolific. Emerson Foulke (1929-1997) wrote a number of articles on compressed speech in the 1960s and 1970s. Blind from a point very early in life, Foulke, a psychology professor at the University of Louisville, founded the Perceptual Alternatives Laboratory there. Improving vision and developing vision alternatives to facilitate action, as well as comprehension, were the guiding principles of the Perceptual Alternatives Laboratory. Foulke was a proponent of acquiring information through non-visual, as well as visual, channels, examples of the former including recorded speech and voice-overs. Foulke's compressed speech research laid the groundwork for the recorded speech research that continues today, characterized by faster/slower presentation rates that do not compromise pitch or intelligibility (Rieser, Lappin & Jones, 1999).

Dr. Harry Goldstein produced some of "…the most frequently cited early work on altering the rate of presentation of oral material" (Duker, 1974, p. 45). Goldstein felt that varying rates of oral and visual presentations was essential in comparing the comprehension effected by the two learning modes. Technology had not yet advanced to the point where Goldstein could utilize a speech compressor to vary the presentation rate of audio material; among other methods, he used playback rates faster than those of the original recordings in his research (Duker, 1974).

Grant Fairbanks worked with associates to develop a speech compressor in the 1950s. Electronically, this device accomplished the work of deleting portions of speech signals that had previously been done by cutting and splicing analog tape by hand for use in accelerated speech research (Duker, 1974).

Within the last ten years, Arthur Wingfield has written and co-written multiple articles on compressed speech, many of which focus on older persons. The norm, however, seems to be one-time research efforts produced in isolation.

Brown, Carlsen, Carstens (BCC) Listening Test

In the literature, the use of a standardized listening test as stimulus material for pause length research is apparently rare. The BCC test used in this study incorporates five components of listening comprehension: (A) Immediate Recall; (B) Following Directions; (C) Recognizing Transitions; (D) Recognizing Word Meanings; and, (E) Lecture Comprehension. The BCC has been used extensively over a number of years to assess the listening ability of subjects from high school through adult levels. Studies involving compressed speech, and studies involving different learning modes have been performed in both college and high-school level situations using the BCC (Lundsteen, 1984). Other uses have included: an investigation of listening ability and success in shorthand (Nunez (1980) found a positive correlation); an investigation of the efficacy of listening skills training (Remark, 1990); an investigation of the correlation between listening ability and retention/attrition in a sample of university students (a positive correlation was found by Conaway (1981)); and, an investigation of the effects of repeated listening, and listener training, on listening comprehension (nonsignificant and significant, respectively, results were obtained by Johnson and Richardson (1968)).

In her review of the BCC, Lundsteen (1984) wrote, “The educational philosophy of this test appears to be holistic and oriented to integrated and real-life uses of listening”

(p. 35). Lundsteen saw the transitions section and lecture comprehension section as the BCC sections of greatest research value.

Kelly (1965) questioned the validity of an earlier version of the BCC, contending that the test may have been more indicative of reading ability or intelligence than of listening in particular.

Bateman, Frandsen, and Dedmon (1964) used a factor analysis procedure to call into question the lecture comprehension portion of the BCC. Their conclusion was that the difficulty of defining “lecture comprehension” leads to the incorporation of different and unrelated dimensions, and consequently some difficulties with validity.

However, Carstens (1996b) wrote that the most recent version of the BCC has corrected earlier validity woes, in part due to test-taking instructions being incorporated into the test recording (as opposed to previously having been read by test proctors, a technique introducing other variables). He added that each section of the current BCC has been found to measure different skills, and that correlation of BCC scores with reading test scores shows that listening and reading are not synonymous (their measures have distinct values). According to Carstens, scores from 8000 test takers in 16 states were used to norm the standardized listening test.

BCC test reliability seems to be high. Early work by Johnson and Frandsen (1963) praised the practicality and reliability of the test. Carstens (1996a) added that one of the measures used to determine BCC reliability was to perform a coefficient study for grade 10-12 students taking the test in geographically separate communities. The range of coefficients was .84 to .90 in the study. He wrote also that the fluency and consistency of speech offered by the entirely recorded format of the test adds to its reliability.

Motivations for Listening

Analogous to reading, listening can be performed with pleasure or learning (or both) in mind. The goal of pleasure seeking is commonly associated with narrative (such as listening to or reading popular fiction (Nell, 1985). Usually one pursues such material for its own sake (intrinsic purposes) (Apter, 1979). Johnson and Giorgis (2002) characterized pleasure reading as that performed without the need to prove any level of comprehension. Nell (1988) wrote that interaction with the material is influenced by a person’s values and personality and produces cognitive “events” that act as a reward.

The goal of information acquisition, to which students devote much of their listening and reading time, is associated with the comprehension of lectures (Mulligan & Kirkpatrick, 2000). This form of material consumption is motivated extrinsically; that is, for purposes and rewards generated by an incentive separate from the activity itself, such as a course grade (Eisenberger & Cameron, 1996).

Though having to do with reading, three studies nonetheless explain that users of different information seeking motivations vary the rates at which they use the same source. For example, Eanet and Meeks (1979) reported that in reading for information, a mean flexibility of 55% (a 1.55 ratio) was found for subjects reading passages of scientific material. Focusing on pleasure reading, Carver (1983) reported that a “flexibility ratio” exists and is calculated by dividing the wpm speed of the passage most quickly read by that of the passage most slowly read within the same material. Nell (1988) also reported that readers place a high value on rate control, and regularly alter their rate within the same text.

Finally, Metsala (1996) reported that both intrinsic and extrinsic motivation relate positively with comprehension.

In summary, as do motivations for acquiring information by other means, motivations for listening differ. Listening can be pursued for purposes of learning or for purposes of pleasure. Related to motivation is that users tend to (consciously) vary rate of information acquisition and value having control over rate of acquisition.

CHAPTER 2

METHOD

Subjects

Subjects, a total of 144 participants, were students drawn from those enrolled in undergraduate psychology classes at Ripon College in Ripon, Wisconsin.

The Ripon College students were attentive and cooperative throughout the testing procedures. They were respectful and friendly to the researcher as well as to their peers, and were willing to ask questions. After explaining to them the purpose of the study, the researcher found the Ripon students quite willing, even eager, to participate.

Subjects were divided into four testing groups with a minimum of 30 subjects in each group. Tests were randomly assigned to each group. Upon obtaining instructor permission to test a particular class, the researcher chose one test version at random to administer to that class, until all four test versions had been administered. Psychology classes to which the tests were administered were made up of both upper and lower academic levels.

An undergraduate liberal arts institution, Ripon College has an enrollment of approximately 950 students (53% female) and is quite homogeneous in the makeup of its student body (*Ripon College*, 2001). The majority of Ripon students come from the Midwest, and almost 90% of the students are White, non-Hispanic. Black, non-Hispanic and Hispanic students represent 2.0% and 3.4% of the population, respectively. International students comprise 2.6% of the Ripon population. On-campus housing is utilized by 97% of the student body (*Ripon College*, 2001).

The mean ACT score for incoming Ripon freshmen in 2002 was 24, with a 22-26 score range representing the middle 50%. Corresponding middle 50% figures for the SAT were 540-670 verbal and 570-640 mathematical. With a high school GPA of 3.37, the modal incoming Ripon freshman in 2002 graduated in the top 27% of his/her high school class (*Facts about Ripon College*, 2002; *Ripon College Student Life*, 2002).

Table 2 displays, by test condition, the numbers and percentages of Ripon College women and men participating in the study. Table 3 displays overall numbers of men and women tested in the study.

Table 2

Age, Gender Breakdown of Subjects by Test Condition

Condition	Men<20	Men 20+	Women <20	Women 20+	**Totals**
Control	1 (3%)	10 (26%)	2 (5%)	26 (67%)	39 (100%)
+300 msec	2 (5%)	11 (28%)	8 (20%)	19 (48%)	40 (100%)
-150 msec	12 (36%)	6 (18%)	15 (45%)	0 (0%)	33 (100%)
-150 msec	14 (44%)	3 (9%)	11 (34%)	4 (13%)	32 (100%)

(note: individual percentages are rounded)

Table 3

Overall Age/Gender Breakdown of Subjects:

	Age <20	Age 20+
Men	29	30
Women	36	49

Overall raw numbers:

Men: 59 (41%)
Women: 85 (59%)

Less than 20 years: 65 (45%)
20 and older: 79 (55%)

Apparatus and Stimulus Materials

A copy of the BCC Listening Comprehension Test audio was used as the stimulus material in this study. The software that was used to alter the pauses within the stimulus material was called "Studio Recorder." It was made available to the researcher by the American Printing House for the Blind for research purposes.

Four versions of the Brown, Carlsen, Carstens (BCC) Listening Comprehension Test were the stimulus materials. Each experimental version presented the test materials with pause increases or decreases in one of three lengths. The pause lengths in the original recording were not decreased or increased when presented to the control group.

The BCC measures five listening skills in separate sections: (A) Immediate Recall ("In the list of words: on, to, in, at, by, the third word is…"); (B) Following Directions ("The number above the first vowel [on the answer sheet] is…"); (C) Recognizing Transitions (subject listens to a sentence and indicates whether it is introductory or transitional in nature); (D) Recognizing Word Meanings ("What does 'run' mean in the sentence, 'The vine will run up the fence…"); and, (E) Lecture Comprehension ([after hearing the lecture] "What did the man at the dinner party sell…"). BCC is the oldest published listening test and has been widely used (Wolvin & Coakley, 1996), with the BCC copyright dating back to 1953. The most recent edition (1996) incorporates a total of 76 questions and is the edition used for this study. This latest version of the BCC is normed not only for students of all college levels, but also for all adults (Wolvin & Coakley, 1996).

A digital recording of the 40.25 minute BCC test was made and converted to CD format from the original cassette tape recording. The researcher transcribed the test (Appendix A); included in the transcription were points of punctuation perceived by the researcher in listening to the test. Three additional CD-based versions of the BCC were then made, with pauses added or subtracted at places where commas, periods, or semicolons existed (as perceived by the researcher), and at other instances where pauses (such as pauses for effect) were included. A total of 385 pauses were shortened or lengthened within each of the 3 versions. Indications of where pauses were altered are recorded in Appendix A. Altered pauses were in the same positions for all three experimental versions of the test and were of exact, electronically measured lengths. A timer incorporated into the software executes numeric shortening/lengthening commands. The lengths of the altered pauses differed. Only the control group version retained pause lengths at their original recorded rate. In instances where a written response to a question was required, pause lengths were left unaltered to allow time for recording of responses. Likewise, pause lengths were left unchanged for the directions given prior to each of the test sections. Appendix A is a text version of the BCC. Positions in the audio text where pauses were altered are indicated.

Pause lengths within the original BCC test vary. Between sentences, between announcement of test question numbers, and reading of questions, pauses tend to be longest, varying from about 700 msec to about 1500 msec. Intra-sentence pauses also vary, from about 300 msec to about 500 msec in most cases. Original pause lengths found to be too short in duration (without resulting in removal in parts of phonemes or inducing a noticeable jolt in the flow of reading) were left unaltered.

The lengths of the pause alterations were chosen on the basis of information from previous research involving pause lengths. The varied recording conditions, speech styles and speech genres used in previous studies made consensus determinations of length index(ces) very difficult (Campione & Veronis, 2002). Pause length multiples of 150 msec seem to emerge most frequently. In Campione and Veronis' work, for example, pause lengths of about 150 msec (for shorter pauses) and 450-500 msec (for longer pauses) were most common in the English speech they analyzed. Most direct in declaration were Feldstein and Welkowitz (1978), who wrote 300 msec is the most common unit of analysis in studies involving lengths of pauses. Thus, on the basis of previous work, and with three experimental cells in this study (along with the lone control group cell), the decision was made to utilize 150 msec and 300 msec for pause shortening, and 300 msec for pause lengthening.

It was decided that four versions of the BCC would be used in the present study. The first version (control group) had no changes in lengths of existing pauses within the text. The second, third and fourth versions were rerecorded to include pause length decreases or increases. The second version had original pauses lengthened by 300 msec, thereby increasing the overall length of the presentation. The third version had original pauses shortened by 150 msec, thereby decreasing the overall length of the presentation. The fourth version had the original existing pauses shortened by 300 msec, thereby further decreasing the overall length of the presentation. Table 4 displays pause length changes, aggregate stimulus material length, and percent stimulus material length change.

Table 4

Pause Length Modifications, Stimulus Lengths, and Percentage Changes

	control group	experimental group #1	experimental group #2	experimental group #3
pause length alteration	(none)	+300 msec	-150 msec	-300 msec
aggregate stimulus	22 min	24 min	21 min	20 min
percent change	0%	+9.1%	-4.55%	-9.1%

The analog BCC Test was then rerecorded onto the digital Studio Recorder software. To accomplish this, the researcher connected a Pioneer VCTW603RS cassette player to a Hewlett-Packard hp pavilion 540n computer. This was accomplished with use of a Belkin F8V235-06 “Y” audio cable that connected the line output jacks of the cassette player with the sound card jack of the computer, as shown on Figure 1.

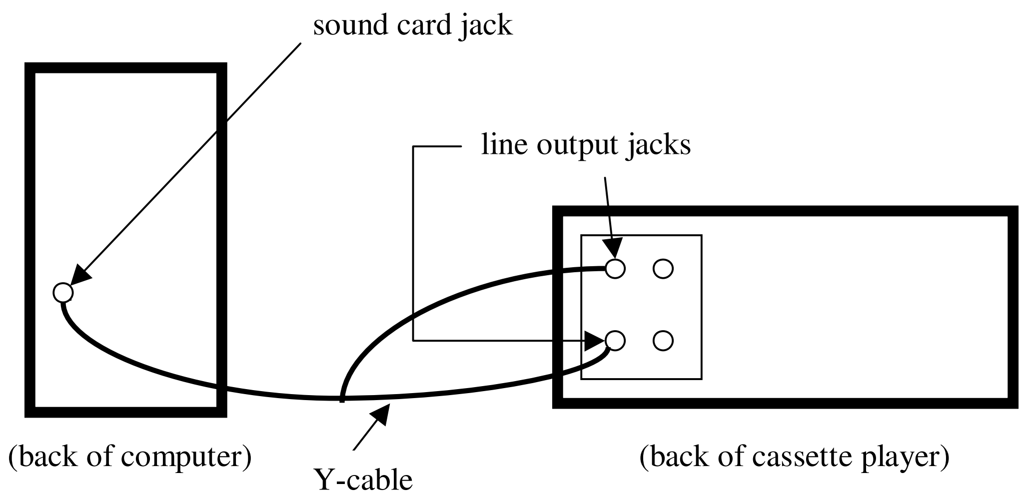

Figure 1. Computer to Cassette Player Connection

The recording software was opened from the desktop. A BCC test cassette was inserted into the cassette player and the play button was pressed. The recording function of Studio Recorder was then initiated when the commands Transport => Record were entered, as shown in Figure 2.

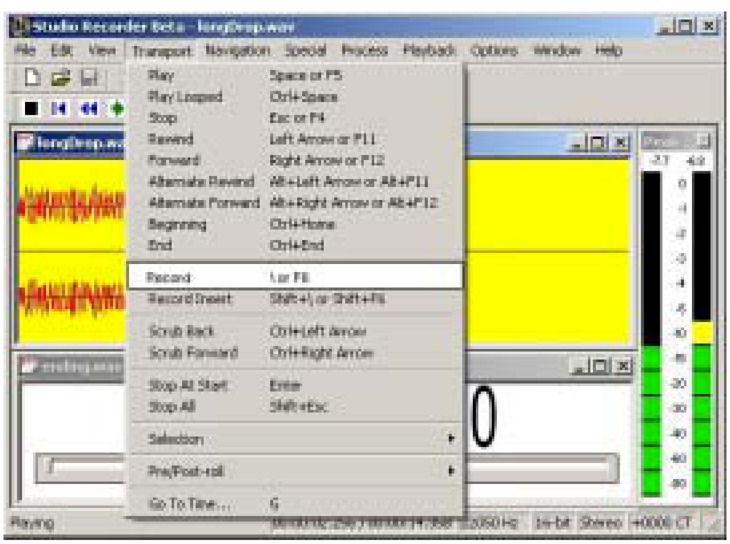

Figure 2. Studio Recorder Recording Commands
(from American Printing House for the Blind, *Studio Recorder User's Manual, 2001-2002*; reprinted by permission)

Once the control group version of the BCC was made and saved as a .wav file on the C: drive of the computer, the three experimental versions were made, using the Studio Recorder software. Each resulting file was then re-saved under a different name. This process was performed three times, once for each of the three experimental test versions. Following this, each version was burned onto its own Spin-X CD-R 700mb compact disc using the CD burning function on the researcher's computer.

Function buttons on the top left of the Studio Recorder screen display can be used to play, stop, fast forward, and rewind the sound files on the software.

When a sound file is played on Studio Recorder, it is concomitantly displayed on the computer screen in the form of sound waves, as shown below on Figure 3.

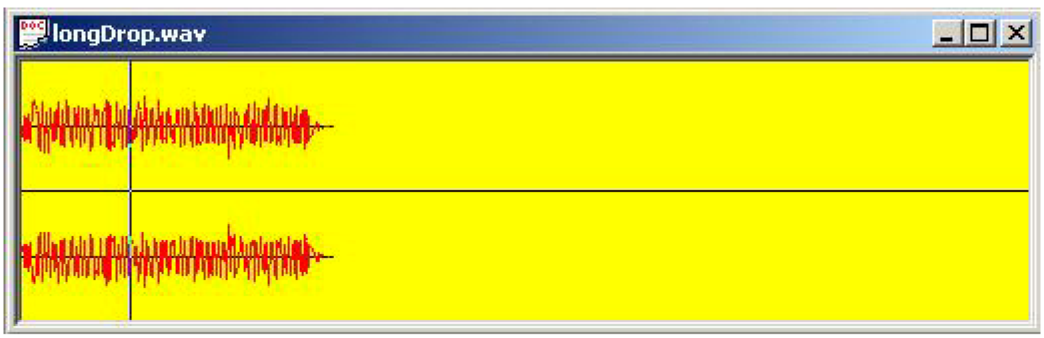

Figure 3. Studio Recorder Sound Wave Display
(from American Printing House for the Blind, *Studio Recorder User's Manual, 2001-2002*; reprinted by permission)

The cursor indicates the current position of the text within the sound file and moves left to right as the file is played. With the mouse one can move the cursor to any point along the wave at any time. A solid horizontal line within a wave display indicates a period of no sound; i.e., a pause in the recorded text (similar to the line found at the end of the sound waves shown in Figure 3).

To find existing pauses, the software was used to play back the recorded text while the researcher viewed the test transcription at the same time. A copy of the test transcription is found in Appendix A. After determining where a pause length was to be altered, the researcher stopped play and placed the cursor at that exact point and executed commands to either lengthen or shorten a pause, according to the following directions.

When pauses were lengthened, the commands used with the software were Process => Insert Silence. As a result of these commands, a digital timer appeared on the screen. The timer allowed the user to insert a pause of any length, to 1/1000th of a second, as shown below in Figure 4:

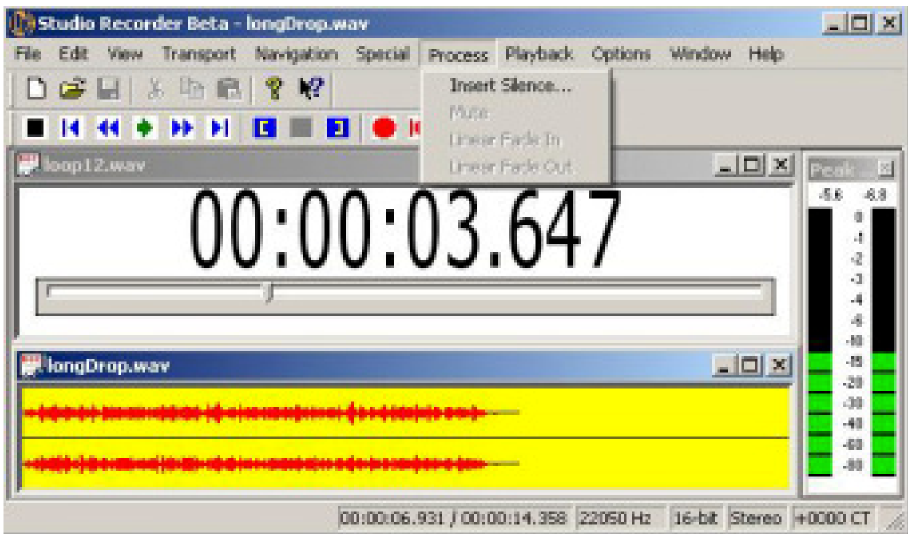

Figure 4. Studio Recorder Pause Insertion Timer
(from American Printing House for the Blind, *Studio Recorder User's Manual, 2001-2002*; reprinted by permission)

When pauses were shortened, the first step was to stop play and place the cursor at the point where a pause length was to be reduced. Again, this entailed placing the cursor at the point where a pause already exists. Then, the commands Edit => Selection =>Set Selection were executed. A small box then popped up with "Start time" and "End time" in separate fields within the box. "Start time" and "End time" are the same at this point. The "Start time" number was then reduced by changing the number in the "Start time" field to a number 300 msec (for example) less. The "Start time" and "End time" then differed by 300 msec. 300 msec (the eventual pause length reduction in this example) is then "selected" by clicking "OK" in the pop-up box. The pop-up box then disappears. Then, clicking Edit => Cut from the main menu of the Studio Recorder software deletes the "selected" 300 msec from the sound wave, which then reduces the length of the pause by 300 msec.

The four versions of the BCC test were recorded on Spin-X CD-R 700mb compact discs.

Playback of CDs during test administrations was accomplished by using a Sony CFD-G55 model 20-watt boombox.

Procedure for Testing

Test administrations were performed in Ripon College classrooms, during regularly scheduled classes on November 11, 15, 18, 19, and 25, 2002, with permission of instructors having been secured in advance. Five days of testing was required to administer the four test versions because two of the classes had relatively small enrollments. Subjects from these two smaller classes (different sections of the same course that met on different days) were administered the same (control group) version of the test, and their scores were combined for analysis. Instructors were present during all test administrations at Ripon College.

The researcher set up a CD boombox on a table in the front of the room, facing the subjects. Prior to arrival of subjects, the researcher loaded the CD player with one of four randomly selected versions of the test.

After being introduced to the class by the instructor, the researcher addressed the class briefly. The researcher mentioned that the testing is part of his dissertation research and that he would come back in a few weeks to return individual scores to students as well as report the results of his statistical calculations. The researcher explained that he first would distribute the FSU informed consent form for human subjects research. The researcher then asked subjects to read the human subjects informed consent form and raise their hands to ask questions they might have. At this time no questions were posed by any subjects in any group. The researcher asked subjects to sign the consent form or allowed them to leave if they chose not to participate. No subjects chose to abstain from participation. After collecting the signed consent forms, the researcher distributed blank BCC test answer sheets, and offered no. 2 pencils to anyone who wished to use them (any pen or pencil to record responses was acceptable).

The researcher then informed subjects that directions for filling out the answer form and taking the test are contained within the CD recording. The researcher then informed subjects that they need not enter their name, occupation, or organizational affiliation on the answer sheet, as requested by the voice on the recording. Instead, subjects were told they could supply any nine-digit number of their choosing where they were requested to enter their social security number, but to try to remember the number entered so that their test results can be identified by them from a composite chart of testing result scores. Finally, subjects were offered the option of indicating on the answer form whether or not they consider themselves to be hearing-impaired (by any criteria of their choosing), or do not consider English to be their native language, by placing a "1" in the first box of the Organizational Affiliation field (researcher held up the BCC answer sheet and pointed to this location) if they are hearing impaired, or a "2" in the second box of the Organizational Affiliation field (again researcher held up the BCC answer sheet and pointed to this location) if they do not consider English to be their native language.

The researcher then asked for and responded to any further questions from subjects. One subject asked about room-related variables that could arise in test taking with the various groups. The researcher responded that such variables were controlled (as well as possible) by administering all tests within the same rooms where individual classes were usually held. When all questions were answered, the researcher indicated that the test would take a little more than forty minutes' time and would begin immediately. The researcher did not tell subjects which version of the test they were taking. The researcher then proceeded to play the CD test version chosen for the testing group.

After testing was completed, the researcher collected the answer sheets and pencils from the subjects and thanked them for their participation.

Answer sheets that indicated a self-reported hearing deficiency or that English was not the subject's native language were noted by the researcher. Overall numbers were recorded. One subject in the +300 msec group reported that English was not his or her native language. Data from that subject were treated no differently than data from any other student in the study.

The researcher then recorded birth date and gender information of the subjects in each of the groups and calculated the results (using chi-square analysis in the "Results" section).

The researcher then sent the answer sheets (separated by version of the test taken) to BCC, Inc. for machine scoring. Score reports were returned to the researcher in early December 2002. The researcher paid BCC, Inc. for their services of providing materials and scoring answer sheets.

The analysis of variance and the Kruskal-Wallis test were performed to determine the statistical significance of experimental effects. The dependent variables were the mean numbers of errors in each of the five sections (A-E) of each of the four versions of the test used, as well as the means of cumulative error totals by each subject. The pause lengths for each versions of the test (0 msec for the control group, +300 msec, -150 msec, and -300 msec, respectively) were the independent variables.

No data was collected that was unused in analysis. As aforementioned, the null hypothesis was that no differences of statistical significance exist among means of the number of errors for each test section as well as the cumulative number of errors. The alternative hypothesis was that such differences of statistical significance exist (.05 significance level, one-tailed testing for analysis of variance).

During the final week of classes at Ripon College in fall 2002, the researcher returned to the college and, again with advance permission of instructors, met with the classes to which the test was administered. The researcher gave subjects copies of their individual score report forms, informed them of the test version their class had taken, and relayed to them a brief summary of the experimental results. The researcher thanked the instructors and students for their cooperation and participation. A couple subjects inquired about Section E of the test (Lecture Comprehension), indicating that discerning the starting point of the lecture material was somewhat difficult. The resultant confusion, the subjects furthermore indicated, might have led to committing more incorrect responses than would otherwise have been the case.

Design

The independent variable in all cases was the version of the BCC test taken by subjects. The dependent variables are the mean numbers of incorrect responses in each of the five sections of the BCC. The experimental design is presented in Table 5.

Table 5

Experimental Design

	Version of BCC Test Used			
BCC Section	Control Group	Experimental Group #1 (+300 msec)	Experimental Group #2 (-150 msec)	Experimental Group #3 (-300 msec)
(A) Immediate Recall				
(B) Following Directions				
(C) Recognizing Word Meanings				
(D) Recognizing Transitions				
(E) Lecture Comprehension				
Total Number of Errors				

CHAPTER 3

RESULTS AND DISCUSSION

Results

Each of the 144 Ripon College subjects contributed eight pieces of data: numbers of incorrect responses on each of the five sections of the listening comprehension test, total number of incorrect responses, gender, and age. Raw data are displayed in Appendix D. Data were entered into *SPSS Student Version 11.0 for Windows* for computation.

For primary purposes of analysis, analysis of variance (ANOVA) and Kruskal-Wallis tests were used. ANOVA was the test of first choice. When its assumptions about data can be met, this parametric test determines to what degree the variability of scores on a dependent variable is accounted for by differences in the levels of the independent variable (*STATPAC Gold IV: Advanced analyses*, 1992). The nonparametric Kruskal-Wallis test, which "…ranks scores and determines if the sums of the ranks are so disparate that they are not likely to be from samples drawn from the same population" (Hernon, 1994, p. 217), was also used to analyze data.

The raw data from the four pause length groups comprised the content of the cells of the four independent variables. Of the 144 subjects who took the test, 39 took version 1, 40 took version 2, 33 took version 3, and 32 took version 4. Some, including Milligan, Wong, and Thompson (1987), contend that statistical testing with cells of unequal sizes can accentuate existing data imperfections and potentially produce erroneous results. Others, including Scott and Yurachek (1981) contend that with use of means for analysis (the case in this study) the potential for such problems is decreased. Keppel (1991) however contends that cells of equal size should be used for testing whenever possible. For this study, testing was done with data in both unequal and equal cell sizes, to see if equalizing cell sizes would affect results in any way. Unequal cells consisted of the data in its entirety. Equal cells were obtained from the random case sampling function of SPSS, which randomly deleted all data from 16 of the subjects (7 from version 1, 8 from version 2, and 1 from version 3) to create equal cells of 32 subjects each.

Computations to determine if all ANOVA assumptions were met proceeded as follows. The first assumption is that distribution of scores is normal (Hernon, 1994). The Kolmogorov-Smirnov test was performed to assess normality. Table 6 summarizes the results of this testing, which showed that all distributions were calculated as normal.

Table 6

Kolmogorov-Smirnov Normality Testing Results

	Section A	Section B	Section C	Section D	Section E	Total Errors
Unequal cells	.0008	.001	.0015	.001	.0007	.0005
32 Each Cell	.001	.001	.002	.001	.0007	.0008

(critical value for alpha =.05 is .120; critical value for alpha = .10 is .108 (Massey(1951))

Since no scores on the Kolmogorov-Smirnov test were equal to or above .120 (or even .108), it was found that all distributions for both unequal and equal cell conditions were normal. Therefore, the first ANOVA assumption, that the distribution of scores is normal (for both unequal and equal cells), was met.

The second ANOVA quantitative assumption is that variances are equal or nearly equal (Hernon, 1994). This assumption was tested using the Levene statistic. Table 7 summarizes the results of this testing.

Table 7

Levene Statistic Homogeneity of Variance Test Results

	Section A	Section B	Section C	Section D	Section E	Total Errors
Unequal cells	.595	.080	.135	.008*	.033*	.345
32 Each Cell	.560	.126	.078	.014*	.058	.365

Sections: A = Immediate Recall
B = Following Directions
C = Recognizing Transitions
D = Recognizing Word Meanings
E = Lecture Comprehension

(* Statistically significant, denoting that variance is not homogeneous)

The .008 and .033 results for Sections D and E in the unequal cell condition, and the .014 result for Section D in the equal cell condition were found to be significant. Therefore, for sections D and E using data with unequal cells, and for section D using data with 32 subjects in each cell, the homogeneity of variance assumption (that variances are equal or nearly equal) was not found to be the case and the homogeneity assumption was not met. Therefore, ANOVA could not be used in analysis of Section D (for both unequal and equal cells) and for the unequal cells portion of Section E.

The third assumption of ANOVA, random sampling, was presumably met in all instances.Written consent from individual subjects was obtained, so all subjects had known, equal chances of participation (known/equal inclusion chances being characteristic of random sampling, according to Drott (1969)). Furthermore, the population selected for sampling was in a single location and was homogeneous, meeting assumptions for random sampling outlined in Hernon (1994).

Means of numbers of incorrect responses generated by the Ripon College students are displayed in Table 8.

Table 8

Mean Numbers of Incorrect Responses

		A	B	C	D	E	Entire Test
Control	Unequal Cells	5.10 (2.198)	4.18 (2.704)	2.18 (1.189)	2.26 (1.272)	9.15 (4.252)	22.87 (7.212)
	Equal Cells	5.09 (2.006)	4.38 (2.768)	2.31 (1.148)	2.31 (1.306)	9.81 (4.169)	23.91 (6.846)
+300 msec	Unequal Cells	4.70 (2.198)	5.03 (3.416)	1.43 (.958)	2.35 (1.626)	9.85 (3.563)	23.35 (8.390)
	Equal Cells	5.03 (2.117)	5.19 (3.459)	1.41 (.911)	2.53 (1.586)	10.31 (3.468)	24.47 (8.156)
-150 msec	Unequal Cells	4.97 (2.271)	4.67 (4.136)	2.21 (1.269)	3.24 (1.458)	10.58 (2.883)	25.67 (7.078)
	Equal Cells	4.97 (2.307)	4.75 (4.174)	2.25 (1.270)	3.25 (1.481)	10.41 (2.758)	25.63 (7.188)
-300 msec	Unequal Cells	5.50 (2.300)	5.56 (4.885)	2.03 (1.402)	2.78 (.975)	9.50 (3.492)	25.38 (9.220)
	Equal Cells	5.50 (2.300)	5.56 (4.885)	2.03 (1.402)	2.78 (.975)	9.50 (3.492)	25.38 (9.220)

(standard deviations in parentheses)

Sections:

A – Immediate Recall (17 questions)
B – Following Directions (20 questions)
C - Recognizing Transitions (8 questions)
D – Recognizing Word Meanings (10 questions)
E – Lecture Comprehension (21 questions)
(76 questions total)

The results of ANOVA testing (utilizing the means in Table 8) are displayed in Table 9. Section D (both unequal and equal cell conditions) and the unequal-cell condition of Section E are not displayed in Table 9 because the data in these instances was not found to be sufficiently homogeneous for meeting the assumptions of ANOVA, as reported in Table 7. The Kruskal-Wallis test (Table 10), a nonparametric technique, was used to test Section D and Section E data.

Table 9

ANOVA Testing Results (F-values)

	Section A	Section B	Section C	Section E	Total Errors
Unequal cells	.779	.833	3.593*	--	1.109
32 Each Cell	.385	.561	3.826*	.475	.326

Sections: A = Immediate Recall
B = Following Directions
C = Recognizing Transitions
E = Lecture Comprehension

(*Statistically significant at .05 level)

In the ANOVA test results, the 3.593 F-value for Section C with the unequal cell condition, and the 3.826 F-value for Section C with the equal cell condition, were found to be significant, indicating that pause lengths did affect the scores on Section C (Recognizing Transitions) to a degree that was statistically significant. For both unequal cell and equal cell situations, Section C was the only section in which statistical significance was found using ANOVA.

It was decided a second test of the differences within all data should be done, utilizing a test where assumptions would not exclude any portion of the data. The Kruskal-Wallis test, the nonparametric equivalent of ANOVA about which no assumptions about data are required, was then used for all data calculations. Table 10 displays the results of the Kruskal-Wallis test.

Table 10

Kruskal-Wallis Testing Results

	Section A	Section B	Section C	Section D	Section E	Total Errors
Unequal cells	2.035	2.177	10.362*^	10.503*^	2.346	2.338
32 Each Cell	1.062	1.818	11.581*^	7.195^	1.324	.624

Sections: A = Immediate Recall
B = Following Directions
C = Recognizing Transitions
D = Recognizing Word Meanings
E = Lecture Comprehension

(*Significant at .05 level. ^Significant at .10 level)

Values of 10.362 (Section C, unequal cells), 11.581 (Section C, equal cells), and 10.503 (Section D, unequal cells) were statistically significant at the .05 level. The value of 7.195 (Section D, equal cells) was statistically significant at the .10 level.

For sections A, B, and E, as well as for total errors, the Kruskal-Wallis testing results were not significant. For Section D with 32 subjects in each cell, Kruskal-Wallis testing was not significant at the .05 level, but was significant at the .10 level. The difference in level for which significance was found in Section D represented the only difference in results, in terms of being significant/not significant, that was effected by testing both unequal-and equal-sized cells. It is important to note that the results of both the ANOVA and the Kruskal-Wallis tests revealed only that somewhere within Section C and Section D data some difference(s) of significance exist. The exact location(s) was not identified by either the ANOVA or the Kruskal-Wallis tests. It was then necessary to identify the specific pause length conditions of Section C and Section D that triggered the significance.

For the two ANOVA F-value results of significance in Section C, the Tukey HSD (Honestly Significant Differences) test was performed to determine exactly where the pause length differentials that triggered significant F-values were located. The Tukey HSD is a multiple comparison testing procedure designed for samples with equal variances, such as the Section C data in this study. Multiple comparison tests, in general, are performed to further assess characteristics of data for which differences of statistical significance are found (Winer, 1971). Table 11 indicates the results of Tukey HSD testing for Section C, using unequal cells, and Table 12 does the same using equal cells. For each of the test versions, the differences between mean scores (representing numbers of incorrect responses) are displayed in the third column.

Table 11

Tukey HSD Testing Results for Section C, Unequal Cells

Test Version	Test Version	Mean Differences, # of Errors
1 (Control)	2	.75*
	3	-.03
	4	.15
2 (+300 msec)	1	-.75*
	3	-.79*
	4	-.61
3 (-150 msec)	1	.03
	2	.79*
	4	.18
4 (-300 msec)	1	-.15
	2	.61
	3	-.18

(*Statistically significant at .05 level)

Table 12

Tukey HSD Testing Results for Section C, Equal Cells

Test Version	Test Version	Mean Differences, # of Errors
1 (Control)	2	.91*
	3	.06
	4	.28
2 (+300 msec)	1	-.91*
	3	-.84*
	4	-.63
3 (-150 msec)	1	-.06
	2	.84*
	4	.22
4 (-300 msec)	1	-.28
	2	.63
	3	-.22

(* Statistically significant at .05 level)

As reported in Table 8, the unequal cell and equal cell conditions produced slightly different numerical values for means of numbers of incorrect responses on Section C (Recognizing Transitions). Likewise, subsequent calculations of differences between means were slightly different numerically. However, for Tukey HSD testing of both unequal cell and equal cell conditions, the breakdown of results, in terms of being statistically significant/not significant, was identical (for example, the mean difference of Version 1 and Version 2 was significant for both conditions, but the mean difference of Version 1 and Version 3 was not significant for both conditions).

In both Table 11 and Table 12, results of significance were found in comparisons of Version 1 (control) with Version 2 (+300msec), and Version 2 (+300msec) with Version 3 (-150msec). Specifically, Version 2 (+300msec) yielded fewer errors than all other versions for Section C (Recognizing Transitions), with significantly fewer errors than Version 1 (control) and Version 3 (-150msec), indicating that for this sample, +300msec was the pause length condition that produced the fewest errors.

For both equal and unequal cells, then, results show that for Section C (Recognizing Transitions) of the listening test, it was the adding of 300msec to lengths of pauses that reduced the numbers of errors to a degree that was statistically significant.

For the two Kruskal-Wallis test results of significance in Section D (Recognizing Word Meanings), the Games-Howell test, a multiple comparison test designed for use with samples with unequal-variance samples, was performed. For Games-Howell testing of both unequal cell and equal cell conditions, the breakdown of results, in terms of being statistically significant/not significant, was the same in both cases. For example, the comparison of the mean difference of Version 1 and Version 3 was statistically significant, but the comparison of the mean difference of Version 1 and Version 2 was not statistically significant. Table 13 indicates the results of this testing with unequal cells, and Table 14 indicates the results of the Games-Howell test with equal cells.

Table 13

Games-Howell Testing Results for Section D, Unequal Cells

Test Version	Test Version	Mean Differences, # of Errors
1 (Control)	2	-.09
	3	-.99*
	4	-.52
2 (+300 msec)	1	.09
	3	-.89
	4	-.43
3 (-150 msec)	1	.99*
	2	.89
	4	.46
4 (-300 msec)	1	.52
	2	.43
	3	-.46

(* Statistically significant at .05 level)

Table 14

Games-Howell Testing Results for Section D, Equal Cells

Test Version	Test Version	Mean Differences, # of Errors
1 (Control)	2	-.22
	3	-.94*
	4	-.47
2 (+300 msec)	1	.22
	3	-.72
	4	-.25
3 (-150 msec)	1	.94*
	2	.72
	4	.47
4 (-300 msec)	1	.47
	2	.25
	3	-.47

(* Statistically significant at .05 level)

As reported in Table 8, the unequal cell and equal cell conditions produced slightly different numerical values for means of numbers of incorrect responses on Section D (Recognizing Word Meanings). Likewise, subsequent calculations of differences between means were slightly different numerically. However, for multiple comparison testing of both unequal cell and equal cell conditions, the breakdown of statistically significant/not significant results was the same. For the Games-Howell tests, reported in Table 13 and Table 14, results of significance were found in comparisons of Version 1 (control) with Version 3 (150msec). Specifically, Version 1 (the control group version) yielded fewer errors than all other versions for Section D (Recognizing Word Meanings), with significantly fewer errors than Version 3 (-150msec). Therefore, Version 1 (the control group) was found to be the pause length condition that significantly produced the fewest errors

For unequal and equal cells, results for Section D (Recognizing Word Meanings) show that reducing lengths of pauses by 150msec increased subject errors to a degree that was statistically significant. Reducing pauses by 300 msec also increased subject errors, but not to a degree that was statistically significant. Obviously reducing pause lengths by 150msec or 300msec would not be prudent for increasing recognition of word meanings.

A separate Games-Howell multiple comparison test was performed on Section C (Recognizing Transitions). The results were identical to those of the Tukey HSD multiple comparison test described previously. That is, Version 2 (+300msec) yielded fewer errors than all other versions for Section C (Recognizing Transitions), with significantly fewer errors than Version 1 (the control group) and Version 3 (-150msec), indicating that for this sample, +300msec was the pause length condition that produced the fewest errors. Therefore, the +300msec pause length condition might be a starting point for future investigations to discover optimal pause lengths for increasing the recognition of transitions in recorded stimulus materials.

Separate two-tailed chi square statistical procedures were performed for age data and for gender data to assess how alike the samples of the subjects taking different versions of the test were. Chi-square testing in general, "…measures the significance of differences between two independent groups" (Hernon, 1994, p. 139).

The total age and gender data in each of the four cell groups in Appendix D were tallied. For age, the samples were divided into two groups: (1) persons less than twenty years of age; (2) persons 20 years of age and older. For gender, the samples were also divided into two groups: (1) male; (2) female. Table 15 displays the final results of chi-square calculations, indicating that differences of statistical significance exist between the age groups and between the gender groups of subjects who took the BCC.

Table 15

Chi-Square Testing Results for Age and Gender

	Chi-square values	
	Age	Gender
32 each cell	54.357*	10.007*

(*Statistically significant at .05 level)

The chi-square test results confirmed that for both age and gender, the sample groups were quite different from each other statistically. These results were not too surprising given that: (1) both lower and upper academic level students were represented in the classes participating in the study; and, (2) more females than males took the test. The test results indeed reflected the tabulated raw data in Tables 2 and 3 (Subjects section).

With regard to age, Table 2 indicates that subjects listening to the longest pause length versions of the BCC (control and +300msec) were predominantly older (at least 20 years of age) and female. The statistically significant disparities in age among test participants could also be in part due to the randomness procedure used to assign tests to the four pause length groups. Also, some age differences within any particular class might be attributed to some classes having a greater number of (relatively) older students enrolled in the class. The average age of a Ripon student is twenty (20), according to *WisconsinMentor* (2002). For this reason, twenty was used as the point dividing age groups for analysis. Students less than twenty years old comprised the first group. Students twenty years of age and older comprised the second group. Age differences were found to be significant in chi-square testing. Gender differences were also found to be significant in chi-square testing. With respect to gender differences (Table 2), it should be noted 26 more females than males participated in the unequal cell tabulation, and 26 more females than males participated in the equal cell tabulation. It should be considered that age/gender differences within a given pause length group can be attributed to chance.

Additional Tests

In a further effort to discover age and sex differences, t-tests were performed on each of the five test sections (Immediate Recall, Following Directions, Recognizing Transitions, Recognizing Word Meanings, and Lecture Comprehension). For all BCC test conditions in aggregate as well as for individual BCC test versions, mean errors for each section, by age and gender, were calculated and compared using the t-tests. It should be noted, however, that for many of these t-tests, data assumptions were unmet, including normality and homogeneity of variance; any or all results of t-tests therefore may be questionable. Tables 16-21 display the means that were used for these t-test calculations.

Table 16

Aggregate Mean Errors by Age, Gender

Test Version	Overall	Female	Male	<20	20+
Control	22.87 (7.212)	22.93 (6.949)	22.73 (8.199)	18.33 (6.807)	23.25 (7.205)
+300 msec	23.35 (8.390)	22.56 (9.345)	25.00 (5.930)	21.10 (6.350)	24.10 (8.934)
-150 msec	25.67 (7.078)	23.93 (6.262)	27.11 (7.561)	25.44 (6.710)	26.67 (9.223)
-300 msec	25.38 (9.220)	24.87 (10.155)	25.82 (8.604)	24.24 (8.531)	29.43 (11.118)

(standard deviations in parentheses)

Table 17

Section A Mean Errors by Age, Gender

Test Version	Overall	Female	Male	<20	20+
Control	5.10 (2.198)	5.11 (2.266)	5.09 (2.119)	5.33 (2.082)	5.08 (2.234)
+300 msec	4.70 (2.198)	4.96 (2.328)	4.15 (1.864)	4.30 (2.497)	4.83 (2.119)
-150 msec	4.97 (2.271)	5.13 (2.167)	4.83 (2.407)	5.00 (2.166)	4.83 (2.927)
-300 msec	5.50 (2.300)	5.60 (1.957)	5.41 (2.623)	5.36 (2.196)	6.00 (2.769)

(standard deviations in parentheses)

Table 18

Section B Mean Errors by Age, Gender

Test Version	Overall	Female	Male	<20	20+
Control	4.18 (2.704)	4.36 (2.542)	3.73 (3.165)	1.67 (1.528)	4.39 (2.686)
+300 msec	5.03 (3.416)	4.48 (3.577)	6.15 (2.853)	4.70 (2.452)	5.13 (3.711)
-150 msec	4.67 (4.136)	3.53 (2.066)	5.61 (5.158)	4.70 (3.811)	4.50 (5.822)
-300 msec	5.56 (4.885)	5.80 (5.990)	5.35 (3.840)	5.12 (4.206)	7.14 (6.986)

(standard deviations in parentheses)

Table 19

Section C Mean Errors by Age, Gender

Test Version	Overall	Female	Male	<20	20+
Control	2.18 (1.189)	2.18 (1.156)	2.18 (1.328)	3.00 (.000)	2.11 (1.214)
+300 msec	1.42 (.958)	1.48 (.975)	1.31 (.947)	1.40 (.966)	1.43 (.971)
-150 msec	2.21 (1.269)	2.20 (1.320)	2.22 (1.263)	2.19 (1.241)	2.33 (1.506)
-300 msec	2.03 (1.402)	1.93 (1.710)	2.12 (1.111)	1.96 (1.274)	2.29 (1.890)

(standard deviations in parentheses)

Table 20

Section D Mean Errors by Age, Gender

Test Version	Overall	Female	Male	<20	20+
Control	2.26 (1.272)	2.36 (1.283)	2.00 (1.265)	2.67 (1.528)	2.22 (1.267)
+300 msec	2.35 (1.626)	2.37 (1.668)	2.31 (1.601)	2.00 (1.764)	2.47 (1.592)
-150 msec	3.24 (1.458)	3.07 (1.335)	3.39 (1.577)	3.33 (1.569)	2.83 (.753)
-300 msec	2.78 (.975)	2.87 (1.060)	2.71 (.920)	2.68 (.988)	3.14 (.900)

(standard deviations in parentheses)

Table 21

Section E Mean Errors by Age, Gender

Test Version	Overall	Female	Male	<20	20+
Control	9.15 (4.252)	8.93 (4.285)	9.73 (4.315)	5.67 (4.509)	9.44 (4.164)
+300 msec	9.85 (3.563)	9.26 (3.591)	11.08 (3.303)	8.70 (2.710)	10.23 (3.766)
-150 msec	10.58 (2.883)	10.00 (3.251)	11.06 (2.532)	10.22 (2.940)	12.17 (2.137)
-300 msec	9.50 (3.492)	8.67 (2.350)	10.24 (4.191)	9.12 (3.492)	10.86 (3.388)

(standard deviations in parentheses)

Table 22 displays results of t-tests with age and gender data by BCC test section.

Table 22

T-Test (Two-Tailed) Results by Sections for Age and Gender

Condition	t-value	critical value (.05 sig.)	degrees of freedom	statistical Significance
All, cumulative errors by age	-.294	1.983	142	No
All, Section A errors by age	-.012	1.983	142	No
All, Section B errors by age	-.316	1.983	142	No
All, Section C errors by age	.625	1.983	142	No
All, Section D errors by age	1.721	1.983	142	No
All, Section E errors by age	-1.196	1.983	142	No
All, cumulative errors by gender	1.576	1.983	142	No
All, Section A errors by gender	-.672	1.983	142	No
All, Section B errors by gender	1.246	1.983	142	No
All, Section C errors by gender	.312	1.983	142	No
All, Section D errors by gender	.495	1.983	142	No
All, Section E errors by gender	2.322	1.983	142	Yes
Control, cumulative errors by age	-1.139	2.027	37	No
Control, Section A errors by age	.187	2.027	37	No
Control, Section B errors by age	-1.718	2.027	37	No
Control, Section C errors by age	1.253	2.027	37	No

Table 22-continued

Control, Section D errors by age	.577	2.027	37	No
Control, Section E errors by age	-1.503	2.027	37	No
Control, cumulative errors by gender	-.077	2.027	37	No
Control, Section A errors by gender	-.020	2.027	37	No
Control, Section B errors by gender	-.650	2.027	37	No
Control, Section C errors by gender	.008	2.027	37	No
Control, Section D errors by gender	-.785	2.027	37	No
Control, Section E errors by gender	.523	2.027	37	No
+300, cumulative errors by age	-.979	2.025	38	No
+300, Section A errors by age	-.660	2.025	38	No
+300, Section B errors by age	-.343	2.025	38	No
+300, Section C errors by age	-.094	2.025	38	No
+300, Section D errors by age	-.782	2.025	38	No
+300, Section E errors by age	-1.185	2.025	38	No
+300, cumulative errors by gender	.860	2.025	38	No
+300, Section A errors by gender	-1.093	2.025	38	No
+300, Section B errors by gender	1.472	2.025	38	No
+300, Section C errors by gender	-.533	2.025	38	No
+300, Section D errors by gender	-.113	2.025	38	No
+300, Section E errors by gender	1.537	2.025	38	No

Table 22-continued

-150, cumulative errors by age	-.377	2.040	31	No
-150, Section A errors by age	.160	2.040	31	No
-150, Section B errors by age	.107	2.040	31	No
-150, Section C errors by age	-.255	2.040	31	No
-150, Section D errors by age	.754	2.040	31	No
-150, Section E errors by age	-1.525	2.040	31	No
-150, cumulative errors by gender	1.298	2.040	31	No
-150, Section A errors by gender	-.373	2.040	31	No
-150, Section B errors by gender	1.462	2.040	31	No
-150, Section C errors by gender	.040	2.040	31	No
-150, Section D errors by gender	.626	2.040	31	No
-150, Section E errors by gender	1.049	2.040	31	No
-300, cumulative errors by age	-1.332	2.042	30	No
-300, Section A errors by age	-.645	2.042	30	No
-300, Section B errors by age	-.967	2.042	30	No
-300, Section C errors by age	-.537	2.042	30	No
-300, Section D errors by age	-1.115	2.042	30	No
-300, Section E errors by age	-1.170	2.042	30	No
-300, cumulative errors by gender	.289	2.042	30	No
-300, Section A errors by gender	-.227	2.042	30	No
-300, Section B errors by gender	-.254	2.042	30	No

Table 22-continued

-300, Section C errors by gender	.366	2.042	30	No
-300, Section D errors by gender	-.460	2.042	30	No
-300, Section E errors by gender	1.281	2.042	30	No

Only one of the t-tests performed was statistically significant: all test conditions for Section E errors by gender. Specifically, men committed more errors than women to a degree that was statistically significant when data from all test conditions for Section E were tested. This one t-test result (men committing more comprehension errors than women) is in agreement with the work of Halay and Roberts (1989) and Dwyer (1980). This t-test result, however, contradicts that of Sewell (1973), who found that men committed fewer errors than women. All other t-tests in the present study yielded results that were not statistically significant, findings that corroborated those of Thomas (1992), who reported no gender differences of statistical significance in his study.

The statistically significant result of one t-test provided some evidence that differences in scores according to gender do exist. However, unlike the ANOVA and Kruskal-Wallis findings, the t-tests did not reveal significant differences for Section C (Recognizing Transitions) and Section D (Recognizing Word Meanings). One of the reasons for this discrepancy may be that in many instances, t-test assumptions were unmet in this gender/age data. Furthermore, in some of the t-test situations, sample size discrepancies were very large (for example, where means of 3 men and 36 women were compared), a situation that renders meaningful comparisons of age and gender differences difficult. Therefore, all the t-test results displayed in Table 21 may be questionable.

This Results section is summarized as follows. Data was analyzed using unequal cell sizes and cells equalized through SPSS-aided random data deletion. The ANOVA and Kruskal-Wallis tests determined the statistical significances of the data. Significance was found in Section C (Recognizing Transitions) and in Section D (Recognizing Word

Meanings). Subsequent multiple comparison tests of these sections (Tukey HSD for Section C and Games-Howell for Sections C and D) revealed that for Section C (Recognizing Transitions) the +300msec version yielded the highest scores with both unequal and equal cells. For Section D (Recognizing Word Meanings) the control group version yielded the highest number of errors with both unequal and equal cells. Chi-square testing for both age and gender yielded differences of statistical significance among the groups that took the four different test versions of the BCC. The differences found in chi-square calculations could have been partially the result of the random assignment of listening stimulus materials (with different pause lengths) to classes. In addition, subjects who happened to be assigned the two longest pause length versions of the test tended to be older (20 or more years of age) and female, which could also account for some of the differences in the results. With respect to the homogeneity of the Ripon College population, it was mentioned that some of the age/gender differences in any academic student group could be attributed to chance. T-tests on age and sex differences yielded only one finding of statistical significance: gender data from all test versions for Section E (Lecture Comprehension). However, the t-test result in this or any other t-test case in this study may be questionable as much of the data failed to meet t-test assumptions. To avoid confusion, it should be mentioned here that the t-test results for age and gender calculations do not in any way affect the statistically significant findings of the analysis-of-variance and Kruskal-Wallis tests, which compared the score means of the four pause length test versions for the five BCC test sections: (A) Immediate Recall; (B) Following Directions; (C) Recognizing Transitions; (D) Recognizing Word Meanings; and, (E) Listening Comprehension.

Discussion

Changes in levels of the independent variable resulted in statistical significance for mean scores on two of five BCC test sections (Section C, Recognizing Transitions, and

Section D, Recognizing Word Meanings). Mean cumulative error totals, however, were not found to be statistically significant.

The null hypothesis of this study was that for (1) each of the individual sections of the BCC listening test, and (2) the cumulative number of incorrect responses, there would be no differences of statistical significance among the mean numbers of incorrect responses. The alternative hypothesis was that such differences of statistical significance indeed exist.

Table 23 breaks down the hypothesis testing of the study.

Table 23

Null Hypothesis Testing Results

	Null hypothesis at .05 level (unless specified)	
	Unequal Cells	32 Each Cell
Section A	Not Rejected	Not Rejected
Section B	Not Rejected	Not Rejected
Section C	Rejected	Rejected
Section D	Rejected	Rejected (.10 level)
Section E	Not Rejected	Not Rejected
Cumulative Errors	Not Rejected	Not Rejected

It will be recalled that studies such as Short (1977), Junor (1992), and Harrigan (1995) demonstrated that students value faster rates for presentation of audio materials. Results of this study would seem to be good news for students, or other listeners who are interested in increased efficiency. Specifically, for three of five listening comprehension elements tested by the BCC, reducing pause lengths—therefore increasing the overall wpm rate of the presentation—resulted in no comprehension losses of statistical significance. These speeding-sans-penalty results with college student subjects mirror those of Brown (1973) as well as Wingfield, Tun, Koh, and Rosen (1999), and contradict the findings of Lass and Leeper (1977), who stated that pauses at syntactic barriers could not be shortened/purged without comprehension loss. One of the three sections for which significance was not found was lecture comprehension, the section perhaps most applicable to the listening needs of undergraduate college students. Further, when means of cumulative numbers of errors for the five sections were tested, statistical significance was not found.

Nonparametric testing corroborated the results of parametric testing in this study. For section E with unequal cells, as well as section D, the nonparametric Kruskal-Wallis test was the sole means of analysis available, because variance homogeneity assumptions of the parametric ANOVA were violated.

For section C (Recognizing Transitions), adding to length of existing pauses increased comprehension to a statistically significant degree. Blau (1990) had a similar result, albeit with foreign-born (college) students in a language laboratory.

It was indeed encouraging to find two significant results in data from (1) Recognizing Transitions and (2) Recognizing Word Meanings. In the statistically significant case of recognizing transitions, where scores were highest with length added to pauses, it is suggested that this result may be due to a need for more mental processing time to change from one set of mental images to another. In the statistically significant case of Recognizing Word Meanings, it is suggested that the finding of highest scores with the control group may be due to a need for pause lengths to fall only within a narrowly defined processing range, with any deviation from the processing range adversely affecting comprehension.

Test sections involving Immediate Recall, Following Directions, and Lecture Comprehension, as well as totals of data for all five test sections, revealed results of no significance. Immediate Recall involved only recall of numbers and words. Following Directions required somewhat more mental effort, including some arithmetic computations. Results from the Lecture Comprehension section were of special interest.

Though no statistical significance was found for lecture comprehension, the tested Ripon students performed quite poorly on that section, with mean scores demonstrating that about half the lecture comprehension questions were answered incorrectly (Table 8). Mean scores for all other sections, and for the entire test, demonstrated that far lower percentages of questions were answered incorrectly. Perhaps so many lecture comprehension questions were incorrectly answered due to the nature of the lecture material presented and queried. The content of the lecture presented was not necessarily analogous to that which students would customarily hear in college classrooms; the lecture material consisted of mostly facts. It will be recalled that Bateman, Frendsen, and Dedmon (1964) questioned the validity of the lecture comprehension section of the BCC test. In future testing, perhaps the order of presentation of the lecture comprehension section—the last of the five test sections as recorded--could be changed to first or second, for example, to reduce the possibility of subject fatigue by the time the lecture comprehension section begins.

The homogeneity of the Ripon College student body can certainly be cited as a factor in results that failed to demonstrate differences of significance. Similarity of student backgrounds and college experiences (small campus in a small community) play into the previously mentioned factors that affect listening comprehension. On the other hand, the demonstration of some statistical significance in results, obtained with such a homogeneous group of subjects, may underscore the value of pause length alteration studies, thereby building a case for further investigations. The researcher suggests that the pause lengths used in all four test versions may not have been appropriate for the content of the lecture material presented. It would be of interest to try shortening and lengthening pauses by amounts different from those used in this study and comparing results with the results of this study.

Recommendations

Again, the finding of two differences of significance in the results of this study involving (1) transitions and (2) word meanings are encouraging. It is recommended that further studies be done following the format of this study. Since two significant measures were attained it is felt additional studies involving pause lengths should be numerically close to those used in this study, to further define any optimal measures.

The results of this study involved only a standardized test as stimulus material. Future studies involving scientific material, pleasure reading material, and academic subject area materials should also be performed.

If further studies again involving use of standardized listening comprehension tests are desired, other tests such as the Kentucky Listening Comprehension Test and the STEP test (Sequential Tests of Educational Progress) may be considered. Composition of listening tests differs by elements of listening comprehension incorporated, so using multiple tests is a way to include the greatest number of these elements.

If the test material used in this study is desired for future work, a second, isomeric version (E-78) of the BCC is available from BCC, Inc., and could be administered in place of the E-87 version that was used in this study to examine the effects of the fraternal test versions. The E-87 and E-78 versions test the same listening comprehension components in the same way, utilizing different questions. The two versions are considered to be equivalent. Additionally, both versions (or portions thereof) could be utilized in pretest-posttest fashion, allowing for interactions of test version to be measured.

Different ages, academic levels, and achievement levels of students, as well as older persons and/or visually impaired persons, should be studied to see if optimal listening rates could be determined for increasing listening comprehension. The pause lengths in web-based audio materials should also be studied to determine pause lengths that result in optimal ranges of listening comprehension. Studies involving not only fixed-length pause modifications, but also percentage modifications (for example, 10%, 15% pause length additions/subtractions), could be performed.

Digital recording of the test material allows for variation in order of test section presentation. For future study, perhaps the lecture comprehension portion of the test—the last to be presented in the BCC--could be moved to first or second in the order of presentation. It was documented that the Ripon students in this research performed quite poorly on the lecture comprehension section; such a move of sections might counteract subject fatigue as a performance factor for the lecture comprehension section of the BCC.

For this study, potential test administration problems such as lack of subject privacy and large room acoustics were controlled for by having all subjects take the test within such conditions. However, testing under different conditions might be of interest. For example, testing could be performed in language laboratories, using headphones for each subject. Using headphones might allow for better sound quality during playback than can be achieved using boombox speakers in a large room setting. However, problems with headphones fitting properly could interfere with results. Private and/or soundproof rooms could be utilized to reduce outside factors of distraction (though Noblitt (1995) reports attempts to minimize acoustic interference generally fail to spark large-scale gains in comprehension, because humans are accustomed to imperfect acoustics in normal listening). Some tests with listening comprehension components are being conducted using computers; perhaps replications of this testing could follow suit. The development of digital playback software with pause shortening and lengthening capabilities would be highly desirable for all users of audio materials, including users of web-based materials. Blind and visually impaired persons have immediate needs for this technology.

CHAPTER 4

SUMMARY AND CONCLUSIONS

Summary

The effect of digitally shortening and lengthening of pauses on listening comprehension was investigated in this experimental study. The independent variable was the version of listening test that was used (a control group version and three experimental versions, each of which incorporated set alterations in pause lengths). The dependent variables were the mean number of errors on each section of the test, and the cumulative number of errors on all sections.

The Brown, Carlsen, Carstens (BCC) Test of Listening Comprehension, form E-87, was obtained from BCC, Inc. on cassette and rerecorded digitally using software called Studio Recorder. Lengths of pauses within the 5-section, 76-question test were altered to create four versions. Version 1 was the unaltered control group version. Version 2 had existing pauses lengthened by 300 msec. Version 3 had existing pauses shortened by 150 msec. Version 4 had existing pauses shortened by 300 msec. Each version of the test was burned onto its own CD.

Only the stimulus portions of the test were altered. The directions (contained within the test recording) and time allowed for subjects to respond to test questions were both left unaltered. BCC, Inc. provided the researcher with test forms for machine scoring, which were used in the test administrations.

144 subjects, with a minimum of 32 in each of the four groups, participated in testing, which was conducted at Ripon College, Ripon, WI, in November 2002. The subjects were undergraduates enrolled in psychology classes at the college. Testing was conducted in college classrooms during regularly scheduled class periods, with

instructors present for all administrations. A Sony CD boombox positioned at the front of the room was used to present the listening test. Test versions were randomly assigned to the classes that took the test. Prior to testing, subjects were not told which version of the test they were taking.

On the machine-scored answer forms, the researcher collected age and gender information from all subjects immediately prior to testing.

Following the test administrations, the researcher tabulated age and gender information from the answer forms and sent the completed answer forms to BCC, Inc. for machine scoring. The researcher then transcribed the information that was returned from BCC, Inc. The information consisted of numbers of incorrect responses on each of the five sections of the listening test, along with the cumulative number of incorrect responses for the entire test.

After returning score reports to the student subjects at Ripon College, the researcher utilized SPSS Student Version 11.0 for Windows to analyze the data. For primary analysis, data were considered in two fashions—complete, with cells of 39, 40, 33, and 32, respectively, and, in condensed form with 32 subjects in each cell (obtained using the random deletion function of SPSS, which eliminated all data from 16 of the subjects in the control, +300msec, and -150msec groups).

Kolmogorov-Smirnov testing revealed all distributions to be normal. However, the

Levene statistic revealed that variances for Section D (with both unequal and equal cells) and for Section E with unequal cells were not homogeneous.

Analysis of variance was performed on all data excluding those mentioned in the previous paragraph, which violated the variance homogeneity assumption of ANOVA. The Kruskal-Wallis test, the nonparametric twin of ANOVA which requires no assumptions about data, was run on all data and served as the sole means of analysis for the data mentioned in the previous paragraph.

ANOVA results showed statistical significance for Section C (Recognizing Transitions) of the test. For other individual sections tested, as well as cumulative errors, results were not statistically significant using ANOVA.

Results of Kruskal-Wallis testing mirrored those of ANOVA testing.

Additionally, results for Section D were of statistical significance. With unequal cells, significance was attained at the .05 level; with equal cells, significance was attained only at the .10 level.

To ascertain where the testing rate differences of significance were located, multiple comparison tests were performed for sections that were significant. Tukey HSD testing was performed for section C, revealing that adding lengths to pauses improved comprehension to a significant degree.

Multiple comparison testing for Section D (Recognizing Word Meanings) was performed using Games-Howell, a multiple comparison test used when equality of variance is absent. The Games-Howell test revealed that reducing pause lengths in Section D by 150msec induced a statistically significant number of additional errors.

It was suggested that significance found in Section C for the +300msec version of the test may have been due to the need for additional cognitive time to change from one set of mental images to another in the comprehension process. It was also suggested that the significance found for Section D (Recognizing Word Meanings), in which control group scores were highest, might be due to a need for pause lengths to fall only within a narrowly defined processing range, with any deviation from the processing range adversely affecting comprehension. Perhaps the pause lengths incorporated within the control group version of the test were ideal for Recognizing Word Meanings.

Scores on the Listening Comprehension section seemed not to be as high as expected. The high rate of errors may have been due to the high number of facts presented, or, perhaps due to pause lengths not being close to optimal for the kind of literature presented in the Listening Comprehension section.

Chi-square testing for age and gender data for the four sample groups yielded differences of statistical significance in all cases. These differences were very likely due to disproportionate number of females taking the test and the use of groups from both lower and upper academic level classes.

T-tests on age and gender data for test results were statistically significant in only one case, gender data for Section E (Lecture Comprehension) with subjects from all pause length groups considered. However, because assumptions for t-tests were often unmet by the age and gender data, results of the t-tests may be questionable.

For future study, the following were suggested: utilization of pause lengths other than those used in the present study; use of different groups of subjects, such as groups of various ages, ability levels, academic achievement levels, etc.; use of different kinds of audio materials for the stimulus; adding to or reducing existing pause lengths in audio materials by fixed percentages (e.g., 10%, 15%); variation in order of section presentation within the BCC listening test; use of a pretest-posttest procedure with the BCC test; use of different tests of listening comprehension; and, use of headphones with each subject in isolation.

The development of software allowing users to decrease and increase lengths of pauses within audio materials to suit listening needs and preferences was suggested.

Conclusions

The finding of differences of statistical significance for two BCC sections in this study was very encouraging. The thought of discovering optimal pause lengths for increasing comprehension of audio materials is nothing less than invigorating. To this end, it is hoped that the use of digital technology for audio materials will be researched to the fullest extent. Studies involving subjects of all ages, academic levels, etc., should be undertaken. It has been suggested that optimal listening for increasing learning may involve only narrow ranges of pause lengths, and that users prefer having control over presentation rates. Technological provisions for user control over pause lengths would seem desirable for present and future audio material delivery systems. The effort and support of future research in pause lengths is important. Efficiency in learning for all persons may be increased by new applications of the technology that was used in this study. The results in this study of two significant findings in millisecond changes in pause lengths may have provided us with a glimpse into some of the requirements for optimal processing of audio information in humans. Because of the positive contributions it could make, we should make haste in producing more research studies measuring the effects of pause shortening and lengthening on listening comprehension.

APPENDIX A

TRANSCRIPTION OF BCC LISTENING TEST WITH PAUSE NOTATIONS

(Note: The stimulus of the presentation consists only of those portions that are read by the female narrator. Underscores indicate where pauses are located in the originally recorded version of the BCC; specifically, pauses exist immediately prior to each underscore)

(male narrator, after brief opening music)

This is the Brown Carlsen Listening Comprehension Test Revised, Form E-87. This listening test determines a listening-learning quotient, or LQ. According to Dr. Ralph Nichols, listening is the most economical way to learn, if we listen correctly. Think of all you learn by listening, and then consider how easy it is to make a listening error. This standardized test will provide you with a comparative score, so that you will know how your LQ compares with people in your age category, and general population. It is important that you accurately and completely fill in the identifying information on your answer form. If you have not already done this, please do it now. Results will be returned by Social Security, or other nine-digit ID number. Be sure you remember your number. Other information on occupation, organizational affiliation, gender, and age will be used to formulate norms and give you comparative scores for your own kind of demographic traits. The audiotape format is appropriate as a testing tool for listening, so that everyone taking the test hears the material at the same rate, and with the same interpretations.

Think of how much time is spent listening to the radio, telephone, or computer messages, and then consider the aural part of your face-to-face contacts. If you can't hear the recording well, raise your hand now so the examiner can adjust the volume or seating arrangement. Is there anyone who can't hear? When you were in elementary school, you had your reading tested. Now, let's test your listening-learning quotient, your LQ. Please mark the answer form carefully, in number 2 pencil, or blue or black inks, so the scanner is able to identify your responses. Do not use felt-tip pens, or red ink. Let's begin. Part A is called, "Immediate Recall." All work must be done mentally, and answers recorded on the separate answer sheet. Listen carefully while I read the sample question. In the series of numbers, 4,5,3,2,1, the first number is…yes, the first number is 4. Therefore, in the sample on your answer sheet, the answer space under the 4 has been filled in. If the correct choice is none of those given, you should fill in the answer space under n. Are there any questions? The others are to be done in the same manner. Be sure your marks are heavy, and black. Erase completely any answer you wish to change. Listen carefully, and try to remember what is said. Each question will be read only once.

(female narrator)

Question number one. In the series of numbers, 4,6,2,8,3,7, a series containing six numbers, the first number is…Question two. In the series of numbers, 3,2,4,7,5, a series containing five numbers, the fourth number is…Question number three. In the series of numbers, 8,9,6,4,7, the fourth number is…Question four. In the series of numbers, 5,8,3,5,7,1, the fifth number is…Question number five. In the series of numbers, 6,8,9,4,2,7, a series containing both odd and even numbers, the second number is…

Question number six. In the series of numbers, 7,1,8,4,2, the third number is…Question number seven. In the list of words, by, an, of, in, on, at, the last word is…Question number eight. In the list of words, in, on, at, by, of, the word beginning with a is… Question nine. In the list of words, by, of, in, an, at, a list containing five words, the second word is…Question number ten. In the list of words, on, to, in, at, by, the third word is…Question eleven. In the list of words, at, of, in, by, to, the fourth word is… Question number twelve. In the list of words, an, to, in, at, of, on, the fifth word is… Question thirteen. In the statement, "Send your name and address with four soap wrappers and thirty cents to Box 20, Minneapolis, Minnesota, 55414, to receive the special seed offer," the number of wrappers is...Question number fourteen. In the statement just read, the box number is…Question fifteen. Listen to this statement: "Place the two braces, marked a on the diagram, in the slots marked d on the shelf. Insert them and inch and an half, then place the shelf against the wall and fix it in place with the four screws marked c on the diagram." The number of inches the braces are inserted into the shelf is…Question sixteen. Listen to these directions: "Seven of you should walk three blocks up this street. Turn to your right and continue to Pine Street, two blocks away. Then angle off on Pine for three more blocks to the green house, 51 Pine." The total number of blocks to the house on Pine is…Question seventeen. The address of the house on Pine is…That is the end of Part A. [110 pause alterations]

(male narrator)

Part B, following directions. In Part B you are to follow oral directions. In the bottom right-hand corner is a group of numbers and letters to which you will need to refer.

Locate it now. The odd numbers and the vowels have been underlined. The numbers four and seven have been circled. Now look at the sample. Referring to the row of numbers above the answer spaces for this part, subtract the smallest number from the largest number. The correct answer is seven. So on your answer sheet, the answer space under the seven has been filled in. If the correct choice is none of those given, you should fill in the answer space under n. All the questions in this part will be answered in the same manner. You are not to do any figuring on the answer sheet. All work must be done mentally. Listen carefully. Each question shall be given only once.

(female narrator)

Question number eighteen. The number above the first vowel is…Question nineteen. Two more than the second underlined number is…Question number twenty. The number one less than the smallest number circled is…Question twenty-one. Add the smallest number to one-half of the largest number. The answer is…Question twenty-two. Add the smallest even number to the largest number, and take half of the sum. The answer is … Question twenty-three. Subtract the smallest number from the next-to-the largest number. The number that is four less than that is…Question twenty-four. Add the smallest number to the next-to-the largest number. Half of that sum is…Question number twenty-five. Multiply the next-to-the largest number by the smallest number, and add the smallest number to it. The answer is…Question twenty-six. Subtract two from the largest number. The next larger number is…Question number twenty-seven. Add the next-to-the smallest odd number to the next-to-the largest even number. The number one less than that is… Question twenty-eight. Subtract the first underlined number from the second circled number. The letter directly below that number is…Question number twenty-nine. The number one greater than the number directly above the second underlined letter is… Question thirty. Add the second smallest number to the next-to-the largest number. Subtract the smallest number from the result. The answer is…Question thirty-one. Add the number above the third consonant to the next-to-the smallest number. Half that sum is…Question number thirty-two. Add the number above the first consonant to the number above the second vowel. The number one greater than that number is…Question thirty-three. The number three greater than the number above the first letter of the word candy is…Question number thirty-four. Subtract the number above the first vowel from the number above the first consonant. Then add the number above the second consonant to that sum. Two more than the resulting sum is…Question number thirty-five. Subtract the first underlined number from the second circled number. The letter directly below one greater than the answer is…Question number thirty-six. From the sum of the two circled numbers, subtract the number above the second underlined letter. Two less than that answer is…Question thirty-seven. Add the number above the letter immediately following the first vowel to the next-to-the largest number. From this sum, subtract the number above the letter which follows the second consonant. One less than the result is…That is the end of part B. [45 pause alterations]

(male narrator)

Part C. Recognizing transitions. A good listener has to note words and phrases that indicate the speaker's plan. An introductory sentence sets the stage for a discussion. A transitional sentence marks a change of thought, or a new point. And a concluding sentence adds a note of finality to what has been said. If you think a sentence is introductory, fill in the answer space under i. If you think it is transitional, fill in the answer space under t. If you think it is a concluding sentence, fill in the answer space under c. And if it is none of these, fill in the answer space under n. Find the proper column for this part on your answer sheet. In the sample, the sentence is, "It is indeed a pleasure to address you on this occasion." This is an introductory sentence. So on your answer sheet, the answer space under the i has been filled in. Listen carefully. Each sentence shall be given only once.

(female narrator)

Question number thirty-eight. And thus, for people in Europe as well as in America, this move seems to indicate better future relationships…Question thirty-nine. Also, newer aspects of the work are encouraging…Question number forty. There are four countries whose actions should be discussed at some length…Question forty-one. In the same way, the forests of the far West are being protected…Question number forty-two. Because of these disastrous failures, it seems time that schools change their programs…Question forty-three. Today, the lecture will be on building a vocabulary…Question number forty-four. For the facts in the case, let us examine these files…Question forty-five. Emergency teachers during World War Two became permanent teachers in the postwar years…Now we will go on to Part D. [8 pause alterations]

(male narrator)

Part D. Recognizing word meanings. In Part D, recognizing word meanings, you are to decide which of the correct dictionary definitions is the meaning intended in the sentences. Look at the sample. In the sentence, "The soldiers pitched their tents," which meaning best defines the word pitched? You can tell from that sentence that "set-up" is the meaning intended. Since set up is choice a, the answer space under a has been filled in on the answer sheet. Listen carefully as each sentence is presented, then mark your choice for the intended meaning. Each sentence shall be presented only once.

(female narrator)

Question forty-six. What does run mean in the sentence, "The vine will run up the fence"…Question number forty-seven. What does run mean in the sentence, "The colors will not run"…Question forty-eight. What does part mean in the sentence, "What part did John act in the play"…Question forty-nine. What does part mean in the sentence, "Your part is to help the leader"…Question number fifty. What does bright mean in the sentence, "The Elizabethan period was a bright period in history"…Question fifty-one. What does bright mean in the sentence, "His prospects for advancement were bright"… Question fifty-two. What does false mean in the sentence, "There were false supports used in constructing the bridge"…Question fifty-three. What does false mean in the sentence, "He sang a false note"…Question number fifty-four. What does open mean in the sentence, "He had a very open face"…Question fifty-five. What does open mean in the sentence, "That date is open"…That is the end of Part D. Do not turn your answer sheet over until you are told to do so. [30 pause alterations]

(male narrator)

Part E. Lecture comprehension. In this part, you will hear a fairly lengthy selection entitled, "Improving your reading ability." You will be required to answer questions about the selection. Do not take notes on what you hear; just listen carefully.

(female narrator)

Improving your reading ability. Good reading is important for several reasons. First, reading gives power to learn. When Edison was six years old, he came home from school with a note from his teacher saying that he was too stupid to learn. Why? His mother asked the teacher. He can't learn to read, replied the teacher. I will teach him myself, answered the mother, and she produced an inventor. Second, you may gain inspiration for your entire life through reading. For example, Lincoln's stepmother was just a homebody, but she inspired and taught the son of her husband, and guided his reading. In later years, Lincoln wrote, "The greatest book I ever read, you ask me, my mother." Reading is important for a third reason, to help you understand your own experience. Louis Untermeyer, writing about how to enjoy poetry, says that most young people, confronted with a poem, make it an academic exercise. They think their part is to figure out the rhyme scheme, and to notice the figures of speech. Reading poetry is reading not to get information, or to notice how words are used, but to understand your own experience. If the reading can convey to you something about life, that you have already felt, or, something new to you, that you have not thought, that is enough. Don't ask for more. If you get the rhyme scheme and the figures of speech, well and good. But if you concentrate on these, you will miss the whole thing. Here, for instance, is a poem written by Walt Whitman. He called it, "When I heard the learned astronomer." Perhaps Walt Whitman had been to a lecture given by one of the famous astronomers of his day. He had looked at charts and pictures of the myriads of stars in the heavens, looking like intricate designs of pin pricks in a piece of blue-black paper. The sky searcher had told the audience how large various ones of the pin pricks were in reality, and how many years it would take a ray of light from one of them to reach the earth. The lecturer had speculated on the origin of the universe, and the number of years before it would be destroyed. The room was hot and stuffy, and people moved restlessly in their chairs. Whitman had the feeling that all of this knowledge of the lecturer did not seem very profound. And so, he wandered out into the clear night air. Later, he wrote, "When I heard the learned astronomer, when the proofs, the figures, were arranged in columns before me, when I was shown the charts and diagrams to add, divide, and measure them, when I, sitting, heard the astronomer, where he lectured with much applause in the lecture room, how soon unaccountable I became tired and sick. Till rising and gliding out, I wandered off by myself in the mystical, moist night air, and, from time to time, looked up in perfect silence at the stars." Finally, reading often will mean the difference between being a boring or an interesting person. Often, you may find yourself with a group of strangers, and cast about for a subject of conversation. Usually, the person who has the most interesting things to talk about is the person who has read widely. The story is told of a shoe salesman who found himself at a dinner party in the home of a prospective client. His hostess seated him on her right, and, during the dinner tried one subject after another to interest him. "Did you see the exhibit of paintings in the museum?" No, he had not seen the exhibit. "What do you think the Dodgers will do this season?" He replied that he seldom followed the sports pages of the daily papers. "Isn't it appalling about the new income taxes, the hostess asked?" The salesman was still silent. He had not been following very closely what the new taxes were to be. The hostess was getting a little desperate. “Have you heard about the new varieties of flowers that are being introduced this season?” Finally, the salesman turned to her and said, “Madam, you have been trying to find something to talk about with me. Why don’t you try shoes; that is the only subject I really know about.” Now, just what can you do in order to improve your reading? What methods will help you to gain skills, so that you can be inspiring, or interesting, or knowing? Well first of all, there is the forcing method. You can do something to improve yourself, simply by making yourself speed up in your reading. Take the case of John Patterson, a farmer in Minnesota. He didn’t read much, except his agricultural journals. Most of that reading had to be done slowly, because he wanted to figure out from the writing and diagrams just exactly how to plow his field, or how to construct a pole barn. Thus, when he read a paper or a magazine story, he tried to read it in the same way. One day, he came across a magazine in a barber shop, that gave the number of minutes it should take the average reader to complete each article or story. John found that he took far longer than the average. He decided that he would see if he couldn’t beat his own record, so he borrowed the magazine. At first, he forced his eyes to move so fast, that he was not understanding what he read. But soon, he could whip through an article and still understand most of what was in it. He discovered also that he could read his agricultural journals more rapidly and still follow the detailed descriptions given. You can do quite a bit to improve your reading by forcing yourself to read faster. Then, there is the observation approach. To read well, you need to know just what happens to your eyes as you read. Sometime, sit on the floor in front of someone who is reading, and watch what happens to the reader's eyes. You will notice that they jump, stop, jump, stop, jump, stop, and suddenly swing back to the beginning of a new line. Some students have said that the eye movements remind them of a typewriter carriage as it moves along, and then swings back to start a new line. You can see that the fewer stops the eyes make on a line, the faster you will read. So, it is wise to practice making your eyes see groups of words, instead of looking at each word by itself. One reading expert suggests that you draw three or four faint lines down a page of print, and that you practice reading the printing by fixing your eyes where each line crosses the line of type. After a while, you will be able to reduce the number of lines you need as you increase the number of words your eyes can see with a single stop. Another thing to practice is a kind of game you can play with billboards or license plates as you are driving. As you glance at a billboard when you pass it, see how much of it you can repeat at a glance. We were playing this game one time when we got into an argument. One person had read, "Use MacLesson's Aromatic…", and that was as much as he had seen. Another got the next word, which he said was soap. But, a third member in the car was sure that the word at the end was soup, not soap. Finally, after a heated argument, the driver had to turn the car around and go back, so that the two could check the answer. Such a game is fun, but, more important, it trains you to read things quickly and accurately. You usually have someone to check your mistakes when you are not right. One summer, an ex-schoolteacher lived with us, who helped us learn to get the general idea of a piece of reading. Ms. Gavigan would come to the dinner table with a lot of short articles that she had cut from daily newspapers. She had cut the headline from each article and put these in a separate pack. While Dad was serving, she would have each of us read one of the articles quickly, and then make up a headline for it. Then we would check to see how close we had come to the original headline. In that way, she forced us to read rapidly, and to pick out the most important idea in the piece of reading as a whole. After a while, Ms. Gavigan moved on to another device. She cut off not only the headline, but also the first sentence. If an article is a typical news story, the first sentence, known as the lead, is supposed to summarize all the important information in the rest of the story. After we had read the clipped article, she would ask us the traditional lead questions: who, what, when, where, why. This drill trained us not only in picking out the major ideas, but in exactness of detail. It was surprising how much our ability in reading improved through this game that Ms. Gavigan had taken the trouble to prepare. The last of the five methods that sometimes helps to improve your reading is through the use of machines. To use machines, you have to be able to go to a reading clinic. The most elaborate of the machines is the metronoscope. It has an opening that will expose one line of print at a time with three shutters that close the opening. These shutters open and close alternately across the line. The length of time a shutter is open can be controlled by the machine so that readers bit-by-bit shorten the time it takes them to read a line. The machine has a speed range of from fifteen to fifty lines per minute. Often, through practice on machines, the reader is able to able speed up eye movement and reading speed tremendously. Machines are expensive, and are not readily available to most people. It should be remembered, also, that they help those students who are not having really serious reading difficulties. They will increase the speed of the accurate, but slow, reader, but they will not increase the accuracy of the inaccurate reader. In working with them, it is important that you test yourself on the accuracy of your reading, as well as drill yourself on the speed of your reading. So much for the individual methods. You may want to use one of them, though it is probable that you should use a combination. It is important, always, to remember that you must use the methods that will give you help with your particular difficulty. If you read slowly, you use one set. If you read inaccurately, you must use another. When you are dissatisfied with the way you read, and most of us are, be sure that you try to find out just what troubles you are having before starting to practice.

[168 pause alterations]

(male narrator)

That is the end of the lecture. Now, turn over your answer sheet. Look at the sample. The question is, "What is the title of the lecture?" Decide which of the five choices given is correct. Choice c, improving your reading ability, is the correct title. Therefore, the answer space under c has been filled in on the answer sheet. Listen carefully; each question shall be read only once.

(female narrator)

Question number fifty-six. What relative of Lincoln was mentioned in the Lincoln story…Question fifty-seven. How old was Edison when his teacher said he could not learn to read…Question fifty-eight. What author wrote about how to enjoy poetry… Question number fifty-nine. What did the man at the dinner party sell…Question sixty. Which subject did the hostess of the dinner party not bring up…Question number sixty-one. In which state did John Patterson live…Question sixty-two. In what place did

Patterson find an article that helped him…Question number sixty-three. Where did Ms. Gavigan give reading improvement drills…Question sixty-four. What is the first sentence of a typical news story called…Question number sixty-five. The speed range of the reading machine is expressed in terms of the number of…what per minute…Question sixty-six. Which reading improvement method was not given a separate place in the organization of the lecture…Question number sixty-seven. The Edison story was used in this lecture to show the importance of good reading for what purpose…Question number sixty-eight. The dinner party story was meant to illustrate the importance of reading, for what purpose…Question number sixty-nine. Which would be the best title for the Ms. Gavigan story…Question number seventy. What did the discussion of the use of machines to improve reading suggest…Question number seventy-one. From the poem that Whitman wrote, what do you think his opinion of lecturers was…Question seventy-two. What did the lecture as a whole seem to suggest about learning to read…Question number seventy-three. Which method did the author seem to feel was the best for learning to read…Question number seventy-four. The reference to Lincoln shows how one can gain what from reading…Question seventy-five. What kind of person do you think Ms. Gavigan was…Question number seventy-six. Which part of the lecture was least directly related to the central idea…That is the end of Part E.

[24 pause alterations]

(male narrator, followed by brief closing music)

Go over your answer sheet carefully, making sure that each mark is heavy and dark. This has been the revised Brown-Carlson Listening Comprehension Test, Form E-87. This test is copyrighted by Jerrald Carstens. Reproduction or duplication of this test is prohibited by law. The tape was recorded at Track Record Studios, Saint Paul, Minnesota. Test items were read by Christin Hurt. Your announcer has been Norton Lewellyn. This concludes the Brown-Carlson Listening Comprehension Test.

[aggregate total of 385 pause alterations in the stimulus portion of the test]

APPENDIX B

FSU HUMAN SUBJECTS APPROVAL LETTER

Florida State UNIVERSITY

Office of the Vice President
for Research
Tallahassee, Florida 32306-2763
(850) 644-5260 • FAX (850) 644-4392

APPROVAL MEMORANDUM

from the Human Subjects Committee

Date: **10/07/2002**

From: **David Quadagno, Chair**

To: Ronald Gregory Reid
2106 Tonka Drive
Orlando FL 32839

Dept: Information Studies

Re: **Use of Human subjects in Research**
Project entitled:
The Effect if Varying Pause Lengths On Listening Comprehension

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The forms that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be exempt per 45 CFR § 46.101(b)2and has been approved by an accelerated review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals which may be required.

If the project has not been completed byOctober 06, 2003 you must request renewed approval for continuation of the project.

You are advised that any change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must promptly report, in writing, any unexpected problems causing risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols of such investigations as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Protection from Research Risks. The Assurance Number is M1339.

cc: Dr Charles Conway
APPLICATION NO. 02.465

APPENDIX C

SAMPLE INFORMED CONSENT LETTER

Informed Consent

I voluntarily, without influence of coercion or force, offer consent to participate in dissertation research titled, "The Effect of Varying Pauses on Listening Comprehension."

R. Greg Reid, doctoral candidate in the School of Information Studies, Florida State University, is conducting this experimental research for use in his dissertation. The purpose of the study is to investigate how pause lengths, electronically lengthened or shortened within digitally recorded text, affect comprehension. I understand that if I participate in the research, I will be asked to take a standardized test of listening comprehension. On a machine-readable score sheet I will enter my responses, in addition to my social security number (or other nine-digit number that I choose to provide), date of birth, and gender.

I understand that the total time of the experimental process will be about 45 minutes. I understand also that I will receive no monetary compensation for participation.

I understand that my participation is completely voluntary and that I may cease participation at any time without prejudice or penalty.

I understand that confidentiality of my responses will be maintained at all times, to the extent allowed by law, and that subjects must be 18 years old.

I understand that risks and discomforts are designed to be kept at a minimum, and that the researcher would like the participant experience to be as enjoyable as possible.

I understand that the results of my participation in this experiment may be beneficial to: (1) providers of audio literature products and services (such as libraries); (2) researchers in fields such as information studies and communication; and, in turn, to (3) persons such as myself.

Information about my test performance, as well as the group's scores, will be provided to me by Mr. Reid at a later date during fall semester 2002.

Any questions I have about this research have been satisfactorily answered.

I understand that I may contact Mr. Reid (rgreid64@hotmail.com) with subsequent questions that I may have. I may also contact Mr. Reid's major professor, Dr. Charles Conaway, at 850-644-8123. Additionally, I may contact the Chair of the Human Subjects Committee, Institutional Review Board, via the Office of the Vice President for Research, at 850-644-8633.

I have read, and understand, this form for consent to participate in Mr. Reid's research.

____________________________ ____________________________

(Subject name) (Date)

APPENDIX D

INCORRECT RESPONSES OF EACH SUBJECT

For Age Group, A = less than 20 years old, B = 20 and older
* denotes deleted (random) by SPSS program in creating cells of 32 subjects each

Treatment	Subject	Section A	B	C	D	E	Total	Age Group	Gender
Version 1	1	6	5	2	2	8	23	B	F
	2	4	1	3	4	8	20	B	F
Control	3	7	2	3	4	10	26	B	M
	4	6	0	3	1	6	16	A	M
	5	6	9	2	3	13	33	A	F
Version 1	6	6	4	1	1	12	24	B	F
	7	6	6	1	3	17	33	B	F
Control	8	6	3	2	1	11	23	B	F
	9	3	12	3	4	13	35	B	F
	10	9	4	1	3	7	24	B	F
Version 1	11	7	9	3	2	14	35	B	F
	12	5	3	4	0	3	15	B	F
Control	13	2	1	4	1	2	10	B	F
	14	4	3	3	1	14	25	B	F
	15	3	2	1	3	7	16	B	F

Version 1	*16	8	5	1	2	11	27	B	M
	17	1	5	1	0	13	20	B	F
Control	18	3	3	2	1	13	22	B	M
	*19	6	2	2	1	7	18	B	M
	20	5	1	5	1	12	24	B	M
Version 1	21	3	9	3	4	15	34	B	M
	*22	1	1	0	1	6	9	B	M
Control	23	9	3	0	3	6	21	B	F
	24	9	4	3	2	6	24	B	F
	25	6	4	1	1	9	21	B	F
Version 1	*26	6	2	4	2	4	18	B	F
	27	4	2	1	2	5	14	B	F
Control	28	3	3	3	3	1	13	A	F
	29	5	5	2	2	9	23	B	F
	*30	9	5	2	3	10	29	B	F
Version 1	31	5	4	2	3	7	21	B	F
	32	8	5	2	1	15	31	B	M
Control	33	5	8	4	3	15	35	B	F
	34	5	6	3	5	11	30	B	F
	*35	1	7	1	1	3	13	B	F
Version 1	36	3	7	1	4	15	30	B	F
	*37	5	1	1	4	2	13	B	M
Control	38	4	2	2	3	10	21	B	F
	39	5	5	3	3	7	23	B	M
Version 2	40	5	8	1	2	15	31	B	M
	41	3	1	1	3	4	12	B	F
+300msec	42	3	4	2	2	11	22	B	M
	43	7	3	2	4	13	29	A	F
	44	3	3	1	2	14	23	B	M

Version 2	45	7	10	1	3	12	33	B	M
	46	5	9	1	3	15	33	B	M
+300msec	47	3	10	3	1	9	26	A	M
	48	2	3	2	1	16	24	B	F
	49	7	5	3	3	15	33	B	F
Version 2	50	3	4	1	1	6	15	B	F
	51	5	6	1	2	9	23	B	F
+300msec	52	4	0	0	1	5	10	B	M
	53	4	3	1	1	7	16	B	F
	*54	3	2	2	0	5	12	A	F
Version 2	*55	2	0	0	1	6	9	B	F
	56	7	6	3	4	13	33	B	F
+300msec	57	4	3	2	2	9	20	B	F
	58	3	3	1	2	7	17	B	F
	59	1	6	0	0	9	16	A	F
Version 2	60	7	11	4	6	15	43	B	F
	*61	7	7	1	0	6	21	B	M
+300msec	62	2	6	1	4	13	26	B	M
	63	6	0	1	0	6	13	B	F
	64	4	2	2	1	7	16	A	F
Version 2	*65	3	5	1	2	7	18	A	F
	66	7	5	1	5	11	29	B	F
+300msec	67	7	6	1	4	8	26	A	F
	68	6	5	1	1	12	25	B	M
	*69	5	5	3	5	8	26	B	M
Version 2	70	3	3	1	2	6	15	A	F
	71	7	3	1	2	9	22	B	F
+300msec	72	3	6	0	5	10	24	A	M
	73	7	17	1	4	11	40	B	F
	*74	5	9	3	1	13	31	B	F

Version 2	*75	1	7	2	1	14	25	B	M
	*76	1	0	0	3	5	9	B	F
+300msec	77	9	4	2	1	13	29	A	F
	78	8	6	1	4	6	25	B	F
	79	8	5	2	5	14	34	B	F
Version 3	80	5	3	3	3	11	25	A	F
	81	10	16	3	3	13	45	B	M
-150msec	82	5	1	1	3	6	16	A	F
	83	3	2	4	4	11	24	A	F
	84	2	7	2	4	7	22	A	M
Version 3	85	3	16	3	7	11	40	A	M
	86	5	5	4	2	13	29	A	M
-150msec	87	5	5	1	4	12	27	A	M
	88	7	3	0	1	10	21	A	F
	89	5	1	1	3	11	21	B	M
Version 3	90	4	3	1	1	6	15	A	F
	91	4	3	4	3	7	21	A	F
-150msec	92	5	1	2	5	12	25	A	M
	93	8	6	2	3	12	31	A	F
	94	5	5	1	2	13	26	A	F
Version 3	95	6	9	3	3	7	28	A	M
	96	5	3	2	0	15	25	A	M
-150msec	97	4	13	1	3	9	30	A	M
	98	4	2	3	5	12	26	A	F
	99	3	3	1	5	11	23	A	F
Version 3	100	1	0	2	3	8	14	A	M
	101	6	3	3	2	6	20	A	F
-150msec	102	11	7	2	2	11	33	A	F
	103	9	10	2	6	12	39	A	M
	104	3	3	4	5	16	31	A	F

Version 3	*105	5	2	1	3	16	27	B	M
	106	8	2	0	4	12	26	A	M
-150msec	107	4	1	1	3	5	14	A	F
	108	5	8	3	4	13	33	A	F
	109	5	3	4	3	8	23	A	M
Version 3	110	5	1	1	4	11	22	B	M
	111	2	5	4	2	10	23	B	M
-150msec	112	2	2	4	2	12	22	B	M
Version 4	113	4	0	1	2	7	14	A	F
	114	2	6	0	4	6	18	A	M
-300msec	115	3	11	3	3	12	32	A	M
	116	4	2	2	3	12	23	A	F
	117	8	15	4	3	7	37	A	F
Version 4	118	2	5	2	3	8	20	B	M
	119	8	3	5	3	10	29	A	F
-300msec	120	4	4	2	2	12	24	A	M
	121	6	1	1	3	8	19	A	F
	122	7	6	3	2	15	33	B	M
Version 4	123	5	1	3	2	13	24	A	M
	124	5	2	3	3	8	21	A	M
-300msec	125	8	6	2	1	7	21	A	M
	126	4	5	2	3	13	27	A	M
	127	3	2	1	1	6	13	A	F
Version 4	128	6	6	4	3	16	35	A	M
	129	10	2	2	3	14	31	B	M
-300msec	130	4	6	1	2	10	23	A	F
	131	3	1	1	3	5	13	A	M
	132	3	2	0	3	10	18	B	F

Version 4	133	7	7	1	4	10	29	A	F
	134	5	4	1	2	8	20	A	M
-300msec	135	8	18	5	5	14	50	B	F
	136	9	5	2	2	8	26	A	M
	137	6	6	3	2	10	27	A	M
Version 4	138	8	9	1	4	9	31	A	F
	139	3	2	1	1	6	13	A	F
-300msec	140	6	3	2	3	6	20	A	F
	141	3	4	3	3	2	15	A	M
	142	6	16	0	3	8	33	B	F
Version 4	143	6	1	4	3	7	21	B	F
-300msec	144	10	17	0	5	17	49	A	M

APPENDIX E

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APPENDIX F

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BIOGRAPHICAL SKETCH

Ronald Gregory Reid was born in Bloomington, Indiana, in 1964. He attended Emmeline Cook Elementary School, Webster Stanley Middle School, and North High School in Oshkosh, Wisconsin. In June 1987 he received a Bachelor of Science degree in German literature from the University of Wisconsin-Oshkosh. In 1990 he completed requirements for a Master of Arts degree in German Literature at the University of Notre Dame. He received a master of Library and Information Science degree from the University of Wisconsin-Milwaukee in 1994. His library work experience includes library directorships at Florida Metropolitan University, Orlando College South and at Westwood College of Technology, Chicago Dupage Campus. His advanced graduate work in Information Studies was completed at Florida State University in 2003.