On the Lookout for Accessible Translation Aids: Current Scenario and New Horizons for Blind Translation Students and Professionals

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ABSTRACT

The introduction of specialised computer software to support translation practice has shaped the translation industry landscape, transforming the use of Computer Assisted Translation (CAT) systems into a prime requirement for translators to successfully enter the marketplace. This technological turn has placed visually impaired translation students −and professionals− at a disadvantage with respect to their sighted peers, as a seamless interaction between translation software and assistive technologies (AT) is not always guaranteed. By drawing on data collected over the last five years from two main exploratory studies involving students and experienced translation practitioners with visual impairments, this paper aims at providing a snapshot of the current state of the art concerning the accessibility of CAT tools for blind users. Additionally, we attempt to offer some insight into the pedagogical implications of the latter for translation technology training in a university setting. In general terms, our findings reveal that the inaccessible design of the most popular CAT systems and the lack of appropriate support from their developers may limit the chances of blind students of fully developing their translation careers. Similarly, they urge for a change of mindset among both tool developers and translation technology lecturers.

Keywords: Computer-Assisted Translation (CAT), Translation Technology Training, Software Accessibility, Visual Impairments, Translator-Computer Interaction (TCI)

1. Introduction

The language industry, which encompasses the translation services market, is considered today a strongly growing sector (SDL, 2016). The increasing demand for professionally translated content has inevitably resulted in heightened work load and faster turnaround times, regardless of the complexity of the file format in which the text to be translated has been stored (García, 2015). This new reality has not only generated attractive career opportunities over the last decade, but also motivated the proliferation of specialised software to aid and support language professionals during the translation process, turning the translation profession into a form of human-computer interaction (HCI) in its own right (O'Brien, 2012).

The use of Computer-Assisted Translation (CAT) systems in particular has become the norm in daily translation practice. Some of the key features offered by this software, such as automating the application of terminology guidelines, facilitating the handling of complex formatting and text encoded in mark-up languages, reusing previous translations held in translation memories (TM) and the integration of machine translation (MT) technology (Folaron, 2010; García, 2015),[1] have transformed CAT systems into 'productivity tools' without which language service providers (LSPs) believe they would lose competitive advantage (SDL, 2016, p. 9). Prior studies have even pointed out that work providers are putting pressure on external translation professionals to adopt CAT tools −often the one of their choice, and not the translator's− with the aim of reducing costs and boosting quality (Dillon & Fraser, 2006). In such scenario, it comes as no surprise to learn that student translators also perceive the ability to use translation technologies as an advantage or even prerequisite to enter the translation market (Doherty & Moorkens, 2013; Olalla-Soler & Vert Bolaños, 2013).

With the technological advances achieved until present concerning the use of assistive technologies[2] to facilitate an enhanced HCI for people with disabilities, one would expect that the establishment of CAT tools as essential components of the translation workflow would have paved the way for blind translators to conduct translation jobs more autonomously. Most people with severe visual impairments access the computer by means of a screen reader: a piece of software that transforms what would be normally displayed on the screen into synthesised speech, converting a two-dimensional digital document to a one dimensional text string and making audio the dominant medium (Freitas, 2010, p. 273). This content "linearisation" process that occurs when accessing any given electronic document can render common tasks traditionally requested by the client extremely time consuming or even impossible without sighted assistance (Dold, 2016) or the help of CAT software; for example, preserving the formatting of the document being translated in the target file. It thus follows that, for current and prospective translators with visual impairments, having or acquiring a high level of translation-related technological competence may be needed not only to satisfy the workplace demands in terms of adherence to established automated workflows, but also to (i) carry out a translation task on an equal footing as their sighted peers and (ii) deliver a translation service that matches the general quality expectations of the profession.[3]

[1] For the purposes of this paper, and as it can be inferred from the above, we do not wish to draw a clear line between TM systems and MT post-editing software. Instead, and following current trends in translation technologies (Moorkens & O'Brien, 2017, forthcoming), we consider 'CAT tools' as machine-assisted translation environments that integrate both solutions in a seamless manner.

[2] The term assistive technology (AT) is used within the context of HCI Studies to refer to any piece of software or hardware designed to facilitate the use of computers by people with impairments (DRC, 2004, p. 1) that cannot use the conventional technologies needed (known as WIMP: Windows, Icon, Mouse, Pointer) to access a graphical user interface (GUI). Functionality provided by assistive technology includes alternative presentations (e.g., synthesised speech or magnified content), alternative input methods (e.g., voice), additional navigation or orientation mechanisms and content transformations (Caldwell, Cooper, Guarino Reid, & Vanderheiden, 2008).

[3] As Gouadec (2010, p. 270) puts it, quality in translation refers to "both the quality of an end-product (the translated material) and the quality of the transaction (the service provided)". While we do not question the ability of blind translators to acquire the linguistic and translational competences needed to reach the former, we hypothesise that they may be at a disadvantage with regard to the latter,

Mastering the use of translation technology, however, does not exclusively rely on the blind person's learning capabilities and instrumental skills. Reaching a smooth interaction between visually impaired users and translation software heavily depends on the accessibility of the latter (i.e. on whether the tool has been designed to provide information and functionality in different modalities and to be supported by the users' ATs). The present paper seeks to shed light on this issue as, according to anecdotal evidence −including personal conversations between the authors and different blind translators, as well as the information regularly exchanged on the topic through *The Round Table*[4] mailing list −, it seems that most CAT tool providers do not list accessibility considerations among their immediate priorities. While it has been reported that, to conduct translation jobs, screen reader users adopt different coping strategies to overcome the accessibility barriers encountered (e.g. use of mouse simulation commands, scripting, collaboration with sighted assistants), these are not considered to be particularly effective (Owton, 2011) and therefore should not be regarded as a solution in the long run.

In what follows, and based on the premise that, as Biau Gil and Pym (2006) stated, "technology is not an option in today's professional world; it is a necessity", we aim at bringing to the forefront the accessibility of CAT tools as an object of scientific inquiry. In order to do so, we first review prior work conducted on the use and adoption of CAT systems from a user-oriented perspective (§2). Section 3 moves from the professional to the academic milieu to look at recent discussions about translation technology training, as well as to explain how our work contributes to the existing body of literature on the challenges of the translation profession and its training for people with visual impairments. In the remaining sections, we present the methodology followed to provide what, to the best of our knowledge, represents the first general assessment of the accessibility of CAT tools and its implications at various levels (education, employment) for the blind community (§4); we then report the results of a series of case studies about the accessibility of SDL technology (§5) and a survey targeting visually impaired translators (§6). The article concludes with a summary of our findings, outlining a series of recommendations for teaching translation technology to blind students (§7) and offering some insight into potential research avenues for the future (§8).

2. The voice of end users within the new translation-computer interaction paradigm

Understandably, throughout the last fifteen years, scholars have devoted continuing efforts to document the technological developments revolving around the translator's work processes. This ever-growing interest has resulted in multiple comprehensive publications on the topic, from seminal books (e.g. Austermühl, 2001; Bowker, 2002; Quah, 2006) to the most recent Encyclopaedia of Translation Technology (Sin-wai, 2015). While these tended to offer a broader picture of the

especially without the assistance of translation technology (e.g. to meet quick turnaround times and productivity levels, adhere to formatting guidelines, deal with complex file formats).

[4] *The Round Table* is the leading information exchange hub for visually impaired translators and interpreters. Retrieved August 22, 2016. http://goo.gl/6ObeOm.

wide array of technologies and electronic resources available (TM, MT, controlled language, localisation standards, terminology management systems, corpus-analysis tools, voice recognition software), more targeted accounts of the advantages and disadvantages of the incursion of these technologies on translation practice emerged along the way, particularly referring to CAT tools.

In general, straight-forward benefits of using this software, such as obtaining gains in productivity and terminology consistency or not having to deal with the translation of repetitive texts thanks to TM leveraging, have been counterbalanced by a considerable list of drawbacks; for instance, the steep learning curve needed to master these tools, the high prices of some of them and the need for continuous updates, the lower rates paid for the editing of fuzzy matches and the post-editing of MT output, or the lack of context due to fragmented texts (García, 2006; Kenny, 2011; O'Brien, 2012). Some authors have also argued that the use of this type of translation technology might have a 'deskilling' effect, restraining translators from being creative, "altering the very nature of the translator's cognitive activity, social relations and professional standing" (Pym, 2011). To this list, we may add that CAT tools' lack of accessibility −understood as the degree to which a product or system can be adapted for the needs of users with different (dis)abilities− can lead to self-depreciation as a translation professional, as well as to inequality in terms of recruitment opportunities. Within our research framework, we are particularly interested in understanding whether these perceptions are shared by the ultimate end users (i.e. translators) and whether their views could be taken into account to alleviate some of the aforementioned negative effects; for example, by considering their input for informing CAT tool design.

One of the first comprehensive studies conducted with a view to capturing user perceptions and practices around CAT tools usage was carried out by Lagoudaki (2006). Her survey, for which she collected 699 usable responses, revealed a high penetration of CAT software −still maintained today, according to more recent industry studies (SDL, 2016, p. 3)−, with 82.5% of respondents stating they were using such tools in their translation-related jobs. The survey focused for the most part on identifying the profile of the typical CAT tool user (translator dealing with technical texts, with advance IT skills) and on the evaluation of the most popular tools among translation professionals in terms of different functional and non-functional criteria (e.g. reliability, efficiency, learnability). However, it did not cover the users' opinions as to how the use of CAT tools affected their professional self-image or their working conditions, two dimensions that the accessibility of CAT software could have a strong impact on and which are of utmost importance in the case of visually impaired translators.

Two further studies sought to provide new evidence on these matters. With respect to the translators' own professional image, Dillon and Fraser (2006) found that those who were new to the industry had an extremely positive view of CAT tools users and, therefore, perceived that mastering these tools would contribute to enhance their profile among colleagues and work providers. This suggests, according to the authors, that the translator's interaction with peers and the broader industry is a key influence on the translator's perception and plays an even stronger role than the individual's user status (ibid). It would thus follow that the blind users'

inability to use CAT tools could not only damage their self-esteem, but also construct a negative image of their professional profile among potential employers.

As far as the translators' views about the influence of CAT tools on their working conditions is concerned, LeBlanc's (2013) data −collected through interviews conducted in the translators' workplace− indicated that, while translators showed overall a positive attitude towards a computer-assisted translation workflow, they considered that most of the disadvantages of using CAT software already set forth in the Introduction of this paper (e.g. barrier to creativity, changes in productivity requirements) had altered their translation *modus operandi*. One interesting finding was that these concerns appeared to stem not necessarily from the tools' conception or design, but rather from the way the companies required their translators to use them (ibid). Nonetheless, as O'Brien (2012, p. 114) argues, there remains a paucity of evidence showing whether translation tools are really being designed (or not) "from the point of view of interaction with translators, as opposed to simply facilitating functions within the translation task or supporting the managers of the translation business."

Through her survey, Lagoudaki (2006) made one of the first attempts to bridge this gap, collecting information about certain preferences of CAT tool users, as well as a list of desired functionalities that translation software could integrate in the future. Yet, most of those have either become outdated (e.g. translators preferred MS Word as text processing environment) or are already featured in most CAT software (e.g. the handling of PDF files or OCR capabilities). Since then, far too little attention has been paid to hear the needs of translators to improve the user interfaces (UI) they need to work with every day. One of the few exceptions has been reported in Bota et al. (2013), where focus groups of experienced translators were created to assist with the development of Lingo24's CAT tool COACH, resulting in improvements related, among others, to configurability issues (e.g. customisable shortcuts, font types and sizes), speed, and quality assurance support (e.g. live highlighting of spelling mistakes). Similarly, with a view to creating user-focused specifications for editing interfaces to better support the post-editing task, Moorkens & O'Brien (2017, forthcoming) consulted over 200 participants and discovered that half of them were unhappy with the default layout, colouring, and display of mark-up tags in their current translation editors, with most of them expressing a preference for a customizable, clean and uncluttered UI. In addition, the survey revealed that a considerable number of translators were continuously experiencing performance issues, such as tool bugs and slow response times.

The aspects referred to above seem to depict an overall dissatisfaction with translation tools among sighted translators, particularly with regard to two of the four dimensions defined in Krüger's (2016) model of CAT tool usability, namely *efficiency* −reliability of the software, suitability of standard configuration, expandability− and *satisfaction* −how users feel about working with the software−. Although our focus is on CAT tools' accessibility,[5] data presented in subsequent

[5] While there is a significant overlap between the two concepts, it is often understood that usability refers to the general quality of usage, whereas accessibility is more concerned with access to content and functionality. In this sense, in a blind translator-computer interaction scenario, we understand that a tool that is designed accessibly will result in an improved usability level for this user group (and potentially to all CAT tool users).

sections will allow us to understand whether blind users, who were not considered in previous CAT tool perception studies, share similar concerns regarding these two dimensions. Additionally, we seek to touch upon the two remaining usability components from Krüger's model when referring to the accessibility of CAT systems for visually impaired users: *effectiveness* −how well a given user can achieve specified goals or perform specified tasks using the software− and *learnability* −how easily users can familiarise themselves with the tool and which resources they can draw on in this process− (Krüger, 2016, pp. 131–132), as we consider them to be especially relevant for this user group in an educational context. To conclude this section, it is worth mentioning that, in the light of the growing willingness to explore, within translation process research, the physical, cognitive, organizational and technological constraints of the translation profession (Ehrensberger-Dow & Massey, 2014a; Ehrensberger-Dow & O'Brien, 2015), it seems reasonable to believe that further studying the accessibility limitations of computer-aided translation software could shed new light on a new and so far unexplored branch of translational ergonomics: the cognitive and social effects of an assistive technology-mediated translator-computer interaction.

3. Fitting accessibility challenges in translation technology training

Unveiling the accessibility barriers that visually impaired users encounter when interacting with CAT tools may have an impact on the pedagogical approaches adopted in a translation technologies classroom with mixed groups of sighted, partially sighted and blind students. In fact, prior work (Figiel, 2015; Hagemann 2016) examining the particularities of teaching translation and interpreting to such a diverse group has indirectly pointed at the translation technology module as potentially the most challenging of all. Figiel (2015) suggests that to overcome existing accessibility limitations, a potential solution would be for blind students to receive the assistance of sighted colleagues. Hagemann (2016, p. 87), in turn, argues that, if the ultimate purpose of the module is for students to understand the working principles of CAT tools and not the mechanical specificities of industry standards, users and non-users of AT could be taught different software, based on their accessibility level. These two aspects (class dynamics and technology used) need to be addressed when trying to design an accessible translation technology module.

Questions have been raised about the particular effects of attending the needs of visually impaired students on precisely class dynamics. In the context of a traditional translation module, Jane and Bidoli (2003), for instance, outlined the associated challenges for the teacher, such as the need to prepare materials at least two weeks in advance so that their accessibility can be verified by the student and, if not, amended on time; not being able to diverge from a pre-planned lesson as a result of the latter; the need to describe everything that is written on the board or any visual content appearing in documents that are referred to during the class, which slows down the pace of the lesson; or having to devote additional time in office hours to clarify difficulties encountered in the classroom. According to Hagemann (2016), sighted peers may be also affected by this kind of interruptions

or a slower pace, causing undesired distractions when concentrating on the text to be translated.

Nevertheless, the very different nature of translation technology modules, which are mostly organised around hands-on labs with their own distinctive dynamics (e.g. students usually talk to each other throughout to share advice on problems found during a given task, the lecturer can see what is happening on each screen and therefore offer individual feedback), could soften some of these effects. In a longitudinal study aiming at evaluating the experience of translation students in CAT labs, Moorkens & Doherty (2013) found, for instance, that a good solution to compensate for the different abilities in IT skills and knowledge among students could be to provide an extended preparation class at the beginning of the semester and offer additional support on an ad hoc basis. A similar initiative could be taken with blind students, not only for the lecturer to learn about their needs before the module starts, but also to familiarise themselves with their AT and foresee any potential problems that may arise. Similarly, Pym (2013) advocates for a translation technology teaching environment in which students use their own laptops. This is particularly relevant for blind students, who otherwise would need to have their AT installed in the computer lab, as well as be given an adaptation period to get use to new hardware and software. In addition, Pym (ibid) supports peer work, arguing that two people are more likely to find a solution to a given technical problem and less likely to remain silent if they need help from an instructor. Realising that sighted peers may need and request help from the lecturer could encourage blind students to speak out about their difficulties too, if any.

Considering the introduction of more accessible CAT tools in the translation technology class to support an enhanced learning experience for visually impaired students only adds a new perspective to the much debated (and still unsolved) question of which tool(s) to showcase in a university setting to prepare students for the marketplace. Austermühl (2013) argues that "choosing what to teach" and "how" when it comes to translation tools can be a challenging endeavour due to differences in translator training institutions (number of years, cycles), the fact of having students with multiple language combinations in the same class or enrolling in MA coming from different subject areas, or simply the isolation of technology teaching as opposed to the implementation of a more transversal "everyware" approach, in Enríquez Raído's (2013) terms. Institutional restrictions and funding availability have also led to new training paradigms, such as those who advocate for the use of FOSS translation software (Pym, 2013; Veiga Díaz & García González, 2015).

While market-leading tools, such as SDL Trados Studio, are still a recurrent choice, we support Enríquez Raído's (2013) idea of developing "multimedia literacy", encouraging students to critically use and evaluate different translation tools, from different operation systems and devices, with the ultimate goal of supporting self-discovery and long-life learning (ibid). In this sense, driving away from a step-by-step tool teaching method to rather embrace the understanding of core functions and concepts would not only support such approach but also better accommodate the introduction of less well-known but more accessible CAT tools in the module, benefit both groups: visually impaired students would be able to adopt a more active role in the learning process and sighted students would test a

different tool with accessibility-enhanced features (such as speech-to-command or text-to-speech, see section 6).

4. Methodological approach

Before further developing and implementing a teaching proposal such as the one briefly outlined above, we deemed necessary to understand first to what extent blind users can interact with market-leading tools. In order to do so, we adopted an exploratory approach, given that, to the best of our knowledge, existing evidence regarding the accessibility of CAT tools was mostly anecdotal in nature. Since we considered that not enough background research existed to conduct a controlled experimental study, it was decided to carry out a series of case studies, and a survey. Both methods are explained in more detail below.

Exploratory case studies. The overall objective of the case studies was to observe the evolution in terms of accessibility of SDL translation technology across different tool versions, namely SDL Trados Studio 2009, 2011 and 2014. It should be noted that we did not intend to carry out exhaustive accessibility tests (i.e. verify full keyboard access, colour contrast, font size, multiple AT support) or a comprehensive CAT tool evaluation following well-established assessment criteria such as those defined in the EAGELS model (Starlander, 2015). Instead, we aimed at understanding where the accessibility boundaries of the tool were and what could be achieved by a blind user with it.

As mentioned earlier, several studies have pointed to SDL Trados as the leading industry standard and one of the most popular tools among freelance translators and LSPs (Lagoudaki, 2006; Bundgaard, Christensen, & Schjoldager, 2016; Moorkens & O'Brien, 2017, forthcoming). It seemed appropriate, therefore, to choose this tool for this phase of our research and further investigate whether the reports made by different blind translators through *The Round Table* mailing list or personal diaries (Owton, 2011; Dold, 2016) regarding its inaccessibility held true.

The case studies took place over a period of one year at the Università degli Studi Internazionali di Roma (UNINT) in Rome, Italy. Concretely, we conducted three single case studies (SCS) −i.e. case studies involving only one subject− which as Lazar, Feng & Hochheiser (2010, p. 150) put it, do not intend to make broad, generally applicable claims, but simply to "understand novel problems or situations, often with the hopes of informing new designs" or "documenting a system or a context of technology use." By combining data from several similar cases (same technology used, although different versions, see Table 1), we can present cumulative evidence about a single phenomenon (Saldanha & O'Brien, 2014, p. 212): the accessibility issues encountered in a context of use characterised by an AT-mediated interaction between the user and the CAT tool. For each SCS, we created a research journal to collect qualitative data according to specific goals:

- *SCS1*: In the first study, we were interested in observing how easily the lecturer and the blind student could learn how to work with the tool, which were the main accessibility barriers encountered, and whether the blind student could complete a simple translation task.

- *SCS2:* In the second study, emphasis was placed on observing whether a blind student could actively participate in a project-based learning (PBL) environment (Kiraly, 2005), and noting the coping strategies adopted by both the lecturer and the student to overcome the accessibility barriers found along the way.
- *SCS3:* The last study was more tool-oriented and aimed at identifying whether the accessibility problems spotted in the previous version were still present and, if so, whether a solution could be proposed.

Table 1. Tools tested, AT used and timing for each case study.

Code	*Context*	*CAT tool*	*Screen reader*	*Braille display*	*Time span*[6]	*Date*
SCS1	Research lab	SDL Trados 2009	JAWS 10.0	No	3 months	July 2010
SCS2	In-class activity	SDL Studio 2011	JAWS 13.0	Yes	6 months	Jan 2013
SCS3	Research lab	SDL Studio 2014	JAWS 14.0, NVDA 2013.2	Yes	3 months	Nov 2013

Survey. With the aim of collecting additional CAT software accessibility data from a larger sample, and inspired by the survey conducted by Lagoudaki (2006) to study the general attitude of language professionals towards CAT systems, we designed a complementary questionnaire[7] particularly targeting visually impaired translators. Its goal was two-fold: on one hand, we sought to gain a deeper understanding of (i) their user experience when interacting with this type of technology and (ii) the impact of the latter on their professional lives. On the other hand, we aimed at gathering knowledge about the tools most frequently used by blind users and their preferences for future accessible developments in CAT systems.

The questionnaire was administered in English via SurveyMonkey and the call for participation was sent to the *Round Table* (see footnote 4) on July 15th, 2015. Potential respondents were given eight weeks time to complete it. Apart from a comprehensive demographics section, the survey contained 40 core questions aiming at collecting information about: (i) the accessibility level of 27 core functionalities of a CAT tool of their choice (tool subjective assessment), and (ii) their general perceptions with regard to different aspects of the use of CAT tools. In this paper we want to outline the main findings related to the latter.

[6] The time span in SCS2 was conditioned by the duration of the CAT course within which it was conducted (see section 5.3). The time span of the other two single case studies depended on the participant's and collaborators' availability.

[7] A PDF version of the questionnaire is available for reference at https://goo.gl/kKF3I3.

5. Exploratory case studies

5.1 Users' profile

For SCS1, we recruited an undergraduate student interpreter, Stephania[8] (congenitally blind, female, 24 years old), who self-reported to have a high proficiency level of IT skills, including the use of JAWS, the screen reader chosen for the study (see Table 1, section 4). Her profile was considered appropriate for the goals of SCS1, as she had followed mainly interpreting courses and was not familiar with CAT tools.

For SCS2 and SCS3, the same participant was involved, allowing us to establish a more meaningful comparison across versions (SDL Trados Studio 2011 and 2014). Anna Rita (congenitally blind, female, 26 years old) was an undergraduate translation student. She reported to have very good IT skills, emphasising that she was very fast at keyboard typing. Additionally, she showed a high degree of commitment to improve the accessibility of CAT tools and was determined to work as a professional translator in the future.

5.2 Single case study (SCS) 1 with SDL Trados Studio 2009 – main findings[9]

Drawing upon our vast experience (15 years) in translation technologies training, we considered that the first step needed to teach a blind student how to use a CAT tool would be to acquire a deep understanding of (i) the AT she would need to access the tool and (ii) the quality of the interaction between the two technologies. This, in turn, would allow us to better estimate whether the use of CAT tools could ultimately bring some additional benefits to the blind translator's job.

To expand her knowledge on the use of JAWS, the lecturer received the assistance of a blind computer engineer, who also helped her identify the interaction gaps between this AT and Studio 2009. A second engineer joined the team to solve a basic problem related to the accessibility of status icons and developed a script to label the translation environment so that it was possible to move the cursor from the source text to the target text and vice versa through a keyboard command, letting the user know in which column the cursor was. Studio 2009 user guide had to be adapted as well according to the input received by the two collaborators –mostly by enriching the list of keyboard shortcuts and adding explanations of which buttons or windows JAWS could not interact with. For example, when creating a translation project, JAWS was not able to read the "Add" and "Create" translation memory buttons, so the only way of activating them was

[8] Although we suggested to use fake names when reporting the study findings, participants gave us their consent to use their real first names without mention to their surnames.

[9] A lay summary of this study's outcome has been published in 2011 in the European Blind Union (EBU)'s Newsletter: http://www.euroblind.org/newsletter/online/2011/november-december/newsletter/online/en/newsletter/feature/nr/899/ Accessed 20 September 2016.

to use a keyboard command; hence, this piece of information had to be included in the user guide.[10]

While the learning curve was steep for the lecturer, given the problems encountered and the fact that it was her first time using a CAT tool by means of a screen reader and a keyboard only, it was expected that the blind student would experience fewer difficulties. Guided by the team's instructions and the knowledge acquired during the previous preparation phase, Stephania learned to use Studio 2009 basic functions. The major downside acknowledged by the participant was the time investment required to learn such an extensive list of keyboard shortcuts just because of the lack of support offered by Studio 2009 for JAWS.

Once she became familiar with the tool, she was requested to translate an .html file of approximately 200 words, using an existing translation memory and a termbase. We sought not only to observe whether it was possible for her to complete the task, but also to measure the time needed to do it and her subjective opinion about the user experience of the whole process. After one hour and 30 minutes, the blind student managed to create a new TM and import a legacy one, convert an .xls glossary with Multiterm Convert, create a new termbase and import the terms into SDL Multiterm 2009, translate the text in Studio and export it back to its original file format. Stephania reported to be satisfied with her job, but acknowledged to have felt stressed by all the shortcuts she had to memorise to use the tool.

While the outcome of the test was positive, it also revealed important accessibility barriers that would prevent AT users from fully exploiting the tool in a professional context. Segment check and retrieval from the TM was troublesome, as JAWS was unable to access the translation results window and was causing Studio 2009 to not display fuzzy matches. Similarly, tags, placeables and termbase entries could not be identified as such by the screen reader. This could lead to serious formatting errors in a real life scenario, particularly in the case of HTML files, thus having a negative impact on the effectiveness of the tool for blind translators. Finally, the learnability of Studio 2009 −as per Krüger's (2016, p. 135) model− when a computer display and a mouse are not available turned out to be low: both users (lecturer and student) had to devote considerable efforts to become familiar with the workarounds needed to access the tool, mainly due to the low level of detail of the documentation and the lack of accessibility-related technical support offered by the tool provider.

5.3 Single case study (SCS) 2 with SDL Trados Studio 2011 − main findings

In SCS2, the focus was placed on observing the interaction between the blind student and the tool, as well the overall learning process, in a situated translation project within a real educational setting (Kiraly, 2005). Anna Rita, the second blind student participating in the case study series, enrolled in the CAT course offered at an undergraduate level at UNINT and was evaluated throughout the course as her sighted peers. There were two main modules: during the first one, students needed

[10] According to SDL developing teams, Studio is a complex tool built using different programming languages (Java, C++) which poses additional accessibility challenges.

to acquire specific instrumental knowledge and know-how with regard to SDL Studio 2011; in the second module, they had to apply the acquired skills in the context of a simulated localisation project, assuming different roles (project manager, translator and reviser).

Although the lecturer was aware of the accessibility limitations of SDL software, it was decided that there would not be, a priori, significant variations in the pedagogical approach traditionally followed. This was based on the belief that no major changes would have been introduced from Studio 2009 and 2011. However, soon after the first module started, the lecturer realised that the blind student could not work autonomously due to a decrease in the number of accessible tool functions (see section 5.4 for specific examples). This inevitably led to slow down the pace of the class, but it did not have a negative impact on the learning process of the other students. The group had been divided intro three sub-groups according to their self-reported IT skills, so Anna Rita's colleagues, who had voluntarily joined her group, were receptive to having more time to work on each task.

In each lesson, Anna Rita was supported by two sighted students, as well as by the detailed descriptions of what was shown on the screen provided by the lecturer for each concrete tool functionality that was being explained. The dynamics of the class improved week after week thanks to the feedback received from the blind student at the end of each lesson. As a result, the pedagogical approach was modified: instead of explaining in detail all the functions a user could find in each menu or tab and then asking the class to carry out a given task, the lecturer simply described the options needed to complete such exercise and what students should expect from each action. This more targeted approach was welcomed by both the blind student and her sighted peers. The fact that the lecturer is still applying it nowadays serves as a real example of Hagemann's (2016) belief that blind students may act as catalysts for innovations and lead to developing new ideas that can be beneficial for all. Additionally, we find that the success of such reductionist approach implicitly reflects, at least to some extent, the usability concerns highlighted by translators in the study conducted by Moorkens & O'Brien (2017, forthcoming), who complained about overcrowded interfaces (with one user referring directly to SDL Trados UI) and considered that rather than having many or few items on the screen, it was important to have the 'right' features.

With the appropriate consent of the group, lessons were recorded to support Anna Rita's learning process, with the hope of contributing to boost her self-confidence too. While this proved to be of valuable help, the blind student still reported unease and frustration when sighted peers had to wait for her to complete a certain task. These feelings, however, were counteracted by situations where, precisely thanks to the use of a screen reader, she was able to quickly find a given functionality and then guide the rest of the class towards it.

Overall, during the second module, Anna Rita showed a positive attitude, probably because of the support provided by the group and the satisfying learning experience of the previous module. From a technical perspective, she was able to perform the main operations to create a translation project, but dealing with terminology management and the translation phase was still challenging. She successfully assumed the role of project manager, preparing a localisation project

and distributing the different tasks to her working team, as well as the role of reviewer. Nevertheless, she could not complete the translation task alone due to multiple accessibility barriers in the translation editor, which will be jointly reported with those of Studio 2014 in the next section.

5.4 Single case study (SCS) 3 with SDL Trados Studio 2014 – main findings

Drawing on our experience from SCS2, where we learned that Studio 2011 was not as accessible as Studio 2009, in the third single case study we sought to explore in more detail the accessibility level of Trados Studio 2014, with the hope of also finding a solution to any possible AT-CAT interaction gap. Since Anna Rita had already become familiar with the CAT tool environment and no major changes had been incorporated from 2011 to 2014 versions, she felt comfortable enough to inspect the tool by herself, listing which steps were accessible and keeping track of those functions she could not have access to. In order to make a more informed judgement, she used two screen readers (JAWS, NVDA). A summary of her interaction experience is presented below. Issues reported here apply to both SDL Trados 2011 and 2014.

a) General functionalities, prior to translation editing

The installation process can be carried out solely relying on keyboard commands, as each button is correctly labelled with a textual description. Nevertheless, when the installation is complete and user personal data needs to be provided, mandatory fields rely on sensory characteristics to be identified (they are marked in red). This information is therefore not accessible for the blind user, who feels obliged to fill in all the details. The creation of an user profile is accessible, as it is possible to use the space bar and Tab to navigate between options. Similarly, the alignment feature and the functionalities provided to create termbases and TMs are accessible. Finally, it is worth higlighting that QA and shortcut customisation options cannot be accessed via keyboard and therefore it is not possible for blind users to learn about or change the tool default settings.

b) Translation editing functionalities

Once in the main UI, the tool does not provide any keyboard shortcuts to access the different windows available through the navigation pane, such as "Projects", "File", "Editor". More specifically, the translation editor does not provide almost any accessible functionality. Without a customised script, it is not possible for the blind user to know where the cursor is placed (source or target segment), although it is possible to easily move from one translation unit to another. Segment status, tags, placeables and TM match information are shown using symbol, colour or graphical coding, but no non-visual alternative representation is offered (only fuzzy percentages can be read using a Braille display). Concordance, AutoSuggest and Termbase windows are not accessible either.

As can be inferred from the above, a blind user would be able to accept certain project-management related tasks in Studio 2011 or 2014, but would need sighted assistance to successfully carry out a translation job. In what follows, we shall report on blind users' interaction with CAT tools in more detail.

6. Survey

This section summarises the key findings from the survey conducted with blind and visually impaired translators about their perceptions around CAT tools.

6.1 Respondents' profile

A total of 35 people completed the questionnaire, but just 30 usable responses were collected. Yet, for the purposes of this paper, only data from visually impaired translators who had tried or worked with CAT tools in the past −or were doing so at present− were considered for analysis. As a result, we limited our sample to 22 translators from 17 different countries (North America, Europe and Asia), aged between 23 and 50, $\bar{x}$ = 34.59, *sd* = 8.65 (5 male, 17 female). Seventeen (*N*=16) respondents were blind, five reported to have a moderate visual impairment and one a severe visual impairment (glaucoma). The most popular screen reader among respondents was JAWS, followed by NVDA, ZoomText and Window-Eyes. As in Lagoudaki (2006), over 85% (*N*=19 out of 22) of the translators rated their general usage competence of AT and computers as good or excellent, held a university degree and had a translation-related qualification. This general profile goes in line with one of the participants recruited for the single case studies.

From the 22 translators who indicated that they had used CAT tools prior to the study, 68% (*N*=15 out of 22) were using them on a regular basis. Overall, sixteen (*N*=16) respondents reported to have or have had a professional translation job (mostly as freelancers, with an average experience of 7.5 years, *sd* = 5.44, Min. 0.5, Max. 20), one (*N*=1) had decided not to enter the translation market and five (*N*=5) respondents did not answer the question. The most popular file format they were used to dealing with was doc/docx (100%), followed by PDF (73%), xls/xlsx (41%), html (27%), xml (23%), CAT proprietary files (18%) and xliff (13%).

6.2 Top level findings

From a general perspective, data collected appears to support the anecdotal evidence we referred to earlier, as well as the conclusions drawn from the single cases studies we have reported above. None of the translators claimed to be satisfied with regard to the accessibility of CAT tools in general. More specifically, we would like to highlight the main aspects where translators reached a higher level of agreement:

6.2.1 Poor interaction between CAT and AT

Fifty-nine percent (59%, N=13) of the respondents considered their level of satisfaction regarding AT-CAT interaction as poor, while 27% declared to not be satisfied at all with the accessibility level of CAT systems. Those who said they were quite satisfied (9%) or very satisfied (5%) indicated that they were only referring to the tool they were using. A substantial majority believed that this fact had negatively affected their translation career −only three respondents (*N*=3 out of 22, 14%) said that they had never seen a translation job offer that asked for CAT

tools knowledge. The following testimonies aim at illustrating how translators are being "devalued by technology" (O'Brien, 2012) from an accessibility perspective:

R13: *I didn't decide (to leave the translation market); unfortunately the CAT tools that are used in translation companies are not accessible to screen readers. I would like to translate without technical barriers that could be solved really easy in the digital age.*

R32: The few times I've had contact with translation agencies, CAT tools have been required, so I haven't pursued translation more seriously.

R45: I realized that I could never get work in a translation agency which was what I wanted (I didn't want to work freelance the rest of my life) because so very few CAT tools are accessible. I would not have been able to perform the work in a satisfying way, not even close.

An important number of translators reported to have become interpreters instead, not only due to the inaccessibility of CAT tools, but also to other challenges related to the translation profession, such as meeting tight deadlines and dealing with inaccessible source files, which had been already mentioned in prior work (Cebrián de Miguel, 2008).

Figure 1 shows the tools more frequently used by the visually impaired translators who completed the survey. Despite the fact that it is an old version (SDL Trados 2007), SDL technology continues to be the most popular choice among translators (N=13, 59%), as it appeared to be the case already among sighted translators more than 10 years ago (Lagoudaki, 2006). A common view amongst respondents was that the only accessible CAT tool available in the market was Fluency Now, by Western Standard,[11] which was used by 11 (50%) respondents. However, it was claimed that it is never used by LSPs and that, consequently, blind translators cannot currently participate competitively in the translation market or have access to other positions in the industry. For instance, responded R39 argued:

R39: With the exception of Fluency, CAT tools can't be used quickly and efficiently with a screen reader [...] It's important to remember that all aspects of the CAT tool need to be accessible so that blind professionals can work not only as translators, but also as revisers or project managers.

The unpopularity of Fluency Now among LSPs could explain why Trados 2007 is still used, despite the fact that no further technical support is offered for this version by the software provider. Another reason reported was that newer versions of SDL Trados were found to be inaccessible, as we have inferred from the case study series presented earlier, and that working in MS Word was easier for screen reader users.

SDL Trados 2007 and Fluency were followed, in terms of popularity, by Wordfast (N=9, 41%); Studio 2011 (N=8, 36%); Studio 2014 (N=6, 27%); STAR Transit (N=5, 23%); Across and OmegaT (N=3,14%); DéjàVu; Wordfast Anywhere and MemoQ (N=2, 9%); and MultiTrans, Studio 2015 and Wordbee (N=1, 5%). The relative high number of users of Studio 2011 and 2014 was found to be particularly surprising, especially when these results are checked against the subjective data provided throughout the survey and the outcome of our two last exploratory studies. We believe, therefore, that further research would be needed to

[11] https://www.westernstandard.com/Fluency/FluencyNow.aspx Accessed 20 September 2016.

gather data about the specific working environment (e.g. human and technical assistance, role within translation projects) of these respondents to better triangulate the output of both studies.

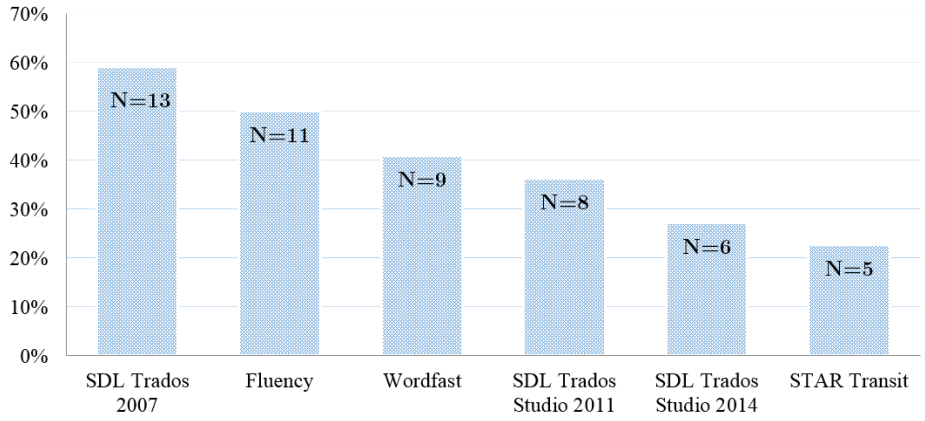

Figure 1. Main CAT tools used by blind and visually impaired users participating in the study.

6.2.2 Lack of comprehensive technical support

Two thirds (N=14) of the respondents indicated that CAT tool user guides were rarely accessible mainly due to the high presence of graphical content and the lack of detail descriptions, which limited the user experience to a continuous trial and error-based interaction. This echoes our experience with SDL technology in the single case studies. When asked about which type of information an ideal CAT tool user guide would include for screen reader users, the majority noted the following: a comprehensive list of keyboard shortcuts, quick access menus, and descriptions of screen layout without references to colour formatting (e.g. avoid "right-click on blue fuzzy match panel"). In the particular case of keyboard shortcuts, we hypothesise that this would be equally beneficial for sighted translators, as studies indicate that they also appear to be keen users of this alternative way of interacting with CAT tools (Moorkens & O'Brien, 2017, forthcoming). Similarly, respondent R39 commented: *It would also help if CAT tool manuals included a short section on accessibility that mentions what settings (if any) should be adjusted for a better screen reader experience.* Fluency Now, for instance, features the possibility of using an "accessibility mode" or allowing translators to use their own screen reader for output. The tool also offers a speech-to-command functionality (see Figure 2) which was appreciated by some respondents.

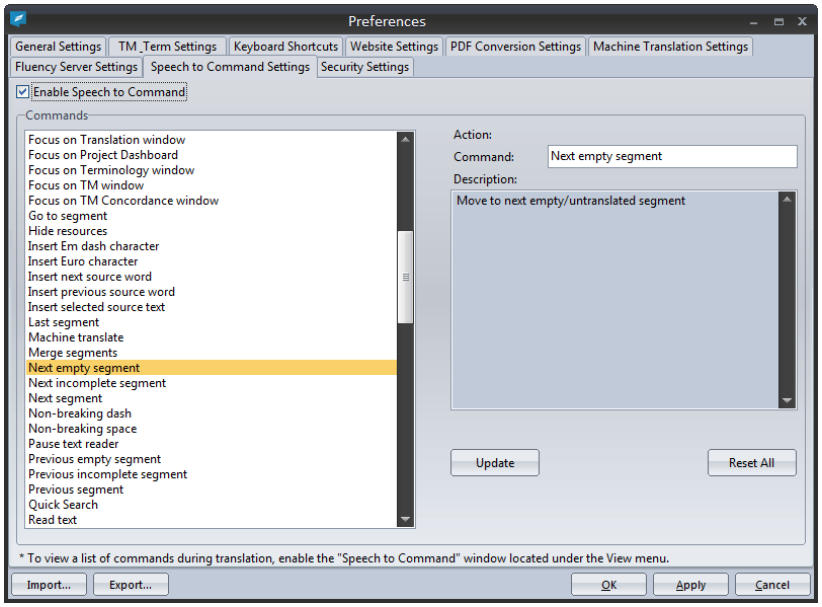

Figure 2. Fluency Now *Speech to Command Settings* in the Preferences window.

In addition, visually impaired translators (N=14 out of 22, 64%) seem to hold, in general, a negative view about CAT tool providers (with the exception of Western Standard) regarding their responsiveness when accessibility issues are reported. For instance, one respondent (R43) said: *I contacted several providers and some replied they would not fix the problems as we represent a small market compared to our sighted colleagues and the costs would be too high.* While further evidence would be needed to fully support this statement, the data collected appears to reveal a low level of awareness among tool developers and suggests that a change of mindset is needed.

6.2.3 Advocacy for accessible design

Almost all respondents (95%) embraced the idea that to fully exploit CAT systems, they should be designed with accessibility in mind and AT users should be involved in the testing phase. Respondent R13 argued: *It would be necessary to take into account the software accessibility from the beginning of the development, but most developers doesn't [sic] have enough information or doesn't know anything on this subject.* It was also suggested that, to facilitate a higher participation of the visually impaired community in the translation industry, the accessibility of other relevant resources should also be improved (e.g. job offer platforms, such as *Proz.com*, or online multilingual termbases). From the publicly available translation memories and termbases, *Linguee* and *TermiumPlu*s were mentioned by multiple respondents as good accessible examples.

7. Conclusions

As Ehrensberger-Dow & Massey (2014b) suggest, "professional translation has become a multi-activity task within a complex system of client expectations,

technological aids, information sources and organizational constraints." In this paper, we have attempted to shed light on how accessibility barriers could add a new dimension to the challenges already associated to the translation profession. More concretely, we have tried to document the needs of visually impaired users when it comes to the use of translation technology, a topic that had not been previously referred to extensively in the related literature. While we are aware of the limitations associated to the methods adopted, including the exploratory nature of the studies, the small samples and the subjective nature of some of the data gathered, we believe that our work has provided some important insights into the most common obstacles faced by visually impaired people who seek to actively engage in a satisfactory translation career.

In general terms, evidence gathered through the single case studies and the survey has revealed low levels of flexibility and usability in state-of-the-art CAT technology for screen reader users, mostly due to a non-accessible design (e.g. lack of accessibility enhancing features, absence of full keyboard access support, overreliance on graphical content to display relevant information for an informed translation process, inaccessibility of tool documentation). According to the subjective opinions collected, only one tool in the market is accessible and provides continuous support to the community, Fluency Now, while market-leading tools like SDL Trados Studio are lagging behind as far as accessibility is concerned. This comes as a surprise, given that, as Figiel (2015) argues, "the growing tendency is not to build separate solutions for the blind, but rather make standard products accessible out of the box." If this approach was to be followed by translation technology providers, it is likely that the number of blind and visually impaired people choosing a translation career would increase.

The above would also bring substantial benefits to translation technology classrooms with mixed groups of sighted and blind students. The inaccessibility of current most popular translation tools can lead to unease, frustration and low self-esteem among blind students, as we have mentioned in previous sections. When presenting the main take-aways of our single case studies, we have suggested some potential solutions to improve their learning experience, such as the customisation of tool documentation based on previous AT-CAT interaction analysis, working in peers or lesson audio recording. Similarly, it seems advisable to work closely with IT teams and to listen to the student needs and concerns (get to know which ATs they are using, their IT skills) in order to avoid any undesired disruptions during the class. At present, another viable −and recommendable− approach would be to consider Fluency Now as an additional tool to be taught since, as it has been highlighted earlier in this article, this could benefit all students, regardless of their functional diversity.

8. Future research directions

We agree with Harper & Yesilada (2008, p. v) in that "people are disabled not by their impairment but are handicapped by the technology, infrastructure surrounding them, and the environment in which they are working or living in." In this sense, we are committed to promote awareness, social inclusion and equality in both the translation professional and academic milieu. While there is abundant

room for further progress in determining how the best AT-CAT interaction can be achieved, future investigations should start by looking at the capabilities of emerging web-based CAT systems, where accessibility best practices could be easier to implement. Additionally, it would be interesting to look at the overlap occurring between translational ergonomics, usability, user experience (UX) and accessibility to identify tool innovations that could be beneficial for all users. This could, in turn, help translation technology providers design more 'caring' translation tools, a suitable term coined by O'Brien (2012). In the short term, we plan to conduct follow up interviews with survey respondents who reported to have more experience in the use of CAT tools to assist with the design of more accessible translation technology training programmes.

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