Cognitive Adaptation in Translation:
an interface between language direction, time, and recursiveness in target text production

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Resumo: Este trabalho foi desenvolvido com três objetivos: (1) investigar, quantitativamente, o processo de tradução de dois grupos de tradutores, diferentes em sua experiência acadêmica e profissional, na tarefa de traduzir do inglês para o português e vice-versa; (2) corroborar, qualitativamente, os dados numéricos com a coleta de protocolos verbais; e (3) apresentar uma definição mensurável para o conceito de recursividade (revisão co-ocorrente com a produção textual). Os resultados mostram que a tradução da língua materna para a língua estrangeira consumiu mais tempo e aumentou a segmentação da tradução em ambos grupos. Entretanto, um aumento de revisões feitas ocorreu apenas no grupo mais experiente. Conclui-se que a recursividade pode ser utilizada como uma medida de adaptação à dificuldade da tarefa de traduzir.
Palavras-chave: Processo de Tradução. Translog. Tempo. Recursividade.

Abstract: The objective of this paper is three-fold: (1) to quantitatively assess the process of translation of two groups of participants with different academic and professional experience, asked to render texts from English into Portuguese and vice-versa; (2) to qualitatively corroborate the figures with think aloud protocols; and (3) to present a measurable definition for the concept of recursiveness (online revision of the text). Results show that translation from the first language into the second language was more time-consuming and broke down the process into more text segments for both groups; but it only elicited more revision for the more experienced group. In conclusion, the measure of recursiveness is presented as an indicator of adaptive behavior to translation task difficulty.
Key words: Translation process. Translog. Time. Recursiveness.

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1 Introduction

The term 'computation' has had new meanings attributed to it since its original definition of a process, method or act of calculating. The term likely reminds readers of computers and computer science rather than mere calculation. Computational Linguistics, likewise, brings additional meaning to the science of language in its attempt to make linguistics and cognitive modeling converge-simulating language use, for example.

In this sense, this paper aims to apply a computational tool to analyze a linguistic process, that is, apply a software called Translog©, developed at the Copenhagen School of Business (Jakobsen, 1999; Jakobsen & Schou, 1999) to the process of translation, from Portuguese to English, and vice-versa. The software logs all keyboard and mouse actions as tasks are performed on an ordinary word-processor interface. Translog data will be cross-referenced with retrospective think-aloud protocols (TAPs) (Ericsson & Simon, 1984/1993) and Camtasia© video files to explore the translation process of participants. The core objective of the analysis is three-fold: (1) to quantitatively assess the target text production process; (2) to combine quantitative and qualitative data to describe target text production; and (3) to measure what in cognitive studies of text production is known as recursiveness (Schilperoord, 1996).

2 Theoretical framework

2.1 *Think-aloud protocols*

Starting with the seminal work carried our by Krings (1986), think-aloud protocols, or TAPs, are increasingly being used in the field of empirical translation process research (Alves, 2003; Alves & Gonçalves, 2003; Jakobsen, 2003; Jääskeläinen, 2000; Séguinot, 2000; Tirkkonen-Condit, 2000). A method widely applied in cognitive research, TAPs allow the researcher to make inferences about cognitive processes in different decision-making situations, such as chess matches and puzzle-solving games, and day-to-day cognitive activities, such as reading (Ericsson & Simon, 1984/1993; Tomitch, 1999/200).

Ericsson and Simon (1984/1993: 62), in their extensive survey on the think-aloud method, state that use of think-aloud protocols is justified if information being processed (that is, information that is in short-term memory, or working memory) is in linguistic form,

and hence can be orally encoded, and concurrently verbalized by the participant. As such, think-alouds provide a window into human cognitive processes without interfering with the ongoing tasks (reading, chess-playing, for example).

However, in the case of in translation, think-alouds may cause some interference. Jakobsen (2003) showed that the use of concurrent think-aloud protocols results in both a slow down and a breakdown in the cognitive processes of translators: Using Translog, the author found that translators worked 25 percent slower, and worked on comparatively shorter pause-defined segments of texts at a time (called translation units) if they were asked to think-aloud during the translation of a text, than if not. This finding in no way invalidates the think-aloud method (Jakobsen, 2003: 93). But it does, nonetheless, call for an alternative to concurrent think-alouds.

In that sense, retrospective (after-the-fact) TAPs (which can also be found in Ericsson & Simon's in-depth survey of the method (1984/1993)) present an alternative for the studies of cognitive processes in translation, and have recently been corroborated in the literature (Alves, 2001; Alves, 2003; Alves & Gonçalves, 2003; Jakobsen, 2003).

The use of concurrent or retrospective think-alouds poses a dilemma for the researcher of translation processes. On the one hand, while concurrent think-alouds allow the researcher to focus on the pieces of information that are being heeded at specific points in time during the translation task, and leave less room for embellishment or elaboration (Ericsson & Simon, 1984/1993), on the other, retrospective think-alouds afford reports that are better structured, and that allow the participant to better report inferential thinking (Alves, 2003: 76)--and in the specific case of translation, without interfering in the task. But with the use of Translog, the risk of embellishment and elaboration on the part of the participant is greatly diminished.

Here, think-alouds were collected retrospectively using the Translog replay function to help participants review and recall what they did in the process of translating.

2.2 *Translation processes-oriented research*

In the interest of parsimony, we will curb a more in-depth discussion of the literature on empirical studies of translation, and point the reader to other studies of interest. Translation research-turned-empirical is relatively young, with its seminal studies dating back to the late 1980s and early 1990s (Krings, 1986; Königs,

1987; Gerloff, 1987; 1988; Jääskeläinen; 1989; Tirkonnen-Condit, 1989; 1991). Translation studies, the umbrella under which process-oriented research rests, is traditionally riddled with product-oriented (target text) and philosophical takes on translation. But that is not the empirical translation researcher's cup of tea--though exactly what is the tea of empirical choice remains to be defined, as researchers 'teapots' to date hold curious blends of their own.

Fraser (1996), for one, provides a review of translation process research over a ten-year span, from 1986 to 1996, and writes that TAPs are basically the only link between the process-oriented studies of the period. One of our objectives, in this sense, is to introduce a three-stage approach to the process of translation and, more importantly, a measure for the concept of recursiveness (used in cognitive studies of oral text production). If proven useful, the three-stage approach can help setting a foothold for process studies. The target text, in turn, will not be discussed in depth, to avoid a comparison of who produced a better text--which greatly breaks away from our objective to provide a quantitative description of the translation process that can be qualitatively corroborated with think-aloud data.

Alves (2003), in that sense, argues that by no means should the process-oriented research neglect the translation product. The author argues that translation research should aim at using a specialized database (corpora), which, in its turn, should allow for stronger generalizations about the translation process, in view of its product. The building-up of a process-oriented database spearheads the *CORPRAT* (Corpus on Process for the Analysis of Translations) project at the Federal University of Minas Gerais (www.letras.ufmg.br/net), to which the data in this paper also contributes.

To the point, Jakobsen (2003) and Alves (2003) put forth the methodological and theoretical support for the empirical approach to translation in this paper.

3 Method

3.1 *Participants*

A total ten participants were recruited from two different populations. One consisting of translators who majored in language (with emphasis on foreign language and translation) and, at the time of the study, were enrolled in the Translation Studies graduate program at the Federal University of Minas Gerais, and carrying out

research under the supervision of scholars from the Center for Translation Studies (called *NET*) at that same university. A total five translators volunteered to participate. All reported some experience with professional, freelance translation jobs. In short, five Translation Studies graduate students with slight professional experience. Another five participants were recruited from a group of students enrolled in a graduate diploma course ministered by the *NET*. Not all reported professional experience. All ten participants were familiar with the use of Translog and of TAPs in translation research.

3.2 *Translog software and the three stages of the translation process*

The software comes in two different types of interface: the *user* and the *supervisor* interface. The Translog *user* interface is applied to carry out the translation, and its screen is divided in two: The top screen allows for displaying a source text, while the bottom screen is used to translate the text. The software records all keyboard and mouse actions, and it times the duration of the translation activity (between the pressing of the 'go' and the 'stop' buttons at the beginning and end of the activity) and the pauses between all actions and movements.

The Translog *supervisor* interface, in turn, allows the researcher to replay the translation after the participant has completed the task. It thus provides an onscreen reenactment of the process. The supervisor interface also generates a chronological, linear representation of all keyboard and mouse actions that were performed during the translation. Translog, hence, provides a rich, descriptive, and timed illustration of the process of translation.

Translog-generated data is used here to break the translation process into three stages as defined by Jakobsen (2002): reading or orientation stage (Ortn); drafting or writing stage (Write); and revision stage (Rev). These three stages are identified as: the first stage, from the start of the process (press "Go" on the user interface) until the instant the first letter is typed; the second, from the typing of the first letter to the typing of the last word (period); and the third, from the last word until the translator stops completely.

This particular dissection of the process is arguable, especially as to what revision truly entails. Some translators do a lot of revision during the actual "Write" stage (online revision). But the above division of the translation process by no means neglects that type of ongoing revision. Here, however, revision carried out during the second stage of the process is assessed in terms of recursiveness (Schilperoord, 1996; Alves, 2003), which is also useful for the profil-

ing of our informants. In Translog terms, recursiveness can be identified as the participant moves about the text and produces what are called "revision keystrokes." Metaphorically, recursiveness can be compared to a spindle, or spinning frame. The spindle is used to twist into thread the rough fibers from a mass of wool, and though it is a very repetitive process, after a while, from a mass of fiber, a tightly spun thread of wool is created. Recursiveness can be just that. It may appear that the writer is stuck in one segment of the text, or going back several times to different parts of the text, but sometimes it actually represents the writer's concern with (and ability of) putting together a tightly-woven text. In Alves (2003), for example, recursiveness is found in one participant's ability to render the target text more concise and coherent (participant 04).

3.3 *Camtasia recorder: the screen 'spy' software*

In addition to the Translog software, the software Camtasia Recorder was set to run in the background. The program records a video of all onscreen activities, and thus allows for analysis of actions outside Translog (for example, internet browsing, electronic dictionary search). This software supplements Translog-collected data analyses, which are restricted to Translog user screen activity, thus informing investigation and description of activity during writing pauses.

3.4 *Source texts*

Two source texts were applied. Both were adapted from well-known journalistic sources: *The Economist* newspaper, for the English source text (titled *A giant stirs*), and the *Folha de São Paulo* newspaper, for the Portuguese source text (titled *Brasil enviará força militar de 1.470 homens ao Haiti*). The former was collected from *The Economist* print edition, the latter, in turn, retrieved online from the *Folha de São Paulo* world wide web news service. Selection criteria were: two texts on the same current (at the time) journalistic event and published by a reliable source.

The texts selected reported Brazil's commanding of the United Nations peacekeeping force in Haiti--widely broadcasted in the national news. Texts were adapted for length purposes, aiming at word counts between 100 and 150 words, in order to keep the tasks short and avoid lengthy retrospective think-aloud, and avoid participants' being too tired in the second, as compared to the first, task. The adapted versions totaled 113 words in English, and 144 words in Portuguese. See texts below:

A giant stirs

Brazil is bidding for big-power status. What sort of power does it want to be?

It is a small force, but of huge symbolic significance. This month, 1,200 Brazilian troops arrived in Haiti, the country's biggest foreign military deployment since the second world war. Brazil is commanding a United Nations peacekeeping force of 6,700 mainly Latin American troops and 1,600 police which is taking over from American and French forces in the Caribbean island. This marks a new departure. Brazil has long been a gentle and introverted giant, content to be a bystander on the world stage. Now that is changing.

June 10th, 2004 Brasília
The Economist print edition

Brasil enviará força militar de 1.470 homens ao Haiti

O Brasil vai enviar ao Haiti seu maior contingente militar de paz da história. Segundo o ministro José Viegas (Defesa), o Brasil irá liderar uma força internacional naquele país, com 1.470 homens da Marinha, do Exército e da Aeronáutica. A força de paz deverá ser composta principalmente por tropas sul-americanas.

A última grande missão do Brasil, segundo histórico do Ministério da Defesa, foi o envio de pessoal para Angola. Depois da assinatura de um acordo de paz entre o governo angolano e os rebeldes da Unita, foi implementada a Missão de Verificação das Nações Unidas para Angola. De agosto de 1995 a julho de 1997, o Brasil contribuiu com 800 homens de infantaria, 200 de engenharia, 40 médicos e assistentes e 40 oficiais do Estado-Maior.

July 04th, 2004
Luis Renato Strauss
Folha de S.Paulo, Brasília

3.5 *Procedure*

All 10 participants were asked to translate the two texts. Originally, the second group of translators (diploma course) was formed by seven participants (hence, our total population would be 12) and the distribution of the tasks ensured that half were to translate first from English into Portuguese (Eng-Pt), and then from Portuguese into English (Pt-Eng). However, of the second group, one participant quit mid-task, and another did not show up. Thus we ended up having six Eng-Pt translations, four Pt-Eng.

Before the task, participants were given a briefing on the topic, source of the texts, and their tasks. The briefing provided short reference to the news topic and instructed to translate the text as if it were going to be published on an online newspaper,

and to use any sources of information necessary. Participants were informed that their keyboard and mouse actions, as well as all actions outside the Translog interface, were being recorded.

The task was carried out under the same conditions and with access to the same tools (separate room; internet access). One of the researchers remained in the room during the whole time. Upon completion, participants were instructed to verbalize their thoughts while the Translog replay function played their own translation process back to them. Speed of replay was increased two-fold or more (using the replay speed function in Translog, which is similar to fast-forwarding a video) so that watching the whole process did not become monotonous. Whenever participants verbalized more extensively, the researcher paused the replay to avoid confusion between thinking-aloud and the ongoing process being played on the screen. Participants were instructed to ask for a pause, or ask to slow down the replay speed if they felt it was moving too fast. They were also instructed to ask the researcher to rewind if they wanted to review a particular instance of the process. Think-alouds were collected using a digital voice recorder.

3.6 *Data analysis*

One of the objectives of this paper is to assess whether translating first from English or from Portuguese had any quantitative effect on the second translation. This analysis will be carried out based on quantitative description of the translation process, that is, using the time and keyboard action log files generated by Translog. The analysis will also bear in mind any time and total number of pause effects on the three stages of the process. In short, the total number of pauses, total number of keystrokes (text production and revision), and total number of what is called translation units will be computed.

The translation unit (TU), or segment, is defined by Alves, Magalhães, and Pagano (2000: 38):

> […] segments of the source text, independent of specific size or form, to which the translator's focus of attention is directed. *It is a segment in constant transformation that changes according to the translator's cognitive and processing needs*. (emphasis added)

TUs are at the core of the analysis that follows. The units can be understood as markers of the cognitive rhythm of the translator. The cognitive rhythm, in short, can range from word to phrase (or

even sentence) level of text production (that is, words, phrases, or sentences within the predefined pauses). In the literature, it is argued that cognitive studies of text production should attend to pauses of three seconds or more, to ensure that the pause-defined segment is not merely a result of motor processes (typing ability, in the case of writing) (Rothe-Neves, 2003). In this study, a more conservative five-second pause criterion will be applied. This criterion may result in overlooking shorter TUs, but helps to ensure that the pauses analyzed are not simply 'noise' in the data, that is, small distractions.

In order not to trust assessment of TUs to pauses alone, the think-alouds of participants will be analyzed for instances that corroborate our quantitative assessment of the data. If a segment of the text (a word, a phrase, or even a full sentence) is instantiated in the verbalization of the participants, it represents a possible problem faced during translation that required more decisive action, and as such is burned on the memory of participants and recalled in the think-alouds. In sum, this study will quantitatively rely on time data and TUs, and qualitatively draw on their think-alouds and Camtasia video files of outside-Translog screen activity.

4 Results and Discussion

First, we will present the quantitative results obtained from the Translog files. Next, the time data will be cross-referenced with the Camtasia files and TAPs. Finally, we will turn to process segmentation and Translog linear representations. In all sections, we will try to triangulate the data with think-alouds to corroborate our interpretations.

4.1 *Translation process time results and TAPs*

Table 01 shows the individual total translation times, in minutes (') and seconds ("), and the subdivision of the translation process into the three steps described (Orientation, Write, and Revision). Next, figure 01 illustrates the sum of the translation times of all participants, in the two different language directions (in seconds); and figure 02 plots the individual translation times, comparing the two language directions.

Table 01. Translation time (TT)
and the three steps in the translation process

Participant		Total Time (TT)	Orientation	Write	Revision
T01					
	Eng-Pt*	52'36"	04'01"	23'13"	25'22"
	Pt-Eng	53'38"	09'30"	43'13"	01'15"
T02					
	Eng-Pt*	32'07"	01'11"	09'46"	21'10"
	Pt-Eng	37'03"	01'17"	34'02"	1'44"
T03					
	Eng-Pt	22'16"	02'48"	14'24"	05'04"
	Pt-Eng*	33'36"	01'56"	24'19"	07'21"
T04					
	Eng-Pt*	38'46"	06'17"	30'34"	01'55"
	Pt-Eng	35'57"	02'14"	25'17"	08'26"
T05					
	Eng-Pt	39'04"	01'46"	11'25"	25'07"
	Pt-Eng*	83'53"	16'03"	51'32"	16'18"
T06					
	Eng-Pt	07'04"	00'11"	05'33"	01'10"
	Pt-Eng*	13'14"	00'07"	05'25"	07'42"
T07					
	Eng-Pt	29'42"	05'01"	20'15"	04'26"
	Pt-Eng*	28'52"	00'52"	25'04"	02'40"
T08					
	Eng-Pt*	22'39"	02'43"	18'07"	01'49"
	Pt-Eng	32'17"	00'15"	30'44"	01'18"
T09					
	Eng-Pt*	19'27"	04'58"	13'49"	00'38"
	Pt-Eng	27'51"	04'26"	22'54"	00'31"
T10					
	Eng-Pt*	17'44"	02'09"	11"25"	04'10"
	Pt-Eng	46'17"	00'14"	44'47"	01'16"

* first task

At first glance, Table 01 displays a lot of information. Careful inspection, however, shows that there may be some trends in the data. First, it appears that almost all participants took longer to translate from Portuguese into English than from English into Portuguese (with the exception of T04 and T07). This trend was to be expected, considering that the source text in Portuguese is longer than that in English (Pt text, 144 words; Eng text, 113 words). However, others have also shown that translating into the first

language results faster than into the second language (Kroll & Stewart, 1994; Miller & Kroll, 2002). Difficulty, in this sense, could also be a factor in longer total times from Portuguese into English. We shall further that discussion later in this paper, looking at the translation units, that is, the segmentation of the cognitive translation process.

The data from the two participants who actually took longer to translate from English into Portuguese (T04 and T07) shows that T04 may have benefited from the first translation, but this can only be asserted by further inspection of the process (e.g. TAPs, TUs). Order effect, or benefiting from the first translation, if that were the case, is, however, not the case of T07, who did Pt-Eng as the first task.

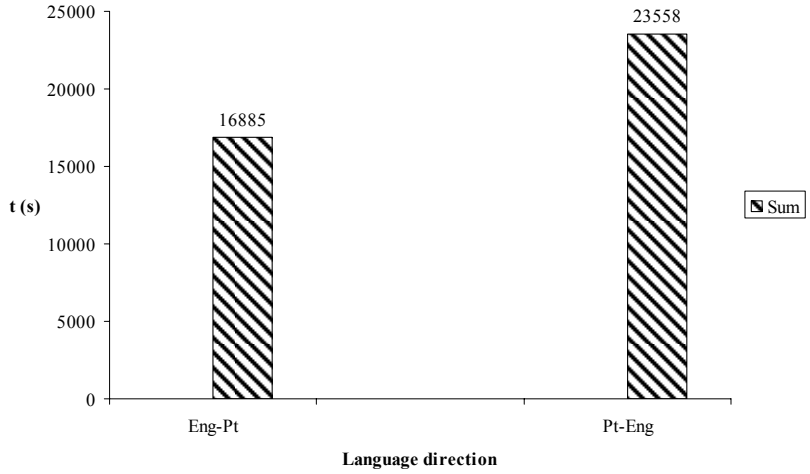

Figure 01. Sum of translation times

Figures 01 and 02 illustrate more clearly that translating from Portuguese into English required more time and, possibly, more effort, from the participants. What is more, the difference between the total sums (6673 seconds) represents an increase in time by a factor of 0.28, or 28 percent. The difference in total number of words in the source text, in turn, is of 31 words, or by a factor of 0.21. Hence, the increase in TTs seems not to be merely an effect of word count. Translating from the first language into the second language (Pt-Eng) required time-wise, approximately 30 percent more of the translators in this study. Hence, it slowed down their rhythm. This result is relevant not only for an academically-

oriented (or educationally) discussion of translation. It is likewise important for learning the ropes of the profession, considering that time, in terms of deadlines, is a very valuable commodity for the job of the translator.

Next, Figure 02 shows the individual distribution of translation times for each participant, in each condition (task). With the exception of participant T04 and T07, the total translation times resemble a pattern, with the Pt-Eng language-order usually taking a greater amount of time to be completed.

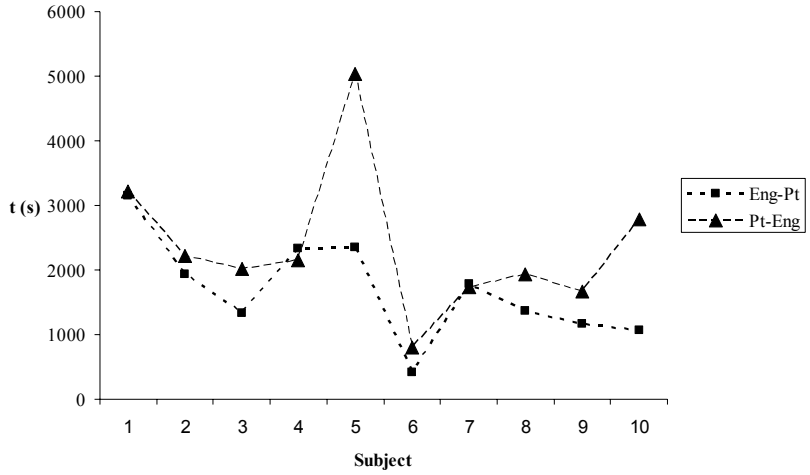

Figure 02. Individual plotting of TTs

What the data in Figures 01 and 02 provide is evidence that rendering text from ones' first language into a second language is more difficult. There is a time-consuming difference between the tasks and, as the graph shows, it affects almost all participants. Thus, the time difference between tasks is not due to one extreme result, or outlier, such as T05. It is a reoccurring difference.

Turning our attention from the whole to the three steps of the translation process (Figures 03 and 04), the data from the first five participants and the last five comparatively show that T06-10 spent less time revising the final rendering of the text than participants T01-05.

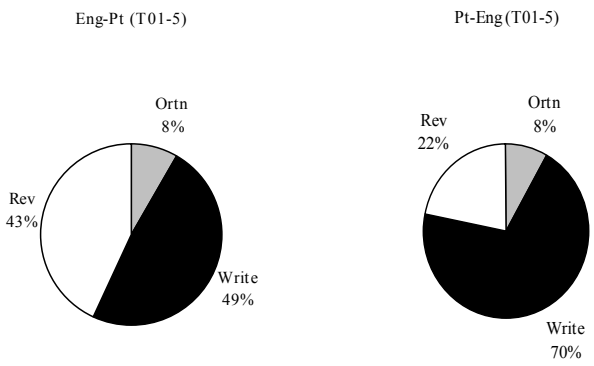

Figure 03. Pie graphs for translation process steps, T01-05

In both tasks, T01-05 spent, on average, eight percent of the total time on orientation for the rendering of the task. Hence, there is indication of a time pattern in how these translators go about getting started. The difference between the "Write" process relative totals for each task (Pt-Eng, 70%; Eng-Pt, 49%) corroborates the interpretation that the translation process from Portuguese into English is more time-consuming (in total time and relative time) and possibly more effortful. The "Write" process total difference is also evident for T06-10 in Figure 04.

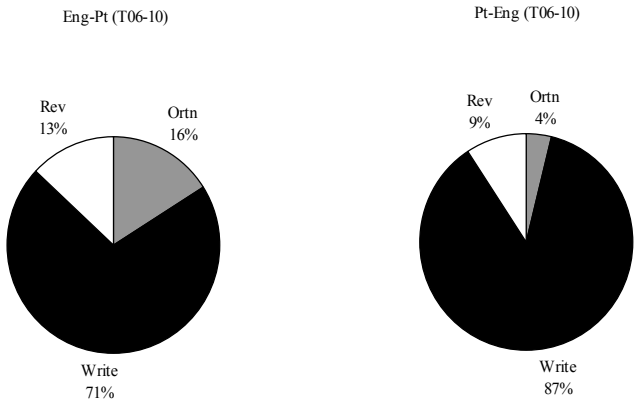

Figure 04. Pie graphs for translation process steps, T06-10

In both pie graphs, the "Write" process percentage shows that, in Pt-Eng, writing eats up a bigger chunk of the time consumed: This is in agreement with the interpretation that Pt-Eng can pose greater difficulty. Obviously, in a relative comparison, the percentage is not affected by word count (higher in Pt source text), as it may be in the total time comparison. Thus, Pt-Eng can be, ultimately and relatively, more time-consuming.

Additional indication that Pt-Eng direction is more effortful is in the revision process carried out at the end of the Pt-Eng translation: it is relatively less than that in Eng-Pt, which could follow from an exhaustion of the translator at the end of the process (reported personally by some of the participants). Also, the TAPs that report on the Pt-Eng revision process were frequently focused on words. The greater difficulty and concern focused on word-to-word translation appears in participants comments on their revision (original comments in Portuguese footnote). See two examples:

T01 Pt-Eng

"Up until the end of the revision I corrected local stuff, spelling. Other more deeper things I didn't do (...) I think this type of translation is a lot more difficult, from Portuguese into English, that is."[1]

T08 Pt-Eng

"After that I started revising, re-reading, and I saw there was a mistake in "happen", it should be past tense, I didn't write "happened," and then I read. And then it's over"[2]

If the translators appear to be operating at the word level (TUs), there is indication that their cognitive rhythm is being slowed down.

4.2 *Camtasia .avi files and think-alouds*

Looking at the one stage of the process that consumed the same percentage time in both language directions, for T01-05, what exactly is done during orientation? The Camtasia files can be used to answer this question. Figure 05 shows an example of the video files generated by the program, being replayed on an ordinary media player. In the picture, T01 is surfing an internet browser engine, during the orientation stage.

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1 Até o final da revisão o que eu fiz foi corrigir coisas bem localizadas, grafia de algumas palavras. Mas coisa assim mais profunda, de ordem das palavras eu não fiz (…) Eu acho que é muito mais difícil esse tipo de tradução. Traduzir do português pro inglês.

2 Depois desse tempo eu fui rever, fui ler novamente, vi tinha algum erro ali no happen era passado, eu não tinha colocado "happened" e aí eu dei uma lida. E aí terminou.

Figure 05. Camtasia .avi file review of onscreen activity

Table 02 reports the activity of translators T01-05 during their orientation stage. The scoring is simple, Camtasia .avi files are reviewed for the duration of the "Ortn" stage, and any activity outside Translog is reported. If no activity other than reading was undertaken, participants are described as reading.

Considering that we neither videotaped nor took notes on the participants' activities outside the PC interface, it is impossible to verify whether, when described as reading, participants were searching for words in a dictionary or simply having a cup of coffee. In this case, the TAPs are the only source of information to corroborate what was being done.

Table 02. “Ortn” stage actions outside Translog interface

	Eng-Pt Ortn actions	**Pt-Eng Ortn actions**
T01	1. Internet search engine: Cue: “envio de tropas ao Haiti” 2. Read related text online 3. Read source text	1. Internet search engine: Cue: “UN peacekeeping force” Cue: “peace agreement signature” Cue: “UN verification mission for Angola” 2. Read source text
T02	1. Read source text	1. Internet search engine: Cue: send+troops 2. Read text online, link left from previous translation task 3. Read source text
T03	1. Read source text	1. Read source text
T04	1. Read source text 2. Online dictionary: Word: “stir” Word: “bid”	1. Read source text
T05	1. Read source text	1. Internet search engine: Cue: força+militar+Haiti+jornal Cue: força+militar+Haiti+folha+de+sao+paulo 2. Read full source text, online newspaper 3. Internet search engine: Cue: military+mission+Brazil+Haiti 4. Read related texts online (e.g. cbsnews.com)
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T06	Immediate start	Immediate start
T07	1. Read source text 2. Online dictionary: Word: “bid”	Immediate start
T08	1. Read source text 2. Internet search engine: Cue: giant+stirs 3. Read related text, comments on the original The Economist article	Immediate start
T09	1. Read source text	1. Read source text
T10	1. Read source text 2. Online dictionary: Word: “stir”	Immediate start

The data show that the Pt-Eng task elicited more orientation before starting the actual translation. T01, T02, and T05, in this sense, searched for related texts online, possibly trying to better inform their choices. The cues entered by T01 show that the participant was looking for exact whole phrases. T02 and T05 entered words without the quotation marks, which produces broader results. As a result, T01 looked for phrases that would help the translation of the title, whereas T02 and T05 were actually looking for related texts, and not phrases, that could provide more information on the subject matter. T01 and T05 (but not T02) recalled their actions during review of the "Ortn" stage:

T01 Pt-Eng

"Before beginning to translate I checked some things, more in terms of vocabulary, like the verification mission to Angola"[3]

T05 Pt-Eng

"It took me a while to start because I was searching for some information (...) I tried to find the text on Folha de São Paulo to read the full article, I didn't know much about the subject, and then I tried to find articles in English about the same topic and from around the same time."[4]

The TAPs corroborate the time and the Camtasia data. When asked to verbalize, participants only have access to the Translog replay function, that is, they do not see what they were doing outside the Translog user screen. In this sense, the think-alouds verify the .avi Camtasia files: T01 searched for phrases (vocabulary), and was even able to recall one of the phrases ("*missão de verificação*"), and T05 searched for the original text, to read it in full, and then for other articles on the matter (hence the open search by typing related words, and not a phrase). T03 and T04, in turn, spent their orientation stage reading the source text (e.g., T03: "*I spent this time reading the title, the text*."[5]). In anticipation of the task, the orientation stage took eight percent of the time in both Eng-Pt and Pt-Eng, but less action was taken in the former. The TAPs corroborate a concern about getting ready for the task at hand, especially when translating Pt-Eng.

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[3] Antes de eu começar a tradução eu verifiquei algumas coisas, mais em termos mais de vocabulário, coisas do tipo missão de verificação na Angola.

[4] Primeiro eu demorei bastante pra começar porque eu tentei buscar informação (...) eu tentei achar esse texto mesmo na Folha de São Paulo pra ler ele inteiro que eu tava por fora do assunto, e depois eu peguei e tentei achar uns artigos em inglês sobre esse mesmo assunto, na mesma época.

[5] Esse tempo eu fiquei dando uma olhada no título, passando o texto.

The "Ortn" stage for T06-10 shows that in many cases translators started rendering the texts right away (immediate start), especially in the Pt-Eng direction. This can be verified in both figure 04 (Ortn stage only 4%), in the total times (immediate starts were defined as starts earlier than one minute), and in the Camtasia files. The latter is the defining source for establishing that the translators took no preparative action before starting to render the text. For T06, T08, and T10 the immediate start is very obvious (15 seconds or less); for T07, however, the 52 seconds for the Pt-Eng Ortn stage might allow for an initial reading, which is reported in the TAPs ("First I wanted to read the whole text to have some idea how to put the information."6). But deeper inspection afforded by the Camtasia file for T07 Pt-Eng reveals otherwise. To read the full source text, T07 would have had to scroll down the Translog user screen, or else only the first paragraph and the first sentence of the second paragraph were visible. T07 did not scroll down. In this sense, the "Ortn" stage action was described as "immediate start", even though T07 might have read the first paragraph. Again, at this point we re-emphasize that our objective is to describe the groups and how their strategies and approach are mirrored in the process. T08, in Eng-Pt, and T07 and T10, also in Eng-Pt, did some preparations for the task. The latter two translators looked up the meaning of individual words, "stir" and "bid", which are actually two words that elicited research from most participants (title words). T08, in turn, actually did an open search for the words online, looking for related texts. T08's think-aloud illustrates the participants concern:

T08 Eng-Pt

"I searched for some of the words even if I knew their meaning (...) I thought the dictionary definition might not work. So I translated "A Giant Stirs" as "Um gigante acorda" [A giant awakes] to give it a sense of rising, and not of moving."[7]

In sum, analysis of the "Ortn" stage of the two groups of translators shows that T01-05 engaged in relatively longer and more thorough orientation, such as reading additional texts, searching for the full, original text, in comparison to T06-10. This

6 Primeiro eu quis ler o texto todo pra ter uma idéia mais ou menos de como colocar essa informação.

7 Eu procurei algumas palavras mesmo que eu soubesse o significado (...) eu imaginei que o significado do dicionário talvez não poderia dar tão certo. Então o próprio "Giant stirs" eu traduzi como "Um gigante acorda" como se fosse alguma coisa do despertar ali, não no sentido de mexer, nada assim.

comparison, in turn, does not inform our investigation much in terms of effects on the process; rather, it provides descriptive characteristics that differentiate how the two groups went about starting the rendering of the target text. But it will, later on, relate to how recursive the "Write" processes reveal to be. Let us turn, in that sense, to the Translog linear representation data and the segmentation of the translation process.

4.3 *Translog figures, linear representations, and think-alouds*

As referred before, the Translog software generates a timed, linear representation of the production of the target text. The symbols are the following:

✶	five-second pause
⌫	backspace key
	mouse movement
←→	cursor movement
[*number*]	longer pauses

The software also generates a count off all text segments within the pre-defined pause length. For example, the linear representation of T01 translating the title:

In this representation, there are four text segments--or translation units, drawing on Alves, Magalhães, and Pagano (2000), referred at the beginning of this paper--within pauses of five seconds or longer--that is, "*u*", "*Um giga*", "*nte*", and "*desperta*." Instead of having to inspect all linear representations for a segment count, Translog automatically generates that figure. Following the approach presented in Alves (2003) and Jakobsen (2003), the segmentation of the process is an indication of the level at which the translator is operating, of the cognitive rhythm, that is, if it is at the morpheme or word level or at, or near the phrase level.

If the translator is stuck working at the word level, it may be difficult to successfully build a coherent textual network (Alves, 2003). This is not to say that working at the word level is not necessary, even essential, sometimes. However, it may be an indication that the translator is not rendering the source text into a target text in a different language. Working at the word level may also be a result of the approach to translation; for example, the translators

who searched for whole phrases and additional texts, and not only words, may find some support in that strategy for working with bigger chunks of text. Table 03 reports the segment count for both tasks, and the difference between the two tasks on the far right-hand side.

Table 03. Total segment count for both tasks (5-s pauses)

	Task	Segments	Task	Segments	Variation (a-b)
T01	Eng-Pt (a)	84	Pt-Eng (b)	59	25*
T02	Eng-Pt (a)	37	Pt-Eng (b)	43	-06
T03	Eng-Pt (b)	41	Pt-Eng (a)	67	26*
T04	Eng-Pt (a)	39	Pt-Eng (b)	55	-16
T05	Eng-Pt (b)	59	Pt-Eng (a)	103	44*
TOTAL		*230*		*327*	
---	---	---	---	---	---
T06	Eng-Pt (b)	5	Pt-Eng (a)	5	0
T07	Eng-Pt (b)	29	Pt-Eng (a)	30	01*
T08	Eng-Pt (a)	22	Pt-Eng (b)	31	-09
T09	Eng-Pt (a)	13	Pt-Eng (b)	24	-11
T10	Eng-Pt (b)	21	Pt-Eng (a)	40	19*
TOTAL		*90*		*130*	

(a): first task; (b) second task; *second task lower segment count

The participants marked with a star (*) are the ones whose second task was less segmented than the first. Considering that the Pt text had a higher word count, the only translator who may have *markedly* benefited--quantitatively--from the first task (that is, whose second task segmentation count was lower despite the higher word count in the source text) is T01. This particular translator is also described being concerned with finding related, parallel texts, and searching for whole phrases (see table 02). The lower second task segment count for T03, T05, T07, and T10, in turn, may be a result of the higher source text word count. If we consider, as in the total time analysis, however, that the word count in Pt is higher by a factor of 0.21, only T07 would not have benefited from the first task. Dividing the variation figure by the second task, or (b) value, T03's segment count decreased by a factor of 0.38; T05's,

by 0.42; and T10's, by 0.47. The quantitative data in the cases of T03, T05, and T10, however, can be misleading, since they cannot take into account the greater difficulty of translating Pt-Eng, which most likely is a factor that helps a higher Pt-Eng segment count, as a first task, in relation to Eng-Pt as a second task. Nonetheless, if we stick to the numbers, these translators could be strategically benefiting, in terms of text segmentation, from the first translation of a source text on the same subject matter.

If taken lightly, however, the above segmentation count can be misleading in describing a group as (cognitively) struggling more to translate the texts. As shown in table 03, the total segment count for both tasks is higher for T01-05 than for T06-T10. Does this mean, hence, that T06-T10 were operating at a higher level of text? Not necessarily. Again, we need to corroborate one type of information, that is, segment count, with another. We will use three other sources, TAPs, linear representations, and a measure that can be postulated to describe recursiveness, which we will better explain below.

Keystrokes and revision keystrokes are measures used by Jakobsen (2003). This figure is simple to calculate (owing to the statistics provided by the Translog software): By adding the total of revision keys (a Translog figure which includes backspace, and mouse and cursor movements), dividing that figure by the total keystrokes and, finally, multiplying by 100, we obtain the number of revision keystrokes per 100 keys logged. The rationale behind the calculation of this figure is that the backspace key (text elimination), mouse actions, and cursor movements (navigation) are an indication of revision being done, be it during the "Write" process or the "Revision" process itself. It is, in this sense, a way to look at recursiveness, or out of the total number of keystrokes, how many times (or what is the percentage times) the translator was going back on (and most likely changing) the text produced. Tables 04 presents keystroke Figures for T01-05:

Table 04. Total keystrokes, text production keys, and revision keystrokes T01-05

	Eng-Pt				
	Total keystrokes	Text production keys	Text elimination	Navigation	Mouse actions
T01	2275	1459	435	311	70
T02	1160	893	56	195	16
T03	2395	872	97	1422	4
T04	966	757	72	111	26
T05	1420	934	184	253	49
SUM	(A) 8216	4915	(B) 844	(C) 2292	(D) 165
Total revision keystrokes (B+C+D) = 3301; Revision keystrokes per 100 keys* = 40.1					
	Pt-Eng				
	Total keystrokes	Text production	Text elimination	Navigation keys	Mouse actions
T01	1333	982	108	199	44
T02	1193	934	68	187	4
T03	3589	983	155	2447	4
T04	1117	861	121	112	23
T05	2005	1246	262	381	116
SUM	(A) 9237	5006	(B) 714	(C) 3326	(D) 191
Total revision keystrokes (B+C+D) = 4231; Revision keystrokes per 100 keys* = 45.8					

*((B+C+D)/A) x 100

Table 05, in turn, the figures for T06-10.

Table 05. Total keystrokes, text production keys, and revision keystrokes T06-10

	Eng-Pt				
	Total keystrokes	Text production keys	Text elimination	Navigation	Mouse actions
T06	872	731	44	82	15
T07	1587	939	217	383	48
T08	1159	927	172	42	18
T09	724	703	16	3	2
T10	1047	841	82	97	27
SUM	(A) 5389	4141	(B) 531	(C) 607	(D) 110
Total revision keystrokes (B+C+D) = 1248; Revision keystrokes per 100 keys* = 23.1					

Pt-Eng					
	Total keystrokes	Text production keys	Text elimination	Navigation	Mouse actions
T06	1033	910	97	10	16
T07	1467	955	377	112	23
T08	1409	1113	206	68	22
T09	879	770	43	44	22
T10	1458	1016	111	275	56
SUM	(A) 6246	4764	(B) 834	(C) 509	(D) 139
Total revision keystrokes (B+C+D) = 1482; Revision keystrokes per 100 keys* = 23.7					

*((B+C+D)/A) x 100

The revision keystroke figures clearly indicate that T01-05 navigated, erased, and moved around the text more (total revision keystrokes) and considerably more often (out of every 100 keystrokes) in Pt-Eng than Eng-Pt and in comparison to the other group. T01-05 also navigated a lot more than T06-10, whereas the text elimination figures are not that different: an indication that T01-05 did shuffle back and forth revising the text significantly more than the other translators. The figure of revision keystrokes per 100 keys represents non-text production keystrokes and, in that sense, can be related to the segment count for T01-05 being higher than for T06-10 in both tasks: The translator returns more often to previously rendered text--be it by erasing, navigating or clicking with the mouse (mouse clicks do include mouse actions outside the Translog user screen, that is, when the participant goes online, for example)--and, hence, will focus on one and the same piece of the text more than once, producing more translation units as he or she pauses to revise a phrase, or word. The alert reader, at this point, may be asking why, then, the need to define a "Revision" stage of the process if we are looking at revision that is both done during the "Write" and the "Revision" stages--and rightly so. On the one hand, the revision keystrokes can be used to investigate recursiveness, that is, a process that, at times, goes around in circles, without moving linearly forward. On the other, the "Revision" stage can be used to investigate to what extent translators are satisfied with their work once they get to the last word, and to what extent do they keep revising. It is exactly the revision keystroke per 100 keys measure that we advocate can be used to assess recursiveness.

The triangulation of data, as advocated by Jakobsen (2003) and Alves (2003) helps understand what is going on with group T01-05 and T06-10. By exclusively looking at the segmentation data, one could misleadingly argue that it appears that T01-05, if compared to T06-T10, are having to concentrate on smaller segments of texts. In other words, the cognitive rhythm (Schilperoord, 1996; Alves, 2003) of T01-05 would be suffering. However, that is not the case. T01-05 are repeatedly trying to build a target textual network and, as the revision keystrokes (especially navigation) show, shuffle back and forth inside the translation to try to render it as a text. Unfortunately, since the analysis of product (the final text) is not the objective of this paper, if the reader is wondering about target text quality comparisons, the question will remain. However, we will, yet again, combine the data with think-alouds to enrich our discussion and try to understand why T01-T05 are producing remarkably more revision keystrokes than T05-T10.

The TAPs of all subjects were transcribed. Those from T01-05 were scored for what part of the text (be it a word, a phrase or a whole sentence) the translators reported focusing on. This scoring was also done in view of saving space and, instead of reproducing the think-alouds of all participants, we will focus on one of the most frequently reported segments of the source text. See Table 06:

Table 06. Text segments recalled, three instances or more

	Eng-Pt					
Text segment	T01	T02	T03	T04	T05	TOKENS
Title/subtitle (A giant stirs…)	*	*	*	*	*	5
Small force/huge symbolic significance		*		*	*	3
The country's (…) military deployment	*	*	*	*	*	5
Taking over		*	*		*	3
This marks a new departure	*	*	*			3
Gentle and introverted giant	*		*		*	3
Bystander on the world stage	*		*		*	3

In addition to the title, the phrase "The country's biggest foreign military deployment…" also deserved reports of attention from all five participants. However, we decided to analyze the linear representation of the title and subtitle, instead of that of the aforementioned phrase because, as reported by the participants themselves, the problem with that phrase was actually more related to the word "deployment" and with a perceived ambiguity in the possessive "the country's". See for example T01's and T04's reports:

T01 Eng-Pt

"I returned to the second sentence because I was not happy with [the translation for] deployment."[8]

T04 Eng-Pt

"I was in doubt about this part, whether they were talking about a [military] force from Brazil or Haiti."[9]

Thus, the title and subtitle, in our opinion, make for a longer, more interesting example of recursiveness. Figure 06 shows the linear representations:

[8] Acabei voltando novamente na segunda sentença lá que eu não estava contente com 'desembarque'.

[9] Essa parte fiquei um pouco na dúvida se tão falando da força do Brasil, ou se era do Haiti.

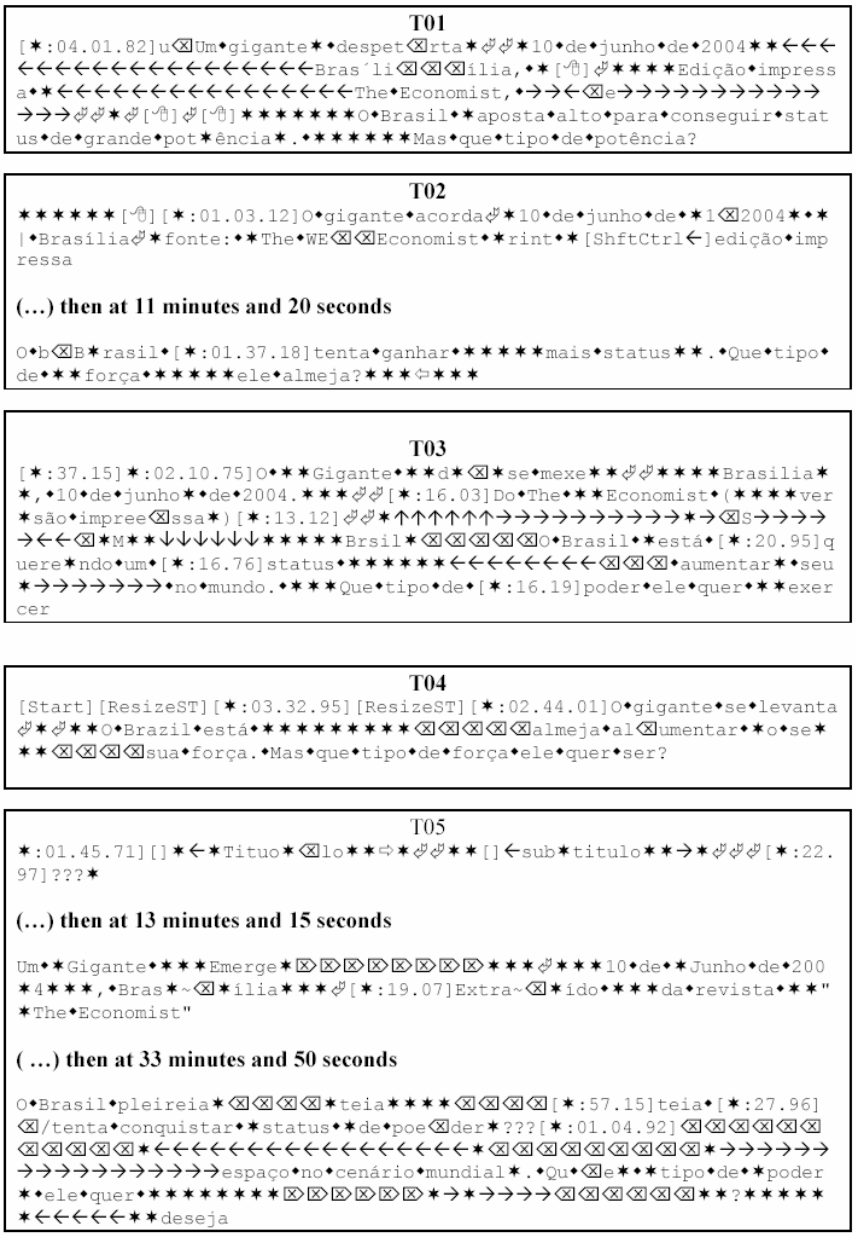

Figure 06. Linear representations,
T01-05, translation of the title.

T02 and T05 offer a remarkable example of recursiveness. T02 rendered the title, data and source (*O gigante acorda;* hits return; *10 de junho de ...*), but only 11 minutes and 20 seconds into the writing of the target text did this translator return to render the subtitle (*O Brasil tenta...*). T02 is also aware of, or strategically, doing so, as the TAPs show:

T02 Eng-Pt

"That's probably the title, which in the end I thought it was better to translate after I finished everything (..) I'd have a better overall view and, maybe, find some cohesive link."[10]

T05 is even more deliberate about returning to the title and subtitle later on. Instead of rendering the title, T05 marks the title and subtitle places in the text (*Título*; *subtítulo*), hits return, and then starts translating the text that follows the title. Almost fourteen minutes into the task, T05 returns to the title, as referred in the TAPs:

T05 Eng-Pt

"I marked the problems I started to encounter and thought, I'll go back to them later. Then I went back to the title and had to look up 'stir' in the dictionary to see if it gave me any ideas"[11]

As to the subtitle, it is only towards the end, approximately 33 minutes and 50 seconds into the process, that T05 goes back to that and decides on how to translate it. T01 and T04, in turn, actually rendered the title pretty smoothly, which corroborates the description of their orientation stage, when T01 did an online search for related texts, and T04 searched specifically for words in the title (see table 02). T03, however, of the five subjects, was the one who struggled a bit more; T03 also operated differently than the other four translators as the participant was not described doing anything but reading the source text during the orientation stage, nor moving on to the translation of the text. There is one characteristic about T03 that separates him or her from the other four translators: T03 was logged carrying out particularly less mouse actions than the others (four mouse actions). A low figure

[10] Isso aí provavelmente o título, que no fim das contas eu achei melhor traduzir depois que eu terminasse tudo (...) eu ia ter uma visão mais geral depois assim, mais claro talvez, algum elo coesivo.

[11] O que foi dando problema eu fui marcando; pensei, daqui a pouco eu volto nisso aí. Aí eu fui lá no título, eu tive que olhar "stirs" no dicionário, ver se me dava alguma idéia assim.

matched only once by two other participants (T02 in Pt-Eng; and T09 in Eng-Pt). This, in turn, may be an indication that this translator relied less on additional resources such as online texts (which could be corroborated with an additional, extensive description of all the "Write" and "Revision" stages).

In a nutshell, the time data showed a pattern in duration of the "Ortn" stage for T01-05. Qualitatively, however, what participants do similarly in terms of time, they do not do in terms of what is done within that time: Camtasia and think-alouds combined to better describe what are possible strategy traits of the translators (doing online search, word look-up). Next, segmentation and revision keystroke measures combined, again, with think-alouds to lay a foundation for an objective measure of recursiveness in translation. This measure, in sum, can combine with segmentation data to help identify translators' adaptive behavior to task difficulty.

Conclusions

In trying to digest all the data presented, one link between the articles that guide this paper (Jakobsen, 2003; Alves & Gonçalves, 2003; Alves, 2003) and the paper itself is a line of thought of describing the process of translation and how different factors are mirrored in, and affect, translation and translators. There is also a common objective of establishing some common ground for the process-oriented and cognitive research on translation. The intention is, hence, to provide a description of certain measures that can, and should, be yet further studied and help dissect translation.

Our assessment of the two groups does not exhaust all possible explanations for differences found in the processes of translators separated by schooling and (some) experience. A significant part of the data analysis is, as Schilperoord wrote in his book, based on silence (Schilperoord, 1996) rather than the text production itself. The segment count and the pauses, in essence, are based on the translator not doing anything on the text itself. But it is that silence in production that helps us break down the process of translation and triangulate text production with other sources of data, such as TAPs and Camtasia files. When collecting the TAPs, it stands out how longer pauses make translators start to wonder and try to remember what they were doing. As text production is ongoing, the statistics of Translog can be very informative, but as it halts, the silence in text production elicits further investigation.

The segmentation alone, however, may lead to a misunderstanding that a higher number of segments means that the translator is stuck at word-for-word translation and may be unsuccessful in the production of a target text. Looking at the Translog linear representations is one way to answer that question; calculating recursiveness, another (and they are not mutually exclusive). More recursiveness combined with higher segmentation can be an indication of translators' adaptive behavior to task difficulty. If there is no increase in recursiveness, but merely on segmentation, as in T06-10, the translator may be simply caught in a trap he or she does not have the strategies to get out of. If, however, there is increase in segmentation and in recursiveness, arguably, there is an adaptive response to increased task difficulty: the translator is trying to claw his or her way out of a more difficult rendering. Figure 07 illustrates this behavior:

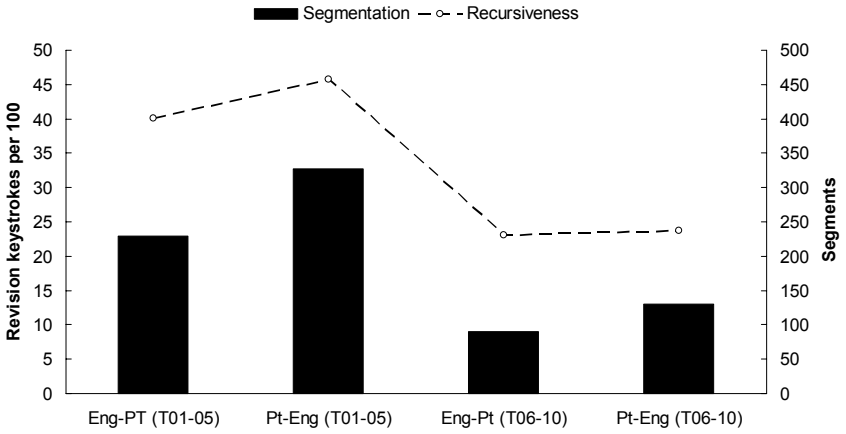

Figure 07. Recursiveness and segmentation

One look at the graph shows that for T01-05 revision increased as segmentation increased, whereas the dotted line between the two tasks for T06-10 remains flat. So not only did T01-05 have their segmentation increased in response to task difficulty, but also their revision keystrokes. T06-10, however, did not show as much of an increase in segmentation, and showed an insignificant difference in recursiveness.

In terms of translation order effect, the different data combine to show that translating Pt-Eng is more difficult. It was more time-consuming, resulted in greater segmentation of the translation, and in more revision keystrokes (among T01-05). These differences are quantitative in nature. A combination of a quantitative figure, revision keystrokes, with a qualitative assessment of TAPs showed that the group of more-experienced translators, T01-05, proceeded moving back and forth on the text more often in the comparison Eng-Pt and Pt-Eng (more revision keystrokes in the latter). The characteristic of group T01-05 is that there is strategic response to the task, that is, the translator's approach to the task is not as unvarying as T06-10, who basically carried out both tasks in the same manner.

Instead of focusing on the target text, or on the result, finding measures that describe the process of translation--such as recursiveness--, and methods that can help the translator (especially the student of translation) understand the constructive process of building a target text--such as replay of his or her own translation, a look-back on the process and reflection upon it with think-alouds, and a look at other translator's (peers) strategies--are all different vantage points that let the translator student, scholar, and professional open, or grow, a different eye. An eye on the path and process that leads to the target text.

Though we deliberately did not focus on the target text, the amount of online and end revision undertaken by T01-05 may lead us to reflect, in passing, upon the issue of "textual durability" in translation, namely the ability to produce target texts which meet the specificities and needs of the translation task (Alves 2005:121). The performance of T01-05 seems to be in line with the claim made by Jakobsen (2002) that more experienced translators produce more durable texts in the drafting or writing phase, and that they are more competent in the end revision phase--that is, have developed strategies to work out the final details of the text. Similar results can be found in Alves (2005). In our analyses, TAPs have also shown that patterns of segmentation and recursiveness among T01-05 can be paired with higher levels of awareness and instances of critical meta-reflection about their own translation processes; evidence which corroborates previous findings in Alves (2003, 2005).

In keeping with our objectives, the computation of figures generated by the translation process offer additional quantitative insights into translation. The study of the process as such can inform both academic studies of, and professional interests in translation.

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