Modeling (Un)Packing of Meaning in Translation: Insights from Effortful Text Production

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Abstract. This paper introduces a proposal aimed at enriching the framework of translation process research with a systemic-functional linguistics perspective for investigating instances of effortful translated text production. Drawing on the concept of grammatical metaphor and its potential for modeling both monolingual and multilingual text production, it examines ongoing meaning construction in translation as a special type of language processing which involves unpacking and repacking meanings construed in the target texts upon reading the source text. By analyzing logs recorded through key logging and eye tracking, we attempt to investigate phenomena that can shed a light into human translators' cognitive processes and which are potential sources for modeling meaning construction at play during the translation process.

Keywords: Modeling of Human Translation, Empirical-Experimental Methodology, Meaning Construction, Translation Process Research, Effortful Text Production.

1 Introduction

In the literature on translation process research, pauses and recursiveness as recorded through key-logging software have been pointed out as indicators of effortful meaning production in translation tasks [1, 2]. More recently, eye tracking has been incorporated in the methodology used by translation process studies [3], whereby data obtained through key logging, eye tracking and verbal protocols are triangulated to both illuminate the translator's behavior during task execution and identify instances of text production that constitute translation problems [4].

Concomitantly, theory-informed text analysis [5, 6] has sought to approach real-time text production as captured in translation tasks in order to seek possible motivations for those instances of effortful production signaled by pauses and recursiveness, envisaging an integration of particular patterns of gaze trajectory and eye fixations into the analysis. One such theory supporting text analysis is systemic functional linguistics [7, 8], which offers a comprehensive approach to meaning making within the context of multilingual text production, its conceptualization allowing for modeling language production in translation. In fact, its architecture is particularly suitable to approach translation process research, since one of the dimensions it adopts to examine language, namely the *logogenetic* one, contemplates the unfolding of discourse, where local decisions are made against the background of

more global orientations taken by the translator on the basis of the values for context configuration adopted by him/her.

In this paper, we propose to enrich the framework of translation process research with a systemic-functional linguistics perspective for examining linguistic phenomena that can be observed to be taking place in instances of effortful translated text production (as revealed by particular patterns of pauses, recursiveness, progressive and regressive fixations within the text, and gaze trajectory across the source and target texts seen as two distinct areas of interest). Drawing on the concept of grammatical metaphor [7] and its potential for modeling both monolingual and multilingual text production [9], we aim at examining ongoing meaning construction in translation as a special type of language processing which involves unpacking and repacking meanings construed in the target texts upon reading of the source text. By analyzing logs recorded through key logging and eye tracking, we attempt to investigate phenomena that can shed a light into human translators' cognitive processes and which are potential sources for modeling meaning construction at play during the translation process.

2   Theoretical Underpinnings

Within the framework of systemic functional linguistics, *logogenetic* instantiation of text has been frequently studied within monolingual text production, with particular focus on phenomena involving recapitulation of higher rank units in language, such as clauses, in lower rank units, such as groups and words [10]. This is accounted for through the concept of grammatical metaphor, which names a phenomenon "whereby a set of agnate (related) forms is present in the language having different mappings between the semantic and the grammatical categories" [7]. This can be seen in the example below:
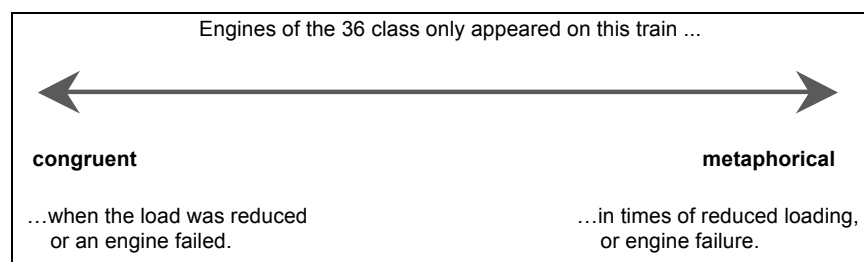

Fig. 1. Example of congruent and metaphorical wordings
Source: Halliday & Matthiessen (1999: 235).

The less metaphorical wording on the left "when the load was reduced or an engine failed" construes meaning through a hypotactic clause subordinated to the main one "Engines of the 36 class only appeared on this train". The meanings construed by this subordinate clause can also be construed through a more metaphorical wording on the right, here through a circumstantial adjunct, where agency is less explicit than in its more congruent wording. Nominalization and adjectivization pack meanings in such a

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way that some of the content becomes more implicit, such as the fact that the load is reduced by an external agent implicated in the passive voice construction on the left.

Grammatical metaphor is deployed throughout the language system and accounts for the fact that states and events represented in texts can potentially be encoded through different wordings (a clause, a phrase, etc.). The choice for a more or less metaphorical wording in turn bears an impact on the degree of implicit or explicitness of the meanings construed in language.

Research on grammatical metaphor as a phenomenon having an implication in translated text [9, 11] has posited the hypothesis of (de)metaphorization as a process accounting for perceived differences between non-translated and translated text. Three sources have been identified as likely explanations for properties characterizing translated texts as opposed to non-translated text. The *typology* of the source language system may be reflected in some of the properties of the translation; the *registers* of a source text and a target text for a given context may not be the same, thus demanding decisions on the translator's part on how to construe meanings oriented to the contextual variables envisaged for the target text; and finally, *understanding* involves relating given units of text to more explicit and more literal paraphrases and in this sense demands decisions on the translator's part as to how metaphorical certain wordings need to be, can be or will ultimately have to be.

Drawing on observations of texts in comparable (translated and non-translated samples and parallel corpora (originals and their translations), understanding in monolingual and multilingual text production can be modeled based on grammatical metaphor, the translator's performance involving relating meaningful (grammatical) units to their more or less metaphorical variants [9]. When the level of metaphoricity is lower in the translated text than in the original one, explicitation of meanings implicitly encoded in the original text is performed by the translator drawing on co-textual and contextual assumptions. The following example, retrieved from a website (www.linguee.com) offering a search engine of parallel corpora shows an aligned occurrence of a clause containing the verb "to evolve" and a circumstance of location realized by a prepositional phrase. This circumstance is partly demetaphorized in its translation into Portuguese and realized as a verb ("come to be") due to typological differences between the two languages:

Source text
Some day it might **evolve** into a real citizens' initiative, found in the legislation of some Member States.
English: www.europarl.europa.eu/sides/getDoc…;language=EN

Target text
Um dia este instrumento poderá **desenvolver-se e vir a ser** uma verdadeira iniciativa popular, que aliás já consta da legislação de alguns Estados-Membros.
Portuguese: www.europarl.europa.eu/sides/getDoc…;language=PT

Back translation into English
One day this instrument may **develop and come to be** a true popular initiative, which by the way is already part of the legislation of some Member States.

Fig. 2. Example of demetaphorization in translation

The wordings in bold above show that the meaning construed in English by "evolve into" need to be construed in Portuguese by two verb groups "desenvolver-se" (develop) and "vir a ser" (come to be), which illustrates explicitation of part of the meaning packed in a circumstance in English ("into ...").

Steiner's observations from the final output or translation product perspective have also been confirmed in studies of the translation process [12], as data obtained through key logging shows a series of micro units within one or more macro units that encapsulate (de)metaphorization processes. In this sense, the concept of micro and macro-units [13] as retrievable from key-logging data allows for capturing paths of (de)metaphorization movements that may be or not perceivable in the final rendition output.

This can be supported by evidence obtained from eye-tracking data, particularly regarding both progressive and regressive fixations within text and gaze trajectory across areas of interest (source and target texts) during instances of (de)metaphorization identified though macro units in tasks logs.

In order to illustrate the methodological steps implemented for tracking (de)metaphorization movements and the analytical procedures adopted to explicate the shifts in the level of metaphoricity, this paper examines results from an experiment involving eight Brazilian professional translators who translated a popular science text from Portuguese (L1) into English (L2). The rationale for the experiment is briefly described in the following section.

3   Methodological Considerations

Focusing on the notion of grammatical shifts (parts of speech changes), Hansen-Schirra, Neumann & Steiner (2007) proposed a methodology for product-oriented and corpus-based studies of translated texts to enable the annotation and alignment of a parallel corpus of source and target texts [14]. This allows for the identification of alignment units between source and target texts, including unaligned segments in the source and target texts ("empty links") and segments which can be aligned only at a higher rank due to differences in grammatical functions in the source and target renditions ("crossing lines").

Probing translated text production but focusing on the notion of translation unit (as *foci of attention*), Alves & Vale (2009) proposed a methodology for process-oriented and corpus-based studies of translated texts to mark, annotate, extract and classify translation units (TUs) as micro and macro translation units [13]. The authors developed the Internet-based software package Litterae (available at http://letra.letras.ufmg.br/litterae/index.xml), which is able to read XML files generated by Translog 2006© and automatically provide micro units on the basis of a user-provided pause unit (in seconds). These micro units can be grouped into macro units and further analyzed as the user inserts annotation categories, such as the phase of the translation process where each micro unit is found.

As far as Hansen-Schirra, Neumann & Steiner's (2007) proposal is concerned, category (part of speech) change is examined by mapping alignment units (AU) from source texts onto corresponding occurrences in target texts (final output of translation)

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[14]. Alves & Vale (2009), on the other hand, try to map translation units from source texts onto sequences of corresponding translation units in the unfolding of target text production [13]. Together, the two proposals can map alignment units in source and target texts onto translation units which can be approached as evidence of *cognitive entities* observable in the process data and, therefore, allocate an entire set of translation process data, consisting of TUs, to appropriate AUs. In this paper we follow a similar approach, based on a methodology put forward in Alves et al (2010) [12], to explore the modeling of language processing in translation on the basis of grammatical metaphor with a focus on instances of effortful text production.

3.1 Sample Experimental Design

Eight Brazilian professional translators (named from BT1 to BT8) participated in an experiment carried out in Belo Horizonte, Brazil, 2010, aimed at investigating, among others, the impact of more or less metaphorical wordings in the source text on the rendition of the target texts. Having access to only one electronic dictionary, they were asked to translate a text from Portuguese into English (inverse translation task, i.e. L1 into L2). Two source texts were used; these were two versions (A and B) of a popular science text, generated through manipulation in order to create analogous instances of more or less metaphorical wordings in each version. Task execution was recorded through key-logging and eye-tracking software. Free and guided recall protocols were carried out upon task completion, both of them being eye-tracked and audio-recorded. Key-logging data was analyzed to identify micro units within macro units. Eye-tracking data was analyzed to investigate subjects' gaze trajectories and fixations. Given time and space constraints and our attempt to illustrate (de)metaphorization movements in detail, the analysis of micro units herein reported is limited to two particular macro units in the translation process of one of the subjects, namely those concerning the first two clause complexes translated by subject BT5.

4   A Case in Point: Analysis and Discussion

As mentioned above, two versions of the source text where used in the experiment, each one having instances of more or less metaphorical wordings when compared against each other.

Figure 3 shows the first two clause complexes in Portuguese of Version B, the input for subject BT5's translation process. Back translations in English are provided, and manipulated wordings are in bold.

Version B
Clause complex 1
A tarefa de identificar um bom café é para os degustadores relativamente simples, **mas a atribuição de uma nota exata para cada amostra** é outra história.
Clause complex 2
O degustador aprecia com base em habilidades que adquire com a experiência.
Back translation
Clause complex 1
The task of identifying a good coffee is for taster relatively simple, but **the assignment of a precise score** to each sample is an entirely different matter.
Clause complex 2
A taster judges [coffee samples] on the basis of skills acquired through experience.

Fig. 3. Clause complexes corresponding to the Macro Units under scrutiny

Macro units in BT5's process were mapped on the basis of key-logged data obtained through Translog with 3-second-long pauses and grouped together using the software package Litterae. Each micro unit corresponds to a meaningful text string found in between pauses either in the drafting phase (i.e., from first keystroke until the first draft of the whole source text) or in the revision phase (i.e., any changes implemented after the rendition of the first draft of the whole source text). Figure 4 below illustrates a macro unit which consists of 8 micro units in the drafting phase and 1 micro unit in the revision phase.

```
Drafting
1[Start]*********The••Xtak Xsk•for•id
ffee**
2 •is•a****
3 Xessentially•a•simple•one•for****
4•degustadores,•
5*but•the*
6•task•of•assyiX Xigning**
7•an•exact•score•to•each•coffee•sample*
8•is•entirelly•differenteX.•
Revision
9*************[🖰][🖰]tasters*
```

Fig. 4. BT5's micro units for the translation of clause complex 1

BT5 translated the text with little recursiveness (related to deletion of typos), and also kept one word in Portuguese (i.e., "degustadores), which is translated in the last micro unit in the revision phase. The pauses seem to be related to effort: in the first micro unit, one of the longest, as the eye-tracking data show, pauses relate to the reading of the whole clause complex; in micro units 2, 3, 5, 6 and 7, they seem to be related to trying to solve a lexical problem, such as the search for a noun in English for "degustadores" (tasters); and in the ninth micro unit, a substantially long pause as

well, eye tracking data shows that this is related to look ups within the dictionary provided.

The second clause complex can be mapped onto the following micro-units below:

```
Drafting
1  *The◆degustador◆
2  *******taste*
3  ◆is◆based*
4  ◆on◆
5  *his;⊠/her◆skills◆acquired**
6  with◆experience.◆
Revision
7  [⟳][⟳]taster**********[⟳]*
8  sa**vore⊠s◆a*
9  ◆beverage***
10 [⟳][⟳]ability◆to◆[⟳]
11 ⊠***[⟳][⟳]previous◆**
```

Fig 5. BT5's micro units for the translation of clause complex 2

Figure 5 illustrates a macro unit which consists of 11 micro units with little recursiveness (related to deletion of typos), those units being related to choices at the word rank. Although this seems to be a very short macro unit, lasting one minute and eight seconds in the drafting phase and 1 minute and 46 seconds in the revision phase, BT5 makes considerable changes in the revision phase, as evidence by the occurrence of 5 micro units (45 % of the macro unit). These changes will be explained below.

The key-logged data reported as micro units in Figures 5 and 6 were mapped onto eye-tracking data in order to verify if gaze trajectory and eye fixations revealed effortful attempts on BT5's part to translate the second clause complex.

In Figure 6 each frame corresponds to 15-second-long gazes. Such eye-tracking data shows considerable effort in the rendition of the macro unit corresponding to the clause complex 2 in the drafting phase. Lines linking fixations from the source text through the target text area of interest (and vice-versa) show the subject's recurrent need to process small portions of the source text in order to produce the target text (see the short distance between lines in frames 2 and 3). Fixation also shows recursiveness in the reading of this macro unit, there being almost one fixation per word.

In Figure 7, each frame corresponds to a 20-second-long gaze. In the revision phase, BT5's gaze does not show recurrent movements from source to source text (and vice-versa). As expected for this phase in the process [15], most fixations are found in the target text area of interest.
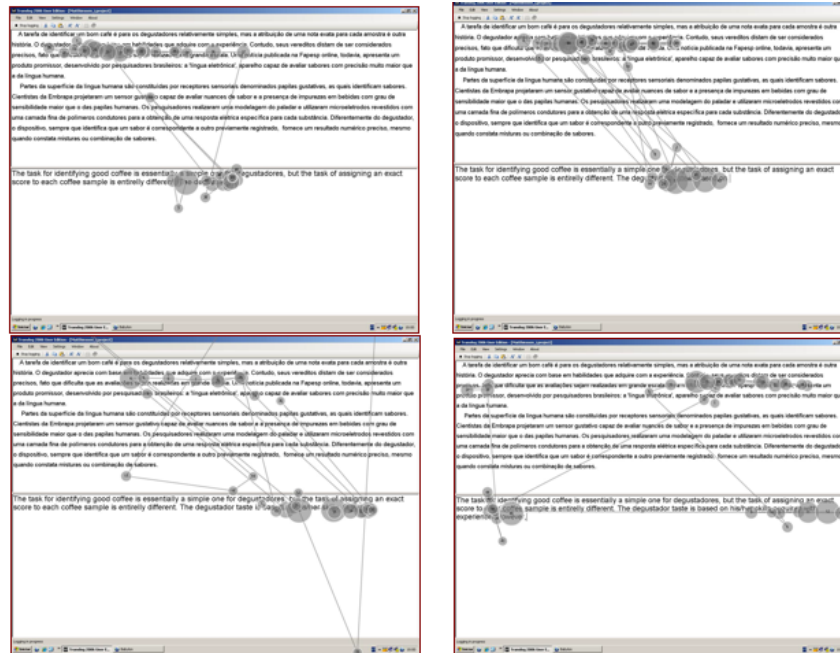
Fig. 6. Sequence of gaze plots generated by eyetracking for the performance of BT5
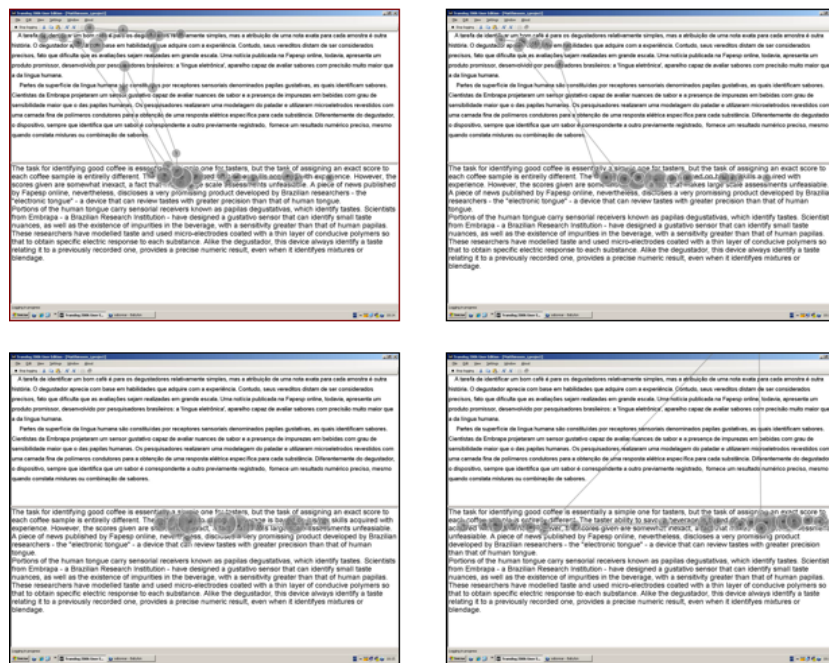

Fig. 7. Sequence of gaze plots generated by eye tracking for the performance of BT5

As a joint analysis of Figures 4-7 shows, particular patterns of pauses, recursiveness and eye gazing and fixations can be cross-analyzed to locate instances in the source and target texts where effort is stronger. Let us now turn to an analysis of motivations for the effort invested by the subject in terms of the constraints in the two language systems to which the translation problem can be ascribed.

If we have a look at the source text, there is a typological problem that exerts pressure on the translator's behavior. Where the source text reads

O degustador aprecia com base em habilidades que adquire com a experiência.

the intransitive use of the verb "aprecia" in Portuguese, back-translatable into English as *judges, savors* or *tastes*, demands that the translator overcome two potential problems: one is the need to turn this intransitive verb in Portuguese into a transitive verb in English, due to typological constraints in the latter; and the other is to seek to avoid the repetition of **taste**, if the choice is for the verb **to taste**.

The final output in BT5's text is

The taster ability to savor a beverage is based on his/her previous skills acquired with years of experience.

where we can see concurrent metaphorization and demetaphorization when compared to the source text meanings. "O degustador aprecia" (the taster savors) is realized as "the taster ability to savor", with a metaphorization added through the noun "ability", which offers a solution to the problem posed by the meaning construed by the intransitivity of the verb in Portuguese. "Aprecia" (savors, tastes) is realized as "to savor a beverage" with a consequent demetaphorization through explicitation of an object selected in order to use a transitive construction in English.

However, and this is where process data comes in to play a fundamental role in our analysis, metaphorical shifts in the translation product may entail further metaphoricity shifts in the process. This can clearly be seen in the micro units identified for the macro units under scrutiny.

During the drafting phase, the subject's log shows the following interim rendition:

The degustador taste is based on his/her skills acquired with experience

where the problem of the intransitive form in Portuguese finds an interim solution in English through the selection of a copula or relational process "is based on". This is taken up in the end-revision phase, where three attempts are made with various degrees of metaphoricity:

1. The taster taste is based	+ metaphorical
2. The taster savors a beverage is based	– metaphorical
3. The taster ability to savor a beverage	+ metaphorical

Fig. 8. Target text renditions during end revision phase

Shifts in levels of metaphoricity such as the ones observed in the translation log above seem to point to a strategy implemented by the subject to deal with typological differences between the two language systems. Interestingly enough, the subject may or may not be aware of this strategic path taken. In the case of BT5, data from the verbal recall recorded upon task completion shows no evidence of awareness on the subject's part, as all he says in his protocol regarding his task is:

> "I did a dirty translation first, using, introducing some words in Portuguese ... that I was not sure that I could use ... *taster* ... and then I used *degustador* in Portuguese all the same ... and ... in order to later on in the revision ... to go back to doubts and improve the text."

Most significantly for the purposes of the present discussion, shifts in levels of metaphoricity such as the ones observed in the BT5's translation log and eye-tracking data seem to provide empirical evidence of meaning making processes at stake in translation of the kind that can be mapped by further research with potential implications for modeling human translation processes.

5 Concluding Remarks

In this paper, we have attempted to provide a brief illustration of a methodology and analytical procedures that can be adopted in order to explore a particular phenomenon in meaning production, namely grammatical metaphor. Its identification in the course of a task execution was clearly made through pauses, eye fixation and gaze plots, indicators of effortful text production. The foci of attention, mapped on time and resources invested by the translator to deal with a translation problem ascribed to such instances of effortful production, need not find a counterpart in recall protocol data, even though a discussion of this kind of data from an expert performance perspective would certainly point to more expert like behavior if evidence of meta-reflection and metalanguage can be found in the protocols.

On the whole, our approach shows the potentiality for exploring eye-tracking data to account for higher-level cognitive processes in translation, along lines somewhat different from those in standard psycholinguistic research which tend to focus on automatic aspects of language processing. The methodology also has implications for translation modeling through shifts in metaphorical wording. Finally, grammatical metaphor seems to offer a productive approach to show instances of effortful language processing in translation by mapping alignment units onto translation units. It also highlights the need for a comprehensive theory of language for translators to develop awareness and metalanguage to account for their choices. As sketched herein, the proposed methodology promises to open up a new avenue for the investigation of meaning construction in translation and should now be tested in larger samples of translation process data to be further developed.

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