The Impact of Presentation Rate on the Effectiveness of Subtitles in Learning

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Abstract

Subtitling has received increasing scholarly attention in audiovisual translation studies. Most of the existing literature has been centred on the benefits of subtitling for learners, but not on how subtitles are presented (e.g. subtitle presentation speed, layout, etc.). The impact of the presentation rate or appearance of subtitles on learners has therefore not been explored sufficiently. Some well-explored topics in subtitling research include language learning, film comprehension and cognitive load (cf., Danan, 2004; d'Ydewalle et al., 1991; Garza, 1991; Kruger, Hefer, & Matthew, 2013; Paas et al., 2004). However, little research has been conducted to investigate the impact of presentation rate on learning, comprehension or cognitive load. Given the increasing use of subtitles in education, an investigation into this aspect has significant theoretical and applied implications, particularly at a time when technological advances have made it possible to create verbatim subtitles relatively cheap to produce.

The experiment in this study has two levels (English as a foreign language, and English as first or second language) and four conditions, namely a control condition without subtitles, and three experimental conditions in which the subtitle speed has been manipulated:: 1) verbatim (an average of about 17 CPS); 2) standard (an average of 15 CPS; 3) and edited (an average of 12.5 CPS). A total of 172 students form King Khalid University (Saudi Arabia) and Macquarie University (Australia) participated in this experiment. Participants were assigned to four groups: (1) a group of 42 participants watching the verbatim video; (2) a group of 40 participants watching the edited video; a group of 53 participants watching the standard video; and (4) a control group of 37 participants watching the video without subtitles. Participants were assigned randomly to the four groups. After inviting students, those who accepted to participate were asked to watch a 6-minute history video and then fill out three questionnaires: a biographical questionnaire; a cognitive load questionnaire, adopted from Brünken et al. (2003); and a comprehension test which was used as an indicator of performance.

This experiment study has found that all subtitle conditions were beneficial when compared to the unsubtitled video in the case of the Arabic group. Particularly, edited subtitles had a significant impact on the results obtained for the Arabic group. In terms of English speakers, however, edited subtitles increased CL and also resulted in lower comprehension, indicating that those subtitles were not useful for this particular group. All English speakers outperformed Arabic speakers under all conditions, particularly in the unsubtitled condition where the difference was significant.

Statement of Candidate

I certify that the work in this thesis entitled 'The Impact of Presentation Rate on the Effectiveness of Subtitles in Learning' has not previously been submitted for a degree, nor has it been submitted as part of requirements for a degree, to any university or institution other than Macquarie University. I also certify that the thesis is an original piece of research and that it has been written by me. Any help and assistance that I have received in my research work and the preparation of the thesis itself have been appropriately acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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List of Abbreviations

CPS: Character per second

CLT: Cognitive load theory

CL: Cognitive load

VS: Verbatim speed (word for word subtitles)

SS: Standard speed (standard subtitles where some words have been omitted)

ES: Edited speed (edited subtitles where a substantial amount of words have been omitted)

L2: Second language

L1: First language

Chapter 1. Introduction

Contemporary technology has developed in recent years in all walks of life and especially in education. Many educators have realised that the conventional ways of teaching and learning need to adapt to the rapidly increasing use of audiovisual materials. Students might not benefit fully from what is being presented by their teachers in classrooms as the current generation rely more on technology than did previous generations. With the increasing availability of technology in the classroom, teachers can rely more heavily on audiovisual material to cater to the changing needs of current students. In addition, researchers have become interested in audiovisual materials in general and subtitles in particular, and their usefulness in education and learning. However, there are conflicting findings regarding the benefits of using subtitled videos for education purposes.

The effectiveness of subtitling in the context of education has been studied extensively in recent years. On the one hand, a considerable number of studies have proven that adding subtitles could provide learners with a positive learning experience. These studies are in the areas of: listening (see, e.g., Huang & Eskey, 1999; Latifi, Mobalegh, & Mohammadi, 2011); vocabulary learning (see, e.g., Alavi, 2011; Bird & Williams, 2002; Neuman & Koskinen, 1992); and the subfield of reading and comprehension (see, e.g., Bean & Wilson, 1989; Garza, 1991; Goldman & Goldman, 1988). These studies argue that the benefits of subtitles could be due to the dual coding effect (the multimodality of audiovisual presentation of learning material) which supports learning through affirmation of learning items, enhancing retention, information processing, and comprehension.

On the other hand, several other studies claim that subtitles could hinder learning by interrupting information processing because the multimodality of audiovisual presentation of information causes cognitive overload - an experience which could be explained by cognitive load theory. Cognitive load theory was developed by John Sweller in the late 1980s (see Sweller, 1988). In the context of education, using cognitive load theory as theoretical framework, Mayer, Heiser, and Lonn (2001) found that when watching an animation, L1 students who listened to the narration learned more than those who also used subtitles. They concluded that, in this case, the subtitles were redundant information as the same content was available in the audio, i.e. the subtitles were distracting (Sydorenko, 2010). This is known as the redundancy effect, which would mean that learning would be easier if students were shown videos without subtitles.

The argument here is that subtitles force learners to give their attention simultaneously to three stimuli: audio, text and images. This can lead to cognitive overload, where the limit of a student's working memory is reached (Baddeley, 1986; Chandler & Sweller, 1991). This notion correlates with cognitive load theory and its principle of redundancy (Sweller, 2005), which assumes that redundant information delays information processing and knowledge acquisition.

Hence, there appears to be a missing link between studies that show benefits in using subtitles and those that show negative results from using subtitles. To address the issue, this study provides some explanations for both results. For those studies that claim subtitles to be beneficial, a legitimate reason for this might be that students do actually need subtitles to support their L2 comprehension as a result of being beginner learners of English. Consequently, this information might not be redundant and might not impede their L2 learning and information processing. In regard to those studies which claim that subtitles could be a hindrance to learning, this study suggests that students who have higher English

language proficiency are more inclined to disregard captions as their aural comprehension abilities are adequate for understanding the audio without them. In fact, Chung, Lei, and Teseng (2014) revealed that students with a high English listening ability had a lower cognitive load compared to their low proficiency counterparts. For this reason, multimodality could either support or hamper language processing according to the current language proficiency of participants.

Since there is an ongoing debate on the benefits of subtitles in learning, this study seeks to investigate different types of subtitles (verbatim, standard, edited, unsubtitled) to test their impact on comprehension (learning) and cognitive load where first language is a factor (Arabic Vs. near or/and native English). After consulting the literature, it seems that very few of the studies on subtitling in an educational context have investigated different subtitle pesentation rates and taken into account the language proficiency of study participants. Hence, this study has attempted to find answers to the following questions:

1) What is the impact of the presentation rate of subtitles at an average of 17 CPS (characters per second - verbatim); 15 CPS (standard), and 13 CPS (edited) on the effectiveness of subtitles in learning?

2) Will there be a difference between conditions in terms of cognitive load when watching the video?

3) Will language proficiency play a role in the effectiveness of subtitles in learning and cognitive load?

Chapter 2. Literature Review

2.1 The definition of subtitles

Subtitles are defined as words that appear at the bottom of the screen of any device that allows the output of audiovisual materials. The idea of subtitles came about as a means of facilitating the enjoyment of film and TV for the hearing-impaired, the Deaf, and the hard-of-hearing (Garza, 1991). The first use of subtitles was thus not intended to translate a foreign language into the native language of the intended audience, as is commonly done these days, but instead it was employed to cater for those who had difficulty hearing or who cannot hear at all. Therefore, it is logical that the language that appears at the bottom of the screen should only reflect the exact wording of the spoken language emanating from the television, for example, which would be same language translation, so-called captioned language (Garza, 1991). Furthermore, Diaz Cintas and Remael (2007) explained that subtitles are presented as written text that appears on the lower part of the screen and shows the original dialogue, as well as any "discursive elements that appear in the image (letters, inserts, graffiti, inscriptions, placards, and the like), and the information that is contained on the soundtrack (songs, voices off)".

Subtitles are classified into three types, namely interlingual, intralingual, and bilingual or multilingual subtitles (Diaz Cintas & Remael, 2007). Intralingual subtitles (same language subtitles) are those that cater for the Deaf and the hard of hearing, or that are used for language-learning purposes, karaoke effects, dialects of the same language, and notices and announcements. On the other hand, interlingual subtitles (also called translation subtitles) are used to serve as a means of making film or TV accessible to a foreign language audience. Lastly, bilingual or multilingual subtitles involve two or more languages being shown on the screen to serve certain contexts and audiences. Having made this distinction, this

study is mainly concerned with intralingual subtitles (i.e. English to English) in the context of education. Moreover, the term 'subtitles' in this study is used interchangeably with captions since they are widely referred to as such in the literature.

Because subtitles provide various practical functions and also have pedagogical implications, they have proliferated worldwide, particularly in the entertainment industry as well as within education at large (Garza, 1991). The use of subtitles has also become popular in language-related research, which has shown the use of subtitles to have a positive influence on learners in general.

2.2 The increase in the use of subtitles

Although the intended goal of subtitling, when it was first introduced, was to meet the needs of those who were Deaf, hard-of-hearing or hearing-impaired (Garza, 1991), many educators quickly saw the value in exploiting its potential in assisting students' processing of language differently by means of this new technology (Goldman, 1996; Holobow, Lambert, & Sayegh, 1984; Koskinen, Wilson, Gambrell, & Neuman, 1993; Parks, 1994). The original idea cannot be more relevant today, particularly when the concept is used in the context of education, allowing for equality and equity of access to educational materials for all individuals. In fact, many educational institutions have made subtitled videos one of their teaching methods. One example is MIT which has implemented subtitles in its open access courses, a practice also followed by Stanford University and many other universities internationally. Similarly, online courses and lectures presented by Khan Academy, Coursera, YouTube, TED and Udemy provide video-based content with subtitles on the basis that they have a positive impact on learning. If implemented globally, the Deaf, the hard-of-hearing and the hearing-impaired would be able to access educational materials equally, with full understanding of the subject matter. Moreover, L1 speakers seem to benefit significantly from captioned videos, particularly with regard to literacy, regardless of

whether they are adults or children (Gernsbacher, 2015). Similarly, Gernsbacher argues that foreign language learners would also benefit from the opportunity of being exposed to subtitles to ensure content comprehension and language learning of video-based materials. Since English language learners are increasing in numbers, the benefits of subtitles would assist an increasing number of students.

2.3 The increase in English learners

According to the IELTS organization in 2018 (https://www.ielts.org/news/2017/ielts-numbers-rise-to-three-million-a-year) more than three million tests were attempted in 2017, showing the important growth of international students and immigrants who are learning English. Added to this number there are many who take the TOEFL test.

An example of the very large number of English learners who could potentially benefit from the use of subtitles is provided by the 26 state universities in Saudi Arabia all of which administer a compulsory English program in the first year for all tertiary students, regardless of their intended specialization. Having such a large number of students engaged in studying English is not peculiar to Saudi Arabia – the hegemony of English as a medium of instruction can be seen in other parts of the world as well. According to a UNESCO student mobility data in 2018 (http://uis.unesco.org/en/uis-student-flow), there are currently 294,438 international students in Australia, whilst in the United States the number is 907,250. The majority of these students study through medium English. All the available information indicates that there are huge numbers of students worldwide who could potentially benefit from the use of subtitles, either in the context of a formal education or an informal one.

2.4 Subtitles in education

The use of subtitles in education has gained popularity among many educators because a number of studies have shown that subtitles have a positive impact on learning. A two-year longitudinal study by

(Collins, 2013) (mentioned by Dallas et. al. 2016), investigated the performance of 340 college students on Native American history in the U.S. Based on assessments, the author indicated that students who watched the subtitled educational video outperformed students who watched the video without subtitles. Collins also pointed out that students who watched the subtitled video were more active, engaged in class interaction, and took more detailed notes.

In another study, Villela (2014) tested journalism students' comprehension of news videos with English subtitles during two consecutive semesters. The students were exposed to content with and without subtitles to test their comprehension levels. The results showed that students did not understand the news content fully until subtitles were shown, which indicates significant pedagogical potential. In another study, 72% of respondents aged between 12 and 25 in Europe agreed on the positive educational consequences of adding English subtitles to films with their original language (Safar et al., 2011). In the same vein, they state:

> Subtitling also presents strong potential in educational contexts: it can reduce the anxiety experienced by foreign language learners. It can also serve as a useful support, in its intralinguistic version, and can be used to help make it easier for immigrants to learn the language of their host country (Safar et al., 2011, p. 4).

The adoption of subtitling in education is well established, and a large amount of research has been conducted on its use. The benefits of subtitling in the domain of language learning will be discussed in the next section.

2.5 The benefits of subtitles in language learning

The benefits of subtitling in language learning have been researched widely in recent years. Many studies have shown that adding subtitles could lead to positive learning particularly in areas such as vocabulary (see Alavi, 2011; Bird & Williams, 2002; Neuman & Koskinen, 1992; Peters, Heynen, & Puimège, 2016; Sydorenko, 2010; Zarei & Rashvand, 2011), listening (see Huang & Eskey, 1999; Latifi, Mobalegh, & Mohammadi, 2011; Yoshino, Kano, & Akahori, 2000), and reading and comprehension (see Bean & Wilson, 1989; Garza, 1991; Goldman & Goldman, 1988; Kothari, Takeda, Joshi, & Pandey, 2002; Markham & Peter, 2003; Neuman & Koskinen, 1990).

2.5.1 Vocabulary

A study by Bird and Williams (2002) revealed that subtitling led to better lexical recognition when subtitles were shown prior to implicit and explicit memory tests compared to single modality (sound or text only). Likewise, Alavi (2011) states that when students engage in a learning activity in which subtitles are used they benefit from them, particularly in terms of vocabulary building, because they are exposed to multimodal output channels such as audio, visual, and print media.

Zarei and Rashvand (2011) tested subtitles with regard to whether they were verbatim or non-verbatim on intralingual (e.g. English-English) and interlingual (e.g. English-Arabic) models. The study showed that non-verbatim subtitles helped participants do better in vocabulary recognition whether they were intralingual or interlingual. However, English to English subtitles were more useful than translated subtitles in that it assisted participants to perform better regardless of subtitle presentation model (verbatim or non-verbatim).

Neuman and Koskinen (1992) studied the influence of Krashen's "comprehensible input" theory, using captioned television to test incidental vocabulary learning of bilingual students. In this study, students who watched captioned television outperformed all other groups namely, without caption group, reading along (while listening to the text) group and textbook only group. Consequently, students who watched captioned television demonstrated better performance than the other groups when recalling specific scientific information. This indicates that exposure to captioned television may lead to increased vocabulary as well as better performance.

2.5.2 Listening

d'Ydewalle, Praet, Verfaillie, and Rensbergen (1991) claim that listening to audio while viewing captions on the screen does not distract viewers from the audio content as one might think. On the contrary, reading subtitles becomes automatic. In fact, Danan (2004) points out that subtitles improve the listening comprehension skills of L2 learners, and also lead to additional cognitive benefits when processing is at great depth.

Likewise, a positive outcome in listening comprehension was found in the performance of ESL students at the University of Southern California (Huang & Eskey, 1999). The students were chosen randomly, put into two groups, and asked to watch two sets of videos: one with audio and English subtitles and the other with audio but without subtitles. The results showed that the group of students who watched the videos with audio and English subtitles outscored the other group.

Similarly, Markham (1999) conducted a study on 118 ESL university students with advanced English proficiency to test their listening skills to investigate word recognition competence. Students viewed two independent educational television programmes that dealt with the civil rights movement and with

whales. Both programs were captioned. The study revealed, by means of multiple choice tests, that word recognition, through listening, was improved significantly in the presence of captions. Therefore, Markham (1999) suggests that captions could enhance L2 listening skills.

2.5.3 Reading and comprehension

Markham and Peter (2003) assigned 213 intermediate Spanish students to take part in their study. The purpose of the study was to investigate the effectiveness of English captions, Spanish captions or no captions (when synchronized with Spanish soundtrack) on the students' listening and reading comprehension. After being randomly assigned to each group, students watched a seven-minute video concerning the preparation for the Apollo 13 NASA space exploration mission. Completing multiple-choice tests, the English-caption group performed better than the Spanish-caption group who, in turn, outperformed the no-caption group. The study, therefore, concluded that utilizing a multimodality approach could enhance second language listening comprehension and, importantly, reading comprehension as well.

Being the first study to investigate the effects of captions on advanced second language learners, Garza (1991) conducted a study to test the effectiveness of captions on the linguistic comprehension of film segments. Data was collected from 70 advanced English learners and 40 advanced Russian learners. Students in both groups were randomly assigned to their corresponding conditions: English learners watched English videos with captions and without captions, and Russian learners watched Russian videos with captions and without captions. The results showed that same language caption groups performed significantly better than no caption groups in comprehension checks. In other words, comprehension scores related to both English or Russian captioned videos were higher than those for English or Russian uncaptioned videos.

Overall, it seems that the findings of all the studies mentioned above agree on the fact that students seem to learn significantly better when engaged in a learning environment that is multimodal in nature, one that provides sufficient, well-rounded information. Thus, the information provided in the videos was confirmed by both aural and visual channels, being complementary to one another. The benefits of multi-channel information delivery is referred to in the literature as "the dual coding theory" (Paivio, 1991, 2007).

2.6 Dual coding effect

Paivio (1991, 2007) identified a dual coding effect, meaning that simultaneous presentation of visual and verbal information enhances information processing. Hence, improvement in learning may occur due to the fact that information (e.g. emanating from the television) in the form of audio and visual modalities enhances information processing because it provides the same information in more than one channel. Moreover, the hypothesis of information delivery supports the dual coding theory in that it emphasizes that when texts (i.e. subtitles) are added to audiovisual material in an educational context, students could learn more because information has been delivered over more than one path (Mayer, Heiser, & Lohn, 2001, p. 190).

In addition, the dual coding effect assumes indirectly that learning takes place when learners are much more comfortable in the ways that they learn. In other words, every human being has a sensory channel preference by which they learn better. For example, a student may learn better by processing visual materials, while another may learn more effectively by listening to aural materials. This sensory-channel preference for learning could be accommodated through the use of multimodal material where students can draw on the material that corresponds to their preference (Mayer, 2009).

With that said, most previous studies that found subtitling to have a positive impact on learning could be explained by the assumptions of the dual coding effect. However, other studies, which will be discussed next, have shown contradictory results which indicate that subtitling could be a hindrance to learning. These negative effects or lack of positive effects could be ascribed to the fact that multimodal texts may place bigger demands on the cognitive resources of users. Cognitive load theory (CLT) in Instructional Design engages with this concept.

2.7 Cognitive Load Theory (CLT)

Sweller, Van Merriënboer, and Paas (1998) explain that CLT assumes a limited capacity working memory that includes partially independent subcomponents to deal with auditory and verbal material and visual (2- or 3-dimensional) information as well as an effectively unlimited long-term memory, holding schemas (already learned information) that vary in their degree of automation (1998, p. 25).

In addition, when novel information is processed, CLT assumes "a limited working memory that stores about seven elements but operates on just two or four elements. It is able to deal with information for no more than twenty seconds…" (Van Merriënboer & Sweller, 2005, p. 148).

As stated above, CLT assumes that the human cognitive system has a limited capacity. Placing too many demands on it could result in cognitive overload, which would be negative for learning. When information is presented through both auditory and visual modes, this may also place higher demands on the cognitive system. If this information were all of the same kind (e.g. aural or visual only) it might be processed comparatively easily. But since multimodal information is diverse in nature in this respect, the brain has to simultaneously attend to those different channels in order to make processing successful.

According to the studies that are in favor of this notion (Sweller et al., 1998; Paas, Renkl & Sweller, 2004; Van Merriënboer & Sweller, 2005), the cognitive capacity of human beings collapses in the attempt to take in new information when there is too much information to be processed, and thus learning is interrupted.

It is evident then that CLT is linked to short-term memory and how information is being processed. If learning takes place, the brain then carries the information over to long-term memory, formulating successfully learned information or schema (Sweller et al., 1998). Therefore, we could say that visual and auditory information is processed in the short-term memory first, contending to be processed within the limited capacity parameters allowed. If information is too much for the brain to calculate within its capacity in the short-term memory, then cognitive overload takes place, resulting in a trade-off in focus selection. In other words, if the combination of auditory and visual information depletes the capacity of the working memory, there will not be capacity for successful comprehension. This is due to the cognitive overload experienced in the short-term memory, giving no choice for the brain but to make a compromise between elements. Furthermore, Sweller et al. (1998, p. 252) points out that any interactions between elements in the working memory require working memory capacity, which will reduce the number of elements dealt with simultaneously. Consequently, cognitive overload takes place when the learning task is cognitively complex and challenging, overwhelming the learners to simultaneously process several pieces of information presented in an attempt at working out novel information (Paas et al., 2004).

In addition to the limited capacity assumption and the dual channel assumption of CLT discussed above, (Mayer, 2009) also identifies the active processing. This assumption assumes that learners process information consciously and formulate knowledge structures. This principle is important in that it

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provides a methodology for the process of learning. According to Mayer (2009), learning is an active process where incoming information is associated with prior knowledge, formulating mental representations to establish new learned knowledge.

According to Paas et al. (2003), CLT consists of three different types of cognitive load: 1) intrinsic cognitive load, which manifests itself in the learner's current cognitive ability and how it can interact with the complexity level of information presented; 2) germane cognitive load, which can be attributable to the learner's level of motivation during information processing of essential material, to form knowledge structures and schemas in the long-term memory; and 3) extraneous cognitive load where extra, unnecessary pieces of information could interrupt learning due to badly-designed material presentation. In recent years, according to Leppink (2015), only intrinsic and extraneous load can really be measured, and conceptually, germane cognitive load is considered an element of intrinsic load. According to Leppink, incorporating germane cognitive load as a third principle in CLT would encourage researchers to find a way to attempt to measure all three types of CLT separately, making it more of a daunting task.

Consequently, extraneous cognitive load is of particular interest in this study as it deals directly with the manner of how material can be adjusted (i.e. changing the presentation rate of subtitles) to reduce cognitive overload experienced by learners and, therefore, potentially facilitate learning.

2.8 Speed Presentation Rate of Subtitles

To investigate the effect of subtitle presentation rates, Guillory (1998) looked at the impact of verbatim (word-for-word) and key-only (edited) subtitles on the comprehension of language learners. Because verbatim subtitles are dense (and therefore present more words in a shorter time), the study assumed that L2 learners might experience difficulty when viewing them, meaning they might experience a cognitive

overload. As a result, the study hypothesized that fewer words in the subtitles should mean less mental demand on the visual channel, and thus should not affect comprehension. To test the hypothesis, three groups were created: 1) verbatim group which viewed the full text of subtitles, 2) key-word group which watched the video with key-word subtitles; and 3) without subtitle group, serving as a control group. It appeared that the full-text group outperformed the keyword-only group. Nevertheless, the keyword-only group outscored the no-subtitle group, which implies that both the full-text group and the keyword-only group performed better than the no- subtitle group. The study confirmed the hypothesis and concluded that the presence of subtitles, irrespective of the type, could have a positive impact on comprehension, which suggests that no cognitive overload was found.

Unlike the previous study, Kruger (2013) examined the impact of near-verbatim vs. edited subtitles on comprehension and distribution of attention in the context of education. The study showed that while the presentation rate of subtitles had no significant effect on comprehension, the higher the presentation rate, the less processing of subtitles took place. This suggests that verbatim subtitles put the reader under pressure to keep up with the rate of presentation of subtitles, which may very well lead to cognitive overload.

Using eye tracking technology, Szarkowska, Krejtz, Klyszejko, & Wieczorek (2011) reported on the results of three groups of participants: nine Deaf, 21 hard-of-hearing, and 10 hearing individuals. In their study, all groups viewed different types of subtitles: verbatim (13 characters per second or cps), standard (10 cps), and edited (7 cps). Although the study's main goal was to test whether subtitle types would be read differently by the groups involved, a secondary objective was also to test the comprehension of participants with regard to subtitle types. When comprehension was tested, the study revealed that, for the edited subtitles, hearing viewers scored lower than the Deaf and the hard-of-hearing. To account for

these results, the authors surmised that due to the major discrepancies between dialogue and caption text, hearing viewers could not effectively link the information between image and dialogue, which resulted in a misunderstanding of the content. More importantly, the authors stated that all groups spent more dwell time reading verbatim subtitles than standard and edited subtitles. This suggests that verbatim subtitles have a high textual density which challenges the reader to keep up with the fast pace of the presentation rate. In other words, verbatim subtitles make more cognitive demand on readers, especially when they have to attend to other audiovisual channels simultaneously. Because Deaf viewers, in the study, were fully dependent on subtitles to understand the content, they did not look at the image as long as the hearing group (Szarkowska et al., 2011) which could mean they had less cognitive load to deal with. This may explain why deaf viewers performed better than the hard-of-hearing and the hearing groups in the comprehension test.

In a later study, Szarkowska et al. (2016) investigated whether intra- and interlingual subtitles and subtitle presentation rates (15 cps vs 12 cps) would have an impact on comprehension and reading patterns of 60 hearing, 33 hard-of-hearing, and 44 deaf Polish participants. Using eye tracking measures, her study showed that whereas edited subtitles had no added benefit with regard to comprehension, verbatim subtitles demonstrated slightly better results. The study concluded that verbatim subtitles at the rate of 15 cps were slightly more effective. Therefore, it seemed that there was no cognitive overload experienced by participants as a result of faster subtitles.

As is evident from the above studies, subtitle presentation rates do not neatly correlate with comprehension, leading to various interpretations regarding the cognitive load involved. Another possible interpretation of this is that subtitles present learners with a more complex learning

environment and that therefore the manner of subtitle presentation is important, something possibly explained by the 'redundancy effect' of audiovisual channels

2.9 Redundancy Effect

A key to understanding why subtitles are not always beneficial could be the redundancy effect. Although they could be beneficial, subtitles could cause further cognitive load particularly when an idea is presented in more than one form. For example, an idea can be presented, in an educational context, as audio output (the lecturer's voice as auditory verbal information) coupled with visual information that could be non-verbal (images) or verbal (text on slides as well as subtitles). Having the same information in both auditory and visual channels could increase the load (extraneous cognitive load), which then could impact learning negatively (see Diao & Sweller, 2007; Kruger, Hefer, & Matthew, 2013). In the previous example, learners attempt to mentally coordinate and process a single idea presented in different channels, resulting in a decrease in performance, which is known as the 'redundancy effect' (Diao & Sweller, 2007, p. 239).

The redundancy effect is confirmed in studies by Diao and Sweller (2007) and Mayer et al. (2001). The study by Diao and Sweller (2007) shows that verbatim subtitle presentation of text, when accompanied with listening comprehension procedures in the EFL context, interferes with the learning process as a result of the cognitive overload experienced by students. The authors explained that this is due to the students attempting to coordinate the same information from different channels, which means the information is redundant. They further concluded that "the redundancy effect plays a role in multimedia EFL instruction when students are learning to listen" (Diao & Sweller, 2007, p. 251).

Mayer et al. (2001) also confirmed the redundancy effect when texts were added for English native speakers, making them perform worse in retention and transfer than those who watched the video without any subtitles. They further explained that this could be because of the effect of the split-attention hypothesis (Kalyuga, Chandler, & Sweller, 1999), where attention usually seems to be linked to visual scanning and viewers therefore could be distracted and overwhelmed if there is more than one visual channel to attend to. Similarly, Kalyuga and Sweller (2014) state that redundant information does not facilitate learning but rather interferes with it. On the other hand, the study by Kruger et al. (2013) found no redundancy effect when students were exposed to more than one information channel simultaneously in auditory and written format. Kruger et al. (2013) explained that under certain conditions, the simultaneous presence of verbal content in both forms, auditory and text, could avoid the redundancy effect.

Moreover, when students have to process spoken and written text simultaneously, their learning could deteriorate due to the cognitive frustration involved compared to a single modality approach (i.e. auditory and visual only method without subtitles) (Diao & Sweller, 2007). A plausible solution for this is to minimize, or even better, eliminate (through effective instructional design) all redundant channels functioning to achieve the same purpose to optimize learning and to make the cognitive overload less severe in order to make learning efficient (Kalyuga, Chandler, & Sweller, 1998; Diao & Sweller, 2007). Both of these studies among others (see Chandler & Sweller, 1991; Sweller & Chandler, 1994) view the redundancy effect as a hindrance to learning in the context of education.

2.10 The Role of Language Proficiency

Contrary to the above, some researchers have argued that multimodality is actually beneficial for learning. According to Zanon (2006), the three-channel connection encourages language retention, while

Baddeley (2000) indicated that different channels, e.g. auditory and visual can be received by the working memory simultaneously. Likewise, Baltova (1999) argued that the multimodal input can create a better learning environment than one or two-way information delivery.

The aforementioned research indicates that multimodal information is effective in second-language learning, despite the claims of cognitive load theory. A potential reason for this could be that students need captions to aid their L2 comprehension. Therefore, this information may not be redundant and may not hinder their L2 learning and information processing. Moreover, subtitles could help their understanding when watching videos if they are able to effectively manage the three different information sources.

For example, Vanderplank (1988) examined the advantages of video captions by studying 15 advanced and high-intermediate ESL students. He used BBC material that incorporated a range of genres, accents, and speaking paces. Not only did his research show that on-screen captions assisted the students' language learning techniques, it also showed a reduction in their affective filters, creating additional capacity for language-processing.

Similarly, Borrás and Lafayette (1994) used subtitled and non-subtitled videos to examine language processing in advanced French learners. The participants were shown a video with or without subtitles and some participants were given a higher level aural task than others. The results indicated that subtitles could help improve students' confidence and encourage better understanding and learning.

The above studies found that subtitles had a positive impact on learning, which was the expected outcome as all the participants in these studies had a high level of proficiency. These students were

arguably the ideal participants for subtitle research as they could successfully and efficiently interact with the audiovisual material presented.

Finardi and Weissheimer (2008) found a positive correlation between working memory capacity scores and L2 proficiency measures that could explain why advanced learners benefit more from subtitled videos than lower proficiency learners. Likewise, proficient students are more likely to be able to read subtitles at the same times as listening to and viewing a video compared to their beginner counterparts. Beginners might also find subtitles useful, but to a lesser extent than proficient students. Beginner students almost certainly will find it difficult to read subtitles and keep up with their presentation speed – let alone viewing the film and listening to what is being said all at the same time. For example, Guillory (1998) conducted a study that involved showing her students videos with only keyword subtitles. The results showed that the L2 students using full subtitles performed better than the remaining groups and that the two groups who used either full or keyword subtitles performed better than the group who did not use subtitles. Guillory further revealed that keyword subtitles may only help low proficiency language learners.

According to Krashen's (1985) comprehensible input theory, the students' level of proficiency is extremely important, upon which researchers and teachers could build the most adequate teaching materials for their students. This means that if the language input given to the students is not slightly above their current proficiency level, language acquisition will fail. Therefore, students' current proficiency level should be taken into consideration when using audiovisual material as a teaching method so that the likelihood of making learning successful and comprehensible could be increased. According to Danan (2004, p. 71) "…even with captions, massive exposure to authentic audiovisual

material which has not been carefully enough selected or made accessible to non-native viewers can be a very inefficient pedagogical approach".

2.11 The Goal of The Study

Subtitles are becoming increasingly popular among institutions as well as individuals, perhaps because they are thought to be beneficial (see Gernsbacher, 2015). Some of the studies that experimented with subtitles within the context of education have reached the conclusion that subtitles could be beneficial and could facilitate learning. On the other hand, several studies have also shown that subtitles could impact learning negatively, presumably due to cognitive overload and the redundancy effect. Then there are those studies that have failed to find either a positive or a negative impact from subtitles. Due to the inconsistency of results regarding the impact of subtitles, it is important to investigate subtitles as a learning method, as proposed in the current study, to contribute to the ongoing debate about their effectiveness in learning.

In this study, we argue that learners' proficiency levels could be one of the reasons that makes subtitling research in learning seem a very challenging task that could lead to varying results. It is understandable that participants could not all be at the same proficiency level. However, a researcher who conducts research in subtitling and learning should bear in mind that the proficiency of the participants is an important factor as it may have some correlation with the usefulness of subtitles

Therefore, this study seeks to investigate to what extent subtitle presentation rate has an effect on learning while examining students' English proficiency as a factor. Equally important, the study will look at the efficacy of the various subtitle presentation rates (see methodology chapter for further

discussion) with regard to an extraneous cognitive load. To investigate these empirically, the current study attempts to answer the following questions:

1) What is the impact of the presentation rate of subtitles at an average of 17 CPS (verbatim); 15 CPS (standard), and 13CPS (edited) on the effectiveness of subtitles in learning?
2) Will there be a difference between conditions in terms of cognitive load when watching the video?
3) Will language proficiency play a role in the effectiveness of subtitles in learning and cognitive load?

2.12 The Significance of The Study

Most of the subtitles available online are of the verbatim type and generated automatically with post-editing. This type of subtitling mode uses speech recognition technology, which is prone to making mistakes during the process of recognizing sounds. When this happens, learners may be exposed to false, inaccurate learning material. Moreover, verbatim subtitles could be too fast for learners and thus might cause cognitive overload. When learners experience cognitive overload, learning may be disturbed. In contrast, standard or edited subtitles are made manually, thus mistakes are less likely. These types of subtitling could provide better, more accurate data for learners compared to the verbatim type. Furthermore, standard and edited presentation rates are significantly slower than verbatim presentation rates, which means that there might be enough time for successful information processing. This would most likely result in a lower cognitive effort by learners and increase the possibility of better learning.

After being aware of the differences between presentation rates, and how each type of subtitle could affect learning differently, English L2 learners may be able to better judge which type of subtitles is best for them. Whereas advanced students might find verbatim subtitles beneficial, beginners might benefit more from edited subtitles because they are less cognitively challenging as edited subtitles stay much longer on the screen and are likely simpler linguistically than verbatim ones.

Particularly this study takes interest in the impact of subtitles on Arabic students who are only exposed to English in an educational context namely Saudi Arabia, and make comparison with English L1 students or those who function in an English society. Examining their outcome in comprehension and cognitive load tests, the difference between the two types of students could provide valuable insights on the effectiveness of subtitles and the way they are processed in an educational context.

Chapter 3. Methodology

3.1 Introduction

In order to tackle the issue of the impact of subtitle presentation rates on learning and cognitive load, it is necessary to find explanation for the research questions presented in the previous chapter. To answer these questions, an experiment was conducted in an academic context at King Khalid University in Saudi Arabia and at Macquarie University in Australia where students were tested on the four conditions of video with no subtitles, serving as a control group, video with verbatim subtitles, video with standard subtitles and video with edited subtitles. To answer the first research question related to the impact of subtitle presentation speed on learning, a comprehension test was used. A cognitive load test was used to answer the second research question related to the impact of condition on cognitive load. In order to answer the third research question, namely the impact of language proficiency on cognitive load and performance, the results of the comprehension test as well as the cognitive load questionnaire were investigated with an emphasis on the difference between second language students in Saudi Arabia with limited exposure to English and first and second language students who have lived and studied in Australia either for their entire schooling career, or at least for the duration of their secondary schooling. Although this does not provide a distinction between first and second language speakers for the second group, it makes it possible to compare students who study through medium English to students studying mainly through medium Arabic.

Drawing upon the literature, the study's hypotheses are: 1) edited subtitles would result in better performance when compared with unsubtitled video; 2) edited subtitles would result in lower cognitive load when compared with unsubtitled video; and 3) edited subtitles would perform better than all 3 test conditions.

3.2 Participants

A total of 172 students majoring in English at King Khalid University (Saudi Arabia) and at Macquarie University (Australia) participated in this study. Based on the speed at which subtitles were presented, participants were assigned to four groups: (1) 42 participants watching the verbatim video (29 in Australia and 13 in Saudi Arabia); (2) 40 participants watching the edited video (25 in Australia and 15 in Saudi Arabia); (3) 53 participants watching the standard video (18 in Australia and 35 in Saudi Arabia); and (4) a control group of 37 participants watching the video without subtitles (20 in Australia and 17 in Saudi Arabia). The assigning to the four groups was random.

3.2.1 King Khalid University

Arabic university students aged between 19-24 years old participated in the study. These students were studying at King Khalid University in Saudi Arabia, majoring in general English, which means that they study several subjects from different fields such as applied linguistics, linguistics, literature, and translation. To ensure the participants' adequate comprehension of English, only those students in either second or third year were selected as it was assumed that they would have a good command of English.

3.2.2 Macquarie University

Participants from Macquarie University were aged between 18-24 years. Students in this group had enrolled in the Ling 111 (linguistics) unit; hence, this was their first semester at Macquarie University. All participants were either native English speakers or close to being native English speakers, having spent at least their secondary school years in Australia.

3.3 Materials

3.3.1 The video

A 6:50-minute video, produced by the Department of History at Macquarie University, was used to test

students' comprehension. Permission to use this video was obtained from the relevant department. In

this video, a young lecturer talks about the importance of history from different perspectives in order to

show its importance with regard to other disciplines. The video is educational and abstract in nature.

Furthermore, we selected a video that was more likely to engage the interest of tertiary students. We

selected a lecturer whose speech is quite fast in order to enable us to modify the speed at which the

subtitles were presented. This was intended to ensure the feasibility of the study under four conditions:

verbatim, standard, edited and the control group.

3.3.2 Questionnaires

Students were asked to complete a **biographical questionnaire** which would collect information

regarding participants' background and frequency of watching videos with English subtitles. The

students' biographical information was used to provide insights concerning results and discussion. In

addition, following their viewing of the video, participants were given **a comprehension test (see**

appendix A) which was intended to measure their performance. The eight multiple choice questions

were based on the content of the video that the participants had watched. Moreover, participants were

invited to complete **a self-report questionnaire on cognitive load (see appendix B)**; this was intended

to determine the mental effort that they experienced while viewing the subtitled and unsubtitled videos.

To understand data collection on cognitive load, we should consider the different dimensions of the

cognitive load a participant may experience, namely, mental load, mental effort and performance (Diao,

Chandler and Sweller, 2007). While mental load expresses how difficult (or otherwise) a task is for a particular participant, mental effort is defined as the total mental processes in which a participant is engaged. The latter, according to Kalyuga, (2012) can offer data on cognitive processing in learning and performance or both.

The self-reported CL questionnaire was adopted from (Brünken et al. 2003) which was also used in the study of (Kruger, Hefer and Matthew 2014). This questionnaire was used to determine the participants' mental effort involved when viewing the video. Although the questionnaire consists of five questions, Brünken et al. (2003) designed it in such a way that it can determine a number of mental processes. The first question is used to collect data on participants' mental demand. The second one measures participants' temporal demand. The third, fourth, and fifth questions gather information on frustration, level of difficulty and concentration, respectively. Participants record their responses to the five questions on a scale ranging from 1 to 7.

The post-test (the comprehension test) given to the participants was a performance test which was administrated to measure their total performance after viewing the video. The higher the score, the better the performance. According to Diao, Chandler & Sweller, (2007), the best way to measure cognitive load is by combining performance measures and mental effort measures.

3.3.3 Subtitles

Those who devise and present subtitles must adhere to certain rules, one of which is the six-second rule. According to this rule, an average reader can comfortably read two full lines of subtitles in six seconds; hence, it has been determined that each line should not exceed 37 characters, which is a total of 74 characters for both lines (Diaz Cintas & Remael, 2007). According to Diaz Cintas and Remael (2007),

the reason behind the six-second rule is that, since two frames give one subtitle space, and a projection of 24 frames is needed for each second for every film image, subtitlers have 12 subtitling spaces per second. Therefore, a total of 72 subtitling spaces are available over six seconds. This rather implies a low reading speed of 140-150 word per minute which is 11.67 character per second, compared to the new standard of DVD reading speed of 180 words per minute which is a 15 CPS.

In our study, the speed rates of subtitle presentations vary. This study has four conditions and three models of subtitle presentation speed: 1) verbatim (an average of about 17.297 characters per second); 2) standard (an average of 15.067 character per second; 3) edited (an average of 12.555 character per second); and 4) without any subtitles to function as the control group.

The verbatim presentation speed (17.297 CPS) and the standard presentation speed (15.067) are higher than the presentation speed followed by the six-second rule (11.67 CPS), indicating that reading might cause some discomfort. Not significantly higher than the six-second rule (11.67 CPS), the edited presentation speed (12.555) in our study should not cause any discomfort to participants reading the subtitles. To put it into perspective, the standard presentation speed rate in our study is in line with today's presentation speed threshold of the DVD standard which is (15 CPS). While the verbatim presentation speed is higher than the DVD standard, the edited presentation speed is significantly lower than the DVD standard speed rate.

Histogram of Speed$VS
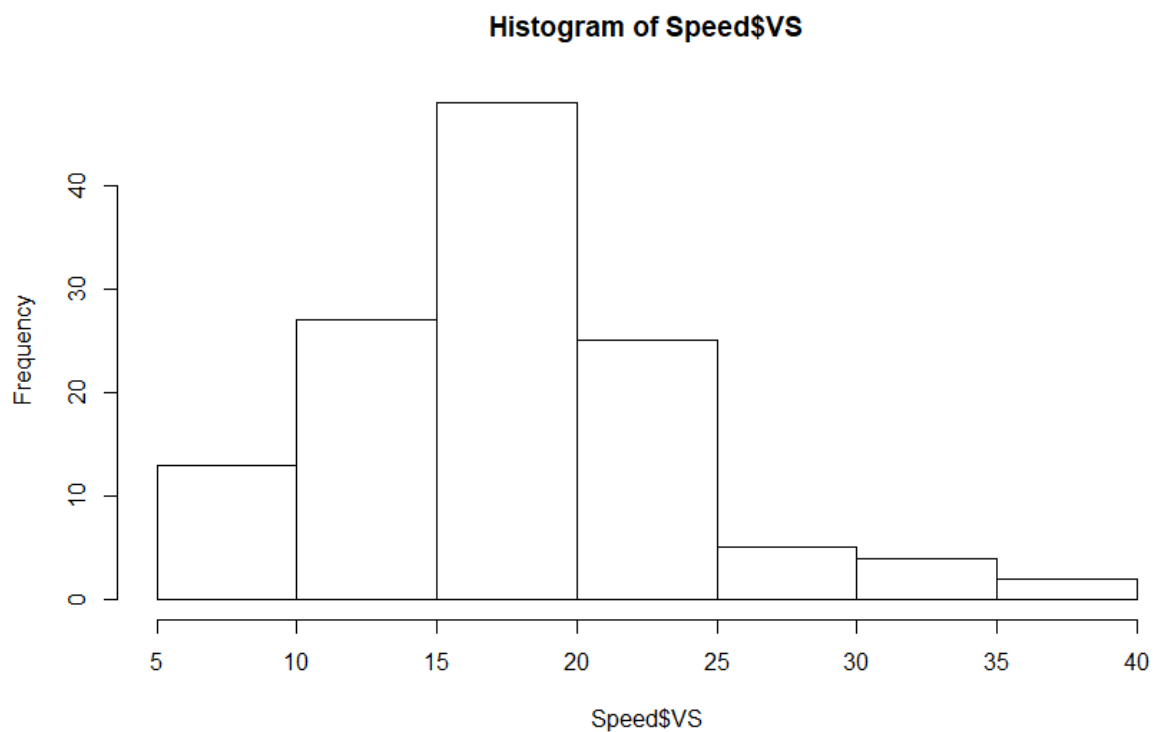
Figure 3.1 Verbatim Presentation Speed.

Min	1st Qu	Median	Mean	3rd Qu	Max
7.176	12.805	16.989	17.297	20.250	39.286

Table 3.1 Verbatim Presentation Speed (VS).

The table shows that subtitles in (VS) range between first quantile (12.805) and third quantile (20.250), while the median value is 16.989, and the mean value is 17.297. Although most subtitles are between 10 and 25, the average speed is 17.297. It is important to note that a high number of the subtitles are presented at a rate higher than 20 CPS, some at exceedingly fast speeds of above 30 CPS.

Histogram of Speed$SS
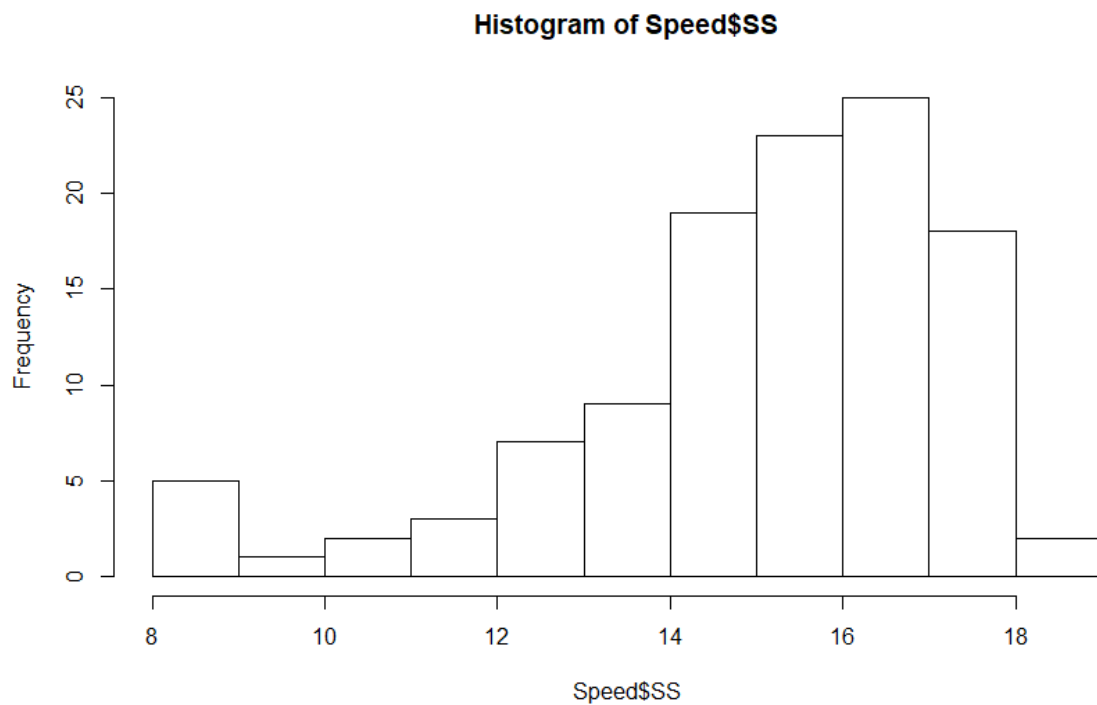
Figure 3.2 Standard Presentation Speed (SS).

Min	1st Qu	Median	Mean	3rd Qu	Max
8.077	14.158	15.599	15.067	16.745	18.224

Table 3.2 Standard Presentation Speed (SS).

Table 3.2 above shows that subtitles in (SS) range between the first quantile (4.158) and the third (quantile) 16.745, while the median value is 15.599, the mean value is 15.067. Although most subtitles are between 14 and 18, the average speed of subtitles is 15.067.
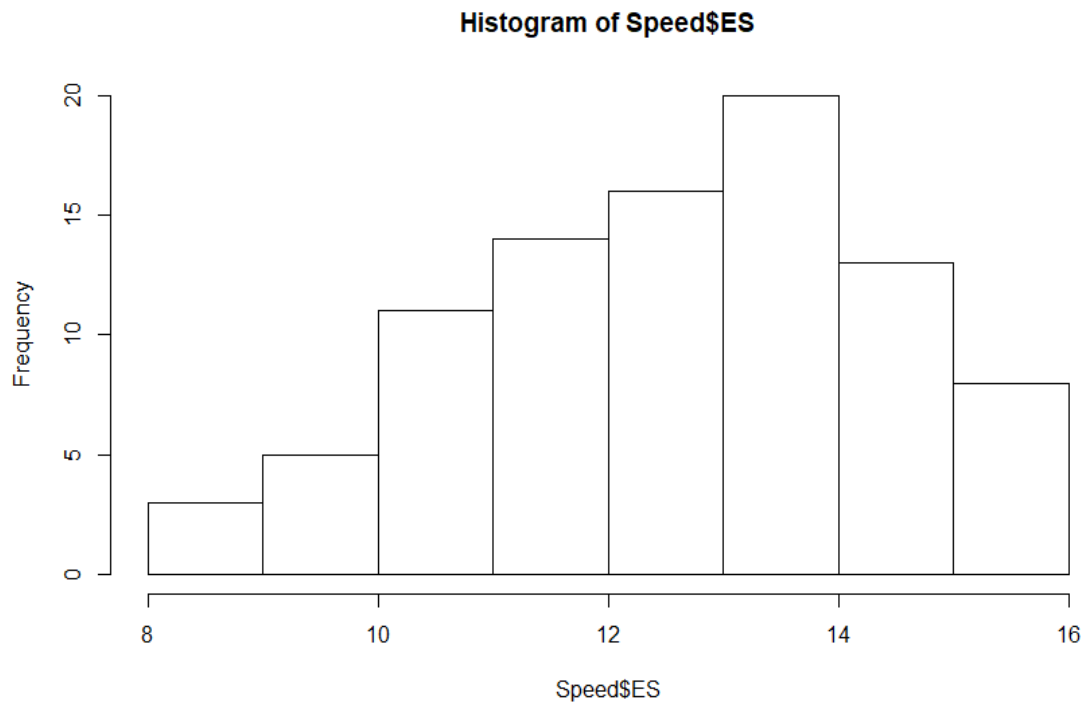
Figure 3.3 Edited Presentation Speed (ES).

Min	1st Qu	Median	Mean	3rd Qu	Max
8.333	11.182	12.693	12.555	13.851	15.435

Table 3.3 Edited Presentation Speed (ES).

Table 3.3 above shows that subtitle presentation speed rates in (ES) range between the first quantile (11.182) and the third quantile (13.851); the median value is 12.693, and the mean value is 12.555. Even though most subtitles are between 10 and 15, the average presentation speed of subtitles is 12.555. The distribution of presentation speed in this condition is more balanced than in either of the two other modes.

3.4 Procedure

Students from King Khalid University and Macquarie University were randomly assigned to one of four groups: verbatim 42, edited 40, standard 53, control 37. To account for English proficiency as a factor, the experiment took place concurrently at King Khalid University in Saudi Arabia and at Macquarie University in Australia. In order to conduct the experiment for this study, formal approval was sought from the head of the English Department at King Khalid University and the head of the Department of Linguistics at Macquarie University.

In the case of King Khalid University, the head of the Department of English assigned very specific tasks to four lecturers to assist with the study's implementation process. Via email, they invited second- and third-year English major students to take part in the study, encouraging them to volunteer as participants. Once the number of participants had been established, the lecturers decided on a date and set up in one of the computer rooms at King Khalid University where the online-based study would be conducted. All students who participated in the study received five extra credits from their respective lecturers.

With regard to Macquarie University's participants, students were invited through email advertisements sent by their Ling111professor and the Department of Linguistics. To encourage participation in the study, students would receive five extra credits from their respective professors. Once the period of the advertisement had finished, students were given the time slots when the researcher would be available to conduct the study which was paper-based. The time slots given by the researcher were sufficient to accommodate an adequate number of participants. The procedure for conducting the study was exactly the same for both King Khalid University participants (Arabic language group) and Macquarie University participants (near/native English group).

To begin with, participants were required to watch a historical video. After viewing the video, participants were asked to fill out three questionnaires. The purpose of the first questionnaire was to obtain biographical information from participants, such as their name, level of study, age and how often they watch videos with English subtitles. Once completed, participants then moved on to the next questionnaire in the form of a self-report, which dealt with the cognitive load experienced by participants. After completing the CL questionnaire, participants were given a comprehension test comprised of 8 questions based on the video they had watched. The information would be used by the researcher as an indicator of performance.

Chapter 4. Results and Discussion

4.1 Introduction

The main goal of this study is to determine whether the rate at which subtitles are presented would result in better learning (performance) and have an impact on cognitive load measures when compared to unsubtitled videos, and also whether there would be a difference between the three subtitled videos in terms of dependent variables, namely comprehension and cognitive load. As mentioned in the previous chapter, a comprehension test, which was interchangeably used with performance, as well as a cognitive load test, were administrated to determine the impact of the various subtitle presentation modes on performance and cognitive load.

4.2 Arabic And English Speakers Combined

Figure 4.1 Comprehension test results for all groups combined

	Arabic	English	Total
Unsubtitled	43.38235294	74.375	60.13513514
Edited	60.83333333	71.5	67.5
Standard	46.78571429	68.75	54.24528302
Verbatim	52.88461538	76.29310345	69.04761905
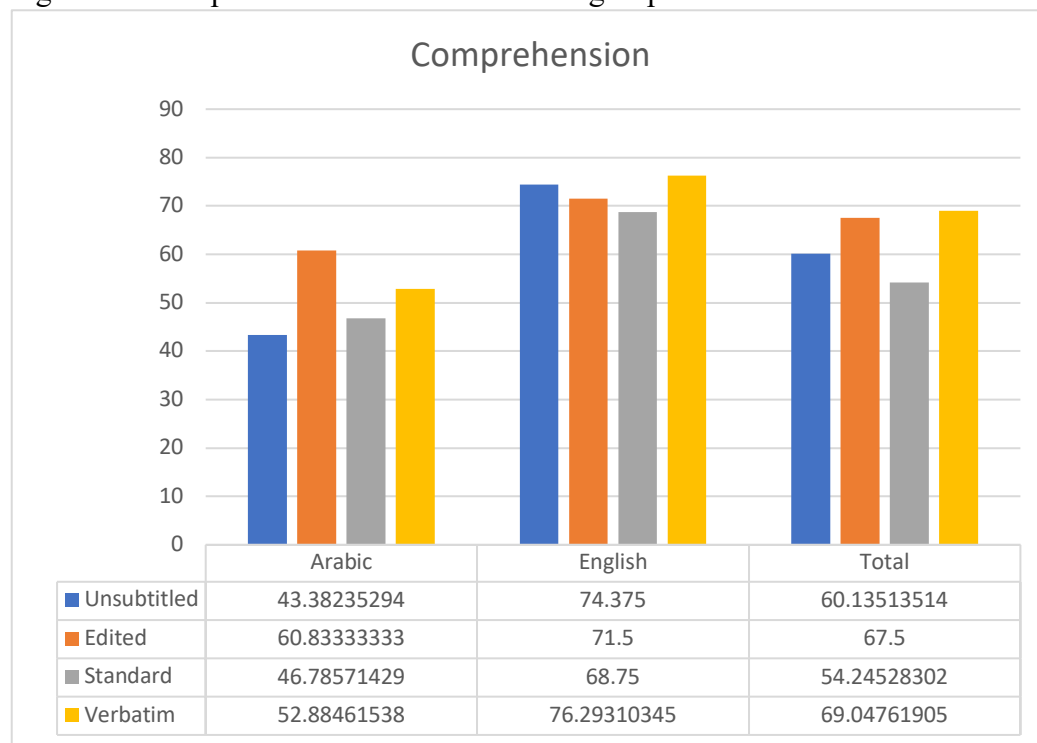
The overall descriptive results (Figure 4.1), for Arabic and English groups combined show that

comprehension increased by 69% when verbatim subtitles were used, but when edited subtitles were utilized, comprehension increased by 67.5%. However, unsubtitled group and standard subtitles impacted comprehension by 60% and 54% respectively.

To be more specific, the descriptive data indicates that all subtitle modes improved the comprehension of Arabic viewers especially in the case of edited subtitles. For the English group, while verbatim subtitles improved comprehension the most, it becomes worse in the presence of edited and standard subtitles.

Table 4.1 shows that there is little difference in means in terms of cognitive load measures and comprehension test results under all four conditions: edited, verbatim, standard and unsubtitled for both groups combined.

Descriptive Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
CL	0	37	18.54	3.694	.607	17.31	19.77	10	25
	1	40	19.05	3.644	.576	17.88	20.22	12	29
	2	42	17.21	4.015	.620	15.96	18.47	11	29
	3	53	17.60	4.280	.588	16.42	18.78	8	28
	Total	172	18.05	3.982	.304	17.45	18.65	8	29
Compp	0	37	60.135	21.2128	3.4874	53.062	67.208	12.5	87.5
	1	40	67.500	16.4570	2.6021	62.237	72.763	37.5	100.0
	2	42	69.048	17.7289	2.7356	63.523	74.572	25.0	100.0
	3	53	54.245	21.2222	2.9151	48.396	60.095	12.5	100.0
	Total	172	62.209	20.1852	1.5391	59.171	65.247	12.5	100.0

Table 4.1 A Descriptive Table Showing Comprehension and Cognitive Load Results for Participants. 0 = Unsubtitled, 1 = Edited, 2 = Verbatim, 3 = Standard.

A one-way ANOVA revealed no significant difference between the four conditions in terms of CL. A one-way ANOVA did show that there was a significant effect of condition on comprehension at the p<0.001 level for the four conditions [F(3, 168) = 5.864, p = 0.000784].

However, this does not take into account the impact of first language. As mentioned, the researcher collected some data in Saudi Arabia and some in Australia. In Saudi Arabia all the participants are Arabic, and in Sydney, they have different first languages but non-mother tongue participants have completed at least their secondary schooling in English, suggesting mother tongue or near-mother tongue levels of English proficiency.

4.3 Cognitive Load Measures of English and Arabic speakers

A linear model with cognitive load as a factor of condition and language (Cognitive Load ~ Condition*FirstLanguage) showed no significance for CL in either the Arabic or English group:

```
Residuals:

    Min        1Q      Median        3Q       Max
-9.3143.    -2.8000    -0.1333     2.5594    12.5172



Coefficients:
                                       Estimate Std. Error t value Pr(>|t|)
(Intercept)                             19.0588     0.9504  20.054   <2e-16 ***
ConditionEdited                         -1.2588     1.3881  -0.907    0.366
ConditionStandard                       -1.7445     1.1584  -1.506    0.134
ConditionVerbatim                       -0.2127     1.4437  -0.147    0.883
FirstLanguageEnglish                    -0.9588     1.2926  -0.742    0.459
ConditionEdited:FirstLanguageEnglish     2.9588     1.8190   1.627    0.106
ConditionStandard:FirstLanguageEnglish   1.8112     1.7212   1.052    0.294
ConditionVerbatim:FirstLanguageEnglish  -1.4046     1.8389  -0.764    0.446
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error:  3.918 on 164 degrees of freedom
Multiple R-squared:  0.07136,  Adjusted R-squared:  0.03173
F-statistic: 1.8 on 7 and 164 DF, p-value: 0.09036
```

Moreover, estimated marginal means were plotted with CL as a factor

(see Figure 4.2). Although there was no significant difference for either group between the

different conditions, it is interesting to note that the edited subtitles resulted in higher mean

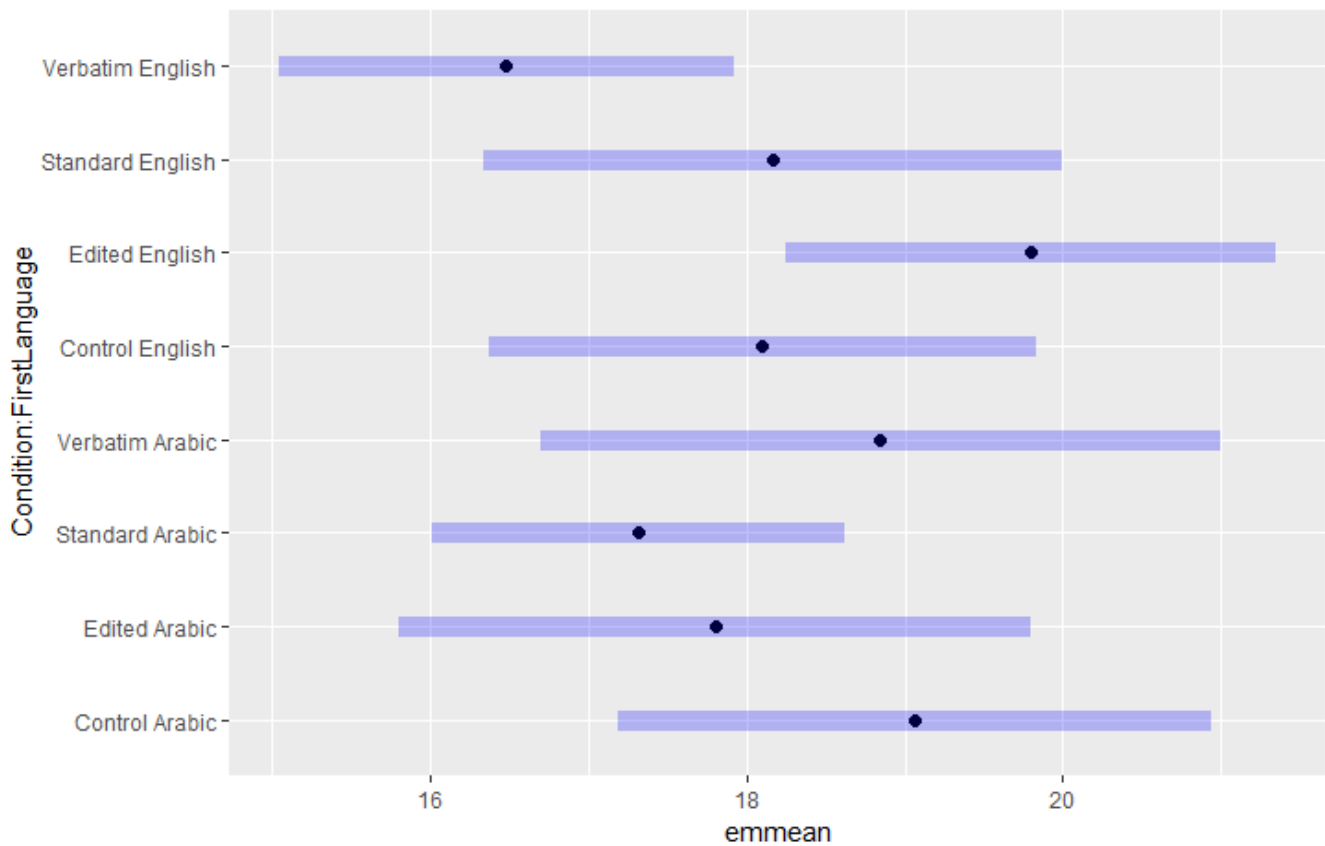cognitive load scores for the English participants.

Figure 4.2 EMMean of CL for English and Arabic groups.

4.4 Comprehension Scores of English and Arabic Speakers

A linear regression model with comprehension as factor of condition interacting with language

(Comprehension ~ Condition*FirstLanguage) revealed some interesting differences. For Arabic

speakers, edited subtitles had a significant impact on comprehension at 60%, which is the highest

comprehension test score for this group. This is 17% higher than for the control condition

(unsubtitled) for the Arabic group (43%). The English group performed significantly better in the

control condition and also in the edited condition than the Arabic group (see Figure 4.3).

```
Residuals:

    Min        1Q     Median        3Q         Max
 -34.286   -10.833      0.625    11.207      53.214
```

```
Coefficients:
                                       Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)                              43.382       3.905   11.108  < 2e-16 ***
ConditionEdited                          17.451       5.704    3.059  0.00259 **
ConditionStandard                         3.403       4.760    0.715  0.47565
ConditionVerbatim                         9.502       5.933    1.602  0.11115
FirstLanguageEnglish                     30.993       5.312    5.835  2.8e-08 ***
ConditionEdited:FirstLanguageEnglish    -20.326       7.475   -2.719  0.00725 **
ConditionStandard:FirstLanguageEnglish   -9.028       7.073   -1.276  0.20360
ConditionVerbatim:FirstLanguageEnglish   -7.584       7.557   -1.004  0.31702
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 16.1 on 164 degrees of freedom
Multiple R-squared:  0.3897,   Adjusted R-squared:  0.3636
F-statistic: 14.96 on 7 and 164 DF, p-value: 4.993e-15
```

In addition, estimated marginal means were plotted with comprehension as a factor

(see Figure 4.3). Edited subtitles impacted comprehension significantly (60%) when they were

viewed by Arabic speakers. This comprehension mean is the highest score compared to other conditions in the Arabic group. In the case of unsubtitled condition, comprehension mean score was 43 %, indicating the lowest mean in the Arabic group. However, English group significantly outperformed Arabic speakers in all conditions particularly in edited (72%) and unsubtitled (75%) conditions.
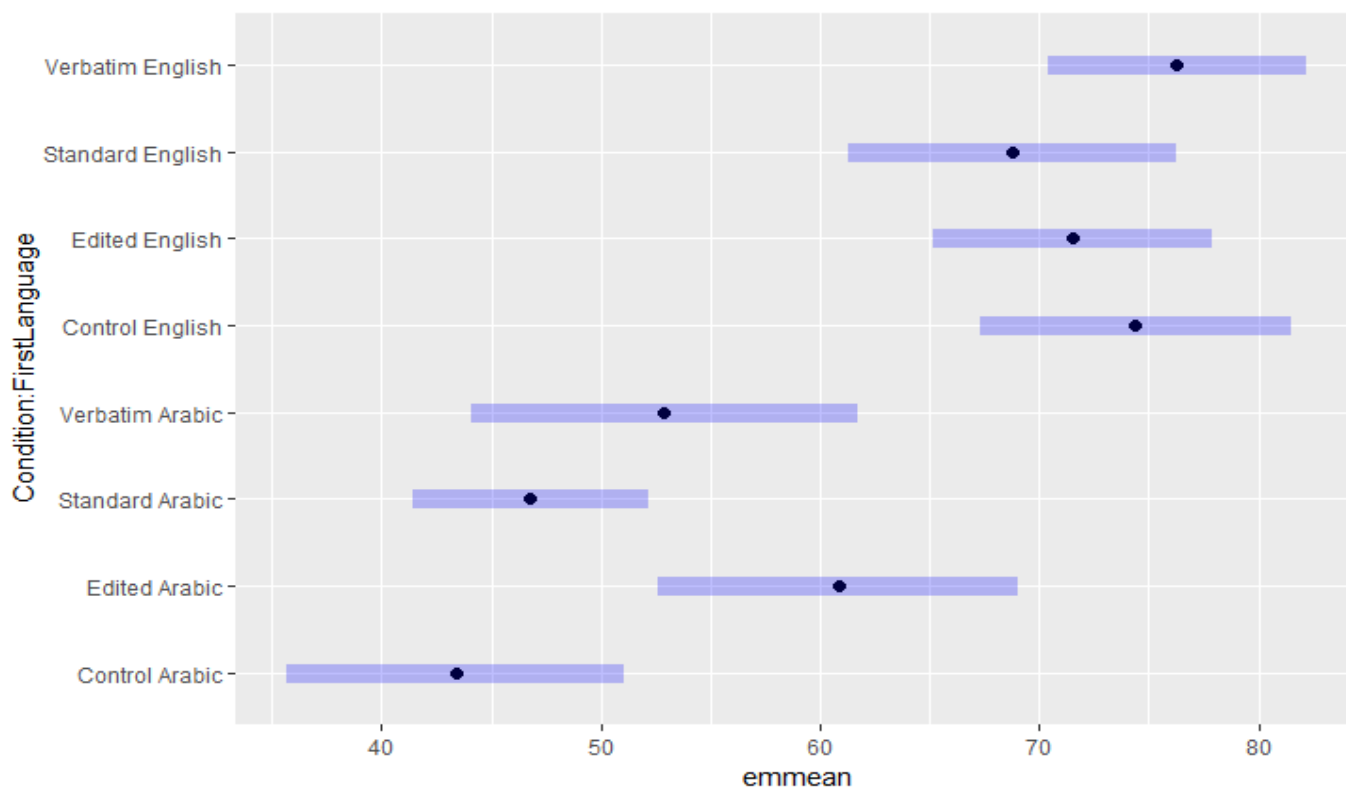
Figure 4.3 EMMean of comprehension for English and Arabic groups.

4.5 The Correlation between Comprehension and CL

In the Arabic group, there is a negative correlation between comprehension and CL. This means that when CL increases, comprehension decreases. However, in the English group, no correlation is found as shown in (Figure 4.4) where the line is flat which indicates that neither comprehension nor CL has an effect on the other.
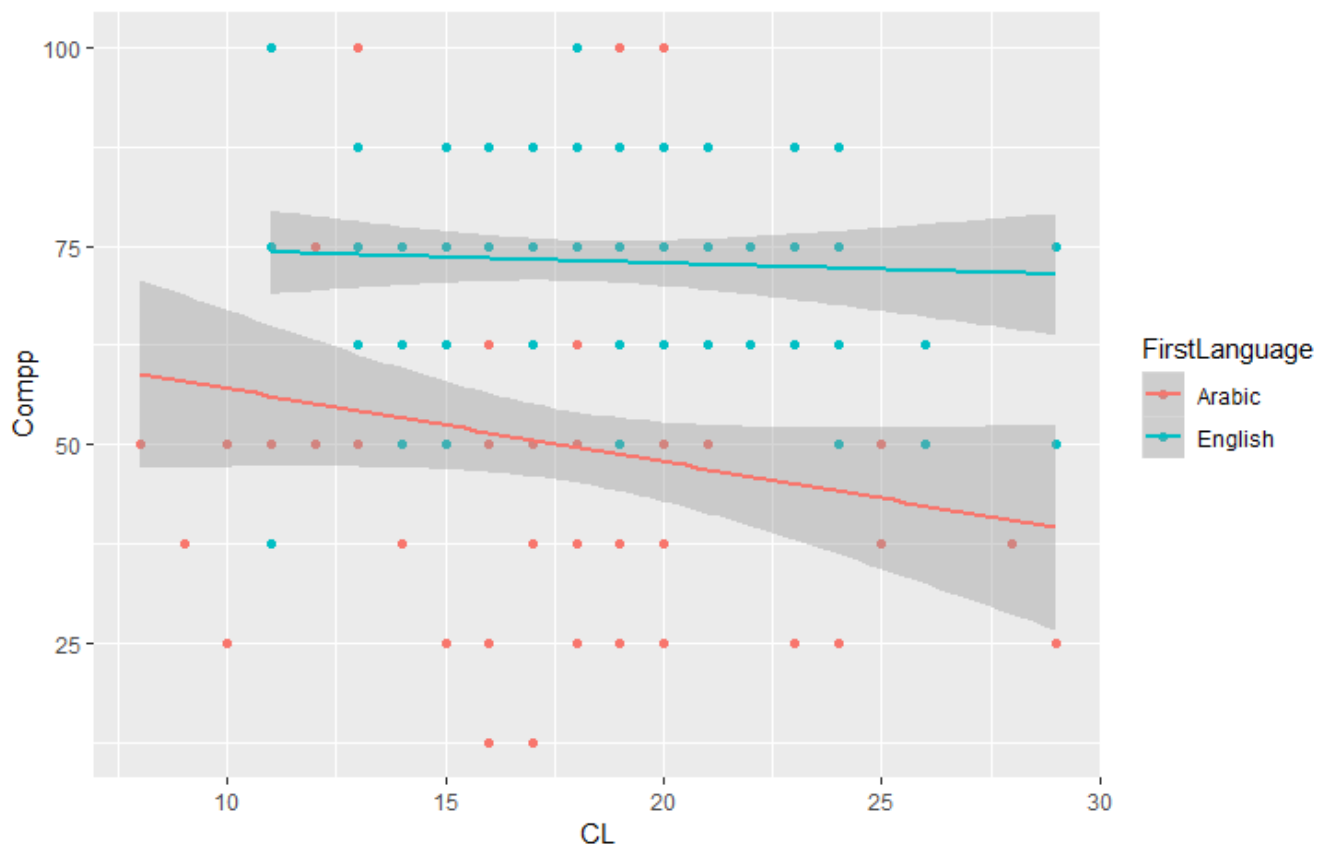
Figure 4.4 Correlation between comprehension and CL scores for English and Arabic speakers.

To conclude, the study did not reveal any significant variation in the performance of the English group, but for Arabic speakers, edited subtitles actually have a significant impact on comprehension. In general, all English speakers performed better than Arabic speakers under all conditions, showing a significant difference under the control condition for both groups and a significant impact of language on comprehension.

4.6 Discussion

The results in this study suggest that different subtitle presentation rates (edited and verbatim) could have significant impact on performance and cognitive load. **When all participants, Arabic and**

English speakers are taken into consideration, it could be noted, as discussed above, that edited subtitles impact comprehension positively at 67.5%. This improvement is slightly lower than verbatim subtitles which impact comprehension at 68%. Although the difference between standard and verbatim presentation speed rates is trivial, data shows, in terms of comprehension, that the difference between edited and standard is significant which means that standard subtitles did not impact comprehension as much. Strangely enough, standard subtitles did even worse than unsubtitled condition, which suggests that for the students with high proficiency in English, subtitles may have been a distraction. In terms of cognitive load, no significance was found for the total number of participants.

With respect to Arabic speakers, the study indicates that edited subtitles did impact learning positively and significantly. This outcome is in line with the study's hypothesis where it suggests that learning could be positively impacted when subtitles are edited down, reducing extraneous CL to allow students to learn better. Importantly, this also means that Arabic students in fact did need subtitles in general, and particularly, to be edited down for them to be able to sufficiently understand the content of the video. In the study of Guillory (1998), she also revealed that keyword subtitles (edited) may only be beneficial for low proficiency language learners. This same conclusion has been reached in this study. Unlike English speakers, edited subtitles were beneficial for Arabic speakers, maybe because their English proficiency was not advanced enough for them to be distracted by captions. Generally speaking, all captioned videos in the Arabic group had higher comprehension scores than the unsubtitled video. Although comprehension scores did not reach significance (except for edited) this allows us to say that, with captioned videos, learning could be more beneficial and positive. This outcome is in accordance with many of the studies mentioned in the literature review: benefits of subtitles in vocabulary (Alavi, 2011; Bird & Williams, 2002; Neuman & Koskinen, 1992; Peters, Heynen, & Puimège, 2016; Sydorenko,

2010; Zarei & Rashvand, 2011), listening (Huang & Eskey, 1999; Latifi, Mobalegh, & Mohammadi, 2011; Yoshino, Kano, & Akahori, 2000), reading and comprehension (Bean & Wilson, 1989; Garza, 1991; Goldman & Goldman, 1988; Kothari, Takeda, Joshi, & Pandey, 2002; Markham & Peter, 2003; Neuman & Koskinen, 1990).

In terms of CL, the study does not show any significant results in CL with regard to conditions. This is in contrast to some of the studies in the literature which speculate that CL should increase under the verbatim condition, particularly in the case of non-native speakers as this condition could be far beyond the current language proficiency of participants. Having said that, there is a trend in the Arabic group that shows a growing negative correlation between comprehension and CL. This indicates that comprehension becomes worse when CL increases. This trend is not significant, although it suggests future research directions in this area where this trend could provide valuable insights if a large population sample were used.

With respect to English speakers, all comprehension scores under the four conditions (edited, standard, control and verbatim) were higher than those of Arabic speakers as shown in Figure 4.4. The difference between the two groups could be ascribed to the fact that English speakers have a high level of English proficiency, whereas Arabic speakers do not. In the case of English speakers, it is worth mentioning that subtitles were beneficial in this order verbatim, control, edited and lastly standard (see Figure 4.4) where verbatim subtitles are the most beneficial and standard subtitles are the least beneficial when looking at comprehension. The reason for this is that English speakers are so proficient in the language that the reading of verbatim subtitles is not a challenging task. And since no words are deleted from verbatim subtitles, they provide full word-for-word transcriptions

of what is being said. This allows English speakers to fully understand the content of the audiovisual material presented to them. Unlike verbatim subtitles, standard and edited subtitles do not correspond word-for-word to what is being spoken on the screen. This creates a gap between the content and captions. Consequently, the gap between what is being said and the content grows wider in this order (standard → edited). The wider the gap, the more challenging it is for native English speakers to understand the content of the audiovisual material being presented. This goes in line with the outcome in the study of Szarkowska, Krejtz, Klyszejko, & Wieczorek (2011). They explained that due to the major discrepancies between dialogue and edited text, viewers could not effectively link the information between image and dialogue, which resulted in a misunderstanding of the content.

More importantly, while edited subtitles benefited the comprehension of participants in the Arabic group, they were not as useful for the English group. Not only did they make English speakers do worse than under the verbatim and unsubtitled conditions with regard to comprehension; they also increased CL significantly. A compelling reason for this is the gap between the content and captions, as discussed previously. Proficient and native English speakers would find it extremely difficult to follow the captions that do not correspond to the spoken words in the audiovisual material. The more they attempt to process the captions, the greater are the mental demands on their cognitive load. This is why edited subtitles increase CL and do not benefit proficient and native English speakers when learning through audiovisual material. This finding in particular requires further investigation in future studies as it could have a significant influence on the design of educational video with subtitles for first and foreign language students.

To sum up, the study has produced several significant differences. First, the difference between Arabic and English group was significant in the unsubtitled condition where English speakers had higher comprehension scores. In addition, while edited subtitles have increased CL in the case of English speakers, they have had a significant influence on the comprehension score. Moreover, although not significant, the data shows that there is a negative correlation between comprehension and CL in the Arabic group.

Chapter 5. Conclusion

5.1 Introduction

This study was conducted to determine whether the rate at which subtitles are presented would have an impact on comprehension and cognitive load. The literature indicates that subtitles presented through audiovisual material could be of benefit to the learning process with regard to content processing, vocabulary retention, language acquisition, and comprehension in an educational context. Many studies suggest that multimodality of audiovisual material presentation of information in fact promotes learning which could be explained by the dual coding theory. Conversely, other studies suggest that multimodality of audiovisual material hinders, rather than assists, learning. Those studies support this point of view with the cognitive load theory that the availability of subtitles on the screen could actually place additional mental demands on viewers, which in turn, could increase CL. When CL increases, learning and comprehension deteriorate.

Several studies reported in the literature promote the use of subtitles and their benefit to the learning process; on the other hand, there are studies which maintain that the use of subtitles provides no benefits to learning in any educational contexts. To help make sense of the contradictory results reported in previous studies, the researcher pointed out earlier in the literature that the level of language proficiency could play a crucial role in explaining the usefulness of subtitles, and merits more thorough investigation. All in all, the majority of studies still suggest the usefulness of subtitles in learning.

5.2 Research motivation

The steady increase in audiovisual materials made available online by a significant number of educational institutions has triggered a huge demand for subtitled videos. Since many institutions and individuals use these online platforms for learning and teaching purposes, it is important to have accurate and comprehensible audiovisual output. One plausible method of ensuring this is to have subtitles presented at a rate that suits a specific audience, such as native English speakers and non-native English speakers. Edited subtitles might be a solution to address the needs of non-native English speakers seeking learning materials online. The current practice of having online subtitles supports only verbatim and standard modes, but the subtitles are not edited. Hence, there is a need for more research on subtitling, particularly edited subtitles and their potential usefulness for learning. In an attempt to fill the gap in this area, it is only logical to experiment with edited subtitles and compare these with other current modes of subtitle presentation as studies in this area are scarce.

5.3 Research findings

This study was conducted to investigate the usefulness of different types of subtitle presentation rates (verbatim, standard, edited) in learning by means of audiovisual materials. Nevertheless, it seems that all subtitle conditions were beneficial when compared to the unsubtitled video in the case of the Arabic group. In fact, edited subtitles had a significant impact on the results obtained for the Arabic group. In terms of English speakers, however, edited subtitles increased CL and also resulted in lower comprehension, indicating that those subtitles were not useful for this particular group. All English speakers outperformed Arabic speakers under all conditions, particularly in the unsubtitled condition where the difference was significant. Therefore, in regard to learning, it seems that language proficiency could determine the usefulness of the various subtitle presentation rates. The outcomes of the study's hypotheses are summarized below:

No.	Hypothesis	Arabic	English
1	Edited subtitles would result in better performance when compared to all 3 conditions.	✔	✘
2	Edited subtitles would result in lower cognitive load when compared with unsubtitled video.	**Null**	✘
3	language proficiency will play a role in the effectiveness of subtitles on learning and cognitive load.	✔	✔

Table 5.1 Summary of hypotheses' outcome

5.4 Implication

Non-native speakers of English, particularly beginners, would find edited subtitles extremely helpful, enabling them to better comprehend the content of an educational video. Unlike the verbatim mode, edited subtitles are presented at a slower speed, requiring less mental demand for the processing of information. This means extraneous cognitive load would be eased, thereby facilitating a positive learning experience. Since the number of non-native speakers of English is on the increase, huge numbers of learners would benefit from the availability of such subtitles online.

Not only could learners make use of subtitles; institutions could also incorporate them in their teaching methods. All subtitle types could open up doors to new ways of teaching. When subtitles are used, institutions should ensure that audiovisual information is presented in such a way that it is cognitively less demanding. When developing audiovisual study materials, informed decisions are required. If not implemented with care and due consideration for the target audience, the use of subtitles might hinder learning, especially if the material has poor instructional design. In this case, the outcome would be the

exact opposite of the intention behind presenting this material in the first place. Impotantly, institutions should realise that the same subtitles will not necessarily work for all students and that some differentiation may be required between first language and foreign language students.

5.5 Limitation and further research

This study suggests that language proficiency is a very important aspect of subtitling research, and that it should be tested prior to treatment in order to choose the appropriate type of subtitles for the intended audience. To have more insightful and deeper research outcomes in future research, a large sample size is crucial to allow for significant results to be manifested. This type of research requires a longitudinal study which would improve the methodology and arrive at more valid results. Since this study used only a comprehension test and a self-report questionnaire, which only gave us the results directly without indicating how students actually processed the information, an eye-tracking device would be better suited for information processing in subtitling research.

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Appendix A

Comprehension Test:

1- According to the video, big history provides us with knowledge about...

A. Our origins as human beings.

B. Maps

C. Cultural norms

2- All life on earth descends from a universal common...

A. Energy.

B. Ancestor.

C. Matter.

3. According to the video, theorists try to interpret historical evidence to arrive at explanation to...

A. Enhance our way of thinking.

B. Make our life better.

C. Judge bad behavior in the past.

4- Science in many ways is…

A. Historical.

B. Complicated.

C. Interesting.

5. Knowing how things work in the past enables us to…

A. Appreciate those who made them work.

B. Tackle the problems in the future.

C. Enjoy past stories.

6. According to the video, which sub-topic did the man mention?

A. University facilities.

B. Good strategies.

C. Critical thinking.

7. We should be careful…

A. About what claims we accept or reject.

B. Not to follow what our ancestors have done.

C. About the way we see things.

8. According to the video, history enriches our lives and allows us to…

A. Be grateful of the present live.

B. Live a thousand lives, instead of only one.

C. Be more creative than ever before.

Cognitive Load Questionnaire[1]

1. How mentally demanding was the video you just watched?

1	2	3	4	5	6	7
(Extremely undemanding)						(Extremely demanding)

2. How hurried or rushed was the video?

1	2	3	4	5	6	7
(Extremely unrushed)						(Extremely rushed)

3. Pleased describe your level of discouragement, irritation, stress or annoyance while watching the video?

1	2	3	4	5	6	7
(Extremely low)						(Extremely high)

4. How easy or difficult was the video to understand?

1	2	3	4	5	6	7
(Extremely easy)						(Extremely difficult)

5. To what extent could you concentrate on the video?

1	2	3	4	5	6	7
(not at all)						(all the time)

Adapted from Kruger, Hefer, & Matthew, 2014

Appendix C

Biographical questionnaire:

1- What is your Name: _____

2 - What is your Age:_____

3- What is your home language?

_____

4- Please Indicate how many months have you spent in Australia?

_____

5- How often do you watch TV programmes in English with English subtitles? (circle)

1	2	3	4	5	6	7
Never						always