

Cognitive Effort Verbalised in Self-reports: Investigating the Influence of Directionality in Translation

Marcelina Pietryga
marcelina.pietryga@us.edu.pl
University of Silesia in Katowice, Poland

ABSTRACT

This study investigates the traces of cognitive effort in two translation directions, L1-L2 and L2-L1, verbalised in the self-reports. Its aim is two-fold: to analyse how translation trainees generally verbalise cognitive effort experienced during the translation process and to investigate whether there are any differences in self-reports of cognitive effort in two translation directions. Therefore, I formulated two research questions directly corresponding to the aims. The method used to study this topic is retrospection in the form of self-retrospection. Translation trainees were asked to first translate a text and then verbalise all conscious decisions they made during the translation process. The verbalisations, under the name of self-reports of cognitive effort were divided into eight categories. The results indicated that participants referred to various aspects of cognitive effort, such as effort related to the drafting phase (Jakobsen 2002), style, punctuation and collocations, which served as fixed points of interest. What is more, seven out of eight categories of self-reports, but with different frequencies, appear in both translation directions. In some cases, the content of the categories also differs in each direction. I used a non-parametric Wilcoxon test to verify whether these differences were statistically significant. In the case of two out of seven categories that appear in both directions, the difference reached the level of statistical significance.

Keywords: retrospection; self-reports; cognitive effort; directionality; trainees

INTRODUCTION

Cognitive effort is defined by Hunziker Heeb (2020, p. 48) as “the total effort the translator expends during the translation task.” It has been analysed based on various aspects of the translation and interpreting process, such as stress (Rojo López et al., 2021), disfluencies (Kruger, 2016; Chmiel et al., 2022), and the translation of fixed text units, like metaphors (Sjørup, 2013). In this study, I aim to examine the impact of directionality on cognitive effort. According to Whyatt (2019), directionality refers to translating texts in two directions, from L1 to L2 and vice versa. Although translating into both directions is a common practice, especially in some language pairs, following the assumptions of the Golden Rule of Translation (Newmark 1988), translation should be performed into a native language (L1). Moreover, Fonseca (2015) observes that L1-L2 translation is frequently perceived as a more cognitively demanding translation direction. Therefore, researchers have recently tried to verify whether these frameworks yield observable differences between the translation directions. However, the majority of studies led to inconclusive results regarding the influence of directionality on cognitive effort, and it cannot be firmly concluded which translation direction results in a higher cognitive effort (for example, in Pavlovič

& Jensen 2009; Whyatt 2019; Hunziker Heeb 2020).¹ There are various ways of measuring cognitive effort, such as subjective (for example, retrospection, questionnaires) and objective process methods (for example, eye-tracking and keylogging). As will be discussed in the next section, retrospection enables the analysis of the personal experience of cognitive effort verbalised by translators and translation trainees. However, to the best of my knowledge, there is no study that employs only retrospection to analyse the influence of directionality on cognitive effort. To address this research gap, I would like to base my study on self-reports obtained via retrospection. Since the question of whether L1-L2 translation direction evokes higher cognitive effort experienced by translators and translation trainees remains open, I am interested in various aspects of cognitive effort that participants may verbalise in their self-reports. I believe that the increased cognitive effort may manifest not only in direct problem triggers related to vocabulary but also in decisions made regarding style or punctuation. I would like to analyse self-reports both globally and locally. In addition to the self-reports referring to the entire translation process (global analysis), I also devote particular attention to the fixed points of interest (local analysis), which are collocations incorporated in the source text. Since collocations are believed to cause serious problems during the translation process, they may be valid indicators of an increased cognitive effort (Pellicer-Sánchez et al., 2022; Pietryga, 2022; Sonbul et al., 2022).

SELF-REPORTS AS A MEASURE OF COGNITIVE EFFORT

Retrospection is a method of verbalisation that stems from cognitive psychology (Ericsson & Simon, 1984). As pointed out by Gumul (2020, p.152), this “is a process-oriented method that may be used to investigate the underlying cognitive processes.” It is frequently applied to study the translation and interpreting process, for example, by Dimitrova and Tiselius (2009), Ferreira et al. (2018), Vottonen and Kujamäki (2021), Gumul (2017, 2020), and Gumul and Herring (2023). As Gumul (2020, p. 152) continues, “this method consists of eliciting verbal reports from the participants after they complete interpreting [or translation] tasks.” The product of retrospection is a set of comments that are referred to as self-reports, for example, in the study by Gumul (2021a). Retrospection is considered to be a subjective method, which means that participants themselves provide the researcher with data related to cognitive effort, and the only type of equipment used in this case is a tape recorder (Gumul 2019). As Ehrensberger-Dow et al. (2020, p. 223) point out, “[s]ubjective measures provide insight into an individual’s perception and experience of cognitive effort during a language processing task.” However, due to the subjectivity of this method, participants are also in full control of the data they provide the researcher with. This can be considered as both an advantage and a disadvantage. First of all, the researcher is able to obtain a specific type of data related to the decision-making process that is verbalised directly by the participant and cannot be obtained using any type of software or equipment (Herring & Tiselius 2020: 58). They can elaborate on the reasons behind translation choices or explain the nature of problem triggers. Moreover, since retrospection is performed after the task is already finished, it neither requires attention divisibility nor adds new cognitive load (Ferreira 2014; Gumul 2019). However, participants are only able to verbalise conscious decisions. Therefore, any automatised processes will not be included in the self-reports (Bartłomiejczyk 2007; Saldanha & O’Brien 2013). Moreover, as the result of the recency effect, which includes the length of the task that precedes retrospection and the length of the break that occurs between the task and retrospection,

¹ A summary of studies analysing cognitive effort in the context of directionality is presented in Pietryga (2025).

participants may be prone to forget a huge number of data (Ericsson & Simon 1984; Ivanova 2002; Gumul 2019). There is also a tendency to provide self-reports that are irrelevant to the study's objective (Bartłomiejczyk 2007; Gumul 2017). Obviously, participants are also able to manipulate the information they provide the researcher with, either as the result of the recency effect or because they do not want to reveal the true reasons behind their decision-making. Sometimes, they may feel ashamed because of the mistakes that appear in their translations, or they may make up comments to help the researcher gather interesting data, a phenomenon known as the white-coat effect (Vik-Touvinen, 2002; Gumul, 2019, 2020, 2021b; Herring & Tiselius, 2020).

To the best of my knowledge, there are two works that employ different types of verbalisations to study the influence of directionality on cognitive effort experienced during the translation process. Pavlovič (2010) applied concurrent verbalisations known as think-aloud protocols, and Ferreira (2014) used retrospective reports. The study by Pavlovič (2010) focuses on the analysis of arguments used to assess tentative solutions by novice translators during the L1-L2 and L2-L1 translation processes. The analysed language pair includes Croatian as L1 and English as L2. The task of 12 participants was to work in groups of three and translate texts derived from travel guides in two translation directions. They were expected to discuss their decision-making and perform the so-called collaborative think-aloud protocols while translating the texts. Pavlovič (2010, p.66) verified two hypotheses: "a) similar types of arguments are used in decision-making processes in both L1 and L2 translation and b) the distribution of arguments differs depending on the direction of translation." The gathered data allowed her to fully corroborate only the first hypothesis. Pavlovič (2010) divided the arguments into nine categories related to tentative solutions, for example, discussing personal preferences and referring to the source text author's intentions and target text reader's needs. It appeared that, in general, there are more arguments referring to the L2-L1 translation and that there are some differences in the distribution of self-reports. However, the differences between the translation directions were minor; therefore, Pavlovič (2010) claimed that she could not confirm this hypothesis.

Another study investigating the differences between the L1-L2 and L2-L1 translation process with the use of verbal reports was conducted by Ferreira (2014). She employed retrospective reports triangulated with keylogging to analyse the influence of translation directionality based on recursive movements and self-reports. In her study, self-reports were analysed for traces of problems and solutions. The data were collected from eight professional translators working in the Brazilian Portuguese (L1) - English (L2) language pair. Participants translated popular science texts on related and unrelated topics. Since the remaining aspects of Ferreira's study lie beyond the scope of my study, I will discuss only the part related to retrospection. One out of four formulated hypotheses referred directly to cognitive effort and self-reports. Ferreira (2014, p.115) hypothesised that in the case of translating unrelated texts, "[L1-L2] translation will result in more comments on lexical problems and spontaneous solutions versus solutions from external resources since translators might experience more lexical problems and solutions when translating in that direction." This hypothesis was fully corroborated. Interestingly, although self-reports of lexical problems were verbalised more frequently in the L1-L2 translation direction, participants found fewer solutions to these problems than in the L2-L1 translation direction.

STUDY DESIGN

RESEARCH QUESTIONS AND HYPOTHESES

The literature review reports various research gaps. Firstly, studies on cognitive effort and directionality led to inconclusive results. Secondly, there is a scarcity of studies analysing cognitive effort experience during the translation process in various translation directions, which is explicitly or implicitly expressed in verbal reports. It is also worth mentioning that previous studies revealed possible similarities in the way translation trainees discuss their L1-L2 and L2-L1 translation processes, which should be analysed further. Therefore, the aim of this study is two-fold. First of all, it aims to analyse how translation trainees, in general, verbalise cognitive effort experienced during the translation process. Secondly, it aims to investigate whether there are any differences in self-reports of cognitive effort in two translation directions, from Polish into English (L1-L2) and from English into Polish (L2-L1). To achieve these objectives, I created two research questions:

- 1) How do translation trainees verbalise cognitive effort experienced during the translation process?
- 2) Are there any differences between the L1-L2 self-reports and L2-L1 self-reports?

As already mentioned, L1-L2 translation is believed to cause higher cognitive effort. Moreover, Englund Dimitrova and Tiselius (2009: 115) found that the more problems participants have to overcome while translating a text, the more self-reports they tend to verbalise during the retrospective session. Therefore, as for the first research question, I hypothesise that participants will explicitly verbalise problems they encountered during the translation process. This assumption follows the results of the study conducted by Gumul (2018), who analysed the evidence of Gile's Effort Model (1995) in retrospective reports based on simultaneous interpreting. Gumul (2018: 34) found almost 600 self-reports referring to Gile's Effort model that were verbalised by almost all participants. Moreover, following the study by Pavlović (2010), I expect participants to refer to their decision-making process, stylistic aspects, and consistency of the target text in their self-reports, which I believe may also indicate an increased cognitive effort. As regards the second research question, I will follow the hypothesis corroborated by Ferreira (2014, p.123), who, in her study investigating cognitive effort in two translation directions, found out that participants verbalised more comments related to problems in the L1-L2 translation. Therefore, I expect that as a result of the increased cognitive effort experienced during the L1-L2 translation process, participants will verbalise more self-reports in this translation direction. They should also be more prone to elaborate on their decision-making process.

METHOD

The method used in this study is retrospection in the form of self-retrospection. It is a subjective process method that provides both qualitative and quantitative data. After translating a text, the participants were asked to verbalise all the conscious decisions they made during the translation process. Its main advantage, which led me to choose retrospection over think-aloud protocols, is that participants do not struggle with multitasking and additional cognitive load (Ferreira, 2014; Gumul, 2019, 2020; Jakobsen, 2011). Since retrospection is performed after the translation task is completed, participants do not have to divide their attention between translating and verbalising. However, the retrospection method is not devoid of obstacles. One of them is the already-

mentioned recency effect, in which a participant forgets the conscious decisions they made during the translation task, known also as the immediacy condition (Ericsson & Simon, 1984; Ivanova, 2000; Gumul, 2017). The recency effect may be the result of the translation task length and the break that happens after the translation task is finished and before the retrospection begins (Ericsson & Simon, 1984; Gumul, 2019). To elicit verbalisations and overcome the recency effect, participants are usually provided with various types of stimuli, like transcripts or recordings of source and target texts. Reading or listening to source or target texts should trigger verbalisations of conscious decisions made during the translation and interpreting process (Saldanha & O'Brien 2013; Gumul 2017, 2020). Since there are various preferences regarding cueing, Gumul (2020) analysed the influence of source and target text cueing on informativeness, accuracy and verbosity of verbalisations. The results indicated that none of the analysed aspects is influenced by the type of cueing. Bearing in mind these findings and following the studies by Englund Dimitrova, and Tiselius (2009, 2014), I decided to use source texts as cueing stimuli. No additional type of cueing was provided. To ensure ecological validity, participants were not informed that the study focuses on cognitive effort and collocations. They were instructed to comment on all conscious decisions they made when translating a text. As opposed to think-aloud protocols, no prior preparation or a warm-up exercise before retrospection is required (Gass & Mackey, 2000/2009: 37)

MATERIALS

The materials were originally used in the previous study and discussed in detail in Pietryga (2025). Two authentic, popular science texts adopted from the National Geographic website were used as source texts in this study. The texts included neither specialised vocabulary nor required any preparation beforehand, and they resemble the texts the participants were used to translating during their translation classes. The Polish text covers the topic of the oldest tortoise in the world, and the English text discusses the manner in which dogs process prices. The texts were modified to fit the purpose of this study; they have similar lengths and difficulty levels measured through the Gunning Fog Index (FOG Index), and secondary education is required for their understanding. Moreover, each text included 12 high-frequency collocations noted in the British National Corpus (Davies 2004) and the Narodowy Korpus Języka Polskiego (Pęzik 2012), which were chosen as fixed points of interest. I expected collocations to be problem triggers that may influence the number of self-reports. The details of the source texts are included in Table 1 below.

TABLE 1. Details of the source texts

	Polish text	English text
Number of words	168	171
FOG Index	11	11.03
Number of collocations	12	12

PARTICIPANTS

The study sample included 35 5th-year translation trainees with Polish as their L1 and English as their L2. 29 women and six men participated in the study, with their ages ranging from 23 to 26 years old (M=24; SD= 0.78). They formed a homogeneous group of advanced translation trainees who participated in at least 90 hours of translation classes in and out of their L1 prior to the study. I additionally verified their language skills in their L1 and L2. Language skills in English were verified via the platform dedicated to assessing proficiency in English, the Lextale test (Lemhöfer

& Broersma 2012), and the self-assessment grid table prepared by the Council of Europe (2001). Since Polish is the participants' native language, I used only the self-assessment grid table to verify the skills in this language. During the Lextale test, participants decided whether the word they saw on the screen was an existing English word. The results indicated that participants have high proficiency in English. Their average result was 76.8% (SD=11), which is comparable to the results obtained by professional translators in similar studies. During the self-assessment of linguistic skills, the participants' task was to assess five skills: listening, reading, spoken interaction, and spoken production. Participants assessed that their skills in Polish and in English are at least at the B2 level.

The study received a Certificate of Ethical Acceptability of Research Involving Human Participants no. KEUS192/12.2021, issued by the Ethics Committee at the University of Silesia in Katowice. All participants were recruited on a voluntary basis and signed the informed consent. They received university gadgets as a form of compensation for the time and effort devoted to the study. To minimise the white-coat effect, none of the participants were my students. In order to protect their identity, their names and surnames were pseudonymised with numbers. I also removed from their self-reports all data that may lead to the identification of the participants.

PROCEDURE

The study was conducted between 29th April and 9th June 2022 in the Research Laboratory of the Institute of Psychology at the University of Silesia in Katowice. Before the experimental procedure the participants were informed about the course of the experiment and asked to fill in a short demographic survey. The study design involved three tasks in two translation directions: L1-L2 and L2-L1. The first task was to translate a text described in the MATERIALS section, the second task was the retrospection, during which participants were supposed to verbalise all conscious decisions made during the translation task, and the third task was to complete some questionnaires. However, in this article I would like to focus on the data obtained solely during the retrospection. Prior to the retrospection, the participants obtained detailed instructions about their tasks and the course of the retrospection. As already mentioned, the source text was provided as a cueing stimulus. Following the studies by Gumul (2020) and Bartłomiejczyk (2007), participants were informed that they could provide verbalisations both in Polish and in English, and they could also mix both languages. They were also informed that they are not limited by any time constraints or the number of self-reports they should provide. It is recommended that unless the retrospection involves an interview, a researcher should not be present in the room where a participant is verbalising and should not interfere in the verbalisation process (Gumul 2019: 180). Therefore, after explaining the details of retrospection, I left the room, and participants were left on their own to verbalise their thoughts freely. Their self-reports were recorded in an audio form. After a short break the procedure was repeated in the reverse translation direction. The whole procedure lasted around 1.5 hours. The order of translation directions was counterbalanced using the website Randomiser.org to minimise confounding variables of tiredness and stress. In the next step, the recordings of verbalisations were transcribed and manually coded by me. I used eight codes that I invented for the purpose of this study. The codes were based on the data from the retrospective verbal reports and are discussed in detail in Table 2 in the RESULTS AND DISCUSSION section.

RESULTS

I conducted both qualitative and quantitative analyses of the self-reports obtained during the retrospective sessions. The descriptive and inferential quantitative analyses were conducted using the SPSS program.

I would like to begin my analysis by discussing the self-reports' verbosity in each translation direction. This includes the number of self-reports, the number of words in each protocol and the duration of each protocol (Gumul 2020; Gumul & Herring 2023). During the retrospective session after the L1-L2 translation, participants verbalised 329 self-reports ($M=9.4$, $SD=4.3$). This retrospective session lasted, on average, 5:28 min ($SD=3:42$), and there were, on average, 293 words per protocol ($SD=237$). During the retrospective session after the L2-L1 translation, participants produced slightly fewer self-reports compared to the L1-L2 translation, namely 261. The average duration of a retrospective session in this direction was also slightly shorter, as it lasted 5:09 min ($SD=3:35$). However, there were slightly more words per protocol after the L2-L1 translation, compared to the L1-L2 translation ($M=299.3$, $SD=193.5$). These results suggest that there may be differences between the L1-L2 self-reports and L2-L1 self-reports.

In the first research question, I set out to investigate how translation trainees, in general, verbalise cognitive effort experienced during the translation process. To answer this research question, I coded the self-reports into eight categories reflecting the cognitive effort experienced during the translation process. Four codes refer to the whole text, and four codes refer to the translation of collocations, which serve as fixed points of interest. The codes and the results are summarised in Table 2 below.

TABLE 2. Self-reports coding

Code	Full Name	Description	L2-L1 number of comments	L1-L2 number of comments
Draft_eff	Drafting effort	A participant describes problems/efforts during the drafting phase.	65	75
Lack_of_cog_eff	Lack of cognitive effort	No effort/ problem was reported.	14	12
PUN	Punctuation	A participant reports problems with punctuation.	13	6
STL	Style	A participant reports a problem or modification with style, like word order.	18	43
CE1	Collocation effort level 1	A participant describes the process of translating a given collocation.	30	22
CE2	Collocation effort level 2	A participant describes the process of decision changing while translating a given collocation.	7	2
CE3	Collocation effort level 3	A participant explicitly states a problem or effort they experienced when translating a given collocation.	17	89
CE_REL	Related to the collocation effort	A participant reports a problem with translating a given collocation; however, it does not stem from lexical problems but rather from grammar or function issues.	4	0

The obtained results show that 7 out of 8 categories appear in self-reports in both translation directions. The most numerous global category of self-reports referring to the whole text rather than fixed interest points is the drafting effort, which refers to the cognitive effort experienced during the drafting phase (Jakobsen 2002) when a participant was actively translating the source text. Regardless of the translation direction, participants most frequently referred to the fact that they did not know how to translate some words or phrases. They either completely did not know the target text equivalent of a given word or temporarily forgot how to translate it. It is worth noting that to provide ecological validity of the study, the participants were not allowed to use dictionaries while translating the texts. Since the objective of the study is to analyse cognitive effort, the use of dictionaries could have significantly lowered the perceived cognitive effort. The most problematic word in the case of the L1-L2 translation was *żółw*, which can be translated from Polish into English either as a turtle or as a tortoise, depending on whether the animal lives on land or in the water. Participants frequently reported that they were not sure which form they should use, for example:

PE02/T/1²: The problem that I had when I started translating was that I was not sure which translation of the word ‘*żółw*’ was the correct one because, in English, there is a difference between a tortoise and a turtle, but I can’t remember which is which.

In the case of the L2-L1 translation, the words most frequently enumerated by the participants as problem triggers were the adjective hierarchically and the verb to process. It should be mentioned that both words have almost identical equivalents in Polish, which may lead to language interference and cause additional translation problems. However, the one-to-one equivalent of the word to process in Polish refers to a noun rather than to a verb. For example, the participants indicated that:

PE38/D/1: In sentence no. 3, I was not sure whether the word ‘*hierarchiczny*’ is the correct one, and whether it means the same as ‘*hierarchical*’ in English, but I left it since nothing else came to my mind.

PE06/D/12: In this sentence, only the verb ‘to process’ is difficult, and after some time, I found out that I can translate it as ‘*przetwarzać*.’

Moreover, in both translation directions participants tried to explain the decisions they applied to problematic phrases. Techniques like generalisation, the use of equivalents, explication and omission prevail in the L1-L2 translation, for example:

PE07/T/5: I have the biggest problem with the last sentence because I forgot how to translate the word ‘*jubileusz*’. Now, I do not precisely remember what I wrote, but I think I did it in a more descriptive way.

² Following the study by Gumul (2017), the quotations of self-reports include the number of participant (PE), the abbreviation of the source text, where T stands for tortoise, which was the L1-L2 translation, and D stands for dog, which was the L2-L1 translation, and the number of the self-report.

PE32/T/10: In sentence no.9, I decided to translate ‘rok jego jubileuszu’ as ‘its 200th birthday.’ I decided to use explicitation as I did not know a good English equivalent of the word ‘jubilee.’

PE35/T/7: In sentence no.6, I had to omit the word ‘żartobliwie’ since I was unsure whether a literal translation ‘jokingly’ is correct.

In the case of the L2-L1 translation direction, participants usually mentioned literal translation as a solution they applied to various problem triggers. Frequently, they were aware of the fact that it might have led to a linguistic calque. For example:

PE10/D/2: In sentence 3, there is a ‘hierarchical way.’ I was thinking about how to translate it, but probably, I would not have come up with any better solution than a literal translation.

Interestingly, both in the L1-L2 and L2-L1 retrospective sessions, there were cases in which participants evaluated their translation choices, although they were explicitly instructed not to do so. In fact, such comments are created post factum and do not reflect the actual decision-making that occurs during the translation process (Gumul 2019, 2021c). For example:

PE13/D/14: I was wondering about ‘a million.’ I remember that everyone always paid attention to the words million and billion, but honestly, I do not remember which is correct. I left ‘million’, but I am afraid it is not a good translation.

PE06/T/11: In sentence 8, there was a problem with the verb ‘ukazać się’, but in this context, I used the verb ‘to launch’, and now I think it is a mistake.

The problem categorised as a drafting effort that appeared only in the L1-L2 translation was the use of personal pronouns when referring to the tortoise and the vet. For example:

PE09/T/8: In sentence 5, I was confused because I did not know which pronoun I should use for the vet. Sometimes, there is a problem trigger; it seems that a vet is a man, and then it appears that this is a woman. But I think I wrote ‘the vet says that their patient’ instead of ‘his or her patient.’

Style is another category of cognitive effort that appears relatively frequently in both translation directions. However, there are some differences in the number of self-reports classified within this category in both directions and in the content of these self-reports. When discussing their L1-L2 translation process, participants emphasised transforming long sentences into two shorter ones, which is in line with the style characteristics of the English language. Moreover, they tried to avoid repetitions. This solution may be strongly influenced by the Polish language, in which it is advisable not to use too many repetitions. For example, the participants stated that:

PE34/T/4: The last thing I would like to mention is that, personally, I do not like many repetitions, and here, the word ‘tortoise’ appeared many times. Its name was mentioned only in the beginning, so in the translation, I decided not to use only the tortoise all the time and to sometimes substitute it with the name of this animal.

PE37/T/2: I split sentence no. 4 into two sentences because it seems too long. Therefore, I made two sentences from one.

Coherence is the main aspect discussed by the participants when referring to style in the L2-L1 translation. They aimed at presenting the target text in such a way that is coherent and understandable to the target audience, for example:

PE02/D/05: In sentence no. 7, I took a moment to think about how to formulate this sentence so that it is more coherent.

The aspect that was mentioned by the participants, regardless of the translation direction, is the word order. Participants were aware that Polish and English have different syntactic structures and tried to prepare the target text in a proper syntactic form.

PE22/T/1: In the first sentence, I had a problem with putting it in the correct word order that sounds good in English. As far as I remember, I changed the word order in this sentence.

PE02/D/6: In sentence no. 9, I paid attention to slightly changing the word order, so I first enumerated these hemispheres, and I said what they are responsible for.

Punctuation is the category that was mentioned several times in both translation directions. It is worth noting that Polish and English have completely different punctuation rules, which may lead to confusion, especially among translation trainees. Moreover, advanced English philology students spend most of their time surrounded by English, which may lead to interference of English with Polish. This is visible, for example, in the number of self-reports referring to punctuation. Participants more frequently struggled with punctuation in their native language rather than in their foreign language. Several issues related to punctuation were mentioned in the self-reports in both translation directions. First of all, regardless of the translation direction, participants referred to the problem of placing commas in the right places, for example:

PE04/T/2: I was wondering where to place commas in the English version of the second sentence, but I think I completely omitted them.

PE06/D/6: In the fifth sentence, I only had problems with commas. There is the word ‘whereas,’ which can be simply translated as ‘podczas gdy,’ and here I had a problem.

Finally, I used two commas to separate these sentences. Moreover, when discussing L1-L2 translation, participants also mentioned introducing modifications to the punctuation, usually during the revision phase (Jakobsen 2002), for example:

PE04/T/7: At first sight, this was not a problematic sentence, but I know that later, I had a slight problem with commas. But it became clear later on when I returned to that when proofreading the text at the very end.

During the retrospective session after the L2-L1 translation, participants frequently referred to problems with quotation marks. Additionally, they verbalised that they are aware of the fact that they may be mixing Polish and English punctuation systems. For example:

PE13/D/07: Sentence no. 6. I was thinking about punctuation, and I may use typical English punctuation, so just as in the source text: colon and upper quotation marks rather than lower. I forgot how to quote in Polish.

PE17/D/4: In the second sentence, I was wondering how to solve it when it comes to punctuation because I could not remember all the Polish punctuation rules.

I was also interested in the self-reports referring to cognitive effort experienced while translating fixed points of interest, which were collocations incorporated in the source text. In total, participants verbalised 113 self-reports of cognitive effort referring to translating L1-L2 collocations and 54 self-reports of cognitive effort referring to translating L2-L1 collocations. The differences in the content of these self-reports allowed me to divide them into three categories, which I denote as the levels of cognitive effort. Interestingly, each level of cognitive effort appeared both in L1-L2 and L2-L1 self-reports, although their frequencies varied in each direction.

Level 1 of cognitive effort referring to translating collocations includes self-reports in which participants describe the process of translating a given collocation. In this case, they do not point out any specific problems encountered during the translation process, but rather they refer to the decision-making process. I observed that regardless of the translation direction, the most frequently commented aspects were translation techniques and strategies applied when translating a collocation. These were usually omission, addition and generalisation, as well as literal translation. Participants also referred to their decision-making process. For example:

PE04/D/7: In the third sentence, there was ‘human brain processes acoustic information.’ In this case, I thought translating it as ‘akustyczna informacja’ was not good. So, I decided to translate it in a more descriptive way.

PE21/T/21: ‘Rozpiera go energia’ – ‘full of energy,’ I translated it literally.

Level 2 of cognitive effort referring to translating collocations includes self-reports in which participants describe the process of decision-changing while translating a given collocation. This category is the least numerous in both translation directions. Participants indicated that decision-changing when translating into their L2 resulted from style adjustments. In the case of L2-L1 translation, apart from style and grammar adjustments, participants also indicated new

knowledge of the context, which they acquired later on during the translation process. For example:

PE03/D/1: In the first sentence, I wrote 'radosnym, wysokim głosem' at first or something like that. But then I saw 'joyful', which I also wanted to translate as 'radosny.' So I left 'joyful,' 'radosny' and changed the beginning.

PE04/T/4: At the beginning, I translated the fourth sentence in the following way: 'lost his smell and he is blind.' I wanted it to look nicely, so I changed it into 'his smell and sight.'

Level 3 of cognitive effort referring to translating collocations includes self-reports in which participants explicitly state a problem or effort they experienced when translating a given collocation. This category was the most numerous in the L1-L2 translation direction. Regardless of the translation direction, participants verbalised a lack of knowledge of a given collocation or its component. They also mentioned translation techniques and strategies they used to overcome translation problems. In the case of the L1-L2 translation, these usually were equivalents or omissions, and in the case of the L2-L1 translation, they frequently resorted to literal translation. For example:

PE06/D/2: Another element that was problematic to me was the adjective 'high pitched,' and I simply translated it as 'wysoki głos.'

PE38/T/11: I do not know how to say 'odcisk', and I am also not sure whether 'łapa żółwia' is also 'paw' in English.

Additionally, there are four L2-L1 self-reports which were categorised as related to collocations, since they do not refer directly to translating collocations but to connecting them with other elements in the sentence. In fact, in the four cases, participants indicated problems related to the collocation 'brain region' resulting from some lack of knowledge. For example:

PE35/D/5: Next, in sentence number 9, the brain region was described as older and newer. I was not really sure what it was about, so I translated it literally.

Despite many problems indicated by trainees in their self-reports, they also referred to situations when the translation process was rather smooth, and they did not struggle with an increased cognitive effort. There were several such self-reports in both translation directions. The content of these self-reports is rather similar in both directions, as participants explicitly stated that they did not have any problems with particular parts of the text, for example:

PE30/D/3: There were no problems in sentence no. 2.

PE14/T/11: Sentence no.8 was super. I wrote everything about the post stamps. I rather knew how to deal with that sentence. I had the least problems with that sentence.

In the second research question, I set out to investigate whether there are any differences between the L1-L2 self-reports and L2-L1 self-reports. As already discussed, even though the same categories can be found in both translation directions, there are some visible differences in the content of these categories. Moreover, the results of the descriptive statistics indicate that the frequency of each category differs in each direction. To verify whether these differences are statistically significant, I conducted an inferential statistics analysis. First of all, I verified the distribution of each category, and then I conducted an appropriate test.

The analysis of the retrospective reports indicated that there are slightly more self-reports categorised as drafting effort in the L1-L2 translation direction (75) compared to the L2-L1 translation direction (65). The analysis of distribution indicated a lack of normal distribution in both cases (L2-L1, $p < 0.001$; L1-L2 $P = 0.001$); thus, I conducted a non-parametric Wilcoxon test. Unfortunately, the difference between the translation directions did not reach the level of statistical significance.

There was also a huge difference in the number and the content of the self-reports classified as referring to style. In the case of the L1-L2 direction, there were as many as 43 self-reports, and the reverse translation direction included only 18 self-reports. Like in the case of the previous category, no normal distribution was found (L2-L1, $p < 0.001$; L1-L2, $p < 0.001$). This time the results of the Wilcoxon test reached the level of statistical significance, as $p = 0.004$. According to these results, the cognitive effort related to style is significantly higher in the L1-L2 translation direction.

Another category of self-reports of cognitive effort embraced punctuation. There were twice as many self-reports referring to the L2-L1 translation direction (13) compared to the L1-L2 translation direction (6). The analysis of the distribution revealed no normal distribution in either case (L2-L1, $p < 0.001$; L1-L2, $p < 0.001$). Despite the difference visible based on the descriptive statistics, the results of the Wilcoxon test did not reach the level of statistical significance, as $p < 0.1$. It can be concluded that the cognitive effort related to punctuation is not statistically higher in the L2-L1 translation direction.

The analysis of the levels of cognitive effort referring to translating collocations indicates that Level 1 prevails in the L2-L1 translation direction. There are 30 L2-L1 self-reports within this category, compared to 22 L1-L2 self-reports. No normal distribution was found regardless of the translation direction (L1-L2 $p < 0.001$, L2-L1 $p < 0.001$). The results of the non-parametric Wilcoxon did not reach the level of statistical significance ($p = 0.138$), which means that the cognitive effort related to the Level 1 L2-L1 self-reports is not significantly greater than the cognitive effort expressed in the L1-L2 self-reports classified within the same category.

The results of the descriptive statistics indicated that Level 2 is the least numerous category in both translation directions, as there were only seven L2-L1 self-reports and two L1-L2 self-reports. Likewise, no normal distribution was found in this case (L1-L2, $p < 0.001$; L2-L1, $p < 0.001$), and the non-parametric Wilcoxon test did not reveal statistical significance.

Level 3 of cognitive effort, referring to translating collocations, prevails in the L1-L2 translation direction. There are as many as 89 self-reports referring to this direction, and only 17 self-reports discussing the L2-L1 translation of collocations. A normal distribution was found for the L1-L2 translation direction ($p = 0.26$), but there was no normal distribution in the case of the L2-L1 translation direction (L2-L1 $p < 0.001$), so I conducted the non-parametric Wilcoxon test. This time, the result reached the level of statistical significance, meaning that the cognitive effort expressed in the L1-L2 self-reports classified as Level 3 is statistically higher. When it comes to significant differences in self-reports related to collocations, they can be found only in Level 3.

The number of self-reports indicating a lack of cognitive effort is almost identical in both translation directions; there were 12 L1-L2 self-reports and 14 L2-L1 self-reports. No normal distribution was found in both directions (L1-L2 $p < 0.001$; L2-L1 $p < 0.001$). Since the results of the non-parametric Wilcoxon test did not reach the level of significance ($p = 0.527$), it can be stated that there are no statistical differences between the translation directions.

DISCUSSION OF FINDINGS

In this study, I attempted to answer two research questions: 1) How do translation trainees verbalise cognitive effort experienced during the translation process? 2) Are there any differences between the L1-L2 self-reports and L2-L1 self-reports? As for the first research question, the self-reports were divided into eight categories that refer to various aspects of cognitive effort. These are: effort experienced during the drafting phase, style, punctuation, three levels of cognitive effort referring to translating collocations, cognitive effort related to collocations and a lack of cognitive effort. Seven out of eight categories appear in both translation directions. The content of the self-reports suggests that translation trainees are aware of many important aspects of the translation process and can elaborate on various reasons contributing to the increased cognitive effort. They are also aware of crucial differences between translating into English and Polish. Their self-reports refer to both the whole text and to the fixed interest points. Translation trainees indicated aspects such as differences in the animals' names in Polish and English, the use of personal pronouns, differences in style, especially word order and length of the sentences, coherence of the target text, as well as differences in punctuation and the problem with mixing up both linguistic systems. They also described in detail their decision-making process and indicated various translation techniques and strategies that they applied in each translation direction. These results are in line with the study by Pavlovič (2010), who found that similar categories of comments should appear in both translation directions.

As for the second research question, although the same categories of self-reports appear in both translation directions, their content slightly differs in each direction. Frequently, trainees discuss different translation techniques and strategies applied in each direction. Visible differences are also observable in the category of style. In the case of the L2-L1 translation, participants emphasised the aspect of target text coherence, and in the L1-L2 self-reports, particular attention was paid to sentence length and the avoidance of repetition. Another example is the use of personal pronouns, which was found only in the L2-L1 self-reports. What is more, the frequency of categories differs depending on the translation direction. According to descriptive statistics results, the self-reports related to punctuation, Level 1 of cognitive effort referring to translating collocations, a lack of cognitive effort and self-reports related to collocations prevail in the L2-L1 translation direction. The categories of drafting effort, style, as well as Levels 2 and 3 of cognitive effort referring to translating collocations prevail in the L1-L2 translation direction. To verify whether these differences in the frequency of the self-reports are statistically significant, I conducted appropriate tests. The results indicate that only in the case of two categories, style and Level 3 of cognitive effort, referring to translating collocations, the difference reached the level of statistical significance. In both cases, the cognitive effort was significantly higher during L1-L2 translation. In the remaining cases, no statistical significance was found. This means that despite the differences visible in the descriptive statistics, it cannot be firmly concluded that the content and the number of self-reports unequivocally indicate the L1-L2 translation direction as a more

effortful one. These findings are in line with the general trend observable in the field. Although some differences between the translation directions are visible, and frequently they indicate the L1-L2 translation direction as a more effortful one, they are not huge enough to draw firm conclusions.

CONCLUSIONS

This study set out to investigate how translation trainees verbalise cognitive effort experienced during the translation process and whether there are any differences between self-reports of cognitive effort experienced during translating texts into L1 and into L2. The task of the participants was to translate two popular science texts, one in each direction (L1-L2 and L2-L1) and perform retrospection during which they verbalised conscious decisions made during the translation process. The results indicated that during retrospection, translation trainees refer to a wide range of aspects evoking cognitive effort. Their self-reports range from comments referring to the entire translation process to a discussion of fixed points of interest, such as collocations. The overwhelming majority of categories (7/8) appear in the self-reports regardless of the translation direction; however, their number and content tend to differ. Although the descriptive statistics results suggest that L1-L2 translation direction evoked increased cognitive effort, in fact, only two out of eight categories reached the level of statistical significance. Interestingly, the content of self-reports also slightly differs, depending on translation direction. While discussing their L1-L2 translation process, participants focused more on words they struggled to recall, especially false friends, the use of personal pronouns and avoidance of repetitions. They also tend to omit more. In the case of the L2-L1 translation process, participants focused more on coherence and punctuation; they also resorted to literal translation.

To sum up, retrospective self-reports appear to provide valuable information about the cognitive effort experienced by the participants during the process of translation. The experience of the increased cognitive effort can be verbalised in multiple ways, ranging from explicit indication of a problem trigger to the decision-making process related to style and punctuation. Frequently, participants tend to be very detailed in their verbalisations of cognitive effort. Not only do they describe the reasons behind particular translation choices but also sometimes they try to justify and assess their decisions.

ACKNOWLEDGMENTS

I would like to thank Maciej Bożek, PhD, the Head of the IP Research Laboratory of the Institute of Psychology (The University of Silesia), for allowing me to conduct the study in the Laboratory and for his help in conducting the experiment. I would also like to thank all participants who agreed to participate in the study.

REFERENCES

- Bartłomiejczyk, M. (2007). Introspective methods in conference interpreting research. In: J. Arabski (ed.), *Challenging tasks for psycholinguistics in the new century. Proceedings of the 7th Congress of International Society of Applied Psycholinguistics* (CD). Katowice: Wydawnictwo Uniwersytetu Śląskiego.
- Chmiel, A., Korzinek, D., Kajzer-Wietrzny, M., Janikowski, P., Jakubowski, D. & Polakowska, D., (2022). Fluency parameters in the Polish Interpreting Corpus (PINC). In: M. Kajzer-Wietrzny, A. Ferraresi, I., Ivaska, S. Bernardini (Eds.), *Empirical investigation into the forms of mediated discourse at the European Parliament*. (pp. 63-91). Berlin: Natural Science Press. DOI: <https://doi.org/10.5281/zenodo.6976930>
- Council of Europe. (2001). *Common European Framework for Reference of Languages Learning, Teaching, Assessment*. Cambridge University Press.
- Davies, Mark. (2004). *British National Corpus (from Oxford University Press)*. Available online at <https://www.english-corpora.org/bnc/>
- Ehrensberger-Dow, M. Albl-Mikasa, M., Andermatt, K., Hunziker Heeb, A. & Lehr, C. (2020). Cognitive load in processing ELF: Translators, interpreters, and other multilinguals. *Journal of English as a Lingua Franca*. 9(2), 217-238. DOI: <https://doi.org/10.1515/jelf-2020-2039>
- Englund Dimitrova, B. & Tiselius, E. (2009). Exploring retrospection as a research method for studying the translation process and the interpreting process. In: I. M. Mees, F. Alves, S. Göpferlich (Eds.), *Methodology, technology and innovation in translation process research* (pp. 109-134). Copenhagen: Samfundslitteratur.
- Englund Dimitrova, B. & Tiselius, E. (2014). Retrospection in interpreting and translation. Explaining the process? *MonTI Special Issue – Minding Translation*. 1, 177-200. DOI: <https://doi.org/10.6035/MonTI.2014.ne1.5>
- Ericsson, K.A. & Simon, H.A. (1984). *Protocol analysis: verbal reports as data*. Cambridge: The MIT Press.
- Ferreira, A. (2014). Analysing recursiveness patterns and retrospective protocols of professional translators in L1 and L2 translation tasks. *Translation and Interpreting Studies*. 9(1), 109-127. DOI: <https://doi.org/10.1075/tis.9.1.06fer>
- Ferreira, A., Gottardo A. & Schwieter, J. W. (2018). An analysis of retrospective protocols in decision-making process of direct and inverse translation. *Translation, Cognition & Behaviour*. 1(1), 98-118.
- Fonseca, N. B., de Lima. (2015). Directionality in translation: investigating prototypical patterns in editing procedures. *The International Journal for Translation and Interpreting Research*. 7(1), 111-125. DOI: <https://doi.org/ti.106201.2015.a08>
- Gass, S. M., Mackey, A. (2000/2009), *Stimulated Recall Methodology in Second Language Research*, Lawrence Erlbaum Associates, Mahwah, NJ.
- Gile, D. (1995). *Basic concepts and models for interpreter and translator training*. Amsterdam; Philadelphia: John Benjamins.
- Gumul, E. & Herring, R. (2023). Employing retrospective process tracing in an international exploratory study. *Translation Cognition & Behaviour*. 5(2), 221-249. DOI: <https://doi.org/10.1075/tcb.00067.gum>
- Gumul, E. (2017). *Explicitation in simultaneous interpreting. A Study into explicitating behaviour of trainee interpreters*. Katowice: Wydawnictwo Uniwersytetu Śląskiego.

- Gumul, E. (2018). Searching for evidence of Gile's Effort Models in retrospective protocols of trainee simultaneous interpreters. *Między oryginałem a przekładem*. 42(4), 17-39. DOI: <https://doi.org/10.12797/MOaP.24.2018.42.02>
- Gumul, E. (2019). O metodzie protokołów retrospektywnych w badaniach nad tłumaczeniem symultanicznym. *Rocznik Przekładoznawczy. Studia nad teorią, praktyką i dydaktyką przekładu*. 14, 171-192. DOI: <https://doi.org/10.12797/MOaP.26.2020.50.02>
- Gumul, E. (2020). Retrospective protocols in simultaneous interpreting: Testing the effect of retrieval cues. *Linguistica Antverpiensia, New Series: Themes in Translation Studies*, 19, 152-171. DOI: <https://doi.org/10.52034/lanstts.v19i0.547>
- 2020Gumul, E. (2021a). Reporting stress in simultaneous interpreting. The analysis of trainee interpreters' retrospective reports and outputs. *Onomazein. Journal of linguistics, philology and translation. Special issue – Emotions in translation and interpreting*. 8, 16-42. DOI: <https://doi.org/10.7764/onomazein.ne8.04>
- Gumul, E. (2021c). Rola bodźca w retrospekcji z perspektywy tłumaczy symultanicznych. *Rocznik Przekładoznawczy. Studia nad teorią, praktyką i dydaktyką przekładu*, 16, 79-106. DOI: <http://dx.doi.org/10.12775/RP.2021.004>
- Gumul, E. (2021b). Explicitation and cognitive load in simultaneous interpreting. Product- and process-oriented analysis of trainee interpreters' output. *Interpreting*. 23(1), 45-75. DOI: <https://doi.org/10.1075/intp.00051.gum>
- Herring, R. & E. Tiselius. (2020). Making the most of retrospective process tracing in dialogue interpreting research. *FITISPOS International Journal*. 7(1), 53-71.
- Hunziker Heeb, A. (2020). *Effects of directionality on professional translators' processes, products and effort*. Hildesheim: Universitätsverlag Hildesheim.
- Ivanova, A. (2000). The use of retrospection in research on simultaneous interpreting. In: S. Trikkonen-Condit, R. Jääskeläinen (eds.), *Tapping and mapping the process of translation and interpreting: Outlooks on empirical research*. (pp. 27-52). Amsterdam; Philadelphia: John Benjamins Publishing Company. DOI: <https://doi.org/10.1075/btl.37.05iva>
- Jakobsen A. L. (2002). Translation drafting by professional translators and by translation students. In: G. Hansen (ed.), *Empirical translation studies. Process and product*. (pp. 191-204). Copenhagen: Samfundslitteratur.
- Jakobsen, A. L. (2011). Tracking translators' keystrokes and eye movements with Translog. In: C. Alvstad, A. Hild, E. Tiselius (eds.), *Methods and Strategies of Process Research: Integrative approaches in translation studies*. (pp. 37-55). Amsterdam; Philadelphia: John Benjamins Publishing Company. DOI: <https://doi.org/10.1075/btl.94.06jak>
- Kruger, H. (2016). What's happening when nothing's happening? Combining eye tracking and keylogging to explore cognitive processes during pauses in translation production. *Across Languages and Cultures*. 17(1), 25-52. DOI: <https://doi.org/10.1556/084.2016.17.1.2>
- Lemhöfer K. & Broersma M. (2012). Introducing LexTale: a quick and valid lexical test for advanced learners of English. *Behavior Research Methods*. 44, 325-343.
- Newmark, P. (1988). *A Textbook of Translation*. New York: Prentice Hall.
- Pavlovič, N., Jensen, K. T. H. (2009). Eye tracking translation directionality. In: A. Pym, A. Perekrestenko (eds.), *Translation Research Projects 2*. (pp. 93-109). Tarragona: Intercultural Studies Group.
- Pavlovič, N. (2010). What were they thinking?! Students' decision-making in L1 and L2 translation process. *Hermes – Journal of Language and Communication Studies*. 44, 63-87.

- Pellicer-Sánchez, A., Siyanova-Chanturia, A. & Parente, F. (2022). The effect of frequency of exposure on the processing and learning of collocations: A comparison of first and second language readers' eye movements. *Applied Psycholinguistics*. 43, 727-756. DOI: <https://doi.org/10.1017/S014271642200011X>
- Pęzik, P. (2012). Wyszukiwarka PELCRA dla danych NKJP. In: A. Przepiórkowski, M. Bańko, R. Górski, B. Lewandowska-Tomaszczyk (eds.), *Narodowy Korpus Języka Polskiego* (pp. 253-274). Warszawa: Wydawnictwo Naukowe PWN.
- Pietryga, M. (2022). Perception of directionality in translation among students. *Acta Neophilologica*, 24(1), 87-109.
- Pietryga, M. (2025). Eye-key span as a measure of cognitive effort in translation. A study on the influence of directionality on cognitive effort. *New Voices in Translation Studies*, 30(1), 104-127. <https://doi.org/10.14456/nvts.2025.4>
- Rojo López, A. M., Foulquié-Rubio, A-I., Espín López, L. & Martínez Sánchez, F. (2021). Analysis of speech rhythm and heart rate as indicators of stress on student interpreters. Perspectives. 29(4), 591-607. DOI: <https://doi.org/10.1080/0907676X.2021.1900305>
- Saldanha, G. & O'Brien, S. (2013). *Research methodologies in translation studies*. London; New York: Routledge. DOI: <https://doi.org/10.4324/9781315760100>
- Sjørup A. C. (2013). *Cognitive Effort in Metaphor Translation: An Eye-tracking and key-logging Study, PhD series*. Copenhagen Business School (CBS): Frederiksberg.
- Sonbul S., El-Dakhs, D., A., S. & Al-Otabi, H. (2022). Translation competence and collocation knowledge: Do congruency and word type have an effect on the accuracy of collocations in translation. *The Interpreter and Translator Trainer*. 16(4), 409-427. DOI: <https://doi.org/10.1080/1750399X.2022.2084251>
- Vik-Touvinen G-V. (2002). Retrospection as a method of studying the process of simultaneous interpreting. In: G. Garzone, M. Viezzi (eds.), *Interpreting in the 21st century: Challenges and opportunities*. (pp. 63-71). Amsterdam; Philadelphia: John Benjamins Publishing Company. DOI: <https://doi.org/10.1075/btl.43.07vik>
- Vottonen, E., Kujamäki, M. (2021). On what grounds? Justifications of students translators for their translation solutions. *The Interpreter and Translator Trainer*. 1-20. DOI: <https://doi.org/10.1080/1750399X.2021.1891514>
- Whyatt, B. (2019). In search of directionality effects in the translation process and in the end product. *Translation, Cognition and Behaviour*. 2(1), 79-100. DOI: <https://doi.org/10.1075/tcb.00020.why>

ABOUT THE AUTHOR

Marcelina Pietryga holds a PhD in linguistics and works as an assistant professor at the University of Silesia in Katowice, Poland. Her research interests include translation and interpreting processes, directionality, and cognitive effort.