Effects of Time Pressure and Text Complexity on Translators' Fixations

Selina Sharmin, Oleg Špakov, Kari-Jouko Räihä
Unit for Computer-Human Interaction
University of Tampere, Finland
{firstname.lastname}@cs.uta.fi

Arnt Lykke Jakobsen
Center for Research and Innovation in Translation and Translation Technology
Copenhagen Business School, Denmark
alj.isv@cbs.dk

Abstract

We tracked the eye movements of 18 students as they translated three short texts with different complexity levels under three different time constraints. Participants with touch typing skills were found to attend more to on-screen text than participants without touch typing skills. Time pressure was found to mainly affect fixations on the source text, and text complexity was found to only affect the number of fixations on the source text. Overall, it was found that average fixation duration was longer in the target text area than in the source text area.

CR Categories: H.5.2 [Information Interfaces and Presentation]: User Interfaces – Evaluation/methodology; Input devices and strategies

Keywords: eye tracking, fixation duration, fixation count, translation, time pressure, text complexity

1 Introduction

Eye tracking is only just starting to be applied to translation research, but is promising to yield much new insight. Our exploratory and essentially naturalistic experiment was designed to study the effects of time pressure and text complexity or text 'difficulty', separately and in combination, on translators' fixations in a group of subjects with supposedly comparable translation skills. We hypothesized that touch typists would have an advantage over less skilled typists in that they would be able to devote more constant visual attention to text on the screen. As a result of this, we expected that skilled typists might be less affected by the combination of increasing time pressure and text complexity than less skilled typists, but we were uncertain to what extent this would show up in their gaze behavior. Our main interest was to see how visual attention would be distributed and managed under constraints that are part of many translators' everyday experience.

2 Background

Eye tracking, when applied to the study of reading, has generally been applied to reading of individual words, sentences or texts (cf. Rayner & Pollatsek [1989] and Radach *et al.* [2004]). Focus has generally been on individual words or sentences or on a single text. In the case of on-screen translation, the translator's visual attention is constantly shifted between two texts, a source text and the translator's emerging target text. (This is equally true of touch-typist translators and non-touch-typist translators, cf. below.) The possibility of tracking the translator's gaze pattern across the source and target text has opened up an exciting new research field, which can draw on existing reading research up to a point, but needs to develop its own body of knowledge in view of the specific constraints that apply in translation. Similarly, there is a need to build new knowledge about the way in which emerging written text is monitored visually. Knowledge of this kind is critically important for constructing translation support tools based on gaze information.

Text complexity has frequently been demonstrated to affect the cognitive effort of readers and translators and the speed with which meaning is constructed and represented, and the experience of time pressure, cf. Davison & Green [1988] and Shreve & Diamond [1997].

While the effect of time pressure on simultaneous interpreters has long been studied, little research has been done into the effect of time pressure on translators working in the written mode. Jensen [1999, 2000] found that increasing time pressure caused translators to shorten the time spent on initial orientation and to abandon end revision rather than change the pace of translation drafting. She also found that time pressure produced degradation both of the manner of text production and in the choice of translation strategies for all of her groups of experimental subjects (non-translators, professionals and translation novices). In similar experiments, Bart de Rooze [2003] found that the quality of his subjects' translations degraded when they had to translate more than 200 words per 10 minutes. Surprisingly, the quality of translation was higher for 25 % of participants when translating under time pressure. Martin [2006] demonstrated similar time pressure effects. The studies by Jensen, Martin and de Rooze were all based on keystroke logging, which captures the time course of translation output. Tracking translators' gaze behavior gives us an insight both into the effort that goes into comprehending a source text (the translation input) and into how a translation is produced.

3 Method

3.1 Participants

Eighteen participants took part in the experiment (6 males and 12 females). All of them were second-year students (or more) at the University of Tampere studying English translation as their major or minor subject. Participants were asked to produce translations that were as good as possible within the given time limit.

3.2 Apparatus

A Tobii 1750 remote eye-tracking device was used to track the users' gaze on its integrated 17 inch TFT color monitor (with 1280 x 1024 pixels' resolution). The experiment was recorded with ClearView and Translog. For the present report only ClearView data were analyzed.

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3.3 Procedure and Design

First, participants were informed about the test procedure. Then the eye tracker was calibrated for the participants' eyes. The distance between monitor and participant was 50-60 cm.

Each participant then translated three short texts of different complexity level from English into Finnish. Text 2 was assessed to be more complex because it had more low-frequency lexical items than text 1. The higher complexity of text 3 over text 2 derived from its greater structural complexity resulting from anaphoric expressions and appositions. All the texts were about 70 words in length. The experiment began with a warm-up copying task of a text, also about 70 words in length. The time frame given for translating each text was 6, 5 and 4 minutes. The sequence of time was constant for each participant but the sequence of texts was different. Texts were presented to the participants following the order T1-T3-T2, T3-T2-T1 and T2-T1-T3 where T1 was the easy text and T3 the most difficult. Flesch-Kincaid reading scores for the texts were 35, 11 and 5, respectively. A higher score indicates that the passage is easier to read while the lower score indicates a more difficult reading passage.

Each text was translated six times with all three time constraints. During the experiment, text appeared in the upper (source-text) half of the screen and participants had to write the translation of that text in the lower (target-text) half of the screen (Figure 1).

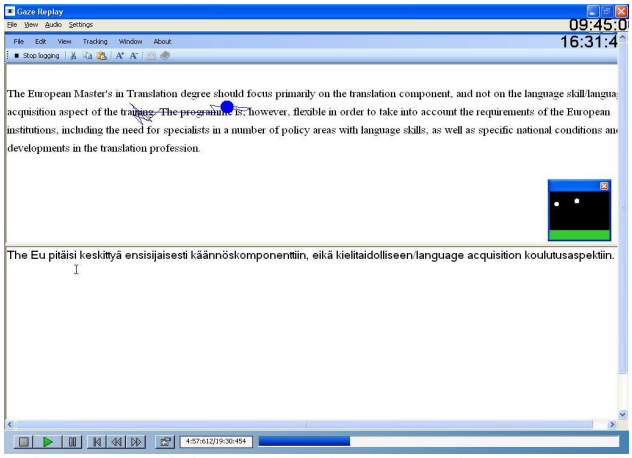

Figure 1: Translating text from the source to the target screen

After translating, all participants filled in a background questionnaire and did a language level test (DIALANG). The whole experimental procedure took about an hour. The total time to translate the texts for each participant was 15 minutes.

4 Results

We used data from 15 participants for analysis. Three participants were rejected due to poor gaze data. This meant that instead of six, as planned, there was an unequal number of participants in each group. Our main interest was to see how fixation duration and the fixation count (our dependent variables) would co-vary with our independent variables, time pressure and text complexity. We also wanted to look at differences that could be attributed to different typing styles and to study translators' attention to the two halves of the screen (the source and target windows).

Test statistics used for the analysis were paired samples t-test, independent samples t-test, one-way ANOVA and repeated measures ANOVA.

4.1 Difference between touch typists and non-touch typists

Based on their observed skills, participants were divided by typing style into two groups, touch typists and non-touch typists. The group of touch typists had six participants, the other had nine. Figure 2 shows a distribution of the total viewing time on the screen (both halves) during translation by all the participants.

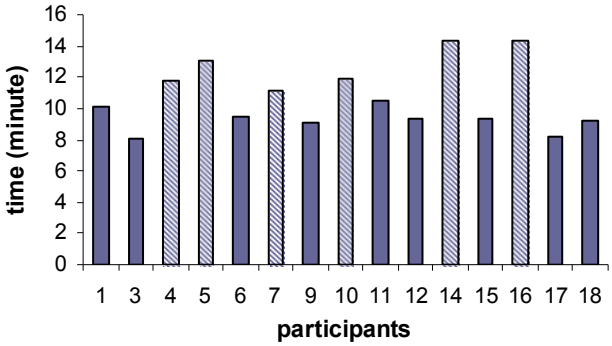

Figure 2: Distribution of total time spent on the screen by all the participants. The bars with striped filling represent touch typists while the others are non-touch typists.

The total viewing time for all the touch typists averaged 12.76 minutes and (as expected) was higher than the time for non-touch-typists, which was 9.25 minutes (Figure 2). The difference is highly significant with $p < .001$, $t = 6.349$, $df = 13$. Moreover, the average fixation duration of the non-touch typists (247.86 ms) on the screen was higher than that of the touch typists (200.33 ms). According to the independent samples t-test, the difference is significant with $p < .05$, $t = -2.433$, $df = 13$. The reason could be the higher number of fixations by the touch typists. This group did not spend as much time looking at the keyboard and produced more fixations on the screen.

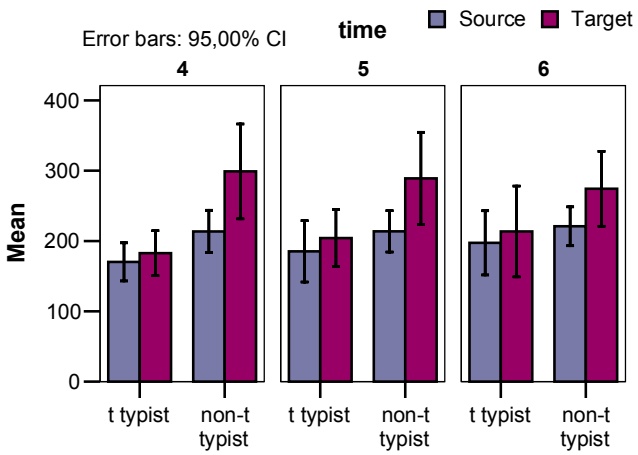

Figure 3: Average fixation duration on source and target areas under different time constraints by touch and non-touch typists

The average fixation count on the target screen for all the tasks was significantly lower for the non-touch typists than that for the touch typists with $p < .05$, $t = 2.532$, $df = 13$. On the other

hand, average fixation duration on the target screen for all the tasks was significantly higher for the non-touch typists than that for the touch typists with $p < .05$, $t = -2.600$, $df = 13$. The same trend was also visible for the source text data, but the difference was not statistically significant (Figure 3).

Typing skill, therefore, has a significant effect both on the duration of fixations and on the fixation count during translation.

4.2 Effect of time pressure

Figure 4 presents the average viewing time per minute on the screen during each task under different time pressure. Though the time pressure was different for each task, the viewing time per minute (for all participants) was almost the same.

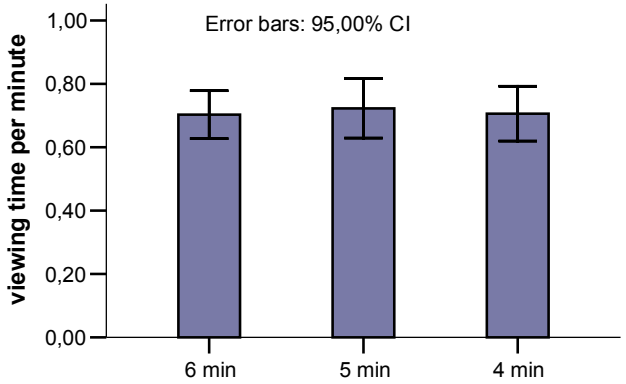

Figure 4: Viewing time per minute on the screen for each task

Repeated measures ANOVA did not find any significant effect of time pressure on the fixation duration over the whole screen. But when we analyzed the screen separately for source and target areas, we found that average fixation duration decreased significantly on the source screen under time pressure with $p < 0.01$, $F_{2,28} = 6.318$. However, the difference was insignificant for the target screen, which might affect the result regarding the whole screen. Table 1 presents the values of average fixation duration over source and target screen during different tasks.

Table 1: Average fixation duration in milliseconds

	6 min task	5 min task	4 min task
Source	211.49	202.31	196.28
Target	249.99	255.12	252.50

4.3 Effect of text complexity

Figure 5 presents the average viewing time per minute on each text. We found that the viewing time per minute was longer on the complex text than that on the easier text during translation.

Repeated measures ANOVA found significant effect of text complexity on normalized fixation count on the source text with $p < .05$, $F_{2,28} = 3.534$. More specifically, average fixation count per minute was significantly higher in the complex text than in the simplest text. Paired samples t-test found that source text with level 2 and 3 had a higher fixation count than text with level 1 with $p < .05$. Test statistics values were $t = -2.770$, $df = 14$ and $t = -2.176$, $df = 14$ respectively. Table 2 presents the average fixation count per minute and average fixation duration on the source text in different complexity level of the text.

It appears that while reading the source text for translation, translators had more fixations in complex text (whether resulting from complex vocabulary or syntax) than in simple text.

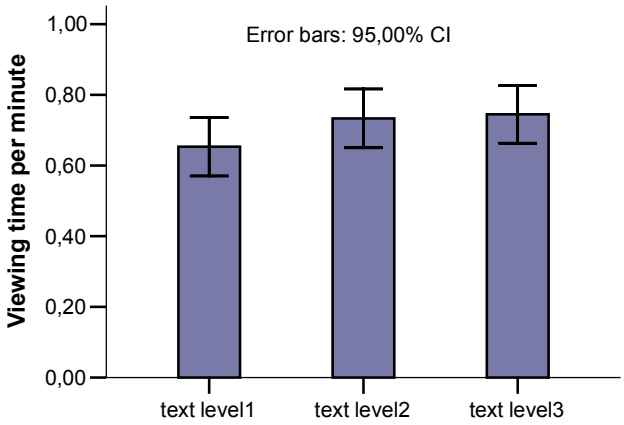

Figure 5: Viewing time per minute on the screen for each text

Table 2: Average fixation count and fixation duration per minute

	Text level1	Text level2	Text level3
Fix count	47.74	66.52	64.75
Fix duration	204.69	201.65	203.74

4.4 Gaze behavior on source and target screen

Figure 6 presents the frequency distribution of the fixation duration by all the participants on source and target area. Fixation durations less than 100 milliseconds were omitted from analysis and the upper limit was restricted at 1000 milliseconds. From this distribution it can be seen that the frequency of fixations with relatively short duration is higher in the source area than that in the target area.

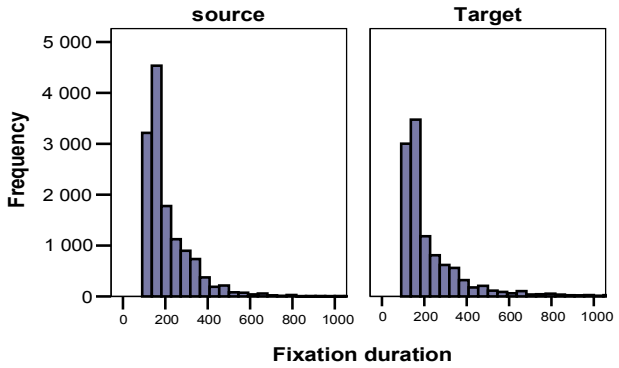

Figure 6: Distribution of fixation duration by all the participants

In general, average fixation duration combined for all the tasks on the target screen was higher than that for the source screen. This difference was found to be highly significant with $p < .01$, $t = -3.584$, $df = 14$ (Figure 7).

More specifically, fixation duration was significantly higher on the target screen than on the source screen for all the tasks regardless of time pressure (Figure 8). Statistical results for the 6, 5 and 4 minute tasks were $t = -2.731$, $df = 14$, $p < .05$, $t = -3.140$, $d = 14$, $p < .01$, and $t = -3.714$, $df = 14$, $p < .01$, respectively. Consequently, the average fixation count for all the tasks on the source screen was higher than that for the target

screen. The difference was close to the threshold of the statistical significance level 0.05 ($t = 1.821$, $df = 14$, $p = .09$).

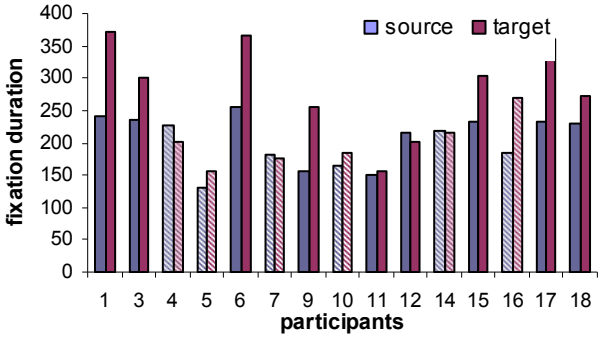

Figure 7: Average fixation duration on source and target area for all the tasks

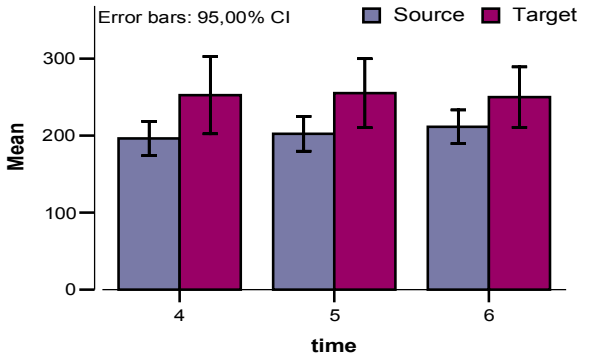

Figure 8: Average fixation duration on source and target area during different time constraints

Thus, it was found that during translation the target screen received fixations with longer duration but fewer in number than the source screen.

5 Discussion

The effect we found of the group difference in typing skills was as expected. Touch typists attended visually to text on screen, whether source text or emerging target text, more than non-touch typists. However, we found no evidence that the difference allowed touch typists to be significantly less affected by time pressure and text complexity. For this reason, only the overall effects of time pressure and text complexity are reported.

The observation that non-touch typists have fewer but longer fixations, especially in the target text area, could be said very tentatively to indicate that they spend time reading and monitoring their emerging target text, whereas touch typists only monitor their target text production.

The only effect of time pressure on fixations that we found was on the average duration of fixations in the source text area. This indicates that it is easier for translators to adapt their reading-for-comprehension to variable time constraints, whereas it is more difficult for them to adapt their reading-and-monitoring of the target text, possibly because this process has to await text being typed. Translators may not be able to adapt their typing speed as flexibly as they are able to adjust the speed with which they read for comprehension. In a study comparing reading of someone else's text versus reading of one's own emerging text, Holmqvist et al. [2007] found that fixation durations were significantly longer while reading the own emerging text than when reading somebody else's text. This result is in line with our findings that fixation duration is longer on the (own) target text than on the source text.

Text complexity was found not to affect fixation duration, which remained constant irrespective of time constraint. However, there was a significant difference between the number of fixations on the simple text and the two more complex texts. It appears that complexity requires more fixations regardless of whether complexity is the result of lexical items or syntax.

6 Conclusion

Our study resulted in several robust findings concerning the (limited) usefulness of touch typing for student translators, how student translators' visual attention was affected by varying degrees of time pressure, how text complexity affected fixation duration, and how visual attention was distributed across source and target text areas.

These findings add insight into the special kind of reading that translators engage in as they create and semantically align an emerging target text with a source text. Detailed knowledge about the way in which translators manage their distribution of visual attention to source and target text elements is critically important for creating gaze-based translation support solutions.

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References

DAVISON A. & GREEN, G. M (EDS.) 1988. Linguistic complexity and text comprehension: Readability issues reconsidered. Hillsdale, N.J: Lawrence Erlbaum Associates.

DE ROOZE, B. 2003. La traduccion, contra reloj [Translating against the clock]. PhD Dissertation. University of Granada.

HOLMQVIST, K., JOHANSSON, R., WENGELIN, A., & JOHANSSON, V. 2007. Reading someone else's finished text versus reading your own emerging text (R5-02). Talk presented in SWAET'2007, Lund, Sweden.

JENSEN, A. 1999. Time pressure in translation. In: G. Hansen (Ed.), Probing the Process in Translation. Methods and Results. Copenhagen: Samfundslitteratur.

JENSEN, A. 2000. The effects of time on cognitive processes and strategies in translation. PhD Dissertation, Copenhagen Business School.

MARTIN, R. M. 2006. Expertise and environment in translation. Unpublished paper presented at the IATIS Conference.

RADACH, R., KENNEDY, A. & RAYNER, K. 2004. Eye movements and information processing during reading. Hove, East Sussex: Psychology Press.

RAYNER, K. & POLLATSEK, A. 1989. The Psychology of Reading. Englewood Cliffs: Prentice Hall.

SHREVE, G. & DIAMOND, B. 1997. Cognitive processes in translation and interpreting. Critical issues. In: J. H. Danks et al. Cognitive Processes in Translation and Interpreting. Thousand Oaks, Cal.: Sage Publications, 233-25.