The Effect of Accents on Cognitive Load and Achievement: The Relationship between Students’ Accent Perception and Accented Voice Instructions in Students’ Achievement

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Jeahyeon Ahn

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This dissertation titled
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by

JEAHYEON AHN

has been approved for
the Department of Educational Studies
and the Gladys W. and David H. Patton College of Education and Human Services by

________________________________________

David R. Moore
Associate Professor of Educational Studies

________________________________________

Renée A. Middleton
Dean, the Gladys W. and David H. Patton College of Education and Human Services
Abstract

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The purpose of this study was to investigate how an instructor’s accent influences students’ learning achievement. Furthermore, this study also explored how students’ accent preference may affect their learning. Unlike native voices, accented voices were not natural to the native speakers; therefore, it required more cognitive resources for processing the information, compared to native voice, which reduces the quality of students’ learning experience (Mayer, Sobko, & Mautone, 2003). However, this did not explain how students’ accent preference might influence their learning achievement. In order to address this unique and challenging issue, the research needed to compare the students’ accent preference to their achievement scores by determining at what level of accent the non native voice causes an increase in cognitive load.

The study was experimental research. The study had three parts; survey, instruction, and assessment. Before the experiment, participants completed a short survey about their general knowledge of statistics, familiarity with multimedia learning, and accent perceptions. During the experiment, participants were randomly assigned to view a short multimedia instruction explaining how to use the software program, SPSS (Statistical Package for the Social Sciences). The instructions were given in either a
native voice or in one of four different accented voices (mild and heavy European accents and mild and heavy Asian accents). After listening to the instructions, participants completed a short assessment. The average completion time, including survey, instruction, and assessment, was 25 minutes. The quantitative data were analyzed by both One-way ANOVA and Two-way ANOVA. Of the 192 participants, 187 were undergraduate students and 5 were graduate students, all from Ohio University.

The research found that; (a) there was no significant difference between students’ achievement scores when given native voice instruction and those with accented voice instruction; (b) students’ perception toward accent did not influence their learning, in general; (c) only students who, prior to the instruction, said they disliked Asian accents and received instruction from an instructor with an Asian accent showed lower assessment performance (this was not the same for European accents); (d) there was a prior knowledge effect in both the native and European accented instructional voice groups, but not with the Asian accented instructional voice group; (e) the duration of time for completion of the study is influenced with (“lower” or “higher”) achievement scores in the European and Asian accented voice groups, but not with the native voice group; (f) according to the instructor evaluation rating report, not only were the native voice rating scores significantly higher than both the European and Asian voice ratings, but also, European voice ratings were significantly higher than Asian voice ratings.

A possible explanation for the no significant difference among different accented voice instructions is listening adaption. Unlike the previous study from Mayer and his associates, in which it took 140 seconds for the instruction, this study instruction time was 10 to 17 minutes. Furthermore, the combination of social identification and having
greater experience with Asian instructors might have accounted for the difference between European and Asian accents on a student’s learning. The most challenging aspect and notable limitation of this study was that the instruction was scripted rather than being recorded from a natural instructional setting; therefore, all other aspects of communication, such as grammar, vocabulary, and speaking style were excluded.

Approved: _____________________________________________________________

David R. Moore
Associate Professor of Educational Studies
# Table of Contents

Abstract ................................................................................................................................3

List of Tables .....................................................................................................................11

List of Figures ....................................................................................................................12

Chapter 1: Introduction ......................................................................................................13

  Introduction ...............................................................................................................13

  Statement of the Problem ..........................................................................................15

  Purpose of the Study ..................................................................................................16

  Theoretical Framework .............................................................................................17

    Working Memory ..............................................................................................18

    Cognitive Load ..................................................................................................19

    Multimedia Learning Theory ............................................................................19

  Research Questions ...................................................................................................20

  Significance of the Study ..........................................................................................21

  Delimitations and Limitations of the Study ...............................................................22

  Definitions of Terms ..................................................................................................23

  The Organizational Plan of the Study .......................................................................24

Chapter 2: Literature Review .............................................................................................25

  Cognition ...................................................................................................................27

    Working Memory ..............................................................................................27

      History of Working Memory ..............................................................................27

      Phonological Loop ..........................................................................................28

      Visuospatial Sketchpad ..................................................................................31

      The Central Executive ..................................................................................32
List of Tables

Table 1 Five Independent Groups ...................................................................................... 65
Table 2 Two-Way Between Groups ANOVA ....................................................................... 66
Table 4 Shapiro-Wilk Normality Test .................................................................................. 91
Table 5 Descriptive Analysis of All Different Instructional Groups ...................................... 92
Table 6 Intelligibility Test Score .......................................................................................... 93
Table 7 Accent Preference Rating (5 Point Rating Scale & 5= Most Preferred) ................. 95
Table 9 Time Duration Post-hoc Comparisons .................................................................... 103
Table 10 Time Duration Groups among Native Voice ........................................................ 104
Table 11 Time Duration Groups among European Voice .................................................... 105
Table 12 Post-Hoc Test for Time Duration Groups and European Accent ...................... 106
Table 13 Time Duration Groups among Asian Voice .......................................................... 107
Table 14 Post-Hoc Test for Time Duration Groups and Asian Accent ............................. 108
Table 15 Post-Hoc Test of Instructor Evaluation Rating ..................................................... 111
Table 16 Correlations among Evaluation Instructors, Asian, & European Accent Preference .......................................................................................................................... 112
Table 17 Students’ Report Number of Their Previous Foreign Instructors’ Nationality 114
Table 18 Participants choice for Relatively Easy Class and Difficult Class ....................... 115
Table 19 Correlations of Classes Choices, Accent Preference, and Overall Foreign Born Instructor Rating .................................................................................................................. 117
List of Figures

Figure 1. The Connection of Accent Perceptions and Cognitive Load ......................... 26
Figure 2. Research Process. ............................................................................................. 67
Figure 3. A Sample Research Question from the Instruction. ...................................... 69
Figure 4. Independent samples T test from The Instruction. ....................................... 70
Figure 5. Independent samples T test Output from The Instruction. ............................. 71
Figure 7. Bar Graph for Dependent Variable (Test Score). ......................................... 91
Figure 8. Instructor’s Accent Evaluation. ..................................................................... 94
Figure 9. Prior Knowledge Effects on Each Instructional Group Mean Score .............. 99
Figure 10. Comparison of Native, European and Asian Accent Groups by Time Duration. ................................................................................................................. 109
Figure 11. How Many Courses Have You Taken Where The Professor Spoke with a Foreign Accent? ......................................................................................... 113
Figure 13. Reasons for Positive Experience with Foreign Born Instructor. ............... 119
Figure 14. Reasons for Preferring a Native English Speaker’s Course. ...................... 120
Figure 15. Reasons for Preferring Foreign Born Instructors’ Course ......................... 121
Chapter 1: Introduction

Introduction

Every year, there are more immigrants and international students attending American universities. This brings up many issues, the first of which is linguistic diversity. Linguistic diversity is often discussed in higher education because of the increasing number of international students and faculty (Ohama, Gotay, Pagano, Boles, & Craven, 2000). During the 1987-1988 academic year, there were 356,187 international students attending American universities and, twenty years later, this number almost doubled, to 623,805 (Bhandari & Chow, 2008). Additionally, the number of international scholars, (including full time teachers, researchers doing postdoctoral work, and visiting professors, including The Fulbright Visiting Scholar Program) was 65,494 in the 1997-1998 academic year, and rose to 106,123 in the 2007-2008 academic year (Bhandari & Chow, 2008). American students have also been studying abroad in larger numbers every year. In the 2006-2007 academic year, 241,791 American students studied abroad (Bhabdari & Chow, 2008). This new environment has brought social and intellectual dynamic interactions to all members of higher education.

English has been an essential language in international business for decades (Cheng, 1999). The fact that many other countries, such as Hong Kong, Singapore, South Africa, India, Philippines, and Kenya use English as a first language or dual-official language is one of the most important factors involved in international business (Cheng, 1999). In recent years, English has also become an important language when pursuing higher education. The annual Times Higher Education-QS (2009) reports that,
out of the universities attended by international students, six of the top ten are American universities. In addition to this, many highly respected journals are published in English. This phenomenon has influenced other countries’ higher education systems. For instance, South Korean universities are increasing the number of English-only classrooms in order to prepare their students for the global society and as a recruiting tool to get other international students to come to their universities.

As the global use of English increases, so does the number of language-related issues. There are many factors that can affect a speaker’s accent, such as geography and native-language influence. This is not a dialect issue; instead, an accent difference is identified by *intonation, rhythm,* and *stress* (Cheng, 1999; Flege, 1995; Strange, 1995). Therefore, adjusting to and accommodating various accents has become an essential ability for effective and respectful communication (Cheng, 1999).

The questions we now face are, “How can we handle this unique language environment?” and “How do accents really impact a student’s learning?” These questions came to the attention of the administration at the University of California, Berkeley, when undergraduate students raised concerns about difficulties overcoming communication barriers with foreign-born teaching assistants speaking English (Cheng, 1999). Rubin and Smith (1990) also said many college students look at their instructor’s name in the course description and try to avoid foreign-born instructors. Furthermore, students also voice their frustration about accents and differing cultural teaching methods to their parents, peers, and administrators (Rounds, 1987).
Mayer, Sobko, and Mautone (2003) studied how accented voices impacted a learners’ cognitive load, which directly correlates with their learning experience. The study found that it does not impact retention tests, but it significantly influences transfer test results, which connects to deeper learning.

If the students’ complaints are supported by scientific data, then what can foreign-born instructors and university administrations do? This is a politically, socially, and culturally sensitive issue. However, if we agree that the purpose of education is to help learners fulfill their potential both academically and socially, then educators must address this issue diligently and truthfully.

**Statement of the Problem**

This experimental research investigates how an accented voice impacts students’ learning. In addition, it explores how students’ accent perception may influence their learning. The primary reason for investigating this topic is that many undergraduate students have complained that their lower achievement in the classroom was due to their instructors’ accented voices. However, not many direct studies have been conducted to determine how a student’s cultural or accent perceptions may influence the outcome of their learning in an accented voice learning environment.

Cognitive load theory suggests that accented voices increase a learners’ cognitive load which, in turn, reduces the quality of their learning experience. However, there are many teaching aids, such as PowerPoint, that have adopted computer or audio and video technology as teaching assistant tools in order to improve students’ learning. Furthermore, many universities have instituted a specific training program for incoming
foreign-born instructors before they teach classes. In contrast, there are not many programs to support or prepare undergraduate students for linguistically diversified classrooms. Neves and Sanyal (1991) state that younger, and lower academically achieving students complain more than students who are older or have higher GPAs. Furthermore, there is an unspoken, general conception that Americans treat speakers with Appalachian, vernacular Black, or any nonstandard accents differently (Cargile & Giles, 1998; Johnson & Buttny, 1982; Luhman, 1990). Therefore, it is possible to assume that a learner’s perceptions of people with accented voices and other cultures may impact their learning in an accented-voice learning environment.

Communication happens when there is a sender and a receiver. So we have to study both sides simultaneously in order to figure out what is effectively being transmitted and received, and what is preventing effective communication. As there is a growing number of international students and faculty in higher education, this challenging issue is not going away anytime soon. This is why we need to investigate and determine how an instructor’s accented voice impacts students’ learning.

**Purpose of the Study**

The purpose of this study is to investigate the impact of foreign accents on students’ learning experience. Furthermore, it explores how students’ accent perception influences their learning. Cognitive load theory and multimedia learning theory indicate that accented voices may increase a student’s cognitive load in working memory, which reduces the quality of students’ learning experience because of a lack of learning resources in working memory. In contrast to long-term memory (LTM), working
memory has very limited resources (Baddeley, 1986). For instance, the voice principle in multimedia learning theory states that a native human voice promotes deeper learning in comparison to a computer-synthesized or accented voice (Atkinson, Mayer, & Merrill, 2005; Mayer, 2009; Mayer, Sobko, & Mautone, 2003).

In order to address this unique and challenging issue, it is necessary to first assess the outcome of students’ learning from different accented-voice instructions. If there is a statistically significant difference among the groups, then the post-hoc study points out which accented groups are different. Then, students’ achievement scores are analyzed with students’ cultural and accent perceptions. Also, it analyzes the students’ prior knowledge and addresses how a student’s accent perception may influence their learning. The result of this investigation should reveal the importance of accented-voice instruction and create awareness of how students’ cultural or accent perceptions can affect a linguistically diversified learning environment.

**Theoretical Framework**

Baddeley and Hitch’s working memory theory (1974), Chandler and Sweller’s cognitive load theory (1991), and Mayer’s multimedia learning theory (2001) provide the main theoretical framework for this research. The reason for choosing these related theories as the main theoretical framework for this study is that accented voice has a very big impact on cognitive load. The importance of cognitive load theory is that working memory has limited resources to process information (Baddeley, 1986). Cognitive load theory explains the process and types of cognitive load. Knowing the structure and functionality of working memory increases understanding of the process and limitation of
resources in cognitive load. Multimedia learning theory explains how to reduce unnecessary cognitive loads, so that a learner is able to have a deeper learning experience. It should be noted that the main instructional multimedia for this research has carefully incorporated all of these theory considerations.

**Working Memory**

The concept of working memory (Baddeley & Hitch, 1974) was developed from the concept of short term memory (Miller, 1956). Baddeley and Hitch suggest that working memory surpasses a simple and short storage function to an active information process, such as integrating and connecting information. Working memory has three different components; phonological loop, visuospatial sketchpad, and the central executive (Baddeley, 2001). Each component has its own unique function. The phonological loop deals with auditory information which can last just a few seconds and fade away. Visuospatial sketchpad is “the function of integrating spatial, visual and possible kinesthetic information into a unified representation which may be temporarily stored and manipulated” (Smith & Kosslyn, 2007, p. 200). The central executive deals with the selection of information, integration of information from two channels, and coordination of information for further usage (Baddeley, 2001; Smith & Kosslyn, 2007). Baddeley includes the episodic buffer as the newest addition of the working memory component. Baddeley (2001) states, “The buffer was proposed in order to account for a range of memory phenomena that appear to involve interaction between the slave systems (phonological loop and visuospatial sketchpad) and LTM.” (p. 118). The importance of working memory in the human learning process is providing the theoretical explanation
of the information process and enhancing human learning based on findings from working memory’s functions and limitations.

**Cognitive Load**

Cognitive load is the brain workload which deals with any incoming novel information (Sweller, 2003, 2005; van Merrenboer & Sweller, 2005). Reducing unnecessary cognitive load is an important issue in learning because working memory has limited capacity (Baddeley, 2002; van Merrenboer & Sweller, 2005; Sweller, 2005). There are three different types of cognitive loads; extraneous, intrinsic, and germane cognitive loads (Chandler & Sweller, 1991; Sweller, 1994, 2003, 2005). Extraneous cognitive load happens when an ineffective instruction is presented to the learners. A futile instruction distracts or increases learners’ cognitive load, which reduces learning. Intrinsic cognitive load deals with the nature of the original difficulty of the learning material (Sweller, 2005). Germane cognitive load occurs when incoming information coordinates with long term memory schema and reorganizes it (Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Sweller, 2005).

**Multimedia Learning Theory**

Multimedia learning theory is based on the limited capacity of working memory (Baddely & Hitch, 1974), dual channel theory (Clark & Paivio, 1991), which suggests that information is obtained through visual or auditoria sources, or both. Mayer (2005) defined multimedia as, “…presenting both words (such as spoken text or printed text) and pictures (such as illustrations, photos, animation, or video).” (p. 2). Using this definition of multimedia, the main issue is, “How can we reduce cognitive load, so that learners
Mayer’s multimedia learning theory deals with extraneous cognitive load (Sweller, 2005) and its main focus is on reducing unnecessary cognitive load and developing the design principles for instructional development. For instance, my multimedia instruction uses the multimedia principal which states that when the presentation material is presented with both words and pictures, there will be a better learning experience than if there was only one channel present (Mayer & Anderson, 1992; Mayer & Gallini, 1990; Mayer, 2001). The instruction also uses the coherence principle, which states that any additional information besides the learning topic (e.g., background sounds, or using a similar color for background and text), causes a reduction in the quality of the learning experience (Harp & Mayer, 1998; Mayer, Bove, Bryman, Mars, & Tapangco, 1996). Most importantly, this research investigates beyond what the voice learning principle states. The voice learning principle states that native voice instruction promotes a better learning experience for the learners when compared to a computer-synthesized or accented-voice instruction (Atkinson, Mayer, & Merrill, 2005; Mayer, 2009; Mayer, Sobko, & Mautone, 2003). However, this research investigates how differing levels of accented voices influence learning and how a student’s perception of accents may influence their learning experience. Therefore, multimedia learning theory provides theoretical and practical evidence for this research.

**Research Questions**

1. Is there any learning outcome difference among students who take native voice multimedia instruction, high-intelligibility German accented
multimedia instruction, low-intelligibility German accented multimedia instruction, high-intelligibility Korean accented multimedia instruction, and low-intelligibility Korean accented multimedia instruction?

2. What degree of foreign accent still provides a reasonable intelligibility to American students?

3. How do students’ accent perceptions influence students’ learning outcome?

4. How does prior knowledge of statistics affect the students’ learning outcome?

**Significance of the Study**

This study will offer both foreign-born instructors and American undergraduate students an opportunity to discuss their teaching and learning challenges in the classroom. The findings of this study will demonstrate what type of relationship is likely to exist between students’ learning achievement and the instructor’s accent. It also will reveal how deeply students’ accent perceptions may influence their achievement. This information will be useful to university administrators and will allow them to take logical corrective actions. For example, if the outcomes of the students’ achievement scores are significantly influenced by the students’ accent perceptions, then, diversity programs can be developed and adopted. On the other hand, if an accented-voice instruction significantly reduces students’ learning, then university administrators should improve or implement new faculty training programs for foreign-born instructors.
Delimitations and Limitations of the Study

Although this study focuses on determining how accents influence students’ learning, it is impossible to test every type of accent. In this study, the accented instructors’ voice will be limited to one western European country, Germany, and one Asian country, South Korea.

The multimedia instruction will be 10 to 17 minutes in length, which will be dependent on each learner’s individual pace. This amount of time is appropriate for learning how to do a simple t-test in SPSS. It may take only a short period of time for the students to get accustomed to the foreign accents; however, chronologically ordered test items may reveal the students’ adaptation ability.

Even though SPSS multimedia instruction has not been used very often in undergraduate courses, students who have taken statistics courses or research design courses in psychology may have prior knowledge of SPSS. Therefore, the research outcome may be influenced by students’ prior knowledge effect rather than accent preference.

Since this multimedia instruction is delivered over the internet, there is no face-to-face instruction advantage, such as non-verbal communication. Interestingly, this is also a unique research design to study the role accents play in learning because other variables have been removed, such as teaching styles, physical appearance, and mannerisms. Since the instruction is scripted, there are no other variables, such as grammatical mistakes or utterances while instructors are speaking. Participants can also access this instruction from their home, or at school, at any convenient time of day during the research period.
Definitions of Terms

*Working memory* refers to memory beyond short-term memory functions that proactively engage and process information to long-term memory (Baddeley, 1986; 2002). Unlike long-term memory, working memory has limited resources (Baddeley & Hitch, 1974).

*Cognitive load* refers to the work load of working memory while processing incoming information (Chandler & Sweller, 1991).

*Extraneous cognitive load* deals with inefficient instructions which increase cognitive load. This type of cognitive load wastes limited working memory resources, so a learner does not have enough remaining resources to process or integrate information (Sweller, 2005).

*Intrinsic cognitive load* refers to the complexity of the original learning material (Sweller, 2005).

*Germaine cognitive load* is the coordination and reorganization of incoming information with long-term memory schemas. (Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Sweller, 2005).

*Multimedia learning* is using two information presentation forms, *words and pictures*, for learning (Mayer, 2001).

*Intelligibility* refers to the level of comprehension of a speaker’s message by a listener (Munro & Derwing, 1995b: Nelson, 1982).

*Culture* refers to a shared system of *beliefs or values* (Building Bridges: a, 2002; Davis, Cho, & Hagensen, 2005; Lustig & Koester, 2003). Obtaining or learning cultural
values is typically done by interacting with social groups, such as parents, friends, and teachers (Lustig & Koester, 2003).

*Social identity* refers to favoritism toward in-groups over other groups, which boosts their own group’s identity and sense of belonging (Tajfel & Turner, 1986).

**The Organizational Plan of the Study**

This study is divided into five different chapters. Chapter 1 addresses the purpose of the study, statement of the problem, theoretical framework, research questions, significance of the study, delimitations and limitations of the study, and definitions of terms. Chapter 2 discusses literature reviews. Chapter 3 describes the research methodology. Chapter 4 is the analysis of collected data. Finally, chapter 5 includes a summary of findings, discussion, and recommendations for future study.
Chapter 2: Literature Review

This chapter reviews literature for this study, in which there are three main themes: cognition, speech communication and linguistics, and the cultural and social aspects. The cognition section addresses working memory theory, cognitive load theory, and multimedia learning theory. The communication and linguistic section discusses intelligibility, adjustment to foreign accents, and both verbal and nonverbal communication. Finally, the cultural and social aspect section reviews culture, cultural competency, intercultural communication, intercultural communication competency, and social identification theory.

The primary reason for separating the accent impact process of learning into three different steps is that this study needs to address how our social or cultural perceptions may influence learning beyond what the cognitive load process states - that an accented voice increases cognitive load. Positive or negative perceptions toward accents may have a similar effect. It is possible that social and cultural norms and/or interpersonal communication experiences can influence the individual’s preference. Therefore, it is important to discuss what variables shape personal preferences regarding accents and how these preferences influence the learning process (cognitive load) through learning outcomes (assessment).

The cultural and social aspect section also discusses the nature of learning environment, which deals with how people perceive accent difference and why we have different preferences (Figure, 1). The communication and linguistic section also describes how accent affects communication and how intelligibility influences the choice
of listening to different accents (Figure 1). In addition, the cognition section explains the basic structure and limitations of working memory, which deals with information processing. It establishes a foundational framework for cognitive load. Cognitive load theory explains the nature of cognitive load itself and the importance of its functions. The main functions of multimedia learning theory are to define what multimedia learning is and explain how to reduce unnecessary cognitive load for the improvement of learning.

![Image of a diagram](image-url)

**Figure 1.** The Connection of Accent Perceptions and Cognitive Load

In this study, multimedia learning was interpreted as a presentation and sensory mode rather than as a medium. The presentation aspect of multimedia learning is using
words and pictures for presenting information and the sensory mode is using dual
channel, auditory, and visual input (Mayer, 2001). The medium aspect of multimedia
learning is using computer technology or any type of audio/video technology to deliver
information (Mayer, 2001). Another reason to circumvent the medium aspect of
multimedia learning is that studies of the effectiveness of medium in learning have
states that [mediums are] “…mere vehicles that deliver instruction but do not influence
student achievement any more than the truck that delivers our groceries causes changes in
our nutrition.”. Since researchers have used radio, film, television, and computers to
show that there is no media effect on students’ learning (Clark, 2001; Clark & Salomon,
1986), it is more meaningful to shift our research focus away from the medium to the
instructional design’s effect on material and cognitive processes (Jonassen, Campbell, &
Davidson, 1994). Therefore, it was better to focus on the presentation and the sensory
aspects of multimedia learning. The research investigated the impact of accent on
students’ learning outcome and how students’ accent perceptions influence their learning
outcome, which dealt directly with cognitive process rather than medium manipulation.

Cognition

Working Memory

History of Working Memory

The structure and concept of working memory is an essential part of information
processing theory. The concept of working memory is developed from short term
memory (Miller, 1956). The impact of Miller’s article, “The Magic Number Seven, Plus
or Minus Two”, helps to differentiate the concept of sensory memory from storage memory (Bruning, Schraw, Norby, & Ronning, 2004). To overcome the limitations of the short term memory span, Miller suggests chunking information. This means to organize information into certain units, so the information can be processed into short term memory. Some well-known examples are phone numbers, social security numbers, and so on which fit into the Miller concept.

Baddeley and Hitch (1974) have pushed the idea of short term memory to another level. Their concept of working memory surpasses a simple, short storage function to include an active information process, such as integration and the connection of information (Baddeley, 1986). Working memory has three components; phonological loop, visuospatial sketchpad, and the central executive (Baddeley, 1986, 2001). A recent addition to the working memory construct is an episodic buffer; "The buffer was proposed in order to account for a range of memory phenomena that appear to involve interaction between the slave systems and LTM." (Baddeley, 2001, p. 118). Working memory is important in the human learning process because it contributes to the theoretical explanation of information processing and cognitive load. Human learning has been enhanced based on research findings regarding working memory functions and limitations (Baddeley, 2002; Smith & Kosslyn, 2007).

**Phonological Loop**

Phonological loop, controlling verbal communication-based information, has two main functions, a phonological store and an articulatory rehearsal system (Baddeley, 1986, 2002). The phonological store concept was developed from the short term memory
concept, which holds auditory information for only a few seconds. Considering the limitations of phonological store, the articulatory rehearsal system inhibits the natural process of fading (Baddeley, 1986, 2002, 2007a). The main function of the articulatory rehearsal system is to repeat words, so that working memory can use them when they are needed (Smith & Kosslyn, 2007). For example, when your friend says his phone number to you, at the same time, you are trying to recall his number in your mind until you write it down or memorize it. The evidence of phonological loop is shown in the phonological similarity effect, the irrelevant speech effect, the word length effect, and articulatory suppression (Baddeley, 2002).

Conrad and Hull (1964) researched the phonological similarity effect. They found that when the sound of one word is similar to the sound of another, it becomes hard to recall the information when compared to dissimilar sounds. The reason is that it is also triggering the other similar sound items, which causes confusion (Smith & Kosslyn, 2007). However, it does not have as significant of an impact when they have similar meanings (Baddeley, 1966). The phonological similarity effect occurs only when it retrieves information from long term memory. Therefore, it is strong evidence for the existence of phonological loop.

The irrelevant speech effect relates to the weakening of information recall because of irrelevant sounds (Colle & Welsh, 1976). However, it does not always interrupt the recall of information, as in the example of white noise (Salame & Baddeley, 1989). Some people can study at a coffee shop without any trouble because the sounds of brewing coffee, music, or chatting become white noise for them. However, this is not
always true for everyone (Salame & Baddeley). This indicates that there are individual
differences in how people define white noise. It also indicates what information should
and should not be processed. However, this decision-making is upon the central
executive function (Salame & Baddeley).

The next evidence of phonological loop is the word length effect, which
minimizes the recall of information because it loops slowly due to the lengthy stretched
sound, thus increasing the probability of losing the information (Baddeley, 2002;
Baddeley, Thomson, & Buchanan, 1975). We all have a difficult time saying unfamiliar,
lengthy foreign names in comparison to relatively short names. This is another indication
of limited phonological loop capacity. It is more dependent on the length of the
pronunciation rather than the number of syllables (Smith & Kosslyn, 2007).

Articulatory suppression occurs when a learner fails to use visual images to store
information in phonological loop (Baddeley, 2007a; Baddeley, Lewis, & Vallar, 1984).
In other words, a learner cannot convey a visual signal to the phonological loop, which
indicates a failing sub-vocal process or the inability to decode visual signals into
phonological signals; therefore, the information fails to store in phonological loop
(Baddeley, 2002). Furthermore, articulatory suppression negates the phonological
similarity effect and irrelevant speech effect (Baddeley, 2002).

The majority of evidence for phonological loop comes from a study of brain-
damaged patients (Baddeley, 1986, 2002). These patients did not have any major
problems with general comprehension skills; however, they did have a difficult time
learning new words (Baddeley, 1993). Baddeley (2003) suggests that the capacity of
phonological loop is the principal player in second language learning and native language leaning in children. Children with a normal intelligence, but who had language impairments, scored significantly lower on non-word recalling, but showed no problems in listening (Gathercole & Baddeley, 1989). The most important function of phonological loop is the acquisition of language (Baddeley, 1986, 2002, 2007a).

**Visuospatial Sketchpad**

The research conducted by Brooks (1967) describes the difference between spatial/visual and auditory information processes. In his study, participants recalled information less accurately when the presentation was spatial/visual, compared to auditory. Furthermore, visual imagery and visual perception use the same resources, but not from the same visual system (Baddeley & Hitch, 1974). These help to differentiate the visuospatial sketchpad, which is also greatly related to language acquisition from phonological loop. Visuospatial sketchpad is “the function of integrating spatial, visual and possible kinesthetic information into a unified representation which may be temporarily stored and manipulated.” (Smith & Kosslyn, 2007, p. 200). However, the limitation of visuospatial sketchpad is that it is only able to process three or four visual cues at any given time (Baddeley, 2003).

The first important distinction that has to be made within the visuospatial sketchpad is to recognize the differences between visual and spatial memory (Baddeley, 2002). Spatial memory involves three-dimensional arrangements whereas visual is more involved with two-dimensional images (Smith & Kosslyn, 2007). The second notable distinction in visuospatial sketchpad is visual imagery. We constantly use visual imagery
every day. For instance, when you give a friend directions to your house, you bring up
the image map in your mind and give verbal directions. At the same time, your friend
listens to your verbal directions and creates a visual image map based on these verbal
directions. If this is the second time he visits your home, he will have an easier time
creating his visual image because the verbal directions will trigger his long term memory
and retrieve the right information. In this case, visual imagery is highly related to verbal
connection. Especially, in early childhood language development, the connection
between words and images is the primary way to learn new vocabulary. Unfortunately,
visuospatial sketchpad has not been sufficiently studied, and also, there are many
unknown facts and disagreements among researchers, especially when compared to
known information about the phonological loop (Baddeley, 2003). For instance, Smith
and Kosslyn (2007) state that spatial rehearsal is similar to phonological rehearsal;
however, Baddeley (2003) doesn’t seem to agree. The concept of neuroimaging is to
provide spatial imaging during the recall of information, as in the previous example of
giving directions.

**The Central Executive**

The most sophisticated functional component of working memory is the central
executive, which determines what information needs to be selected for storage,
integration of information from the phonological loop, and the visuospatial sketchpad
(Baddeley, 2002). It also provides coordination of information for future manipulation
(Smith & Kosslyn, 2007). In computer information process analogy, the central
executive is the central processing unit (CPU) and the phonological loop and visuospatial
sketchpad are the random access memory (RAM). The concept of the central executive is derived from the supervisory attentional subsystem model (Norman & Shallice, 1986). Attentionally controlled systems are both the core function of working memory and a way to differentiate it from short term memory. This total attention control function includes focusing attention, dividing attention, and switching attention (Baddeley, 1996, 2001, 2003). Daneman and Merikle (1996) found that working memory span, or central executive functionality, determines individual reading and comprehension ability. Even though the central executive is the most important component of working memory, it has not been researched as much as other components (Baddeley, 2003).

**Episodic Buffer**

If the phonological loop and visuospatial sketchpad contain information for only a brief second and are controlled by the central executive, then where does the selected information go after this brief second? Does it go back to LTM or does it go somewhere else? If all information goes to LTM directly, then selecting, integrating, and organizing information all have to happen in a split second, because storing the information into LTM means that it is learned. Baddeley (2007b,) explains those questions or challenges by using the concept of the episodic buffer, “…the function of integrating information from the visuospatial and phonological subsystems, from sensory sources and from long-term memory” (p. 152). Based on his assumption, the episodic buffer coalesces information from the visuospatial and phonological systems as it holds accessible quantified information from the LTM (Baddeley, 2000; 2002; 2003). Furthermore, Prabhakaran, Narayanan, Zhao, and Gabrielli (2000, p. 89) state, “…the present fMRI
results provide evidence for another buffer, namely one that allows for temporary retention of integrated information.”.

The next inquiry about the episodic buffer relates to its capacity and duration. Baddeley and Wilson (2002) assume that it can recall or seize up to 20 or more ideas or chunked information. Hummel (1999) also claims a limited capacity for the buffer because of the computational demands. Braddeley (2000) states that the episodic buffer holds information for an extended time; however, the exact duration is unknown.

If we consider Rapid Eye Movement (REM), one of the functions of REM is to organize and consolidate our memory during sleep. If this assumption is true, then the episodic buffer is active throughout the day. Similarly, many of us have been overwhelmed or experienced an overflow of information in our brain when we studied or worked intensely for a long period of time. However, when you take a short break, you feel refreshed and reenergized. Incubation theory (Browne & Cruse, 1988) suggests that taking breaks allows the brain to clear out or organize information for effective usage. For example, if you take a break before a test, you can recall the information better because your brain has time to process or reorganize the information (Browne & Cruse, 1988). If we assume that there is no episodic buffer, then taking a break to organize information would make no sense. This way, we are not overwhelmed by information retrieving and processing.

If there is too much information, we cannot process it all because of capacity limitations. The episodic buffer can take a certain amount of information, but it has to
organize it sooner or later, just like the defragment function of a computer. Otherwise, the brain would be overwhelmed or inefficient.

Since retrieval processes also become an important function in the episodic buffer, the next question should be, “What is the most effective and efficient way to retrieve information from the long term memory?” Let us compare working memory to a computer system. There is a new computer technology called Nand flash technology which holds the Windows operating system or other software caches and critical information. This allows the computer to start up more quickly and software to open much faster. In addition, it is possible that the episodic buffer may also be able to hold critical information for a certain period time which can be used to retrieve or connect information from the long term memory more efficiently and effectively. If we consider a learning strategy of cues, cues help us to connect encoding information to retrieving information efficiently and effectively from the LTM (Bruning, Schraw, Norby, & Ronning, 2004).

**Cognitive Load**

Cognitive load is the brain workload during processing any incoming novel information (Chandler & Sweller, 1991; Sweller, 1988, 1994, 2003, 2005). The two main components of information processing in our brain are working memory (Baddeley, 1986; Baddeley & Hitch, 1974) and long-term memory (LTM). Cognitive load occurs when working memory processes or integrates the information and connects it to LTM (Clark, Nguyen, & Sweller, 2006; Ericsson and Kintsch, 1995; Paas, Renkl, & Sweller, 2003). The importance of cognitive load is that working memory’s capacity is limited
(Baddeley, 2002). The central executive function from working memory is deeply related to cognitive load (Baddeley, 2002). However, Sweller and Baddeley have a different view on the relationship between cognitive load and the central executive function (Reed, 2006). In Sweller's view (2003, 2005) there are three different types of cognitive loads, extraneous, intrinsic, and germane.

**Germane Cognitive Load**

Germane cognitive load occurs when long term memory builds schema and fluency into memory (Paas & van Merriënboer, 1994b; Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Sweller, 2005). Therefore, a high germane cognitive load means that learning is occurring rapidly, which means building schemas. However, this does not mean that a lower germane cognitive load indicates that learning is not occurring. When a learner has already built a schema or automated, then it does not require high germane load (McKeough, Marini, & Lupart, 1995; Paas & van Merriënboer, 1994b; Quilici & Mayer, 1996; Sweller, 2005). Unlike extraneous or intrinsic cognitive load, germane cognitive load is a positive and essential cognitive load for learning and applying information (Sweller, 2005). On the other hand, if extraneous and intrinsic cognitive loads are high, the learning experience will be reduced.

**Intrinsic Cognitive Load**

Intrinsic cognitive load is "the natural complexity of the information" (Sweller, 2005, p. 27). It is impossible to reduce intrinsic cognitive load through instructional design techniques (Carlson, Chandler, & Sweller, 2003; Paas, Renkl, & Sweller, 2003; Pollock, Chandler, & Sweller, 2002; van Merrenboer & Sweller, 2005). Another way to
construe intrinsic cognitive load is as a baseline for total cognitive load in working memory, because the nature of the learning material intricacy cannot be manipulated. After calculating the cognitive load for learning material, the rest of cognitive load deals with other external load or the design of instructional presentation, which is called extrinsic cognitive load. Therefore, when intrinsic cognitive load is high, indicating difficult material, then reducing the unnecessary stimulus of presentation methods or materials, or extrinsic cognitive load, is the primary objective for developing an instruction. However, when intrinsic cognitive load is low, indicating uncomplicated material, then reducing extrinsic cognitive load becomes a secondary goal. To determine either high or low intrinsic cognitive load is done by the ratio of interaction between elements which have to be processed simultaneously (Carlson, Chandler, & Sweller, 2003; Marcus, Cooper, & Sweller, 1996; Tindall-Ford, Chandler, & Sweller, 1997; van Merrenboer & Sweller, 2005). For instance, translating the words hand, live, or mouth to another language does not demand high cognitive load because translating the word hand does not require knowledge of the words mouth or live. Each element does not interact with the others and is not a complicated word for translation. Put another way, there is no interactivity between the words. However, translating he lives hand to mouth demands more cognitive load, but not because of the difficulty of vocabulary. Even though a learner can understand each word’s meaning, the dynamic element of each word generates a different meaning to the sentence.

However, Paas, Renkl, and Sweller (2003) suggest that removing any element just for reducing cognitive load may bring about other problems. They say,
“… only a simpler learning task that omits some interacting elements can be chosen to reduce this type of load. The omission of essential, interacting elements will compromise sophisticated understanding but may be unavoidable with very complex, high-element interactivity tasks. Subsequent additions of omitted elements will permit understanding to occur. Simultaneous processing of all essential elements must occur eventually despite the high-intrinsic cognitive load because it is only then that understanding commences.” (p. 1)

**Extraneous Cognitive Load**

Extraneous cognitive load relates directly to instructional design because it occurs when ineffective designs lead to poor connections with schemas, and it also increases cognitive load unnecessarily, which overloads the capacity of working memory (Kirschner, 2002; Sweller, 2003, 2005). Extraneous cognitive load becomes a significant problem when learning material is difficult (Paas, Renkl, & Sweller, 2003). For instance, when you watch a movie which has a half-second audio delay, sooner or later you realize that you just cannot process the story anymore, or you may become frustrated because of it. Also, for example, you may have a very difficult time reading some website descriptions which are presented with similar background and text color. These types of design flaws can be improved by instructional design principles. Cognitive load theory both identifies extraneous cognitive load and makes suggestions for how to reduce it.
Cognitive Load Design Techniques

Intrinsic cognitive load is a base line for total cognitive load in working memory because the nature of learning material difficulties cannot be changed. Then, a challenging question for instructors is how we can reduce extraneous cognitive loads, so we can use the rest of working memory resources for germane cognitive load at the same time, if necessary. Cognitive load theory (Paas & van Merriënboer, 1994a; Sweller, 1994) proposes reducing unnecessary usage of working memory resources and increasing its efficiency by applying effective instructional design techniques (Kalyuga, Chandler, & Sweller, 1998; Kirschner, 2002; Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Sweller, 2005). Sweller (2003, 2005) suggests five methods, split attention, the modality effect, the redundancy effect, the expertise reversal effect, and the worked example effect to reduce unnecessary extraneous cognitive load.

Split Attention

Split attention occurs when more than two pieces of visual information are presented and require integration of information by learners that increases cognitive load (Chandler & Sweller, 1992; Kalyuga, Chandler, & Sweller, 1998; Sweller, Chandler, Tierney, & Cooper, 1990; Ward & Sweller, 1990). Information integration in working memory is a preliminary activity to learning (Kalyuga, Chandler, & Sweller, 1998) which requires many cognitive demands (Sweller, 2005) and is not relevant to learning. In this case, instruction should be visually integrated and presented to learners, so learners do not necessarily mentally integrate it (Chandler & Sweller, 1991; Mayer & Moreno, 1998). When students are able to reduce working memory load, working
memory has more free resources, which can be used for learning and understanding the information.

**Modality Effect**

The modality effect is using two channels, auditory and visual, rather than using only one channel for delivering information (Mayer & Moreno, 1998; Tindal-Ford, Chandler, & Sweller, 1997; Sweller, 2005). Dual modality reduces cognitive load by preventing overload on one channel and efficiently using two channels for understanding information because it prevents split attention (Mousavi, Low, & Sweller, 1995; Penney, 1989; Tindall-Ford, Chandler, & Sweller, 1997). For instance, when you watch an animated scientific phenomenon with on-screen caption, it’s not easy to process two sources of visual information simultaneously; however, if you change the on-screen caption to narration, it becomes an effortless task (Mayer, 2001).

**Redundancy Effect**

The modality effect does not always work the best because of the redundancy effect. The redundancy effect (Chandler & Sweller, 1991; Kalyuga, Chandler, & Sweller, 2000; Sweller, 2005) occurs when one channel of information is sufficient to learn the material, but multiple channels are used to repeat the information. It actually increases cognitive load; therefore, it is better to eliminate it rather than keep it (Bobis, Sweller, & Cooper, 1993; Chandler & Sweller, 1991; Kalyuga, Chandler, & Sweller, 1998). Mayer and Moreno (2002) report that when there is no animation, learners benefit more from narration with on-screen caption than narration-only instruction, because it has only one visual representation.
The Expertise Reversal Effect

A certain extended level of the redundancy effect is called the expertise reversal effect. The expertise reversal effect only happens to the advanced learners because most of the multiple resource instructions are designed for novice learners, so those instructions are redundant information to advanced learners (Kalyuga, 2006; Kalyuga, Ayres, Chandler, & Sweller, 2003; Mcnamara, Kintsch, Songer, & Kintsch, 1996; van Merrenboer & Sweller, 2005). For instance, a simplified graph explains enough for an advanced learner; however, if a narration or text explanation is added, it might prove to be a disadvantage for the advanced learner because of redundancy.

The Worked Example Effect

The worked example effect provides guided instructional directions and solutions, and it also helps to reduce learners’ cognitive load by eliminating unnecessary usage of working memory when searching for a solution (Carrol, 1994; Cooper & Sweller, 1987; Quilici & Mayer, 1996; Trafton & Reiser, 1993). For instance, true discovery learning has failed to prove that students are learning more comprehensively, effectively, and extensively than teacher-guided instruction (Kirschner, Sweller, & Clark, 2006; Klahr & Nigam, 2004; Mayer, 2004). The reason may be that problem-based or discovery learning requires a high cognitive demand in early stages for retrieving information, which uses most of working memory resources. It ends up interfering with learning because of a lack of working memory resources for building schemas (Kirschner et al., 2006). Furthermore, Sweller (2005, p. 26) suggests that “instructional guidance provides a substitute for the missing schemas and allows learners to develop their own schemas.
without engaging in the difficult, time-consuming process of almost limitless random generation followed by testing.”. Therefore, when learners deal with new information, using worked example is more effective and efficient.

**Multimedia Learning Theory**

The dual-channel assumption is the fundamental component of multimedia learning, which is based upon dual-coding theory (Clark & Paivio, 1991; Paivio, 1990) and working memory theory (Baddeley, 2001). The basic assumption of dual-coding theory is that incoming information often comes through visual, pictures, animation, text, and auditory channels (Mayer, 2001).

Our sensory memory selects incoming information from the ears or eyes. Words can be presented by speaking or in writing. Depending on the words’ presentation mode, sensory memory selects the information as words (sounds) or images (text) (Cook, Zheng, & Biaz, 2009; Mayer, 2001, 2009; Mayer & Anderson, 1992; Mayer, Bove, Bryman, Mars, & Tapangco, 1996). In working memory, words are organized into the verbal model and images are organized into the pictorial model (Baddeley, 1986, 2001 & Mayer, 2001). When these two models are integrated, they are connected to long-term memory and incorporated with prior knowledge; the processing of pictorial multimedia information is the same with words as with text (Mayer 2001, 2009).

How many multimedia presentation modes can a person handle at any one time? Mayer and Moreno (2003) state that, “…limited capacity assumption is that only a limited amount of cognitive processing can take place in the verbal channel at any one time, and only a limited amount of cognitive processing can take place in the visual
channel at any one time” (p.44). The principle of limited capacity is based upon working memory theory (Braddeley, 1986; Braddeley & Hitch, 1974) and cognitive load theory (Chandler & Sweller, 1991; Sweller, 1994). If working memory has limited capacity, then understanding how to make a learner effectively and efficiently process the information is a key issue, which Mayer (2001) defines as active learning. Active learning occurs when learners integrate, organize, and apply information in meaningful ways to convert information from working memory into long-term memories (Mayer, 2003). Active learning theory is based upon generative-learning theory (Wittrock, 1989) and the selecting-organizing-integrating theory of active learning (Mayer, 1999; Mayer & Anderson, 1991).

The basic assumption of multimedia learning theory is that by reducing unnecessary cognitive load, learners will be able to use the rest of their cognition capacity to promote meaningful learning. Meaningful learning is a deep understanding of the material, which includes attending to focus on the vital information from presented material, mentally organizing it into a working memory structure, and integrating it with relevant prior knowledge (Mayer, 2001, 2009; Mayer & Moreno, 2003). However, Mayer’s multimedia learning theory and Sweller and Chandler’s extraneous cognitive load share the same principles and have many similar methods of reducing unnecessary cognitive load caused by inefficient instruction.

Mayer suggests the following multimedia learning principles to reduce cognitive load: multimedia principle, spatial contiguity principle, temporal contiguity principle, coherence principle, modality principle, redundancy principle, personalization, and voice
principle. Each principle has been developed to optimize the instructional learning environment.

**Multimedia Principle**

The multimedia principle is that learning enhancement occurs when the information is presented as both words and pictures, as opposed to words alone (Mayer, 1989, 2001; Mayer & Gallini, 1990). Based on two information processing channels, *verbal* and *pictorial*, it is beneficial to use two channels to present the information because it requires less cognitive load, which promotes a better learning experience (Mayer, 2001). For instance, when your friend gives you a verbal direction on how to get to his house, you are not only listening to the verbal directions, but you are also trying to create your own mental images in order to make a meaningful connection. It is a very challenging task unless you are already very familiar with the area. However, when you receive verbal directions while also looking at a map, less cognitive load is required because reading the map helps you make a more smooth information transition. Plass and Jones (2005) tested the theory within a second language learning situation. They reported that students who use both graphics and words for learning a language do better than students who use only words (Al-Seghayer, 2001; Chun & Plass, 1996; Plass & Jones, 2005). Therefore, fully incorporating two channels for a multimedia instruction can be beneficial for the learners, in comparison to only using one channel of instruction.

**Spatial Contiguity**

The spatial contiguity principal states that it would take less effort for learners to integrate information when text and pictures are physically integrated or close to each
other (Chandler & Sweller, 1992; Ginns, 2006; Levin & Mayer, 1993; Moreno & Mayer, 1999). The most well-known example of this is when you are reading any type of engineering, biology, or chemistry books. On one page, there is a display of various human organs or an engine with no text descriptions. On the next page are the text descriptions of the parts. In this case, you would end up spending a lot more time looking back and forth to connect a picture to its corresponding textual information. However, if the text and pictorial information were presented right next to each other, then learners would spend less cognitive resources searching for and connecting the two (Mayer & Moreno, 2002). Then, learners can use the rest of their cognitive capacity to meaningfully integrate information into working memory.

**Temporal Contiguity**

Temporal contiguity refers to the learning effectiveness that occurs when visual and spoken materials are presented concurrently rather than consecutively (Baggett, 1984; Baggett & Ehrenfeucht, 1983; Ginns, 2006; Mayer & Anderson, 1992; Mayer, Moreno, Boire, & Vagge, 1999; Moreno & Mayer, 1999). In Baggett’s (1984) study, he used a film which was presented to students with visual and spoken information either concurrently or consecutively. He concluded that if both presentation modes cannot be concurrently presented, then the visual mode should be presented first. However, the reason concurrent presentation works so well is that when paralleled spoken and visual information is being processed in the working memory, learners use less effort to integrate information and are not as likely to confuse information because of a disharmonized information presentation (Mayer & Moreno, 2002; Moreno & Mayer,
Temporal contiguity offers learners two different channels on which to process the same information simultaneously. Therefore, learners can have a better learning experience than if the pictures or narration were not synchronized (Chandler & Sweller, 1991; Mayer, Steinhoff, Bower, & Mars, 1995; Pass & Van Merrienboer, 1994b; Sweller & Chandler, 1994; Sweller, Chandler, Tierney, & Cooper, 1990). We often miss the importance of temporal contiguity. For instance, we all have experienced a television show or movie where the sounds and characters’ lips are not synchronized. This actually causes our mind so much distress that we have a very difficult time processing the information. The reason we often forget about a temporal contiguity is that it is built into our consciousness. We only notice it when a technical error causes an irregular condition. This is one of the big challenges posed to multimedia learning or distance learning. Malfunctions of projectors and other devices, and often Internet connection speed, can cause media to become unsynchronized.

**Coherence Principle**

The coherence principle states that any unnecessary or additional information, which may or may not be related to the learning material, reduces the potential for a deeper learning experience (Harp & Mayer, 1998; Mayer, Bove, Bryman, Mars, & Tapangco, 1996; Mayer & Moreno, 2002; Wade, 1992; Wade & Adams, 1990). Mayer (2001) states that superfluous materials divert and distract the learner, causing the learner to have difficulty organizing and processing the presented information. This interruption can come in the form of background music, or overly complex images (Mayer & Moreno, 2002; Renninger, Hidi, & Krapp, 1992). However, there are cases where manipulating
the background will improve the transfer of information to learners. For instance, a
darker background color with similar dark color fonts will generate unnecessary
cognitive load because the text is hard to differentiate from the background. A darker
background color with a lighter color font will help readers to read the text more
effectively than black text on a white background, especially to learners with vision
problems. In contrast, some other researchers use seductive information, which is
interesting material, but is not relevant to the learning object (Garner, Brown, Sanders, &
Menke, 1992; Harp and Mayer, 1998). This emotional aspect increases learners’
interest, which promotes a better learning experience (Kintsch, 1980; Weiner, 1990).
However, interesting but irrelevant information may win the students’ attention, but it
interrupts the processing of relevant information, and potentially reduces the learning
outcome (Lehman, Schraw, McCrudden, & Hartley, 2007; Shirey, 1992; Shirey &

**Modality Principle**

The modality principle states that when a multimedia instruction uses two
different channels (visual & voice) for delivering the same instruction, it is better than if
it were presented by only one channel, such as animation with on-screen descriptions
(Craig, Gholson, & Driscoll, 2002; Mayer & Moreno, 1998, 2002; Mousavi, Low, &
The rationale is that when two different pieces of information are presented by one
channel simultaneously, it often leads to an overloaded information process in the
working memory because each channel has a limited capacity to process at any given
time. For instance, when you watch an animated scientific phenomenon with on-screen captions, it becomes difficult to simultaneously process both sources of visual information. However, if the on-screen caption is replaced with narration, it becomes an effortless task because it uses two different channels to process the same information, which is more effective and efficient (Craig, Gholson, Driscoll, 2002; Ginns, 2005; Harskamp, Mayer, Suhre, & Jansma, 2007; Low & Sweller, 2005; Mayer, 2001, 2005).

**Redundancy Principle**

The redundancy principle is similar to the modality principle. Mayer and Moreno (2002) state that when two presentation methods (animation and narration) are enough for meaningful learning for the learner, additional on-screen text may be redundant, which inhibits a deeper learning experience. The reason is that adding redundant on-screen text on top of animation and narration will cause the visual channel to become overloaded by processing the animation and on-screen text at the same time (Chandler & Sweller, 1991; Kalyuga, Chandler, & Sweller, 1998, 1999; Mayer, 2003; Mayer, Heiser, & Lonn, 2001). It is simply the addition of unnecessary information. To improve the learning experience, additional on-screen text should be omitted (Mayer, 2001). Mayer and Moreno (2002) also report that if there is no animation, learners benefit more from narration with on-screen captions than narration-only instruction because it has only one visual representation (modality principle). However, the redundancy principle does not explain the impact of on-screen text, such as a summary before or after an animation.
**Personalization Principle**

The personalization principle is that the learner can process the presented information easily when the instruction uses an *informal* or *conversational* style (Moreno & Mayer, 2000; Mayer & Moreno, 2002). The theoretical rationale is that personalized instruction increases the learners’ interest (Lepper, Woolverton, Mumme, & Gurtner, 1993). The personalization principal claims that learners will exert more effort to engage in active cognitive processing during learning, which promotes deeper learning, when receiving personalized instruction (Mayer, Fennell, Farmer, & Campbell, 2004; Moreno & Mayer, 2004; Reeves & Nass, 1996). For instance, Moreno and Mayer (2004) used an agent that incorporated “I” and “You” into a conversation with the learner, thus considering the conversation to be informal. The control group agent used a third-person formal style of speaking, which is called “nonpersonalized”. This research supports that students learn more deeply when the information is presented in a personalized style rather than a formal approach (Moreno & Mayer, 2004; Nolen, 1995; Paxton, 2002).

**Voice Principle**

The voice principle states that a natural human voice promotes deeper learning when compared to a computer-synthesized or accented voice (Atkinson, Mayer, & Merrill, 2005; Mayer, 2009; Mayer, Sobko, & Mautone, 2003). People naturally or sensitively respond to other social and cultural aspects of voice, such as gender, race, and emotion (Nass & Brave, 2005). Reeves and Nass (1996) introduced social agency theory, which provides the social conversation schema, consisting of voice or images, to learners; therefore, learners more positively and actively engage the learning process. This
supports the case that natural human voice instruction promotes a deeper learning outcome in comparison to a computer-synthesized voice instruction (Mayer, Sobko, & Mautone, 2003). Furthermore, when researchers compared an English native voice instruction to an accented voice instruction, the native voice instruction led students to have a better learning experience (Atkinson, Mayer, & Merrill, 2005; Zahn & Hoppers, 1985). Even though accented voices are human voices, they do not synchronize with the style of speaking with which the learner is most familiar. Therefore, it reduces their social responses toward the instructional voice (Mayer, Sobko, & Mautone, 2003). This newest addition to multimedia learning theory has not yet been fully developed. For instance, it shows that a native voice has a positive impact on students’ learning, but it does not explain why students can be negatively affected when their instructor has different cultural values. Furthermore, it does not try to determine to what level of accent students can adapt without excessive cognitive demands. Understanding these issues is the motivation for the present research.

Culture and Cultural Competence

One of the benefits of living in a pluralistic society is having a variety of social and cultural experiences. Having diversified experiences helps people to understand others, and themselves as well, because you are constantly interacting with people with differing life perspectives. Understanding and communicating with each other has become the most valuable skill. Although not all experiences with people of differing cultural values will necessarily be positive ones, people can learn from all of their experiences. For instance, some cultures have very clear differences in the roles men and
women should play in society, or the way animals should be treated. When people
dynamically interact with other cultures and experience differing social values and
norms, cultural competence is extremely important in order to be able to adapt to
differing values without losing your own cultural identity. Lynch and Hanson (1993)
defines cultural competence as “the ability to think, feel, and act in ways that
acknowledge, respect, and build on ethnic, [socio-] cultural, and linguistic diversity” (p. 50). After accepting that there are many ways to view the world, the next step is learning to understand other cultures.

**Culture**

People often use the terms “culture”, “nationality”, “race”, and “ethnic group” interchangeably. However, nationality is based upon *geography*, race is based upon *physical appearance*, and ethnicity has the extended meaning of sharing a common *language, history, religion, and cultural values* (Lustig & Koester, 2003). Culture is more limited in scope than the common definition of ethnicity. Culture specifically refers to a shared system of *beliefs* or *values* (Lustig & Koester, 2003; Building Bridges: a, 2002; Davis, Cho, & Hagensen, 2005). Obtaining or learning cultural values is typically done by interacting with various social groups, such as *parents, friends, and teachers* (Lustig & Koester, 2003).

In order to improve cultural competence, a person has to start by understanding one’s own culture. However, it is not an easy task, and Diller and Moule (2005) state, “Culture is basic to human societies and so intertwined with our natures that its workings are seldom acknowledged or thought about by those who have internalized it.” (p. 66).
Another reason why it is so difficult is that it has multiple layers. For instance, Brown and Lundrum-Brown (1995) list eight different perspectives on understanding culture: *psycho behavioral modalities, axiology, ethos, epistemology, logic, ontology, concept of time, and concept of self.* Furthermore, differences in culture run even deeper when people consider history, ecology, and language. Awareness of one’s own culture is the key starting point for having cultural competency, because culture is the backbone shaping who they are.

**Cultural Competence**

Spitzberg and Cupach (1989) define competence as doing things accurately and effectively. Cultural competence is incorporating multifaceted aspects of a supporting system, such as *human resources, policy, emotional and social attitudes,* into a diversified cultural group to work together effectively (Isaacs & Benjamin, 1991). Diller and Moule (2005) define it a little differently because they approach the topic with an educational focus. Their definition of cultural competence is the effective teaching of students with different backgrounds. They also suggest that it is an ongoing process that is best started by *unifying values.* Banks and Banks (2001) also suggest the concept of ‘*diversity within unity*’. Furthermore, there are five essential teaching proficiencies; *awareness and acceptance of differences, self-awareness, dynamics of differences, knowledge of the students’ culture, and adaptation of skills* (Cross Bazron, Dennis, & Isaacs, 1989). The main reason why people have to pay attention to cultural competence in education is not only because of the diversified student body, but how that diversity influences the student’s learning. All students may have the same basic educational
needs; however, how they obtain knowledge in practice can be very different among culture groups (Diller & Moule, 2005).

For both teachers and students, the most challenging part of learning cultural competence is internally dealing with conflicting cultural values (Diller & Mouler, 2005). Most of their cultural miscommunication stems from their past experiences and different style of expression of cultural values (Diller & Mouler). If teachers understand a student’s cultural background, then it helps them to predict or empathize with their behavior or thinking process. Understanding and adapting to different cultural values is the core issue of cultural competence.

**Social Identification**

Bourhis, Giles, and Lambert (1975) report that listeners often identify a speaker’s social class, ethnicity, and personality based upon a speaker’s speech style, which includes accent. Most of the time, nonstandard accents are painted as a lower social group (Luhman, 1990). For instance, white majority groups graded Spanish accented voices as having a lower social class and they also reacted negatively toward the accent (Sebastian, Ryan, Keogh, & Schmidt, 1980). This negative reaction toward accented voice can be explained in two ways. First, it simply slows the listener’s understanding because they have to expend more time and have difficulty processing the incoming accented voice. This perspective is based on cognitive load within the working memory theory. Another possible scenario is social identification theory, which explains that people often give positive feelings or evaluation toward their group members when they can identify with them (Tajfel 1974; Turner, 1982). In-group or out-group attitude
happens when people recognize their own group and are more emotionally attached to it (Tajfel, 1974). As many Americans share their heritage with Europeans, Wyld (1997) makes a point related to Americans’ reaction to accented voices; “Students have complained about the accents of Asian teachers. At the same time, an instructor with a European accent many be considered perfectly acceptable, even prestigious” (p, 21).

**Communication**

Lustig and Koester (2003) define communication as “…a symbolic, interpretive, transactional, contextual process in which people create shared meanings.” (p. 10). Symbols can be words or nonverbal actions which have a certain meaning. Interpretation is what we use to understand the symbolic messages. Transaction is sending and receiving messages simultaneously. The contextual aspect is focused on the time, space, and social context in which the communication is occurring. The process is how “things are changing, moving, developing, and evolving.” (p.17). The main function of communication is sharing meanings. Lustig and Koester define meanings as “created and shared by groups of people as they participate in the ordinary and everyday activities that form the context for common interpretations” (p.17).

**Nonverbal Communication**

In communication, nonverbal communication is every bit as important as verbal communication (Matsumoto, Yoo, & LeRoux, 2007). For instance, Korean culture says to respect your teacher and American culture says the same thing. However, that value manifests itself differently in the two cultures. When Korean students look at the teacher’s eyes while they are talking to each other, it means that they are challenging the
teacher’s authority. In American culture, it is a sign of good listening, truth, and empathy. The way of showing respect to their teacher in Korea is that they look down and nod their head occasionally. In America, that would be an indication of dishonesty, camouflage, and impudence. LeBaron (2003, p. 4) states:

Since nonverbal behavior arises from our cultural common sense—our ideas about what is appropriate, normal, and effective as communication in relationships—we use different systems of understanding gestures, posture, silence, emotional expression, touch, physical appearance, and other nonverbal cues.

Therefore, people often use nonverbal signals when people deal with ambiguous messages because it helps to clarify, assist, or explain the message (Lustig & Koester, 2003; Inoue, 2007). This is the main reason that people use emblems.

There are two main ways to communicate: verbally and nonverbally. People often think that as long as we speak the same language or understand nonverbal signals, then people will not have any communication problems. Unfortunately, this assumption is not always true. For instance, there are plenty of miscommunications that have happened between teenagers and their parents, between married couples, or teachers and students. Having the same spoken language and knowing nonverbal signals are not the only two essential conditions for reaching the perfect communication relationship, it is only the starting point of communication. Of course, it would help tremendously to see what happens if the verbal or nonverbal elements of communication are removed, but the most important aspect of communication is knowing and understanding each person’s
background or social and cultural values; cues or codes are the additional essential part of improving communication (Lynch, 1991; Cheng, 1999).

**Intercultural Communication**

Intercultural communication is focused on individual communication, whereas international communication has an emphasis on *groups* or *nations* (Gudykunst & Mody, 2002). This is not a new concept. All of the principles are the same. There is a message sender and a message receiver in each communication (Gao, 2006). Due to the growing number of interactions between cultures, intercultural communication is now more important than ever. Intercultural communication is sharing and understanding meanings between people of two different cultures (Lustig & Koester, 2003; Davis, Cho, & Hagensom, 2005). Davis, Cho, and Hagensom also point out that it requires an ongoing personal internalization process.

When intercultural communication happens between two different cultures, using Inoue’s five essential skills is paramount in transmitting messages successfully (Inoue, 2007). Inoue’s five essential skills are: *tolerance of ambiguity, behavior flexibility, knowledge discovery, respect for otherness,* and *empathy*. In Howard Gardner’s multiple intelligence theory (1993), he also emphasizes a similar intelligence, interpersonal and intrapersonal intelligence. Gardner (1993) defines interpersonal intelligence as the ability to understand others, which not only includes their behavior but also their motivation. Interpersonal intelligence is what leads us through the social interactions of daily life. On the other hand, intrapersonal intelligence is focused on oneself. It includes knowledge and understanding of one’s own *cognitive strengths, emotion, and intelligence* (Ramos-
Ford & Gardner, 1997). Utilizing these skills, people who have high inter/intrapersonal communication skills or intelligence will handle intercultural communication situations more effectively.

**Intercultural Communication Competence**

The concept of intercultural communication was developed through a research project for the Peace Corps (Gardner, 1962; Wiseman, 2001). Spitzberg and Cupach (1989) define competent communication as “interaction that is perceived as effective in fulfilling certain rewarding objectives in a way that is also appropriate to the context in which the interaction occurs.” (p.68). Spitzberg’s main point is that to communicate effectively, your interactions must be perceived as having purpose and be appropriate at the same time (Wiseman, 2001). Appropriate communication means an appropriate reaction to any given contextual circumstance (Lustig & Koester, 2003). Therefore, intercultural communication competence stems from background knowledge of cultures, and both interpersonal and intrapersonal communication skills (Wiseman, 2001).

Without knowing and understanding the value of your own culture, you will not be a complete communicator even if your interpersonal and intrapersonal communication skills are high. As Collier and Thomas (1998) point out, solving cultural conflict starts from identifying and understanding one’s own culture.

Spitzberg and Cupach (1984) suggest *knowledge, motivation, and skills* as the essential parts of intercultural communication competence. Knowledge refers to the background information of a culture or society, which will allow you more flexibility in accommodating your listener’s situation (Spitzberg & Cupach, 1984). Motivation is the
willingness to interact or adapt to possible challenges or communication differences 
(Spitzberg & Cupach, 1984). We all have some fear of or prejudice against the unknown and how our actions might elicit a negative reaction from someone of another culture. In order to overcome personal challenges, a highly motivated mind can reduce anxiety of the unknown and we can more easily approach new experiences. Skill refers to your interpersonal and intrapersonal communication skills (Spitzberg & Cupach, 1984). When you know what you can and cannot do, you can effectively communicate with others. It is also important to express your thoughts and feelings effectively and appropriately in each intercultural communication situation. Wiseman (2001) states that knowledge, motivation, and skills can be learned through guided practice and experience.

**Intelligibility**

Intelligibility is “the apprehension of the message in the sense intended by the speaker” (Nelson, 1982, p. 63). It is also used for measuring a non-native speaker’s degree of understandable spoken levels. For instance, the Test of Spoken English (TSE®) measures the degree of intelligibility for a non-native speaker (Munro, 2008). Intelligibility is also the core focus when teaching pronunciation (Munro & Derving, 1995b).

Even though intelligibility is important, there is no universal way to measure it (Munro, 2008). A standard way of measuring intelligibility is to have the non-native speaker read a scripted story and a native speaker give feedback based on what was heard (Anderson-Hseih & Koehler, 1988). Bent and Bradlow (2003) suggest a different scoring system in which native speakers write down key words from the non-native speakers’
speech correctly, not entire sentences. However, transcribing exact sentences is commonly used (Brodkey, 1972; Munro, 2008). Instead of focusing solely on exact sentence transcription, summarizing non-native speakers’ speech is another useful test for measuring intelligibility (Perlmutter, 1989). Therefore, choosing an intelligibility test depends on the specific situation and goals of the research.

Whether to use scripted or unscripted text reading for non-native voice is also an important issue in intelligibility testing. Using unscripted voice is more natural and realistic. However, issues other than accent may influence the outcome of the intelligibility. For instance, spoken grammar mistakes or unintended utterances may easily impact the evaluation (Munro, 2008). However, it does not mean that using a scripted voice is the perfect alternative. Still, using the scripted voice prevents previous concerns, but non-native speakers are then able to produce better sounds than their normal speech sounds (Munro, 2008).

Munro and Derwing (1995b) state that intelligibility is achieved when “…a speaker’s message is actually understood by a listener, but there is no universally accepted way of assessing it” (p. 289). One of the main reasons for this is that the level of intelligibility may also influence listeners’ perception of a speaker’s character, either positively or negatively (Cargile & Giles, 1998). Rubin’s report (1992) confirms that many native college students reported that they had more difficulty comprehending the lecture because they believed the speaker was a foreigner, even though the speaker did not have accent. Munro and Derwing (1995a) report that intelligibility is not influenced by the level of accented voices, but instead, that accented voices usually have an impact
on the perception of comprehensibility. Gass and Varonis (1984) also report that listeners’ topic familiarity is the main factor in intelligibility test outcomes.

After considering all evidence related to the reliability of intelligibility, it was still unclear what impact it has on students’ learning. A speaker’s unintelligible sounds make it difficult for learners to comprehend the message; however, the learners’ comprehension of the given message depends on their familiarity with the message and degree of the accent.

**Intelligibility and Speech Rate**

Everyone has a different speech style and speech rate. Talking slowly does not necessarily mean that you are incapable of speaking at a faster rate or are underestimating a listener’s intelligence. At the same time, talking fast does not give the impression to others that you are more intelligent or a good communicator. Unless you intentionally alter your speaking style, speech rate is a personal style and is influenced by many other factors. However, speech rate also influences intelligibility (Yuan, Liberman, & Cieri, 2006). The premise of speech rate is that if the speech rate is too fast, then listeners have a difficult time processing the message because of cognitive process delays associated with identifying words. Speech rate can be influenced by gender, age, culture, linguistic background, and region (Yuan, Liberman, & Cieri, 2006). Some research has shown that women usually talk faster than men (Quene, 2005), while other research has found that there is no difference (Robb, Maclagan, & Chen, 2004). Regional or social and cultural differences are other factors for differing speech rates (Yuan, Liberman, & Cieri, 2006).
rate, there is a difference in the speech rate because of their differing social and cultural norms and lifestyles. Additionally, younger generations usually speak faster than seniors (Stolten & Engstrand, 2003).

Two important questions have to be addressed regarding speech rate and intelligibility. What is an average speech rate, and at what speech rate will comprehension be reduced? An average speech rate is around 190 words per minute (WPM) (Abd-Elbasseer & Barakat, 2004) and the range of speech rate is between 111 WPM to 291 WPM (Yuan, Liberman, & Cieri, 2006). A significant decline in comprehension begins around 220 WMP. Foulke and Sticht (1967) report a six percent loss in comprehension from 225 to 325 WPM. Furthermore, if the listening material is difficult or unfamiliar to a listener, then increasing the speech rate will inhibit comprehension even more (Foulke, 1962; Goldhaber, 1970). For the purpose of reducing unnecessary variables in this research, all five of the speech sample rates were below the average speech rate. They all ranged between 142 WPM and 170 WPM. Therefore, speech rate should not be a significant factor in this research.

**Intelligibility and Adjustment to Foreign Accents**

Another core question of this topic is “Can listeners adjust to foreign accents?” If they can adjust, then it is important to know how long it takes to adjust and what is the best way to facilitate the adjustment. First, we have to discuss the nature of the perceptual adjustment made by listeners of foreign accents. The basic premise is that the nature of foreign accents diverges from the native accents, which causes increased cognitive load by *perceptual difficulty for listeners* (Clarke, 2002). This assumption is
supported by cognitive load theory (Atkinson, Mayer, & Merrill, 2005; Mayer, Sobko, & Mautone, 2003). Schmid and Yeni-Komshian (1999) state that it takes a significantly longer amount of time to decode a foreign accent and requires more of the listener’s attention in comparison to a native accent. However, Nygaard and Pisoni reported (1998) that people are able to improve intelligibility of foreign accents with just three days of interaction. Clarke (2002) reports that participants exposed to 16 different sentences were able to adjust to the accent after four sentences. How fast students can adjust to foreign accents varies by each individual and situation; however, it is clear that listeners can improve their comprehension over time.

For foreign-born instructors, an accent reduction program has been shown to effectively reduce a foreign accent (Ferrier, 1991; Perlmutter, 1989). Ferrier reports that using an isolation correcting treatment on each problem sound improves intelligibility levels, as reported by students taking courses from foreign-born instructors. Students who have a positive attitude toward accented voices and differing cultures had a tendency to make more of an effort to understand accented voices (Anderson-Hsieh & Koehler, 1988).

**Reflection of Research Review**

Cognitive load theory supports that any accented voice increases the cognitive load in working memory. Learners have limited resources for processing and organizing information, so when a learner receives instruction through an accented instructor their educational experience suffers. At the same time, many intelligibility studies indicate that there is no conclusive result to show a direct relationship between intelligibility and
learners’ achievement score. However, intelligibility can affect students’ perception toward a speaker either negatively or positively. In addition, two conflicting research reports may be explained through cultural or accent perception because learners’ perception influences their learning. The main reason to have two different background accents (European and Asian) in the present study was that listeners prefer and give higher ratings to accents which were similar to their own speech background (Munro, Derwing, & Morton, 2006). It reveals how young American students’ preference may have an impact on their learning achievement because Americans share a history and a linguistic background more with Europeans than with Asians. However, this research implied that overcoming barriers to effective international learning communities in universities depends both on the foreign-born instructors’, as well as students’ efforts. How students and professors understand their own culture and how it differs from other cultures is only the starting point. How they express their culture or accent perception in a globalized learning environment and learn to come together to enrich the learning experience is the only way to create a “Flat Learning Environment”.
Chapter 3: Methodology

Method

The purpose of this study is to investigate how an instructor’s accent influences the students’ learning outcome. This study also addresses how students’ accent perceptions may affect their learning outcome. This chapter discusses the studies’ design (research process, multimedia instruction, instructional voices, measurement of intelligibility, survey questions), participants, procedures, and the outcome of the pilot study.

Design

The research design is mixed one-way ANOVA and two-way ANOVA. In this study, there was one independent variable with five different levels (native voice instruction, mild German-accented voice instruction, heavy German-accented instruction, mild Korean-accented instruction, heavy Korean-accented instruction), and one dependent continuous variable (assessment). What were considered to be mild and heavy accents was decided upon by a panel of native speakers who used an intelligibility test in order to make their decision.
Table 1

_Five Independent Groups_

<table>
<thead>
<tr>
<th>Three Different Regional Accented Voice Instructions</th>
<th>Sub-groups of Accented Voiced Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native</td>
<td>Native Voice</td>
</tr>
<tr>
<td>German Accent</td>
<td>High-Intelligibility (Mild) German Accent</td>
</tr>
<tr>
<td></td>
<td>Low-Intelligibility (Thick) German Accent</td>
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<tr>
<td>Korean Accent</td>
<td>High-Intelligibility (Mild) Korean Accent</td>
</tr>
<tr>
<td></td>
<td>Low-Intelligibility (Thick) Korean Accent</td>
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</tbody>
</table>

The research incorporated a one-way ANOVA test to analyze the students’ achievement score differences among the accent groups (Table 1). If there is a statistically significant difference, then two covariates (participants’ cultural or accent perceptions and their prior knowledge of statistics) will be used to investigate the possibility that these covariates may influence the students’ achievement score. However, it is possible that there will be no statistically significant difference in the one-way ANOVA. In this case, it may be better to use two two-way between-groups ANOVA analyses because they not only test the main effect, but also investigate the potential interaction effect (Table 2). For instance, the first two-way between-groups ANOVA examines the main effect of accented voice and the additional effect of participants’ accent perceptions. Then, it will examine the interaction between these two independent variables. The second two-way between-groups ANOVA follows the same
procedure with a new independent variable, which is the participants’ prior knowledge of statistics.

Table 2

Two-Way Between Groups ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>Additional Independent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Two-way</td>
<td>Five different groups</td>
<td>Assessment</td>
<td>Participants’ accent perceptions</td>
</tr>
<tr>
<td>groups ANOVA</td>
<td>(Native, Mild &amp; Thick</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>German Accents, and</td>
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<td></td>
<td>Mild &amp; Thick Korean</td>
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<td></td>
<td>Accents)</td>
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<tr>
<td>2. Two-way</td>
<td>Five different groups</td>
<td>Assessment</td>
<td>Participants’ prior knowledge</td>
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<td>groups ANOVA</td>
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<td>of statistics</td>
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<td>German Accents, and</td>
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<td></td>
<td>Accents)</td>
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</tbody>
</table>

Research Process

This research process had three different steps (Figure 1). The first step was a survey which acquired basic information about the participants, such as prior knowledge
of statistics and accent perceptions. The second step was viewing the multimedia instruction. All participants were randomly assigned to an instruction. Before the instruction, they were informed how to navigate the multimedia instruction and they were also informed how to take the test after the instruction. This instruction was developed based on self-paced learning, which allowed students to play, pause, or revisit previous pages in the instruction. However, there was no option to advance pages in order to prevent students from skipping the instruction. Therefore, the instruction time would be approximately 10-17 minutes, depending on each participant’s learning pace. The third part of the research process was assessment. This assessment had a total of fifteen questions. The first seven questions were procedural questions related to SPSS. The last eight questions were knowledge transfer questions based on statistics.

*Figure 2. Research Process.*
Multimedia Instruction

Topic of instruction

This multimedia instruction taught participants how to use SPSS. This instruction had three major components; inputting data into SPSS, using statistical analysis (Independent samples t-test), and interpreting the data output. The topic of the statistical analysis was an independent T test.
Research Question:

A researcher investigated the effects of a new writing method used to prepare students for the new SAT writing exam. Students were randomly assigned to the new writing method or the traditional writing method. The data from the two samples is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Method</th>
<th>Score</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>580</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>525</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>620</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>520</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>495</td>
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<tr>
<td>6</td>
<td>1</td>
<td>530</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>410</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>480</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>510</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>420</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>515</td>
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<tr>
<td>12</td>
<td>1</td>
<td>505</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>625</td>
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<td>700</td>
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<td>16</td>
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<td>2</td>
<td>525</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>500</td>
</tr>
</tbody>
</table>

Figure 3. A Sample Research Question from the Instruction.
Figure 4. Independent samples T test from The Instruction.

The Independent-Samples T-Test compares the statistical difference between the means of two independent groups.
From our example, we can conclude that the outcome of the independent t-test is statistically significant, $t(22) = -2.202$, $p = .038$. Students who were taught using the old teaching method ($M=509.167$, $SD=57.99$) received lower scores on the SAT Writing section than students learning with the new method ($M=568.33$, $SD=72.78$).

**Figure 5.** Independent samples T test Output from The Instruction.
Rationale for the Topic

The independent T test is one of the fundamental statistical analysis tools and includes the most essential concepts of statistics; dependent variables, independent variables, and descriptive statistics. The independent samples T test showed whether or not the data results were statistically significant, which could be beneficial for participants to learn that their actual learning could be statistically analyzed. Additionally, an independent samples t-test is not too difficult to understand for a novice, and at the same time has been used by researchers to ask in-depth knowledge transfer questions. Also, a multimedia instruction of the independent samples t-test function in SPSS allows for two different types of questions; procedural questions specific to the application and statistics knowledge transfer questions. This approach also led to research questions that investigate how the participant’s prior statistics knowledge or computer literacy affected the outcome.

Authoring Program

Adobe Captivate was the main program used to design the instruction. It is an authoring program for designing multimedia instruction and e-learning content. It was used to record all SPSS instructional steps and add instructional directions. Captivate has the ability to record and dub voices live or at a later time. In this instruction, the instructional voices were added later.

Instruction Voices

For this study, accents of three different nationalities were used. Male voices were used throughout the instruction. The instructors’ age range was twenty-one to
The first instructional voice was a native American accent, used as a control. He was born and raised in Colorado and currently is employed as an airline pilot. The second instructional voice was a German-accented voice. He was born and raised in Leipzig, Germany. He was an exchange student at Ohio University and had been in America for seven months at the time of recording the instruction. The last instructional voice was a Korean-accented voice. He was born and raised in Chunchen, Korea and had been in America for five years at the time this study was conducted. His entire family immigrated here at the same time. Also, he was both serving in the U.S. Army and attending Ohio University.

The German and Korean students were selected to provide heavily-accented voices. Each would speak his normal accented voice for the high-intelligibility accented instruction. The second time, they spoke with a thick accented voice for the low-intelligibility accented instruction. Using this approach, it was possible to eliminate possible differences in speech patterns, such as dynamics.

**Measurement of Intelligibility**

The intelligibility test was conducted by ten native speaker volunteers. These volunteers judged each sample’s intelligibility level independently. Each speaker read a short six sentence paragraph. There were five different voice samples; a native voice, two German-accented voices, and two Korean-accented voices. The native voice sample was used as the control for the test. All of the voice samples were selected from the multimedia instruction. The idea to measure intelligibility in this manner came from a combination of Anderson-Hseith and Koehler’s (1988) suggestion of the reading of a
scripted text by non-native speakers and Brodkey’s (1972) suggestion of the transcribing each sentence by native speakers. In this test, the evaluators wrote down what they heard, and their accuracy rating was used as the baseline for determining intelligibility. Additionally, they ranked their preference of the voices. Measuring intelligibility was not part of the pilot study because the main focus of the pilot study was testing the instruction, survey questions, and assessment.

**Survey Questions**

The survey had three different components (Appendix B). The first was collecting the participant’s basic background information, such as gender and age. The second was collecting information about the participant’s prior knowledge of statistics. For instance, they were asked if they had or had not taken a statistics or research methods class. The final component was collecting information about participants’ accent perceptions. Participants rated their accent preference for accents from twelve countries (including African, Asian, European, and South American countries). The reason for adding African and South American countries was to determine a pattern of participants’ preferences. Some participants might have a strong negative opinion toward a certain nationality or accent group but at the same time have a favorable opinion toward other groups. In other words, participants might not have a negative attitude toward all accents. Munro, Derving, and Morton (2006) report that listeners prefer and give higher ratings to accents which were more similar to their own speech background. Furthermore, the reliability of the accent preference was Cronbach’s Alpha .852.
Participants

The target population for this study was undergraduate students taking education, business management, modern language, or sciences courses at Ohio University in Athens. These courses were offered during the winter quarter of the 2009-2010 school year. All potential participants ranged from freshman to senior and their majors were as diverse as education, business, modern language, psychology, engineering, and science. These participants were informed of the details of the research by their instructors. There was no compensation for participation, but the instructors had the option to give extra credit in their course, which was to be determined by each instructor individually.

Considering G*Power analysis for predicting a sample size (Faul, Erdfelder, Lang, & Buchner, 2007), this study needed at least 123 participants. G*Power analysis suggested that the One-way ANCOVA design would need 123 samples, which ran with a large effect size (f = .04), Power (1-β err prob) = .85, α = .05, five groups, and two covariates. The G*Power analysis program also suggested that the One-way ANOVA design would need at least a sample size of 90, which ran with a large effect size (f = .04), Power (1-β err prob) = .85, α = .05, and five groups.

Procedures

Participants utilized their home computer or any school computer lab for accessing the research website. Also, participants used either Internet Explorer or Firefox to visit the website designed for this study. The first page displayed the informed consent form. By clicking “Click to the Next Page”, they acknowledged that they had read and understood the statement and consented to participate in the study (see Appendix A).
The study began with a survey of basic background information about each participant, their prior knowledge of statistics and SPSS, and their accent perceptions. Then, the participants were randomly assigned to one of the instructions. This random assignment was controlled by the website programming. Five different instructional treatments were randomly assigned to each participant when they finished the survey. Before the instruction, they were informed about how to navigate the multimedia instruction, and took the assessment after the instruction was complete.

During the multimedia instruction, participants navigated the tutorial at their own pace and had to interact dynamically with the instruction. For instance, if the instruction indicated to type numbers, then participants would have to type the exact number using the keyboard. Otherwise, the multimedia would not move forward. There was an additional controller on the bottom left corner of the screen to pause or replay the instruction. However, there was no forward button in order to prevent participants from skipping through the multimedia instruction. After the instruction, each participant completed a follow-up assessment consisting of fifteen questions. Seven of the questions were about SPSS procedures. The other eight were research statistics methods and interpretation. All surveys and assessment results were recorded on the web server.

After the assessment, there was an option for the participants needing to get extra credit for their course to notify their instructor. This email was sent to the researcher, who then forwarded it to their instructors. Participants also completed a post-survey regarding the instruction and assessment. This information was automatically sent to the principal researcher’s email account. The survey, instructions, and assessment appear in
Appendix B, C, and D. After the participants were finished, they were debriefed (see Appendix E) and thanked for their participation.

**Pilot Study Report**

The main purpose for conducting the pilot study was to test the reliability of the instrument.

**Participants and Design**

The participants consisted of 43 undergraduate college students taking either a business management or an education class from Ohio University. They were randomly assigned to either Native Voice instruction (NV) or Asian Accented Voice instruction (AAV). Twenty-two students (11 male and 11 female) were assigned to NV with an average age of 21.32. Each participant’s class ranking was above junior. Fourteen students were studying education, with the rest studying aviation, civic engineering, pre-medicine, public administration, or art. There was only one international student among the participants. Participant heritage included European (72.7%), Hispanic (9.1%), and others. Twenty-one students (11 male and 10 female) were assigned to AAV with an average age of 22.10. Each participant’s class ranking was also above junior. Ten students were studying education and the other eleven students were majoring in business, civic engineering, and sociology. They were all domestic students. Participant heritage included; European (66.7%), African American (9.5%), unspecified (14.3%), and others.
**Main Research Outcome**

The outcome of the assessment indicated that there was no significant difference, \( t(41)=.405, \ p=.688, \) between NV (M=6.41, SD=1.843) and AAV (M=6.19, SD=1.692). The magnitude of the difference between the means was very small (eta=.004). To further analyze the assessment, participants were asked two different types of questions, a knowledge retention measurement and a knowledge transfer measurement. Retention test items were focused on recalling the steps of the SPSS process and transfer test items were focused on applying statistic knowledge to interpreting independent t-test output from SPSS. The accented voice instruction group had a slightly higher average (M=3.95, SD=.161) than native voice instruction (M=3.68, SD=.995) on the retention test; however, there was no significant difference, \( t(41)= -.822, \ p=.416. \) The Cronbach alpha coefficient was -.338. On the knowledge transfer test, native voice instruction (M=2.73, SD=1.316) scored a higher average than accented voice instruction (M=2.24, SD=1.261). However, the outcome of this test was not significantly different, \( t(41)=1.243, \ p=.221. \) The Cohen’s d statistic was low moderate effect (eta=.036). The Cronbach alpha coefficient was .24. Despite finding no statistical differences in the results, the mean score differences were still consistent with most multimedia research. The majority of multimedia research data indicated either that there was no significant difference or reached an inconclusive result on the retention test, but there was a significant difference on the transfer test because multimedia learning promotes deeper knowledge learning (Mayer, 2003).
Other Findings

Through further investigation of the test, there were two notable results. First, based on two different independent groups, previous research/statistic course taken or not taken, the course taken group (M=6.79, SD=1.693) and not taken group (M=5.68, SD=1.668) were statistically different, t(41)=-2.143, \( p = .038 \). The effect size was also large (eta=.1). At the same time, students’ self-reporting of their statistic knowledge and preference had no effect on the test outcome.

Second, participants were asked to rate their preference on accents (Least Likely, 1 to Most Likely, 5). There were four geographical groups, Europe, Asia, Africa, and South America. The Cronbach alpha coefficient was .852. Besides the Asian group (China M=2.81, Korea M=2.88 and India M=2.77), most of the other groups’ mean scores ranged from 3.35 to 4. Based on their average score, each group was categorized into high and low preference accent groups. This preference rating did not have an impact on the overall study; however, when the Asian low accents rating group listened to the similar foreign accent (Asian) instructional video, there was an interesting outcome. Comparing the Low Rating Asian Group (M=5.45, SD=1.293) and High Rating Asian Group (M=7, SD=1.764) the test result was significantly different, t(19)= -2.305, \( p = .033 \). The Cohen’s d statistic for this data set was also large (eta= .22). Furthermore, as like with other multimedia learning research, there was no significant difference, t(41)= -.546, \( p = .592 \), in the knowledge retention test scores between LRAG (M=3.82, SD=1.079) and HRAG (M=4.10, SD=1.287), but there was a significant difference, t(41)= -2.603, \( p = .017 \), in the transfer test between LRAG (M=1.64, SD=.924)
and HRAG (M=2.90, SD=1.287). The Cohen’s d statistic for the data indicated an effect size estimate of .26, which was a large effect size.

Based on these outcomes, there were two main possible influence factors for the relationship between students’ achievement and the instructor’s accent. First, students’ prior knowledge of the subject might influence their achievement. Second, when students had a lower preference toward a certain ethnic accent and received instruction from a similar accented voice, then their learning experience might suffer. The reason was that there was no difference among all other geographical low or high rating groups’ comparisons. And, there was no difference in the overall test results between the high and low preference groups. However, there was a significantly different result when compared within the Asian accented voice instruction group. Therefore, students’ negative preference toward a certain accent group might negatively impact their learning when they were instructed by the similar accented voice.

**Analysis of Survey Items**

The most unsatisfactory survey result I received was about the study abroad program. Only one student had participated in the program. The original intention of asking this question was to determine how learning other languages in a different country might influence their perception of accents and learning achievement. However, this pilot study indicated that the majority of Ohio University students had not participated in a study abroad program. Conversely, 84% of students said they had taken foreign-born instructors’ courses either three times or more than four times. Only one student had not yet taken such a course.
Based on their experience, the students’ average rating for foreign-born instructors was 5.74 on a 10-point scale. The mean scores for each group were NA (M=5.78) and AAV (M=5.7). Overall, this rating system did not work well because many of the students expressed that they had had either strong positive or negative experiences. It was suggested that having two separate rating systems for positive and negative experiences would make it possible to analyze how experiences influenced their perceptions of accented voice and learning achievement. The main reason for this assumption was that when these different rating groups were analyzed in only the accented voice instruction group, the high-rating group (M=7, SD=1.8) and low-rating group (M=5.55, SD=1.44) had a large difference in mean score, but it was not enough to be significantly different, statistically, t(18)= -.2.009, p=.06. Also, the Cohen’s d score was large (eta=.18).

Furthermore, students were also asked the reason for their either negative or positive experiences. When students were asked about their most challenging issue in taking the foreign-born instructor’s class, 32.6% of students answered, “the instructor’s accent”. Students also responded with “unorganized instruction”, (14%) and “different teaching style”, (14%). Interestingly, 11.6% of students responded with “the nature of subject difficulty”. Two students said that the instructor did not adjust well to the culture of an American classroom. The majority of other opinions were based upon speaking clarity or speech rate. Considering all students’ responses and suggestions, the two main themes of dissatisfaction with foreign-born instructors are either speech/communication related issues or the teaching ability/style. In addition, when students were asked what
they believe to be the barriers to effective communication with a foreigner, they responded with: Vocabulary (37.2%), Accent (32.6%), Grammar (26.3%), and Intonation (7%).

When students were asked, “If you had a positive experience, what was the biggest reason?”, 32.6% of the responses were that the instructor was a knowledgeable and effective teacher. The other two top answers were, “I enjoyed my instructor’s sense of humor” (25.6%) and “I had an opportunity to learn another culture” (18.6%). Seven percent of responses were that they enjoyed listening to a different accent.

Over half of the students (53.5%) preferred to take the native English-speaking instructor when all other learning conditions were the same. Meanwhile, only two students were willing to take the instructor with the foreign accent, then, 42% of students were impartial between the two. To follow up this response, students were asked, “For what reason would you prefer a native speaker’s course?”. Of the responses, 44.2% were that they preferred to learn from a native voice as opposed to an accented voice. Furthermore, a majority of the remaining opinions (23.3%) expressed that an English-speaking teacher would just be easier to comprehend. In addition to this, 14% of students said that foreign instructors were less likely to understand their needs as a student. Less than 10% of students responded with either, “foreign instructors tend to give more homework” or “their teaching style tends to be more unconventional”.

Students were also asked, “For what reason would you prefer a foreign instructor’s course?”. Of the students’ responses, 11.7% were either that they like the challenge that learning from an accented instructor may present or that the course will be
easier than the native English speaker’s class. However, the majority of responses were:

“The foreign instructor often has a wealth of worldly information and shares unique
stories not often found in a native English speaker’s classroom” (41.9%) or “I wanted to
learn new cultural values and customs” (25.6%).

Conclusion

The majority of young American undergraduate students were not questioning
foreign-born instructors’ intellectual or teaching abilities, in general. Students’ main
concern was effective communication with their foreign-born instructors, especially
concerning accents. However, this pilot study had failed to suggest that foreign-born
instructors’ accents actually reduce students’ learning achievement overall. It instead
suggested that students’ achievement was influenced by either their prior knowledge of
the subject matter or their strong positive or negative perceptions toward a certain accent
group and a similarly accented instructor. This pilot study was unable to determine how
and why the students’ cultural experiences or their previous learning experiences with
foreign-born instructors impact their learning achievement or accent preferences.
However, the benefits of conducting this pilot study were to find out the reliability of the
research instruments and to discover unexpected problems in order to improve the
experimental research design. Considering these factors, it was a very successful
experiment.

Action Taken

The researcher should change the survey’s focal point to students’ prior statistical
knowledge and their accent preference. Furthermore, developing or changing some of
the survey items to find how students’ cultural experiences might relate to their perception and achievement. On the assessment, reducing multiple-choice options for some questions might improve the overall test score. For instance, the most difficult item was question twelve, which concerned reading independent sample t-test output correctly. The original answer choices were four different ways of interpreting the output. Only 10% of students answered this question correctly. However, this test item was one of the most important items for interpreting independent t-test output. Based on students’ responses, it was beneficial to keep only two answer choices instead of four because the two most obviously incorrect answers to an expert were chosen by the students over 50% of the time. These two choices were too complex to figure out for students who just learned the material in a short period of time. Dropping this item from the survey or disregarding these results would improve the overall accuracy of the test results, but would simultaneously remove one of the fundamental items for interpreting the SPSS output from the given instruction.

Previously, the multimedia instruction video did not include navigation buttons because it prevented the students from skipping parts of the instruction or the multiple reviews of the instruction, which might reduce the accent impact. However, since students’ overall test scores were low, it was better to incorporate the navigation button in order to enhance multimedia instructional video visual presentation, which would provide more learning options for the learners.

Due to a technical difficulty, students watched the instruction on a computer screen, but had to take the test on paper. After the pilot test, this issue was addressed, so
the collection and processing of data will be much more efficient. The new site provided the opportunity to keep track of the time each student spent viewing the instruction. This was useful information when comparing each instructional group’s average viewing time. It might be possible that the accented instruction media takes longer to view than native speaker media. However, this would also be useful for identifying students who might have skimmed through the assessment without giving it their full effort. If a student got a very low score, and just skimmed the material, then it could be assumed that the student’s score reflects their behavior rather than a difficulty with the instructor’s accent or difficulty with the learning material. All of the data were saved at the webhosting main server, then downloaded and saved as an excel file or data file. Therefore, the chances of data entry error were reduced.

The biggest challenge in collecting data would be to achieve an appropriate sample size. Even though all of the testing materials are on online, it did not mean that students would be interested in participating without some incentive. I contacted each of the instructors who were interested in this research and discussed with them the possibility of compensating the participating students with extra credit points for the course. Appendix E contains a sample of the recruitment letter that was sent to potentially interested professors.
Chapter 4: Result

Research Design

This chapter provides an analysis of the data collected from 192 Ohio University undergraduate and graduate students. This chapter will also discuss descriptive statistics, analyses, and other findings.

Participants

Of the 192 participants, 187 were undergraduate students and 5 were graduate students. The majority of participants were sophomores (60.9%) and juniors (24.5%). There were 108 female students and 84 male students. There were 3 international students and the rest were native students. The students’ majors were much diversified (Figure 6) with the majority coming from the College of Health and Human Services and Scripps College of Communication.
Participant heritage included; Caucasian (88.5%), African American (4.7%), Asian (2.1%), Hispanic (1%), Multiracial (1.6%), and others (2%). The average time taken to complete the survey, instruction, and assessment was 25 minutes. The shortest time taken to finish the study was 3 minutes and 17 seconds, while the longest was 1h:21m:3s. Three participants took significantly longer than this: 6 hours, 22 hours, and 44 hours. It is difficult to determine why the study took such a long time for these 3 students. It is possible that they simply forgot to click the submit button or stopped at some point in the study and finished it later while keeping the window open. Due to the extreme length of time taken for these three students to complete the study, the researcher decided to exclude them from the analysis. The participants’ average age was 20.46 years. Other detailed information is provided in table 3.
Table 3

Participants Distribution Table

<table>
<thead>
<tr>
<th>Accented Group</th>
<th>Age</th>
<th>Class Ranking</th>
<th>Gender</th>
<th>Time Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native (total = 41)</td>
<td>Average Age = 20.61 yrs</td>
<td>Freshman – 3, Sophomore – 23, Junior – 10, Senior – 3, Graduate – 2</td>
<td>Male - 14, Female -27</td>
<td>Average Time = 23m:57 sec</td>
</tr>
<tr>
<td>Mild European Accent (total = 33)</td>
<td>Average Age = 20.33 yrs</td>
<td>Sophomore – 24, Junior – 5, Senior – 3, Graduate – 1</td>
<td>Male -18, Female -15</td>
<td>Average Time = 24mm:51 sec</td>
</tr>
<tr>
<td>Heavy European Accent (total = 37)</td>
<td>Average Age = 20.62 yrs</td>
<td>Freshman – 1, Sophomore – 21, Junior – 9, Senior - 6</td>
<td>Male - 11, Female - 26</td>
<td>Average Time = 25m:30 sec</td>
</tr>
<tr>
<td>Mild Asian Accent (total = 45)</td>
<td>Average Age = 20.24 yrs</td>
<td>Sophomore – 30, Junior – 10, Senior – 4, Graduate - 1</td>
<td>Male – 23, Female – 21</td>
<td>Average Time = 27m:46 sec</td>
</tr>
<tr>
<td>Heavy Asian Accent (total = 36)</td>
<td>Average Age = 20.53 yrs</td>
<td>Freshman – 1, Sophomore – 19, Junior – 13, Senior – 2, Graduate - 1</td>
<td>Male – 18, Female - 18</td>
<td>Average Time = 22m:27 sec</td>
</tr>
</tbody>
</table>
All participants were randomly assigned to one of the following instructions: native voice instruction, mild European accent, heavy European accent, mild Asian accent, and heavy Asian accent. In this study, the Native voice instruction had 41 participants, the mild European accent had 33 participants, the heavy European accent had 37 participants, the mild Asian accent had 45 participants, and the heavy Asian accent had 36 participants. The main reason for the unequal distribution of participants was due to students who only partially participated and did not fully complete the assessment (109 participants). The majority of these partial participants finished the survey, but did not watch the instruction or failed to finish the assessment. The randomly-assigned instruction was automatically generated and assigned to a participant after completion of the survey. The total number of participants was 301 (192 fully submitted and 109 partially submitted). These partial completions (109) were excluded from the analysis.

**Research Questions and Findings**

**First Research Question**

The first research question was, “Is there any learning outcome difference among students who take native voice instruction (Native), mild European accented instruction (Mild European), heavy European accented instruction (Heavy European), mild Asian accented instruction (Mild Asian), or heavy Asian accented instruction (Heavy Asian)?”. In order to answer the question, One-way between-group analysis of variance (ANOVA) was conducted. Assessment reliability was tested and the Cronbach’s alpha was .621, which was lower than the recommendation (α=.7). The previous pilot test had lower reliability score; therefore, the researcher repeated the study for the reliability test and it was α=.695. However, the main problems were the small sample size (n=10) and that
most of the participants had already taken a research methods class or had prior experience with SPSS. The reliability score could either increase or decrease as the sample size was increased. In this case, it led to a decrease in reliability. There were two additional problems with the assessment. Even though the researcher made the questions easier than in the pilot study, the assessment was difficult for students in a non-math or research related major, because they had to learn so much new information in a short period of time (10-17 minutes). Also, because the assessment was taken immediately after the instruction, participants did not have time to review the material or have personal study time. The second problem was that the students’ diversified educational background led to a lower reliability score because the instruction was designed for students who had a statistics background or were interested in research and analysis in general. Having to study a foreign topic that did not interest some of the students most likely scared off many participants, which resulted in a higher partial completion rate than was expected.

The first assumption was the normality of dependent variable. This assumption was tested with histogram (Figure 7), Q-Q plot (Appendix E), and Shapiro-Wilk (Table 4). The normality test, Shapiro-Wilk, showed that there was no violation of normality (all of the instruction p values were greater than .05). However, the mild European group’s p value is close to .05. Therefore, it was tested with a Q-Q plot. Each data point from the Q-Q plots showed that the expected values were clustered around a normal distribution line (Appendix E).
Table 4

Shapiro-Wilk Normality Test

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Shapiro-Wilk Statistic</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Score</td>
<td>.965</td>
<td>41</td>
<td>.229</td>
</tr>
<tr>
<td>Native</td>
<td>.941</td>
<td>33</td>
<td>.073</td>
</tr>
<tr>
<td>Mild European</td>
<td>.969</td>
<td>37</td>
<td>.392</td>
</tr>
<tr>
<td>Heavy European</td>
<td>.972</td>
<td>45</td>
<td>.332</td>
</tr>
<tr>
<td>Mild Asian</td>
<td>.972</td>
<td>36</td>
<td>.485</td>
</tr>
<tr>
<td>Heavy Asian</td>
<td>.972</td>
<td>36</td>
<td>.485</td>
</tr>
</tbody>
</table>

a. Lilliefors Significance Correction

Figure 7. Bar Graph for Dependent Variable (Test Score).
The assumption of homogeneity samples was obtained from populations of equal variances. The Levene test was conducted for equality of variances. The significance value was .705, which does not violate the assumption of homogeneity of variance.

One-way ANOVA explored the impact of accented instructional voice on the students’ learning outcome (Table 5). Participants were randomly assigned to one of five different groups. There was no statistically significant difference at the $\alpha > .05$ level in assessment scores for the five instructional groups [$F(4, 187)=.878$, $\rho=.478$]. The effect size was .018, which was a very small value (Cohen, 1988).

Table 5

*Descriptive Analysis of All Different Instructional Groups*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native</td>
<td>41</td>
<td>7.5854</td>
<td>1.93618</td>
</tr>
<tr>
<td>Mild European</td>
<td>33</td>
<td>7.3333</td>
<td>1.84842</td>
</tr>
<tr>
<td>Heavy European</td>
<td>37</td>
<td>7.0811</td>
<td>2.34969</td>
</tr>
<tr>
<td>Mild Asian</td>
<td>45</td>
<td>7.5556</td>
<td>2.02883</td>
</tr>
<tr>
<td>Heavy Asian</td>
<td>36</td>
<td>6.8611</td>
<td>2.14013</td>
</tr>
<tr>
<td>Total</td>
<td>192</td>
<td>7.3021</td>
<td>2.06502</td>
</tr>
</tbody>
</table>

*Intelligibility Test*

This intelligibility test was conducted with 6 different experts from speech pathologists, English teachers for international students, and students who had a rich experience with international students and faculty. Each evaluators assess five different
accented voice samples; native, mild and heavy European accents, and mild and heavy Asian accents. Each accent has six different sentences. The shortest sentence had four words and the longest words had eleven words. The total words count was arranged between 246 to 294 words (Table. 15).

Table 6

*Intelligibility Test Score*

<table>
<thead>
<tr>
<th></th>
<th>Native</th>
<th>Mild European</th>
<th>Heavy European</th>
<th>Mild Asian</th>
<th>Heavy Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total words</td>
<td>264</td>
<td>252</td>
<td>246</td>
<td>294</td>
<td>276</td>
</tr>
<tr>
<td>Correct words</td>
<td>256</td>
<td>238</td>
<td>210</td>
<td>262</td>
<td>251</td>
</tr>
<tr>
<td>Accuracy</td>
<td>97%</td>
<td>94%</td>
<td>85%</td>
<td>89%</td>
<td>91%</td>
</tr>
</tbody>
</table>

The voices the evaluators listened to were the same as the voices used in the full instruction. The largest difference in the rating of the accent between the evaluators and students was .16 and the smallest was .11 (Figure. 16). It was not possible to measure for statistical difference because the evaluator group had too few participants to be analyzed. The group of evaluators was small because it was difficult to recruit experts for the study.
Figure 8. Instructor’s Accent Evaluation.

**Second Research Question**

The second research question was, “What degree of foreign accent still provides a reasonable intelligibility to American students?”. This acts as a follow up to the first research question. However, one-way ANOVA showed that there was no statistically significant difference among all of the accented instruction groups. Therefore, this question is no longer applicable.

**Third Research Question**

The third research question was, “How do students’ accent perceptions influence the students’ learning outcome?”. In order to answer this question, we need to address accent preferences (Table 7). This table measures the reliability of accent preference rating. Cronbach’s alpha was $\alpha=.892$. However, the two most important accent
preference rating scores were European and Asian accent preference because these two voices were used as instructional voices in the study. The reliability of Asian accent preference rating was $\alpha=.890$. However, the reliability of European accent preference rating was only $\alpha=.687$.

Table 7

*Accent Preference Rating (5 Point Rating Scale & 5 = Most Preferred)*

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>European</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>British</td>
<td>3.69</td>
<td>1.344</td>
<td>192</td>
</tr>
<tr>
<td>German</td>
<td>2.61</td>
<td>1.223</td>
<td>192</td>
</tr>
<tr>
<td>French</td>
<td>2.84</td>
<td>1.219</td>
<td>192</td>
</tr>
<tr>
<td><strong>Asian</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>1.89</td>
<td>.951</td>
<td>192</td>
</tr>
<tr>
<td>Korean</td>
<td>1.88</td>
<td>.929</td>
<td>192</td>
</tr>
<tr>
<td><strong>South American</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td>2.09</td>
<td>1.126</td>
<td>192</td>
</tr>
<tr>
<td>Mexican</td>
<td>2.46</td>
<td>1.139</td>
<td>192</td>
</tr>
<tr>
<td>Argentinean</td>
<td>2.41</td>
<td>1.172</td>
<td>192</td>
</tr>
<tr>
<td>Brazilian</td>
<td>2.72</td>
<td>1.164</td>
<td>192</td>
</tr>
<tr>
<td><strong>African</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenyan</td>
<td>2.43</td>
<td>1.173</td>
<td>192</td>
</tr>
<tr>
<td>Ghanaian</td>
<td>2.32</td>
<td>1.198</td>
<td>192</td>
</tr>
<tr>
<td>Ethiopian</td>
<td>2.22</td>
<td>1.161</td>
<td>192</td>
</tr>
</tbody>
</table>

Two-way between-groups ANOVA was conducted to explore the influence of European accent preference rating groups and five different accented instructions and was measured by the students’ learning outcome (assessment). The European accent preference group was subdivided into two different groups (Lower and Higher Preference) according to their mean score of three different accents (British, German, &
French). The lower European accent preference group (M=7.27, SD=1.97) and higher European accent preference group (M=7.34, SD=2.19) showed no statistically significant difference in European accent preference effect [F(1, 182)=.006, ρ=.938]. The effect size was also a very small (partial eta squared ≤ .001). Different accented instructional groups were also found to be not statistically significant [F(4, 182)=.789, ρ=.533]. The effect size was small (partial eta squared=.017). The interaction effect [F(4, 182)=.385, ρ=.819] also did not reach statistical significance. Its effect size was also very small (partial eta squared=.008). This indicates that there is no European accent preference effect.

A second Two-way ANOVA was conducted to explore the influence of Asian accent preference rating groups and five different accented instructions and was measured by assessment. The Asian accent preference group was also subdivided into two different groups (Lower and Higher Preference) according to their mean score of three accents (Chinese, Korean, & Indian). The effect of Asian accent preference groups, lower Asian accent preference group (M=7.05, SD=1.95) and higher Asian accent preference group (M=7.52, SD=2.15), was not statistically significant [F(1, 182)=1.963, p=.163]. The effect size was small (partial eta squared=.011). Different accented instructional groups was not statistically significant [F(4, 182)=1.231, p=.299]. The effect size was small (partial eta squared =.026). The impact of interaction did not prove to be statistical significant [F(4, 182)=1.535, ρ=.194]. Its effect size was also small (partial eta squared =.033).

It appears that the students’ accent preference ratings did not affect assessment performance. However, these two-way ANOVA analyses did not detect how these two
accented preference groups were affected when a student listened to the same accent in their instructor’s voice. For instance, when a student gave a low preference rating to Asian accented voices and then took the Asian accented voice instruction, did the low preference rating affect their achievement? This relates to the third research question about how a student’s perceptions might affect their learning achievement. In order to analyze this, the researcher redistributed participants from the five different instructional groups to only three instructional groups (Native, European, and Asian), divided files among these new groups, then conducted an independent sample t-test. The main reason to redistribute participants into three different groups was that there was no significant difference between the mild and heavy accents among the European and Asian groups. Another reason for this is that an independent sample t-test is more effective with a larger sample size for the analysis.

*Independent Sample T-test*

The first test analyzed two groups of students, who viewed European accents favorably and unfavorably. The test showed no statistically significant difference in scores for students in the lower European preference rating group (M=7.21, SD=2.33) and students in the higher European accent preference rating group [M=7.19, SD=1.78; t(68)=.046, p=.963]. The European accent preference rating effect was very small (eta squared $\leq .001$). The second independent-sample t-test was conducted with Asian accent preference rating as an independent group. There was a statistically significant difference [t(79)=-2.634, p=.010] in scores for lower Asian accent preference group (M=6.70, SD=1.77) and higher Asian accent preference group (M=7.89, SD=2.28). The effect size of the differences in the means had a moderate effect (eta squared=.08). This indicates
that accent preference had little influence on students’ learning in general; however, when a student had a negative attitude toward a certain type of accent and was instructed by an instructor with that same accent, their performance on the assessment was relatively lower.

**Fourth Research Question**

The fourth research question was, “How does prior knowledge of statistics affect the students’ learning outcome?”. Prior knowledge of statistics was determined from the students’ answers of the survey question that asked if they were currently or had previously been enrolled in a statistics or research methods class. Of these participants, 48.5% indicated that they met these criteria. Two-way ANOVA was conducted to explore the effect of the students’ prior knowledge and learning outcome when given different accented instructional voices. The results were measured using the assessment score. Participants were divided into two groups (Taken or Not Taken). This analysis indicated that there was a statistically significant difference for prior knowledge \[F(1, 182)=24.8, p \leq .001\]. The effect size in this case is large (partial eta squared=.12). However, it was not possible to conduct a Post-hoc test because there were only two independent variables. The following demonstrates the mean score for each instruction type and for students with or without prior knowledge of statistics and SPSS (Figure 9). The main effect for the instruction types \[F(4, 182)=1.396, p=.237\] and the interaction effect \[F(4, 182)=.916, p=.456\] were not significantly different. The effect size of these two were small (Instruction types Cohen’s d =.03 and Interaction Cohen’s d =.02).
Figure 9. Prior Knowledge Effects on Each Instructional Group Mean Score.

In this study, prior knowledge affected most students’ achievement score. However, a follow-up question to this research question is, “How does prior knowledge affect a student’s achievement when dealing with accented instructional voices?” Does prior knowledge still influence a student’s achievement when instructed by an accented voice, or do accented voices eliminate a prior knowledge effect? The main research question was to discover how accented voices affect a student’s learning. Therefore, it is necessary to investigate this question through as many avenues as possible.

In order to investigate this question, an independent T-Test was conducted. Three groups were formed (Native, European, and Asian), and three different independent t-tests were conducted (Table 8). There was a statistically significant difference in the
prior knowledge effect on the native voice instruction \([t(41)=3.944, p \leq .001]\) and European accent groups \([t(68)=3.389, p=001]\). However, there was not a statistically significant difference in prior knowledge effect with the Asian accent group \([t(79)=1.704, p=092]\).

Table 8

*Independent T-Test Result of Prior Knowledge*

<table>
<thead>
<tr>
<th>Accent Group</th>
<th>Prior Knowledge</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>T-test Result &amp; Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native</td>
<td>Prior Knowledge</td>
<td>19</td>
<td>8.684</td>
<td>1.734</td>
<td>(t(41)=3.944, p \leq .001) Cohen’s d =.275 (large effect)</td>
</tr>
<tr>
<td></td>
<td>No Prior Knowledge</td>
<td>22</td>
<td>6.636</td>
<td>1.590</td>
<td>(t(68)=3.389, p=.001) Cohen’s d =.144 (large effect)</td>
</tr>
<tr>
<td>European</td>
<td>Prior Knowledge</td>
<td>28</td>
<td>8.179</td>
<td>1.982</td>
<td>(t(68)=3.389, p=.001) Cohen’s d =.144 (large effect)</td>
</tr>
<tr>
<td></td>
<td>No Prior Knowledge</td>
<td>42</td>
<td>6.548</td>
<td>1.966</td>
<td>(t(79)=1.704, p=.092) Cohen’s d =.035 (small effect)</td>
</tr>
<tr>
<td>Asian</td>
<td>Prior Knowledge</td>
<td>41</td>
<td>7.634</td>
<td>2.130</td>
<td>(t(79)=1.704, p=.092) Cohen’s d =.035 (small effect)</td>
</tr>
<tr>
<td></td>
<td>No Prior Knowledge</td>
<td>40</td>
<td>6.850</td>
<td>2.007</td>
<td>(t(79)=1.704, p=.092) Cohen’s d =.035 (small effect)</td>
</tr>
</tbody>
</table>
Additional Findings

Time Duration Impact

The study was conducted through the internet and students were able to access the assessment at any time that was convenient. It is useful to determine if the amount of time the student took completing the instruction and assessment had an impact on their achievement score. The instruction was self-paced; however, this factor was neither a part of the original research question nor a countable variable. The main reason for this was that during the pilot study, it was impossible to measure the time due to technical limitations. Recently, the research site updated its technology to be able to measure time spent on the instruction accurately.

Some students spent more than 1 hour, while others spent less than 10 minutes. The shorter times could indicate that the students did not watch the instruction carefully or read through the assessment thoroughly. The longer times could indicate that students were dividing their attention or for some reason paused and resumed the instruction. The researcher estimated that the duration of time needed to complete the entire study should have been between 18-30 minutes for most students; 5-7 minutes for the survey, 10-17 for the instruction, and 3-6 for the assessment. The average completion time was 25 minutes.

Completion times were divided into 5 different groups (20% per group): Time Group 1) 3m:17s to 15m:58s with 38 participants, Time Group 2) 15m:59s to 20m:58s with 39 participants, Time Group 3) 20m:59s to 25m:39s with 38 participants, Time Group 4) 25m:40s to 33m:16s with 39 participants, and Time Group 5) 33m:17s to 1h:21m:03s with 38 participants. In order to analyze this data, a two-way ANOVA was
conducted. The dependent variable for this analysis was assessment scores. There was a statistically significant difference for completion times \([F(4, 167)=4.698, p=.001]\). The effect size was also moderately large (partial eta squared=.10). Post-hoc comparisons using the Tukey HSD test (Table 9) indicated that the mean score for time group 1 (M=6.21, SD=1.79) was significantly different from time group 3 (M=7.74, SD=2.09), time group 4 (M=8.05, SD=1.92), and time group 5 (M=7.30, SD=2.07). The main effect for the instructional types \([F(4, 167)=.679, \rho=.608]\) and the interaction effect \([F(16, 167)=.637, \rho=.851]\) did not result in any statistically significant differences.
### Table 9

**Time Duration Post-hoc Comparisons**

<table>
<thead>
<tr>
<th>Total Score</th>
<th>Tukey HSD</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I)</td>
<td>(J)</td>
<td>Mean Difference (I-J)</td>
</tr>
<tr>
<td>Time Duration</td>
<td>Time Duration</td>
<td>5 Groups</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-.6869</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-1.5263*</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-1.8408*</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>-1.3947*</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>.6869</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-.8394</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-1.1538</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>-.7078</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1.5263*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>.8394</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-.3144</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>.1316</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1.8408*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.1538</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>.3144</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>.4460</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1.3947*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>.7078</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-.1316</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-.4460</td>
</tr>
</tbody>
</table>

Based on observed means.

The error term is Mean Square(Error) = 4.052.

* The mean difference is significant at the .05 level.
Although completion time affected the students’ achievement scores, another important question is, “How does completion time influence the students’ achievement score when they learned from accented voices?”. In order to answer this question, three different one-way ANOVA analyses were conducted. The first analysis was of the native voice group. This analysis (Table 10) indicated that there was no statistically significant difference for completion times among the native voice group [F(4, 36)=.621, p=.651]. The effect size was .064, which was a medium effect.

Table 10

*Time Duration Groups among Native Voice*

<table>
<thead>
<tr>
<th>Time Duration Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.6667</td>
<td>1.41421</td>
</tr>
<tr>
<td>2</td>
<td>6.8000</td>
<td>1.98886</td>
</tr>
<tr>
<td>3</td>
<td>7.6250</td>
<td>2.44584</td>
</tr>
<tr>
<td>4</td>
<td>8.2000</td>
<td>2.16795</td>
</tr>
<tr>
<td>5</td>
<td>8.0000</td>
<td>1.87083</td>
</tr>
<tr>
<td>Total</td>
<td>7.5854</td>
<td>1.93618</td>
</tr>
</tbody>
</table>

The second one-way ANOVA was of the European accent group (Table 11). There was a statistically significant difference in completion time groups among the European accent group [F(4, 65)=3.436, p=.013]. The effect size was .174, which was a
large effect. Post-hoc comparisons using the Tukey HSD test (Table 12) indicated that the mean score for time group 1 (M=5.938, SD=2.112) was significantly different from time group 4 (M=8, SD=1.840).

Table 11

*Time Duration Groups among European Voice*

<table>
<thead>
<tr>
<th>Time Duration Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Duration Group 1</td>
<td>5.9375</td>
<td>2.11246</td>
</tr>
<tr>
<td>Time Duration Group 2</td>
<td>6.4167</td>
<td>2.19331</td>
</tr>
<tr>
<td>Time Duration Group 3</td>
<td>7.8235</td>
<td>2.21459</td>
</tr>
<tr>
<td>Time Duration Group 4</td>
<td>8.0000</td>
<td>1.83973</td>
</tr>
<tr>
<td>Time Duration Group 5</td>
<td>7.9091</td>
<td>1.13618</td>
</tr>
<tr>
<td>Total</td>
<td>7.2000</td>
<td>2.11687</td>
</tr>
</tbody>
</table>
### Table 12

**Post-Hoc Test for Time Duration Groups and European Accent**

<table>
<thead>
<tr>
<th>TotalScore</th>
<th>Multiple Comparisons*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tukey HSD</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(I) TimeDuration5Groups</th>
<th>(J) TimeDuration5Groups</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>-0.47917</td>
<td>0.75673</td>
<td>0.969</td>
<td>-2.6024</td>
<td>1.6441</td>
<td>2.6024</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-1.88603</td>
<td>0.69022</td>
<td>0.060</td>
<td>-3.8227</td>
<td>-0.0506</td>
<td>3.8227</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-2.06250*</td>
<td>0.72519</td>
<td>0.045</td>
<td>-4.0972</td>
<td>-0.0278</td>
<td>4.0972</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>-1.97159</td>
<td>0.77614</td>
<td>0.094</td>
<td>-4.1493</td>
<td>2.061</td>
<td>2.061</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0.47917</td>
<td>0.75673</td>
<td>0.969</td>
<td>-2.6024</td>
<td>1.6441</td>
<td>2.6024</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-1.40686</td>
<td>0.74713</td>
<td>0.337</td>
<td>-3.5032</td>
<td>0.6895</td>
<td>0.6895</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-1.58333</td>
<td>0.77955</td>
<td>0.263</td>
<td>-3.7706</td>
<td>0.6039</td>
<td>0.6039</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>-1.49242</td>
<td>0.82716</td>
<td>0.380</td>
<td>-3.8133</td>
<td>0.8284</td>
<td>0.8284</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1.88603</td>
<td>0.69022</td>
<td>0.060</td>
<td>-0.0506</td>
<td>3.8227</td>
<td>3.8227</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.40686</td>
<td>0.74713</td>
<td>0.337</td>
<td>-0.6895</td>
<td>3.5032</td>
<td>3.5032</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-0.17647</td>
<td>0.71516</td>
<td>0.999</td>
<td>-2.1831</td>
<td>1.8301</td>
<td>1.8301</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>-0.08556</td>
<td>0.76678</td>
<td>1.000</td>
<td>-2.2370</td>
<td>2.0659</td>
<td>2.0659</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2.06250*</td>
<td>0.72519</td>
<td>0.045</td>
<td>0.0278</td>
<td>4.0972</td>
<td>4.0972</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.58333</td>
<td>0.77955</td>
<td>0.263</td>
<td>-0.6039</td>
<td>3.7706</td>
<td>3.7706</td>
</tr>
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<td></td>
<td>3</td>
<td>0.17647</td>
<td>0.71516</td>
<td>0.999</td>
<td>-1.8301</td>
<td>2.1831</td>
<td>2.1831</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.09091</td>
<td>0.79840</td>
<td>1.000</td>
<td>-2.1493</td>
<td>2.3311</td>
<td>2.3311</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1.97159</td>
<td>0.77614</td>
<td>0.094</td>
<td>-0.2061</td>
<td>4.1493</td>
<td>4.1493</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.49242</td>
<td>0.82716</td>
<td>0.380</td>
<td>-0.8284</td>
<td>3.8133</td>
<td>3.8133</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.8556</td>
<td>0.76678</td>
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<td>-2.0659</td>
<td>2.2370</td>
<td>2.2370</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-0.09091</td>
<td>0.79840</td>
<td>1.000</td>
<td>-2.3311</td>
<td>2.1493</td>
<td>2.1493</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

a. InstructionGroup3 = 2.00
The last one-way ANOVA was of the Asian accent group (Table 13). There was a statistically significant difference in completion time groups among the Asian accent group \[F(4, 76)=3.414, p=.013\]. The effect size was .152, which was a large effect. Post-hoc comparisons using the Tukey HSD test (Table 14) indicated that the mean score for time group 1 (M=5.539, SD=.877) was significantly different from time group 4 (M=8.05, SD=2.012).

Table 13

*Time Duration Groups among Asian Voice*

<table>
<thead>
<tr>
<th>Time Duration Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>5.5385</td>
<td>.87706</td>
</tr>
<tr>
<td>Group 2</td>
<td>7.2941</td>
<td>2.20127</td>
</tr>
<tr>
<td>Group 3</td>
<td>7.6923</td>
<td>1.84321</td>
</tr>
<tr>
<td>Group 4</td>
<td>8.0500</td>
<td>2.01246</td>
</tr>
<tr>
<td>Group 5</td>
<td>7.2222</td>
<td>2.34033</td>
</tr>
<tr>
<td>Total</td>
<td>7.2469</td>
<td>2.09482</td>
</tr>
</tbody>
</table>
Table 14

Post-Hoc Test for Time Duration Groups and Asian Accent

<table>
<thead>
<tr>
<th>Total Score</th>
<th>Multiple Comparisons&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tukey HSD</td>
<td>Mean Difference (I-J)</td>
</tr>
<tr>
<td>(I) Time Duration Groups</td>
<td>(J) Time Duration Groups</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
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<td></td>
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<td>4</td>
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<tr>
<td></td>
<td>5</td>
</tr>
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<td>3</td>
<td>1</td>
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<td></td>
<td>2</td>
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<td>4</td>
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<td>1</td>
</tr>
<tr>
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<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

a. Instruction Group 3 = 3.00
Completion time did have an impact on the students’ achievement scores. When considering each accent group individually, time spent was not a factor for the native voice group, however, it was a factor for students who received instruction from European or Asian accented instructors (Figure 10). Overall, students who spent minimal time (time group 1) on this research earned a lower achievement score than students who spent an appropriate amount time (time group 4) for completing this research. This also indicated that foreign-accented voices required more time to process the information in comparison to native voice in general.

**Comparison of Native, European and Asian Accent Groups by Time Duration**

<table>
<thead>
<tr>
<th>Time Group</th>
<th>European</th>
<th>Asian</th>
<th>Native</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time 1 (3m:17s to 15m:58s)</td>
<td>5.94</td>
<td>5.54</td>
<td>7.67</td>
</tr>
<tr>
<td>Time 2 (15m:59s to 20m:58s)</td>
<td>6.42</td>
<td>7.3</td>
<td>6.8</td>
</tr>
<tr>
<td>Time 3 (20m:59s to 25m:39s)</td>
<td>7.82</td>
<td>7.7</td>
<td>7.63</td>
</tr>
<tr>
<td>Time 4 (25m:40s to 33:16s)</td>
<td>8.00</td>
<td>8.05</td>
<td>8.2</td>
</tr>
<tr>
<td>Time 5 (33m:17s to 1h:21m:03s)</td>
<td>7.9</td>
<td>7.22</td>
<td>8.0</td>
</tr>
</tbody>
</table>

*Figure 10. Comparison of Native, European and Asian Accent Groups by Time Duration.*
Instructor’s Evaluation Rating Report

After the assessment, students evaluated their instructor’s accent or speech. The rating scale ranged from 1 to 7 points (Appendix C). This analysis was also divided into three different groups (Native, European, and Asian). One-way ANOVA was conducted to explore the difference among instructor evaluation scores among the three different groups. The test indicated that there was a statistically significant difference at the $\alpha<.05$ level in instructor evaluation scores for the three different groups $[F(2, 188)=34.214, \ p=.01]$. The effect size was .267, which was very large. Post-hoc comparisons using the Tukey HSD test (Table 15) indicated that the mean score for the native group ($M=5.07$, $SD=1.37$) was significantly higher than both the European ($M=3.96$, $SD=1.09$) and Asian groups ($M=3.28$, $SD=1.14$). Also, the European group had a significantly higher score than the Asian group.
**Table 15**

*Post-Hoc Test of Instructor Evaluation Rating*

<table>
<thead>
<tr>
<th>Evaluation Instructors</th>
<th>Tukey HSD</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(I) Instruction Type</td>
<td>(J) Group</td>
<td>Mean Difference (I-J)</td>
<td>Std. Error</td>
<td>Sig.</td>
<td>Lower Bound</td>
<td>Upper Bound</td>
</tr>
<tr>
<td>Native</td>
<td>European</td>
<td>1.11682*</td>
<td>.22033</td>
<td>.000</td>
<td>.5963</td>
<td>1.6373</td>
</tr>
<tr>
<td></td>
<td>Asian</td>
<td>1.79243*</td>
<td>.21696</td>
<td>.000</td>
<td>1.2799</td>
<td>2.3050</td>
</tr>
<tr>
<td>European</td>
<td>Native</td>
<td>-1.11682*</td>
<td>.22033</td>
<td>.000</td>
<td>-1.6373</td>
<td>-.5963</td>
</tr>
<tr>
<td></td>
<td>Asian</td>
<td>.67561*</td>
<td>.20237</td>
<td>.003</td>
<td>.1975</td>
<td>1.1537</td>
</tr>
<tr>
<td>Asian</td>
<td>Native</td>
<td>-1.79243*</td>
<td>.21696</td>
<td>.000</td>
<td>-2.3050</td>
<td>-1.2799</td>
</tr>
<tr>
<td></td>
<td>European</td>
<td>-.67561*</td>
<td>.20237</td>
<td>.003</td>
<td>-1.1537</td>
<td>-.1975</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

**The Relationship between Accent Preference and Instructor Evaluation**

The relationship between accent preference (European and Asian) and instructor evaluation scores were investigated using the Pearson product-moment correlation coefficient (Table. 16). Preliminary analyses were performed to ensure that there were no violations of the assumptions of normality, linearity, and homoscedasticity. There was a medium, positive correlation between instructor evaluation scores and Asian accent preference scores \( r=.310, n=191, p \leq .001 \), and there was a small, positive correlation between instructor evaluation scores and European accent preference scores \( r=.179, n=191, p=.013 \).
Table 16

Correlations among Evaluation Instructors, Asian, & European Accent Preference

<table>
<thead>
<tr>
<th></th>
<th>Instructor Score</th>
<th>Asian</th>
<th>European</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>.310**</td>
<td>.179*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.013</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>191</td>
<td>191</td>
<td>191</td>
</tr>
</tbody>
</table>

Asian

| Pearson Correlation | .310** | 1 | .286** |
| Sig. (2-tailed)     | .000   |   | .000   |
| N                   | 191    | 192| 192    |

European

| Pearson Correlation | .179*  | .286** | 1 |
| Sig. (2-tailed)     | .013   | .000   |   |
| N                   | 191    | 192    | 192|

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Other Descriptive Analysis

Participants were asked how many courses they have taken where the professor spoke with a foreign accent (Figure 11). Only 17 participants reported none, whereas 73 participants reported four or more times. The participants’ answers also included one time (26 participants), two times (43 participants), and three times (33 participants). This indicates that the majority of students have taken a class with an accented-voice instructor three or more times.
Participants were also asked to identify the country of origin of their previous foreign instructors (Table 17). The main reason for collecting this information was to compare their experience with the Open Door 2007/2008 statistics of international scholars (Bhandari & Chow, 2008). The top 10 countries of origin for international scholars are; China (20, 149), India (9,138), South Korea (9,291), Japan (5,557), Germany (5,039), Canada (4,398), France (3,588), Italy (3,148), United Kingdom (2,877), and Spain (2,193). The top 4 countries (total of 51.5%) that provided the most scholars to the United States are all located in Asia (China, India, South Korea, and Japan). This matched the students’ report of their previous foreign instructors’ nationalities (Table 17). Additionally, it was determined that the participants have had the most classes with Asian instructors. The participants have also taken more courses from African instructors than the national average.
Table 17

*Students' Report Number of Their Previous Foreign Instructors’ Nationality*

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
<th>Total count</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>0 (92)</td>
<td>71 (71)</td>
<td>42 (21)</td>
<td>15 (5)</td>
<td>4 (1)</td>
<td>10 (2)</td>
<td>142</td>
</tr>
<tr>
<td>Asian</td>
<td>0 (76)</td>
<td>60 (60)</td>
<td>64 (32)</td>
<td>42 (14)</td>
<td>20 (5)</td>
<td>25 (5)</td>
<td>183</td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>0 (115)</td>
<td>49 (49)</td>
<td>36 (18)</td>
<td>21 (7)</td>
<td>8 (2)</td>
<td>5 (1)</td>
<td>119</td>
</tr>
<tr>
<td>Central &amp; South American</td>
<td>0 (129)</td>
<td>34 (34)</td>
<td>36 (8)</td>
<td>18 (6)</td>
<td>12 (3)</td>
<td>10 (2)</td>
<td>110</td>
</tr>
<tr>
<td>Eastern European</td>
<td>0 (132)</td>
<td>34 (34)</td>
<td>34 (17)</td>
<td>12 (4)</td>
<td>8 (2)</td>
<td>15 (3)</td>
<td>103</td>
</tr>
<tr>
<td>Western European</td>
<td>0 (142)</td>
<td>26 (26)</td>
<td>30 (15)</td>
<td>15 (5)</td>
<td>8 (2)</td>
<td>10 (2)</td>
<td>89</td>
</tr>
<tr>
<td>Other</td>
<td>0 (161)</td>
<td>23 (23)</td>
<td>12 (6)</td>
<td>0 (0)</td>
<td>4 (1)</td>
<td>5 (1)</td>
<td>44</td>
</tr>
</tbody>
</table>

*( )= actual number of students’ indication

**Overall Rating and Class choices**

When participants reported their overall experience with foreign-accented instructors, the average rating was 4.03 on a –7-point rating scale. This indicated that most participants did not have either a strong positive or negative experience or feelings. However, participants were also given the choice to pick between a class taught by a native speaker and one taught by a foreign-accented speaker, with all other conditions being the same. There were two different scenarios that the participants were presented with, a difficult class and a relatively easy class (Table 18). In the relatively easy class
situation, 67.2% students preferred an English speaking instructor, and only 7.1% students preferred a non-native speaking instructor. This number changed drastically when presented with a difficult class. Of the students, 87.5% preferred the native English speaking instructor while only 3.1% preferred the non-native speaking instructor. This indicated that if students had to take a harder course, they unequivocally preferred a native English speaking instructor over an instructor with a foreign accent.

Table 18

*Participants choice for Relatively Easy Class and Difficult Class*

<table>
<thead>
<tr>
<th></th>
<th>Relatively Easy Class</th>
<th>Difficult Class</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>The native English speaking instructor</td>
<td>64 (33.3%)</td>
<td>107 (55.7%)</td>
<td>+22.4%</td>
</tr>
<tr>
<td>The instructor with the foreign accent</td>
<td>11 (5.7%)</td>
<td>5 (2.6%)</td>
<td>-3.1%</td>
</tr>
<tr>
<td>I am impartial between the two, but I prefer the native English speaking instructor</td>
<td>65 (33.9%)</td>
<td>61 (31.8%)</td>
<td>-2.1%</td>
</tr>
<tr>
<td>I am impartial between the two, but I prefer the instructor with foreign accent</td>
<td>4 (2.1%)</td>
<td>1 (.5%)</td>
<td>-1.6%</td>
</tr>
<tr>
<td>I have absolutely no preference between the two courses</td>
<td>48 (25%)</td>
<td>18 (9.4%)</td>
<td>-15.6%</td>
</tr>
<tr>
<td>Total</td>
<td>192 (100%)</td>
<td>192 (100%)</td>
<td></td>
</tr>
</tbody>
</table>
It is also necessary to explore the relationship between these two choices, accent preference ratings, and ratings of their instructors’ voice (Table 19). Spearman’s Rank Order Correlation was conducted to explore the relationship among: difficult class accent preference, easy class accent preference, Asian accent preference, European accent preference, and overall foreign-born instructor rating. There was a medium and positive relationship between difficult class choice and Asian accent (r=.301, n=192, p<.001) and difficult class choice and overall foreign-born instructor rating (r=.310, n=192, p<.001). There was a moderately high and positive correlation between easy class choice and Asian accent preference (r=.214, n=192, p=.003). There was a medium and positive relationship between each class choice and overall foreign-born instructor rating (r=.343, n=192, p<.001). The difficult and easy class choice relationship was large and positive (r=.498, n=192, p<.001). There was no relationship between European accent preference and easy or difficult course instructor accent preference.
Table 19

*Correlations of Classes Choices, Accent Preference, and Overall Foreign Born*

*Instructor Rating*

<table>
<thead>
<tr>
<th>Spearman's rho</th>
<th>Asian</th>
<th>European</th>
<th>Overall FBI Rating</th>
<th>Difficult Class choice</th>
<th>Easy Class Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>Correlation Coefficient</td>
<td>1.000</td>
<td>.285**</td>
<td>.159*</td>
<td>.302**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.028</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>European</td>
<td>Correlation Coefficient</td>
<td>.285**</td>
<td>1.000</td>
<td>.123</td>
<td>.089</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.090</td>
<td>.217</td>
<td>.525</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>Overall FBI Rating</td>
<td>Correlation Coefficient</td>
<td>.159*</td>
<td>.123</td>
<td>1.000</td>
<td>.310**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.028</td>
<td>.090</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>Difficult Class choice</td>
<td>Correlation Coefficient</td>
<td>.302**</td>
<td>.089</td>
<td>.310**</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.217</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>Easy Class Choice</td>
<td>Correlation Coefficient</td>
<td>.214**</td>
<td>.046</td>
<td>.343**</td>
<td>.498**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.003</td>
<td>.525</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).
Reasons for Decisions

There were four additional questions: 1) If you had a negative experience with a foreign instructor, what was the most challenging issue for you? 2) If you had a positive experience with a foreign instructor, what were the biggest reasons? 3) Why would you prefer a native English speaker’s course? 4) Why would you prefer a foreign instructor’s course? The most common reason given for a negative experience (Figure 12) with foreign-born instructors (FBI) was the instructor’s accent (48.4%). Poor communication (17.7%) was the second most common reason. However, the third and fourth most common answers were related to either teaching skills or the difficulty of subject matter. Students also suggested that it was more likely to have multiple reasons for a negative experience than only one reason. Participant feedback suggests that FBIs need to focus not only on communicating effectively, but also on ensuring that their teaching methods are effective.

<table>
<thead>
<tr>
<th>Negative Experience</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others</td>
<td>11</td>
</tr>
<tr>
<td>Poor communication</td>
<td>34</td>
</tr>
<tr>
<td>Poor teaching skills</td>
<td>25</td>
</tr>
<tr>
<td>Lack of confidence on the subject</td>
<td>2</td>
</tr>
<tr>
<td>The difficulty of the subject matter being taught</td>
<td>20</td>
</tr>
<tr>
<td>The instructor did not adjust to the culture of...</td>
<td>7</td>
</tr>
<tr>
<td>The instructor’s accent</td>
<td>93</td>
</tr>
</tbody>
</table>

Figure 12. Reasons for Negative Experience with Foreign Born Instructor.
The most common reason for having a positive experience (Figure 13) with FBIs was that they were knowledgeable and effective teachers (28.1%). Students appreciated both their FBI’s unconventional humor (19.8%) and learning another culture (19.3%). However, 8 out of 11 students who picked other reasons as an option expressed either that they did not have any positive experience or that the question was not applicable. If either not applicable or no positive experience was one of the available options, then the amount of positive experience feedback was reduced.

**Positive Experience**

- The instructor was a knowledgeable and effective teacher: 54
- I enjoyed my instructor’s sense of humor: 38
- I enjoyed listening to a different accent: 15
- The instructor’s unconventional style: 11
- I had an opportunity to learn from another culture: 37
- My instructor was approachable: 26
- Others: 11

*Figure 13. Reasons for Positive Experience with Foreign Born Instructor.*
There could be many reasons why students wanted to have a native English speaker over a FBI; however, based on this survey (Figure 14), the most common reason was that FBIs can be difficult to understand (79%). Other reasons, such as teaching style, represented a very small percentage in comparison. Two unique responses from participants in the study summarize the findings well: *Native speakers have better cultural references, and English as a first language denotes more precise English.* *Concepts can be misunderstood, not because of their accent, but because of a lack of complete mastery of the English language.*

### Figure 14. Reasons for Preferring a Native English Speaker’s Course.

<table>
<thead>
<tr>
<th>Reason for Native Speaking Instructor</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign instructors can be difficult to understand</td>
<td>151</td>
</tr>
<tr>
<td>Foreign instructors' teaching style tends to be more unconventional</td>
<td>10</td>
</tr>
<tr>
<td>Foreign instructors tend to expect more from students, grade tougher, and are less flexible</td>
<td>8</td>
</tr>
<tr>
<td>Foreign instructors' often do not have the same level of subject expertise</td>
<td>4</td>
</tr>
<tr>
<td>None of these apply and I have no concerns with foreign instructors</td>
<td>17</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
</tr>
</tbody>
</table>
The final question was, “Why would you prefer a foreign instructor’s course?” (Figure 15). Of the students, 38.5% reported having no preference for foreign instructors. However, 21% of students said that they liked to learn new cultural values and customs. Some other students (16.1%) reported that foreign instructors often have a wealth of worldly information and share unique stories not often found in a native English speaker’s classroom.

**Figure 15.** Reasons for Preferring Foreign Born Instructors’ Course.
Chapter 5: Discussion

This chapter includes a summary of the findings, study limitations, recommendations for future study, and conclusion.

Summary of Findings

The purpose of this study was to investigate the effect of accents on students’ cognitive load and achievement, specifically exploring the relationship between a student’s accent perceptions and accented voice instruction in the student’s achievement. Participants were randomly assigned to five different multimedia instructions. These five instructions had the same instructional conditions, including topic, instruction process, and a scripted spoken instruction; however, each of the five instructions had a different accent. These five accents were; native voice, mild European accent, heavy European accent, mild Asian accent, and heavy Asian accent.

The method chosen for the study was experimental research and all of the study was conducted via the internet. The study included a survey, the instruction, and an assessment. The survey was designed to acquire participants’ basic background information and prior knowledge of statistics or research, and to determine accent preferences and other additional information. The participants were randomly assigned to an instruction. The last step was taking the assessment. The study used a combination of One-way ANOVA and Two-way ANOVA to investigate the main research questions. The target population for the study was current Ohio University undergraduate or graduate students. The total sample size was 192 participants. The statistical software, SPSS 17.0, was used for the analysis.
Discussion of Findings

Research Question 1 & 2

Mayer, Sobko, and Mautone (2003) reported that an accented voice increased cognitive load in working memory, which reduced working memory resources available to process information to learn. This caused the learner’s learning process to suffer because of a lack of working memory resources, caused by the accented voice. However, this research supports a claim that an accented voice does not have a negative effect on students’ achievement \( (F(4,187)=.878, p=.478) \). The major difference between the earlier study (Mayer, Sobko, & Mautone, 2003) and this one is length of the instruction. The previous study was only 140 seconds of narrated animation, but this self-paced study typically provided 10 to 17 minutes of multimedia instruction. This different instruction time might have caused the difference in the studies’ outcome. Decoding a foreign accented voice takes a longer time than with native voice (Schmid & Yeni-Komshian, 1999); however, how long it takes to adjust to the accented voice varies. Estimates of the adjustment time range from 3 days of interaction to 20 different sentences (Clarke, 2002). Therefore, it is possible to assume that the participant’s ability to adapt to the accent may have influenced the results of this study.

The second research question is not necessary to discuss because One-way ANOVA supported that there was no performance on the assessment after hearing instruction given by varying accents.
The reliability of accent preference was .892, and the two main accent preference groups were Asian $\alpha=.890$ and European $\alpha=.687$. Two two-way ANOVA were conducted. The first one was with European accent preference (High and Low) and there was found to be no statistically significant difference in assessment performance $[F(1, 182)=.006, p=.938]$. The second two-way ANOVA was with Asian accent preference (High and Low) and no statistically significant difference was found$[F(1, 182)=1.963, p=.163]$. There was no direct correlation between accent perception and a student’s achievement. However, when a student had a low preference (dislike) toward Asian accents and they listened to an Asian accented voice, their learning achievement was lower at a statistically significant level $[t(79)=-2.634, p=.01]$. However, this connection was not statistically significant with the European accent $[t(68)=.046, p=.963]$.

There are two possible explanations for why the students who said they disliked Asian accents scored poorly when given an Asian-accented instructor, but the same did not hold true for the European accent. The first plausible explanation is social identification theory, which states that listeners try to identify a speaker’s social class, ethnicity, and personality by their speech style (Bourhis, Giles, & Lambert, 1975). As soon as they identify the speaker, they evaluate them as In-group or Out-group, which affects their evaluation of the speakers (Tajfel, 1974; Turner, 1982). American culture has more common ground with European culture than with Asian culture. In this study, all of the instructors spoke the exact same words using standard American English. A previous study showed that students often judged their instructor to have an accent when
the instructor’s ethnicity was different from their own (Rubin, 1992). Wyld (1997) also
reports, “Students have complained about the accents of Asian teachers, while an
instructor with a European accent is considered perfectly acceptable by most, and even
prestigious.” (p, 21).

A second possible explanation is that students have been more exposed to Asian-
accented instructors than to any other continental group. The annual report from Open
Door (Bhandari & Chow, 2008) reported that scholars from these top four countries
(China, India, Korea and Japan) combined to comprise 51.5% of all foreign-born scholars
in the United States. The data collected from Ohio University students support this.
Based on the students’ report of their previous foreign instructors’ nationality, Asian
instructors were the most prevalent. It is reasonable to assume that students would have
stronger feelings both positively and negatively about Asian instructors, because they
have been exposed to them more than any other continental group.

After the assessment, students evaluated their instructor’s accent. One-way
ANOVA was conducted and there was a statistically significant difference among the
five different instructors’ evaluation ratings \[F(2, 188)=34.214, p<.001\]. A Post-hoc test
showed that the native voice was rated higher than both the European and Asian
instructors’ voices, and the European-accented voices were rated higher than Asian
accented voices. Mayer, Sobko, and Mautone (2003) also reported that learners rated the
native voice more positively than foreign-accented voices. Students who gave the Asian
accent a low rating after the assessment did not show a decline in performance on the
assessment. Only students who, prior to the instruction, said they disliked Asian accents
and received instruction from an instructor with an Asian accent showed lower assessment performance.

The combination of social identification and having more experience with Asian instructors might have accounted for the difference between European and Asian accents on a student’s learning.

**Research Question 4**

After participants were divided into two groups, taken or not taken (a statistics or research methods course), two-way ANOVA was conducted to analyze the effect of prior knowledge. There was a statistically significant difference for prior knowledge \( F(1, 182) = 24.8, p \leq 0.001 \). Even though this analysis answered the research question, it is useful to explore how prior knowledge influences accented voice instructions. In order to answer this question, an independent t-test was conducted and the researcher regrouped the different instructional groups (5 groups) into three different instructional groups (Native, European, and Asian). There was a prior knowledge effect in both the native \( t(41) = 3.944, p \leq 0.001 \) and European accent groups \( t(68) = 3.389, p = 0.001 \). However, there was no prior knowledge effect on the Asian accent group \( t(79) = 1.704, p = 0.092 \). This indicates that something in the Asian accent instruction negated the prior knowledge effect.

**Conclusion**

The most common reason for having a negative experience with foreign-born instructors (Figure 11) was their accent (48.4%). Another reason for why students preferred to have a native English speaker over a foreign-born instructor (Figure 17) was
that foreign instructors could be difficult to understand (79%). These findings are similar to a decade-old research report which said that students were frustrated with foreign-born instructors because of communication barriers (Cheng, 1999; Rubin & Smith, 1990; Rounds, 1987). Furthermore, Mayer, Sobko, and Mautone’s (2003) research also showed that a foreign-accented voice increases cognitive load, which leads to a reduction in the ability to process other information, and thereby decreases learning, because working memory has limited resources.

If the premise that an accented voice reduces a student’s learning experience is true, this raises serious issues. If however, this premise is false, then it is not a relevant issue. Borjas (2000) reported that students’ grade point averages were 0.2 points lower (4.0 point scale), which is not statistically significant, in an identical course taught by a foreign-accented instructor in comparison to a native English instructor in a different term. This research supports that there is no significant difference among different accented voice instructions. Given this, how can the cognitive load research outcome be explained? A big difference between the cognitive load research and these two studies was instruction completion time. Mayer and his associates’ research instruction time was only 140 seconds. The completion time for this study was 10-17 minutes, depending on the learner’s own pace, and also, Borjas’s research was conducted throughout one full academic term. Therefore, listening adaption is the most plausible explanation for the different outcomes.

If accented voices do not hinder students’ learning, why do students have less positive experiences with foreign-born instructors, and why do students think that their
grades suffer in courses taught by foreign-born instructors? Alberts (2008) reports that when students complained about their foreign-born instructors’ accent, the two main reasons were to hide their prejudices, or to use accent as a scapegoat to excuse their lower achievement. Many students complained regardless of the thickness of their instructor’s accent, even if it was barely perceptible (Rubin, 1992; Clayton, 2000).

In this study, the instructor’s accent evaluation scores showed a statistically significant difference among the three accented groups (Native, European, and Asian). The Asian-accented instructor’s evaluation score was almost 2 points less than the native speaker’s score, while the European accented instructor’s score was 1 point lower on a 7-point rating scale. This, however, did not affect the students’ assessment scores.

In conclusion, first impressions are very important to our daily life. First impressions can be right or wrong, but they are important. How we first perceive a person creates the lens through which we will view them as we learn more about them. If a student’s dislike of a particular accented voice negatively affects their learning while being taught by that voice, what can be done to mitigate the problems of this situation? Questions that must be asked include: Could raising the student’s cultural awareness or gaining a greater appreciation for diversity help the student to learn more effectively? Does the teacher have a responsibility to adjust their teaching methods to be more conventional to the area in which they are teaching and do more to reduce communication barriers?
Limitations and Recommendations for Future Study

The limitations of this study are closely tied to recommendations for future study. First, the instruction was scripted. This helped to limit variables such as grammar, vocabulary, and speaking style. This also created a great environment in which to test the affect of pure accent. However, this was not a natural speaking environment. It could not bring together all other aspects of communication. Kuhn (1996) suggests that cross-cultural communication is a bigger problem than the problem with accent. Furthermore, Alberts (2008) states:

Students consider language issues the main factor in complicating classroom interactions. However, there was a wide range of answers concerning how much the accent hindered their learning, with the vast majority of the students at most reporting temporary difficulties, indicating that the accent is only rarely a major long-term obstacle. (p.194)

Another limitation of this study was that it was restricted to accent only. This study shows the need for future research on the many other aspects of teacher-student communication, such as teaching style, ability, non-verbal communication, speaking fluency, grammar, and cross-cultural understanding. These aspects of communication have never been the main focus of any research about cross-cultural communication with regards to teaching.

Another limitation of this study that future studies may be able to improve upon is the number of accents. This study only used native, European, and Asian accents, when there are instructors of all ethnicities in American classrooms. How a student’s
achievement is influenced by the relationship between a student’s perceptions toward Asian accents and Asian-accented instructors is difficult to substantiate because European was the only other foreign accent involved in the study. If this only happens with Asian accents, then there is a need to investigate the relationship of Asian instructors and American students. If, however, this happens with other ethnic groups (African or South American), future research is needed to address multicultural or cross-cultural education with American students.

The fourth limitation and suggestion for future study is improving the reliability of the assessment, which was lower than the recommendation ($\alpha=.7$). The assessment needs to be modified for novice learners. The assessment was too difficult for them to do well on because they had limited instruction time and there was no reviewing time before taking the assessment. If the research is targeted on novice learners, then it is necessary to consider those learning conditions and modify the assessment accordingly.

The fifth limitation and suggestion for future study would be to have a short (less than 2 minutes) and a long instruction (over 10 minutes). This would allow for an exploration of how students are able to adapt to accented voices. This study failed to take into account the possibility of accent adaptation. One participant said, “I learned that I had to pay attention more to the accent of the man speaking compared to if the person speaking was an English native.”. This student’s response resembles what Mayer and his associates found in their study (2003). An accented voice requires more cognitive load to understand than a native voice. The same student responded to the following question from the post survey, what did you like most about instruction?; “I liked that he did have
an accent because it actually made me pay more attention to the subject being taught. If it was an English native then I believe I would not have paid as much of attention”. This shows that accented voice can have a positive effect on a student’s learning; however, it does not refute the fact that it also requires more cognitive load to process the information. Therefore, the relationship between students’ perceptions and attitudes toward accents and the ability of accent adaptation need further study.

The final limitation and suggestion for future study would be to have an in-depth interview with the participants. This would allow for getting more of the participants’ reactions and thoughts about their instruction and accents. This interview could help to explain some of the questions that could not be quantified, such as why students had a strong negative reaction toward Asian accented voice when compared to other accented voices or how they were able to become acclimated to listening to an accented voice during the instruction.

In my personal journey in America, I have had many different and interesting communication problems and episodes. When I moved into a college dorm for the first time, I could not understand anything that young American students said to me because they spoke too fast for me to understand. Of course, this was a normal speaking rate for them, but it was an incredibly fast rate for me. The reason for this was that I lived with an elderly American lady who knew how to communicate with international students before I moved into the dorms. When I traveled to southern states for the first time, I could not understand a policeman who had a thick southern accent. It was my first time hearing a southern accent and it was almost impossible for me to understand. Also, I
could not understand my first roommate, who came from England. Of course, it was also my first experience speaking to anyone from Britain. After I learned to communicate with him, it was so much easier for me to talk to other international students, because I had figured out their speaking patterns. Many international students share similar English communication problems, so it was easy for me to figure out what they wanted to say and vice versa.

Communication requires both a sender and a receiver, and effective communication requires an active involvement from both parties. Sharing the same language is beneficial for effective communication; however, people who share the same language still can have a lot of communication problems. The question is, what can both parties, learners and instructors, do to improve communication in the classroom and beyond when accents are involved?

**Suggestions for Students, Foreign-Born Instructors and University Administrators**

**For Students**

Accented voices increase cognitive load which requires more attention from the learners; however, it does not hinder learning. At any given time, learners can figure out the pattern of speech and be able to accommodate an accent. As long as students have a positive attitude toward accents, accents will not hinder students’ achievement. Therefore, having a positive and open mind and attitude toward accented voice is very important when students take a class with foreign-born instructors.
For Foreign-Born Instructors

The primary finding of this research is that accent is not the main factor involved when students have a poor learning experience. However, it does not mean that a thick accent is not an obstacle for learners. In other words, an accented voice increases a learner’s cognitive load, but it does not hinder the learner’s opportunity for achievement. The main reason for this would be accent adaption. As soon as a learner figures out the patterns of speech, the learner can reduce the unnecessary cognitive loads. Therefore, it would be beneficial to let students know of your speaking patterns beforehand. It would help to reduce learners’ effort in adapting to your speech.

Interestingly, accent is a personal signature and it is not easy to reduce completely. Reducing accent to a certain level is necessary for improving communication, but expanding or improving the usage of English language is more important. One participant notes; …Conce...
method is better or worse, but it is important to know and understand learners’ typical learning environment.

**For University Administrators**

The most notable finding of this research indicates that students’ perception toward foreign-born instructors may influence students’ achievement more than instructors’ accents. Furthermore, European-accented voice does not influence students’ achievement; however, when students have a less positive attitude toward Asian-accented voice, students’ achievement scores dropped significantly when compared to students who have a positive attitude toward Asian-accented voice. Therefore, it is more effective to address students about cultural awareness and linguistic differences.

The primary reason for why students have fewer problems with European-accented voices is that both European and American cultures share similar values and linguistic roots. Therefore, it is necessary for non-European foreign-born instructors to be aware of the cultural and linguistic differences, which can be challenging issues for both students and instructors. Having an open discussion about linguistic and classroom cultural differences during the orientation time for both instructors and new incoming students would allow for a more smooth transition for both parties.
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Appendix A

Consent Form

Ohio University Consent Form

Title of Research: The effect of accents on multimedia learning: How a student’s cognitive load is influenced by his cultural perceptions and the instructor’s accent. Researchers: JeahyeonAhn

You are being asked to participate in research. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should receive a copy of this document to take with you.

Explanation of Study
The purpose of this study is to investigate the relationship between students’ culture perceptions and accented voice instruction. Before the experiment you will complete, a short survey about your general knowledge of statistics, multimedia learning familiarity and cultural perceptions. During the experiment you will be randomly assigned to view a short multimedia instruction about SPSS (Statistical Package for the Social Sciences) program which can be either a native voice or an accented voice instruction. In addition, you will complete a short assessment. Your total participation should last approximately 20-25 minutes.

Risks and Discomforts
There should be no risks or discomforts to you during your participation in the study.

Benefits
The benefits of engaging in this study are that you will get a first-hand glimpse at how scientific educational research is conducted, and you will also learn how to use SPSS. You will use this program if you take any statistics or research classes from the psychology or education department.

Confidentiality and Records
Materials completed by experimental participants will only be identifiable by subject numbers. No link will be able to be made between your name and your responses during the experiment. In addition, all data collected will be automatically forwarded to the principal investigator’s email account and stored on his personal computer.

Compensation
Upon full completion of the experiment, you will receive some extra credit toward your class. It depends on your instructor. You may withdraw from the experiment at any time for any reason and will be given credit for all completed parts of the experiment including the session for which you withdrew.

Contact Information
If you have any questions regarding this study, please contact JeahyeonAhn, ja106104@ohio.edu or Dr. David Moore, moored3@ohio.edu.
If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

By signing below, you are agreeing that:
• you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions
• known risks to you have been explained to your satisfaction.
• you understand Ohio University has no policy or plan to pay for any injuries you might receive as a result of participating in this research protocol.
• you are 18 years of age or older
• your participation in this research is given voluntarily
• you may change your mind and stop participation at any time without penalty or loss of any benefits to which you may otherwise be entitled.

By clicking "Click to the Next Page" and proceeding with this study, I acknowledge that I have read and understood the above statement and consent to participate in this study.
Appendix B

Survey

1. Age: ________(Type)
2. Gender: _____ Male _____ Female (Check)
3. What is your major? ____________ If applicable, you may type “undecided”. (type)
4. Are you a domestic or an international student?
   Domestic            International
5. What is your current class ranking?
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
   e. Graduate
6. Have you taken or are you currently enrolled in a statistics or research methods class?
   Yes or No
7. How would you rate your general knowledge of statistics?
   1- None
   2- Below average
   3- Average
   4- Above average
   5- High
8. Have you used the computer program SPSS program before?
   Yes or No
9. How many times have you used any type of multimedia instructional computer programs?
   1- Never
   2- Once or twice
   3- Three or four times
   4- Five or six times
   5- More than six times
10. To what foreign countries have you travelled, including Canada & Mexico? (List all)

11. When interacting with an international student or teacher, how likely are you to have a good experience?
   (Very Unlikely 1 to Extremely Likely 5) 1 2 3 4 5

12. When interacting with an international student or teacher, how likely are you to have a bad experience?
   (Very Unlikely 1 to Extremely Likely 5) 1 2 3 4 5

13. How would you describe your ethnic heritage?
   1- Hispanic
   2- African American
   3- Native American
   4- Caucasian
   5- Asian
   6- Multiracial
   7- Other (Specify):

14. Other than English, what language(s) have you studied?
   German, French, Spanish, Arabic, Chinese, Japanese, Korean, Italian, Russian, Any South Eastern Asian language, any African language, other (specify)__________

15. In how many courses have you taken where the professor spoke with a foreign accent?
   1- None
   2- One
   3- Two
   4- Three
   5- Four or more

16. Identify the accent that your foreign instructor(s) spoke? (Circle as many as is applicable)
   Ethnic                Times
   African              0 1 2 3 4 5+
   Asian                0 1 2 3 4 5+
   Central & South American 0 1 2 3 4 5+
   Eastern European     0 1 2 3 4 5+
   Western European     0 1 2 3 4 5+
17. If you have taken a course taught by an instructor with a foreign accent, how was the overall negative experience? Rate on a scale of 1-7, with 1 being a terrible experience and 7 being good

1 2 3 4 5 6 7 Not Applicable

18. If you had a negative experience with a foreign instructor, what was the most challenging issue for you? Choose one

1- The instructor’s accent
2- The instructor did not adjust to the culture of American classrooms
3- The difficulty of the subject matter being taught
4- Lack of confidence on the subject
5- Different teaching style
6- Poor communication
7- Other (Specify):

19. If you have taken a course taught by an instructor with a foreign accent, how was the overall positive experience? Rate on a scale of 1-7, with 1 being the lowest

1 2 3 4 5 6 7

Not Applicable

20. If you had a positive experience with a foreign instructor, what was the biggest reason? Choose one

1- I had an opportunity to learn from another culture
2- The instructor’s unconventional style
3- I enjoyed listening to a different accent
4- I enjoyed my instructor’s sense of humor
5- The instructor was a knowledgeable and effective teacher
6- Other (Specify):

21. When you have a conversation with your foreign instructor that does not go smoothly, what typically, do you think is the barrier to effective communication?

1- Accent
2- Grammar
3- Intonation
4- Vocabulary
22. In a hypothetical situation, you have a choice between two classes taught by two different instructors, a native English speaking instructor and an instructor with a foreign accent. **This course (excluding foreign language classes) is very difficult and it demands a lot of work.** If all other conditions are the same, including class time, instructor’s gender, and academic credentials which instructor would you prefer? (This is not a foreign language class)

1- The native English speaking instructor
2- The instructor with the foreign accent
3- I am impartial between the two, but I prefer the native English speaking instructor
4- I am impartial between the two, but I prefer the instructor with foreign accent
5- I have absolutely no preference between the two courses

23. Considering the same situation, if the course was relatively easy and did not demand much study time, which instructor would you prefer?

1- The native English speaking instructor
2- The instructor with the foreign accent
3- I am mostly impartial between the two, but I would choose the native English speaking instructor
4- I am mostly impartial between the two, but I would choose the instructor with the foreign accent
5- I have absolutely no preference between the two courses

24. Why would you prefer a native English speaker’s course?

1- Foreign instructors can be difficult to understand
2- Foreign instructors’ teaching style tends to be more unconventional
3- Foreign instructors tend to expect more from students, grade tougher, and are less flexible
4- Foreign instructors’ often do not have the same level of subject expertise
5- None of these apply and I have no concerns with foreign instructors
6- Other (Specify):

25. Why would you prefer a foreign instructor’s course?

1- I like to learn new cultural values and customs
2- I enjoy hearing accented speakers speak
3- The course will likely be easier than the native English speaker’s class
4- I like to support minorities in the work environment
5- The foreign instructor often has a wealth of worldly information and shares unique stories not often found in a native English speaker’s classroom
6. None of these apply and I have no preference for foreign instructors
7. Other (Specify):

26. How much do you enjoy listening to the following accent?
   (1 – I dislike hearing this accent to 5 – I prefer to hear this language)

<table>
<thead>
<tr>
<th>Accent</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>British</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>German</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>French</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Chinese</td>
<td></td>
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<tr>
<td>Korean</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Indian</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Mexican</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Argentinean</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Brazilian</td>
<td></td>
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<tr>
<td>Kenyan</td>
<td></td>
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<tr>
<td>Ghanaian</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Ethiopian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix C

Assessment

1. Gender was a variable name and you assigned numeric codes for male and female. Under which heading in the variable view did you choose between ‘nominal’, ‘ordinal’ and ‘scale type’?
   a. Type
   b. Transform
   c. Values
   d. Measure

2. Before you analyzed your sample data, you separated analyses by gender. What were the steps for this?
   a. Data → Sort cases
   b. Data → Split file
   c. Data → Select cases
   d. Transform → Recode

3. After you chose one of steps from question 2, you also had to choose another option from a new dialog box for completing the process. Which one should you choose to see output by gender?
   a. Analyze all cases, do not create groups
   b. Organize output by groups

4. Which statistical analysis did you use to get a statistical summary table, such as mean, standard deviation, so on from the instruction?
   a. Crosstabs
   b. Descriptives
   c. Ratio

5. When you ran the t-test for a statistical analysis of the two groups, what was the first step you had to choose from ‘Analyze’ on the tool bar?
   a. Report
   b. Compare means
   c. Correlate

6. If you wanted to compare mean spelling test scores for boys and girls in a class, which t test option would you use?
   a. One-Sample T Test
   b. Independent-Sample T Test
   c. Paired-Sample T Test
   d. Dependent-Sample T Test

7. In the test above (question 6), the test variable is _________ and the grouping variable is ________.
   a. spelling test score; gender
   b. gender; spelling test score
8. John wants to know how tall he is compared to his weight in a class of fellow students. What is the better statistical method of analysis for answering his question?
   a. Dependent variable
   b. Frequency score
   c. Regression
   d. Z-score

In order to find out whether a new physical therapy technique will reduce lower back pain, a random sample of patients is given either the new technique or traditional therapy. Pain scores will be measured to determine therapy success. (Question 9, 10, & 11)

9. Which one is the independent variable?
   a. Pain scores
   b. The type of physical therapy
   c. Random sample of patients

10. Which one is the dependent variable?
    a. Pain scores
    b. The type of physical therapy
    c. Random sample of patients

11. The test result was $t(24) = -3.84$, $p=.062$. Patients with a new physical therapy ($M=13.98$, $SD=6.89$) on the average pain scored less than those in traditional therapy ($M=15.24$, $SD=5.34$). Was the result statistically significant at $\alpha = .05$?
    a. Significant
    b. Not Significant

A researcher studied the effect of text messaging on high school students. Participants were randomly assigned to two groups. The first group was asked to completely spell all of the words they used. The other group was asked to abbreviate words every time. All participants sent at least ten text messages every day for two months. After two months, the researcher gave a spelling test to both of the groups (Question 12 & 13) ($\alpha = .05$).

### T-Test

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Score</td>
<td>Equal variances assumed</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
</tr>
</tbody>
</table>
12. Which one is the better way to report the results of the t-test from this table?
   a. \( t(38) = 4.364, p = .025 \)
   b. \( t(37.686) = 4.364, p = .027 \)

13. Based on the t-test results from the table, the test result is?
   a. Significant
   b. Not Significant

The Following is an optional survey that will help me to improve the analysis.

A. What nationality do you believe the speaker to be? __________________

B. How easy was it to understand the speaker?
   
   Could not understand at all \( \leftarrow 0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \rightarrow \) Easily understood
   
   all of time

C. How would rate the degree of the speaker’s accent?
   
   Heavily Accented \( \leftarrow 0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \rightarrow \) Not accented at all

D. If there was an accent, how did you like hearing it
   
   Strongly dislike \( \leftarrow 0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \rightarrow \) Strongly like

E. How would you rate the speaker’s fluency with the English language?
   
   Not even close to fluent \( \leftarrow 0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \rightarrow \) Completely fluent

F. How would you rate the speaker’s speech rate?
Very Slow ← 0 1 2 3 4 5 6 7 → Very fast

G. How would you rate the speaker’s speech clarity?
   Not clear at all ← 0 1 2 3 4 5 6 7 → Very clear

H. How would you rate your preference of having him as your instructor?
   Not interested ← 0 1 2 3 4 5 6 7 → Very interested
Appendix D

A Sample Letter for Recruitment

Dear Instructor’s Name (Sociology)

I am a PhD student who is working on my dissertation. I believe that I have a very unique topic and you may be interested in. The reason I am sending this email to you is that I need your help to promote my research. If you think that this research topic is related to your class, or would be beneficial to your students, I would be very grateful if you recruited your students as participants in my research.

The goal of this research is to determine the relationship between students’ cultural perceptions and views of accented voiced speakers with their achievement when being taught by a professor with an accented voice. If there is a connection between the two, I intend to find out why it exists. The research should last approximately 20-25 minutes. Participants will do a short survey, watch an instructional video, and take an assessment.

It has been somewhat challenging finding students who understand how important your own cultural values and perceptions are when dealing with people with differing accents and world views. Since your class is teaches about culture, social issues, and how they can shape you, your students may are perfect candidates to take part in this study.

All materials are on the internet, so you will not need to use any of your class time to allow your students to participate. I would love to answer any questions you might have or send the website address so that you can see the test for yourself. If you are interested in helping with this research, please let me know. I am looking forward to hearing back from you soon.

Sincerely,
Appendix E

Normality Q-Q Plots

Normal Q-Q Plot of Total Score

Mild European

Expected Normal

Observed Value
Normal Q-Q Plot of Total Score

Heavy European Accent Group

![Normal Q-Q Plot](image-url)
Normal Q-Q Plot of Total Score

Mild Korean Accent Group

Expected Normal vs. Observed Value
Normal Q-Q Plot of Total Score

Heavy Asian Accent Group

- Expected Normal
- Observed Value

0.0  2.5  5.0  7.5  10.0  12.5
Normal Q-Q Plot of Total Score

Native Instruction Group

Observed Value

Expected Normal