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Reviewed by **Zhang Guangfa & Wen Jun**

Beihang University, School of Foreign Languages, Beihang University,  
No. 37, Xueyuan Road, Haidian District, Beijing 100191, China  
E-mail: zgfasz@163.com (Zhang), junwen@vip.163.com (Wen)

*New Directions in Empirical Translation Process Research: Exploring the CRITT TPR-DB* is an edited volume collected in “New Frontiers in translation studies”, a Series which focuses on new and emerging themes in translation studies. The three editors compiled a very innovative volume on diversified topics of empirical translation process research (TPR). This book is divided into three parts. The first part covering Chapter 1 and 2 provides introductions to this book and CRITT TPR database respectively, the second part ranging from Chapter 3 to 7 is dedicated to various issues of post-editing with CSMACAT, and the third part consisting of chapter 8 to 14 deals with the modeling of human translation process.

The volume starts with a brief historical and technological overview of TPR by the editors of this book. Preceded by the longest prescriptive stage, and the descriptive stage prevailing since the 1970s, translation studies has come to a new stage in its development where translation research becomes predictive. This new trend is mainly attributable to the development of modern technologies such as keylogging softwares and eye-trackers.

Empirical TPR which was based only on the analysis of target texts or TAPs some 20 years ago did not undergo substantial changes until the emergence of a new data-acquisition software, Translog which was developed by a group of researchers at the Copenhagen Business school. This tool and the emerging research activities around it have given rise to the foundation of CRITT in 2005 and considerable research which has been reported in a number of edited volumes published within the Copenhagen Studies in Language series. This volume is centered around the CRITT TPR DB. At last the authors provide a chapter-by-chapter review of this book.

Chapter 2 written by the editors too describes CRITT TPR DB. TPR-DB is a publicly available database of recorded translation (and other text production) sessions, and has accumulated a large amount of process data with the aim to stimulate large-scale TPR facilitated by a consistent database format and a

well-defined set of features. All TPR-DB studies contain recorded key logging and many contain eye-tracking data. Usually, a TPR-DB study consists of one or more sessions, during which a text is translated, copied, edited or revised. The compilation of translation process data produces various tables, and the data contained in these tables can be analyzed, evaluated and visualized in many different ways. TPR-DB is comprehensive in terms of data forms, because it includes translators' keystroke data produced within and outside the GUI and recorded by Translog-II, CASMACAT, and Inputlog.

Chapter 3 describes a pilot study testing the integration of online and active learning features into the computer-assisted translation (CAT) workbench in the CASMACAT project. It compares the results obtained during an evaluation of the CASMACAT workbench with human efforts under three different conditions: (1) interactive translation prediction (ITP), (2) ITP with online learning(OL), and (3) ITP with active learning(AL). Within the ITP framework, the user collaborates with a statistical machine translation so as to improve translation quality with less effort. During OL, the system learns the modifications by the translators in real time so as to prevent the same errors in the machine generated translations. During AL, only the machine-generated translations with worst quality are post-edited so as to maximize the final translation quality and minimize user efforts. Results showed that the translators using ITP systems incorporating OL consistently required less typing effort than those using regular ITP. The translation quality obtained using ITP with AL was consistently better than that obtained by means of conventional ITP at the same level of typing effort.

Chapter 4 analyses the impact of interactive machine translation on post-editing effort by comparing interactive post-editing(IMT) with traditional post-editing(MT) using metrics of temporal, technical and cognitive efforts. In this study, two medical texts from the EMEA corpus for English-Portuguese language pair were post-edited by 16 participants with recordings of their gaze and keyboard activities collected by the post-editing tool of CasMaCat workbench in conjunction with a Tobii T60 eye tracker. The participants were asked to carry out post-editing tasks under two different conditions: (1) MT and (2) IMT. In MT condition, the MT system, as the translator types, suggests alternative target translation which he can interactively accept or overwrite, while in the MT condition, no assistance is provided when he is editing the raw MT output. It was found that participants neither became faster when carrying out post-editing task with IMT nor showed a reduction in the number of keystrokes. IMT post-editing has significantly lower fixation duration and fewer fixation counts in comparison with traditional post-editing.

Chapter 5 investigates whether and how the performance of professional post-editors working with ITP improved over time by comparing the CASMACAT

ITP with traditional post-editing mode (PE). The study involved five post-editors working alternatively with both modes over a period of 6 weeks in which their activity data was recorded. After that, the translators' learned activity was compared with a control group of post-editors with no experience of using ITP. It was found that professional translators needed an average of 6 weeks to familiarize themselves with ITP, and that the technical post-editing effort using ITP was lower after 6 weeks than that in the control group who had no experience with ITP before.

Chapter 6 explores the effectiveness of consulting external resources during translation and post-editing of general text types by comparing 40 from-scratch translation sessions with 40 post-editing sessions of 10 master's students of translation from English to Dutch. This study made use of two state-of-the-art logging tools, i.e. CASMACAT, and Inputlog. The study found that translation students spent significantly more time in external resources for from-scratch translation than for post-editing, and no statistical evidence for the hypothesis that different types of resources are used in translation and post-editing was found. And longer consultation of external resources in from-scratch translation correlated with higher translation quality, while the opposite was true for post-editing, where longer consultation of external resources correlated with lower translation quality.

Chapter 7 introduces a pilot study of translators' interaction with digital information and information tools. To be specific, the information tool examined in this chapter is a prototype biconcordancer (BiConc) integrated in the CASMACAT workbench. The BiConc is one of external online tools that participants could use while post-editing two machine-translated texts under two conditions: (1) traditional post-editing, and (2) interactive post-editing with online learning. It was found that only three out of seven participants made use of the BiConc. Participants who did not use this tool were also the ones who used fewer external resources overall, and the opposite was true for those who used BiConc because they reported using other internet resources such as online dictionaries, term banks and corpora. The reasons for the results may be participants' familiarity with and trust of this tool.

Chapter 8 evaluates an automatic statistical method to annotate TPR data against manual annotation by human experts with a background in TPR. It is assumed that human translators go through three human translation processes (HTPs) during post-editing of machine translation output: orientation, revision and pausing. Modern translators' workbenches with efficient logging capabilities usually produce a large amount of translator activity data. The complexity and abundance of these data make it impossible to analyze them manually. The authors, thus, put forward a statistical model for data annotation based on the assumption that the probability of executing a particular HTP next is fully determined by the

current HTP. At last they evaluate this statistical model with annual annotation. It was found that the annotation shows good agreement with that by human experts, thus automatic annotation of translation logs promising to be a valuable tool for translation process researchers.

Chapter 9 reports on an investigation into the relationship between the number of translation alternatives for a single word and eye movement on the source text. Two features of the TPR-DB: relative word order and word translation entropy, are used to predict first fixation duration, among other early eye movement measures. It was found that the number of translation alternatives for a single word and word order differences between source text and target text have an effect on very early and late eye movement measures. The results can be interpreted in terms of semantic and structural cross-linguistic priming. Items with similar word orders in source and target texts tend to have similar syntactic structures, and therefore are more likely to prime structurally. Source items with few translation alternatives are likely to have a semantic representation and are hence more likely to prime semantically than the ones with more translation alternatives.

Chapter 10 explores the relationship between syntactic entropy and priming in translation. Syntactic entropy measures the uncertainty for different translators to produce the same TT structure for a ST sentence, and is indicative of the literality of translations on a syntactic level. The authors investigate the correlation of syntactic entropy with the observable measurements from the TPR DB for three language pairs: English-German, English-Danish, and English-Spanish. The results demonstrate positive correlations between syntactic entropy and the durations for the translation tasks for the language pairs. This corroborates the claim that both the lexicon and syntactic structures might be co-activated for the two languages.

Chapter 11 investigates the impact of the type of cohesive chain including main cohesive chain and secondary cohesive chain on cognitive effort in Portuguese-Chinese translation and post-editing tasks. Participants fall into two groups with one group translating and the other post-editing the same text. Eye movements and keyboard activity data for the two cohesive chains were analyzed using a linear mixed-effects regression model. It was found that the type of chain had an effect on target text reading and production, but the type of task had no effect on the processing of cohesive chains. It means that cohesive chains are processed similarly in post-editing and translation.

Chapter 12 discusses three different ways of operationalizing restructuring of source material in the target text. The first one appears in Chap. 10. The author points out that the annotations used for the analysis in Chap. 10 are relatively shallow, and puts forward improvement suggestions for them in order to better capture the variation in the alternative translations. In particular, the author

suggests an annotation system used in a large product-based corpus. This system would probably capture more fine-grained details, which are missed by the system used in Chap. 10. This new system although improved to a great extent is not the optimal choice. The most promising annotation schema uses the relevance theoretic notions of procedural and conceptual encodings to investigate the cognitive load of structuring information in translation. This system, the author holds, might best capture restructuring effort in translation processes.

Chapter 13 reports on an experiment which tests the hypothesis that novices tend to translate more literally than professionals or experts. A total number of 60 participants were involved to do French-Polish translation of a newspaper article and they were divided into three groups of twenty, including non-professional bilinguals, student translators and professional translators. The experiment had two conditions: (1) translating after a first reading of the source text and producing a summary of the source text in the target language, (2) translating straight away without a first reading and summary. The variable was examined with a  $3 \times 2$  analysis of variance. It was found that the students translated less literally than professionals. There are no significant differences in the amount of text translated literally between professionals and non-professionals.

Chapter 14 introduces an annotation schema of TPR data. The study investigates the differences between from-scratch translation and post-editing for general purpose texts as compared with domain-specific texts with respect to production times, key-logging and eye-tracking data. Results showed that post-editing was faster than from-scratch translation irrespective of the domains of texts. However, no significant difference was found between the two text types in spite of the tendency toward translation taking longer for domain-specific texts than post-editing.

This book does reflect new directions in empirical TPR, and has many strengths, including but not limited to:

First, the publication of this book is based on the technological advance in TPR. When the pioneers of TPR (such as Lörscher 1991; Jääskeläinen 1999) began to pay their attention to TPR, the only tool available was TAPs. In the past two decades, however, the rapid development of information and communication technologies provides strong technological support of TPR. The tools used in this volume include Translog, eye trackers, CASMACAT BiConc tool, CASMACAT workbench, etc, and the application of these modern tools extends to a great extent the scope of TPR so that the topics which were not possible for TPR decades ago have become feasible.

Second, all of the languages involved in this book except for Chinese discussed in chapter 11 belong to Indo-European language family. As for chap. 11, one of the difficulties it has to deal with in the experiment is the completely different

input method of Chinese. For languages written in the Latin script, there is an isomorphism between the pressed keystrokes and the words appear on the screen, while this is not possible in Chinese, because typing Chinese texts involves using special input method such as SoGou which converts sequences of Alphabetic letters into Chinese characters.

Though the editors only spare one chapter for the investigation of translation related to non-Western languages, it is a welcome change in TPR. The focus on these languages and related translation traditions, I believe, will surely expose more of their distinctive features from Western languages and translation traditions, thus extending the denotation, and enriching the connotation of translation studies.

All in all, this book collects innovative and pioneering ideas from researchers with various discipline background, is well-edited, thought-provoking, and praise-worthy, and as its name implies, does encompasses new directions in TPR which explore possibilities of explaining and predicting translators' behavior. It represents the latest development in empirical TPR. Translation teachers, researchers, and graduate students who want to get acquainted with new frontiers in this area will benefit from this enlightening book.

## References

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