Syntactic processing in sight translation by professional and trainee interpreters

Professionals are more time-efficient while trainees view the source text less

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The study examines how professional and trainee interpreters process syntax in sight translation. We asked 24 professionals and 15 trainees to sight translate sentences with subject-relative clauses and more difficult object-relative clauses while measuring translation accuracy, eye movements and translation durations. We found that trainees took longer to achieve similar translation accuracy as professionals and viewed the source text less than professionals to avoid interference, especially when reading more difficult object-relative sentences. Syntactic manipulation modulated translation and viewing times: participants took longer to translate object-relative sentences but viewed them less in order to avoid interference in target language reformulations. To the best of our knowledge, this is the first study to show that reading measures in sight translation should be analysed together with translation times to explain complex reading patterns. It also proposes a new measure, percentage of dwell time, as an index of interference avoidance.

Keywords: sight translation, interpreter, interpreting trainee, eye-tracking, syntactic processing

1. Introduction

When performing sight translation interpreters have to obtain input by reading a text in the visual modality in order to express its meaning orally. Unlike simultaneous interpreting, which is speaker-paced, sight translation is interpreter-paced (Agrifoglio 2004). However, the goal is the same – the target text should reach the target audience with no delay. Just as in simultaneous interpreting, when faced with a written text interpreters have to complete the necessary syntactic refor-
mulation in order to provide a natural-sounding target text. However, unlike in simultaneous interpreting, in sight translation the source text is always available in front of the interpreter’s eyes. The presence of the source text is a double-edged sword: on the one hand, it reduces the memory load because all the information is available; however, on the other hand, it might lead to interference because of the constant visual access to the verbal form of the source text. It may also entail another disadvantage, namely divided attention. The transient nature of the source text in simultaneous interpreting naturally forces attention away from the source text. In sight translation, attention is divided between the ever-present source text and the emerging target text. It seems that experience should make interpreters more immune to interference and should lead to more restructuring, resulting in a more natural target text. Thanks to the widespread use of modern process research methods such as eye-tracking, we can now tap into the reading and processing of text in sight translation by tracking the eye movements of the interpreters. In the present study, we asked professional and trainee interpreters to perform sight translation. The participants’ eye movements and sight translation performance were recorded to examine how the participants cope with syntactic processing while completing the task. We operationalised syntactic processing through sentences including subject-relative and object-relative clauses. We expected to find an effect of experience, that is, professional interpreters being more efficient and successful in syntactic processing than trainee interpreters, and an effect of syntactic complexity, with more complex syntactic structures entailing longer viewing times and longer translation durations than less complex structures. The novel contribution of this study is the application of a combination of common eye-tracking measures and translation durations to explain the participants’ reading patterns in sight translation. We also propose a new eye-tracking measure, percentage of dwell time, which could help to interpret data patterns recorded when eye-tracking the process of sight translation.

2. Syntactic processing in interpreting

Interpreters are expected to express the meaning of the source text in natural-sounding target language. This involves syntactic processing, among other levels of language. In the case of typologically close languages, syntactic processing might be facilitated thanks to the cross-language similarity of syntactic structures (Maier, Pickering, and Hartsuiker 2017). When working between languages from different language families, interpreters are more frequently forced to engage in syntactic restructuring (Gernsbacher and Shlesinger 1997). When faced with complex syntactic structures, interpreters might resort to segmentation or chunking,
that is, producing simpler and more fragmented structures (Jones 2002; Pöchhacker 2004). Other required syntactic shifts might involve, for instance, changing the subject-object-verb order of a German subordinate clause to a subject-verb-object order in English (Seeber 2011). Sometimes syntactic reformulation may not be required but still desired; for instance, many English passives need to be turned into active-voice sentences in Polish for stylistic reasons (Hejwowski 2004; Chmiel, Janikowski, and Cieślewiecz, forthcoming).

Despite the importance of syntactic reformulation for quality performance in interpreting, there are very few experimental studies that use syntactic manipulations in interpreting as an independent variable. One example is a study by Timarová, Čeňková, and Meylaerts (2015), who manipulated syntax in simultaneous interpreting to test the relationship between interpreters’ working memory (measured in a letter span task and a visuospatial span task) and interpreting performance. They predicted that complex structures (sentences with double subject-relative clauses) would be processed more efficiently by individuals with greater working memory capacity, in line with Andrews, Birney, and Halford (2006) and King and Just (1991). Timarová, Čeňková, and Meylaerts (2015) found that efficiency in syntactic processing correlated positively with interpreting experience but not with working memory measures.

Using a different paradigm, Ruiz et al. (2008) studied syntactic processing performed by professional translators in a self-paced reading task. The sentences were read either for repetition or for translation and included a syntactic congruency manipulation: syntactically congruent sentences required no syntactic restructuring in translation, while syntactically incongruent sentences entailed mandatory restructuring in the target language (the noun-adjective order had to be reversed and a personal pronoun had to be added). As expected, congruent sentences were read faster than incongruent ones and reading for translation was slower than reading for repetition. These findings suggest that parallel target language syntactic structures were activated when the participants read the to-be-translated sentences. This study supports the findings of Maier, Pickering, and Hartsuiker (2017) regarding structural priming, although the latter study did not involve professional interpreters or translators. The finding that more efficient processing of sentences requires less syntactic restructuring has been confirmed by another study that measured cognitive load operationalized by means of pupil dilation. Seeber and Kerzel (2011) manipulated syntax in German-English simultaneous interpreting performed by professional interpreters. The source language sentences were either syntactically symmetrical with English (i.e., subject-verb-object structure in the embedded clause) or not (i.e., verb-final position in the embedded clause). In line with their predictions, Seeber and Kerzel (2011) found an increase in cognitive load when processing the second half of the embedded
clause with an asymmetrical structure. Such findings are also in line with Viezzi (1989), who contrasted sight translation with simultaneous interpreting and compared information retention after these two tasks. He found an interesting correlation between retention rates and language-pair-specific morphosyntactic features. The interpreters in his study worked either between Spanish and Italian (i.e., two Romance languages with many morphosyntactic similarities) or between German and Italian (i.e., a Germanic and a Romance language which share fewer morphosyntactic features). The participants remembered more after sight translation from Spanish into Italian (85%) than after sight translation from German into Italian (64%), while there was no difference in the control conditions involving listening and reading. This seems to suggest that interpreters remember more from a sight translation task if it involves less syntactic transformation due to similarities between the working languages.

Another study including a syntactic manipulation in a sight translation task was conducted by Shreve, Lacruz, and Angelone (2010). They used either simple sentences or sentences with several embedded relative clauses. They expected more processing effort (operationalized as more numerous and longer fixations and more regressions) for sentences with complex syntactic structures. Contrary to their expectations, they found no overall syntactic complexity effect (which might have been due to the possibly low power of the experiment as it involved 11 participants). The effect was only statistically significant or approached significance for some of the experimental stimuli.

Taken together, these few studies suggest greater cognitive load posed by sentences that need to be syntactically restructured in the target language – with cognitive load measured as pupil dilation, viewing duration or retention rates. Contrary to expectations, no correlations have been found between syntactic performance and memory capacity. The current study extends this line of research by investigating the influence of interpreting experience on syntactic processing during sight translation.

3. Effects of interpreting experience

To examine how conference interpreting experience influences linguistic processing professional interpreters have been compared to trainee interpreters in a number of studies. Professionals have been found to outperform trainees on a variety of measures, such as accuracy (Díaz-Galaz, Padilla, and Bajo 2015; Setton and Motta 2007), source text processing and prioritizing of information to be interpreted (Sunnari 1996; Liu, Schallert, and Carroll 2004), anticipation (Jörg 1997),
retrieval of translation equivalents (Garcia et al. 2014), general lexical flexibility and formulaic language (Riccardi 1996).

To the best of our knowledge, to date only two studies have compared professionals and trainees in tasks involving syntactic processing in interpreting, and have yielded conflicting results. Riccardi (1996) compared the syntactic restructuring of professional and trainee interpreters in German-Italian interpreting and found that professionals used it more often than trainees in order to arrive at a natural target language formulation. Setton and Motta (2007) analysed syntactic reformulations performed by professional and trainee interpreters when simultaneously interpreting with text. They expected more reformulations and greater target text autonomy from professionals and wanted to test if target text autonomy predicts interpreting quality, that is, whether interpretations with more reformulations would receive higher performance scores. Contrary to their expectations, they found more reordering in the trainees’ interpretations than in the professional ones. They also found no association between syntactic restructuring and quality. These counterintuitive findings were explained by a low number of participants and by the fact that the experiment included interpreting between French and English, two languages that are not syntactically as distinct as French and Japanese, for instance. Additionally, the fact that the participants had access to the written text may have induced limited reformulation in the oral output.

As far as sight translation is concerned, prior experience in either translation or interpreting has been shown to influence reading patterns during sight translation tasks. In a study carried out by Jakobsen and Jensen (2008) translators completed the sight translation task faster than trainees, which suggests that translation experience makes sight translation less cognitively demanding. When the data from translators were compared to those from interpreters, the latter seemed to have been more efficient in sight translation processing due to their professional practice. Dragsted and Hansen (2009) compared sight translation performed by a small sample of professional interpreters and translators. They found more numerous and longer fixations by the translators, which was interpreted as a reflection of higher cognitive effort expended by translators as compared to interpreters during comprehension and production. However, a small (one-year) difference in interpreting experience has been found not to lead to significant differences in eye-tracking measures, as shown by Chmiel and Mazur (2013). The beginner and advanced trainee interpreters examined in this study did not differ on such measures as fixation count or total fixation duration in the sight translation task. In a more detailed analysis, Chmiel and Mazur (2013) compared these two groups on the processing of simple and complex sentences in the sight translated text and again found no reliable difference. This suggests that one year of difference in training between beginner and advanced trainee interpreters is
not sufficient to show a development of more efficient reading patterns in sight translation. In the present study, we have thus applied a different comparison: we examined sight translation performed by professional and trainee interpreters to capture the effect of experience.

As shown above, there are conflicting accounts of how syntactic processing is modulated by experience: some studies show that professionals outperform trainees in syntactic reformulation, while others report more reformulation on the part of trainees as compared to professionals, or no difference between beginner and advanced trainees. Such a varied pattern of results might stem partially from low comparability and low statistical power of some of these studies.

4. The present study

The aim of the present study was to examine how professional and trainee interpreters deal with syntactic processing in sight translation. We asked participants to sight translate English sentences with subject-relative clauses (such as *The lady that kissed my uncle was a liar*) and object-relative clauses (such as *The lady that my uncle kissed was a liar*) into Polish, and measured their accuracy, eye movements and translation times. Object-relative clauses are generally considered to be more difficult to process than subject-relative clauses due to role assignment (Caplan et al. 2002) and more demanding parsing which taxes working memory (Caplan and Waters 2013). The processing difficulty of object-relative clauses might be explained by the distance-based dependency locality theory, according to which integration costs for syntactic structures are higher when the distance between the elements to be integrated increases (Gibson 2000; Warren and Gibson 2002). When interpreted from English into Polish, such object-relative structures require reformulation – either into a subject-relative clause in the passive voice or a past participle phrase. Alternatively, the object-relative clause may be maintained but the relative pronoun has to be rendered in the accusative (see also Section 4.5.6).

Based on the above reviewed literature focusing on the effects of interpreting experience, we expected a general group effect, namely, professionals outperforming trainees on accuracy and manifesting shorter reading measures and translation times as a consequence of more efficient processing. We also expected that professional interpreters would better cope with visual interference by looking away less and viewing the source text more than trainee interpreters, particularly when processing object-relative sentences. We further hypothesized that professional interpreters would be more autonomous in their translation solutions and would opt for more restructuring of the object-relative sentences than trainee
interpreters. We predicted a sentence type effect and expected that object-relative sentences, being more difficult to process, would yield lower accuracy rates and longer viewing and translation times. However, as these sentences require more reformulation due to contrastive differences between English and Polish, we expected a lower value of the percentage of dwell time measure, that is, more looking away and less viewing of the source text to avoid interference.

It is important to mention that visual interference is understood here both as stemming from the visual presence and salience of the written text, which is less transient and less prone to deverbalisation than an oral text, and as resulting from the differences in syntactic structures of the source and target language. In the current design of the study, it is difficult to disentangle the two (see Chmiel, Janikowski, and Cieślewicz [forthcoming] as an example of a study that does that).

4.1 Participants

The participants included a group of 24 professional interpreters (11 males and 13 females) and another group of 15 trainee interpreters (4 males and 11 females). The professional interpreters were active as freelance interpreters on the Polish market and were recruited via a translation agency. Their mean age was 38 ($SD = 8.25$) and their self-reported mean professional interpreting experience was 13 years ($SD = 8.00$). The mean age of trainee interpreters was 23 ($SD = 0.91$). They were all enrolled in a two-year conference interpreting programme at the MA level. At the time of the experiments they were all at the end of the first year of the programme, which means they had completed approximately 200 contact hours of intensive interpreting training. All participants had Polish as their A language and English as their B language. Some of them had additional working languages. The participants’ English proficiency assessed via LexTale (Lemhöfer and Broersma 2012) was very high: 89.31% ($SD = 9.31$) for professionals and 90.57% ($SD = 7.93$) for trainees.

4.2 Apparatus

The eye movement data were recorded with a desktop version of the EyeLink 1000 Plus eye-tracker. The participants viewed the stimuli binocularly but only the right eye movements were tracked. The stimuli were presented on a 21-inch monitor placed approximately 60 cm from the participants’ eyes. The data were collected in the remote mode, that is, the participants’ heads were not constrained in any way, thus ensuring ecological validity. Instead, target stickers were positioned on the participants’ foreheads to assist in eye movement tracking. Sight translation performance was recorded in SR Research Experiment Builder.
4.3 Materials

The materials included 32 English sentences with subject-relative clauses and 32 sentences with matched object-relative clauses (partially taken from Macizo and Bajo 2004). Table 1 shows sample experimental materials.

<table>
<thead>
<tr>
<th>Subject-relative sentences</th>
<th>Object-relative sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>The accountant that described the lawyer read</td>
<td>The accountant that the lawyer described read</td>
</tr>
<tr>
<td>the newspaper on the train to New York.</td>
<td>the newspaper on the train to New York.</td>
</tr>
<tr>
<td>The governor that admired the comedian answered</td>
<td>The governor that the comedian admired</td>
</tr>
<tr>
<td>the telephone in the fancy restaurant.</td>
<td>answered the telephone in the fancy restaurant.</td>
</tr>
<tr>
<td>The doctor that supported the salesman watched</td>
<td>The doctor that the salesman supported</td>
</tr>
<tr>
<td>the movie later with several friends.</td>
<td>watched the movie later with several friends.</td>
</tr>
</tbody>
</table>

Macizo and Bajo (2004) manipulated pragmatic bias in their study, but we did not include this manipulation. In order to obtain uniform stimuli, we took relative clause verb phrase biased sentences from that study and replaced biased verbs (i.e., those that could be predicted from the sentence context) with unbiased ones. The changed sentences were normed to remove any context constrained sentences. We performed one round of online norming. Twenty-seven students of English not enrolled in the conference interpreting programme performed a cloze task and completed the sentences with verbs. Only one sentence turned out to be context constrained (which means that over 30% of the respondents completed the sentence with the same verb). We reformulated the sentence to meet the stimuli criteria, repeated the norming and this time no verb reappeared in more than 30% of responses).

We also constructed 60 filler sentences without subject-relative or object-relative structures, but similar to the experimental sentences in terms of syntactic or lexical complexity. We included those in the experiment because we wanted to expose our participants to various structures to avoid bias stemming from repeated processing of two types of structures.

4.4 Procedure

The experiment was programmed and run in SR Research Experiment Builder. It included a practice block with 10 sentences and an experimental block with 92 sentences: 32 experimental sentences (16 subject-relative and 16 object-relative sentences) and 60 filler sentences. The presentation of experimental sentences was
randomized in two counterbalanced lists of 46 sentences. Each participant saw one sentence only once, either in the subject-relative or object-relative condition.

The session began with a 13-point calibration. Any time between the trials, the experimenter could activate recalibration if the data accuracy was insufficient. An obligatory recalibration was included in the experimental procedure after the presentation of 46 sentences.

The participants were asked to sight translate the English sentence appearing on the screen into Polish. They were instructed to abide by professional standards, in other words, perform the task bearing in mind the usual time constraints. When the sight translation of the sentence was finished, another trial was initiated by the experimenter, preceded by recalibration if needed. The experimental session took approximately 25 minutes.

4.5 Data analysis and results

We analysed all data by means of linear mixed-effects models and logistic regression in R (R Development Core Team 2013). Such methods make it possible to better capture individual differences between participants and experimental items and better deal with unbalanced data than traditional ANOVA analyses (Barr et al. 2013; Bates et al. 2015). All models included two random effects (participants and items), two fixed effects (group and sentence type) and a two-way interaction between group and sentence type. To estimate p-values, we used Laplace approximations in the logistic regression model and Satterthwaite approximations in the linear mixed effects models. Sliding contrasts were used throughout to estimate model parameters.

4.5.1 Accuracy

Accuracy is operationalised here as structural accuracy, established by comparing the structure of the translated sentence to the original sentence structure. If the source text structure was retained in the target text or if it was correctly reformulated, it was judged as accurate. Subject-relative clauses required no restructuring when rendered into Polish. In the case of object-relative sentences, correct reformulations included changing the case of the relative pronoun, rendition of the relative clause in the passive, or reduction of the relative clause into a sentence-initial past participle clause (see Section 4.5.6, where we discuss these reformulations in more detail). If the reformulation was incomplete (i.e., an element was missing) or incorrect (either grammatically or the reformulation changed the meaning of the sentence) it was judged as inaccurate. The accuracy judgement was performed by an experienced conference interpreter and translator. To analyse accuracy, we fitted a logistic regression model and found a
counterintuitive effect of sentence type ($b = -1.72, z = -3.56, p < 0.001$) with object-relative sentences translated more accurately ($M = 98.7\%, SD = 11.1$) than subject-relative sentences ($M = 94.9\%, SD = 21.8$). Contrary to our expectations, there was no group effect and no interaction between group and sentence type.

4.5.2 Viewing measures for relative clauses

We then calculated the following reading measures for the relative clauses that created different sentence types (subject-relative vs. object-relative): gaze duration, regression path duration and total duration. Gaze duration was calculated as the sum of all fixations from first entering the relative clause area until the eyes moved to another area. It is a first pass reading measure assumed to be modulated by early lexical processing. Regression path duration was the total duration of all fixations occurring from the first fixation on the clause area until the clause area was exited to the right. This means that the measure included also fixations regressive to the clause area, that is, on the part of the sentence preceding the clause. This measure, sometimes referred to as go-past time, reflects the integration of text into prior sentence context (Liversedge, Paterson, and Pickering 1998; Reichle et al. 2009). Total duration was operationalized as the sum of the first pass viewing and all rereading.

We analysed these data for accurate trials only, which meant removal of 4.7% of the data. Models fitted for all measures are presented in Table 2. To normalize data distribution for gaze duration, we removed all observations longer than 4000 ms (4.5% of data) and we further log-transformed the values. No effects turned out to be significant ($p > 0.05$).

As regards regression path durations, all observations exceeding 10,000 ms were removed, which resulted in the removal of 4.7% of the data. Log-transformation was needed to normalize the distribution. We report model parameters as log-transformed values and means as non-transformed values for the ease of presentation. We found a significant sentence type effect ($b = 0.11, t = 2.45, p < 0.05$), with higher regression path duration values for subject-relative clauses ($M = 1616\text{ ms}, SD = 1294$) than for object-relative clauses ($M = 1486\text{ ms}, SD = 1217$).

For the total duration measure, we normalized the data by removing observations longer than 8000 ms (3.7%) after visual inspection. We fitted a linear mixed-effects model with group and sentence type as fixed factors and participants and items as random factors. We found a group effect ($b = 404.52, t = 2.15, p < 0.05$): with trainees ($M = 2978\text{ ms}, SD = 1514$) viewing the relative clause 383 ms longer than professionals ($M = 2595\text{ ms}, SD = 1244$). This time we found no sentence type effect and no interaction.
Table 2. Analysis of eye-tracking measures of the relative clause region (significant p-values at the level of $p < 0.05$ are marked with *)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Effect</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group</td>
<td>0.02</td>
<td>0.08</td>
<td>35.1</td>
<td>0.215</td>
<td>0.83</td>
</tr>
<tr>
<td>Gaze duration</td>
<td>Sentence type</td>
<td>−0.02</td>
<td>0.04</td>
<td>996.4</td>
<td>−0.46</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>Group x Sentence type</td>
<td>−0.11</td>
<td>0.09</td>
<td>998.7</td>
<td>−1.24</td>
<td>0.21</td>
</tr>
<tr>
<td>Regression path duration</td>
<td>Group</td>
<td>−0.09</td>
<td>0.13</td>
<td>34.9</td>
<td>−0.72</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>Sentence type</td>
<td>0.11</td>
<td>0.04</td>
<td>993.8</td>
<td>2.45</td>
<td>0.01 *</td>
</tr>
<tr>
<td></td>
<td>Group x Sentence type</td>
<td>0.03</td>
<td>0.09</td>
<td>993.8</td>
<td>0.358</td>
<td>0.72</td>
</tr>
<tr>
<td>Total duration</td>
<td>Group</td>
<td>404.52</td>
<td>187.88</td>
<td>35.30</td>
<td>2.153</td>
<td>0.04 *</td>
</tr>
<tr>
<td></td>
<td>Sentence type</td>
<td>93.18</td>
<td>80.51</td>
<td>1210.7</td>
<td>1.16</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>Group x Sentence type</td>
<td>97.92</td>
<td>161.34</td>
<td>1215</td>
<td>0.607</td>
<td>0.54</td>
</tr>
</tbody>
</table>

To sum up this part of the results, we found an expected group effect in total duration and a counterintuitive sentence type effect in accuracy and regression path duration, with object-relative clauses triggering higher accuracy and shorter viewing times. As object-relative clauses are syntactically more complex structures (due to more demanding parsing and role assignment [Caplan et al. 2002], as mentioned earlier), we expected lower accuracy and longer viewing times for these structures as compared to subject-relative clauses. Our results show that this was not the case. Before we discuss these results, we present other findings for measures pertaining to the whole sentence, namely, sentence viewing times, sentence translation times and the percentage of dwell time.

4.5.3 Sentence viewing times

The analysis of the sentence viewing time was performed for accurate trials only. First, to normalize the data distribution all observations below 250 ms and above 20,000 ms were excluded from the analysis (1% of the data). We fitted a linear mixed-effects model and found the predicted group effect ($b = 1141.5$, $t = 2.25$, $p < 0.05$), with professionals ($M = 8353$ ms, $SD = 3062$) spending less time viewing the sentence than trainees ($M = 9394$ ms, $SD = 3872$). We also found a sentence type effect ($b = 1225.7$, $t = 6.17$, $p < 0.01$): contrary to our expectations, subject-relative sentences ($M = 9287$ ms, $SD = 2894$) were viewed longer than object-relative sentences ($M = 8173$ ms, $SD = 3766$). There was no interaction between group and sentence type.
4.5.4 Sentence translation times

To obtain a normal distribution of translation duration data, we excluded outlying observations shorter than 250 ms and longer than 27,000 ms, which resulted in the exclusion of 2.4% of the data. Again, we found the expected group effect \((b = 2744.0, t = 3.56, p < 0.01)\). Professional interpreters \((M = 12,866 \text{ ms}, SD = 3601)\) took less time to sight translate sentences than trainee interpreters \((M = 15,512 \text{ ms}, SD = 4110)\). The analysis also showed a sentence type effect \((b = -525.0, t = -2.48, p < 0.05)\). This time, in line with our predictions, subject-relative sentences \((M = 13,596 \text{ ms}, SD = 3805)\) were processed faster than object-relative sentences \((M = 13,998 \text{ ms}, SD = 4173)\). No interaction was found in this analysis.

4.5.5 Percentage of dwell time

Finally, we calculated the percentage of dwell time for each sentence. The percentage of dwell time is the percentage of total translation time spent viewing the sentence: the higher the value, the greater the percentage of the whole sentence processing time was spent by the participant actually looking at it. The lower the value, the less the sentence was viewed during its sight translation, as the participants looked away. To normalize data distribution, we excluded 5.1% of the outlying observations (values lower than 25). We fitted a linear mixed-effects model and obtained a group effect \((b = -4.610, t = -2.24, p < 0.05)\) with professionals spending on average 65% of the trial time viewing the sentence and trainees spending on average 60% of the trial time viewing the sentence, thus confirming our prediction about professional interpreters being more immune to visual interference. We also found a sentence type effect \((b = 11.03, t = 10.47, p < 0.001)\). As expected there was less viewing the source text and more looking away when processing object-relative sentences (the mean percentage of dwell time was 58%) than when processing subject-relative sentences (67%). We also found the predicted group by sentence type interaction \((b = 4.68, t = 2.22, p < 0.05)\) presented in Figure 1, mainly pointing at more looking away from object-relative sentences by trainee interpreters.

Additionally, following Timarová, Čeňková, and Meylaerts (2015), we wanted to correlate the results with a working memory measure to determine whether larger working memory capacity correlated with shorter reading times and translation times. We took the memory data from another study done with the participants of the current experiment (Chmiel 2018) and we correlated their reading span scores with the dependent variables in the current study. No correlations turned out to be significant, which means that we found no evidence for more efficient syntactic processing due to higher working memory scores.
4.5.6 Strategies in interpreting object-relative clauses

It was interesting to notice some strategic behaviour of the participants. When exposed to object-relative clauses, they opted for one of four potential solutions. They either chose to maintain the structure of the original clause and translate the relative pronoun in the accusative (or any other case necessitated by the relative clause verb) or to render the relative clause in the passive, which meant that the object-relative clause changed into a subject-relative one. In the latter case, some participants chose to reduce the relative clause to a past participle clause and put it at the beginning of the sentence. Table 3 presents syntactic restructuring used by participants in sight translating object-relative clauses.

Table 3. Syntactic restructuring used by the study participants

<table>
<thead>
<tr>
<th>Experimental sentence</th>
<th>Sight translation</th>
<th>Back translation into English</th>
<th>Syntactic restructuring</th>
</tr>
</thead>
<tbody>
<tr>
<td>The accountant that the lawyer described…</td>
<td>Księgowy, którego opisał prawnik…</td>
<td>The accountant that the lawyer described…</td>
<td>The structure is maintained. The relative pronoun has to be in the accusative in the Polish sentence.</td>
</tr>
<tr>
<td></td>
<td>Księgowy, który został opisany przez prawnika…</td>
<td>The accountant that was described by the lawyer…</td>
<td>The object-relative clause changes into a subject-relative clause in the passive voice.</td>
</tr>
<tr>
<td></td>
<td>Księgowy opisany przez prawnika…</td>
<td>The accountant described by the lawyer…</td>
<td>The object-relative clause is replaced with a past participle phrase.</td>
</tr>
<tr>
<td></td>
<td>Opisany przez prawnika księgowy…</td>
<td>Described by the lawyer, the accountant…</td>
<td>The past participle phrase is placed sentence initially.</td>
</tr>
</tbody>
</table>
Both groups of participants used the first strategy predominantly (86% in the group of professionals and 90% in the group of trainees), that is, they maintained the object-relative clause structure. The voice of the relative clause was changed in 2% of sentences sight translated by professional interpreters and in 9% of sentences sight translated by trainee interpreters. The professionals used the past participle phrase sentence-initially in 4% and following the subject in 5% of their translations. The percentages for the group of trainees were marginal (0.3% and 0.6% respectively). In order to determine whether these differences are more than numerical, we collapsed three types of syntactic restructuring (those involving the introduction of the passive voice or the past participle phrase) into a single category and compared the frequency of translation involving the maintenance of the original structure to the frequency of restructured translations performed by the two groups. We performed a chi-square test of independence to examine the relation between the group and the applied strategy. The relation was insignificant, \( \chi^2 (1) = 0.064, p > 0.05 \). Trainees were not more likely to keep the source language structure in their translations than professionals.

### 4.6 Discussion

The aim of the present study was to test whether interpreting experience modulates syntactic processing in sight translation as operationalised by subject- and object-relative clauses. We intended to investigate if experience and syntactic difficulty lead to differences in accuracy, reading measures, reformulation patterns and translation times. Professional and trainee interpreters sight translated sentences with manipulated syntax: subject-relative or object-relative sentences. We generally expected professionals to outperform trainees and sentences with subject-relative clauses to be easier to process than those with object-relative clauses. The study, however, revealed more complicated patterns in the data, which became interpretable only when the novel measure, percentage of dwell time, was considered. This is an important contribution of the current study to eye-movement research of sight translation.

#### 4.6.1 Group effects

Contrary to our expectations, we found no group effect in accuracy. However, this finding is easily explained if we consider the sentence translation data. Trainee interpreters took on average 2646 ms longer to translate the sentences than professional interpreters. Since the task was not time-constrained, the trainees spent more time processing the sentences to arrive at an accuracy level comparable to that of the professionals. We also found that professional interpreters spent less time viewing the whole sentence and the relative clause. This might also be related
to the fact that professional interpreters were generally faster in their processing than trainee interpreters, which confirms the results of other studies showing superior performance of professionals over trainee interpreters (Díaz-Galaz, Padilla, and Bajo 2015; Liu, Schallert, and Carroll 2004; Riccardi 1996). We also found that trainees viewed the source text less and looked away more, especially when processing object-relative sentences, which, we propose, shows their greater proneness to interference from the written text. Since object-relative sentences included structures that needed reformulation in the target language, it was easier for trainees not to divide their attention between reading the source text and formulating the restructured target text. They stopped parallel processing that involved viewing the text in order to focus on the target text only. If we wanted to explain these results by employing Gile’s (2009) effort model for sight translation (including reading, production, memory and coordination), we could say that trainees stopped reading in order to focus on production and lessen the coordination effort. Contrary to our expectations, we found no group effect in restructuring. Both professional and trainee interpreters tended to process object-relative sentences similarly (mainly through maintaining the word order and changing the case of the relative pronoun) and professionals were not more autonomous in their reformulation choices. This contradicts the findings by Riccardi (1998), who found more reformulation by professional interpreters, and the results obtained by Setton and Motta (2007), who found more reordering in interpretations by trainees. However, we have to keep in mind that these studies might not be directly comparable as the former involved simultaneous interpreting as a task and the latter used simultaneous interpreting with text. Both these modes are speaker-paced while sight translation, investigated in the present study, is interpreter-paced. And indeed, as our translation time data show, trainee interpreters used a slower pace to gain accuracy. This lack of time constraints could have given them enough comfort to apply similar reformulation strategies as professional interpreters. It would be interesting to compare the performance of both groups in all three types of interpreting to identify how time constraints and availability of the written text modulate syntactic processing. The study also confirmed the findings of Timarová, Čeňková, and Meylaerts (2015), namely, that there is no correlation between successful syntactic processing and working memory capacity.

4.6.2 Sentence effects

The study showed that sentence type modulated accuracy. However, the findings were contrary to expectations since object-relative clauses were translated more accurately. This might be related to the time-accuracy trade-off since sentence translation times were longer for object-relative sentences. Since these sentences are generally confirmed to be more difficult to process, the participants may have
taken greater care when translating these sentences and sacrificed time for accuracy. Longer translation durations for more syntactically difficult sentences confirm the findings of Seeber and Kerzel (2011), although obtained with a different eye-tracking measure, namely pupil dilation. As regards reading measures, we found no sentence effect in gaze duration and total clause viewing, and a significant counterintuitive effect for regression path duration and sentence viewing, with subject-relative sentences viewed longer than object-relative ones. These findings may seem surprising but only until percentage of dwell-time is considered. It is this measure which explains why the more difficult object-relative clauses appear to be viewed shorter than the easier subject-relative ones. Having analysed the percentage of dwell time, we found more looking away for object-relative clauses (smaller percentage of dwell time). Thus, subject-relative clauses and sentences containing these clauses were viewed longer since no major reformulation was needed and the participants could follow the syntax. When processing object-relative clauses, on the other hand, the participants viewed the source text less and looked away more to avoid visual interference and perform reformulation. This was especially true for trainee interpreters, who looked away much more than professionals when processing object-relative clauses. As mentioned above, looking away might mean that in the case of object-relative clauses and especially in the case of trainees, it was difficult to coordinate concurrent reading (source text decoding) with target text production and, rather than divide their attention between reading and production, the participants allocated their attentional resources to reformulation in the target language. The percentage of dwell time is a novel measure that turned out to be highly informative with respect to the understanding of other, seemingly counterintuitive, eye-movement data.

5. Conclusion

This study showed how professional and trainee interpreters differ in processing syntax in sight translation. Professional interpreters were time-efficient and performed faster than trainee interpreters, while trainee interpreters took longer to arrive at a comparable accuracy and similar reformulation patterns. Trainees viewed the source text less and looked away more than professionals, potentially to avoid interference from the written text, especially when processing more difficult object-relative sentences. In this way, they avoided parallel processing of the source text and the target text, lessened the coordination effort, avoided interference and focused on target language restructuring only. Object-relative sentences generally took longer to translate but they triggered less viewing than subject-relative sentences, possibly again due to avoidance of interference. The unques-
tionable novelty of the present study is that it shows that typical eye-tracking measures used in reading research are not directly transferable to sight translation research without considering possible avoidance of visual interference reflected in the percentage of dwell time. This is because sight translation triggers reading patterns that are much less continuous, and which are further modulated by concurrent interlingual processing. It is the combination of reading measures, total translation time measures and the new measure proposed here, the percentage of dwell time, that helped explain reading patterns in the present study. The percentage of dwell time, that is, the measure of how much the participants look away when being exposed to the written source text, might be a good index of interference avoidance and could be used in further studies employing the eye-tracking method in the study of the sight translation process.

References


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