

Chapter 6

Cognitive effort and explicitation in translation tasks

Igor A. Lourenço da Silva

Universidade Federal de Uberlândia

Adriana Silvina Pagano

Universidade Federal de Minas Gerais

Drawing on the framework of systemic-functional linguistics, this paper examines cognitive effort for meaning explicitation in translation tasks. Two hypotheses were formulated building on Steiner (2001a,b) and Tirkkonen-Condit (2005): (1) literal translation, as a default translation procedure/strategy, minimises cognitive effort; and (2) explicitation of more implicit realisations in the source text requires more cognitive effort. To test these hypotheses, 16 Brazilians and 16 Germans, proportionally distributed as field specialists and professional translators, were asked to perform a translation task of one of two versions of an L2 (English) source text into their L1. Both source text versions construed analogous meanings, but they had either the most explicit or the most implicit variants of ten agnate realisation pairs (five of each in each version). The task was recorded using the key-logging program Translog 2006. From a process-oriented perspective, the key-logged data were analysed to determine the renditions per variant, number of micro-units per word, number of pauses per word, and drafting time per word. From a product-oriented perspective, subjects' renditions were analysed to investigate the impact of their choices on the explicitness and implicitness of the target texts. Overall, the results confirm the hypothesis that literal translation is a default procedure that requires less cognitive effort. As to the second hypothesis, more implicit variants in the source text do not necessarily require more cognitive effort than their less implicit variants.



1 Introduction

Building on empirical-experimental research, Tirkkonen-Condit (2005) hypothesises that 'literal' translation, i.e., opting for wordings in the target text (TT) that are closely patterned upon the lexico-grammar of the source text (ST), is a default translation procedure/strategy adopted by both experts and novices. Assuming that similar lexico-grammatical patterns entail similar levels of explicitness in wordings Steiner (2001b) and that the human translator as a 'cognitive miser' (Fiske & Taylor 1984) resorts to explicitation as a complex strategy for TT production when problem solving is demanded, literal translation, as a default procedure, is expected to minimise cognitive effort. According to Tirkkonen-Condit, a monitoring process called 'monitor', usually better developed in experts, enables translators to recognise instances in the ST that constitute translation problems unlikely to be solved through a literal translation strategy.

If literal translation is a default procedure in translation and it involves similar lexico-grammatical patterns, translated texts would be expected to evidence a good deal of shared level of explicitness with their source counterparts. However, corpus-based research has pointed to translated texts as being more explicit (Olohan & Baker 2000; Steiner 2001a,b). Explicitation has been reported as a phenomenon partially accounted for by typological differences between source and target languages as well as differences in the source and target contexts of culture and situation. In addition, a third source of explicitation has been claimed to be translators' understanding of the ST and its role in TT production (Steiner 2001a,b).

Drawing on insights of both empirical-experimental research and corpus-based research, this paper reports on a process and product-oriented investigation of explicitation with a view to testing two hypotheses, namely:

- literal translation, as a default translation procedure, minimises cognitive effort;
- translating more implicit realisations in the ST requires explicitation on the translator's part, which entails an effortful translation procedure.

To test these hypotheses, 16 Brazilians and 16 Germans, proportionally distributed as field specialists and professional translators, were asked to perform a task of translation of one of two versions of an L2 (English) ST into their L1. Both versions construed analogous meanings, but they had either the most explicitated or the most implicated variants of ten agnate realisation pairs (five of each in

each version). The task was recorded using the key-logging program Translog 2006. To operationalise an investigation of ‘literal’ translation and explicitation, we relied on the notions of ‘grammatical metaphor’ and ‘de-metaphorisation’ as expounded in the Literature Review.

This paper is made up of five sections including this Introduction. The Literature Review section provides the framework that was used to support this study. The Methodology section describes materials and methods for data collection and analysis. The Results and Discussion section focuses on the analysis of key-logging data. The Final Remarks section summarises our findings and points out future research avenues.

2 Literature review

According to Tirkkonen-Condit (2005), translators tend to adopt the default, less effortful strategy of providing renditions patterned upon the ST – i.e., ‘literal’ translations. However, as translators move up in the novice-expert cline, they increasingly develop a monitoring mechanism (Monitor) that enables them to abandon such a strategy when they recognise ST patterns that require more careful attention due to target language constraints.

The tendency to use ‘literal’ translation can be seen in translation process data, as Tirkkonen-Condit (2005) argues, when first renditions are examined. These tend to be reached by novices and experts through automatism and are subsequently revised, as shown by interim renditions, when the Monitor mechanism is activated, usually in the case of more expert performance. In a 2006 study, Tirkkonen-Condit, along with Mäkisalo and Immonen, investigated the changes implemented by professional translators in the drafting phase and found out that 40% of the revisions were triggered by the need for adjusting instances that had previously been literally translated.

Automatism is ascribed by Tirkkonen-Condit to solutions patterned on the source language lexico-grammar and to translation at ranks lower than the clause (e.g., word). Working at higher ranks and dealing with rearrangement of meanings differently construed in the ST and TT are assumed to be instances of the Monitor mechanism at work (Tirkkonen-Condit 2005: 409) and can be deemed as instances of effortful TT production. One such example is explicitation, a phenomenon that has been investigated in studies of both translated text (e.g. Blum-Kulka 1986; Klaudy 1998) and translation process (e.g., Séguinot 1988; Englund Dimitrova 1993; 2005; Alves et al. 2011; Carl & Dragsted 2012; Schaeffer 2013; Carl & Schaeffer 2014; Halverson 2015).

Explicitation, as explained by Hansen-Schirra et al. (2007), is a process or a relationship between intralingual variants and/or translationally related texts.

We assume explicitation if a translation (or, language-internally, one text in a pair of register-related texts) realizes meaning (not only ideational, but also interpersonal and textual) more explicitly than its source text – more precisely, meanings not realized in the less explicit source variant but implicitly present in a theoretically motivated sense. The resulting text is more explicit than its counterpart (Hansen-Schirra et al. 2007: 243).

Hansen-Schirra et al. (2007: 243) point out, and we follow suit, that their definition deliberately excludes the indefinite number of possibilities through which meaning can simply be added to some text/discourse, without being in any motivated sense implicit in the source variant. In their approach, explicitation is characterised by a comparative measurement of explicitness as a property of encoding, not as a property of the communicative act as such. In other words, explicitness is a property of lexico-grammatical or cohesive structures and configurations, and explicitation is the result of a process taking place in rewording tasks such as paraphrasing and translation.

From the very first process-oriented studies (Séguinot 1988; Englund Dimitrova 1993), explicitation has been reported to be a phenomenon partially accounted for by typological differences between source and target languages as well as differences in the source and target contexts of culture and situation. However, Steiner (2001a,b), building on the notion of explicitation as a translation universal (Baker 1995; 1996) and further developing it as a property of translated texts empirically observable in corpora, has posited a model in which he adds a third factor that may account for explicitation, namely understanding on the part of the translator.

Steiner models understanding as an operation of de-metaphorisation. A key concept to this is *grammatical metaphor* as conceived of by systemic functional linguistics (SFL, Halliday & Matthiessen 1999; 2004) and defined as “the phenomenon whereby a set of agnate (related) forms is present in the language having different mappings between the semantic and the grammatical categories” (Halliday & Matthiessen 1999: 7). Figure 1, elaborated with variants of a sentence used in our experiment, displays four agnate forms with different levels of grammatical metaphoricity in a cline from less metaphorical, and hence more congruent, to more metaphorical and less congruent.

As can be seen, congruency and metaphoricity are a matter of level and may be identified through comparison of different agnate wordings. On the one hand, the more congruent wordings provide explicit agency (i.e., the researchers are

6 Cognitive effort and explicitation in translation tasks

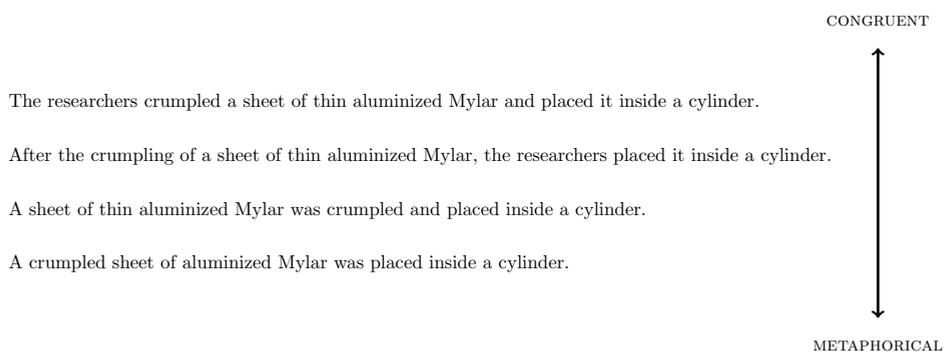


Figure 1: Different levels of grammatical metaphoricity

the agents of the processes ‘to crumple’ and ‘to place’) and explicit causal and temporal relations (i.e., the researchers first crumpled the sheet of Mylar and then placed it inside a cylinder). On the other hand, the more metaphorical a wording, the more implicit and the more densely packed the meaning construed with increasing numbers of nominal forms and decreasing agency.

According to Steiner, understanding in translation involves mapping ST units onto their congruent meanings. This implies de-metaphorising and making meanings more explicit. As a result, due to typological features, registerial differences or understanding processes (also influenced by fatigue), the wordings produced in the TT may end up being less metaphorical than those in the ST.

Within the discipline of translation studies, systematic differences in the amount of explicated information between original and translated texts have been approached from different perspectives and theoretical standpoints through the concepts of implicitation and explicitation (see Vinay & Darbelnet 1958; Blum-Kulka 1986; Séguinot 1988; Klaudy 1998; Olohan & Baker 2000, among others). In particular, Englund Dimitrova (2005) is one of the few process studies, which draws on think-aloud protocols (TAPs) and key-logged data, to show how translators deal with explicitation. Even though these concepts have proved very insightful and researchers have attempted to pin down their definitions, there remain many uncertainties as to how to measure what is a more explicit or implicit rendering of meaning. A more theoretically-informed approach to this issue draws on the aforementioned concept of grammatical metaphor, which allows a more precise determination of what is explicit or implicit in a wording of meanings and where in the overall system of the language those meanings can be located.

To the best of our knowledge, process-oriented studies that have, to a greater or lesser extent, drawn on the notions of ‘grammatical metaphor’ and ‘de-metaphorisation’ are Hansen (2003); Liparini Campos (2008; 2010); da Silva (2007); Pagano & da Silva (2010b). In her translation experiment with a professional translator and a translation student working in the German-English and French-English language pair (both L2-L1), Hansen observed that (1) re-metaphorisation (i.e., providing renditions with metaphoricity levels analogous to that in the ST) was the most frequent strategy, and (2) de-metaphorisation was more frequent than metaphorisation (e.g., increasing metaphoricity level in the TT compared to the ST) when the subjects worked under no time pressure. Similarly, in an experiment involving novice translators working in the English-Portuguese language pair (2008) and in an experiment involving professional translators working in the both English-Portuguese and German-Portuguese language pairs (2010), Liparini Campos also found more instances of metaphorisation in under no time pressure condition. However, contrary to Hansen, she identified metaphorisation as the most frequent strategy also under time pressure condition. Finally, da Silva (2007) and Pagano & da Silva (2010b) analysed the L1-L2 translation process and product of a Brazilian Medicine field specialist and showed how he managed to render a highly grammatically metaphorical English-language text. They noticed that de-metaphorisation instances were at play during the entire translation process before the production of more metaphorical realisations in the target text.

3 Methodology

The data analysed in this paper were collected in an experimental study described in da Silva (2012) and Alves et al. (2014a). A group of 8 German and 8 Brazilian professional translators and another group of 8 German and 8 Brazilian physicists were recruited to take part in an experiment in which they translated an English ST (L2 for all subjects) into German or Brazilian Portuguese, their respective L1.

Physicists were recruited as participants in the experiment in the capacity of field specialists who “perform translation tasks as part of their daily work, but neither have formal education in translation nor claim to be translators” (Pagano et al. 2013: 264). Given their domain knowledge and discourse knowledge, field specialists in many countries are considered successful disciplinary writers, in both their L1 and L2 (mostly, English) even though their texts usually undergo through some editing before reaching the publication stage (Vascon-

cellos et al. 2007), and given their domain knowledge and discourse knowledge (Scardamalia & Bereiter 1991), and despite their lack of formal training and experience in translation, therefore they constitute, along with professional translators, a rich source of insights to understanding tap into processes involved in the understanding and production of highly metaphorical texts (Pagano & da Silva 2010a) as is the case of scientific texts (Halliday 2006).

Subjects were instructed to carry out their task with no time pressure and with the sole external support of a general reference dictionary in electronic format. Their translation processes were key-logged using Translog 2006. A translation brief drafted in the subjects' L1 was displayed on the computer screen prior to the subjects being allowed access to the ST (displayed on the top half of the screen). English-Portuguese language data were collected at Universidade Federal de Minas Gerais in Brazil, while English-German language data were collected at Universität des Saarlandes in Germany.

Subjects were randomly assigned one of two versions (A or B) of an ST on the behaviour of crumpled balls, which was manipulated from an original publication of a popular science magazine. Both versions construed analogous meanings, but they had either the most explicit or the most implicit variants of ten agnate realisation pairs (five of each in each version). For each of these variants we investigated the number of renditions (interim and final solutions) and the implicitation levels of the first and last renditions, as well as their related number of micro-units (see definition below) per word, number of pauses per word in intervals of 2.4 seconds (see Jakobsen 2005 and below) or longer, and drafting (see Jakobsen 2002 and below) time per word. The analysis focused exclusively on the sentence parts that varied, and most variables were computed per word to assure comparability across ST wordings and TT renditions. Figure 2 illustrates segmentation as carried out for the purposes of identifying variables in the key-logged data.

Figure 2 shows a total of 12 micro-units – 11 in the drafting phase, and 1 in the revision phase. According to Jakobsen (2002), the drafting phase starts when the subject types the first character and ends when s/he types, for the first time, the last character that concludes a preliminary first version of the TT, while the revision phase starts immediately after the drafting phase and ends when the subject completes the task. In this study, each rendition was assigned to either the drafting or the revision phase, and only those in the drafting phase had their duration computed.

Following Alves & Couto-Vale (2011: 107), micro-units were observed in “the flow of continuous TT production, which may incorporate the continuous read-

Drafting

- M1 * * * * poruq ☒ ☒ que ◆
- M2 * uma ◆ bola ◆
- M3 * * [Ctrl←][Ctrl←]☒ ☒ ☒ a
- M4 * * ⇨ amassada ◆ se ◆ compot ☒ rta ◆
- M5 * * * * * * * * * [⌫][⌫] como ◆ ☒ ☒ ☒ ☒ ☒ porque ◆ ☒ ↓
- M6 * * * * * * * * * * * * * [⌫][⌫][⌫]
- M7 * * * * * * * * * [⌫][⌫]* *
- M8 ↓ da ◆ maneira ◆
- M9 * ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒
- M10 * * * * * * * [⌫] a ◆ sua ◆ maneira ◆
- M11 * * * * * * * * [⌫]de ◆ uma ◆ maneira ◆ particular ◆

Revision

- M12 * * * * * * * * * * * * * * * [⌫][⌫] peculiar ◆ ☒ * * *

Note: * = pause intervals of 2.4 seconds, ◆ = blank spaces, ← = cursor left, ☒ = backspace, ☒ = delete, ⇨ = tab key

Figure 2: Portuguese language rendition by BP1 for “why the crumpled ball behaves the way it does”

ing of ST and TT segments, separated by pauses during the translation process”. In Figure 2, the pauses are represented by * and their duration is 2.4 seconds, a threshold determined by Jakobsen (2005).

First interim renditions were mapped and a new rendition was mapped onto it every time the subjects’ keystrokes showed indications of recursiveness, such as deletion, backspacing, and mouse clicks, that were related to attempts at constructing or revising meaningful forms. The mapping concluded when subjects arrived at a final rendition in the TT. In Figure 2, for instance, the first rendition is “*porque uma bola* [why a ball]” (corresponding to micro-units M1 and M2), and the second rendition is “*porque a bola* [why the ball]” (micro-unit M3), since replacing the indefinite article “*uma*” with the definite article “*a*” was considered a meaningful change. Different renditions could also be found within the same micro-unit as in M5, in which the subject first replaced “*porque* [why]” (rendered in M1) with “*como* [how]”, and then rendered back “*porque*”. Notice that non-meaningful changes, such as correcting typos (as in M1: “*poruq*” instead of “*porqu[e]*”), were not identified as new renditions.

Each rendition had its grammatical metaphoricality level determined. The metaphoricality level of the first rendition was compared to that in the ST, and the

metaphoricity level of the last rendition was compared to that in the ST and the first rendition.¹ Instances of 'literal' translation were identified when the metaphoricity levels tended to be analogous to that in the ST, instances of explicitation were ascribed to reduced metaphoricity levels, i.e. de-metaphorisation. Implication was considered the opposite of explicitation and ascribed to instances of increased metaphoricity levels.

Descriptive statistics (mean, standard deviation, and absolute and relative numbers) was used to explore the data. For some of the variables, we ran, whenever possible, non-parametric tests, namely Mann-Whitney U test or Fisher's exact test, using SPSS v. 17.0. The significance level was set at $p < 0.05$. The tests were aimed at comparing ST versions (A and B), subjects' nationality (as a proxy for language pair), profile (translators/field specialists), metaphoricity level of the first rendition compared to that of the ST (analogous or non-analogous as proxies for 'literal' translation and explicitation/implication, respectively), and metaphoricity level of the final rendition compared to that of the ST (analogous, higher or lower as proxies for 'literal' translation, implication and explicitation, respectively) and that of the first rendition (analogous or non-analogous).

Since first and interim renditions are on-going solutions, distinguishing (or rather predicting) de-metaphorisation or metaphorisation (which fairly depends on further choices within a sentence) was not possible to all variants, and therefore the analysis was restricted to determining analogous or non-analogous renditions. Metaphorisation at a certain point may be followed by de-metaphorisation further in the sentence, and vice-versa.

In other words, this method ignored changes in interim renditions when the final solution was arrived at the third or further rendition (e.g., instances that first had the same level of metaphoricity, were then modified in the interim version and switched back again in the final version). This is a trade-off we had to make to avoid noise in the data: as Halliday & Matthiessen (1999); Steiner (2001a,b) predict, de-metaphorisation and metaphorisation may be necessary at a given point of a text in order to make it in all more implicit or more explicit. Despite this

¹This method ignored changes in interim renditions when the final solution was arrived at the third or further rendition (e.g., instances that first had the same level of metaphoricity, were then modified in the interim version and switched back again in the final version). This is a trade-off we had to make to avoid noise in the data: as Halliday & Matthiessen (1999); Steiner (2001a,b) predict, de-metaphorisation and metaphorisation may be necessary at a given point of a text in order to make it in all more implicit or more explicit. Despite this trade-off, we believe this method ensured the internal validity of our experiment, since we worked with a tendency of 'literal' translation in the first rendition (assuming it as a default procedure) and had the full metaphoricity level in the final rendition.

trade-off, we believe this method ensured the internal validity of our experiment, since we worked with a tendency of 'literal' translation in the first rendition (assuming it as a default procedure) and had the full metaphoricity level in the final rendition.

- literal translation, as a default translation procedure, minimises cognitive effort;
- translating more implicit realisations in the ST requires explicitation on the translator's part, which entails an effortful translation procedure.

Hypothesis (1) was expected to be confirmed through (1.1) a greater number of final solutions that were arrived at in the first rendition tendency to keep the metaphoricity level of the ST in both first and final renditions and (1.2) higher values for measures number of renditions, pauses per word, drafting duration per word and micro-units per words in the production of non-analogous renditions. Hypothesis (2) would be confirmed through higher values for measures number of renditions, pauses per word, drafting duration per word and micro-units per words in the translation of more metaphorical variants.

Analyses for ST version (A or B), subject profile (professional translator or field specialist) and subject nationality (Brazilian or German) were expected to provide further insight into the matter. More specifically, we tested if those independent variables could (also) have an impact on the results.

4 Results and discussion

Table 1 shows the number of renditions till a final solution was arrived at by the two groups of subjects for the variants in each ST version used in the experiment.

The first rendition was frequently the final solution in the experiment with this occurring in 55% of the renditions for variants in both versions A and B among the Brazilians and at least 40% of the renditions among the Germans. Mann-Whitney U test pointed to no significant differences between versions A and B ($p=0.235$ among Brazilians; $p=0.253$ among Germans), but to significant differences between different nationalities ($p=0.004$). This may be interpreted as evidence of a tendency for the final solution to be the first rendition in both nationality groups, though the Brazilians tended to resort to such a strategy even more often. Since extending the final solution to the fourth or further rendition seemed to be rarer among the subjects, this is a potential threshold to be used in

Table 1: Absolute and relative numbers of final solutions arrived at in the nth rendition per text version and subject nationality

Final solution arrived at in the ...	Version A variants				Version B variants			
	Brazilians		Germans		Brazilians		Germans	
	n	%	n	%	n	%	n	%
... first rendition	44	55.00	33	41.25	44	55.00	32	40.00
... second rendition	15	18.75	24	30.00	23	28.75	18	22.50
... third rendition	6	7.50	12	15.00	8	10.00	16	20.00
... fourth rendition	8	10.00	4	5.00	3	3.75	7	8.75
... fifth rendition or further	7	8.75	7	8.75	2	2.50	7	8.75

further studies as indicative of additional cognitive effort to produce the translated text.

Table 2 further explores general data in Table 1 to provide the results for the nth renditions and final solutions per subject nationality, subject profile, and metaphoricity level of the variants in the ST.

Table 2: Absolute and relative numbers of final solutions arrived at in the nth rendition per subject nationality, subject profile and metaphoricity level compared to that in the ST (↑: high metaphoricity level variants; ↓: low metaphoricity level variants)

Final solution arrived at in the ...	Brazilians				Germans			
	Field Specialists		Translators		Field Specialists		Translators	
	↑	↓	↑	↓	↑	↓	↑	↓
...first rendition	22	19	26	21	20	19	16	10
...second rendition	10	8	8	12	10	10	9	13
...third rendition	2	3	1	3	7	6	7	8
...fifth rendition or further	4	3	–	1	1	4	4	5

In Table 2, it is to be noted that instances of high metaphoricity levels in the ST did not result in a higher number of renditions till the final solutions were arrived at than the instances of lower metaphoricity levels. The number of final solutions arrived at in the first renditions was higher among the variants with higher metaphoricity levels, regardless of profile and nationality. The difference, however, was not statistically significant.

Table 3 provides results on the metaphoricity level of the first renditions compared to their respective ST variants. Results are split by nationality and ST version.

Table 3: Absolute and relative numbers of first renditions with analogous or non-analogous metaphoricity levels compared to those in the ST per subject nationality and source text version variants

Metaphoricity level of 1st rendition compared to that in the ST	Brazilians				Germans			
	Version A variants		Version B variants		Version A variants		Version B variants	
	n	%	n	%	n	%	n	%
Analogous	57	71.25	67	83.75	58	72.50	65	81.25
Non-analogous	23	28.75	13	16.25	22	27.50	15	18.75
Total	80	100.00	80	100.00	80	100.00	80	100.00

As shown in Table 3, the metaphoricity level of the first solution tended to be analogous to that in the variants in both ST versions. That was so in 70% of the sample. Fisher’s exact test indicates that the difference of 12.5 percentage points between the ST versions is significant among the Brazilians ($p=0.044$), whereas the difference of 9.25 percentage points is not among the Germans ($p=0.130$).

The difference in the numbers of analogous and non-analogous renditions between the two ST versions may be ascribed to the Brazilians’ performance in variants 5 and 8 and the Germans’ performance in variant 8, because, as discussed in da Silva (2012), the metaphorical versions of these two variants required subjects to cope with complex translation problems related to typological and registerial differences between source and target languages. As such, they needed to be de-metaphorised, i.e., be made more explicit in the TT.

Excluding from the sample variants 5 and 8 from both text versions A and B (cf. Table 4), the difference between the versions is no longer significance among both Brazilians (4.25 percentage points) and Germans (3.62 percentage points), with $p=0.317$ and $p=0.413$ among Brazilians and Germans, respectively. In other words, when highly influential typological and registerial differences are not at play, the first renditions do tend to have explicitness levels analogous to those in the ST wordings.

Table 5 shows to what extent the tendency for first renditions to have metaphoricity levels analogous to those in the ST is also observed in the final solutions. The number of first renditions with metaphoricity levels analogous to those in the ST is divided by the number of final renditions with metaphoricity levels analogous to those in the ST.

As shown in Table 5, final solutions have metaphoricity levels analogous to those in first renditions compared to the their ST counterparts. Such a tendency

6 Cognitive effort and explicitation in translation tasks

Table 4: Absolute and relative numbers of first renditions with analogous or non-analogous metaphoricity levels compared to those in the ST per subject nationality and text version (excluding variants 5 and 8 from both versions)

Metaphoricity level of 1st rendition compared to that in the ST	Brazilians				Germans			
	Version A variants		Version B variants		Version A variants		Version B variants	
	n	%	n	%	n	%	n	%
Analogous	55	86.00	52	81.75	52	81.75	50	78.13
Non-analogous	9	14.75	12	18.25	12	18.25	14	21.78
Total	64	100.00	64	100.00	64	100.00	64	100.00

Table 5: Tendency of keeping the metaphoricity level of the source text in both first and final renditions (excluding variants 5 and 8 from both versions)

Brazilians				Germans			
Version A		Version B		Version A		Version B	
n	%	n	%	n	%	n	%
49/55	89.00	48/52	92.31	50/52	96.10	47/50	94.00

was of at least 89% considering only analogous renditions and at least 73% considering the lowest number (47) of analogous renditions and the total number of renditions (64 for Germans' translation of version B, excluding variants 5 and 8).

Subtracting divisors from dividends in Table 5 we obtain the number of final renditions having metaphoricity levels analogous to those in the ST though not necessarily so in first renditions. In total, that was the case of 15 (23%) final renditions. This indicates that no more than 23% of the total number of revisions made during a translation task has to do with metaphoricity changes, the remaining 77% being mostly related to changes in lexis rather than in grammar.

Table 6 provides the absolute and relative number of final solutions comparing their metaphoricity levels to those in the ST.

Confirming previous results provided above, Table 6 shows that at least 76.56% instances of the variants were rendered with metaphoricity levels analogous to those in the ST (i.e., 'literal' translation). This seems to corroborate Tirkkonen-Condit (2005) and to provide further food for thought regarding the concept, usefulness and potential role of 'literal' translation forin both humans and machines translation (e.g. Chesterman 2011; Carl & Schaeffer 2014; Halverson 2015).

Table 6: Absolute and relative numbers of first renditions with analogous or non-analogous metaphoricity levels compared to those in the ST per subject nationality and metaphoricity level (excluding variants 5 and 8 from both versions; †: high metaphoricity level variants; ‡: low metaphoricity level variants)

Metaphoricity level of 1st rendition compared to that in the ST	Brazilians				Germans			
	↑		↓		↑		↓	
	n	%	n	%	n	%	n	%
Analogous	49	76.56	50	78.13	50	78.12	51	79.69
Higher	8	12.50	12	18.75	7	10.94	8	12.50
Lower	7	10.94	2	3.12	7	10.94	5	7.81
Total	64	100.00	64	100.00	64	100.00	64	100.00

In addition, the results point to a slight tendency for decision making to involve metaphorisation (implication, metaphoricity level higher than that in the ST) rather than de-metaphorisation (explicitation, metaphoricity level higher than that in the ST), namely 29 instances of metaphorisation (11 among physicists) vs. 27 instances of de-metaphorisation (121 among translators), with no differences significantly ascribable to subject profile (Fisher’s exact test: $p > 0.05$). This seems to support da Silva’s (2007), Liparini Campos’s (2008, 2010) and Pagano & da Silva’s (2010a) findings though run counter Hansen’s (2003) findings.

In order to investigate whether ‘literal’ translation is a cognitive effort-minimising strategy and explicitation and implication require more cognitive effort, a close look at Table 7 can be enlightening. Table 7 shows the means and standard deviations of four variables (number of renditions, pauses per word, drafting time per word, and micro-units per word) per metaphoricity level of the ST variant, ST version, subject profile, and subject nationality.

The significance analysis of the data summarised in Table 7 points to no significant differences ($p > 0.05$) for the variables when comparing within metaphoricity level and within ST version. The result for ST version is reasonable, since versions A and B were carefully manipulated to be strongly comparable. However, the finding for metaphoricity level somehow came as a surprise, since we expected that translating more metaphorical variants would be more effortful than translating less metaphorical variants. For two variables (number of renditions and micro-units per word), it was even more effortful to translate the less metaphorical variant. A potential explanation may be the fact that congruent sentences are not those with best readability (Wolfer et al. 2015), but this should be further investigated for the data in question.

Table 7: Mean and standard deviation of cognitive effort measures per metaphoricity level of the source text variant, source text version, subject profile, and subject nationality

Variable	Metaphoricity level of the ST variant		Source text version		Subject profile		Subject nationality	
	↑	↓	A	B	Translators	Field Specialists	Brazilians	Germans
	Number of renditions	1.94 / 1.38	2.16 / 1.38	2.10 / 1.47	2.00 / 1.28	2.08 / 1.34	2.02 / 1.42	1.89 / 1.36
Pauses per word	1.59 / 2.08	1.53 / 1.56	1.62 / 2.20	1.51 / 1.39	1.27 / 1.48	1.86 / 2.10	1.43 / 2.11	1.69/1.51
Drafting duration per word	6.84 / 6.37	6.51 / 4.74	6.67 / 6.43	6.68 / 5.61	5.49 / 4.19	7.87 / 6.53	5.87 / 5.60	7.49/5.52
Micro-units per word	0.47 / 0.30	0.53 / 0.89	0.52 / 0.89	0.49 / 0.33	0.44 / 0.31	0.57 / 0.89	0.49 / 0.89	0.52/0.33

As for the subject profile, the differences are significant ($p < 0.05$) for all variables but number of renditions, i.e., translators were faster than the field specialists, since the translators had fewer pauses, rendered words within a shorter interval, and needed less micro-units to accomplish the translation of each variant. These results are indicative of translation competence (Alves & Gonçalves 2007; PACTE 2014).

As for subject nationality, the differences are significant ($p < 0.05$) for all variables, i.e., the Brazilians were faster than the Germans when rendering the variants under scrutiny. These differences should be further explored, and may be ascribable to typological differences (Steiner 2001a,b), different notions of translation (Matthiessen 2001; Tirkkonen-Condit 2010) and/or differences in TT quality (Alves et al. 2014a).

A further step in our analysis was looking at the impact of the final solutions having or not metaphoricity levels analogous to those in the ST variants. The results are displayed in Table 8, where category ‘non-analogous’ embraces both higher and lower metaphoricity levels in the final renditions compared to those in the ST.

Table 8 seems to show that opting for more or less metaphorical wordings in the TT than in the ST has processual implications. For all variables, the means are higher when the metaphoricity level in the TT is non-analogous to that in the ST. Bearing in mind that human beings are cognitive misers (Fiske & Taylor 1984), this result seems to corroborate that ‘literal’ translation is a default, effort-minimising strategy, whereas alternative strategies are more cognitively effortful (Tirkkonen-Condit 2005).

Table 8: Mean and standard deviation of cognitive effort measures per metaphoricity level in the final rendition compared to that in the source text variant

Variables per variant	Analogous (n = 247)	Non-analogous (n=73)
Number of renditions	1.95 / 1.32	2.40 / 1.50
Pauses per word	1.46 / 1.54	1.93 / 2.58
Drafting duration per word	6.35 / 4.57	7.80 / 8.14
Micro-units per word	0.50 / 0.74	0.52 / 0.33

5 Final remarks

We set out this study aiming to test two hypotheses, namely:

- literal translation, as a default translation procedure, minimises cognitive effort;
- translating more implicit realisations in the ST requires explicitation on the translator's part, which entails an effortful translation procedure.

Overall the results point to the independent variable (ST level of grammatical metaphoricity) as having little or no impact on our dependent variables (i.e., number of renditions, total drafting time, number of pauses, and number of micro-units). In other words, subjects do not seem to show more or less effort spent to translate a more or less metaphorical version of the ST. Our data suggest, however, that they do seem to invest more effort to change the level of grammatical metaphoricity of their own previous solutions in cases of multiple interim renditions.

In other words, the results confirm hypothesis (1) that the production of TT with lexico-grammatical realisations analogous to those in the ST is a default procedure and requires less cognitive effort. Nevertheless, they do not confirm hypothesis (2) that more metaphorical variants in the ST require more cognitive effort than the congruent variants. Returning to Tirkkonen-Condit's (2005) Monitor model, this additional effort may be ascribed to 'literal' translation as a default procedure and to the activation of the monitor mechanism as an effortful event. That seems to be much so that the variants that led to the highest occurrences of de-metaphorisation were those having to do with constraints due to typological and registerial differences between source and target languages and revisions tended to involve changes in the lexical rather than in the grammatical pole.

De-metaphorisation as an inherent property of translation has been probed in experimental studies of the translation process by da Silva (2007; 2012); Alves et al. (2010; 2011; 2014a,b). All these studies have relied on the present data to account for different aspects of the translation process, providing comparable analyses that complement each other. As stated in Alves et al. (2014a,b), however, more fine-grained data including analyses of the TT should be incorporated to cast further light on the role of explicitation in translations tasks. Besides, the role played by subject profile and subject nationality (as a proxy for language pair) remains poorly explored and should be addressed more deeply. Yet, we believe that our effort to carry out such an extensive study will provide further insight on cognitive aspects of the translation process and encourage collaborative work as the one involved in the experiment design and data collection.

Acknowledgements

Research funded by the National Council for Scientific and Technological Development (CNPq) under grants No. 307964/2011-6; 308652/2010-0; 308652/2010-0; 305129/2013-9; and 461054/2014-0; the State Funding Agency of Minas Gerais (FAPEMIG) under grants SHA/PPM-00495-12; SHA/PPM-00087-12; PPM-00087-12; and PPM-00289-14; the Coordination for the Improvement of Higher Education Personnel (CAPES) under grant Probral 292/08; and Universidade de Uberlândia under grant RECEM2014-0071.

References

- Alves, Fabio & Daniel Couto-Vale. 2011. On drafting and revision in translation: A corpus linguistics oriented analysis of translation process data. *Translation: Computation, Corpora, Cognition* 1(1). 105–122.
- Alves, Fabio & José Luiz Gonçalves. 2007. Modelling translator's competence: Relevance and expertise under scrutiny. In Yves Gambier, Miriam Schlesinger & Radegundis Stolze (eds.), *Translation studies: Doubts and directions. Selected papers from the IV congress of the European Society for Translation Studies*, 41–55. Amsterdam: Benjamins.
- Alves, Fabio, Adriana Pagano & Igor Antônio Lourenço da Silva. 2011. Modeling (un)packing of meaning in translation: Insights from effortful text production. In Bernadette Sharp, Michael Zock, Michael Carl & Arnt L. Jakobsen (eds.), *Proceedings of the 8th international NLPCS workshop (natural language processing*

- and cognitive sciences). *Special theme: Human-machine interaction in translation*, 153–162. Copenhagen: Samfundslitteratur.
- Alves, Fabio, Adriana Pagano & Igor Antônio Lourenço da Silva. 2014a. Effortful text production in translation: A study of grammatical (de)metaphorization drawing on product and process data. *Translation and Interpreting Studies* 9(1). 25–51.
- Alves, Fabio, Adriana Pagano & Igor Antônio Lourenço da Silva. 2014b. Evidence of de-metaphorization in target text unfolding. In Kerstin Kunz, Elke Teich, Silvia Hansen-Schirra, Stella Neumann & Peggy Daut (eds.), *Caught in the middle: Language use and translation. A festschrift for Erich Steiner on the occasion of his 60th birthday*, 5–24. Saarbrücken: Universitätsverlag des Saarlandes.
- Alves, Fabio, Adriana Pagano, Stella Neumann, Erich Steiner & Silvia Hansen-Schirra. 2010. Translation units and grammatical shifts: Towards an integration of product- and process-based translation research. In Gregory Shreve & Erik Angelone (eds.), *Translation and cognition*, 109–142. Amsterdam: Benjamins.
- Baker, Mona. 1995. Corpora in translation studies: An overview and suggestions for future research. *Target* 7(2). 223–244.
- Baker, Mona. 1996. Corpus-based translation studies: The challenges that lie ahead. In Harold Somers (ed.), *Terminology, LSP and translation: Studies in language engineering in honour of Juan C. Sager*, 175–186. Amsterdam: Benjamins.
- Blum-Kulka, Shoshana. 1986. Shifts of cohesion and coherence in translation. In Juliane House & Shoshana Blum-Kulka (eds.), *Interlingual and intercultural communication: Discourse and cognition in translation and second language acquisition studies*, 17–35. Tübingen: Gunter Narr.
- Carl, Michael & Barbara Dragsted. 2012. Inside the monitor model: Processes of default and challenged translation production. *Translation: Corpora, Computation, Cognition* 2(1). 127–145.
- Carl, Michael & Moritz Schaeffer. 2014. Word transition entropy as an indicator for expected machine translation quality. In Keith J. Miller, Lucia Specia, Kim Harris & Stacey Bailey (eds.), *Proceedings of the workshop on automatic and manual metrics for operational translation evaluation – MTE 2014*, 45–50. Paris: ELRA.
- Chesterman, Andrew. 2011. Reflections on the literal translation hypothesis. In Cecilia Alvstad, Adelina Hild & Elisabet Tiselius (eds.), *Methods and strategies of process research: Integrative approaches in translation studies*, 23–35. Amsterdam: Benjamins.
- da Silva, Igor Antônio Lourenço. 2007. *Conhecimento experto em tradução: Aferição da durabilidade de tarefas tradutórias realizadas por sujeitos não-tradutores*

- em condições empírico-experimentais*. Universidade Federal de Minas Gerais dissertation.
- da Silva, Igor Antônio Lourenço. 2012. *(Des)compactação de significados e esforço cognitivo no processo tradutório: Um estudo da metáfora gramatical na construção do texto traduzido*. Universidade Federal de Minas Gerais dissertation.
- Englund Dimitrova, Birgitta. 1993. Semantic change in translation: A cognitive perspective. In Yves Gambier & Jorma Tammola (eds.), *Translation and knowledge*, 285–296. Turku: Centre for Translation & Interpreting, University of Turku.
- Englund Dimitrova, Birgitta. 2005. *Expertise and explicitation in the translation process*. Amsterdam: Benjamins.
- Fiske, Susan T. & Shelley E. Taylor. 1984. *Social cognition*. Reading: Addison-Wesley.
- Halliday, Michael A. K. 2006. Some grammatical problems in scientific English. In Jonathan J. Webster (ed.), *The language of science*, 159–198. London: Continuum.
- Halliday, Michael A. K. & Christian M. I. M. Matthiessen. 1999. *Construing experience through meaning: A language-based approach to cognition*. London: Continuum.
- Halliday, Michael A. K. & Christian M. I. M. Matthiessen. 2004. *An introduction to functional grammar*. 3rd edn. London: Arnold.
- Halverson, Sandra L. 2015. Cognitive translation studies and the merging of empirical paradigms: The case of ‘literal translation’. *Translation Spaces* 4(2). 310–340.
- Hansen, Silvia. 2003. *The nature of translated text*. Saarbrücken: Language Technology Lab.
- Hansen-Schirra, Silvia, Stella Neumann & Erich Steiner. 2007. Cohesive explicitness and explicitation in an English–German translation corpus. *Languages in Contrast* 7(2). 241–265.
- Jakobsen, Arnt Lykke. 2002. Translation drafting by professional translators and by translation students. *Traducción & Comunicación* 3. 89–103.
- Jakobsen, Arnt Lykke. 2005. Instances of peak performance in translation. *Lebende Sprachen* 50(3). 111–116.
- Klaudy, Kinga. 1998. Explicitation. In Mona Baker (ed.), *Encyclopedia of translation studies*, 80–85. London: Routledge.
- Liparini Campos, Tânia. 2008. O efeito da pressão de tempo na realização de tarefas de tradução: Considerações sobre o produto tradutório. *Revista da ABRALIN* 7(2). 223–241.

- Liparini Campos, Tânia. 2010. *O efeito do uso de um sistema de memória de tradução e da pressão de tempo no processo cognitivo de tradutores profissionais*. Universidade Federal de Minas Gerais dissertation.
- Matthiessen, Christian M. I. M. 2001. The environments of translation. In Erich Steiner & Colin Yallop (eds.), *Exploring translation and multilingual text production: Beyond content*, 41–124. Berlin: de Gruyter.
- Olohan, Maeve & Mona Baker. 2000. Reporting that in translated English: Evidence for subconscious processes of explicitation? *Across Languages and Cultures* 1(2). 141–158.
- PACTE. 2014. First results of PACTE group's experimental research on translation competence acquisition: The acquisition of declarative knowledge of translation. *MonTI Special Issue – Minding Translation*. 85–115.
- Pagano, Adriana Silvina & Igor Antônio Lourenço da Silva. 2010a. Text segmentation and task representation as indicators of translator's performance: Insights from translation process research. In Togtip Poonlarp (ed.), *Proceedings of the first international conference on translation and interpretation*, 117–122. Bangkok: Chalermprakiat Centre of Translation & Interpretation.
- Pagano, Adriana Silvina & Igor Antônio Lourenço da Silva. 2010b. Tradução e (des)metaforização. In Elsa Ghi & María Delia Fernández (eds.), *Estudios del discurso en español y portugués desde una perspectiva sistémico-funcional*, 311–346. Santa Fe: Centro de Publicaciones de la Universidad Nacional Del Litoral.
- Pagano, Adriana Silvina, Igor Antônio Lourenço da Silva & Fabio Alves. 2013. Tracing the unfolding of metaphorical processes in translation: Insights from an experimental exploratory study. In Marcel Thelen (ed.), *Proceedings of the Maastricht session of the 5th international Maastricht–Łódz duo colloquium on translation and meaning*, 263–275. Maastricht: Zuyd University – Maastricht School of Translation & Interpreting.
- Scardamalia, Marlene & Carl Bereiter. 1991. Literate expertise. In K. Anders Ericsson & Jacqui Smith (eds.), *Toward a general theory of expertise*, 172–194. Cambridge: CUP.
- Schaeffer, Moritz. 2013. *The ideal literal translation hypothesis: The role of shared representations during translation*. University of Leicester dissertation.
- Séguinot, Candace. 1988. Pragmatics and the explicitation hypothesis. *TTR* 1(2). 106–114.
- Steiner, Erich. 2001a. Intralingual and interlingual versions of a text: How specific is the notion of translation. In Erich Steiner & Colin Yallop (eds.), *Exploring translation and multilingual text production: Beyond context*, 161–190. Berlin: de Gruyter.

- Steiner, Erich. 2001b. Translations English–German: Investigating the relative importance of systemic contrasts and of the text-type “translation”. *SPRIKreports Reports from the project Languages in Contrast* 7. 1–49.
- Tirkkonen-Condit, Sonja. 2005. The monitor model revisited: Evidence from process research. *Translators’ Journal* 50(2). 405–414.
- Tirkkonen-Condit, Sonja. 2010. Prototype definition of translation revisited. In Barbara Lewandowska-Tomaszczyk & Marcel Thelen (eds.), *Meaning in translation*, 217–230. Frankfurt: Peter Lang.
- Tirkkonen-Condit, Sonja, Jukka Mäkisalo & Sini Immonen. 2006. The translation process: Interplay between literal rendering and a search for sense. *Across Languages and Cultures: A Multidisciplinary Journal for Translation and Interpreting Studies* 9(1). 1–15.
- Vasconcellos, Sonia M. R., Sorenson Martha M. & Jaqueline Leta. 2007. Scientist-friendly policies for non-native English-speaking authors: Timely and welcome. *Brazilian Journal of Medical and Biological Research* 40(6). 743–747.
- Vinay, Jean-Paul & Jean Darbelnet. 1958. *Stylistique comparée du français et de l’anglais: Méthode de traduction*. Paris: Didier.
- Wolfer, Sascha, Sandra Hansen-Morath & Lars Konieczny. 2015. Are shorter sentences always simpler? Discourse level processing consequences of reformulating jurisdictional texts. In Karin Maksymski, Silke Gutermuth & Silvia Hansen-Schirra (eds.), *Translation and comprehensibility*, 263–287. Berlin: Frank & Timme.

