The Universal Design Paradigm: An Examination of Real-Time, C-Print, Meaning-for-Meaning Transcription and Individual Differences in Learning

2014

Amanda Boone
University of Central Florida

Find similar works at: https://stars.library.ucf.edu/honorstheses1990-2015

University of Central Florida Libraries http://library.ucf.edu

Part of the Psychology Commons

Recommended Citation


This Open Access is brought to you for free and open access by STARS. It has been accepted for inclusion in HIM 1990-2015 by an authorized administrator of STARS. For more information, please contact lee.dotson@ucf.edu.
THE UNIVERSAL DESIGN PARADIGM: AN EXAMINATION
OF REAL-TIME, C-PRINT,
MEANING-FOR-MEANING TRANSCRIPTION
AND INDIVIDUAL DIFFERENCES IN LEARNING

by

AMANDA M. BOONE

A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Psychology
in the College of Sciences
and in the Burnett Honors College
at the University of Central Florida
Orlando, Florida

Spring Term 2014
Thesis Chair: Valerie K. Sims, PhD
© 2014 Amanda M. Boone
Abstract

The intent of this thesis is to guide further research and discussion of C-Print, meaning-for-meaning transcription and its applications to today’s dynamic classroom settings under a Universal Design Paradigm. Evidence suggests that providing these captions can benefit Deaf and Hard of Hearing populations and also that concise, textual representations of information increase retention for average learners in multimedia settings. Individual differences were considered and low internal control participants did significantly better on exams when material was captioned compared to when it was not. They also tended to outperform high internal control participants on captioned material exams.
ACKNOWLEDGMENTS

I would like to thank my committee members who assisted me with this project. Your encouragement, guidance, enthusiasm, and willingness to invest your time and energies are greatly appreciated. Thank you.
# TABLE OF CONTENTS

INTRODUCTION ........................................................................................................................................... 1

Universal Design Paradigm and C-Print ........................................................................................................ 1

C-Print Research ............................................................................................................................................. 4

Qualitative ...................................................................................................................................................... 4

Quantitative ................................................................................................................................................... 6

New C-Print Software Capabilities ................................................................................................................ 8

C-Print Research Summary ........................................................................................................................... 9

Cognitive and Learning Theories ................................................................................................................... 9

Working Memory .......................................................................................................................................... 9

Dual Coding................................................................................................................................................ 11

Cognitive Theory of Multimedia Learning ...................................................................................................... 12

Multimedia Learning Revisions .................................................................................................................... 14

The Classroom .............................................................................................................................................. 17

Present Study ............................................................................................................................................... 18

METHOD ....................................................................................................................................................... 20

Participants ................................................................................................................................................... 20

Apparatus ..................................................................................................................................................... 20

Procedure .................................................................................................................................................... 20
Materials ........................................................................................................... 21

Internal Control Index ...................................................................................... 21

Need for Cognition ............................................................................................ 21

Metacomprehension Task ................................................................................... 22

Task/Ego Orientation ........................................................................................ 22

Transcript Perception ........................................................................................ 23

Design .................................................................................................................. 23

RESULTS ............................................................................................................. 25

Exams and Internal Control .............................................................................. 25

Internal Control .................................................................................................. 26

Need for Cognition .............................................................................................. 27

Metacomprehension Task ................................................................................... 29

Task and Ego Orientation .................................................................................. 29

Transcript Perception Overall ......................................................................... 30

DISCUSSION ...................................................................................................... 32

Limitations ........................................................................................................... 34

Future Research .................................................................................................. 37

Implications ......................................................................................................... 39

APPENDIX A: UCF IRB LETTER ...................................................................... 42
APPENDIX B: INFORMED CONSENT ................................................................. 44

APPENDIX C: EGO/TASK ORIENTATION QUESTIONNAIRE ............................. 46

APPENDIX D: INTERNAL CONTROL QUESTIONNAIRE ........................................ 48

APPENDIX E: NEED FOR COGNITION QUESTIONNAIRE ................................. 51

APPENDIX F: TRANSCRIPT PERCEPTIONS QUESTIONNAIRE ......................... 54

APPENDIX G: DEBRIEFING STATEMENT .......................................................... 58

References ............................................................................................................. 59
LIST OF FIGURES

Figure 1. Mean exam score percent across all 4 exams. ................................................................. 25

Figure 2. Mean exam scores for high and low internal control participants when captions are available and when captions are unavailable. ................................................................. 26

Figure 3. Mean exam scores for participants with high and low need for cognition. .................... 28
LIST OF TABLES

Table 1. Correlations among perceived visibility, accuracy, usefulness, and referencing frequency for high and low IC (n = 32) ................................................................................................................. 27

Table 2. Correlations among perceived visibility, accuracy, usefulness, and referencing frequency for high and low NC (n = 33)................................................................................................................. 29

Table 3. Correlations among perceived visibility, accuracy, usefulness, and referencing frequency (n = 67) ........................................................................................................................................ 31
INTRODUCTION

Universal Design Paradigm and C-Print

The Universal Design Paradigm (UDP) is a construct concerned with the implementation of products with universal affordance designs. The goal of UDP is to provide consumers in many markets, especially education, with multiple formats for information processing and accommodations in order to avoid exclusion effects due to individual differences in abilities and preferences. Several organizations like The Center for Applied Special Technology and The Center for Universal Design have developed recommendations and guidelines to outline the basic principles encompassing this idea including presenting information for multiple modality processing and flexibility in assessment and individual goal achievement in educational environments (Morra & Reynolds, 2010).

UDP is closely related to the Americans with Disabilities Act which states that individuals with disabilities must be properly accommodated to receive equal access to information and activities. Educational institutions employ many forms of accommodation to individuals with documented, diagnosed disabilities under the Act. From sign language interpreters to student note takers, these accommodations can be coordinated together depending on individual need. One interesting type of accommodation which falls along this spectrum and is gaining popularity for many reasons is C-Print™.

C-Print is a software program created by the National Institute for the Deaf (NTID) at Rochester Institute of Technology for the accommodation of Deaf and Hard of Hearing (D/HH) individuals in business and education. The program uses special abbreviations for commonly used words as well as rules based on phonetics and condensing strategies to produce
grammatically correct, context laden, interpretations of real-time auditory events. For example, the previous sentence might be typed as, “T prgrm uses spshl abrvxs f kmn words, fntk abrvxs, n ndnsg strtjes to prvd akrt trnskrpx of live adtre evnts.” The software would have expanded each abbreviation to read, “The program uses special abbreviations for common words, phonetic abbreviations, and condensing strategies to provide accurate transcription of live auditory events.” C-Print is typically implemented for students who qualify with a diagnosed disability under the Americans with Disabilities Act as a cost effective alternative to verbatim transcription and abstract, less consistent note taking and is considered a meaning-for-meaning (MFM), speech-to-text (STT) system.

How does it work? The system was designed for two C-Print service providers or captionists to tag team an audio event (usually switching control of a session every 15-30 minutes) while streaming their transcript to a student’s computer in real-time. The student computer, netbook, tablet, or phone is equipped with the C-Print Client version of the software which receives the transcript and also allows for instant messaging to the service providers as well as several embedded note taking options. Captionists typically sit in the classroom with the student but can also provide remote captioning from a location off site through internet streaming options.

The condensing strategies of C-Print STT are an important aspect of what makes this service so unique and interesting. Spoken language is often full of grammatical errors, incomplete thoughts, and superfluous information which need to be filtered out and are usually done so quickly and relatively easily by listeners. This type of language is what I will refer to as descriptive; it is the way people use spoken language. Prescriptive language, or the prescribed
form which abides strictly to grammatical rules and punctuation to convey meaningful ideas, is typically found in literature or written language. Verbatim services like Communication Access Real-time Translation (CART) provide a descriptive text, recording every utterance regardless of grammatical errors, superfluous details, or incompleteness. In contrast, it is the intention of C-Print providers to record descriptive, spoken language as a prescriptive, textual presentation of meaningful thoughts. Condensing strategies like reforming sentences into active voice and filtering out superfluous or redundant details help providers to create this abridged version of spoken language and to enable readers to keep pace with real-time events by reducing their processing load.

Students, currently, must qualify for services by providing documentation of a diagnosis. They are given an intake consultation and asked about their specific learning barriers and the accommodations they have tried, both those that have worked and those that have not. Examples of the different available services are provided and explained and usually include: American Sign Language, CART, C-Print, note taking, and FM Loops among other strategies like sitting in certain areas of a classroom or microphone use by instructors. Coordinators report that most students choose C-Print during these sessions based on its format which allows for easier reading in order to follow along with lectures. CART is far less commonly chosen as an educational communication accommodation except in certain cases of profound deafness.

C-Print technology provides several considerations both in classroom and multimedia learning environments with respect to the UDP. The UDP movement is gaining traction as technologies exponentially emerge allowing for efficient information format manipulation. Face-to-face classrooms, while still the major form of educational instruction, are increasingly
morphing into technology-enhanced or mixed-mode classrooms. This transition has sparked investigation into learning processes and how technologically enhanced presentations affect information perception and retention for D/HH students and others.

**C-Print Research**

*Qualitative*

The research team at NTID and other universities across the country have been actively investigating the perception, use, and benefits of C-Print and its paper and digital transcripts since the software’s introduction two decades ago (Stinson, Elliot, & Francis, 2008). Over 20 studies have been conducted at both secondary and post-secondary levels of education. These studies have had a wide range of investigation. Many have looked at the benefits of C-Print transcripts in real-time as compared to classroom sign language interpreting and peer or professional note taking. Comparisons have also been investigated between C-Print and other forms of verbatim STT systems like CART or Automatic Speech Recognition (ASR).

Researchers and developers of C-Print have focused on the need to reduce the visual load on learners who are D/HH and may not be able to use an auditory channel for processing effectively or at all. They have identified that other learners may benefit from C-Print and have indicated a connection to its success and a reading level comparable to a hearing 10-year-old but have conducted very limited studies with hearing students. Most recently investigations have looked more directly at retention outcomes based on C-Print services, their transcripts, and student study habits. Let’s consider these investigations more fully.

In 2001, NTID’s researchers concluded that C-Print was well received by 36 mainstreamed D/HH students when C-Print, note taking, and interpreting services were provided
(Elliot L. B., Stinson, McKee, Everhart, & Francis, 2001). Their questionnaire and interviews provided significantly higher ratings for understanding of material for C-Print enhanced lessons than understanding ratings for interpreter services. Students indicated that C-Print included the important points of their lectures and that C-Print texts were used more often to study from than notes from a note taker, a common finding in this literature as we will see. The authors differentiate between active and passive study habits and indicated that greater reading comprehension skills were related to more positive reception of C-Print services.

Another study looking at perceptions of C-Print found that mean self-rated understanding of teachers’ and fellow students’ comments were significantly greater when students were provided the C-Print transcription than when they received their usual support services (Elliot, Stinson, & Coyne, 2006). Elliot, Stinson, and Foster (2003) found positive responses from teachers who had experience with note takers in their classrooms. Teachers, in their qualitative study, found that C-Print was of higher quality and more accurate than note taking and attributed those differences to C-Print providers’ greater motivation to capture lecture content and more reliable attendance rates. Teachers also gave higher engagement and interaction ratings to students when they received C-Print as compared to note taking and interpreting. Another study looking at perceptions of C-Print and its software capabilities differentiated between understanding of instructors and understanding of fellow students by learners who are D/HH (Bourgeois, Elliot, Stinson, & Easton, 2008). Here, higher understanding ratings were given to classroom comments that were interpreted compared to when classroom comments were transcribed. The authors attributed this difference in understanding of other students through interpreters to the inherently higher degree of nonverbal expressiveness of sign language.
Because, like all qualitative research, these attributions leave a rather open field for spurious explanation, I now turn to quantitative investigations of C-Print’s effects on learning for students who are D/HH.

Quantitative

The same article that found higher ratings for understanding of student comments when classroom interpreting was offered also showed that the more students made use of the note taking capabilities within the C-Print Client software the more understanding of their instructor they experienced. (Bourgeois, Elliot, Stinson, & Easton, 2008). The study additionally found greater frequency and more diverse use of C-Print produced notes compared to notes produced by note takers. One study connected older college students with more elaborate C-Print transcript study habits (Elliot, Foster, & Stinson, 2002). Similar C-Print transcript use was found in a study that investigated how course perception and performance were related to grade outcomes for students who were D/HH and received C-Print transcription services (Stinson, Stinson, Elliot, & Kelly, 2004). The notes were rated as more helpful and were used more frequently and in accordance with broader study strategies than notes from note takers again. Ultimate findings from this study supported correlations between grade outcomes and course clarity/ease ratings for both C-Print services and combined interpreter and note taking services but found reading proficiency was related to C-Print while motivation to do well was related to interpreter/note taking.

To further investigate C-Print service and transcript influences on information retention Marschark et al. (2006) performed several studies comparing retention scores for digitally recorded lectures lasting about 15 minutes. Participants included students who were deaf and a
small group of hearing students as a comparison group. The hearing students viewed the lessons on a TV monitor while deaf students received a life-size projection of the lectures and had real-time exposure to prerecorded C-print transcription, sign language interpretation, or both. The C-Print alone group scored significantly higher on retention tests than either of the other deaf groups while hearing students, despite not viewing the sign language interpretation, real-time C-Print, or combination lectures performed significantly higher than the other three groups. A similar experiment in the same paper compared real-time C-Print transcripts to CART transcripts and interpreting services and included a delayed review of notes before testing condition. While the immediate retention assessments showed higher scores for students receiving interpreting, the delayed review of notes assessment yielded higher scores for students in the C-Print condition. This situation is more akin to students who study before an exam. It is not common for students to be tested immediately after presentation of a new lesson.

Another study comparing interpreting and C-Print in real-time for recorded, controlled lecture scenarios and delayed review of condition transcripts shows very similar trends with delayed review of C-Print transcripts followed by assessment yielding higher scores than immediate review groups (Stinson, Elliot, Kelly, & Liu, 2009). This study also took into account differences in retention rates for sentence completion versus multiple-choice assessments. Delayed review of notes conditions resulted in higher mean retention scores for both types of assessments regardless of whether STT or interpreting services were received and the STT condition did better on all assessments except for multiple choice following immediate study which produced an equal mean score for both STT and interpreting groups. These findings suggest that C-Print notes served as a valuable if not superior study tool for D/HH students in a
more applicable scenario to real classroom assessment traditions and directly relate to the C-Print software updates which will now be discussed.

*New C-Print Software Capabilities*

Since its conception, the C-Print software has gone through several updates and modifications. The most recent modifications have included a smart phone application and a Tablet PC Support service which can either provide real-time graphic note taking services where D/HH students can view other students note taking processes in real-time or a C-Print service that combines graphics with the traditional MFM transcription. These new adaptations have evolved out of concerns for cognitive overload which will be discussed more fully in the next section.

Qualitative studies investigating the reception and usability of these new features for small trials have reported positive results most pointedly with the ability for students to amend real-time, shared notes in correspondence with their production (Elliot, Stinson, & Francis, 2009). Another study in this paper showed strong to very strong positive reactions to C-Print with graphics support and its overall helpfulness in understanding lecture material over a 5 week trial period. Also, in the final study of this paper C-Print Tablet PC supported notes with graphics were supplied to all members of a college class in an attempt to gather information about how these new types of notes were used under a Universal Design in Education paradigm. The notes were uploaded to the course web application after each class within a 24 hour period. The class was compared to another section of the same course which served as the control group and received no posted notes. Pretest, posttest, pre- and post- test difference scores, final course grades, and self-report data were collected and compared across groups. A significant difference
in pre- and post-test scores was found only for the experimental group; however, overall final course grades were not significantly different between the groups.

*C-Print Research Summary*

It is clear that the implementation as well as the research related to C-Print transcription and its applications through produced notes and software modifications have evolved significantly in the past two decades. Of particular interest here is that only a small fraction of this research included quantitative and controlled lesson studies, few to no students who were not D/HH were included as participants, and that no real-time transcription was implemented on larger scales under a UDP. I now turn to a broader investigation of cognitive and learning theories and their applications to classroom and multimedia learning. C-Print’s unique MFM, prescriptive format will relate directly or indirectly to these older and newer ideas.

**Cognitive and Learning Theories**

*Working Memory*

The first cognitive theory that needs to be addressed in the current learning environment is Baddeley’s (1992) model of working memory which suggests limited resources for cognitive tasks. In this model, there is a mechanism for directing attention between two forms of sensory input processing, auditory or linguistic and visual, called the central executive. The central executive dictates whether to attend to the spatial or verbal information around us. It decides if it is more important, given cognitive and contextual constraints, to attend to a lecture and send information to the phonological loop or to attend to the power point slide containing a diagram of the concept being described and to send that information to the visuo-spatial sketchpad. Baddeley’s model provides an explanation for the tradeoff found between these input modalities.
due to working memory capacity; the more information there is to take in, the shallower the processing because more resources are being used to intake and quickly evaluate the situation. When there are fewer sensory inputs, more processing power can be allocated to deeper understanding.

According to Baddeley’s model, face-to-face lectures would need to be specifically designed to avoid overloading working memory and also to avoid requiring too much allocation to one modality. It is easy to hypothesize that some students would attend to visual cues and others to verbal ones when they are simultaneously presented. Who would retain more information? Lectures typically are designed with power point outlines, definitions, diagrams, and sometimes videos. Are students supposed to attend to the outline and definitions while the instructor is speaking? If so, they will be attending to their visuo-spatial sketchpad rather than their phonological loop which may cause loss of important verbal information being presented by the speaker. A student, on the other hand, may attend to the lecturer and miss valid points being made on slides through visual representations that needed to be processed by the visuo-spatial sketchpad. Most instructors create parallel courses but without a pointed effort to do so, students with different abilities and different focus may struggle to retain all pertinent information.

A C-Print transcript is meant to capture the spoken language. In this scenario it would provide a buffer for echoic memory specifically, which is processed by the phonological loop. Students who were not able to attend properly to the auditory stimuli either because of environmental distractions, personal limitations, or lecture structure are able to reference the transcript when working memory is freed up to do so either during the lecture or afterward.
**Dual Coding**

Another model of cognition that needs to be readdressed is Dual Coding (Clark & Paivio, 1991). The theory suggests that the phonological loop and the visuo-spatial sketchpad from Baddeley’s model provide the best opportunity for memory allocation and retention when they are engaged simultaneously. A word presented with an image or sensation to which the word refers will be more likely remembered than the word, picture, or sensation learned independently because representational encoding of both inputs as well as referential encoding between the two representations occurs. Good examples of this idea are found in studies where context cues increase recall such as when Godden and Baddeley (1975) taught SCUBA divers word lists and found they remembered more when tested in the same context, or spatial environment, as when the lists were learned. Tulving and Thompson (1973) discovered that word lists presented in pairs were better remembered than lists presented alone which can also be interpreted as an additional opportunity to encode both referential and representational cues. The keyword method of remembering, a mnemonic device, is also an example of how, when encoding connects words and spatial representations, more lasting learning effects are produced.

How does C-Print fall into Paivio’s theory? Here I turn to assessment methods, which, under the UDP guidelines, should be adjusted to fit a person’s abilities. Most of a lecture’s information, in standard classrooms, is presented through the lecturer’s speech. However, assessments of information retention are typically given in written format. When we consider Dual Coding theory and its effects on information recall, it is easy to see that providing information in one format and then requesting its recall in a different format may cause difficulties just as the Godden and Baddeley experiment demonstrated. C-Print would capture the
spoken information in grammatically correct textual language which can be viewed either in real
time and/or after the lecture. Because exams are formatted in similarly prescriptive textual
formats, recall of information encoded in that manner would be expected to increase due to
additional referential coding during the learning process.

*Cognitive Theory of Multimedia Learning*

In this same vein of research, Richard Mayer has done extensive work with the benefits
of learning by combining verbal and visual modalities. His Cognitive Theory of Multimedia
Learning is directed particularly at this new classroom topography and posits that simultaneous
narration of visual demonstrations, either in the form of images or dynamic graphics, produces a
significant increase in recall and transfer abilities particularly when capacity limits are
considered (Mayer & Moreno, 2002).

In one experiment, participants who learned about the function of a tire pump performed
best on assessment of transfer abilities when shown a diagram that was narrated compared to
participants who learned the material with the narration before the diagram or with the narration
or diagram alone (Mayer & Anderson, 1991). These findings suggested that simultaneous
presentation of narration and image information results in better comprehension. In a later,
similar study, Mayer and Sims (1994) differentiated between this effect for high and low spatial
ability learners and found that higher spatial ability learners, as measured by paper folding and
mental rotation tasks, presented more responses to divergent assessments of topic knowledge.
The authors conclude that individual differences in spatial ability affected allocation of working
memory resources by decreasing the need for representational processing which, theoretically,
already existed for the high spatial ability learners. Resources were reallocated to the establishment of referential connections resulting in more creative problem solving capabilities.

While again focusing on individual differences, specifically preferred learning style, Mayer, Heiser, & Lonn (2001) performed studies with multimedia animations and redundant text which matched the lesson’s narration verbatim. Findings from the experiments confirmed a redundancy effect where the additional processing of words in the two modalities resulted in lower retention and knowledge transfer scores. A split-attention hypothesis is cited to explain these results as the product of the visual channel overload arising from a need to alternate between the visual presentation of the narration and the visual animation.

Another paper describes multimedia lessons which consisted of an animation lesson with several conditions including: a narration alone, a narration with redundant text only, an animation followed by narration, and an animation followed by narration with redundant text (Moreno & Mayer, 2002). The first study found that when redundant narration and text follow an animation, higher retention, transfer, and matching scores were obtained compared to the other groups. The second study found that retention and matching scores were higher for the narration with animation group but were closely followed by scores from the animation followed by the narration and redundant text group which produced the highest transfer scores. The authors theorize that split-attention effects were overcome by allowing the animation to run before the redundant visual text was presented.

In a subsequent paper, Mayer & Moreno (2003) outlined a more complex model of working memory for multimedia learning largely taking into account processing capacity and modality. The evolved theory distinguished three types of processing involved in a dual coding
working memory model: essential, incidental, and representational holding. Essential processing is required to make sense of input information. Incidental processing is processing that is irrelevant to making sense of input information akin to a filtering process. Representational holding is processing required to maintain representations in working memory while continuous, essential processing occurs. Of particular interest in the paper are the techniques suggested to decrease cognitive load. Weeding and signaling, or avoiding seductive details which are not essential and directing attention through cues, help to reduce incidental processing for multimedia learners in order to free up resources for essential processing and representational holding.

Before moving on, it is a good idea to revisit some of the main aspects of C-Print STT services. First, the main purpose of C-Print is to reduce redundant or superfluous information in order to provide a concise account of spoken information. Second, C-Print, as it was created to provide equal access to D/HH populations, specifically aims to retain pertinent, conceptual information. Third, C-Print’s unique manifestation on a standard keyboard allows for multiple formatting options including bolding, italicizing, and underlining, as well as numbering and bullet pointing among many other techniques which allow service providers to maintain meaning through visual emphasis. These characteristics fall directly under the weeding and cueing suggestions in the previously discussed work and remain relevant to revisions made to this theory which will now be discussed.

Multimedia Learning Revisions

In accordance with the suggestions for reducing cognitive load by weeding and cuing, Mayer & Johnson (2008) exposed participants to a short power point presentation that included a
narration as well as short textual statements of the main point printed near the action being described. When higher retention scores were seen with this group compared to a no text group, Mayer explains that the text, “served to guide the learner’s attention without priming extraneous processing” (p. 380). The phrases were short enough to avoid overloading the visual channel of processing and also helped the learners by cuing to the relevant visual stimuli and weeding out less relevant auditory stimuli.

More recently others have considered the length of lessons with respect to the redundancy theory aspects of multimedia learning as well. Because most of the studies related to working memory capacity, dual coding theory, and multimedia learning have taken place using short and relatively uncomplicated graphic presentations, it is important to consider more realistic information processing. Classroom lessons are usually far longer than a couple of minutes. Additionally, they are frequently highly complex in nature. In response to these considerations, one study presented the Transient Information Effect (Leahy & Sweller, 2011). In two experiments with young participants, presentations on reading temperature maps were created to compare a version with graphics and narration and a version with graphics and visual text in place of the narration. When the presentations were long and complex, the visual only group answered significantly more questions correctly than the group with narration and no text. When the presentation was made shorter and less complicated, the effect reversed and more questions were answered correctly by the narration and diagram group. The authors state that because auditory information is transient in nature, far more processing power is needed to maintain it in working memory. They suggest that providing a more permanent information source that can be referenced and, under the control of the learner, re-referenced if necessary,
meant that cognitive resources can be allocated to more essential representational and referential mechanisms. Another important aspect of this study is that it was done in a classroom setting rather than in a laboratory.

Another study done in a classroom-like setting found similar results for students who learned vocabulary in a foreign language through a presentation (Samur, 2012). Comparing an animation with narration group to an animation with narration and text group resulted in significantly higher retention scores for students in the animation with narration and text condition.

Most recently a study by Yue, Bjork & Bjork (2013) investigated more extensively and directly the retention effects of full text versus abbreviated text for a short presentation comparing groups which included: animation with narration (control), animation with narration and identical text, animation with narration and “abridged” text, which was comparable to C-Print transcription, and narration only, which served as a comparison to podcast lessons which are a budding addition to online learning tools. The presentation was almost twice as long as others in this line of research.

The first study’s results showed better recall and transfer scores for participants in the abridged text condition although not significantly so between the control group on recall and only marginally so for transfer questions compared to the control group. In the second study participants were placed in either of 5 conditions which included: the identical full text and the abridged text versions from the first experiment, a near change abridged text where the same number of words as the narration were shown but slight variations in wording were used, a far change presentation where the same number of words as the narration were presented but
sentence structure was altered, and a shorter, abridged version of the presentation which provided an identical narration to the text. Interestingly, the recall and transfer results from this experiment showed that, again, the abridged text condition produced the highest scores of all the conditions but that the near change group was the second highest scoring group. The authors suggest that the near change in text caused participants to uncomfortably but beneficially use deeper processing mechanisms in an attempt to reconcile the wording differences between the narration and texts.

These final results closely resemble Mayer & Johnson’s (2008) work, previously described, with short, direct narration quotes placed within presentation material and speak markedly to the type of C-Print transcription supplied by service providers in real class situations. Given the awareness of the wide variety of characteristics in learners, under the UDP, as well as the increased retention rates seen when concise textual messages are presented alongside visual information and narration, this type of captioning may provide an additional information presentation addition to live classrooms in general.

The Classroom

It is important to note that 400+ student lecture halls still exist and present challenges for every learner in the way of environmental factors as well as individual characteristics. It is typical, in this and smaller classroom scenarios, for distractions or less than optimal auditory presentation of information to exist. It has been widely known that echoic memory lasts, on average, only 10-15 seconds in the best possible conditions. Is this enough time to process, filter, and type or write the relevant information for later review? It is true that for some learners, such techniques pose no problem. However, it is perfectly plausible that a student may feel
uncomfortable requesting repetition of missed or unrecorded information for reasons related to individual differences, environmental factors such as microphone malfunctions, or distractions from other students and/or mobile technologies. Regardless of environmental or individual difficulties, this type of information presentation would not fall under the UDP. The transition to technology-enhanced classrooms seems to be making such instances irrelevant. As these technologically enhanced classrooms become more prevalent, new considerations of old cognitive processing theories need to be addressed.

**Present Study**

This study aims to investigate the research gap that exists between the general cognitive theories of education presented here and the research conducted with C-Print for students who are D/HH. It is clear that findings indicating higher retention and transfer scores for learners exposed to abridged textual representations of spoken language alongside visual presentations seem to suggest that C-Print transcription, which produces such abridged texts in real-time, might prove beneficial to many learners. Under the UDP, if C-Print is generated as a standard tool in all educational events, ultimately, there would be no need for students with disabilities to have diagnoses which result in accommodation use of C-Print; these students could attend any lecture because they would be accessible through a service already widely accepted by the population. Additionally, learners who may have differences which affect their abilities to process educational materials but that may not warrant diagnoses under the medical model of disability would have access to a form of textual representation of spoken language that has produced evidence of its beneficial effects.
An additional gap exists in the cognitive theories of education research. Aside from the previously mentioned study that took into account spatial ability as an individual difference and showed that higher spatial abilities increased retention for learners of a narrated multimedia presentation, no other individual differences were identified to affect a person’s ability to learn from such environments.

We addressed these issues by presenting a regular, face-to-face class with projected C-Print transcription in real-time. A focus was placed on collecting several individual difference measures as well as exam grades and perception of transcript ratings. Our goal was to confirm whether course material presented alongside C-Print STT transcription in a live classroom setting would result in higher retention as measured by exams and to determine if individual differences related to retention or transcript perception. We predict that positive receptions to C-Print will highly correlate with improved exam scores on materials that are captioned.
METHOD

Participants

Sixty-seven students from an upper level psychology class at a large southeastern university (Male = 13, Female = 54, $M_{age} = 21$) participated in this study for extra course credit. All participants were assumed to have normal or corrected-to-normal vision and hearing. All but 11 participants were native English speakers.

Apparatus

A Dell Latitude E6430s laptop equipped with C-Print Pro Server was connected by an ad hoc network and, through the software application, communicated with a Dell Latitude netbook equipped with C-Print Client. The netbook was connected via VGA to a travel projector. A travel screen was used to project the transcription from the Pro Server laptop, through the Client netbook and projector, and onto the screen.

Procedure

Students received projected C-Print transcription during the second and fourth quarters of their class. Students were informed that a study about transcription would be taking place during their class and that two extra credit options would be made available to them at the end of the course; one option would contribute to research project and the other, worth an equal number of points, was available. The alternative assignment was offered in order to avoid coercive participation in the study. No elaboration on the exact focus of the study, meaning-for-meaning transcription, was made in order to avoid confounding expectation effects. After their final exam, students were presented with the two extra credit options. A consent form and a survey about the transcript format and presentation were given to those who chose the research questionnaire.
Participants received 10% extra credit on their final for completing the survey which included measures of need for cognition (NC), internal control (IC), metacomprehension, and ego/task orientation. The survey, which also collected basic demographic information, gathered transcript opinions related to accuracy, visibility, usefulness, and referenced frequency.

**Materials**

*Internal Control Index*

The Internal Control Index is a measure of the construct locus of control, which has been linked to personality traits that explain human behavior considering motivation factors beyond simple stimulus-response chains. The measure was developed to overcome criticisms of previously used scales (Duttweiler, 1984). Twenty-eight fill in the blank statements were presented on a 5-point scale to gauge how frequently participants typically felt in accordance with them. Statements such as, “I ___ prefer situations where I can depend on someone else’s ability rather than just my own,” were scored on a scale where 1 = *usually* and 5 = *rarely*. Statements such as “When I’m involved in something I ___ try to find out all I can about what is going on even when someone else is in charge,” were scored on a scale where 1 = *rarely* and 5 = *usually*).

*Need for Cognition*

Need for cognition refers to the degree to which a person derives pleasure from engaging in cognitive tasks which require great effort. An adaptation of the 18-item short form of the Need for Cognition Scale was used to sample this measure (Cacioppo, Petty, & Kao, 1984). A 9-point Likert scale (-4 = *very strongly disagree* and +4 = *very strongly agree*) was applied to statements such as, “Thinking is not my idea of fun” and “I would prefer complex to simple problems”.

21
Metacomprehension Task

Metacomprehension refers to the ability of one to understand the way they think. Task knowledge is knowledge about basic processes related to comprehension in general (Moore, Zabrucky, & Evans Commander, 1997). Three 5-point Likert scale questions (1 = Disagree and 5 = Agree) from the Metacomprehension Scale were used to estimate the degree to which participants possessed Task knowledge:

1. For most people, reading material that is not interesting is easier to understand than reading material that is interesting.
2. Most people find it easier to understand abstract information rather than concrete information.
3. For most people, it is easier to understand topics they know nothing about than topics they are familiar with.

Task/Ego Orientation

Task and Ego Orientation refer to constructs related to whether a person values achievement based on personal performance as opposed to relative performance. Task oriented people react positively to successful achievement regardless of how easy the same task was for others. Ego oriented people place a much higher degree of value on tasks they perform better or easier than others. The task and ego orientation scales were modified and used to measure individual differences in these two constructs among participants with respect to classroom performance (Jagacinski & Strickland, 2000). The two 5-point scales (1 = Agree and 5 = Disagree) provided statements such as “I feel most successful in class when I learn a new skill by trying hard” or “I feel most successful in class when I’m the best.”
Transcript Perception

Perception of transcripts were measured using 5-point Likert scales (1 = very poor or very useless and 5 = very good or very useful) for visibility, accuracy, and usability and how often students felt they referenced the transcripts during class was measured on a 5-point scale (1 = never and 5 = always). Perception measures also included questions about how useful transcripts made available after class would be (1 = very useless and 5 = very useful) and whether/how these copies would affect participants’ lecture attendance habits.

Design

An ABAB design was employed where, prior to class, during the second and fourth quarters, the projector and netbook were set up in front of the first row of desks. The projector screen was erected to the right of the whiteboard and angled 25-40 degrees toward the center of the room to provide as many students as possible with a clear view of the screen. Transcripts were not posted or disbursed after classes in order to avoid incentivizing attendance attrition. I served as the C-Print captionist for the study. To avoid distracting students by typing and to keep students from being able to look at the C-Print Pro laptop, I sat on the far end of the room angled away from students. I was able to see the transcripts and monitor their projection and had a clear view of Dr. Sims’s demonstrations and whiteboard use.

I have over 6 years of extensive captioning experience in the post-secondary level and had captioned Dr. Sims’s class the spring semester before the investigation. Further, I took the class in the summer semester prior to the implementation of this experiment and received an A in the course. Considering my vested interest in the quality and beneficial possibilities of the
meaning-for-meaning transcription as well as my previous knowledge of the course material, the students received the best possible C-Print transcription available.
RESULTS

Exams and Internal Control

Out of the 67 participants, 50 indicated that they usually took notes by hand and 13 typically used a computer or other digital device to record lecture material. The remaining 4 participants used either a combination of computer and paper notes or indicated they used other practices.

Course exam grades served as the dependent variable. Exam grades were highest for test 3 ($M = 79.85, SD = 9.96$) followed by test 2 ($M = 79.54, SD = 10.16$), test 4 ($M = 77.40, SD = 10.90$), and test 1 ($M = 76.18, SD = 12.70$) respectively.

![Figure 1. Mean exam score percent across all 4 exams.](chart)
Internal Control

IC scores ranged from 75 to 128 with a median score of 110. A median split was performed and a 2 (Manipulation: captioned vs. not captioned) by 2 (Internal Control: High vs. Low) repeated measures ANOVA revealed a significant interaction between internal control scores and exam performance $F(1, 62) = 4.98, p = .03, \eta^2 = .07$. Main effects for manipulation and IC failed to reach significance. To investigate the interaction, two one-way paired samples t tests on high and low IC measures indicated that low IC participants performed significantly better when given captions ($M = 79.49, SD = 8.32$) than when they were not given captions ($M = 76.81, SD = 9.51; t(31) = -2.09, p = .02$). High IC participants did not perform significantly better on exams when they were given captions ($M = 78.17, SD = 9.08$) compared to when they were not given captions ($M = 79.91, SD = 9.60; t(31) = 1.15, p = .13$).

![Figure 2](image-url)

*Figure 2.* Mean exam scores for high and low internal control participants when captions are available and when captions are unavailable.
Pearson’s correlations revealed a weak correlation between IC scores and transcript accuracy ratings \((r = .26)\). No other significant correlations were found with other perception measures. However, when high and low IC participants are isolated, low IC participants provided strong correlations between transcript visibility and accuracy \((r = .49, p = .004)\), usefulness \((r = .51, p = .003)\), and how frequently students referenced the transcripts \((r = .41, p = .021)\). Visibility was not significantly correlated with other perception measures for high IC participants. High IC participants provided a moderate correlation between their NC scores and how useful transcripts made available after class would be \((r = -.35, p = .048)\). There were no correlations between exam performance and other measures for high IC participants.

Table 1. Correlations among perceived visibility, accuracy, usefulness, and referencing frequency for high and low IC \((n = 32)\)

<table>
<thead>
<tr>
<th>IC</th>
<th>Visible</th>
<th>Accurate</th>
<th>Reference</th>
<th>Useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accurate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>.190</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>.491**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>.212</td>
<td>.414*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>.407*</td>
<td>.409*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Useful</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>.105</td>
<td>.590**</td>
<td>.660**</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>.509**</td>
<td>.381*</td>
<td>.814**</td>
<td></td>
</tr>
<tr>
<td>Online</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>-.125</td>
<td>.243</td>
<td>.286</td>
<td>.041</td>
</tr>
<tr>
<td>Low</td>
<td>-.234</td>
<td>-.039</td>
<td>.272</td>
<td>.338</td>
</tr>
</tbody>
</table>

**Need for Cognition**

NC scores, which weakly correlated to transcript accuracy ratings \((r = .28)\), ranged from -30 to 52 \((M = 20.66, SD = 18.79)\) with a median score of 23. When a median split for NC was performed, a 2 (Manipulation: Captioned vs. Not Captioned) by 2 (Need for Cognition: High vs. Low) repeated measures ANOVA revealed no significant effects. A main effect for exam resulted from a 4 (Exam) by 2 (Need for Cognition: High vs. Low) repeated measures ANOVA,
$F(3, 192) = 3.12, p = .03, \eta^2 = .05$. A main effect for NC and an interaction did not reach significance. However, high need for cognition participants scored, on average 3.77% better on the first three exams but only .99% better on the final.

![Figure 3. Mean exam scores for participants with high and low need for cognition.](image)

Mean performance for exams without captioning correlated to ego orientation ($r = .39, p = .030$) for low NC participants but to task orientation for high NC participants ($r = .35, p = .044$). No such correlations were found for high or low NC when captions were provided. Visibility for low NC participants strongly correlated with accuracy ratings ($r = .63, p = .000$) while visibility for high NC correlated with referencing frequency ($r = .38, p = .028$).
correlation between accuracy ratings and referencing frequency was significant for high NC participants \((r = .35, p = .045)\) but not for low NC participants.

*Table 2. Correlations among perceived visibility, accuracy, usefulness, and referencing frequency for high and low NC \((n = 33)\)*

<table>
<thead>
<tr>
<th></th>
<th>NC</th>
<th>Visible</th>
<th>Accurate</th>
<th>Reference</th>
<th>Useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accurate</td>
<td>High</td>
<td>.194</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>.626**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference</td>
<td>High</td>
<td>.382*</td>
<td>.351*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>.130</td>
<td>.330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Useful</td>
<td>High</td>
<td>.275</td>
<td></td>
<td>.717**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>.285</td>
<td>.476**</td>
<td>.698**</td>
<td></td>
</tr>
<tr>
<td>Online</td>
<td>High</td>
<td>-.184</td>
<td>.098</td>
<td>.303</td>
<td>.168</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>-.258</td>
<td>.026</td>
<td>.253</td>
<td>.174</td>
</tr>
</tbody>
</table>

**Metacomprehension Task**

Metacomprehension Task scores ranged from 4 to 13 \((M = 11.25, SD = 2.00)\) and were moderately correlated with overall exam performance \((r = .47)\) but was not significantly correlated to any transcript perception measures. Isolation of low IC participants showed that overall exam performance was significantly correlated with metacomprehension task scores \((r = .53, p = .002)\). This correlation was not significant for high IC participants. Additionally, metacomprehension task was significantly correlated to ego orientation for low NC participants \((r = .54, p = .001)\) and to task orientation for high NC participants \((r = .45, p = .009)\).

**Task and Ego Orientation**

Task orientation scores ranged from 15 to 25 \((M = 22.70, SD = 2.24)\) moderately correlated to performance on exam 1 \((r = .43)\) as well as average performance for exams without transcription \((r = .37)\). It was weakly correlated to performance on exam 2 \((r = .24)\), average exam performance \((r = .30)\), and with how frequently participants referenced transcripts \((r =
A weak, negative correlation existed between task orientation and the difference between captioned classes and uncaptioned classes ($r = -0.26$). As task orientation goes up, the more likely students performed better without captions. Ego orientation was not significantly correlated to exam performance or transcript perception, however, a weak correlation existed between ego orientation scores and ratings of usefulness for transcripts if they had been made available after class ($r = 0.26$).

For low IC participants, ego orientation was correlated with how useful transcripts made available after class would be ($r = 0.35, p = 0.049$). Low IC task orientation was correlated with referencing frequency ($r = 0.43, p = 0.013$) and usefulness in real-time ($r = 0.41, p = 0.020$) as well as overall exam performance ($r = 0.47, p = 0.007$). Ego orientation was correlated with usefulness of transcripts made available after class ($r = 0.36, p = 0.040$) for low NC participants. These participants also provided correlations between task orientation and how often they felt they referenced the transcripts ($r = 0.45, p = 0.009$) and how useful they found transcripts during class ($r = 0.42, p = 0.015$).

**Transcript Perception Overall**

Participants rated the transcripts’ visibility ($M = 4.18, SD = 0.90$), accuracy ($M = 4.01, SD = 0.84$), usefulness ($M = 3.87, SD = 1.06$), and how often they referenced the transcripts ($M = 3.07, SD = 0.92$). A Pearson’s $r$ data analysis with visibility ratings revealed weak positive correlations between usefulness ratings ($r = 0.29$) and how often students referenced the transcripts ($r = 0.29$). A moderate correlation existed between visibility and accuracy ratings ($r = 0.37$). Accuracy ratings were moderately correlated to referencing frequency ($r = 0.37$) and with usefulness ratings ($r = 0.44$). The strongest correlation was between usefulness ratings and
referencing frequency ratings ($r = .71$). No significant correlations existed between exam performance or post-class presentation of transcripts and transcript perceptions.

Table 3. Correlations among perceived visibility, accuracy, usefulness, and referencing frequency ($n = 67$)

<table>
<thead>
<tr>
<th></th>
<th>Visible</th>
<th>Accurate</th>
<th>Reference</th>
<th>Useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accurate</td>
<td>0.37*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference</td>
<td>0.29*</td>
<td>0.37</td>
<td></td>
<td>0.71**</td>
</tr>
<tr>
<td>Useful</td>
<td>0.29*</td>
<td>0.44**</td>
<td></td>
<td>0.71**</td>
</tr>
<tr>
<td>Online</td>
<td>-0.18</td>
<td>0.06</td>
<td>0.28</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Participants indicated that transcripts made available after class would be useful to very useful ($M = 4.37$, $SD = 0.75$). These indications, however, were not significantly correlated to any of the other perception measures. Of the 67 participants, 25 (37%) reported that transcripts made available after class would impact their decision to attend lectures. Of those 25, 84% said that they would be less likely to attend lectures. Overall 22 (32.84%) participants indicated they would be less likely to attend lectures if transcripts were made available after class.
DISCUSSION

This study was the first to implement C-Print, MFM, STT services on a large scale for general students in a face-to-face lecture scenario. Individual differences were considered in order to gauge whether personality or learning preferences align with transcript perception and benefit.

The results of this study indicated that students with low IC perform significantly better on exams where material is captioned compared to when material is not. They also tend to score slightly better on these exams compared to high IC students. A greater degree of IC was connected to overall higher accuracy ratings for the transcripts. These finding suggest that high IC individuals are able to reconcile the summarization of the transcripts more comfortably than low IC students. This is similar to what Yue, Bjork, & Bjork (2013) discovered when participants found it uncomfortable to attend to the mismatched versions of language but also performed better on retention and transfer assessments. Participants in this study who were lower on the IC scale gave lower accuracy ratings to the transcripts but performed better regardless of their perceptions.

Visibility tended to be a strong correlate with other perception measures only for low IC participants. When these participants felt they could see the transcripts, they tended to rate them as more accurate and useful and referenced them more often. When these participants could not see the transcripts, they tended to rate them lower on these characteristics. The fact that visibility was not a correlate for transcript perception among the high IC participants seems to suggest that these individuals placed less trust upon the transcripts whether they were within viewing range or not. Further, low IC participants’ overall performance was highly correlated with their
metacomprehension task scores while performance was not significantly correlated with this measure for high IC participants. It remains to be investigated whether the measure is related to reading comprehension or cognitive processing knowledge but results here indicate that the measure is a predictor of performance for those with lower IC.

NC scores were correlated to overall performance. This trend is consistent for the first 3 exams but does not hold for the final. There are many possible explanations for this. One is that high NC participants did not need to perform as well on the final in order to reach their overall grade. Another explanation includes the incentivization of participation in the study. All participants were aware that they would receive a letter grade on the final and may have considered this when planning their study strategies. Low NC participants, having performed consistently lower for the first three exams needed to work harder to achieve relatively similar grades and did not rely as heavily on the 10% bonus. This is a confounding variable that will need to be eliminated in future research.

Similar to the findings with NC, metacomprehension task and its moderate correlation to overall performance have many possible explanations. It is possible that, as mentioned previously, given the type of questions, participants who scored high have generally better reading comprehension skills. It also makes sense that those who had basic knowledge of comprehension processes would perform well in a course about cognitive processing in general.

Task orientation’s moderate correlation to performance without captions can most reasonably be attributed to its much stronger correlation to exam one performance. It may have been helpful to have had information about individual motivation for taking the course. Extrinsic motivation, for example, taking the class solely to fulfill course credits toward a degree,
compared to intrinsic motivation, or genuine interest in the course content, might have been a moderating variable. NC measures seem to get at this relationship. Low NC provided a significant relationship between ego orientation and exam performance without transcripts while high NC provided a significant relationship between task orientation and exam performance without transcripts. This trend is dispersed when classes are captioned suggesting motivational factors, at least related to NC, do play a role in the type of learning that takes place in traditional classrooms. The presentation of transcripts seems to have had a mediating effect with respect to ego and task orientation.

The most notable relationship regarding participant perception of transcripts was the strong correlation between referencing frequency and usability ratings. However, neither of these variables was related to exam performance. Also, no significant relationships between exam scores were found when looking at participants’ belief that transcripts made available after class would be helpful. Yet, almost 30% of the class thought that such a practice would increase their likelihood to skip lecture.

Overall this study has shown that certain individual differences do play a role in how students benefit from and perceive C-Print transcription. Caution should be exercised when interpreting these results, however, particularly due to the effect seemingly connected to the incentivization of participation in the study, namely, extra credit on the final. This is arguably the largest limitation of this study.

**Limitations**

Other limitations included transcript visibility and dispersal. Because classroom technology was not designed to display this type of captioning, a smaller, less powerful method
of projection was used. Although visibility ratings were relatively high, it was the number one complaint when participants were given free response opportunities to suggest what they would have liked changed about the transcripts.

This limitation is one that is easily solved. C-Print’s recent updates and modifications are aligning it nicely for live streaming capabilities that would make possible the ability to provide real-time captions to several clients on several different devices. If research in this area continues to provide evidence that certain learner characteristics make MFM transcription a beneficial factor in retention, there will likely be a greater demand for the service. In that case, given technological diversity and increasing power, it is not unreasonable to envision an educational environment that provides this type of transcription, if not as a sole accessibility tool, then, as one alternative to information presentation under the UDP.

Another easily remedied limitation focuses on the type of individual difference measures that were not taken in this study. Working memory and spatial ability might yield forecasting potential with respect to C-Print transcript presentation. Those with shorter working memory spans and less spatial ability would be expected to struggle far greater in courses without captioning than those with larger working memory spans and greater spatial ability.

Further limitations include the lack of comparisons between course contents, D/HH students and hearing students, and captionist skill levels. Participants in this study were not exposed to captioning in other classes. The course content consisted of several topics included in the introduction of this paper and may have influenced perceptions. Participants, learning about the dual coding principles and about the differences between descriptive oral language and prescriptive written language, may have referenced the transcript in a far different manner than
students in a course about computer science or business administration, for example. Additionally, though this was an upper level undergraduate course, there was little discussion. Given that the Transient Information Effect appears when lessons become long and more complex, captioning in a graduate level course where discussion is more prevalent may lend well to retention effects by providing a more permanent record of individual contributions. Future research should investigate C-Print effects on performance and retention in different course conditions.

Furthermore, the lack of research comparing D/HH and hearing students’ perceptions and educational benefits from C-Print persisted in this study. Are there metacognitive differences between the two populations? Dye, Hauser, & Bavelier (2009) report that visual attention changes for individuals who are deaf in that they are able to more efficiently allocate attention to peripheral stimuli compared to hearing individuals. The study indicated that reaction times for focal stimuli recognition were no different between deaf and hearing participants, but that individuals in the deaf condition tended to be distracted by superfluous information in their periphery. It remains to be explored whether these visual attention differences would hinder or help retention when C-Print captioning is provided in an equal capacity for all learners, hearing or D/HH.

Moreover, the quality of captioning in this study was ideal. However, most captioned classes are shared by two service providers and the transcript may change style and/or diction multiple times within a given class period. In this study, one captionist served as the provider so transcription style remained consistent throughout each class period. Quality control of C-Print is on the incline but there is currently a wide range of skill level within the field. Efforts are slowly
being made to increase accountability and standardization that resemble the accreditation procedures used to ensure quality interpreting for D/HH individuals. Further research should consider a more true to life approach to C-Print services. As the field grows and becomes more standardized, this consideration may fall by the wayside. However, research should investigate how and to what extent such diction alteration and skill level variability have on retention for individuals with normal hearing as well as individuals who are D/HH.

**Future Research**

Future studies must consider a more controlled environment similar to the multimedia learning studies but with extended lesson times to replicate more realistic educational encounters in order to account for the Transient Information Effect (Leahy & Sweller, 2011) and the fact that lessons are continually being converted to include online presentation of educational material. Also, because C-Print is real-time, presentation of a transcript includes correcting events which might be of interest. Does the word-by-word presentation along with these correcting events distract learners as compared to block presentation of sentences or sentence fragments? This type of investigation could only be done on a controlled environment where prerecorded materials, captioned block texts or captioned real-time texts, can be adequately compared.

Additionally, note-taking practices should be investigated to determine if paper/pen methods, which cause the learner to look away from the visual demonstrations and transcripts, provide a beneficial kinesthetic encoding without overwhelming processing capacity. Comparisons to computer based note taking methods where students may not need to look away from content while typing should also be addressed. Does the kinesthetic encoding of material
either through typing or writing cause a further processing load and, if so, to what degree? Do C-Print transcripts provide a buffer for visual channel learning when pen/paper notes are being taken? If so, students would likely benefit from this practice and feel comfortable given that C-Print transcripts are subject to efficient search queries as well as formatting modifications which their typed notes provide. In such a scenario, students would take hand written notes and be able to corroborate them with the digitally formatted, easily manipulated and searched transcripts.

Further, second language learning is an area in which this type of transcription has gone relatively uninvestigated. A criticism of C-Print’s use in second language learning is that it has the potential to largely eliminate meaningful idioms from English expression. However, an argument can be made that, like the theorized deeper processing which apparently benefited learners by causing a need for reconciliation of the two presentations, C-Print provides a longer lasting representation of information as well as a less figurative translation of the spoken word. This may, in fact, increase second language learning. Further research in this area is needed.

Finally, delayed review of transcripts may yield greater retention as in the studies by Elliot, Stinson, and Francis (2009). The difference would be that students receiving real-time transcripts as well as a delayed review may substantially benefit from the additional encoding opportunities of the real-time presentation of C-Print. Students often increase their study efforts toward the approach of an exam so this may reflect a truer to life scenario. The results of this study do indicate a significant number of students feel that transcripts would serve as an adequate replacement to lecture. However, it is possible that students might find, after missing lectures, that the combination of tools, lecture, real-time C-Print, and later review of transcripts,
benefit them far more than a single presentation, either in lecture or textually with C-Print transcript review.

**Implications**

Assuming C-Print is to become a standard tool in educational environments both online and in face-to-face lecture or discussion, several considerations can be made. Firstly, far greater availability of streaming and graphic embedding capabilities needs to take place. Courses that require a great deal of visual demonstration through graphics, videos, power points, and other visual stimuli will require a greater degree of integration of these applications. Secondly, the quality control of C-Print and the credentialing system for its providers are sorely lacking at this time. Strides are being made to create distinctions between beginner, intermediate, and expert level service but these will need to be further operationalized in order to develop stricter standards of quality control and assignment matching. These practices are far more established in CART and ASL domains and C-Print’s programs will need to catch up with respect to this issue.

Lastly, C-Print transcripts offer a unique subset of versatility in learning material. Because they capture real time events in a coherent and grammatically correct digital format, they are easily manipulated for search queries and hyperlink capacity. This is a unique and driving cultural change in the technologically advanced classroom. It is theoretically possible that students receiving real-time C-Print would be able to interact, manipulate, and provide hypertexts to images, outside resources, and even student created notes or graphics which help them self-reference material and further increase retention. A fully accessible classroom could implement C-print allowing students to consume the product in ways that best fit their learning
style and preferences as well as through available technologies like smart phones, tablets or computers, and possibly classroom projection as was done in this study.
APPENDIX A: UCF IRB LETTER

Approval of Exempt Human Research

From: UCF Institutional Review Board #1
FWA00000851, IRB00001138

To: Valerie K. Sims and Co-PI, Amanda M. Boone

Date: August 26, 2013

Dear Researcher:

On 8/26/2013, the IRB approved the following activity as human participant research that is exempt from regulation:

- Type of Review: Exempt Determination
- Project Title: C-Print, Meaning-for-Meaning Transcription in the Modern Classroom
- Investigator: Valerie K. Sims
- IRB Number: SBE-13-09541
- Funding Agency: N/A
- Grant Title: N/A
- Research ID: N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in IRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patricia Davis on 08/26/2013 01:58:55 PM EDT

IRB Coordinator
APPENDIX B: INFORMED CONSENT
APPENDIX B:
INFORMED CONSENT

EXPLANATION OF RESEARCH

Title of Project: C-Print, Meaning-for-Meaning Transcription in the Modern Classroom

Principal Investigators: Valerie K. Sims, PhD
Co-PI: Amanda Boone

You are being invited to take part in a research study. Whether you take part is up to you. You may withdraw from the study at anytime without penalty. Participation in the study will have no bearing on your grade.

Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study, which will include about 60 people in the Fall, 2013 Cognitive Psychology course at UCF. You must be 18 years of age or older to be included in the research study. The person doing this research is an undergraduate student in Psychology working on an Honors thesis.

Purpose of the research study: The purpose of this study is to examine meaning-for-meaning transcription in the classroom.

What you will be asked to do in the study: During this study, you will be given several measures of cognitive and learning styles. Additionally, you will be given a questionnaire about your personal experience of the transcription process.

Location: This study is conducted in EXP3604 Fall 2013, PSY 105. All data will be saved on a secure server and password-protected computer. No personally identifying information will be collected.

Time required: We expect that you will be in this research study for approximately 1 hour.

You must be 18 years of age or older to take part in this research study.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, please contact Amanda Boone, Undergraduate Student, Psychology Program, College of Sciences, email address: amanda.boone@ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

1 of 1
APPENDIX C: EGO/TASK ORIENTATION QUESTIONNAIRE
APPENDIX C:
EGO/TASK ORIENTATION QUESTIONNAIRE

Use the following scale to indicate the extent to which you identify with the items below.

1  2  3  4  5
strongly disagree  disagree  neutral  agree  strongly agree

I feel most successful in class when...

1. I can do better than my friends.
   ___

2. I finally master a concept I find difficult after much effort.
   ___

3. I can perform better than others.
   ___

4. I learn a new skill and it makes me want to learn more.
   ___

5. I work really hard at it.
   ___

6. I show people I am very good at it.
   ___

7. I’m the best.
   ___

8. I do my very best.
   ___

9. I learn a new concept by trying hard.
   ___

10. I master a task more quickly than other students.
    ___

11. I can master a new task with little effort.
    ___

(Jagacinski & Strickland, 2000)
APPENDIX D: INTERNAL CONTROL QUESTIONNAIRE
APPENDIX D:
INTERNAL CONTROL QUESTIONNAIRE

Please read each statement. Where there is a blank ___, decide what your normal or usual attitude, feeling, or behavior would be:

<table>
<thead>
<tr>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
<th>(E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RARELY</td>
<td>OCCASIONALLY</td>
<td>SOMETIMES</td>
<td>FREQUENTLY</td>
<td>USUALLY</td>
</tr>
<tr>
<td>(Less than 10% of the time)</td>
<td>(About 30% of the time)</td>
<td>(About half the time)</td>
<td>(About 70% of the time)</td>
<td>(More than 90% of the time)</td>
</tr>
</tbody>
</table>

*Of course, there are always unusual situations in which this would not be the case, but think of what you would do or feel in most normal situations.

1. When faced with a problem, I ____ try to forget it.
2. I ____ need frequent encouragement from others for me to keep working at a difficult task.
3. I ____ like jobs where I can make decisions and be responsible for my own work.
4. I ____ change my opinion when someone I admire disagrees with me.
5. If I want something, I ____ work hard to get it.
6. I ____ prefer to learn the facts about something from someone else rather than have to dig them out for myself.
7. I will ____ accept jobs that require me to supervise others.
8. I ____ have a hard time saying “no” when someone tries to sell me something I don’t want.
9. I ____ like to have a say in any decisions made by any group I’m in.
10. I ____ consider the different sides of an issue before making any decisions.
11. What other people think ___ has a great influence on my behavior.
12. Whenever something good happens to me, I ____ feel it is because I’ve earned it.
13. I ____ enjoy being in a position of leadership.
14. I ____ need someone else to praise my work before I am satisfied with what I’ve done.
15. I am ____ sure enough of my opinions to try and influence others.
16. When something is going to affect me, I ____ learn as much about it as I can.
17. I ____ decide to do things on the spur of the moment.
18. For me, knowing I’ve done something well is ___ more important than being praised by someone else.
19. I ____ let other peoples’ demands keep me from doing things I want to do.
20. I ____ stick to my opinions when someone disagrees with me.
21. I ____ do what I feel like doing not what other people think I ought to do.
22. I ____ get discouraged when doing something that takes a long time to achieve results.
23. When part of a group, I ____ prefer to let other people make all the decisions.
24. When I have a problem, I ____ follow the advice of friends or relatives.
25. I ____ enjoy trying to do difficult tasks more than I enjoy trying to do easy tasks.
26. I ___ prefer situations where I can depend on someone else’s ability rather than just my own.
27. Having someone important tell me I did a good job is ___ more important to me than feeling I’ve done a good job.
28. When I’m involved in something, I ___ try to find out all I can about what is going on even when someone else is in charge.

(Duttweiler, 1984)
APPENDIX E: NEED FOR COGNITION QUESTIONNAIRE
APPENDIX E:
NEED FOR COGNITION QUESTIONNAIRE

Use the following scale to describe the extent to which you agree with each statement:

- +4 = very strongly agree
- +3 = strongly agree
- +2 = moderately agree
- +1 = slightly agree
- 0 = neither agree nor disagree
- -1 = slightly disagree
- -2 = moderately disagree
- -3 = strongly disagree
- -4 = very strongly disagree

- I would prefer complex to simple problems. ___
- I like to have the responsibility of handling a situation that requires a lot of thinking. ___
- Thinking is not my idea of fun. ___
- I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. ___
- I try to anticipate and avoid situations where there is likely a chance I will have to think in depth about something. ___
- I find satisfaction in deliberating hard and for long hours. ___
- I only think as hard as I have to. ___
- I prefer to think about small, daily projects to long-term ones. ___
- I like tasks that require little thought once I’ve learned them. ___
- The idea of relying on thought to make my way to the top appeals to me. ___
- I really enjoy a task that involves coming up with new solutions to problems. ___
- Learning new ways to think doesn’t excite me very much. ___
- I prefer my life to be filled with puzzles that I must solve. ___
- The notion of thinking abstractly is appealing to me. ___
- I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought. ___
- I feel relief rather than satisfaction after completing a task that required a lot of mental effort. ___
o It’s enough for me that something gets the job done; I don’t care how or why it works. ___

o I usually end up deliberating about issues even when they do not affect me personally. ___

(Cacioppo, Petty, & Kao, 1984)
APPENDIX F: TRANSCRIPT PERCEPTIONS QUESTIONNAIRE
APPENDIX F:
TRANSCRIPT PERCEPTIONS QUESTIONNAIRE

PID ___________________  Age _____  Gender _____  Handedness ________

The following questions are about your undergraduate progress. Answer as accurately as possible.
- How many semesters have you taken at a community college? _____
- How many semesters have you taken at UCF? _____
- According to your UCF transcript, are you a: __Freshman, __Sophomore, __Junior, __Senior
- Do you consider yourself a traditional student? __Yes, __No
- Why/Why not?

Using the diagram of your classroom, mark one box to indicate where you most often sat in Dr. Sims's class.

<table>
<thead>
<tr>
<th>Far Wall</th>
<th>Dr. Sims</th>
<th>Projected Transcript</th>
<th>Doors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Middle</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Back</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

When answering the following questions, consider your most typical behavior. Of course, there are situations that require adjustments but try to respond according to your most average experience.

1. How do you prefer to Take Notes?
   - Pen/Paper
   - Laptop Computer
   - Printed Power Points
   - Tablet
   - Other

2. How do you typically Study?
   - Create/Use Flashcards
   - Review Notes
   - Review Power Points
   - Review Textbook
   - Review Audio Recording
   - Attend Study Groups/Review Sessions
   - I don't study
   - Other

3. How do you prefer to Encode or Learn Material?
   - Through attending lectures
   - From reading the textbook
   - By getting notes from classmates
   - By taking my own notes
   - Other

4. Do you typically Audio Record lectures? __Yes, __No
   - Why/Why not?
5. How often do you typically Attend Lectures?

   1. Rarely: Less than 10% of the time
   2. Occasionally: About 30% of the time
   3. Sometimes: About half the time
   4. Frequently: About 70% of the time
   5. Usually: More than 90% of the time

6. When in class, about how often do you send and/or receive Text Messages?

   1. 0 times
   2. 1-5 times
   3. 6-10 times
   4. 11-15 times
   5. 15+ times

7. When in class, about how often do you use Facebook?

   1. Rarely: Less than 10% of the time
   2. Occasionally: About 30% of the time
   3. Sometimes: About half the time
   4. Frequently: About 70% of the time
   5. Usually: More than 90% of the time

8. When in class, about how often do you use other internet applications? [Eg. Surfing the web, other social media, Tumbler, Reddit, etc.]

   1. Rarely: Less than 10% of the time
   2. Occasionally: About 30% of the time
   3. Sometimes: About half the time
   4. Frequently: About 70% of the time
   5. Usually: More than 90% of the time

9. When in class, about how often do you Watch Movies/Videos or Play Games on a device?

   1. Rarely: Less than 10% of the time
   2. Occasionally: About 30% of the time
   3. Sometimes: About half the time
   4. Frequently: About 70% of the time
   5. Usually: More than 90% of the time

10. Compared to other students, about how often do you participate in lectures by making comments or asking questions?

    1. Never
    2. Rarely
    3. Sometimes
    4. Often
    5. Frequently

11. About how often, in general, are you distracted in class? [Eg. By other students, media, noises, work for other classes, etc.]

    1. Rarely: Less than 10% of the time
    2. Occasionally: About 30% of the time
    3. Sometimes: About half the time
    4. Frequently: About 70% of the time
    5. Usually: More than 90% of the time

12. When Power Points are available, do you typically print them out? ___Yes___ No

13. Outside of class time, about how often do you watch TV/films with captions turned on?

    1. Rarely: Less than 10% of the time
    2. Occasionally: About 30% of the time
    3. Sometimes: About half the time
    4. Frequently: About 70% of the time
    5. Usually: More than 90% of the time

14. Outside of class and in relation to your usual amount of TV/film consumption, about how often do you watch foreign films with subtitles?

    1. Rarely: Less than 10% of the time
    2. Occasionally: About 30% of the time
    3. Sometimes: About half the time
    4. Frequently: About 70% of the time
    5. Usually: More than 90% of the time
The following questions are in regards to the transcripts that were projected in class. Please answer as accurately and honestly as possible. Again, your responses are anonymous.

1. How would you rate the visibility of the Projected Transcripts from where you most often sat?
   - 1: Very Poor
   - 2: Poor
   - 3: Fair
   - 4: Good
   - 5: Very good

2. How would you rate the accuracy of the Projected Transcripts?
   - 1: Poor
   - 2: Fair
   - 3: Good
   - 4: Very Good
   - 5: Excellent

3. How often did you reference the Projected Transcript in order to capture information?
   - 1: Never
   - 2: Rarely
   - 3: Sometimes
   - 4: Most of the Time
   - 5: Always

4. Did you find the transcripts useful DURING class?
   - 1: Very Useless
   - 2: Useless
   - 3: Neutral
   - 4: Useful
   - 5: Very Useful

5. Please give your overall opinion/Impression of the transcripts.

6. If you could change something about the transcripts, what would you change?

7. Are there classes you have taken in the past, including online, in which you would have liked to have had this kind of transcription? _Yes, __No
   - If so, which classes?

8. Given what you know about information encoding and retrieval, would transcripts made available after class affect your decision to attend lectures? _Yes, __No
   - If so, in what way?

9. Do you think the transcripts influenced your performance? _Yes, __No
   - If so, in what way?

10. If transcripts were made available after class, how useful would they have been to you?
    - 1: Very Useless
    - 2: Useless
    - 3: Neutral
    - 4: Useful
    - 5: Very Useful

11. Please feel free to share any other comments you'd like about the class and/or the Projected Transcripts.

Thank you for participating! Have a great Winter Break!
APPENDIX G: DEBRIEFING STATEMENT
APPENDIX G:
DEBRIEFING STATEMENT

For the study entitled:
“C-Print, Meaning-for-Meaning Transcription in the Modern Classroom”

Dear Participant,

During this study, you were asked to complete several measures of cognitive and learning styles and to complete a questionnaire about your personal experience with the transcripts provided in class. You were told that the purpose of the study was to examine meaning-for-meaning transcription in the classroom. The actual purpose of the study was to examine the effects of real-time, meaning-for-meaning transcription in the classroom on student comprehension and recall, study habits, and attendance. Currently this service is provided as an accommodation to individuals with diagnosed hearing disabilities. The process of attaining this accommodation can be difficult and time constraining. Evidence that suggests the service benefits everyone can alleviate the constraints of accommodation attainment for students with disabilities by bolstering efforts to make the service a standard practice in all classroom environments.

We did not tell you everything about the purpose of the study because we wanted to avoid and demand or expectation effects. Demand effects occur when participants provide information they think investigators are looking for. Expectation effects occur when participants provide information they were told to expect only because they were expecting them and not because the manipulation affected their responses.

You are reminded that your original consent document included the following information: You may withdraw from the study at any time without penalty.

If you have any concerns about your participation or the data you provided in light of this disclosure, please discuss this with us. We will be happy to provide any information we can to help answer questions you have about this study.

The responses in this study are de-identified and cannot be linked to you.

Study contact for questions about the study or to report a problem: If you have any questions on your rights as a participant, please contact the Investigators at the Applied Cognition & Technology Lab:
Dr. Valerie Sims, PhD, valerie.sims@ucf.edu or Amanda Boone, undergraduate researcher, amanda.boone@ucf.edu

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2501.

If you have experienced distress as a result of your participation in this study, a referral list of mental health providers is attached to this document for your use. (Please remember that any cost in seeking medical assistance is at your own expense.)

Please again accept our appreciation for your participation in this study.
References


