The impact of lexical density in simultaneous interpreting of slide presentations: A replication

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The impact of lexical density in simultaneous interpreting of slide presentations: A replication.

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LIST OF ABBREVIATIONS

AIIC – International Association of Conference Interpreters

DV – dependent variable

FTI – Faculty of Translation and Interpreting (University of Geneva)

IV – independent variable

ISO – International Organization for Standardization

PPT – PowerPoint presentation

SI – simultaneous interpreting

SI+T – simultaneous interpreting with text

SL – source language

ST – source text

TL – target language

TT – target text

VI – visual input

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ABSTRACT

PowerPoint and other digital slide presentations are now commonplace in the conference room, but there remains little research into their impact on the challenging cognitive process of simultaneous interpreting. This thesis replicates a previous study exploring the impact of the lexical density (the proportion of words in a text with lexical properties) and visual clarity of visual input on simultaneous interpreters' fluency. Student interpreters work with varying PowerPoint presentations and their output is evaluated by counting prosodic disfluencies. On average, the interpretations of speeches accompanied by less lexically dense and less visually clear presentations (where the same information was displayed in more words) are found to be more fluent, confirming the counterintuitive results of the original study. This suggests visually displayed keywords are more difficult to process than full sentences during simultaneous interpretation; there is growing evidence that simultaneous interpreters interact with slide presentations very differently to audiences.

1. INTRODUCTION

1.1. Overview

Interpreters at multilingual conferences have not escaped the technological boom of recent years, in particular the popularity of digital presentation programmes such as Microsoft PowerPoint (Baxter, 2016; Berber Irabien, 2010; Esteban Causo, 2011). Within the field of simultaneous interpreting (SI), there has been extensive work on topics such as cognitive load (Gile 1991; Seeber, 2013) and the significance of visual input, usually in the form of body language and gestures (Anderson, 1979; Jesse, Vrignaud, Cohen, & Massaro, 2000; Moser-Mercer, 2005; Rennert, 2008). There has also been interest in the optimal design of digital slide presentations, and the reception of different kinds of visual input in diverse fields outside of SI (Bucher & Niemann, 2012; Mackiewicz, 2008; Mayer, Heiser, & Lonn, 2001; Mayer & Johnson, 2008). However, there is little research that brings these issues together and looks at the impact of digital slide presentations on the work of simultaneous interpreters, other than Blatter & López Conceiro (2015) and Crenicean (2016), who both came to conclusions that seem to show simultaneous interpreters' interaction with slides is quite different to that of audiences.

Given the prevalence of slide presentations at events where interpreters are relied on, there is clearly an interest in ensuring visual aids are not designed in such a way that diminishes the quality of interpreters' work. Existing literature on the best use of slides in other contexts suggests they should be kept clear and simple with minimal redundancy (where the same is information presented aurally and visually), but Blatter & López Conceiro (2015) found that student interpreters were more fluent when working with presentations that contained full sentences. This would seem to suggest that the nature of optimal slide presentations for audiences, on the one hand, and simultaneous interpreters, on the other, are not one and the same.

This paper further investigates the link between the lexical density and visual clarity of slides, and the fluency of simultaneous interpretation, a factor that has been acknowledged as a significant component of quality evaluation in the field (Christodoulides & Lenglet, 2014; Pöchhacker & Zwischenberger, 2010; Plevoets & Defrancq, 2016; Pradas Macías, 2006, 2007). A replication of the 2015 study is carried out with improvements made to the design in order to ensure the independent variable (IV) is better controlled and any confoundment caused by the specific speeches used is accounted for. The author aims to catalyse further academic interest in the field, so that research can eventually inform guidance for conference organisers and speakers on how best to use visual aids where simultaneous interpreters are present.

1.2. Research Question

In this study, we set out to test how the lexical density and visual clarity of digital slide presentations influence fluency in simultaneous interpretation.

2. LITERATURE REVIEW

2.1. Simultaneous Interpreting and Technology

SI is described by the International Association of Conference Interpreters (AIIC) as follows:

> *The interpreter sits in a booth, listens to the speaker in one language through headphones, and immediately speaks their interpretation into a microphone in another language. The interpreting equipment transmits the interpretation to the headphones of listeners in the meeting room* (2011).

Setton (2003) provides an overview of the many models that attempt to explain how the interpreting process is achieved. He details the variety of approaches that have been applied to the task since Gerver (1975) and Moser's (1978) initial publications and acknowledges that most break down the process into components including language comprehension, short-term memory, long-term memory, speech production, and resource allocation. The field's basic understanding of how SI works has not shifted a great deal, as illustrated by Setton's own 1999 model, according to which verbal, visual and conceptual input is decoded from the source language (SL) and transposed into a single *lingua franca* of mental representation, which is then used to form the target language (TL) output (Setton, 2003).

The first records of the use of this modality date back to the early 1920s (Seeber, 2015), then referred to as "telephonic" interpreting at the International Labour Conference (Baigorri-Jalón, 2014). Later, from 1946 onwards, it was thanks to this new modality of multilingual communication that the Nuremberg Trials after the Second World War could take place in four languages at once (Flerov, 2013; Gaiba, 1998). Since, simultaneous interpreters and their booths have become a permanent and essential fixture at international organisations and conferences. All along, technology has paved the way for the emergence of SI as a profession: from the early Filene-Finlay *simultaneous translator* to the IBM system used at Nuremberg, and beyond (Flerov, 2013).

The profession has continued to be shaped by advances in information and communications technology (Berber Irabien, 2010; Esteban Causo, 2011), including "the most ubiquitous form of digitally assisted demonstration" (Stark & Paravel, 2008, p. 32), namely PowerPoint (PPT) presentations, along with similar alternatives such as Google Slides, Apple Keynote and Prezi. They are now commonplace not only in boardrooms and classrooms (Garrett, 2016; Kosslyn, 2007) but also in the conference rooms where interpreters are present (Baxter, 2016). Mackiewicz (2008) goes as far as stating "academic and workplace cultures often pressure presenters to use PPT, even if the message does not necessarily lend itself to the software" (p. 151). Similarly, Nowak, Speakman & Sayers (2016) found nursing school trainers overused PPT because time constraints meant they otherwise struggled to cover the syllabus.

Another recent development in the field has been the trend towards speakers reading out prepared texts rather than speaking freely (Seeber, 2015; Seeber & Delgado Luchner, 2020). This has led to interpreters often working in the modality known as simultaneous interpreting with text (SI+T), which has subsequently piqued academic interest (Setton & Motta, 2007). However, there has been little research into the related field of SI with slide presentations, although many speakers who do not have a prepared a manuscript use slide presentations to the same effect, reading out the text shown on-screen (Seeber, 2012). SI+T alone is perceived to be more taxing than pure SI, and research has identified a number of cognitive constraints that explain this, as is summarised by Cammoun, Davies, Ivanov, & Naimushin (2009):

> *(1) dual input (aural and visual);*
> *(2) higher speed;*
> *(3) lack of redundancy;*
> *(4) absence of planning marks at surface level;*
> *(5) monotonous oral delivery;*
> *(6) negative interference from the SL;*
> *(7) risk of missing the speaker's digressions from the written text.* (p. 26)

These factors can of course equally be present when speakers read out the content of a slide presentation. The format also confronts interpreters with additional challenges in that they are seldom provided with slides in advance and have no time to prepare, meaning they discover the content of the presentation as it is spoken, sometimes even line by line (Seeber, 2017).

2.2. Effort Models in Simultaneous Interpreting

SI in itself has been identified by many authors who have written on the subject as a challenging cognitive task (Seeber, 2011). It involves "objective stress factors" such as "the constant information load, the time factor, the tremendous amount of concentration required, fatigue, the confined environment of the booth, etc." (Kurz, 2003, p. 51). Seeber (2013) provides a comprehensive summary of the abundant and diverse research that has been dedicated to explaining the "mental effort required to perform a simultaneous interpreting task" (p. 18), often through the lens of cognitive psychology. As Seeber (2017) stresses, it is the multimodal nature of SI that distinguishes it from written translation; the fact that interpreters listen, understand, and speak, all at the once. Many researchers agree that the SI process relies on an "inherently capacity-limited" system (Seeber, 2011, p. 176); that the processes involved all draw from the same finite pool, or pools, of resources, based on Kahneman's (1973) Single Resource Theory or Wickens' (1984) Multiple Resource Theory.

Gile's (1991) effort model expresses this as a simple mathematical equation. The requirements (R) must be smaller than or equal to the available capacity (A) for each given task, listening (L), producing (P) and short-term memory (M).

a. $SI = L + P + M$

b. Interpretation can be performed if:

(1) $LR + PR + MR = TR \ \leq TA$

(TA: total available processing capacity)

(2) $LR \leq LA$

$MR \leq MA$

$PR \leq PA$ (p. 17)

However, Seeber (2013) questions the applicability of Gile's model outside of teaching due to its simplicity, arguing SI may be a task in itself that amounts to "more or less than the sum of its parts" (p. 21). He points out Wickens' (2002) findings that concurrent tasks interfere more where they are structurally similar, meaning some of the processes involved in SI might interact and be able to draw on the same resources, for example. Seeber created the Cognitive Load Model to account for these interactions and interferences, but as Blatter & López Conceiro (2015) underline, no model considers the possible impact of new technologies. Though Seeber's model does not account for VI, the principles behind it would mean that the design of slides could determine to what degree visual processing interfered or interacted with auditory processing, and thus whether slides were a help or a hindrance.

Seeber (2017) notes the significance of whether audio-visual information is complementary or redundant; whether the information presented on a second channel is different and can therefore "compensate for inadequacies" (p. 463), or is the same, which some research has found to benefit performance. He predicts that signal redundancy, where the same information is presented on the auditory and visual channels increases interference, adding to the overall cognitive load on the interpreter. The consequence may be less overall capacity being available, possibly to the detriment of quality, for instance. Gile (1997) states that where input is particularly difficult to process (e.g. foreign accents, incorrect use of language, fast or dense speech), production can temporarily cease altogether, and Seeber & Delgado Luchner (2020) recognise some of the same features as particular stumbling blocks in SI. However, it should be noted that Lu et al. (2012) found redundancy can improve performance by increasing processing speed, though their study was from aviation, and there were some exceptions in their results.

Cognitive Load Theory was initially devised in the field of education psychology, a field in which similar attempts have been made to understand which factors have an impact on the amount of cognitive load individuals face in particular contexts. In his work on instructional design, Sweller (2010) divides cognitive load into three categories: *intrinsic* cognitive load is defined by the inherent complexity of particular content, *germane* cognitive load is caused by learners' efforts to understand that content, and *extraneous* load is a result of how content is presented. While the first cannot be manipulated, germane and extraneous cognitive load can, the latter being of particular interest in relation to this study. These principles have been used in the field of multimedia education to explore the cognitive load imposed on learners by a particular exercise, with the aim to minimise it (Chang, Kinshuk, Chen, & Yu, 2012; de Jong, 2009; Pollock, Chandler, & Sweller, 2002). This paper similarly aims to understand the impact of so-called extraneous cognitive load on simultaneous interpreters, with a view to minimising it.

2.3. The Influence of Visual Input on Simultaneous Interpreting

Given VI can increase cognitive load, it is perhaps unexpected that most interpreters feel they need VI to interpret well, according to Rennert's (2008) study on non-verbal VI, which focuses on kinesics (gestures, facial expressions and postures). She defines VI as including not just the speaker, but "the venue, the audience, and visual presentations, which all provide additional information" (p. 204). Access to VI seems to be perceived as highly important across the board, with AIIC (2000; 1999) guidelines stating interpreters need to see "what's happening in the meeting room", including not only speakers but also slides, which should be "clearly visible" from the booths, with copies distributed in advance. ISO standard 2603:2016 (2016) calls for either "a direct, unobstructed view of the entire conference room, including a projection screen and the rostrum", or video displays where that is not possible, and goes as far as stating the minimum "angle of the interpreters' line of vision towards a screen" (p. 3).

In fact, there is evidence behind the assertion that interpreters need VI. Moser-Mercer's (2005) paper concludes limited access to VI has a substantial negative effect on conference interpreters' performance, which she puts down to the early onset of fatigue caused by the extra effort required in the comprehension process. Moreover, Kurz (2003) found TV interpreting and remote interpreting, where VI can be significantly limited, were measurably more stressful than other SI contexts. The reason for this perhaps lies in the fact that bimodal (visual and oral) presentation has been shown to improve understanding and speech perception in the fields of multimedia education and cognitive psychology, respectively (Brünken, Plass, & Leutner, 2003; Massaro, 1998). Lu et al.'s (2013) study on the possible introduction of auditory information to aviation contexts found auditory-visual redundancy can improve accuracy, but also underlined "the dual information-processing load of reading and listening…can delay the time to process information and therefore reduce efficiency….and result in a performance cost on the ongoing task." (p. 699)

Several studies on access to non-textual VI (e.g. gestures, facial expressions) within the field of SI have been inconclusive, though, with no change recorded in interpreters' performance, whether measured using qualitative methods (Rennert, 2008), or quantitatively with perception (Jesse, Vrignaud, Cohen, & Massaro, 2000), or "intelligibility and informativeness of output" as DVs (Anderson, 1979, as cited by Seeber, 2017, p. 465). Jesse et al. (2000) hypothesised this may have been because of the high quality of the source audio used in their study, leaving no need for the interpreters to use VI as a backup. Seeber & Delgado Luchner (2020) call this the signal complementarity effect: where one signal is "corrupted or decayed", interpreters can fall back on the second "intact signal" (p. 135). Viaggio (1996), too, recognises this, stating non-verbal communication can complete or clarify a speaker's message where it is unclear due to factors such as "*langue de bois*, accent, inarticulateness, speed, defective audition" (p. 285). It may be the case that VI of this nature comes into play in real-life scenarios that are not usually imitated in the lab, for instance short and/or concise segments of speech that Gile (1997) states are more likely to be missed by interpreters.

Verbal VI seems even more likely to be an issue because reading alone is an "extremely complicated process" (Rayner, Pollatsek, Ashby, & Clifton, 2012, p. 3) that requires a certain level of concentration. Gile (1997) further notes linguistic interference is likely to be more frequent in sight-translation, defined as "translating an SL text aloud while reading it" (p. 203), than in any form of interpretation per se, due to the distraction caused by the constant visibility of the text. It would follow that text might also be a distraction when doing SI with text present on a PPT. However, SI+T differs significantly from sight-translation, not least in that input is unimodal in the former (visual) and multimodal in the latter (auditory and visual); SI+T therefore presents the additional risk of signal redundancy slowing down processing (Seeber & Delgado Luchner, 2020). That is why Seeber & Delgado Luchner suggest "manuscripts should be prepared with a view to help interpreters exploit complementarity effects…and avoid redundancy effects" (p. 147). It may be the case that PPTs designed with the same goal in mind also prove to yield higher quality interpretations.

In a similar vein, Blatter & López Conceiro (2015) conjectured the way in which simultaneous interpreters choose to look or not to look at VI may be significant; if a visual stimulus is too complex for an interpreter to feasibly benefit from processing it whilst interpreting, but the interpreter does not realise this, valuable cognitive capacity could be wasted. Seeber (2017) notes many studies do not establish whether interpreters actually look at visual stimuli or not due to practical barriers. Seeber's (2012) eye-tracking study, perhaps the only exception, found that when large numbers were displayed, simultaneous interpreters looked specifically at the figures in question on slides. Moreover, Desmet, Vandierendonck, & Defrancq (2018) carried out a pilot study emulating technology that would automatically recognise numbers uttered in source speeches and display them on a screen to interpreters, and found the technology greatly reduced errors in the interpretation of numbers.

In any case, interpreters seem to feel access even to verbal VI (texts) is important: in Cammoun, Davies, Ivanov, & Naimushin's (2009) survey of professional conference interpreters, 98% of respondents said they either always or sometimes used manuscripts when provided. Indeed, Lambert's (2004) study found subjects' performance in SI+T (referred to as sight interpretation) was considerably better than their performance in SI without text. However, Seeber & Delgado Luchner (2020) caution that, due to the specific challenges of interpreting written discourse, SI+T should only be compared, if anything, to the simultaneous interpretation of a read text to which interpreters do not have access, which was not the case in Lambert's study.

Moreover, the results of studies on SI with manuscripts may not always be applicable to slide presentations due to their unique nature; interpreters cannot look ahead to anticipate, for example. An extreme case of this would be what Bucher & Niemann (2012) call *dynamic* slides, where animation is used to make visual information appear in small bursts as the presenter utters corresponding sentences. As has always been the case when working for television, interpreters working with visual presentations now find "the interplay of visual and acoustic channels [...] is almost totally out of their control" (Mack, 2002 as cited in Baxter, 2016, p.13). In practice, this means interpreters are not free to moderate their Ear-Voice-Span, a strategy used to improve quality by reducing cognitive effort, because they have to try and align their output with what is being shown on the screen (Baxter, 2016). Doing so is seen to be important for interpreters' listeners, and indeed coherence between information presented in different modes has been found to have a positive impact on knowledge transfer (Bucher & Niemann, 2012).

On the other hand, slides arguably provide interpreters with an additional tool on some occasions in that, where appropriate, they can opt for "as you can see in this image" rather than verbally explaining a particular point, which saves both time and effort. (Bühler, 1980; Alonso Bacigalupe 1999; Eder 2003 as cited by Rennert, 2008)

2.4. The Perception of Slide Presentations

PPTs continue to be regularly used across the board even despite the fact that slides are often "blamed for failures to communicate clearly" (Kosslyn 2007, p.1). Tufte (2003), stipulates that PPTs force speakers to simplify their message, impeding them from developing "a coherent and substantive" one (as cited by Mackiewicz, 2008, p.149). However, Bucher & Niemann (2012) underline that technology cannot communicate alone, and that the focus should be on working out how presenters can use PPT to their advantage, rather than simply condemning it; "communication is not determined by technical devices, as such, but by the competence of dealing with them and understanding their limitations and possibilities" (p. 302). Kosslyn (2007) concurs, citing a lack of understanding around "how humans perceive, remember and comprehend information" (p. 2).

A great deal of research has thus been dedicated to establishing general best practices when working with this medium. Mackiewicz (2008) summarises that PPT users have been advised to keep presentations simple, as too many slides or those cluttered with text, bullet points, figures and images can be more of a visual distraction than a visual aid. She quotes the "six by six" (p. 151) or "seven by seven" (p. 152) rule of thumb, which states a single slide should contain no more than six or seven lines of six or seven words. In the field of multimedia education, advice has traditionally gone further and advised against any redundancy at all, as this had been shown to cause extraneous processing in students (Mayer, Heiser, & Lonn, 2001). However, this was later revised by Mayer & Johnson (2008), who found a limited form of redundancy led to students scoring higher on retention tests. They used 2 or 3 on-screen keywords, aiming to guide learners' focus without causing extraneous processing.

This could perhaps be explained by considering how the human eye reads text. Rayner, Pollatsek, Ashby, & Clifton (2012) explain that eyes do not "sweep continuously across the text", but in fact "come to rest for periods that are usually between 150 and 500 ms" called fixations, between which they jump in rapid movements called saccades (p. 91). Research has shown that particular factors affect the likelihood a word will be skipped when reading; shorter, more predictable and more frequent words are less likely to be fixated upon (Rayner, Slattery, Drieghe, & Liversedge, 2011). It may be the case that processing verbal visual input in the form of text on slide presentations can be made less taxing for individuals by removing in advance the words most likely to be skipped, leaving only the longer, less predictable and less frequent words that seem to be of most use to the brain when digesting visual verbal information.

Bucher & Niemann's (2012) study looks at multimodality in scientific presentations using PPT, focussing on what works best for audiences in terms of knowledge transfer. They concluded presenters need to learn to master the art of multimodal communication, as referential actions (e.g.

using a laser pointer, or verbally referring to information on a slide), and coherence between the information presented verbally and visually were found to improve listeners' ability to assimilate the intended meaning. This aligns with the performance perspective outlined in their introduction, which states that meaning is created when several communicative means are used harmoniously; not only slides, but slides in conjunction with speech, gestures and other visual material. They also defined two categories of text slides: *static,* where text is presented all at once in a block, and dynamic, where text is displayed incrementally, as mentioned above. They concluded that dynamic slides were best for receptive audiences, as they allowed listeners to alternate their attention between the speaker and the slide, thus facilitating truly multimodal communication.

However, it is well-known that many presenters ignore such advice and read off PPT slides filled with blocks of text (Mackiewicz, 2008). There may be justification for this in some cases: Garrett (2016) advises caution in a one-size-fits-all approach, as his results showed a legitimate distinction in PPT use based on the subject matter.

2.5. Research to date into Slide Presentations and Simultaneous Interpreting

In a rare paper looking specifically at slide presentations and SI, Crenicean (2016) found static visual representations (including text slides like those used in this study) were generally helpful for interpreters, whether they had been prepared in advance or not. This was not the case for dynamic visual representations, which Crenicean put down to their visually and logically complex nature, and the fact that interpreters receive training in working with written text and are accustomed to the format. This would seem to suggest where dynamic slides work best for audiences (Bucher & Niemann, 2012), this may not be at all applicable to interpreters.

Blatter & López Conceiro (2015) set out to determine whether more or less lexically dense slides provided for a more fluent simultaneous interpretation of a speech. They asked student interpreters to interpret two speeches that were very similar but contained different information and measured fluency by counting prosodic features. One speech (on Bulgaria) was accompanied by a lexically dense, visually clearer PPT containing only keywords; the *clearer* presentation. The other speech (on Estonia) was accompanied by a PPT with the same information in the form of simple clauses, making it less lexically dense and visually clear; the *less clear* presentation.

Based on the available literature on cognitive load in SI and the reception of slide presentations, the authors hypothesised the clearer presentation would lead to more fluent interpretations. It seems reasonable to have expected that removing the linguistic packaging of full sentences would allow interpreters to more quickly and easily find useful visual information, such as proper names, technical terms and numbers, thus reducing redundancy and maximising complementarity. However, the results of their study surprisingly did not confirm this hypothesis.

On average, the interpretations of the speech accompanied by the clearer PPT were found to contain more silent pauses (silences longer than 500 ms) and salient pauses (silences lasting 2-6 s) as compared both to the less clear PPT and, significantly, the original speech. As discussed below in chapters 4.2.2. and 4.2.3., silent and salient pauses can be indicators of disfluency, but can also be used deliberately for rhetorical effect, which is why their frequency in interpretations should be measured with reference to the source speech. The two other dependent variables, filled pauses (such as “um”) and false starts (corrections), were present in close to equivalent numbers in both conditions tested, leading the authors to purport these may not be “relevant as cognitive load markers” (p. 29), but this seems unlikely given their use in other past research (cf. chapters 4.2.4. and 4.2.5.).

As well as the counterintuitive nature of Blatter & López Conceiro’s (2015) results, there are a number of issues with their experiment that leave room for further work in this area, and will be addressed in the present replication: There was only one PPT for each speech, and as a result, every interpretation accompanied by a clearer PPT, for example, was of the same speech, making it impossible to account for the impact of the content on the interpreters’ performance. This also meant results could not be checked against interpretations of another speech accompanied by a similar PPT. Moreover, though the speeches were similar in content, steps were not taken to ensure they were linguistically as similar as possible to avoid any particular syntax posing a challenge in one speech but not the other. Finally, the dependent variable was not sufficiently controlled: though the clearer slides contained fewer words, they still contained a great deal of text, even compared to the less clear slides (cf. figures 1 and 2), and therefore do not appear to be particularly visually clear, and certainly do not comply with the six-by-six or seven-by-seven rules, for instance. The less clear presentation was arguably not particularly unclear, either, given it contained bullet points and some short, verbless sentences.

In the past, it has been considered that visually simpler slides would be of benefit to simultaneous interpreters as they are for audiences, but these recent studies seem to suggest this may not be the case. It is that counterintuitive fact, as well as the improvements that can be made to Blatter & López Conceiro’s (2015) design that motivate the present replication.

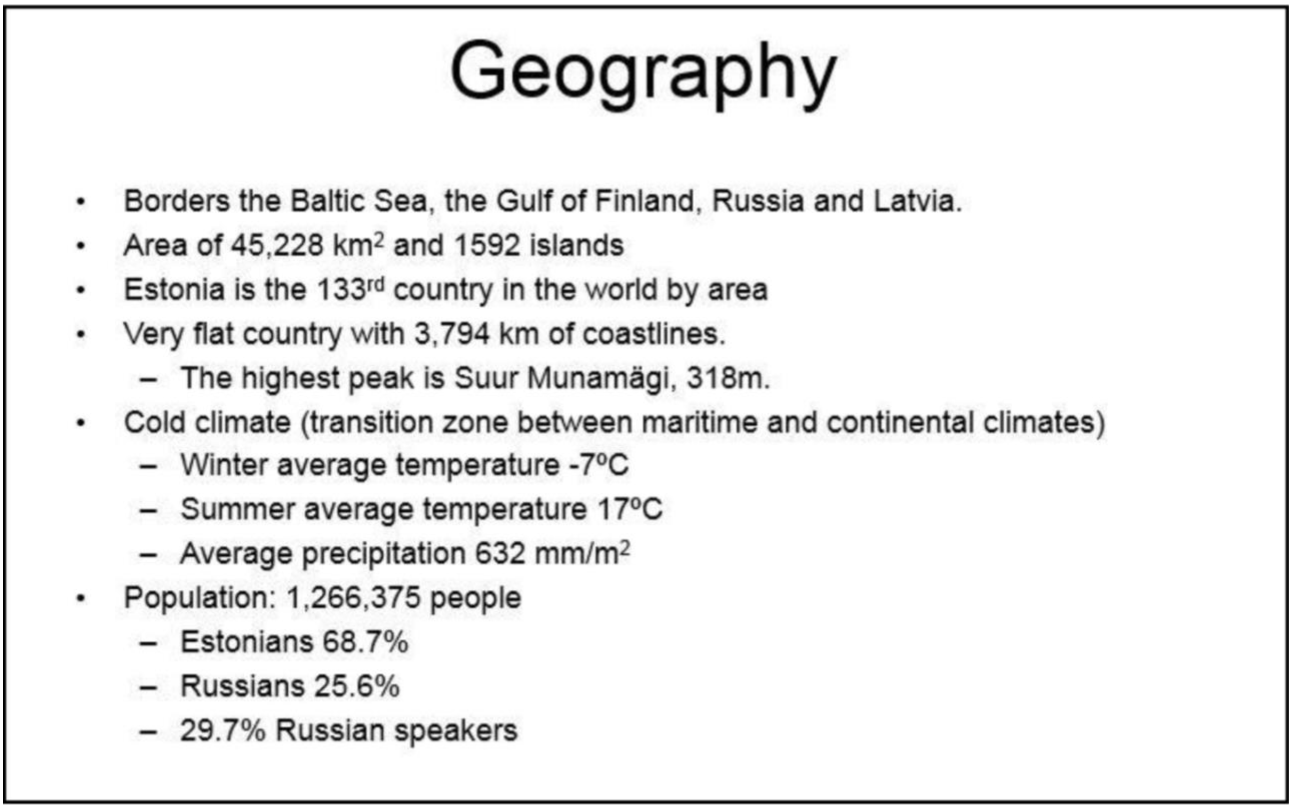


Figure 1: Geography slide from less clear presentation on Estonia from Blatter & López Conceiro's (2015) study

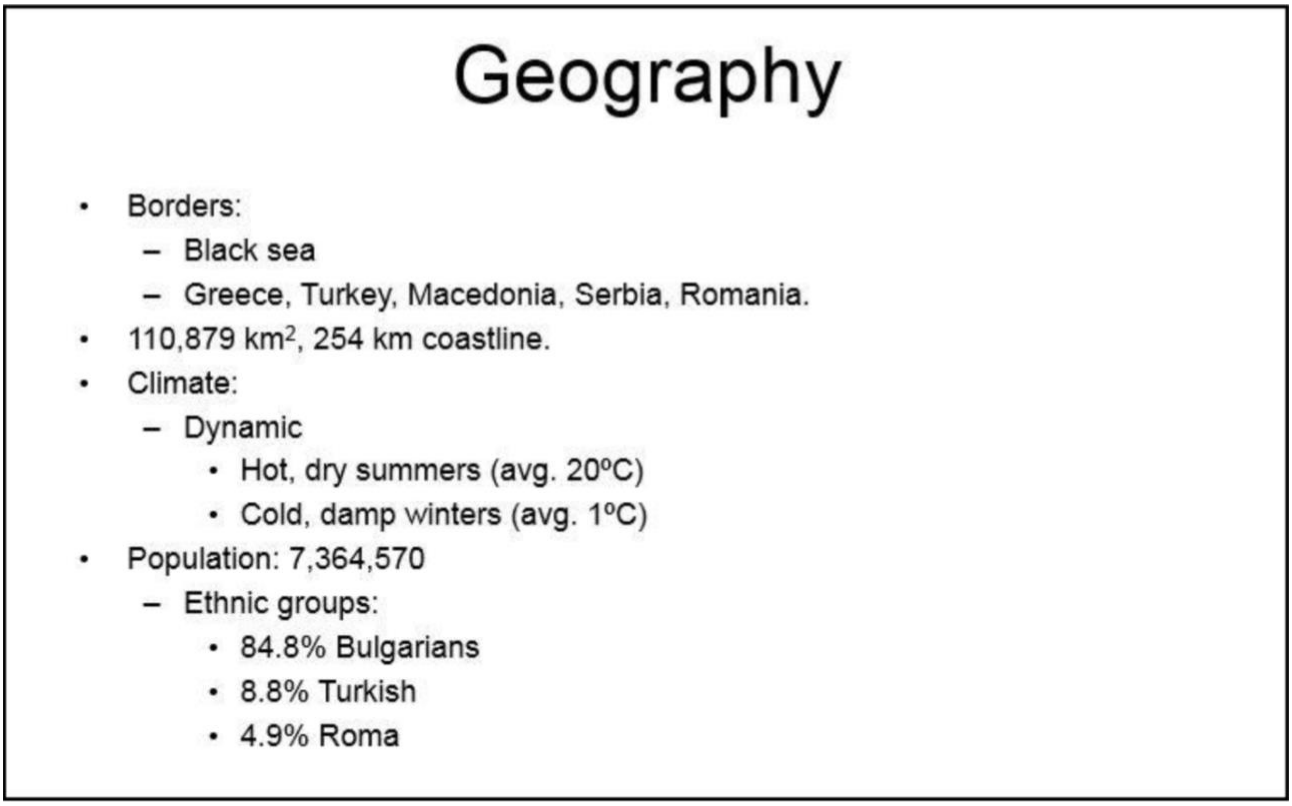


Figure 2: Geography slide from clearer presentation on Bulgaria from Blatter & López Conceiro's (2015) study

2.6. Summary

On review of the relevant literature, it is clear that there is a great deal of academic interest in the subtopics that make up the subject of this paper (cognitive load in SI, cognitive load and visual perception, best practices with PPT). Despite this, and although both SI and slide presentations are commonplace at international organisations and conferences, little research is dedicated specifically to the impact of slide presentations in SI. In fact, a non-negligible proportion of the research cited comes from fields not directly related to conference interpreting. As Blatter & López Conceiro (2015) suggest, this may be as work is currently concentrated more on measuring cognitive effort within SI more generally, rather than choosing a more specific focus.

In summary, it has been established that SI is a complex cognitive task that relies on finite resources, but no cognitive effort model yet illustrates the impact of different kinds of VI or a lack of VI. As VI also draws on cognitive resources, it could feasibly cause extraneous processing where it is not of use. This seems particularly likely where PPTs are concerned because interpreters often do not have copies in advance, and thus discover the content as it is presented: slide by slide, or even line by line. However, the right kind of VI can be an asset in the interpreter's toolkit. Studies have struggled to prove the link between VI and interpreter performance, but access to VI continues to be seen as paramount. Existing advice on how to best use slide presentations emphasises visual simplicity is key, but this is geared towards audiences, and it seems the interests of simultaneous interpreters may be altogether different.

Given the prevalence of PPT in meeting rooms and the lack of specific research in this area, it would be desirable for more work to be carried out so that this technology can be used in a way that is conducive to successful SI.

3. RESEARCH DESIGN & AIMS

A replication study was devised based on Blatter & López Conceiro's (2015) model, with the materials revised and expanded versions of the originals (see chapter 4.4.). The aim remained to explore the relationship between slide presentations and the quality of SI, and either confirm or call into question the results of the original study. The experiment again involved the simultaneous interpretation of two speeches that were accompanied by PPTs with higher and lower lexical density and visual clarity; the independent variables (IV). The dependent variable (DV) was the fluency of the resulting interpretations, determined by measuring the frequency of a number of prosodic elements.

However, some changes were made to the original design to make the study more comprehensive, accounting for some of the original limitations. Two different PPT presentations were created for each speech, one *full* containing every word uttered by the speaker, and one *light*, containing the same information in keyword format (see chapter 4.4.2.). Each participant (see chapter 4.3.) was required to interpret two of the four videos from English into French in a specific order, so that the effect of interpreting a particular speech first or second could be accounted for. A modified Latin square design was used to ensure all combinations were covered, as illustrated in Table 1.

Participant	***Speech 1***	***Speech 2***
Participant 1	**Bulgaria full**	**Estonia light**
Participant 2	**Bulgaria light**	**Estonia full**
Participant 3	**Estonia full**	**Bulgaria light**
Participant 4	**Estonia light**	**Bulgaria full**

Table 1: Latin square showing speeches assigned to each participant

In addition, elements of the study also had to be adapted to the social distancing measures enacted by the Swiss government due to the CoVid-19 pandemic. The final videos had not yet been edited, so the materials were somewhat simplified, and significantly, the experiment could not be carried out at the FTI lab as planned and had to be done remotely (see chapter 4.4.4. for the full procedure). It had been planned to use eye-tracking technology to measure participants' eye movements as an additional DV, which also became unfeasible.

As discussed above, the original 2015 hypothesis was that a visually clearer, lexically dense presentation would decrease cognitive load and thus increase interpreter fluency, which would seem to be in accordance with existing literature on elements of this topic as discussed in chapter 1. However, it was not confirmed by the results of the earlier study, so this paper will aim to test earlier findings on the possible links between the visual clarity of visual stimuli and the fluency of SI. Either way, this paper aims to inform further investigation of this field that eventually might influence the design and use of slide presentations at interpreted events.

4. METHODOLOGY

4.1. Independent Variables

As outlined above, simultaneous interpreters are working with more and more slide presentations in diverse contexts, with some speakers following advice to keep them simple, and others simply reading full sentences off the screen. The IV will therefore be the difference between the two variants of PPT, as in the original study (Blatter & López Conceiro, 2015, PPT. 13-14). The speeches and sets of full and light slides were designed to be as identical as possible, creating two clear conditions for each participant to interpret in, and each performance to be compared to the rest.

Blatter & López Conceiro (2015) note one possible nomenclature for the IV would be *structure* as defined below by Amiran & Jones' (1982) as one of three factors of *readability*, along with *texture* and *content density*.

> *"Texts that are very hard to comprehend may be composed of short and familiar words and short sentences, as readers of Beckett or the Bible will readily agree. What makes texts difficult to understand, beyond complex <u>text structures</u>, is the amount of inference they demand, a quality we shall call <u>texture</u>. Thus a Sartre story which a traditional readability scale assigns to sixth grade could not be understood by sixth grade readers, since they would be unable to infer the existentialist principles that motivate its main character and define 'what happens.' In short, a text may be difficult to read because of a complicated structure, or because of its inexplicit texture, the number of 'holes' between its propositions."*
>
> (p. 14, Blatter & López Conceiro's emphasis)

As Blatter & López Conceiro (2015) note, the two original PPTs differ in structure, though neither contains truly complex structures, hence this term is not used for the sake of clarity. It is worthy of note, however, that Blatter & López Conceiro's clearer presentation, and this study's light presentations, could also be considered to have more texture than their more comprehensive counterparts. A PPT made up of only keywords provides the interpreter with the central information of a speech without them having to search for it, but it does not make explicit the relationships between different keywords in the way full sentences do. This could perhaps account for the reduced fluency in interpretations of the speech accompanied by the visually clearer PPT in the original study.

Given the complexity of the term readability as defined above, Blatter & López Conceiro opted to refer instead to the IV as a combination of the interlinked factors of visual clarity and lexical density.

The term visual clarity is used by Chang, Kinshuk, Chen, & Yu (2012) when investigating how several pedagogical materials should be presented simultaneously on one computer screen in such as to limit extraneous cognitive load, as it is defined by Brünken, Plass, & Leutner (2003). Lexical density is used by Ure (1971) to refer to the proportion of orthographical words within a text that have lexical properties. These two terms used together thus aptly describe the way in which the two PPTs used in this study differ. The light PPT made up of keywords is has high lexical density and visual clarity, whilst the full PPT containing full sentences has lower lexical density and visual clarity.

4.2. Dependent Variables

4.2.1. Fluency as a measure of quality in SI

Fluency is significant when measuring the quality of SI (Christodoulides & Lenglet, 2014; Pradas Macías, 2007). Audiences prioritise accuracy above all, but they are usually unable to measure this criterion as they do not understand the source language, so their perception of whether an interpreter's performance is satisfactory is heavily impacted by whether they find the interpretation fluent (Christodoulides & Lenglet, 2014; Kahane, 2000). Pradas Macías (2006) found 44% of surveyed "occasional or regular users of SI" ranked fluency as having a "strong influence" as a quality parameter, with 19% even ranking it fundamental (PPT. 32-34). From the opposite perspective, 70.7% of conference interpreters who took part in an AIIC study stated fluency of delivery was a "very important" quality criterion (Pöchhacker & Zwischenberger, 2010). This is reflected in research, where academics have moved away from using accuracy as an indicator of quality due to the subjectivity involved in measuring it, choosing instead to focus on fluency (Plevoets & Defrancq, 2016).

The significance attached to this factor is legitimate, given simultaneous interpretations bear unique prosodic markers caused by the constraints of the process, including "longer silent pauses" and "an increased number of filled pauses, corrections and restarts" (Christodoulides & Lenglet, 2014, p. 1002). Plevoets & Defrancq (2016) note psycholinguists consider such disfluencies to be indicators of cognitive load. Some studies have found this can have a negative effect on listener's understanding, such as Shlesinger (1994); Christodoulides & Lenglet (2014) note "the interpreters' liveliness appears to influence the listeners' understanding of the speech content" (p. 1002).

Given fluency is studied within different academic fields (interpreting itself, foreign language teaching, psycholinguistics etc.) and varied approaches are applied, there is some variation in which exact markers tend to be measured (Pradas Macías, 2007; Tissi, 2000). However, all papers have in common the study of pauses in some form, whether referred to as "silent pauses", "non-filled pauses", "filled pauses", "stylistic hesitations" or "doubt phenomena" (Pradas Macías, 2007, p. 56).

Pradas Macías adds that some of these “intraparameters of fluency” also contribute to the measure of other SI quality markers (i.e. intonation, diction and voice), reinforcing their validity a measure of quality. Therefore, a number of different pauses will measure the DV of this study.

Blatter & López Conceiro (2015) note the significance of relation to the source text when observing prosodic markers, so this will be taken into account. Although pauses can be indicators of speakers or interpreters using processing capacity, e.g. to plan what they are going to say (Goldman-Eisler, 1958, as cited by Ahrens, 2005), it has also been acknowledged that disfluencies, particularly pauses, are part and parcel of spoken language. They can be used deliberately, and can also be carried over from the source speech; “successful interpretation depends not only on TT quality but also on ST language and presentation” (Tissi, 2000, p.106). However, given the source text in this study is the recording of a text that was prepared in advance, it will likely contain fewer disfluencies than spontaneous speech, and the comparison of two interpretations by the same interpreter may yield more valid and interesting conclusions.

4.2.2. Silent Pauses

Silent pauses are clearly related to fluency, and their overuse can have a negative impact on fluency (Pradas Macías M. , 2006). However, it is not clear if they have a consistently negative or positive impact on quality. They can also be used tactically for rhetorical effect, for example to create emphasis if used immediately before a word (Ahrens, 2005; Deese, 1980; Duez, 1982). Tissi (2000) points out prosodic features are just as important in an interpretation as they are in source texts in terms of effect. Therefore, it is essential to consider their frequency in an interpretation in relation to their frequency in the source text (Pradas Macías E. M., 2007).

Silent pauses have been defined in previous studies as periods exceeding a minimum duration during which the speaker or interpreter makes no sound. The minimum duration is used because shorter micropauses (under 400 ms) occur frequently in the speech of native speakers, and are often not indicative of disfluency (Riggenbach, 1991). Blatter & López Conceiro (2015) note the minimum duration used in research has varied between 250 and 600 ms, and choose a value within that range: 500 ms. Due to the natural frequency of silent pauses in speech and the subjectivity of listener perception, they opted to detect silent pauses electronically. In the interest of consistency with the original study, it was sought to retain this methodology and definition. The software used to identify silent pauses was tested with the same value (500 ms) to ensure all noticeable silent pauses were detected.

4.2.3. Salient Pauses

Pradas Macías (2006) defined salient pauses as a subset of silent pauses that lasted between 2 and 6 s, and found such pauses played a role in expert users' evaluation of SI fluency. Blatter & López Conceiro (2015) defined them as pauses lasting over 2 s that constituted a "complete interruption of the interpretation" (p. 17). Like silent pauses, though, these longer pauses can also be used deliberately, for instance between two ideas, and in such cases are "forgivable" from a listener perspective (Riggenbach, 1991, p. 425). It is therefore important that sections of interpretation including longer pauses were manually analysed and only those that cause an "unnatural break in the flow of speech" are recorded (Blatter & López Conceiro, 2015, p. 17).

4.2.4. Filled Pauses

Filled pauses have been measured in addition to silent pauses in previous research. Riggenbach (1991) defines them as "voiced fillers which do not normally contribute additional lexical information" (p. 426). Duez's paper focuses on French, the TL for this study, and defines a filled pause specifically as an occurrence of "euh", whether standalone or attached to the beginning or end of another word, excluding extended optional schwas such as in "que", "le" or "de" (p. 34). Pöchhacker (1994) similarly refers to the hesitation sound examples "äh", "uhm" and "heu" depending on the language (p.133), and notes they are considered impermissible in interpreter circles. Plevoets & Defrancq (2016; 2018) used filled pauses as a measure of cognitive (over)load and successfully drew conclusions about certain factors being more likely than others to trouble interpreters and cause them to utter filled pauses. As was the case in the original study, a high frequency of filled pauses will be considered a marker of reduced performance caused by the study's IVs. Blatter & López Conceiro (2015) note it is "almost impossible" to use software to identify hesitation sounds reliably, and thus filled pauses are identified manually based on listener perception.

4.2.5. False Starts and Repetitions

Blatter & López Conceiro (2015) note there is no common definition for what has been called a "*false start, repetition, correction* etc.", but that what is referred to is much the same. Riggenbach (1991)'s *repair phenomena*, for example, include the following:

> *"retraced restart – reformulations in which part of the original utterance is repeated*
> *repetition – exact adjacent repeats of sounds, syllables, words or phrases*
> *insertion – a retraced restart in which new unretraced lexical items are added*
> *unretraced restart – reformulations in which the original utterance is rejected (="false start")"* (Riggenbach, 1991, p. 427)

The same disfluency is referred to by Pöchhacker (1994, p. 134) as a "*Planänderung* (change of plan)" and by Magnifico & Defrancq (2019, p. 352) as "self-repair". These are corrections made to speech in order to then express an idea in a different way, rather than to remedy specific errors in the original utterance. Blatter & López Conceiro (2015) considered false starts and repetitions as one DV, and they were identified based on manual listener analysis. This study will carry out the same analysis.

4.3. Participants

The participants were four (female) students currently in their fourth semester of the FTI's MA in Conference Interpreting, who had been practising SI for just over one year. They were native French speakers with French as their principal active ("A") language and had English in their language combination as a passive or retour ("C" or "B") language. Their mean age at the time of the experiment was 28.75 (Standard Deviation of 5.12), and they had no professional experience as conference interpreters. They participated in this study on a voluntary basis from their homes. The exercises they were asked to perform were very similar to those practised in the classroom over the course of the programme.

4.4. Materials

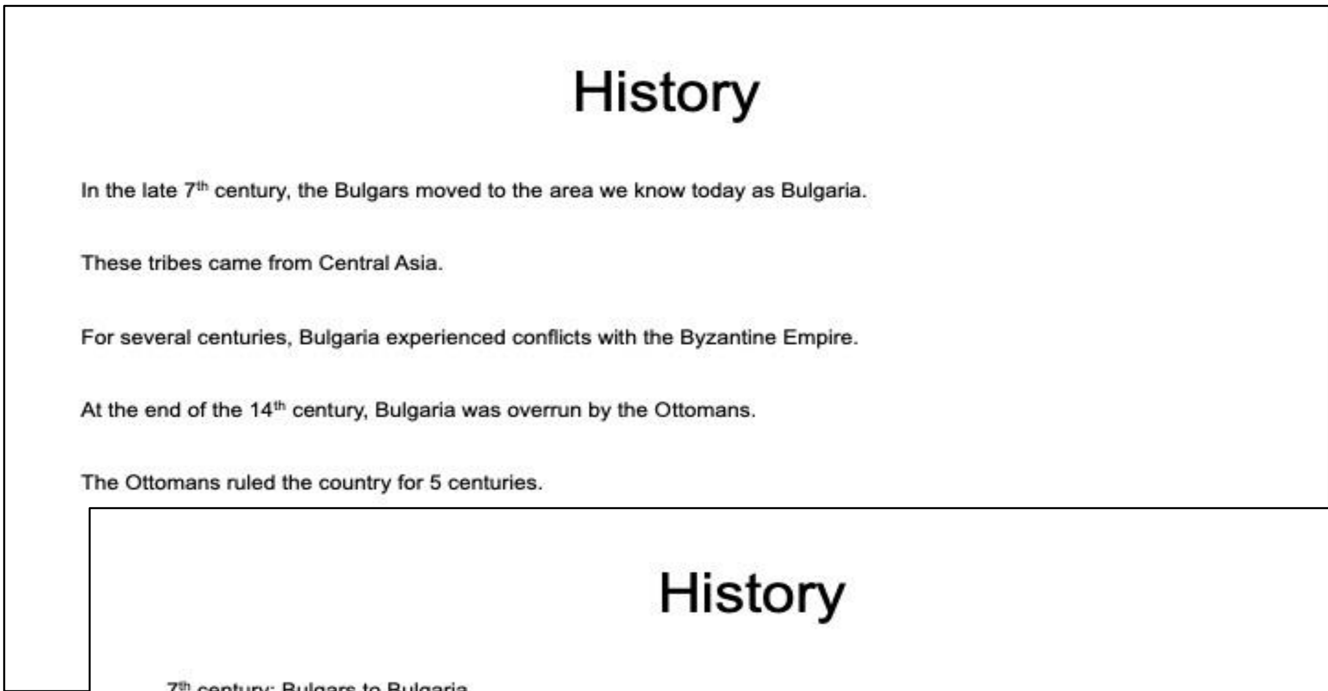
4.4.1. Speeches

Blatter & López Conceiro's (2015) two English source speeches about Bulgaria and Estonia were drafted to be "of comparable difficulty", "feasible in SI", and on a topic that participants were unlikely to be familiar with (p. 19). They used speeches about countries so that each could contain near-identical information on each's history, geography, government and culture, expressed in different linguistic packaging. Excluding the introduction (slide 1) intended as a warmup for the interpreters, the original speeches were syntactically aligned by the author of this paper, a native speaker of English, to ensure they were linguistically as close to identical as possible, whilst still using different words. The frequency and complexity of numbers used in each text were also matched. On average, the speech on Bulgaria contained 121 words per minute, and the speech on Estonia, 126 words per minute.

4.4.2. PowerPoint Presentations

Four accompanying text-only PowerPoint presentations were drafted; two for each speech loosely based on Blatter & López Conceiro's (2015) materials. The presentations were sized for widescreen display (16:9 aspect ratio), and each slide had a white background with a title (Arial, 44 pt, black), and a number of lines of text (Arial, 15 pt, black). Figures 3 and 4 illustrate how the full presentations contained every word spoken by the speaker, making them visually more complex, and the light presentations contained the same information displayed on each line but in minimal detail, using fewer words, making them discernibly visually simpler. Mainly, the basic nouns, numbers and prepositions required for the slides to make sense were retained, and in many cases punctuation (e.g. colons and parentheses) was introduced to replace verbs. The majority of verbs, definite and indefinite articles, conjunctions, adverbs and modifiers were removed, with a few exceptions necessary to retain meaning. Some frequent nouns were also removed, such as the second and third occurrences of “Bulgaria” and the second occurrence of “Ottomans” in the example below. In order to achieve the level of visual clarity desired, the number of slides was increased from eight for Blatter & López Conceiro’s (2015) study to eleven for this experiment. See Appendices 1-4 for the four full presentations.

Figure 3: Slide 2 of full presentation on Bulgaria



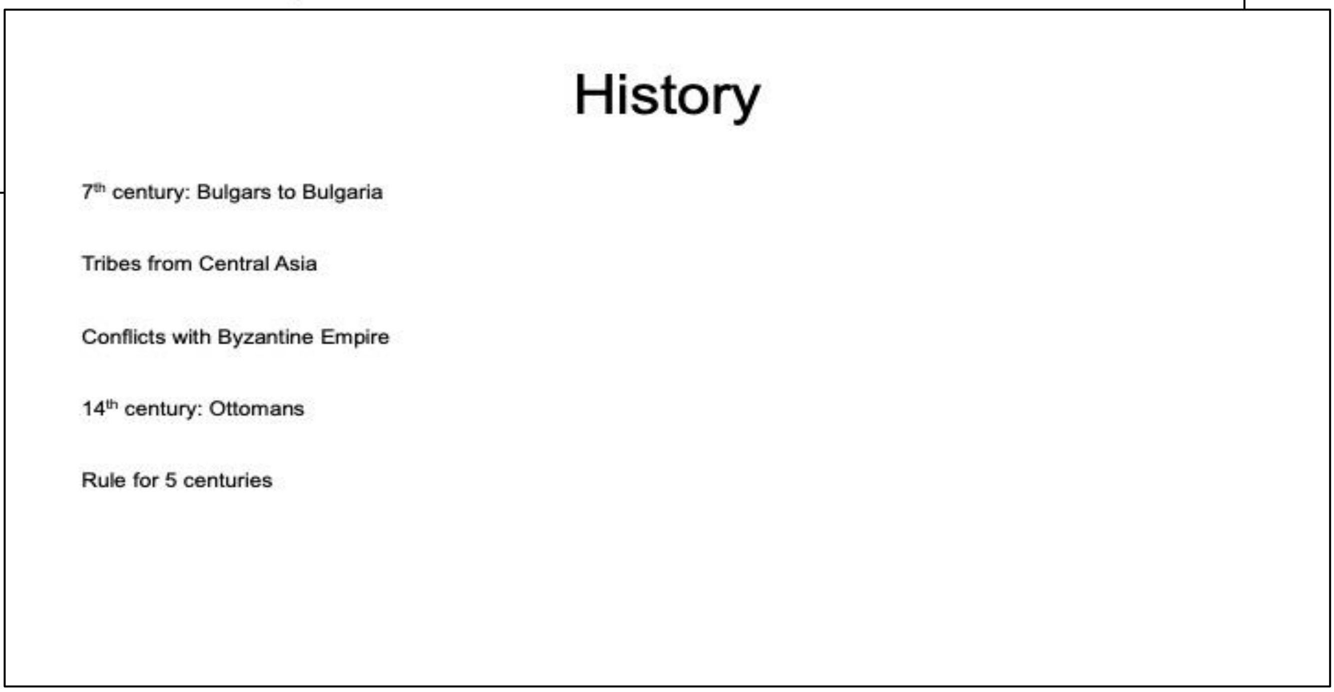


Figure 4: Slide 2 of light presentation on Bulgaria

The aim was thus to simulate the two most common uses of PPT: what is seen as correct use (light) and the common trend of reading full sentences from the screen (full), which is frowned upon. All slides in all presentations had a maximum of six lines, and the light slides generally had less than seven words (with few exceptions), thus roughly respecting the “seven-by-seven” rule.

4.4.3. Videos

Initially, a video recording was made of the author reading the speech in front of a green screen, with the intention being to create a video where the participants would be able to see the speaker and the PPT presentation. As video-editing technology became inaccessible after the introduction of social distancing guidelines, the audio recordings made as a backup were used instead. The audio was cut into sections that pertained to each individual slide of the PPT. The presentations were programmed to automatically advance through the slides, playing the relevant audio, and were exported as mp4 video files. The videos were encoded with the H.264 codec and had a resolution of 1920 x 1080 pixels at 30.3 frames per second. The stereo audio was codified with the AAC codec, with a sampling rate of 48,000 Hz. The duration of the videos on Bulgaria was 5 min 2 s, and on Estonia, 4 min 45 s.

4.4.4. Procedure

The experiment was set up as a course on the FTI’s virtual learning environment, TR@IN, with each participant invited to the course by email and allocated a specific assignment. This ensured all participants received identical instructions. The homepage (figure 3) advised participants of the deadline to complete their assignment, two weeks later, and invited them to ask any questions on the TR@IN forum, as well as providing a link to the study consent form. The assignment pages (figure 4) contained instructions to download and interpret two videos in a specific order with a 5-minute break in-between, to record the interpretations and to upload them with the consent form to the same page. Participants were directed to use the ERITON platform’s dual-track recording function. The participants were not made aware of the purpose of the study, were not advised to prepare in any way, and were not provided with any feedback. The 5-minute break was intended to ensure the second interpretations were not affected by fatigue. The four participants completed their assignments within the two-week window, and their interpretations were downloaded as mp4 video files for analysis.

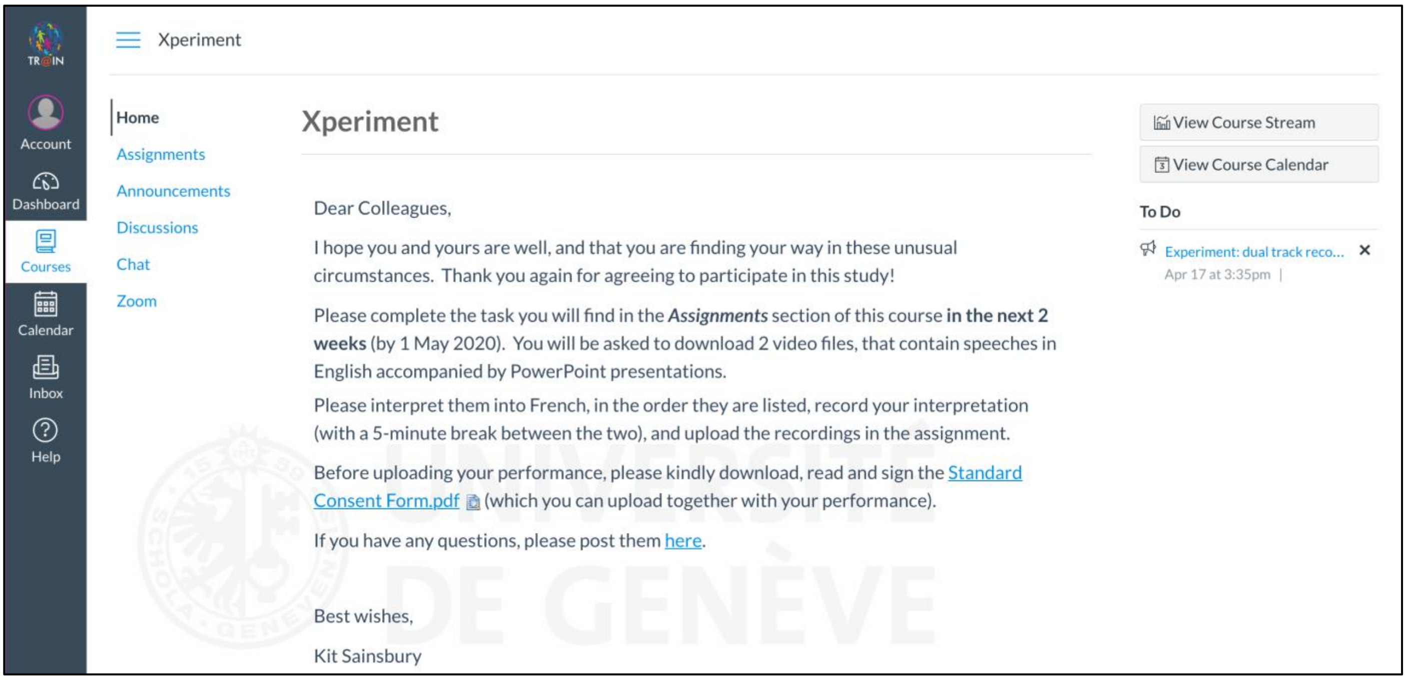


Figure 5: TR@IN course homepage

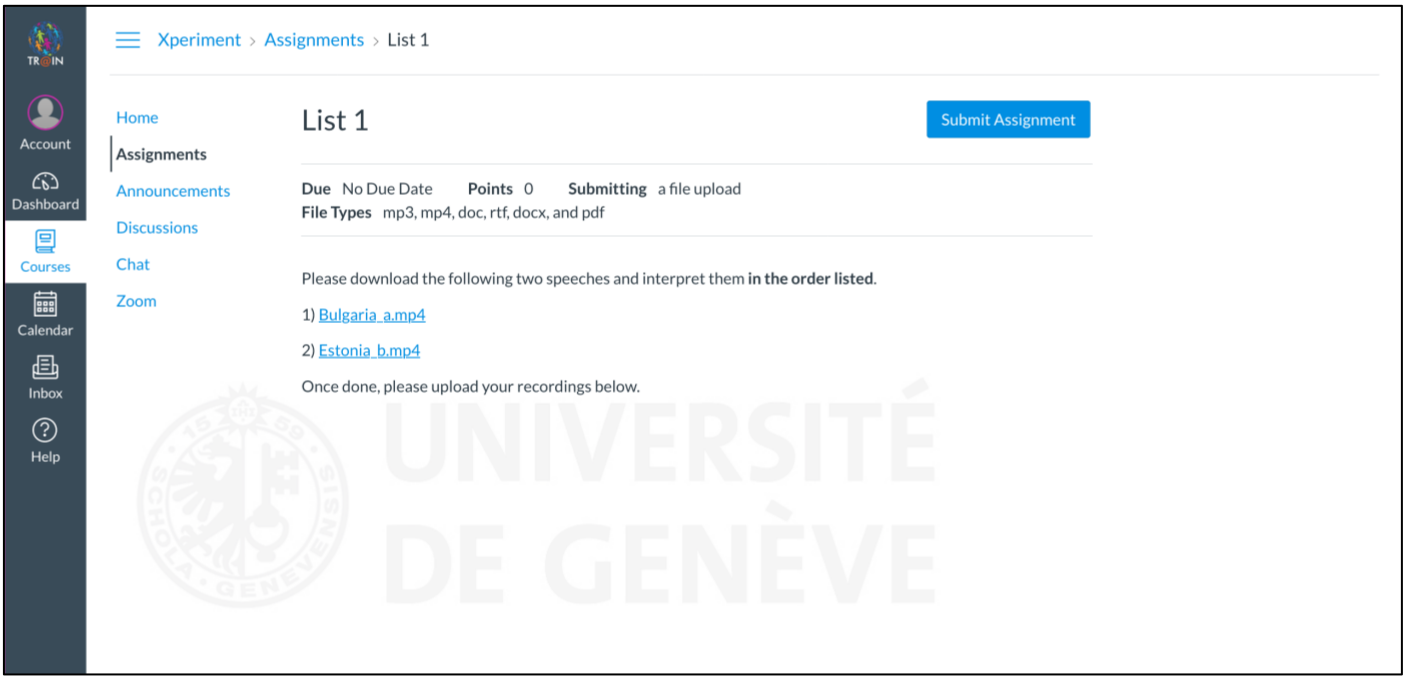


Figure 6: One of the four TR@IN assignment pages

5. RESULTS

5.1. Data collection and analysis

The video files downloaded from TR@IN were converted to mp3 audio files using VLC media player so that they could be analysed using Audacity, audio editing software, and Praat, speech analysis software (Boersma & Weenink, 2019). As the experiment was carried out at the participants' homes rather than in sound-proofed interpreting booths, in some cases it was necessary to use Audacity's *Generate Silence* function to remove the ambient sound between utterances so that silent pauses would later be correctly recorded by Praat.

A combination of computer and human analysis was used to calculate the frequency of the DVs. Silent pauses were identified using Praat, and longer pauses were then manually checked based on the criteria set out for salient pauses. Filled pauses, false starts and repetitions were manually identified by the author using Audacity. The same analysis was carried out on all interpretations and original speeches.

Praat's "Annotate To TextGrid (Silences)" function was used to detect silent pauses with the software's default minimum pitch (100 Hz) and time step ("0.0 s (= auto)"), a variable silence threshold between -25 and -45 dB depending on the volume of the interpreter's voice, a minimum silent interval duration of 0.5 s and a minimum sounding interval duration of 0.05 s. After Praat's TextGrid was thoroughly checked for accuracy by the author, the results were exported as a table in plain-text (.txt) format and imported into a spreadsheet for collation.

A second TextGrid was generated with a minimum pause duration of 2 s. This was then reviewed by the author, and pauses deemed to cause an unnatural break in the discourse were manually annotated as salient. The grid was then exported as with silent pauses and added to the spreadsheet.

As well as excluding the introduction accompanying the first slide from analysis, any pauses at the very beginning and very end of the interpretations were not counted, as SI requires a certain lag at the start of a speech, and silence after the interpreter has finished speaking cannot be considered a pause.

An Audacity label track was used to manually annotate occurrences of filled pauses and false starts/repetitions. This label track was exported as a table in plain-text format (.txt) and imported into the results spreadsheet for analysis.

Finally, the frequency of the DVs were analysed with respect to the IV.

5.2. Results

On average, all disfluencies apart from false starts were more frequent in interpretations of the *light* PPTs, though by quite a small margin. Conversely, the average number of false starts and repetitions was lower in interpretations of the light PPT.

	Filled pauses	*False starts and repetitions*	*Silent pauses*	*Salient pauses*
Light PPTs	6	10.25	47.5	1.25
Full PPTs	4.5	13	46	0
Source speeches	*n/a*[1]	*n/a*[1]	*52*	*0*

Table 2: Average disfluencies in interpretations of speeches accompanied by light and full PPTs

5.2.1. Filled pauses

	Light *PPT*	Full *PPT*	*Difference*
Subject 1	3	7	+4
Subject 2	7	2	-5
Subject 3	12	8	-4
Subject 4	2	1	-1
Average	6	4.5	-2.5
Total	24	18	-6

Table 3: Frequency of filled pauses in interpretations with full and light PPTs

Full PPT interpretations by Subjects 2, 3 and 4 contained fewer filled pauses than their light PPT interpretations. Though the difference in frequency between subject 4's interpretations is small, the

[1] The source speeches contained 0 filled pauses, false starts and repetitions as they were read from a manuscript

decrease is of notable size in subjects 2 and 3. On the other hand, subject 1's full interpretation contained more filled pauses, and the difference was just as substantial.

5.2.3. Silent pauses

	Source speech	Average light PPT	Average full PPT
Bulgaria	54	45.5	46
Estonia	50	46.5	46
Average	52	46	46

Table 4: Frequency of silent pauses in source speeches, and in full and light interpretations on average

On average, the interpretations of both speeches contained fewer silent pauses than the originals, but there is no major difference between the frequency of silent pauses in interpretations with light and full PPTs.

	Light *PPT*	Full *PPT*	Difference
Subject 1	41	44	+3
Subject 2	61	57	-4
Subject 3	36	35	-1
Subject 4	52	48	-4
Average	47.5	46	-1.5
Total	190	184	-6

Table 5: Frequency of silent pauses in interpretations with light and full PPTs

The individual results paint a different picture, with subjects 2 and 4's results showing moderately fewer silent pauses in full PPT interpretations. However, subject 3's full interpretation contained only 1 less silent pause than her light interpretation, and subject 1 once again shows an increase rather than a decrease.

5.2.4. Salient pauses

	Light *PPT*	Full *PPT*	Difference
Subject 1	1	0	-1
Subject 2	1	0	-1
Subject 3	0	0	0
Subject 4	3	0	-3
Average	1.25	0	-1.25
Total	5	0	-5

Table 6: Frequency of salient pauses in interpretations with full and light PPTs

The most striking trend regarding salient pauses is that all 4 subjects' full PPT interpretations contained 0 salient pauses (as did the original speeches), whereas 3 of the light PPT interpretations contained at least one. Subjects 1 and 2's light PPT interpretations contained just 1 salient pause, and subject 4 was the only participant to have a notably higher number, 3. Neither of subject 3's interpretations contained any salient pauses.

5.2.2. False Starts and repetitions

	Light PPT	Full PPT	Difference
Subject 1	9	7	-2
Subject 2	13	17	+4
Subject 3	14	23	+9
Subject 4	5	5	0
Average	10.25	13	+2.75
Total	41	52	+11

Table 7: Frequency of false starts and repetitions in interpretations with full and light PPTs

This is the only variable according to which, the light PPT interpretations were on average more fluent than the full PPT interpretations. The interpretations of full PPTs by subjects 2 and 3 both contained more false starts and repetitions than their interpretations of light PPTs, with subject 2 showing a moderate increase, and subject 3 a large increase. However, both of subject 4's interpretations contained the same frequency of this variable, and subjects 1's results once again show an opposite trend, with her full PPT interpretation containing slightly fewer false starts.

5.2.5. Analysis of results

The results are not consistent across the board, and some increases and decreases are not particularly pronounced, but there remain a number of trends for discussion.

The clearest pattern is that, with the exception of filled pauses, all disfluencies were generally more frequent in interpretations accompanied by light PPTs. This trend is observed in the average values for three of the four variables measured; filled, silent and salient pauses. However, the difference between the average frequencies in full and light PPT interpretations remains very small (between 1.25 and 1.5). Looking at the individual data for each variable, though, three of the four subjects performed better when working with a full PPT in each case. In some cases, the fall in frequency of the variable was of moderate size (between 3 and 5). However, in other cases (one subject for filled and silent pauses and two subjects for salient pauses), the decrease was only of 1, making it inconsequential.

On the other hand, the results for false starts and repetitions illustrate a possible opposite correlation, with two out of four subjects' full PPT interpretations showing an increase of this disfluency, one showing no difference at all, and just one showing a small decrease. On average, full PPT interpretations contained 13, whereas light PPT interpretations contained 10.25, meaning this variable has the greatest average difference. Though a moderate increase of four was recorded for subject 2, subject 3 had the greatest increase of nine, a figure which will have impacted the average.

In three cases (filled pauses, silent pauses, and false starts and repetitions), it is subject 1's results that buck the trend. With regard to filled and silent pauses, subject 1 shows a moderate increase where all other subjects showed a decrease, and in terms of false starts and repetitions, subject 1 shows a small decrease, where either no difference or an increase was recorded for other participants.

The results tend to support Blatter & López Conceiro's (2015) findings that full PPTs seem to provide for a more fluent interpretation, both generally as well as on closer inspection, but it is important to note that the accuracy of the interpretations was not measured by this study. Both of the principal patterns identified by Blatter & López Conceiro are also visible in this study's results:

1. The interpretations of lexically denser, visually clearer PPTs contained more salient pauses as compared to both the original speeches and the lexically less dense, visually less clear PPTs.
2. The interpretations of lexically denser, visually clearer PPTs contained more silent pauses as compared to the lexically less dense, visually less clear PPTs.

Moreover, where Blatter & López Conceiro found filled pauses were similarly frequent across the board, this study's results on filled pauses tend to support the trend.

In both cases, false starts and repetitions did not align with the rest of the results. Blatter & López Conceiro found them, like filled pauses, to be "present in similar numbers across the board" (p. 28). In this study, this DV seemed to react to the IV in the opposite direction to the rest.

6. DISCUSSION

This study has added to a growing body of research in a somewhat overlooked field that tends to show that the impact of slide presentations on simultaneous interpreters differs greatly from their impact on audiences. Where Bucher & Niemann (2012) found dynamic visual representations were best for audiences, Crenicean (2016) found static visual representations were better for interpreters. Mackiewicz's (2008) paper provides a good summary of the general perception that a good PPT is a simple one that follows rules like "seven-by-seven", like the light PPTs for this study. Mayer & Johnson (2008) find redundancy can have a positive impact on learners, albeit only if very limited. Yet both this paper and Blatter & López Conceiro's (2015) experiment found slides that were less lexically dense and visually clear, thus with increased redundancy, led to simultaneous interpreters' work being more fluent.

It seems to be the case that increasing the lexical density and visual clarity of slides generally leads to an increase in the frequency of some prosodic disfluencies. This is understood to be a consequence of this variant of visual input requiring more cognitive processing, leaving fewer resources available for the processes involved in SI, though visual input has not yet been included in SI effort models (Gile, 1991; Seeber, 2013). Lu et al. (2013) have noted dual visual and auditory input can sometimes make processing slower, which seems to be the case in this instance. It would be positive for future research to attempt to better understand the impact of VI on cognitive load, and perhaps present an effort model that includes the impact of VI, or more generally the new technologies entering the conference room.

In simple terms, written keywords seem to be harder to process than written full sentences during simultaneous interpretation; Blatter & López Conceiro (2015) note this in their discussion and suggest this may be down to the reduced redundancy in their clearer presentation. The explanation could, however, lie in Amiran & Jones' (1982) notion of texture as a factor of the readability of texts, according to which texts that do not state the obvious but require inference are more difficult to understand. The use of keywords means the linguistic packaging that makes the meaning of sentences explicit is removed. Interpreters thus have to work out the relationship between different keywords themselves. Though this task is perhaps insignificant for audiences, it likely bears much more significance for an individual already tackling the cognitively taxing exercise of simultaneous interpretation.

This seems particularly plausible given interpreters work primarily with what is said and not with what is written. If a speaker reads every word on a slide, as was the case with this study's *full* PPTs, it becomes clear very quickly that the visually presented information is trustworthy, and little effort is required to check that visual and auditory input match. In the case of the *light* PPTs, though, interpreters would have to wait until the keyword or figure itself had been uttered before knowing if the visual information could be relied on.

Alternatively, Blatter & López Conceiro (2015) also raise the possible significance of whether interpreters know when to look at VI. The participants of this study have been trained not only in SI but also in SI with text, where they are provided with a written copy of a speech that is read out. They are therefore accustomed to integrating written full sentences into the interpreting process and have most likely also practised sight translation. They might, however, have much less experience working with keywords and may not have realised if this meant the light PPT became more a hindrance than a help at any stage.

Where manipulating the IV led to a decrease in the average frequency of all other variables, the frequency of false starts and repetitions increased. It is therefore interesting to consider that the latter, referred to by Riggenbach (1991) as *repair phenomena*, are used by interpreters when they wish to restart their sentence in order to explain a point in a different way. Gile (1997) stated that linguistic interference was likely to be more frequent in sight-translation due to the distraction of the text, and a side-effect of displaying full sentences on screen in the source language may be that interpreters are more prone to initially emulating the original syntax, forcing them to make more corrections when they realise a particular structure is incompatible with the TL. It would be of interest for future research to measure the frequency of such occurrences and investigate their possible link with the presence of written source text. Moreover, if the pattern of pauses decreasing but false starts increasing were to be confirmed by future study, it would be interesting to survey interpreters and regular users of SI to find out how important false starts are in relation to other disfluencies when it comes to SI quality.

Moreover, there are a number of limitations to be considered when analysing the results of this study.

The sample size of this study was small, and all participants were students who had been through the same training programme. In future research, it would be desirable to use a larger sample of professionals with varied degrees of experience to ensure conclusions were applicable across the board, and to ensure this study's results were not confounded by the participants' lack of experience. Of particular note is that the results pertaining to subject 1 consistently did not follow the trends observed in the other subjects, perhaps due to her personal level of aptitude or experience, the conditions in which she carried out the exercise, or the way in which she used the VI provided. It would be interesting for further research to focus on such individuals who seem to be less affected by variance in visual input. Seeber (2012) notes insufficient research in the field records how interpreters do or do not use visual input, so eye-tracking technology could be used to establish whether there is a correlation between what interpreters look at and the fluency of their interpretation. Another focus could be the employment of strategies such as anticipation, stalling and chunking in the presence of varying visual input.

Though fluency is one of the established measures of quality in SI (Christodoulides & Lenglet, 2014; Pradas Macías E. M., 2007), and has been proven to indicate cognitive load (Plevoets & Defrancq, 2016) future research should aim to measure output quality more comprehensively, for instance taking accuracy into account. Accuracy seems to be what matters most to both practitioners and their audiences. In Pöchhacker & Zwischenberger's (2010) study where 70.7% of interpreters surveyed ranked fluency as a "very important" quality criterion, 88.3% assigned "sense and consistency with the original" equal importance. Pradas Macías (2006) found the quality parameter "delivery not fluent" had either a strong (44%) or fundamental (19%) influence on the evaluation of the majority of occasional or regular users of SI surveyed, but "incorrect rendition of sense" was assigned even more significance, with 28% stating it had a strong influence and 65% a fundamental influence. It would be interesting to establish to what extent fluency and accuracy are interlinked, and whether reduced fluency is ever compensated for by increased accuracy, for instance.

Furthermore, this study focuses on one particular variant of visual input in SI. In order to isolate the IV, all slides only contained text, rather than graphics or images, though Stark & Paravel (2008) argue the real advantage of slide presentations is their ability to bring together text, sound and image. Research into a wider variety of slide presentations and other forms of visual input would also be positive contributions to the field. Regarding lexical density and visual clarity as a variable, even the full PPTs only contained short, simple sentences, separated on the screen by empty space. It is certainly possible for a slide to be even less lexically dense and visually clear, and this might lead to different conclusions. Though the present study used more extreme levels of the DV than Blatter & López Conceiro (2015), what was defined as low lexical density and visual clarity is perhaps closer to a medium level of the variable that happens to work particularly well for interpreters.

It should also be noted that the near-identical nature of the two speeches and their accompanying PPTs likely impacted results. Though the Latin square design was used in an attempt to account for the impact of interpreting two similar speeches one after the other, this still seems to have had an impact. On average, the frequency of every DV was lower in second interpretations, though not by very much, pointing to a possible warm-up effect. Moreover, subject 4's second interpretation contained a false start clearly caused by having interpreted the previous speech not long before.

Bucher & Niemann (2012) further argue speakers must interact with the technology for multimodal discourse to be effective, for instance using gestures, and Moser-Mercer (2005) found limited access to VI had a substantial negative impact on interpreter performance. As this study had to be adapted after the introduction of restrictions related to CoVid-19 outbreak, interpreters were not able to see the speaker's body language, which may have impacted the results of the study. In future, it would be a priority for interpreters to have a clear view of the speaker as well as any other visual stimuli. Similarly, Bucher & Niemann (2012) argue research into multimodal presentations should be carried out in real-life settings where possible, and though the experimental design of this study had the advantage of allowing for the two speeches to be closely controlled, it would be a positive step to analyse interpreters' performances at real events, to ensure a realistic range of VI was covered, and to avoid interpreters misguidedly anticipating the content of very similar speeches

7. CONCLUSIONS

This study set out to investigate the impact of the lexical density and visual clarity of slide presentations on the fluency of simultaneous interpretations, in order to confirm or refute the findings of Blatter & López Conceiro (2015).

The results of this study provide some further evidence to support the claim that simultaneous interpretations of speeches accompanied by slides of lower lexical density and visual clarity (i.e. with more words) contain fewer disfluencies. This means the general wisdom that PowerPoint and other similar digital slide presentations should be kept visually simple is not applicable when it comes to simultaneous interpreters, at least where text is concerned. This is a meaningful finding because, at interpreted events, it is just as important for those listening to simultaneous interpreters to understand presentations as it is for those listening to the original.

Efforts should therefore be made to provide guidance to organisations, conference organisers and speakers, so that simultaneous interpreters are able to work to the highest standard without being hindered by visual aids that are not designed with interpretation in mind. There is a surprising lack of research in this field, and though this paper has contributed by confirming earlier unexpected findings, further investigation is required. Though there have been extensive publications in fields such as cognitive load in SI and the reception of visual input, few bring together these different elements and look at the whole picture. Moreover, the limited scope of this small-scale experiment and limitations brought about by the 2019/20 CoVid-19 pandemic leave room for more work.

Recommendations for future study include a larger-scale study analysing performances by a variety of professional conference interpreters, perhaps from a corpus, as this would provide more solid evidence for the claims made in this paper. In the lab, future research could use speeches and visual aids that were less similar to one another and expand the variety of dependent variables measured, including by using equipment such as eye-tracking technology to establish what interpreters look at and when.

BIBLIOGRAPHY

Ahrens, B. (2005). Prosodic phenomena in simultaneous interpreting: A conceptual approach and its practical application. *Interpreting, 7*(1), 51-76.

AIIC. (1999, December 1). *Checklist for conference organisers.* Retrieved February 28, 2020, from aiic.net: http://aiic.net/p/33

AIIC. (2011, November 28). *How interpreters work*. Retrieved February 16, 2020, from aiic.net: http://aiic.net/p/4005

AIIC Technical Committee. (2000, March 24). *What about monitors in SI booths?* Retrieved March 11, 2020, from aiic.net: http://aiic.net/p/148

Amiran, M. R., & Jones, B. F. (1982). Toward a new definition of readability. *Educational Psychologist, 17*(1), 13-30.

Anderson, L. (1979). Retrieved July 17, 2020, from Simultaneous interpretation: Contextual and Translation Aspects [MA Thesis, Concordia University]: https://spectrum.library.concordia.ca/

Baigorri-Jalón, J. (2014). *From Paris to Nuremberg: The birth of conference interpreting.* Amsterdam, Netherlands; Philadelphia, PA: John Benjamins.

Baxter, R. N. (2016). Exploring the Possible Effects of Visual Presentations on Synchronicity and Lag in Simultaneous Interpreting. *Sendebar, 27*, 9-23.

Berber Irabien, D. (2010). *Information and Communication Technologies in Conference Interpreting [Doctoral thesis, Universitat Rovira i Virgili].* Retrieved July 17, 2020, from http://hdl.handle.net/10803/8775

Blatter, R., & López Conceiro, H. (2015). *Visual input in simultaneous interpreting: the role of lexical density [Master's thesis, University of Geneva].* Retrieved July 17, 2020, from http://archive-ouverte.unige.ch/unige:56060

Boersma, P., & Weenink, D. (2019). *Praat: doing phonetics by computer [Computer program]. Version 6.1.13.* Retrieved April 19, 2020, from http://www.praat.org/

Brünken, R., Plass, J. L., & Leutner, D. (2003). Direct Measurement of Cognitive Load in Multimedia Learning. *Educational Psychologist, 38*(1), 53-61.

Bucher, H.-J., & Niemann, P. (2012). Visualizing science: the reception of powerpoint presentations. *Visual Communication, 11*(3), 283-306.

Cammoun, R., Davies, C., Ivanov, K., & Naimushin, B. (2009). *Simultaneous Interpretation with Text: Is the Text 'Friend' or 'Foe?: Laying Foundations for a Teaching Module [Master of Advanced Studies Paper].* Retrieved July 17, 2020, from https://archive-ouverte.unige.ch/unige:28305

Chang, T.-W., Kinshuk, Chen, N.-S., & Yu, P.-T. (2012). The effects of presentation method and information density on visual search ability and working memory load. *Computers & Education, 58*, 721-731.

Christodoulides, G., & Lenglet, C. (2014). Prosodic correlates of perceived quality and fluency in simultaneous interpreting. *SpeechProsody 7: Proceedings of the 7th international conference on Speech Prosody* (pp. 1002-1006). Dublin, IE: Science Foundation Ireland.

Crenicean, T. O. (2016). *Visual aids in SI: help or hindrance? A study of simultaneous interpreters' performance in the presence of dual input [Master's dissertation, London Metropolitan University].* Retrieved July 17, 2020, from https://www.academia.edu/31699337/

de Jong, T. (2009). Cognitive load theory, educational research, and instructional design: some food for thought. *Instructional Science, 38*, 105-134.

Deese, J. (1980). Pauses, prosody, and the demands of production in language. In H. W. Dechert, & M. Raupach, *Temporal Variables in Speech: Studies in Honour of Frieda Goldman-Eisler* (pp. 69-84). Berlin: De Grutyer Mouton.

Defrancq, B., & Plevoets, K. (2018). Over-uh-Load, Filled Pauses in Compounds as a Signal of Cognitive Load. In M. Russo, C. Bendazzoli, & B. (. Defrancq, *Making Way in Corpus-based Interpreting Studies* (pp. 64-64). Singapore: Springer Nature.

Desmet, B., Vandierendonck, M., & Defrancq, B. (2018). Simultaneous inter- pretation of numbers and the impact of technological support. In C. (. Fantinuoli, *Interpreting and technology* (pp. 13-27). Berlin: Language Science Press.

Duez, D. (1982). Silent and Non-Silent Pauses in Three Speech Styles. *Language and Speech, 25*(1), 11-28.

Duez, D. (2001). Caractéristiques acoustiques et phonétiques des pauses remplies dans la conversation en français. *Travaux Interdisciplinaires du Laboratoire Parole et Langage, 20*, 31-48.

Esteban Causo, J. (2011). Conference interpreting with information and communication technologies – experiences from the European Commission DG Interpretation. In S. Braun, & J. L. Taylor, *Videoconference and remote interpreting in criminal proceedings* (pp. 199-203). Guildford, UK: University of Surrey.

Flerov, C. (2013, October 30). *On Comintern and Hush-a-Phone: Early history of simultaneous interpretation equipment*. Retrieved February 15, 2020, from aiic.net: http://aiic.net/p/6625

Gaiba, F. (1998). *The origins of simultaneous interpretation: the Nuremberg trial .* Ottawa: University of Ottawa Press.

Garrett, N. (2016). How do Academic Disciplines Use Powerpoint? *Innovative Higher Education*(41), 365-380.

Gerver, D. (1975). A Psychological Approach to Simultaneous Interpretation. *Meta, 20*(2), 119-128.

Gile, D. (1991). The processing capacity issue in conference interpretation. *Babel, 37*(1), 15-27.

Gile, D. (1997). Conference Interpreting as a Cognitive Management Problem. In J. H. Danks, G. M. Shreve, S. B. Fountain, & M. K. McBeath, *Cognitive Processes in Translation and Interpreting* (pp. 196-214). Thousand Oaks, London, New Delhi: SAGE.

Goldman-Eisler, F. (1958). Speech analysis and mental processes. *Language and Speech, 1*, 59-75.

International Organization for Standardization [ISO]. (2016, December). *Simultaneous interpreting — Permanent booths — Requirements (ISO Standard No. 2603).* Retrieved July 17, 2020, from https://www.iso.org/standard/67065.html

Jesse, A., Vrignaud, N., Cohen, M. M., & Massaro, D. W. (2000). The processing of information from multiple sources in simultaneous interpreting. *Interpreting, 5*(2), 95-115.

Kahane, E. (2000, May 13). *Algunas consideraciones sobre calidad en interpretación.* Retrieved April 2, 2020, from aiic.net: https://aiic.net/p/198

Kahneman, D. (1973). *Attention and Effort.* Englewood Cliffs, NJ, USA: Prentice-Hall.

Kosslyn, S. M. (2007). *Clear and to the Point: 8 Psychological Principles for Compelling PowerPoint Presentations.* Oxford, UK: Oxford University Press.

Kurz, I. (2003). Physiological stress during simultaneous interpreting: A comparison of experts and novices. *Interpreters Newsletter*(12), 51-67.

Lambert, S. (2004). Shared Attention during Sight Translation, Sight Interpretation and Simultaneous Interpretation. *Meta, 49*(2), 294-306.

Lenglet, C., & Michaux, C. (2020). The impact of simultaneous-interpreting prosody on comprehension: An experiment. *Interpreting, 22*(1), 1-34.

Lu, S. A., Wickens, C. D., Prinet, J. C., Hutchins, S. D., Sarter, N., & Sebok, A. (2013). Supporting Interruption Management and Multimodal Interface Design: Three Meta-Analyses of Task Performance as a Function of Interrupting Task Modality. *Human Factors, 55*, 697-724.

Lu, S. A., Wickens, C. D., Sarter, N. B., Thomas, L. C., Nikolic, M. I., & Sebok, A. (2012). Redundancy Gains in Communication Tasks: A Comparison of Auditory, Visual, and Redundant Auditory-Visual Information Presentation on NextGen Flight Decks. *PROCEEDINGS of the HUMAN FACTORS and ERGONOMICS SOCIETY 56th ANNUAL MEETING*, (pp. 1476-1480).

Mack, G. (2002). New perspectives and challenges for interpretation: The example of television. In G. Garzone, & M. Viezzi, *Interpreting in the 21st Century* (pp. 203-213). Amsterdam, Netherlands; Philadelphia, PA: John Benjamins.

Mackiewicz, J. (2008). Comparing PowerPoint Experts' and University Students' Opinions about PowerPoint Presentations. *Journal of Technical Writing and Communication, 38*(2), 149-165.

Magnifico, C., & Defrancq, B. (2019). Self-repair as a norm-related strategy in simultaneous interpreting and its implications for gendered approaches to interpreting. *Target, 31*(3), 352-377.

Massaro, D. (1998). *Perceiving talking faces: From speech perception to a behavioral principle.* Cambridge, MA: MIT Press.

Mayer, R. E., & Johnson, C. I. (2008). Revising the Redundancy Principle in Multimedia Learning. *Journal of Educational Psychology, 100*(2), 380-386.

Mayer, R. E., Heiser, J., & Lonn, S. (2001). Cognitive Constraints on Multimedia Learning: When Presenting More Material Results in Less Understanding. *Journal of Educational Psychology, 93*(1), 187-198.

Moser, B. (1978). Simultaneous Interpretation: A Hypothetical Model and its Practical Application. In D. Gerver, & H. Sinaiko (Ed.), *Language Interpretation and Communication: NATO Conference Series. 6*, pp. 353-368. Boston: Springer.

Moser-Mercer, B. (2005). Remote Interpreting: Issues of Multi-Sensory Integration in a Multilingual Task. *Meta, 50*(2), 727-738.

Nowak, M. K., Speakman, E., & Sayers, P. (2016). Evaluating PowerPoint Presentations: A Retrospective Study Examining Educational Barriers and Strategies. *Nursing Education Perspectives, 37*(1), 28-31.

Pöchhacker, F. (1994). *Simultandolmetschen als komplexes Handeln.* Tübingen: Gunter Narr.

Pöchhacker, F., & Zwischenberger, C. (2010, March 15). *Survey on quality and role: conference interpreters' expectations and self-perceptions.* Retrieved March 28, 2020, from aiic.net: http://aiic.net/p/3405

Plevoets, K., & Defrancq, B. (2016). The effect of informational load on disfluencies in interpreting: A corpus-based regression analysis. *Translation and Interpreting Studies, 11*(2), 202-224.

Pollock, E., Chandler, P., & Sweller, J. (2002). Assimilating complex information. *Learning and Instruction, 12*, 61-86.

Pradas Macías, E. M. (2007). La incidencia del parámetro fluidez. In A. Collados Aís, E. M. Pradas Macías, E. Stévaux, & O. García Becerra, *La evaluación de la calidad en interpretación simultánea: parámetros de incidencia* (pp. 53-70). Granada, ES: Interlingua.

Pradas Macías, M. (2006). Probing quality criteria in simultaneous interpreting: The role of silent pauses in fluency. *Interpreting, 8*(1), 25-43.

Rayner, K., Pollatsek, A., Ashby, J., & Clifton, C. J. (2012). *Psychology of Reading: Second Edition.* New York; Hove: Taylor and Francis.

Rayner, K., Slattery, T. J., Drieghe, D., & Liversedge, S. P. (2011). Eye movements and word skipping during reading: Effects of word length and predictability. *Journal of Experimental Psychology: Human Perception and Performance, 37*(2), 514-528.

Rennert, S. (2008, March). Visual Input in Simultaneous Interpreting. *Le verbal, le visuel, le traducteur, 53*(1), 204-217.

Riggenbach, H. (1991). Toward an understanding of fluency: A microanalysis of nonnative speaker conversations. *Discourse Processes, 14*(4), 423-441.

Seeber, K. G. (2011). Cognitive load in simultaneous interpreting: Existing theories - new models. *Interpreting, 13*(2), 176-204.

Seeber, K. G. (2012). Multimodal Input in Simultaneous Interpreting: An eye-tracking experiment. In L. Zybatov, A. Petrova, & M. Ustaszewski, *Proceedings of the 1st International Conference TRANSLATA* (pp. 341-347). Frankfurt am Main: Peter Lang.

Seeber, K. G. (2013). Cognitive load in simultaneous interpreting: Measures and methods. *Target, 25*(1), 18-32.

Seeber, K. G. (2015). Simultaneous Interpreting. In H. Mikkelson, & R. Jourdenais, *Routledge Handbook of Interpreting* (pp. 79-95). Oxon and New York: Routledge.

Seeber, K. G. (2017). Multimodal Processing in Simultaneous Interpreting. In J. W. Schwieter, & A. Ferreira, *The Handbook of Translation and Cognition.* John Wiley & Sons, Inc.

Seeber, K. G., & Delgado Luchner, C. (2020). Simulating Simultaneous Interpreting with Text: From Training Model to Training Module. In M. D. Rodríguez Melchor, I. Horváth, & K. Ferguson, *The Role of Technology in Conference Interpreter Training* (pp. 129-151). New York: Peter Lang.

Seeber, K. G., & Kerzel, D. (2011). Cognitive load in simultaneous interpreting: Model meets data. *International Journal of Bilingualism, 16*(2), 228-242.

Setton, R. (2003). Models of the interpreting process. In A. Collados Aís, & J. A. Sabio Panilla, *Avances en la investigación sobre la interpretación* (pp. 29-91). Granada: Editorial Comares.

Setton, R., & Motta, M. (2007). Syntacrobatics: quality and reformulation in simultaneous-with-text. *Interpreting, 9*(2), 199-230.

Shlesinger, M. (1994). Intonation in the production and perception of simultaneous interpretation. In S. Lambert, & M.-M. B., *Bridging the gap: Empirical research in simultaneous interpretation* (pp. 225-236). Amsterdam, NL: John Benjamins.

Stark, D., & Paravel, V. (2008). PowerPoint in Public: Digital Technologies and the New Morphology of Demonstration. *Theory, Culture & Society, 25*(5), 30-55.

Sweller, J. (2010). Element Interactivity and Intrinsic, Extraneous, and Germane Cognitive Load. *Educational Psychology Review, 22*, 123-138.

Tissi, B. (2000). Silent pauses and disfluencies in simultaneous interpretation: A descriptive analysis. *The Interpreters' Newsletter, 10*, 103-127.

Tufte, E. (2003). *The Cognitive Style of Powerpoint.* Cheshire: Graphics Press.

Ure, J. (1971). Lexical density and register differentiation. In G. Perren, & J. L. Trim, *Applications of Linguistics* (pp. 443-452). London: Cambridge University Press.

Viaggio, S. (1996). Kinesics and the simultaneous interpreter: The advantages of listening with one's eyes and speaking with one's body. In F. Poyatos, *Nonverbal Communication and Translation: New perspectives and challenges in literature, interpretation and the media* (pp. 283-293). Amsterdam, Netherlands; Philadelphia, PA, USA: John Benjamins.

Wickens, C. (1984). Processing Resources in Attention. In R. Parasuraman, & D. Davies, *Varieties of Attention* (pp. 63-102). New York: Academic Press.

Wickens, C. (2002). Multiple resources and performance prediction. *Theoretical Issues in Ergonomics Science, 3*(2), 159-177.

APPENDICES

Appendix 1: Full PowerPoint Presentation on Bulgaria

Bulgaria

History

In the late 7th century, the Bulgars moved to the area we know today as Bulgaria.

These tribes came from Central Asia.

For several centuries, Bulgaria experienced conflicts with the Byzantine Empire.

At the end of the 14th century, Bulgaria was overrun by the Ottomans.

The Ottomans ruled the country for 5 centuries.

History

By 1910, Bulgaria had achieved independence from the Ottoman Empire.

After World War II, the country came under Soviet influence.

It became a People's Republic in 1946.

Eventually, in 1990, the communist regime ended.

Consequently, Bulgaria became a member of NATO in 2004.

It also joined the EU in the spring of the same year.

Geography

Bulgaria is located in Eastern Europe and is one of the Balkan states.

It borders the Black Sea to the East and Serbia to the West.

It also borders Greece to the South and Romania to the North.

It covers 121,312 square kilometres (slightly more than 2.5 times the size of Switzerland).

It has a coastline of 254 kilometres.

It is the 119th largest country in the world.

Geography

Bulgaria's highest peak stands at 2925 metres.

Two of the country's important topographical features are the Danubian Plain and the Balkan mountains.

The Danube and the Iskar are two of the country's best-known rivers.

The climate is very dynamic.

Bulgaria is positioned at the convergence point between the Mediterranean and continental air masses.

Geography

Summers are hot and winters are cold and damp.

The annual average rainfall is about 700 millimetres per square metre.

In winter, the average temperature is -1º Celsius and in summer, 19º Celsius.

The average monthly sunshine period is 64 hours in December and 286 hours in July.

Geography

The population of Bulgaria numbers 7,182,000 (approximately ⅘ of the population of Switzerland).

Of these, 84.8% are Bulgarians, while 8.8% are Turks and 4.9% Roma.

Bulgarian is the official language.

About 72% of Bulgarians reside in urban areas.

Approximately ⅙ of the population is concentrated in the capital, Sofia.

Flag

The flag of Bulgaria is a tricolour consisting of three equal-sized horizontal bands.

White symbolizes peace, green stands for the fertility of the Bulgarian land and red for bravery.

The current flag was re-established in 1991.

Economy

The country's GDP per capita is $9,780 according to the International Monetary Fund.

Before World War II, Bulgaria's economy was based on agriculture.

The private sector accounts for 70% of GDP.

The country's currency is the Lev.

The mining & tourism industries are key sectors of Bulgaria's economy.

The country is Europe's fifth largest coal producer.

Government

Bulgaria (officially the Republic of Bulgaria) is a parliamentary democracy.

The system is similar to that in other European countries.

Currently, the President is Mr. Rumen RADEV and the Prime Minister, Mr. Boyko BORISOV.

In Bulgaria, the Prime Minister is elected by universal suffrage for a five-year term.

Culture

Bulgaria's culture is influenced by Thracian and Slavic heritage.

Famous Bulgarians include writer Tzvetan Todorov and artist Christo.

Nestinarstvo is a traditional Bulgarian dance performed in the mountains:

Barefoot dancers from the Southeast of the country dance on hot coals.

Appendix 2: Light PowerPoint Presentation on Bulgaria

Bulgaria

History

7^{th} century: Bulgars to Bulgaria

Tribes from Central Asia

Conflicts with Byzantine Empire

14^{th} century: Ottomans

Rule for 5 centuries

History

1910: independence from Ottoman Empire

After WWII: Soviet influence

1946: People's Republic

1990: end of communist regime

2004: member of NATO

2004: member of EU

Geography

Eastern Europe, one of the Balkan states

East: Black Sea, West: Serbia

South: Greece, North: Romania

Area: 121,312 km^2 (over 2.5 times Switzerland)

Coastline: 254 km

119th largest country

Geography

Highest peak: 2925 m

Topographical features: Danubian Plain, Balkan mountains

Best-known rivers: Danube, Iskar

Climate: dynamic

Positioned between Mediterranean and continental air masses

Geography

Summers: hot, winters: cold and damp

Annual average rainfall: approx. 700 mm/m^2

Average temperature: winter -1º C, summer 19º C

Average sunshine/month: 64h December, 286h July

Geography

Population: 7,182,000 (approx. ⅘ of Switzerland)

84.8% Bulgarians; 8.8% Turks; 4.9% Roma

Official language: Bulgarian

Urban areas: approx. 72%

Capital (Sofia): approx. ⅙

Flag

Tricolour: equal horizontal bands

white (peace); green (fertility); red (bravery)

Re-established 1991

Economy

GDP per capita: $9,780 (IMF)

Before WWII: agriculture

Private sector: 70% GDP

Currency: Lev

Key sectors: mining, tourism

Europe's 5th coal producer

Government

Republic of Bulgaria: parliamentary democracy

Similar to other European countries

President: Mr. Rumen RADEV, Prime Minister: Mr. Boyko BORISOV

Prime Minister elected by universal suffrage for 5-year term

Appendix 3: Full PowerPoint Presentation on Estonia

Estonia

History

In the early 9th century, the Vikings invaded the region that is known today as Estonia.

These peoples were from Northern Scandinavia.

For many years, Estonia witnessed war with the Kingdom of Norway.

At the beginning of the 13th century, Estonia was occupied by Teutons.

The Teutons influenced the country for 7 centuries.

History

By 1918, Estonia had become independent from Germany and Russia.

During World War II, the country came under Soviet dominion.

It became a Socialist Republic in 1940.

Finally, in 1991, the Soviet Union collapsed.

Subsequently, Estonia became a member of NATO in 2004.

It also joined the EU in the autumn of the same year.

Geography

Estonia is situated in Eastern Europe and is one of the Baltic states.

It borders the Baltic Sea to the West and Russia to the East.

It also borders Latvia to the South and the Gulf of Finland to the North.

It covers 45,327 square kilometres (slightly more than 1.5 times the size of Switzerland).

It has a coastline of 3,794 kilometres.

It is the 129th biggest country in the world.

Geography

Estonia's highest point is at 318 meters.

Among the country's topographical features are the Baltic islands and the Pandivere Upland.

The Pärnu and the Võhandu are two of the country's most important rivers.

The climate is rather cold.

The country is located in the transition zone between the maritime and continental climates.

Geography

Winters are cold and summers are cool and rainy.

The annual average precipitation is around 600 millimetres per square metre.

In winter, the average temperature is -7º Celsius and in summer, 17º Celsius.

The average monthly sunshine period is 18 hours in December and 299 hours in June.

Geography

The population of Estonia is 1,319,000 (approximately ⅙ of the population of Switzerland).

Of these, 68.8% are Estonians, while 1.8% are Ukrainians and 3.4% others.

Estonian is the official language.

Around 69% of Estonians live in urban areas.

Almost ⅓ of the population is concentrated in the capital, Tallinn.

Flag

The flag of Estonia is a tricolour consisting of three equal-sized horizontal bands.

Blue symbolizes the sky, black stands for attachment to the homeland and white for purity.

The current flag was re-adopted in 1990.

Economy

The country's GDP per capita is $22,420 according to the International Monetary Fund.

Before the Second World War, Estonia's economy was based on agriculture.

The service sector employs over 60% of the workforce.

The country's currency is the Euro.

The shale oil & technology industries are important branches of Estonia's economy.

The country is the world's second largest oil producer.

Government

Estonia (officially the Republic of Estonia) is a parliamentary republic.

The system is similar to that in other European countries.

Now, the President is Mrs. Kersti KALJULAID and the Prime Minister, Mr. Jüri RATAS.

In Estonia, the Prime Minister is nominated by the President for a five-year term.

Culture

Estonia's culture is influenced by Finnish and German culture.

Famous Estonians include composer Arvo Pärt and singer Kerli.

Laulupidu is a well-known Estonian Song Festival, held in the capital:

Amateur choirs from all over the country perform in front of a wide audience.

Appendix 4: Light PowerPoint Presentation on Estonia

Estonia

History

9th century: Vikings to Estonia

Peoples from Northern Scandinavia

War with Kingdom of Norway

13th century: Teutons

Influence for 7 centuries

History

1918: independence from Germany and Russia

During WWII: Soviet dominion

1940: Socialist Republic

1991: collapse of Soviet Union

2004: member of NATO

2004: member of EU

Geography

Eastern Europe, one of the Baltic states

West: Baltic Sea, East: Russia

North: Gulf of Finland, South: Latvia

Area: 45,327 km^2 (over 1.5 times Switzerland)

Coastline: 3,794 km

129th biggest country

Geography

Highest point: 318 m

Topographical features: Baltic islands, Pandivere Upland

Most important rivers: Pärnu, Võhandu

Climate: cold

Located between maritime and continental climates

Geography

Winters: cold, summers: cool and rainy

Annual average precipitation: approx. 600 mm/m^2

Average temperature: winter -7º C, summer 17º C

Average sunshine/month: 18h December, 299h June

Geography

Population: 1,319,000 (approx. ⅙ of Switzerland)

68.8% Estonians; 1.8% Ukrainians; 3.4% others

Official language: Estonian

Urban areas: approx. 69%

Capital (Tallinn): approx. ⅓

Flag

Tricolour: equal horizontal bands

blue (sky); black (attachment to homeland); white (purity)

Re-adopted 1990

Economy

GDP per capita: $22,420 (IMF)

Before WWII: agriculture

Service sector: 60% workforce

Currency: Euro

Important branches: shale oil, technology

World's 2nd oil producer

Government

Republic of Estonia: parliamentary republic

Similar to other European countries

President: Mrs. Kersti KALJULAID, Prime Minister: Mr. Jüri RATAS

Prime Minister nominated by President for 5-year term

Culture

Finnish and German influence

Famous Estonians: composer Arvo Pärt, singer Kerli

Laulupidu – song Festival in capital:

Amateur choirs in front of a wide audience