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Master's Thesis (MA)

Excuse me! Was it 7,559 or 759? –

Memory strategies in sign language interpreting

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ABSTRACT

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Abstract:

Sign language interpreting often occurs in a simultaneous mode, which requires interpreters to retain some information while processing other information, thus it is a complex cognitive activity that involves a heavy cognitive load. Numbers and names have been suggested as being some of the most challenging items to retain and recall during the interpreter's time lag and have therefore been chosen as the focus of this study by asking the following research question:

How do sign language interpreters describe retention and recall strategies during simultaneous interpreting of numbers and proper names?

This qualitative study consists of a retrospective semi-structured interview with 8 Danish sign language interpreters, conducted immediately after interpreting a source text containing a high amount of numbers and proper names. The interpreters are all trained sign language interpreters and have a minimum of 8 years experience working as full time interpreters.

By analysing the results several commonalities and patterns arise from the responds. Factors that influence the ability and the necessity to retain information seem to be dependent on length of the time lag, the ability to contextualise the information, attention, and effort. Phonological and visual recall strategies are efficient tools used by the participants in order to retain and recall the item correct.
It is important to be aware of the inherent limitations of reaching a full and correct result from this empirical study. This particularly relates to the fact that the participants are asked to consider how they *think* they recall the to-be-remembered items, which by its very nature adds an element of uncertainty to the resulting findings. However, the answers gathered indicate signs of patterns concerning methods and strategies to retaining and recalling, in this case, numbers and proper names in particular, which indicates that further investigations into the field is necessary. Investigating how interpreters approach the interpreting process may enable us to train interpreters and interpreter students in enhancing their cognitive abilities.

Keywords Memory, short-term memory, working memory, phonological memory, visuospatial memory, phonological similarity effect, sign loop, mental models, attention, contextualisation phonological recall, visual recall.

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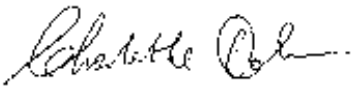
Declaration.

I declare that the thesis embodies the results of my own work and has been composed by myself. Where appropriate within the thesis I have made full acknowledgement to the work and ideas of others or have made reference to work carried out in collaboration with other persons. No other sources or tools have been used other than those cited in the bibliography. I understand that as an examination candidate I am required to abide by the examination regulations and to conform to my university's regulations, discipline and ethical policy.



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List of abbreviations

TBR	To-be-remembered
ST	Source text
SL	Source language
TT	Target text
TL	Target language
STM	Short-term memory
WM	Working memory
LTM	Long-term memory
LT-WM	Long-term working memory

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1. Introduction

Sign language interpreting often occurs in a simultaneous mode (Napier, Rohan, & Slatyer, 2005, p. 188), which indicates that the interpreter's mind is at constant work listening to the source language (SL) message, processing the message, and producing the target language (TL) message while listening to a continuous flow of new SL information. Interpreters retain some information temporarily while processing other information (Moser-Mercer, 2010, p. 263-264), and this is termed a time lag. In order for the interpreter to render a meaningful unit in the TL they need to gather sufficient information from the SL (Isham, 1992, p. 192). Cokely's (1986) study concerning the influence of time lag on the quality of the output in simultaneous sign language interpreting, showed that greater time lag resulted in fewer miscues. Cokely concluded that "[t]he primary reason for this is the quantity of the SL message available to the interpreter. The greater the lag time, the more information available; the more information available, the greater the level of comprehension" (p. 24). Another aspect requiring the interpreter to lag behind is the syntactic differences between the SL and the TL. Dissimilarities in syntactic structures require the processing of larger segments of information (Kirchhoff, 2002, p. 113), so one may posit that, if the time lag is too short, the interpretation will become a transliteration or a direct transfer of the spoken language. Direct transfer refers to the act of transferring "something unchanged" (Schjoldager, Gottlieb, & Klitgård, 2008, p. 92). Thus simultaneous interpreting can rightly be described as a complex cognitive activity that involves a heavy cognitive load (Gile, 1999; Macnamara, Moore, Kegl, & Conway, 2011, p. 121) and as such it is relevant to look into how interpreters allocate their available processing capacity.

1.1 Memory and interpreting

There is a consensus that the cognitive activity taking place during the interpreting process relies heavily on short-term memory (STM) or working memory (WM). Timarova (2008) declares WM to be "one of the cognitive cornerstones underlying simultaneous interpreting" (p.1). Through the years, a number of empirical studies have specifically focused on working memory capacity (WMC) and interpreting (Boutla, Supalla, Newport, & Bavelier, 2004; Darò & Fabbro, 1994; Gerver, 1974; Isham, 1994; Liu, Schallert, & Carroll, 2004; Padilla, Bajo, & Macizo, 2005; J. Wang, 2013). The most prevalent measurement is a memory span task, where subjects are required to recall words or digits in different positions, either recalling items in the order they were presented, i.e. serial recall, or as free recall. Thereupon WMC is calculated by the number of correct recalled items. Memory span tasks may reveal details about an individual's cognitive abilities and capacity, but they only examine how much participants can recall and not how they recall. Timarova (2008) states that "empirical studies of working memory rarely include interpreting tests" (p. 20). Similarly, the author has been unable to find studies that required test participants to simultaneously interpret while performing WMC tests.

Van Dijk, Christoffels, Postma, & Hermans (2012) suggest that "The simultaneity of language comprehension and production during interpreting makes it difficult for interpreters to retain information from the source language, as it hinders the retention of information in short-term memory through phonological processes such as active rehearsal" (p. 349). This posits that phonological processes are the only option when it comes to rehearsing information in memory. The aim of this study is to investigate whether other strategies than active rehearsal present themselves as methods for retaining and recalling information.

In her study, Wang (2013) presented a group of Auslan (Australian Sign language) interpreters with memory span tasks. The post-task interview required that they considered the

applicability of WM span tasks for measuring the particular type of memory required when performing simultaneous interpreting. In answering, 71 % of the questioned participants "[…] considered that the WM span tasks did not measure the type of memory required in simultaneous interpreting" (p. 77). It was argued that this might be because simultaneous interpreting requires retention of meaningful and coherent sentences and concepts whereas the WM span task requires memorizing unrelated words and signs. However, her data displays the usage by several of the interpreters of methods such as phonological, visuospatial as well as semantic strategies to recall the to-be-remembered words/signs (p. 74). From this information, it is deemed reasonable for this study to be based on the assumption that interpreters make use of similar strategies while interpreting.

1.2 Increased difficulty and interpreting

Unfortunately for the topic of this study, there seems to be little research into how interpreters deal with processing information on increased levels of difficulty in the ST. Increased levels of difficulty can include instances of dense information, unfamiliar topics, fast delivery, which can include specific items such as numbers, names, technical terms, etc. Gile (2002) points to numbers and names as being some of the interpreters' weaknesses. He claims that even interpreters with high professional reputation that have good working conditions, such as no noise, well understood pronunciation of the ST, normal speed of speech, no complexity of syntactic structure in the ST or technical complexity, are found to produce errors and omissions in numbers and names (p. 163). In an analysis of an English-French interpretation Lederer (2002) finds the same obstacles with numbers or figures. She claims that when the interpreter lags behind and the speaker utters a number, the interpreter abruptly catches up with the speaker to translate the number (p. 136), thus aborting a current translation he/she is working on. This may be one strategy to avoid retaining the information in memory for a longer period, but in some circumstances it will have an effect on the

quality of the interpretation. The present study is motivated by interest and curiosity about the utilisation by sign language interpreters of their cognitive abilities and capacities during the interpreting process.

1.3 Aim of study

Given that interpreters often find it particularly challenging to memorise and recall very specific information such as numbers and names, these are the to-be-remembered (TBR) items that are the focus of this study. For the sake of the study, names have been limited to proper names (for a definition see chapter 3).

A psychologist with expertise in cognitive psychology would have the proper background to examine this field. Since this is not an option the author seeks to investigate the area by an indirect approach, which involves asking interpreters about their reflections on what goes on in their minds.

This empirical study will seek to document the ways in which sign language interpreters describe and characterise their methods for recalling numbers and proper names during the interpreting process, by asking the following research question:

How do sign language interpreters describe retention and recall strategies during simultaneous interpreting of numbers and proper names?

In conclusion, it is important to be aware of the inherent limitations of reaching a full and correct result from this empirical study. This particularly relates to the fact that the participants are asked to consider how they *think* they recall the TBR items, which by its very nature adds an element of uncertainty to the resulting findings. However, should answers gathered indicate signs of

patterns emerging concerning methods and strategies to retaining and recalling, in this case, numbers and proper names in particular, this could very well prove grounds for further investigations into the field. So far, research into interpreting has focused mainly on capacity, but if, instead, focus were shifted to investigating how to approach the process, we will be able to examine the best practise and ultimately train interpreters and interpreter students with the purpose of enhancing their abilities.

Finally, a presentation of the organisation of this thesis. After this introduction, chapter 2 will present theoretical material concerning memory and memory in relation to interpreting. In chapter 3 method and procedure for data collection will be described along with method and procedure for data analysis. Next, chapter 4, will consist of a presentation of the results from the data analysis, and allow for extraction of patterns, should any present themselves. Finally, chapter 5 will see a discussion of results presented in chapter 4, and the significance of these results will also be presented and discussed, ultimately leading to suggestions for further research.

2. Literature review

This chapter will describe the literature on working memory (WM), long-term memory (LTM), and how sign language and interpreting relates to memory.

2.1 Memory

Memory is denoted as the process during which information is encoded, stored, and retrieved. Typically a distinction is made between short-term memory (STM) and long-term memory. STM is the process by which you retain information for only a short period of time without creating the neural mechanisms for later recall. LTM occurs when information that forms our experience, knowledge, and beliefs is permanently stored (Ericsson & Kintsch, 1995, p. 222). Thus, once stored, it can be recalled weeks, months, or years later. In the 1970's Baddeley and Hitch (1974) proposed the concept of working memory. Previously, STM was viewed as a simple faculty for storing and maintaining information, but Baddeley's WM model (fig. 1) incorporated executive control of the cognitive processes available. WM has also been related to reading comprehension, language comprehension, reasoning, problem solving, among others (Timarova, 2008, p. 2-3). Within the field, however, it seems that the usage of the two terms, STM and WM, is not consistent with regard to creating a clear distinction, resulting in occasional overlap in meaning. See Aben et al. (2012, p. 2) for different hypothetical models of the relation between STM and WM. When referring to authors and their usage of the terms, I shall adhere to the notions used, but within the framework of this study, the term WM will take precedence.

Subsequent models of WM have since been introduced, most of which are directed at adding elements to Baddeley's original concept, particularly with regard to the process of interaction between WM and LTM. Three models; Baddeley's multi-component model, Ericsson & Kintsch's long-term WM model, and Cowan's embedded process model of WM are compared to

three interpreting models by Timarova (2008). She concludes that the models differ in a number of ways. Significantly, they differ in a perception of WM as either a structural or a functional entity, on the assumed capacity of WM, and in their treatment of an executive component that, among others, control and manage attention-sharing (p. 10-11). In relation to the purpose of this paper, only the presumably relevant concepts of WM and LTM in relation to sign language interpreting have been extracted below. It may be important be observe the fact that several models will refer to similar ideas, only from different perspectives.

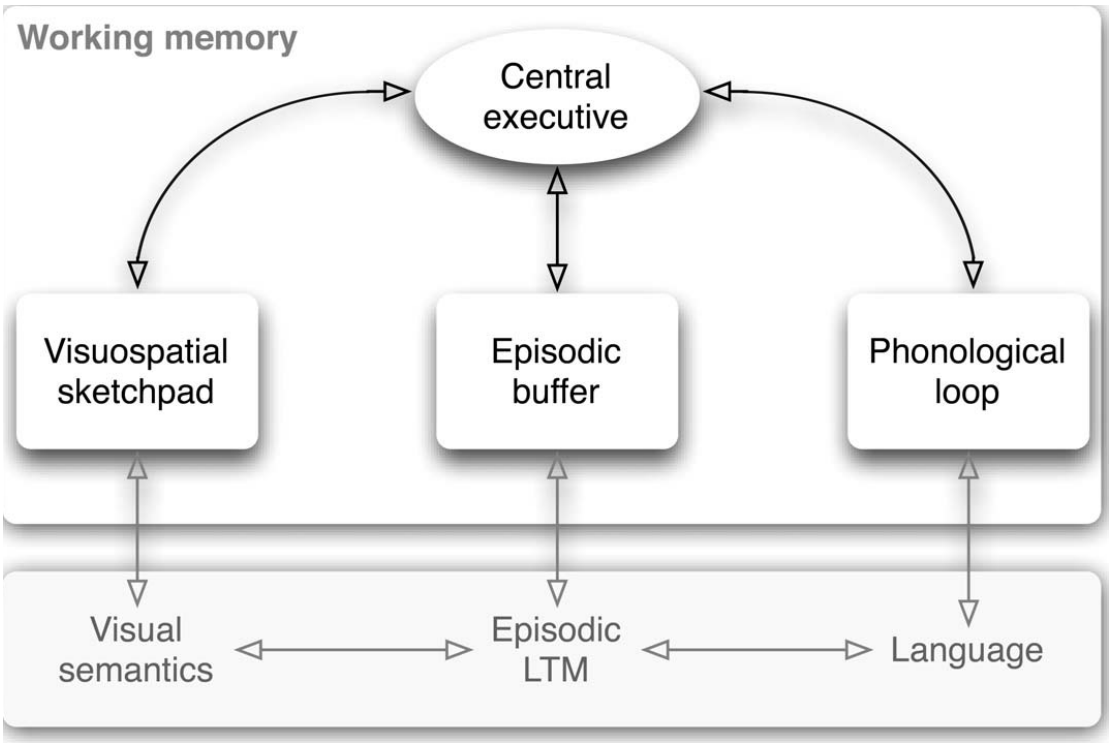

Fig. 1. The multi-component model of working memory (RepovŠ & Baddeley, 2006, p. 6)

2.2 Phonological memory

Phonological memory was introduced by Baddeley & Hitch (1974), as part of their multi-component working memory model (fig. 1). They proposed that spoken words were stored according to how they sound, as opposed to storing in terms of meaning. Their WM model consists

of a phonological loop and a visuospatial sketchpad, both of which depend on a central executive, coordinating the two 'slave systems' (see chapter 2.3 and 2.6). In turn, the phonological loop consists of two sub-systems; a phonological short-term buffer and an articulatory rehearsal routine which works to refresh information by subvocalization, a usage of an 'inner voice' (Baddeley, 2010, p. 138). The registered information is suggested to fade after approximately 2 seconds, after which it becomes irretrievable due to trace decay. This statement is supported by Boutla et al. (2004, p. 2), adding however, that the storage buffer can last from 2 up to 4 seconds (Ibid, p. 5). Also, not being able to rehearse the information has a negative effect on the so-called memory traces (Chincotta & Underwood, 1997) resulting in reduction of memory span. This effect is displayed most clearly in articulatory suppression tasks where participants are required to overtly repeat unrelated words throughout a memory span task and in this way interfere with the rehearsal systems (Darò & Fabbro, 1994, p. 366). In spoken language interpreting, this could present an issue seeing as the interpreter is articulating the TL concurrently, but how it affects the sign language interpreters working between two different modalities is yet to be developed on.

It seems that some interpreters use a speech-based code when performing signed memory span tasks thus moving from a visual receptive code to storing that information through a phonological code (Van Dijk, Christoffels, Postma, & Hermans, 2012, p. 347; Wang, 2013, p. 81). In her ph.D. thesis, Wang (2013) investigated working memory and sign language interpreting. The participants were Australian sign language interpreters working between English and Auslan. Upon carrying out Auslan and English memory span tasks, post-task interviews were undertaken in order for participants to document memory strategies. One participants described having covertly recited "sleep, third, problem, sleep, third, problem" in spoken English, when performing what was in fact an Auslan memory span task (p. 74). Correspondingly, Van Dijk et al. (2012) observed the same tendency in their study of Dutch sign language interpreters (p. 347). This presents an interesting

perspective, seeing that interpreters in this early stage of the process seem to have already translated the sign into spoken English. Finding interpreters who reversely go through a process of receiving verbal input and storing it in their visual memory would assist in proving that interpreters make use of multiple codes to store and retain information in WM. However, so far no studies researching this particular process have been forthcoming.

Furthermore, Wang's study showed that interpreters used mouthing in order to memorize the TBR words, hence making use of subvocalization (Wang, 2013, p. 74). Interestingly, they describe using initial sounds in order to recall words, "such as /p/, /t/, /k/ for "pork, term, cage"" (Ibid). This suggests that interpreters possibly recall tones as opposed to entire words. While these different strategies for memory and recall strategies may be carried out while merely listening, it remains to be seen whether it is possible while concurrently producing a TT.

2.2.1 Phonological similarity effect

The phonological similarity effect refers to the concept that phonologically similar TBR items will result in increased confusability and lower recall than items that are phonologically dissimilar, due to the absence of interference (Conrad & Hull, 1964; Copeland & Radvansky, 2001; B. N. Macnamara, Moore, & Conway, 2011). In the study undertaken by Macnamara et al. (2011) it is suggested that rhyming creates a list retrieval cue (p. 1184). From the perspective of interpreting this presents intriguing possibilities, as the phonological similarity inherent in rhymes may aid retention as the retrieval cues increase in durability. One could imagine an instance where the interpreter was able to develop an individual rhyming pattern prior to initiating an assignment, possibly increasing efficiency in retrieval cues leading to greater correctness in recall. Wang (2013) found that in some instances participants recalled a phonologically similar word instead of the correct one (p. 74). Similarly, regarding signs, some instances saw participants recalling

phonologically similar signs, exemplified by the Auslan sign for DELICIOUS and LUCKY, two signs merely differing in location (p. 76). Further investigation into this particular field may possibly throw up further clues to the course of the interpreting process, ultimately leading to improvement through raised awareness.

2.3 Visuospatial memory

In Baddeley's multicomponent WM model he refers to visuo-spatial memory as a visuospatial sketchpad that stores spatial information, visual images, e.g. shapes, figures, colours, and possibly kinesthetic information (Baddeley 2003, p. 200). In a recent study by Allen et al. (2014) this characterisation of visual WM is altered slightly due to a recency effect. They suggest that visual WM consists of two components, one where items that are encountered recently are retained in an automatic manner and the other where items encountered earlier rely on a certain amount of executive control (p. 1506). Other results imply that visual memory for colour is superior compared to visual memory for shape (Allen, Baddeley, & Hitch, 2006, p. 311). Though this is Baddeley's concept, it seems an incomprehensive definition of the idea.

Wang (2013) reports that a total of 12 participating professional interpreters mentioned using visuospatial strategies to retain the TBR words or signs. The strategies were visualizing the object, the Auslan sign, the written form of the TBR item, picturing the whole sentence, or spatial ordering (p. 76). One of the participants describes visualizing a cat flicking its tail upon hearing the sentence "The cat became angry and started to flick its tail" (Ibid). This is similar to the concept of mental models (Johnson-Laird, 1983; Setton, 1999, p. 15-17). Emmorey, Kosslyn, & Bellugi (1993) define the concept as image generation; "the process whereby an image (i.e., a short-term visual memory representation) is created on the basis of information stored in long-term memory." (p.141). In fact, an image generation initially formed the basis for baddeley

developing his WM model; he describes having quasi-visual images of a football game while listening to it on the radio (A. Baddeley, 2003, p. 200). From the perspective of interpreting, mental models come to represent context and meaning disassembled from the ST (Setton, 1999, p. 15). Unfortunately, the literature presents only limited documentation of sign language interpreters using mental models and WM while performing simultaneous interpretation. Timarova (2008) mentions "…information from several sources can be processed in parallel" (p. 12). Whether this includes the usage of a mental model is unfortunately not quite clear. It would seem logical to conclude that mental models and knowledge structures are closely related, given that not understanding the input would result in difficulties, if not the impossibility of constructing a mental representation of the received input.

Furthermore, Wang (2013) mentions the concept of "chaining"; a semantic recall strategy of creating a story-line from the TBR items, as (p. 77). Chaining may be an option in memory span tasks presenting only isolated items, however, it seems highly unlikely for simultaneous interpreters to create a different and independent story-line than the ST during the actual interpreting process.

2.3.1 Sign loop

A concept developed by Wilson & Emmorey (1997) is the sign loop, reminiscent of the phonological loop, but based on manual articulation. They describe that the sign loop contains a buffer, which holds information on the phonological structures of the sign language, i.e handshape, orientation, place of articulation, and movement. Furthermore, it holds a sign-based rehearsal system that refreshes the information. The sign loop storage buffer may possibly only lasts for one second (Boutla et al., 2004, p. 5) unless rehearsed. This, however, seems dependent on the various recall tasks being compared, e.g. serial recall span tasks or free recall span tasks. The sign-based

system is affected by a manual articulatory suppression effect similar to articulatory suppression. By presenting irrelevant visual input, such as pseudo-signs, a disruption to visual representations held in WM followed (Wilson & Emmorey, 2003), resulting in the manual articulatory suppression effect. The pseudo-signs disrupted more than non-linguistic shapes, which may indicate that the sign loop and Baddeley's visuospatial sketchpad are indeed two separate phenomena. At the current stage of research into the area, the exact relationship between the sign loop and Baddeley's visuospatial sketchpad is not clearly defined.

2.4 Long-term working memory

Ericsson & Kintsch (1995) put forth two different concepts to be distinguished from each other; long-term working memory (LT-WM) and short-term working memory (ST-WM). They are based on the assumption that accessing sentences stored in LTM is more time consuming than accessing sentences in STM (p. 215). Thus a sole retrieval from LTM would be too slow, and would not meet the demands of a rapid and efficient retrieval. At the same time limitations in capacity of STM are met through an efficient and rapid retrieval from LT-WM. LT-WM works as an extended WM for LTM (p. 223). Ericsson & Kintsch acknowledge the existence of STM and WM models and rather than replacing these models, an attempt is made to extend and add to said models. In particular, attention is directed towards the ways in which working memory supports specific skilled activities, ranging from instances of highly specialised activities, such as expert chess playing, to rather mundane, yet very skilled activities such as reading and comprehension. Ericsson & Kintsch present a set of three criteria for achieving extended WM capacity: (1) Subjects must be in possession of a large amount of relevant knowledge in order to store the information in LTM in a rapid manner, (2) They must be familiar with the particular task, and be able to anticipate the retrieval of relevant information, and (3) associate information with appropriate retrieval cues (p. 215-216). This act of

association allows the individual to activate the retrieval cue at a later time and consequently gain access to the desired information in LTM. The instance of reading a text is presented as one example of information being stored in LTM. Re-reading the last sentence of the text activates retrieval cues for retrieval from LTM (p. 225). One would expect that in preparing for an interpreting assignment, context-related information, lexical terms and signs, etc. would be made associable with appropriate retrieval cues and stored in LTM for later retrieval. Ericsson & Kintsch display the opinion that "…through practice, working memory based on storage in and retrieval from LTM could attain speeds similar to those for STM" (p. 217). Should this in fact be the case, this would be of great consequence for simultaneous interpreting, since fast access to lexical and semantic information is a prerequisite for this particular field of work. Retrieval cues would enable efficient retrieval of chunks of information from LTM, particularly beneficial when working with increased lag time (Pöchhacker, 2004, p. 133).

Yet another factor with great influence on the success of LT-WM is the concept of familiarity, as it increases the quality of the performance (Ericsson & Kintsch, 1995, p. 214). This is consistent with Napier's suggestion that interpreters with a higher degree of familiarity or prior knowledge of the subject, have the tools to infer meaning from what they cannot hear properly (2004, p. 133).

2.5 Episodic memory

Episodic memory is described as controlled by the central executive and is responsible for binding together information from different sources; thus it can integrate multimodal information (A. Baddeley, 2000, p. 421). Consequently, episodic memory, or as denoted by Baddeley; the episodic buffer, through the gathering of information from both WM and LTM components, ultimately constructs coherent scenes or episodes (RepovŠ & Baddeley, 2006, p. 15-16). As an example; while

reading a written text, episodes are constantly constructed and linked to previously constructed episodes, e.g. other parts of the text (Ericsson & Kintsch, 1995, p. 232). According to Ericsson & Kintsch these constructed episodes are stored in LTM and subsequently cues are used to retrieve those structures from LTM (Ibid). Padilla, Bajo, & Macizo (2005) propose that transfer to episodic memory may be enhanced in interpreters, enabling them to retain information from the SL in episodic memory (p. 217). In her study, Wang (2013) claims that episodic memory was made use of during the Auslan memory span task as some subjects bound the "…phonological features of Auslan signs to their underlying semantic representations and to their English equivalents" (p. 104). In fact, this could be an instance of mere translation, and unfortunately it is not quite evident whether Wang is of the opinion that interpretation takes place in episodic memory as it occurs between two languages with different modalities. Van Dijk et al. (2012) are more in alignment with Padilla et al. when they argue: "An enhanced ability to bind information in episodic memory will reduce interpreters' reliance on short-term memory for the retention of information in the source language during interpreting, and will positively affect the quality of their interpretations" (p. 348). Episodic memory, the term suggested by Tulving (1989) and Baddeley's (2000) episodic buffer are terms as yet lacking clear definitions. Episodic memory seems to be a means of contextualising information and possibly relate chunks of information to each other.

2.6 Executive control

Several WM models incorporate a central executive function (e.g. Cowan, 2000, p. 134; Engle, Tuholski, Laughlin, & Conway, 1999, p. 311; RepovŠ & Baddeley, 2006, p. 6). The central executive is described as functioning as a controller; managing attention as well as controlling allocation of resources towards the influx of information, an influx emanating from several different sources, as well as integrating this information. Also, the executive control is believed to be in

charge of decision-making (Ibid). When interpreting, the ability to control attention is an essential skill, as attention needs to be dedicated to the task, while obstructing irrelevant information (Cowan, 2000, p. 129-131). According to Fougnie (2008), attention refers to "the processing or selection of some information at the expense of other information" (p. 2). However, from the point of view of simultaneous interpreting, this definition lacks some grounding, as it would be impossible to exclude processes such as attention-sharing (Cowan, 2000, p. 117; Pöchhacker, 2004, p. 116) and attention switching (Timarová, Ivana, & Meylaerts, 2014, p. 162). Processes of vital importance, enabling the interpreter to attend both the ST and the production of the TT, in the knowledge that both are of equal importance (Kirchhoff, 2002, p. 117). Macnamara (2009) finds that the executive control does allow simultaneity of cognitive tasks, while conceding, however, that simultaneous interpreters cannot perform the cognitive tasks at full capacity (p. 21). Thus a form of capacity-sharing is also taking place.

This leads very naturally to Gile's effort model for simultaneous interpretation (Gile, 2002; Pöchhacker, 2004, p. 99-100). He divides the model into three efforts; the listening and analysis effort, the memory effort, and the production effort. Attention must be allocated to all three and all are simultaneously active (Gile, 2002, p. 165), giving rise to an inevitable fluctuation in attention allocated to each of the three, throughout the interpreting process. Gile claims that each effort has a certain capacity, depending on the individual, the task at hand, etc. The capacity available for each effort must be equal to or larger than the requirements for the task, otherwise resulting in errors or omissions (p. 166). Consequently, should an interpreter afford particular attention to the listening effort in the case of an unfamiliar name while additionally having to pay particular attention to the production effort, in attempting to render a number consisting of several digits, the processing capacity may be saturated and will result in unsuccessful completion of the task. Despite Gile describing the model thoroughly, he seems to offer no suggestions on managing

the division of capacities.

Only a few have cross-tested parameters of executive control with spoken interpreting performance, and among these are Timarová et al. (2014). The parameters chosen to gage executive control are all intimately linked to attention and coordination. These were (1) resistance to interference, (2) resistance to automatic responses, e.g. avoiding postponement of interpretation, (3) updating, and (4) task switching. One result concerning interpreting numbers seems to indicate that success depends on capability of rapid updating on information held in memory and swiftness in switching attention from one task to another. Another result indicated that interpreters adept at attention switching attention would display shorter lag time, or, in the case of spoken language interpreters, ear-voice span. The cause of this may be decreased cognitive load, as a result of reduced lag time, leading to a diminished demand in effort when switching attention, which would be in line with Gile's theory.

A further attribute of the central executive is the consideration of possible outcome and planning further action, consequently playing a part in the act of decision-making. Reflecting on information requires a conscious awareness, i.e metacognition or metalinguistic awareness (Napier, 2004, p. 119). The awareness denotes knowledge about the self, the tasks, and the strategies (Flavell, 1979, p. 907). From the interpreting perspective, conscious awareness presents an opportunity for interpreters to monitor and self-regulate (Pöchhacker, 2004, p. 98). One of Wang's participants reports: "I was listening to the whole sentence but I was also repeating "pork, spoon" in my head while he [the speaker] was talking. So, I was playing the final words in one side of my head while I was listening to a new sentence in the other and going "Did that make sense?"" (Wang, 2013, p. 74). This example displays an ability of metalinguistic awareness on the topic on the part of the interpreter while performing the task of memorizing TBR items. It would be interesting to see to what extent metalinguistic awareness can be beneficial to interpreting and

conversely to what degree metalinguistic awareness has an adverse effect on elements such as capacity.

In conclusion, the literature review clearly exemplifies that memory is a highly complex phenomenon just as interpreting is a highly complex skill. Storing and retrieving information in memory are not processes to be regarded as rigid or assigned to one particular feature, rather they show themselves to be flexible and mutually context-dependent (Hanczakowski, Zawadzka, & Coote, 2014).

3. Method

This qualitative study consists of a retrospective semi-structured interview. Firstly, the participant was video recorded while performing a Danish-to-Danish sign language interpretation. This recording subsequently acted as basis for the retrospective semi-structured interview carried out by that same participant. The interview consisted of prompt questions focusing on bringing to light how the participant *thought* they had recalled the TBR items. The ST in question is a budget follow-up performed in spoken Danish, containing a high amount of numbers, abbreviations, and proper names, the majority of which being the focus of the interview. Thus the data from the video recorded interviews form the basis of this study.

3.1 Material

There is one set of source text material, which has been interpreted by eight different interpreters, and for this purpose named the target text material. The video recorded retrospective interview functions as the primary data source.

3.1.1 Source text material

The source text video recording was a simulated budget follow-up in the Danish Deafblind Association, the material carried out in spoken Danish by the employee in charge of finances. The speaker is very familiar with deafblind people, as well as interpreters, and speaks in a clear, well articulated voice. The recording took place in a meeting room at the Danish Deafblind Association and was recorded with a Sony handycam HDR-PJ620 camera on a tripod. The length of the recording was 6 minutes and 44 seconds. Prior to the recording the speaker had presented the

material at an executive board meeting, which made the simulated presentation authentic and natural. During the recorded presentation, only the author was present.

The topic of the ST material was deliberately chosen, in pursuance of a high amount of numbers and proper names. The ST contains a total of 38 numbers and 17 proper names. In order to ensure sufficient time during the retrospective interview the questions were limited to 20 numbers and 12 proper names, thus 18 numbers and 5 proper names were omitted, resulting in a total of 32 items (see appendix 1). Numerals omitted comprise ordinal numbers, one-digit numbers, round numbers that included 50 and 100, as well as numbers that were subsequently repeated. These omissions reflect the assumption of them being easier to remember and therefore possibly engaging less recall strategies. Numbers consisting of a decimal fraction were all included with the purpose of potentially releasing recall strategies. In the ST, all numbers consisting of a decimal fraction were below 10, but as a result of the decimal fraction pronunciation they become similar to that of a two-digit number. For instance, in Danish, 3,1 is pronounced “tre-komma-en” (three-comma-one). Five proper names were omitted on the basis of them being either repetitions or a name that had previously appeared in relation to the information sheet on the interpreting topic (see appendix 2). 50 % of the proper names selected (6) were abbreviations used by the speaker, possibly revealing the ways in which abbreviations might influence the recall strategies.

3.1.2 The target text material

The participants were requested to carry out simultaneous interpretation of the Danish source text into Danish sign language. In the case of the first three participants, the TT was video recorded with a Sony handycam HDR-PJ620 camera on a tripod, while the five remaining participants were recorded with the camera on a MacBook Air laptop. The ST being spoken material, the participants were, however, able to view the ST recording and the speaker all through the recording of their

work. The same MacBook Air laptop that was used to record the last five participants, was used to show the ST recording. It was possible to view the ST recording and record the TT interpretation simultaneously. The participants were not informed of the purpose beforehand, only of the procedure and were presented with at time frame of 2 hours. Upon arrival they received an information sheet presenting the topic and some background information on the deaf recipient (see appendix 2). During all interpretations, a deaf recipient was present in order to maintain as naturalistic an environment as possible.

3.1.3 Retrospective interview

Having concluded the interpretation, the recording was subsequently played again for the participant, during which the interview was carried out. The retrospective interview was a semi-structured interview with prompt questions relating to selected data; numbers and proper names. The structure of the interview was of a flexible nature; allowing for the participants to exemplify and add thoughts. Furthermore, the participants were free to comment on any additional items other than numbers and proper names.

The questions that were posed for each TBR item were:

- If they could remember how they recalled the TBR items.
- If so, how they *think* they had retained and recalled them.
- If attention on the TBR items was required in order to retain and recall them
- If so, could they explain how they managed the required attention

The third and fourth question which relate to attention were not asked to the first participant as the interviewer only later, during the second interview, became aware of the significance of questioning attention. By their very nature, some answers prompted more questions, in order for the participant

to describe their thoughts in further detail. On the part of the interviewer the detailed questions were kept as open as possible to avoid the leading of the participant. The interviews were recorded and subsequently formed the basis of the process of data analysis. The first three participants were recorded on a MacBook Air laptop and the remaining five using a Sony handycam HDR-PJ620 camera on a tripod. Unfortunately, due to technical issues discovered after the event, the interview with participant no. 3 was lost, which was also the reason why the cameras were switched. Notes were taken during all interviews, and the notes taken during the interview with participant no. 3 was used instead of the video recording. Therefore, transcription of the interview with participant no. 3 is slightly limited when compared to transcriptions from interviews with the remaining participants; each comprising recordings of up to 2 hours in length (see appendix 11-18 for the entire transcriptions of all eight participants).

Upon completing the retrospective interview, each participant filled in an informed consent form and a small-scale questionnaire to obtain information on their demographic background (see appendix 3-10). Time span of both interpretation activity and interview was 1.5 to 2.5 hours, due to variation in elaboration on the part of the participants. Interviews were carried out individually; whether it be at their home, at the participant's place of work[1], or at a location chosen by the interviewer, who is also the author of this thesis.

3.2 Participants

A total of eight Danish sign language interpreters were selected for participation on the basis of their experience and because it was assumed that they would give their time for the project. All received a personal request. All are hearing and the group comprise one native signer and seven non-native signers, all female, the mean age being 41.5. All eight participants have attended the

[1] The office of employment.

Danish interpreter education programme and, at the time of participation, all were working interpreters. All attended the 3.5 year interpreter education programme, with the exception of participant no. 2, who concluded the programme in 1991 when it lasted only 2 years. The participants have all been working as full-time sign language interpreters from 8 to 15 years averaging at 11.75 years. Thus all participants can realistically be termed experienced sign language interpreters, which may have an influence on level and usage of memory strategies.

3.3 Data

To transcribe the data, ELAN (Crasborn & Sloetjes, 2008), was used. In ELAN, the tiers were coded: 1) Danish Sign Language, 2) English translation, 3) Glosses of numbers, 4) Glosses of names.

Each of the target texts was merged with the ST transcription. All eight participant recordings differed in starting time from the ST recording, as a result of the participant recordings being initiated at different times in relation to the ST. To match both the ST and the TT in the new TT recording, it was played at a rate of 40 until initialisation of the first word in the ST in order to locate the time difference between the initialisation of the original ST and the ST in the recorded interpretation. This was done for each TT recording. Thereupon all annotations in the respective recordings were shifted according to the registered time. The merged edition present glossing of selected numbers and proper names. Glossing of names include fingerspelling of names and abbreviations. Letters are separated by hyphen according to Johnston & Schembri's Conventions for sign annotation (2007). Glossing through lower case letters is an indication of the usage of the

Danish Mouth-Hand-System[2]. If mouthings do not correspond with the sign, these are indicated through the use of brackets.

While reviewing the recordings, a pattern was noted, concerning false-starts or slips of the hand (Hohenberger & Leuninger, 2012, p. 719-720), resulting in the glossing of false-starts for the entire interpretation, not only for the TBR items.

The resulting information was transferred to an excel spreadsheet comprising six columns (see table 2). One spreadsheet exists for each participant.

Item #	Gloss	Time lag	Reflection	Theme	Comment

Table 2. Overview of spreadsheet.

Time lag was measured from the initiation of the spoken word to the initiation of the sign. The frame chosen for the initiation of the sign is the frame in which the handshape in the place of articulation initiating the movement becomes notable.

A thematic analysis (Hale & Napier, 2013, p. 102-103) was carried out, seeking to identify themes or patterns from reflections brought about by the participants. From this, eight themes were chosen for further analysis; time lag, metalinguistic awareness, mental models, knowledge, attention, phonological recall, visual recall, and effort. An excel spreadsheet was created for each theme and quotes pertaining to the specific theme extracted from the main reflection sheets (appendix 19-26) and inserted in each of the theme reflection sheets (appendix 11-18).

[2] The Danish Mouth-Hand-System (MHS) consists of 13 handshapes that represent consonants. Vowels are produced using the lips.

In the themes column of the main reflection sheet, errors and omissions were also noted. Interpretations were categorised as errors if the item was not translated literally. Erroneous abbreviations, numbers, as well as missing digits, for instance interpreting 95 instead of 95.5 are all categorised as errors. Inaccuracy in sign phonemes were likewise categorised as errors, e.g. NEPAL produced with an incorrect handshape, despite the mouthing being correct. In other instances where mouthing and sign differed, the mouthing is determined as subordinate to sign production.

All items not interpreted have been categorised as omissions. This includes interpretations that only refer to antecedents through pointing, as is the case with the name in item # 2 (appendix 1).

NMR in the themes column, denotes no memory of recall or no comments on the part of the participant. No exact purpose lay behind this decision, other than a possible need for this particular category.

As a result of the relative openness of the interview structure, several different themes were referred to when discussing one item. Consequently, one item may throw up different themes. For comprehension reasons, a few reflections are repeated in full in more than one theme reflection sheet. Within each theme, data comparison was carried out in order to identify possible coincidence of various elements, ultimately presenting these in the result section of this thesis. For ease of reading, reflections in the results section, when quoted, are referred to by participant number followed by item number. Thus, a quote by participant no. 6 related in item # 32 is referred to as 6 #32.

Analysing the video recordings, it became apparent that transferring recordings of the interpretations to a programme, such as for instance ELAN, might have proved an advantage. This would have enabled the author to view the material in slow motion while with the participant thus making way for clarifications concerning cases of false starts, facial expressions, eye gazes,

hesitations etc. As these instances were not readily accessible to the author during the interview session itself, and there was no clear pattern to be extracted from the video recordings, consideration concerning these items has not been included, except for a brief mention of false starts.

The qualitative results of this study have come about through the indirect approach of inquiring from interpreters how they think their mind works. This approach introduces obvious elements of uncertainty, i.e. the lack of estimation of objective truthfulness. This should very much be taken into consideration concerning the elements of this thesis.

3.4 Definitions

3.4.1 Definition of TBR items

The TBR items in this study are items which require direct transfer (Schjoldager, Gottkieb, & Klitgård, 2008, p. 92). They cannot be condensed or in other ways altered, as they would loose their exact meaning. Direct transfer makes it crucial to remember the items, henceforth the TBR items.

3.4.2 Definition of the term proper name

In this study, proper names are defined as identifiers to the referent of the name. The proper names are quite specific and cannot be reconstructed from context.

4 Results

> It is a more difficult number to remember because it is not a round number. But I hear the number before me again. I remember that the first two digits are easy and I control them, but the last two digits are slow, like there is a pressure on them. But it is [speaker's] voice - no doubt about that. I often hear the tape recorder, but I need to have heard it in the ST to be able to recall it. I need to focus on the number in the ST when it is complicated like this, but in this example the focus is necessary for the last two digits - "59". (4 #27 – about recalling the number 7,559)

While reviewing the interviews with the participants, they describe various aspects involved with recalling a TBR item, all displaying several similar features. No one singular method is apparent from the reflections by the participants, however patterns appear in regard to factors supporting memory of the TBR items as well as direct recall strategies. In this chapter these commonalities will be denoted themes. The themes will be introduced by the most significant example or most common comment, then clarified and when deemed valuable, variations to this feature will be provided.

4.1 Time lag

> Also thinking that I am so close. That is the strategy I use because I know it is finances and there will be a lot of numbers so I stay close behind. (4 #17)

Some participants refer to short time lag as the main reason for not making use of the strategies of

storing and recalling (see appendix 19). They refer to the TBR item as "just there" (4 #23), "clear in my memory" (1 #27) and "it just goes through" (5 #15). In those instances where a short time lag was referred to as a reason for not retaining and recalling the item, the average duration of the time lag was 1.275 seconds. This is approximately half the average time lag of all participants; 2.466 seconds, which confirm that they did apply a short time lag. There is a total of 29 instances where participants refer to short time lag, 26 of these are accounted for by participants 1, 4, and 5. As can be seen from table 1, the same participants have the shortest overall time lag, not only in relation to the instances where mentioned it. Interestingly, the same participants account for the highest number of false-starts. It might be assumed that this is due to initiating interpretation too early.

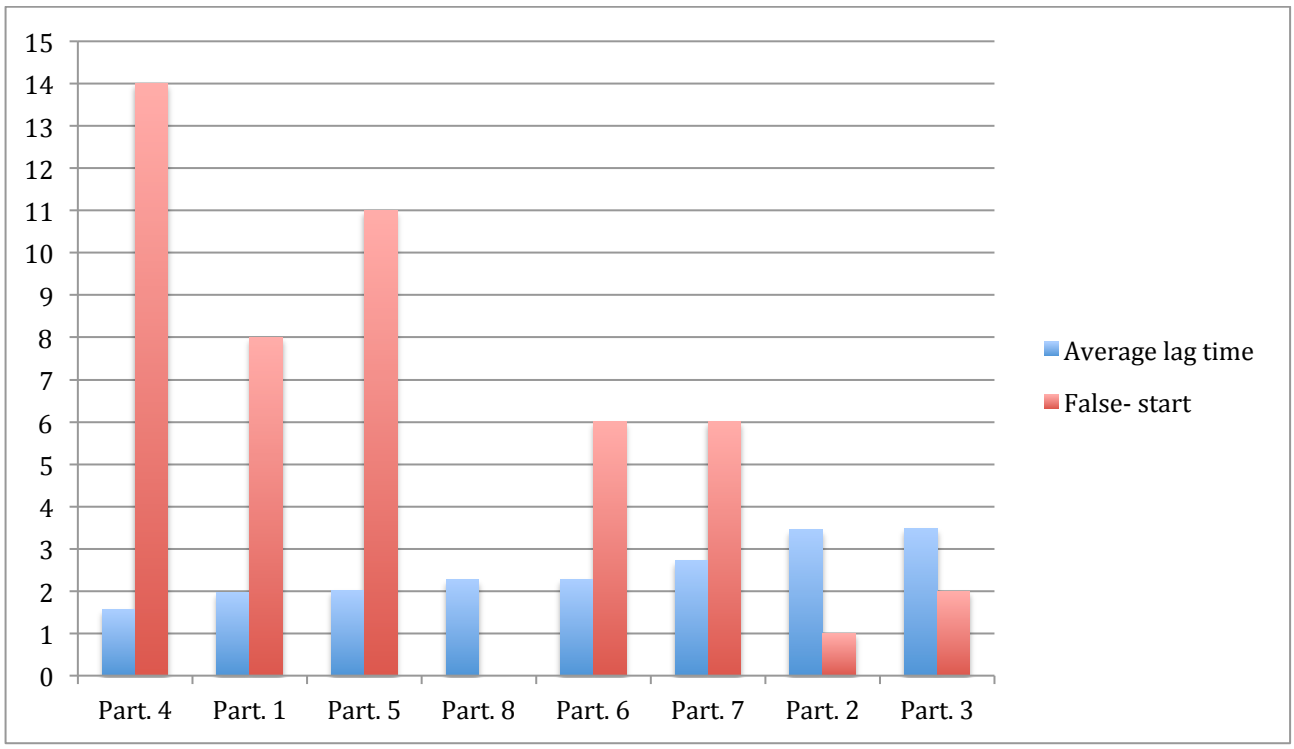

Table 1. Average time lag and number of false-starts. Shortest average time lag left and increasing.

4.2 Metalinguistic awareness

> …I also get round to thinking "Wonder if I should stop her and say "sorry, can you repeat that number again."" and then I think "I can't do that. Should I say to [recipient] "I am not sure that it is 59. I think it is 59." No, I will skip that". So when I produce it, I am not sure that it is correct, and I have a lot of other thoughts instead of just focusing on interpreting what I need to interpret. (1 #23 – about metalinguistic awareness concerning the number 59)

The implementation of metalinguistic awareness is extremely prevalent among the participants. All participants report numerous occasions of metalinguistic awareness, both of the interpreting (see appendix 20) along with an awareness of the surroundings. These considerations concern several issues, some beneficial and others possibly not. The deliberation concerning decision-making, which is referred to in the above quote is a common occurrence throughout the reports although, in this case, the number 59 was interpreted correctly.

Another aspect of metalinguistic awareness is contextualising information. Most of the participants use metalinguistic awareness to relate to the information, for instance, considering the size of the number in question, whether it is high or low, comparing it to other numbers. Participant no. 4 describes it as:

> I remember I get to thinking - 80 %, so we are close to 100. I manage to think logically at the same time. I manage to create my own opinion about it. Thinking 80% that is pretty well achieved in 6 months. And I also think "I wonder who they are?" [budget entry on business members]. But it's not like I am thinking: "Now I must remember it's 80" - not at all. Maybe it is because I make a calculation, because I also think about that there is only 20 % left. So maybe this meta-thinking where I relate it to other things is what makes me remember it.

> When the number is related to and put into context. (4 #21 – on storing and recalling the number 80)

Or, as in this case, being caught by surprise and relating this to the number

> I was thinking that it is funny that it is 101 % over - not 100 %, but 101 %. So it was like I started to relate to the figures. It is not so much a tone, but now it becomes part of the story. With other figures it is about hanging on and remembering and there I use the resonance, but here I am surprised about the number and relate it to the story. (2 #19)

In this case, concerning numbers, relating it to the surrounding information seems a significant memorising technique.

Participant no. 8, who reports creating primarily quasi-visual representations, uses metalinguistic awareness to create meaning, allowing for reference to the TBR item in her use of sign space. This is expressed in her reflection “Again I saw [quasi-visual representation] the number, but that is not what takes up my capacity. Instead it is " Over what? Which budget?" To give meaning takes up space.” (8#20)

In this case, participant no. 8 has other strategies and is not merely relying on meaning as a memorisation tool for the TBR item, though she seems to be relying on contextualisation in order to render the entire sentence in a meaningful way.

Not all numbers can be contextualised or related to, described by no. 4 in this manner:

> More complicated numbers are more difficult to have a metacommunication about and therefore they are more difficult to remember. But even a number that is not round can make

sense somehow, e.g. 7.899 would be easy because of the "99" or 1898 because I can think of it as a year. In this way it makes sense to me. (4 # 27)

Some participants claim that 2-digit numbers and smaller numbers are easier to retain, whereas others are of the opinion that round numbers are easier to retain and recall. This opinion is likely due to the ease of relating to a round or a smaller number. In order to see whether these claims are veritable table 2 presents us with the total amount of TBR numbers displayed in percentage. Next, table 3 illustrates the percentage of errors and omissions in rendering these numbers. In all, only one number was omitted, the number 13 (#26) by participant no. 7, and in the rendering of numbers, errors occurred in a total of 21 instances. In table 3 the errors along with the solitary omission are organised into round numbers, 2-digit numbers, 3-digit numbers, and the last category consists of 4-, 5- and 6-digit numbers.

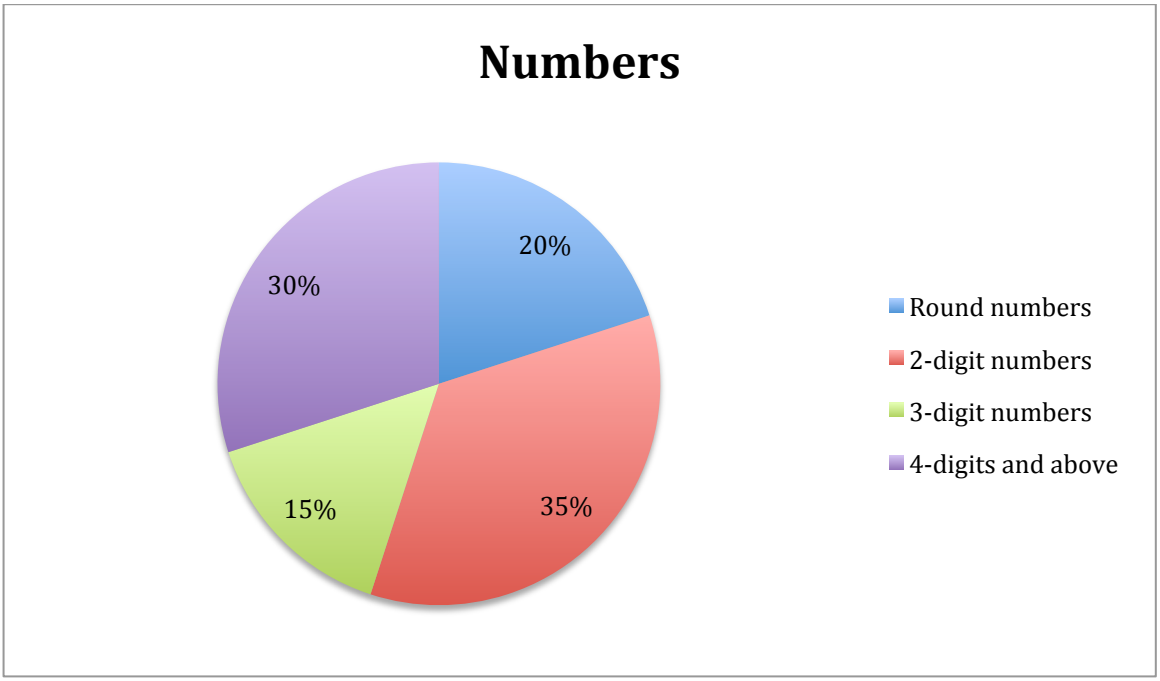

Table 2. Amount of TBR numbers displayed in per cent.

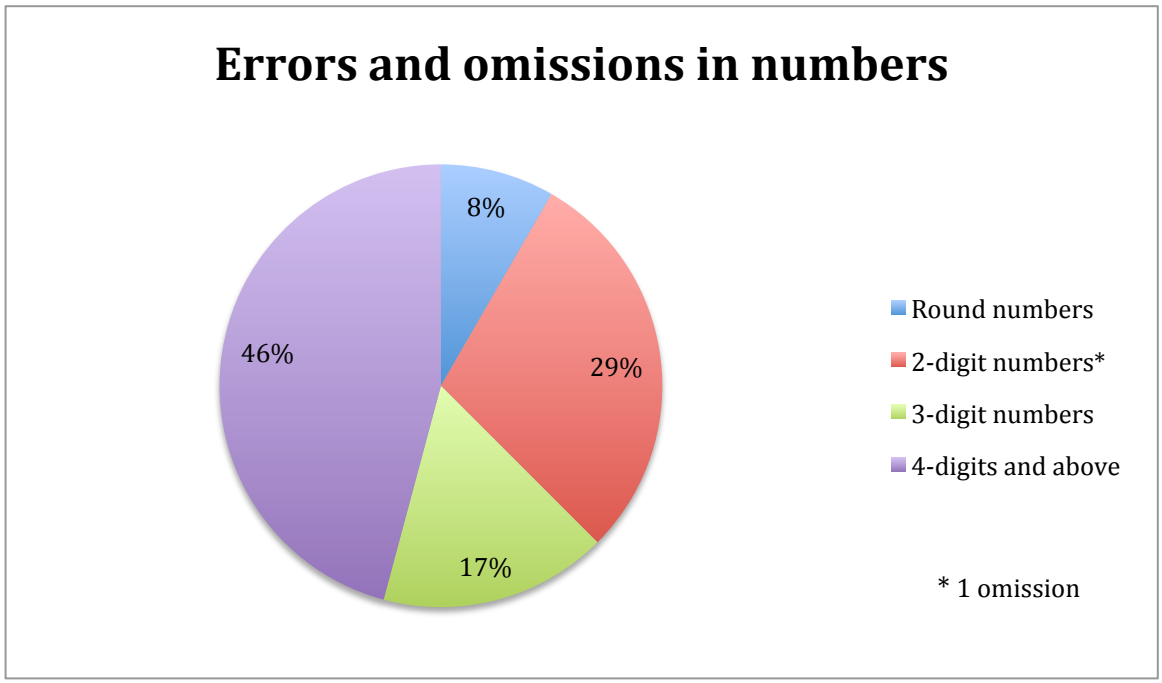

Table 3. Percentage of errors and omissions in rendering numbers

The category of numbers with the highest amount of digits account for almost half of the number of errors, despite the fact that, of the TBR numbers, only 30 % consist of more than 4-digits. This corresponds well with some participants referring to 'complicated' numbers being difficult to retain and recall. By complicated they likely mean longer numbers that are not round. Errors in 2-digit numbers total 29 %, of which 2% (1) are omissions; a relatively high percentage when considering that retaining 2-digit numbers could be considered the least complicated of processes. Round numbers account for the least amount of errors, two in total, corresponding with claims by some participants that these are easier to retain. Interestingly, one of the participants claiming this also produced one of the errors in round numbers. When rendering numbers containing three digits errors occur in a total of four instances, of which three instances relate to the same number; 134 (#25). Interestingly, three participants made that same error while producing this number. They all produced 103 in sign and immediately adding 34 – see chapter 4.7 for further description. They were, possibly, of the belief that the number did not require retention or recall, and taken by

surprise when this was not the case.

Round numbers account for the least number of errors, two instances in all; one relating to the number 900 and one to the number 80. Participant no. 2 interpreted 900 as 920 and reports the following reflection “During this I was a little bit fucked - there are a lot of numbers now.” (appendix 20 – 2 #18). In this case, it appears that her capacity was exceeded, furthermore, the appearance of the number 20 is quite interesting. The previous number; (item # 17) 407.000, was interpreted by participant no. 2 as 420.000, most likely due to the phonological similarity of 7 [syv] and 20 [tyve] (see section 4.7). Participant no. 7 interpreted the number 80 as 85, adding the comment that she only remembers not interpreting 80 [%] (appendix 25 – 7 #21). From the recording of the TT it appears that the interpreter is struggling to produce the sign for KONTINGENT [‘*fee’*], as the number 80 is being uttered in the ST. The eventual production of the number 85 in some ways resemble the previous number (item #20); 95.5.

Some participants also report a tendency to dwell upon mistakes; “I think I am still hanging on to my past mistakes. I know I have missed something. I am using energy thinking how I can redeem it and saying to myself how stupid it was.” (7 #27). They are either considering how to correct mistakes, although it is no longer possible (1 # 23), having ineffectual thought processes, like for instance. the previously mentioned example concerning participant no. 4, # 21, in which she is contemplating the who of the 80%. Examples provided by participants included thinking about things completely unrelateted to the topic to be interpreted, e.g. grocery list. In the case of this study, however, the latter was not reported as having taken place during the interpretation exercise.

Other participants report “discussing signs with themselves”, e.g. whether to use one sign as opposed to another and in some cases they find themselves searching their LTM for a sign which is not readily available to them in their WM. Metalinguistic awareness while searching for a sign is the case for four participants in item # 10, which is Nepal. Participant no. 7 reflects “I am thinking

straight away that I don't remember the sign. So I am having a talk with myself about the sign, and then I think it is easier to remember because I have a reference." (Appendix 12 - 7 #10). All are searching their memory for the sign for Nepal, and therefore they claim that, in this instance, recall is not required as the item is constantly active in memory throughout the interpreting process. Searching through LTM or discussing signs has only been reported for proper names, not for numbers.

4.3 Mental models

> I create a scene with pictures of what is happening, the action. Numbers and names etc. are up to the right. When the flow of speaking comes in, I create pictures and try to order it in my head. I use this as a resource in regards to what I want to produce. It is a "working space" in my head. …[E]verything that is messages and action, that takes place down here [mental model space in front of person]. It has nothing to do with language. I know I work this way. Somehow that platform is a representation of the SL, but there are no words there. It is a combination of seeing things taking place, establishing loci, seeing some referents, seeing a budget, and other things. But it is not the TL. I don't have a picture of sign language sentences there. It is like a dissection of the SL, taking it apart, and putting it back together again. When a number comes up, I have to zoom in on that and place it up right. Not really as a part of my picture, but hanging up there on a different track. (8 # 14)

Some participants explain that the interpreting process is progressing along two tracks. One track contains the general message being interpreted, while the other relates to specific information that cannot be contextualised within the story. Participant no. 2 distinguishes contextualising items and

relating to specific items, such as numbers and proper names by saying that specific items are "happening on another subconscious level than the context thinking." (Appendix 13 - 2 #3). The four participants who mentioned these two parallel tracks (participant 2, 6, 7, and 8 – see appendix 13) all agree that these specific TBR items are stored in a different space from other items that lend themselves easily to understanding and contextualisation. In relation to item # 5, which is the name for the Danish lottery association, participant no. 8 explains "The reason why it is not in my mental picture I think, is because there [mental model] I don't necessarily have to use those exact words. But in my 'fact box' I cannot get around those words" (appendix XX, 8 #5). The "working space", which may be similar to a mental model is non-lingual and according to participant no. 8 it cannot be used for information that requires direct transfer, as for instance, a number. Instead numbers are placed in, what she refers to as, a "fact box" located slightly upward to her right side. Interestingly, the three participants who display the largest number of visual recall strategies (appendix 14) all report that, of those TBR items that require special attention, the resulting quasi-visual images are located upward, to the right. Among them, the method varies slightly. Participant no. 6 only places complex numbers upward to the right, whereas numbers she finds easier to hold remain part of her mental model (Appendix 13 - 6 #26).

4.4 Knowledge

> I know that they receive money from TIPS/LOTTO, so I think it is my background knowledge that remembers for me. (4 #5 – about storing the name of the Danish lottery association)

In fact, it seems that mental picture and previous knowledge are closely associated. A recurring

assumption among the participants is that previous knowledge of the item or topic enables the interpreter to contextualise the item and excludes it from demanding particular attention. For instance, participant no. 4 points out “I know the organisation, so it is an established concept” (appendix 15 - 4 #9) or that previous knowledge “provides a hook to hang it on” (8 #9). Participant no. 8 describes that lack of subject knowledge requires a shortening of lag time, explaining “I don't know the name, so I know I have to get it produced pretty fast” (8 #1).

The importance of subject knowledge has only been mentioned in instances of proper names, whereas previous knowledge was not referred to in relation to interpreting numbers. This may be due to the relative difficulty of pre-knowledge of arbitrary numbers. From the answers it would appear that approximately half of the participants have a higher level of subject knowledge in relation to proper names. Previous subject knowledge was not focused upon in the interview, though

4.5 Attention

> ...the way I look with my eyes is definitely to focus on the number, and in that split second I leave my story, my picture and pay full attention to the number. If I didn’t focus like this, I wouldn't be able to interpret the number correct.” (6 #27 – on the attention required in order to retain the number 7,559)

Excepting no. 1, all participants cite attention as a vital tool in interpreting the TBR items (see appendix 16). Information that cannot be contextualised will need specific attention, a directed focus. Vocabulary describing the focusing of attention to a TBR item varies, expressed in terms such as zooming in, listening sharply, having focus, listening particularly carefully and allocating

the item full attention.

Participants citing attention concur that attention to the TBR item is required at the exact moment it is uttered in the ST, exemplified by participant no. 3; “Here, I zoom in when she is saying the number [ST] and I repeat it aloud in my mind to myself.” (Appendix 16 – 3 #15). Participant no. 4 explains that recalling the item becomes impossible without specific attention having been allocated; ”If I haven't heard it properly the first time, I cannot rehear it to myself.” (Appendix 16 – 4 #27). Statements that seem to suggest that particular attention allocated to the TBR item is essential in order to retain as well as recall it when required. Participant no. 6 reports a lack of attention to be the cause of her inability to retain and ultimately interpret the number 443,151 (Appendix 16 - 6 #32).

Anticipation supports the interpreter in determining and regulating attention. The participants state that preparing for a particular state of alertness is supported by understanding rhythm, intonation, and syntax of the SL;“...when she says "på" [on], then I know a number is coming up. Then I can be more alert.” (7 #15). Regarding item # 32, comparing reflections presented by participant no. 2 and no. 3 provide some interesting points. Participant no. 3 reports that the reason she was unable to interpret the six-digit number was that the speaker’s “tone goes down at the end, which makes me think there is no more. Instead I am surprised by the amount of numbers, meaning I don't keep my focus.” (3 #32). Referring to tone, it would seem likely, however, that she means intonation. Conversely, participant no. 2 anticipates the production of a number through her knowledge of the semantics of SL, while relying on logical thought, concluding that “dividend on shares” would be expressed through a high number; “I think I know the number is high, because she says it is the "udbytte på aktier" [dividend on shares]. So I know I have to shorten my lag time.” (2 # 32).

4.6 Effort

> It is like a very intense concentration directed at precisely what is being said. My production becomes secondary and then it becomes a bit sloppy, as if it is deprived of energy due to the act of listening (appendix 17 – 5 #2 – on dividing capacity)

Most participants emphasize the consumption of energy involved in the focusing of attention, this energy representing the interpreter's capacity. In the case of concurrent tasks requiring attention, be it for instance listening to the ST and producing a TT, one or both tasks may consequently be affected. This being reflected in experiencing "not having more room" (2 #27) or an "overload" (3 #14). Accomplishing these concurrent tasks would appear feasible while capacity remains unstrained, in the words of a participant "I use energy remembering the number, and less energy on what I do besides that. I usually describe it as holding on to the number or name in my head. I use my primary energy holding on to that and trust that the rest, grammar, etc. it gets less energy." (8 #14). Should either the ST or the TT require a greater amount of effort, this will become apparent to the interpreter. As evidenced by item #32, containing the number 443,151. No more than two participants succeeded in interpreting this number correctly. The reason, according to participant no. 7 being "…stocks and dividend got my attention, so I didn't hear the number. I didn't give the number attention and it didn't pop up [visually]. When it shows up written I can maintain it there." (7 #32).

Moreover, effort can be allocated to the aforementioned metalinguistic awareness, needlessly occupying invaluable capacity; "I remember I was irritated that I missed the previous word, I didn't understand how such a name could exist. So I directed my energy toward that." (2 #16)

4.7 Phonological recall

> I hear the number before me again. I remember that the first two digits are easy and I control them, but the last two digits are slow, as if there is a pressure on them. But it is Ilse's [speaker] voice - no doubt about that. I often hear the tape recorder, but I need to have heard it in the ST to be able to recall it. (Appendix - 4 #27 - on recalling the number 7559)

All participants noted instances, whereby the TBR item is recalled via phonological memory. Instances described range from one to 19 for participants respectively. The phonological recall is likened to “replaying a tape recorder” (1 #23) or recalling using one’s own voice while producing the TT (3 #28). Phonological recall appeared to be a phenomenon highly prevalent among all participants, and some were in fact able to provide detailed descriptions. Some participants report that they are able to sub-divide an item depending on what required a future recall. One such example would be the number 443,151, interpreted correctly by only participant 1 and 2. Participant no. 1 reports “[c]oncerning the last 3 digits I recall her voice, but not the first 3. I don't know why, maybe I am closer to the first 3 and remember them better” (1 #32). Based on knowledge of syntax structure, leading up to the item, participant no. 2 made use of anticipation to decrease lag time and allocate the required attention. Subsequently, when recalling the item, she explains ”The first three digits are easier to recall than the last three. The last three digits are a bit fuzzy. I am not sure that I can maintain that soundscape. So I use the tone, but with less certainty.” (2 #32). In general, participant descriptions create the impression that phonological recall can be engaged at crucial stages, and not necessarily for the entire item.

Interestingly, several participants describe how it is not always the entire item in its full pronunciation they are recalling. Instead it may be tones, pressure, and/or rhythm of the TBR items.

In the words of participant no. 2:

> “Pure resonance. I know I need to remember the number when I hear it, so it is the tone I hold on to. I don't hear the number, but I hear the sound [toogtredive] - like an "O" and then two pressures. It is not repeated, but it stays at the back of my head like a tone. Recalling for my production I hear the same sound.” (2 #22)

Participant no. 3 ”I repeat it in my head, it is sort of the rhythm I hear. There might be a pressure on 7” (3 #17).

In item # 17, the TBR item is 407,000, and participant no. 2 describes part of the sound as being fuzzy “No doubt hearing 400 and hearing "Y", and I hear a consonant prior to the “Y” because of a glottal stop. So the consonant becomes fuzzy” (2 #17). Similarly, others describe unclear, muffled, and muddled sounds; ”I know that she said something, but I am not sure what she said. The sound becomes a bit muddled [at ST], as if it was uttered through a mumble, which I can now hear that it is not.” (Appendix 25 - 7 #6). Or as recounted by participant no. 4 “I hear [firehundredetrefyrretusindeethun....], the last two digits sound muffled, almost fading away.” (appendix 18, 4 #32). In several instances, unclear recall is attributed to the directing of capacity toward producing a TT ultimately resulting in a lack of attention to the ST.

In the example above concerning participant no. 2 interpreting the number 407,000, the fuzzy sound she recalled may have caused an error in production. The item was interpreted 420,000, and interestingly, In Danish, the numbers 7 [syv] and 20 [tyve] display phonological similarities. In the ST used in this study, other phonological similarities occur when coming across for example abbreviations. Consequently, the interpretation by two participants of item # 7, D-D-B-F, becomes D-B-B-F, most likely due to the phonological resemblance between the Danish

pronunciation of the letters D and B (appendix 18, 3 #7 and 8 #7).

Participant no. 6 describes mouthing as a way to seek correspondence between the ST and the TT as illustrated by this reflection:

> "I don't see the letters before me. I don't hear it again, but I sort of check the sound. When I produce it, I feel on my mouthing whether that sound tone is the same as the one I heard in the ST. I think the same happened in DBS [#1]" (6 #7)

This use of mouthing as a method to self-evaluate appears several times. For three participants the same error occurs when having to interpret the number 134 (# 25); initially producing "103" and immediately correcting to "34". Two of the three produce "103" in sign language, while mouthing "104". Danish spoken language as well as Danish sign language express numbers from 21-99 in reverse order, thus 34 in an English transcription is pronounced [fourandthirty]. Whether this affect the result is not clear. Concerning this item, none provided any comment on the lack of hand-mouthing correspondence, whereas in the case of participant no. 7 producing in sign F-C-S while mouthing F-S-C, she explains "then I say FSC on my mouthing, but it doesn't rhyme with what I am doing with my hands, so I know it is wrong." (7 # 3). Had the recording been viewed in slow motion with the participants during the retrospective interview, more reflections on the matter may have arisen to clarify the cause.

4.8 Visual recall

> …the way I look with my eyes is definitely a focus on the number, and in that split second I

> go away from my story, my picture and give my full attention to the number. If I wouldn't have this focus, I wouldn't be able to interpret the number correctly. I see the number, but the numbers are murky, because the other stuff is overlapping. There is some 7 and some 5's but not sure where they are located, they are not in their proper spaces. (Appendix 14 - 6 # 27 – about recalling the number 7.559)

6 out of the 8 participants describe making use of some form of visual recall. The TBR items are recalled as quasi-visual images either in the central space in front of them or located upward to the right in their quasi-visual space. For some participants visually recalling a TBR item in the space in front of the interpreter mainly involves instances they possess previous knowledge about. When recalling a specific magazine, participant no. 6 describes “I see the magazine before me, actually specifically on the shelf at UCC in Aarhus.” (Appendix 14 - 6 #12). Remembering the name of a person, participant no. 3 states “I see him before me.” (3 #2) while participant no. 4 states

> “I translate the name in my head when hearing the source text and I store it as the name sign. If there are several names, I always leave those with name signs until the end because they are easier to remember.” (4 #2).

These examples provided by the participants display strategies of employing visual images for storing and recalling names, albeit with slight variations. Only in cases of previous knowledge of the TBR item does this method of generating images occur. Some interpreters described an ability to incorporate a visual image of the TBR item into their mental model, for instance when encountering numbers about which the interpreters could have no pre-existing knowledge. Regarding retaining and recalling the number 13, participant no. 6 describes ”I create a picture of

the web shop, what I think it looks like, I have the whole story in a picture, and then 13 comes on as a layer on top. (Appendix 14 - 6 #26) and participant no. 2 reports that how “In the story it becomes the presenter holding a piece of paper and above the paper on the right hand side is the number 101 written.” (2 #19)

It seems that participant no. 8 is consistent in placing TBR items in a quasi-visual location upward to the right, a space she refers to as her “fact-box”; basing it on the rationale, that the information placed there must be conveyed directly (appendix 14 – 8 #5), hence it is placed separate from her mental picture, which is essentially a non-lingual space comprising meaning and concepts. Although expressed by differing terms, references to a “fact box” are indicated by several participants. Described as a location upward to the right, in which are located items to remember and of which to be aware. Participant no. 6 explains “…often if it is a more complicated number, it would be up there saying "see me!" I don't think they are clearer there, but it is more about a kind of alertness.” (Appendix 14 - 6 #26). Those participants who described creating similar visual images located upward to the right described it as taking on the appearance of a box, as post-its, one participant described alternately seeing the numbers in glimpses and as a still picture (participant no. 3), all seeing the visual images represented in a clear computer or calculator font as opposed to hand written. Participant no. 7 explains “...again I see it to my right upward, like on a post-it or a little box. The text is clear, as if has been typed or printed on a computer.” (7 #3)

As with the reflections on phonological recall, participants reported that not allocating appropriate attention to the item, may result in indistict visual images in the “fact-box”. Participant no. 6 express

> “I remember that I don't hear it properly. I remember that I don't remember the decimal number and then I remember that I sense that she is correcting herself. It is like what I hear

> becomes a visual impression and I see there is a comma, but what comes after that is hard to see, whether it is a 5 or a 3. I can't really see the number. It's like looking at a computer screen and there is light hitting the screen so it's hard to see.” (6 # 20)

Yet another method could be the accentuation of part of the item, described by participant no. 3 concerning the number 1.5 ”The point is highlighted stronger than the numbers.” (Appendix 14 – 3 #16)

Some participants report making use of combined visual and phonological recall strategies, supporting the visual strategy, particularly when dealing with longer numbers. Participant no. 6 describes how the figures are “jumping” when recalling the number 7,559:

> “There is a 7 and some 5's but I’m not sure where they are located, they are not in their proper places. The reason is because of two 5's, because I can be unsure where they should be in the written text. So I turn to the sound and can hear that it is the number 7 it starts with, and check that that is what she says at the same time as I produce it. So if I would have started saying 5 I think I would have remembered that it sounded like 7.” (Appendix 14 – 6 #27).

Interpreting that same item, participant no. 8 describes a “rhythm” in conjunction with the visual image of the number. This is particularly prevalent involving longer numbers. In relation to the number 137,000, participant no. 8 states “When it is longer numbers like that I also listen to the rhythm [repeats 137]. It is a mix of both. In my visual picture the 0's are not clear.” (8 #15) Noticably, she describes the three figures representing thousand, ,000, as visually unclear. Probably, this is not due to a lack of attention, but a mirroring of the participants who only recall

phonologically the last three digits of 443,151, because there is no great necessity for recall.

Utilizing visual recall strategies, succeeding depends on attention being afforded to the TBR item. Participant no. 7 reflects “I didn't give attention to the number and it didn't pop up [visually]. When it comes up in writing I can maintain it there.” (appendix 14 – 7 #32)

Visual impressions held in memory average a duration of 4.35 seconds, compared to recalling the item phonologically with an average lag time of 3.05 seconds and resulting in approximately the same amount of errors.

4.9 Omitted items

Items that were omitted were not recalled. A few omissions were conscious, e.g. item #8, as it is the proper name uttered immediately after its abbreviation.

5. Discussion

5.1 Time lag

The necessity of memorising a TBR item depends heavily on the two factors: time lag and the nature of the TBR item. According to the participants of this study, shorter time lag, essentially removes the demand for specific attendance to memory as the item in question is rendered directly and consequently not retained. Lederer (2002) states "figures have to be repeated while still within the span of short-term memory" (p. 136) for them to be rendered correctly. This would seem to suggests that a short lag time the duration of which is dependent on several factors, such as concurrent tasks and capacity, nature of item etc., contains the TBR item as still active and in a readily available state. In which case, ultimately rendering a semantically correct TT would appear feasible. Under different circumstances, the results of this study seem to indicate that other means to retaining meaning as well as the TBR items manifest themselves. According to the results, usage of short lag time may still leave certain numbers too long for them to be retained in an active state. Exemplified by the fact that participants tend to subdivide longer numbers, directly rendering the initial part of the item, completely dispensing with memory strategies, whereas further into the item implementation of a strategy in some shape or form is required. The reason for this may be the initial part of the item is afforded less effort due to the lack of strain on the production effort, while proceeding further through the item effort is required for both listening to the ST and producing a TT.

Some participants refer to variating the lag time, e.g. anticipating the introduction of a number, hence shortening lag time with the objective of occupying less capacity when rendering the item. This is also in line with Lederer, who describes how the "interpreter abruptly catches up with the speaker" (Ibid.).

5.2 Contextualisation

Contextualisation seems an essential tool for determining whether or not the interpreters needed to utilise phonological or visual memory strategies. The interpreters in this study described how contextualisation of the TBR items could either be performed through the usage of pre-existing knowledge or metalinguistic awareness. Should this be the case, the participants did not need to embark on other memory strategies.

5.2.1 Contextualisation and knowledge

From the reports of the participants of this study it may be supposed that knowledge enables contextualisation of the TBR item. The item becomes part of the story and therefore no specific effort is allocated to retaining or recalling the item. Some interpreters make use of quasi-visual mental models, contextualising the TBR items within the model, not as a method for memorising the specific name or number, rather a method for remembering the concept. For instance, as the interpreter had previously seen the magazine, to which a reference made, she created a quasi-visual representation of the magazine lying in the exact same place, on the shelf. This does not seem like a memory strategy of the exact name itself, as she does not see the actual name in her visual image. Instead she sees the concept of the magazine, a visual based on previous knowledge. Another participant, with no pre-existing knowledge of the magazine, in fact she is not even ”sure it is physical magazine”, reports that she also visualises a magazine in her quasi-visual space. She hold no knowledge of the specific magazine, yet through a general knowledge of magazines, she establishes a notion of it hence contextualising it; leading to a suggesion that through understanding and contextualising the concept interpreters may be able to remember it.

During interpretation some interpreters experienced searching for the sign of a TBR item in their LTM. While carrying out the search this search is allocated a certain amount of effort

leading to the TBR item remaining in memory. No certainty can be offered, however, that this will result in the sign being recovered from LTM or indeed be recovered correctly. According to Ericsson & Kintsch's (1995) view of domain knowledge and retrieval cues (p. 231), interpreters with a high degree of background knowledge should have retrieval cues readily available to them. Three of the participants in this study mobilise a substantial amount capacity in searching for the sign for NEPAL in their LTM with only one succeeding in finding the correct sign. Were interpreters to establish a greater consciousness concerning establishing retrieval cues in case of encountering new signs, the process of retrieving that same sign from LTM may become more efficient.

5.2.2 Contextualisation and metalinguistic awareness

In this study only proper names were reported to be contextualised through the use of pre-existing knowledge. Contrarily numbers lend themselves to being contextualised and related to through metalinguistic awareness by considering the size of the number in relation to other numbers or to the topic, and thusly eliminating the demand for phonological or visual recall. Metalinguistic awareness becomes a tool for relating to a piece of information and relating to the information enables the interpreter to remember the item. Furthermore, when metalinguistically aware of a TBR item, attention is naturally allocated, bringing it into mental proximity which ultimately suspends specific memorising strategies.

One participant, suggests that should they somehow make sense or be relatable, longer numbers can indeed be reflected upon as, for instance, relating a number to a year, yet, generally, participants reported mainly relating to numbers below 100. For instance, the number 80% is related to by its proximity to 100%, one going as far as calculating it is only 20% off 100%. This enables the interpreter to remember the meaning of the ST, and therefore it is not necessary to retain

the TBR number. Generally, this method appears impracticable for longer numbers, since contextualising and relating to an arbitrary number, say 443,151, seems close to impossible. Albeit slightly less from the perspective of memorising TBR items, metalinguistic awareness seems a highly efficient tool for the purpose of saving vital capacity, since items are contextualised and specific memorisation thus not required .

Data shows, however, that interpreters employ metalinguistic awareness in a fruitless manner. While interpreting, some interpreters report thoughts and considerations on matters of no assistance to the interpretation. Returning to the number 80%, topically related to business members, while interpreting, the participant diverted capacity toward considering the identity of these members despite this not being part of the actual interpretation. Unproductive considerations such as these were not unusual among the participants of this study, leading to the conjecture that improving patterns of the interpreters' metalinguistic awareness, may result in increased efficiency in the use of this otherwise mismanaged capacity.

Thus metalinguistic awareness has the potential of being friend and foe, depending on how we apply it.

5.3 Attention

Should attention be allocated to the TBR item when uttered in the ST and should a storage method, e.g. phonological or visual, be available to the interpreter it would seem that recalling the item correctly becomes attainable. Attention to the item enables the interpreter to focus on the item, listen to the sounds or have a visual representation of the item. When to direct attention can be supported by anticipation in order for the interpreter to be alert. This requires that the interpreter possess comprehensive knowledge of the SL, its structure and syntax in order to anticipate what to bring attention to.

As the executive control of WM is in charge of managing attention and controlling allocation of resources (RepovŠ & Baddeley, 2006, p. 6) it seems important to consider how to enhance the use of the executive control function for sign language interpreters.

5.3.1 Attention and phonological similarities

If sufficient attention was not given to TBR items parts of the item was replaced with phonologically similar units. This was the case for both numbers and abbreviations.
The reason for this was that, in the cases where the participants utilized a phonological recall method, they experienced an unclear sound, referred to as muffled or fuzzy when recalling, if the item had not been allocated with sufficient attention. Sometimes only part of the sound was available, which resulted in a search for possible alternatives. The same phenomenon occured for those interpreters primarily making use of visual recall. All saw quasi-visual representations of numbers or, in the case of abbreviations, letters written before them. Other proper names were located as part of their mental model, as in the case of the aforementioned magazine. If sufficient attention was not given to the TBR item, they would only recall part of the written visual representation clearly, and could therefore not recall the whole item. For the participants mainly using visual recall strategies, they all mentioned being able to have support from a phonological recall as well. When they were not able to recall the entire item visually they could gain support from phonological recall. As episodic memory is responsible for binding together information from different sources (Baddeley, 2000, p. 421) it may be the process responsible in this situation. On the other hand, in this situation the original information does not stem from two sources, but one verbal source, and is stored in two modalities. Further research would need to be undertaken to clarify the dual-recall.

5.4 Phonological recall

The sign language interpreters, who participated in this study, all make use of phonological memory to support the process of recalling. In some instances they rehear the full pronunciation of the TBR item, and in other instances the interpreters hear elements of prosody, i.e. the tone, pressure and/or rhythm within the TBR item. The prosodic elements seem to have a great influence on the way in which numbers are recalled and to what degree the item is rendered correctly. When primarily using visual recall strategies, nonetheless, participants report concurrently making use of prosodic elements in order to supervise that the item is equivalent to that of the ST. The participants in Wang's study also described using initial sounds in order to recall words (2013, p. 74).

In among the reflections presented by the participants some discrepancies emerge when discussing the relative complicated nature of various items. Some refer to 2-digit numbers being the least complicated and others to round numbers. The amount of errors occurring in round numbers corresponds well with this perception, resulting in the least amount of errors. A certain degree of inconclusiveness surrounds 2-digit numbers, as some interpretations result in errors while others do not. Again this seems to be linked to elements of prosody. The pronunciation of the number 80 [firs] is short and distinct, whereas pronunciation is longer when it comes to the numbers 50 [halvtreds], 70 [halvfjerds], and 90 [halvfems], which may therefore require increased capacity for retaining and recalling. Prosodic memory of this nature may also be effective in relation to high numbers ending in two or three zeros, e.g. 2000, 21,800 and 137,000, all of which resulted in no errors. The pronunciation of a simple, even thousand [tusinde] or hundred [hundrede] is shorter and attention would most likely merely be required for a smaller portion of the number compared to an odd number, e.g. 443,151 or 7,559, in which case, all digits require attention allocated. Furthermore, the prosodic nature of an even thousand or hundred may be highly familiar to

interpreters , in effect minimising the effort needed. The term ‘less complicated’ numbers may therefore not necessarily reflect the length of the number.

Studies of prosodic perception describe that as speaking “rate increases, the speaker preserves those aspects of the acoustic structure which are valuable for encoding segmented and prosodic structure” (Clark & Yallop, 1995, p. 322). Meanwhile, results from this study would indicate that delivering the ST at a normal rate of speaking, it is possible for the interpreter to extract those aspects of the acoustic structure deemed adequate for encoding and processing the information. Very likely, this method requires less effort compared to a full quasi-recital of the item, which requires the memorising of the totality of prosodic elements for a longer segment. Performing the interpretation task to its ideal end would entail extracting the appropriate amount of acoustic structure, no more than needed; this requiring additional capacity, and no less than needed as that would conceivably result in errors or omissions. Devoting capacity to either storing and recalling a full recital of the item or simply to the prosodic elements is not a conscious act while interpreting. Therefore it may be assumed that the executive control is involved in this unconscious process in order to ensure capacity for other tasks.

The results seem to exhibit that memory of a previous number may affect the manner in which the present number is recalled. Particularly in the case of an overload of tasks to be attended or a lack of capacity available during the retention of the present number. When errors occurred in interpreting numbers, the results show that two interpreters substituted the TBR number with parts of the previous number. In the instance of the first TBR number being 95.5 and the following TBR number 80, yet interpreted to 85. This would suggest that previously memorised sounds are still latent in memory upon production. Unmistakably, resulting from capacity being allocated to other aspects, while not affording attention to the TBR item. In both cases the initial digit was interpreted correctly, unlike the second digit, implying that the initial digit remains active

and readily available in memory (see section 5.1 on time lag), corresponding well with other examples of short time lag and the rendering of longer numbers.

While the process of phonological recall seems to occur unconsciously, to some extent, the focus of attention seems to be conscious. Further research into this field may reveal methods for enhancing the process.

5.4.1 Mouthing

The use of mouthing appears to be yet another method for controlling the correct rendereding of the interpreted item . Some interpreters display correspondence between production of the hands with the (production of) mouthing, and in case of discrepancy they oftentimes manage to correct themselves. One example is an item containing the number 134, initially interpreted by two participants to 103 with the mouthing of 104, however both immediately added 34 to their interpretation. This implies that the number is retained in a phonological manner. However, Danish spoken language as well as Danish sign language express numbers from 21-99 in reverse order, thus 34 transcribed into English is pronounced [fourandthirty]. This may imply a visual recall strategy, as the initial quasi-visual number, 3, would correspond with the number rendered in sign language. Furthermore, it supports statements made by participants mainly making use of visual recall strategies, who describe how using phonological strategies support their visual strategy.

5.5 Rehearsal strategies

None of the participants explicitly described being able to rehearse the phonological input as was the case for one of the participants in the study carried out by Wang (2013). This might be due to a concurrent phonological interference from the ST. One participant describes how the TBR item "stays in the back of my head like a tone" (2 #22), though stating that she does not hear it repeated,

it remains unclear whether this particular retention of ‘tone’ indicates a form of rehearsal. A tone present during the entirety of the time lag could be considered a form of continuous rehearsal. In fact, some participants did make use of a visual rehearsal mechanism of some description, in which the quasi-visual representation was seen flashing. This method of listening to verbal input and retaining it in a visual code have no obvious references in the literature, possibly due to the lack of visual interference resulting in remaining capacity in this ‘space’. Instances of the reverse being the case would make for an interesting field of further research. Should the ST be produced in sign language would the amount of visual interference be too great for the interpreter to make use a visual rehearsal mechanism, instead translating into spoken language subsequently storing it in the phonological buffer with the associated rehearsal mechanism.

5.6 Visual recall

TBR items prove to be recalled visually either as part of a mental model or as images separate from the mental model. As in the case of the aforementioned magazine, results indicate that participants who have prior topic knowledge, tend to place their visual image within their mental picture with the purpose of contextualising it thus becoming an element in their story line. On the other hand, information that cannot be contextualised or somehow related to seems to requires particular attention. In the case of participants who primarily create visual images, this particular attention manifests itself as a written form of the TBR number or abbreviation located upward to the right, in, and from, which space items are retained and/or recalled. One participant refers to this space as a ‘fact box’. The precise relationship between the mental model space and this ‘fact box’ space is not yet clearly defined. Descriptions of this phenomenon mainly moved along two differing avenues. For one participant the ‘fact box’ became a location for all numbers and abbreviations that were unalterable and required direct rendering . Whereas other participants placed all items that could be

contextualised, including less complicated numbers, within their mental model. Only those TBR items that could not be contextualised were placed in the so-called ‘fact box’. A clearer distinction between the two phenomena would require a higher number of participants. The participants referring to visual recall all agree that items located in the ‘fact box’ demand a great deal of effort to retain and recall, but it still remains unclear how much effort is requires by a TBR item contextualised within the mental model.

Furthermore, it remains unclear how verbal input is interpreted into a visual representation, as in this case the written form. It could be suggested that some form of translation occurs. Since the interpreter needs to have some degree of focus on the verbal input, this information will be stored phonologically as well as visually, which would explain how participants who primarily make use of methods of visual recall describe gaining some support from phonological recall, usually in the form of rhythm. Reversely, participants primarily making use of phonological recall, describe no support from visual recall. This would suggest that some translation takes place when using visual recall. The method of phonological recall coupled with the method of visual recall , would inevitably be advantageous in the form of flexibility and stronger memory . Further information was not extracted on those interpreters who reported using this dual-recall method, but it would be interesting to investigate how interpreters making use of a dual-recall method utilise their memory strategies and how they control attention and capacity.

5.7 Effort

According to the participants, consumption of energy and dividing effort toward concurrent tasks are highlighted as dominant factors affecting the outcome. The participants describe how allocation of attention and capacity to one of the concurrent tasks will take capacity from other tasks. This is directly in line with Gile’s effort model (1999). All of the strategies mentioned in this chapter

require an effort in, balancing out the exact amount of effort allocated for one particular task in order to solve it, while avoiding too much energy being taken from other tasks rendering them unsuccessfully. Attention and effort seem to be intimately linked. Through greater control of attention, would we see a superior balance of effort and capacity? Should this be the case, it follows that an improvement in attention control within the executive control is essential for gaining greater capacity. Furthermore, greater awareness of one's own strengths and weaknesses as well as consciously rehearsing recall strategies may be a way to release capacity.

5.8 Anticipated contribution of the research.

In the light of the extensive responses given by the participants in this study, coupled with their eagerness and surprise when expressing their thoughts, undoubtedly research into this field is called for. Participants were of the impression of being alone in recalling items in this manner, or that everyone worked in the same fashion. This research may therefore improve our knowledge of memory operations in relation to sign language interpreting. Hopefully, this research may contribute as a starting point for an increased awareness within the interpreting community of the availability of various strategies of retaining and recalling information in sign language interpreting. Furthermore, for interpreters this study may assist in developing a greater interest in discussing this particular field and its inherent practices. This may lead to a higher level of awareness of the interpreter's self and the interpreter's mind, both of great importance. Finally, this study could hopefully encourage further research in the field, with the ultimate objective of improving interpreter education.

5.8.1 Limitations of this research

It is important to be aware of the limitations of this empirical study. Particularly relating to the fact

that the participants are requested to consider how they *think* they recall, which by its very nature adds an element of uncertainty to the resulting findings. Furthermore, the relatively small size of the resulting sample does not provide sufficient proof that methods utilised are universal.

The research question describe a broad and open approach, resulting in a large array of perspectives concerning the interpreting process. Therefore touching on many aspects, rather than an in-depth analysis of one aspect. Furthermore, the choice of both numbers and proper names as the selected TBR items may have been too broad, covering too many different aspects.

Some outcomes were predictable, others not, and the latter resulted in de facto incomplete questionnaires. Upon reflection, the questionnaire ought to have included information on participants' pre-knowledge of topic in order to compare that with the results. Prior research regarding the particular topic of this study was very limited, narrowing the scope of relevant literature, resulting in uncertainty in regards to which direction to go.

Information on topic, content and recipient was afforded the interpreters just prior to the task, possibly resulting in insufficient time for retrieving information on the topic from their LTM and subsequently referring it to their LT-WM.

Watching their work on video a few participants noted that deducing from the expression on their faces, they were allocating attention or recalling the TBR item. For results to have displayed greater precision, watching the interpretations in slow motion, thus enabling focus on eye movements and other facial expression may have proved beneficial . It would seem reasonable, that This would have revealed further details on how they recall in the exact moment.

5.8.2 Further research

All themes that have arisen in this thesis could form the basis for further research, in particular control of attention, as this seems essential for retaining the TBR item in the first place. Preferably,

research should be undertaken with a larger sample size in order to show more clear patterns.

Furthermore, research into this field could be in the frame of an experimental study with a two test groups; one receiving WM training and the other not, and measure for possible outcomes.

6. Conclusion

The findings of this study seem to support the theory that working memory is involved in many of the tasks required during simultaneous sign language interpreting. Clearly, among interpreters strategies have been developed with the object of rendering correctly specific items such as numbers and proper names, To some extent these strategies, when made use of correctly, solve issues of overload and lack of capacity. The main issue for interpreters is how to manage whatever strategies in use within the frame of simultaneous interpreting, when operating through the multitude of concurrent tasks all requiring attention.

Attention, therefore, is a key point when dealing with retaining and recalling a piece of information, which must be rendered directly. Not allocating attention, and ultimately capacity, to a given item at the instance of utterance, greatly diminishes the likelihood of retaining, recalling, and ultimately rendering the information. Resolving this issue would be the first step – improving interpreter allocation of attention. Enhancing cognitive abilities within working memory, specifically the executive control function, and raising awareness prove to be some measures for attaining improved results. Unquestionably, within the interpreting community awareness of the cognitive patterns inherent in the working mind needs further promotion. Patterns, which are oftentimes subconscious in the moment, hence subject to less debate unlike a field such as ethical decision-making, which by its very nature begets reflecting on conscious choices.

In conclusion, a great deal of further research is required to elucidate this particular field within interpreting!

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