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LOOKING FOR RELEVANCE INTO THE EYES: IN SEARCH OF INTERPRETIVE RESEMBLANCE IN TRANSLATION THROUGH GAZING DATA

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Abstract: This paper is situated at the translation process research branch of the Descriptive Translation Studies and aims at exploring some eye-tracking, key-logging and retrospective protocol experimental data (originally from Fonseca, 2016) building on the Relevance theory framework and its key-concept of interpretive resemblance in translation (*cf.* Gutt, 2000; Alves, 1995). It aims at identifying and discussing instances of optimal interpretive resemblance and the expected balance between processing effort and cognitive effects in translating. The data was collected at the Laboratory for Experimentation in Translation (LETRA-UFMG), Brazil, and for this exploratory study the subject chosen was a professional translator who translated a short popularization of science text from English into Portuguese with no external support and no time pressure to accomplish the task. *Tobii T-60 eyetracker*, *Tobii Studio* and *Translog II*, besides written retrospective protocols, were used as the main methodological tools for data collection and analyses. After carrying out discussions and some qualitative and quantitative analyses, hypotheses were raised proposing challenging questions for future research on translation processes and eventually cognitive studies and translation competence and expertise.
Keywords: Translation Process Research; Relevance Theory; Empirical-Experimental Methods; Eye-Tracking Data

EM BUSCA DE RELEVÂNCIA NO OLHAR: À PROCURA DE SEMELHANÇA INTERPRETATIVA ATRAVÉS DE DADOS DE RASTREAMENTO OCULAR

Resumo: Este trabalho se situa no ramo dos estudos descritivos da tradução e no sub-ramo de estudos processuais, desenvolvendo-se a partir de dados de rastreamento ocular, registro de teclado e de protocolos retrospectivos, coletados na pesquisa de Fonseca (2016). Utiliza-se como arcabouço teórico a Teoria da Relevância e o seu conceito-chave de *semelhança interpretativa* (*cf.* Gutt, 2000; Alves, 2000). O objetivo principal é identificar e discutir potenciais ocorrências de *semelhança interpretativa ótima* e o suposto equilíbrio entre esforço processual e efeitos cognitivos no processo tradutório. Os dados foram coletados no Laboratório Experimental de Tradução (LETRA) da UFMG e este estudo explora somente dados de um participante que traduziu um texto curto de popularização da ciência, do inglês para o português, sem acesso a auxílios externos e sem pressão de tempo para concluir a tarefa. Como ferramentas para a coleta e análise de dados, foram utilizados o rastreador ocular *Tobii T-60*, o *software Tobii Studio*, o *software Translog II*, além de protocolos retrospectivos escritos. Após o desenvolvimento de análises quantitativas e qualitativas, algumas hipóteses são levantadas com vistas ao desenvolvimento de pesquisas futuras, apontando questões desafiadoras para o campo dos estudos processuais da tradução e, consequentemente, para os estudos sobre competência tradutória e expertise em tradução e estudos da cognição em geral.
Palavras-chaves: Estudos Processuais da Tradução; Teoria da Relevância; Métodos Empírico-Experimentais; Dados de Rastreamento Ocular

1. Introduction

Translation Studies have enjoyed an expressive progress, with qualitative and quantitative developments in the academic-scientific landscape in the last decades since its inception in the 1970's. Following this general trend, translation process research (TPR), established mainly in the descriptive branch of Translation Studies, has been progressively achieving new and relevant developments. Especially for some methodological and empirical data advancements

and their consolidation, we are increasingly in a better position to further probe and discuss the cognitive basis underneath translation processes. On the other hand, given the high complexity and relatively low scrutiny involved in any instance of cognitive phenomena, there is still much more to be explored in the years to come. After all, we have realized that the more we learn about the translator's (and eventually human) *black box*, the more there is still to be learned and investigated about it, and eventually the more it looks like a *Pandora's box*, full of new and amazing surprises.

After the TPR first methodological age, from the mid-1980's to the mid-1990s, with the massive application of think-aloud protocols (TAPs) and other introspective methods (IM) to collect and analyse empirical data (Ericcson & Simon; Tirkkonnen-Condit & Jääskeläinen), besides some other sparse methods like direct observation in experimental translation sessions, new technologies started to contribute to important improvements in its methodological scenario. In the late 1990s, the software *Translog* (Jakobsen (a)) brought the possibility to keep track of the target text production in a very detailed way. Some years later, in the mid-2000s, eye-tracking technology started to be applied in empirical-experimental TPR (*e.g.* Göpferich, Jakosen & Mees), providing extremely accurate information on eye fixations, eye saccades and pupil size, and thus allowing new insights about reading and cognitive focus in translation processes. More recently, some researchers have been looking for further methodological possibilities in order to approach cognitive processes, especially regarding the neural-physiological aspects involved in translation, like FMRI (Annoni, Lee-Jahnke & Sturm; Garcia; Szpak) and EEG (Hansen-Schirra). However incipient, with relatively low experimental ecological validity and still hardly applicable to translation practice, this new methodological and theoretical front of investigation represents extremely important research initiatives aiming at shedding light on the neural-physiological substrate underneath translation processes and translation competence, thus opening new avenues for future developments in TPR and also for the applied branch of Translation Studies.

As an exploratory, case study, this paper aims to discuss some eye-tracking, key-logging and retrospective protocol data originally collected for a PhD research in TPR (Fonseca). That work focuses on different types of effort (temporal, technical and cognitive) building on Krings's categories, mainly in monolingual post-editing experimental tasks, but also, in a smaller scale, in direct bilingual post-editing and translation tasks. The investigation was carried out at the Laboratory for Experimentation in Translation (LETRA), in the Federal University of Minas Gerais (UFMG), Brazil. In this case study, I focus on the gazing data obtained from one of the subjects who accomplished the translation task, from English into Portuguese. The main theoretical support for the discussion herein is Relevance theory (Sperber & Wilson) and its principle, which postulates that processing effort and cognitive effects are always working in conjunction to balance and guide inferential (and eventually problem solving and decision making) processes in all instances of human communication. Some cognitive models for translation processes have been proposed drawing on Relevance theory (*e.g.* Gutt; Alves; Gonçalves; Alves & Gonçalves (b)). However, most of them focus mainly on the processing effort factors, having not dealt with cognitive effects either in depth or in a more objective fashion. Frequently, effects are approached only qualitatively and mainly subjectively. Therefore, this exploratory, case study aims at discussing some conceptual basis for dealing with cognitive effects in a more empirically-based and possibly quantitative fashion through the analyses of empirical-experimental data, drawing on the principle of relevance.

Besides this introduction, this paper includes a section on the theoretical framework based on the Relevance theory concepts and their implications for the translation process; then the methodological section presents the main issues concerning the experimental design and data analyses; after that, a section with results and discussions will be presented, followed by some final remarks, with a general assessment of the study and possible developments for the area in the near future.

2. Theoretical underpinnings: the principle of relevance and the translation process

Relevance theory (Sperber & Wilson, RT henceforth) builds on two main fields of knowledge - linguistic pragmatics and cognitive studies. Its conceptual framework, on the one hand, aims at describing and explaining human communication, especially the inferential phenomena related to language exchanges, on the other hand, takes cognitive processes as essential for the theory, as it draws on some precepts of the modularity of mind (Fodor) to explain how linguistic interpretation and production would be ruled by the principle of relevance. That principle is an explanatory construct about the regulation and balance between processing effort and cognitive effects in human communication. Thus, according to Sperber & Wilson (260), "[h]uman cognition is geared to the maximisation of relevance", whose principle guides inferential processing towards the maximum (possible) of cognitive effects with the minimum (necessary) amount of processing effort while looking for coherence and knowledge expansion through linguistic communication.

RT was first applied to translation by Gutt (a) and then by Alves. After their seminal works demonstrating the promising interfaces between translation and RT, many other researchers followed that path and started to investigate the processes and products of translation using the RT framework[1].

As regards the investigation of cognitive processes in translation, LETRA, at the Federal University of Minas Gerais in Brazil, has been carrying out some empirical-experimental research projects which apply RT as their main theoretical basis, achieving important results for this branch of studies (*e.g.* Gonçalves; Alves & Gonçalves((a); (b); (c)); Alves, Pagano & Silva; Koglin; Szpak).

However, in most works applying RT and its principle to translation processes, one will more frequently find discussions about the factors related to processing effort involved in interpreting

[1] For a compilation of works applying RT to translation and other fields, see Yus.

source texts and producing target texts. Giving the methodological research tools available nowadays, it is eventually easier and more trustworthy to measure variables related to processing effort in experimental contexts than those related to cognitive effects. When the cognitive-effect side of the relevance "equation" is considered, there are very few research initiatives dealing with it in a quantitative and more objective fashion. In TPR one will more frequently find methods applying criteria for product (target texts) assessment or at most translator's satisfaction self-assessment (*e.g.* Gonçalves; Koglin). No doubt those initiatives are necessary and important for deepening our comprehension of the complexity involved in translation processes. However, so far, they have neither effectively described nor objectively measured cognitive effects in TPR. This is so because such a goal in the current TPR methodological and theoretical scenarios is not simple at all.

As far as the theoretical and methodological restrictions for precisely identifying and measuring cognitive effects are concerned, whenever one deals with any kind of assessment or evaluation of a process or product in a research work, subjectivity and imprecision come into play, especially when the object to be assessed or measured is in the cognitive field. Thus, in the effort-effect two-fold explanatory construct postulated by the principle of relevance for the cognitive processes in human communication, the effort side is much more developed since the methodological tools available so far offer various and generally trustworthy ways for data collection and analyses. In our field of research for instance, the conjunction of retrospective verbal protocols, key-logging, eye-tracking and some other methods, applied in experimental designs, and conceptual frameworks from cognitive sciences, psycholinguistics and TPR itself allows researchers to look deeper into the phenomena related to cognitive effort. I believe that with the development of descriptive methods for analysing and quantifying the effect-side of the process we will be in a better position to describe and explain translation processes and, more specifically, their implications for and applications to translation competence and expertise.

2.1 Relevance and interpretive resemblance in translation

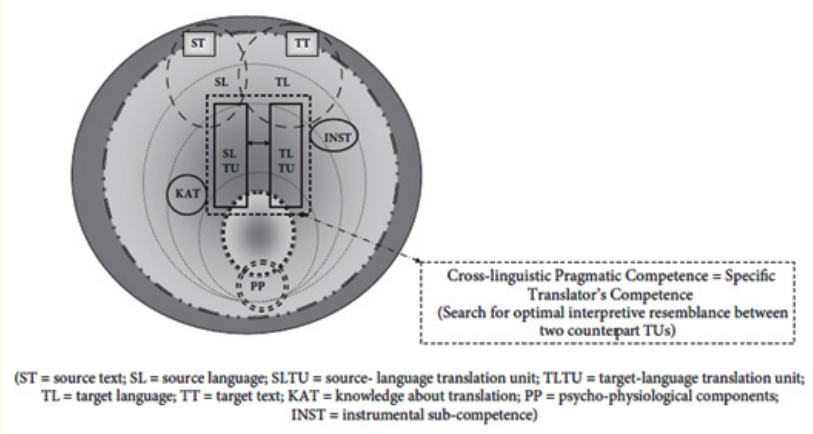
Drawing on RT, Gutt (a) explores the concept of *interpretive resemblance* as the core mechanism in translation process. He poses that translation is an instance of interlingual interpretive use of language, a process through which the translator must overtly say or write in the target language what had been said or written in the source language by the source-text author. This process of interlingual interpretive use is guided by the principle of relevance, which determines the maximization of interpretive resemblance between source and target texts in translation: the source text must resemble the target text in relevant aspects, that is, the cognitive effects (explicatures plus implicatures) triggered from the source text interpretation must maximally resemble the interpretation from the target text in a certain context. To successfully accomplish this search for maximum interpretive resemblance between *utterances* (this is the translation unit adopted by that author), Gutt (b) highlights the essential role of metarepresentation. Thus, beyond the various semantic and pragmatic processes, expert translating demands a highly complex and effort-consuming level of metacognitive processing – metarepresentation – which requires that the subject represents in his/her cognitive environment other people's mental representations. Therefore, the translator must metarepresent the source text author's mental representations related to that communicative context, as well as the source text audience's, and mainly the target text audience's mental representations. All these complex, second-order representations are expected to require a significant level of processing effort to take place.

Alves & Gonçalves (b), drawing on RT, develop a cognitive model of translation competence highlighting the centrality of metacognition (and eventually metarepresentation) for inferential processing in translation and translator's expertise profile. The so called "broadband" (expert) translators, according to the authors, are better equipped with the skills for generating and assessing explicatures and implicatures for each counterpart translation unit

[TU] in the working languages. Thus, the expert translator compares (generally in an automatic and less conscious way) the quantity and quality of the cognitive effects (explicatures plus implicatures) of the counterpart TUs, progressively working on the improvement of the target-language TU until it reaches an optimal level of interpretive resemblance with its source-language counterpart.

As depicted in Alves & Gonçalves (b), besides those central pragmatic and metarepresentational skills, the expert translator is expected to adequately integrate some other sub-competences.

Figure 1- Cognitive modelling of translator's competence



Source: Alves & Gonçalves, ((b) 46).

Taking that translation process and translator's competence model into account, this exploratory study intends to search for instances of interpretive resemblance search and assessment in translation, *i.e.*, those moments in which one can observe the relation between effort and effects, which will "tell" the translator whether or not (and how much) his/her rendering for the TU is relevant (optimally interpretively resemblant to the source-text counterpart TU). My hypothesis is that there is some kind of behavioural and/or physiological information from eye-tracking and key-logging

data which may give cues on the amount of effects, or at least on the final relevance balance, for a certain TU. Therefore, it will be possible to look deeper into the translator's *black box*.

2.2 Eye-tracking and key-logging: on the track of interpretive resemblance in translation

In this study, I intend to identify variables in eye-tracking and key-logging experimental TPR data which may be correlated to instances of optimal (or at least good enough) interpretive resemblance between counterpart TUs in a translation task.

As mentioned above, there are trustworthy methodological tools available for experimental TPR focussing on the identification and measurement of processing effort. In most cases, effort is straightforwardly correlated to problem-solving and decision-making complexity in translation, normally demanding proportionally more time for the task accomplishment, more editing procedures in the draft and revision phases (*cf.* Jakobsen (b)), longer eye-fixation duration and mean fixation duration, besides wider eye pupil sizes. On the other hand, there are indicators of easiness and lack of difficulty in translating. Besides showing low values for the complexity parameters mentioned above, there are some other indicators for easiness or fluency instances in translating (*i.e.* Königs's, *ad hoc block*). An important example is Jakobsen's (d) peak performance TUs, which are long target-text segments typed without any significant interruption, indicating instances of low difficulty or absence of problems in translating.

Anyway, observing either high or low processing effort (difficulty or easiness) in translating does not necessarily give insights on the cognitive effects generated and self-assessed by the translator about his/her own decisions and the level of interpretive resemblance he/she attributes to the TU counterparts. Therefore, in this study, I explore eye-tracking and key-logging experimental data in order to identify instances of cognitive effects and/or interpretive resemblance and ways of isolating and quantifying them.

Among gazing data obtained from eye-tracking technology, pupillometry is a method which can be used to study some cognitive, behavioural and physiological variables (light intensity and acoustic noise control, cognitive load/ processing effort, emotional and cognitive arousal, as well as intellectual and sexual interest, moral and physical rejection, appetite etc) as discussed in many works from different fields so far (*e.g.* Hvelplund; Hyona, Tommola & Alaja; Tamaliunaite). Therefore, I decided to explore mainly the pupillary data from the case under scrutiny in order to find out possible correlations among processing effort, cognitive effects, interpretive resemblance and, therefore optimal relevance in translation.

3. Methodological framework

Given the exploratory nature of this study, the data analysed here is only a small portion taken from a broad and extensive collection gathered for a PhD research (Fonseca), carried out at LETRA. Fonseca investigated the different types of effort (*cf.* Krings) involved in monolingual post-editing, but she also collected data from some bilingual post-editing and translation experimental tasks, from L2 into L1, in the English-Portuguese, Spanish-Portuguese and Chinese-Portuguese language pairs, in order to control some variables. For the post-editing tasks the automatic translation system *Google translate* was used, and just for the monolingual post-editing tasks, think-aloud protocols were applied as the independent variable. That study counted on the participation of 64 subjects, Brazilian Portuguese native speakers, among which 59 accomplish the monolingual post-editing tasks (*i.e.* with no access to the source texts but only to the machine translation outputs) from the three foreign languages mentioned; just two of the subjects accomplished both the translation and bilingual post-editing tasks from English and from Spanish, while two others post-edited from Chinese in the bilingual condition, and another one only translated from Chinese into Portuguese.

The results of Fonseca's study confirmed the influence of TAPs on the subjects' performance during the experimental monolingual post-editing tasks, showing a significant increase in the amount of *temporal, technical* and *cognitive* processing effort for most of the subjects in this main experimental group. Therefore, that study expands the results by Jakobsen (c), who observed a significant growth only in *temporal effort* due to the influence of TAPs in translation tasks from English into Danish, with no significant difference between the two conditions regarding the length of the TUs produced.

3.1 The experimental design

The main objective of this case study is to explore possibilities of identifying and quantifying instances of cognitive effects, and their correlations with the respective processing effort records in order to establish a parameter based on the principle of relevance, which guides the processes of interpretive resemblance search and assessment in translation (*cf.* Alves & Gonçalves (b)). I focus mainly on eye-tracking data, and complementarily on key-logging and written retrospective protocol data from Fonseca, choosing one main unit of analysis, a macro translation unit (*cf.* Alves & Vale) which includes the set of smallest pupil size records from the research subject P63-T1. S/He translated from English into Portuguese (L2 into L1) a short popularization of science text (Appendix) using *Translog II* (Carl) in an eye-tracked experimental session (eye-tracker *Tobii T-60* and software *Tobii Studio*), in a light-intensity controlled and acoustic noise-free lab environment. There was no time pressure for the subjects to conclude the translation task and no external search was allowed.

In Fonseca the two subjects who accomplished the translation tasks from English into Portuguese were chosen after answering a prospective questionnaire that demonstrated their L2 proficiency and translation competence. For this case study, subject P63-T1 was randomly chosen.

3.2 Data explored in this study

The main dependent variable to be explored here is pupil size. I looked for instances of very small pupil size records from the eye-tracking raw data as far as works on pupillometry have shown potential correlations between this variable and some other independent variables related to physiological, cognitive and emotional phenomena as briefly mentioned above. Even top-down cognitive processes (*e.g.* voluntary thoughts) seem to impact on pupil size variation (Goldman). Thus, pupil dilation can be correlated to light-intensity variation, processing effort, interest/motivation, cognitive and emotional arousal etc., and, on the other hand, pupil constriction can be correlated to events of (more or less) conscious rejection, repulse, disgust, or even lack of interest for something in the subject's visual field.

Drawing on these general trends in pupillometry, it is expected that both processing effort and some kinds of cognitive effects may cause pupil dilation. Therefore, those moments a translator implements processes of metarepresentation (searching for and assessing interpretive resemblance) are expected to be reflected in pupil dilation events. However, up to this point, there is no systematic, objective way to separate effort and effect components reflected in pupil size, which represents a huge theoretical and methodological challenge for TPR.

To analyse the data in this study, I propose a hypothetical scenario drawing on RT and the cognitive model mentioned earlier. Thus, as soon as one reaches a satisfactory level of interpretive resemblance, the principle of relevance would "tell" the translator to stop processing that TU for having achieved enough and adequate effects. At that moment an optimal balance between effects and effort is obtained in the translator's cognitive environment. It means that optimal (or at least enough) interpretive resemblance between the two counterpart TUs has been reached. Just after that, the level of cognitive effects and eventually processing effort is expected to drop down, making the pupil return to its baseline size or close to

it, before a new TU is focused, and other dilations take place. On the other hand, as regards pupil constriction, *i.e.* the reduction of its size below the baseline value, there are some studies which have demonstrated that constriction may be also a response to emotional, cognitive or physiological low (or lack of) motivation/ interest, rejection, disgusting, besides being a result for the use of certain drugs and some pathologies (*e.g.* Bradley *et al.*).

However, how would this type of responses fit this discussion? My hypothesis in this case is that whenever there is any excessive amount of either effects or effort, the cognitive system would go off the "relevance alarm", "telling" the translator to stop processing that TU either for already having achieved enough and adequate effects or for having spent too much effort and time without obtaining enough effects.

Besides some pupil size records, I also analysed the respective eye-fixation, saccade durations, and some comments in the written retrospective protocol on translation problems and solutions for the macro TU in focus.

4. Results and discussions

4.1 Analysing macro translation unit 1: looking deeper into effects and effort

In this subsection, I analyse the *macro translation unity* (*cf.* Alves and Vale; MTU henceforth) which included the smallest pupil size record, exploring its potential implications for the relevance-theoretic concept of interpretive resemblance. It refers to the translation of the text title, which was first drafted and almost immediately revised into its final version in the *draft phase* (*cf.* Jakobsen (b)). Therefore, MTU1 was chosen for this study because it encompasses the set of the smallest pupil size records in the whole experimental session.

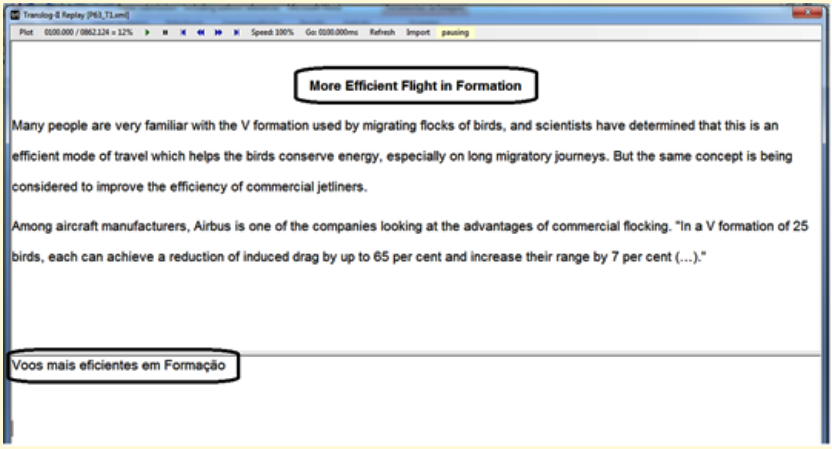
This takes place at the timestamp 192,433 ms, with a 1.12 mm diameter record, referring to saccade 808. It refers to the moment

when the subject had just started to read the revised version of the target text title for the last time, apparently getting satisfied with his/her translation solution, not changing it anymore.

As mentioned above, pupil constriction may be influenced by different factors. As the experimental session was carried out in a light-intensity controlled and sound-noise free environment, and the pupil size variations in focus occurred essentially while subject's gaze attention was on the computer screen, those factors are not taken as significant for the case in focus. Thus, I tried to find out some connection between this pupil variation episode and the level of interpretive resemblance in translation, and eventually the balance between processing effort and cognitive effects.

The first draft of MTU1 was a literal rendering into Portuguese (*Voos mais eficientes em Formação*) of the source-text title (*More Efficient Flight in Formation*), as can be seen in Figure 2.a.

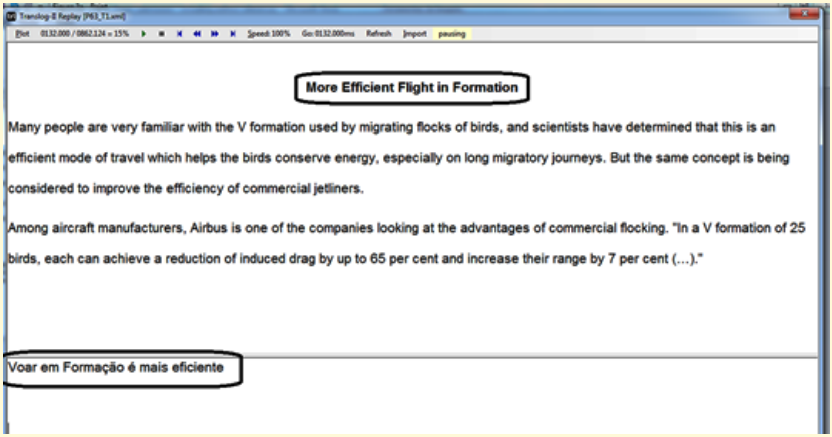
Figure 2.a - First draft of the text title translation



(*Translog II* screen print with emphases [circles] added)

The first draft solution was almost immediately revised into its final version (*Voar em Formação é mais eficiente* [Flying in formation is more efficient]), as seen in Figure 2.b.

Figure 2.b - Revised, final version of the text title translation



(*Translog II* screen print with emphases [circles] added)

The main gaze events in MTU1 are listed in Table 1.

Table 1 - Macro Translation Unit 1 - translating the text title[2]

Variables* / Gaze events	RTS	GEI	GET	GED	AOI-st	AOI-tt	PMD[2]	KPEI	KPE
(1)	74,647	271	fixation	67	1	0	*2.62*		
(2)	80,743	300	fixation	266	1	0	*2.77*		
(3)	81,549	-	unclass	1582	0	0	*2.77*	2	V
(4)	91,349	334	fixation	433	0	1	*2.58*	40	0
(5)	94,949	359	saccade	283	0	0	*2.61*	43	[Up]
(6)	113,933	441	saccade	150	0	0	*2.51*	79	[delete]
(7)	114,045	443	saccade	50	0	0	*2.53*	80	V
(8)	124,668	471	saccade	33	0	1	*2.55*	127	E
(9)	151,677	545	fixation	33	0	1	*2.26*		

[2] Variable added to the raw data spreadsheet simply by calculating the mean value between the right and left pupil diameter records. Whenever a specific line chosen to be analysed did not present any pupil size records, I calculated the mean value among the 6 valid records before and 6 after it.

(10)	176,626	758	fixation	150	0	1	*2.65*	
(11)	183,939	803	saccade	433	1	0	*2.50*	
(12)	184,355	803	saccade	433	0	0	*3.83*	
(13)	192,417	789	fixation	50	0	1	*1.34*	
(14)	193,665	797	fixation	33	1	0	*2.56*	

(*Variables generated from *Tobii Studio* raw data exported into a *MS-Excel* spreadsheet; RTS: Recording Timestamp in milliseconds, GEI: Gaze Event Index, GET: Gaze Event Type, GED: Gaze Event Duration in milliseconds, AOI-st: Area of Interest - source text, AOI-tt: Area of Interest - target text, PMD: Pupil Mean Diameter in millimetres; KPEI: Key-Pressing Event Index, KPE: Key-Pressing Event).

In order to understand the gaze events listed in Table 1, it is necessary to present a brief description of the records and some contextual information: (1) The subject starts to read the text title just after reading the whole text (orientation phase, *cf.* Jakobsen, 2002); (2) s/he finishes reading the title just before starting the drafting phase; (3) s/he starts to type the translation first draft; (4) s/he finishes typing the title first draft; (5) s/he decides to change it and takes the typing cursor back to the beginning of the typed title, highlighting it by pressing *shift* plus arrow keys; (6) s/he deletes that first draft; (7) s/he starts to type the new version; (8) s/he finishes typing it; (9)/(10) s/he reads the revised translated title; (11)/(12) during saccade 803, the subject presents a considerable increase in pupil size, having just finished to read the beginning of the source text (some lines after the title) and then moving his/her visual attention back to the target text; (13) s/he finishes reading the revised title for the last time in the experimental session; and then (14) s/he moves his/her visual attention back to the source text, starting to read another TU.

In Table 1, gaze event records (11) and (12), related to saccade 803, show dramatic increase in pupil size (from 2.50 to 3.83 mm), while the subject moves his/her visual attention from the source text to the translated and revised title. This outstanding increase was shortly after followed by an outstanding decrease (to 1.34 mm), and then by another increase (to 2.56 mm) with the pupil size returning to its baseline value in gaze event (14).

Those variations can be plausibly related to instances of interpretive resemblance search and assessment for MTU1, since those typing and editing procedures are consistent with highly confident decisions but with little or no evidence for doubts about them. The subject produced the first draft of the title but corrected it immediately and kept it unchanged until the end of the translation session. Besides, no further eye fixation records are found on MTU1 area. It is plausible that the subject should have assessed the revised version as highly satisfactory, *i.e.,* with an optimal level of interpretive resemblance. In this case, drawing on the principle of relevance, the subject (not consciously) calculated that the cognitive effects generated by his/her target-text TU would generate adequate and enough cognitive effects in his/her target-text audience cognitive environment. This highly complex, metacognitive and mainly metarepresentational process would demand a high level of processing effort. At the same time, the translation steps and procedures observed from the gazing data and *Translog II* replay function can be regarded as an indication of satisfactory interpretive resemblance assessment by this Subject as regards MTU1.

In the written retrospective protocol, the subject mentioned that the translation task was not difficult for him/her because s/he was used to that text genre. S/He also mentioned his/her concern about the target text audience and its influence on the decisions made, showing awareness about metarepresentation issues, which is an important component of the translator's competence. The comments about the text title in the protocol were not very specific and took place after two comments on other MTUs:

> Then, the title problem came about. I usually write the translation for the words as a first step and then I try to find out the highest probability for a translation choice. In this case it would be a news headline, thus the translation was 'flying… etc."[3]

[3] All the experimental subjects wrote their retrospective protocols in Portuguese.

At a first glance, it seemed relatively easy to translate it and probably a high level of satisfaction was achieved regarding the effects assessed from that result.

Therefore, taking this description as well as the theoretical and methodological discussions above into account, I would hypothesize that impacts of both cognitive effects and processing effort are interwoven in pupil size phenomena. Thus, the great challenge would be finding a method to separate the influence of these two variables over pupil size variation. Then, I will suggest here a tentative hypothesis for future investigations: that pupil size can be a quantitative indicator for the combination of processing effort and cognitive effects, in different combinations: large pupils may indicate high levels of either cognitive effects or processing effort, or even a combination of both.

Taking some other variables into account, eye fixation duration, for instance, is widely accepted as a trustworthy parameter for processing effort. In the records in focus pupil size and fixation duration values have not always varied correlatively, what may corroborate pupil size sensitivity to multiple causation factors. While pupil size increased fast (in the gaze events close to items 11 and 12 in Table 1), the respective fixation duration records decreased dramatically to usually irrelevant values (below 100 ms) and, on the other hand, saccade duration records increased to unusual values (above 100 ms). With this picture in mind, I would also hypothesize that the amount of effects would have increased while the level of effort would have started to decrease in line with the trend of the fixation duration decrease. As regards longer saccades, they could be attributed in this situation to longer chunks of text being processed together and eventually longer TU patterns – when a synthesis of the whole segment is taking place

Then the excerpt above is a literal rendering of the following paragraph: *Depois, veio problema do titulo. Em geral, eu costumo colocar a traducao das palavras como um primeiro passo e depois tentar achar a probabilidade maior para uma escolha na tradução. neste caso, seria o título de uma notícia, por isso a tradução ficou como "voar…etc.*

and the cognitive focus is wider. Although highly speculative, this hypothesizing may be tested in detail in future works in TPR whose experimental designs include eye-tracking methodology.

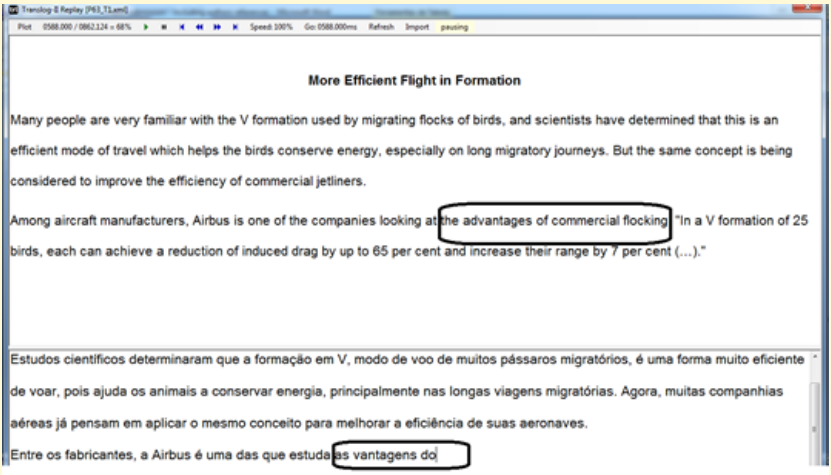
In the next subsection, I will include some quantitative analysis to these initial explorations.

4.2 Looking at some quantitative gazing data

With the aim of giving more insight to the explorations in focus, I compared three sets of gazing data from the experimental Subject P63-T1: one from the whole experimental session, the second from MTU1, discussed in section 3.1, and the other from a second macro TU (MTU2), related to problem solving processes of the noun phrase "commercial flocking", found in the second paragraph of the source text, as indicated in Figures 3.a below. The final target-text solution for MTU2 is depicted in Figure 3.b (*voo em bando* [flocking flight]). Compared to MTU1, this translation problem took a little longer to be solved, the Subject identified it consciously and mentioned it as the first in a list of 4 MTUs. S/He comments that "flock of birds: I couldn't remember the collective noun for birds in Brazilian Portuguese, which took me some time."[4]

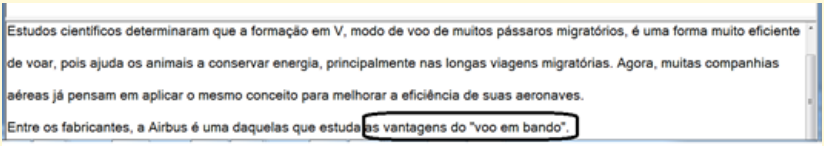
[4] Translated from the protocol excerpt in Portuguese: *flock of birds: eu nao conseguia lembrar qual é o coletivo de pássaro em PB, o que demorou um pouco*. This excerpt is the beginning of a longer comment on the MTU2 (115 words).

Figure 3.a - MTU2



(*Translog II* screen print with emphases [circles] added)

Figure 3.b - Final solution for MTU2



(*Translog II* screen print with emphasis [circle] added)

The variables chosen for this comparison are *Recording Duration (RD)*, *Mean Pupil Size (MPS)*, *Median Pupil Size (MdPS)*, *Fixation Duration (FD)*, *Fixation Count (FC)*, and *Mean Fixation Duration (MFD);* all of them calculated from the raw data spreadsheet and presented in Table 2.

Table 2 - Gazing Data: comparing the MTUs and the Whole Task

Variables* / Units analysed	RD	MPS	MdPS	FD	FC	MFD

MTU1	117,770	2.56	2.58	47,667	198	241
MTU2	270,416	2.38	2.37	19,789	90	220
Whole task	872,782	2.53	2.54	392,544	1,637	240

(* MPS and MdPS values are in millimetres and include all valid records, tagged as 0, 1 or 2 in the raw data spreadsheet; FD, FC and MF values were calculated from fixation records above 100 ms; FD and MFD values are in milliseconds).

The MPS and MdPS values were obtained from all the records concerning pupil size tagged with validity 0, 1 or 2 (0 refers to the most trustworthy records, and 4 refers to no record), including all gaze events (fixations, saccades and *unclassified*). On the other hand, FD, FC and MFD included only values for fixations equal or higher than 100 ms, excluding saccade and *unclassified* records. This methodological option can be explained since the pupil size is taken here as an indicator of combined variables (at least processing effort and cognitive effects at the same time) and fixations are mainly correlated to effort. Therefore, any pupil size record may be relevant to assess the dynamics of this combination along the experimental session. In turn, fixation duration has been consistently correlated with processing effort in many areas of research applying eye-tracking methodology, while records including values under 100 ms are considered of no or very little relevance for the cognitive processes involved in complex tasks as reading, writing, translating and the like, being considered much more as erratic.

Focusing on the results in Table 2, there is an apparent contradiction between them and the previous discussions. It would be expected that MTU2 values surpassed MTU1ones as well as those for the whole task, since the Subject focused on and commented the translation problem in MTU2 in more detail than that in MTU1 in the written protocol. Besides, the time duration and procedures to solve each of the problems were markedly distinct: very fast and with no clear hesitation for MTU1, and for MTU2, in turn, demanding more time and apparently a higher degree of internal support. Taking Krings's categories into account, MTU2 surpasses

MTU1 in terms of *temporal effort* (*RD* in Table 2), but, as far as *cognitive effort* potential variables are taken into account, the opposite relation is observed.

These two MTUs have different degrees of linguistic complexity. MTU1, as the text title, despite its nominal structure, has propositional content. On the other hand, MTU2 is just a noun phrase, with conceptual but no propositional content. This aspect can be a plausible explanation for this unexpected result in the quantitative gazing data. In MTU1 the Subject worked on to reorganize grammatically the propositional contents from the source text into a target-text TU aiming at achieving a higher level of interpretive resemblance than that assessed in the first literal translation. In MTU2 there was essentially an internal search for lexical or terminological correspondence. This type of result corroborates the distinction between *conceptual* and *procedural encoding* (*cf.* Alves & Gonçalves (c)) in translation processes, indicating that expert translators tend to spend more processing effort in grammatical problems than in those essentially lexical ones. Therefore, it seems to offer some more input to deepen and improve methods which deal with correlations between processes and products in translation.

There are still some important aspects to be discussed from the results in Table 2. Taking *MFD* as a general cognitive effort indicator, MTU1 is very close to the whole task value while MTU2 shows the lowest level for this variable. *MPS* and *MdPS* values for MTU1 are the highest. As hypothesized above, these pupil size records may be influenced by both effort and effects. So MTU1 presents a processing effort pattern close to that observed in the whole task, but different from the one in MTU2. In turn, pupil mean and median sizes indicate higher values for MTU1 and lower for MTU2. According to the discussions above, there would be a higher demand for processing effort to solve the MTU1 problem, with the production of a great amount of cognitive effects that probably surpassed a “desirable” limit for that context and triggered a cognitive alert which may have caused the pupil constriction records.

5. Final remarks

This exploratory study aimed to approach and analyse some eye-tracking data from a PhD research (Fonseca) in order to verify the productivity of RT concepts and its principle in the analysis of processing effort and cognitive effects, especially trying to identify variables which may help distinguish and assess the impact of these elements in instances of interpretive resemblance search and assessment in translation tasks (*cf.* Alves & Gonçalves (b)).

The analysis focused mainly in one macro translation unit (MTU1), chosen from the gazing raw data for including the set of the smallest pupil size records in the experimental session. I looked at MTU1 more qualitatively than quantitatively, focussing mainly in instances of pupil size variation and its potential correlations with some other variables, including cognitive effects and processing effort. Then some quantitative analyses were carried out, comparing MTU1 gaze variable values with the ones from MTU2, which seemed to include a more complex problem, demanding more time to be solved but having presented lower values for the processing-effort related variables (gazing data).

The main contribution of this exploratory study is the postulation of new theoretical hypotheses. They were raised from the relevance-theoretic concept of interpretive resemblance search and assessment in translation, which encompasses the balance between processing effort and cognitive effects in inferential processes taking place during human communicative interactions (Sperber & Wilson).

Although the case explored has dealt with a very limited set of data and analysed it mainly on qualitative basis, future research possibilities are left open and many questions were raised regarding TPR issues. Therefore, for future research developments on this subject, one must broaden the scope of the data and apply quantitative and statistical validation methods in order to search for significant correlations between the theoretical constructs in focus and the variables taken from empirical experimental data building on comparable research designs.

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APPENDIX

Source Text

More Efficient Flight in Formation

Many people are very familiar with the V formation used by migrating flocks of birds, and scientists have determined that this is an efficient mode of travel which helps the birds conserve energy, especially on long migratory journeys. But the same concept is being considered to improve the efficiency of commercial jetliners.

Among aircraft manufacturers, Airbus is one of the companies looking at the advantages of commercial flocking. "In a V formation of 25 birds, each can achieve a reduction of induced drag by up to 65 per cent and increase their range by 7 per cent (...)."

Target Text (P63-T1)

Voar em Formação é mais eficiente

Estudos científicos determinaram que a formação em V, modo de voo de muitos pássaros migratórios, é uma forma muito eficiente de voar, pois ajuda os animais a conservar energia, principalmente nas longas viagens migratórias. Agora, muitas companhias aéreas já pensam em aplicar o mesmo conceito para melhorar a eficiência de suas aeronaves.

Entre os fabricantes, a Airbus é uma daquelas que estuda as vantagens do "voo em bando".

"Numa formação em V com 25 componentes, cada pássaro reduz 65 por cento a força do vento e aumenta a sua autonomia de voo em 7 por cento (…)".