1 Translation and Cognition

An Overview

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1.1 Introduction

Translation has been carried out for millennia, but understanding the particularities of the complicated process of transforming a piece of information from one language into another increasingly intrigues researchers around the world. Perhaps this is one of the many reasons why researchers have become so motivated to conduct studies explaining the processes of translation and interpreting. The integration of cognitive science into translation and interpreting studies (TIS) has formed an interdisciplinary-rich field that is the foundation and impetus of *The Handbook of Translation and Cognition.* In a comprehensive and critical review, the Handbook builds on existing theories and research designs by bringing together contributions from international experts affiliated with institutions and research centers in 18 countries.

As noted by Ferreira, Schwieter, and Gile (2015), "the continued diversity and ever-deepening exploration of various aspects of translation and interpreting are naturally associated with interdisciplinarity and […] the input of cognitive science has been considerable" (p. 7). We exploit this observation in this introductory chapter by foreshadowing prominent themes at the forefront of research in translation and cognition. In the following sections, we briefly present and comment on each of the chapters in the Handbook in the order that they appear within the main parts of the book, namely: theoretical advances; methodological innovations; translator and workplace characteristics; competence, training, and interpreting; and moving forward.

1.2 Theoretical Advances

In Part II, "Theoretical Advances," nine chapters present an overview of translation process research (TPR) and discuss the contributions from and interfaces with cognitive science. In Chapter 2, "Translation Process Research" by Arnt Lykke Jakobsen, the author

provides a review of the behavioral-cognitive experimental paradigm that has been popularly used by researchers around the world. Jakobsen explains the correlation between the events in the mind and the body when humans translate. He presents the historical context of TPR and its development since the first methodologies such as think-aloud protocols. The chapter paints a colorful picture of current TPR and illuminates how translation itself is changing as a result of multimedia forms and machine translation.

Chapter 3, "Models of the Translation Process" by Michael Carl and Moritz Schaeffer, reviews translation models since the late 1940s. Models of translation processes have been developed for machine and human translation and in both TS (translation studies) and in computational linguistics. The idea of linguistic stratification was the basis for translation models, mostly established on the belief that the syntax of natural languages could be formalized. The authors explain rule-based and example-based machine translation, focusing on the decoding process of the source text (ST), followed by the analysis, transfer, and regeneration of sentences in the target text (TT). In the 1980s, as humans continued to gain access to personal computers and more translations were conducted in electronic format, the foundations of statistical machine translations (SMTs) were formulated. Also around the same time, more attention was given to translation functions in the target culture, and less to the linguistic aspects of the STs. The authors move to review models based on empirical data (Gutt, 1991/2000; PACTE, 2003; Risku, Windhager, & Apfelthaler, 2013) and discuss Schaeffer and Carl's (2013) recursive translation process model. The chapter demonstrates that both TS and TPR have generated models and hypotheses that have been concerned with both translation process and product, by investigating typical phenomena in the product, the representation of translation in the translator's mind, and how translations are carried out. Although experiments have been conducted across different languages and tasks, there is still a need to formalize, operationalize, and test the variables that have been identified as relevant in TPR.

Based on the notion that written, auditory, and audiovisual translations are built on two cognitive processes—production and reception—Chapter 4 by Kruger and Kruger, "Cognition and Reception," discusses the importance of a more solid, empirical approach to translation effects. The asymmetrical focus on producers and receivers in cognitive studies is discussed, and it is clear that the importance of analyzing how the translated texts are reconstituted every time the product is read, viewed, and received has been neglected in the literature. An overview of Chesterman's (1997) explanation of translation effects on the reader is presented (i.e., change of mental state, change in actions, and effects in the target culture or intercultural relationships). Kruger and Kruger first explain the relevance of the analysis of cognitive processing in the reception of translation. A target orientation has been accepted by scholars (Chesterman, 1997; Nida & Taber, 2003/1969); however, how receivers (both original and receivers of translations) respond to those texts is scarcely investigated. As such, Kruger and Kruger present a critical review of the links between cognitive-linguistic and sociocultural or ideological approaches to translation, followed by an explanation of the connections between the micro-level of cognitive processing and the macro-level of texts, cultures, and ideologies. A brief discussion on the theory of mind (Annoni, Lee-Jahnke, & Sturm, 2012) is offered to examine the translator's ability to assess the target audience's knowledge and needs, which is related to a person's mental state. Next, Kruger and Kruger present the

theoretical models of translation reception, followed by a discussion on usability studies, accessibility, and translation evaluation. They also offer an overview of empirical research on cognitive processing in terms of reception for written and audiovisual translation from different perspectives, such as reading behavior, cognitive effort, comprehension, and attitudes. The chapter concludes with a discussion on the complexity characteristic of cognitive processing in translation spanning several modalities.

In Chapter 5, "Directionality in Translation," Ferreira and Schwieter bring to light the importance of translating into a non-mother language (inverse translation, IT) and how research in this area has not been adequately recognized even though its practice may be more common than translation into the mother language (direct translation, DT). Traditional assumptions regarding the superiority of DT relative to IT have been made without empirical support, even though IT is a necessity as it may be difficult to have access to translators who are native speakers of the target language. The authors analyze the few empirical studies that have compared DT and IT and their often misleading discussions of the translator's ability to perform IT. They also review data from questionnaires carried out in Europe, where IT seems to be a common practice accepted by both clients and translators. The idea of the perfect translator, or a balanced bilingual, is briefly discussed. From a Chomskyan perspective, the perfect informant would be an authority on the language and would be able to make grammatical judgments. The chapter considers issues relating to a translator's identity and ideologies and notes that in terms of social and cultural approaches, little interest has been shown in answering these important questions. Both IT practice and teaching have been criticized by scholars without having the empirical data to support their claims. The field has now reached a point where studies must be developed to not only describe IT's specificities but also the development of IT competence. Future work should try to uncover the array of variables that play a role in the translation process, including translators' own abilities and experiences.

Celia Martín de León, in Chapter 6, "Mental Representations," discusses two perspectives of mental representations: The first defines a mental representation as an image-like or a language-like construct, and the second explains cognition through mental representations. The chapter begins by discussing the nature of mental representations and how their components have been tested in multiple frameworks and by different philosophers over the last century. It then turns to symbolic representations in cognitive science from a relevance theory perspective and to the imagery debate and its role in TS. Focusing on social and cultural dimensions, Martín de León applies experience-based mental representations to TS, assuming that mental representations may be differently organized by different groups (source culture and target culture) and that translators would be able to identify such differences. Experiential mental representations are also used to describe the translators in a user-centered approach, as well as to describe how TTs are mapped. Next, she explains embodied representations and mental simulations in cognitive science, including image schemas, followed by a review of how they form part of TS. According to these approaches, cognition relies on mental representations, although alternative perspectives are also discussed. The chapter concludes with a commentary on how the mind and world are coupled in dynamic ways and that mental representations are "more like internal simulations of external actions and situations than like internal static structures."

Chapter 7, "Aspects of a Cognitive Model of Translation," is contributed by Gregory M. Shreve and Isabel Lacruz. The chapter explains how translation and cognition has developed in sync during the last two decades and how there is every reason to believe that it will continue to rapidly increase. The fusion of translation and cognition allows research to build a solid empirical framework that supports the creation of a robust cognitive model of translation. The chapter presents a review of translation competence as understood by Wilss (1976) and discusses the cognitive resources required during translation as interpreted in expertise studies. The authors also discuss the idea that being able to solve transfer problems is a required starting point for a cognitive translation model. Under this assumption, the process of solving transfer problems, based on several knowledges, is presented. Because reading, writing, and transfer are essential components of translation processes, the authors provide an overview of models from various perspectives. They point out that there is not a wide range of theoretical apparatus to explain the transfer process of a comprehensive psycholinguistic model of reading, text comprehension, and writing. Perhaps the most significant contribution of the model is that it provides an explanation of the transfer processes that occur between ST reading and TT writing. The chapter transitions to explain that translation is a complex cross-language activity that involves sequences of activation and inhibition. This discussion integrates language switching models from the bilingual literature into translation activities and explains a cognitive model of translation that situates activities such as reading, writing, and transfer within the scope of general and specialized models of cognition and bilingualism. The integration of models from various disciplines can lead to more robust models of translation processes.

In Chapter 8, "Bilingualism in Cognitive Translation and Interpreting Studies," Schwieter and Ferreira outline issues related to the interface between cognitive bilingualism and TIS. A discussion on the differences and similarities between translation and interpreting from psycholinguistic perspectives is first contextualized, followed by a review on language recoding as articulated in Christoffels' (2004) meaning-based strategy and transcoding strategy. The authors underscore the differences between translation and interpreting—both of which are complex tasks, yet involve different strategies and decision-making processes. The chapter then turns to a discussion on literal translation and cognitive effort (Schaeffer & Carl, 2014; Tirkkonen-Condit, 2005) and then to an examination of the role of working memory (WM) in interpreting tasks. Key studies are reviewed that measure the relationship between WM and multilingualism while focusing on the multilingual lexicon and multilingualism in general. The cognitive consequences of bilingualism are presented in a brief review of important studies that have analyzed different groups of bilinguals in order to access executive control, among other aspects. Even though there are still mixed and rather controversial findings to be clarified, it has generally been shown that bilinguals have cognitive advantages compared to their monolingual counterparts. Schwieter and Ferreira's chapter demonstrates the essential integration into TIS of studying multilingualism from psycholinguistic perspectives.

In Chapter 9, "Recognizing Social Aspects of Translation," Sonia Vandepitte presents an overview of the development of sociological approaches to TS. As a subfield of TS,

sociological perspectives and methodologies are rather recent and traditionally have been treated separately from cognitive approaches to TS. The chapter presents a discussion on interlingual *tertium comparationis* applied to translation that compares the meaning of an ST in its respective language to the ST in the target language. It also focuses on how a transition from a linguistic approach to a more social approach could replace the focus on the shift from languages (ST and TT) to audiences. Throughout the chapter, the author presents aspects of cognitive research that help shed light on social characteristics of translation work. She discusses the construction of the meaning as described in previous work and moves to a reflection on how translation solutions are carried out. Through her commentary on the principle of relevance (Gutt, 1991/2000), Vandepitte explains translation as interlingual interpretive language use. She then reviews the notion of prototypes as explained by Halverson (2007) and the idea that translation is a mental activity based on both prototypes *and* schemas (Langacker, 2008). The chapter concludes by discussing reception and cognitive characteristics of the audience and advocates for future work that integrates social aspects into cognitive approaches.

Boguslawa Whyatt, in Chapter 10, "Intralingual Translation," presents a discussion on the process of reformulating, rewording, or paraphrasing—also known as intralingual translation. The author explains that there are obstacles to effective communication within the same language, even though they may be less pronounced than the obstacles involved between different languages. The chapter presents a review on the semiotic approach to intralingual translation, followed by a discussion of language and meaning and how words are used as material mediators (Barthes, 1967) for communicative purposes. It also discusses how intralingual translation might be a less obvious type of linguistic mediation compared to interlingual translation and then offers a commentary on how glosses found in religious manuscripts were used as aids in their interpretative process. The author looks at the effects of time in intralingual translation and leads a dialogue on the reinterpretation of canonical texts that are adapted for new generations, in its written form, and also for stage or screen. She also presents some insights from studies on reading and how intralingual translation may remove linguistic obscurity. She also articulates the objectives of the ParaTrans Project, which promises to contribute to TPR in its understanding of how translation and paraphrasing share similar stages of processing information from texts. Whyatt's chapter argues that cognitive-oriented approaches to translation should not underestimate the contributions that intralingual translation has to offer to TS.

1.3   Methodological Innovations

In Part III, the Handbook turns to methodological innovations of translation and cognition. Chapter 11, "Multimethod Approaches" by Sandra L. Halverson, explains how cognitive translation studies (CTS) has developed hand in hand with research methodologies eliciting new types of data. She identifies important reasons for employing a mixed-methods approach as informed by Bryman (2008) and explains the role of

theory in mixed-methods research projects as they are applied to quantitative and qualitative studies. Moving to a discussion on the constructs that have been used especially within the TRP paradigm, Halverson presents an overview of some of the studies that have analyzed cognitive effort during translation. The author also comments on literal translation as a default rendering procedure following her previous work (Halverson, 2015). This overview is followed by a discussion on an additional set of constructs within CTS, including the concept of "functional fixedness." Its relevance is related to the idea of translation as a problem-solving activity. She also presents a review on the notion of automaticity as discussed by Schaeffer and Carl (2013), in which it is assumed that the smaller the number of potential translations, the more likely the translation decision will be "automatic." The chapter illuminates the fact that the traditional dichotomy of product vs. process has become outdated in light of new data types that are available and analyzed in cognitively-oriented work. It also argues that research questions cannot be answered on the basis of only process- or product-oriented data (e.g., corpus or gaze data).

In Chapter 12, "Verbal Reports," Riitta Jääskeläinen offers a review of a popular methodology that is strongly associated with fundamental ontological and epistemological convictions. Jääskeläinen starts the chapter by discussing Ericsson and Simon's (1984/1993) theory of verbalization. As a result of practice, cognitive processing tends to become automated but still unavailable for verbalization. The chapter presents the limitations of verbalization and points out that few studies have focused specifically on methodology—something she argues is long overdue. In terms of TPR designs, she draws attention to the fact that researchers have commonly neglected a theoretical reflection that might be related to the fact that TPR is a young discipline. Questions related to the validity and reliability of verbal protocols are discussed in order to offer a critical view of the methodologies employed thus far in TPR. These questions, however, remain unanswered and require specific testing. The chapter also argues that future research should explore the possible incompatibility of verbal reports with the evolutionary view of consciousness.

Silvia Hansen-Schirra, in Chapter 13, "EEG and Universal Language Processing in Translation," presents an overview of EEG methods and event-related potentials that have recently been used in research in translation and interpreting. She starts with an overview of translation universals as they are related to cognitive processes during translation (e.g., explicitation, cohesive features, and simplification) and continues on to a review of the concept of grammatical metaphor (Halliday, 1985; Halliday/Matthiessen, 1999) as used to model translation. In translation, TTs are made more explicit as the translator's own understanding and interpretation are transferred, when the easiest alternative for formulation of the TT is used (Steiner, 2001; Tirkkonen-Condit, 2005), leading to explicitation and simplification. The chapter next reviews Toury's (1995/2012) two laws of translational behavior: growing standardization and the law of interference. Other references are incorporated to understand normalization, including Baker's (1996) universal feature of normalization and the use of parallel corpora (Hansen, 2003; Teich, 2003). A mixture of normalization and shining-through phenomena, as proposed by Hansen-Schirra (2011), is then discussed. Other studies that discuss normalization

and shining-through (Hansen-Schirra & Steiner, 2012; Tirkkonen-Condit, 2004) are also presented. The chapter then transitions to discuss several models of the translation process and key studies that have employed EEG technology. In psycholinguistics, priming, inhibition, and monitoring, among other tasks, have been investigated using cognates, non-cognate word recognition tasks, and word translation tasks, among others. Quantitatively, as we move forward to new methods and approaches to investigate translation, it seems that it is possible to operationalize and measure certain processes. Triangulation appears to be a productive way of analyzing translation processes, in contexts in which ecological validity complements experimental control.

Chapter 14, "Eye Tracking in Translation Process Research" by Kristian T. Hvelplund, explains how eye tracking has become a well-established method in TPR. He starts the chapter by presenting central methodological issues currently being debated in the field. There are several challenges involved in the research designs discussed, from the choice of equipment to the selection of participants. Hvelplund presents a nonexhaustive list of studies that have explored the main questions on TPR by using eye-tracking data, including studies on interpreting, sight translation, reading in translation, cognitive effort in translation, time pressure and text difficulty, directionality, expertise, competence, translation styles, metaphor translations, and post-editing translation. In terms of future research, the chapter points out that technology could redefine research practices in terms of developing in situ "ecological" data collection. Hvelplund also takes into account the importance of triangulation and the production of a translation. With eye-tracking technology, research questions that were previously tested using other methods could be revisited to obtain qualitative, fine-grained analyses and potentially a better comprehension of translation processes.

Chapter 15 by Patricia Rodríguez-Inéz, "Corpus-Based Insights into Cognition," presents a review on the most common corpus linguistics method used in TPR. The chapter begins under the assumption that corpora cannot provide direct insights into cognition, leading researchers to combine corpus and experimental data and analyze both process and product. Rodríguez-Inéz presents an overview of corpus methods and techniques and turns to a discussion on the few studies of translation competence and corpora along with an overview of studies that have focused on translation units. From this conversation, the chapter moves to discuss style in translation followed by a brief review of translation universals, post-editing and genre, and translator training. Finally, the chapter critically looks at the corpus-based research that has contributed to studies of cognitive aspects of translation and argues that the combination of data from other methods should be included in corpus-based studies to offer a more comprehensive view of the processes involved in translation.

Hanna Risku, in Chapter 16, "Ethnographies of Translation and Situated Cognition," presents a review on situatedness and translators' interaction with the environment and how cognitive translation processes benefit from a situated approach to cognition. This new approach highlights novel data collection methods, including an ethnographic approach to TPR. Risku begins the chapter with foundational definitions of knowledge from its theoretical and epistemological origins and moves to a discussion on the relevance of ethnography for TS. The chapter then focuses on the methodological challenges

that an ethnographic approach faces (e.g., ethnographic research focuses on a deep, close analysis of selected cases, capturing as many factors in one single case). Practical challenges for this type of research, such as finding relevant and willing translation settings, are also discussed in the chapter. Qualitative data analysis methods including grounded theory (Glaser & Strauss, 1967) are discussed along with a discussion on data reporting in ethnographic research. The chapter concludes with a critical review of the contributions of ethnographic research, emphasizing that quantitative and qualitative approaches in translation and cognition should be intertwined.

1.4   Translator and Workplace Characteristics

Part IV of the Handbook focuses on characteristics of translators and the workplace. Chapter 17 by Sharon O'Brien, "Machine Translation and Cognition," starts with a review on human interaction with machine translation (MT) in its three basic forms: evaluation, revision, and use. Evaluation relies on human perception, from a cognitive point of view, and can be approached from different perspectives, such as error classification and annotation, adequacy, fluency, and ranking. O'Brien points out some of the problems associated with human evaluation and calls attention to the relationship between limited processing capacity and quality of evaluations. She then moves to a discussion on automatic evaluation metrics (AEMs); although they have overcome several of the weaknesses in human evaluation, they still present some challenges. A review on post-editing MT as a complex cognitive task is put forth. The author also reviews Risku's (2012) discussion of the three cognitive frameworks used in TPR, including the information processing model, followed by a review of the information processing view of post-editing. O'Brien then explains the dynamic connectionist system, its use in cognitive science, and how it might help us to understand the complexities in post-editing. She extends this discussion to include how information integration takes place during translation as hypothesized in Smith and Thelen's (2003) dynamic field model. In all, the chapter makes a clear argument for the fact that MT evaluation presents several limitations that might not be solved with AEMs. Future research must recognize that post-editing is a complex cognitive process and that as technology develops, complexity will also increase, making it all but necessary to make methodological alterations.

In Chapter 18, "An Ergonomic Perspective of Translation," Maureen Ehrensberger-Dow discusses an under-researched subfield of TS, namely, the role of ergonomics in translation. Ergonomics is concerned with the interaction between humans and the application of theories, principles, and methods to optimize human well-being and overall system performance. Ehrensberger-Dow opens the chapter by presenting an overview of ergonomics, its three main domains, and its application in TS. She first explains the physical ergonomics of translation and moves to the cognitive ergonomics of translation, and later explains some aspects related to the organizational factors that affect a translator's situated activity. She explains how translators interact with the tools they use, such as in computer-aided translation, for which research has shown both positive and negative effects on the translator's work. The chapter explains how a translator's decision making might be affected by ergonomics, and she uses the translator's

health as an example. In fact, there seems to be a relationship between translator health and training: Meidert, Neumann, Ehrensberger-Dow, and Becker's (2016) results showed that health problems were more noticeable among younger professionals and freelancers who may have missed out on translator training programs which address good ergonomic practices. It is clear from this chapter that taking into consideration ergonomic resources, tools, settings, equipment, and organizational systems will lead translators to a better deployment of their cognitive resources, positively affecting translation quality.

Ana Rojo, in Chapter 19, "The Role of Creativity," describes how creativity has been approached in TPR by beginning with a review of creativity and how it has been measured in different research areas. She brings into the discussion how creativity has encountered problems of measurement and definition, and how those problems have emerged in other subareas. The chapter also explains how creativity has been examined in literary texts and across several domains such as comprehension, production, and revision. As per interpreting and translation, Rojo notes that research has been unable to come to a conclusion on the relationship between creativity and expertise. However, she is more optimistic when it comes to future studies that incorporate more homogeneous criteria that would make data comparable. The last sections of the chapter look at the role of creativity in problem-solving processes, the function of emotions as a key element in decision making, and the role of creativity in translation teaching. Moving forward, the chapter advocates for several changes in creativity research in TPR such as a redefinition of the measurement instruments, data triangulation, and sample size.

Rojo has also contributed Chapter 20, "The Role of Emotions." Rojo begins the chapter by describing the interface between emotions and reason and, even though we now know that this interface is a key component in cognitive processes, it has been neglected or underexplored in TPR. Rojo explains how four central aspects have been the focus in previous work in this area: emotionality of TTs, processing styles, quality, and reception. She also describes how emotion may be related to the translator's verbal creativity skills, but more research is needed to improve measures of the translator's emotional involvement with the text. Rojo briefly reviews how personality traits and degree of professional expertise are correlated with emotional regulation as seen in studies that have shown that intuition and emotional intelligence play an important role in translation performance. The chapter also looks at how expertise affects emotion regulation and helps to guide behavior in translators and interpreters. Studying emotions in TIS is a new research area that merits further attention for a comprehensive evaluation of the effects of various affective states on translation performance.

Chapter 21, "Cognitive Effort in Translation, Editing, and Post-editing," contributed by Isabel Lacruz, describes the relationship between cognitive effort, speed, and accuracy in TPR. The author starts by defining cognitive effort and how it has been analyzed by researchers outside TPR followed by an overview of studies that used eye-tracking data to analyze language processing, including reading and translation. Analyses of pauses have played an important role in TPR, and also in studies on writing, post-editing, and MT. These analyses have explored factors such as the average pause ratio, pause to word ratio, and the relationship between demand and effort as it has been analyzed in work on MT. The chapter also comments on measures that have been used to

analyze cognitive effort, the interventions that might reduce cognitive effort, and the neuroscientific methods employed in this research area. In this chapter, Lacruz defines cognitive effort in the context of translation, editing, and post-editing processes and argues that subsequent studies can help better explain how to build strategies and facilitate productivity and quality.

Susanne Göpferich presents a discussion in Chapter 22, "Cognitive Functions of Translation in L2 Writing," on the use of the L1 in L2 writing and how translation from the L1 is a natural process while writing in L2. She offers a review of studies on L1 and L2 writing processes and on how the level of L2 proficiency and attention are correlated in writing. The author points out the fact that academic and nonacademic writing have not been investigated as two distinct processes, as the cognitive load on the writer would be higher in academic writing. The chapter digs deeper in a discussion on the general functions of translation during L2 writing, including translation as a writing practice in L2, while pointing out the disadvantages of translation as a subprocess of L2 text production. She also explains how L2 proficiency affects the functions for which the L1 is used in L2 writing. Other variables that have an effect on this process are also described, such as the cognitive complexity of the task being performed. It seems as though task complexity is related to reliance on the L1: if a task is too complicated, the more inclined the writer will resort to his or her L1, likely to avoid cognitive overload. Göpferich acknowledges that translation is a necessity in our multicultural societies and argues for developing translation competence in students of all disciplines, not just for future professional translators.

1.5   Competence, Training, and Interpreting

Part V explores issues of competence, training, and interpreting and begins with Elisabet Tiselius and Adelina Hild's Chapter 23, "Expertise and Competence in Translation and Interpreting." Although competence and expertise are sometimes used as synonyms, in this chapter, the two concepts are defined as different constructs. Models for competence in translation and interpreting are presented, including models in which competence and expertise overlap. Tiselius and Hild discuss how expertise has been investigated in terms of professionalism in TIS and how professionalism and expertise are not coextensive. They move to a discussion on deliberate practice as it has been approached in expertise studies, and then present prominent research methods used to investigate competence and expertise (e.g., verbal protocols, interviews, expert–novice comparisons, and neuro-cognitive methods such as fMRI and EEG). The chapter closes with a discussion of the implications for practice, as both competence and expertise can be based on empirically-researched practice. Competence and expertise are topics that will continue to draw attention from researchers as new methods promise to provide a better view of the cognitive functions that play a role in translation performance.

Chapter 24, "Interpretation and Cognition," is presented by Barbara Ahrens and offers a review of the development of interpreting process research from psycholinguistic and cognitive approaches. Beginning with a historical look at one of the first questions in simultaneous interpreting (i.e., how are interpreters able to listen and speak at the same time?),

the author looks at methods of analyzing speech rate and pauses, short-term memory, and training. The chapter then reviews Gile's (1995/2009) effort model and also presents a review on how cognitive processes have been modeled in interpreting studies (e.g., Gerver, 1976; Moser, 1978; Paradis, 1994; Setton, 1999). The underlying cognitive processes involved in consecutive interpreting are also discussed, and the common factors measured in interpreting studies such as memory, knowledge, and expertise are described.

Kilian G. Seeber's Chapter 25, "Multimodal Processing in Simultaneous Interpreting," offers an appraisal of multimodal processing during simultaneous conference interpreting, explaining how SI is different from translation in terms of multimodal processing. Seeber starts his discussion by explaining how multimodal stimuli are present in our environment. He then explains audiovisual comprehension and redundancy and shows how the latter affects performance. The integration of audiovisual information in terms of synchronicity and mismatches is discussed following a review of audiovisual integration in SI (e.g., how visual input affects the interpreter's output). The chapter also presents a brief overview of studies that aim to explain the complexity of SI from a processing perspective, including Gile's (1995/2009) effort model and the cognitive resource footprint (Seeber, 2007). Seeber expands on this in the cognitive resource footprint for simultaneous interpreting with text, which identifies the visual verbal component. This chapter demonstrates the potential benefits and disadvantages of multimodal processing and explores its cognitive implications.

In Chapter 26, "Deliberate Practice and Neurocognitive Optimization of Translation Expertise," Bruce L. Diamond and Gregory M. Shreve offer an articulation of cognitive factors that impact translator performance and suggest ways in which consideration of these factors may be implemented in deliberate practice to develop translator expertise. The chapter starts with a review on expertise, deliberate practice, cognitive context, and a definition of optimization. As highly complex cognitive activities, translation and interpreting involve several interacting cognitive processes and subprocesses. The authors present an overview of concurrent semantic and lexical activation and executive control to describe how two languages are activated, controlled, and processed by bilinguals. For less- and more-proficient bilinguals, language interference occurs, and when there is an increase in the cognitive effort required to produce the output, a high stress condition might ensue. The authors discuss stress-related interferences and possibilities for managing those conditions. The chapter then moves to a discussion on bilingualism, switching costs, and executive control as seen in work from developmental psychology. On the basis of studies among bilingual children, the chapter presents an overview on lexical retrieval and verbal and nonverbal recall, and transitions to a discussion on the relationship between age and deliberate practice. The cognitive benefits of bilingualism are also discussed, followed by a review of work on WM, translation, and interpreting.

Chapter 27, "Translation Competence Development and Process-Oriented Pedagogy," is authored by Gary Massey and discusses the process-oriented cognitive approaches to translation competence, competence development, and translation pedagogy. Massey opens the chapter with a review of the pedagogical interest in the development of translation competence by discussing translation process models including, among others,

Gile's (1995/2009) idealized sequential model of the translation process, Kiraly's (1995) model of the translator's mental space, PACTE's (2003) holistic model of translation competence, and Kelly's (2005) model that fits on the European Master in Translation wheel of competence. Massey then explains how process-oriented methods can be applied as training techniques to help develop translation competence and then reports on learning effects that have been found in prior work. The chapter argues that future work in TS should be more rigorous and consistent in order to widen the focus of process-oriented pedagogical studies and to emphasize the sociological event of translation.

Following the discussion on translation competence and training, Chapter 28, "Implicit Theories and Conceptual Change in Translator Training" by Marisa Presas, offers a review of implicit theories and conceptual change. Training, in general, focuses on modifying learners' initial translation procedures while ignoring theory. As a result, there is a separation between procedural and conceptual knowledge during students' learning process. Presas reviews implicit theories before explaining how translation didactics show a dichotomy between theory and practice. The chapter explains the conveyance of theoretical knowledge and how researchers have been trying to construct a theory of practice. The chapter then looks at the translator's theoretical knowledge and its assessment, followed by a discussion of the idea of translation norms. It then describes the concept of conceptual change and its pedagogy and proposes a methodology that would promote conceptual change for students and enhance knowledge acquisition in translation, assuming that learners have initial theories that affect their process.

1.6   Moving Forward

In Part VI, the Handbook offers two commentaries on ways in which future research can flourish and move forward the field of translation and cognition. Fabio Alves and Amparo Hurtado Albir's Chapter 29, "Evolution, Challenges, and Perspectives for Research on Cognitive Aspects of Translation," provides an overview of the development of the cognitive aspects of translation for the last 40 years with an eye on where the field is and should be headed in the future. The authors focus on TPR's evolution and review translation competence studies before and after the increase of empirical research in the field. The chapter then looks at research that has been conducted on the acquisition of translation competence while highlighting some aspects that require more robust empirical knowledge. Alves and Hurtado Albir also present a review of the contributions from empirical studies, which have been strongly expanded in recent years, and offer a discussion of the challenges that lie ahead and ways of overcoming such obstacles.

Chapter 30, "Looking toward the Future of Cognitive Translation Studies" by Ricardo Muñoz Martín, concludes *The Handbook of Translation and Cognition.* The chapter critically discusses the next steps to be taken in future research on CTS. The author presents a brief on the seminal contributions to the discipline and takes issue with theoretical models of translating that have not formulated hypotheses or interpreted results properly. The chapter calls for a renewal of computational translatology and the development of cognitive translatology. The author also discusses possibilities that

combine quantitative and qualitative data collection procedures and analyses. Other challenges the author identifies for future research include an analysis of the workings of the brain, a validation of views of translation cognition and their impact on reality, and the need for clarification of key terms.

   The Handbook of Translation and Cognition is the first handbook-length resource to capture the fruitful intersection of cognitive science and TIS. It offers an overview of current issues in TIS from cognitive perspectives and also provides important theoretical and empirical implications. The Handbook provides the most complete and coherent overview of cognitive approaches to TIS currently available.

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