Original Research

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

Gary Massey Zurich University of Applied Sciences, Switzerland mssy@zhaw.ch

The exploratory study reported in this article is predicated on the notion that human translators' cognition represents a key added value over disembodied artificial intelligence. It re-frames the methods, data and results of a precursor study, and supplements them with additional data and analyses to develop a new cognitive perspective on re-positioning human translation competence and translators' expertise in the age of neural machine translation (NMT). The study is centred on an investigation of culturally specific complex conceptual metaphor in translation, and it melds a more conventional product-oriented approach with experimental translation process research (TPR). It indicates that human translators' decision-making and problem-solving at different levels of training and experience take place on a conceptual level. Compared with the translations of the same metaphors by publicly available NMT systems and by beginners as well as more advanced students, the product data of the professionals involved in the study produce more varied translation solutions, with a range of deviations from the standardised output. This suggests that, after accessing the conceptual level of meaning realised in a particular lexical form, experienced professionals, as a group, are able to generate multiple potential target-text solutions in order to reach their target audience. The supplementary process data indicates that they do so situationally, based on 4EA cognition, through intuition and/or deliberative rationality. It is this, the author argues, that is the distinguishing feature of seasoned professional translators and a hallmark of their added value.

KEYWORDS: *conceptual metaphor theory, translation process research, product-oriented studies, process-oriented studies, 4EA cognition, neural machine translation, human added value, GoogleTranslate, DeepL, cognitive translatology*

1. INTRODUCTION

As artificial intelligence and machine learning make ever deeper inroads into translation ecologies and markets, researchers and educators in the applied linguistic discipline of translation studies, along with representatives and exponents of the translation industry they serve, are seeking to re-conceptualise and re-position human translation in the production chains of multilingual communication content. In particular, they have been increasingly concerned to identify and maximise the added value of human intervention during translation and (post-)editing processes. In doing so, they are participating in a broader discourse on artificial intelligence and human expertise that has been under way for decades.

Examples of the current preoccupation in the study, practice and teaching of translation are legion. The International Federation of Translators (FIT), an international grouping of associations of translators, interpreters and terminologists, with more than 100 affiliated professional associations representing more than 80,000 translators in 55 countries, has seen it necessary to issue a position paper on machine translation to support member associations, translation service providers and translators, and to advise clients and users of translation services (FIT, 2019).

Another case in point is the recent conference organised by the worldwide *Conférence internationale permanente d'instituts universitaires de traducteurs et interprètes* (CIUTI) devoted wholly to the conjunction of artificial and intercultural intelligence in translation and interpreting (CIUTI Conference 2020, 2020). Indeed, a 2018 survey of CIUTI members, comprising some 50 of the world's leading translator and interpreter education and research institutes worldwide, placed artificial intelligence – in the shape of neural machine translation (NMT) – among the most significant challenges facing training and graduate employability of the future (Massey, 2020).

In common with numerous other translation studies and translator training events, the 2021 conference of the UK and Irish Association of Programmes in Translation and Interpreting Studies (APTIS) focuses on evolving profiles and the future of translation and interpreting training (APTIS, 2020).

The conversation about (N)MT and professional human translation has even reached the courts. The language industry business news and intelligence platform *Slator* reported a Polish court ruling from February 2021 on what constitutes a professional (human) translator, applying the criteria of educational qualifications and professional competence to do so (Marking, 2021). The court concluded that a professional translator must have proper university training in translation techniques, be knowledgeable in the rules of translation and have practical experience and substantive knowledge in the field of the translation task. The court's decision was in favour of the defendant in the case, a dissatisfied client who had refused to pay language-service provider (LSP) for low-quality work, 92% of which had been poorly post-edited output from the free NMT tool *Google Translate*.

In similar vein, a growing number of publications, professional and academic, have been addressing the position, roles and value of human translators in the current and future translation ecosystem (e.g. Joscelyne, 2018; Macken et al., 2020; Massey & Ehrensberger-Dow, 2017a; Schmitt, 2019). Indicative of this wider trend is the 2020 issue of *Cultus: The Journal of Intercultural Mediation and Communication*, which is dedicated to the topic of 'Translation *plus*: the added value of the translator' (Cultus Journal, 2020).

One of the key works to launch the discourse surrounding human and artificial intelligence was the seminal *Mind over Machine: The Power of Human Intuition and Expertise in the Era of the Computer* (Dreyfus & Dreyfus, 1986). In it, the Dreyfus brothers locate superior skill in approaching and solving complex problems in the situated human experience of 'knowing how', as opposed to the 'knowing that' (Dreyfus & Dreyfus, 1986, p. 16-21) of the calculative rationality on which artificial intelligence was based: *'Only with greater human experience comes know-how – a far superior holistic, intuitive way of approaching problems that cannot be imitated by rule-following comput-*

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

ers' (Dreyfus & Dreyfus, 1986, p. 193). They propose a five-stage model of skill acquisition from novice to expert, which privileges a combination of reflective, deliberative rationality and situational, experience-based intuition in human progress towards the *arationality* of expert judgment. In a later contribution by Stuart E. Dreyfus (2004, p. 178-181), the primacy of situational, experience-based know-how is closely associated with embodiment at the three higher stages of the Dreyfus model of adult skill acquisition (competence, proficiency and expertise) – in explicit contradistinction to 'disembodied' artificial intelligence (Dreyfus, 2004, p. 178). The Dreyfus model broadly squares with key findings from expertise research (e.g. Ericsson et al., 1993) and leading models of embodied, embedded, enacted, extended and affective (4EA) cognition (Hutchins, 2010; Wheeler, 2005) from second-generation cognitive science. Experience endows human cognition with the progressive goal-oriented involvement, situational discrimination and frequently intuitive adaptivity in approaching new problems and unfamiliar tasks that are essential to the successive attainment of consistently superior expert performance. The overwhelming conclusion is that any human added value is most likely to reside here when translators engage in solving the novel, idiosyncratic, ill-defined problems that characterise the complexity of translation tasks (Muñoz Martín, 2014, p. 9; Larina, 2015).

The present article is premised on the implicit notion that the added value that human translators can and do bring to bear resides in their socio-cultural, socio-technical 4EA cognition, as opposed to disembodied, de-contextualised artificial intelligence. It reframes and re-contextualises the methods, data and results of a study, originally conducted some three years ago, in the light of attempts to identify and re-position human translation competence and translators' expertise in the age of artificial intelligence, most visibly and tangibly represented in translators' working lives by NMT. Human added value, it is argued, is manifest in translational decision-making and problem-solving on a conceptual level that transcends the surface lexi-

'The present article is premised on the implicit notion that the added value that human translators can and do bring to bear resides in their socio-cultural, socio-technical 4EA cognition, as opposed to disembodied, de-contextualised artificial intelligence'

cal realisations by which meaning is conveyed in source and target texts. This exploratory study seeks evidence of this in selected data drawn from an experimental translation process research (TPR) project containing salient source-text examples of culturally specific complex conceptual metaphor. Unusually for studies of conceptual metaphor in translation, the data comprise not only the source-text and target-text products, but also data elicited by established TPR methods during the actual process of translation. The target-text solutions produced by the participants were also compared with those proposed by publicly available NMT systems.

2. MATERIAL AND METHODS

The material in the present article is drawn from a prior experimental study of how translation students and professional translators interlingually manage the original source-text domain mapping of conceptual metaphor when translating. Massey and Ehrensberger-Dow (2017b) analysed the products and processes of professional translators working into their first language (L1) from German into English and English into German, and of MA and BA students translating the same English text as their professional counterparts into German (also their L1). In all cases, the conceptual metaphors under examination appeared in newspaper articles reporting research findings in the area of marine biology. Previously unpublished findings relating to the translators' specific target-text realisations of conceptual metaphor are also used in the present article, which are compared to disembodied NMT realisations.

The processes and product data analysed were collected during the *Capturing Translation Processes* (CTP)[1] project and predate the general availability of public online NMT systems. The data subset comprises translations of a German source text into English and an English source text into German. None of the translators used MT in any phase of the translation process. This means that none of them were exposed to the priming effects that have been observed in cognitive investigations of the way translators post-edit MT output (cf. Bangalore et al., 2015; Carl & Schaeffer, 2017).

Both of the source texts in the present study are of comparable genre and degree of difficulty, and they treat a similar topic. The processes were recorded in a usability lab under similar conditions. The participants translated the text at a computer equipped with an eye-tracking monitor and software[2] in addition to keystroke-logging[3] and screen-recording[4] programmes. They were asked to translate as they would normally do, and at their own pace. They then verbalised what they had been doing, prompted by the process recordings of their screen activities overlaid with visualisations of their eye movements. The use of these recordings was intended to stimulate recall and commentary by providing richer visual cues to what the participants had been doing. Retrospective verbal protocols (RVPs) of the commentaries and screen activities were transcribed in XML-markup according to the TEI P5 guidelines[5].

The German source text translated by one group of professional participants is the opening of a news report on the use of naval sonar equipment allegedly causing whales to beach (96 words long). It appeared in the quality Swiss German-language newspaper *Neue Zürcher Zeitung* in April 2009. The 95-word English source text translated

by the other three groups comprised the title and abridged opening paragraph of an article on a similar topic (the risk of naval sonar systems to whales) published in the British Sunday newspaper *The Observer* in August 2004. Both source texts were selected for their typical stylistic features and for their various potential translation problems or 'rich points' (PACTE Group, 2009, p. 212-216).

All participants were asked in the translation brief to translate the text for publication in an equivalent newspaper in a target lingua-culture. They were permitted to use any external online linguistic or knowledge resources they wished to.

In the context of the present study, the target text segments produced by the participants are also compared with those of the public NMT engines, *GoogleTranslate* and *DeepL*, in order to ascertain similarities and differences in the solutions arrived at through embodied human cognition and disembodied artificial intelligence. Both source texts were translated in full by *DeepL* twice, first in November 2019, and then in February 2021, and by *GoogleTranslate* once, in February 2020. The two translations by the *DeepL* NMT tool were made so as to ascertain possible variations over time in the NMT target-text segments.

3. THEORETICAL BACKGROUND
3.1. TPR and cognitive translatology

Within the closer confines of translation studies research, there has been an upsurge of interest in how translators' minds respond to and interact with the computer-assisted translation (CAT) tools and (N)MT systems embedded in the complex socio-cognitive and socio-technical environments in which they work (e.g. Cadwell et al., 2018; Risku et al., 2019; Macken et al., 2020). This has been a key concern of the burgeoning interdisciplinary

---

[1] The corpus comprises translation processes and products from translators working with various language combinations on different source texts in workplace and/or lab settings, collected between 2007 and 2012

[2] A Tobii T60 screen-based eye-tracker and Tobii Studio 2 software were used. The gaze path recordings were used to stimulate recall for the retrospections in order to obtain richer verbal data

[3] Inputlog 2.0 was used, which was the most recent version of this logger at the time

[4] Camtasia Studio

[5] The Text Encoding Initiative (TEI) Guidelines for Electronic Text Encoding and Interchange specifies methods for marking up machine-readable texts. More information is available at https://tei-c.org/Guidelines

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

'Within the closer confines of translation studies research, there has been an upsurge of interest in how translators' minds respond to and interact with the computer-assisted translation (CAT) tools and (N)MT systems embedded in the complex socio-cognitive and socio-technical environments in which they work'

sub-field that is now increasingly referred to as 'cognitive translatology' (e.g. Muñoz Martín, 2016), demarcated and in large part defined by the adoption and implementation of an empirical methodology centred on translation process research (TPR) (Muñoz Martín, 2013, p. 79).

The initial impulse that drove the emergence of this sub-field was an interest in the development and constitution of translators' cognition, competence(s) and expertise as these deploy strategies to solve problems and arrive at decisions during the various phases of the translation process. Krings's (1986) pioneering work to explore the black box of translators' minds launched TPR as a means of investigating the processes behind translation products and the effects of those processes on the quality of target texts. Researchers have also consistently addressed the competences and/or expertise of groups of translators with different degrees and forms of experience, from beginners to seasoned professionals, and how translators' skill sets develop over time. Situated 'within a behavioural cognitive experimental methodological paradigm' (Jakobsen, 2017, p. 21), the various methods and tools deployed in various combinations to research translation processes have been borrowed from psychology, cognitive science, psycholinguistics and writing research (O'Brien, 2015). Translation process data can be elicited and collected concurrently during the act of translation itself, or as soon as possible after this has taken place. Techniques can be sub-divided into verbal data elicitation, such as concurrent think-aloud protocols

(TAPs) or cue-based retrospective verbalisations (RVPs), and behavioural observation, either with researchers actually present as translators work or by means of workplace video recordings, keystroke logs, computer screen recordings, eye tracking and/or psychophysiological methods to collect physiological sensor data (Jakobsen, 2017). Processes render a complex web of data that makes it unfeasible to model them holistically. Process data therefore tend to be used selectively to construct partial models. Examples are Angelone's (2010) model of uncertainty management or PACTE's (Hurtado Albir, 2017) competence clusters, both of which are mentioned below.

In step with the development of second-generation cognitive science, and 4EA cognition in particular, the purview of translation process researchers has extended beyond experimental studies of cognitive acts in translators' minds to the socio-cognitive spaces and socio-technical environment in and with which translators interact (Jakobsen, 2017, p. 38-42). TPR has been moving out of the laboratory into 'the field' (Risku et al., 2019) to research socio-cognitive practices and processes (Risku & Windhager, 2013) in the authentic, situated settings of the translator's workplace, combining ethnographic and experimental techniques in mixed methods approaches.

Among other things, it has addressed the situatedness of translation work and competence (e.g. Risku, 2010; 2014), translation as human-computer interaction (e.g. O'Brien, 2012), the physical, cognitive and organisational ergonomics of translation in the workplace (e.g. Ehrensberger-Dow & Hunziker Heeb, 2016; Ehrensberger-Dow & Massey, 2017) and the role of intuition and emotion in translation performance and competence (Lehr, 2021). It has progressed 'from the microlevel of solving linguistic challenges to the macro level of the influence of societal expectations on translatorial decisions' (Ehrensberger-Dow et al., 2017, p. 116), re-embedding translation in its real-life environments and entering a new paradigm of cognitive translatology that is driven by an embodied, embedded, extended and enacted approach to the way the mind works (Muñoz Martín, 2016).

TPR before and within a fully emergent cognitive translatology paradigm has often been motivated by didactic considerations of how to develop the ability to translate (Massey, 2017, p. 496), and some research groups have proposed and tested models of translation competence and expertise. A leading exemplar is the PACTE group's model, validated over a number of years in a series of TPR experiments (Hurtado Albir, 2017). PACTE's research has led to the NACT translation competence framework (PACTE Group, 2018), a set of performance level descriptors for translator training and assessment. The descriptive categories used cover language competence (reception of the source language and production in the target language, in relation to the genres liable to be translated at each level), cultural, world knowledge and thematic competence (mobilising knowledge of source and the target cultures, world knowledge and thematic knowledge in specific fields), instrumental competence (using documentation resources and technological tools), translation service provision competence (managing aspects of professional practice and the work market), and translation problem-solving competence, the central strategic competence governing the deployment of all the others to solve various problem types (PACTE Group, 2018, p. 120-122). All of these categories and components are shared, in various permutations, by other key heuristic and evidence-based models of translation competence (e.g. Kelly, 2007; Göpferich, 2009).

The way some of these models have transitioned over time reflects an increasing awareness of just how relevant the situated cultural, social and technological contexts of 4E cognition are to the competent (and expert) practice of professional translation. For example, compared to its predecessor (EMT Expert Group, 2009), the influential heuristic competence framework of the European Master's in Translation (EMT) network (EMT Board, 2017), a widely applied benchmark for profiling the skill sets required of translation graduates entering the work market, clearly upvalues socio-technical knowledge and skills in the reflective handling of language and translation technology

'In step with the development of second-generation cognitive science, and 4EA cognition in particular, the purview of translation process researchers has extended beyond experimental studies of cognitive acts in translators' minds to the socio-cognitive spaces and socio-technical environment in and with which translators interact'

as well as digital social media. It also places distinctly more emphasis on socio-cognitive (inter-)personal competences in contexts of work. It maintains the previous model's emphasis on (inter-)cultural competence, but no longer anchors it a discrete category of sociolinguistic and textual descriptors (Smakman, 2019). Instead, it offers a transversal, situated description of the many (inter-)cultural, transcultural and multicultural aspects of a translator's work. Graduates, and by extension translators, should obviously be able to translate and mediate in specific intercultural contexts and work in multicultural, multilingual teams and environments (EMT Board, 2017, p. 8-10). But from the beginning, the framework stresses that the transcultural and sociolinguistic awareness and communicative skills making up language and culture competence *'encompasses all the general or language-specific linguistic, sociolinguistic, cultural and transcultural knowledge and skills that constitute the basis for advanced translation competence. It is the driving force behind all the other competences'* (EMT Board, 2017, p. 6).

3.2. Conceptual metaphor in translation

As cognitive translation research has evolved, the potential for developing closer synergies between TPR, cognitive translatology and the broader field of cognitive linguistics has been explored (e.g. Rojo & Ibarretxe-Antuñano, 2013). One major theoretical cluster that has been repeatedly identified is conceptual metaphor (e.g. Samaniego Fernández, 2011; Muñoz Martín, 2013, p. 80-81;

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

Shuttleworth, 2014) which, in emphasising the psychological rather than textual aspects of metaphor, offers insights into cognitive processes that are clearly applicable to TPR (Schäffner & Shuttleworth, 2013, p. 94).

Broadly speaking, conceptual metaphor theory locates metaphor not in language *per se* but in how we 'conceptualise one mental domain in terms of another' (Lakoff, 1993, p. 203), seeking to account for all manifestations of metaphorical thought, from the everyday to the poetic, which is itself merely 'an extension of our everyday, conventional system' (Lakoff, 1993, p. 246). Metaphor is understood as a process of mapping from one domain of human experience (the source domain) to another (the target domain) in order to understand and convey understanding of abstract concepts in the target domain. The mapping is realised by means of surface metaphorical expressions in lexical form. Far from being arbitrary, mapping draws on our *embodied experiences* of the world to create ontological (structural) and epistemic (inferential) correspondences between the conceptual source and target domains. Mapping between domains is often necessarily partial and asymmetrical (Lakoff, 1993, p. 245) as the focus will fall only on those features needed to establish functional analogy (Göpferich, 2003, p. 34).

The theory posits two distinct types of conceptual metaphor. Primary metaphors are *'grounded in the everyday experience that links our sensory-motor experience to the domain of our subjective judgements'* (Lakoff & Johnson, 2003, p. 255). Complex metaphors represent combinations of primary conceptual metaphors and are frequently subject to culturally specific variation (Lakoff & Johnson, 2003, p. 257; Muñoz Martín, 2013, p. 85; Fougner Rydning & Lauchaud, 2011, p. 173; Schäffner, 2005, p. 65).

As we have seen, cultural and intercultural components have recurrently featured in leading models of translation competence. It is therefore hardly surprising that the cultural specificity of complex conceptual metaphor has been the impulse behind much of the research into the way translators handle conceptual transfer as they

'The relatively recent phenomenon of investigating conceptual metaphor in translation has built on earlier work devoted to the translation of surface manifestations of lexical metaphor, centred on issues of translatability, establishing 'laws' and procedures for their transfer or creating typologies for handling metaphor translation'

translate from one language and culture to another. As Samaniego Fernández (2013, p. 169) puts it, *'language boundaries are at the same time boundaries of distinct cultural communities, and metaphor interpretation is strongly culturally conditioned: it does not consist in mere decoding of language signs. At the end of the day, what seems to be impeding the translation process is culture'.*

The relatively recent phenomenon of investigating conceptual metaphor in translation has built on earlier work devoted to the translation of surface manifestations of lexical metaphor, centred on issues of translatability (e.g. Dagut, 1976), establishing 'laws' and procedures for their transfer or creating typologies for handling metaphor translation (e.g. Newmark, 1981; Toury, 1995; Van den Broeck, 1981).

Göpferich's (2003) problem-solution model, specifically tailored to metaphor translation, marks a break with this heuristic, prescriptive tradition. The model is divided into an analysis phase, in which source-text metaphors are first identified, interpreted and their textual function determined, and a transfer phase, which envisages the translator verbalising a target-text solution after first selecting from four basic translation procedures: literal translation of a source metaphor, changing a metaphor into different metaphor, paraphrase a metaphor into sense and, introducing a metaphor where none exists in the source text. It thus seeks to align target-text renditions with the assumed strategic cognitive processes that have generated them.

Göpferich's (2003) approach reflects a nascent interest in the intersection of cognitive linguistics and translation that saw researchers more consistently applying contemporary conceptual metaphor theory to their work. Like the bulk of research and modelling on lexical metaphor, most of it has been text-based and therefore product-oriented, with investigators applying what Chesterman (2015) has referred to as reverse-engineering of the processes by which conceptual metaphor has been translated. In reverse-engineered processes, the researcher proceeds from products – the target-text segments – to infer and reconstruct one or more plausible sequences of thought processes, actions, decisions and/or strategies that the translators are assumed to have applied.

Various researchers have collected and analysed bilingual and multilingual corpora of textual products to describe the procedures and parameters of metaphor in translation from the conceptual perspective. Schäffner (2004) adopts an empirical, product-oriented approach to discuss authentic examples of conceptual metaphor in translations of German political discourse. She concludes that the *'analysis of texts with respect to metaphors and metaphorical reasoning processes in different languages can, thus, reveal possible cultural differences in conceptual structures'* (Schäffner, 2004, p. 1267) transcending the heuristic and prescriptive procedure-based approaches to metaphor common in previous contributions from translation studies. She elaborates on her cognitive approach to metaphor in subsequent detailed studies of English translations of German political and news texts about the financial crisis (Schäffner, 2012; 2014).

Monti (2009) examines a corpus of French, Italian and Spanish translations of Lakoff and Johnson's *Metaphors We Live By* (2003), uncovering a more-or-less shared repertoire of mental schemes across the four languages, despite the significant degree of variation in lexical realisations that he observes. Focusing on providing target-language models for translation didactics than on translation procedures, Nicaise (2011) compares and contrasts lexical realisations of discursive conceptuali-

'Göpferich's (2003) approach reflects a nascent interest in the intersection of cognitive linguistics and translation that saw researchers more consistently applying contemporary conceptual metaphor theory to their work'

sations in financial and economic reporting by using a bilingual Belgian corpus of French-language and Dutch-language newspaper articles. Samaniego Fernández (2013) presents a descriptive study of novel metaphors and their translation in a corpus of 122 source newspaper texts and their translations in Spanish published over a one-year period. She concludes from her analysis of actual translation occurrences that translators are 'sharp text creators', and that traditional notions we have of equivalence are a simplification that must be enlarged to cover the multiplicity of translational answers given by translators, from 'unfaithfulness' to the source text and author to the creation of new material (Samaniego Fernández, 2013, p. 192).

Shuttleworth (2011) reports on a multilingual corpus-based study, overtly framed by conceptual metaphor theory, to identify 'types of translation behaviour' (Shuttleworth, 2011, p. 302) at the conceptual level in translating popular science metaphor. In addition to stressing the sheer complexity of the product-based analysis, his findings show little clear evidence of obvious manipulation or subversion of source-text metaphors, or that metaphor presents a major problem to translators of popular science texts in his corpus-based study.

Finally, Tebbit and Kinder (2016) use conceptual metaphor theory to develop a decision-making model for analysing extended metaphors (which they refer to as 'developed' metaphors) in translation in order to *'contribute to deeper and more systematic understandings of how metaphors work in texts and the responsibility that translators assume in front of these understandings'* (Tebbit & Kinder, 2016, p. 419). Basing their study on a limited corpus four target-text products from Bible

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

'Various researchers have collected and analysed bilingual and multilingual corpora of textual products to describe the procedures and parameters of metaphor in translation from the conceptual perspective'

translation, where they find no consistency in the handling of developed metaphor, they stand very much in the tradition of early prescriptive approaches to metaphor translation by proposing that translators should choose from three possible (and rather obvious) strategies (Tebbit & Kinder, 2016, p. 418-420): retain all the metaphorical expressions; maintain some metaphorical expressions; abandon the developed metaphor in the interests of target-text-oriented transparency for each individual expression.

By contrast, and somewhat puzzlingly, studies in conceptual metaphor translation of what Chesterman (2015, p. 13) calls 'actual processes' – observations of the translation process 'as it unfolds, rather than retrospectively inferring from the end-result how this result might have arisen' – have remained very rare. There are only a handful known to the author. These include Mandelblit's (1995) early pioneering experiment to test her 'cognitive translation hypothesis' that translation of metaphors may involve, in addition to linguistic shift, a conceptual shift between different conceptual ontologies (Mandelblit, 1995, p. 486). She recorded the time taken, and additional comments, by professional and student translators asked to translate various time expressions from their L2 to their L1. One group translated from English into French, the other group from French into English. Her results showed that, over both groups of participants, conceptual metaphor translation takes significantly longer, and is presumably more effortful, if the target domains differ in the source language and in the target language.

Tirkkonen-Condit's (2002) two TAP studies, again involving students and professionals but this time in near-authentic translation conditions, was

a response to Mandelblit's (1995) experiment. Her results show evidence of her participants encountering difficulties where equivalent idiomatic expressions of equal conventionality to the source-language expression are not available in the target language (see also Anisimova et al., 2018). The degree of difficulty appears to increase with domain conflict, in other words the need to map across domains, which leads to translators stagnating in the source-language domain. The fact that translation difficulty is increased by domain conflict indicates strongly that translation does not take place primarily through word association but at the conceptual level.

In a later psycholinguistic study, Fougner Rydning and Lachaud (2011) take up the distinction between primary and complex metaphors in an experiment directed at metaphor comprehension. 50 participants processed 80 different manipulated sentences each in on-screen stimulation sequences to measure reaction times and the accuracy of their responses in interpreting metaphorical meaning at the conceptual level. Their findings show that conceptual clarity (or comprehension) among the participants was lower for complex metaphors. One final piece of research worth mentioning in this context is Sjørup's (2011, 2013) eye-tracking study of lexical metaphor in translation. Though not directed towards conceptual metaphor as such, it does indicate that metaphor production in general is more effortful than non-metaphor translation, but somewhat inconclusively points out that effort varies according to the translation procedure chosen by the translator.

Product-oriented studies of conceptual metaphor are increasingly common, but process-oriented studies of conceptual metaphor are still few and far between. Yet, it would only make sense to bring together a product-oriented, reverse-engineered approach with TPR on actual processes to obtain deeper insights into the behaviour, decision-making and problem-solving of translators as they translate. This is precisely what Schäffner and Shuttleworth (2013) suggest as a beneficial avenue for conceptual metaphor studies, and it is one that the study reported here pursues.

4. STUDY AND RESULTS

4.1. Stages of analysis

As already mentioned, aspects of the analyses undertaken here have been presented and discussed from a different perspective in Massey and Ehrensberger-Dow (2017b) and, partially, in Massey (2016). The initial studies had set out to analyse the processes and products behind source-text reception and target-text production of the concepts underlying surface lexical metaphors in order to identify patterns of conceptual mapping behaviour according to educational level, professional experience and translation direction (into L1 and/or their second language, L2).

The current study considers how a group of native English-speaking professional translators translate a complex conceptual metaphor in the first sentence of their German source text, 'Hang' (i.e. 'inclination' or 'tendency', post-modified by 'zum Selbstmord', meaning 'to[wards] suicide'). This data is then compared to the way three groups of native German-speaking professionals and students translate a complex metaphor in the second sentence of the English source text, 'race' (pre-modified in the source text by 'low-frequency'). Nine professionals working into their L1, English (ProE), translated the German source-text metaphors. Twelve professionals (ProG), ten MA students (MAG) and eleven BA beginners (BAG) translated the English source-text metaphor into their L1, German. For all translators, the process data consist of pauses identified in the keystroke logs and any comments in the RVPs.

'Hang [zum Selbstmord]' represents a personification, endowing whales with human psychological attributes to help us understand the phenomenon of mass beaching. The German term 'Hang' is itself, in its original sense, an ontological metaphor relating to topography, a downward slope, defined by the German dictionary resource *Duden Online* in the first entry for the term as a downward sloping side of a mountain (the metaphorical meaning intended in our source text is contained in the dictionary's second definition) (Duden Online, 2021). This conceptual metaphor is complex because it brings together the primary ontological metaphors of topography and personification with the orientational metaphor of the *downward* ('abfallend' in the *Duden Online* definition) slope (lack of control is down; unconscious is down). The closest correspondence in English to the use of this metaphor in its source-text sense is 'inclination', though the directionality implied in the English word is not downward but upward. The second complex conceptual metaphor examined in this study is 'race'. This combines the primary metaphors of *action is motion* and *purposes are destinations* (implicit in the notion of the winning line that will be crossed) with the general-to-specific mapping of *a competition is a race*.

Data were analysed in four stages. First, the translation products were categorised according to the scheme of four procedures proposed by Toury (1995, p. 81-84): metaphor into same metaphor (M:M), metaphor into different metaphor (M1:M2), metaphor into non-metaphor, or sense paraphrase (M:P), and omission of the metaphor (M:0). Toury's (1995) fifth and sixth procedures (creating metaphors from non-metaphors and adding metaphors with no linguistic motivation in the source text) are irrelevant to the present study. Every metaphorical realisation was classified independently by two researchers and then compared.

Second, the process data from the keystroke logs and the RVPs were analysed for problem indicators. In line with PACTE (2005) and Alves and Vale (2009), a pause of five seconds or more (>5 s.) was taken to be a problem indicator in the keystroke logs (see Kumpulainen (2015) for a details on operationalising pausing data in translation process research). A distinction was made between pre-pausing (pauses after a target-text segment immediately preceding the segment corresponding to the source-text metaphor) and peri-pausing (pauses during the production of the target-text segment). Pausing is assumed to indicate both that a problem exists and that it is being processed with internal cognitive resources (see Langlois, 2020), either with or without external resource consultation. In the RVPs, it was assumed that any participant mentioning either of the rich points indicated their awareness of a translation issue.

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

'A distinction was made between pre-pausing (pauses after a target-text segment immediately preceding the segment corresponding to the source-text metaphor) and peri-pausing (pauses during the production of the target-text segment). Pausing is assumed to indicate both that a problem exists and that it is being processed with internal cognitive resources, either with or without external resource consultation'

Third, the RVPs were analysed in greater depth to determine participants' conceptual clarity (Fougner Rydning & Lachaud, 2011). Angelone's (2010) uncertainty-management model was used, which presents translation as a chain of decision-making activities with multiple, interconnected sequences of problem-solving behaviour that are activated when problems occur. These sequences are segmented into source-text comprehension uncertainty (Comp), mediation-based transfer uncertainty (Trans), when translators *'cannot match language structures (lexemes, collocations, standard phrases) in the source text to appropriate equivalents to use in the target text'*, and target-language production (Prod) uncertainty, indicating *'the application of conscious, deliberate strategies for overcoming comprehension, transfer, or production indecision'* (Angelone, 2010, p. 19-21).

Finally, the NMT products (labelled DL19 for the 2019 *DeepL* translations, DL21 for the 2021 *DeepL* translations and GT21 for the 2021 *Google-Translate* translations) were analysed according to the Toury (1995) scheme. The results were then compared to the human product data.

4.2. Product data analyses

The product analysis of the ProE translations of '[Hang [zum Selbstmord]' shows eight (89%) participants translating the metaphor into a different metaphor (M1:M2) and one (11%) paraphrasing its sense (M:P). There were no omissions (M:0) or translations using the same metaphor (M:M). The NMT target texts DL19, DL21 and GT21 were all translated M:M2.

The ProG translations of '[low-frequency] race' revealed eight M:M (67%), one M1:M2 (8%), one M:P (8%) and two M:0 (17%) translations. The pattern of MAG products is slightly less spread: seven translated M:M (70%), two M1:M2 (20%) and one M:0 (10%). The BAG products are a little more uniform than the ProG and MAG groups: nine participants translate M:M (82%) and two M1:M2 (18%). The DL19, DL21 and GT21 translations of '[low-frequency] race' are all M:M.

4.3. Process data analyses

The ProE keystroke pausing data show that two participants paused for more than five seconds (22%): one pre-paused (11%) and the other peri-paused (11%). In the RVPs, five ProE participants (56%) mentioned the metaphor: one in relation to comprehension (11%), one to transfer (11%) and three to target-text production (33%).

ProG pausing behaviour differed sizeably from the ProE group: ten participants paused for five seconds or more (83%): seven pre-paused (58%), two pre- and peri-paused (17%) and one peri-paused (8%). In the RVP data, ten ProG participants referred to 'race' (83%): five in relation to comprehension (42%), two to transfer (17%) and three to production (25%).

MAG pausing is a little less pronounced, though comparable, with seven interrupting their processes for five seconds or more (70%), three pre-pausing (30%), one pre- and peri-pausing (10%) and three peri-pausing (30%). In the RVPs, all ten MA students mention the metaphor (100%): five in relation to comprehension (50%), three to transfer (30%) and two to production (20%).

BAG pausing behaviour differed noticeably from that of the other two groups. Only four participants paused five seconds or more (36%): three before target-text production (27%) and one during it (9%). The RVP data analysis reveals that ten participants mentioned 'race' (91%), seven in relation to comprehension (63%), two to transfer (18%) and one to production (9%).

Table 1

Overview of results of the product and process analyses

PRODUCT DATA ANALYSES				
TT realisation	% procedures			
'Hang'	M:M	M1:M2	M:P	M:0
ProE (n=9)	-	89	11	-
DL19 (n=1)	-	100	-	-
DL21 (n=1)	-	100	-	-
GT21 (n=1)	-	100	-	-
Σ NMT (n=3)	-	100	-	-
'Race'				
ProG (n=12)	67	8	8	17
MAG (n=10)	70	20	-	10
BAG (n=11)	82	18	-	-
DL19 (n=1)	100	-	-	-
DL21 (n=1)	100	-	-	-
GT21 (n=1)	100	-	-	-
Σ NMT (n=3)	100	-	-	-
PROCESS DATA ANALYSES				
Pauses >5s.	% participants			
'Hang'	Pre-	Peri-	Both	Σ
ProE (n=9)	11	11	-	22
'Race'				
ProG (n=12)	58	8	17	83
MAG (n=10)	30	30	10	70
BAG (n=11)	27	9	-	36
RVP mentions	% participants			
'Hang'	Comp	Trans	Prod	Σ
ProE (n=9)	11	11	33	56
'Race'				
ProG (n=12)	42	17	25	83
MAG (n=10)	50	30	20	100
BAG (n=11)	63	18	9	91

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

5. DISCUSSION

5.1. Human translations of 'Hang'

Analysis of the product data showed all but one of the ProE group rendering 'Hang' through other lexical metaphorical realisations, such as 'propensity [to suicide]', '[suicidal] tendencies', or '[death] wish', with only one resorting to the paraphrase 'commit [suicide]'. The culture-specific realisation 'Hang' was only partially mapped by the L1 English speakers, who retained the personification but omitted the source-culture topographical and orientational elements. As an interesting aside, a tenth translator, a German L1 speaker wrongly included in the initial data analysis, was the only one seen to produce an M:M solution ('inclination [to commit suicide]') – a possible indicator of conceptual transfer occasioned by his socialisation and embeddedness in the lingua-culture that produced the source text.

The actual translation process data show that only two participants paused for five seconds or more. However, a majority of the ProE group (56%) did verbalise awareness of the metaphor as a rich point in the source text: one participant had a comprehension/conceptual clarity issue, one indicated a transfer problem and two further RVPs indicated production or formulation issues. As a group, therefore, the professionals do appear to have been engaging conceptually with this complex source-text metaphor, but they seem to have relied in large part on intuition in reaching their solutions.

5.2. Human translations of 'race'

The analyses show that 'race' is handled by the German L1 translators less uniformly overall. There are indications that experience does appear to make a difference in terms of both products and, perhaps more pertinently, processes.

Two-thirds of the ProG group used the identical corresponding metaphor in the target language (either 'Wettrennen' or 'Rennen'), but M:M realisations (either 'Wettrennen' or 'Rennen') in the BAG group were even higher, at four fifths. At 70%, the MAG realisations (either 'Wettlauf' or 'Rennen') are, at first glance, closer to those of the ProG

group. But a closer examination of the M1:M2 tokens reveals that two MAG participants, and also the remaining two BAG members, realise at least partially the metaphorical components of the original source-language domain mapping. When these M1:M2 solutions are aggregated with the M:M results, 90% of the MA students and 100% of the BA beginners can be said to render at least one metaphorical component from the source-language target domain. By comparison, relatively fewer professionals mapped as closely to the source-language target domain (67%). The one ProG professional with the M1:M2 solution chose the metaphor 'drive forward [a development]' ('[eine Entwicklung] vorantreiben'). While this is a realisation of the primary metaphor action is motion, it bears no direct relation to the complex culture-specific conceptual metaphor of competition and/or race.

The students therefore demonstrate a distinctly closer orientation on the original source-text mapping. How can this difference between the students and the professionals be accounted for? The process data for the entire subset can help answer that question.

Pausing for the translation of 'race' was substantially higher among the ProG (83%) and MAG groups (70%) compared to the ProE results for 'Hang' (22%). On the other hand, pausing was noticeably lower among the BAG beginners (36%). If we accept that pausing indicates the deployment of internal cognitive resources, suggesting a conceptual engagement with the metaphor, then the German L1 professionals appear to deliberate and reflect more than both groups of students, especially before beginning to write (75% in total). For their part, the MA students also seem to reflect more than the beginners (70%), though fewer do so before target text production (40% in total).

The RVP process analyses show that the proportion of mentions for the 'race' rich point among all three German L1 groups lay between 83% and 100%, notably higher than for 'Hang' (56%). In particular, the uncertainty management analysis of the BAG group shows that seven beginners remarked overtly on conceptual clarity problems in

the RVPs (63%). Strikingly, however, only *one* of those who did so actually paused before, and *none* paused during target-text production.

Pulling the strands together, therefore, we can say that the professionals seem to proceed in a markedly more reflective manner than the beginners, quite probably as a result of the experience they have accumulated, the (inter-)cultural awareness they have developed and the deliberative rationality they have acquired. Between the beginners and professionals are the MA students, who exhibit behaviour towards the professional end of a spectrum – as befits competent learners on the verge of embarking on professional careers.

5.3. NMT and human translation products compared

Returning to the NMT product tokens for the translations of 'Hang', both DL19 and DL21 used the same noun ('tendency') chosen by four of the nine of the professional translators. However, while all four of the latter opt for a plural noun with the standard pre-modifier 'suicidal', the NMT versions have a singular noun post-modified with 'towards suicide' (DL19) and 'to suicide' (DL21). The three M:M translations of 'race' by the NMT tools also reveal slight grammatical variation. DL21 and GT21 use the compound noun 'Nieder-

frequenzrennen' in place of DL19's grammatically non-standard (and semantically ambiguous) post-modification ('das Rennen der niedrigen Frequenzen'). In this respect, therefore, the *DeepL* engine appears to have learned.

Standardisation appears to be the rule in the NMT target-text segments. When compared closely to the human translations, an interesting pattern emerges. Allowing for minor grammatical shifts, and the use of the synonyms 'Wettrennen' and 'Wettlauf' for 'Rennen' in the German target texts (three instances in all), the NMT translations correspond exactly to 44% of the total solutions and 50% of the M:M2 solutions for the ProE group, to 33% of the total solutions and 50% of the M:M solutions for the ProG group, to 50% of the total solutions and 71% of the M:M solutions for the MAG group; and to 82% of the total solutions and 100% of the M:M solutions for the BAG group (see Table 2). In all other cases where omission was not used, the translators either explain the metaphor to the reader or establish more context for it. They do so by using metaphorical alternatives (such as 'death wish' instead of 'suicidal tendencies') or by expanding the source-text metaphor with additional semantic components (for example, with explicit reference to sonar systems and their development or to low-frequency ranges).

Table 2

Exact correspondences between NMT and human translation products

GROUP	% CORRESPONDENCE NMT SOLUTIONS		
	Total	M:M	M1:M2
ProE (n=9)	44	-	50
ProG (n=12)	33	50	-
MAG (n=10)	50	71	-
BAG (n=11)	82	100	-

In this admittedly small sample, we can identify a distinct cline in the variation across the translator groups as degrees of experience increase, and a correspondingly growing range of deviation from the standardisation that is represented in the solu-

tions produced by the publicly available NMT systems. The variation (and deviation) is lowest among the beginners and considerably higher among the professionals, with the MA students again in-between.

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

What can such variation be telling us? Echoing the conclusion reached by Samaniego Fernández (2013, p. 192) above, the variation in the data strongly suggests that the principal distinguishing feature of the experienced, competent professionals as a group is their ability to access the conceptual level of meaning realised in a particular lexical form, and then to use intuition (as in the case of 'Hang') and/or deliberative rationality (in the case of 'race') to generate multiple potential target-text solutions in a specific communicative situation, in order to best serve the intelligibilities, interests and needs of a (pre-defined or projected) target audience. There is nothing particularly new about this implication – Venuti (2019, p. 1), for instance, has long and vociferously advocated a hermeneutic model of understanding translation not as *'the reproduction or transfer of an invariant that is contained in or caused by the source text'* but as *'an interpretive act that inevitably varies source-text form, meaning, and effect'*. But it does provide some empirical evidence related to Venuti's claim, and in so doing adds topical relevance and renewed force to Pym's (2003, p. 489) brilliantly pithy minimalist definition of translation competence as *'the ability to generate a series of more than one viable target text (TTI, TT2 … TTn) for a pertinent source text (ST); the ability to select only one viable TT from this series, quickly and with justified confidence'*. More combined product-oriented and process-oriented research into conceptual metaphor translation is likely to provide the additional evidence to validate or invalidate this thesis.

5.4. Further implications and caveats

The exploratory findings discussed above appear to indicate that investigating conceptual metaphor research in translation with a combined product-oriented and process-oriented approach can provide clues to precisely where the added value of human translation resides in the age of NMT. The most obvious potential application lies in the (further) development of translator competence among students and working professionals for a language industry looking to make the most

of its translators. As already stated in Massey (2016) and Massey and Ehrensberger-Dow (2017b), the results tend to reinforce didactic implications that have already been drawn as a result of previous cognitive linguistic research. The admittedly small exploratory study presented here seems to confirm work done by Nicaise (2011) and Tabakowska (2014), who stress the importance of alerting students and teachers alike to the cognitive base of all meaning by systematically introducing cognitive linguistics into translator education curricula and professional development courses. Translator education can only benefit from knowing how members of given lingua-cultural communities *'use metaphors to reflect their attitudes towards the world in general and the life of their community in particular'* (Nicaise, 2011, p. 421).

However, there are also implications to be drawn from the inescapable methodological caveats associated with the research. Although the focus on conceptual metaphor signals a fruitful avenue of research into the processes and products of conceptual transfer in translation, Shuttleworth (2014, p. 60) and Samaniego Fernández (2011, p. 268) sound a justified note of caution that is shared by the present author.

The extent to which translators' production of target texts can be said to be generalisable and to reflect target-language and target-culture norms and conceptualisations should be treated with care, given the essential situatedness of translation and the multiple actors and factors influencing decision-making processes at any given time during the situated activity of translation. Those addressing translated conceptual metaphor must bear this in mind when collecting and analysing their data and when interpreting results, and they should be prepared to do go out into the field – the actual environments in which translators work – to collect their data.

Moreover, the data in the present study, having been collected within the context of a project not specifically dedicated to research conceptual metaphor, contained a range of possible impact variables on participants' decision making that has made it difficult to interpret the results. Future field

research will therefore require not only more ecological validity by being situated in the authentic environments of translation, but also more rigorous control of tasking and setting (such as specific cross-language matching of metaphors) and more targeted elicitation methods (such as immediate retrospective interview questions) to eliminate the noise that the data caused in the original experimental studies.

6. CONCLUSION

Behind the exploratory study reported in this article is the notion that human translators' cognition represents a key added value over disembodied artificial intelligence. Re-framing the methods, data and results of a prior study, and supplementing them with additional data and analyses, it presents a new cognitive perspective on re-positioning human translation competence and translators' expertise in the age of NMT. Focusing on culturally specific complex conceptual metaphor, the research combines target-text product analysis with experimental TPR findings to reveal how translational decision-making and problem-solving take place on a conceptual level that transcends the lexical realisations by which meaning is conveyed in source and target texts. When compared with translation output of the same metaphors by publicly available NMT systems, the variation in the product data of professionals suggests that what

distinguishes them as experienced, competent translators is their ability to access the conceptual level of meaning realised in a particular lexical form, and then to generate multiple potential target-text solutions in order to reach a given target audience. The process data indicates that they do so situationally, through intuition and/or deliberative rationality, presumably based on their 4EA cognition. This is the distinguishing feature of seasoned professional translators and a hallmark of their added value.

Notwithstanding the caveats of the study mentioned in the previous section, the research presented here points to the fundamental logic and congruence of combining reverse-engineered product data with data from actual processes. The present author wholeheartedly concurs with other translation studies researchers, like Schäffner and Shuttleworth (2013), that an approach melding actual process data analysis with reverse-engineered product data can add an enriching and insightful layer to translation research. Given the current and likely future direction of increasingly technologised professional translation practices, it has the distinct potential to unveil precisely where and how embodied, embedded, enacted, extended and affective experience can add the tangible value of tailored high-quality services to complement the presence of NMT in the translation market and industry.

References

Alves, F., & Vale, D. (2009). Probing the unit of translation in time: Aspects of the design and development of a web application for storing, annotating, and querying translation process data. *Across Languages and Cultures*, 10(2), 251-273.

Angelone, E. (2010). Uncertainty, uncertainty management and metacognitive problem solving in the translation task. In G. M. Shreve & E. Angelone (Eds.), *Translation and cognition* (pp. 17-40). Amsterdam, Netherlands: John Benjamins. doi: 10.1075/ata.xv.03ang

Anisimova, A., Pavlyuk, M., & Kogotkova, S. (2018). Selecting a translation equivalent: Factors to con-

sider in the classroom. *Training, Language and Culture, 2*(1), 38-50. doi: 10.29366/2018tlc.2.1.3

APTIS. (2020). *CFP: APTIS 2021. Evolving profiles: The future of translation and interpreting training.* Retrieved from https://www.aptis-translation-interpreting.org/aptis-2020

Bangalore, S., Behrens, B., Carl, M., Ghankot, M., Heilmann, A., Nitzke, J., Schaeffer, M., & Sturm, A. (2015). The role of syntactic variation in translation and post-editing. *Translation Spaces, 4*(1), 119-144. doi: 10.1075/ts.4.1.06sch

Cadwell, P., O'Brien, S., & Teixeira, C. S. (2018). Resistance and accommodation: Factors for the

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

(non)adoption of machine translation among professional translators. *Perspectives, 26,* 301-321. doi: 10.1080/0907676X.2017.1337210

Carl, M., & Schaeffer, M. (2017). Why translation is difficult: A corpus-based study of non-literality in post-editing and from-scratch translation. *Hermes – Journal of Language and Communication in Business, 56,* 43-57. doi: 10.7146/hjlcb.v0i56.97201

Chesterman, A. (2015). Models of what processes? In M. Ehrensberger-Dow, B. Englund Dimitrova, S. Hubscher-Davidson & U. Norberg (Eds.), *Describing cognitive processes in translation: Acts and events* (pp. 7-20). Amsterdam, Netherlands: John Benjamins. doi: 10.1075/bct.77.02che

CIUTI Conference 2020. (2020). *Artificial intelligence & intercultural intelligence. Actions and interactions in translation, interpreting and target contexts.* Retrieved from https://www.ciuti2020isit.org

Cultus Journal. (2020). *Call for papers. CULTUS 14: Translation plus: The added value of the translator.* Retrieved from https://www.cultusjournal.com/index.php/call-for-papers

Dagut, M. (1976). Can 'metaphor' be translated? *Babel, 22*(1), 21-33. doi: 10.1075/babel.22.1.05dag

Dreyfus, H. L., & Dreyfus, S. E. (1986). *Mind over machine: The power of human intuition and expertise in the era of the computer.* New York, NY: Free Press. doi: 10.1109/MEX.1987.4307079

Dreyfus, S. E. (2004). The five-stage model of adult skill acquisition. *Bulletin of Science, Technology & Society, 24*(3), 177-181. doi: 10.1177/0270467604264992

Duden Online. (2021). *Der Hang. Rechtschreibung. Bedeutungen.* Retrieved from https://duden.de/rechtschreibung/Hang

Ehrensberger-Dow, M., & Hunziker Heeb, A. (2016). Investigating the ergonomics of a technologized translation workplace. In R. Muñoz Martín (Ed.), *Reembedding translation process research* (pp. 69-88). Amsterdam, Netherlands: John Benjamins. doi: 10.1075/btl.128.04ehr

Ehrensberger-Dow, M., Hunziker Heeb, A., Jud, P., & Angelone, E. (2017). Insights from translation process research in the workplace. In D. Perrin & U. Kleinberger (Eds.), *Doing applied linguistics: Enabling transdisciplinary communication* (pp. 116-123). Berlin, Germany: Mouton de Gruyter. doi: 10.1515/9783110496604-014

Ehrensberger-Dow, M., & Massey, G. (2017). Socio-technical issues in professional translation practice. *Translation Spaces, 6*(1), 104-121. doi: https://doi.org/10.1075/ts.6.1.06ehr

EMT Expert Group. (2009). *Competences for professional translators, experts in multilingual and multimedia communication.* Brussels, Belgium: European Commission. Retrieved from https://ec.europa.eu/info/sites/info/files/emt_competences_translators_en.pdf

EMT Board. (2017). *European Master's in Translation. Competence framework 2017.* Brussels, Belgium: European Commission. Retrieved from https://ec.europa.eu/info/sites/info/files/emt_competence_fwk_2017_en_web.pdf

Ericsson, K. A., Krampe, R., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100*(3), 363-406. doi: 10.1037/0033-295X.100.3.363

FIT. (2019). *FIT position paper on machine translation.* Retrieved from https://fit-ift.org/fit-position-paper-on-machine-translation

Fougner Rydning, A., & Lachaud, C. (2011). Are primary conceptual metaphors easier to understand than complex conceptual metaphors? An investigation of the cognitive processes in metaphor comprehension. In C. Alvstad, A. Hild & E. Tiselius (Eds.), *Methods and strategies of process research: Integrative approaches in translation studies* (pp. 169-186). Amsterdam, Netherlands: John Benjamins. doi: 10.1075/btl.94

Göpferich, S. (2003). Metapher und Translation: Zur Universalität bzw. Kulturgebundenheit der Metapher und der Modellierung des Metaphernübersetzungsprozesses [Metaphor and translation: On the universality and/or cultural constraint of metaphor and of modelling the metaphor translation process]. In B. Nord & P. A. Schmitt (Eds.), *Traducta Navis. Festschrift zum 60. Geburtstag von Christiane Nord* (pp. 31-52). Tübingen, Germany: Stauffenburg.

Göpferich, S. (2009). Towards a model of translation competence and its acquisition: The longitudinal study 'TransComp'. In S. Göpferich, A. L. Jakobsen & I. M. Mees (Eds.), *Behind the mind: Methods, models and results in translation process research* (pp. 11-37). Copenhagen, Denmark: Samfundslitteratur Press.

Hurtado Albir, A. (2017). *Researching translation competence by PACTE group*. Amsterdam, Netherlands: John Benjamins. doi: 10.1075/btl.127

Hutchins, E. (2010). Cognitive ecology. *Topics in Cognitive Science, 2*(4), 705-715. doi: 10.1111/j.1756-8765.2010.01089.x

Jakobsen, A. L. (2017). Translation process research. In J. Schwieter & A. Ferreira (Eds.), *The handbook of translation and cognition* (pp. 21-49). Chichester, UK: Wiley-Blackwell. doi: 10.1002/9781119241485.ch2

Joscelyne, A. (2018). *Translators in the algorithmic age. Briefing based on the TAUS industry leaders forum in Amsterdam in June, 2018*. De Rijp: TAUS. Retrieved from https://info.taus.net/translators-in-the-algorithmic-age-full-version

Kelly, D. (2007). Translator competence contextualized. Translator training in the framework of higher education reform: In search of alignment in curricular design. In D. Kenny & K. Ryou (Eds.), *Across boundaries: International perspectives on translation studies* (pp. 128-142). Newcastle upon Tyne, UK: Cambridge Scholars.

Krings, H. P. (1986). *Was in den Köpfen von Übersetzern vorgeht. Eine empirische Untersuchung zur Struktur des Übersetzungsprozesses an fortgeschrittenen Französischlernern* [What happens in the minds of translators: An empirical study of the structure of the translation process in advanced French teachers]. Tübingen, Germany: Gunther Narr.

Kumpulainen, M. (2015). On the operationalisation of 'pauses' in translation process research. *Translation and Interpreting, 7*(1), 47-58.

Lakoff, G. (1993). The contemporary theory of metaphor. In A. Ortony (Ed.), *Metaphor and thought* (pp. 202-251). Cambridge, UK: Cambridge University Press. doi: 10.1017/CBO9781139173865

Lakoff, G., & Johnson, M. (2003). *Metaphors we live by*. Chicago, London: University of Chicago Press.

Langlois, J. (2020). Language and cognitive science: How language affects reasoning and memory. *Training, Language and Culture, 4*(3), 66-76. doi: 10.22363/2521-442X-2020-4-3-66-76

Larina, T. (2015). Culture-specific communicative styles as a framework for interpreting linguistic and cultural idiosyncrasies. *International Review of Pragmatics, 7*(2), 195-215. Doi: 10.1163/18773109-00702003

Lehr, C. (2021). Translation, emotion and cognition. In F. Alves & A. L. Jakobsen (Eds.), *The Routledge handbook of translation and cognition* (pp. 294-309). New York, NY: Routledge.

Macken, L., Prou, D., & Tezcan, A. (2020). Quantifying the effect of machine translation in a high-quality human translation production process. *Informatics, 7*(2). doi: 10.3390/informatics7020012

Mandelblit, N. (1995). The cognitive view of metaphor and its implications for translation theory. In B. Lewandowska-Tomaszczyk & M. Thelen (Eds.), *Translation and meaning: Part 3* (pp. 483-495). Maastricht, Netherlands: Hoogeschool Maastricht.

Marking, M. (2021). *Poland rules on LSP using Google Translate, defines 'professional translator'*. Retrieved from https://slator.com/industry-news/poland-rules-on-lsp-using-google-translate-defines-professional-translator

Massey, G. (2016). Remapping meaning: Exploring the products and processes of translating conceptual metaphor. In Ł. Bogucki, B. Lewandowska-Tomaszczyk & M. Thelen (Eds.), *Translation and meaning* (pp. 67-83). Frankfurt am Main, Germany: Peter Lang.

Massey, G. (2017). Translation competence development and process-oriented pedagogy. In J. Schwieter & A. Ferreira (Eds.), *The handbook of translation and cognition* (pp. 520-544). Chichester, UK: Wiley-Blackwell.

Massey, G. (2020). *CIUTI report. TIGES 21 survey 2018: T&I graduate employment strategies in the 21st century*. Retrieved from https://ciuti.org/wp-content/uploads/2020/04/TIGES-21_2018-Report-for-CIUTI-Website-final-rev1.pdf

Massey, G., & Ehrensberger-Dow, M. (2017a). Machine learning: Implications for translator education. *Lebende Sprachen, 62*(2), 300-312. doi: 10.1515/les-2017-0021

Massey, G., & Ehrensberger-Dow, M. (2017b). Translating conceptual metaphor: The processes of managing interlingual asymmetry. *Research in Language, 15*(2), 173-189. doi: 10.1515/rela-2017-0011

Monti, E. (2009). Translating the metaphors we live by: Intercultural negotiations in conceptual metaphor. *European Journal of English Studies, 13*(2), 207-221. doi: 10.1080/13825570902907243

Re-framing conceptual metaphor translation research in the age of neural machine translation: Investigating translators' added value with products and processes

by Gary Massey

Muñoz Martín, R. (2013). More than a way with words: The interface between cognitive linguistics and cognitive translatology. In A. Rojo & I. Ibarretxe-Antuñano (Eds.), *Cognitive linguistics and translation* (pp. 75-94). Berlin, Germany: Mouton de Gruyter. doi: 10.1515/9783110302943.75

Muñoz Martín, R. (2014). Situating translation expertise: A review with a sketch of a construct. In J. W. Schwieter & A. Ferreira (Eds.), *The development of translation competence: Theories and methodologies from psycholinguistics and cognitive science* (pp. 2-56). Newcastle upon Tyne, UK: Cambridge Scholars.

Muñoz Martín, R. (2016). Reembedding translation process research: An introduction. In R. Muñoz Martín (Ed.), *Reembedding translation process research* (pp. 1-20). Amsterdam, Netherlands: John Benjamins. doi: 10.1075/btl.128.01mun

Newmark, P. (1981). *Approaches to translation. Language teaching methodology senes*. Oxford, New York: Pergamon Press.

Nicaise, L. (2011). On going beyond the literal: Translating metaphorical conceptualizations in financial discourse. *Meta, 56*(2), 407-423. doi: 10.7202/1006184ar

O'Brien, S. (2012). Translation as human-computer interaction. *Translation Spaces, 1*(1), 101-122. doi: 10.1075/ts.1.05obr

O'Brien, S. (2015). The borrowers: Researching the cognitive aspects of translation. In M. Ehrensberger-Dow, S. Göpferich & S. O'Brien (Eds.), *Interdisciplinarity in translation and interpreting process research* (pp. 5-17). Amsterdam, Netherlands: John Benjamins. doi: 10.1075/bct.72.02obr

PACTE Group. (2005). Investigating translation competence: Conceptual and methodological issues. *Meta, 50*(2), 609-619. doi: 10.7202/011004ar

PACTE Group. (2009). Results of the validation of the PACTE translation competence model: Acceptability and decision making. *Across Languages and Cultures, 10*(2), 207-230.

PACTE Group. (2018). Competence levels in translation: Working towards a European framework. *The Interpreter and Translator Trainer, 12*(2), 111-131. doi: 10.1080/1750399X.2018.1466093

Pym, A. (2003). Redefining translation competence in an electronic age. In defence of a minimalist approach. *Meta, 48*(4), 481-497. doi: 10.7202/008533ar

Risku, H. (2010). A cognitive scientific view on technical communication and translation: Do embodiment and situatedness really make a difference? *Target, 22*(1), 94-111. doi: 10.1075/target.22.1.06ris

Risku, H. (2014). Translation process research as interaction research: From mental to socio-cognitive processes. *MonTI, 1,* 331-353. doi: 10.6035/MonTI.2014.ne1.11

Risku, H., Rogl R., & Milošević, J. (Eds.). (2019). *Translation practice in the field. Current research on socio-cognitive processes* (pp. 1-24). Amsterdam, Netherlands: John Benjamins. doi: 10.1075/bct.105

Risku, H., & Windhager F. (2013). Extended translation: A sociocognitive research agenda. *Target, 25*(1), 33-45. doi: 10.1075/target.25.1.04ris

Rojo, A., & Ibarretxe-Antuñano, I. (Eds.). *Cognitive linguistics and translation*. Berlin, Germany: Mouton de Gruyter. doi: 10.1515/9783110302943

Samaniego Fernández, E. (2011). Translation studies and the cognitive theory of metaphor. *Review of Cognitive Linguistics, 9*(1), 262-279. doi: 10.1075/rcl.9.1.12sam

Samaniego Fernández, E. (2013). The impact of cognitive linguistics on descriptive translation studies: Novel metaphors in English-Spanish newspaper translation as a case in point. In A. Rojo & I. Ibarretxe-Antuñano (Eds.), *Cognitive linguistics and translation* (pp. 159-198). Berlin, Germany: Mouton de Gruyter. doi: 10.1515/9783110302943.159

Schäffner, C. (2004). Metaphor and translation: Some implications of a cognitive approach. *Journal of Pragmatics, 36*(7), 1253-1269. doi: 10.1016/j.pragma.2003.10.012

Schäffner, C. (2005). A roof is an umbrella: Metaphor, culture and translation. In M. Sidiropoulou (Ed.), *Identity and difference: Translation shaping culture* (pp. 49-78). Bern, Switzerland: Peter Lang.

Schäffner, C. (2012). Finding space under the umbrella: The Euro crisis, metaphors, and translation. *The Journal of Specialised Translation, 17,* 250-270.

Schäffner, C. (2014). Umbrellas and firewalls: Metaphors in debating the financial crisis from the perspective of translation studies. In D. R. Miller & E. Monti (Eds.), *Translating figurative language* (pp. 69-84). Bologna, Italy: Bononia University Press.

Schäffner, C., & Shuttleworth, M. (2013). Metaphor in translation. Possibilities for process research. *Target, 25*(1), 93-106. doi: 10.1075/target.25.1.08shu

Schmitt, P. A. (2019). Translation 4.0 – evolution, revolution, innovation or disruption? *Lebende Sprachen 64*(2), 193-229. doi: 10.1515/les-2019-0013

Shuttleworth, M. (2011). Translational behaviour at the frontiers of scientific knowledge: A multilingual investigation into popular science metaphor in translation. *The Translator, 17*(2), 301-323. doi: 10.1080/13556509.2011.10799491

Shuttleworth, M. (2014). Translation studies and metaphor studies: Possible paths of interaction between two well-established disciplines. In D. R. Miller & E. Monti (Eds.), *Translating figurative language* (pp. 53-65). Bologna, Italy: Bononia University Press.

Sjørup, A. C. (2011). Cognitive effort in metaphor translation: An eye-tracking study. In S. O'Brien (Ed.), *Cognitive explorations of translation* (pp. 197-214). London, UK: Continuum.

Sjørup, A. C. (2013). Cognitive effort in metaphor translation. An eye-tracking and keylogging study (Doctoral dissertation). Copenhagen Business School, Denmark.

Smakman, D. (2019). Cultural bias and sociolinguistics. *Russian Journal of Linguistics, 23*(1), 9-22. doi: 10.22363/2312-9182-2019-23-1-9-22

Tabakowska, E. (2014). Teaching translation: Can cognitive grammar be of any use? In M. Piotrowska & S. Tyupa (Eds.), *inTRAlinea special issue: Challenges in translation pedagogy.* Retrieved from http://intralinea.org/specials/article/teaching_translation_can_cognitive_grammar_be_of_any_use

Tebbit, S. & Kinder, J. J. (2016) Translating developed metaphors. *Babel, 62*(3), 402-422. doi: 10.1075/babel.62.3.03teb

Tirkkonen-Condit, S. (2002). Metaphoric expressions in translation processes. *Across Languages and Cultures, 3*(1), 101-116.

Toury, G. (1995). *Descriptive translation studies – and beyond.* Amsterdam, Netherlands: John Benjamins. doi: 10.1075/btl.4

Van den Broeck, R. (1981). The limits of translatability exemplified by metaphor translation. *Poetics Today 2*(4), 73-87. doi: 10.2307/1772487

Venuti, L. (2019). *Contra instrumentalism: A translation polemic.* Lincoln, NE: University of Nebraska Press.

Wheeler, M. (2005). *Reconstructing the cognitive world: The next step.* Cambridge, MA: MIT Press. doi: 10.7551/mitpress/5824.001.0001

AUTHOR INFORMATION: GARY MASSEY

Zurich University of Applied Sciences | Gertrudstrasse 15, 8401 Winterthur, Switzerland

mssy@zhaw.ch