

Chapter 8

What does a translator do when not writing?

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In this paper, I revisit the notion of translation unit in both a production and a product sense. In particular, I present evidence that the relation between writing bursts (production segments) and grammatical structures (product segments) is not as simple as currently assumed and that the length of writing pauses does not directly correspond to cognitive effort in translation. Finally, I contrast my approach to pauses with Dragsted's (2005) and present evidence that typing pauses might be less biased indicators of cognitive effort than the standard writing pauses currently being used.

1 Introduction

In process-oriented translation studies, researchers report using a diverse set of devices for tracking translator's behaviour, amongst which keystroke loggers play a central role. When observing and describing the translation process, "typing" pauses are often used as indicators of cognitive effort (Hansen 1999; 2002; Alves 2003; PACTE 2005; Dragsted 2004; 2005). However, in most studies if not all, very little attention is given to what physically happens when someone interacts with a keyboard. In this paper, I shall explain how the keyboard layout and the translator's typing habits can enlarge and shorten the interval between two writing actions independently of how difficult the translation task is and I shall demonstrate how the writing system and the lexicogrammatical system of the target language cause pauses in writing of their own, which are unrelated to the translation task. Finally, I shall propose an experimental setup and a post-processing of keyboard logs aimed at discounting the time spent with translation-unrelated behaviour to achieve a better approximation of the time spent translating, that is, the time spent on intellectual bilingual activity.



1.1 Key-moving, typing and writing actions

When a translator types, the translator moves keys down and up. These key-moving actions are called by some **key down** and **key up** (e.g. Javascript key listeners), by others **key press** and **key release** (e.g. Java key listeners), and by others **key press** and **key break**. I shall refer to them as **key down** and **key up** actions because that term pair seems the least prone to misunderstanding.

To ground this discussion, I shall start by pointing out that a keyboard is not a tool simply for inserting, replacing and removing characters in the text area. There are at least two software levels above a key-moving action¹: the typing system² and the writing system³.

Descriptively speaking⁴, a keyboard layout maps each key to a key value. Counting from left to right in rows and top down in a single column, keys may be numbered #1, #2, #3... until the last key in the lower right corner of the keyboard. Keyboards vary greatly in how many keys they have. After numbering them in such a way, a keyboard layout can be understood as the mapping of a key index such as #1, #2, and #3 to a unicode character such as LATIN SMALL LETTER A (U+0061), CIRCUMFLEX ACCENT (U+005E), and SPACE (U+0020).

Let us consider that a particular typing system has one or more of such keyboard layouts. And let us consider that some key-down and key-up actions trigger the replacement of a layout by another. For instance, let us say that Layout *LC* maps the key #60 to the value LATIN SMALL LETTER A (U+0061) whereas Layout *UC* maps the key #60 to the value LATIN CAPITAL LETTER A (U+0041). Finally, let us assume that both layouts map the key #87 to the value SHIFT IN (U+000F). Now let's say that there is a layout controller that does the following. It keeps a **U+000F key state**, which can be either **low** or **high** and it updates the shift key state to low whenever the **U+000F key down action** is performed and it updates that state to high whenever a **U+000F key up action** is performed. Moreover, let us assume the layout controller applies Layout *LC* to key-moving actions whenever the shift key state is high and applies Layout *UC* to them whenever the shift key state is low.

¹A.k.a. a keyboard event in informatics

²A.k.a. a layout controller in informatics

³A.k.a. an input system in informatics

⁴The description I shall make does not necessarily correspond to any actual software implementation. It is a description of typewriting for the purpose of advancing translation studies and not a documentation of any particular driver, operating system or word processor.

Finally, let's suppose a writing system works in the following way. The writing system would have a typing layout that maps typing actions to writing actions. For instance, a particular typing layout would map the typing action **U+0061 key down** to the writing action **U+0061 char insert**, the typing action **U+0041 key down** to the writing action **U+0041 char insert**, while assigning the typing actions **U+0041 key up**, **U+0041 key up**, **U+000F key down**, **U+000F key up** to no writing action.

Assuming the above process, the following key-moving actions would be recognised as the following typing actions, which in turn would be recognised as the following writing actions (see Table 1). The fourth column contains the resulting text with the resulting cursor position (see §1.2 for more on text versions and cursor positions).

Table 1: Key-moving, typing, and writing actions

key-moving	typing	writing	resulting text
#60 key down	U+0061 key down	U+0061 char insert	a
#60 key up	U+0061 key up		a
#87 key down	U+000F key down		a
#60 key down	U+0041 key down	U+0041 char insert	aA
#60 key up	U+0041 key up		aA
#87 key up	U+000F key up		aA
#60 key down	U+0061 key down	U+0061 char insert	aAa
#60 key up	U+0061 key up		aAa
#60 key down	U+0061 key down	U+0061 char insert	aAaa
#60 key up	U+0061 key up		aAaa

Here is where the first issue lies. A large portion of translation process studies was developed with “key-logging” software that does not record key-moving and typing actions. One of the most used software in translation studies is Translog® and it only records writing actions. However, as we can see in Table 1, inserting some characters such as ‘A’ (U+0041) takes more typing actions than inserting other characters such as ‘a’ (U+0061): the first char insert action is realised by moving down the shift key to switch the keyboard layout and by moving down the U+0041 key (both keys need to be moved up afterwards); the second char insert actions is realised simply by moving down the U+0041 key. Because of this, the interval between inserting the char ‘a’ and the char ‘A’ is likely to be

larger than the interval between the char ‘a’ and the char ‘a’. Similarly, because the number of keys that need to be moved up after inserting the char ‘A’ is larger than after inserting the char ‘a’, the interval between inserting the char ‘A’ and the char ‘a’ is likely to be larger than the interval between the char ‘a’ and the char ‘a’.

In this way, if we take the whole time between two char insertions to be a pause in typing/writing, two typing/writing pauses of the same length may include sequences of finger movements of various lengths. If we do this, we can make no claim that similarly long pauses correspond to a similar amount of cognitive effort since part of this time is spent moving keys down and up after a decision of what to write has been made.

The ideal and long-lasting solution for this issue would be to update ‘key-logging’ software so as to start logging key-moving and typing actions. With this new kind of log, we would be able to see when typing indeed stops and when it indeed resumes. However, in the absence of a more precise solution and in the presence of large expensive corpora containing solely writing actions, I shall propose a way to treat writing pauses in a less naïve way so that some correspondence between such pauses with typing-unrelated effort can be established (see §2).

1.2 Text Versions

Let us assume, as some linguists do (Hasan 1999), that a human language ‘includes’ texts.^{5,6,7} That means, when a text is received, it not only occurs but also becomes an option of what to say in a language. Let us also assume that a language is the meaning potential in Halliday’s sense, in other words, that it is not a lexical or grammatical potential in Chomsky’s sense⁸ (1957) and that it is not

⁵This section does not focus on the dichotomy between text production and text as product.

⁶The notion of series of text versions, which applies both to translation and to other kinds of text production, is not covered by Vermeer’s model of translation.

⁷The understanding of a final target text as a translation product (“translatum”) as proposed by Vermeer in his Skopos Theory (Vermeer, 2004[1989]) follows the ancient dichotomy between text production (*ἡ ποίησις* ‘poiesis’) and text as product (*τὸ ποίημα* ‘poiema’), which traces back to Plato’s discussion about who the narrator of Iliad and Odyssey is. Similarly to the difference in function (“Skopos”) between an original text and its translations, ancient rhetoricians were concerned with the fact that Homer composed Iliad and Odyssey once whereas several cithar-playing singers performed those *epoi* multiple times throughout the ages.

⁸According to Chomsky, a language consists of all words and all grammatical rules for combining them.

a graphological potential in Eddington's sense^{9,10} (1929, p. 72). From such a perspective, a physical text is a print of a semantic form, which also gets called 'text'. For that reason, two distinct prints of 'the same play' can be understood as being 'two physical texts' *as instances* (token) but also as expressing 'the same text' *as a semantic form* (type). In that linguistic sense, each text version during translation is a separate text (*a separate instance*) and each new text version that is different from all previous ones expresses a new text (*a new semantic form*). In other words, from this perspective, language is a semantic potential, not a lexicogrammatical nor a graphological potential, in the same way as a text is a semantic form, not a lexicogrammatical form (a sequence of words) nor a graphological form (a sequence of characters).

From a formal perspective, a semantic form such as the play *Romeo & Juliet* is realised by a grammatical form in the sense that the semantic structure is associated with a corresponding lexicogrammatical structure (a sequence of words). In turn, the lexicogrammatical form is associated with a graphological form in so far as the lexicogrammatical structure is associated with a graphological structure (a sequence of characters). At the graphological stratum, when only one resolution, one font, one font format (size, font style, weight, colour, fill colour, underline, baseline shift, character spacing, shadow, etc.), and one single-column text area are available, a graphological form consists solely of a sequence of characters, and a graphological structure is an instance of that sequence of characters. Finally, at the graphic stratum, a graphological structure resulting from a combination of resolution, fonts, font formats, text areas and character sequences is associated with a graphic structure, which can be a series of different coloured pixels in a grid on screen or on paper (digital alternative), or a series of glyphs stamped, carved, or drawn (analogical alternative).

When studying the translation process with the help of key-logging software such as Translog®, the graphological stratum is strongly constrained. The only graphological system that a translator has control over is the one that is responsible for the selection of character sequences. It is this limited stratum (the grapho-

⁹This tradition of making arguments by supposing a random choice of letters traces back to Cicero when he stated that the annals of Ennius could be written by throwing a bag of metal letters on the floor whereas a poetry verse could not be created in such a careless way (*Dē nātūrā deōrum* II, 37 § 93).

¹⁰During the development of set and probability theory, Borel (1913: p. 194) conceived of texts again as strings, i.e. as sequences of characters. According to him, a team of illiterate typists would create random sequences of characters and would create one day by chance all texts conserved in the largest national archives. Eddington made the same argument for monkeys typing the texts in the British Museum.

logical stratum) that interacts with the writing process. In this restricted environment, each character sequence is a different graphological form that is completely or partially associated with a text at the semantic stratum. And, in this context, each writing action such as **U+0041 char insert**, **left char erase**, and **right char erase** alter the graphological form and potentially the associated grammatical and semantic forms. Therefore, these writing actions are actions of replacing one text by another. In that sense, during a translation, we can talk about a series of target texts. Each pair of consecutive target texts is the input and the result of a text-replacing action, which is a writing action.

I shall follow Halliday (1987) and call each node in this series of texts a **version**. The **initial version** is an empty character sequence, and the **non-initial versions** are the **products of writing** or simply **products**, the **final version** is the **final product [of writing]**, and **non-final products** are **intermediate versions**. Finally, **intermediate products [of writing]** are what Halliday calls **drafts**.

However, not all writing actions are meant to replace a text by another. Some of them change the state of the a text in text production. Some typing and mouse/trackpad actions are associated with cursor motions such as **cursor back**, **cursor forward**, **cursor up**, **cursor down**, **cursor to [x]**, **cursor to line start**, **cursor to line end**, **cursor to area start**, **cursor to area end**, and with text span selection such as **back select**, **forward select**. Those are text-affecting actions that alter the state of a text (dot and mark positions) but do not replace a text by another.

In the process of writing, mouses/trackpads present an additional methodological issue for empirical studies of cognitive effort in translation. Mouse actions associated with writing actions such as **cursor to [x]** demand the displacement of either the right or the left hand from the keyboard onto a mouse or a trackpad. However, this action is logged either only at the advent of a mouse click or from the moment the pointer starts moving. The time taken for the hand to reach the mouse/trackpad is also part of this action but is not logged. I see no solution in the short term to detect the point in time when the writing action of placing the cursor at a position with the mouse starts ,since we cannot easily track with current technology when a translator starts moving his or her hand onto the mouse/trackpad. Moreover, due to their relatively infrequent occurrence, an estimation of the duration of mouse/trackpad-related non-tracked hand-motion shall not be attempted in this paper.

1.3 Pauses in Typing

Still in the process of writing, there is another much more frequent and yet non-tracked hand-motion: simple typing. Typing has been often described as happening in bursts. In that description, typing would be cuttable into units of text-production separated by typing pauses. In that sense, typing rhythm would be a good behavioural evidence for underlying cyclic cognitive processes. However, even though a cyclic translation process is a reasonable model of what happens during translation, the analysis of typing rhythm has not been an unbiased one. Researchers did not start studying typing rhythm without an expectation of what they would find. They were in a search for evidence that a particular model of translation was the case. In other words, a cyclic cognitive model was assumed and evidenced with typing rhythm.

The assumed translation cycle consists of three steps: 1) a character sequence associated with a complete grammatical structure of the source text is read, 2) then the source text segment is mentally translated into a target text segment (semantic structure), and 3) only then a character sequence realising an equivalent grammatical structure would be fully written. Given the underlying model of translation, it became imperative that the typing bursts and consequent writing bursts resulted in additions of grammatical units.

This naïve assumption that translation cycles would be the sole reason for typing bursts is pervasive and is at the core of descriptions of translation process. These studies aim at relating spans of writing actions (typically between pauses of a given size) with a **grammatical structure under translation**. However, this naïve assumption of direct correspondence between typing bursts and a translation cycle opposes on the other extreme a rather counter-intuitive assumption that random or non-grammatical segments of the character sequence of the source text are read and translated at a time.

Because the counter assumption is so unlikely to be the case, I do not want to give the impression that this cyclic process is not a reasonable approximation of what happens, but I shall claim that the boundaries of the source text segment under translation is by no means the only reason why a typing pause occurs between the production of two adjacent grammatical structures. As I shall point out next, there are several other reasons for a pause to occur that are completely unrelated to a 'grammatical structure under translation'. I shall bring some examples of places where I found translation-unrelated typing pauses in writing for supporting this viewpoint. Examples are in German. They are sequences of **char insert** actions separated by either breve (˘) or long (ˉ) typing pauses (see §2 for an explanation of these pause lengths in terms of milliseconds and for es-

timations of typing pause length based on writing pause length). The symbol · indicates a **space char insert** action.

- (1) ·Äüřwǎñdř· (Translator 2)
- (2) ·Fǎhīg-kěĩť· (Translator 2)
- (3) ·75· (Translator 2)

In Example 1, the pause we see happened between two bound morphemes of a genitive noun in German. In German, there are two alternative character sequences that can realise the suffix for this genitive word, namely *es* as in *Aufwandes* or *s* as in *Aufwands*¹¹. Both character sequences realise the same grammatical structure, one being possibly more expected than the other in the situation type that the text implied. However, this grammatical structure – a bound morpheme – does not correspond to any bound morpheme in the English source text. Therefore, the pause does not correspond to the boundary of a grammatical structure under translation. Table 2 shows a reconstruction of the typing process based on the writing actions we have in our logs. The longer pause between U+0064 **char insert** and U+0073 **char insert** is represented by a table break.

Now, let us move to Example 2. Here we find a very interesting pause from a cognitive perspective. As far as lexicogrammatical composition is concerned, here we have the lexical item *Fähigkeit* as in *die Fähigkeit einer Papierkugel [das zu tun]* ‘the capacity of a paper ball [to do that]’. This lexicogrammatical structure is a mention of a paper ball’s capacity to do something which is lexically agnate to *die Kraft einer Papierkugel [das zu tun]* ‘the power of paper ball [to do that]’. In this case, *Fähigkeit* is in the same lexical set as *Kraft*. These two lexicogrammatical structures are also grammatically agnate to other more congruent representations of the same physical phenomenon such as *die Papierkugel ist fähig [das zu tun]* ‘the paper ball is capable [of doing that]’, *die Papierkugel kann [das tun]* ‘the paper ball can [do that]’, and *die Papierkugel [leistet das]* ‘the paper ball [offers that]’. Because all these representations are agnate, we can expect that translators could have considered two or more of those options when translating that passage. In particular, as an alternative to *die Fähigkeit einer Papierkugel [das zu tun] ist ein Faktum* ‘the capability of a paper ball [to do that] is a

¹¹Explaining how the standard (phylos) of human language named Modern High German developed from other standards in the past (phyloi) demands an observation timeframe of hundreds of years (phylogenetic timeframe). Since the current observation timeframe is of a few seconds (logogenetic timeframe), etymological considerations such as the appearance of such suffixes should play no role.

Table 2: Key-moving, typing, and writing actions for Example 1

key-moving	typing	writing	resulting text
#87 key down	U+000F key down		
#60 key down	U+0041 key down	U+0041 char insert	A
#60 key up	U+0041 key up		A
#87 key up	U+000F key up		A
#45 key down	U+0075 key down	U+0075 char insert	Au
#45 key up	U+0075 key up		Au
#63 key down	U+0066 key down	U+0066 char insert	Auf
#63 key up	U+0066 key up		Auf
#24 key down	U+0077 key down	U+0077 char insert	Aufw
#24 key up	U+0077 key up		Aufw
#60 key down	U+0061 key down	U+0061 char insert	Aufwa
#60 key up	U+0061 key up		Aufwa
#82 key down	U+006E key down	U+006E char insert	Aufwan
#82 key up	U+006E key up		Aufwan
#62 key down	U+0064 key down	U+0064 char insert	Aufwand
#62 key up	U+0064 key up		Aufwand
#61 key down	U+0073 key down	U+0073 char insert	Aufwands
#61 key up	U+0073 key up		Aufwands

fact’, the same translator might have considered an alternate representation such as *die Tatsache, dass eine Papierkugel fähig ist, [das zu tun], ist ein Faktum* ‘the fact that a paper ball is capable [of doing that] is a fact’¹². However, when comparing the lexical options of grammatically agnate translation alternates, a particular pair of lexical items shows a graphological resemblance (resemblance in terms of character sequences): in the same way as in English, the Base morpheme of the words *Fähigkeit/Fähigkeiten* ‘Capacity’/‘Capacities’ resembles the base of its agnate *fähig/fähiger/am fähigsten* ‘capable’/‘more capable’/‘most capable’. The resemblance between these two lexical words happens both in graphological form (sequence of letters) and in semantic form (meaning), but not in grammatical affordances (the structures they can fit in). Moreover, the resemblance is present not due to a derivation process such as the one that led the Old German term

¹²The way other translators chose to translate this passage reveals that such a structure was considered by at least some of the translators.

fāhan/fānhanan to evolve into the lexical items *fähig sein etwas zu tun* ‘being capable of doing something’ and *ein Tier oder jemanden fangen* ‘encarcerating an animal or someone’, but due to a synchronic graphological and semantic connection between the two. In this sense, it is quite interesting that a translator stopped shortly at the end of the overlap in graphological form between the agnate lexical words: namely, at the end of *Fähig*-insertion and before *keit*-insertion during *Fähigkeit*-insertion. Furthermore, even if the pairing of graphological and semantic forms *fähig:Fähigkeit* could be taken as evidence for a Construction Grammar explanation of how these structures came to exist in German, it is very unlikely that this translator had *capabil:fähig* and *ity:keit* in separate source text segments under translation, that is, that this translator translated each segment – the one before and the one after the typing pause – in a different translation cycle. Even if I claim this second hypothesis is unlikely, how much of such a typing pause is due to the overlap of graphological structures in the target language, and how much of it is due to a truly bilingual intellectual process, is still unresolved at the current stage of research.

Finally, Example 3 shows another process that seems unrelated to translation. The pauses before and after writing the number 75 may be in fact an indicator that 75 in the source text reading *seventy five* is indeed aligned with 75 in the target text reading *fünfundsiebzig* ‘five and seventy’. What is interesting here from an alignment perspective is that there is a pause in between 7 **char insert** and 5 **char insert**. Since the order of digits is different in written and spoken German, the question that one can raise is whether part of the pause before and after those actions was due to a cognitive writing procedure in which the translator cognitively writes *fünf und •siebzig fünf und siebzig* ‘five and •seventy •five and seventy’ and only physically writes *•siebzig* ‘•seventy’ with 7 **char insert** and *•fünf* ‘•five’ with 5 **char insert**. This underlying cognitive writing would imply that the pauses before 7 **char insert** and after 5 **char insert** are longer than the one in between, and that is indeed what happens, these pauses being approximately 2⁶ times the length of the middle one, which is already significantly longer than average (more on quantifying pauses in §2). This pause pattern does not prove that the above cognitive writing happened. Understanding this pattern as caused by such a cognitive writing is simply a way of explaining translators’ behaviour, which might be plausible for some and less plausible for others that have other explanations. Alternative explanations might include, for instance, lack of practice by the translator with digit key typing: consequently, translators would switch

between looking at the screen and at the keyboard before inserting the first digit and after inserting the last digit of a number¹³.

Since there are many reasons for pauses in typing to occur, it would be naïve to hold the assumption that such pauses mostly indicate a grammatical structure boundary that corresponds to source text segments under translation and to a translation cycle. In other words, what I aim at foregrounding is that there is an issue with the standing assumption that typing pauses would be mostly due to an iterative segmentation of the source text into translatable units followed by a translation of each unit. A direct mapping of typing rhythm onto translation cycles is not to be achieved when a thorough and close analysis of typing behaviour is carried out.

1.4 Erase actions

In addition to the assumption of translation boundaries at pauses, another problematic assumption is that online revisions, i.e. revisions during the drafting phase, are related to change in the choice of semantic features. Some of these pauses indeed seem to be semantically motivated, whereas for many others such an interpretation seems questionable. In the following examples, the symbol ☒ indicates a **left char erase** action, where **left char** is the character left of the cursor.

- (4) ·K~f☒r~a~f~t~· (Translator 2)
- (5) ·k~e~i~e~n~☒s~ ~☒☒☒~n~e~s~· (Translator 2)
- (6) ·b~v~☒e~s~t~e~h~t~· (Translator 2)

In Example 4, what might have happened is something along the following lines. The translator had the right hand well positioned on the keyboard and the left hand somewhat misplaced and was aware of it. When typing, the left shift key was still under the left hand and was quickly moved down, which was followed by a ‘**k**’ **key down** action with the right hand in regular speed. However, after inserting the ‘**k**’ character, the time taken to insert the next character, namely ‘**f**’, is longer than usual. Here, the translator might have had the need to reposition

¹³Notice that the typicality of typing pauses and the occurrence of them in other similar co-texts do not give us information about what is going on during these pauses. We need to observe the process as a whole and characterise each pause point on its own terms with different cognitive/behavioural hypotheses. What may be the case for one translator may not be the case for another.

his/her left hand and accidentally moved down the 'f' key instead of the 'r' key. In the German keyboard used in the experiment, the 'f' key is directly below the 'r' key and a badly positioned left hand is a sufficient reason for a 'typo'. After inserting 'f' instead of 'r', there is another long pause¹⁴, which is followed by a **left char erase** action. Such pauses and such an erase action do not seem to have anything to do with any bilingual process.

In Example 5, something else happens. The translator ends up writing the word *keines*, but in the first run of char insert actions, he or she writes *keien* instead of *keine*. The issue here was not one of moving the wrong keys, but one of moving the right keys in the wrong order. A good point to notice here is that the 'e' key **down** action is usually performed with the left hand with a German keyboard whereas the 'n' key **down** action is usually performed with the right hand. This means that this mistaken order happened when coordinating the motion of both hands. The correction procedure is quite interesting too. Only part of the problem is solved by the first attempt, resulting *keies* instead of *keines*, this is again noticed and the second revision procedure leads to the version *keines*.

Example 6 is not so simple. Here the translator ends up writing *besteht*, but types two letters very quickly and with the same hand. In the German layout used, the 'v' key and the 'b' key are adjacent and are both right of the index finger (the finger a translator would move these keys down with). Was it that the translator was unsure which key was the 'b' key and moved both down in a sequence to decide which character to keep on screen or was it that the translator just moved both keys down accidentally? I do not have an answer for such a question. But one thing is for sure, this was not a bilingual process, not even a monolingual process in the sense of choosing what to say.

Furthermore, there is another type of revision that seems to be related to the translation process in a rather 'non-linguistic' way. Such revisions are also not graphological, nor lexical, nor grammatical, nor semantic. Examples 7 and 8 illustrate these. In such cases, the translator seems to copy the source text instead of writing a target text. In Example 7, the character sequence under translation is *demands*, the target character sequence is *bedarf*. Grammatically valid alternatives in German could have been *bedürfte*, *benötigt*, *braucht*, and *bräuchte* but no word starting with *d*. Example 8 shows a similar phenomenon: the source character sequence is *paper* and the target character sequence is *Papier*. However,

¹⁴It is definitely the case that some online revision are initiated by a production failure being detected in quality monitoring processes. Missed keys are an example of such cases since it is by comparing the intended text and the produced one that such mistakes (typos) are likely to be detected and fixed.

the translator writes *Pape*. Is it the case that he or she just missed typing the ‘i’ key, or that he or she copied the source character sequence instead of writing the target one? Again, I do not have an answer for this, but it does not seem to be a bilingual process in the typical sense of what we understand by translation.^{15,16}

(7) ·d̃̄b̃̄ẽ̄d̃̄ã̄r̃̄f̃̄· (Translator 2)

(8) P̃̄ã̄p̃̄ẽ̄ĩ̄ẽ̄r̃̄· (Translator 2 : 1st ‘Papier’)

Other revisions such as Examples 9 and 10 look more linguistic. However, they are also not grammatical: the first is a replacement of a *latin small letter P* by a *latin capital letter P* and the second is a replacement of *latin capital letter G* by a *latin small letter G*. As seen before, replacements of characters are not performed necessarily with one **left char erase** action followed by one **char insert**. It may take more than two writing actions for realising the replacement of one character: in Example 10, a total of eight writing actions were performed for changing one letter from capital to small. Tables 3 and 4 show the series of resulting texts for both examples.

(9) ·p̃̄P̃̄ã̄p̃̄ĩ̄ẽ̄r̃̄· (Translator 11 : 6th ‘Papier’)

(10) ·G̃̄r̃̄ȭg̃̄g̃̄r̃̄ȭB̃̄ẽ̄ñ̄·

As far as translation studies are concerned, such online character replacements are not very interesting, and pauses related to them, independent of how long they are, should not be assumed to be motivated by the boundaries of grammatical structures.

1.5 Lexicogrammatical choice

Other pauses and online revisions appear to be motivated by lexicogrammatical choice. However, some of them do not occur in grammatical boundaries, not even when taking bound morphemes into account. The motivation for the pauses,

¹⁵This source text copying does not seem to be an effect of ‘priming’ given that the translator is unlikely to accept the source language character sequence as a valid word in the target language. However, the notion of priming could be applied to other examples if translators choose a marked lexical item instead of a less marked one because of string similarity or shared etymological origin of the lexical items in both languages.

¹⁶As for any other online revision preceded by a breve typing pause, a quality-monitoring process can be inferred for such cases.

Table 3: Writing actions of Example 9

writing	resulting text
U+0070 char insert	p
left char erase	
U+0050 char insert	P
U+0061 char insert	Pa
U+0070 char insert	Pap
U+0069 char insert	Papi
U+0065 char insert	Papie
U+0072 char insert	Papier

Table 4: Writing actions of Example 10

writing	resulting text
U+0047 char insert	G
U+0072 char insert	Gr
U+006F char insert	Gro
left char erase	Gr
left char erase	G
U+0067 char insert	Gg
left char erase	G
left char erase	
U+0067 char insert	g
U+0072 char insert	gr
U+006F char insert	gro
U+00DF char insert	groß
U+0065 char insert	große
U+006E char insert	großen

as we shall see next, seems to be at the graphological stratum, namely at the comparison between character sequences. If you are familiar with German, take some time to read Examples 11-15 before going. Make your own conjectures and contrast them with mine.

- (11) ·-g-ä-n-z-~~g~~~~g~~-ä-n-z-l-i-c-h·
 (12) ·-e-i-n-e-s-~~s~~-o-l-c-h-e-n·
 (13) ·D-i-e-~~s~~-a-s-~~V~~-e-r-h-a-l-t-e-n·
 (14) ·-d-e-r-~~s~~-V-e-r-h-a-l-t-e-n-s·
 (15) ·-w-e-i-t-e-r-e-~~r~~-K-o-m-p-r-ä-s-s-i-o-n-~~-z~~-u-~~w~~-i-e-d-e-r-s-t-e-h-e-n·

In Examples 11 and 12, we see a very interesting pause and erase pattern. I suspect the translator was unsure whether to write the more frequent *eine ganz andere Geschichte* ‘a whole different story’ and *so eines Balls* ‘this kind of ball’ or the less frequent and register-specific variants *eine gänzlich andere Geschichte* ‘a completely different story’ and *eines solchen Balls* ‘such a ball’. The overlap between the underlined strings is *gänzlich* and *solchen*. Coincidentally or not, the translator paused once at the end of each overlap and, in Example 11, he or she erased the left characters up to the end of the first overlap, where he or she could finish the word either as *ganz* or as *gänzlich*, and ended up choosing *gänzlich* and writing it without pauses until the end. Are these pauses motivated by lexical choice? I would say so.¹⁷ But are their locations motivated by word boundary? I would say no. Comparison of graphological classes of words (comparison of strings) seems to be the motivation.

Moreover, in logs of writing actions we find not only direct replacements of lexical words, but also indirect clues that such a replacement took place in an underlying cognitive process. It seems to be the case that the translator first produces a segment of the target text cognitively and then writes this cognitive segment down. While writing the segment down, it seems to be the case that the translator continues the production of the target text and, depending on what comes, he or she needs to change parts of this text that were already written down.

¹⁷6 other translators chose *eine ganz andere Sache*, 1 *eine ganz andere Frage*, 1 *eine ganz andere Angelegenheit*, 4 *eine komplett andere Sache*, 1 *doch eine andere Angelegenheit*. This indicates that the deictic modifier *ganz* is the least marked one for this co-text, followed by *komplett*, followed by the once produced modifiers *gänzlich* and *doch*.

Examples 13 and 14 are evidence that such a process might happen. In both cases a ‘feminine’ Deictic word¹⁸, namely *Die* and *der*, was replaced by a ‘neutral’ Deictic word, namely *Das* and *des*. In German, Deictic words typically agree with the Thing word in grammatical gender: masculine *der/den/dem/des*, feminine *die/die/der/der*, and neutral *das/das/dem/des*. I looked up in a synonyms dictionary what could be alternative ‘feminine’ Thing words for *Das Verhalten* and *des Verhaltens*. There were many. However, since the translator made a pause after *Ver* in *Verhalten*, I assumed the lexical item he or she was considering might start with *Ver* and continue with a different letter than *h*. Then I listed all ‘feminine’ alternatives starting with *Ver* and reached the following list: *Verhaltensweise*, *Verhaltensweise*, and *Verfahrensweise*. Only *Verfahrensweise* has a letter different from ‘h’ following *Ver*. So, if the assumptions that the translator revisited his/her lexical choice and that he/she stopped at that point because of the string overlap are right, the other lexical item considered for that position might be *Verfahrensweise*, as in *Die Verfahrensweise* and *der Verfahrensweise*. Such a claim has no scientific validity at the current stage, but being able to make such hypotheses might be helpful. Researchers can ask the translator right after the translation whether this was indeed a lexical choice they considered. It might be the case that translators are able to recall what they considered at that point in time.

When looking at these examples, one might assume that only adjacent words or Deictic words within a nominal or verbal group such as *das Verhalten* ‘the behaviour’ and *die Verfahrensweise* ‘the behaviour’, or such as *hat sich so verhalten* ‘behaved in this way’ and *ist so verfahren* ‘behaved in this way’, would be subject to such changes. Example 15 shows that neither the notion of adjacency nor the notion of co-constituents is sufficient for explaining such phenomena. In this case, the translator had three gender options and four case options for the nominal group. Given the replacement of *weitere* ‘further’ by *weiterer* ‘further’, I suspect that this was a choice between accusative and dative cases for the feminine gender. For this hypothesis, the translator considered the options of

¹⁸Following the tradition of Systemic Functional Linguistics, the contextual function of words is capitalised. For instance, the word *selbe* in *dieselbe rote Regenjacke* ‘the same red rain jacket’ is as much an adjective as the word *rote* because both of them are inflected in the same way. However, *selbe* works as a Deictic₂ because it relates the mentioned jacket with previously mentioned or previously observed jackets whereas *rote* works as a Classifier because it adds a color restriction for discriminating the jacket. Meanwhile, the word *rain* also works as a Classifier because it adds a functional restriction for discriminating the jacket. Despite this fact, it is not an adjective itself. In that sense, Deictic, Classifier and Thing are functions of words and not inflectional classes of words such as determiner, adjective and noun.

feminine accusative *weitere Kompression* ‘further compression’ and of feminine dative *weiterer Kompression* ‘further compression’. The combination of a fixed gender with a variable case would imply that the lexical item *Kompression* ‘compression’ was already selected for the nominal group and that the lexical item for the verbal group *etwas widerstehen* ‘to resist to something’ was not.

This hypothesis is very interesting from a linguist’s perspective. A ‘compression’ is not a physical thing. It is rather something that we would rather call an ongoing process. Such ‘processual things’ often have the role of Scope in a material figure (Halliday & Matthiessen 2004: 192), and are typically represented in clauses with the following participant role sequence: Agent + Process + Scope as in *[das] [tut] [weitere Kompression]* ‘this does further Kompression’, *[das] [macht] [weitere Kompression]* ‘this makes further Kompression’, *[das] [verursacht] [weitere Kompression]* ‘this causes further Kompression’. The nominal group representing the processual thing and functioning as Scope is typically accusative, which justifies the default choice for accusative by the translator. However, the lexical item for the verbal group did not represent a process of doing, making or causing something, i.e. making something happen. It represented a process of resisting something, acting against some external force so that nothing happens. In German, the lexical item *etwas widerstehen* ‘to resist something’ happens in clauses such as *[so ein Ball] [widersteht] [weiterer Kompression]* ‘such a ball resists further Kompression’, which have a Scope Complement constituent that is a dative nominal group. Based on this, when the translator reached the ‘critical’ point for case selection, having decided that the next lexical item is *Kompression* ‘compression’ was not sufficient. He or she is likely to have selected the lexical item *etwas widerstehen* ‘to resist to something’ at this point in order to avoid a time-consuming online revision if this decision were to be postponed.

Moving on, it must have become clearer by this point that some typing pauses seem to be motivated by lexical item choice, but that simultaneously these pauses are not necessarily placed at the boundaries of grammatical constituents such as morphemes, words, groups, phrases, and clauses. They are often placed at the borders of overlapping character sequences among two or more considered graphological classes of words.

Whether this lexicogrammatical feature selection is a bilingual intellectual process is still open to debate. In my opinion, none of these revisions are necessarily supported by bilingual processes, and I can imagine they might also happen when writing an original text from scratch. These revisions may be more frequent in one activity than in the other. I do not have evidence for sustaining any claim in this or that direction.

1.6 Micro/macro units of translation

Online revisions are just one kind of revision. Since text-replacing writing actions are a process of replacing a text by another, I shall consider any sequence of text-replacing writing actions a **revision** at the graphic and graphological strata. Also assuming that one grammatical structure – namely, a non-random source text segment – is put under translation at a time, Alves & Couto-Vale (2009; 2011) defined the notion of a micro-unit of translation: the span of writing activity that produces a target text segment that is equivalent to a source text segment under translation. The first span of writing actions for a given source text segment equivalent was understood as a segment insertion (P0), and the replacements of that segment by other source text segment equivalents was understood as a segment replacement. The first replacement was classified as P1 if it happened in the drafting phase, and it was classified as P2 if it happened in the revision phase. The second, third and following replacements of equivalents of the same source text segment were classified as P3. Finally, a sequence of text revisions that affects equivalents of the same segment of the source text was conceived of as a macro-unit. A macro-unit is composed of one or more revisions: it contains necessarily a P0 revision, which is either final or followed by a P1 or P2 revision, which is either final or followed by one or more P3 revisions. ‘P’ here stands for ‘process unit’.

Whereas online replacements (P1 or P3) can be easily understood just by looking at a sequence of writing actions, the understanding of revision phase replacements (P2 or P3) depends strongly on the reconstructed text and on the position of the cursor during erase actions and char insert actions. In the log of writing actions, they look like this: `^⌘^⌘D`.

However, there is nothing special about those events in the nature of replacements as far as what they actually do to the target text, except that, as Alves & Couto-Vale (2011) point out, translators seem not to go back to the source text so often during the revision phase. Therefore, the reasons for replacements during that phase are even less directly motivated by the source text, and possibly not supported by any bilingual intellectual process. This means that, as the translation moves from P0 to P3, chances are that the translator thinks progressively less bilingually and progressively more monolingually.

Taking this into account, it is important to notice that the very notion that supports such a micro-unit and a macro-unit rationale is a correspondence or an alignment between source and target lexicogrammatical structures. This is the very assumption that makes us researchers in translation studies want to

take process units as evidence for anything in the process of translation. But are we misguided in taking the micro-units, as Alves & Couto-Vale (2009; 2011) call them, to be *any* span of writing actions between pauses in typing of a given length? I am afraid we are. If the amount of grammatically unrelated phenomena that motivates pauses were not enough evidence, let us consider the following example:

- (16) d̄iē·K̄r̄āf̄t̄·āūf̄ḡēw̄ēn̄d̄ēt̄ē
 K̄f̄r̄āf̄t̄·z̄ū·
 K̄ōm̄p̄r̄ēs̄s̄īōn̄s̄k̄r̄āf̄t̄·

In Table 5, when considering replacements at the grammatical stratum, it seems reasonable to imagine that the nominal group had three versions. The first version is completed at text version 3, thus resulting in the P0 minor-unit of translation 0-3; the second version of the nominal group would be complete at text version 9, thus resulting in the P1 minor-unit of translation 3-9; an incomplete attempt would end at version 11, resulting in the P3 minor-unit of translation

Table 5: Target text segments during each pause of Example 16

text version	character sequence segment
0	
1	die·
2	die·K
3	die·Kraft
4	die·
5	die·aufgewende
6	die·aufgewendete·K
7	die·aufgewendete·Kf
8	die·aufgewendete·K
9	die·aufgewendete·Kraft·
10	die·aufgewendete·Kraft·z
11	die·aufgewendete·Kraft·zu
12	die·aufgewendete·Kraft·z
13	die·aufgewendete·Kraft·
14	die·aufgewendete
15	die·aufgewendete·Kompressionskraft·

9-11; and, finally, the span from 11-15 would be a fourth minor-unit of translation at the grammatical level. We were able to reach this chunking of the process not based on pauses, but based on the grammaticality of character sequences as products of writing.

At the same time, if we take another criterion such as key-moving actions, we find other 'minor units' (this time not of translation). This time, we can explain the pause before the 'r' **key down** action at versions 2 and 6 as being possibly due to the translator's bad left hand position, and the replacement of the character 'f' by the character 'r' – spanning from version 7-9 – as being motivated by an erroneous **key down** action, possibly due to a bad left hand position. In the typing process, the span from 6 to 7 would be a P0 revision and the span from 7 to 9 a P1 revision: the first span inserts the character 'f' and the second span replaces the character 'f' by the character 'r'. In parallel to this, there is probably another process going on. The lexical item *aufgewendete* is an alternative to the lexical item *aufgewandte*; the overlap of the written word with the alternative is *aufgewendete*. At the end of the overlap, there is a pause. Did the translator reconsider which lexical item to choose at this point? This might well be the case. Finally, the partially written character sequence *zu...* might have been completed as *zur Kompression* 'in the compression', as in *die aufgewendete Kraft zur Kompression* 'the force spent in the compression', or as *zu komprimieren* 'in compressing', as in *die aufgewendete Kraft zu komprimieren* 'the force spent in compressing'. Such target text segments were likely discarded and a new one was typed until the end *die aufgewendete Kompressionskraft* 'the spent compression force'. This kind of replacement is different from the one of replacing *die Kraft* by *die aufgewendete Kraft*. The earlier revision is an insertion of a word before another word that was already written. The later revision is indeed a revision of a way of formulating to another. In that case, if we go down from the nominal group to the constituents of the nominal group, what looked like four minor-units of translation becomes one P0 minor unit of translation for *aufgewendete*·[*Kraft*] 'spent·[force·]', and two minor units of translation, [*Kraft*]·*zu*[*r*·*Kompression*] | *Kompressions*[*kraft*] '[force·]in·the·compression' | 'compression·[force·]'.

In other words, it is a selection of the process (motion, typing, writing, saying), the stratum (graphics, graphology, lexicogrammar, and rhetoricosemantics), and the rank (morpheme, word, group, phrase, clause), that makes the detection of micro-units and macro-units possible. Pauses do indeed help us in finding out whether there is more or less effort at a particular point in writing. But the reasons why a pause is there is multivariate. Next, I shall review how pauses in typing have been calculated so far and suggest a heuristics to estimate a pause

in typing. With such a heuristics we shall be able to avoid relying on pauses in writing, as has been the praxis so far.

2 Handling pauses

As seen in §1.1, there is a need to build more reliable cognitive effort indicators. Pauses of writing activity are definitely not as reliable as pauses of typing activity, which in turn are less reliable than pauses of moving activity. As said previously, we cannot calculate the time taken to reach the mouse and place the mouse hand back onto the right position of the keyboard. Moreover, it would be nice but very difficult to account for the difference in time between typing the same and different keys consecutively with the same finger, typing two keys consecutively with different fingers of the same hand and typing two keys with different hands. In that way, we would be able to account for the actual time that the translator was inert and still, after finishing a writing burst and before starting the next writing burst. If we were to add a video input, we could also subtract the time a translator moves for purposes other than translating such as adjusting the chair, the glasses, and moving back a lock of hair that falls onto one's face every once in a while (for those that have long hair), or such as sneezing and scratching one's eyes and nose (for those that have allergies and/or a cold). All these translation-unrelated actions that would motivate pauses would be subtracted in this way. Unfortunately, we cannot do this automatically at the present time and, in particular, we cannot do this retroactively for the corpora that we have already collected.

What we can do is to improve our guess, i.e. to increase the chance that what we see as a pause in writing is indeed a pause in typing and, potentially, a pause in moving. If we add an eye tracker to this improved guess, we might get closer to what is going on during translation that is truly translation-related. As for now, I shall discuss a way to improve our guess of typing pauses based on writing pauses and suggest a way to classify them according to a non-linear scale.

2.1 Classes of writing pauses

As pointed out in §1.1, latin capital letters demand a different keyboard layout from that of latin small letters. The same is true for other characters that are reachable only while the shift key is held down. In our case, we ran experiments using a German keyboard and using a German keyboard layout manager in Windows. In those experiments the following list of **char insert** actions relied on

moving a **shift key** or the **alt-gr key** down beforehand and moving it up afterwards. We have ignored the fact that sequences of capital letters and punctuation could be typed sequentially while holding the shift key (or after clicking the caps lock key) because such sequences were very rare in our logs of writing actions.

Table 6: Types of char insert depending on keystroke combinations

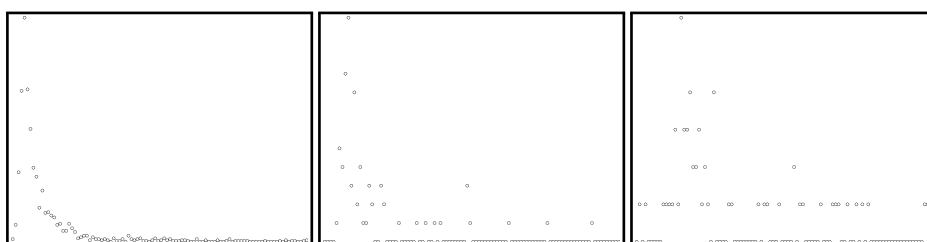
key number	standard value	shift-key-low value	alt-gr-key-low value
#18 Key	'1' Key	!' Key	'@' Key
#19 Key	'2' Key	"" Key	;' Key
#20 Key	'3' Key	'§' Key	
#21 Key	'4' Key	'\$' Key	
#22 Key	'5' Key	'%' Key	'_ ' Key
#23 Key	'6' Key	'&' Key	'^ ' Key
#24 Key	'7' Key	'/' Key	'{ ' Key
#25 Key	'8' Key	(' Key	'[' Key
#26 Key	'9' Key)' Key]' Key
#27 Key	'0' Key	'=' Key	}] Key
#28 Key	'ß' Key	'?' Key	'\ ' Key
#29 Key	' ' Key	"" Key	"" Key
#39 Key	'q' Key	'Q' Key	
#40 Key	'w' Key	'W' Key	
#41 Key	'e' Key	'E' Key	
#42 Key	'r' Key	'R' Key	
#43 Key	't' Key	'T' Key	
#44 Key	'z' Key	'Z' Key	
#45 Key	'u' Key	'U' Key	
#46 Key	'i' Key	'I' Key	
#47 Key	'o' Key	'O' Key	
#48 Key	'p' Key	'P' Key	
#59 Key	'ü' Key	'Ü' Key	
#50 Key	'+' Key	'*' Key	'~' Key
#60 Key	'a' Key	'A' Key	'≤' Key
#61 Key	's' Key	'S' Key	'≥' Key
#62 Key	'd' Key	'D' Key	
#63 Key	'f' Key	'F' Key	
#64 Key	'g' Key	'G' Key	

key number	standard value	shift-key-low value	alt-gr-key-low value
#65 Key	‘h’ Key	‘H’ Key	
#66 Key	‘j’ Key	‘J’ Key	
#67 Key	‘k’ Key	‘K’ Key	
#68 Key	‘l’ Key	‘L’ Key	
#69 Key	‘ö’ Key	‘Ö’ Key	
#70 Key	‘ä’ Key	‘Ä’ Key	
#71 Key	‘#’ Key	“” Key	
#77 Key	‘<’ Key	‘>’ Key	‘ ’ Key
#78 Key	‘y’ Key	‘Y’ Key	
#79 Key	‘x’ Key	‘X’ Key	‘»’ Key
#80 Key	‘c’ Key	‘C’ Key	‘©’ Key
#81 Key	‘v’ Key	‘V’ Key	‘«’ Key
#82 Key	‘b’ Key	‘B’ Key	
#83 Key	‘n’ Key	‘N’ Key	‘_’ Key
#84 Key	‘m’ Key	‘M’ Key	
#85 Key	‘;’ Key	‘;’ Key	
#86 Key	‘:’ Key	‘:’ Key	
#87 Key	‘-’ Key	‘-’ Key	

Table 6 shows some of the keys and the corresponding values in three layouts, namely the standard layout for the shift-key-high alt-gr-key-high state, the shift-key-low layout, and the alt-gr-key-low layout. There is also a fourth layout for when both shift and alt-gr keys are held down, but none of the characters contained in it were inserted frequently in our log of writing actions. The key values in the alt-gr-low layout were also not inserted frequently enough for any statistical analysis. The other two layouts, on the other hand, were used quite extensively.

As we have seen in Table 1 in §1.1, there are three frequent kinds of writing pauses in translation: in between two **standard char insert** actions (writing actions), there is one **char key up** action (one typing action); in between a **shift-key-low char insert** and a **standard char insert** action (writing actions), there is one **char key up** and one **shift key up** actions (two typing actions); and in between a **standard char insert** and a **shift-key-low char insert** action (writing actions), there is a **char key up** and a **shift key down** (two typing actions). Based on this realisation, I classified the pauses between writing actions into four groups: pauses between **standard char insert** and **standard char insert** were named *AA*, those

between **shift-key-low char insert** and **standard char insert** were named *BA*, those between **standard char insert** and **shift-key-low char insert** were named *AB*, and the others were named *o*. Below are three graphs showing the distribution of the pause length in each group. In these graphs, there is one bullet point for each 32 millisecond window, namely from 0 to 31 milliseconds, from 32 to 63 milliseconds, and so on. The higher a bullet point, the larger the number of pauses in that 32 millisecond window. The y-axis is adjusted to the most frequent pause window within the graph and is different among the graphs. What I aim at showing is not the absolute frequency of pauses of each kind, but the way they are distributed along the x-axis. See below:



(a) AA pauses **std ch+std ch** (b) BA pauses **shift ch+std ch** (c) AB pauses **std ch+shift ch**

Figure 1: Different writing pause lengths depending on AA, AB, BA pause type

Figure 1 shows that AA pauses were the smallest, BA pauses (those containing a **shift key up** action) were longer, and AB pauses (those containing a **shift key down** action) were the longest. In addition, it seems quite evident from the images that most pauses lay between 0 milliseconds and about twice the size of the most frequent pause window. For this reason, I find twice the length of the maximum value of the most frequent window a good estimate of where the start of the typing pause is. In the next section, I shall discuss how to classify typing pauses according to their length in a meaningful way for the purpose of translation studies.

2.2 Classes of typing pauses

Since we have an estimate of typing pause that is seemingly imprecise, it is not very informative to look at very small pauses. Therefore, what we count as typing pauses close to zero are actually rough guesses that these might be typing pauses and even rougher guesses that these might potentially be a motion pause. Any

actual counting of such short pauses would be very unreliable. We shall see in the following that they are nonetheless useful, even if imprecise.

Longer typing pauses with large pause windows are likely to be less unreliable. For this reason, I found 128 milliseconds of estimated typing pause length to be a good start. A typing pause window starting at 128 milliseconds was called tpw_1 . Since we need a way to compare similar-sized pauses with each other in an order of magnitude way (not in very precise ways), I find a logarithmic scale for pause windows fitting for our task. Therefore, I conceived of pause windows with the time segment $[62 \times 2^i, 62 \times 2^{i+1}[$ where the minimum pause length is included and the maximum pause length is excluded. With this pause window formula, we would have the following typing pause windows (tpw) in Table 7.

Table 7: Typing pause windows

Typing Pause Window	Minimum Length (included)	Maximum Length (excluded)
tpw^-	0 ms	128 ms
tpw_1	128 ms	256 ms
tpw_2	256 ms	512 ms
tpw_3	512 ms	1,024 ms
tpw_4	1,024 ms	2,048 ms
tpw_5	2,048 ms	4,096 ms
tpw_6	4,096 ms	8,192 ms
tpw_7	8,192 ms	16,384 ms
tpw_8	16,384 ms	32,768 ms
tpw_∞	32,768 ms	–

The first and last lines of Table 7 indicate special typing pause windows. tpw^- are the pause windows where it is a mere guess that what we see is in fact a typing pause, whereas tpw_∞ indicate pauses beyond 32 seconds. These pauses are very infrequent and they occurred not more than 5 times per participant. Making cognitive claims on typing pauses this long seemed rather unrealistic and I opted to discount them. Figure 2 shows the distribution of such pauses for a particular translation process from English to German in our corpus.

The logarithmic windows of Figure 2 contain a decreasing number of typing pauses as they get larger. The drop in typing pause frequency between one window and the next is smooth, which is a good sign for a classification of this kind.

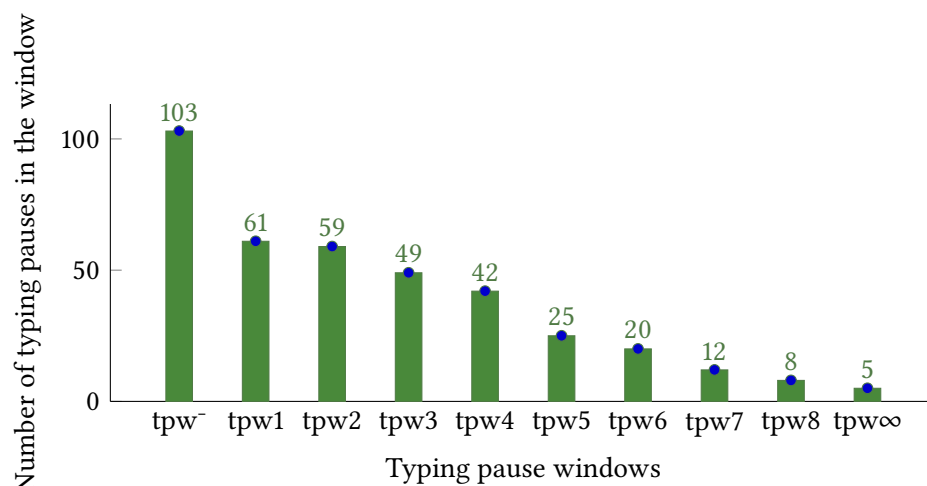


Figure 2: Frequency of typing pauses per window for a translation process

2.3 Comparison with other approaches

Up to now in translation studies, two procedures to cut a translation process into units have been tried, and both of them ignore the fact that the length of different writing pauses (AA, BA, AB) correlate differently with typing pause length. Both approaches considered gaps between two writing actions longer than a fixed threshold pause in translation, that is, these gaps were considered the boundaries of translation process units. They were not understood as pauses in writing nor as pauses in typing nor as pauses in finger motion.

The first fixed threshold used in translation studies was user-unspecific and was picked by the researcher him or herself. Early thresholds ranged between 5 and 6 seconds (Hansen 1999; 2002; Alves 2003; PACTE 2005). The second approach to cut the writing process into units during translation was proposed by Dragsted (2004; 2005). Her approach consisted of finding a writing pause¹⁹ for each participant that ‘seemed to reveal a certain pattern of syntactic units’²⁰. The attempt is valid and it does reveal a certain patterning that looks similar to a word/group/phrase based cutting of the target text production.

However, even though Dragsted’s approach is much better at capturing the writing rhythm of fast and slow writers, it tells little about how much ‘cogni-

¹⁹Typing speed in her terms since she did not distinguish typing actions from writing actions

²⁰Here called *grammatical structures*

tive' effort was put in each pause. It is also a poor indicator of cognitive effort since it tends to find boundaries of translation process units before all capital letters. This might lead researchers to believe that sentence beginnings and German nouns are especially charged with cognitive effort, when that is not really what is happening. It just takes longer for a person to type a capital letter than a small letter. Dragsted's approach also has the tendency to underestimate the cognitive effort of writing pauses between two small letters, which are typically shorter because less typing occurs during them. Examples 17 and 18 show respectively an undervaluation and an overvaluation of pauses.

- (17) ·[˘]A[˘]s[˘]p[˘]e[˘]k[˘]t[˘]· (TPW cut)
 ·•A[˘]s[˘]p[˘]e[˘]k[˘]t[˘]· (Dragsted's cut)
- (18) ·[˘]z[˘]u[˘]·57[˘]53·2P[˘]r[˘]o[˘]z[˘]e[˘]n[˘]t[˘]· (TPW cut)
 ·[˘]z[˘]u[˘]·•7[˘]5[˘]·•P[˘]r[˘]o[˘]z[˘]e[˘]n[˘]t[˘]· (Dragsted's cut)

In Example 17, the *tpw*- pause before the 'A' **char insert** action was taken by Dragsted method as being significant whereas I estimate this pause to be on the borderline of being a typing pause or not. It is barely longer than the regular gap between two typing actions of the translator. In contrast, Example 18 shows an undervaluation of pauses. *tpw*- and *tpw*₃ pauses between **standard char insert** actions are not recognised, whereas a *tpw*₂ pause before a capital letter is. In other words, even though Dragsted's approach adapts better to the writing speed of each participant, it might give us a skewed view of pauses in translation.

3 Conclusion

In the first part of this work, I went through a series of translation-unrelated linguistic phenomena that motivate pauses during translation. The assumption that the boundaries of the grammatical structure under translation are the core and sole reason for there to be writing pauses in the translation process was put in check. Reasons for there to be pauses vary between motion, typing, writing processes; in written products they vary between graphic, graphological, lexicogrammatical, and semantic strata, and in the lexicogrammatical stratum they vary between morpheme, word, group/phrase, and clause ranks. Each way of looking at the data allows us to identify different micro-units and corresponding macro-units of translation.

After listing some phenomena that occur in the translation process, I revisited the issue of what is an adequate pause to take as indicator for cognitive effort. As

pointed out in the first part, the assumption that the length of a writing pause is a good indicator of cognitive effort or translation-related activity does not hold. For this reason, I devised another indicator that results from estimating and classifying typing pauses. This indicator seems less biased than the one used so far and it is modal, i.e. it is not a cut but a scalar value that increases together with the length of the pause at a logarithmic pace.

Finally, for the future, given that we might have come to conclusions in prior publications based on skewed measurements, there is a large amount of work in need of reassessment. This work would include revisiting the claims that were defended with skewed measurements and which are now wide-spread assumptions in the field. We need to reassess whether these claims can still be sustained when analysing evidence in more detail and with less naïvité.

Acknowledgments

The classification of typing pause windows was performed at the German Research Foundation (DFG) project TRICKLET (Translation Research in Corpora, Keystroke Logging and Eye Tracking), research grant no. NE1822/2-1. The linguistic annotation of hashtags was performed within the IfAAR – English Linguistics.

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