Translator-computer interaction in action — an observational process study of computer-aided translation

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ABSTRACT

Though we lack empirically-based knowledge of the impact of computer-aided translation (CAT) tools on translation processes, it is generally agreed that all professional translators are now involved in some kind of translator-computer interaction (TCI), using O'Brien's (2012) term. Taking a TCI perspective, this paper investigates the relationship between machines and humans in the field of translation, analysing a CAT process in which machine-translation (MT) technology was integrated into a translation-memory (TM) suite. After a review of empirical research into the impact of CAT tools on translation processes, we report on an observational study of TCI processes in one particular instance of MT-assisted TM translation in a major Danish translation service provider (TSP). Results indicate that the CAT tool played a central role in the translation process. In fact, the study demonstrates that the translator's processes are both restrained and aided by the tool. As to the restraining influence, the study shows, for example, that the translator resists the influence of the tool by interrupting the usual segment-by-segment method encouraged by translation technology. As to the aiding influence, the study indicates that the tool helps the translator conform to project and customer requirements.

KEYWORDS

Translator-computer interaction (TCI), computer-aided translation (CAT), translation memory (TM), machine translation (MT), MT-assisted TM translation, professional translation, translation processes, observational study.

1. Introduction

Currently, all professional translators tend to interact extensively with computers in the course of their work (see Christensen and Schjoldager 2016), and yet we know very little about how computer-aided translation (CAT) impacts on translation processes. In particular, we do not know very much about the relationship between translators and machines in actual working practices (Muñoz Martín 2014: 70). As Pym (2011: 2) puts it, "when we ask what translators really do with translation memories and machine translation, there is not an enormous amount of empirical data to speak of". However, as many practising translators will tell you, CAT tools now play such a central role in professional translation processes that translators can be assumed to be less in charge than they used to be, which may mean that translators are being pushed towards the periphery of the translation profession. Highlighting the business aspect of the profession, Risku (2014: 336) actually goes so far as to characterise today's translation industry as a computer-assisted network economy.

In order to obtain a better understanding of how translations are produced in the translation industry, more research on professional translators' tool usage is needed. In our paper, based on an observational study, we shall look at the role of CAT tools in translation processes from a translator-computer interaction (TCI) perspective, using a term that was coined and introduced by O'Brien (2012) drawing on human-computer interaction (HCI), a well-established discipline within computer science and social sciences, especially applied psychology (e.g. Johnson 1992; Carroll 1997, 2013). Based on Olohan (2011), who uses Pickering's "mangle of practice" theory to analyse professional translators' views on TM translation, TCI may be seen as a "dance of agency", in which a human agent (translator) interacts with a non-human agent (the technology) in a process of resistance and accommodation. Thus, for instance, while the CAT tool is generally expected to aid and support the translation process, it may also offer resistance and restrain the process in several ways. In order to accommodate the restraining influence of the tool, translators may need to carry out certain actions enabling the ongoing interaction between the tool and the translator to progress.

The TCI processes that we have studied occurred in one particular instance of CAT in which machine-translation (MT) technology was integrated into a translation-memory (TM) suite (SDL Trados Studio 2011). The overall aim of the paper is to gain a deeper understanding of the interaction between machines and humans during translation and to investigate which types of TCI occurred in an actual translation process. Furthermore, by providing illustrative examples from the data, the paper attempts to document how the tool restrained and aided the translation process. Thus, the study is an example of translation process research as interaction research (cf. Risku 2014) investigating an actual CAT process from a translator studies perspective (cf. Chesterman 2009). Inspired by Olohan (2011) and based on the studies reviewed in section 2, below, we assume that a translation tool may have a restraining influence on the translation process when it seems to interfere with the translator's workflows and mental processes. When the tool seems to help the translator — to meet customer requirements or improve translation consistency, for instance — we regard this as an aiding influence.

When using a TM, the translator accesses and re-uses segmented and paired source and target texts (text segments) stored in a database. While translating, the translator is provided with translation proposals, so-called matches. If the string of words of a segment from the database matches the string of words of the source-text segment exactly, this is referred to as a *100 % match*. If the segment from the source text and the segment from the TM also have the same "document context," SDL Trados Studio (the most used TM suite) refers to this as a "context match," meaning that the source segment and the TM segment are preceded by the same segment. If a match is less than 100 %, it is referred to as a "fuzzy match," which — in principle — could be anything

between 99 % and 1 %, but the fuzzy-match threshold is usually set at 70 %. If no usable content is found in the TM, this is referred to as a "no match" (SDL; see also Christensen and Schjoldager 2010). If an MT engine is integrated into the TM suite, as in the current study, MT matches are provided when the TM finds no matching segments, i.e. the "no matches" are translated by the MT engine (see also section 3, below). We shall refer to this mode of translation as MT-assisted TM translation, which is a newly developed type of CAT (see also Flanagan and Christensen 2014; Christensen and Schjoldager 2016).

The data used in this paper to investigate one instance of MT-assisted TM translation were generated as part of Bundgaard's ongoing PhD project (see Bundgaard 2013) at TextMinded Danmark A/S, the second-largest translation service provider (TSP) in Denmark. The project is a field study investigating how professional in-house translators revise TM and MT matches in actual translation processes when carrying out MT-assisted TM translation tasks. The present study investigates which types of observable actions a single translator carried out in an experiment taking place in the translator's usual work environment. After a brief literature review of relevant translation process research in section 2, we shall present the set-up of the experiment and the research methods applied to elicit the data analysed in the present study in section 3. In section 4, we shall present and discuss some results of our analyses, followed by some concluding remarks in section 5.

2. Empirical studies

In this section, we shall review translation process research on the impact of CAT tools. Focusing on investigations into MT-assisted TM, we shall confine ourselves to a presentation of results from selected studies which (1) test the usefulness of CAT tools or (2) investigate the impact of CAT on translators' workflows and mental processes.

Quite a number of studies assess the usefulness of CAT by investigating translation quality and productivity by means of parameters like translation speed, the degree of post-editing and the number of errors in the end product, that is, the impact of CAT on productivity and the product. In particular, studies focusing on MT seem to evaluate translation quality, typically comparing the quality of human translated texts with post-edited MT output, or comparing the quality of TM and MT matches. Fiederer and O'Brien (2009), for instance, compared the quality of post-edited MT output with human translation and found that qualified evaluators regard the quality of post-edited texts as on a par with, if not greater than, the quality of human translations as far as clarity and accuracy are concerned. However, as regards style, human translation is preferred over the post-edited product by evaluators.

Garcia (2011), in an experiment comparing post-editing of MT-generated text with human translation, found that productivity gains are only marginal in connection with MT. With regard to quality, however, the study showed that post-editing produces better results than human translation. As for MT-assisted TM translation, Guerberof Arenas' (2009) experimental study suggested that professional translators have higher productivity when using MT matches than when processing fuzzy matches and that they make more errors in TM matches than in MT matches. Interestingly, Guerberof Arenas' 2012 study contradicted her former findings when she found that there were no significant differences in productivity or quality between TM and MT matches (Guerberof Arenas 2012). Yet the 2012 study also showed that translators worked significantly faster when processing TM and MT matches compared to translating from scratch and that they made significantly more errors in segments translated from scratch than in TM and MT matches (also reported in Guerberof Arenas 2014a, 2014b).

In an experiment with freelancers, Teixeira (2011) found that it does not impact significantly on the overall speed and quality of the end product whether or not translators are provided with information about the provenance of a match during the MT-assisted TM process (i.e. whether the match is an MT or a TM match, and at which match percentage).

Based on a field study, Federico *et al*. (2012) found that the post-editing effort decreases when translators are supplied with TM matches as well as with MT matches, and that most translators achieve substantial time savings when they are offered MT matches in addition to TM matches. Tatsumi (2010) investigated the editing speed and the degree of editing. For instance, she found that it is faster to edit MT matches than to edit 75–79 % fuzzy matches.

Läubli *et al*. (2013) carried out an experiment with student translators working in a realistic work environment with the aim of exploring quality and translation speed under two conditions: In one task, translators had access to a TM, a terminology database as well as any other translation aid. In another task, translators were also offered MT matches. Läubli *et al*. (2013) found that, by adding MT matches to other translation aids, the translation time was reduced by 17.4 % and that the quality of translations produced when MT is integrated equals, or in some cases, is even better than the quality of translations produced without MT.

Relatively few studies have investigated how CAT tools impact on workflows and mental processes (for overviews, see Christensen and Schjoldager 2010 and Christensen 2011). Notwithstanding this lack of empirical evidence, there is a consensus that the use of CAT tools is changing the content and procedures by which professional translators translate (Folaron 2010; Muñoz Martín 2014: 70). Also, the very role that translators play in translation has changed: whereas most of their work

previously involved primarily linguistic transfer, professional translators currently spend much of their time interacting with computers, besides dealing with linguistic issues. It would be logical to expect this change to influence translators' mental processes too. Thus, for instance, due to the inherent segment-by-segment method underlying most CAT tools, the translation process tends to become more linear, as translators are invited to work their way through the translation sequentially, rather than going back and forth in a recursive process (Bowker and Fisher 2010: 4). Jiménez-Crespo (2009: 233) found that this segment-based processing leads to the replication of source-text structures (see also Dragsted 2006).

Applying processing speed as a measure of cognitive (i.e. mental) effort in an experiment, O'Brien (2007) found that lower TM-match values require more cognitive effort than higher match values. In an experiment carried out by Alves and Liparini Campos (2009), it was found that using a TM increases the number of pauses in which translators orientate themselves during the translation process and forces translators to focus on TM proposals as sources of information. This finding is supported by O'Brien *et al*. (2010), who found that translators find the concordance feature very useful, as it allows them to search for translation proposals, in the form of strings of words or single words. Interestingly, this feature seems to have a positive impact on translation quality, but a negative impact on translators' productivity.

Based on an experiment, Christensen and Schjoldager (2011) investigated student-translators' perceived impact of TM tools on translation processes. All subjects found that TM-assisted translation differed from translating without a TM, and most also said that they found TM translation easier, more interesting, faster and more efficient. The subjects also argued that TM translation is more consistent as the TM allows for easy access to other people's knowledge. A TM was, however, also considered a deceptive tool as students thought they lost track of the text and the aim of the translation, focusing too much on the source text, the sentence level and terminology, and generally losing their critical sense. Furthermore, subjects stressed that translating becomes more mechanical, less personal, more fragmented and less creative.

To sum up, the above-mentioned studies seem to support our assumption, which was also mentioned in the introduction, that translation tools have an aiding as well as a restraining influence on the translation process. Almost all studies reviewed in this section have been carried out in experimental settings, and most studies of MT-assisted TM have focused on factors such as productivity and quality in connection with MT translation, rather than on what actually happens during the translation process when TM and MT are integrated. Aiming at providing new insights into CAT processes, the present study investigates which types of TCI actions a professional translator carried out when working with an

authentic MT-assisted TM translation in his/her usual work environment at Denmark's second largest TSP, TextMinded Danmark A/S.

3. Data

At the time of data collection (2013), TextMinded Danmark A/S employed 11 in-house translators, and the company was in the process of integrating MT into its usual TM tool. As mentioned above, the data used for this paper were generated as part of Bundgaard's ongoing PhD project, in which professional translators' revision of MT-assisted TM translation is investigated, using a combined approach to study micro-level translation processes (based on textual data) and macro-level translation processes (based on contextual data). Micro-level translation processes are investigated through an experiment with eight in-house translators, and the macro-level translation processes are studied primarily through ethnographic methods, namely participant observation, semi-structured interviews and document collection. In the experiment, which we shall focus on in this paper, data were collected using screen capture (BB FlashBack Express), keystroke logging (Inputlog) (see Leijten and Van Waes 2013), observation, retrospective interviews and a post-experimental questionnaire.

In the experiment, eight translators worked at their usual desks and computers and had access to their usual sources of information. They were asked to translate a technical text and a marketing text, which were authentic translation assignments from a major Danish production company, a regular customer of TextMinded. The TM suite used was the TM software SDL Trados Studio 2011 integrated with the MT engine SDL BeGlobal Enterprise. The TM applied was a client-specific one, and the MT engine had been trained with TM data on the language pair of English-Danish as well as a client-specific termbase. In addition, the client-specific termbase was added as a terminology management system in the TM suite.

In this paper, we shall analyse the process regarding the technical text translated by a state-authorised translator with more than 10 years of professional experience. The translator had previously translated texts for the client in question and thus had some knowledge of the client's preferences. The translator had extensive experience with technical translation and CAT, but reported no experience with MT-assisted TM translation. At the TSP, s/he was known as a very good and highly productive translator.

The source text, comprising Frequently Asked Questions for a surround-sound speaker system, contained 625 words divided into 76 segments, which were pretranslated, using the TM and the MT engine. When the TM contained matches with match values of 70 % and above, these matches were inserted by the CAT tool into the target-text segments and displayed

on the screen. Segments with a match value below 70 % were treated as no matches and were pretranslated using the MT engine. Thus, for every source-text segment, the translator was automatically presented either with a TM match — that is, a context match, a 100 % match or a fuzzy match above 70 % — or an MT match. As a reference text, the translator received a PDF file with the fully formatted source text.

Figure 1 shows the interface of the TM suite and some of the matches that were provided. In this tool, MT matches are marked by the abbreviation of AT for Automated Translation.

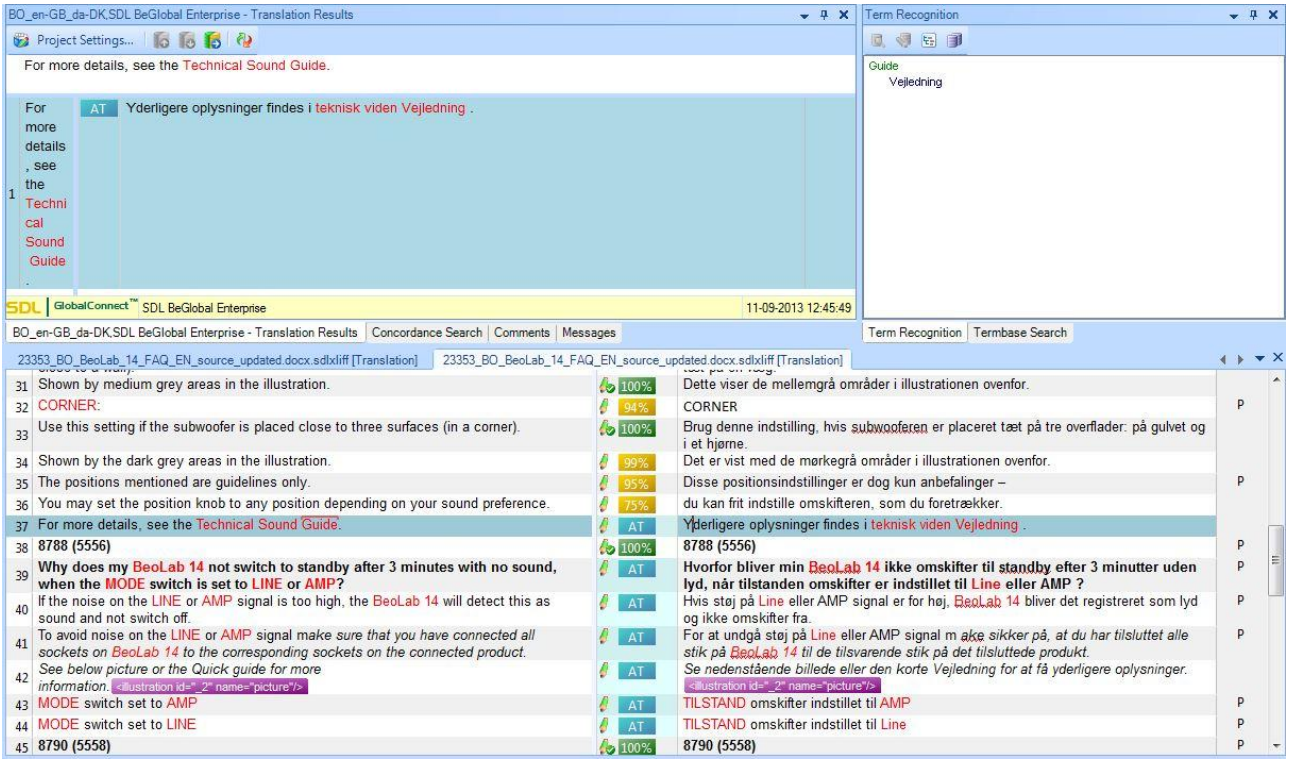

Figure 1: Screen shot of the MT-assisted TM environment.

The translator in question spent approximately 25 minutes on the translation, which made him/her the fastest translator in the experiment. After the translator had translated the text, we compared the final translation with the pretranslated version by means of the software SDLXLIFF Compare, in order to highlight all changes made by the translator. Approximately one hour after the experiment, the translator participated in a cued retrospective interview in which s/he was asked to verbalise his/her processes regarding specific segments, while watching the corresponding parts of the translation process on the screen-capture video. For this, Bundgaard had selected segments in which the translator had made either many, very few or no changes. At the end of the interview, the translator filled in a post-experimental questionnaire about his/her background and experience.

In order to investigate which types of TCI actions can be observed in the process analysed for this paper, the entire process was first analysed to quantify the number of the various match types offered to the translator. As a translator interacting with an MT-assisted TM suite can either choose to *accept* a match as it is, i.e. without any changes, to *revise* it or to *reject* it, i.e. delete the match and translate the segment from scratch, the translator's observable actions were categorised for each match as belonging to one of three choices: Accept, Revise or Reject. Based on an analysis of the screen-capture data, Table 1, below, gives an overview of match types and the translator's choices. In this case, the MT-assisted TM tool offered the following match types: two context matches, 28 100 % matches, 16 fuzzy matches (from the 70-99 % match range) and 30 MT matches.

Match types	**Number of matches in the text**	**Translator's choices**		
		Accept	**Revise**	**Reject**
Context matches	2	2	0	0
100 % matches	28	26	2	0
Fuzzy matches	16	2	14	0
MT matches	30	2	28	0
In total	**76**	**32**	**44**	**0**

Table 1: Overview of match types and the translator's choices.

As shown by Table 1, regarding the 76 matches analysed, the translator chose to accept 32 matches, to revise 44 matches and to reject none. This means that at no point did the translator choose to delete a proposed match and translate it from scratch. Consequently, in the following we shall not deal further with the reject category. However, as one might expect the MT engine to generate at least some MT matches of poor quality, we find it very interesting that the translator did not reject any of them and translate the segment him/herself. In the course of the retrospective interview, the translator explained that sometimes s/he found MT matches hard to handle (in our translation):

> […] in some cases it is actually confusing, you think it is rubbish, and I would actually have been better off just thinking this from the beginning because now I have been trapped by this and this word, which I feel obliged to use, and it can be difficult to set this aside and say it is **me** who makes this translation, it is me who decides what to write […].

Subsequently, the translator mentioned that his/her reason for feeling "trapped" was that s/he did not know the origin of the MT matches: The translator did not know whether the MT engine drew on material from the

Internet, which s/he was allowed to reject, or whether it drew on material from the customer in question, which s/he should probably accept, in accordance with a general norm of giving priority to customer preferences. The fact that the translator felt trapped in this way suggests that the tool had a restraining influence on the translator's processes, and that his/her decision not to delete any MT matches, but to retain (parts of) them, might be regarded as his/her way of accommodating resistance from the tool, to use Olohan's (2011) terms (see section 1, above).

4. Results and discussion

To gain a deeper understanding of how this particular translator interacted with the CAT tool, to describe what happened in the translation process and, if possible, to determine the types of TCI actions carried out, the matches mentioned in Table 1 belonging to the Accept and Revise categories were analysed adopting a qualitative and inductive approach (cf. Saldanha and O'Brien 2013: 190). In section 4.1, we shall look at the matches that were analysed as belonging to the Accept category and, in section 4.2, we shall look at the Revise category (4.2). To illustrate types of TCI actions, examples will be provided with a description of the unfolding translation process. If relevant, the translator's retrospective interview will be used as supplementary data. For each example, we shall consider if the tool seemed to have a restraining or aiding influence on the translation process.

4.1. The Accept category

As shown by Table 1, above, of the 32 matches which the translator accepted without making any changes, 26 were 100 % matches, two were context matches, two were fuzzy matches (from the 95-99 % match range) and two were MT matches. Hence, it seems that the translator tended to accept 100 % matches and content matches, whereas only very few fuzzy matches and MT matches were accepted. At TextMinded, when project managers prepare the source files for translation, SDL Trados Studio is configured automatically to mark all 100 % matches and context matches as *confirmed* translations. This means that when a translator opens a file, these segments already have the status of *Translated*. As the translator in question almost always used the shortcut Ctrl+Enter to jump to the next *unconfirmed* segment, this meant that the system automatically skipped these segments and therefore also that the translator only entered these segments when actively choosing to do so. In other words, the TM suite encouraged the translator simply to accept these matches. It can be argued that, when the translator is encouraged to act like this, s/he might more easily lose track of the text as a cohesive entity (see also Pym 2011, 2014; Federico *et al*. 2012), which may be seen as a restraining influence. As for fuzzy matches from the 95-99 % match range, the translator probably accepted these without changes as these matches are characterised only by minor differences between the

wording of the current source-text segment and the wording of the segment retrieved from the TM.

What might be surprising is that the translator decided to accept two MT matches without changes. One of these is illustrated by Example 1, below, indicating segment number, match type, the wording of the source-text segment, the wording of the provided match and the translator's final translation. Back-translations (BT) are provided for the match and the final translation. Lines are broken in the BTs to make them more comparable with the Danish segments.

Segment number	**Match type**	**Source-text segment**	**Wording of provided match**	**Final translation of the segment**
66	MT	Placement of the indicator light.	*Placering af indikatorlampe*. BT: Placement of indicator light.	*Placering af indikatorlampe*. BT: Placement of indicator light.

Example 1: The Accept category.

As can be seen in Example 1, the source-text segment is very short, which might be the reason why the MT engine was able to produce a translation that was acceptable to the translator. According to our data, what the translator did was to run a concordance search on the term *indicator light* before accepting the match. Interestingly, the term was offered by the termbase and, thus, the tool may have had an aiding influence on the translation process by providing the translator with a suggestion which conformed to customer requirements. That the translator chose to run the concordance search anyway indicates that s/he either did not notice the termbase entry or for some reason felt a need to check whether the proposed term reflected the typical language use in the client's texts.

4.2. The Revise category

As shown by Table 1, above, the translator chose to revise 44 matches, which included two 100 % matches, 14 fuzzy matches and 28 MT matches. Hence, our data indicate that fuzzy matches and MT matches were typically revised by this translator, whereas content matches were never revised and 100 % matches only very rarely so. As the coding of the segments belonging to the Revise category revealed two overall types of TCI, the category was divided into subcategories: match-internal revision and match-external revision. Match-internal revision refers to a

match in which the translator revises without making use of any other sources or functionalities than the proposed match itself. Match-external revision refers to a match in which the translator makes use of one or more sources or functionalities that are external to the match. As we analysed the translator's observable actions, not conjectures, we could only categorise a revision as match-external when an observable action indicated that the translator had looked at information outside the match, e.g. when s/he ran a Concordance search. It should also be noted that the use of the so-called Autosuggest function integrated in the TM suite to speed up translation, offering automatic and predictive suggestions after the translator has typed only a few of the first characters of a word, was categorised as a match-internal activity as the suggestions were provided automatically. Of the 44 revised matches, 18 matches were match-internal revisions, while 26 were match-external revisions.

4.2.1. Match-internal revision

Example 2, below, illustrates a match-internal revision, indicating segment number, match type and the wording of the source-text segment. Steps in the process are numbered and registered in chronological order, including the wording of the match provided (step 1). The example also shows the interim translation of the segment in question (Interim target segment). In this way, so-called micro-actions below the segment level are also included. Translations are provided for Danish words (italicised) in the explanations of each step, and a BT is provided for the first interim target segment. Again, lines are broken in the BT to make it more easily comparable with its Danish source.

Segment number		**Match type**	**Source-text segment**
39		MT	Why does my BeoLab 14 not switch to standby after 3 minutes with no sound, when the MODE switch is set to LINE or AMP ?
Steps			**Interim target segment**
1	Wording of provided match		*Hvorfor* *bliver min BeoLab 14 ikke omskifter til standby efter 3 minutter uden lyd*, *når tilstanden omskifter er indstillet til Line eller AMP* ? BT: Why does my BeoLab 14 not become switch to standby after 3 minutes without sound, when the mode switch is set *at Line or AMP* ?

2	Moves the text cursor so it is placed after *Hvorfor* ('Why') and writes *skifter* ('switch'). Deletes *bliver min* ('does my … become').	*Hvorfor skifter BeoLab 14 ikke omskifter til standby efter 3 minutter uden lyd, når tilstanden omskifter er indstillet til Line eller AMP?*
3	Moves the text cursor so it is placed between *Hvorfor* ('Why') and *skifter* ('switch'), moves it back between *skifter* ('switch') and *BeoLab 14* and deletes an unnecessary space.	*Hvorfor skifter BeoLab 14 ikke omskifter til standby efter 3 minutter uden lyd, når tilstanden omskifter er indstillet til Line eller AMP ?*
4	Replaces the space between *BeoLab* and *14* with a non-breaking space. Deletes omskifter ('switch').	*Hvorfor skifter BeoLab□14 ikke til standby efter 3 minutter uden lyd, når tilstanden omskifter er indstillet til Line eller AMP ?*
5	Replaces the space between *3* and *minutter* ('minutes') with a non-breaking space. Moves the text cursor so it is placed between *når* ('when') and tilstanden ('the mode'). Writes *MODE-om*. Deletes *tilstanden* ('mode'). Deletes the space between *om* and *omskifter* ('switch') and deletes *om* in *omskifter* ('switch').	*Hvorfor skifter BeoLab□14 ikke til standby efter 3□minutter uden lyd, når MODE-omskifter er indstillet til Line eller AMP ?*
6	Writes the definite article *-en* at the end of *omskifter*	*Hvorfor skifter BeoLab□14 ikke til standby efter 3□minutter uden lyd, når MODE-omskifteren er indstillet til*

	('the switch'). Selects *Line* ('Line') and changes it to capital letters using a shortcut. Deletes an unnecessary space after *AMP* ('AMP').	*LINE eller AMP?*

Example 2: Match-internal revision

As is visible from the wording of the match (step 1), the MT engine translated the construction *Why does my BeoLab 14 not switch to* […] into *Hvorfor bliver min BeoLab 14 ikke omskifter* til […] ('Why does my BeoLab 14 not become switch to'), which is not a correct translation since the verb *switch* has been translated into the Danish noun *omskifter* ('switch'). Furthermore, the noun *omskifter* ('switch') cannot be combined with *bliver* ('become'). The reason for this translation is possibly that the termbase contains the English noun *switch* with the Danish noun *omskifter* ('switch') as its translation, and that the termbase is set to overrule the MT translation if the source-text segment contains a word included in the termbase (here: *switch*). Hence, it seems that the integration of MT and the termbase required the translator to revise this part of the segment. In Olohan's (2011) terms, the combination of MT and the termbase might have constituted resistance offered by the system, and therefore the translator ended up accommodating this resistance by revising the match and by using the Danish verb *skifter* ('switch'), which was the appropriate translation (steps 3 and 4). Interestingly, however, in step 5, the tool in fact provided a correct translation of the noun *switch* into the noun *omskifte*r ('switch'), thereby aiding the translator to meet the customer requirements.

Prior to the experiment, the translator was told not to translate words written in red in the source text. Thus, for instance, s/he was not to translate *MODE* in Example 2. However, no techniques had been applied in the MT process to prevent words written in red from being translated and the MT engine thus translated *MODE* into *tilstanden* ('the mode'). As shown, the translator changed this back to *MODE* (step 5). Hence, here the translator again accommodated resistance from the tool.

The integration with the termbase is probably also the reason for another problem in the match (step 1), namely the translation of *LINE* into *Line* ('Line'). In the termbase, *LINE* is translated into *Line.* As a result, the translator has to change the lower-case letters of *Line* to capital letters: LINE (step 6). By contrast, *AMP* is not included in the termbase and the MT engine therefore transferred this unchanged to the target text.

The rest of the match seems to have been acceptable to the translator, except that s/he chose to delete *min* ('my') (step 2) and to replace the space between *BeoLab* and *14* with a so-called non-breaking space (a symbol preventing a line break at its position), marked by □ in steps 4, 5 and 6. These activities were explained by the translator in the interview like this: The target-text item of *min* ('my') was deleted because the customer in question prefers to keep texts more impersonal in Danish, and the insertion of a non-breaking space between *BeoLab* and *14* was due to the fact that the customer prefers to write product names without line breaks. Both these preferences are also mentioned in the customer style guide, which, however, was not consulted by the translator during the translation process, most probably due to his/her prior experience with this particular customer (cf. section 3, above). That translators are expected to give priority to customer preferences was also mentioned by other translators participating in the experiment.

4.2.2. Match-external revision

For the purposes of this paper, match-external actions (defined in section 4.2, above) are operationalised as follows:

(1) Use of the Copy Source to Target function (where the proposed match is replaced by the source text segment)
(2) Use of the Concordance Search
(3) Insertion of an MT match instead of a proposed TM match
(4) Moving back to a previous segment
(5) Use of the reference text (the fully formatted source text)

In the following, due to space restrictions, we shall confine ourselves to discussing examples of match-external actions 1 and 3-5. Example 3 includes action 1 and action 5. Again, BTs are provided, in lines that correspond to those of the source.

Segment number		**Match type**	**Source-text segment**
3		MT	Which MODE setting to use depends on the type of your Bang & Olufsen television.
Steps			**Interim target segment**
1	Wording of provided match		*Hvilken TILSTAND indstilling afhænger af dit Bang & Olufsen fjernsyn.* BT: Which MODE setting depends on your Bang & Olufsen television.
2	Looks in the pdf with		*Which MODE setting to use*

	the reference text. Selects *afhænger af dit Bang & Olufsen fjernsyn* ('depends on your Bang & Olufsen television') and copies it. Uses "Copy Source to Target".	*depends on the type of your Bang & Olufsen television.*
3	Writes *Den* ('The'). Deletes *Which*.	*Den MODE setting to use depends on the type of your Bang & Olufsen television.*
4	Writes *-indstil* ('set') after *MODE* ('MODE') and accepts *indstilling* ('setting') suggested by the AutoSuggest function. Deletes an unnecessary space after *MODE* ('MODE').	*Den MODE-indstilling setting to use depends on the type of your Bang & Olufsen television.*
5	Places the text cursor after *MODE-indstilling* and writes *, du skal brug,* (', you should us,'). Deletes the second comma. Adds *–e,* to *brug* ('us,')	*Den MODE-indstilling, du skal bruge, setting to use depends on the type of your Bang & Olufsen television.*
6	Inserts *afhænger af dit Bang & Olufsen fjernsyn* ('depends on your Bang & Olufsen television').	*Den MODE-indstilling, du skal bruge, afhænger af dit Bang & Olufsen fjernsyn setting to use depends on the type of your Bang & Olufsen television.*
7	Deletes *setting to use depends on the type of your Bang & Olufsen television*.	*Den MODE-indstilling, du skal bruge, afhænger af dit Bang & Olufsen fjernsyn.*
8	Inserts a non-breaking space between *Bang* and *&*.	*Den MODE-indstilling, du skal bruge, afhænger af dit Bang□& Olufsen fjernsyn.*

Example 3: Copy Source to Target (action 1) and reference text (action 5).

As it appears, the translator first decided to take a look at the reference text (step 2). This indicates that the translator wished to see the text in

context before determining how to translate the segment. Next, the translator copied *afhænger af dit Bang & Olufsen fjernsyn* ('depends on your Bang & Olufsen television') and used the Copy Source to Target function. Interestingly, our data show that the translator typically uses this strategy to transfer visual elements or different types of formatting to the target text, the red colour of *MODE*, for instance. In the interview, when commenting on another segment, the translator stated that s/he usually uses this function to make sure that the formatting is the same in the translation as in the source text and in order to save him/herself from unnecessary typing. The translator's action of using the Copy Source to Target function illustrates both an aiding and a restraining influence from the CAT tool: The translator was aided when s/he reduced the typing effort by inserting the source segment into the target segment, but was restrained when the tool could not transfer formatting from the source text. After having used the Copy Source to Target function, the translator typed the translations of *which* and *setting* (steps 3 and 4).

The MT engine left out *to use* in the translation and the translator therefore typed the Danish translation *du skal bruge* ('you should use') (step 5). At the end of the interview, the translator touched upon cases like this, saying that a difficult thing when working with MT matches was that small parts of the source-text segment were sometimes omitted and that the MT engine does not highlight these omissions. As the translator reported no experience with MT prior to the experiment, we assume that this perception mainly stems from experience gained during this experiment, though it may also stem from a webinar held at the TSP about MT prior to the experiment, during which some very general guidelines about working with MT were discussed, or from some colleagues with MT experience. In any case, the fact that parts of the source-text segment were omitted by the MT engine can be regarded as resistance from the CAT tool. The translator subsequently inserted the sentence copied and deleted the rest of the source-text segment (namely "setting to use depends on the type of your Bang & Olufsen television", cf. steps 6 and 7). Finally, the translator inserted a non-breaking space between *Bang* and *&* (step 8), to meet the customer preference already discussed above.

In Example 4, below, the translator carried out match-external action 3 and action 1.

Segment number		**Match type**	**Source-text segment**
51		70	PICTURE A software update in progress:
Steps			**Interim target segment**
1	Wording of provided match		*En optagelse er i gang*

		BT: A recording is in progress
2	The translator inserts an MT match from the Translation Results window using the shortcut alt+2.	*En softwareopdatering i gang:*
3	Selects *En softwareopdatering i gang* ('A software update in progress') and copies it using ctrl+c. Uses Copy Source to Target.	PICTURE *A software update in progress:*
4	Selects *A software update in progress* and replaces it with *En softwareopdatering i gang* ('A software update in progress') using ctrl+v.	PICTURE *En softwareopdatering i gang:*

Example 4: Insertion of MT match instead of proposed TM match (action 3) and Copy Source to Target (action 1)

As illustrated by Example 4, when offered an alternative MT match, the translator chose to insert this into the target-text segment instead of the proposed TM match (step 2). As the MT match does not contain the picture included in the source text, the translator then copied *En softwareopdatering i gang* ('A software update in progress') in order to be able to re-use it before s/he carried out a match-external action 1 (Copy Source to Target function) (step 3). Then s/he selected *A software update in progress* and replaced it with *En softwareopdatering i gang* by using ctrl+v (step 4). Consequently, the final translation of the segment is a combination of the MT match and the source-text segment.

Examples 5a and 5b, below, illustrate match-external action 4. As shown by example 5a, the actions were carried out in segments 28 and 31 in combination with segment 34:

Segment number	**Match type**	**Source-text segment**
28	100	Shown by light grey areas in the illustration.

31	100	Shown by medium grey areas in the illustration.
34	99	Shown by the dark grey areas in the illustration.

Example 5a: Moving back to a previous segment (action 4)

What is interesting about Example 5a is that, at first, the translator accepted segments 28 and 31 without any changes. Segment 28 was automatically skipped because of the use of Ctrl+Enter, as described above, and the translator briefly entered segment 31, but then left it again. However, as illustrated by Example 5b, below, after entering segment 34, which is a 99 % TM match with a character string very similar to those of segments 28 and 31, albeit somewhat differently structured, the translator chose to copy part of segment 34, returning first to segment 28 and then to segment 31 to insert the wording and the same sentence structure provided by the TM for segment 34. The translator then returned to segment 34 and revised something here as well, thus obtaining parallel structures in all three segments.

Segment	**Steps**	**Interim target segment**
34	Wording of provided match	*Det er vist med de mørkegrå områder i illustrationen ovenfor.* BT: This is shown by the dark grey areas in the illustration above.
	Selects *er vist med* ('is shown by') and copies it using ctrl+c	*Det er vist med de mørkegrå områder i illustrationen ovenfor.*
28	Wording of provided match	*Dette viser de lysegrå områder i illustrationen ovenfor*. BT: This the light grey areas show in the illustration above.
	Selects *viser* ('show') and replaces it with *er vist med* ('is shown by') using ctrl+v	*Dette er vist med de lysegrå områder i illustrationen ovenfor.*
31	Wording of provided match	*Dette viser de mellemgrå områder i illustrationen ovenfor.*

		BT: This the medium grey areas show in the illustration above.
	Selects *viser* ('show') and replaces it with *er vist med* ('is shown by') using ctrl+v	*Dette er vist med de mellemgrå områder i illustrationen ovenfor.*
34	Adds *-te* to *det* ('this')	*Dette er vist med de mørkegrå områder i illustrationen ovenfor.*

Example 5b: Match-external revision

As illustrated by Examples 5a and 5b, the translator first accepted the 100 % matches in segments 28 and 31 and then returned to revise them after having been provided with relevant matches later in the translation process. The translator's attempt to ensure consistency in the target text by breaking with the sequential, segment-by-segment method encouraged by the CAT tool may be seen as his/her way of accommodating resistance from the tool.

5. Concluding remarks

The observational study of TCI processes reported on in this paper gives us some indication of the impact of CAT tools on translation processes from the translator's perspective and, in particular, provides us with a deeper understanding of how CAT in the form of MT-assisted TM is carried out as an interaction between translator and computer. Of course, it should be noted that our data are limited to one particular instance of MT-assisted TM translation involving a single translator, which means that our results cannot be generalised.

According to our results, out of the 76 TM and MT matches that were offered to the translator during the process analysed for this paper, the translator chose to reject none, to accept 32 and to revise 44. We were surprised that no MT matches were rejected as these, unlike TM matches, are machine-generated and therefore could be expected to be of poorer quality. However, the behaviour of the translator in the experiment indicates that s/he generally valued all kinds of matches and tried to re-use as much of the provided matches as possible, regardless of whether it was an MT match or not.

As for the matches accepted by the translator, these were content matches and 100 % matches, 95–99 % fuzzy matches and very short MT matches, as might have been expected. As regards matches revised by the translator, the majority were MT matches and fuzzy matches.

It was found that, when revising matches, the translator used two overall strategies, which we categorised as match-internal revisions and match-external revisions. The revisions were mainly categorised as match-external, indicating that the translator felt a need to carry out various kinds of research outside the match offered. Hence, it seems that the translator was aware that the suggestions provided by the tool were not always adequate for a professional translation. So, while the translator seemed to have been aided by the CAT tool, in several cases, the translator also appeared to accommodate resistance from the tool, to use Olohan's (2011) terms. Such accommodation was necessary, for instance, when the translator wished to conform to a general norm of giving priority to customer preferences — a norm that is also mentioned by LeBlanc (2013).

It was interesting to see how the translator broke with the sequential, segment-by-segment method that is encouraged by the CAT tool, indicating that s/he was (still) focused on the text as a cohesive entity, an approach that is generally assumed to be discouraged by the CAT tool (Pym 2011, 2014; Federico *et al*. 2012). Thus, even though the translator was invited by the tool to work on one segment after the other checking for terminological and phraseological consistency, which Pym (2011: 3) describes as the prototypical behaviour when translators are asked to use TM in combination with MT, the translator never seems to have lost track of the syntagmatic cohesion. Hence, our results do not confirm the assumption of Bowker and Fisher (2010), for instance, that using CAT tools necessarily imply working sequentially with the text instead of going back and forth in a recursive process. The translator in our experiment seems to have worked recursively sometimes, and — contrary to the students in the experiment of Christensen and Schjoldager (2011) — s/he did not seem to lose track of the text and of the aim of the translation. However, our study also suggests that translators need to be better informed about the origin of MT matches. Thus, for instance, the translator in question might have felt less "trapped" by the MT matches (see the quote from the retrospective interview in section 3, above) and interacted better with the CAT tool had s/he known more about the technicalities of MT translation, how the MT engine had been trained, for instance.

To sum up, the observational study reported on in this paper sheds light on the interaction between the translator and the computer and exemplifies how the CAT tool restrains and aids the translation process. The study indicates that the CAT tool played a central role in the process and that the translator was able to juggle various kinds of challenges, such as customer preferences, complications caused by the integration of the MT engine and the termbase, a feeling of being "trapped" by the suggestions provided by the MT engine and a wish to create a cohesive text within the CAT environment. Consequently, though the CAT tool seems to have offered resistance in different ways, the translator seemed

to be able to accommodate this resistance, to use Olohan's (2011) terms. Hence, in this particular instance of MT-assisted TM translation, the translator appeared to remain in charge of the translation process and, consequently, though in constant interaction with the technology, s/he remains at the centre stage of the translation profession.

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