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Machine Translation and Fair Access to Information

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Abstract

This article contributes to the discussion on fairness and ethics in MT by highlighting efforts that have been made to use MT for the humanitarian purpose of increasing accessibility to information for groups that are underserved. The article provides an overview of example projects in which MT has been implemented for this purpose in three contexts: civic participation, public health and safety, and media and culture. In addition, the article examines some of the ethical issues surrounding efforts to use MT for accessibility, including issues of quality, acceptability, and the need to involve stakeholders in development.

Keywords

machine translation, accessibility, ethics, machine translation for information purposes, post-editing, linguistic accessibility

A number of motivations have fueled the research and development of machine translation (MT), including those from science, defense, government, and industry (Melby and Warner 1995; Hutchins 2010). A further motivation has been the idea that MT could be used to benefit humankind by promoting accessibility to information. Especially in the early days of development, mentions were made of researchers being motivated by "idealism: the promotion of international cooperation and peace, the removal of language barriers, the transmission of technical, agricultural and medical information to the poor and developing countries of the world." (Hutchins 1986, 15)

However, research interests quickly became devoted to methods, technologies and evaluations of different systems, with little attention given to utopian motivations. In the late 1990s, research emerged on the need for language technology solutions for minority languages and immigrant populations, and the humanitarian motivations for MT resurfaced. Coinciding with this was the rise of artificial intelligence systems and a subsequent re-energization of discussions on ethical issues. All of these actions have led to the current examination of ethics and fairness in machine translation.

As part of this examination, we want to reconsider the utopian idea that, in addition to providing commercial enterprises with a way to increase efficiency to reduce translation costs, MT can be used for humanitarian purposes. The IEEE Global Initiative for Ethical Consideration of Artificial Intelligence and Autonomous Systems (A/IS) lists three general principles related to the use of artificial and autonomous systems, stating that they should: "1) embody the highest ideals of human beneficence as a superset of Human Rights, 2) prioritize benefits to humanity and the natural environment from the use of A/IS, and 3) mitigate risks and negative impacts, including misuse, as A/IS evolve as socio-technical systems" (IEEE 2017, 23). The first goal of this paper is to bring into the discussion on ethics and MT part of the second IEEE general principle, namely, the benefits to humanity that are enabled by MT. Access to information can be seen as a human right necessary for participation in society and as a means of ensuring equality, and efforts to improve accessibility to information can thus be viewed as beneficial to society as a whole. Various governmental institutions, non-governmental organizations, private businesses and academic researchers have indeed stepped in to develop tools to address the issue of multilingual access to information and help ensure accessibility for various, previously underserved, groups. A second goal of the paper is to introduce some of the ethical issues that might arise in efforts to use MT for accessibility purposes. We do not aim to provide a comprehensive account of all past and ongoing projects, nor all ethical issues. Rather, our objective is to raise awareness of the concrete actions being taken to use MT to benefit humankind, and to introduce some of the ethical issues that may be involved in these actions.

Because many of the projects we introduce in this paper are recent or ongoing, our data consisted of websites, white papers, project proposals, reports and personal communications in addition to scientific articles. The structure of the paper is as follows: the first section describes the phenomenon in question and the main needs it

sets out to meet. Section 2 introduces example projects that use MT to improve accessibility to civic participation, health and safety information, and media and culture. In Section 3 we review some ethical issues that may arise in implementing MT for accessibility, and Section 4 contains our conclusions and recommendations.

1. Accessibility to information and machine translation

In this paper we examine efforts that aim to increase target audiences' accessibility to the information they need by lowering or removing language barriers through the use of MT. Barriers to accessibility can be defined in many ways, and various recommendations and requirements have been drafted to remove them (see, for example, European Commission 2015). While measures aiming to remove barriers to accessibility often focus on sensory and physical or cognitive barriers, another factor is language and linguistic accessibility (see Matamala and Ortiz-Boix 2016, 13–14), and this factor is the focus of this paper. The audiences targeted in linguistic accessibility initiatives include groups who need certain types of information but are not able to access or read that information because of insufficient command of the languages it is offered in. Such groups include, for example, refugees, migrants, and people in crisis situations.

1.1 Access to information as a human right and language as an obstacle to accessibility

The right to information is both a practical question and one of the principal human rights that can be derived from international agreements such as the UN's Universal Declaration on Human Rights (United Nations 1948) and the European Convention on Human Rights (Council of Europe 1950). Although the European Convention on Human Rights, for example, does not list the right to obtain information as such, in the case law of the European Court of Human Rights this right has been upheld on the basis of other articles of the human rights convention, particularly Article 10, which guarantees freedom of expression, but also Article 2 (right to life), Article 6 (right to a fair trial), and Article 8 (right to private and family life) (Tiilikka 2013). Tiilikka (2013, 102) argues that public authorities can be considered to have an obligation to provide information, and the promotion of access to information is often covered not only in international agreements, but also in national laws.

In part, the obligation to provide information concerns openness and availability of official information, but availability alone does not guarantee accessibility. A key point for linguistic accessibility is the language (or languages) in which information is available. When information is provided only in certain languages, insufficient knowledge of those languages may become a barrier to accessibility. The role of multilingualism as essential for disseminating information and knowledge is widely acknowledged. For example, the European Union considers supporting multilingualism to be important for promoting both cultural identity and social cohesion (European Commission 2012, 2). Accessibility of information in multiple languages, and multilingual practices as a whole, can be seen as "a basic condition for the development of a truly inclusive knowledge society" (UNESCO Executive Board 2007, 2).

1.2 The challenges of multilingualism and MT as a potential solution

In recent years, growing global movement has increased the need for multilingual information, both in terms of the amount of text and the variety of languages. Translation and interpreting are increasingly needed during immigration and refugee processes, and on a continuing basis to make social services and education accessible to immigrants (Biel and Sosoni 2017, 354). The provision of multilingual information is, however, limited by the resources required. One argument raised against multilingualism has been the costs of producing information in multiple languages through translation and other measures, and arguments have been made for using only official language(s) or a lingua franca, often English. However, reliance on English as a "common language" is not unproblematic. For example, a survey of European Union residents found that, of those who did not speak English as a native language, only 38% indicated they were able to hold a conversation in English, and only 25% were able to read a newspaper or follow news on television or radio (European Commission 2012, 21, 28–29). In a study carried out among the refugee and migrant population in Greece, 65% did not understand spoken English, and 80% did not understand written English (Ghandour-Demiri 2017, 16–17).

As a counterpoint to the costs of multilingualism, Gazzola and Grin (2013, 99) note that focusing only on the monetary costs related to translation and interpreting ignores other factors that are relevant when comparing multi- and monolingualism. Factors related to monolingualism include: the potential costs for the (governmental or other)

organization caused by misunderstandings, exhaustion and lower efficiency when workers at that organization who speak a language other than the official language are forced to constantly operate in the official language; costs incurred by the people who need to communicate with that organization in a language they do not know; and psychological costs due to exclusion (Gazzola and Grin 2013, 99–100).

Technology, particularly MT, could offer one solution for the problem of limited human and monetary resources. However, a long-recognized problem in the area of MT for accessibility is a discrepancy between the languages needed in accessibility solutions, for example, the languages spoken in countries from which large numbers of people are currently migrating, and the languages for which solutions are being developed for commercial or large organizational use (Somers 1997). As Carbonell et al. (2006, 120) pointed out, "[u]nfortunately, such economic imperatives exclude most minority languages where MT is most needed for humanitarian purposes." Somers (1997, 11) predicted that only governmental agencies will fund solutions for these languages "unless the private sector sees this as an area where it can make charitable donations." Over the past decade, attention has turned to the question of language technology solutions and resources for languages that have been underserved. For example, in 2017 the non-profit organization Translators without Borders launched the Gamayun initiative, the focus of which is to "bring language technology to bear for the world's most marginalized communities" (Ansari and Petras 2018, 2). Interest in these languages has also risen in MT research, as is evidenced by two recent conference workshops devoted to MT for "low resource languages."[1,2]

2. Example projects using MT to promote fair access to information

Over the years MT has been a component in a number of concrete projects aimed at increasing accessibility to information. Some of these projects have a broad scope, with a variety of target groups, accessibility issues to be addressed, and tools involved. Others focus specifically on MT, as a productivity boost for translators' work or as a tool used directly by target groups to access information. In our research, we aimed to include projects that involved not only the development of MT solutions,

[1] https://sites.google.com/view/loresmt-2018/

[2] https://sites.google.com/view/loresmt/

but also well-defined use cases and target users for those solutions. This section introduces several example projects which aim at increasing accessibility to civic participation, health and safety information, and culture and media.

2.1 Accessibility to civic participation

Projects implementing MT to promote accessibility to civic participation have been undertaken by large governments as well as smaller national bodies. One of the pioneers in this area is the European Union, where efforts to develop MT started as early as 1976 in the European Commission (European Commission 2010, 68). As the EU grew, with more member states, languages, and information to translate, the development of machine translation continued and its use accelerated. The current iteration of MT technology, eTranslation, relies on neural MT and is used by translators as a part of the translation workflow, with material being first machine translated and then post-edited before publication. eTranslation is also offered as a service to people working in public administrations in the EU, Norway and Iceland[3]. Civil servants can access eTranslation directly or it can be integrated with other EU information systems. As with many activities of the European Union, the ultimate goals of the eTranslation service concern multilingual inclusion and participation. Other very large multinational organizations such as the United Nations have also implemented MT systems in their translation workflows (Pouliquen et al. 2013). Projects on a smaller scale also have similar goals of participation and civic engagement, aiming to deliver more information to users in official languages or to ensure access to information for new, previously underserved, groups of people, including speakers of non-official languages, minority languages, and minority languages that arrive with migrant populations.

In the early 2010s, Latvia was facing the need to provide information for a large Russian-speaking minority and also to provide government materials in English to facilitate the country's growing role in the European Union. To address both of these issues, the government decided to implement MT "to facilitate communication between the Latvian public sector and Latvia's citizens" (Vasiljevs et al. 2014, 183). Working with a language technology provider, an MT system was developed to translate between Latvian and Russian and between Latvian and English. Public

[3] https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/Machine+translation

administration employees can use the tool to translate official texts, which they then post-edit for publication. For the general public, the tool also provides an internet portal where anyone can enter text, documents or websites to be machine translated for gisting purposes.

Another project born out of a need for improved accessibility to public services, for recent immigrants as well as people with reduced reading capabilities, was the DigInclude project in Sweden, started in 2016. This cooperative effort between university researchers, language technology providers, and governmental organizations, aimed to improve civic engagement through the development of linguistic resources and tools for writing support, text simplification, multilingual terminology, and MT (Jönsson 2016). At the time of writing, two phases of the project had been completed, but funding for a third had not been secured. However, the MT part of the project has continued in two follow-up projects between the MT provider and the Swedish Migration Agency. The goal in these new projects is to develop MT solutions between Swedish, English and Arabic, to be used initially in translating the agency's website and, in the second project, for translating documents related to applications for asylum and citizenship[4].

The MuTUAL project addressed Japanese municipalities' need to offer official information in languages other than Japanese, which was deemed challenging to accomplish through human translation or post-editing due to expense and time constraints (Miyata, Hartley, Paris, et al. 2015). The MuTUAL system aimed to create tools that would help content creators to produce public information in a form that would optimize MT output quality, enabling them to distribute information in unedited MT form (Miyata, Hartley, Kageura, et al. 2016). Currently, no municipality has implemented the MuTUAL system although many offer access to MT tools integrated into their websites. There are, however, plans to implement and evaluate the MuTUAL system in real-world situations in the future[5].

2.2 Accessibility to health and safety information

Difficulty in accessing health information, resources and services due to language barriers has been linked with negative consequences, such as receiving less

[4] Anna Sågvall Hein, email message to authors, October 8, 2019

[5] Rei Miyata, email message to authors, October 3, 2019

preventative healthcare (see Dew et al. 2018, 57). Some research has been conducted on the use of MT for increasing accessibility to health information, although in their recent review, Dew et al. (2018, 60) found that most publications on this topic involve pilot studies or evaluations of the feasibility of existing tools, often freely available online systems like Google Translate (e.g. Das et al. 2019). Work has focused on text translation, although some projects, such as BabelDr (Bouillon et al. 2017), have involved automatic speech translation systems to assist in communication between doctors and patients.

One of the pioneers in implementing MT, the Pan American Health Organization (PAHO) aimed specifically at increasing the spread of health information throughout North and South America. MT development in the organization began in 1976 and by 1980 MT and post-editing were part of the translation process (Vasconcellos and León 1985). By 2009, MT was fully integrated into the translation workflow and used to process more than 90% of translation jobs (Aymerich and Camelo 2009). Another early international MT and public health initiative was the Global Public Health Intelligence Network GPHIN (Blench 2008), developed by the Public Health Agency of Canada in partnership with the World Health Organization. This system, still in use today, monitors global media sources and websites to identify reports of disease outbreaks and other potential public health events, utilizing MT to translate English to/from Arabic, Chinese, Farsi, French, Russian, Portuguese and Spanish (Blench 2008).

The TransPhorm project[6] (Kirchhoff et al. 2011), carried out in the US, involved a collaboration between university researchers and health departments at the state and local level and investigated the use of MT in the public healthcare sector, focusing on MT from English into Spanish and Chinese. The work carried out in the project involved testing the feasibility of generic and domain-specific MT tools and post-editing for disseminating public health information. The work included MT and post-editing experiments for translating English content into Spanish for public health information websites as well as for health promotion materials used by public health departments (Turner, Bergman, et al. 2014). A web-based translation system was developed in which public healthcare workers could produce multilingual material by

[6] http://www.nwcphp.org/research/projects/current/transphorm-machine-translation-of-public-health-information

using MT and post-editing (Laurenzi et al. 2013). Turner, Choi, et al. (2019) further evaluated Google Translate and a domain-specific system for communication between emergency medical services and patients in Chinese and Spanish.

The recent EU-funded Health In My Language project[7] developed MT systems adapted for translating public health information from English into Czech, German, Polish and Romanian. The project involved collaboration between academia and two partners: a website that publishes systematic reviews of medical studies[8], and regional public health service providers in Scotland. One use case involved professional translators post-editing MT output for plain language summaries of medical reviews to be published on the medical review website, while other use cases investigated the feasibility of publishing information in the form of unedited MT either on the medical review website or on the website of the regional health services (Birch, Ried, et al. 2018).

MT has also been implemented to improve access to safety information and resources. It has proven to be helpful in ensuring accessibility in circumstances in which information plays a critical role, specifically in crisis situations. Since 2014, the Words of Relief program[9] of Translators without Borders has been instrumental in mediating information in a number of natural disasters, public health and refugee situations through translation and interpreting services and training. The program uses language technology to enable quicker responses to information needs. Their Kató translation platform[10] includes MT alongside a variety of other tools used by their community. The EU-funded INTERACT (International Network on Crisis Translation) project[11] was initiated in April 2017 to specifically address translation needs in crisis scenarios. The project is being conducted in cooperation between partners from universities, private companies, and NGOs, and includes the development of MT systems and processes for use in crisis scenarios. Crisis translation and MT in that context have recently attracted growing research interest and is emerging as a field of its own (see, for example, Federici and O'Brien 2020).

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[7] http://www.himl.eu/

[8] http://www.cochrane.org

[9] https://translatorswithoutborders.org/our-work/crisis-response/

[10] https://translatorswithoutborders.org/our-work/kato-translation-platform/

[11] https://sites.google.com/view/crisistranslation/home

2.3 Accessibility to culture and media

Accessibility to media, including audiovisual (AV) media like television or films, is another factor recognized as important for social inclusion and for promoting intercultural dialogue (see Matamala and Ortiz-Boix 2016). Accessibility of news content is also very relevant for participation in society. Audiovisual media poses its own set of challenges, as obstacles to accessibility may be sensorial (hearing, vision) in addition to linguistic. Various projects have aimed to promote linguistic accessibility of AV media through the use of MT.

Some projects have explored fully automated generation and translation of subtitles, such as the MUSA project[12] where speech recognition and MT were used to create English, French and Greek subtitles for documentaries and current affairs programs (Piperidis et al. 2004). The EU-funded HBB4All project[13] also investigated English-to-Spanish MT as well as automatic intralingual English subtitling through automatic speech recognition as a way to increase access to news content originally produced in English (Matamala, Oliver, et al. 2015).

Other projects have focused on the use of MT post-editing as a way to increase productivity. The eTITLE project (Melero et al. 2006), a collaboration between university researchers and broadcasting companies in Spain and the Czech Republic, developed a web-based subtitling platform where MT was offered as a tool for subtitlers alongside translation memories for language pairs involving English, Spanish, Catalan and Czech. MT post-editing of subtitles was also investigated in the EU-funded SUMAT project[14], conducted by academia and industry partners in the fields of subtitling and media/video content production. The project developed MT systems for subtitling in language pairs including English, German, French, Spanish, Swedish, Portuguese, Dutch, Serbian and Slovenian, and included a large-scale evaluation where professional subtitlers tested the usability of MT and post-editing for subtitling (Bywood, Georgakopoulou and Etchegoyhen 2017, 496–497).

While most projects aiming to address accessibility of audiovisual media have focused on MT for subtitles, the Spanish ALST Linguistic and Sensorial Accessibility

[12] http://sifnos.ilsp.gr/musa

[13] http://pagines.uab.cat/hbb4all/

[14] http://www.fp7-sumat-project.eu/

project investigated the use of MT and post-editing for voice-overs (Ortiz-Boix and Matamala 2017) and audio description (Matamala and Ortiz-Boix 2016) from English to Spanish and from Catalan to Spanish. Audio description refers to a process where "an oral explanation of the most relevant visuals (characters, settings, actions, etc.)" is inserted into audiovisual products such as films, making them accessible to blind and visually impaired audiences (Matamala and Ortiz-Boix 2016, 13). Based on their preliminary experiments, Matamala and Ortiz-Boix (2016, 22) suggest that MT in combination with audio description offers a way to increase multilingual accessibility of AV content.

The EU-funded MeMAD[15] project, which involves partners from academia, public service broadcasting and audiovisual archiving in Finland and France, as well as language service and technology companies, aims to increase the accessibility of audiovisual and audio material through automatic speech recognition, automatic video content description and machine translation. The project investigates the use of MT for subtitling, but also for other content like audio description and (human or machine generated) content descriptions of videos. For subtitling, the use cases defined involve both the use of MT and post-editing by professional subtitlers working for public service broadcasters and the use of fully automatic translation of subtitles as potential ways to increase accessibility to news, current affairs, and cultural programming for minority language speakers (Braeckman et al. 2019, 29–32). The language pairs for MT include Finnish, Swedish, English, French and Dutch (Braeckman et al. 2019, 48).

Another recent EU project, GoURMET[16], also brings together academia and public service broadcasters from Germany and the UK, and focuses on MT tools that would enable the production of content in selected low-resource languages as well as the monitoring of media, such as business news, in these languages. The language pairs covered include English to/from Turkish, Gujarathi, Swahili and Bulgarian (Birch, Haddow, et al. 2019).

3. Ethical considerations in MT for accessibility

[15] https://memad.eu/

[16] https://gourmet-project.eu/

As mentioned earlier, besides providing the case of MT for accessibility as part of the higher-level discussion on MT and ethics, a second goal of this paper is to explore ethical issues involved in using MT for accessibility purposes. We identify here potential ethical issues related to quality, acceptability, and the inclusion of key stakeholders. However, this list is meant as a starting point for discussion and not an exhaustive list of issues.

3.1 Quality issues

A common method of using MT for accessibility is to have raw MT output post-edited by humans before being disseminated to end users. This process is increasingly used in the translation industry and has been found to increase productivity (see e.g. Plitt and Masselot 2010, 10), suggesting that MT with post-editing could also promote accessibility by making it possible to translate more content with the same resources. Post-editing can take different forms depending on issues such as the context in which the translation will be read and the level of quality that is required. A common distinction is made between "full" (or "maximal") post-editing, which entails more thorough editing aiming for "publishable quality," and "light" (or "rapid") post-editing, which aims to ensure that information is accurate and comprehensible, but does not include stylistic improvements to the MT output (for an overview, see Hu and Cadwell 2016). However, the extent to which post-editing can improve productivity depends on MT quality, which varies for different language pairs and text types. Furthermore, productivity gains are affected by conditions such as whether experienced professional post-editors are involved and whether the MT system is tailored for the content type in question (García 2011, 228).

Many of the projects covered in Section 2 involved MT and post-editing. In the Health In My Language project, post-editing MT output of medical summaries was shown to increase productivity and received favorable feedback from professional translators in all language pairs except English-to-Polish, where MT quality was considered too poor (Birch et al. 2018, 16). Turner, Bergman, et al. (2014) also suggest that based on the TransPhorm project, MT and post-editing by bilingual public health staff—rather than professional translators—could be a feasible method for producing multilingual health promotion materials. Although the use of MT and post-editing has been less common for audiovisual translation than for more conventional text, it was seen as a viable solution for subtitling in the SUMAT project

evaluations (Bywood, Georgakopoulou and Etchegoyhen 2017, 504), and the ALST project suggests its feasibility for voice overs and audio description also (Matamala and Ortiz-Boix 2016; Ortiz-Boix and Matamala 2017).

Another way of using MT is to distribute information in its raw, unedited form. In these cases, quality is a critical question in two ways. First, information in the form of poor MT output may be very difficult to read or even unintelligible, thereby forming an obstacle to accessibility. Second, unedited MT might contain errors that result in misinformation. Even with the improvements in quality reported recently, particularly for neural MT approaches, MT output remains imperfect. Recent studies suggest that the adoption of neural MT approaches can produce more fluent and idiomatic output compared to phrase-based statistical models. Castilho et al. (2017, 118), however, point out that the improved fluency of neural MT is not necessarily accompanied by a corresponding improvement in adequacy. For example, neural MT output may involve more frequent omissions of words or even longer passages (Castilho et al. 2017). Such omissions can lead to missing information, which is particularly difficult to recover without access to or understanding of the source text (Koponen and Salmi 2015).

Furthermore, more fluent translations can in fact make errors of meaning more difficult to detect. This in turn exacerbates the risk of misinformation, as the apparently fluent output may foster unwarranted trust in the MT. In their study of MT and trust, Martindale and Carpuat (2018) indeed observed that participants reacted much more strongly to errors in fluency than errors in meaning, pointing out that the participants were perhaps not even aware of some of the content errors. Even if apparently fluent, and therefore convincing, incorrect translations are relatively rare, they can still be particularly dangerous as they mislead the reader (see Martindale et al. 2019). Although some recent studies (e.g. Martindale and Carpuat 2018) have looked into reading comprehension with neural MT, the effect of such potentially misleading errors on a reader using raw machine translated content for information purposes is largely unexplored. Particularly in situations where a misunderstanding could lead to harm for the person accessing the information, or for others, raw MT alone is not sufficient.

3.2 Acceptability of the use of MT

Two important issues of acceptability need to be considered when using MT for increasing accessibility to information. The first involves data privacy. As is well established, while free online MT systems are convenient, there are privacy issues and potential data breach issues involved in their use. Care must be taken to ensure that systems developed for accessibility purposes offer the levels of data privacy and protection required, with much depending on the types of information involved. For example, data privacy requirements may be lower for general information and instructions concerning immigration, whereas content relating to specific people involves a need for very high protection. For these reasons, many of the projects introduced in Section 2 involve protected or proprietary MT systems.

The second issue of acceptability we see concerns how acceptable the practice is to the target audience. Their perception of acceptability can be affected by several factors, including the quality of the MT output, the situations in which MT is used, the text types involved, and the purpose users have for certain texts in their own language.

This perspective was addressed most extensively in the context of civic participation in two studies carried out in Canada, investigating the feasibility of using raw and post-edited MT to increase the accessibility of information. Bowker (2009) addressed information provided online by municipal or provincial governments to "official language minority communities" of Canada (French-speaking communities in predominantly English-speaking areas and vice versa), whereas Bowker and Buitrago Ciro (2015) addressed information offered by a public library to newly arrived Spanish-speaking immigrants. Both studies focused on a recipient evaluation, in which participants from the target communities read translated versions as raw MT, rapidly post-edited MT, maximally post-edited MT and human translation, and assessed which version met their needs best, also considering the time and cost needed to produce each version (Bowker 2009, 142; Bowker and Buitrago Ciro 2015, 179). The findings of the two studies differed. In the study involving official language minority communities, neither group considered raw MT acceptable. The French-speaking participants showed a clear preference for human translation, whereas nearly half of the English-speaking participants considered the rapidly post-edited MT suitable for their needs (Bowker 2009, 142, 146). In the later library study, the majority indicated that rapidly post-edited MT met their needs best, and depending on text type, up to 38% even considered raw MT most suitable (Bowker and Buitrago

Ciro 2015, 180). These findings suggest that post-edited and even raw MT can be a viable solution for increasing access to information. Users of the information may even find these solutions preferable when considering the time and cost aspects, which affect how fast the information can be updated and how much of it can be translated (Bowker and Buitrago Ciro 2015, 179).

The lower acceptance observed in Bowker (2009) may reflect differences in the quality of the MT, which likely improved between the older and newer study due to developments in MT models. However, Bowker (2009) also proposed that acceptability is also influenced by the reasons people have for wanting to have information in their own language: if the purpose is to vindicate the rights and preserve the culture of a recognized language minority, users want all official information as well-formed human translations. This also relates to an important question of perception. Having information available in "only" machine translated form may lead to a perception of that language as less important than languages for which the same information is translated by humans. Close attention, therefore, needs to be paid to the needs and perspectives of the people targeted by information accessibility efforts.

The needs of users accessing public health information and the acceptability of raw MT were also investigated in the Health In My Language project. Again, the reasons for accessing information and the context where it was offered appeared to affect the results. In a survey conducted with people using the medical review website to read plain language summaries, most users (75% of German users and nearly 50% of Czech and Romanian users) found raw MT output acceptable, but due to lower quality, raw MT was acceptable to only 6% of Polish users (Birch et al. 2018, 20). On the other hand, on the website of the National Health Services in Scotland, Romanian and Polish users found the use of raw MT unacceptable and indicated that they would expect only fully accurate health advice to be provided by the public health services (Birch et al. 2018, 27). Overall, information in the medical setting is particularly critical. For example, Kirchhoff et al. (2011) argue that the use of unedited MT for health information is never acceptable, so MT output must be always post-edited. In a more recent experiment involving "anticipatory guidance" resources for child well-being, Das et al. (2019, 249) also found unedited MT to contain inaccuracies that could "pose significant risks to child health outcomes" and therefore argued for the need for high-quality human translations. Similar findings were reported by Turner,

Choi, et al. (2019, 11), who found MT too risky for communication between emergency medical services and patients due to potentially critical errors.

3.3 Involvement of stakeholders in development efforts

A common thread seen in research and projects to implement MT for accessibility is that resourcing and financial support are provided by a consortium of stakeholders from different areas such as governments, NGOs, universities and the private sector. Contrary to earlier views that solutions for humanitarian purposes might be supported only by government agencies (see Carbonell et al. 2006; Somers 1997), most of the projects described in Section 2 involved collaboration between various of these different stakeholders. Also, an analysis of the 19 papers accepted for the two workshops on MT for low resource languages mentioned in Section 1.2 reveals not only a variety of languages being studied, but also a variety of funding sources for research efforts. In addition to the universities that traditionally provide human resources and funding for research, these projects were supported by private companies, national governments, the European Union, and non-profit organizations for the advancement of specific languages (Liu 2018; Liu and Karakanta 2019). Possible explanations for this tendency toward collaboration might be a recognition of the need for diverse competences to achieve the goals of such initiatives, the need to pool resources, or stakeholders' desire to have an influence on the outcomes of the projects. It also reflects the early motivations to enlist technologies not only for commercial gain but also for humanitarian purposes.

Other stakeholders in MT for accessibility projects are the eventual users of the systems to be developed and the eventual readers of the information to be produced, and the inclusion of these groups has been called for by some of these projects. For example, the INTERACT project's Ethics Recommendations for Crisis Translation Settings emphasize the importance of considering the needs of the affected communities when developing translation technology for crisis situations, which "requires consultation with and training of users as well as community-based evaluation of such technologies through participative research practices." (O'Mathúna et al. 2019, 8) A community-based participatory research framework was also employed by Bowker and Buitrago Ciro (2015) in order to best meet the needs of potential future users, and a survey of user needs was conducted in the Health In My Language project (Birch et al. 2018).

Recommendations have also been made to involve language professionals in projects. For example, Parra Escartín and Moniz (2020), addressing the context of crisis translation, note the value of professional translators in curating and managing data quality. Current MT technology also relies on large amounts of training data in the form of translated texts (parallel corpora). As pointed out by Parra Escartín and Moniz (2020, 135), ethical considerations related to data, such as ownership of data and acknowledgement of the contribution of the translators who created it, should not be ignored. Furthermore, they highlight the need to curate such training data, particularly the need to remove/anonymize potentially sensitive information.

4. Conclusions

In this article we contributed to the ongoing discussion of ethics and MT by highlighting example efforts to use MT for humanitarian purposes, specifically for increasing accessibility to information for groups that were previously underserved, and by examining ethical issues in efforts to use MT for accessibility. We reviewed a number of projects implementing MT for increasing accessibility to civic participation, health and safety information, and culture and media, and then discussed the ethical issues of quality, acceptability and stakeholder participation. One limitation of our work is that it is not based on a systematic review of projects. Mostly because of the recent or ongoing status of many projects of this sort, we relied on convenience sampling, personal communications, and other less formal methods for data gathering. In the future, a more systematic approach could be employed to compile a comprehensive list of projects that use MT for accessibility purposes. Another area for future development is the contemplation of ethical guidelines for using MT to improve accessibility. A good starting point might be the INTERACT project's ethics recommendations, specifically those related to translation technology development and deployment (O'Mathúna et al. 2019).

Based on our analysis of the MT projects discussed in this article, we propose four conclusions for future consideration. First, projects have benefited from the inclusion of a variety of stakeholders from different areas. Involving the organizations responsible for promoting accessibility, groups with technical expertise, future users of systems, and language professionals is a best practice. These best practices should also address ethical factors such as protection of potentially sensitive data and proper acknowledgement of stakeholder contributions. Second, although accessibility efforts

in individual projects may involve low-resource languages that are unfamiliar to the project team, there may be other projects working with the same languages which also have limited resources. Collaboration between organizations could be mutually beneficial. Third, we recognize that there are contexts in which raw, unedited MT might be useful. However, we encourage stakeholders to carefully analyze contexts for suitability before implementing raw MT, taking into consideration quality issues and other aspects of acceptability.

A final observation is that finding information on projects that were in the planning or implementation phases proved much easier than finding follow-up information on the eventual use and users of the systems produced in those projects. It was not always clear whether this was due to projects being discontinued or if research on use and users was limited. In the future, we would like to see research focus continue throughout the implementation of systems and we would also like to see more research on the users of those systems.

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