Dissertations in Translation and Interpreting Studies 4

Stockholm University

Cognitive load in dialogue interpreting

Experience and directionality

Aleksandra Adler

Doctoral Thesis in Translation Studies at Stockholm University, Sweden 2023

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Experience and directionality

Aleksandra Adler

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Abstract

This dissertation investigates the effect of experience and language direction on cognitive load in dialogue interpreting. The general objective of the study is to contribute to a better understanding of cognitive processes involved in dialogue interpreting. The present inquiry employs a multi- and mixed- method design and seeks to investigate disfluency measures as indicators of cognitive load in dialogue interpreting. Furthermore, the study aims to explore whether blink-based measures are sensitive to changes in cognitive load of dialogue interpreters. The present study is positioned within cognitive translation and interpreting studies (CTIS) and employs cognitive translatology as a framework, encompassing both cognitive and psycholinguistic approaches to translation and interpreting. Chen's multidimensional theoretical construct of cognitive load in interpreting is explored in the study and remodeled to fit the context of dialogue interpreting and the assumptions of cognitive translatology. The data were collected from 17 dialogue interpreters during simulated interpreted encounters that recreated a situation commonly arising in a public service context in Sweden. The 10 inexperienced and 7 experienced interpreters all had Swedish as their working language, and the other working languages were French, Polish, and Spanish. Following the revised cognitive load model, the analyses of cognitive load focus on interpreter characteristics (interpreting experience) and on task and environmental characteristics (directionality). The results of analyses show that, in line with previous research, both interpreting experience and directionality modulate cognitive load of dialogue interpreters. Specifically, interpreting experience is demonstrated to attenuate cognitive load. In terms of directionality, interpreting into L2 is shown to be more cognitively demanding than interpreting into L1. Moreover, blink rate and blink rate variability (BRV) are explored as possible indicators of cognitive load. The analyses of blink measures suggest that no meaningful relationship can be found between blink measures and cognitive load.Finally, the complementary analyses of disfluency types in the utterances of the Polish interpreters (n=4) point to multifunctionality of disfluency in dialogue interpreting and to the multiple origins of cognitive load in interpreting dialogues. The analysis is performed from the perspective of the functional-cognitive view of disfluency proposed in the dissertation, whereby three disfluency context categories are identified and applied (cognitive-monitoring, cognitive-pragmatic, and cognitive-processing). Lexical access and rendition planning are identified as recurrent causes of cognitive load in dialogue interpreting. The study also makes theoretical and methodological contributions, primarily by revising the theoretical model of cognitive load in interpreting, which allows for operationalization of cognitive load with additional measures, in both experimental and naturalistic settings. Practical implications are a contribution to the understanding of the challenges interpreting into L2, and the impact of interpreters' experience on interpreting. Overall, the study contributes to the emerging cognitive profile of dialogue interpreters.

Keywords: *dialogue interpreting, cognitive load, interpreting experience, directionality, cognitive translation and interpreting studies, disfluency, eye-tracking, mixed-methods.*

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Till Simon och Zachary

אם אין אני לי, מי לי.
וכשאני לעצמי, מי אני.
ואם לא עכשיו – אימתי.
(פרקי אבות א׳:י״ד) *

**If I am not for me, who will be for me? And when I am for myself alone, what am I? And if not now, then when? (Pirkei Avot 1,14)*

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Stockholm, September 2023

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Abbreviations

BRV	Blink Rate Variability
CI	Consecutive Interpreting
CLM	Cognitive Load Model
CLT	Cognitive Load Theory
CTIS	Cognitive Translation and Interpreting Studies
IC	Inhibitory Control Model
L1	First Language
L2	Second Language
SI	Simultaneous Interpreting
TIS	Translation and Interpreting Studies
WM	Working Memory

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1 Introduction

Nearly a quarter century ago, Miriam Shlesinger asked whether one can "know what really happens" in the interpreter's mind (2000:3). Today, the discipline of translation and interpreting studies (TIS) is past its formative years, with the field's maturation bringing about a range of perspectives and technological advances that have enabled the research into interpreter's cognition to expand even further. Still, twenty-three years later Shlesinger's question remains relevant as TIS scholarship pursues ways to tap into cognitive processes that are not directly observable.

The present dissertation is an attempt to contribute to the knowledge about cognitive processes involved in dialogue interpreting, focusing specifically on cognitive load of dialogue interpreters. The term *dialogue interpreting* was first proposed by Wadensjö (1992) and stands for the type of bidirectional, (very) short consecutive interpreting (CI) that usually takes place in the public sector, business meetings, or diplomatic encounters. The terminology used to describe this type of interpreting is inconsistent[1], and terms like dialogue interpreting, public service interpreting, and community interpreting are often used interchangeably. Importantly, the terms community interpreting and public service interpreting refer to the context of the interpreting. Whereas the term dialogue interpreting describes the mode of interpreting. Dialogue interpreting is the most common mode of interpreting used by public service interpreters working in multi-party encounters in the public sector (Tiselius 2022:50). As this mode of interpreting is central to the present work, the terms dialogue interpreter and dialogue interpreting have been adopted as they put emphasis on the interaction and mutuality of communication.

In an attempt to take a broader perspective on the field of interpreting studies, Pöchhacker (2004) suggests that interpreting be viewed as a conceptual continuum. Rather than focusing on where different modes (e.g., simultaneous or consecutive) end up on the interpreting spectrum, Pöchhacker (2004:96) instead emphasizes that interpreting as a "socio-communicative practice can and should be seen as a unified concept". In line with the view of interpreting as a *socio-communicative* practice, the present work acknowledges that cognitive processes involved in interpreting are embedded in a socio-communicative context rather than occurring in isolation. Also, the

[1] For a comprehensive review of the terminology and taxonomy, see Tipton and Furmanek (2016:2–7). For a comparison of conference and community interpreting, see Tiselius (2022:49–63).

notion of interpreting as a *unified concept* is relevant to the present inquiry, with different modes of interpreting exhibiting similarities regardless of mode. Indeed, processes in all interpreting modes share at least some commonalities in terms of comprehension, bilingual control, and production. Furthermore, this notion is also relevant with regard to the study's assumptions about dialogue interpreting based on research on simultaneous interpreting (SI)

The general objective of this dissertation is to contribute to a better understanding of cognitive processes inherent to dialogue interpreting with a focus on cognitive load. [2] In the analyses, the emphasis is placed on understanding whether interpreting experience and directionality affect cognitive load in dialogue interpreting. The approach in the present work can generally be defined as descriptive, empirical study of interpreting processes. Muñoz Martín (2010:178–179) differentiates three levels at which translation processes can be understood (which can be extended to interpreting processes). The first, fundamental level comprises sets of mental states and operations of individual translators and interpreters. The second level involves observable, recursive sub-tasks executed during the translation process, such as for example reading, writing, speaking, and listening. These first two levels are closely related, since mental processes cannot be directly observed, but can be hypothesized on the basis of observable behavior. The third and final level pertains to the situatedness of translation and interpreting processes involving many agents and encompassing the period from the commission to the reception of the final product by the addressee. Following this division, the present work focuses on the first two levels of understanding interpreting processes – i.e., mental operations involved in interpreting and their hypothesized, observable representations. More specifically, this empirical study seeks to investigate disfluency measures as indicators of cognitive load in dialogue interpreting. Furthermore, the study aims to explore whether blink-based measures are sensitive to changes in cognitive load of dialogue interpreters.

The next section (1.1) presents the outline of the present dissertation, which is followed by a brief discussion of ontological, epistemological, and methodological considerations in section 1.2. Chapter 1 concludes with a description of the aims of the present work in section 1.3.

1.1 Outline

The present dissertation is organized as follows. Chapter 1 introduces the topic and theoretical assumptions adopted in the dissertation. Section 1.2 presents

[2] The present work was carried out at the Institute for Interpreting and Translation Studies at Stockholm University, as a part of a research project "Invisible process – cognition and working memory in dialogue interpreting" initiated by Elisabet Tiselius. The project is supported by the Swedish Research Council, VR2016-01118.

the ontological, epistemological, and methodological considerations underlying the study, particularly with respect to pragmatism. Section 1.3 introduces the aims and scope of the dissertation. Chapter 2 is concerned with theoretical framework and background and includes relevant previous research. Chapter 3 accounts for methods and data used in both quantitative and qualitative analyses. Chapter 4 reports the results of the quantitative and qualitative analyses, which are subsequently discussed in Chapter 5. The dissertation ends with conclusions, a discussion on strengths and limitations, and suggestions for further research in Chapter 6.

1.2 Ontological, epistemological and methodological considerations

Dialectical pragmatists consider both objective observation and subjective explanation as valid approaches to obtaining knowledge (Christensen et al. 2014). By this logic, applying different explanations to the same reality or approaching an object of study from different perspectives and using different methods would give a holistic interpretation of an object of study and as a result contribute to the advancement of knowledge. In interpreting studies, combining different methods of data collection or analysis has gained increased popularity in the last decades (Han 2018; Tiselius 2011; Vargas-Urpi 2017; Xiao and Muñoz Martín 2020). The terms *mixed-methods*, *triangulation*, or sometimes *multi-method* approaches, refer to employing different methods of data collection and analysis when investigating a specific object of study. However, Vargas-Urpi (2017:89) points out terminological confusion between these different terms and that these are used inconsistently in the published literature. She argues that *mixed-methods* means integrating qualitative and quantitative paradigms in data collection or analysis, while *multi-method* implies a use of specific analytical approach under one of the mentioned paradigms, usually quantitative. Xiao and Muñoz Martín (2020:15) emphasize that the three terms tend to get misinterpreted and state that mixed-methods research combines quantitative and qualitative methods, multi-method simply refers to using more than one data collection method, while triangulation means using two quantitative data collection methods to decrease the possibility of error in one or both methods. For some authors such as Gile (2005), Tiselius (2011), and Hild (2007), *triangulation* is the preferred term since it coincides with the original usage of the term, referring to the combination of data elicited by different methods, regardless of whether these are quantitative or and qualitative in nature. In this study, the adopted term is mixed-methods and is understood as using both quantitative and qualitative methods at different stages of the inquiry.

Research on interpreting has seen a surge in the use of mixed-methods designs in recent years (for a review, see Han 2018); however, these designs have not always been prevalent in the field (Pöchhacker 2011; Tiselius 2013:66). Traditionally, quantitative methods were used to research SI, while dialogue interpreting research relied primarily on qualitative methods. The split between qualitative and quantitative research traditions in interpreting studies took the form of two division, i.e., *the liberal arts paradigm*, associated with explication of individual cases or events, and the *natural sciences* or *empirical science* paradigm aiming at generalizing explanations (Moser-Mercer 1994; Gile 2009a; Pöchhacker 2011). Since this division has previously focused more on accusations of an alleged insufficient scientific rigor on the one hand and an alleged trivializing attitude to theory on the other rather than any particular philosophical rationale (Pöchhacker 2011:11), the split has given rise to tensions between proponents of the two paradigms (Han 2018:156). It is beyond the scope of this dissertation to present a thorough review of the paradigmatic debate in humanities in general or interpreting studies, in particular. Suffice to say, there is common ground to be found between these paradigms despite some fundamental epistemological and methodological differences (Seeber 2011:176). Current methodological discussions in interpreting studies have moved on from overly emphasizing the opposition between the two paradigms and instead favors explorations on their value should they be combined (Hild 2007; Pöchhacker 2011; see also, section 2.1.1).

A growing number of proponents of mixed-methods research designs in interpreting and translation studies emerged with the need to find answers to research questions that require different types of data (Hild 2007; Pöchhacker 2011; Tiselius 2013; Vargas-Urpi 2017; Han 2018; Meister 2019). As an interdisciplinary field of study from its very advent, Interpreting Studies benefits from integrating different methods that create opportunities to take advantage of the different perspectives provided by both qualitative and quantitative approaches. The primary benefit of mixed-methods research is its ability to enrich findings, provide researchers with confidence in the results, and offer broader and deeper understanding of the researched phenomenon. It favors a *pluralistic* (Meister 2018), *creative* and *integrationist* approach (Hild 2007) and allows for research in interpreting studies to be both *holistic* and *detailed*, permitting both explanation and understanding (Pöchhacker 2011:14; Han 2018). Furthermore, it is consistent with Pöchhacker's (2011) compellingly pragmatist portrayal of interpreting studies as an empirical-interpretive discipline.

In interpreting studies, the most frequently given rationale for using mixed-methods has been triangulation (Han 2018:159) in the sense of combining qualitative and quantitative research methods to confirm and corroborate findings. However, according to Meister (2018:68), contemporary mixed-methods paradigms have evolved beyond integrating qualitative and quantitative methods of data collection and now encompass an approach in which different elements of "qualitative or quantitative character" are combined in any phase of research. Yet, mixed-methods designs are not an uncontroversial concept. A valid concern often raised in discussion on mixed-methods designs is whether making assumptions based on triangulated methods in favor of a study's validity is justifiable. For instance, Hild (2007:102) addresses the issue by critically examining how demonstrating scientific rigor throughout the different stages of a research process remains a major challenge for mixed-methods studies. Despite the growing number of studies in interpreting studies that adopt mixed-methods research designs few authors validate their use or provide specific reasons to justify the study design beyond comments related to triangulation and completeness. One step toward achieving robustness, completeness, and a deeper understanding of the investigated construct would be more explicit descriptions of how the mixing of methods is accomplished in a given study (Hild 2007:2). In this dissertation, the rationale for mixing was based on the need to complement the quantitative instrument with qualitative analyses to yield a more complete exploration of the construct – namely, cognitive load. In other words, the qualitative method was supplementary to the quantitative results so as to answer questions that had emerged from the quantitative analysis. Thus, the strands were given different priority, and the integration of quantitative and qualitative methods was sequential.

Of note in this section is the differentiation between the decision to adopt a mixed- and multi-method design. The section also situates the author as a researcher since ontological and epistemological commitments provide rationale for the chosen methodology (Bryman 2012:629). In the case of the present study, the overarching research paradigm is pragmatist in nature. Importantly, this research paradigm seeks a middle ground between positivist and constructivist views and was chosen because pragmatism accommodates multiple worldviews while recognizing both qualitative and quantitative methods as well as abductive reasoning. As such, it acknowledges that an objective reality exists but that the knowledge about it is socially co-constructed (Mellinger and Hanson 2022b:110).

1.3 Aims and scope

The overreaching goal of the present work is to shed light on the construct of cognitive load in dialogue interpreting. As will be evident from the discussion on the construct (see section 2.3), cognitive load is a multidimensional concept and therefore cannot be assessed using a single measure. In the present study, interpreters' cognitive load is investigated by analyzing two real-time measures: disfluencies and spontaneous blinks. Disfluencies are a commonly accepted measures of cognitive load in SI but have previously not been empirically explored in dialogue interpreting. Blinks have shown sensitivity to changes in cognitive load and are an established measure of cognitive processing in other disciplines, like psychophysiology or cognitive neuroscience. However, blinking has not been empirically tested as a real-time indicator of cognitive load in translation or interpreting. These decisions related to data collection seek to fill gaps in the extant scholarship and determine their appropriateness for this type of research moving forward.

The first aim of the present work is to investigate whether cognitive load in dialogue interpreters is modulated by both interpreter experience and interpreting directionality (see section 2.7, RQ 1). Since this dissertation builds on holistic and functional approaches to disfluency (Crible 2018), disfluencies are also empirically explored in terms of their cognitive functions in dialogue interpreting (see section 2.7, RQ 6). The second aim is to investigate whether temporal dynamics of blinking are responsive to fluctuations in cognitive load of dialogue interpreters (see section 2.7, RQs 2, 3, and 4). The third and final aim is to explore a potential relationship between disfluency measures and blink-based measures of dialogue interpreters (see section 2.7, RQ 5).

In terms of scope, the present inquiry does not address stuttering-type disfluencies (see Lickley 2017 for a review). Here, only disfluencies in interpreters' utterances and interpreters' eye movements are analyzed here. As a result, disfluency perception is not taken into account in the study – i.e., this study does not seek to understand how interlocutors perceive interpreter disfluencies, nor how the interpreter perceives and understands the interlocutors' disfluencies.

To conclude, the present work compares experienced and inexperienced interpreters' disfluencies and spontaneous blink measures in order to study the construct of cognitive load in dialogue interpreting. The more general objective of the study is to contribute to a better understanding of cognitive processes involved in dialogue interpreting.

2 Background and theoretical framework

This chapter situates the study within the discipline of translation studies in section 2.1, positioning this work by means of a brief discussion on cognitive perspectives in interpreting process research in sections 2.1.1 and 2.1.2. Section 2.1.3 provides readers with a background on the Swedish dialogue interpreting context. Sections 2.2–2.2.7 present dialogue interpreting as an object of study and outlines the fundamental cognitive processes that dialogue interpreting entails. Section 2.3 focuses on the central construct of the study, cognitive load. Relevant cognitive load models in interpreting studies are discussed in section 2.3.1 followed by a revision and adaptation of the cognitive load model for the present study. Section 2.3.2 focuses on the construct of cognitive load in the present work. The sections that follow (2.4 and its subsections) address disfluency as another central topic of this dissertation. A brief review of previous research on disfluency in speech production (2.4.1), dialogues (2.4.2), and bilingual speech production (2.4.3) is followed by a section (2.4.4) on empirical and corpus research on disfluency in interpreting. The penultimate section on disfluency (2.4.5) presents a typology of disfluency markers whereas the final section (2.4.6) accounts for how disfluency is defined in the present study and how it is used to operationalize cognitive load. The final sections of this chapter briefly describe eye-tracking measures. After a general introduction to eye-tracking measurements used in previous research on interpreting and cognition (2.5), and a brief discussion on eye measures previously used as indicators of cognitive processing (2.5.1). Before blink-based measures are introduced as a potential measure of cognitive load in interpreting in section 2.5.1.3, sections 2.5.1.1 and 2.5.1.2 present the measures commonly used in research on cognitive load, that is pupillary dilation and fixations. Section 2.5.2 presents previous research on blinking and cognitive load with focus on two measures used in the present study, that is blink rate (2.5.2.2) and blink rate variability, BRV (2.5.2.3). The penultimate section 2.6 summarizes the theoretical and conceptual approaches adopted in the present dissertation. The final section presents the research questions that were addressed in the present study (2.7).

2.1 The position of the present work TIS

After nearly 50 years since it was first presented,[3] Holmes' (1987) map remains unceasingly influential, such that some scholars have characterized this overview as "a monument in Translation Studies" (van Doorslaer 2007:217). Despite having been criticized, for instance by Pym who argued that maps "tend to make you look in certain directions; they make you overlook other directions" (1998:2), Holmes' map remains a useful heuristic to epistemologically orient researchers within the field of TIS. For example, the division into process- and product-oriented approaches appears to be relevant to some degree even today and for the present study. Whereas this dissertation is undoubtedly concerned with the process of interpreting, it seems that "Holmes' vision of Translation Studies was highly weighted toward texts rather than the people that produce them" (Chesterman 2007:19). In this work, equal emphasis is put on the process and *agents of translation*,[4] that is dialogue interpreters and their cognitive processes during *interpreting* (see section 2.1.2).

2.1.1 Cognitive approaches in TIS

In the past few decades, the field of TIS has demonstrated an increased interest in cognition, in line with the developments in other disciplines, where efforts have been made to bring together both the cognitive and the social domains in the empirical study of human behavior (Halverson and Kotze 2021:51). Different accounts and designations have been proposed,[5] such as *translation process research* (Shreve and Koby 1997; Göpferich and Jääskeläinen 2009; Jakobsen 2014) or *cognitive translation and interpreting studies* (CTIS; Halverson 2010:349; Muñoz Martín 2017; Olalla-Soler et al. 2020; Xiao and Muñoz Martín 2020). The different labels have often been used interchangeably to refer to the entire subfield of research on cognitive processes of translation and interpreting; however, as Pöchhacker (2011) argues, conceptualization should precede any terminological distinctions.

The emergence of the different frameworks gave rise to a clear tension between the *cognitive* and the *social* (see Kotze 2019:339) when studying translation processes. Muñoz Martín (2017:561) proposes two major and, as he postulates, epistemologically opposing and mutually exclusive views on cognition in translation[6] – i.e., *computational translatology* and *cognitive*

[3] Holmes unpublished 1972 paper "The Name and Nature of Translation Studies" was first reprinted in a collected volume, *Translation Across Cultures*, edited by Toury (1987).
[4] *Interpreting* is regarded here as a form of translation (Pöchhacker 2016:11) and is therefore assumed that the reviewed theoretical approaches include interpreting despite using the hypernym, *translation*.
[5] For reviews and discussions, see Jääskeläinen and Lacruz (2018) and Marín García and Halverson (2022).
[6] For a similar distinction, see Risku (2013).

translatology. The former sees translation as a type of information processing in the human brain, in which *meaning* is objective and can be transferred by means of various serial intercranial processes. Cognitive translatology opposes the mechanistic view of the mind and sees translation as a *situated* action, such that meaning is constructed via interaction with an individual's environment. According to situated accounts, the relative stability of language is a result of "evolutionary stability even in the face of change", and not a result of innate universals (Johnson 2018:637). Following embodied and situated cognition (e.g., Clark 1998/2017),[7] one of the assumptions of cognitive translatology is that cognition transcends internal brain processes and depends on how individual translators and interpreters interact with their social environment.

This conceptualization of translation process as being irreducibly sociocognitive suggests that cognitive processes cannot be analyzed in isolation.[8] Importantly, the view of interpreting as a socially situated activity is not new and interpreters have been shown to *co-construct meaning* (Wadensjö 1992; Pasquandrea 2012), conversational *common ground* (Davidson 2002:1274) and negotiate meaning to co-create *shared cognitive environment* (Delizée and Michaux 2019:265). Tiselius (2022) argues that embodied cognition can be understood through the study of dialogue interpreters' turn-taking, gestures, and gaze. Tiselius and Englund Dimitrova (2023:311) discuss cognitive processes of dialogue interpreting against the backdrop of what they understand as *distributed cognition*.[9] In their view, cognition is distributed among the interpreter, the primary parties and the artifacts (e.g., a notepad and a pen) that all constitute integral parts of a cognitive system performing the interpreting task. In a similar vein, Mellinger (2023) explains that interpreters may interact with artefacts in a technologized environment. However, the framework of distributed cognition is not to be viewed as mere interaction with tools or artifacts. Rather, it assumes that multiple agents are involved in the cognitive process of interpreting, which means interpreters rely on their own cognitive resources and those originating from external sources, such as other interpreters or technological tool developers (Mellinger 2023:204). Thus, interpreters' cognitive resources are distributed across multiple participants and pieces of technology. The role of

[7] Embodied and situated cognition have collectively become known under the label of 4EA cognition – i.e., *embodied*, *embedded*, *enactive*, *extended*, and *affective* cognition, although each represents a slightly different perspective (Newen et al. 2018:6).
[8] At the extreme end of that conceptualization is the work of Risku and colleagues (e.g., Risku 2010, 2014, 2017; Risku et al. 2013) who posit that cognitive processes are not only irreducibly sociocognitive, but cannot be analyzed without considering "the cultural, ecological, physical, historical, social and other aspects of the environment" (Risku 2014:339).
[9] Distributed and situated cognition are related paradigms in the field cognitive science but they offer slightly different perspectives and scope. For a discussion on both notions and their relevance for CTIS, see e.g., Muñoz (2010:169–189), Risku and Rogl (2020:478–499), Sannholm (2021:23–27), and Mellinger (2023:191–213).

technology and artifacts is to facilitate the distribution of cognitive resources among individuals belonging to the same cognitive system (see Mellinger 2023:202).

Tiselius and Englund Dimitrova suggest that the indivisibility of mental processes and environment in dialogue interpreting is reflected in the process of *monitoring* (see section 2.2.1), since interpreters "monitor not only themselves but also other participants" (2023:311). Similarly, the authors emphasize the importance of *coordination*, which is not only central to the dialogue interpreter's work (see Wadensjö 1998) but is also salient given the cooperation and coordination of disparate internal and external resources within a cognitive system (Tiselius and Englund Dimitrova 2023:311). As such, Tiselius and Englund Dimitrova (2023:310) perceive cognitive processes of the dialogue *interpreting act* as situated in the interactive *event of interpreting*.

The notions of interpreting event and interpreting act go back to Toury's (1995, 2012) distinction between *translation acts* and *translation events*. In Toury's (2012:67) view, the translation act takes place in the human brain and is understood as a cognitive activity of rendering a target text from one language into a different language. In contrast, the translation event is defined as the social framework or "the situation in and for which the act is performed" (Toury 2012:67). Chesterman (2015) elaborates on the idea of acts and events using Toury's notion of *problems* to discuss how different models establish a relationship among the processes of the translation act. However, Chesterman's approach has been criticized as being reductionist, specifically by Muñoz Martín (2016b) who refutes the idea of separation between "cognitive" acts and "social" events of translation based on the premise that they are *cognitively indivisible*. As Muñoz Martín notes: "cognitive processes are the consequence of interacting with the environment, and they affect the environment" (2016b:156–157). In the present work, the relationship between interpreting act and interpreting event is understood as one of causality. This relationship is further reflected in the choice and adaptation of the model of cognitive load (see section 2.3).

To conclude, the present inquiry is conducted within the cognitive translatology framework. As will be argued in the next section, there may be certain flaws to this approach; however, for the purposes of this type of study, this approach has been determined to be the most appropriate.

2.1.2 Dialogue interpreting and cognition in the present work

Dialogue interpreting encompasses a multitude of processes that involve not only the interpreter, but all the participants involved in the interpreting encounter (see Tiselius and Englund Dimitrova 2023:311). Viewed in this manner, dialogue interpreting is understood as a sociocognitive activity that is embedded and embodied within the communicative context. However, it should be noted that dialogue interpreting is not analyzed as embedded nor embodied in the present inquiry in the truest sense of these terms for several reasons.

First, the main objective of this dissertation is to understand the nature of cognitive processes involved in interpreting dialogues, with a focus on *individual dialogue interpreters* (see Englund Dimitrova 2010:406). As such, the study does not entirely fit within the framework of cognitive translatology insofar as the cognitive processes involved are not wholly related to these external features. On the one hand, the embeddedness and the embodiment of the interpreting task are reflected in how the study was designed – the set up was a simulated interpreted encounter with both interpreter and the two interlocutors on site. Moreover, the study uses psychophysiological measures, based on the assumption that human perception, thought, emotion, and action are embedded and embodied (Cacioppo et al. 2007:14). On the other hand, priority is given to quantitative method and the analysis is focused on the interpreter, emphasizing cognitive aspects that have not been explicitly linked to these external factors.

Researching translation processes from the perspective of embedded cognition is fraught with potential problems (Risku 2014:339; Muñoz Martín 2016a:10; Kotze 2019:354). A major challenge lies in accounting for all confounding variables introduced by "reembedding […] the translational tasks in their environments" (Muñoz Martín 2016a:10). In this respect, modeling cognitive translation as embodied, embedded, enactive, extended, and affective still lacks a comprehensive methodological foundation that can fully account for the complexity of translation and interpreting processes. A helpful heuristic for reducing methodological challenges is identifying them and seeking out pragmatic solutions. Marín García (2019) argues that epistemic *pluralism* is an approach that provides the field of CTIS with "the acceptance that there is more than one way of knowing, describing and understanding a given phenomenon" (2019:169) without implying that all systems are valid (Marín García 2021:224).

In sum, the present study is conducted within the CTIS, encompassing both cognitive and psycholinguistic approaches to translation and interpreting. More specifically, the study adopts a "descriptive, empirical, experimental approach to translation studies based on close, technology-supported observation of translational (micro)behavior" (Jakobsen 2014:65).

2.1.3 Public service interpreting in Sweden

Since the current study investigates public service interpreters working in the dialogue interpreting mode who have been trained and are professionally active in Sweden, some information on public service interpreting in Sweden is provided for context.

As of 2017, when data were first collected for this study, there were 391 state authorized interpreters in Stockholm and 961 in Sweden. This study relies on interpreters who work with French, Polish, or Spanish. There are 74 Spanish interpreters nationwide, with 49 of these interpreters working or residing in Stockholm. At the same time, 63 Polish interpreters were working in Sweden (25 in Stockholm) and 15 French interpreters (7 in Stockholm).

Since 2016, the Legal, Financial and Administrative Services Agency (*Kammarkollegiet*) that is responsible for interpreter authorization maintains a registry both of authorized interpreters and trained interpreters (*utbildade tolkar*) who do not hold authorization but have received training at vocational training institutions or universities. It is impossible to determine how many of the authorized interpreters are professionally active. Similarly, the number of non-authorized interpreters is unknown. Almqvist (2016:5) notes that there are no reliable statistics on how many dialogue interpreters in general are professionally active in Sweden; however, the Swedish Agency for Public Management (*Statskontoret*), in two reports from 2012 and 2015, estimated the number at around 6000 interpreters. This number differs considerably from the estimates provided by the Swedish National Agency for Higher Vocational Education (*Myndighet för yrkeshögskolan*), which place this figure between 2500 and 4000 interpreters in 2015. Almqvist (2016) argues further that the figures provided by the two agencies and the records administered by the Kammarkollegiet indicate that the majority of professionally active interpreters are neither authorized nor trained.

Surely, many of the non-authorized interpreters have gotten experience through practice and some might have taken short interpreting courses not recognized by the national registry.

Importantly, the experienced participants recruited for the present study were required to hold state authorization and have at least 4 years of interpreting experience (see section 3.1)

2.2 Dialogue interpreting processes

Despite the growing body of research on dialogue interpreting in interpreting studies (Gile 2006; Liu 2008:86), cognitive processes of dialogue interpreting have not been widely researched to date (Tiselius and Albl-Mikasa 2019:233), with dialogue interpreting having been investigated primarily from sociological and interactional perspectives (e.g., Englund Dimitrova 1991; Wadensjö 1992, 1998; Roy 1993; Angelelli 2004; Baraldi and Gavioli 2012). Englund Dimitrova and Tiselius (2016) point out the increasing interest in investigating interpreting from a cognitive perspective. However, it has mainly been SI and long CI that received attention, whereas cognitive processes involved in dialogue interpreting remain understudied. More recently, the works of Englund Dimitrova and Tiselius (2016), Tiselius (2018) and Tiselius and Englund Dimitrova (2019, 2021, 2023), as well as Arumí Ribas (2012), and Arumí Ribas and Vargas-Urpi (2017, 2018) have established cognition of dialogue interpreters as a more regularly studied object of investigation. Tiselius and Englund Dimitrova note that, "understanding also the cognitive (mental) processes underlying dialogue interpreting […] is both theoretically important and crucial from an applied perspective, not the least in the context of education and professionalization of interpreters in the public sector" (Tiselius and Englund Dimitrova 2023:309). In terms of research on cognitive load, it is potentially advantageous for both prospective and professionally active interpreters to be aware of how cognitive load is reflected in their performance and physiology.

Tiselius and Englund Dimitrova (2021:333) propose that the cognitive processes of dialogue interpreting comprise comprehension, monitoring, and prediction of the unfolding turn, planning and preparation of the upcoming rendition, storing it in a buffer until the rendition can be produced, taking the turn, and speech production. Accounting for the different subprocesses inherent to dialogue interpreting is central to the discussion on the *cognitive load* that these processes potentially place on the interpreters' *working memory (WM).*

This section (2.2) introduces cognitive processes central to dialogue interpreting and constructs relevant to the present inquiry. Each section presents a different process as well as its relationship to interpreting along with previous research conducted on the subject. The review starts with the process of *bilingual language control* in section 2.2.1 and is followed by sections on the processes of *monitoring* (2.2.2), *comprehension* (2.2.3), and *production* (2.2.4). Subsequently, the construct of *directionality* is discussed in section 2.2.5. Then, *experience* together with a related construct of *automaticity* are discussed in section 2.2.6. Finally, the construct of WM is discussed in section 2.2.7. The review of previous research on these processes and constructs lays the groundwork for the discussion and analyses in later sections.

2.2.1 Bilingual language control

A great deal of empirical evidence points to language co-activation in bilingual and multilinguals in both comprehension and production (e.g., Marian and Spivey 2003; Blumenfeld and Marian 2007; Thierry and Wu 2007; Wu et al. 2013).[10] This evidence implies that interpreters, like all bilingual speakers, must exercise control over which of their languages to select in any

[10] This evidence also is present for bimodal bilingualism as well (see e.g., Emmorey et al. 2015; Giezen and Emmorey 2016; Ormel et al. 2022; Villameriel et al. 2022); however, discussion of bimodal bilingualism is beyond the scope of the present work.

given context. Consequently, multilingual speakers must inhibit one or more languages in order to use only one language at a time.[11] The fact that interpreters comprehend a message in one language and produce a rendition in another, might modulate comprehension (Díaz-Galaz 2020:309).

Thus, a process essential to both production and comprehension in interpreting is bilingual language control.[12] Bilingual language control comprises cognitive subprocesses related to cross-activation of multiple languages in one brain (Green 1986, 1993, 1998; Abutalebi and Green 2008, 2016; Calabria et al. 2018). These processes underpin the Adaptive Control Hypothesis forwarded by Green and Abutalebi (2013). Since both (or more) languages are active and compete for selection in bilinguals, the demands on control processes change depending on the different contexts (e.g., monolingual context, dual-language context, dense code-switching). Consequently, cognitive control processes are believed to adapt to the higher or lower demands of the context by either increasing control or by staying neutral (Green and Abutalebi 2013:520). More recently, Hervais-Adelman and Babcock (2020) proposed that SI constitutes a separate context in which interpreters execute *extreme language control* (Obler 2012; Hervais-Adelman et al. 2015). In other words, the demands put on language control processes are particularly high. Considering that bidirectionality is implied in the task of dialogue interpreting (Tiselius 2022:54), dealing with cross-activation of two competing language systems seems at least equally demanding as in other forms of interpreting (Tiselius and Englund Dimitrova 2019), both in language production and comprehension. It is also possible that dialogue interpreting constitutes an additional and separate context in terms of bilingual language control (Tiselius and Babcock 2023).

2.2.2 Monitoring

The process of *monitoring* in dialogue interpreting is not synonymous with speech production monitoring. In models of speech production, monitoring is considered "a cognitive system that inspects language production processes and intervenes when necessary" (Hartsuiker 2014:417). Generally, two accounts of self-monitoring system exist that distinguish between perception monitoring and production monitoring (Postma 2000). Perception monitoring theories include Levelt's (1983, 1989) perceptual loop theory and the perceptual loop model (Hartsuiker and Kolk 2001) that derives from it. The fundamental tenets of these accounts are that speech perception system is used in the detection of errors and that monitoring is restricted by attentional

[11] cf. Blanco-Elorrieta and Caramazza (2021) who propose a selection mechanism that operates on the highest level of activation and does not require inhibition.
[12] Language control in comprehension has not been extensively researched to date. However, there is evidence that bilinguals exert cognitive control in comprehension (see Ibáñez et al. 2010; Wang 2015).

capacity. Production monitoring theories (e.g., Laver 1980; Levelt 1989) argue that pre-articulatory monitoring devices exist within the speech production system. However, interpreters' monitoring processes surpass self-monitoring of speech production. Englund Dimitrova and Tiselius (2016:203) note that interpreters monitor not only themselves, but also the primary interlocutors of the interaction. More recently, the authors define dialogue interpreters' monitoring as "a cognitive process through which they observe, evaluate, and take actions relating to their own cognitive processing and that of the other participants in the interpreting event" (Tiselius and Englund Dimitrova 2023:315). Monitoring is thus central to dialogue interpreting, such that it is an integral part of all cognitive and linguistic processes involved in interpreting and is reflected in interpreters' speech production, performance, and gaze, as well as the ways in which they cope with cognitive constraints (Tiselius and Englund Dimitrova 2023:316). Monitoring is also essential in interpreters' coordination work, whereby they are in control of the interaction. Notably, the monitoring capacity of dialogue interpreters is most likely related to interpreting experience, such that more interpreting experience contributes to better monitoring (Tiselius and Englund Dimitrova 2023:317).

2.2.3 Comprehension

The process of comprehension in dialogue interpreting involves recurrent listening to both L1 and L2 as a result of the bidirectional nature of this mode of interpreting. In general, processes involved in comprehension in L1 and L2 share many commonalities. Both are fast and incremental (Rayner and Clifton 2009) and involve decoding at the levels of words, sentences, and discourse (Fernández and Smith Cairns 2017:185). Tokowicz and Perfetti (2009:173) identify five subprocesses of comprehension: perception, parsing, semantic-syntactic representations, and understanding. Previous research has also demonstrated that L1 listeners engage in phonological, semantic, and syntactic prediction (Pickering and Garrod 2007; Pickering and Gambi 2018). Prediction has also been shown to take place during L2 comprehension, although slower and to lesser extent than in L1 (Ito et al. 2018). Comparably, in interpreting studies, researchers have suggested that interpreters predict incoming linguistic information (Chernov 1994; Moser 1978), with a growing body of empirical evidence that support views of predictive processing in interpreting (Amos and Pickering 2019; Amos 2020). A study by Amos et al. (2022) demonstrates that both simultaneous interpreters and untrained high proficiency bilinguals engage in prediction. Similarly, Zhao et al. (2022) suggest that interpreters predict source language in consecutive interpreting provided that there are enough cognitive resources available.

Since comprehension in bilinguals (and, by the same token, interpreters) assumes linguistic cross-activation, dealing with competing linguistic representations is most likely to be reflected in the speed of comprehension.

The presence of language cross-activation has been shown to place a small, but significant, disadvantage on bilinguals in terms of lexical access in comprehension (Gollan et al. 2002; Gollan et al. 2011). In this view, bilinguals are likely to exhibit slower retrieval simply as a result of using each language only part of the time (Gollan et al. 2011:6). Similarly, comprehension is a frequency-driven mechanism which is reflected in the speed of lexical processing in bilinguals. Frequency effects have also been proven to affect lexical processing in interpreters. For instance, Chmiel et al. (2023) found that lexical frequency modulates cognitive load in interpreters during comprehension.

In long CI, parallel processing of the target language during source language comprehension has been shown to be modulated by both directionality (see section 2.2.5) and interpreters' cognitive resources (Dong and Lin 2013). Consequently, it seems possible that some aspects of comprehension in dialogue interpreting will be affected by language proficiency, directionality, and experience, as well as cognitive resources available to the interpreter.

According to Gile (2005), the listening phase of CI is more cognitively demanding since it is paced by the speaker, whereas the production phase is a self-paced process. In contrast, in dialogue interpreting the listening phase is paced both by the speaker and by the interpreter as a result of the inherently bilateral character of dialogue interpreting. In other words, the listening phase of dialogue interpreting incorporates the process of comprehension and at the same time the processes of monitoring and coordination.

The dialogue interpreters' control of turn-taking permits them to actively adapt the speed of the listening phase according to their WM capacity. The listening phase in dialogue interpreting is thus qualitatively different than listening in simultaneous and long CI.

Building on Tiselius and Englund Dimitrova's (2021) model of dialogue interpreting and borrowing from Shreve et al.'s (1993) notion of *reading for translation*,[13] the present work proposes the term of *listening for interpreting*. It is related to the pedagogical concept in SI training of *active listening* suggested by Seleskovitch (1978).

A related concept is investigated by Díaz-Galaz (2020) in her review of research on listening comprehension in SI as a goal-oriented activity. Substantial evidence demonstrates that skilled listening is at the core of interpreting and may be influenced by a variety of factors such as language proficiency, knowledge, or mastery of cognitive and metacognitive strategies (2020:305).

In a similar vein, Amos et al. (2023:6) refer to the notion of *purposeful listening* in CI. The authors find that purposeful listening associated with CI

[13] Cf. *reading for translation* in Macizio and Bajo (2006) and *reading for interpreting* in Zhao et al. (2022).

does not differ in the extent of prediction compared to regular listening for comprehension.

Here, the concept of listening of interpreting is suggested in order to emphasize that the listening phase in dialogue interpreting involves multiple, both concurrent and incremental, cognitively demanding subprocesses. Also, listening for interpreting surpasses the processes of comprehension in a non-interpreting context as is driven by the listeners' purpose to interpret. Furthermore, the notion of listening for interpreting takes into account the impact of monitoring (see section 2.2.2) which is manifested in, among others, interpreters' control of turn-taking and coordination work (Wadensjö 1998, 2018). Thus, while listening for interpreting, dialogue interpreters engage in subprocesses of comprehension, monitoring, prediction of the unfolding turn, and rendition planning.

Regarding rendition planning, the model of turn-taking proposed by Levinson and Torreira (2015) as well as empirical evidence (for a review, see Corps 2023) both support early response planning in dialogues. Therefore, it is reasonable to expect that rendition planning in dialogue interpreting has already begun during the listening phase. Consequently, with all its subprocesses, the putative process of listening for dialogue interpreting may place greater demands on WM than comprehension alone. Moreover, the demands may be expected to increase even further in inexperienced interpreters.

A related construct of *professional listening competence*, introduced into research on dialogue interpreting by Viljanmaa (2020), is motivated by the communicative goals of the interpreting event. Building on listening research, Viljanmaa (2020) conducted a qualitative inquiry into professional listening competence of dialogue interpreters. She found that the interpreter "decides with which type of listening and with which type of listening behavior to achieve the profession-specific listening goals in a given communicative situation" (2020:62).[14] Similarly, listening for interpreting is motivated by the communicative goals inherent to a specific interpreting encounter and influenced by the individual interpreter's WM capacity.

2.2.4 Production

Bilingual speech production models (e.g., de Bot 1992/2007; Kormos 2006; for a review, see de Bot and Bátyi 2022) are to a large extent built on Levelt's (1989) influential monolingual model. Generally, the speech production process in both L1 and L2 is executed in a similar manner; however, the various models disagree on the extent to which lexical and syntactic

[14] "[…] der Zuhörer weiß, mit welcher Zuhörart und mit welcher Art von Zuhörverhalten er die jeweiligen professionsspezifischen Zuhörziele in einer bestimmten Kommunikationssituation am besten erreicht", my translation.

information is shared between languages (see Ullman 2001; Hartsuiker et al. 2004; Hartsuiker et al. 2016). Briefly, Levelt's (1989:9) blueprint for the speaker comprises the following elements: 1) conceptualizer, where the concepts are chosen; 2) formulator, where lemmas are accessed and retrieved from the mental lexicon and the message is linguistically coded; and 3) articulator, where the utterance is pronounced.

In interpreting, the production process is somewhat different. The primary difference in speech production between interpreted and non-interpreted speech exists on the level of the conceptualizer. Namely, interpreters do not conceptualize the content of their utterance as they are to convey the concept already generated by the speaker. In other words, during the process of interpreting, there is an overlap in meaning between what has been comprehended and what is being produced (see Amos 2020:82). Feasibly, the overlap in meaning could lead to an automatic selection of target language structures and translation equivalents.[15] As a result, producing interpreting output would then potentially rely less heavily on cognitive resources (see Amos 2020:81). The release of cognitive resources could potentially enable the interpreter to redirect attentional resources to other processes involved in producing the target message.

The processes of lexical retrieval that take place at the level of formulator have been shown to fundamentally differ in production compared with comprehension. As noted previously, lexical access is a frequency-driven mechanism during comprehension. In contrast, constrained semantic context has been shown to attenuate the effects of lexical frequency during bilingual speech production (Gollan et al. 2011). In other words, lexical access is predominantly guided by meaning and context in language production. In terms of interpreting, empirical evidence of context as a facilitating factor has been provided by Chmiel (2016), who investigated effects of directionality during a word translation task. Notably, context effects were significant for both unidirectional and bidirectional conference interpreters, which suggests that context could also facilitate lexical retrieval in dialogue interpreters.

There is a wealth of empirical evidence consistent with the view that linguistic cross-activation in bilinguals occurs at every level of representation, including speech execution and articulation (for a review, see Brysbaert and Duyck 2010). In other words, even in the presence of a meaning overlap or a facilitating effect of context, language production is believed to be more cognitively demanding than language comprehension alone (De Groot and Christoffels 2006:196). Consequently, speech production in interpreting will be at least equally cognitively effortful if not more so than during non-

[15] This description may seem reductionist, but activation of translation equivalents does not imply that an interpreter is a conduit (see the conduit metaphor, Reddy 1979). Rather, the claim merely illustrates how overlap in the meaning between the interpreting input and prospective output may facilitate production of that output when it has already been conceptualized.

interpreted speech. As previously stated, (section 2.2.1), bilingual language control that enables the inhibition of language(s) currently not in use is more cognitively demanding in the context of interpreting where interpreters alternate between the two languages. Additionally, the bidirectionality in dialogue interpreting is likely to place more cognitive demand on interpreters since they engage in both comprehension and production in both languages. Furthermore, since dialogue interpreters' language proficiency is functionally asymmetrical (Tiselius and Englund Dimitrova 2019:308) and interpreting into L2 is generally more effortful (see section 2.2.5), speech production in dialogue interpreting will rely heavily on cognitive resources. Also, the cognitive demand of speech production while interpreting into L2 may be larger for interpreters with limited experience.

2.2.5 Directionality

Directionality is a frequently debated and researched subject in the field of interpreting studies (see Bartłomiejczyk 2015:108–110), which concerns whether there is a difference in interpreting from an interpreter's L1 into their L2, and vice versa (Chen 2020:100). There are two possible reasons for this difference. According to the Inhibitory Control model (IC; Green 1986, 1993, 1998), bilinguals recruit inhibition in order to overcome the activation of the language that is not used in production. In other words, when one language is used, the other is suppressed. Thus, the asymmetrical inhibitory demands might be visible in the patterns of processing and in reactivation costs. Since according to the IC,[16] bilingual costs arise when switching into the dominant from the weaker language (e.g., Meuter and Allport 1999), the need to recruit inhibitory control may be expected to be greater in interpreting into L2. Accordingly, for interpreters, parts of cognitive load associated with interpreting into L2 may correspond to the amount of inhibitory control necessary to suppress the more dominant L1. Consequently, interpreters may be expected to recruit more inhibitory control when interpreting into L2. However, the higher demand of formulating the output in the non-native language may depend on interpreters' L2 proficiency (see Babcock and Vallesi 2015).

Also, as shown in section 2.2.3, lexical retrieval in bilinguals in L2 is slower, which can also be expected to have an effect on interpreting into one's L2. Chmiel (2016) found an effect of directionality on the speed of lexical retrieval but only in bidirectional conference interpreters. The study showed shorter translation latencies for L2–L1 direction as opposed to L1–L2 direction.

[16] cf. BIA+ ; Bilingual Interactive Activation model assumes that in language comprehension, inhibition of the weaker language is greater (Dijkstra and van Heuven 2002). It is debatable, whether bilingual production and comprehension can be confined to a single model of bilingual processing (Mosca and de Bot 2017).

Directionality in interpreting has been discussed by Seleskovitch and Lederer (1989:200), among others, who have argued in favor of interpreting into L1. The disadvantage of interpreting into one's L2 has gained empirical support in a number of studies. For instance, the results from experimental studies on SI using pupillometry (Hyönä et al. 1995) or reaction times (de Bot 2000) suggest that interpreting into one's L2 is more cognitively demanding. Brain imaging studies demonstrate similar findings. For example, a positron emission tomography (PET) investigation into SI found that brain activation patterns are affected by directionality (Rinne et al. 2000). The results indicate more extensive brain circuits activation during interpreting into L2, which suggests that this interpreting direction requires more resources given that this task is more cognitively demanding. Similarly, an fMRI study conducted by Elmer (2016) showed that more cerebral resources are required when interpreting into L2. Also, Boos et al. (2022a) conducted a multi-method behavioral and EEG study on simultaneous interpreters and demonstrated that interpreting into L2 results in less accuracy, increased N400 amplitudes, and slower reaction times.

Directionality has also been found to modulate disfluency production in interpreting. For instance, Mead (2005) tested both interpreter students and professional interpreters and demonstrated that both groups were more fluent when consecutively interpreting into L1. Importantly, the inexperienced group exhibited a larger number of disfluencies in their L2 production, which points to a larger cognitive demand in interpreting into that direction and a possible effect of interpreting experience. Similarly, Lin et al. (2018) found that inexperienced interpreters produced fewer disfluencies in SI from L2 to L1. More recently, Chen (2020) conducted an eye-tracking and pen-recording study of directionality in CI. The results suggest that interpreters experience less cognitive load when interpreting into L1 as indicated by higher speech fluency. Conversely, Chmiel et al. (2023) found more disfluencies in L2–L1 direction for low frequency words. Although these results run counter to previous studies on directionality, the effect may be explained by the difficulty in comprehension, which has been shown to be a frequency-driven mechanism (see section 2.2.3). Nonetheless, the majority of studies on directionality in interpreting point to a superior performance in L2—L1 direction.

In line with interpreting being a highly strategic activity (Gile 2009b), interpreters have also been shown to adopt different strategies in response to the difficulties posed by both interpreting directions. For instance, Bartłomiejczyk (2006) demonstrated that strategy use in SI between Polish and English depends mostly on directionality. Interpreting trainees used strategies like inferencing or word-for-word in L2–L1 interpreting more often than in L1–L2 interpreting.

Also, Chang and Schallert (2007) investigated strategies in Chinese–English SI and revealed differences in strategy use as a result of, among other potential reasons, directionality and language proficiency. Gumul (2017) explored explicitation in SI of inexperienced interpreters and showed that interpreters use explicitation more often in the L1 into L2 direction.

In terms of dialogue interpreting, the existing research on directionality is scarce. However, similarly to SI, dialogue interpreters have been shown to exhibit a disadvantage when interpreting into L2. Thomsen (2018:43) reports divergent strategy use depending on language proficiency, interpreting direction and experience. Specifically, experienced interpreters use fewer strategies compared with inexperienced interpreters probably as a result of facing fewer problems. Tiselius and Englund Dimitrova (2019:308) point out that language proficiency in dialogue interpreters is functionally asymmetrical. It may be expected that interpreting experience determines how interpreters handle that asymmetry. One of the issues that may also both contribute to and result from the asymmetrical language proficiency is the linguistic and educational heterogeneity of dialogue interpreters as compared with conference interpreters, who tend to be a homogenous group, both linguistically and academically (Tiselius and Englund Dimitrova 2019:307).

More recently, Tiselius and Sneed (2020) conducted an eye-tracking study and found that interpreting into L2 was likely to place larger cognitive demand on dialogue interpreters, as they averted their gaze more when interpreting into L2. Whether language asymmetry is reflected in the dialogue interpreters' performance depending on directionality will be tested in the present study.

In light of the reviewed literature, the cognitive demand of interpreting to one's L2 may be expected to be higher than during interpreting into one's L1. Furthermore, given the asymmetrical language proficiency in dialogue interpreters (Tiselius and Englund Dimitrova 2019) and since dialogue interpreting is bidirectional, it can reasonably be expected that the cognitive demand placed on the interpreters will be different depending on interpreting direction.

To summarize, there may be at least two different reasons behind the higher demand of interpreting into one's L2. First, the higher demand of formulating the message in L2 may depend on interpreters' language proficiency. Second, the higher demand may depend on the need to inhibit the more active L1. A third, related possibility may be that interpreting into one's native language is usually more trained and practiced (see Hervais-Adelman 2022:480), which raises the issue of the impact of experience and automaticity on interpreting.

2.2.6 Experience and automaticity

In research on interpreting, experience is often associated with automaticity.[17] Shreve (2018:101) describes automaticity in terms of “lower-level operations” becoming more routinized in such a way that cognitive resources are released and available to be allocated to “metacognition and executive control”. In other words, some processes can become more routinized and automatic with increasing experience.

Experience is also closely related to the concept of *expertise*, the definition of which is often different from study to study (Mercer-Moser 2021). Here, interpreter expertise is understood as the set of special skills and knowledge derived from extensive experience within interpreting (see Yudes et al. 2011:2), while experience, which is the variable of interest in the present study, is defined as accumulated professional interpreting practice.

Consistent with research in cognitive psychology, Gile (2021:143) argues that with practice, controlled processes in interpreting become more automated, in turn making interpreters “less vulnerable to processing capacity and their consequences.” Indeed, extensive empirical evidence points to the impact of experience on interpreting processes and to differences between experienced and novice interpreters (Moser-Mercer 2010, 2022). The effects of training and experience on interpreters’ cognitive control have been investigated in a number of both cross-sectional and longitudinal studies (Liu 2008). For instance, Liu et al. (2004) conducted a cross-sectional study of interpreters with different experience but with comparable WM capacity and found that experienced interpreters’ more efficient pattern of cognitive resource allocation may be attributed to extended interpreting practice. In a cross-sectional study, Tiselius and Jenset (2011) compared three interpreter groups – with no experience, limited experience, and extensive professional experience. The results indicated that experienced interpreters monitor their output better than inexperienced interpreters and that inexperienced interpreters are likely to struggle with lexical access to a greater extent than experienced interpreters (see also Tiselius 2013:86). In a longitudinal study of interpreting trainees, Macnamara and Conway (2014) discovered that students improved in almost all cognitive ability measures as a result of interpreter training. Also, Babcock and Vallesi (2017) demonstrated that interpreter’s superior performance on behavioral tasks is probably a result of interpreter training. In a more recent study, Chmiel (2021) compared experienced interpreters and the same group of interpreting trainees before and after

[17] Automaticity is somewhat related to the concept of *default translation* (Halverson 2019), insofar as it draws “on easily accessible, routinized knowledge, including bilingual linguistic knowledge, metalinguistic knowledge (including knowledge of communication norms), and knowledge of the specific task. This knowledge is dynamic, individual, and personal, but maintains a principled relationship to language patterns characteristic of relevant usage situations within the relevant linguistic communities” (2019:190).

interpreter training. The two groups performed a translation task, and the results exhibited the effects of training, but not experience on word-translation latency. However, the experienced group demonstrated lower costs in the low constraining context, suggesting an advantage in lexical processing in experienced interpreters.

The above-mentioned results are consistent with findings in neuroimaging studies of interpreters. Specifically, brain activation patterns in studies that investigated experienced interpreters differ in extent compared to results of studies on novices. For instance, in a study of simultaneous interpreters, Elmer et al. (2014) found that interpreting experience is likely to lead to reduction in brain volume in response to automatized tasks. Hervais-Adelman et al. (2015) tested novice interpreters to examine the neural basis of interpreting in inexperienced interpreters. The study demonstrated more extensive cerebral activation compared to previous studies conducted on experienced interpreters. The findings suggest that experience and practice may potentially reduce inhibitory control demands placed on interpreters. Similarly, Babcock (2015) compared training-induced changes in brain structure between simultaneous interpreters and translators. She found a greater decrease in volume in participants after translator training than in participants after interpreter training. In a more recent study, Hervais-Adelman et al. (2017) examined changes in brain structure after a 15-month interpreter training and revealed that areas associated with attention control and WM thickened after training. As a result of the experience-driven automation, interpreters may presumably have more cognitive resources to expend on delivery of interpreting output (Hervais-Adelman 2022:481). Correspondingly, Boos et al. (2022b) conducted an EEG study of simultaneous interpreters and found that interpretation training reduces cognitive load in experienced interpreters.

In sum, the reviewed literature implies an advantage in some aspects of executive functioning in experienced interpreters. Sustained interpreting practice and experience seem to lead to automatization of a number of processes, and thus indirectly to a decrease in effort expended on (at least some) processes involved in interpreting. Notably, García (2014; 2019) proposes the *interpreter advantage hypothesis.* In other words, as a result of sustained interpreting practice interpreters acquire skills that allow them to cope with the cognitive demands of the interpreting task, and that those skills generalize to other domains leading to more efficient linguistic and cognitive abilities (García 2014:232).

Therefore, a reasonable prediction is that experienced interpreters will differ from inexperienced interpreters in terms of dealing with the cognitive load placed on their WM.

2.2.7 Working memory

The review of the processes inherent to dialogue interpreting concludes with the discussion on WM and its pivotal role interpreting with respect to memory storage, information processing, and attention. WM is a construct comprising multiple specialized components of cognition that are involved in the temporary storage and manipulation of information (Baddeley and Hitch 1974; Cowan 1988; Baddeley 2000).[18] Baddeley's and Cowan's models remain the most influential models of WM. The two models are not mutually exclusive, but dissimilarities exist. One of the main differences between the two models is that Cowan (1988) puts greater emphasis on the possibility of interference between different domains (Cowan 2014:204). The common, and generally acknowledged assumption in the two models is that WM is limited in its capacity when it comes to both its storage and processing functions. This central tenet of WM is also crucial to the present inquiry since cognitive load is a construct that originates from the idea of limited processing capacity. In other words, given that WM capacity is related to the number of resources available to execute an interpreting task (Seeber and Amos 2023:261), the demand that the task places on these resources is reflected in cognitive load. Cognitive load is thus inherently linked to WM.

As a consequence of the limited capacity of WM, dialogue interpreting places different levels of cognitive demand on the WM of interpreters resulting in increased cognitive load. For example, dialogue interpreters have been found to experience universal cognitive constraint resulting in a limited processing span. Processing span is operationalized as the mean length of the original turn and its interpreted rendition and reflects the average cognitive demand that interpreters are able to cope with (Tiselius and Englund Dimitrova 2021:350). In the present study, the amount cognitive load is expected to depend on the degree of experience-driven automaticity and interpreting directionality (see section 2.2.5) or the mutual constraints these notions put on each other.

2.3 Cognitive load in interpreting

Recent years have seen the construct of cognitive load become one of the central research topics in the field of interpreting studies (for a review, see Gieshoff et al. 2021), which resulted in a number of empirical studies on the subject and adoption of a somewhat divergent terminology (Gieshoff and

[18] Since it is out of the scope of this study to discuss all existing WM models, see Chai et al. (2018) or D'Esposito and Postle (2015) for reviews on WM in psychology and neuroscience, and Liu (2008), Hodzik and Williams (2021), and Moser-Mercer (2023) for reviews of WM in interpreting. For meta-analyses of WM in interpreting studies see Mellinger and Hanson (2019), Wen and Dong (2019), and Ghiselli (2022).

Hunziker Heeb 2023; Prandi 2023). However, discussions on the nature of interpreters' cognitive resources and their management have been ongoing at least since the works of Barik (1971, 1973, 1975), Gerver (1974, 1976), Goldman-Eisler (1967, 1968, 1972) and Moser (1978). Psycholinguistic interest in SI and the difficulties that interpreters encounter gave rise to several processing models of SI, such as Gerver's (1976) information processing model, Moser's (1978) model of SI, or Setton's (1999) cognitive-pragmatic model of SI.[19]

In terms of dialogue interpreting, Englund Dimitrova and Tiselius (2016) point out, that the "unique processing conditions […] mean that traditional models of interpreting are not wholly applicable to community interpreting" (2016:201). There remains to date no model of cognitive load in dialogue interpreting. Given that both the processes and the communicative context of dialogue interpreting are unique, it can be expected that the origin of the demands placed on interpreters' WM will differ to some extent from SI. However, before addressing cognitive load in the context of DI it is important to consider how the construct has been modeled in other types of interpreting.

2.3.1 Modeling cognitive load in interpreting

The following sections present a brief review and discussion of existing models of cognitive load in interpreting. The section's focus are the three models originating from the discipline of TIS that explain cognitive load in interpreting, that is Gile's Efforts Models (1999), Seeber's (2011, 2013) Cognitive Load Model (CLM) , and Chen's (2017) construct of cognitive load.[20]

Gile (1997, 2008) describes interpreting in terms of cognitive or processing capacity management, while Seeber (2017) views interpreting as an activity requiring allocation of attention to multiple streams of information. These related, yet different views of the interpreting process are reflected in their respective process models of interpreting with an explicit focus on cognitive load. The third model (Chen 2017) is not a process model of interpreting but a theoretical model of cognitive load components. The review of the three models is accompanied by a discussion on their relevance to dialogue

[19] Different models of SI exists, each offering a different perspective. For example, Darò and Fabbro's (1994) general model of memory during SI, Paradis's (1994) model that highlights language control, de Bot's (2000) model with focus on language production, or Hervais-Adelman's (2021) process model from the perspective of cognitive control. Accounting for all existing models of SI is outside the scope of the present inquiry. For a most recent review, see Amos (2020:30–36).

[20] Whether Chen's (2017) proposal of CL can be considered a model is somewhat unclear; however, an epistemological discussion on models is beyond the scope of this dissertation. The term model was chosen here for pragmatic, rather than epistemological, reasons.

interpreting, as well as their advantages and limitations. Finally, Chen's model is revisited and revised to fit the dialogue interpreting context.

2.3.1.1 Gile's Efforts Models

In the field of interpreting studies, the ideas of limited cognitive resources and the intrinsic difficulty of conference interpreting were first crystallized in Gile's (1985) cognitive framework, i.e., the Efforts Models. The Efforts Models is a componential model of the cognitive subprocesses of interpreting that Gile defines as *efforts*. The model components are a main source of cognitive load and are engaged in constant competition for resources and in the process of interpreting. According to Gile's (1999) tightrope hypothesis, interpreters always work close to their total available capacity and "any instance of mismanagement of cognitive resources can bring about overload or local attentional deficit in one of the Efforts" (Gile 1999:159). The core efforts of interpreting are listening, production, memory, and coordination efforts. The process of SI is thus described as a sum of the efforts, that is

$$SI = L + P + M + C$$

The effort of listening and analysis (L)[21] accounts for the processes of perception of incoming speech and decoding the intended meaning of the source text. The production effort (P) is responsible for the processes leading to the delivery of the target text, including self-monitoring. The effort of memory (M) describes the demand placed on WM during interpreting; however, it is defined as a distinct component of the model and not a part of comprehension or production. Finally, the coordination effort (C) refers to the interpreter's awareness of the necessity to manage their attention. Since its conception, Gile's model has been used as a didactic tool (Gile 2021) or explanatory model (Gile 2002:170). Despite Gile's intention for the model to be "largely intuitive and functional – not cognitive-theoretical" (Gile 2021:140), it also served as a conceptual framework, for instance in the works of Gumul (2006, 2018, 2019), Kurz (2009), Plevoets and Defrancq (2016, 2018a), or Vik-Tuovinen (2005).

Gile also proposed a model of CI that could perhaps be more relevant for dialogue interpreting since both are comparable in terms of mode where interpreters alternate with speakers. Gile (2002:167) views CI as a "two-phase process" that includes a listening phase and reformulation phase. In terms of the listening phase, the model is essentially the same as for SI, except for the note-taking effort. Note-taking effort encompasses decisions regarding what should be noted and the actual note-taking process. Incidentally, in dialogue

[21] In later versions of the model, the effort of listening was relabeled as reception effort (R) to include visual modality, for example in sign language interpreting. For a comprehensive review of the different versions, see Gile (2021:143ff).

interpreting, interpreters do not usually rely on note-taking (Tiselius and Englund Dimitrova 2021:329), which makes the note-taking effort redundant in this case. Gile (2009b:175) also maintains that the model was deliberately created for "long, as opposed to sentence-by-sentence consecutive in which there is no systematic note-taking". The two remaining efforts, namely recall from memory and reading effort, are connected to note-taking and operations involved in retrieval of the relevant segment from memory and notes (Gile 2002:168).

As previously noted, Gile (2005) describes the listening phase in CI as a speaker-paced process and the reformulation phase as paced by the interpreter. In dialogue interpreting both of these processes are at least to some extent controlled by the interpreter through the related processes of monitoring and coordination. The coordination effort in Gile's model is understood as the interpreters' awareness of how they manage attention. In this way, the effort of coordination differs fundamentally from the concept of coordination in dialogue interpreting (see Wadensjö 1992, 2018). Dialogue interpreters engage in coordination of the interaction, which is also directly related to the process of monitoring in dialogue interpreting (Tiselius and Englund Dimitrova 2023:318). Gile (2021:144) also points out that "no special cognitive cost is assigned to the Coordination Effort, which makes it different from 'executive functions' to which psychologists have compared it". As previously suggested, in the dialogue interpreting context monitoring is a process through which interpreters "observe, evaluate and take actions relating to their own cognitive processing and that of the other participants in the interpreting event" (Tiselius and Englund Dimitrova 2023:315). Thus, the first limitation of the Efforts Models in the context of dialogue interpreting is the absence of components (or efforts) that would account for both monitoring and coordination. The second, related limitation of the Efforts Models is the disregard of the other participants of the communicative event (Englund Dimitrova and Tiselius 2016:201). Finally, a model of cognitive load in interpreting should be able to account for the causal relationship between the interpreting act and the interpreting event (see section 2.1.1).

2.3.1.2 Seeber's Cognitive Load Model

Seeber (2007, 2011) develops the CLM to account for the many concurrent tasks involved in SI. Contrary to Gile (2009b), Seeber (2011:187) argues that the notion of a single pool of cognitive resources cannot account for the simultaneity and interference of the tasks in the interpreting process.[22] In short, when different tasks require the same reserve, information must be

[22] The theory of a single pool of attentional resources is present in the field of cognitive psychology (e.g., Kahneman 1973). Gile (2009b:205) forwards that "the competition-between-Efforts principle is consistent with the theory of one central pool of processing capacity, not with the theory that there may be several pools that the Efforts can draw upon without there being interference with them."

processed sequentially. When tasks require different resources, they can be processed simultaneously. Thus, Seeber proposes an adaptation of Wickens's (1984, 2008) multiple resource theory that considers not only concurrent cognitive tasks, but also their interactions and interference (Seeber 2011:187).

The model was tested empirically by Seeber and Kerzel (2012) in a study of moment-to-moment changes in cognitive load during simultaneous interpretation. In the study, the authors model cognitive load during four different interpreting strategies (i.e., waiting, stalling, chunking and anticipating) as compared to the model baseline, that is simultaneous interpretation between syntactically asymmetrical languages (English-German). Subsequently, they run a set of experiments using pupillary dilation as an index of cognitive load, which all corroborate the models' prediction regarding cognitive load. Chmiel et al. (2020b) use Seeber's adaptation of the conflict matrix to model language interference in sight translation and SI. In line with the model's prediction, the cognitive demand caused by interference in sight translation is found to be higher than in SI. Similarly, Prandi (2023) adapts Seeber's model to analyze simultaneous interpretation with digital terminology support, which she predicts to elicit higher cognitive load than standard simultaneous interpretation. The validity of the model is tested experimentally and accurately predicts the level of resource recruitment for the different CAI (computer assisted interpreting) tools (Prandi 2023:230).

The CLM has some advantages in comparison to the Efforts Models. First, through the notion of *local cognitive load*, Seeber's model explains momentary changes in cognitive load as both output and input features, which Gile's model does not account for. Seeber's CLM is an analytical method (Seeber 2013:20–22) that allows for both quantitative and qualitative assessment of cognitive load in interpreting. Second, the model is a "first attempt at quantifying cognitive load, relying principally on Wickens's demand vectors and conflict coefficients" (Seeber 2011:189). Thus, the model's analytical tool – the conflict matrix – can be used for experimental modeling of cognitive load, both globally and locally. Third, the model benefits from being grounded in cognitive psychology, whereupon its validity is supported by sound theoretical foundation and empirical evidence from the field. At first glance, Seeber's CLM could potentially be used to model cognitive load in dialogue interpreting. For example, the model could account for how the combination of different tasks in dialogue interpreting affects the cognitive demand. Particularly, the process of monitoring in dialogue interpreting could be analyzed as an additional resource recruitment. Next, its interference with the different sub-tasks in dialogue interpreting could be measured using the conflict matrix. Moreover, since cognitive load might be modulated by the different strategies that interpreters engage in (see Seeber and Kerzel 2012:190), examining them could account for how cognitive load in dialogue interpreting changes at a micro-level.

However, similarly to Efforts Models, the main disadvantage of Seeber's CLM is the disregard of the other participants and the shared environment of the communicative event. Both models were developed for the SI mode, which does not occur in a bilateral context like dialogue interpreting. Since the individual dialogue interpreter's cognitive resources are influenced by the shared environment in which the interpreting event is performed, the cognitive load model in dialogue interpreting needs to be a framework in which that environment is explicitly present. A model of cognitive load in interpreting should be able to capture the multiple causal interactions between the interpreting task, interpreting environment and the interpreter (Chen 2017:643).

2.3.1.3 Chen's construct of cognitive load revised

Building on previous research on cognitive load in the discipline of interpreting studies and borrowing from, among others, Cognitive Load Theory (CLT; Sweller 1988, Paas et al. 1994, Sweller et al. 1998, 2019), Chen (2017) defines CL as a "portion of an interpreter's limited cognitive capacity devoted to performing an interpreting task in a certain environment" (2017:643). In other words, Chen focuses not on the mental processes involved in interpreting, but on how the three elements, that is the interpreter, the process, and the environment interact and influence the cognitive load in interpreting.

In line with CLT and a general model of cognitive load presented in Paas et al. (1994), Chen (2017) proposes that the construct of cognitive load in interpreting comprises two dimensions, causal and assessment dimension. The causal dimension reflects the relationship between the interpreting task, environment, and interpreter characteristics. According to Chen (2017), interpreting task complexity, speed of delivery of the source speech and directionality all interact causally with the level of an interpreter's expertise, their language proficiency, and motivation, among other factors. Furthermore, the relationship between the different components impacts the cognitive load of the interpreter. For instance, a complex interpreting task is probably more cognitively taxing for a less experienced interpreter than it would be for an experienced interpreter and the level of expertise possibly impacts the cognitive load of the two interpreters differently. Figure 1 presents Chen's model, in which the three characteristics influence the interpreter's cognitive load.

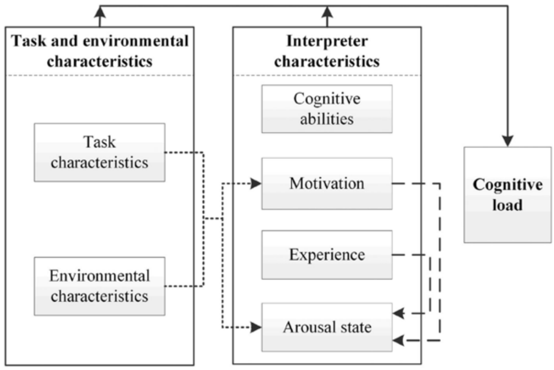

Figure 1 The causal dimension of cognitive load model (Chen 2017:644).

In terms of interpreter characteristics, Chen (2017:646) suggests that cognitive abilities encompass a large variety of features, such as *language proficiency*, *WM capacity*, *cultural competence*, *knowledge*, and *skills* that are specific to the particular type of interpreting in which one is engaged. The unification of these very different capacities fails to distinguish between the putative language-specific and cognition-specific characteristics that might have separate and divergent effects on cognitive load in interpreting. Consequently, this interpreter characteristic should be split into three separate characteristics, namely cognitive abilities, language proficiency, and skills and knowledge. Cognitive abilities encompass WM and executive control mechanisms, while language proficiency accounts for the level of competence in interpreter's working languages, that is L1, L2, and so on. The third characteristic, skills and knowledge, comprises interpreting skills, cultural competence and knowledge acquired through training, education, and professional practice.

Another limitation of Chen's model, as seen in figure 1, is that cognitive abilities do not interact with any other interpreter characteristics, which not only contradicts the assumptions of cognitive translatology, but also disregards empirical research showing that cognitive performance is affected by bilingualism (Bialystok 2009). It also goes against research that links cognitive benefits, for example greater WM capacity to expertise in interpreting (e.g., Mellinger and Hanson 2019). In the revised cognitive load model presented in figure 2, cognitive abilities interact with language proficiency, influence skills and knowledge, and are influenced by interpreting experience.

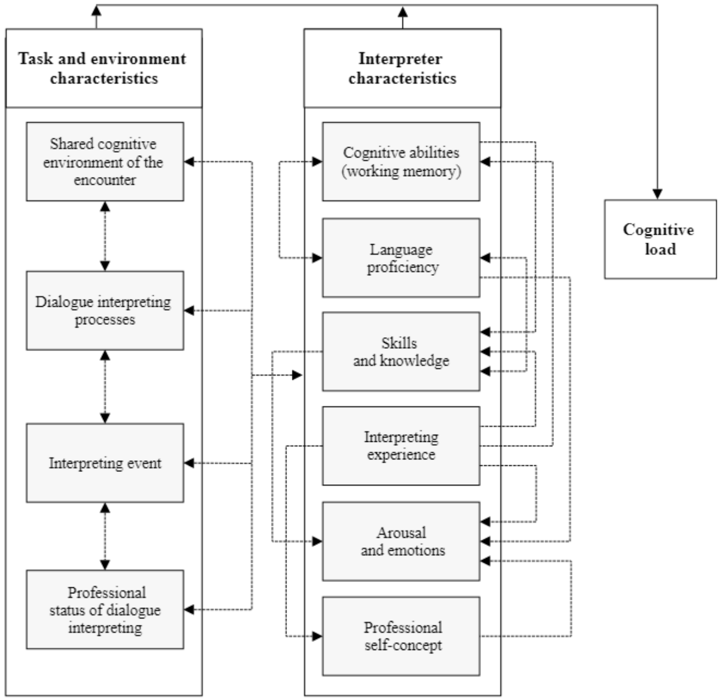

Figure 2 The revised causal dimension of cognitive load model for dialogue interpreting

In Chen's model (figure 1) interpreting experience only affects the interpreter's arousal state. In the revised model (figure 2), interpreting experience influences cognitive abilities, in line with research on experience-driven automation of interpreting processes (see section 2.2). Additionally, interpreting experience interacts with language proficiency and skills and knowledge, as they are likely to develop as a result of accumulated interpreting experience. Another interpreter characteristic that is related and affected by experience, but is not included in Chen's model, is the interpreters' professional self-concept. For example, Sela-Sheffy and Shlesinger (2011) argue that dialogue interpreters working in the public service sector are insecure about their professional status. The level of uncertainty of one's professional status can be expected to have a direct impact on interpreter behavior and their cognitive load. Also, the level of knowledge and skills, and the level of training are expected to influence the professional self-concept of the interpreter, and thus their cognitive load. Englund Dimitrova and Tiselius (2016:211) suggest that professional self-concept is related to how dialogue interpreters manage turn-taking during interpreted encounters and that it manifests itself, for instance, through turn-taking strategies. The professional self-concept is therefore added in the revised model (figure 2).

Returning to the interpreter characteristic that Chen refers to as *arousal state*, in the revised model, arousal state is replaced with *arousal and* *emotions*. This way, the characteristic accounts not only for the intensity of the emotional state (i.e., arousal) but also for valence, that is the extent to which emotions are positive or negative. The characteristic also includes motivation, which is a separate characteristic in Chen's (2017:646) model, despite the lack of research explicitly linking motivation to cognitive load.

In the revised model, arousal and emotions are the characteristic affected by at least four other interpreter characteristics, that is language proficiency, skills and knowledge, interpreting experience and professional self-concept. Therefore, it can be expected that more interpreting experience and higher level of language proficiency might lead to less negative valence and arousal.

When it comes to the different interpreting task characteristics, Chen's focus is not on the different subprocesses of interpreting, but on performance and "factors that could determine potential quality of interpretation" (2017:643). For Chen, interpreting task characteristics cover interpreting mode, features of speech or speaker, total hours of working, and duration of speech. Thus, these characteristics are expected to vary from assignment to assignment. In terms of environmental characteristics, Chen's (2017:645) focus is entirely on the conditions of an individual assignment, such as noise, location, or visibility of the speaker.

The understanding of task and environment characteristics in the present work is different to Chen's. Importantly, as shown in figure 2, task and environment characteristics are indivisible in line with the assumptions of cognitive translatology, where the task of interpreting (the act) is always embedded in the environment (the event). The characteristics encompass four interactive components. The first component pertains to the subprocesses of dialogue interpreting, that is listening for interpreting, planning and preparation of the upcoming rendition, taking the turn, and production. This component also pertains to the bidirectional character of dialogue interpreting. Inherently, it is also affected by other task and environment characteristics, as well as the interpreter characteristics.

The three remaining task and environment characteristics change as a result of their interaction with one another and with interpreter characteristics.

First, the interpreting event is understood as the sociological context of the interpreting encounter on a macro-level. It relates to the situatedness of the interpreting processes and involves many agents apart from the interpreter and participants in the encounter, for example the translation agency responsible for the booking. The event extends beyond the encounter and encompasses the period from the commission to the end of the interpreting assignment (see Muñoz Martín 2010:178–179).

The shared cognitive environment of the interpreting encounter refers to the impact that all participants of the encounter have on the interpreting event. This characteristic manifests itself through, for example, shared communicative goal of the interaction, negotiation of meaning, the interpreter's coordination work, turn-taking, the participants' and the interpreter's gestures and gaze. Importantly, the interpreters' embeddedness within the environment influences their cognitive load (see Mellinger 2023:197).

Lastly, professional status of dialogue interpreting pertains to the attitude toward the profession and its impact on the interpreting event and encounter. For example, Gentile (2016) conducted a study on the professional status of interpreters in the public sector and found that interpreters believe that laypeople compare their status with that of semi-professionals. This attitude is expected to influence both the interpreting event and the interpreting encounter.

To reiterate, all task and environment characteristics are expected to interact with interpreter characteristics. Altogether, the described components in the revised model (figure 2) affect the dialogue interpreters' cognitive load.

2.3.1.4 Cognitive load measures

The second dimension of the construct is related to load assessment and regards cognitive load's measurable aspects, that in CLT are defined as *mental load* and *mental effort*. In the case of interpreting, mental load is the load imposed on the interpreter's cognitive system, whereas mental effort is the effort actually allocated by the interpreter to accommodate the demands placed on that system. Consequently, it is the interpreter's mental effort that has the potential to reflect the actual cognitive load. All measurable aspects are understood as indicators of cognitive load in interpreting and can be assessed through their respective cognitive load measures.

Contrary to Paas et al.'s model (1994) Chen's (2017) assessment dimension comprises 4 and not 3 measurable aspects of cognitive load and four corresponding cognitive load measures, all of which are presented in figure 3.

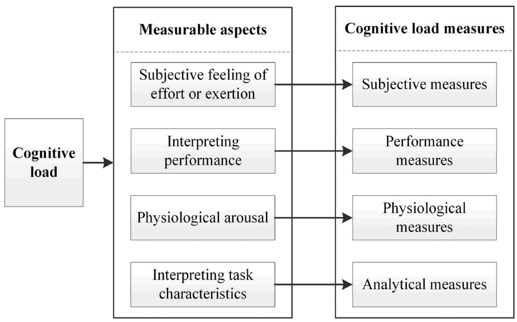

Figure 3 The assessment dimension of cognitive load model (Chen 2017:647)

Chen's assessment dimension of cognitive load is also revised here to accommodate dialogue interpreting. The revised model of the assessment dimension with five measurable aspects of cognitive load is presented in figure 4.

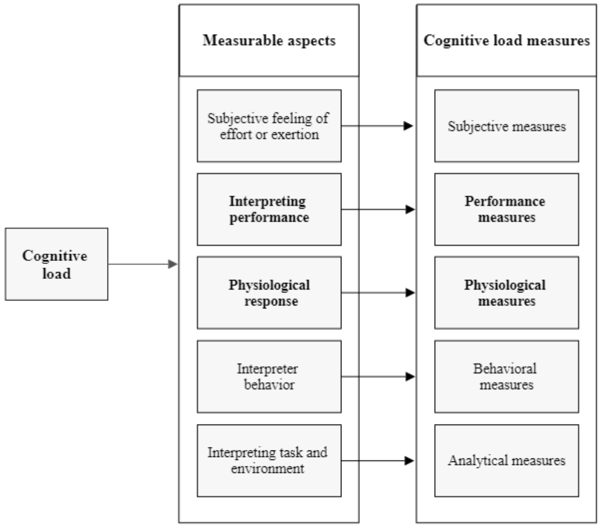

Figure 4 The revised assessment dimension of cognitive load model for dialogue interpreting

Both Chen's model (figure 3) and the revised model (figure 4) consider the subjective feeling of effort and exertion that can be assessed with subjective measures, like rating scales (for example NASA-TLX; Hart and Staveland 1988)[23] or retrospection. Retrospection is based on the premise that people can recall and reflect upon their cognitive processes. Although overlooked by both Paas et al. (2003) and Chen (2017), retrospective verbal tracing methods have a long tradition in process-oriented studies on interpreting (e.g., Ivanova 2000; Vik-Tuovinen 2002; Napier 2004; Bartłomiejczyk 2006; Englund Dimitrova and Tiselius 2009; Tiselius 2013; Englund Dimitrova and Tiselius 2014; Herring 2018) and have been referred to as post-task interviews, retrospective evaluations, protocols or stimulated recalls (see Herring 2018 and Herring and Tiselius 2020 for reviews). Although retrospective protocols "cannot be taken as sole evidence for cognitive processes" in interpreting as empirically demonstrated by Englund Dimitrova and Tiselius (2009:129), they can give valuable insight into the process of interpreting if combined with more objective measures. Despite their validity (see e.g., Ayres et al. 2021), subjective measures of cognitive load present certain disadvantages. Seeber (2013:23), for instance, cautions against subjectivity making "its way into scientific inquiry through the backdoor of material selection for experimental

[23] In the field of TIS, NASA-TLX has been employed for example by Liu et al. (2019) or Yang et al. (2022) to assess translation difficulty. It is also one of the measures in a study described by Chmiel and Spinolo (2022), who aim to test the impact of remote interpreting on the performance and experience of interpreters.

purposes." Mellinger (2020:99) argues that participants may be hesitant to provide answers to certain questions as a result of *social desirability bias*. On a similar note, Ehrensberger-Dow et al. (2020:224) posit that individual differences in terms of both willingness and ability to report experiences may constitute additional limitation in using subjective measures.

The second measurable aspect that is present in both Chen's (figure 3) and the revised model proposed in this work (figure 4) is interpreter performance. Performance measures are based on the assumption that increase in cognitive load may have an effect on interpreting performance. In line with CLT, Chen (2017:648) distinguishes between *primary task measures* and *secondary task measures*. Primary task measures are usually interpreter performance variables and include Ear-Voice-Span (e.g., Barik 1976), errors and disfluencies (Bakti 2009), pauses (Gieshoff 2018, 2021) as well as reaction times, accuracy or delivery rate (Korpal and Stachowiak-Szymczak 2020) to indicate changes in cognitive load. Secondary task measures entail participants carrying out an additional task parallel to interpreting task. However, employing secondary task paradigm during interpreting is challenging since the interpreting process already comprises many tasks (Seeber 2013:24).

The third measurable aspect in Chen's (2017) model is referred to as physiological arousal, which is described as "the activation level of the human body" (2017:647). In the revised model proposed here physiological arousal is altered to physiological response, as it is a generally accepted term in psychophysiological science (see Cacioppo et al. 2007:1). Physiological response is measured with psychophysiological measures, and it is assumed that changes in cognitive processing are reflected in physiological variables, for instance in eye movements, heart rate (Sweller et al. 2019) or brain activity (Antonenko et al. 2010). In the field of interpreting studies cognitive load assessment by means of eye-tracking has been employed for example by Hyönä et al. (1995) and Seeber and Kerzel (2012), who employed pupillary dilation as index of cognitive load. In a study investigating the effects of combined problem triggers in interpreting, Korpal and Stachowiak-Szymczak (2020) used fixation measures as indicators of cognitive load. Studies that use eye-tracking to investigate cognitive processes in interpreting are discussed further in section 2.5.

The measurable aspect of cognitive load that is not included by Chen but is added in the revised model (figure 4) is the interpreter behavior. Interpreters' behavior includes for example their actions during the interpreting encounter, such as how they handle coordination through gaze (Tiselius and Sneed 2020) or gestures (Chwalczuk 2021). It also pertains to interpreter's use of interpreting strategies (Arumí Ribas and Vargas-Urpi 2017) and turn-taking (Tiselius and Englund Dimitrova 2022). Interpreter behavior can be assessed through behavioral measures, that is observation of interpreters' behavior both in natural settings and in highly constrained laboratory tasks.

The final measurable aspect of cognitive load is interpreter event characteristics that can be measured with analytical measures such as task analysis (Wickens 2008; Seeber and Kerzel 2012). Interpreting task analysis, for instance measuring task difficulty, might potentially help assess the amount of cognitive load the given task will place on the interpreter.

To conclude, revising Chen's (2017) construct of cognitive load was necessary in terms of alleviating the potential shortcomings of the model. Consequently, the present inquiry uses the revised model as a conceptual framework in the assessment of cognitive load in dialogue interpreters.

Chen (2017:648–649) makes a compelling argument in favor of criteria that should be considered when selecting cognitive load measures, *sensitivity*, *diagnosticity*, and *intrusiveness*. Sensitivity refers to the measure's ability to distinguish between different levels of cognitive load. Diagnosticity is the measure's potential to identify the origin of cognitive load. Finally, intrusiveness pertains to the extent to which the measure interrupts the interpreting task at hand. The following sections describe the measures chosen to operationalize cognitive load.

2.3.2 Cognitive load in the present work

Because of the indirect nature of its assessment it is challenging to confine cognitive load within a specific model and to provide unambiguous evidence toward its underpinnings. In the present study Chen's construct of cognitive load was revised and adapted to the contexts of dialogue interpreting and the present study. At the same time, the author is aware of the revised model's possible shortcomings, since "no model ever solves all the problems it defines, and no two models leave all the same problems unsolved" (Moser 1978:353).

From the perspective of the causal dimension, the present investigation considers both interpreter characteristics and task and environment characteristics as factors that modulate cognitive load. Given that interpreting into one's L2 is more cognitively demanding (see section 2.2.5), the interpreter's cognitive load might increase as a result of directionality. Thus, interpreting direction is chosen as the task and environment characteristic that potentially modulates cognitive load.

As previously discussed, automaticity associated with experience in interpreting may lead to a release of cognitive resources and perhaps to less cognitive load during certain processes (see section 2.2.6). Therefore, experience is the interpreter characteristic that is expected to have an effect on the interpreter's cognitive load. To conclude, interpreting *directionality* and interpreter *experience* are used in the present investigation as independent variables that might modulate cognitive load.

In terms of the assessment dimension, two measurable aspects of cognitive load are selected for its assessment (marked in bold in figure 4), that is interpreter performance and physiological response.

Regarding interpreter performance and performance measures, cognitive load is operationalized with disfluency measures that have proven a reliable measure of cognitive load (see section 2.4). In terms of psychophysiological measures, blink-based measures (see section 2.5) are investigated as potential indicators of cognitive load in interpreting in terms of their sensitivity, diagnosticity, and intrusiveness.

The subsequent sections are devoted to reviewing the two chosen measures in light of previous research with emphasis on interpreting.

2.4 Disfluency

The following subsections present a review of studies investigating disfluency phenomena. Section 2.4.1 starts with a general introduction to research on disfluency in speech production and how the phenomenon is associated with the symptom of production problems and the two opposing views of disfluency. Special attention is dedicated to disfluency in dialogues (2.4.2) as it is more relevant to present inquiry than research on disfluency in monologues. Furthermore, research on disfluency in bilingual speech production (2.4.3) and existing research on disfluency in interpreting (2.4.4) are presented. The penultimate section (2.4.5) presents a typology of disfluencies and describes different types of these phenomena, i.e., hesitations and repairs, in more detail. The final section 2.4.6 summarizes the assumptions made in the present inquiry related to disfluency as a predictor of cognitive load in dialogue interpreting.

2.4.1 Disfluency in speech production

In spontaneous speech people rarely produce a stream of uninterrupted, fluent speech. On the contrary, as Goldman-Eisler (1968:31) observed, "spontaneous production in any speaker is a highly fragmented and discontinuous activity in which hesitations act as necessary and natural speech management strategies". Disfluencies have been shown to occur at the rate of every five to six per hundred words of spontaneous speech (Bortfeld et al. 1999). This estimate concerns only vocalized disfluencies and not silent pauses, and it has been consequently observed across different languages (Bortfeld et al. 2001, Eklund 2004). Although disfluencies have been studied extensively for decades in different languages and fields of study (for a review see, e.g., Eklund 2004; Lickley 2015; Crible 2018), there is no agreement as to the term, definition, nor the underlying causes of the phenomena. The term disfluency does not fully capture the scope of what the phenomenon entails but it was adopted here as it remains the most influential and universal term across disciplines (see Crible 2018).

Disfluencies have been studied as the evidence of cognitive load associated with speech planning and in early psycholinguistic research were labeled as *disturbances* (Mahl 1956), *hesitation phenomena* (Maclay and Osgood 1959; Goldman-Eisler 1961, 1968), and were associated with uncertainty or disruption, speech production problems (Levelt 1983, 1989) and removeable errors (Shriberg 1994). Others attributed pragmatic and communicative functions to disfluencies and researched *self-corrections* and *repairs* (Schegloff et al. 1977:361), *repeated words* (Clark and Wasow 1998:201) or *speech management phenomena* (Allwood et al. 1990:3). Consequently, two fundamentally different approaches emerged (Clark and Fox Tree 2002:73). The first approach reflects the traditional psycholinguistic view of disfluencies as symptoms of speech production difficulties (Maclay and Osgood 1959; Levelt 1983, 1989; Lickley 1994; Shriberg 1994; Pickering and Garrod 2004). According to this view, disfluency is automatic in its connection to increased cognitive load. The second approach presents a view of disfluencies as having the potential to signal certain linguistic and/or pragmatic functions and serve a communicative role in conversation (Schegloff et al. 1977; Allwood et al. 1990; Clark and Wasow 1998; Clark and Fox Tree 2002; Arnold et al. 2003). According to the second approach, disfluency is not automatic in its connection to increased cognitive load.

2.4.2 Disfluency in dialogue

Building on the two opposing approaches described above, Nicholson (2007:94) identifies two paradigms in the study of collaborative dialogue that put forward divergent ideas regarding the nature of speakers' disfluencies in dialogue. According to the *Strategic Modeling View*, disfluencies serve as a communicative signal, as proposed by Clark and Wasow (1998:203) in their *commit-and-restore* model of repairs. The authors posit that disfluency may be used to signal the interlocutor that the utterance is still being constructed, that they are committed to the interaction and desire to maintain continuity. Notably, the strategic view acknowledges that speech production is effortful (Nicholson 2007:71) and that speakers are capable of signaling difficulty and effort to their listeners by employing disfluency strategically. Indeed, due to conversational pressure, speakers avoid longer gaps between speech increments since these may be understood as the end of conversational turn. In non-interpreted interactions, gaps between turns are short and have been shown to last 200 ms on average (Levinson and Torreira 2015:6). However, as demonstrated by Englund Dimitrova (1991:34), some of the principles of turn-taking put forward by conversational analysts (e.g., Sacks et al. 1974) do not apply to dialogue interpreting. The idea that interpreter-mediated encounters are a specific type of communicative situation and deserve exploring in their own right is later developed by Wadensjö (1998:12) who famously called dialogue interpreting the *communicative pas de trois*. Importantly, dialogue interpreters are "active participants with their own agency" (Wadensjö and Gavioli 2023:1) but at the same time, they are not primary parties in the interaction. Perhaps the assumptions presented by the proponents of Strategic Modeling View are then not entirely applicable to dialogue interpreting.

The *Cognitive Burden View* assumes that disfluency is an indication of processing difficulty and cognitive load resulting from that difficulty. It arose from the notion of disfluency as a window to underlying cognitive processes associated with speech production monitoring (e.g., Levelt 1983, 1989; Postma 2000; Pickering and Garrod 2004; Kormos 2006; Hartsuiker 2014). There is evidence suggesting that difficulties in the initial stages of lexical retrieval leads to disfluencies (e.g., Schnadt and Corley 2006; Hartsuiker and Notebaert 2010; Fraundorf and Watson 2014; Pistono & Hartsuiker 2023; Pistono et al. 2023). For example, Hartsuiker and Notebaert (2010) conducted an experiment using a network description task and found that most disfluencies were likely occur more frequently in low name agreement contexts. Except for repetitions that occurred equally often in both conditions. The data also demonstrated a distinct disfluency pattern in terms of difficulties in initial stages of lexical access and subsequent stage of function word selection. Disfluencies have also been shown to reflect the competition between response options (Pistono et al. 2023)

A third approach, that proposes a functionally ambivalent view of disfluency was put forward by Pallaud (2013) and Götz (2013) and applied empirically by Crible (2018) and Kosmala (2020). According to this notion, formally similar disfluencies can potentially serve different functions simultaneously. In other words, they can serve facilitative functions and be a symptom of processing difficulties at the same time. In line with that view, Götz (2013) proposes an integrated and comprehensive model of fluency and introduces the term of *fluenceme*, which is understood as "an abstract and idealized feature of speech that contributes to the production or perception of fluency, whatever its concrete realization may be" (2013:8). The notion of fluenceme emphasizes the functional ambivalence of disfluency phenomena, and their potential to contribute to both fluency and non-fluency of speech.

The idea of disfluencies as an inherent part of global impression of fluency was also taken up by Segalowitz (2010, 2016) in his multidimensional model of L2-fluency. Integrating cognitive, pragmatic, and psycholinguistic perspectives, the model draws on the assumption put forward by Goldman-Eisler who argued that "the complete speech act is a dynamic process, demanding the mobilization in proper sequence of a series of complex procedures and is the temporal integration of serial phenomena" (1968:6). Segalowitz's (2016:81) model is explanatory, such that it is interested in the processes underlying disfluency production. Three different aspects of L2 fluency are distinguished, that is *utterance fluency*, *cognitive fluency*, and *perceived fluency*. Utterance fluency refers to the fluidity of observable speech and can be operationalized using temporal measures, such as filled and unfilled pauses or disfluencies. Cognitive fluency corresponds to the efficiency and speed of the processes involved in speech production that are L2-specific. Cognitive fluency may also involve automatization of these processes (Segalowitz 2016:86). Finally, perceived fluency is where cognitive fluency and utterance fluency interact and is concerned with “the inferences listeners make about a speaker’s cognitive fluency based on their perception of utterance fluency” (Segalowitz 2010:48). The ideas presented by Segalowitz tap into the idea of a functionally ambivalent disfluency and go against the prescriptivism of ideal delivery, which is the evidence of the prevailing written language bias (Linell 1982) and the monologic view of “speech as text” (Wadensjö 1998:27). Indeed, conversational speech is more disfluent than monologues (Oviatt 1995; Nicholson 2007), however being disfluent at the level of utterance is not the same as being disfluent at the level of interaction (Kosmala 2021:54).

Disfluencies in dialogues have been shown to follow different distributions than monologues (Bortfeld et al. 2001) with disfluencies occurring more commonly at the beginning of conversational turns. In a study that investigated possible underlying effects of disfluency in dialogue, Bard et al. (2001) found that disfluency was linked to the process of production and was more likely to occur as a result of length, complexity, and planning during dialogue. Lickley (2001) demonstrated that disfluencies in dialogue varied systematically across different types of conversational behavior: repetitions were associated with stalling, whereas repairs occurred at turns that involved planning. Nicholson (2007) came to a similar conclusion in an experimental study, where she found that repairs tended to occur as a result of increased attention, while repetitions indicated commitment to the listener and message. In line with reviewed literature, it would seem, that disfluency phenomena are multifunctional devices whose functions are not mutually exclusive.

2.4.3 Disfluency in bilingual speech production

In terms of disfluency in bilingual speech production, a number of studies investigated the impact of language co-activation and proficiency on disfluency in L2 production. More recent results from studies on disfluency in bilinguals suggest that L2 speakers are more disfluent than L1 speakers. For instance, Bergmann et al. (2015) found that L2 speakers and L1 attriters[24] exhibit significantly higher disfluency incidence than monolinguals. They posit that disfluencies in the speech of L2 speakers arise mostly as a result of

[24] Individuals who lost certain abilities in a language by using another language.

language competition and not as an artifact of incomplete acquisition in L2. Conversely, in a study using picture naming task to test the effect of cognates and code-switching on disfluency occurrence, Neveu et al. (2022) demonstrated that disfluencies are more common in the non-dominant language, and that they are highly related to word finding difficulties. As previously reported in section 2.2, it has been shown that asymmetrical language proficiency, or when speakers have not fully acquired their L2, leads to weaker linguistic representations, and slower lexical retrieval. In the context of dialogue interpreting where both languages are highly active, language control demands are high, and language proficiency is asymmetrical, the cognitive load resulting from the combination of these factors is expected to have an impact on disfluency occurrence in interpreters' outputs.

2.4.4 Disfluency in interpreting

Interpreter fluency has long been an area of interest in interpreting studies, mainly as a reflection of interpreting quality (Pradas Macías 2015:166). Since "one perspective on fluency is to consider evidence of its absence" (Mead 2000:91) disfluency in the field of interpreting has often been considered a from the perspective of *quality assessment parameter*. It has been shown that disfluency phenomena in interpreting may impact listeners' judgement of accuracy (Ahrens 2005) and influence their assessment of quality (Pradas Macías 2006). Pradas Macías (2015:165) defines interpreter fluency as having two aspects. First, on a more general note, fluency relates to speakers' ability to express themselves proficiently in a particular language. The second aspect of fluency, a more specific one, refers to articulation of a message, where parameters of speech production like prosody, speech rate and disfluencies are of importance (see also Yu and van Heuven 2017). Pradas Macías's classification bears comparison to the model of fluency proposed by Segalowitz (2016), reviewed in section 2.4. According to both accounts, a prerequisite for fluency is a high level of automaticity in lexical access, speech planning, and production. Altman (1994:36) notes that fluency is the most tangible aspect of interpretation that distinguishes between experienced and inexperienced interpreters. Therefore, given that automaticity of some processes implicated in interpreting could be attributed to experienced interpreters (see section 2.2), it may be predicted that experienced interpreters will potentially exhibit fewer disfluencies in their speech compared to inexperienced interpreters. So far, disfluency and its cognitive underpinnings have not been investigated in dialogue interpreting with the frequency that has been devoted to simultaneous and long CI modes. So far, disfluencies in research on cognitive aspects of dialogue interpreting have only come to focus in the context of monitoring (Tiselius and Englund Dimitrova 2023:313). Findings from studies on SI and CI are relevant for dialogue interpreting (Tiselius and Albl-Mikasa 2019:233) since they offer valuable insight into the processes of interpreting that are common for all interpreting modes. Notably, empirical studies on disfluency in interpreting have been conducted using both corpus-based analyses and experimental designs. The following two sections present previous research on disfluency in SI and CI.

2.4.4.1 Corpus-based analyses of disfluency in interpreting

Pöchhacker (1995) investigated *slips* and *shifts* in a corpus of 145 texts and found that the most common disfluency in both source and target speeches were *false starts*. Tissi (2000) conducted qualitative and quantitative analyses of interpreter trainees' *non-fluencies*, a category that included both pauses and disfluencies. Petite (2004, 2005) analyzed repairs in authentic data from a corpus of eight interpreters recorded at four conferences and found that monitoring in interpreting "leads to detection of trouble and consequently the production of repairs" (2005:44). She also put forward a model of SI for repair analysis and distinguished between *input generated* and *output generated repairs*. The former are used by interpreters to "achieve greater resemblance with original input" and the latter are meant to "achieve greater relevance" while minimizing the effort associated with producing the output and receiving the input (Petite 2005:44). Some studies compare disfluencies in interpreted and non-interpreted speech and associate disfluency occurrence with greater cognitive load. Bendazzoli et al. (2011) conducted a corpus analysis of repairs in SI to establish occurrences and causes of disfluencies. In a corpus-based analysis of *non-fluencies* Dayter (2020) found fewer repairs, filled pauses, and repetitions in interpreted English, as opposed to non-interpreted English. In a corpus study of interpreted and non-interpreted texts, Plevoets and Defrancq (2016) demonstrated the opposite for Dutch interpretations of French, that interpreters produce significantly more filled pauses than non-interpreters and that more filled pauses occur as a result of faster delivery rate of the source text. Defrancq and Plevoets (2018) also investigated cognitive load and filled pauses by comparing interpreted and non-interpreted Dutch corpora. They demonstrated that compounds generate increased cognitive load and that intra-word filled pauses are more frequent in interpreted Dutch. What is more, filled pauses produced as a result of cognitive load are associated with interpreting compounds. In a more recent corpus study, Plevoets and Defrancq (2018) investigated interpreters' disfluencies and found that interpretations exhibit higher number of filled pauses with the increase of lexical density in the source text. Moreover, they attributed the frequency of disfluencies to the higher cognitive load experienced by interpreters. In a corpus study carried out on the European Parliament Interpreting Corpus, Collard and Defrancq (2019) demonstrated that input delivery rate and Ear-Voice Span are significant predictors of disfluencies in SI. Using lexical frequency as a problem-trigger, Chmiel et al. (2023) investigated current cognitive load and exported cognitive load (spillover effect) which they operationalized with filled and unfilled pauses.

They found an increase of current load for less frequent words manifested in disfluencies.

2.4.4.2 Experimental studies on disfluency in interpreting

In an experimental study of pauses in CI, Mead (2000) found that student interpreters produced more filled pauses when interpreting to their L2. Bakti (2009) conducted an investigation of disfluencies in the outputs of interpreters working with English and Hungarian. The results of the study indicated that both student and professional simultaneous interpreters experienced problems at the stages of lexical access and grammatical planning. In a more recent study, Bóna and Bakti (2020) compared performance of interpreter trainees on four different speech production tasks that potentially induce cognitive load operationalized, among others, as disfluency. In their experiment, they investigated nine different measures related to disfluency and found that CI and sight translation placed the highest cognitive load on the participants. In an experimental study on a group of interpreting and translation students, Lin et al. (2018) tested the effect of WM capacity, language proficiency, and directionality on fluency in SI. The results demonstrated that both WM capacity and directionality significantly predicted the number of disfluencies in interpreting outputs, indicating the critical role of WM in interpreting fluency. In an investigation of student interpreters' performance, Zhao (2022) tested the impact of language proficiency, WM, and anxiety on the disfluency occurrences. Interpreters demonstrated an increase in disfluencies as a function of anxiety. However, contrary to Lin et al.'s (2018) study, WM and language proficiency demonstrated no effect on instances of disfluency. Furthermore, Shen and Liang (2021) conducted a study on Chinese-English CI and compared experienced and inexperienced interpreters on repair forms. The results pointed to the effect of experience on both cognitive resource allocation and the levels of syntactic and semantic processing.

As demonstrated by the ample evidence above, in the case of SI, disfluencies may indicate change in cognitive load of interpreters and give insight into stages of speech planning and production processes in interpreting. The qualitative differences between SI and dialogue interpreting in terms of for instance monitoring may possibly be reflected in the occurrence, distribution, and type of disfluencies. Also, since the processes underlying speech production in L1 and L2 are considered to be essentially the same, despite some differences (e.g., Kormos 2006), the cognitive load as indicated by disfluency in dialogue interpreting could possibly be attributed to other processes than speech production or planning alone. The review of studies on disfluency is complemented with a typology of disfluency in the section 2.4.5.

2.4.5 Typology of disfluencies

In an attempt to model disfluency phenomena, various categorization systems have been devised (Levelt 1983; Nakatani and Hirschberg 1994; Shriberg 1994; Lickley 1994). Majority of these models adopted a formal and structural view of disfluency, that made no assumptions about the underlying causes of these phenomena. Most classifications (e.g., Kormos 2006; Götz 2013; Lickley 2015) distinguish between unfilled (silent) pauses, filled pauses, and other disfluencies. Unfilled, sometimes called silent, pauses are phonetically empty interruptions. The phenomenon of silent pauses has not been investigated in the present study and a number of empirical studies of silent pauses in interpreting can be found elsewhere (e.g., Goldman-Eisler 1968; Mead 2000, 2005; Wang and Li 2015; Han and An 2021). For the purposes of the current inquiry Lickley's (1994, 2015) typology of disfluencies is partially adopted[25]. Lickley's system was chosen as a point of departure since his categorization is based on a conversational corpus and as mentioned earlier it does not make assumptions about the underlying cause of disfluency, thus being atheoretical. The following disfluency markers are considered: *hesitations*, represented by filled pause, prolongation, and repetition, as well as *repairs*.

Hesitations involve a temporary suspension of the flow of speech by producing a *filled pause*, a *prolonged syllable* or by *repeating* an onset of the current utterance (Lickley 2015:456). Repairs involve alternations of the original utterance before interruption by substituting or inserting new material or by entirely deleting the utterance. The following sections present hesitations and repairs in more detail.

2.4.5.1 Hesitations: filled pauses, prolongations, and repetitions

Filled pauses can be realized as brief vocalizations built around central vowels of a language (Clark and Fox Tree 2002). More specifically, they comprise either elongated vowels or vowels followed by a nasal with no specific lexical content (Lickley 2015). Phonetically, filled pauses are similar in quality to the mid-central vowel *schwa* (Clark and Fox Tree 2002; Tottie 2011). However, in some languages, like Spanish (*este*), Japanese (*eeto*), and Mandarin Chinese (*zhege*, *nage*) filled pauses have a lexical form in addition to prolonged vowel (Zhao and Jurafsky 2005; Tseng 2006; Watanabe 2009; Crible and Pascual 2020). It has also been suggested that clicks, sniffs and throat clearings belong to the category of hesitations (for an extensive discussion see Belz 2023), but they will not be addressed here. Depending on the language and type of discourse (e.g., narrative speech, spontaneous speech) filled pauses make up a different portion of all speaking time and are considered an inherent part of

[25] Excluding *silent pauses*. More on *silent pauses* can be found, for instance, in a multilingual study by Campione and Véronis (2002).

speech (Fletcher 2010:573). Table 1 accounts for examples of filled pauses that commonly occur in the four working languages used in the present study.

Table 1 Filled pause variations in the four languages in the present study.

FILLED PAUSE	**LANGUAGE**	**SOURCE**
eu, euh, em, eh, hein	French	Duez (1997)
eh, äh, m	Swedish	Allwood (1990:12)
eh, em, este	Spanish	Crible et al. (2017:72)
yyy, mmm, eee	Polish	Majewska-Tworek (2014:183)

Prolongations are marked syllable or phoneme lengthenings that result in a word or syllable duration that is longer than the otherwise expected or normal duration (Betz et al. 2016:1). Prolongations are either adjacent to other disfluent phenomena or occur and phrase endings to signal utterance boundary to the listener (Turk and Shattuck-Hufnagel 2007). Elsewhere, Eklund (2001) argues that prolongations are similar to filled pauses, such that they tend to signal hesitation in terms of vocalization and duration.

Repetitions, that is reiterations of previously uttered material, are the most common form of disfluency (Lickley 2015) and similarly to filled pauses, there is large experimental evidence connecting repetitions with cognitive load (Crible and Pascual 2020).

The following example 1 presents repetition and two prolongations found in one of the two experienced Polish interpreter's Swedish rendition of the clients turn in Polish. The number in brackets corresponds to the turn number in the transcribed role play. Transcription key can be found in appendix 4.

Example 1 Repetition and prolongations

```
(26) Interpreter:  men (.) mene: som sagte: de
                   kommerå ta lite tid...

                   but (.) butuh: as I saiduh: it's
                   goin' to take some time…
```

Hesitations occur in speech for several reasons and their frequency and distribution are affected by different factors (Corley and Stewart 2008). Filled pauses are likely to occur at the beginning of utterances which is a consequence of planning demands in the pre-articulatory phase (Level 1989; Corley and Stewart 2008). Filled pauses are associated with increased cognitive load (Betz et al. 2023) as they occur more often before longer, more complex utterances (Oviatt 1995; Shriberg 1996) or when the topic is unfamiliar (Bortfeld 2001; Merlo and Mansur 2004). Filled pauses have also been suggested to occur before content words (Macklay and Osgood 1959) and as a consequence of lexical access problems and lower lexical familiarity (Hartsuiker and Notebaert 2010). In experimental studies, retrieval of lexical items has been demonstrated to cause more prolongations (Schnadt and Corley 2006), whereas L2 speakers were shown to use more repetitions (Bergmann et al. 2015:45). The previously mentioned corpus studies by Plevoets and Defrancq (2016, 2018) on interpreters' filled pauses also support the view that cognitive load is an important predictor of disfluencies. Moreover, empirical evidence points to different distribution of filled pauses in bilingual speech, depending on speakers' L1 and L2. In L1 speech production filled pauses are more likely to occur in initial positions, often following a discourse marker (Kosmala and Crible 2022:228). Additionally, in L1 speakers, disfluencies and discourse markers often become entrenched as one unit (see e.g., *butuh* in Schneider 2014). In L2 speech production, filled pauses were shown to occur in medial positions in the context of lexical retrieval and were often clustered with other disfluencies. In conclusion, hesitations, that is filled pauses, prolongations, and repetitions, may be expected to occur in longer utterances, mostly at turn-initial junctures and in connection to less frequent words.

2.4.5.2 Repairs

Terminological discrepancies in the different fields of study concerning the phenomenon of *repair* have led to two main definitions of repair.[26] According to the first definition, repairs are "instances in which an emerging utterance is stopped in some way and is then aborted, recast, continued, or redone" (Fox et al. 1996:189). That is the definition adopted in the present study. The second definition is associated with Levelt's (1983, 1989) seminal work on speech production, where the term repair corresponds to two phenomena. First, to a repair on a macro-level as in the definition above, and second to a structural component of that repair on a micro-level, where fluency is resumed (Levelt 1983:45). In later contributions the latter is renamed *reparans* (see Shriberg 1994). Figure 5 illustrates the structure of repair with all its components as shown by Levelt.

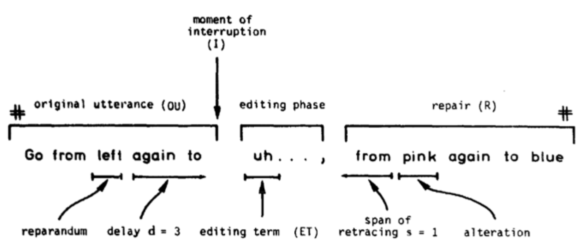

Figure 5 Structure of repair (Levelt 1983:45)

[26] Many researchers have addressed this issue. For a comprehensive review, see Crible (2018).

In the present study, Levelt's model is not considered in terms of analysis but is presented here as it remains highly influential in the field of linguistics and the structural approach separating disfluency into reparandum and reparans is adopted by many researchers in the study of disfluency phenomena.

Turning to repair as a type of disfluency, different factors are attributed to its occurrence and distribution. As previously reported, it is well-established that a self-monitoring cognitive mechanism exists that oversees one's own language production and intervenes when necessary (Postma and Kolk 1993; Hartsuiker 2014:417). It was Levelt (1983) who in his cognitive theory of disfluencies first distinguished between *covert* and *overt repairs*, both resulting from self-monitoring processes. Covert repairs refer to repairs that occur in the pre-articulatory stage, whereas overt repairs involve a change in the speech production process, after the error has been articulated. A similar two-fold categorization was proposed more recently by Ginzburg et al. (2014), who differentiate between *backward-looking* and *forward-looking disfluencies*. The definition of the two also bears comparison to Levelt's covert and overt repairs, such that backward-looking disfluencies refer to an already-uttered material, while forward-looking disfluencies correspond to "completion of the utterance which is delayed by a filled or unfilled pause or a repetition" (2014:4). In the present inquiry, only overt repairs are studied as repairs, that is disfluencies that comprise an auditory component and constitute a "correction of errors without external prompting, frequently within a short span of time from the moment of error occurrence" (Postma 2000:98). The following example 2 presents a repair found in one of the two experienced Polish interpreter's Swedish rendition of the clients turn in Polish. The number in brackets corresponds to the turns number in the transcribed role play.

Example 2 Repair in the interpreter's rendition

```
(16) I:          ja känne- ja kan inte varken svenska
                 eller engelska
                 I don't kno-I don't speak either Swedish
                 or English
```

Covert repairs are disfluencies which do not modify already-uttered material but announce the incoming completion of the ongoing speech. In the present study, such structures were included here in the category of hesitations (see section 2.4.5.1 for examples).

The underlying assumptions of Levelt's (1989:470) theory of *perceptual loop monitor* is that production of repairs is under attentional control, rather than automatic. According to Levelt's *Main Interruption Rule Hypothesis*, speakers interrupt their speech immediately upon detecting trouble.

Notably, Levelt (1983:63–64) argues that the rule does not apply to what he calls *appropriateness repairs*, that is when the word in question is not erroneous but simply unsuitable (see also Hartsuiker and Kolk 2001). In a corpus study of monolingual repairs, Seyfeddinipur et al. (2008) found that speakers interrupt themselves when they are ready to produce the repair rather than at the time in which they detect an error. This finding implies that speakers may prefer being efficient, are likely to favor fluency over accuracy and tend to wait for an appropriate moment to correct their speech.

When it comes to repair occurrence and distribution, they have been shown to follow an analogous pattern in both in L1 and L2 production (Van Hest et al. 1997; Kormos 1999; Declerck and Kormos 2012). Nevertheless, the resources available for monitoring are different in L1 compared to L2 and as a result monitoring efficiency is different in L1 compared to L2 speakers. For instance, Lennon (1990) argued that increased L2 competence leads to more cognitive resources available for monitoring, which in turn results in more repairs. At the same time, Van Hest (1996) found that L2 proficiency attainment affects the type of repairs but not their overall frequency. While there is ample research within the fields of psycholinguistics and Second Language Acquisition on monitoring efficiency in bilinguals, there are no studies devoted to interpreters and their patterns of repair. On the one hand, interpreters, like other speakers, may prefer fluency to accuracy in line with Seyfeddinipur et al.'s (2008:837) theory of *Delayed Interruption for Planning Hypothesis*. On the other hand, in accordance with the codes of ethics,[27] interpreters are expected to be accurate and should therefore suspend speaking as soon as they discover an error in their production. However, as research has shown, interpreters' adherence to professional codes is not always the case (Englund Dimitrova and Tiselius 2016:198). It would seem that dialogue interpreters, maybe more than any other speakers, might have to balance these competing demands.

2.4.5.3 Other

The category of other includes two types of phenomena that are not disfluencies *per se* but often appear around disfluencies and their functions are ambivalent. These are *discourse markers* and *explicit editing terms*. Discourse markers are defined as "sequentially dependent elements which bracket units of talk" (Schiffrin 1987:31) and include linguistic elements such as *like*, *I mean*, *you know*, or *yeah*. Discourse markers often co-occur with disfluencies (e.g., Crible 2018:178). Since discourse markers are not the object of the present investigation, they were not analyzed separately. However, since they occur in connection to some disfluencies, they were taken into consideration.

[27] The Swedish Public Service Interpreters' Code of Ethics, §9, states that "during the interpretation, a state-accredited interpreter is required to transfer all information as accurately as possible" (*God tolksed* 2019:3; my translation).

The second category, explicit editing terms are defined as metacommentaries on interpreters' own renditions and can either be expressed with discourse markers (e.g., *oops*) or longer utterances. Interpreters' requests for clarification are also included in the category (see also *explicit coordinating moves;* Wadensjö 1998:109).

2.4.6 Disfluency in the present work

Disfluencies can be perceived as "overt, measurable indications of processing activity which requires a certain amount of time" (Chafe 1980:170) and thus "provide an interface between externally observable behavior and the underlying cognitive processes" (Little et al. 2013:191). Consequently, during a particular utterance, disfluency reflects, albeit indirectly, cognitive processing associated with certain aspects of language production or delays associated with these processes. Converging lines of evidence support the view that disfluencies are predictors of cognitive load (see sections 2.4.4.1 and 2.4.4.2 for examples). Thus, disfluencies are likely to shed light on the cognitive load experienced by particular speakers, or in the case of the present study – dialogue interpreters. Furthermore, in dialogue interpreting, it can reasonably be expected that disfluencies reflect cognitive load associated not only with comprehension and production in the two languages, but also in connection with monitoring, and interactional and situational factors of the interpreting event (see Tiselius and Englund Dimitrova 2023:310–311).

The view of disfluency in the present study is close to the ambivalent approach, although it does not entirely follow the assumptions presented by Götz (2013) and Crible (2018). In dialogue interpreting, disfluencies are understood as *discrete multifunctional devices that reflect the cognitive load associated with different processes inherent to interpreting dialogues while simultaneously serving various functions that the context of dialogue interpreting demands* (cf Crible 2018:23). The definition of disfluency in the present study allows for integration of elements from different contributions, i.e., the notion of cognitive fluency from Segalowitz's model and the ambivalent view of disfluency that combines the assumptions of both the cognitive burden and strategic modeling views. Accordingly, it will be referred to as the *cognitive-functional view of disfluency*.

Crible (2018:14) distinguishes between two methodological approaches to the study of disfluency, that is *holistic* and *componential*. The holistic approach is concerned with a global impression of fluency, which is not restricted to the measurement of discrete phenomena and is usually qualitatively inclined. The componential approach investigates different separate features of disfluency, often turning to quantitative methods of inquiry. However, the two-fold distinction is not straightforward (Crible 2018:14–15), no less in the case of the present investigation that adopts a mixed-methods approach. In other words, the current study of disfluency comprises both holistic and componential elements. What is more, the holistic impression of fluency, or interpreters' cognitive fluency is explored here by means of quantitative analyses of disfluency phenomena. In terms of cognitive load, the investigation that includes holistic analysis of disfluencies during dialogue interpreting provides insight into interpreters' *global cognitive load* during the entire interpreting encounter. Whereas the componential approach is realized here by the qualitative analyses of separate phenomena in the interpreters' utterances. The componential approach to disfluency is likely to provide better understanding of interpreters' *local cognitive load* (Seeber 2013:29) and the different functions that disfluencies may fill at the different moments of the interpreting event.

To reiterate, the *cognitive-functional view of disfluency* adopted in the present investigation can be summed up as follows: 1) disfluencies are indirect markers of cognitive load, 2) the cognitive load indicated by disfluencies has multiple origins, 3) disfluencies serve multiple concurrent functions in interpreting.

Lastly, since different disfluency measures have been used as reliable indicators of cognitive load in interpreting (e.g., Plevoets and Defrancq 2016, 2018; Defrancq and Plevoets 2018; Chmiel et al. 2023), in the present work cognitive load is operationalized with following 3 disfluency measures: disfluency duration, disfluency count, and disfluency rate. The three measures are used in combination to avoid the issue of using a single measure as an indicator of cognitive processing. The measures are defined and described in detail in section 3.1.1.

2.5 Eye movements and cognition in interpreting studies

Eye-tracking refers to "an experimental method of recording eye motion and gaze location across time and task" (Carter and Luke 2020:50). Ocular behavior is believed to reflect the cognitive processes behind memory, attention, language use, and decision-making. Therefore, studying interpreting through the means of the eye movements has the potential of extending our knowledge about its underlying processes and the cognitive resources of interpreters.

Following eye movements through eye-tracking instruments has grown in popularity in the fields of translation and interpreting (Korpal 2015; Hvelplund 2017; Chmiel 2022; Hu et al. 2022). Currently, there is a growing body of eye-tracking research that investigates various aspects of interpreting processes in its different modalities, such as SI (e.g., Seeber and Kerzel 2012; Korpal and Stachowiak-Szymczak 2020; Amos et al. 2022; Arbona et al.

2022), SI with text (e.g., Seeber et al. 2020; Chmiel et al. 2020a), CI (e.g., Chen 2018, 2020; Stachowiak-Szymczak 2019), or sight translation (e.g., Shreve et al. 2011; Chmiel and Lijewska 2019; Su 2023).

The main advantage of eye-tracking in studying cognitive processes of interpreting is its non-invasiveness, which allows for investigating eye movements without interrupting the ongoing task (Richardson et al. 2007; Seeber 2015:157). Another benefit of eye-tracking is its high temporal resolution, such that eye movements can be recorded at the speed of at least 60 times per second, and up to 5000 times per second, depending on the sampling frequency of the used eye-tracker (Hvelplund 2017:248). These advantages allow for fine-grained analysis of various eye movements on a moment-by-moment basis.

Despite the growing number of eye-tracking studies in research on SI and long CI, there are still only few studies on dialogue interpreting that apply eye-tracking methodology (e.g., Vranjes et al. 2018a, 2018b), particularly from a cognitive perspective (e.g., Tiselius and Sneed 2020; Vranjes and Oben 2022) – a gap which the present work is intending to fill.

Drawing on the assumptions put forward by CLT and Chen (2017) concerning cognitive load measurement reported earlier in the section 2.3.2.4, cognitive load experienced by the participants during the process of interpreting can be assessed by measuring eye movements. In eye-tracking studies of cognitive load in interpreting, two measures have been employed so far, that is *pupillary dilation* and *fixation-based measures* which will briefly be described in sections 2.5.1.1 and 2.5.1.2. Importantly, the two measures were not chosen in the present investigation. A few conclusions that address the exclusion of these two eye-tracking measures from the present study are added after each section.

2.5.1 Eye measures as indicators of cognitive processing

When it comes to potential issues of eye-based cognitive processing measurements, they are technical and methodological in nature. For instance, accuracy is vital to studies that are interested in where participants are looking. Since accuracy is also determined by the precise calibration procedures, low quality calibration can result in imprecise starting point for further measurements (Holmqvist et al. 2011:128). Another challenge to data accuracy is sampling frequency. The eye-tracker used in the present study recorded at the frequency of 60 Hz. It is potentially disadvantageous, as noise can easily appear in data sensitive to sampling frequency as suggested by Andersson et al. (2010). However, experimental setups demanding unconstrained body movement (Tiselius and Sneed 2020:783) benefit from mobile eye-trackers despite the lower speed. Notably, data quality and data loss are common issues in eye-tracking research are often determined factors like participants, recording environment, or experimental setup (Holmqvist et al. 2023:365). Finally, the main challenge to using eye-tracking measures is the issue of validity of eye movements in researching online cognitive processing. The issue of validity is further explored in section 2.5.1.3.

2.5.1.1 Pupillometry

Pupillary dilation has been used as a robust index of cognitive load in a variety of disciplines (see Holmqvist et al. 2011 for a review). In the field of interpreting studies, only a few studies so far used this measure, possibly due to its complexity (Seeber 2015) and the need for a strictly controlled experimental design (see e.g., Holmqvist 2011:391).

Tommola and Hyönä (1990) and Hyönä et al. (1995) demonstrated that pupil dilation for three different translation tasks (listening, shadowing and SI) varies as a function of cognitive load. They found that SI that placed the largest portion of cognitive load on the participants, also generated the largest pupil size. Seeber and Kerzel (2012) investigated how morphosyntactic asymmetry between English and German affects cognitive load in SI by measuring participants' pupil size. The study demonstrated that pupil size was larger when processing verb-final constructions from German to English, thus confirming the usability and validity of the measure in research on cognitive load in SI. Gieshoff (2018, 2021) measured changes in pupil size throughout an experiment that tested whether seeing the speaker's lip movements during SI alleviates the interpreter's cognitive load. The pupillary data did not support the hypothesis and demonstrated an inverse trend than predicted (Gieshoff 2018:112).

The rejection of pupillometry was based on the fact that the current study was not conducted using a strict experimental set up. Certain variables, like for instance, luminance, were not controlled for and as a result pupil measures were unreliable.

2.5.1.2 Fixations

Chmiel (2022:467) notes that many of the eye-tracking studies conducted on interpreting take advantage of eye measures defined for reading, e.g., fixation-based measures. Indeed, in reading, scene perception and usability research, it has been demonstrated that longer fixations indicate more effortful cognitive processing. Rayner (1998) for example, argues that linguistic factors influence fixation duration in reading. Meghanathan et al. (2015) find, that in free viewing conditions, fixation duration is sensitive to both memory and processing load. The idea of fixations and processing occurring simultaneously is known as eye-mind hypothesis and was put forward by Just and Carpenter (1980) in their theory of reading. The authors argue, that "the eye remains fixated on a word as long as the word is being processed. So, the time it takes to process a newly fixated word is directly indicated by the gaze duration" (Just and Carpenter 1980:330). In other words, fixation equals processing. With the rise of popularity of eye-tracking in research on translation and interpreting, the hypothesis has become a go-to theory supporting interpretations of eye fixations (for examples see Muñoz Martín and Olalla-Soler 2021:206). However, as Muñoz Martín and Olalla-Soler (2021:206) point out, the hypothesis has been criticized nearly since its inception. Some of the heaviest criticisms against Just and Carpenter's (1980) interpretation of eye movements was that it lacked validity and that it was applicable to reading research alone, or even exclusively to the study conducted by Just and Carpenter. For instance, Irwin (2004:105) points to a few possible issues with eye-mind hypothesis. First, cognitive processing may include areas extending beyond fixation location. Second, fixation location and the loci of cognitive processing may be separate. And third, cognitive processing has been shown to occur during fixations, but also during eye movements. More recently, Holmqvist et al. (2011:379) argue that while most eye-tracking research assumes that no time lag exists between eye fixations and processing, there is evidence to the contrary. Deubel et al. (2008) for example demonstrated that processing precedes eye movements by up to 250 milliseconds. In other words, measure based on fixations should be used with caution, and possibly also readjusted to make data interpretable (Chmiel and Lijewska 2019:392).

Fixation-based measures were not used in the present study. The main shortcoming of fixation measures in the context of the present study has already been discussed, that is, fixation does not imply that increased cognitive processing is taking place. On the other hand, fixations proved useful in tracing dialogue interpreters' gaze in a study that Tiselius and Sneed (2020) conducted using the same data as the present work. However, a significant feature of their investigation is that the analysis was not concerned with individual fixations or average fixation durations during interpreting but with "overall gaze pattern of participants to the faces of those they are interpreting for" (Tiselius and Sneed 2020:783). Importantly, gaze is a behavioral measure insofar as it is controlled by the participant.

Exclusion of fixations was done after careful consideration[28] of their advantages and possible drawbacks. Initially, the present inquiry also considered prolonged fixation durations as a measure of cognitive load in interpreters. However, the measure has proven unreliable in the context of this study for the following reasons: 1) the study did not use any visual stimuli, nor areas of interest were chosen, 2) no established lower cut-off point for fixation durations exists when it comes to eye-tracking studies in interpreting (cf Stachowiak-Szymczak 2019:93) and 3) no upper threshold for fixation durations exist in eye-tracking studies in interpreting 4) fixations may indicate

[28] I would like to thank Jan Louis Kruger for his helpful comments which prompted me to discard the idea of fixations as indices of cognitive load in dialogue interpreting and turned my attention to blinks as a measure potentially sensitive to cognitive processing.

other processes apart from increased cognitive load, and finally 5) unconstrained head movements and peripheral gaze may have resulted in poor data accuracy and data loss.

2.5.1.3 Rationale for selecting blink measures to investigate cognitive load in dialogue interpreting

From the perspective of validity, when a measure exhibits sensitivity to an array of factors, as seems to be the case with many physiological markers, it may present potential challenges. However, according to Borsboom et al. (2004:1016), any measure is valid for assessing a construct if the construct exists and if changes in the construct causally produce changes in the measure outcomes. In a systematic review of physiological measures employed to estimate cognitive load (in the analysis referred to as "mental workload"), Charles and Nixon (2019) found that blink rate is a valid measure, sensitive to fluctuations in cognitive load resulting from increasing task demands. Similarly, in a more recent meta-analysis, Ayres et al. (2021) looked at construct validity and sensitivity of psychophysiological measures and found that blink rate measures are more sensitive as indicators of cognitive load than other physiological markers, such as heart rate. Apart from being a valid psychophysiological measure of cognitive processing, the key advantages of blink related measures are that they are non-invasive and inexpensive and relatively easy to extract. Thanks to technological advances and eye-tracking equipment becoming more accessible, collecting blink data can be done with quite uncomplicated (and inexpensive) means. In fact, since calculating blink rate only requires detecting blink occurrences, blinks can be recorded on video and counted manually without relying on any eye-tracking equipment. Certainly, depending on the level of granularity one's investigation requires, blinks can be recorded using video cameras, eye-trackers, or electrooculograms (EOG). Finally, blink rates have not yet been explored in the field of interpreting studies as a measure of cognitive load fluctuations during dialogue interpreting. To conclude, the measure's validity, non-invasiveness, and novelty support the choice of blink rates to investigate cognitive load in dialogue interpreting. The following sections discuss how blinking and cognitive load may be related.

2.5.2 Blinking and cognitive load

Blinking is the most frequent type of human movements. It is a complex phenomenon (Rodriguez et al. 2018) regulated by several different factors (Karson 1989) from ocular surface health, through general visual function to cognition. Depending on their functions, three types of blinking can be distinguished in healthy humans, more specifically, voluntary, reflex, and spontaneous blinking (McMonnies 2010:202). Voluntary blinking depends entirely on the subject's will and the motor function (McMonnies 2020:75).

Reflex blinks are involuntary responses that occur to protect the eye and lubricate the cornea. Spontaneous blinks occur unconsciously in a highly symmetrical fashion and in the absence of any evident exogenous stimulation (Cruz et al. 2011). Among the different kinds of blinks, most blink behaviors are spontaneous, that is unconscious responses under both perceptual and cognitive control (Stern et al. 1984). The neural basis of spontaneous blinking is still largely unknown. However, spontaneous blink rates (number of blinks per minute) are believed to reflect "the complex interaction between peripheral influences mediated by the eye surface and dopaminergic activity" (Cruz et al. 2011:29). Since only spontaneous blinks are of interest to the present study, for ease of further discussion, they will be referred to as "blinks" hereafter.

Since Ponder and Kennedy's (1927) work on blinking and "mental tension", blinks have been linked to various cognitive processes, and it has been suggested that their distribution is non-arbitrary. As already mentioned, dopamine, a neurotransmitter that is linked to different functions in the brain, is known to affect blink rates (Colzato et al. 2009; Jongkees and Colzato 2016). Moreover, converging evidence from studies in various domains demonstrates that dopamine plays a critical role in WM functioning (see e.g., Bäckman et al. 2006, 2010; Zhang et al. 2015). Consequently, one can expect that placing greater demands on WM will manifest with changes in the temporal distribution of blinks. Indeed, changes in blink rate have been linked to cognitive processes, such as inhibition, attention, cognitive control, and cognitive load (Holmqvist et al. 2011; Van Bochove et al. 2013; Charles and Nixon 2019; Ayres et al. 2021).

2.5.2.1 Blink rates and cognitive load

Whereas it is generally accepted that cognitive processing modulates blink rate, the temporal characteristics of blink rate during cognitive processing are still unclear and existing results are diverging. One of the reasons behind the contradictory results may be the complexity of distinguishing between the influence of bottom-up sensory factors and top-down cognitive factors on blinking (Brych and Händel 2020). Several previous studies found that blink rates increase as a function of greater cognitive demand (Fukuda 2001; Tsai et al. 2007; Recarte et al. 2008) fatigue, or time-on-task (Stern et al. 1994; Maffei and Angrilli 2018). Similarly, Oh et al. (2012) report that blink rates increase during both visual and auditory Stroop task performance. Rac-Lubashevsky et al. (2017) reveal that blink rates increase as a function of gating and updating WM.

At the same time, much prior research devoted to cognitive load and blink rate has consistently shown that blink rate decreases during tasks of varying complexity, such as visual search (Benedetto et al. 2011), driving (Recarte et al. 2008), video viewing (Nakano et al. 2009) and reading (Bentivoglio et al. 1997; Doughty 2001; Rosenfield et al. 2015). However, since these studies employ visual tasks alone, the decrease in blink rate appears to be due to increased visual processing and not as a result of increased cognitive demand. A theory that could potentially accommodate the contradictory findings is the *load theory of attention* (Lavie et al. 2004), according to which there are two selective attention mechanisms. The early, perceptual attention mechanism, whereby irrelevant information can be excluded from perception simply by not perceiving them when capacity for their processing is insufficient. Bottom-up attentional processes that cause perceptual load (e.g., Chen and Epps 2014) are stimulus-driven and may attract attention even if the subject is not aware. In this case, as a result of higher perceptual load, blinks might be suppressed, causing lower blink rates. The second, more active cognitive mechanism of top-down attentional control depends on WM and is required to actively maintain processing priority. In other words, there is a distinction between two types of load that can cause difficulty during a period of time. Consistent with the theory of attention, Chen and Epps (2014) find that blink rate increases with cognitive load during low perceptual load but changes little under high perceptual load.

Studies have also demonstrated that blink rates are modulated during auditory inputs. For instance, Magliacano et al. (2020) employ an auditory odd-ball paradigm and find that that blink rates increase as a function of cognitive load in auditory modality. When it comes to blink rate modulation during dialogues and conversation, Hömke et al. (2017) attribute changes in blinking dynamics to conversational feedback. Doughty (2001) suggests that blink rates increase in conversation owing to emotional engagement, whereas Bailly et al. (2010) argue that blink rates decrease during listening in conversation. Contrary to the above-mentioned studies, Brych et al. (2021) demonstrate that listening in conversation has no effect on blink rate and that blink rates in conversation increase mainly due to motor aspects of speaking, like lip and tongue movement. Similarly, Li et al. (2020) found that what they called *communication load of conversation* had no effect on blink rates, and no differences were found between listening and speaking in terms of blink rates. Indeed, if sensory, cognitive, and motor aspects may modulate blink rate, distinguishing between their individual impact is complex.

2.5.2.2 Blink rate variability and cognitive load

Another measure related to blink rate that emerges as a potential indicator of changes in cognitive processing, is blink rate variability (BRV). BRV is a physiological measure that only recently has been demonstrated to exhibit sensitivity to cognitively demanding tasks (Lenskiy et al. 2016; Gebrehiwot et al. 2016; Paprocki et al. 2017; Ren et al. 2019). It is based on the notion that the temporal dynamics of blinking have properties comparable to other human movements and physiological processes, such as walking or heart rate variability (Paprocki et al. 2017). Analogous to heart rate variability (HRV), which is estimated based on a time series of consecutive intervals between heart beats (Rojo and Korpal 2020:198; Korpal and Rojo 2023:100), BRV is calculated using time series composed of consecutive inter-blink intervals. Comparable to heart rate variability, BRV can be investigated in two domains, that is frequency domain and time domain. The frequency-domain indices of HRV are not directly applicable to BRV and previous studies used non-linear measures instead, like the scaling exponent α (see e.g., Lenskiy et al. 2016). The use of the scaling exponent α relies on the assumption that certain physiological processes, including blinking, are self-similar and exhibit fractional dimensionality. The exponent α is obtained by performing detrended fluctuation analysis (Ihlen 2012) and is then used to estimate the rate of unpredictability in the fluctuations of BRV. There are, however, much less complicated measures that can be employed to quantify short-term fluctuations in BRV in the time domain. One such parameter, is the standard deviation of inter-blink intervals (SDNN). SDNN is comparable to a similar measure in HRV, it is easily calculated and reflects the amount of variability between consecutive eye blinks. Consequently, the higher the BRV, the more variability there is between the inter-blink intervals. As mentioned before, the properties of BRV are possibly subject to change, for example due to higher cognitive demand. Findings from studies using reading and memory recall tasks (Lenskiy et al. 2016) show that BRV (operationalized as the exponent α) increases during memory task compared to baseline and decreases during reading (Gebrehiwot et al. 2016). In a more recent study Paprocki et al. (2017) demonstrate the opposite, that BRV (exponent α) decreases because of high cognitive demand elicited by IQ tests and is significantly lower in the resting baseline.

2.5.2.3 Blink measures in the present work

It appears that blinking has not yet been investigated in CTIS in relation to cognitive processing or cognitive load.[29] Nevertheless, it is a promising measure (Chmiel 2022:468), with the potential to shed light on cognitive processes involved not only in dialogue interpreting, but also in other forms of interpreting and translation.

The discrepancy in findings that emerges from studies on blink rate, the relative novelty of the BRV measure, and the fact that none of the two measures has yet been employed in research on interpreting may constitute a potential challenge. However, the decision to investigate blink measures was made with consideration of their potential drawbacks. Thus, building upon the premise that dialogue interpreting is a cognitively demanding task (Tiselius and Sneed 2020:780) and that blinking may act as a window into WM and cognitive processing, the present study attempts to explore blink rate and BRV as potential indicators of changes in cognitive load of dialogue interpreters.

[29] See Gieshoff et al. (2021) for a review of psychophysiological measures used in CTIS.

2.6 Summary: approaches adopted in this work

This chapter established the theoretical and conceptual frameworks for the study of cognitive load in dialogue interpreting. It provided a review of relevant previous research on dialogue interpreting, cognitive load, disfluency, and eye-tracking measures.

First, the framework of cognitive translatology within CTIS was selected as the paradigm most suitable for the study of the construct of cognitive load in dialogue interpreters. A short description of public service interpreting in Sweden was also given to provide the reader with the context of the present inquiry. Subsequently, dialogue interpreting and its fundamental tenets were discussed in the context of the different cognitive processes inherent in interpreting. In terms of two constructs that have been shown to influence interpreters' cognitive processes and their cognitive load, directionality, and experience were identified as variables of interest.

Regarding cognitive load, three models were reviewed, that is Gile's Efforts Models, Seeber's CLM, and Chen's construct of cognitive load in interpreting. Chen's static model was chosen as a point of departure for the present inquiry since it considers the interaction between the interpreter and task and environment characteristics.

Chen's model was revised and adapted to fit the dialogue interpreting context and the assumptions of the present study. Using the revised model as a theoretical framework, experience (interpreter characteristic) and directionality (task and environment characteristic) were selected as independent variables for the study of cognitive load. In the assessment dimension of cognitive load, the chosen measurable aspects were interpreter performance and their physiological response. Cognitive load was then operationalized with performance measures (disfluency). Also, a psychophysiological measure (eye movements) was chosen to be tested as a potential indicator of cognitive load.

Further, both functional and cognitive perspectives on disfluency were discussed. Functional-cognitive view of disfluency was then proposed and adopted as the conceptual framework for the investigation of cognitive load in the present work. The chapter concluded with a review of two eye-tracking measures previously used in assessing cognitive load in interpreting studies. In addition, blink rates and BRV were closely examined, and it was argued that they are more appropriate measures of cognitive processing in the context of the present investigation than previously used pupillometry or fixation-based measures. Altogether the presented theoretical foundations serve as background against which the study is conducted.

2.7 Research questions

The following research questions along with hypotheses and predictions are addressed in the present study:

1) Is there a difference in cognitive load between experienced and inexperienced interpreters and depending on interpreting direction?

    a. Disfluency durations (ms) will be different across groups and interpreting directions
    b. Disfluency counts will be different across groups and interpreting directions
    c. Disfluency rates (per minute) will be different across groups and interpreting directions

2) Is there a difference in blink rates between interpreting and non-interpreting?

    If yes, is there an effect of interpreting phase, directionality, and experience on blink rates?

    a. Blink rates will be different depending on interpreting phase
    b. Blink rates will be different depending on interpreter experience
    c. Blink rates will be different depending on interpreting direction

3) Does interpreting have an effect on BRV?

    a. BRV will be different between interpreting and non-interpreting

4) Is there a difference in BRV between groups?

    a. BRV will be different depending on interpreting experience

5) Is there a relationship between disfluencies and blink measures?

    a. There will be a quantifiable relationship between blink measures and disfluency measures.

Complementary questions and hypotheses:

6) What are the different types and categories of disfluencies in the Polish interpreters' utterances?

a. Inexperienced interpreters will produce more hesitations (filled pauses, repetitions and prolongations) than experienced interpreters regardless of interpreting direction.

b. Interpreters will demonstrate more turn-initial filled pauses than mid-utterance filled pauses.

c. Inexperienced interpreters will demonstrate fewer repairs than experienced interpreters.

The following chapter (chapter 3) presents the methodological framework, data, and measures used to address the research questions.

3 Methods

Since this study is a part of a larger research project certain methodological choices were dictated in advance. Accordingly, it is useful to demonstrate where the choices were restricted, and which methodological choices were independent. This may also help to reveal overall strengths and possible weaknesses of the methodological assumptions. These ideas will be put forward in the first part of the chapter. In the second part of the chapter, the methodological background of the current work, the data and participants will be presented. Also, a detailed presentation of the disfluency and blink annotation procedures will be given.

Selecting appropriate methodology is a challenging process, especially in cases as this one, where research begins with preexisting requirements. It is therefore crucial that I present not only the methodological background and justify the reasoning behind the assumptions made but also present how certain methodological decisions had been made before I embarked on the project. The following dissertation is a part of a larger research project called Invisible process – cognition and WM of dialogue interpreting initiated by Elisabet Tiselius and Birgitta Englund Dimitrova. The project was financed by the Swedish Research Council between the years 2017–2023. The project set out to analyze and investigate cognitive resources in dialogue interpreting, in particular functions of WM and monitoring (Tiselius 2016). One of the project's organizational goals was enlisting a PhD candidate, whose role in the project was to design and formulate a PhD proposal within the framework of the larger project. The prospective PhD dissertation were to explore the aspects of cognitive processes dialogue interpreting, contribute to answering of the research questions of the larger project while, at least to some extent, using its data and data collection methods. It should be noted that majority of the data were collected after the recruitment process had been completed, and that the author provided additional data to the larger project. Also, the author collected additional data that has not been used by the larger project.

One of the fundamental tenets of conducting research is critical thinking. Bourdieu (1996) postulated that the distance necessary to engage in critical thinking is an act of epistemic reflexivity, which can be achieved by for instance explicitly describing stages of data collection and choices made in the analysis process. Thus, the following sections are an act of reflexivity, in which data elicitation and preparation are described together with tools of analysis used in the present investigation.

3.1 Participants

The data were collected during experimental simulated interpreted encounters that recreated a situation commonly arising in a public service context in Sweden. The data from one subject were excluded from analysis because they had withdrawn their consent. The final number of participants of the study was seventeen (*n*=17). The experienced group consisted of seven (*n*=7) dialogue interpreters with at least four years of interpreting experience and a proof of authorization from the Swedish state. The inexperienced group consisted of ten (*n*=10) student interpreters with an average of less than one year of interpreting experience. The inexperienced participants were final year students[30] of the Public Service Interpreting program at the Institute for Interpreting and Translation Studies at Stockholm University (*n*=5) or were trainees at the Swedish Armed Forces Interpreter School (*Tolkskolan*). Participant selection was limited to a convenience sample. Participants were recruited based on the following criteria:

1) Experienced interpreters were required to have a minimum of 4 years of experience (at least part-time) and a proof of state authorization (*auktorisation*)
2) Inexperienced interpreters were required to have no professional interpreting experience (working experience under one year was accepted)
3) Swedish as a working language
4) French, Spanish, or Polish as the second working language

As already mentioned, in dialogue interpreting, the interpreter works actively into both languages. In this study, participants had either French, Polish, or Spanish as one of their working languages and all had Swedish as the other working language. The rationale for choosing these three languages was the project research group's mastery of those languages which benefits the investigation (Tiselius and Englund Dimitrova 2019:313). Experienced participants that matched the criteria were chosen from a registry of authorized interpreters administered by the Legal, Financial and Administrative Services Agency (*Kammarkollegiet*) that is responsible for interpreter authorization. The chosen interpreters were contacted by email. Similarly, inexperienced interpreters were chosen from a list of recent graduates and students that matched the criteria and were also contacted by email. All participants signed a consent form before taking part in the experiment. Since the data collection was initiated in 2017, that is before the General Data Protection Regulation (GDPR) was enforced in the EU, the consent forms after 2018 may differ in scope (see appendix 1 for consent form). Ethical approval for this study was

[30] The two Polish inexperienced interpreters were recent graduates.

obtained from the Swedish Ethical Review Authority (*Etikprövningsmydigheten*), approval ID 2017/2208-31. Data were stored according to the recommendations devised by the Swedish Ethical Review Authority.[31]

Each participant also filled out a background questionnaire devised by Tiselius and Englund Dimitrova, in which participants stated their age, mother tongue, level of education and interpreting experience (see appendix 2). Questions were also devoted to language use and language proficiency, that is which of the two working languages participants consider stronger. In the present study, the chosen labels are L1 and L2 and refer to stronger and weaker working language, respectively. The terminology was borrowed from Tiselius and Englund Dimitrova (2019:311), whose definition of "stronger" and "weaker" is specific to an individual and situation. In the case of the current investigation, L1 and L2 were also consistent with the participants' first and second languages, respectively. When it comes to language use, participants were asked to report on their strongest language(s), language(s) they spoke with their parents, and if relevant, partner and children. Also, they were requested to give an approximate of the time spent speaking different languages at work or school, as well as during spare time. Language use questions included in the questionnaire can be found in the appendix 2. Apart from self-assessment, participants language proficiency was tested with DIALANG test. The DIALANG test is an online[32] diagnostic language

Table 2 Self-reported and tested strongest working languages (n=17)

Number of participants		**Strongest working language**	
		Self-reported	**DIALANG**
	7	SE	SE
	4	PL	n/a[33]
	2	SE/ES	SE
	1	SE/FR	SE
	2	SE	SE/FR
	1	ES	SE
Total	17		

[31] https://etikprovningsmyndigheten.se/en/responsibility-for-research/, accessed April 11, 2023.
[32] https://dialangweb.lancaster.ac.uk, accessed March 25, 2023.
[33] All Polish participants scored level C1 or above in DIALANG in Swedish.

proficiency test that assesses language level following the Council of Europe's framework for language proficiency, CEFR (Huhta et al. 2002). The test was administered online and for all languages except Polish, as DIALANG is not available in that language. Self-assessment and DIALANG test results (where available) along with number of participants are presented in table 2.

Nine participants reported Swedish as their strongest language. The self-assessment was confirmed by DIALANG for eight of the participants and one scored equally on both languages. Five participants reported other language than Swedish as their L1 which was not confirmed for the one participant who took DIALANG test. The other four could not be tested since DIALANG is not available in Polish. Finally, three participants reported both working languages as equally strong, but DIALANG results indicated that they were more proficient in Swedish. The average L2 proficiency level of the inexperienced group was B2 on the CERF scale, whereas the experienced group demonstrated a C1-level of proficiency in their L2.

The four working languages are all European languages with official status of working languages of the European Union. Moreover, twelve out of the 17 participants completed a college or university degree (one PhD). Table 3 presents relevant features of participant demographic.

Table 3 Summary of the participant demographic (n=17)

Features	**Group**	
	Experienced[34]	**Inexperienced**[35]
Number (female)	7 (5)	10 (7)
Mean age (SD)	54 (11)	33 (13)
Mean years of experience (SD)	15 (11)	0.27 (0.53)

3.2 Procedure

The experiment was conducted on the premises of Stockholm University. Each role play was filmed with two video cameras at different angles, and the study participants wore eye-tracking glasses.[36] Triangular layout is the most common seating configuration in dialogue interpreting (Pokorn 2017). Consequently, participants and actors were placed in a triangular seating

[34] The experienced interpreter with shortest experience (4 years) in dialogue interpreting had worked as conference interpreter for over 15 years.
[35] Only 3 out of 10 inexperienced participants worked with interpreting before the experiment, all for less than a year. None worked full-time.
[36] Video recordings were not used in the present study.

arrangement, where actors were facing each other, and the interpreter was seated neutrally in between. One person from the research team was present during all experiments to set up the video and eye-tracking hardware. During recordings, the researcher was sitting out of the interpreters' view to avoid distraction, but they stayed in the room. The experiment was conducted using SMI 2.0 Glasses and SMI Smart RecorderS4. Before each recording, eye-tracking glasses were calibrated for the participant using point calibration procedure, whereby the eyes' features are established to ensure accurate gaze estimation. Participants were asked to look at three specific points that were presented sequentially at different viewing angles. Figure 6 shows participant view during the calibration procedure. The red dot indicates where the participant is looking.

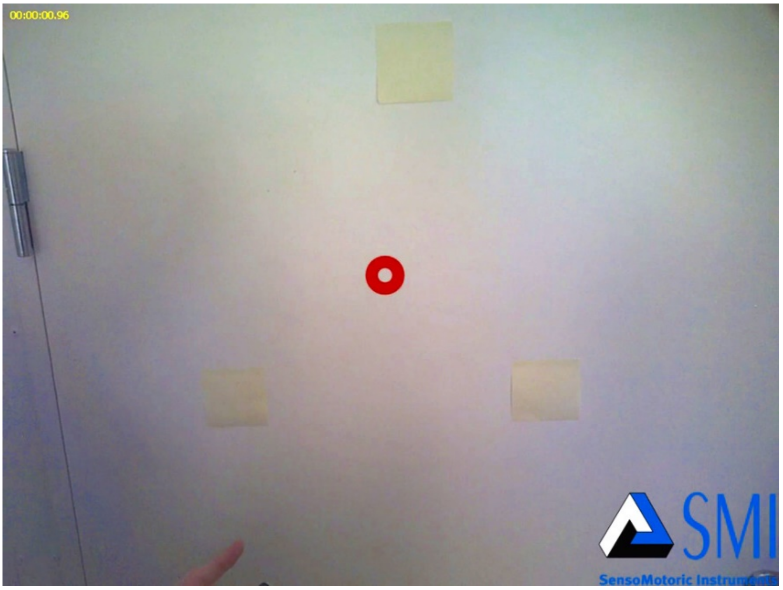

Figure 6 Three-point calibration procedure

In the role-plays, the parts of the service provider and client were played by actors, who had varied understanding of the working languages. Actors playing clients were all native speakers of the languages tested. At two instances, due to actor's unavailability, a member of the research group[37] played the role of the client instead.

Role-plays were designed to last up to 20 minutes on average, and actors were instructed to bring the conversation to an end if the interpretation took longer than anticipated. The manuscript can be found in appendix 3. A summary of the features of the role play is presented in table 4.

---

[37] Native speaker of the relevant language.

Table 4 Role play summary

Context and setting	**Primary parts**	**Objectives**	**Actor instructions**	**Interpreter instructions**
Swedish Employment Agency; job counseling for newly arrived immigrants	A mother of three newly arrived in Sweden (M) Counselor (C)	M: to find out about employment possibilities, becoming self-sufficient as quickly as possible C: to present activities and support program offered by the employment agency	Asked to keep to the general script but encouraged to improvise and follow the other party if interpreting deviated from the script; asked to keep the time of the encounter to under 20 minutes	Requested not to take notes; and asked to interpret as one would in reality

Naturalistic interpreter-mediated encounters are highly complex, and interpreters work under cognitively demanding conditions. The objective was to create an environment that was as close to real life, as possible. Role play manuscripts were complemented with rich points to additionally increase demand on interpreters' cognitive resources (Tiselius and Englund Dimitrova 2021). Cognitive demand was expected to change depending on the different phases (listening, speaking) and interpreting direction (L1, L2) and possibly due to interpreters' experience.

To approximate standard dialogue interpreting practice, the participants were informed on the general topic of the interpreting task one week prior to the experiment. Although it is not possible to assess the level of preparation of different participants, we can assume that it varied. Some participants claimed not having gotten any information prior to the experiment, while others came prepared with glossaries of terms. Participants were instructed to not take notes during the experiment to increase the cognitive demand and to avoid data loss as a result of looking outside the range of eye-tracking glasses, and finally to keep data relatively homogenous. Few of the interpreters acted against the instructions and took notes, a few had prepared glossaries ahead of time and looked down at them during the interpreting task. Despite these issues, repeated testing would not have been possible because of the character of the experiment, therefore all participants were only tested once.

The data preparation for analyses together with relevant units of analysis are described in more detail in section 3.3.

3.3 Data preparation for analyses

The following sections present the data elicitation and analysis methods. Section 3.4.1 is devoted to the identification and annotation of disfluencies and section 3.4.2 accounts for the process of identification and annotation of eye movements, whereas section 3.4.3 is devoted to the methods used in the supplementary analysis of disfluencies in the Polish interpreter sample (*n*=4). The remainder of the section (3.5) provides the summary of the methodological approaches adopted in the study.

3.3.1 Identification and measurement of interpreters' disfluencies

This section details the coding scheme and annotation procedure of disfluencies. The growing body of research on disfluency resulted in an increasing number of annotation models that are not always replicable or generalizable (see Crible 2018 for discussion). Given that the present mixed-methods study comprises quantitative and qualitative elements and different aspects of disfluency are being investigated, the annotation procedure had two stages with different levels of scope and granularity. Section 3.3.1.1 presents the disfluency annotation procedure that was conducted on the data of all seventeen (*n*=17) participants in preparation for quantitative analyses. While section 3.3.1.2 accounts for the more fine-grained annotation of disfluencies in the data of the four (*n*=4) interpreters alone in preparation for qualitative analyses.

3.3.1.1 Quantitative annotation procedure

The initial annotation procedure was carried out by the author. To check coding reliability, two other non-expert annotators, one a native speakers of French, the other of Spanish, were asked to code interpreters' disfluencies in 4 different audio files each. Both annotators coded 3-minute role play excerpts interpreted by two experienced and two inexperienced participants. All recordings lasted 24 minutes per language, that is about 36% of all Spanish role-plays in terms of duration and about 19% of all French role-plays in terms of duration. The excerpts corresponded to the same manuscript fragment and were selected by the author. The annotators were requested to count the number of disfluencies based on subjective observation and following instructions. The results of the two non-expert codings and coding by the author were then compared and weighted *Cohen's kappa* and relative agreement were computed. For Spanish disfluencies the inter-rater reliability was very high (κ=0.73, 90% relative agreement). For French disfluencies the agreement was excellent (κ=0.84, 93% relative agreement).

The initial disfluency annotation by the author was performed in SMI's BeGaze 3.6. software. The software's tool allows for color-coding annotations directly above the recording's oscillogram (see figure 6). Prior to identifying disfluencies in the recordings, four different interpreter actions were annotated according to interpreting phase (listening, speaking) and directionality (L1, L2). Importantly, the phase of listening corresponds to listening for interpreting as defined in section 2.2.3. but was abbreviated for ease of exposition. The speaking phases encompass all interpreter utterances in each working language (L1 or L2). The rationale behind including not only renditions (or outputs) but all utterances in the analyses was that interpreters' requests for clarification or explicit coordinative expressions (*explicit coordinating moves;* Wadensjö 1998:109) are considered to be an integral and essential part of the interpreting process. The actions were thus annotated as speaking L1, speaking L2, listening L1, and listening L2. The view of the interface is shown in figure 7.

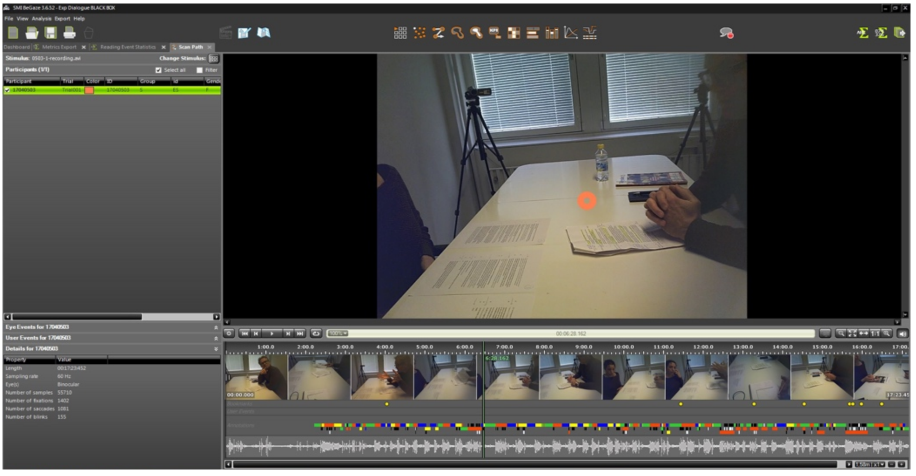

Figure 7 BeGaze 3.6. interface. Participants' (n=17) color-coded disfluencies and interpreting phases are visible above the oscillogram.

In anticipation of both quantitative analyses and qualitative annotation stage, disfluencies were first identified in the recordings and labeled in BeGaze 3.6 using the same annotation tool. Disfluency annotation was carried out manually by listening to and viewing the recordings and annotating relevant sections of interpreters' speaking phases in L1 and L2 that were perceived as disfluent. At this point of annotation, each token was only labeled as "disfluency" following the operational definition presented in section 2.4. Disfluency annotations together with their time stamps were extracted and exported to a .csv file to be further quantitatively analyzed in RStudio Version 2022.07.2.576 (RStudio Team, 2022).

3.3.1.2 Cognitive load measures

Three disfluency measures were used in the study to avoid using a single index of cognitive load. Importantly, all three disfluency measures are measured during the speaking phases of interpreting in both L1 and L2.

First, disfluency duration is measured in milliseconds from the onset of sound to the offset of sound. Since silent pauses were not included in the analyses, they were not counted in disfluency durations, including in cases when silent pauses preceded or followed disfluency.

The second measure – disfluency count – corresponds to the number of disfluencies that occur during interpreters' speaking phases.

The third measure – disfluency rate – is measured with the number of disfluencies per minute, instead of the more common measure of disfluency per 100 words. Disfluency rate is measured per minute in order to be comparable to blink-based measures that were measured in milliseconds as well. An increase in cognitive load results in longer disfluencies, more disfluency counts and higher disfluency rates (i.e., more disfluencies per minute).

3.3.1.3 Qualitative annotation procedure

The second part of the annotation procedure was performed on the data of the Polish interpreters (*n*=4). First, transcriptions of the relevant sections in the four (*n*=4) recordings were carried out in Microsoft Word by the author and two external transcribers naïve to the purposes of the study. All transcriptions are presented with line numbers and turn numbers, followed by the symbol of the speaker, that is C for job counselor, M for mother, and I for interpreter.

Transcription is inherently a selective process reflecting theoretical goals and therefore rarely an objective act (Ochs 1979:44). Central to transcribing is thus being reflexive and aware of the consequences that transcription has on spoken discourse, especially in terms of the written language bias which is reflected in the assumption that written language can represent speech. The choice of what should be represented in transcription is guided by the inquiry's analytical focus (Linell 2009). Transcriptions were reviewed and compared by the author and together with disfluencies previously annotated in BeGaze 6.3 were reapplied in transcriptions in EXMARaLDA (Schmidt and Wörner 2014), an annotation tool that allows for time aligned transcription of audio and video. The view of the EXMARaLDA interface is shown in figure 8.

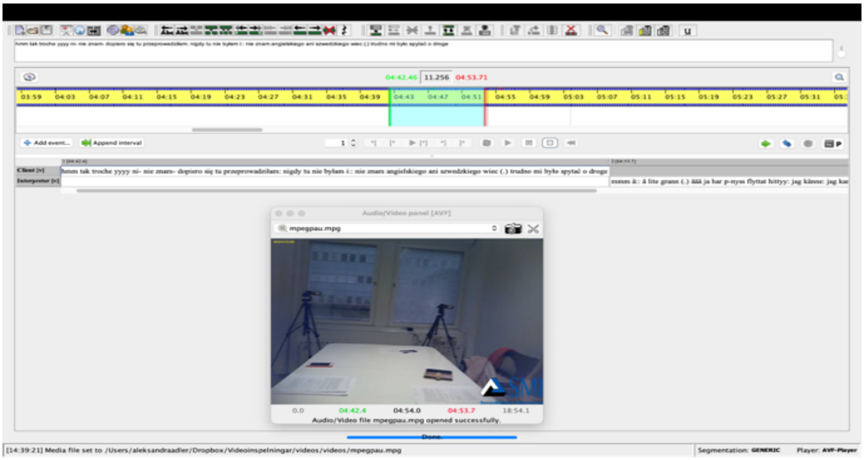

Figure 8 EXMARaLDA interface

The transcription used in this work follows a simplified version of conventions generally adopted in Conversation Analysis (Linell 2009:465–466) and can be found in appendix 4. Despite not being analyzed, silent pauses longer than 100 ms were annotated to provide the readers with a transcription that is closest to the actual spoken discourse. Translations into English adhere as much as possible to the Swedish and Polish originals, together with deviations in grammar and non-idiomatic expressions or incongruencies.

The second part of the annotation procedure draws on the conventions proposed by Crible (2016), Crible et al. (2016), and Crible and Degand (2019), such that disfluencies were annotated at word level and the annotation did not explicitly define the *reparandum* or the *reparans* in disfluency sequences (see section 2.4).

Disfluency types were manually labeled in the transcriptions by the author alone since coding on this level of granularity required proficiency in Polish. Coding was conducted building on the disfluency types distinguished by Lickley (2015) as described in section 2.4.3. In case of any disambiguation, the author resorted to the audio recordings and relied on subjective judgement (Lickley 2017:375). Table 5 accounts for the coding labels used during the qualitative annotation of disfluencies in the Polish sample alone.

Table 5 Disfluency types and coding labels

Disfluency type	**Label**
filled pause	FIL
prolongation	PRO
repetition	RET
repair	REP
other editing term	OET

3.3.2 Qualitative analysis

Disfluencies in the Polish sample were also analyzed qualitatively to complement and the quantitative results. The complementary qualitative analysis of disfluencies in the utterances of the Polish dialogue interpreters was conducted to shed light on the potential reasons behind cognitive load in dialogue interpreting. For that purpose, rich points were inserted in the role play and coupled turns in the analyzed rich points were used. The two tools of data elicitation and analysis are defined and described in the two sections that follow.

3.3.2.1 Rich points

Rich points are defined as "specific source-text segments that contain "prototypical" translation problems, i.e., the most salient, characteristic, and difficult problems in a text" (PACTE 2011:322; cf. "problem triggers" in Gile 1999:157). In research in dialogue interpreting, rich points have been used to investigate strategies dialogue interpreters employ when faced with interactional challenges (Arumí Ribas and Vargas-Urpi 2017), self-regulation problems (Herring 2018) or cognitive constraints (Tiselius and Englund Dimitrova 2021). The rich points used in this study were chosen from those devised and incorporated in the original role play manuscript by Tiselius and Englund Dimitrova (2021). The lines of the newly arrived immigrant in the original Swedish script were translated into Polish by the author. The rich points chosen in the present study, correspond to long discourse segments in the manuscript, in either L1 or L2, intended to be delivered by the actors playing the parties in the role play. The aim of these long stretches of talk was to elicit higher cognitive load for the interpreters who, as a result, were expected to address it or react in a way that would indicate that they experienced cognitive load. The interpreters' response to the increased cognitive load could possibly manifest itself in a number of ways, for example through increase in disfluencies, changes in blinking modulation, or through interrupting the interlocutor or "chunking" (Davitti 2018:14; cf. Goldman-Eisler 1972:128 and Seeber 2011:193) the input into several units. All six rich points chosen for analysis can be found in appendix 5. For the qualitative analyses of disfluency markers in the Polish interpreters' utterances, only six rich points were addressed in the manuscript.[38] The first three of the rich points chosen were operationalized as long stretches of talk to be delivered in Swedish by the actor playing service provider, and the remaining three rich points were operationalized as long stretches of talk to be delivered in Polish by the actors playing service users. Altogether, interpreter utterances that were the result of the twenty-four (*n*=24) rich points were analyzed (six per

[38] Out of total of 71 rich points inserted in the role play by Tiselius and Englund Dimitrova who authored the manuscript in preparing for the study.

interpreter, three in Polish and three in Swedish). To account for potential effects of fatigue due to time spent on interpreting the role play, rich points were also selected based on their occurrence in the manuscript, that is two from the beginning, two from the middle, and two from the end of the manuscript.

3.3.2.2 Coupled turn

Following Geiger Poignant (2020) and Tiselius and Englund Dimitrova (2021) the present study takes advantage of the *coupled turn* (Poignant and Wadensjö 2020:3) that is the segment from the onset of the original turn and until the end of its subsequent rendition, which is "a united and adjacent pair".[39] Central to Tiselius and Englund Dimitrova's study (2020:329) is the idea that the analysis of coupled turns can give an indication of interpreters' *processing span*, that is their cognitive capacity at a micro-level. The coupled turns' textual and temporal properties are expected to change as a result of the rich points inserted in the role play manuscript. Based on these assumptions, the cognitive load of the four Polish interpreters was investigated within the boundaries of coupled turns identified in the transcriptions. Given that the focus of the present study is on the interpreters' disfluencies, only the rendition segments of the coupled pair were analyzed. Figure 9 shows an example of a transcribed coupled turn (the Swedish source utterance and its Polish rendition). The presented example is the first coupled turn from the rich point number six transcribed from the recording of an experienced Polish interpreter. The English translation is provided under the example.

```
1  (119)  C:  Nej jag ska bara förberedda det här lite:
              No I'm just going to prepare this a little

2             gällande barnomsorg
              regarding childcare

3             till nästa gång (.) för.
              for next time (.) be-

4             [att (.) m: m:].
              [cause (.) uhm: uhm:]

5  (120)  I: [e: przygotuję] tylko y: m:
              uhm: I will only prepare u:h uhm:

6             dokumenty wy: w związku z dziećmi na
              documents re: regarding children

7             następny raz
              for next time
```

Figure 9 Transcribed coupled turn. Swedish original utterance and its subsequent Polish interpretation.

[39] Cf. *adjacency pair* in Schegloff and Sacks (1973:295).

3.3.3 Identification and measurement of interpreters' blinks

Data preprocessing and extraction of eye movement events was conducted with the use of SMI BeGaze 3.6 software. The eye-tracker event detection algorithm (Holmqvist et al. 2021:28) processed and segmented the recorded binocular signal into labeled, meaningful units or eye events (e.g., fixation, saccade or blink) that were subsequently output as raw data. The raw data contained time stamps in milliseconds corresponding to onset, offset, and duration of eye events. Further, only data registered as blinks were saved, all other eye events were removed. The next step involved removing noise that the eye-tracker erroneously identified as blinks. First, samples with tracking ratio[40] below 85% were interpreted as insufficient and removed from analyses. Since no established standards for spontaneous blink extraction from eye-tracking data exist, blink duration boundaries have not been systematically employed or reported in the literature (Hollander and Huette 2022:2). Therefore, setting appropriate cut-off values and accurate data cleaning is necessary. It is well documented that the average duration of a blink in healthy humans is approximately 250 milliseconds (McMonnies 2010:202). This value was used as guideline in setting upper and lower blink thresholds. Several lines of evidence show that including blinks with durations below 80 milliseconds greatly increases the probability of including signal noise in the analyses (Holmqvist et al. 2011; Hollander and Huette 2022). When it comes to upper cut-off points, blinks with durations above the average blink duration may potentially be voluntary. Consequently, blinks with durations over 250 milliseconds and under 100 milliseconds were not taken under consideration in the present study. It is noteworthy, that the decision to exclude blinks longer than 250 milliseconds was made with consideration of its possible drawbacks. Since eye closures for an extended amount of time may help reduce cognitive load or trigger memory (Vredeveldt et al. 2011:1254; Tiselius and Sneed 2020:781) they are potentially interesting to this study. However, as prolonged blinks are executed by choice, they could not be considered in the analyses of spontaneous blinking.

After blink data were extracted and cleaned by the author, they were subsequently labeled according to interpreting phase and interpreting direction in which they occurred. In other words, blinks that occurred during speaking L1, were labeled blink SL1, blink LL1 for listening L1, blink SL2 and blink LL2 for speaking L2 and listening L2, respectively.

Blink rates for each interpreting phase, direction and participant were calculated by dividing the number of blinks by the time spent in each interpreting phase and interpreting direction. Additionally, in anticipation of

[40] Tracking ratio is commonly operationalized as the proportion of samples registered by the eye-tracker as signal. Consequently, the tracking ratio of 85% represents a data loss of 15%.

analyses, blinks that occurred during the entire interpreting encounter were labeled as belonging to the *interpreting condition*. Blink rates in interpreting condition were calculated for each participant by dividing the number of blinks by the time spent in the entire role play. To obtain baseline blink measures, the three first minutes of each recording before the start of the experiment were considered. In other words, the time after eye-tracking glasses calibration procedures were completed and the participant was sitting in the experiment room, either silently or chatting with the present actors. Baseline measures were calculated over the time period before the role play.

BRV was operationalized as the standard deviation of the intervals between consecutive blinks. Prior to estimating BRV, the periods between consecutive blinks were calculated as series of inter-blink intervals. Inter-blink intervals were measured in milliseconds from the offset of one blink to the onset of the consecutive blink. Contrary to blink rate, BRV was only measured in the baseline and interpreting conditions as the basis of its calculation are consecutive intervals between blinks. In cases, where participants' speaking or listening phases were either short or when participants blinked once during a particular phase, calculating BRV values would have rendered unreliable values. Figure 10 presents a schematic overview of the blink data preparation process.

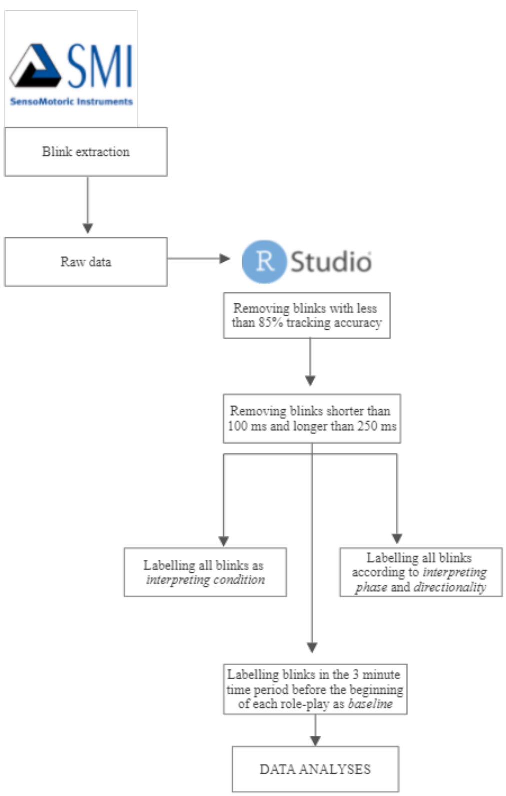

Figure 10 Eye-tracking data preparation process

3.3.3.1 Blink measures

Previous research on blink measures used in the present study is described in sections 2.5.2.1 and 2.5.2.2. Blink rate is defined as the number of spontaneous blinks per minute. Blink rate is calculated in baseline, entire interpreting condition and across all interpreting phases and directions. BRV is defined as the standard deviation of consecutive inter-blink intervals measured in milliseconds. BRV is calculated in baseline and the entire interpreting condition.

3.4 Summary of the methodological framework

Methodological approach in the present dissertation can be summarized as explorative multi- and mixed-methods study of dialogue interpreters' cognitive load. Further, the empirical inquiry is complemented by method investigation, whereby blinking is explored as possibly sensitive to changes in of cognitive load in dialogue interpreting. Together, blink measures and disfluencies constitute an instrument of analysis that lends itself to exploration of interpreters' local cognitive load in real time adopting a microcognitive approach (Muñoz Martín and Martín de León 2020:57). Furthermore, using the same measures, the interpreters' cognitive load can be explored globally during a specific interpreting phase or interpreting direction, as well as during the interpreting task as a whole.

As previously mentioned, research questions are addressed using both quantitative and qualitative data analysis methods, and different priority is given to the respective strands. To reiterate, the qualitative methods are used as a complement to gain a clearer understanding of the quantitative findings. The different data elicitation methods together with their descriptions, type of analysis and corresponding research question are presented in table 6.

Table 6 Summary of the methods used in the study

Elicitation material	Elicitation method	Data	Method of analysis (QUAN-qual)[41]	Final representation	RQs
Role play	Coding in the audio recording *Qualitative*	Disfluency data (all 17 participants)	Statistical analyses	Disfluency rate, duration and count	1,5
Role play	Eye-tracking *Quasi-experimental*	Raw eye-tracking data (all 17 participants)	Statistical analyses	Blink rates, BRV	2,3,4,5

[41] Primarily quantitative method but uses some qualitative data collection and analysis.

Rich points (in the role play manuscript)	Transcription of coupled turns in the four (*n*=4) Polish interpreters' recordings *Qualitative*	Transcripts of coupled turns in MS Word and EXMARaLDA	Coding and qualitative analysis of disfluencies in the Polish interpreters' utterances	Disfluency types (filled pauses, repetitions, repairs)	6

3.4.1 Study design and variables

The study design of disfluency analyses (table 7) were 2 (experience: experienced, inexperienced interpreters) by 2 (directionality: L1, L2) with experience as a between-subject factor and directionality as within-subject factor. Disfluency durations (ms), disfluency count and disfluency rate (per minute) were used as dependent variables.

Table 7 Sudy design of disfluency analyses (2x2)

Directionality	**Level of experience**	
	inexperienced	experienced
L1	10	7
L2	10	7

The first study design (table 8) of blink rate analysis was 2 (group: experienced and inexperienced interpreters) by 2 (condition: baseline, interpreting).

Table 8 Study design 1 for the analysis of blink rate (2x2)

Condition	**Level of experience**	
	inexperienced	experienced
Baseline	10	7
Interpreting	10	7

The second study design (table 9) of blink rate analysis was 2 (experience: experienced and inexperienced interpreters) by 2 (interpreting phase: listening, speaking) by 2 (directionality: L1, L2), with experience as a between-subject factor and interpreting phase and directionality as within-subject factors, and blink rate (blinks/min) as a dependent variable. Baseline condition was used as reference.

Table 9 Study design 2 for the analysis of blink rate (2x2x2)

Interpreting phase and directionality	**Level of experience**	
	inexperienced	experienced
Reference: Baseline	10	7
Listening L1	10	7
Speaking L2	10	7
Listening L2	10	7
Speaking L1	10	7

The study design (table 10) of BRV analysis was 2 (group: experienced and inexperienced interpreters) by 2 (condition: baseline, interpreting).

Table 10 Study design for the analysis of BRV (2x2)

Condition	**Level of experience**	
	inexperienced	experienced
Baseline	10	7
Interpreting	10	7

All statistical analyses of both disfluency and blink data were conducted in R (R Core team 2021) and RStudio Version 2022.07.2.576 (RStudio Team 2022) using packages rstatix (Kassambara 2021), lme4 (Bates et al. 2015), lmerTest (Kuznetsova et al. 2017) ggplot2 (Wickham 2016), lubridate (Grolemund and Wickham 2023), optimx (Nash and Varadhan 2022), performance (Lüdecke et al. 2022), psych (Revelle 2023) and emmeans (Lenth et al. 2023).

4 Results

The following chapter presents results of quantitative analyses and qualitative analyses. First, sections 4.1, 4.2 and 4.3 report the results of quantitative analyses conducted on the sample of all seventeen (n=17) participants. Next, the supplementary qualitative analyses of disfluencies conducted on the data of four interpreters with Polish as L1 (n=4) are accounted for in section 4.4. Each section in the chapter is devoted to answering one research question, such that the proposed hypotheses are examined against the results.

4.1 Effects of experience and directionality on cognitive load of dialogue interpreters

The first research question was posed to determine whether there was a difference in cognitive load between experienced interpreters and inexperienced interpreters and depending on interpreting direction. Since cognitive load was operationalized with disfluency measures, the following three hypotheses regarding disfluency durations, rates and counts were tested:

a. Disfluency durations (ms) will be different across groups and interpreting directions
b. Disfluency counts will be different across groups and interpreting directions
c. Disfluency rates (per minute) will be different across groups and interpreting directions

Longer disfluency durations, more disfluency occurrences as well as higher disfluency rates were interpreted as an increase in cognitive load.

First, means and standard deviations for the three disfluency measures are reported in table 11 by interpreting direction and group.

Table 11 Mean disfluency durations (ms), counts and rates (per minute) by group and directionality. Standard deviations are shown in parentheses.

Measure	**Interpreting direction**	**Experienced (*n*=7)**	**Inexperienced (*n*=10)**
Disfluency durations	L1	1684 (440)	2619 (333)
	L2	1722 (374)	2788 (523)
Disfluency counts	L1	32.14 (19)	36.7 (10.9)
	L2	31.28 (8.86)	50 (22.89)
Disfluency rates	L1	9 (2)	11(2)
	L2	9 (1)	10 (3)

In order to test the first hypothesis, a linear mixed-effects model was fitted on disfluency duration scores. Two of the participants were identified as outliers with long mean disfluency durations, but because outlier removal did not change the results, their data were not excluded from the analyses. Next, directionality (L1, L2) and experience (experienced, inexperienced) were set as fixed effects, and participants (*n*=17) were set as random intercepts. The model was overall significant (β=7.28, *SE*=.10, $t[27]$=69.86, p<.001, η_p^2=-.74). The analysis showed a robust effect of experience on disfluency durations (β=.27, *SE*=.10, $t[17]$=2.30, p=.035, η_p^2=.73). Inexperienced interpreters exhibited significantly longer disfluency durations (*Mean*=2347 ms, *S*=1283 ms) compared to experienced interpreters (*Mean*=1689 ms, *SD*=426 ms). Further, both groups demonstrated a significant effect of directionality on disfluency durations (β=.23, *SE*=.10, $t[17]$=2.27, p=.037, η_p^2=-.63). The effect of directionality was such that disfluencies were much likely to be longer in L2. The results are plotted in figure 11.

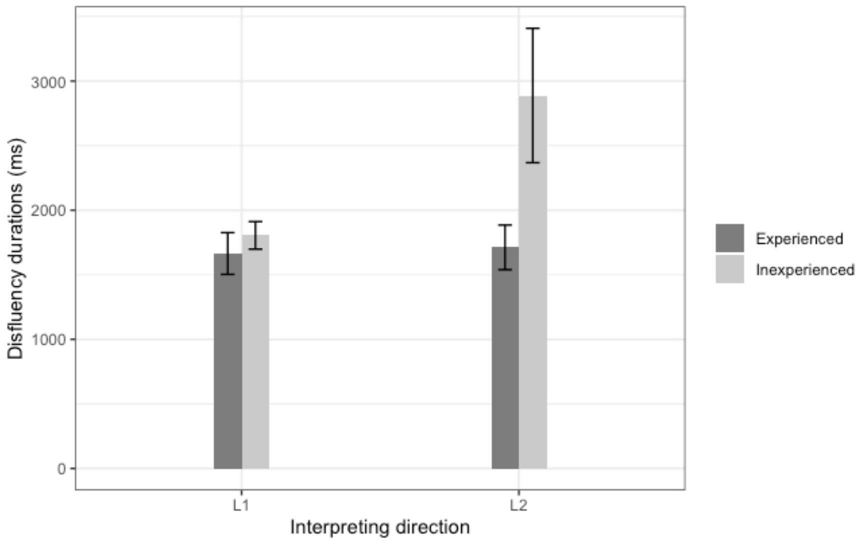

Figure 11 Disfluency durations for all participants (n=17) by interpreting direction and group. Error bars show the standard errors of the mean.

Thus, the first hypothesis was corroborated – *there was a difference in disfluency durations between groups and between interpreting directions*. Inexperienced interpreters demonstrated longer disfluency durations compared to experienced interpreters and longer disfluencies were more likely to be produced in L2.

To further explore the relationship between cognitive load and directionality, a simple linear regression was calculated on disfluency durations and time spent on interpreting the encounter. Overall, interpreting time predicted disfluency duration increase by 196 milliseconds for every minute of interpreting ($F[1,15]=12.13$, $p=.003$, $R^2=.447$). In L1, a significant regression equation was found ($F[1,15]=9.57$, $p=.007$) with an R^2 of .389. Interpreters' predicted disfluency durations in L1 increased 166.8 milliseconds for each minute of interpreting into L1. Similarly, for L2, a significant regression equation was found ($F[1,15]=10.59$, $p=.005$), with an R^2 of .41. In other words, interpreters' predicted disfluency durations in L2 increased by 365 milliseconds for each minute of interpreting into L2. Thus, the larger increase in disfluency durations in speaking L2 as compared to speaking L1 further supports the first hypothesis. Figure 12 illustrates the relationship between interpreting time and disfluency durations.

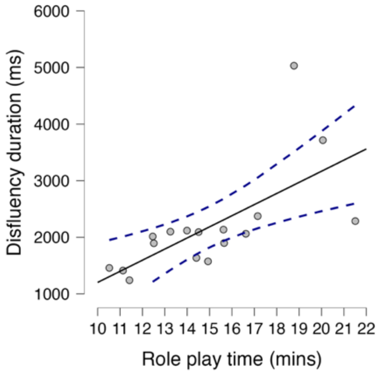

Figure 12 The relationship between disfluency duration (in ms) and time spent interpreting the encounter for all participants (n=17) in both interpreting directions. The line represents the line of best fit and the gray area shows the 95 percent confidence interval

The second hypothesis stated that disfluency counts will be different across groups and interpreting directions. A mixed-effects ANOVA with directionality (L1, L2) as a within-subjects factor and experience (experienced, inexperienced) as a between-subjects factor revealed main effect of experience (F[1,15]=4.95, p=.042, η_p^2=.12) but no effect of directionality on the number of disfluencies (F[1,15]=.53, p=.478, η_p^2=.021). Also, there was no interaction effect of experience and directionality (F[1,15]=4.38, p=.182, η_p^2=.072). The second hypothesis was partially confirmed – experienced interpreters produced significantly fewer disfluencies than inexperienced interpreters. However, directionality did not have a significant effect on the number of disfluencies. Figure 13 shows disfluency counts by group and directionality.

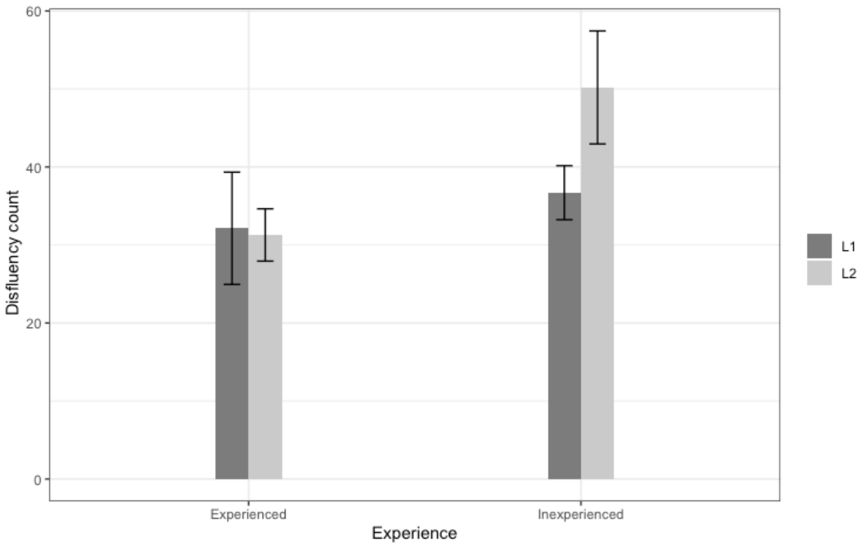

Figure 13 Disfluency counts by group and directionality for all participants (n=17). Error bars show the standard errors of the mean.

Similar to disfluency duration, disfluency counts were also explored in terms of their relationship to the time spent on role play. A linear regression analysis was conducted and revealed that the time spent on interpreting role play predicted 77% of disfluency counts, (F[1,15]=50.140, p<.001, R^2=.77). Figure 14 shows the relationship of disfluency counts and times spent interpreting.

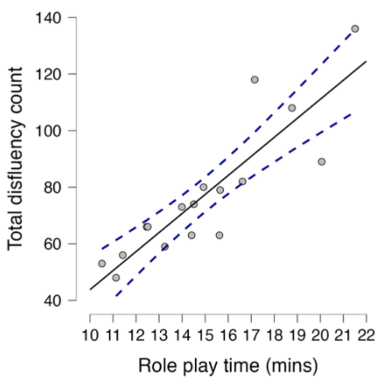

Figure 14 The relationship between disfluency counts and time spent interpreting the encounter for all participants (n=17) in both interpreting directions. The line represents the line of best fit and the gray area shows the 95 percent confidence interval

Disfluency rates were analyzed to address the third hypothesis that stated *that disfluency rates will be different across groups and interpreting directions.*

A linear mixed-effects model with directionality (L1, L2) and experience (experienced, inexperienced) as fixed factors and participants (n=17) as random intercepts was fitted on the scores of disfluency rates. The model, which was overall significant (β=9.16, *SE*=.69, *t*[31.9]=13.31, *p*<.001, η_p^2=-.34) demonstrated a robust effect of experience (β=2.45, SE=.90, *t*[31.9]=2.73, *p*=.010, η_p^2=1.13), with inexperienced interpreters likely to exhibit higher disfluency rates. Directionality had no effect (β=-.14, *SE*=.84, *t*[17]=-.16, *p*=.874, η_p^2=-.06) on disfluency rates. There was also an observable interaction effect between experience and directionality, although it was not significant (*t*[17]=-1.96, *p*=.067, η_p^2=-.99). Figure 15 shows disfluency rates plotted across groups and for each interpreting direction.

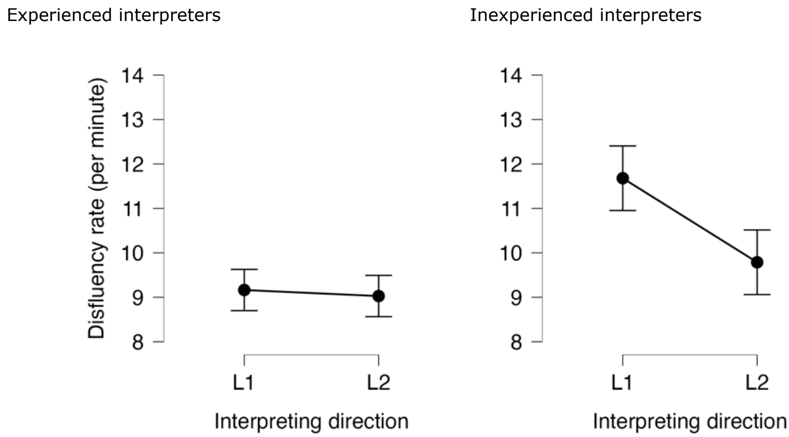

Figure 15 Disfluency rates in each interpreting direction by experience. Error bars show the standard errors of the mean.

The third hypothesis was thus partially confirmed. Overall, all disfluency measures were affected by the level of experience, with inexperienced interpreters demonstrating longer and more disfluencies and higher disfluency rates. Directionality had an effect on disfluency durations, with longer disfluencies more likely to occur in L2. To conclude, the results suggest that cognitive load in dialogue interpreting is likely to be affected by the level of experience, whereas directionality affected only one of the three measures of cognitive load.

Additionally, to confirm the robustness of the selected disfluency measures, and to resolve the issue of directionality, all three disfluency measures were analyzed using a multivariate test. Disfluency data were standardized by calculating their *z*-scores and then a multivariate multiple regression was computed. The analysis yielded qualitatively similar results to the ones reported for each separate disfluency measure. Results showed that 16.6% of the variance in cognitive load was predicted by both experience and directionality collectively, F(4,97)=4.82, *p*=.001, R^2=.166. Looking at the unique contribution of the two predictors, experience was found to be the highest predictor of increase in cognitive load (t=3.47, p<.001), followed by directionality (t=2.68, p=.009). The results suggest, as previously reported, that inexperienced interpreters were likely to experience higher cognitive load compared to experienced interpreters. The results also demonstrate that cognitive load was likely to increase during interpreting into L2, which indicates that directionality had an effect on cognitive load of dialogue interpreters.

The first research question that was posed inquired *whether there was a difference in cognitive load between groups and interpreting directions*. The assumption that there would be a difference between interpreters depending on experience was supported by the results. The assumption that interpreting direction would influence interpreters' cognitive load was partially supported by the individual analyses but was later confirmed by the multivariate analysis.

4.2 Effects of experience, interpreting phase, and directionality on blink measures of dialogue interpreters

The second research question was posed to determine whether there is a difference in blink rates between interpreting and non-interpreting, and if so whether interpreting phase, directionality, and experience will have an effect on blink rates. The following three hypotheses regarding blink rates were tested:

a. Blink rates will be different depending on interpreting phase
b. Blink rates will be different depending on interpreting experience
c. Blink rates will be different depending on interpreter direction

First, descriptive results of blink rate data are presented. Mean blink rates (blinks per minute) in baseline and across the two interpreting phases and two interpreting directions are shown in table 12.

Table 12 Average blink rates per interpreting phase and direction by experience for all participants (n=17). Standard deviations are reported in parentheses.

	Baseline	Listening		Speaking	
		L1	L2	L1	L2
Experienced	25 (19)	25 (21)	24 (17)	28 (18)	26 (22)
Inexperienced	13 (13)	17 (19)	20 (17)	19 (15)	20 (18)

Second, to test the first hypothesis *whether there is a significant difference in blink rates during interpreting in relation to baseline*, the two conditions were compared. Since the sample size did not meet the guidelines for parametric tests and blink rate data were not normally distributed[42], a non-parametric Wilcoxon signed rank test was used to compare blink rates in the two conditions. The analysis revealed a significant difference in blink rates between baseline and interpreting condition. (Wilcoxon W=101, Z=-2.98, p=.0028, r^2=-.91). Blink rates in interpreting condition were higher than in the baseline condition by a mean difference of 5 blinks per minute. The results are plotted in figure 16.

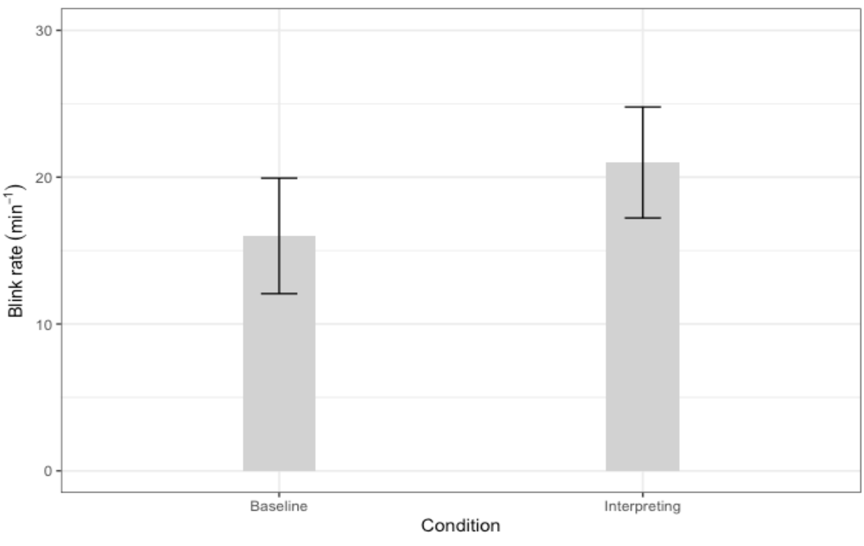

Figure 16 Blink rates (blink/min) during baseline and interpreting condition for all participants (n=17). Error bars show the standard errors of the mean.

[42] In the present study, normality of data was always assessed using the visual method by plotting histograms to assess the formation of a bell-shaped curve via the frequency distribution. Mellinger and Hanson (2017:60) caution against statistical testing of normality as it has been shown to inflate error.

To address the three remaining hypotheses, blink rate data during interpreting were first split by interpreting phase (speaking, listening) and directionality (L1, L2) (see section 3.3.3). As a next step, linear mixed-effects model was fitted to test whether the interpreting phase, directionality, and interpreter experience had an effect on blink rate. The model included random intercepts by interpreter (*n*=17) together with interpreting phase and directionality (speaking L1, speaking L2, listening L1, listening L2) and the two levels of experience (experienced, inexperienced).[43] Baseline was added to the model as reference level, so that the effect of each interpreting phase and interpreting direction would be tested relative to the baseline condition. The model, which was overall significant (β=20.60, *SE*=6.53, *t*[18.9]=3.4, *p*=.003, η_p^2=-.04) showed a significant effect of speaking phase on blink rate: both in L1 (β=8.12, *SE*=2.23, *t*[68]=3.65, *p*<.001, η_p^2=.47) and in L2 (β=5.22, *SE*=2.3, *t*[68]=2.35, *p*=.02, η_p^2=.30). Blink rates were significantly higher during both speaking phases than during the baseline condition.

Moreover, interpreters demonstrated lower blink rates in speaking L2 (*Mean*=21 blink/min) compared to speaking L1(*Mean*=24 blink/min), but the difference was not significant (*p*=.19). Similarly, in listening phases, results demonstrated significant effects on blink rate in L1 (β=6.53, *SE*=2.3, *t*[68]=2.94, *p*=.005, η_p^2=.38) and in L2 (β=5.66, *SE*=2.3, *t*[68]=2.3, *p*=.013, η_p^2=.33). This indicates that blink rates during both listening phases were likely to be significantly higher than blink rates in baseline condition. Also, listening phase in L2 exhibited lower blink rates (*Mean*=21 blink/min) than in listening L1 (*Mean*=22 blink/min), however the difference was not significant (*p*=.66).

Overall, in terms of blink rates, both speaking and listening phases and both interpreting directions were significantly different from the baseline condition. Whereas blink rates were not significantly different in the two interpreting directions, there were observable differences. Numerically, blink rates in L2 were lower (*Mean*=21 blinks/min) than in L1 (*Mean*=23 blinks/min).

The first hypothesis – *whether there is a significant difference in blink rates during interpreting in relation to baseline* – was confirmed. The second hypothesis – *that blink rates will be different depending on interpreting phase* – was not confirmed. Blink rates in each of the interpreting phases were significantly different from baseline, but there was no significant difference between blink rates in either the speaking phase or the listening phase. In terms of experience, the model revealed no effect on blink rates (β=-7.91, *SE*=7.67, *t*[17]=-1.03, *p*=.317, η_p^2=-.46). Thus, the third hypothesis – *that blink rates*

[43] A note on model selection. Since the effect of age on blink rate is unclear and the existing results are inconclusive, two models (with and without age as a fixed factor) were compared by running an ANOVA. The addition of age did not result in a significantly better fit (χ^2[1,2]=2.42, *p*<.12) therefore the model without age was selected.

will be different depending on interpreter experience was not confirmed statistically. The results are plotted in figure 17.

Regarding the fourth hypothesis – *that blink rates will be different depending on interpreting directionality* – it was not confirmed. Directionality did not have an effect on blink rates – there were no differences in blink rates between the two interpreting directions.

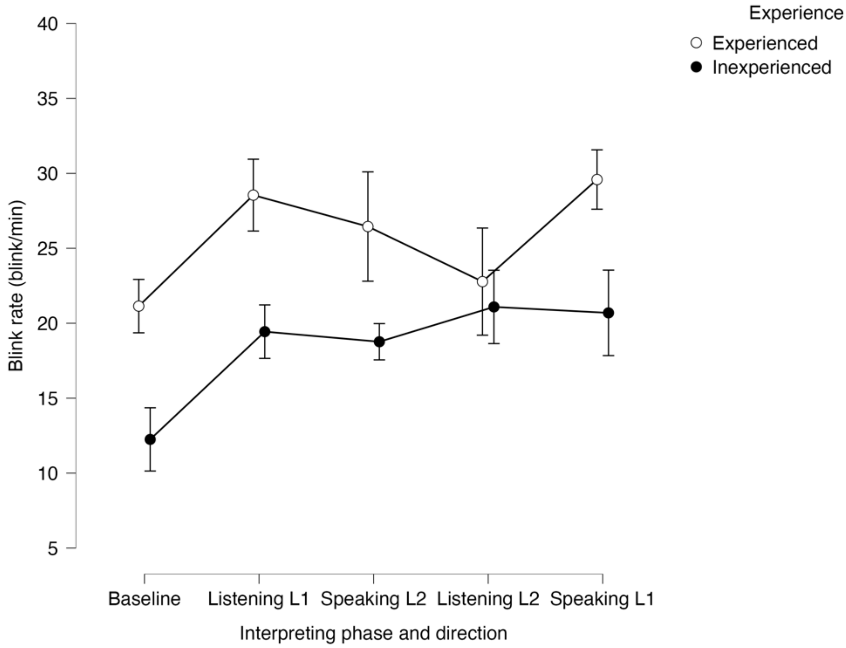

Figure 17 Average blink rates per interpreting phase, directionality and by group for all participants (n=17). Error bars show the standard errors of the mean.

Blink rates were also plotted by interpreting direction and phase, as shown in figure 18 in order to visualize the difference despite it not being significant. The figure shows how blink rates were likely to increase during interpreting from L2 into L1 (left plot) and how they were likely to decrease during interpreting from L1 into L2 (right plot).

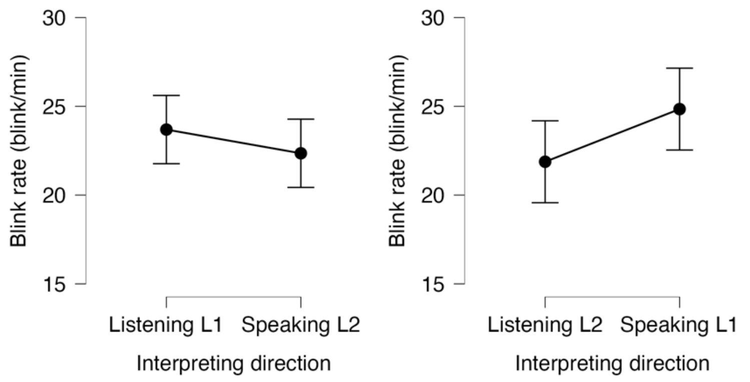

Figure 18 Blink rates in interpreting phases for all participants (n=17) averaged across experience. Interpreters' blink rates were likely to increase when interpreting into L1 and decrease when interpreting into L2. Error bars show the standard errors of the mean.

Examining the relationship between blink rates and time spent on interpreting role-plays could potentially grant more insight into the differences in blink rate between interpreting conditions. Hence, a Pearson's correlation analysis was computed. The analysis revealed an observable negative correlation between the two variables, although non-significant (r[15]=-0.409, p=.052). In other words, blink rates were likely to decrease with increasing interpreting time, but it was not confirmed statistically. The between-groups difference in mean times spent in each interpreting condition is shown in figure 19.

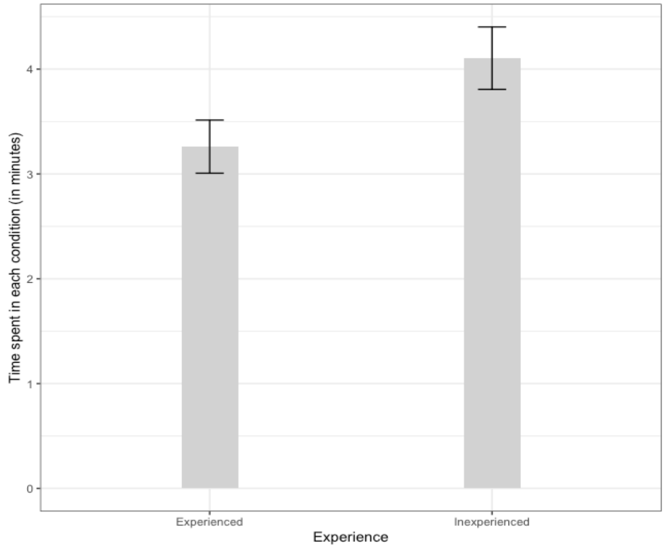

Figure 19 Average times spent in interpreting condition by experience for all participants (n=17). Error bars show the standard errors of the mean.

As the next step, answer research question three whether *interpreting will have an effect on BRV* and question four whether *there is a difference in BRV between groups,* BRV was analyzed. It was hypothesized that *interpreting will have an effect on BRV* and that there is *a difference in BRV between groups*. Data of three participants in baseline were identified as extreme outliers. Since the participants in question blinked only once during baseline, there were no consecutive blinks to calculate intervals with. As a result, the standard deviation was zero. Hence, their BRV data were removed from analyses. Data of the remaining fourteen participants (n=14) were analyzed with a mixed-effects two-way ANOVA with condition (baseline, interpreting) as a within-subjects factor and experience (experienced, inexperienced) as a between-subjects factor. The analysis revealed a main effect of condition on BRV (F[1,12]=5.25, p=.041, η_p^2=.30), such that there was less variability in blink rates during interpreting condition (*Mean*=3.6, *SD*=2.3) than in the baseline condition (*Mean*=4.7, *SD*=3.4). There was no main effect of experience (p=.456) and no interaction effect between experience and condition (p=.903).

Result of the analysis of BRV further confirm the hypothesis that *interpreting has an effect on BRV*. Comparable to results of blink rate analyses, the BRV results failed to corroborate the hypothesis that *there is a difference in BRV between experienced and inexperienced interpreters*. Figure 20 shows the difference in BRV between baseline and interpreting condition averaged across groups and for fourteen participants (n=14).

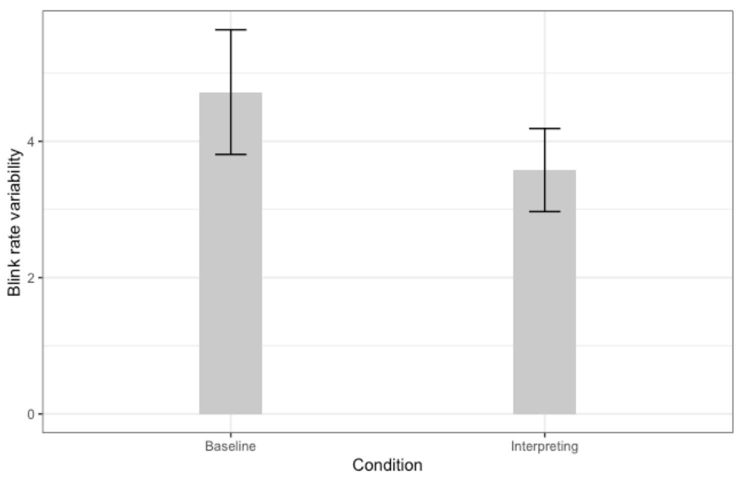

Figure 20 BRV by condition averaged over experience. Error bars show the standard errors of the mean. The plot shows data without outliers (n=14).

In conclusion, the results of analyses of the two blink measures – blink rate and BRV – have equally shown that *interpreting has an effect on blink rates and BRV in dialogue interpreters, whereas experience and directionality do* *not*. For ease of exposition, the summary of all eye-tracking results is presented in table 13.

Table 13 Statistical significance and effect sizes of the eye-tracking results

Measure	Test	Effects		p	η_p^2
Blink rate	Wilcoxon	Condition:	baseline < interpreting	.0028	1.04†
	LMM††	Condition:	baseline < speaking L1	<.001	.47
			baseline < speaking L2	.020	.30
			baseline < listening L1	.005	.38
			baseline < listening L2	.013	.33
		Experience:	experienced > inexperienced	.317	.46
BRV	2x2 repeated measures ANOVA	Condition:	baseline > interpreting	.041	.30
		Experience:	experienced > inexperienced	.456	.047

Note. †Effect size was converted from r=-.92. ††LMM – Mixed-effects model

4.3 The relationship between cognitive load and blink measures

In order to address the question whether there is a relationship between cognitive load and blink-based measures in dialogue interpreting (RQ5), one hypothesis was tested. The hypothesis stated that *there will be a quantifiable relationship between blink measures and disfluency measures*. Both linear regressions and correlation coefficients were calculated on disfluency and blink measures.

Before analyses, the z-scores of all three disfluency measures were collapsed into a single variable that corresponded to cognitive load. Then, blink rate data were z-score transformed. Results demonstrated that 5.8% of variation in total blink rate was significantly predicted by cognitive load, $F(1,100)=6.209$, $p=.014$, $R^2=.058$. Further, a test of the Pearson correlation coefficient revealed a significant result $r(100)=-.242$, $p=.014$ suggesting a negative relationship between cognitive load and total blink rates. In other words, blink rate was likely to decrease with increasing cognitive load.

As the next step, the relationship between BRV and cognitive load was analyzed. Data from fourteen participants ($n=14$) were used in the analysis of BRV (see section 4.2). Prior to analysis BRV data in the interpreting condition were z-score transformed. As a next step, linear regression was calculated. Results showed that 10.8% of the variation in BRV was significantly predicted by cognitive load, $F(1,76)=9.231$, $p=.003$, $R^2=.108$. Further a Pearson's correlation analysis demonstrated positive relationship between BRV and cognitive load, $r(76)=.329$, $p=.003$. The relationships between cognitive load and the two blink measures are plotted in figure 21.

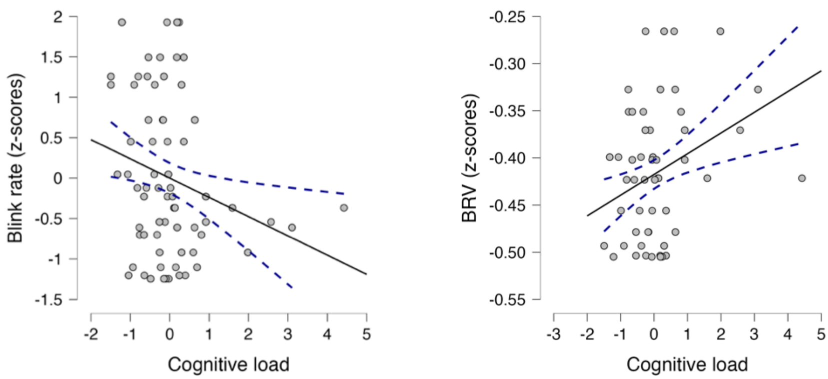

Figure 21 Scatterplots of the relationship between cognitive load and blink measures. The left graph illustrates the relationship between cognitive load and blink rate (n=17). The right graph illustrates the relationship between cognitive load and BRV (n=14). The dashed lines represent the 95% confidence intervals.

To account for any potential effects of interpreting phase, linear regressions and correlation coefficients were computed for cognitive load and blink rates in listening and in speaking phases separately.

Regarding blink rate in listening, results of a linear regression test revealed that blink rate during listening was not significantly predicted by cognitive load, $F(1,100)=1.542$, $p=.217$, $R^2=.015$, whereas a test of the Spearman correlation coefficient revealed a significant result ($r[100]=-.166$, $p=.047$) suggesting a weak negative relationship between cognitive load and blink rates in listening.

When it comes to the speaking phase, a linear regression test exhibited non-significant results $F(1,100)=1.043$, $p=.310$, $R^2=.010$. Similarly, there was no significant correlation between blink rates in the speaking phase and cognitive load ($r[100]=.157$, $p=.058$).

The hypothesis – *that there will be a quantifiable relationship between blink measures and cognitive load* was only partially confirmed.

There was a negative relationship between the interpreters' blink rates during the entire interpreted encounter and their cognitive load, such that blink rates were likely to decrease with increased cognitive load. The relationship between the interpreters' cognitive load and BRV was positive, such that BRV was higher with increased cognitive load. The separate tests of interpreters' blink rates in each interpreting phase and their relationship to interpreters' cognitive load revealed non-significant results, suggesting that interpreting phase had no effect on the relationship between the two variables.

In conclusion, sections 4.1, 4.2, and 4.3 presented results that address the first three research questions. In sum, the results of disfluency analyses revealed the effect of both directionality and experience on disfluency measures (section 4.1). Blink measures analyzed in section 4.2. were influenced by the interpreting condition but showed no sensitivity to interpreting phase, direction, or experience. Finally, section 4.3. reported the analyses of the relationships between cognitive load and blink measures. The analyses revealed a relationship between blink rates, BRV, and cognitive load.

4.4 Types of disfluency in dialogue interpreting

The present section reports a complementary analysis of cognitive load of dialogue interpreters. The analysis was conducted on the utterances of the Polish interpreters that were identified within the same six rich points that for every interpreter were distributed across different coupled turns. The analysis seeks to answer the research question number 6, that is *what are the different types and categories of disfluencies in the Polish interpreters' utterances*?

Only the Polish interpreter group was selected since Polish is the L1 of the author and the analysis of the utterances of the entire group of 17 interpreters extends the scope of this dissertation.

The first part of the analysis quantitatively describes the types and categories of the disfluencies, the second part describes the qualitative differences between disfluencies of the inexperienced and experienced interpreters.

Finally, as already discussed in section 2.1, the analysis is conducted within the framework of cognitive translatology, despite its focus on only two levels of the translation process as defined by Muñoz (2010:178–179). As discussed earlier in section 1.2, the complementary analysis reported here was conducted as a supplement to the quantitative investigation and is not the main focus of the study. The analysis of the Polish data is a complementary method used to gain a clearer understanding of the quantitative findings.

4.4.1 Multifunctionality of disfluency in dialogue interpreting

First, a quantitative summary of disfluency types in the utterances within the coupled turns that occurred during the six rich points is presented in table 14 for each participant. The total time spent in the six rich point encompasses the time of the coupled turns, that is the time from the onset of the original utterances until the offset of the interpreters' renditions.

Table 14 Disfluency types in the analyzed utterances of Polish interpreters (n=4). The total time spent in all six rich points is provided in the last column.

	Hesitations				**Repair**	**Other**	**Total**	**Time (mins)**
	Filled pause		**Repetition**	**Prolongation**				
	Initial	**Mid.**						
exp	1	5	28	1	10	5	50	4.54
exp	11	15	11	7	3	1	48	5.00
inex	7	26	10	2	0	1	46	5.05
inex	7	18	15	7	4	2	53	5.45
total	26	64	64	17	17	9	*Mean* 49	*Mean* 5.01

The disfluency occurrences were not analyzed statistically, since the purpose of the present investigation was to complement the statistical analyses already conducted in section 4.1. The quantitative summary presented in table 14 was deemed sufficient for the purpose of the supplementary analyses reported here.

Overall, the interpreters produced a similar total number of disfluencies within the analyzed utterances (49 disfluencies on average) and the average time of all coupled turns within the selected rich points was five minutes (5.01 mins).

Despite the similar total number of disfluencies, their distribution was heterogenous. However, some tendencies could be observed. For instance, filled pauses were the most common type of disfluency amounting to 90 occurrences in total. They were followed by repetitions with a total of 64 incidences in the analyzed utterances. Repairs and prolongations amounted to 17 occurrences each. Finally, disfluencies of the type "other" occurred only nine (9) times within the analyzed utterances.

The first hypothesis predicted *that inexperienced interpreters will produce more hesitations (filled pauses, prolongations, and repetitions) than experienced interpreters regardless of interpreting direction.*

While there was a numerical difference between the groups such that inexperienced interpreters produced six more hesitations than experienced interpreters, overall both groups produced a similar number of hesitations (see figure 22). It appears that the difference in the number of hesitations depends on one experienced interpreter who produced fewer hesitations (35) than the three remaining interpreters, that produced a similar number of hesitations (45 on average). Therefore, the first hypothesis is rejected.

Given that hesitations were the most common disfluency type to occur in both experienced and inexperienced interpreters' utterances, the dissimilarities are qualitative rather than quantitative. The differences between the two groups in terms of disfluency types are shown in figure 22. Filled pauses, repetitions, and prolongations were collapsed in to one variable to better visualize the hesitation production.

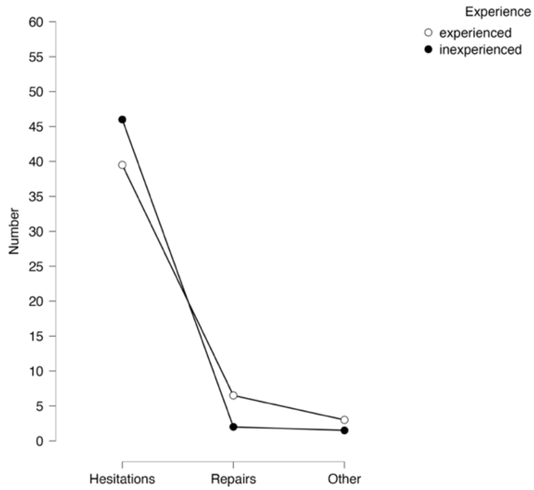

Figure 22 Disfluency types in the utterances of the Polish interpreters

The implementation of the functionally and cognitively oriented disfluency definition (see section 2.4.6) gave origin to three functional context categories in which disfluency appears in dialogue interpreting, that is *cognitive-pragmatic*, *cognitive-monitoring*, and *cognitive-processing*. The context categories were a bottom-up result of the disfluency annotation process. Importantly, none of the context categories imply intentionality of disfluency, only its potential function within its current cognitive context. The central assumption in the present work is that all disfluencies reflect cognitive load. All disfluency context categories are thus by definition cognitive and reflect the context of cognitive load. Depending on the context they appear in, disfluencies may be ascribed different categories simultaneously, in line with the assumptions put forward by the cognitive-functional view of disfluency. Finally, the context categories dovetail with the theoretical construct of cognitive load and consider the influence of interpreter characteristic (experience) and interpreting task and environment characteristic (directionality) as discussed in section. 2.3.1.3.

Disfluencies in the cognitive-pragmatic context category reflect the experienced cognitive load and at the same time can fill pragmatic functions in discourse. A filled pause implying more incoming speech or used in order to hold the floor is a type of disfluency appearing in that context category, as will be shown in the examples provided in section 4.4.1.1.

Cognitive-monitoring category pertains to disfluencies that reflect cognitive load in the context of monitoring as defined in section 2.2.2, that is when interpreters monitor both the interlocutors, as well as themselves. As the qualitative analysis in sections 4.4.1.1 and 4.4.1.2 will reveal, some repetitions and repairs may fit the cognitive-monitoring disfluency category.

Finally, the cognitive-processing context category refers to disfluencies that indicate cognitive load occurring as a result of the impact processes involved in bilingual language processing and reformulation may have on WM. For example, when interpreters struggle with lexical retrieval or are searching for an appropriate term, they are likely to produce a mid-utterance filled pause. Similarly, repetitions and repairs may occur in the context of lexical retrieval and selection. The third context category will be exemplified in sections 4.4.1.1 and 4.4.1.2. The examples presented in the following subsections serve as an illustration of how cognitive load may be reflected in disfluency use.

4.4.1.1 Filled pauses and repetitions

There were qualitative differences between the two groups, as well as individual differences in both filled pause and repetition production. For example, both inexperienced and experienced interpreters produced fewer utterance-initial filled pauses compared to mid-utterance filled pauses. Thus, the second hypothesis, that is *that interpreters will demonstrate more turn-initial filled pauses than mid-utterance filled pauses* was not corroborated.

Both experienced and inexperienced interpreters were more likely to produce filled pauses in the cognitive-processing context category than the cognitive-pragmatic or cognitive-monitoring category. In other words, filled pauses occurred more often in a lexical retrieval context than in an initial utterance planning, monitoring, or in a turn-taking context.

Filled pauses in the context of lexical retrieval occurred as a result of lower lexical familiarity in both L1 or L2, or in the context of lexical selection, when interpreters were searching for a proper term. Filled pauses that indicate cognitive load associated with problems in lexical access usually appear mid-utterance and before content words or noun phrases. These types of filled pauses were more common in L2-utterances of the inexperienced interpreters, as shown in example 3.

In the example, the client –a newly arrived immigrant– is telling the story of her arrival to Sweden to the job counselor who is not yet familiar with the case. The client explains, in turn 44, lines 1 and 2, that she and her children had applied for and were recently granted a residence permit. Next, the client makes a very short pause (0.3 seconds) in line 2 and the interpreter almost immediately starts her rendition in turn 45, line 3. At the end of line 3, the interpreter produces a filled pause while searching for a Swedish (L2) term for “pozwolenie o pobyt” (residence permit). Ultimately, lexical retrieval fails, and when the interpreter must come up with a solution, she ends up using a verb phrase “för att vara här” (to be here), in line 6. At the same time, during the interpreter’s filled pause (line 3, turn 45), the client resumes talking (line 4, turn 46). The interpreter attempts to retake the turn in line 5, by continuing the translation, but the client does not give up the floor, which results in overlapping speech, or in a *simultaneous phase* (Englund Dimitrova 1991:50) throughout lines 4, and 5. The inexperienced interpreter might not have enough cognitive resources to expend on the concurrent engagement in the processes of lexical retrieval and in the processes of listening for interpreting. In this case, the interpreter’s cognitive load is reflected in the filled pause that echoes the delay in lexical retrieval of an L2-term while simultaneously listening to the client’s utterance in lines 3 through 6. The interpreter is only able to retrieve the term “tillstånd” (permit) in turn 48 line 10. The filled pause that the interpreter produces before uttering the term in turn 48, line 10, indicates that the cognitive load experienced by the interpreter has also possibly to do with delayed lexical access in L2. Thus, the described filled pauses appear in the cognitive-processing context of disfluency.

Example 3 (Participant 4, inexperienced)

1	(44)	M:	i *wtedy złożyłam wniosek o: pozwolenie o* and then I applied for residence
2			*pobyt↑ (0.3)* permit↑ (0.3)
3	(45)	I:	*sen ansökte ja om y[yy] (0.8)* then I applied for u[hh] (0.8)
4	(46)	M:	*[i:] (.) i [dostaliśmy]* [aan’] (.) *an’ [we got]*
5		I:	*[för att vara här]* [to be here]
6	(47)	M:	*yyy i i i dostaliśmy: y y y (.)* uuh an’ an’ an’ we got that uh (.)
7			*i właśnie dostaliśmy to toto pozwolenie↑* and we jus’ got that thatthat permit↑

8 *y: i gmina pomogła mi w znalezieniu*
and the municipality helped me find an

9 *mieszkania↑=*
apartment↑=

10 (48) I: =v*i[fick] ä: de tillståndet*
=we [got] uh that permit

11 M: *[y:m]*
[uh]

12 I: *ochä: kommunen(.)ä:*
andu:h the municipality(.)u:h

13 *hjälpte oss å hitta lägenhet↑*
helped us find an apartment↑

When it comes to the two experienced interpreters, they are both *quick turn-takers* (Englund Dimitrova 1991:45). The quick turn-taking can possibly be ascribed to monitoring skills developed as a result of interpreting experience and practice. Feasibly, the cognitive load experienced by interpreters prior to turn beginnings may be reflected in utterance-initial disfluencies, that is filled pauses and repetitions in the case of the two interpreters. Consequently, these disfluencies appear in the cognitive-monitoring context in both L1 and L2. However, there were qualitative differences in how the two experienced interpreters would take their turns. One of the interpreters would initiate her utterances with filled pauses in the both working languages, which was also reflected in the largest number of utterance-initial filled pauses in her renditions (11), in comparison to the remaining three interpreters. The second experienced interpreter was more likely to initiate her renditions with repetitions instead, which is also reflected in the large number of repetitions (28) in both L1 and L2 and only one initial filled pause in that interpreter's renditions. The first example (example 4) illustrates utterance-initial filled pauses occurring in the context of monitoring. Whereas the subsequent example (example 5) is focused on repetition-type disfluencies used in the context of monitoring.

In example 4, the job counselor describes the different requirements that the client must agree upon and fulfill when participating in the establishment plan for newly arrived. This example is a fitting illustration of the process of monitoring during the listening for interpreting phase.

The interpreter presumably monitors both her own understanding and the job counselor's utterance in this excerpt. The interpreter most likely makes a quick assessment of both the pause and the raised intonation of the speaker's voice in line 5. At the same time, she probably makes a swift evaluation of her own understanding of the potentially difficult terms “etableringsplan” (establishment plan) in line 4 and “etableringsersättning” (establishment benefit) in line 5. The cognitive load is presumably related to the process of monitoring and indicated here by the initial filled pause (line 6), together with the fact that the interpreter uses only “plan” (plan) (line 8) and “zasiłku” (benefit) (line 11) and avoids the first part of the Swedish term “etablering” (establishment). However, since she is a quick turn-taker, as soon as the job counselor’s utterance ends with raised intonation in line 5, thereby inviting a response, she will take her turn (67) in line 6.

Example 4 (Participant 2, experienced)

1	(66)	C:	*.hh ä: <okej> ä: men(.)då ere på de sättet* .hh uh: <okay> uh: well(.)so it’s like this
2			*att ä: när du deltar i aktivi- aktiviteterna* thatu:h when you partake in activi-the activities
3			*som vi har kommit överens(.)om* that we’ve agreed(.)upon
4			*i din etableringsplan* in your establishment program
5			*så får du etableringsersättning↑(.)* you get an establishment benefit↑(.)
6	(67)	I:	*ee: okej to w takim razie będzie tak(.)* u:hm okay so it’s going to be like this(.)
7			*jeżeli pani będzie brała udział w tych* if you partake in these
8			*aktywnościach które ustalimy w planie↑(.)* activities that we will agree on in the plan↑*(.)*
9			*wtymy:mmm przystosowania się do b-bycia tutaj↑* uhm o:ff this adaptation to be-being here↑
10			*[.hh] yy to będzie podstawą do* [.hh] uhm it will be the basis of that benefit
11			*wypłacania pani: tego zasiłku↓* that you:’ll be paid↓

The cognitive load associated with the processes of monitoring may be expressed here by the turn-initial filled pause in line 6. Importantly, utterance-initial filled pauses are also associated with cognitive demands of planning, which further supports the assumption of the multifunctionality of disfluencies. Consistent with the early response planning in dialogues (see section 2.2.3), the interpreter may be allocating her cognitive resources to planning the renditions early in the process. Thus, the filled pause in the beginning of turn 67 may also be an overt indication of this demand. Additionally, it may also clarify why the interpreter is more likely to interpret longer turns.

The filled pause is followed by the discourse marker “okej” (okay) in line 6. The interpreter may be rendering the job counselor’s discourse marker from turn 66, line 1, although it has been shown that interpreters predominantly omit such devices in their renditions as they consider them “superfluous and therefore disposable” (Hale 1999:80). Additional possibility, although equally speculative, may be that the discourse marker is a representation of the end of the planning and monitoring processes and points to the interpreter’s readiness to render the speaker’s turn.

The different patterns in production of filled pauses and repetitions in utterance-initial position may possibly correspond to individual disfluency style when interpreters are confronted with the cognitive demands of concurrent monitoring, planning, and speech production. Shriberg (2001:157) identifies different disfluency styles in speakers and points a bimodal distinction between “repeaters” and “deleters”. The interpreters’ disfluencies analyzed in the present work also seem to have different stylistic properties. One of the experienced interpreters’ disfluency style may be characterized by the frequent occurrence of filled pauses in utterance-initial position. Whereas the other experienced interpreter may be described as a “repeater”, as the majority of the disfluencies uttered by that interpreter are repetitions (see table 14). Another recurrent feature in the analyzed utterances was that the interpreters verbalized L1-filled pauses in the L2-renditions of the clients’ turns, which may perhaps be related to bilinguals switching languages when using discourse markers (Maschler 2000:437).

The next example (Example 5) illustrates how repetitions occur in the experienced interpreter’s utterances. In the example, the client expresses her concerns with reconciling work and childcare. Gradually, the client becomes more emotional and tells the story of her separation from her husband during their move to Sweden.

The interpreter’s inhale in line 4 suggests that she is ready to take over the turn and interpret. However, the client does not give up the floor, which prompts the interpreter to start rendering the client’s turn in line 8. This results in overlapping speech throughout lines 7, 8, and 9. The interpreter’s utterance in L2 begins with a repetition, as demonstrated in line 8 and 9 of turn 56. The first time the interpreter utters “men jag oroar mig också” (but I am also worried) (line 8) it is in a slowed pace. Conceivably, the interpreter is explicitly trying to signal the client to give up the turn. It is also possible that the interpreter’s speaking rate is slowed down since she may still be engaged in the process of monitoring the client’s speech. The two speakers compete over the turn, and when the client yields the floor, the interpreter returns to a regular conversational tempo (line 10) and proceeds with delivering her rendition.

The repetition exemplified here may be assigned to at least two disfluency context categories, that is the cognitive-monitoring context, and the cognitive-pragmatic context. Also, given that the interpreter almost never produces filled pauses in the rendition planning context, it is plausible that the repetition in lines 8 and 9 is an overt representation of the cognitive load resulting from these planning processes as well. Thus, repetitions may also appear in the third, cognitive-processing context.

Example 5 (Participant 1, experienced)

1	(55)	M:	*=ale też się martwie troche bo yy ile to* =but am also bit worried cause uh how much
2			*czasu zajmie i i i co mam z dziećmi:* time will it take an’ an’ an’ what to do
3			*zrobić ii w-[no bo] właściwie* ‘bout the kids an’ a [cause] actually
4		I:	[.hh]
5		M:	*jest tak że że* *it’s that that*
6			*ja i i ich ojciec rozstaliśmy* their father and and I we separated
7			*[sie podczas przeprowadzki tutaj↑]* [during the move here↑]
8	(56)	I:	[m*en <ja oroar mig också>* [but <am worried a bit too>
9			*>men ja oroar] mig också<* >but am worried] a bit too<
10			*om det här om tidsaspekten hur my- lång tid* about this issue with time how muc- how long
11			*kommer det att ta eftersom-*

is this going to take because-

12 *och vad kommer att- vad ska jag göra me*
and what's going- what do I do with

13 *mina ba-barn under den här tiden*
my ki-kids during this time

14 *eftersom de nämligen så att ja å barnens*
because it's like that that I and the kids'

15 *y: pappa vi: y: har separerat*
u:h dad we: u:h have separated

16 *o de hände de hände*
an' it happened it happened

17 *under den här- me den här- när vi h-håll-*
during thee- with thee- when we w- wer-

18 *för att för att flytta hit*
to to move here

Another repetition during the same turn (56) is verbalized mid-utterance in line 16. The interpreter repeats the phrase "och det hände" (and this happened), which implies an ongoing retrieval of the stored rendition from the episodic buffer (see section 2.2). Feasibly, in this case, the repetition is an overt representation of cognitive load associated with planning, retention, and retrieval of information from WM. It may therefore be assigned to the cognitive-processing category of disfluency.

The repetition in turn 56, line 16 is followed by a number of repairs, that imply the interpreter may be searching for the appropriate way to translate the phrase "podczas przeprowadzki" (during the move) from turn 55, line 7. The initial two repairs in turn 56, line 17, begin with incomplete noun clauses comprising a Swedish definite article "den" suggesting that the interpreter is perhaps trying to translate the Polish noun "przeprowadzka" (move) with a corresponding noun in Swedish. However, as third repair is uttered the interpreter seems to have made a different choice and translates the original noun clause with a verb clause "för att flytta hit" (to move here) in line 18.

There are multiple feasible interpretations of that disfluency cluster. First, as already mentioned, the interpreter is under cognitive load. Possibly, the cognitive load is a result of rendition planning and retrieval from WM and the repetition disfluency may be indicative of that process. Second, there is evidence that repetitions are more likely to precede complex syntactic structures (Clark and Wasow 1998) or that they are used as a stalling strategy when planning an utterance requires more time (Lickley 2001:96). Third, the interpreter may possibly use repetitions to maintain the impression of uninterrupted speech. This account is in line with the *Delayed Interruption for*

Planning Hypothesis (Seyfeddinipur et al. 2008), which postulates that in face of a problem, speakers prefer being efficient and instead of suspending the speech as soon as a problem occurs, they continue their utterance until the appropriate point of interruption is found.

There is an additional pattern in the same experienced interpreters' production of repetitions further where filled pauses would be expected otherwise. In instances of potentially delayed lexical retrieval, the interpreter verbalizes repetitions and not filled pauses, as demonstrated in example 5 (turn 56, line 16) and in example 6.

In example 6, the job counselor explains the client's obligation to inform the employment agency of sick leave. In turn 91, line 7, the interpreter repeats the phrase including a preposition and a demonstrative pronoun "w tych" (in these), indicating that she is indeed searching for the appropriate term for "activities" in her L1, before she eventually manages to find the right term, i.e., "zajęcia" (activities). The demonstrative pronoun is again repeated twice after the term has been uttered.

Example 6 (Participant 1, experienced)

1	(90)	C:	*=å om du e borta från aktiviteterna då* =an' if you miss your activities then
2			*måste du ha giltiga skäl sattsäga* you need a valid reason so to speak
3			*sjukdom oftast ådu måste anmäla på första dan* sickness most often and you must inform the first day
4			*du e sjuk↑[(0.25)på arbetsförmedlingen mm]* you get sick↑[(0.25) at the employment office mm]
5	(91)	I:	*[natomiast tak](.)* [so it's like that](.)
6			*jeżeli pani nie będzie mogła* if you're not able
7			*brać udziału wtych yy wtych zajęciach tych tych* to participate in these in these activities these these

8 *to wtedy b- najprawdopodobniej*
so then it- most probably

9 *będzie to związane z tym z pani z chorobą*
it will have to do with the with your with illness

10 *prawdopodobnie i jeżeli tak (.)*
probably and if so (.)

11 *wtedy jeśli pani jest chora:↑ zachoruje*
then if you are sick:↑ will get sick

12 *to musi pani poinformować nas już pierszego dnia*
you must inform us already the first day

13 *zgłosić to do urzędu pracy*
report it to the employment agency

For the experienced interpreters in the present study, filled pauses and repetitions serve both cognitive-monitoring and cognitive-pragmatic functions. Nevertheless, they also reflect the consequences of planning demands, in which case they also belong in the cognitive-processing disfluency context. As seen in examples 4, 5, and 6, experienced interpreters produce both filled pauses (4) and repetitions (5, 6) in the context of lexical retrieval as well. In the case shown in example 4, in turn 67, line 9, the interpreter is not familiar with the term “etableringsplan” (establishment plan)[44] and therefore renders the term with a more descriptive phrase, that is “plan przystosowania się do bycia tutaj” (plan of adaptation to being here).

Indeed, this particular participant is struggling with that term throughout the role play, such that at one point, shown in example 7, after encountering it, she makes a meta-comment to herself expressing frustration by saying “ten etablering” (that etablering; the interpreter never translated the Swedish term “etablering” [establishment] into Polish [osiedlenie]). The interpreter utters the comment in a lower voice, but it is still perceptible, (turn 147, line 8). The example shows the job counselor concluding the meeting and referring to the key matters (line 2, 3, and 4) left to discuss at a following meeting.

[44] Interestingly, the term was not equally problematic for the interpreters with the other two working languages (i.e., French and Spanish). It is possible that their cognate status facilitated the translation (e.g., Costa et al. 2005; Lijewska and Chmiel 2015).

Example 7 (Participant 2, experienced)

1 (146) C: *ja å nu tar tyvärr tolktiden slu:t↑ (.)ä:m*
yeah an' now unfortunately the interpreter's
time is up↑ (.) uhm

2 *allt de praktiska me*
all the practicalities with

etableringsplanen
the establishment plan

3 *blanketter barnomsorg*
forms childcare

4 *de ta vi näs:ta gång↓=*
all that we'll take up next time=

5 (147) I: *=teraz już czas tłumacza się kończy:↑ także*
=now the interpreter's time is running out so

6 *wszyskie te praktyczne: e: y: sprawy*
all thee practicaluh uh things

7 *jeśliodzi o ten plany: na za:mm-*
when it comes to that plan uhm of accom-

8 *°mieszkanie ten etablering° yyy*
°modation that etablering° *uhm*

9 *ja wwsz- jeśliodzi o opiekę dla dzieci:*
I al- when it comes to childcare:

10 *i te praktyczne rzeczy*
and these practical things

11 *zrobimy na- następny raz=*
we'll do it ne- next time=

The interpreter's preoccupation with the unfamiliar term in L2 seems to have an apparent impact on the interpreters' cognitive load reflected in her disfluencies in L1. The two cases of filled pauses are both accompanied by a repair. In the first repair, in turn 147, lines 7 and 8, the interruption occurs mid-word "zamm-mieszkanie" (accom-modation), which is almost immediately continued. The subsequent meta-commentary on the interpreter's own translation is followed by another filled pause (*yyy*, in line 8*)*. Finally, the second repair (turn 147, line 9) is initiated and subsequently aborted and substituted by a different utterance. Lastly, the amount of cognitive load placed on the interpreter's WM may have also caused the omission of the word "blanketter" (forms) in the Swedish original, in turn 146, line 3, which the interpreter leaves untranslated.

On a few occasions experienced interpreters initiate their turns with discourse markers, sometimes followed by a filled pause. In Example 8, the client continues the story of separation from her husband (see example 5). She is overwhelmed with emotions and starts crying in turn 57 line 2. Example 8 demonstrates one of the experienced participants initiating her rendition in turn 58, line 3 with a discourse marker "asså" (I mean) which is not present in the source utterance.

Example 8 (Participant 1, experienced)

1	(57)	M:	*yy właściwie się już nie kontaktujemy i* uh actually we're not in touch anymore an'
2			ja nawet ja nawet nie wiem czy ~on czy on ŻYJE~= I don't even know I don't even know if ~he's if he's ALIVE~= {*starts crying*}
3	(58)	I:	*=asså egentligen har vi ingen kontakt me varann* I mean basically we are not in touch with one another
4			*nu f- fö- för närvarande så egentligen så* the the- these days so actually so I don't even
5			*vet ja inte ens om han yy lever* know if he is uh alive

It appears that utterance-initial filled pauses indicate cognitive load resulting from the various demands that dialogue interpreting puts on the interpreters. Thus, filled pauses in this position fill cognitive-pragmatic, cognitive-monitoring, and cognitive-processing functions, supporting the view of multifunctionality of disfluency.

Filled pauses that occur within utterances are more likely to be associated with lexical retrieval. Possibly by signaling increased cognitive load resulting from problems and delays in lexical access as demonstrated in examples 3, 4, and 7. The qualitive analyses also suggest that utterance-initial repetitions are employed in a similar fashion as filled pauses in that position, as demonstrated in example 5. Also, mid-utterance repetitions seem to fill the same functions as filled pauses that occur within utterances, that is possibly indicating speech planning and lexical retrieval.

Finally, interpreter characteristics, that is experience and directionality, have an effect on cognitive load, as has been demonstrated in the quantitative results reported in section 4.1. The qualitative analysis of disfluencies illustrates and supports those findings, pointing to a qualitative difference in disfluency use between experienced and inexperienced interpreters. Also, inexperienced interpreters produce more filled pauses in both L1 and L2 than the experienced interpreters. In other words, experienced and inexperienced interpreters seem to handle the many sources of cognitive load differently.

4.4.1.2 Repairs

Turning to the third most common disfluency in the analyzed data, repair, both quantitative and qualitative differences are present between the two groups. Also, individual differences exist in how repairs are distributed. The third and final hypothesis of research question number 6 stated that *inexperienced interpreters will demonstrate fewer repairs than experienced interpreters*.
The hypothesis was supported, however not statistically. Together, within the analyzed rich points, the experienced interpreters produced 13 repairs. One inexperienced interpreter produced 4 repairs, whereas the second inexperienced interpreter produced none at all (see table 13).

As previously demonstrated in Example 7, repairs can occur in the context of lexical retrieval and are in such cases often accompanied by filled pauses. The following example, Example 9, illustrates a repair in a cognitive-monitoring and cognitive-pragmatic context. The example shows the client describing the difficulties with finding the employment office. The interpreter takes over the turn when the client starts speaking in a lower voice in turn 17, line 3, which leads to simultaneous phase as shown in lines 3 and 4.

The act of *wanting* can be expressed in several different ways in Swedish. The interpretation starts with a rendition of the Polish source word "chciałam" (I wanted) with the Swedish "jag ville" (I wanted) in turn 17, line 4. The interpreter subsequently interrupts her own utterance to substitute the "jag ville" (I wanted) with "jag tänk-" (I thou-) probably to render it as *jag tänkte fråga* (I thought of asking) but abandons the utterance before completion and returns to the first choice, that is *jag ville* (I wanted). The interpreter corrects her own word choice twice before achieving an accurate translation. Additionally, the repair is uttered in the cognitive-pragmatic context as well, similar to example 5, turn 56, lines 8 and 9. There the interpreter uttered the repetition when she was taking the turn. In the current example 9 in turn 17, line 4, she initiates a simultaneous phase with an utterance containing a number of repairs. The client gives up the turn, and the interpreter continues her rendition.

Example 9 (Participant 1, experienced)

1	(17)	M:	*nawet chciałam kogoś spytać o droge ale aleale* I wanted to ask someone for directions but I
2			*no n-nie znam szwedzkiego: in- angielskiego* don’t speak Swedish or English
3			*[°więc jakoś tak wyszło°]* [°so it ended up like that°]
4	(18)	I:	[*ja ville ja tä- ja ville tillomä fråga*] [I wanted- I thou- I wanted even to ask]
5			*någon om om vägen hit yy men eftersom jag kan* someone for directions but because I speak
6			*varken svenska eller engelska så var de* neither Swedish nor English so it was
7			*inte så lätt att göra de* not easy to do

Repairs in the utterances of the experienced interpreters were qualitatively different to those that occurred in the inexperienced interpreter’s utterances. As already mentioned, repairs can be produced as a result of speech planning and cognitive processing associated with lexical retrieval and selection, as illustrated by example 7. Additionally, repairs are often produced by experienced interpreters in the context of monitoring as demonstrated in example 9.

Repairs appear in a cognitive-monitoring context in a few of the utterances of one of the inexperienced interpreters. In example 10, similar to example 9, where the client is explaining her trouble with finding the employment office. The client is slightly late and is therefore somewhat embarrassed.

In the example, the interpreter’s utterance in L2, in turn 14, lines 7, 8, and 9 is interrupted twice before it is restored in line 10. Here, the repair is induced by the choice between two alternative ways of interpreting line 3, from turn 13. First, the interpreter attempts to translate the *phrase* “właściwie po raz pierwszy tu jestem” (actually I’m here for the first time) with a negative clause starting with “jag har inte-” (I have not-) in line 8, turn 14. She interrupts the clause and delivers a more accurate translation in lines 8–9 “jag är här första gången” (I am here for the first time). Contrary to the experienced interpreter in example 5, the inexperienced interpreter seems to have chosen accuracy over fluency, and corrected her rendition as soon as the problem was detected.

Example 10 (Participant 4, inexperienced)

1	(13)	M:	*no właściwie troche troche tak bo yy* well actually a bit yeah cause uh
2			*dopiero co sie tu sprowadziłam↑ i i yyy* I just moved here↑ an an u:h
3			*właściwie po raz pierwszy tu jestem mm* am actually first time here uhm
4			*nawet chciałam kogoś spytać o drogę n- ale ale* I even wanted to ask someone for directions but
5			*nie znam szwedzkiego i e: ani angielskiego* but I don’t speak Swedish an u:h or English
6			*więcy: no tak y: takno wyszło(.)* so: yeah uh it is what it is (.) {chuckles nervously}
7	(14)	I:	*y ja de ha vart lite svårt ja har nyss flyttat* uhm yes it was a bit difficult I just moved
8			*hit och y: jag har inte- de e- jag e här* here anduh I have n-it is-I am here for the
9			*första gången och ja ha velat fråga* first time and I wanted to ask someone for
10			*nån om: vägen me- å ja kan varken svenska elle* directions but I speak neither Swedish
11			*engelska så de ha blivit så hh.* nor English so it got like that hh.

The majority of repairs appear in the utterances of the experienced interpreters, which confirms the third hypothesis. Notably, repairs fit in all three of the context categories, depending on the context in which the interpreter experiences cognitive load. The greater number of repairs in the utterances of experienced interpreters may suggests that interpreting experience possibly has an effect on the number of repairs. In other words, extended interpreting experience increases the cognitive resources available for speech monitoring, which in turn results in more repairs. Furthermore, repairs appear in both L1 and L2, suggesting that language proficiency attainment leads to more lexical choices and thus to more repairs.

4.4.1.3 Prolongations

Both prolongations and filled pauses are hesitation-type disfluencies (see section 2.4.5.1) and are also qualitatively similar, such that their overt form is based on both phonation and its duration.

Contrary to filled pauses, the investigated interpreter characteristic, that is experience, does not have any effect on the occurrence of prolongations in the analyzed utterances. Prolongations occurred in both L1 and L2 utterances

The feature that is common to all prolongations in the analyzed material is their distribution. As was the case in examples 9 and 10, in Example 11 the client is describing the difficulties she had with finding the employment office. Regarding the distribution of prolongations, none occurred in utterance-initial position unless they were linked to a preceding filled pause, as shown in example 11, in turn 16, line 5. There in line 5, the filled pause *mmm* is followed by a prolonged interjection *aa*: (yes). Possibly, the turn-initial filled pause together with the subsequent prolongation are produced in the cognitive-processing context category. In other words, the filled pause together with prolongation may indicate the cognitive load associated with rendition planning.

Example 11 (Participant 1, experienced)

1 (15) M: *=mhm tak troche(.) yy n-nie znam- dopiero sie tu*
=mhm yes a little(.)uh I don't know- I just moved

2 *przeprowadziłam nigdy tu nie byłam i (.) nie znam*
here I've never been here an (.) I don't speak

3 *angielskiego ani szwedzkiego więc trudno mi było*
English or Swedish so it was difficult for me

4 *pytać o drogę=*
to ask for directions=

5 (16) I: *=mmm ä: aa litegrann ä: jag har p- nyss flyttat*
=mmm.uh yeah a little u:h I ju- I recently moved

6 *hity: ja känn- jag kan inte varken svenska*
here: uhm I kno- I can't speak either Swedish

7 *eller engelska så det var lite svårtå:*
or English so it was a bit difficult to u:h

8 *fråga om vägen hit↓hh*
ask for directions here↓hh

Frequently, prolongations are produced in connection to conjunctions, like “och”[45] (and) that get entrenched with the preceding word, as demonstrated in the Example 11, in turn 16, line 7. Prolongations often accompany conjunction “och” possibly due to its phonological characteristic in spoken discourse, such that it is a long vowel *å* [o:]. Also, here the prolongation appears before a final clause in the utterance which may conceivably be associated with the cognitive-processing and cognitive-monitoring context categories. Since the interpreter is arriving at the end of her interpretation, she is possibly experiencing cognitive load due to retrieval of the stored rendition from buffer. At the same time, she is probably expending her cognitive resources on monitoring of the job counselor’s understanding.

4.4.1.4 Other: explicit editing expressions

When it comes to the category of “other”, as described in section 2.4.3 it comprised explicit editing expressions (see also *explicit coordinating moves;* Wadensjö 1998:109), discourse markers, or metacommentaries on interpreters’ own performance. These type of disfluency in the interpreting process can potentially indicate cognitive processing or an increase in cognitive demand, as suggested in example 7 when the experienced interpreter made a meta-comment on terminology (“ten etablering”). In Example 12 the job counselor is explaining the importance of reporting sick leave to the employment office. In example 12, turn 93, line 11, the inexperienced interpreter uses an explicit editing expression, turning to the primary party and asks them to “ta det långsamt” (take it slowly).

Example 12 (Participant 3, inexperienced)

1 (92) C: *om due borta från din aktivitet↑*
if you miss your activity↑

2 *ska också sägas*
this also needs to be said

3 *så måste du ha giltiga skäl säga*
you must have valid reasons that is

---

[45] Pronounced as *å* [o:]

4 *sjukdom och sånt va*
sickness and such right

5 *föratt de e viktit att du .hh*
cause it’s important that .hh

6 *rredan första dan du blir sjuk anmäler till oss*
already the first day you get sick you report

7 *här på arbetsförmedlingen är du sjuk mer*
to us here at the employment office if you’re

8 *sjuk mer än sju dagar måste du ha*
sick for over than seven days you need a

9 *läkarintyg och det måste också*
doctor’s note and this too must be

10 *(göras) på arbetsförmedlingen me det(0.95)*
(done) at the employment office with that(0.95)

11 (93) I: *ä: kan vi(.)? ta de(.) långsamt↓ä:*
uhm can we (.)? take it (.) slowly↓u:hm

Presumably, the use of the explicit request to “take it slowly” indicates that the cognitive demand of rendering a longer stretch of talk with high information density possibly exceeded the cognitive resources available to the interpreter. In other words, it demonstrates that the interpreter’s WM capacity and processing span are limited (see Tiselius and Englund Dimitrova 2021).

The interpreter may have failed to take the turn at an appropriate point during the client’s utterance. The increasing processing difficulty may have additionally hampered the interpreters’ monitoring. On the one hand, the interpreter’s insufficient monitoring skills might be a consequence of lack of interpreting experience. On the other hand, the failure to interpret could perhaps also be ascribed to other factors like fatigue, given that at the time of that particular exchange, the encounter had already lasted for over 10 minutes.

Experiencing fatigue after this amount of time is somewhat earlier than suggested by Moser-Mercer et al.’s (1998) pilot study on prolonged turns in simultaneous (i.e., exceeding 30 minutes).[46] The experiment was conducted on a cohort of five simultaneous interpreters whose quality of interpretation

[46] In SI, a 30-minute turn corresponds to an interpreter’s normal work span (Moser-Mercer 2003).

(measured with number of errors) exhibited a visible decline after each elapsed 15 minutes of the task. While Moser-Mercer et al. focused on experienced interpreters alone, the authors also suggest that for "moderately advanced students", it is usually the 10-to-15-minute mark when interpreting quality deteriorates. Notably, the authors attribute the inexperienced interpreters' inability to interpret longer intervals to the yet undeveloped automation of subprocesses (Moser-Mercer et al. 1998:55).

Returning to the present study, the cognitive load arising from the inefficient utilization of cognitive resources are reflected in the results of quantitative disfluency analyses of the entire sample (*n*=17) in section 4.1. To reiterate, both disfluency durations and disfluency counts were likely to increase with time spent interpreting the encounter. It is pivotal to note that dialogue interpreters oftentimes work alone, and they have no colleague to alternate with. Furthermore, no official recommendations exist in terms of working hours (in Sweden) and no empirical research exists on dialogue interpreters' maximum work span (cf. *processing span* Tiselius and Englund Dimitrova 2021).

Thus, for the inexperienced interpreter in the example 12, fatigue may have occurred approximately 10 minutes into interpreting. Subsequently, during the second attempt at rendering, the interpreter chunked the job counselor's talk and delivered her interpretations on a sentence-by-sentence basis. Summary of the results of the Polish data set

To reiterate, the two most frequent types of disfluencies within the analyzed interpreters' utterances were filled pauses (90) and repairs (64), followed by repetitions and prolongations that occurred 17 times each in the analyzed utterances. Disfluencies classified under the "other" type, such as explicit editing terms, occurred only nine times for all the investigated role play excerpts.

When it comes to the disfluency categories presented in section 4.4.1, the qualitative analyses revealed that most disfluencies fill multiple functions at once, that is cognitive-monitoring, cognitive-pragmatic, and cognitive-processing. For instance, the analysis has shown that filled pauses and repetitions served cognitive, pragmatic, and monitoring functions at turn beginnings, associated with turn-taking and utterance planning. Whereas mid-utterance filled pauses and repetitions occurred in contexts that were clearly related to increased cognitive demand due to lexical retrieval of less familiar terms. Repairs were also related to lexical selection in experienced interpreters. Filled pauses associated with pragmatic and monitoring functions, contrary to predictions, occurred less often than the filled pauses induced by lexical retrieval. Moreover, fewer repairs occurred in the inexperienced interpreters' utterances. Mostly experience but also directionality played a role in how disfluencies were distributed in the analyzed utterances. The complementary investigation into disfluency shed further light on how interpreter and interpreting task characteristics influence cognitive load in dialogue interpreting.

To conclude, the disfluency data exhibit a considerable variation in terms of types of disfluencies and their distribution, both between and within groups. Thus, the many functions of disfluency indicate that cognitive load is a possible result of the engagement of an array of resources in the processes of both listening for interpreting and production.

5 Discussion

The goal of the present work was to explore the construct of *cognitive load* in *dialogue interpreting*. The study was designed and conducted within the framework of cognitive translatology. Due to methodological limitations (see sections 2.1.1 and 2.1.2), the focus of the data analyses was on the cognitive processes of individual interpreters. The study was a multi- and mixed-methods study with a core quantitative component and a supplementary component where disfluency types were described and qualitatively analyzed.

The independent variables that were selected as predictors of dialogue interpreters' cognitive load were interpreter characteristics (experience) and task and environment characteristics (interpreting phase and directionality).

Since cognitive load is a multidimensional construct (Chen 2017) and should therefore not be assessed using a single measure, two types of measures were selected. The measures selected were performance measures (disfluencies) and physiological measures (blinks). Cognitive load was operationalized with three disfluency measures, that is duration, count, and rate. Whereas blink-based measures (blink rate and BRV) were tested in terms of their sensitivity to cognitive load, diagnosticity, and intrusiveness (Chen 2017) since they have not yet been used in cognitive load assessment in TIS.

The first aim of the present work was articulated in the first research question that investigated whether there was a difference in the interpreters' cognitive load depending on the level of experience and interpreting direction. The results demonstrated that the dialogue interpreters' cognitive load was modulated by both experience and directionality. These results are discussed in section 5.1.

The second aim was to investigate blink-based measures as potentially sensitive to changes in cognitive load of dialogue interpreters, and was expressed in the second, third and fourth research questions. The two blink-based measures showed different results. For blink rates, the hypotheses predicted that interpreters' blink rates would change depending on the level of experience, interpreting phase, and directionality. The results have shown that blink rates in interpreting phases were different from baseline. However, experience, directionality, or interpreting phase had no effect on blink rates. The other measure, BRV was a second, novel measure tested in terms of sensitivity to cognitive load in dialogue interpreting. The hypothesis regarding BRV predicted that experience and dialogue interpreting as a task will have an effect on BRV. The results demonstrated that experience did not have an effect on BRV, but that there was a difference in BRV between baseline and interpreting. The results are discussed in detail in section 5.2.

The third aim of the present study was conveyed by research question number five which sought to explore a potential relationship between cognitive load and blink-based measures of dialogue interpreters. The prediction was, that there would be a quantifiable relationship between blink measures and cognitive load. However, that prediction was only partially confirmed by the results and is discussed in section 5.3.

To explain variability in disfluency use and explore different plausible causes of cognitive load, disfluency types were explored in terms of their cognitive functions in dialogue interpreting. This aim was articulated in research question number six that inquired about the different types and categories of disfluencies in the Polish interpreters' output. The results demonstrated qualitative differences between interpreters and are discussed in the penultimate section 5.4.

The penultimate section 5.5 is devoted to the discussion on cognitive load in dialogue interpreting. The final section 5.6 discusses the strengths and limitations of the present inquiry with focus on issues like sample size, ecological validity, and data availability in research on interpreting.

5.1 Both experience and directionality affect cognitive load of dialogue interpreters

With regard to the first research question, three hypotheses were tested to investigate whether there was a difference in interpreters' cognitive load depending on interpreting direction and the level of experience. Since cognitive load was assessed with three disfluency measures, the hypotheses predicted there would be a difference in disfluency durations, counts, and rates across groups and interpreting directions.

In line with existing findings on experience-driven automaticity (see section 2.2.6) it was expected that the inexperienced group would demonstrate higher cognitive load during interpreting. Given the previous research on directionality (see section 2.2.5), larger cognitive load was expected in interpreting into L2.

As predicted, all three disfluency measures were significantly different between groups, suggesting that interpreting experience modulates cognitive load. The analyses demonstrated that the experienced interpreters' disfluencies were on average 658 ms shorter than the inexperienced interpreters' disfluencies (p=.035). Experienced interpreters also produced significantly fewer disfluencies (p=.042). Similarly, in terms of disfluency rates, the effect of experience was also significant (p=.010) with experienced interpreters demonstrating fewer disfluencies per minute of interpreting. The magnitude of the effect of experience on disfluency rates was particularly large, especially in comparison with the two other disfluency measures. The results suggest that experienced interpreters may be faced with cognitive load less frequently than inexperienced interpreters, presumably through experience-driven automation of some processes (Moser-Mercer 2010, 2022).

With regard to the effect of directionality, as predicted, a significant difference was found between disfluency durations in L2 and L1 (p=.037). The average difference in disfluency durations between the groups was smaller in L1 (935 ms), compared to L2 (1066 ms). Of interest, consistent with findings on disfluency and utterance length (e.g., Oviatt 1995), time spent in the role-plays significantly predicted disfluency durations and disfluency counts. The increase in disfluency durations of 365 milliseconds for every minute of interpreting the encounter[47] was found in interpreting into L2, and a smaller increase was found in interpreting into L1 (196 ms). Notably, inexperienced interpreters spent on average 2 minutes longer in the speaking L2 condition compared to experienced interpreters (p=.040).

Surprisingly, no effect of directionality was found in the analyses of disfluency counts and rates. Because of the discrepancy in the results, it might be difficult to provide explicit evidence of the effect of directionality on cognitive load in dialogue interpreters. The absence of directionality effect on disfluency counts and rates could be attributed to a small dominance difference between the interpreters' working languages that the analyses were unsuccessful in capturing. However, it leaves unclear why one of the cognitive load measures (disfluency durations) was responsive to directionality while the remaining two were not. Specifically, since previous studies on cognitive load and disfluency in interpreting found that disfluency occurrence and occurrence rate do have an effect on interpreters' cognitive load (e.g., Plevoets and Defrancq 2016, 2018; Defrancq and Plevoets 2018). It is possible, that the individual disfluency measures may reflect different aspects of cognitive load and as such might be affected by directionality to a different extent. Also, a closer inspection of the disfluency data revealed that the effect of directionality was mostly carried by the inexperienced group.

Given that the three dependent variables are in fact measures of the same construct, it was deemed appropriate to conduct a post-hoc multivariate test on normalized disfluency measures. This was done in order to confirm the robustness of the cognitive load measures and to examine whether a multivariate analysis would yield a significant effect of directionality. Indeed, the multivariate test confirmed the effect of experience (p<.001) with inexperienced interpreters exhibiting higher overall cognitive load. The

[47] Notably, there was a difference between times spent on role play, such that inexperienced interpreters spent 3.5 minutes longer interpreting than experienced interpreters (p=.013, d=-1.37). Separately, in terms of directionality and times spent on speaking, there was no significant difference.

analysis also yielded a significant effect of directionality *(p*=.009) on cognitive load suggesting that that it is more cognitively demanding to interpret into one's L2, which is in line with previous research (e.g., de Bot 2000; Tiselius and Sneed 2020).

The higher cognitive load during interpreting into L2 may be attributed to the interpreters' language proficiency. As outlined by the revised model of cognitive load (section 2.3.1.3, figure 2) all interpreter characteristics interfere with and influence each other. Interpreters' language proficiency may thus be expected to be affected by interpreting experience. It is therefore possible that inexperienced interpreters were under higher cognitive load due to lower language proficiency. Consequently, as a result of the lower language proficiency in L2, inexperienced interpreters demonstrated slower and less effective lexical retrieval. This further supports the assumption of dialogue interpreters' asymmetrical language proficiency (Tiselius and Englund Dimitrova 2019), which may lead to weaker linguistic representations, and thus slower lexical retrieval. Notably, disfluency rates for the inexperienced group were higher in L1 (F[1,15]=7.625, p=.015). One way to interpret this asymmetry is by assuming that inexperienced interpreters were either unfamiliar with L2 terminology or had difficulty accessing translation equivalents in their L1. The disadvantage in lexical retrieval as demonstrated by the inexperienced interpreters in production can be interpreted in light of research on semantic constraint in bilinguals (e.g., Gollan et al. 2011) and interpreters (Chmiel 2016, 2021). The results are supplemented with qualitative analyses of the Polish interpreters' utterances (for discussion see section 5.4).

Another possible explanation of the results, although admittedly speculative, is the previously discussed IC model (Green 1998). It might be the case, that cognitive load associated with interpreting into L2 in part corresponds to the amount of inhibitory control necessary to suppress the more dominant L1. It should be noted that during interpreting both working languages are explicitly present. Also of interest with respect to the present study is that cognitive load increased in L2 for both groups, with experienced participants exhibiting lower cognitive load. Because of this, one might suggest, that the cognitive costs arising from the asymmetrical language proficiency and asymmetrical inhibitory demands might be attenuated by interpreting experience.

The results of disfluency analyses confirm that cognitive load in interpreting is affected by interpreter characteristics (experience) and task and environment characteristics (directionality).

5.2 No evidence that directionality or experience affect blink measures in dialogue interpreting

A review of previous research on blink rate as an indicator of changes in cognitive load demonstrated that the findings were not in agreement (see section 2.5.2). Some studies find blink rates increase as a result of cognitive load (e.g., Recarte et al. 2008), and others demonstrate lower blink rates as a result of increased cognitive load (e.g., Bentivoglio et al. 1997). Based on these findings, the prediction was that the demands of dialogue interpreting placed on WM would manifest with changes in the temporal distribution of blinks.

With regard to the second research question, there was a significant difference in blink rates between baseline and interpreting (p=.0028) with higher blink rates in interpreting compared to baseline. More precisely, assuming that cognitive load during dialogue interpreting was higher than in baseline, the results obtained are consistent with the findings that associate increase in blink rates with higher cognitive load (e.g., Magliacano et al. 2020).

Further, pertaining to interpreting phase and directionality, blink rates were higher in all phases and directions compared to baseline condition. Specifically, speaking L1 (p<.001) and speaking L2 (p=.020), as well as listening L1 (p=.005) and L2 (p=.013) all demonstrated higher blink rates compared to baseline. In terms of effect sizes, the magnitude of the effects was large[48] (see table 12), which suggests that the difference in blink rates between baseline and the different conditions were meaningful. However, there were no significant differences between the two interpreting phases (speaking and listening) or the two interpreting directions (L1-L2 and L2-L1). Also, contrary to predictions, experience did not show a significant effect on blink rates.

Interpreting had a significant effect on blink rates, but there was no effect of interpreting phases. The lack of the effect of interpreting phase on blink rates may have two possible causes. On the one hand, it is plausible that the amount of cognitive load induced by both listening and speaking phases may not have been large enough to elicit changes in interpreters' blink rates. On the other hand, it can be speculated that both processes – listening for interpreting and production – are equally effortful. The lack of interpreting phase effect is consistent with findings of Li et al. (2020), who showed that blink rates were not sensitive to changes in cognitive load between the speaking and listening phases in conversation. Also, as shown by Recarte et al. (2008) and Chen and Epps (2014) blink rate patterns may be attributed to two separate attentional mechanisms that control blinking. However, it cannot

[48] All effect sizes were benchmarked against Cohen's criteria (1969:278–280) for small, medium and large effects that correspond to η_p^2 values of .0099, .0588, and .1379, respectively.

be excluded that the effect is related to task vs. no task and that characteristics of interpreting had little to do with the observed blink rate differences between baseline and interpreting task.

In terms of BRV, the results showed that there was less variability in blink rates during the interpreting than in baseline. This result in line with findings of Paprocki and Lenskyi (2017), who reported lower BRV during IQ testing compared with baseline. Interestingly, the authors point to a possibility of predicting cognitive performance from the BRV in rest. This would have to be tested in a separate study. Furthermore, the lack of significant difference in BRV between inexperienced and experienced interpreters may point further to the effect related to task vs. no task rather than interpreting per se.

One of the aims of the present study was to examine blink-based measures as possible indicators of cognitive load. As described earlier, a valid cognitive load measure should fill three selection criteria (Chen 2017; see also 2.3.1.4), that is sensitivity, diagnosticity, and intrusiveness.

The results of blink rate analyses revealed no effects of directionality, interpreting phase, or experience. Thus, blink rates did not demonstrate sensitivity to the different levels of cognitive load that was placed upon the interpreters. Unfortunately, the diagnosticity criterion was not met either since blink rates were not able to clearly indicate the origins of cognitive load. As described earlier, the analysis only revealed the difference between baseline and interpreting task, with the latter being more cognitively demanding. As far as intrusiveness is concerned, eye-tracking technology is a well-established and non-invasive method of data collection (see section 2.5.1.3), which implies that measuring blinks does not interrupt the task at hand.

It would seem that blink-based measures do not meet the necessary validity criteria. Consequently, blink measures may not be suitable as indices of cognitive load in dialogue interpreting. The next section discusses the putative link between cognitive load and blink measures that was investigated quantitatively.

5.3 No evidence that cognitive load in dialogue interpreting modulates blink measures

Although cognitive load during dialogue interpreting was significantly predicted by both blink rates ($F[1,100]=6.209$, $p=.014$, $R^2=.058$) and BRV ($F[1,76]=9.231$, $p=.003$, $R^2=.108$), the evidence pointing to a relationship between disfluencies and blinks is challenging at least for a few reasons.

First, the magnitude of the effects was small, that is only 5.8% of blink rates and 10.8% of BRV predicted cognitive load. Second, the results of correlational analyses between cognitive load and blink measures contradicted findings on blink measures discussed in section 5.2. The significant correlation between blink rates and cognitive load ($r[100]=-.242$, $p=.014$) demonstrated that cognitive load was likely to increase as blink rate decreased, whereas blink rate data (see table 12) exhibited an increase during interpreting. The correlation between BRV and cognitive load ($r[76]=.329$, $p=.003$) revealed that cognitive load was likely to increase as BRV increased, which again is in contrast to the results of BRV analyses (see table 12) that revealed a decrease in BRV during interpreting. Thus, the presented findings are not convincing in terms of making any credible claims about the link between blink rates, BRV, and cognitive load.

Why are the correlation results at odds with the results of blink measure analyses? At a closer inspection, the data revealed that inexperienced interpreters, that is the group with the larger increase in cognitive load, had overall lower total blink rates (*Mean*=17) than the experienced group (*Mean*=26). Similarly, the inexperienced group exhibited higher BRV in interpreting (*Mean*=4.05) than the experienced group (*Mean*=2.9). Based on this, an alternative interpretation of the results might be that the significant correlations are an artefact of the group differences in blink measures.

Conceivably, the observed increase in blink rates (table 12) could be attributed to the processes of WM rather than cognitive load. Recall that several studies reviewed in section 2.5.2 associate blink rates with WM functions (e.g., Jongkees and Colzato 2016). For example, Zhang et al. 2015 found that higher blink rates are related to better shifting, that is changing back and forth between different tasks, and inhibition, that is the ability to suppress dominant response. The process of updating, or actively maintaining and quickly retrieving information from WM was found to be associated with increased blink rates in a study by Rac-Lubashevsky et al. (2017). Further research is needed to explore the potential relationship between blink rates and WM functioning in interpreting.

Recall, that in their research on WM in dialogue interpreting, Tiselius and Englund Dimitrova (2021) report that dialogue interpreters' universal WM constraint may be manifested in their processing span (see section 2.2.7) which is independent of interpreting experience (2021:350). Notably, the authors also report WM tests on the same participants as the present study and find no significant differences in WM functioning between experienced and inexperienced interpreters (Tiselius and Englund Dimitrova in press). Given that interpreting experience was found to be a robust predictor of cognitive load in dialogue interpreting in the present study (see section 4.1), the absence of the effect of experience on blink measures may further suggests that blinks are not modulated by cognitive load. Whether the lack of experience effect is evidence in favor of the hypothesis that blink measure modulation can be ascribed to changes in WM functioning is speculative. However, provided that blink rates are indeed sensitive to WM functioning, it is plausible that the differences in cognitive control are not inherent to interpreting experience (e.g., Togato et al. 2022; but see Mellinger and Hanson 2019) and can instead be attributed to individual cognitive differences. This possibility would have to be tested in a separate study.

As earlier evidence has shown, changes in blink rate very much depend on the type of task and stimuli used (see 2.5.2.1). The main difference between previous studies on blink rate modulation and the present study lies in the setup and the stimuli used. While the present study used a semi-experimental setup in order to investigate dialogue interpreting as a situated process, the majority of the studies discussed in section 2.5.2.1 collected their data in carefully controlled experiments. Moreover, studies investigating blink measures often track demand-related changes in eye-blink rate during repeated performance on the same tasks. Whereas in the present inquiry repeated testing was not possible because of the character of the study and the division of data into interpreting phases was done post-hoc.

A more systematic way to address this issue would be by changing the data elicitation method. One could for example have participants consecutively interpret short sentences in single-language and mixed-language blocks. However, there are two main implications to such experimental design. First, it would come at a cost of situatedness of the interpreting encounter. Second, as Amos et al. (2023:21) suggest in their study of prediction in noise, using short and uncomplicated sentences may mean that the cognitive load resulting from interpreting them might not be much different from the load experienced while listening to them. Therefore, it is unlikely that the change in study design of the present investigation would provide any additional information about the specific mechanisms behind cognitive load.

To conclude, while the analyses demonstrated significant quantifiable relationship between blink measures and disfluency measures, the underlying nature of that relationship remains uncertain. Importantly, the present study has shown that blink measures may be informative of the general nature of dialogue interpreting as a cognitively demanding process. However, blink measures' relationship to cognitive load and perhaps to WM functioning should be investigated further.

5.4 The multifunctionality of disfluency in dialogue interpreting

The final research question concerned types and categories of disfluency in the data of Polish interpreters. To reiterate, disfluencies in dialogue interpreting were defined in the present study as discrete multifunctional devices that reflect the cognitive load associated with different processes inherent to interpreting dialogues while simultaneously serving various functions that the context of dialogue interpreting demands (see section 2.4.6).

The qualitative analysis of disfluency in the Polish interpreters' utterances was conducted considering the proposed *cognitive-functional* definition of disfluency. The implementation of this definition resulted in a suggestion that disfluency in dialogue interpreting usually occurs in three cognitive-functional context categories, that is *cognitive-pragmatic*, *cognitive-monitoring*, and *cognitive-processing* category. The investigation revealed that disfluencies exhibit substantial variability in terms of both distribution, type, and category.

Difficulties at different stages of the interpreting processes may lead to distinct patterns of disfluency, suggesting that the cognitive load indicated by disfluencies has multiple origins (see section 2.4.6). The data imply that disfluency is an idiosyncratic measure and possibly reflects how different interpreters cope with their cognitive load. Also, the qualitative results provide a better understanding of cognitive load on both local (Seeber 2013) and global levels.

Consistent with previous research (e.g., Eklund 2004), filled pauses were the most frequent type of disfluency in the analyzed data. Given that filled pauses in utterance-initial position have been found to reflect predominantly planning functions (e.g., Tottie 2011) and pragmatic functions (Clark and Fox Tree 2002), it was hypothesized that the context of dialogue interpreting will induce more filled pauses in the turn-initial context as a result of rendition planning and monitoring. However, contrary to prediction, the majority of filled pauses (64 out of 90) occurred in the mid-utterance position. Mid-utterance filled pauses appeared primarily in cases of delayed lexical retrieval, like retrieving a low frequency word or a difficult term, which corroborates existing findings (Hartsuiker and Notebart 2010; Pistono & Hartsuiker 2023). Filled pauses that occurred within utterances thus mainly appeared in the cognitive-processing context category. Whereas utterance-initial filled pauses predominantly reflected cognitive load associated with planning processes while simultaneously fitting the cognitive-monitoring and cognitive-pragmatic contexts such as turn-taking (e.g., Bortfeld et al. 2011; Kosmala and Crible 2022).

The qualitative disfluency analyses suggest that a large portion of inexperienced interpreters' cognitive load occurred as a result of lexical retrieval in both L1 and L2. Consequently, the qualitative analyses shed more light on the quantitative results of cognitive load analyses and strengthen the measure's diagnosticity (Chen 2017).

Similarly to filled pauses, repetitions in mid-utterance context seem to arise as a result of lexical search and retrieval. Additionally, as previously suggested, an alternative possible explanation for the use of repetitions might be the *Delayed Interruption for Planning Hypothesis*, (Seyfeddinipur et al. 2008:837). According to that view speakers tend to show preference for fluency instead of accuracy, which implies that repetitions may perhaps be a way of maintaining an impression of fluency.

As far as cognitive fluency is concerned (Segalowitz 2010,2016; see section 2.4.2.), the present results suggest that utterance fluency does not necessarily tap into cognitive fluency. In other words, the efficiency and speed of the processes involved in speech production in L2 is not always reflected in the absence of disfluencies. As shown above, some disfluencies may be used to maintain the impression of fluency.

Recall that one the experienced interpreters was more likely to produce repetitions instead of filled pauses in turn-initial context. In fact, that interpreter exhibited fewest filled pauses of all four participants, and only one in the beginning of a turn. Further, as previously mentioned, the results are consistent with findings that assign the occurrence of both filled pauses and repetitions to increased planning effort as a result of divided attention (Oomen and Postma 2001:1003). Indeed, since dialogue interpreting comprises many concurrent tasks, and interpreters' attentional resources are distributed across all of those tasks, the occurrence of turn-initial repetitions is consistent with increased planning, as is the case of turn-initial filled pauses.

The analyses of other types of disfluencies in this study present divergent but not mutually exclusive results. For instance, in one experienced participant's utterances repairs do not occur in the usual context of error detection (e.g., Levelt 1989). Specifically, repairs in the utterances of that participant seem to occur in line with findings that associate repairs with more choice as a result of L2 proficiency attainment (e.g., Lennon 1990). Notably, more choice does not imply that cognitive load is attenuated, on the contrary, as Corley and Stewart (2008:590) suggest, more options to choose from or competition between response options (Pistono et al. 2023) may lead to increased cognitive load.

The complementary investigation of the different types of disfluencies in the Polish interpreters' utterances confirmed the assumptions of the proposed cognitive-functional view of disfluency. First, the results shed more light on disfluencies as indicators of cognitive load and its multiple origins. Also, the analyses are evidence in favor of the assumption that disfluencies serve multiple concurrent functions in dialogue interpreting. Fundamentally, the results bring awareness to the fact that disfluencies cannot be ascribed a single role in speech and that they are informative with regard to multiple processes underlying speech production in L2, dialogue interpreting, and cognitive load.

5.5 Evaluating the revised cognitive load model

The present study empirically investigated cognitive load in dialogue interpreting and adapted the existing theoretical model of cognitive load in interpreting (Chen 2017) to dialogue interpreting (section 2.3.1.3).

The revised theoretical model proposed in the present work lends itself to the investigation of cognitive load in interpreting as a situated process.

Cognitive load is thus modelled in line with the assumptions of cognitive translatology as “[t]he consequence of interacting with the environment” (Muñoz Martín 2018:151–152) and as a construct that affects the environment (2018:151–152). The interaction between the many characteristics that influence cognitive load is illustrated by the causal dimension in the revised model (figure 2). As already discussed, the present inquiry focused on two factors that affect cognitive load in dialogue interpreting, that is interpreter experience (interpreter characteristic) and directionality (task and environment characteristic). The remaining characteristics warrant further investigation.

The development of the model’s assessment dimension (figure 4) allows for operationalization of cognitive load with additional measures, in both experimental and naturalistic settings. It also allows for converging different methods of inquiry, whereby one might investigate various aspects of cognitive load in interpreting without relying on quantitative methods alone. Overall, the revised model provides a useful framework for researching cognitive load in interpreting. The model accommodates dialogue interpreting as a situated process, where cognitive load is the result of interpreter and task and environment interacting.

In general, the findings of the present inquiry confirm that cognitive load in dialogue interpreting is modulated by both interpreter experience and directionality, and that cognitive load in interpreting may have multiple sources. The results also show that cognitive load in dialogue interpreting does not modulate blink measures. Finally, the complementary analyses point to multifunctionality and multiple sources of disfluency in dialogue interpreting.

5.6 Strengths and limitations

The following sections examine the strengths and limitations of the present work. Among challenges in conducting empirical research on dialogue interpreting, two have been identified as particularly prominent in the present study, that is sample size and availability of naturally occurring data. On a related note, the question of ecological validity is also discussed.

5.6.1 Sample size and data availability

The present study was conducted on the data of seventeen (*n*=17) interpreters. On the one hand, the low number of participants in the study poses some challenges. Specifically, small samples often lead to underpowered studies that result in lack of statistical significance (Mellinger and Hanson 2022a:317). On the other hand, the use of eye-tracking as data elicitation method brought about an extensive number of datapoints. This issue was particularly challenging during data cleaning and verification as there are no established blink duration cut-off points or standards for spontaneous blink extraction (see section 3.3.3).

Thus, in the present study the issue of sample size was twofold. Specifically, it concerned both the limited number of participants but also the large amount of raw data that was trimmed and cleaned to extract a meaningful data set for further analysis and interpretation (see Mellinger and Hanson 2022a:317). Also, the issue of sample size in the present study can be considered both as a limitation and as a strength. The relatively small sample might have led to low statistical power, which may potentially limit the meaningfulness of the study's findings and makes generalization of results impossible (see Mellinger and Hanson 2022a:318). On the positive side, smaller samples give an opportunity for exploration of different methods of analysis, which in the case of the present study is reflected in the complementary analyses of disfluency. In addition, large data samples are not automatically unproblematic. Specifically, the extensive raw data elicited in the present study by means of eye-tracking might pose potential risks in terms of noise, that is large amount of additional, and meaningless information.

A related issue that emerged in connection to sample size in the present inquiry was data availability. As already mentioned in section 2.1.3, there is a limited number of public service interpreters in Sweden that meet the study's selection criteria (391 state authorized interpreters in Stockholm and 961 in Sweden in 2017). However, access to study participants has always been an issue in research on interpreting (Gile 2009a:146). That is for at least two reasons. Mainly because, as Tiselius (2013:24) points out, the interpreter community is small, which makes access to participants limited. Lambert (1994:5) adequately summarizes the scarcity of "sufficiently skilled interpreters available as subject-collaborators who are in one place, who have a specific language combination, and who are willing to become involved in research."

Tiselius (2013) also quotes Gerver (1971) who takes note of the few interpreters available for experimental research and points out that the issue arising from the small sample size puts the very experiment execution at risk. While Gerver (1971) as well as Lambert (1994) and Tiselius (2013) refer to conference interpreting, where the professionals are even fewer than in the public service interpreter community (Tiselius 2013), the issue of sample size remains a prevalent in research on dialogue interpreting as well. In the case of a study like the present one, chances of finding a large group of participants who match the selection criteria decrease severely. It should also be noted that considering access to participants for this particular study and in this particular geographical region, the study would most likely not be possible had a larger sample been an absolute condition.

According to Bendazzoli (2016:4) the interpreter-researcher is obliged to make one's position clear, both as a researcher and a member of interpreting community. That is accurate not only in fieldwork but also in experimental research, as shown by Tiselius (2019).

Collecting empirical data from peers has long been a common practice in research on interpreting. Gile (1994:150) famously labeled practicing interpreters who are involved in academic research *practisearchers*. Initially, the term referred to interpreters engaging in research without any prior or systematic knowledge of the research process. Today, it is no longer the case and interpreter-researchers receive thorough research training, but many still work in double capacity: as researchers and as members of the interpreting community.

In case of the present inquiry, my own position is more of a researcher than an interpreter. On the one hand, I have graduated from the public service interpreting program in Swedish and Polish at Stockholm University, where I also teach professional ethics to student interpreters as a part of my employment. On the other hand, I work as an interpreter only sporadically and I was not active professionally as an interpreter at the time of data collection.

I have also been socialized into the interpreting community through my research, and because of my background I am a member of the Polish community. In other words, my perspective is not the one of an outsider, but it is not an emic perspective in its purest sense (see Tiselius 2018:749). The proximity to potential study participants has made the data collection less challenging but did not guarantee privileged access to data. On the contrary, some potential participants presumably viewed this type of exposure and scrutiny by their peer negatively and decided to not participate in the study (see Gile 2016:224).

5.6.2 Simulation and naturally occurring data

The conditions in experimental designs are often notably different from actual interpreting encounters, which is why ecological validity of experimental studies has been a prevalent issue in interpreting research (e.g., Köpke and Signorelli 2012; Gile 2016; see also Mellinger and Hanson 2022b).

The critics of the experimental design in research on interpreting processes note the experiments' reductionist approach. In other words, experiments are criticized for their focus on one component in isolation, in conditions different from actual interpreter-mediated encounters. In the case of the present dissertation, to elicit data the quasi-experimental study uses *simulated interpreter-mediated encounter* in form of a *role play*.

Criticism against using role plays instead of naturally occurring data is particularly evident in research on role play as a pedagogical method in dialogue interpreter training, but some points of criticism can be extended to any interpreting research relying on role-plays. For example, Niemants and Stokoe (2017:298) identify two major challenges to using role-plays. First, they argue that role-plays and authentic conversations are organized differently making the authenticity of interpreters giving their renditions on a turn-by-turn basis questionable. According to the authors, authenticity is further undermined by the complexity of having different identities. Participants in simulated activities tend to shift between framings (Goffman 1974) and redefine the situation they are in as Linell and Persson Thunqvist demonstrated in a study (2003:412). Participants appeared to alternate between two activities and identities they were engaged in, namely the framed activity (job interview) and framing activity (role play). The writers note that participants showed tendency to move in and out of their respective roles and either acted out their role play characters or interacted as themselves, i.e., students and tutors. Wadensjö (2014:439) noticed that for the students and their two identities, different things were at stake, depending on the framing they were in. Conversely, in a study investigating the cognitive processes behind interpreters' omissions, Englund Dimitrova (1995) demonstrated that in the communicative situation of an interpreting lesson consisting of different communicative events, students interpreted only the utterances that framed activity of "speech". Thus, despite the frequent changes in between the different framings in a simulated interpreting exercise, interpreters seem to be able to evaluate what belongs to the situation and what does not (Englund Dimitrova 1995:75).

In the case of the present study, most participants did not move in and out of framings. However, one participant happened to chuckle at times during the task, particularly between long pauses and repeated disfluencies. The participant's behavior indicated that they have been shifting from the framed activity (interpreter-mediated encounter) to the framing activity (role play). The participant's data was not excluded from analysis.

The actors playing interlocutors in the role-play were required to acquaint themselves with the manuscript prior to the experiment, which might have potentially resulted in unnatural turn-taking and interaction as commented by Niemants and Stokoe (2017). Nevertheless, the encounter was as ecologically valid as possible from the perspective of the study participants who did not have access to the manuscript (Tiselius and Englund Dimitrova 2021:351).

One of the fundamental tenets of ecological validity in is that study participants must be asked to complete tasks that are "generally familiar or at least similar to their everyday experience" (Mellinger and Hanson 2022b:6). In terms of the present inquiry, dialogue interpreters in Sweden are familiar with the situations of simulated encounters at least in two contexts. First, role-plays are used as a didactic tool in interpreter training, and second, when interpreters apply for state authorization their interpreting skills are tested by means of role play (see Dahnberg 2015, 2023). In other words, the communicative situation of a role play or simulated interpreted encounter was a familiar to the interpreters that took part in the experiment conducted for the purposes of the present study.

Another advantage of using (quasi)experimental designs over naturalistic methods is the high degree of control (Gile 2016:221). As far as the present study is concerned, role plays were prepared in accordance with the researchers' goals, unlike authentic discourse that is structured entirely by participants and thus limits the researcher's involvement to none. Therefore, when it comes to replicability or possibility of repeated observation, using naturalistic data would not have been possible in a study like this one.

Finally, it should be stressed that in all research, data suffers from some degree of limitation, error, and bias (Mellinger and Hanson 2022a:319). The discussion of the challenges that arose from research data in the present study was necessary for producing trustworthy conclusions and helpful in identifying potential improvements in future research on dialogue interpreting.

6 Conclusions and future research avenues

The present study investigated cognitive load in dialogue interpreting by combining disfluency measures and eye measures. The study found that cognitive load operationalized as disfluency is influenced by experience and directionality. Further, interpreter's blinking patterns were analyzed to determine whether cognitive load affects blinking in dialogue interpreting. The findings of the present investigation remain inconclusive in terms of blink rate, BRV, and their relationship to cognitive load. Nevertheless, the contribution of the present work is threefold: it explored new measures (blink rate and BRV) in relation to cognitive load in dialogue interpreting; it explored cognitive load in dialogue interpreting experimentally, and it demonstrated that both quantitative and qualitative methods together provide an appropriate instrument to study the complex processes underlying dialogue interpreting.

Many aspects regarding cognitive load, disfluency and blink measures in dialogue interpreting have not been investigated in this dissertation and as such merit further exploration. At least few possible lines of inquiry emerge from that conclusion.

For example, in terms of further research on blinks and their relationship to different processes in dialogue interpreting, future experiments should establish whether the observed effect of interpreting on blink rates and BRV is in fact the effect of interpreting or similar cognitively demanding tasks. One could compare a resting baseline with different tasks such as listening, answering questions, speaking in a different language and so on. Should these comparisons compare a unique interpreting effect, one could perhaps benefit from a different segmentation of the data, for instance on a turn-by-turn basis. This way, one could potentially observe if turn-taking, rather than directionality or interpreting phase, modulates blink rates in dialogue interpreting.

Another line of inquiry that was not taken up in the present investigation is the way blinks are distributed in relation to various stimuli. For instance, Siegle et al. (2008) demonstrate that blinks occur before and after increased cognitive load indexed by pupillary dilation. Other studies suggest that changes in temporal distribution of blinking are modulated by general mechanisms independent from modality (Brych and Händel 2020) and that blinks may occur at transition point between different cognitive processes. In their study using both visual and auditory stimuli, Murali and Händel (2021) argue that blinks "act as precise indicators of periods of cognitive processing"

(2021:10), and thus map changes in cognitive demand. These findings confirm results from much earlier studies, such as Stern's (1988) who labeled blinks as *mental punctuation* and found that blinks occur after cognitive processing has been completed.

Similarly, Boehm-Davis et al. (2000) demonstrated experimentally that blinks tend to "rebound" after cognitive load subsides. It deserves further investigation. On a related note, another avenue worth pursuing could be addressing suspension of blinks prior to cognitive load and the cognitive disengagement after sustained cognitive load. Thus, another intriguing possibility would be an investigation of blink latencies in relation to cognitive load indexed by disfluency. Blink latencies could also be explored in terms of a release of information from WM (Siegle et al. 2008) or in relation to a putative spillover effect (on spillover effect see e.g., Shlesinger 2000; Seeber and Kerzel 2012; Chmiel et al. 2023).

Finally, considering the absence of the effect of experience on blink measures, future studies would perhaps benefit from a longitudinal approach and focus on the effect of training instead. In particular, to determine whether there are differences in blink rates in interpreters before training and after training.

When it comes to disfluencies, focus could be shifted from disfluency production to disfluency perception, such that one could explore whether disfluencies in the interlocutors' utterances contribute to the interpreters' cognitive load. Further, future scholarship could also explore whether interpreters render the primary speakers' disfluencies and discourse markers (see Hale 1999).

Future studies may want to develop and add further depth to the three cognitive-functional context categories of disfluency, that is cognitive-processing, cognitive-monitoring, and cognitive-pragmatic. For instance, these could serve as a point of departure in a mixed-methods study of different types of interpreters' renditions (Wadensjö 1998). All these potential research avenues may contribute to the development of empirical research on cognitive processes in dialogue interpreting.

6.1 Final remarks

The present dissertation contributes to the knowledge on cognitive processes of interpreting with a particular focus on cognitive load in dialogue interpreting. Cognitive load in dialogue interpreting is shown to be influenced by both interpreting experience and directionality and to have multiple sources depending on interpreter, task and environment characteristics.

The findings presented here have methodological, theoretical and practical implications.

Regarding methodological exploration the present dissertation investigates blink rate and BRV as potential cognitive load measures. Also, by applying both quantitative and qualitative methods of inquiry to research on cognitive load this dissertation contributes to the growing body of mixed- and multi-method research. It also offers a suggestion of methods that can be combined for a deeper understanding of cognitive load in interpreting.

In terms of theoretical contributions, the dissertation proposes an adaptation of the model of cognitive load in interpreting (Chen 2017) to the assumptions of cognitive translatology and to the context of dialogue interpreting, where interpreter characteristics interact with both interpreting event and the shared cognitive environment of the interpreting encounter. This revision further strengthens the applicability and flexibility of the model of cognitive load in interpreting and allows for operationalization of cognitive load with additional measures, in both experimental and naturalistic settings.

Furthermore, the present work suggests the term *listening for interpreting* as a series of both incremental and simultaneous processes involved in goal-oriented listening phase during dialogue interpreting. The introduced term brings awareness to the fact that the task of listening is performed differently depending on interpreting mode. Thus, the concept of listening for interpreting represents an important theoretical starting point in research on language processing mechanisms in dialogue interpreting.

By introducing three disfluency context categories (cognitive-pragmatic, cognitive-monitoring, and cognitive-processing), the dissertation contributes to the knowledge on the multifunctionality of disfluency that is analyzed using a functional-cognitive approach.

In terms of pedagogical implications, understanding how cognitive load impacts interpreters' performance might prove useful in interpreter training and education. First, the revised model of cognitive load might help bring more awareness to the various factors that potentially influence cognitive load in interpreting. Second, the three disfluency context categories contribute to understanding of cognitive load in dialogue interpreting and hold significant potential for both theoretical and didactic development. For instance, the categories might be helpful as a pedagogical tool, whereby a detailed analysis of the students' own disfluency categories could lead to a deeper understanding how cognitive load manifests in the individual student. Awareness of one's own disfluency patterns could potentially have implications for interpreting techniques, which warrants future exploration.

In terms of practical implications, the dissertation further establishes the impact that directionality has on interpreting performance. Additionally, the present work contributes to the understanding of the many challenges that dialogue interpreters may face as a result of bidirectionality. The findings of the dissertation also demonstrate the impact of interpreting experience on interpreting performance. The results show that experienced dialogue interpreters are likely to interpret with greater ease as they are more resilient to increases in cognitive load. Overall, the present dissertation provides evidence that dialogue interpreting improves with experience and that superior language proficiency is fundamental for well-functioning interpreting. Finally, the study contributes to the emerging cognitive profile of dialogue interpreters.

Sammanfattning

Det övergripande syftet med avhandlingen är att bidra till kunskapen om kognitiva aspekter av dialogtolkning med särskilt fokus på kognitiv belastning. Närmare bestämt att undersöka om och hur erfarenhet och språkriktning påverkar kognitiv belastning hos tolkar under dialogtolkning. Dialogtolkning förstås som mycket kort konsekutivtolkning ofta utan anteckningar, vanlig i dialoger och i offentlig sektor. Studien är genomförd inom ramen för det VR-finansierade projektet ”Den osynliga processen – kognition och arbetsminne i dialogtolkning” (VR 2016-01118, 2017–2023), som undersöker kognitiva aspekter av dialogtolkning. Projektet initierades av mina handledare, Elisabet Tiselius och Birgitta Englund Dimitrova.

Avhandlingen har sin övergripande teoretiska anknytning till kognitiv översättningsvetenskap, *Cognitive Translation and Interpreting Studies (CTIS)*, den gren inom översättningsvetenskapen som undersöker kognitiva processer i tolkning och översättning (se avsnitt 2.1–2.1.2). Den här studien placeras vidare inom fältet kognitiv översättningsvetenskap, *cognitive translatology* (Muñoz Martín 2017:561) som bygger på de situerade ansatserna inom kognitionsvetenskapen (för genomgång se t.ex., Sannholm 2021:23–27; Mellinger 2023:191–213).

Enligt Muñoz Martín (2017) är översättning och tolkning inte begränsade till översättarens eller tolkens inre mentala processer. Tolkningsprocesser är således situerade eller inbäddade (*embedded*) och förkroppsligade (*embodied*) och utgör därmed ett resultat av ett samspel (se också Wadensjö 1992, 2018) mellan tolken, samtalsparterna och den omgivning de verkar inom.

Den här avhandlingen ansluter sig till detta perspektiv i hur studien har utformats – upplägget är ett simulerat tolkat samtal, där tolken och de två samtalsparterna fanns på plats. Dessutom använder studien psykofysiologiska mått, baserat på antagandet att mänsklig perception, mentala processer, känslor, och handlingar är både inbäddade och förkroppsligade (Cacioppo et al. 2007:14). Denna ansats betonas i avhandlingen också genom hur modellen för kognitiv belastning i tolkning (Chen 2017) bearbetas och anpassas för dialogtolkning som situerad verksamhet (avsnitt 2.3.1.3).

I den bearbetade modellen beskrivs tolkens kognitiva belastning som ett resultat av ett samspel mellan tolkens, uppgiftens och omgivningens egenskaper (*interpreter, task and environment characteristics*). I min studie analyseras hur erfarenhet och språkriktning påverkar kognitiv belastning hos den individuella tolken, vilket innebär att det situerade perspektivet inte undersöks i analyserna av studieobjektet, själva tolksituationen som används i studien är dock situerad och autentisk om än simulerad. Det bör också påpekas att de situerade ansatserna inom översättningsvetenskapen fortfarande saknar den omfattande metodologiska grund som skulle göra en heltäckande analys av kognitiva processer i tolkning möjlig (avsnitt 2.1.2).

Studien tar avstamp i tidigare forskning inom tvåspråkig språkkontroll (avsnitt 2.2.1), monitorering (avsnitt 2.2.2; Tiselius och Englund Dimitrova 2023), språkförståelse (avsnitt 2.2.3), talproduktion (avsnitt 2.2.4), språkriktning (avsnitt 2.2.5), tolkerfarenhet (2.2.6), och arbetsminne (2.2.7) för att synliggöra och belysa de olika aspekter som kan påverka kognitiv belastning hos dialogtolkar. I diskussionen om språkförståelse myntas dessutom begreppet "lyssna för att tolka" (*listening for interpreting*). Lyssna för att tolka beskrivs som en typ av målmedvetet lyssnande i dialogtolkning och omfattar flera delprocesser, till exempel språkförståelse, monitorering, antecipering av den pågående turen och planering av nästa yttrande.

Två av de ovannämnda begreppen är särskilt viktiga för avhandlingen, nämligen, språkriktning (*directionality*) och tolkerfarenhet (*experience*). Det är väl belagt i tidigare översättningsvetenskaplig forskning att det är mer kognitivt ansträngande att tolka till det svagare språket, vanligen L2 (avsnitt 2.2.5). Det är vidare bevisat att mer erfarna tolkar använder sina kognitiva resurser på ett effektivare sätt än tolkar utan eller med lite erfarenhet (se exempelvis Tiselius 2013). Detta sker troligen på grund av *automatisering*, det vill säga omfattande övning och bruk av vissa tolkningsprocesser fram tills de blir rutinmässiga (Shreve 2018:101). En stor del av den forskning som hittills utförts om språkriktning och erfarenhet i tolkning bygger på studier av simultan- eller (lång) konsekutivtolkning av monologer, med få undantag (till exempel, Tiselius och Englund Dimitrova 2019; Tiselius och Sneed 2020; se också avsnitt 2.2). Denna avhandling undersöker däremot hur språkriktning och erfarenhet påverkar kognitiv belastning hos dialogtolkar.

Den här avhandlingen föreslår en definition av disfluensbegreppet i dialogtolkning utifrån ett funktionell-kognitivt perspektiv. Närmare bestämt definieras disfluenser som enskilda multifunktionella verktyg som återspeglar kognitiv belastning förknippad med de olika delprocesserna i dialogtolkning. Samtidigt som verktygen fyller olika funktioner som dialogtolknings-sammanhanget kräver (avsnitt 2.4.6)

För att undersöka kognitiv belastning hos dialogtolkar använder studien två mått: disfluenser (avsnitt 2.4–2.4.6) och blinkningsmått (avsnitt 2.5–2.5.2.2). För disfluenser operationaliseras kognitiv belastning med tre disfluensmått. I linje med vad tidigare forskning visat (Defrancq och Plevoets 2018; Plevoets och Defrancq 2018, 2020; Chmiel et al. 2023), använder studien följande disfluensmått som tecken på kognitiv belastning: disfluenslängd (i millisekunder), antal disfluenser, och disfluensfrekvens (per minut).

Ögonrörelsemätning, ibland kallat ögonspårning, (*eye-tracking*) är numera en allt oftare använd datainsamlingsmetod inom översättningsvetenskapen

(Korpal 2015; Hvelplund 2017; Chmiel 2022; Hu et al. 2022). Tidigare fokus har dock legat på två mått, pupillutvidgning (2.5.1.1) och fixeringar (2.5.1.2). Blinkningar har däremot hittills inte prövats som indikatorer på kognitiv belastning varken i studier inom tolkning eller inom översättning. Avhandlingens antaganden om blinkningsmåttens validitet och reliabilitet grundar sig således i första hand på forskning om kognitiv belastning och uppmärksamhet i andra forskningsområden, till exempel psykologi och neurovetenskap (avsnitt 2.5.1.3). Metodmässigt ligger tonvikten i avhandlingen på att undersöka huruvida två blinkningsmått, blinkningsfrekvens (*blink rate;* 2.5.2.1) och blinkningsfrekvensvariabilitet (*blink rate variability, BRV;* 2.5.2.2) påverkas av ökad kognitiv belastning hos dialogtolkar.

Det begrepp som står i centrum för avhandlingen är således kognitiv belastning. Givetvis har kognitiv belastning i tolkning utforskats tidigare av flera forskare inom och bortom det översättningsvetenskapliga fältet (för en genomgång se Gieshoff et al. 2021).

De tre modeller för kognitiv belastning som diskuteras i studien är följande: Giles *Efforts Models* (1999), Seebers (2011) *Cognitive Load Model*, och Chens (2017) *Cognitive Load in Interpreting.* De ovannämnda modellerna granskas utifrån frågeställningar om dialogtolkningens unika karaktär (Englund Dimitrova and Tiselius 2016:210). Efter granskningen fokuserar jag på Chens (2017) modell och föreslår en vidare anpassning och bearbetning för att spegla dialogtolkningens sammanhang. Den bearbetade modellen (figur 2 och 4) tillsammans med Chens (2017) ursprungliga bidrag (figur 1 och 3) återfinns i avsnitt 2.3.1.3.

Det empiriska materialet som ligger till grund för studien har samlats in under simulerade tolkade samtal i form av rollspel. Sju erfarna och auktoriserade tolkar i offentlig sektor samt 10 oerfarna tolkar i offentlig sektor/tolkstudenter deltog i studien. Materialet som analyserades bestod av 17 tolkade rollspel mellan en svensktalande arbetsförmedlare och en nyanländ som talade antingen polska, spanska eller franska. Tolkarnas ögonrörelser spårades med SMI 2.0 Glasses och SMI Smart RecorderS4 samtidigt som rollspelen spelades in med två videokameror. Rollspelet utarbetades med så kallade analyspunkter, *rich points,* d.v.s. ”specifika segment i källtexten som innehåller prototypiska översättningsproblem, d.v.s. de mest framträdande, karakteristiska och svåra problemen i en text” (PACTE 2011:322; min översättning). Analyspunkterna användes för att skapa situationer som ställde ökade krav på tolkarnas kognitiva resurser. I studien används också begreppet tur-par (*coupled turn*) d.v.s. ”ett relativt kort yttrande på ett språk och dess direkt efterföljande återgivning på ett annat” (Geiger Poignant 2020:43) för att analysera disfluenserna kvalitativt. Disfluenserna studeras kvalitativt inom tur-paret.

Två typer av data analyseras i studien. De disfluenser som analyseras kvantitativt, har identifierats och kodats i de 17 tolkarnas yttranden från rollspelsinspelningarna. Vidare analyseras också de 17 tolkarnas blinkningar kvantitativt. En detaljerad beskrivning av hur både disfluenser och blinkningar har identifierats och mätts i studien återfinns i avsnitt 3.3.1, respektive 3.3.3.

För att komplettera de kvantitativa resultaten, analyserades disfluenser i inspelningarna av de polska dialogtolkarnas yttranden. De disfluenser som analyseras kvalitativt i de polska tolkarnas yttranden har identifierats inom de sex utvalda analyspunkterna och i återgivningsdelen av de relevanta tur-paren. De analyserade disfluenserna har dessutom kodats utifrån den typologi som presenteras i avsnitt 2.4.5. De disfluenser som identifierades i det polska materialet är följande: tvekljud (*hesititations)*, som omfattar fyllda pauser (*filled pauses*), förlängningar (*prolongation)* och upprepningar (*repetitions*). Det förekommer också reparationer (*repairs*) och det som i avhandlingen har kallats för “andra disfluenser” (*other*), som till exempel diskursmarkörer eller metakommentarer till egen tolkning. En sammanställning av datainsamlingsmetoderna finns i tabell 6 i avsnitt 3.4.

Två oberoende variabler användes i den kvantitativa delen av studien, erfarenhet och språkriktning. Under analysen av blinkningar delades tolkningarna upp i lyssnandefas och talandefas. Dessutom jämfördes blinkningar under en period innan tolkningen startade (icke-tolkning) med blinkningar under tolkning. Dessa indelningar gjordes för att undersöka om den kognitiva belastningen förändras i de olika faserna och om den förändras under tolkning jämfört med icke-tolkning. Den andra, kompletterande undersökningen av de polska tolkarnas disfluenser utfördes i linje med disfluensbegreppets kognitiv-funktionella definition som nämndes ovan (se också avsnitt 2.4.6).

Studiens forskningsfrågor sammanfattas nedan. Fullständiga forskningsfrågor med tillhörande hypoteser återfinns i avsnitt 2.7. Forskningsfrågorna 1–5 är formulerade för att kunna besvaras med hjälp av kvantitativa metoder och teorier hämtade från forskning om kognitiv belastning, disfluenser, samt tolkerfarenhet och språkriktning. Forskningsfråga nummer 6 gäller disfluenstyper i det polska materialet och har som syfte att komplettera de kvantitativa analyserna:

1. Är det skillnad i kognitiv belastning mellan erfarna och oerfarna tolkar och beroende på språkriktning?
2. Är det skillnad i blinkningsfrekvens mellan tolkning och icke-tolkning?
3. Har tolkning en effekt på blinkningsfrekvensvariabilitet (BRV)?
4. Är det skillnad i blinkningsfrekvensvariabilitet (BRV) mellan grupperna?
5. Finns det en relation mellan disfluensmått och blinkningsmått?
6. Vilka olika typer och kategorier av disfluenser förekommer i de polska tolkarnas yttranden?

Resultaten visar att både erfarenhet (t=3.47, p<.001) och tolkningsriktning (t=2.68, p=.009) påverkar kognitiv belastning hos tolkar. Både erfarna och oerfarna tolkar visade högre kognitiv belastning när de tolkade till sina respektive L2. Detta är i linje med tidigare forskning om språkriktning (avsnitt 2.2.5). De erfarna tolkarna visar lägre kognitiv belastning i jämförelse med de oerfarna tolkarna vilket bekräftar tidigare forskning kring tolkerfarenhet (avsnitt 2.2.5).

När det gäller blinkningsfrekvens, visar resultaten på en signifikant skillnad mellan tolkning och icke-tolkning (*p=.0028*). Däremot finns det ingen effekt av erfarenhet (p=.317). Språkriktning och tolkningsfas påverkar blinkningsfrekvensen men bara i jämförelse med det ursprungliga tillståndet under icke-tolkning (baseline). Med andra ord kan inga signifikanta skillnader påvisas mellan de två tolkningsfaserna (lyssna, tala) eller mellan språkriktningarna (L1, L2). Resultaten av blinkningsmåttsanalyser återfinns i tabell 14 i avsnitt 5.2.

När det gäller kognitiv belastning och blinkningar har analyserna inte visat att det finns något tydligt samband mellan blinkningsfrekvens och kognitiv belastning. Trots att kognitiv belastning under dialogtolkning har signifikant predicerats av både blinkningsfrekvens (F[1,100]=6.209, p=.014, R^2=.058) och BRV (F[1,76]=9.231, p=.003, R^2=.108) är den uppskattade effektstyrkan liten.

Sammanfattningsvis kan man konstatera att denna studie inte har kunnat fastslå att blinkningsmått lämpar sig som markör på kognitiv belastning.

Disfluenser träder fram i avhandlingen som idiosynkratiska mått som visar att dialogtolkning ger upphov till förhöjd kognitiv belastning beroende på tolkerfarenhet, språkriktning och den aktuella kognitiv-funktionella kontexten. Resultaten visar att disfluenser i dialogtolkning vanligtvis förekommer under tre kognitivt-funktionella kontextkategorier, nämligen kognitiv-pragmatisk (*cognitive pragmatic*), i kognitiv-monitorering (*cognitive monitoring*), och kognitiv-processning (*cognitive processing*). De kompletterande analyserna av det polska materialet ger en nyanserade bild av disfluenser i dialogtolkning.

Gällande de olika disfluenstyperna i de polska tolkarnas yttranden pekar resultaten som förväntat mot multifunktionalitet av disfluenser. Undersökningen visar vidare att disfluenser präglas av betydande variation när det gäller både fördelning och typ. De svårigheter som kan upplevas vid olika faser av tolkningsprocessen har konsekvenser för disfluensförekomsten, som i sin tur antyder att den kognitiva belastningen har flera orsaker (se avsnitt 2.4.6). I linje med tidigare forskning (t.ex., Eklund 2004) är fyllda pauser den mest frekventa disfluenstypen i det analyserade materialet och förekommer oftast till följd av svårigheter i lexikal åtkomst (*lexical retrieval*) (Hartsuiker and Notebart 2010; Pistono & Hartsuiker 2023). Resultaten pekar dessutom på att de oerfarna tolkarna upplever kognitiv belastning både i L1 och L2, oftast på grund av svårigheter vad gäller lexikal åtkomst. Vidare är fyllda pauser i början på turer oftast tecken på kognitiv belastning på grund av yttrande- och återgivningsplanering. Samtidigt förekommer de disfluenserna inom både kognitiv-monitoreringskontext och kognitiv-pragmatisk kontext, d.v.s. turtagning (Bortfeld et al. 2011; Kosmala and Crible 2022). De erfarna tolkarnas yttranden präglas av reparationen i linje med den forskning som förknippar reparationer med större möjligheter till ordval som en följd av L2-färdigheter (Lennon 1990). Det rör sig troligen om förhöjd kognitiv belastning på grund av flera valmöjligheter eller till och med konkurrens mellan olika valmöjligheter.

Slutsatsen av det som framkommit i resultaten är att både tolkerfarenhet och på språkriktning är orsaker till förändringar i tolkens kognitiva belastning under dialogtolkning. Vidare har undersökningen visat att kognitiv belastning yttrar sig på olika sätt både beroende på tolkerfarenhet, språkriktning och på den aktuella kognitiva kontexten. Som konstaterats tidigare kan disfluenser inte tillskrivas en enda funktion i dialogtolkning. Disfluensanalysresultaten belyser de processer som ligger till grund för talproduktion i L2, för dialogtolkning och för kognitiv belastning.

Avhandlingens bidrag har teoretiska, metodologiska och praktiska implikationer för forskningen om tolkning.

Vad gäller teoretiska bidrag föreslår avhandlingen en anpassning av modellen för kognitiv belastning i tolkning (Chen 2017) till dialogtolkning som situerad verksamhet. Den omarbetade kognitiva belastningsmodellen har visat sig relevant för undersökningen och lämplig för att beskriva hur kognitiv belastning kan yttra sig beroende på tolkens, uppgiftens och omgivningens egenskaper (*interpreter, task and environment characteristics*). Den omarbetade modellen är vidare tänkt att kunna tillämpas som teoretisk referensram i olika analysmetoder vilket också har metodologiska implikationer för forskningen om kognitiv belastning i dialogtolkning som situerad verksamhet.

De tre disfluenskategorierna i dialogtolkning bidrar till kunskapen om kognitiv belastning i tolkning och har samtidigt en stor utvecklingspotential både teoretiskt och didaktiskt. De tre kategorierna har potentiella implikationer för tolkutbildning. Till exempel, en detaljerad analys av tolkstudentens egna disfluenskategorier skulle kunna leda till en fördjupad förståelse av hur kognitiv belastning yttrar sig hos den individuella tolkstudenten. Medvetenhet kring egna disfluensmönster skulle eventuellt kunna ha implikationer för tolktekniken. Detta skulle kunna undersökas i framtiden.

Vidare föreslår avhandlingen begreppet *lyssna för att tolka* (*listening for interpreting*) som en serie processer inblandade i den för tolkning specifika och målinriktade lyssningsfasen. Olika aspekter och delprocesser i lyssna för att tolka har inte gjorts i mina analyser och lämpar sig för vidare utveckling i framtida forskningsuppgifter.

När det gäller metodutveckling tillämpar den här studien mått som inte tidigare använts inom översättningsvetenskapen, nämligen blinkningsfrekvens och BRV (blinkningsfrekvensvariabilitet) som potentiella mått på kognitiv belastning. Det svaga sambandet mellan kognitiv belastning och blinkningsmått tyder på att framtida undersökningar av blinkningsmått i tolkning skulle kunna gynnas av ett ändrat fokus. Som ett första steg kan man undersöka om de ändringar som sågs mellan tolkning och icke-tolkning enbart gäller för tolkning eller också för andra kognitivt belastande uppgifter. Vidare skulle man kunna undersöka ändringar i blinkningsfrekvens som tecken på uppdateringsprocesser i arbetsminnet (Rac-Lubashevsky et al. 2017).

Dessutom bidrar avhandlingen metodologiskt genom att ge ytterligare exempel på hur kvantitativa och kvalitativa undersökningsmetoder kan tillämpas och kombineras i forskning om kognitiv belastning i dialogtolkning.

De praktiska implikationerna rör som sagt ökad förståelse av hur olika disfluenser påverkar tolkningen. Vidare bekräftar avhandlingen att de kunskaper som redan finns om kognitiv belastning i simultantolkning och konsekutiv tolkning av långa monologer också gäller för dialogtolkning. Detta bidrar till att stärka kravet på och förståelse för behovet av tolkutbildning. Dessutom visar resultaten i avhandlingen att en erfaren tolk på ett positivt sätt kan bidra till ett bättre samtal i tolkning i offentlig sektor.

Sammantaget bidrar den här avhandlingen till kunskapen om kognitiva aspekter av dialogtolkning och dialogtolkarnas kognitiva profil (Tiselius och Babcock 2023).

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Appendix 1 Consent form

1(1)

Stockholms universitet

Den osynliga processen – kognition och arbetsminne i dialogtolkning

Tack för att du vill delta i en studie om dialogtolkning! Vårt mål med studien är att förstå mer om arbetsminne och kognition hos tolkar. Det gör vi genom att undersöka dialogtolkning ur olika perspektiv.

Studien går till på följande sätt:

- Du kommer att få göra flera olika tester av språkkunskaper, arbetsminne och emotionell intelligens.
- Om du tillhör gruppen som ska genomföra en tolkning kommer du också att få genomföra ett tolkat rollspel. Vi spelar in rollspelet och du kommer också att använda glasögon som följer dina ögonrörelser. Efter rollspelet gör du en retrospektiv intervju.

Allt material som samlas in (svar på frågor, inspelningar, resultat i tester) behandlas konfidentiellt. Inga data sparas tillsammans med personlig information. Videoinspelningarna raderas så snart de transkriberats. Materialet som samlas in kommer bara att användas i forskningssyfte. När resultatet presenteras kommer man inte att kunna förstå att det är just du som deltagit och vad du har fått för resultat.

Du deltar helt frivilligt. Du kan när som helst välja att inte delta i studien längre. I så fall talar du bara om det för forskaren och du behöver inte ange någon orsak.

Har du frågor är du välkommen att kontakta oss.

Elisabet Tiselius, Forskargruppsledare
Mobil: 0707-303777
E-post: elisabet.tiselius@su.se

Jag har förstått den information jag fått skriftligt och muntligt och jag godkänner att materialet som samlas in används i forskningssyfte. Jag har fått möjlighet att ställa frågor och få dem besvarade.

__________________________ __________________________
Namn Datum

____
Underskrift

Tolk- och översättarinstitutet

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Hemsida: www.tolk.su.se

Appendix 2 Background questionnaire (English translation)

Background questions – The invisible process

1. Are you? ☐female ☐male ☐non-binary

2. How old are you? _________________

3. Are you ☐right-handed ☐left-handed?

4. Do you have normal vision?
   ☐ Yes ☐ No, I use________________________________

5. Do you have normal hearing?
   ☐ Yes ☐ No Comments: _______________________

6. Here you should:
   1) Check the box for your highest completed education besides interpreter training
   2) Indicate which languages were the language of instruction in all parts of your education

   ☐Education equivalent to Swedish elementary school _____________ (language)
   ☐Education equivalent to Swedish secondary school _________(language)
   ☐Bachelor's degree______________________(language)
   ☐Master's degree_____________________(language)
   ☐Doctoral degree____________________________(language)

7. What is your mother's highest completed education?

   ☐No education
   ☐Equivalent to Swedish elementary school, number of years: ___________
   ☐Equivalent to Swedish secondary school, number of years: ___________
   ☐Bachelor's degree
   ☐Master's degree
   ☐Doctoral degree
   ☐Don't know

8. What is your father's highest completed education?

   ☐No education
   ☐Equivalent to Swedish elementary school, number of years: __________
   ☐ Equivalent to Swedish secondary school, number of years: __________
   ☐Bachelor's degree
   ☐Master's degree
   ☐Doctoral degree
   ☐Don't know

9. What is your first language/ mother tongue?

---

10. Which language(s) do you consider your strongest?

---

11. Which language(s) do you speak with your parents?

---

12. Which language(s) do you speak with your partner?

---

13. Which language(s) do you speak with your children?

---

14. Which other language(s) do you speak?

---

15. Which language(s) do you interpret INTO?

---

16. Which language(s) do you interpret FROM?

---

17. How much do you estimate that you use your respective languages in your free time (indicate in %, the total should be 100)?

Swedish ____________________ %

Second working language, the one tested today ____________________ %

Other languages ____________________ %

18. How much do you estimate that you use your respective languages in education and/or work (indicate in %, the total should be 100)

Swedish _________________ %

Second working language, the one tested today ____________________ %

Other languages____________________ %

19. Do you have any interpreter training? (If there is not enough space, write in the back)

☐ No

☐ Yes, vocational training, individual courses. Where: _____________, which courses:_________________

☐ Yes, internally at an interpreting agency. Where: _____________, which courses:_________________

☐ Yes, comprehensive vocational training, completed year:___, where:_____________

☐ Yes, at a university (community interpreting/public sector interpreting), completed year:______,where:_______________

☐ Yes, at a university (conference interpreting), completed year:____, where:_____________

☐ Yes, at a university (sign language interpreting), completed year:___, where:___________

☐ Yes, other________________________

20. Are you a certified interpreter?

☐No

☐Yes, general authorization year:_________, language(s):_________

☐Yes, specialized authorization health care year:_________, language(s):_________

☐Yes, specialized authorization legal year:_________, language(s):_________

21. How many years have you worked as an interpreter? ____________________

22. How many days a week do you estimate that you have worked as an interpreter in the last 10 years (if you have not worked for 10 years, the years you have been professionally active)? ________

23. How many hours per day, on average, do you interpret on a normal working day?

---

24. We are investigating cognitive processes in interpreting, so we wonder if you have any diagnosis that may affect your cognitive processes (it can be things like epilepsy, dyslexia, autism spectrum, or similar; you do not need to specify what or which one)?

☐No ☐Yes

Appendix 3 Role play manuscript (English translation)

Background Information

The participants have prepared for an interpretation at the Employment Service regarding the establishment benefit. It's not an exam; the purpose is to gather data for a research project. Therefore, it's essential that the conversation flows and is as authentic as possible. Even if you understand what the job seeker is saying, follow the interpreter's interpretations, even if it means you can't continue with your next line in the script. However, it's desirable that you improvise as little as possible, meaning you return to the script as quickly as possible after any digressions. Of course, you can ask the interpreter for clarification, etc. You have a written dialogue, but it's desirable for you to memorize it and also follow the interpreter's interpretation.
Not all lines need to be exact, but it's preferable if the sequence is followed as much as possible. It's crucial that you, to the best of your ability, address the difficulties embedded in the role-play (emotions, interruptions, etc.). Keep in mind that an experienced interpreter user (which you are) primarily focuses on the other interlocutor and not the interpreter.
The conversation should take approximately 20 minutes. Keep an eye on the time and wrap up when you approach 20 minutes, even if you haven't reached the end. It's okay to go a little over, so you don't need to end abruptly. We've included some challenges in the conversation, and it's good if they indeed become challenges.

ROLE PLAY

C: Hello and welcome to the Employment Agency. We haven't met before, but my name is [________], and I'm your case worker.

M: Hi, I'm sorry I'm late. My name is [_____________].

C: We have an interpreter today, and, I don't know, (*to the interpreter*) do you want to introduce yourself? (*act like you find it unnecessary*)

Interpreter: []

C: Thank you! Great! First, I want to ask if you and the interpreter understand each other.

M: Yes.

C: Yes, you were a bit late, but I think we'll manage to cover what we need to discuss today. Was it difficult to find your way here?

M: Yes, a bit. I've just moved here, and it's my first time in this area. I tried to ask for directions, but it's not easy when you don't speak Swedish or English.

C: Well, it's good that you found your way here, and now that you're here, we can get started. Do you have any questions before we begin?

M: No, it's good that we have an interpreter because I was worried if there would be one or not. I wanted to ask my daughter to come with me and help, but she has school, and I didn't want to take her out of school.

C: No worries, we always arrange for an interpreter here at the employment agency, and it's usually better when family members don't interpret.

M: I see, but my daughter is very capable. However, as I mentioned, I'm new here, and it takes time for me to understand how things work in Sweden.

C: (*interrupt the client before she finishes her sentence and be a bit impatient*) Yes, I understand what you mean. But let's get started now. We're here to talk about the establishment plan and the establishment benefit. I'll explain more to you shortly. But first, maybe you can tell me a bit about yourself.

M: (*Get a little confused and concerned that you were interrupted in the previous sentence*) What should I say?

C: I've received your paperwork from the Migration Agency but haven't had a chance to read it all yet. So, I think it would be faster if you tell me a bit about yourself, your education, your children, when you came to Sweden, and when you were granted the residence permit.

M: Alright. I have three children, and we came to Sweden eight months ago and then we applied for residence permits. We've just received them, and I've also received assistance from the municipality in finding housing. I've learned that I can get help finding a job, so now we'd like to take the next step and finally settle in Sweden.

C: That sounds great. Next time you visit me, we'll create an establishment plan that will form the basis for your future activities. We'll support you in quickly learning Swedish, finding a job, and becoming self-sufficient.

M: (*interrupt the case worker before he finishes speaking and become agitated*) But I'm worried too. Are the activities full-time? What about the children? I'm taking care of them alone now. Their father and I got separated when we were fleeing, and we still haven't heard anything from him. (*Become sad and speak softly instead*) It feels really heavy. I don't even know if he's alive or...

C: (*on one hand, you're a bit irritated that you don't really have time for this, but on the other hand, you can't be heartless*) I'm sorry, but we'll have to hope for the best and that he'll get in touch.

M: Thank you, that's kind of you! (*Wipe away your tears*)

C: Let's take it one step at a time, I think. We can discuss what to do with the children later. But I understand that your children are in school, right?

M: Yes.

C:(*You've now realized that you need to shorten your sentences, but you're a bit annoyed with the interpreter for making you do that. Let it show through*) In that case, when you participate in the activities, we agree upon in your establishment plan, you'll receive establishment benefit. You'll receive your benefit for five days per calendar week, and the money is paid out once a month.

M: Who pays out the benefit? How much is it? How is it paid?

C: It's the Social Insurance Agency that pays the benefit. At the end of each month, you must notify us at the Employment Agency that you've attended your activities and explain why you might have been absent. You'll do this using a form that you'll receive from us at the Employment Agency. The money will be deposited into your bank account.

M: I don't have a bank account yet.

C: You can go to the bank yourself, and they'll help you open an account. After that, you'll fill out a form and send it to the Social Insurance Agency so that they can pay the benefit. I can assist you in filling out the form once you have an account. The benefit is a maximum of 308 SEK per day, but the amount can vary.

M: Okay... mmmm... (*give clear signals that you haven't really understood*)

C: (*You realize that the client hasn't fully understood but choose to ignore it*) If you're absent from your activity, you must have valid reasons for your absence, such as being ill. If you become sick, you must contact us at the Employment Agency and report it. You must make your report on the first day you fall ill. If you're sick for more than seven days, you'll need to submit a doctor's certificate to us at the Employment Agency.

M: Oh, my goodness! (*You become upset again, a bit angry and almost on the verge of tears*). There's so much information, so many rules! And so much paperwork and forms here and there. How am I going to manage all of this? I don't know Swedish, or English for that matter. Also, I'm all alone with the children. What am I going to do here without my husband?

C: (*You're a bit tired of your emotional client now and maybe become a bit brusque than you intended*) Don't worry. Every time we meet, I'll book an interpreter. In the beginning, I'll help you fill out the necessary forms and provide guidance. Here's some information about the establishment in your native language.(*Hand over the brochure*) It contains everything I've told you today and more. You can go home and read it at your own pace. We'll continue our discussion at our next meeting.

M: Thank you! (*You wipe your tears and compose yourself*)

C: By the way, about the children... How old are your children?

M: 10, 7, and 4 years old. Why do you ask?

C: I thought I'd prepare some forms for our next meeting. The older children are already in school if I understood correctly. But you can also apply for after-school care for the older ones and preschool for the youngest. This means they'll receive childcare while you're occupied with the activities. In Sweden, it's quite common to have single parents, both single fathers and mothers. Now, unfortunately, the interpreter's time is up. We'll handle all the practicalities about the establishment plan, forms, and childcare next time. How about Monday at 10:00?

M: That works for me. I'll go home and try to read the informational material.

C: Thank you for today. See you on Monday at 10:00. Goodbye!

M: Goodbye!

Appendix 4 Transcription key

[	beginning of simultaneous (overlapping) talk
]	end of simultaneous (overlapping) talk
° °	speech in a low volume
WORD	speech in a louder volume
* *	laughter
(.)	micro-pause under 100 ms
(0.7)	timed pause in seconds
=	latching (no pause between utterances)
.hh	inhale
hh.	exhale
< >	slower tempo
> <	accelerated tempo
:	prolonged sound
# #	creaky voice
~ ~	shaky voice
↑	rise in intonation
↓	drop in intonation

Appendix 5 Rich points (English translation)

	RICH POINTS	TURN
1	Long stretch of talk in Polish	M: Yes, a bit. I've just moved here, and it's my first time in this area. I tried to ask for directions, but it's not easy when you don't speak Swedish or English.
2	Long stretch of talk in Polish	M: Alright. I have three children, and we came to Sweden eight months ago when we applied for residence permits. We've just received them, and I've also received assistance from the municipality in finding housing. I've learned that I can get help finding a job, so now we'd like to take the next step and finally settle in Sweden.
3	Long stretch of talk in Polish Interruption, quiet speech, emotional language	M: (*interrupt the case worker before he finishes speaking and become agitated*) But I'm worried too. Are the activities full-time? What about the children? I'm taking care of them alone now. Their father and I got separated when we were fleeing, and we still haven't heard anything from him. (*Become sad and speak softly instead*) It feels really heavy. I don't even know if he's alive or...
4	Long stretch of talk in Swedish Difficult terminology	C: It's the Social Insurance Agency that pays out the benefit. At the end of each month, you must notify us at the Employment Agency that you've attended your activities

		and explain why you might have been absent. You'll do this on a form that you'll receive from us at the Employment Agency. The money will be deposited into your bank account.
5	Long stretch of talk in Swedish	C: (*You realize that the client hasn't fully understood but choose to ignore it*) If you're absent from your activity, you must have valid reasons for your absence, such as being ill. If you become sick, you must contact us at the Employment Agency and report it. You must make your report on the first day you become ill. If you're sick for more than seven days, you'll need to submit a doctor's certificate to us at the Employment Agency.
6	Long stretch of talk in Swedish Difficult terminology	C: I thought I'd prepare some forms for our next meeting. The older children are already in school if I understood correctly. But you can also apply for after-school care for the older ones and preschool for the youngest. This means they'll receive childcare while you're occupied with the activities. In Sweden, it's quite common to have single parents, both single fathers and mothers. Now, unfortunately, the interpreter's time is up. We'll handle all the practicalities about the establishment plan, forms, and childcare next time. How about Monday at 10:00?

Dialogue interpreting is a cognitively demanding activity. In interpreter-mediated encounters, the dialogue interpreter not only translates, but simultaneously monitors all participants' understanding, including one's own understanding in the two languages, as well as coordinates the encounter between the interlocutors. All these processes are likely to place high cognitive demands on the interpreter's limited resources, which results in cognitive load. How does cognitive load change depending on the interpreter's experience? How does interpreting into the interpreter's stronger or the weaker language affect cognitive load? How can cognitive load in dialogue interpreting be measured?

This dissertation explores dialogue interpreters' cognitive load, drawing on an empirical study involving simulated interpreter-mediated encounters, eye-tracking, and disfluency analyses. In terms of theoretical development, the dissertation explores and adapts the construct of cognitive load in interpreting to the assumptions of cognitive translatology, which understands cognitive processes as consequences of interacting with the environment. The dissertation thus contributes to the growing body of knowledge of cognitive processes in dialogue interpreting.

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