GOOGLE TRANSLATE SEARCH STRATEGIES AMONG LEARNERS OF SPANISH L3 – A COMPLEX LEXICO-MORPHO-SYNTACTIC WEAVE OF TRIAL-AND-ERROR

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ABSTRACT

This article presents a study on Google Translate search strategies among 16 Swedish upper secondary school pupils (age 17-18) engaging in writing tasks during their sixth year studying Spanish L3. The pupils wrote on laptops with Internet access and were allowed to use Google Translate to search for Spanish words. Analyses of approximately 43 hours of screen recordings covering the writing of 57 essays reveal a complex weave of Google Translate search strategies performed in Swedish, English, and Spanish. The strategies combine lexical and morphosyntactic searches, ranging from single words to longer sequences of words. The searches were frequently characterised by trial-and-error-based approaches which comprised numerous control translations of already known words. The observations also reveal search behaviours interpreted as a lack of trust among the pupils in the search results as well as in their own language skills.

KEY WORDS

Free online machine translation; Spanish as a foreign language; foreign language learning; foreign language writing; computer-assisted language learning

RESUMEN

Este artículo presenta un estudio sobre las estrategias de búsqueda en el Traductor de Google durante la escritura de redacciones en el sexto año de estudios de español L3 en un grupo de 16 estudiantes suecos del bachillerato (17 a 18 años de edad). Los estudiantes utilizaron ordenadores portátiles con acceso libre al Internet y podían usar el Traductor de Google para buscar palabras en español. Los análisis de aproximadamente 43 horas de grabaciones de

pantallas, correspondientes a la escritura de 57 redacciones, revelan un tejido complejo de estrategias de búsqueda hechas en sueco, inglés y español. Estas estrategias constan de búsquedas lexicales y morfosintácticas, desde las búsquedas de palabras sueltas hasta las de secuencias más largas. Las búsquedas fueron frecuentemente caracterizadas por métodos de prueba y error que incluyen numerosas traducciones para controlar palabras que los estudiantes ya conocían. Las observaciones revelan también métodos de búsqueda interpretados como basados en una falta de confianza tanto en los resultados de búsqueda como en los propios conocimientos de la lengua.

PALABRAS CLAVE

Traducción automática; español como lengua extranjera; aprendizaje de lenguas extranjeras; escritura en lenguas extranjeras; aprendizaje de lenguas; enseñanza de lenguas asistida por computador

1. INTRODUCTION

Foreign language learners' frequent use of Google Translate (GT) and similar sites offering free online machine translation (FOMT) is a reality that is well-known among language teachers; indeed, Ducar and Schocket (2018, p. 779) call GT "an inescapable reality in today's second language (L2) classroom", and studies have shown that language learners frequently resort to FOMT tools even when instructed not to (O'Neill, 2019; Fredholm, 2015a; Kazemzadeh & Fard Kashani, 2014; Garcia & Pena, 2011; Niño, 2009; Williams, 2006; Luton, 2003). Machine translation use among L2 and L3 learners is being studied in a small but growing number of publications. However, despite the omnipresence of easily available machine translation services such as GT, so far language learners' search strategies when using GT during written text production have not been studied in detail, apart from a small number of studies which do not focus exclusively on GT search strategies. Fredholm (2015a) has observed spontaneous use of online resources among upper secondary pupils writing in Spanish L3 and found that different machine translation sites were used for almost half the word count in each text. In a partially similar study, Knospe, Sullivan, Malmqvist, and Valfridsson (2019) observe the use of online sources among German L3 learners and describe the GT use among some of them. Although the above-mentioned studies show to some degree what FOMT use among young L3 writers may look like, no study so far explicates the complex interplay of different search strategies. The present article delves further into FOMT use among Spanish L3 learners, studying in closer detail their GT search strategies. It gives insights into a wide variety of GT search strategies within a group of Swedish learners of Spanish L3. These insights are of importance to researchers in the language education and foreign language writing fields, and to practicing language teachers who face the presence of a competing source of information in their classrooms, in the form of a digital translation interface.

Hyland (2016, p. 40) states that a literate person needs to have "control over a range of print and electronic media", and concludes that these media have affected our ways of writing and of accessing information, and that this has given "writing teachers new challenges and opportunities for classroom practice" (ibid.). The use of FOMT, in combination with an increase in computer-based writing instead of paper-and-pen-based approaches, constitutes such a challenge but, perhaps, also an opportunity for language teachers and pupils to resort

to a wider array of ways to tackle language problems in foreign language writing. Of course, GT may not be the only resource a struggling language learner resorts to in order to solve a linguistic conundrum; yet, the present study focusses on GT usage as this is one of the most easily available and most frequently used language resources (Aiken, 2019), and a topic of much concern to many a language teacher. Clarifying pupils' strategies for searching lexical and morphosyntactic information in schools with free access to one of the most common online language resources, can help foreign language teachers better to understand the needs of their pupils, and may serve as valuable input for further studies on how language learners tackle problems in modern foreign language writing settings.

2. PURPOSE AND RESEARCH QUESTIONS

The purpose of the present study is to give a detailed account of GT search strategies used by a group of Spanish L3 learners during essay writing, and to discuss what the observed strategies may imply for foreign language teaching. In line with Fredholm (2015a, 2015b), the word *strategy* is used to denote all actions performed by the participants in order to solve L3 writing problems; in the present case specifically to denote actions performed to search for lexical and morphosyntactic information needed to communicate a desired content in essays written in Spanish L3.

Explicating how pupils solve problems in a digital writing situation further deepens the insights from earlier studies such as Fredholm (2015) and Knospe et al. (2019). No earlier study has been found that aims to clarify in a detailed manner how L3 learners use GT's affordances (cf. Gibson, 1986; Adolph & Kretch, 2015) while writing.[1] The present study, thus, contributes to FLW researchers' and foreign language teachers' understanding of the complex interplay of search strategies used by L3 learners.

The study focusses on the following research questions:

- What GT search strategies do Spanish L3 learners use to search for lexical and morphosyntactic information during essay writing?
- What possible implications for foreign language teaching can be drawn from the observed GT search strategies?

[1] There are, certainly, studies of professional translators' and translator students' use of machine translation within the computer-assisted translation research field (cf. Kim, 2019), but the differences between translation professionals and intermediate level L3 learners make the findings from these studies of little significance here.

The observed search strategies are presented in section 5 of this article. Implications for foreign language teaching are discussed in section 6.

3. Earlier studies on machine translation use in foreign language writing

Foreign language writing (FLW) constitutes a vast research field that studies different aspects of L2 and L3 writing. After Flower and Hayes' (1981) model of the writing process, several models have been proposed to pinpoint the special characteristics of FLW processes (Nas & van Esch, 2018). The present article focusses on strategies for FOMT use in FLW, a field of research which is highly relevant in today's digitalised foreign language learning settings.

Earlier studies on FOMT use among foreign language learners have investigated different aspects of what happens with texts written with FOMT support. Studies such as Niño (2008), Garcia and Pena (2011), and Fredholm (2015c) point to benefits as well as drawbacks. (See Kim, 2019, Thue Vold, 2018, and Errol Marinus O'Neill, 2012 for more comprehensive summaries of earlier research on FOMT use in FLW settings.) Likewise, there is little consensus regarding the question whether FOMT use should be seen as plagiarism and cheating or not (Ducar & Schocket, 2018; Correa, 2014), but more recent papers on the subject seem more accepting of GT's presence as a reality, and tend to advocate for a judicious use of the technology, rather than a complete ban.

A few attempts (such as Fredholm, 2019) have been made to elucidate aspects of longitudinal outcomes of FOMT use. Within the field of translation studies, Alsalem (2019) shows that post-editing translations executed with GT may be beneficial for learning translation skills, but writes that this effect may be reduced if users over-rely on GT and do not work sufficiently with their texts, concluding that "students should avoid using technology to circumvent the requirements for proper training, which could ultimately lead to less learning" (p. 58). Similar hypotheses are presented by Larson-Guenette (2013), Garcia and Pena (2011), and Garcia (2010), but long-term learning outcomes are not investigated.

Leaving the difficult question about learning outcomes aside, only a small number of studies, primarily Fredholm (2015a) and Knospe et al. (2019), investigate *how* pupils use FOMT and other online resources during L3 writing. Farzi (2016) approaches the question, but does not give a detailed account of FOMT use strategies. Fredholm (2015a) observed L3 writing behaviours based on a variety of Internet-based information retrieval strategies; apart

from using Google searches for information, grammar help such as verb paradigms, retrieval of language-specific letters and punctuation marks, and picture searches to verify the accuracy of translated words, the participants resorted to a high degree to the FOMT sites *Google Translate* and *Lexikon24*. An average amount of 44.43% of the total amount of words in each essay were machine translated, with a wide individual range in single essays from 6% to 100%. Even in the control group, prohibited to use online resources, a majority of the pupils resorted to FOMT by using their mobile phones. The search strategies lead to frequent switches between the text that was being written, the FOMT sites, and the Google searches.

Similar actions as in Fredholm (2015a) were observed in a study on the use of online sources among seven Swedish learners of German L3, conducted by Knospe et al. (2019). The researchers found a constant split attention between writing and information retrieval. As in Fredholm (2015a), the pupils started using the online sources early on in the writing sessions, and wrote without much planning beforehand. Great variations were found among the participants, who mainly used their L1 to search for words, grammar, and other information. Knospe et al. (2019) divide the writers into two main categories based on writing behaviour: a group called "controlling the sources" and another called "controlled by the sources" (p. 265). This is to some extent comparable to Tate and Warschauer's (2019) study on American 8th graders' use of computers while writing, presenting five writer profiles ranging from more efficient to less efficient computer users. They conclude that abilities to handle digital writing depend on the instruction pupils receive on keyboarding and other aspects of computer use.

In Knospe et al. (2019), the "controlling the sources" group did not rely on FOMT and were able to search for words in their uninflected forms, and/or were able to detect what led to problems in their search for words, and could correct their search terms. The "controlled by the sources" writers relied more frequently on online sources and were less critical when judging the search results. Many searches are described as unnecessarily time-consuming. The researchers found frequent double-checking of words or sentences in some pupils' writing processes, a strategy also found by Clifford, Merschel and Munné (2013), and stepwise changes in translations of complex phrases until reaching a satisfactory result. Knospe et al. (2019, p. 277) conclude that writing while using online sources "is a complex process of hypothesis testing that frequently involves a high degree of learner attention and

cognitive load". According to Knospe et al. (2019), this may entail a cognitive load that struggling writers with a very reduced vocabulary are not able to support for extended writing sessions.

The complex hypothesis-testing view of writing with online sources that Knospe et al. (2019) describe can be seen in light of Hyland's (2016, p. 41) statement about the new "challenges and opportunities" that media access presents to classroom writing practices, mentioned in the introduction to this article. Hyland (2016) further states that the use of electronic media allows the assembly of text and images. In the context of today's foreign language classrooms, we might elaborate this statement by adding that the easy access to GT enables written products in foreign language writing to become assemblies of both independently written text snippets and search results. Freely available online tools such as GT afford even inexperienced writers with the possibility to produce texts or parts of texts far beyond the writers' own capabilities. Whether the writers can evaluate the correctness or context adequateness of these translations is another question.

Kim (2019, p. 10) points to the complexity of using mediational tools such as online translation, dictionaries or thesauri, and writes that a deep understanding of both "benefits and potential dangers of misuse" is necessary to enable a good usage of the tools. The author finds that GT often cannot handle homophones (in the particular case, in Korean), nor colloquial expressions or "cultural-specific phrases" (p. 18). A mix of FOMT approaches and online dictionaries is recommended, and FOMT can be used as a way of raising language awareness through discussions, an educational application of FOMT tools also highlighted by Thue Vold (2018). Kim (2019) also mentions the importance of "schematic world knowledge" (p. 20), that is, common sense based on one's knowledge about the world, in order to judge context appropriateness. As learners need guidance, they should not be left to fend for themselves as best they can with the technology. This concords also with views in Medvedev (2016, p. 188), who stresses the need for "more critical thinking on the part of the educator and the learner", especially when determining context adequacy and correctness of synonymous or polysemous lexemes and expressions, an area where he finds GT unreliable. The opinions found in recent literature on FOMT use in language learning settings may, thus, perhaps be summarised as a need for more critical thinking rather than letting the machine take control over what is being written.

4. METHODS

4.1 Participants and data collection

In collaboration with two Spanish teachers in a Swedish upper secondary school, the researcher followed 31 pupils (aged 17-18) during their sixth year of Spanish L3 studies, a level intended to correspond to levels A2.2 to B1.1 in the *Common European Framework of Reference for Languages* (Council of Europe, 2001). From September 2016 to May 2017, the pupils wrote a pre-test, four intervention essays, and a post-test. The pre- and post-tests were written by hand without any translation tools, whereas the intervention essays were written on the pupils' laptops.

The pupils were randomly divided into "googlers" (N=16), allowed Internet access, and "non-googlers" (N=15), who used printed bilingual dictionaries and were blocked from Internet access. The grouping was slightly altered to gain an even distribution of Spanish grade levels within each group, based on the pupils' grades in Spanish from the previous school year. The non-googlers functioned as a control group for other parts of the study, and will not be commented upon in the present article.

The pupils received the same teaching, worked with the same themes, and wrote about the same essay topics (albeit in different chronological orders). They were not allowed to interact during the writing sessions and received no help apart from technical assistance with the screen recordings. The googlers' computer screens were recorded with the screen-recording application *apowersoft.com*. This enabled a detailed analysis of the pupils' writing and search behaviours. Two screen recordings failed due to technical issues; the two corresponding essays are not included in the analysis. The screen recordings amount to a total time of 43 hours, 8 minutes and 16 seconds, ranging from 27 minutes and 36 seconds to 57 minutes and 22 seconds with a mean length of 45 minutes and 24 seconds. Mean text length in the essays was 191.59 words, ranging from 51 to 342 words. The data used for the present study are summarised in Table 1.

TABLE 1. DATA USED FOR THE STUDY.

Data type	Amount	Mean length	Shortest	Longest
Intervention essays	57	191,59 words	51 words	342 words
Screen recordings	57 recordings 43 h. 8 min. 16 sec.	45 min. 24 sec.	27 min. 36 sec.	57 min. 22 sec.

4.2 Methods for analysis

The screen recordings were observed in close detail and every action performed to make a GT search was annotated, as well as what parts of each text were the result of the GT searches. All-in-all, 7137 actions related to GT searches – typing or deleting words, clicking, copying and pasting – were found. These actions produced 4112 instances of GT searches. Out of these 4112 searches, 117 consisted of translations into Swedish or English of parts of the Spanish instructions to the essay topics. These searches are not considered here, as they have less to do with the pupils' ability to write than with their passive vocabulary and capability for written comprehension. When these cases are removed, thus, 3995 GT searches remain.

The observed GT search actions were given a first, rough categorisation based on the content of the searches: translations of single words or word sequences; translations of new words previously not sought; double-checking of already written words; types of changes made within series of searches, for instance to spelling or morphosyntactic elements; languages that were used; interactions with the GT interface. These categories were further elaborated and refined stepwise during several subsequent analyses of the material intended to clarify and simplify the multifaceted complexity of actions found in the screen recordings. In this process, subcategories with a common denominator were grouped together, for instance the different kinds of morphosyntactic changes which were found in the material. The data guided the process inasmuch as no categories were established beforehand.

Arriving at a clear and irrefutable categorisation of the observed GT search strategies was an arduous and by no accounts self-evident task, as the strategies more often than not intermixed with each other. Indeed, an initial attempt at a categorisation of the translated words in parts of speech or other morphosyntactic subdivisions was found to be of little practical value, as a large part of the search actions continuously mixed lexical and morphosyntactic elements. The search strategy categorisation presented in section 5 is an attempt to show this complexity in as uncomplicated a way as possible.

4.3 Ethical considerations

Essay writing is a natural part of the curriculum, and the participants were accustomed to using their laptops at school. The writing sessions were designed together with the teachers to form a natural part of the Spanish lessons, to ensure as little disruption of the normal course content as possible, and to avoid unnecessary nervousness among the participants. All pupils

were asked to write the essays, but could choose freely to give their consent for the researcher to take part of the material, and were able to withdraw this consent at any time during the school year. They were informed that the essays would not affect grading, and that screen recordings and results from pre- and post-tests would be available only to the researcher. The teachers had access to the intervention essay texts and used them to give formative feedback at a group level. The collected documents and recordings were de-identified prior to analysis, and the pupils were informed that any text or screen recording used as examples in publications would be anonymised. No sensitive topics or questions were used in the project.

5. RESULTS

This section answers the first research question – What search strategies do Spanish L3 learners use to search for words and phrases in Google Translate during essay writing? – by presenting the GT search categories found in the screen recordings. Each category is given one or several examples consisting of commented screenshots selected to clarify the various search categories. The screenshots are cropped to show only the GT search bar (except in a few cases where additional details need to be visible). Sharpness and contrast have been enhanced with the picture editing tool in Microsoft Word for Mac (version 16.16.7) to increase legibility. Text size and appearance of the GT search bar in the examples vary depending on the amount of text written in the GT search box and whether the pupils performed the searches in a GT search bar on the general Google search page (www.google.com) or on the GT homepage (www.translate.google.com).

Time indications (minutes ’ and seconds ’’) show when an action was performed during a specific writing session. English translations of Swedish and Spanish words are given ‘between single quotation marks’ and are kept as close as possible to the original search strings. Additional clarifications are given [in brackets] when needed. Further comments on search actions, and information about how search results were used in the essays, are given in the tables in connection with related searches when relevant.

The pupils have been given fictitious names, followed by a number to indicate which of the four intervention essays an example denotes, for instance *Anton*:1 referring to *Anton’s* first essay.

5.1 Amount of GT use

The mean amount of machine translated words out of the total word count in the essays was 43.69%. No earlier study stating the amount of machine translated text in FLW has been found, apart from Fredholm (2015a); earlier studies have investigated how many foreign language students that resort to FOMT or how often they use it, reporting a widespread use (O'Neill, 2019; Jolley & Maimone, 2015; White & Heidrich, 2013; Clifford et al., 2013). The amount of machine translated words found here comes very close to the mean amount of 44.43% in Fredholm's earlier studies on FOMT use among Swedish learners of Spanish (Fredholm 2015a, 2015b, 2015c). In Fredholm (2015c), no statistically significant correlation was found between the amount of FOMT use and grade levels, whereas such a correlation (Fisher exact test p 0.001) can be seen in the data for the present study, where pupils with lower grades used GT more extensively (Fredholm, 2019). An amount of 40% to 50% of machine translated words may perhaps be expected among L3 writers at this proficiency level; however, this needs to be studied further.

Studies such as Chandra and Yuyun (2018), Clifford et al. (2013), and O'Neill (2012) have found that FOMT searches among foreign language writers predominantly concern vocabulary, rather than grammar. In the present study, the observations revealed highly mixed search approaches among all the participants, blurring separation lines between vocabulary and grammar searches, as will be shown in the following sections.

5.2 Languages used in the GT searches

The use of English, restrained to one participant in Knospe et al. (2019), was seen among 13 of the 16 pupils in the present study. The pupils mainly translated from Swedish to Spanish (64.25% of all searches), but English was also used, primarily when translations from Swedish did not yield clear results. More than a fifth (22.15%) of the GT searches involved the use of the English language. Four pupils used almost exclusively English, and three additional pupils used predominantly English in their last essay. One pupil with English L1 only performed searches from English to Spanish. This pupil, however, performed relatively few searches which do not affect the amount of English use to any greater extent; when he is removed from the data, the amount of GT searches involving English still reaches 20.8% of the remaining searches. The language use is summarised in Figure 1.

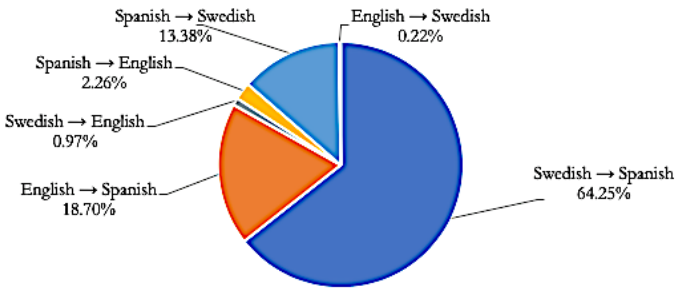


FIGURE 1. LANGUAGES USED IN GOOGLE TRANSLATE SEARCHES (% AMOUNT OF TOTAL NUMBER OF SEARCHES).

On rare occasions, words were translated between Swedish and English (or vice versa), before the translated word was used to find a word in Spanish. Translations from Spanish to Swedish (and sometimes English) were common and mainly represent control translations of words that the pupils already knew (but were not sure of) and of words and phrases already translated to Spanish. The use of three languages was seen in all of the GT search strategies.

5.3 Google Translate search strategies encountered in the screen recordings

The GT search strategies found in the screen recordings can be subdivided into four main categories:

- single word translations (seen in 31% of all GT searches)
- translations of word sequences (58%)
- stepwise re-elaborations of words and sequences (45%), and
- control translations (11%).

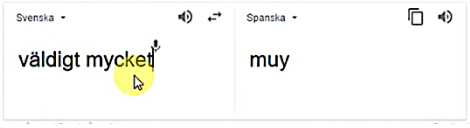
The total amount reaches more than 100% as several searches involved more than one strategy; for instance, many series of word sequence searches also contained stepwise re-elaborations and/or control translations. Whereas the translation of single words may be seen as a fairly straightforward use of GT as a dictionary, the re-elaborative searches and the control translations were characterised by iterative trial-and-error approaches to finding the appropriate wording.

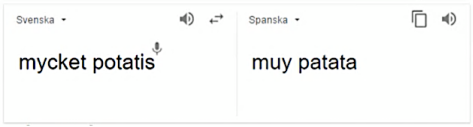
5.4 Single word translations

Almost a third (31%) of the GT searches concerned single words. This strategy may be compared to the use of a printed dictionary, with the exception that GT also makes searching for inflected word forms possible (sometimes helping the pupils, in other cases not, such as

when translating polysemous words). GT can handle translations of basic vocabulary fairly well, but mistakes may occur as GT often cannot determine context adequateness of a single word or expression (cf. Medvedev, 2016, p. 185). Single word searches without additional re-elaborations were seen for instance when pupils produced lists or enumerations of (mainly) nouns, such as in the example in Table 2, where *Astrid* writes about what her family usually eats during a Swedish holiday.

TABLE 2. GT USED AS A DICTIONARY FOR SINGLE WORD SEARCHES. ASTRID:2

Time	**GT search**	**GT result**
	Before the first search, she has written *Comemos* 'we eat'.	
13'47''		
	'egg[s]'	'eggs'
13'54''		
	'herring'	'herring'
13'58''		
	'fish'	'fish'
14'06''		
	'potato'	'potato'
	Goes to the Word document, writes *huevos, pescado y much*. Deletes *much*. Returns to GT.	
14'52''		
	'a huge lot of'	'very'
14'56''		
	'a huge lot of potato'	'a large quantity of potatoes'

15’04’’	 ‘a lot of potato’ ‘very potato’	
	Returns to the text and adds *muy patatas* ‘very potatoes’ at 15’28’’.	

Single word searches were often an initial stage or an interposed part of searches that led to longer sequences, built up step by step, as can be seen at the end of *Astrid’s* search in Table 2. The initial translation of a single word may thus evolve into a search for longer sequences, which underlines the many times unstructured trial-and-error approach to GT searches and to the stepwise formation of a text. Combined with direct translations of word sequences (section 5.5), this illustrates the pupils’ extensive use of GT to string words together, and their apparent insecurity regarding basic vocabulary.

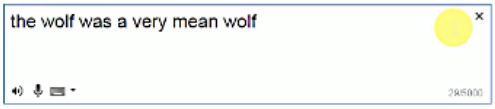
5.5 Word sequence translations

More than half (58%) of the GT searches comprised translations of collocations, phrases, clauses, and complete sentences, here called “word sequences” to simplify and to avoid further subcategorisations; it proved difficult to draw a clear line between phrases, complete clauses, and full sentences, since these searches, as we shall see in section 5.6, often began with a few words and were augmented and re-elaborated until a satisfactory result was achieved. The word sequence translations were generally executed intermittently during the writing processes, whenever the pupils needed them to communicate the desired content.

On rare occasions, the screen recordings reveal a linear writing process where idea generation and writing are performed almost exclusively sequence by sequence, directly in the GT search bar. This is the case with *Amanda’s* writing, especially in her fourth essay. The adoption of such an approach does not mean that the pupils were content with the first thing that appeared in the search result box (frequent changes were made to the search strings before a search result was accepted), but rather that some pupils did not bother to write primarily in the Word document. The text document, in these cases, can perhaps be seen more as a canvas onto which the accepted search results were transcribed, and the GT search bar as a kind of scribbling paper discarded later on.

Table 3 shows two consecutive sequence searches accepted as they are and inserted into the text without changes.

TABLE 3. WORD SEQUENCE TRANSLATIONS WITHOUT RE-ELABORATIONS. AMANDA:4

Time	GT search	GT result
21'47''		 'The wolf was a very bad wolf'
	Copies and pastes the translation into the text.	
22'12''		 'And when I went away'
	Manually transcribes the translation in the text and continues the phrase with her own words.	

5.6 Re-elaborations of words and sequences

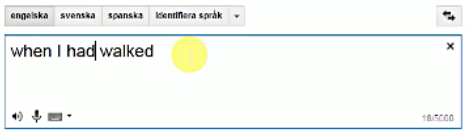
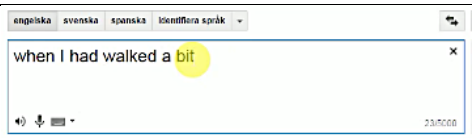
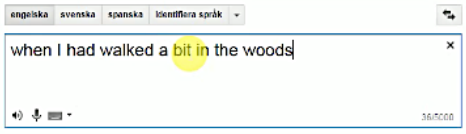
Every pupil resorted to trial-and-error-based search strategies, re-elaborating search strings by changing, adding or deleting words until they were satisfied with a word or a longer sequence. Re-elaborations were found in 45% of all GT searches, often combined with translations of word sequences or control translations. The intermediate steps were often contextually or syntactically incomplete in ways that rendered the translations more difficult and less accurate, depending for instance on missing subject pronouns or auxiliary verbs with the main verbs left out. For many participants, re-elaborations were a very frequent strategy; only two pupils used it sparingly.

Many of the re-elaborations led to search strategies found also by Knospe et al. (2019), who describe them as "long-lasting, complicated and in many cases ineffective" (p. 271), which is true for many re-elaborative searches also in the present study. The re-elaborative strategies can be subdivided into sub-categories according to the changes made in the search string. In the following subsections, we shall take a closer look at these search strategies.

5.6.1 Stepwise re-elaborations

The example in Table 4 shows a common strategy combining stepwise additions (or deletions) of words and reformulations of parts of the search string.

TABLE 4. STEPWISE ELABORATION OF A SEQUENCE. AMANDA:4

Time	GT search	GT result
10’29’’		‘When I had walked’
10’32’’		‘When I had walked a little’
10’37’’		‘When I had walked a little in the forest’
	Copies and pastes entire phrase into text.	

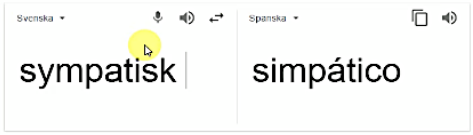
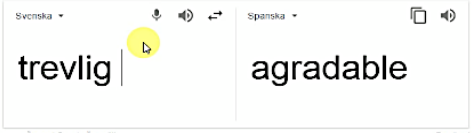
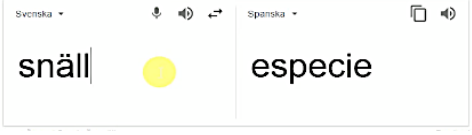
Reformulations like the above mentioned also included two pupils (*Bella* and *Anna*) changing word order in the GT search box, from subject-verb to verb-subject, a strategy that led to no changes in outcome.

5.6.2 Synonyms and circumlocutions

When the first attempt did not yield a satisfactory translation, many pupils used GT to try out circumlocutory expressions, synonyms, and words from the same semantic field. They used it for nouns, adjectives, and verbs. Circumlocutions are mentioned in Knospe et al. (2019) as a way for (competent) writers to resolve problems. The screen recordings in the present study further underscore the need for a good grasp of the target language for this strategy to be successful.

Table 5 shows an excerpt from *Beata’s* third essay. She used synonyms as one of her main strategies. This may also be seen as an example of the frequently encountered trial-and-error approaches. The excerpt also shows how GT, translating from Swedish via English to Spanish, mistakes the Swedish adjective *snäll* ‘kind’ for the English noun *(a) kind*.

TABLE 5. TRYING OUT SYNONYMS. BEATA:3

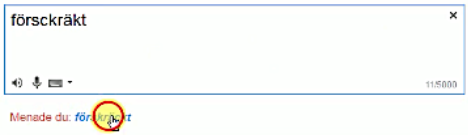
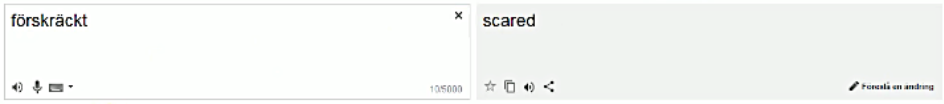
Time	GT search	GT result
	She has searched *Santa Claus*, arrived at *Papá Noel* 'Father Christmas', and written *En navidad Papá Noel es muy* 'At christmas Santa Claus is very' in her text.	
12'22''		
	'kind' [adj.]	'kind' [noun]
12'32''		
	'sympathetic'	'sympathetic'
12'37''		
	'nice'	'nice'
	Switches to the Word document, writes nothing, then goes back to GT.	
12'45''		
	'friendly'	'please'
12'49''		
	'kind' [adj.]	'kind' [noun]
12'53''		
	'nice'	'nice'
13'06''		
	'kind' [adj.]	'kind' [noun]
13'12''		
	'Santa Claus is kind'	'Santa Claus is a kind'
	Switches to the Word document. At 13'34'' she adds *especie* to the text, switching back to GT twice to check the spelling.	

5.6.3 Changing spelling

Changes to spelling occurred in two types: instigated by the pupils themselves, or performed after a suggestion from GT, as in Table 6. GT is sometimes also capable of producing translations of misspelled words, without asking the user to first choose the correct spelling (cf. Ducar & Schocket, 2018), something that was seen a few times in the screen recordings.

This category also comprises the use or non-use of accents and other diacritics, an area where some pupils clearly struggled to write them correctly. When diacritics were omitted, misplaced or incorrectly written, some translations were incomprehensible, and the omission of English genitive apostrophes rendered translations with plural forms.

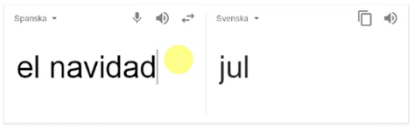
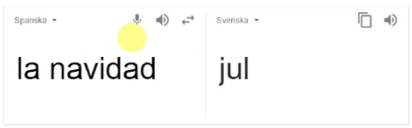
TABLE 6. CHANGING SPELLING. AURORA:4

Time	GT search	GT result
23'24''		
	'terrified' [misspelt]	* 'försckräkt'
	Clicks GT's suggestion for spelling correction.	
23'25''		
	'terrified'	
	Uses the result to continue with a translation of a paragraph from English to Spanish.	

5.6.4 Morphosyntactic changes

A frequent strategy to find the right translation consisted in making small morphosyntactic changes to word forms. The strategy was used in several different ways and was adopted for verbs, nouns, pronouns, adjectives, and even prepositions in a few cases where alternative forms are available in Swedish, such as *från* and *ifrån* (both meaning 'from'). The changes sometimes also involved a change of word class, for instance from a noun to an adjective. As for the nouns, the morphosyntactic changes included re-elaborations from singular to plural or vice versa, changing noun definiteness or changing noun genders by trying out different articles. In the example in Table 7, *Beata* tried different determinate articles, plausibly in order to ascertain the gender of the Spanish noun *Navidad* 'Christmas'.

TABLE 7. TRYING OUT GENDERS. BEATA:3

Time	GT search	GT result
23’53’’		
	*‘the christmas’ [incorrect masc. article]	‘Christmas’
23’58’’		
	‘the christmas’ [correct fem. art.]	‘Christmas’

Strategies like these often failed, as search strings in the determinate form sometimes were given anarthrous translations, thus not guiding the pupils to the correct article or gender. In cases like these, a printed dictionary would solve the problem more easily, provided that the pupil know how to use it.

Spanish verbs constitute a difficult task to master due to their rich morphology, and it is not surprising that the pupils used GT to search for verb forms. These frequent trial-and-error approaches included adding or subtracting the sign of the Swedish infinitive *att* ‘to’, trying out different verb endings (existing and non-existing), and translating both diphthongised and monophthongised versions of verb stems (thus sometimes creating new forms that do not exist in standard Spanish). Table 8 shows an example of these complex search strategies. The excerpt is from *Betty’s* second essay, where she tried out different endings for the preterit tense of *aprender* ‘to learn’. As the previous sentences in her essay were written in first person singular, it is likely that she searched for “I learned”.

TABLE 8. TRYING OUT VERB ENDINGS. BETTY:2

Time	GT search	GT result
9’10’’		
	*‘aprené’	‘I *aprené’
9’17’’		
	*‘aprendé’	‘Learn how to’ [imperative]

9’29’’		
	*‘aprendó’	‘you learn’ [2nd p. sg.]
9’37’’		
	‘learned’ [3rd p. sg. pret.]	‘he learned’
	Adds *Aprende muchos* ‘He/she learns many’ to the text.	

In this case, GT did not help, and in the end, *Betty* failed to find the correct form and opted for the present tense, third person singular. A strategy like this undoubtedly requires a good basic knowledge of the Spanish verb system to be able to recognise the correct form; naturally, if one already knows the correct form, one does not need to make use of GT in the first place. As found also in Fredholm (2015), pupils sometimes not only did not recognise correct/incorrect verb forms, but also seemed to hesitate when confronted with search results that could not possibly constitute a verb, such as when *Barbara* in her fourth essay searched for a Spanish translation of the Swedish verb form *bad* ‘prayed’ or ‘asked [for]’, preterit tense of *be*) and GT showed a translation of the homograph *bad* ‘[a] bath’, *natación*.

Finding and correctly understanding Spanish pronouns appeared problematic for many pupils, who mixed personal and possessive pronouns without recognising their different forms or functions. Morphological changes were made also to pronouns as a strategy to find the correct form. When enclitic object pronouns such as *lo* and *la* ‘him’, ‘her’, ‘it’ appeared in search results, they seemed to confuse the pupils, who tried back-translations of these words to ascertain their meaning, often with incorrect or incomplete results.

The informal second person plural pronouns *du* ‘you’ and *din*/*dina* ‘your’ caused many problems as they were frequently translated with the formal Spanish third person singular *usted* ‘you’ (sg.) and the polysemous *su*/*sus* ‘your’, ‘his’, ‘her’, ‘their’. Ducar and Schocket (2018) discuss how context depending levels of formality are rendered differently in GT searches from English to Spanish or French, stating that GT uses the informal second person singular in Spanish translations of English *you*, but the formal second person plural in translations to French. In the 3995 GT searches analysed for the present study, GT did render English *you* (both as subject and object) and *your*, as Spanish informal *tú*, *te*, *tu* and *tus* in most cases, but exceptions were also found, especially concerning the possessive pronouns.

When Swedish *du* was used, the search results were highly inconsistent, repeatedly showing translations with alternating second person singular and third person singular verbal endings within a few seconds after each other. The excerpt in Table 9 gives an example of *Beata* looking for the right translation for *dig* 'you' (2nd p. sg. dir. obj.).

TABLE 9. CHANGING PRONOUNS. BEATA:1

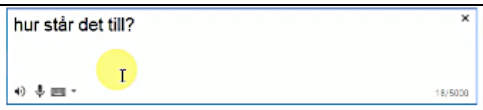
Time	GT search	GT result
30'47''	ingen ska bestämma över dig	nadie debe decidir sobre ti
	'no-one must decide for you'	'no-one must decide about you'
	Writes *pienso que de nadie debe decidir sobre* in the text, looking four times at the search result.	
31'35''	dig	usted
	'you' [2nd p. sg. obj.]	'you' [3rd p. sg. subj.]
31'39''	du	usted
	'you' [2nd p. sg. subj.]	'you' [3rd p. sg. subj.]
31'43''	dig	usted
	'you' [2nd p. sg. obj.]	'you' [3rd p. sg. subj.]
31'49''	bestämma över dig	Si decide
	'decide for you'	'If [3rd p. sg.] decide(s)'
31'53''	bestämma över dig!	decidir sobre ti!
	'decide for you!'	'[to] decide about you!'
	Adds *ti!* 'you!' to the text.	

5.6.5 Adding punctuation

A few pupils tried adding punctuation (full stops, question marks or exclamation marks) to their searches, and this sometimes altered the translations, albeit in unclear and unsystematic ways that were probably difficult for the pupils to understand or to evaluate. Giannetti (2016, p. 75) remarks that "proper punctuation" is vital for gaining a good search result in GT, but

the effects of adding punctuation are inconclusive in the material used for the present article. The strategy can be seen in Table 10 and in the final step shown in Table 9.

TABLE 10. ADDING PUNCTUATION. ANNA:4

Time	GT search	GT result
15'04''		
	'how are things'	'¿How are you' [3rd p. sg.]
15'07''		
	'how are things?'	'How are you?' [2nd p. sg.]
	Returns to text, writes nothing. Switches back to GT, reformulates the question.	

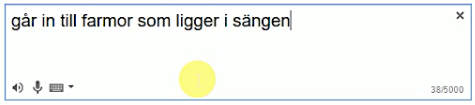
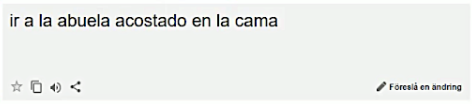
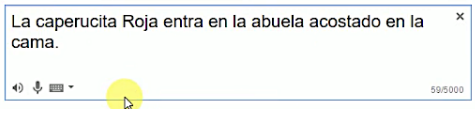
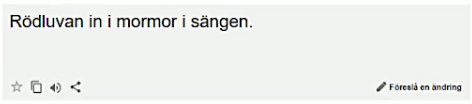
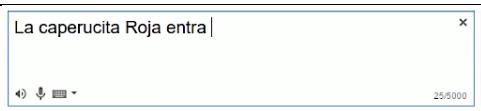
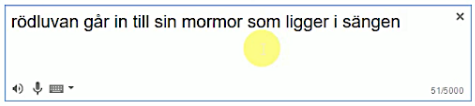
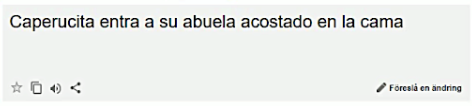
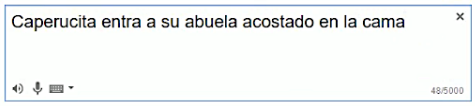
5.7 Control translations

Control translations used to double-check the accuracy of single words and word sequences constituted 11% of all GT search actions. Pupils performed back-translations to Swedish and/or English as a means to control a GT search result, a strategy also found in Knospe et al. (2019). A similar use was found to be frequent also in Farzi (2016). The control translations were mainly performed in proximity to the initial search, sometimes resulting in a pupil repeatedly switching back and forth between translations, using two or three languages. More rarely, double-checking occurred with parts of texts written earlier, as a part of text revision. As in Fredholm (2015a), pupils were apparently aware of the occurrence of errors in GT's output and tried to avoid them as best they could.

Control translations frequently concerned not only GT search results, but also Spanish words and sequences that the pupils had written without any help from GT. This seems to indicate an insecurity on the part of the pupils regarding their own knowledge of vocabulary, spelling, and grammar. On a less pessimistic note, the strategy may reveal an interest and a will to ascertain the accuracy of word choice or grammatical form, but it seems nevertheless indicative of a lack of confidence in the pupils' own knowledge of the language.

An example of control translations and re-elaborations of a sequence can be seen in Table 11.

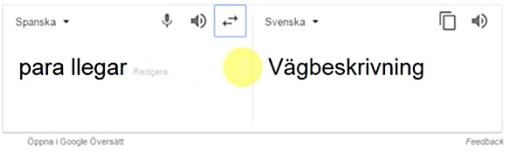
TABLE 11. CONTROL TRANSLATIONS. AUGUSTA:4

Time	GT search	GT result
32’55’’		
	‘goes in to [paternal] grandmother who is lying in the bed’	‘[to] go to the grandmother lying in bed’ [wrong agreement of perf. part. “acostado”]
	Deletes *y* ‘and’, adds *en la abuela acostado en la cama.* ‘in the grandmother lying in bed’, looking at GT three times. Copies the phrase and pastes it in GT search box.	
33’43’’		
	‘Red riding hood enters in the grandmother lying in bed.’ [wrong perf. part. agreement]	‘Red Riding Hood in inside grandmother in the bed.’
	Copies *La caperucita Roja* from text, pastes in GT search box.	
34’03’’		
	‘Red riding hood enters’	‘Red Riding Hood in’
34’30’’		
	‘red riding hood goes in to her [maternal] grandmother who lies in the bed’	‘Red Riding Hood enters to her grandmother lying in the bed’ [wrong perf. part. agreement]
	Changes *en la abuela* ‘in the grandmother’ to *a su abuela* ‘to her grandmother’ in the text.	
34’57’’		
	‘Red Riding Hood enters to her grandmother lying in the bed’ [wrong perf. part. agreement]	‘Riding Hood in [adv.] her [paternal] grandmother in the bed’
	Makes no further changes.	

Besides mere control translations of words and sequences, the pupils also used additional functions provided by the GT interface to control their searches. The availability of these supplementary affordances depends on what languages are used in the searches. The pupils used instant direction switches between languages, highlighting of translated words, and suggestions from GT. Three pupils executed control translations very swiftly and efficiently by clicking on the double arrow icon in the GT search interface, which affords the user the possibility to instantly change the direction of the translation. Sometimes, this was used simply to change the direction between separate searches. On other occasions, the function

was used repeatedly during series of searches to double-check translations, sometimes involving three languages, and comprising different kinds of re-elaborations, again mixing several strategies at once. Medvedev (2016) talks of the language switching affordance as a way to check "what is lost in translation" (p. 188). The strategy, however, often created new errors and confusions, such as in Table 12, adding to the elements that were lost in translation, rather than clarifying them.

TABLE 12. SWITCHING DIRECTION. ANITA:4

Time	GT search	GT result
6'33''		
	'to reach'	'in order to get [to]'
6'34''		
	'in order to get [to]'	'road direction'

Six pupils used the possibility to highlight translated words to see the corresponding words in the original search string. This also enabled the pupils to choose from alternative phrasings in pop-up lists, as in the examples in Table 13.

TABLE 13. HIGHLIGHTING WORDS. *ANNA*:3

Time	GT search	GT result
28'52''		
	'then you don't understand what the rest of the world is like'	'why [3rd p. sg.] does not understand how the rest of the world'
29'17''		
	'then you don't understand what the real world is like'	'why [3rd p. sg.] does not understand how the real world is'
	Copies the translated phrase into the text.	

14 of the 16 pupils used suggestions from GT, some of them frequently. These suggestions appeared below the search bar as *Menade du:* 'Did you mean:' followed by a suggestion for an alternative spelling or phrasing. Suggestions also appeared directly in the search bar as words were being written, and could be clicked to be inserted directly without writing the entire word. Common misspellings were automatically corrected by GT, indicated as *Visar översättning av:* 'Shows translation of:'. These affordances sometimes helped pupils to correct some lapsus, but suggestions were also accepted even when saying something else than originally intended by the pupils, which raises questions about who really controls what is being written (cf. Knospe et al., 2019).

In addition to the aforementioned affordances, clarifying word definitions sometimes appeared on-screen below the search bar (after searches from English to Spanish), but were apparently not consulted by the pupils, judging from the position of mouse cursor and from the short time intervals pupils watched the screen before switching to the Word document.

6. DISCUSSION

The previous section of this article showed highly varied GT search strategies, ranging from simple dictionary-like searches for single words, to complex, trilingual, stepwise morphosyntactic searches for short sequences, phrases, and entire sentences, searches where several of the affordances of the GT interface were employed.

Naturally, the findings from a group of 16 participants cannot be generalised to every foreign language learner, but the observations in this study, combined with earlier findings in Fredholm (2015a), and Knospe et al. (2019), contribute to clarifying that foreign language learners' GT search strategies may be highly varied and complex. Some of the observed behaviours also concur with findings in Lantz-Andersson et al. (2009), which further underlines that trial-and-error approaches and a transfer of one's own reasoning to the machine may be indicative of pupils' interaction with different digital resources, and not isolated only to GT use. The affordances of the GT interface enable and invite the user to adopt stepwise, trial-and-error-based search and writing approaches, a fact that probably needs to be taken into greater consideration when discussing digital writing strategies in today's L2/L3 learning contexts (cf. Hyland, 2016).

The search strategies were to a great extent characterised by trial-and-error approaches, combined in various ways and ranging from changes of minute details such as spelling and punctuation to more complex aspects concerning sentence structure and morphology. Overall, the GT searches were regularly used to facilitate the writing of larger chunks of words, rather than to fill in single lacunae where pieces of vocabulary were missing, and the searches often encompassed both lexical and morphosyntactic aspects of the language. This is important to stress, as the almost effortless GT searches may seem deceptively simple, to teachers and learners alike. The study shows that one single series of GT searches may contain a large variety of linguistic information, some of it at a level of complexity that the writer may not be able to comprehend. Lexical information may be mixed with morphology and syntax to a point far beyond a language learner's grasp, resulting in confusion and exasperation – the latter was indeed seen in *Benedict's* first essay where a series of inconsistent translations eventually made him write *AAAH jväla goggle* 'AAAH blody goggle' in the search box (only to find it translated to *AAAH muy bueno* 'AAAH very good'!).

Now, what can this tell us about foreign language learners' writing ability in general, and what are the possible implications for foreign language teaching? The frequent mix of lexical and morphosyntactic searches seems to indicate a need among the pupils to work with foreign language writing skills on a global level rather than with single words which may or may not be missing from their active vocabulary. The participants often did not search *either* for a word *or* for a grammatical form, but used GT to search for words in inflected forms and in strands of syntactically more or less complex contexts, to help them string their texts together. This complex weave of search strategies might stem primarily from a lack of adequate sentence-building proficiency, but it is also possible that the pupils simply perceived it as a more convenient way of writing, in contrast to being forced to think up the linguistic content of the texts by themselves. The approach does lead to morphosyntactic and lexical errors and inconsistencies, but so too does writing in a foreign language with a printed dictionary or without any help at all (Fredholm, 2015c).

The key point is not, then, that errors are produced in GT searches and accepted by the pupils. GT is continuously improved and today's errors may be gone tomorrow (albeit new errors can occur as the technology is developed; cf. Ducar & Schocket, 2018; Aiken & Balan, 2011). An insight that is far more important, especially to foreign language teachers, is the

lack of linguistic self-esteem that appears in many of the screen recordings. Sometimes, language learners' FOMT use is dismissed as a sign of laziness (cf. Garcia & Pena, 2011; Larson-Guenette, 2013). However, the screen recordings revealed great efforts to find solutions to lexical and morphosyntactic problems, pupils sometimes going to great lengths to revise searches before accepting a result. This speaks, it may be argued, less of laziness than of a lack of necessary linguistic resources, or a lack of trust in one's own knowledge of the language. The most important finding in the present study, from a foreign language teaching and learning perspective, may actually be that the participating pupils often did not trust their own knowledge of the Spanish language enough to abstain from searching for even very basic vocabulary in GT, or enough to critically question results of GT searches that did not match their own language instincts.

If the observation is correct, that is that many of the pupils lacked confidence in their own knowledge of the language, then why is that so? Is it an effect of wanting to perform well in a writing task, leading to the double- or triple-checking of words, just to be on the safe side? Does it indicate that the pupils really do lack the ability to write better after more than five years of Spanish studies? Or do we fail, as language teachers, to instil in them a sense of linguistic self-confidence needed to communicate without unnecessary hesitation? The answer may be a combination of all three hypotheses, and can, of course, vary from pupil to pupil. In the post-test, written by hand and without any translation support, the pupils performed as well or as badly as in the intervention essays; looking merely at vocabulary variation, at a group level (and in most cases also on an individual level) they performed better than during the entire school year (Fredholm, 2019). Thus, the main problem does not seem to reside in language proficiency per se.

That said, it must also be pointed out that the fact that the pupils frequently mistrusted GT search results and tried to amend them by various re-elaborations of the search terms, may indeed also be interpreted as signs of language awareness, a view that, if correct, mitigates the observations above about the pupils' lack of proficiency. However, seeing that pupils often, after series of re-elaborations, accepted search results that were either incorrect or contextually inadequate, it is perhaps more reasonable to say that for many, the main issue was that they lacked sufficient Spanish proficiency and/or did not sufficiently trust their own

knowledge of the language. Strengthening foreign language learners' awareness of and trust in their own knowledge appears, thus, as an important task for foreign language teachers.

Finally, if a rather more philosophical approach to the subject may be allowed, one might stop for a moment to ponder what the possible effects of free access to GT could be; not the effects on lexical variation, syntactic complexity, grammatical accuracy, text length or other more or less easily measured aspects (where some answers already exist, e.g., Fredholm, 2014, 2015c, 2019; O'Neill, 2012, 2016), but rather the possible effects on the writer's psyche. What does it do to an inexperienced writer in a foreign language to know that there is constant and easy access to – in theory – all the words on the World Wide Web? How does the possibility to check everything you write or want to write over and over again, with just a few clicks on a screen right there in front of our eyes, affect your writing behaviour? If you know that you *can* look something up, and you feel a little insecure, then are you not tempted to do so, just in case? These questions cannot be given any answers here, but are worth exploring in further studies, where perspectives from language teaching, applied linguistics, and cognitive research fields, for instance within ecological psychology, could strengthen our understanding of the machine-translating foreign language writer's experiences.

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