Mobile translation applications: On the verge of a post-Babel world 2.0?

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Abstract

Situated within the technological realm of Translation Studies, this thesis provides an analysis of the ways in which people are using Machine Translation (MT) on a mobile device. This is a growing area of use of MT, given the increased accessibility of the technology and the proliferation of mobile devices this millennium. The thesis explores the history of MT, how the technology works and how it has reached the point of being accessible to almost anyone almost anywhere in the world, exploring the fact that MT is a form of Artificial Intelligence (AI) and that the emergence of AI and specifically MT can be examined through the lens of mobility and ubiquitous connectivity.

This thesis offers an insight into how people are using the technology, what effects this may be having on their perceptions of translation and potential implications for the language barrier. It does this through two principal methods of data collection and analysis. The first is a survey of people's use of MT on a mobile device, soliciting new data from them to enable a deeper understanding of how they use the technology, the particular features they use, their thoughts on its quality and limitations. The second is a more novel approach as it is an analysis of reviews left on the Google Play Store by users of two MT apps, Google Translate and Microsoft Translator, exploring what information can be gathered and analysed from an unsolicited dataset.

This thesis offers an initial study of this new way of interacting with the technology of MT and seeks to lay groundwork for future studies, including a categorisation tool and a taxonomy of MT use, to enable reliability and comparability across studies, platforms and time. Ultimately, it argues that the technology has improved substantially since its inception in 1954, but that it is

too soon to say that we are on the verge of a post-Babel world 2.0. Rather, the technology is moving human society further in this direction and towards this possibility.

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List of Abbreviations

AI	:	Artificial Intelligence
AR	:	Augmented Reality
AVT	:	Audiovisual Translation
CAT	:	Computer-Assisted Translation
EBMT	:	Example-Based Machine Translation
FAHQT	:	Fully Automatic High Quality Translation
HAMT	:	Human-Aided Machine Translation
HCI	:	Human-Computer Interaction
HT	:	Human Translation
LSP	:	Language Service Provider
MAHT	:	Machine-Aided Human Translation
MT	:	Machine Translation
MTA	:	Mobile Translation Application
NMT	:	Neural Machine Translation
NPU	:	Neural Processing Unit
OCR	:	Optical-Character Recognition
PBMT	:	Phrase-Based Machine Translation
RBMT	:	Rule-Based Machine Translation
SL	:	Source Language
SMT	:	Statistical Machine Translation
ST	:	Source Text
TB	:	Termbase
TL	:	Target Language
TM	:	Translation Memory
TS	:	Translation Studies
TT	:	Target Text
TTS	:	Text to Speech
UI	:	User Interface
VR	:	Virtual Reality

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Chapter 1 Introduction

This thesis presents an exploratory study into the ways in which people are using Machine Translation (MT) on a mobile device. Its overarching aim is to further understanding of how translation, technology and mobility are interacting within these new technologies and giving rise to new instances of translation and new ways for people to interact with translation. Indeed, translation and technology have always been closely intertwined (Cronin 2013), but the act of translation was, for a long time, carried out exclusively by human agents. However, in the context of, firstly, an industrialised world, and, more recently, a digital world, it has become possible for translation to be carried out by non-human agents, i.e., machines. Machine Translation is, then, the automation of the act of translating, translation carried out, in the moment, by a machine rather than a person.[1]

A lot has changed in the subsequent 70 or so years since the development of the first MT system in 1954, which was initially the size of a room, as will be discussed in more detail in **Chapter 2.** Exponential increases in computing power allowed for the device to become smaller and new architectures to be created and the development of computers allowed for the technology to become more accessible. More recently, within the last 30 years, the internet and other new technological developments – cameras, speech and text recognition, text-to-speech technologies and Augmented Reality (AR) technology, to name but a few – have dramatically increased mobility through

[1] This is a simple, working definition of MT to provide context here. As will be seen throughout this thesis, and particularly in **Chapter 2**, **sections 2.1** and **2.2**, what constitutes MT and how it works is actually more complex and detailed than this definition. Furthermore, there can be varying degrees of human involvement, leading to human and machine often working in tandem.

enabling people to do more whilst on the move, as will be explored throughout this thesis. MT has increasingly become integrated with other technologies and these technologies have changed what constitutes MT and what MT is capable of to the extent that nowadays it is available to almost anybody on the planet,[2] provided they have a device with an internet connection and a browser.[3] As such, this has presented new opportunities for people to engage with this technology and with translation more generally. This thesis focusses on MT on a mobile device as these devices, as will be argued throughout, have enabled the technology to become more accessible than ever before and enabled more interaction with and use of MT. As such, this represents an exciting and novel area for research to explore and understand better how these technological developments and subsequent explosion in the use of and interaction with translation are changing society and humanity's relationship with translation. Indeed, this is necessary and timely given that millions of people are now commissioning billions of translations every month through using MT and MT on a mobile device. This research is significant as it introduces ways in which MT use, both on a mobile device and more widely, may be studied and provides tools, directions and insights for subsequent and comparable study in the future.

This introduction starts by examining the relationship between translation and technology more broadly, discussing the intrinsic link between the two. It then

[2] There are, of course, areas where access to devices with an internet connection or access to the internet are still not available.
[3] There are offline tools as well, but these are more limited and will often require an internet connection at some point (e.g., to download and install).

moves on to examine and problematise the notions of ‘users’ and ‘use’, exploring how they have been used and what they mean. These are terms which are commonly employed when discussing MT, but little attention has been afforded to what is actually meant by each of them and how they might interrelate. As this thesis explores how and why people rely on and use MT on a mobile device, it is first necessary to establish what exactly is meant by the term ‘users’. It then moves on to a discussion of the five purposes of MT, which are key underpinning purposes that are drawn upon throughout this thesis, followed by a discussion of the main research questions. It ends with an explanation of what each chapter of the thesis will cover, briefly explaining the methodological approaches that will be taken in this thesis to address the aims and questions of this research.

1.1 The relationship between translation and technology

Translation, specifically translation of the written word,[4] is born of technology – the technology of writing. Prior to the emergence of writing in around ‘3400 BC’ (Powell 2009: 3), only oral translation, or interpreting, could take place since written texts did not exist. As such, since its inception, translation of the written word has been dependent on and intrinsically linked to technology. Whether writing itself (using tools for carving, a quill, a pin or e-ink), the printing press or the computer, all of these technologies have played an important but often overlooked role in the development of translation throughout history. As previously mentioned, translation of the written word is only possible thanks to

[4] Rather than interpreting, which is usually understood to mean translation of the spoken word. However, there is a blurriness between the two, as will be discussed later in this piece.

the technology of writing and the printing press served primarily to increase the production of texts and translations, to disseminate these works more widely and to democratize the end product, the translated text. More recently, as Cronin (2013) highlights, the digital age is changing what it means to be a translator and to translate. Whilst the printing press led to the increased distribution and democratisation of the end product, the digital age has enabled the process of translating to become a democratized practice.[5] The very notion of translation and what it is to translate is changing, with the development of crowd-sourced translations, audiovisual translation and machine translation. Translation no longer involves simply translating a text from language A to language B (if it ever did[6]), it also requires translators to be business-savvy, deal with branding and reputation issues, consider localization of a product for a market, consider working rates and conditions and work as editors of texts translated by MT (post-editing). Work traditionally carried out by humans is now being performed by machines. New forms of translation practices are emerging, both the translation product and process are becoming increasingly democratized and the profession is arguably becoming demonetized (Olohan 2014: 18; Cronin 2017b: 95).

Littau has called the current turn in TS a 'medial turn' (Littau 2011: 261), due to increased publications 'on various aspects of media translation: audio-visual translation; translation and film adaptation; translation at the movies; translation

[5] My MA dissertation (Watts 2017), examining how the printing press and the digital age affected translation, particularly the mobility of translations and translators, discusses this is in greater detail.
[6] In the past, it was common for translators to often work from fragments of source texts, sometimes in different languages, i.e., already a translation, to produce a translation of a text (Littau 2011: 266) – so it has arguably never been quite as simple as moving a text from A to B.

and global news broadcasting; translation and communication technologies' (ibid.). Littau highlights the need to study 'the role that media forms have played in the history and constitution of translation' (ibid.). Others, such as Cronin (2010) and O'Hagan (2012, 2016a), have suggested that the latest turn that Translation Studies (TS) is undergoing is the technological turn and that greater attention must be paid to the relationship between the two. Cronin (2010: 1) highlights that this turn 'is driven not by theoretical developments in cognate areas of inquiry, though it can be informed by them, but is an emergent property from new forms of translation practice.' As such, it would seem that the medial turn could be described as one aspect of the larger technological turn, in that the new media Littau mentions, as well as the more historical aspects such as oral, scribal and print cultures, all emerge from new technological developments. More recently, Jiménez-Crespo (2020) has argued that the technological turn in TS has been completed in that technology permeates all aspects and areas of TS and research into translation.

Despite this technological turn, which has been embraced and driven by industry (Cronin 2010: 1; Jiménez-Crespo 2020: 319), TS as a discipline 'has been slow to adopt such translation technologies within its mainstream' (Doherty 2016: 952). This is perhaps surprising given that one of the principal aims of TS as a discipline, according to James Holmes, largely credited as the discipline's founder (Gentzler 2001: 93; Snell-Hornby 2006: 3), is 'to describe the phenomena of translating and translation(s) as they manifest themselves in the world of our experience' (Holmes 1994: 71). To ignore technology, and particularly digital technology, would appear to be doing the discipline a disservice. It is, therefore, important to engage with the broad topic of

translation and technology to address the perceived research gap (Munday 2009: 15; O'Hagan 2012), especially as 'the effects of digital technology and the internet on translation are continuous, widespread, and profound' (Cronin 2013: 1).

Christensen and others (2017) have attempted to map research on translation technology by analysing the number of articles on this topic present in eight TS journals since 2006. Whilst there are limitations to the study, particularly in the number of journals included, which the authors themselves acknowledge, the study nevertheless represents an important starting point and provides empirical evidence that reinforces the need for further study of translation and technology. Their research showed that among the eight journals they studied during their research 'some 192 out of 1840 papers published in the nine journals (corresponding to 10.4%) deal with translation technology' (Christensen and others 2017: 14). The authors define 'translation technology research as research that deals with

- Communication and documentation tools and resources (Alcina's category 2).
- Language tools and resources (Alcina's category 4).
- Translation tools (Alcina's category 5)'[7] (ibid.: 11).

It is also worth highlighting that the authors find that 'the total output of papers on translation technology research is rather constant over the period' (ibid.: 14). This is surprising, as it might be expected that there were fewer papers earlier

[7] The authors are using categories established by Amparo Alcina in her 2008 paper 'Translation technologies: scope, tools and resources'.

on and that more emerged over time given the growing importance of technology, particularly given its growing relationship with translation, but does give credence to the idea that technology is underrepresented within TS or that TS has failed to keep up with discussions regarding technological developments.

Indeed, in the translation workflow, technology and translation are integrated with many translators employing a variety of Computer-Assisted Translation (CAT) tools. These are tools that emerged from the failures of earlier MT systems to produce usable MT (Chan 2015: 3), with proponents instead developing technological tools to aid translators in their work and the translation process. CAT tools cover a broad range of technologies including termbases (TBs), translation memories (TMs), MT itself, spellcheckers, quality assurance checkers, project management tools and many more. Over the years, there has been research into the effect that these tools have had on translators and their work practices, through a variety of methods such as case studies and experiments involving eye-tracking technologies.

Considering this well-documented pervasion of technology within the profession of translation, there is clear scope for Translation Studies to continue expanding its research in this area. What follows is some examples of ways in which TS is investigating technology and translation and the impact of technology on TS – the rise of non-professional translation thanks to new technologies, CAT tools that support translators in the translation process and how technological developments are blurring the line between translation and interpreting.

1.1.1 Pervasive technology, pervasive translation

Firstly, it is important to note that there are a large number of terms referring to translation carried out by non-professional translators thanks to technology, the definitions of which are not agreed or fixed: crowdsourcing, community translation, volunteer translation and collaborative translation to name a few. As O'Hagan (2016b: 941) notes, 'the varied terminology arguably reflects unclear distinctions currently made between these similar, competing concepts'. However, all of these concepts essentially involve breaking down a large, complicated task (in this case, something which needs to be translated) into smaller chunks which can be distributed to and completed by a large number of people on the internet. The distinction in terms seems to be related to:

- whether those who complete the translation task are paid or unpaid.
- who initiates the translation task (i.e., whether a company or commissioner decides on the content to be translated or whether users themselves select the content to be translated).
- whether those who complete the translation task belong to the community they are translating for or whether they do not.
- whether those who complete the translation work alone or can work collectively and collaboratively with others.
- whether those who complete the translation are professional translators or not.

Regardless of the name used, all of these are recently-emerged types of translation made possible thanks to technological developments. They gave rise to a growing area of research in recent years within TS, with several scholars researching the phenomenon and its potential implications for translation, such as O'Hagan (2009, 2016b); Olohan (2014); Garcia (2015);

Littau (2016); Orrego-Carmona and Lee (2017). Examples of community or crowdsourcing translation can be found for different types of translation:

- Audiovisual translation: Unofficial subtitling and dubbing of anime (fansubs/fandubs), TED videos, Youtube videos.
- (Traditional) Text-based translation: Translation of manga (scanlation), working for translation crowdsourcing websites.
- Website localization/translation: Facebook, Wikipedia.

As Garcia (2015: 30) notes, the translation industry of the 1990s (and earlier) 'catered for one category of translator: the professional'. However, 'translation is essentially a manifestation of bilingual literacy, and just as no one needs to be a professional writer to write, no one needs to be a professional translator to translate' (ibid.: 31). Garcia also emphasises that the 'democratisation of the technology has been crucial' (ibid.: 30) to widening the translation industry to non-professional translators. Thus, he is emphasising that the role of technology has been crucial in making these new forms of translation possible. Without computers and the internet, it would be impossible to break these tasks down into smaller, more manageable tasks and easily distribute them to a large group of people for completion. There are, however, negative implications to this trend as well, such as the demonetisation and deprofessionalisation of translation (Olohan 2014: 18; Cronin 2017b: 95). As an emerging area of TS, this prompts questions regarding who can translate and what they can translate, the role of translation in the world and the value of the profession.

Interpreting has not, so far, seen the rise of crowdsourcing in the same way that the translation industry has. This is likely due to the fact that most interpreting happens live and does not lend itself so easily to this chunking or bitesizing of

work. A comparable occurrence is the rise of non-professionals, i.e., those who do not have formal training or a qualification in the field, fulfilling the role of the interpreter. These people are often friends or family of the person needing the interpreting and known as interpreter proxies. The use of nonprofessional interpreters is often more common than professional interpreters in healthcare settings and is often down to a variety of reasons including interpreter availability (Hsieh 2016: 103–4). For both translation and interpreting, what is comparable in this instance is that the work of a once-specialised domain is increasingly carried out by non-specialists, which may contribute to the devaluing of the professions if they are seen as tasks which can be carried out by anyone or even a machine.

1.1.2 The technological blurring of translation and interpreting - hybridity 2.0

Thanks to technology, the boundaries between the oral, the written and the visual are increasingly blurred (Snell-Hornby 2012: 370) and our understanding of traditional notions such as text, knowledge, identity and translation are being challenged (Cronin 2013: 130). A basic but powerful example to illustrate this is the use of emoji, voice notes and written text in instant messaging apps such as WhatsApp – the communication is, at the same time, written (the text), oral (the voice notes) and visual (the emoji). A large part of this hybridity stems from technological developments and new human-technological interactions and this has led to a blurring of the lines between translation and interpreting, as discussed below.

In an academic and professional context, translation and interpreting are usually seen as two distinct, yet closely related, disciplines. This separation

does not seem to always hold true at a more general level in society - many people use ‘translator’ to refer to someone fulfilling the role of ‘interpreter’. This blurring of the lines is nothing new and in fact, in the past, translation and interpreting were blurred together, particularly when the development of writing was still quite new and societies were still primarily orally oriented, with the oral often given greater prestige (Ong 1982). MTAs in particular, but also MT on a mobile device more generally, may be further accentuating this blurring as they are usually referred to and marketed as translators, but are apps which can, to an extent, fulfil the role of an interpreter as well. Indeed, although they can act as an interpreter, whereas a human interpreter converts orally from one language to another, without recourse to written language to produce the translation[8] (although notes are used as an aide-mémoire and written resources such as dictionaries can be consulted), this is not the case for MTAs when used to interpret. They rely on three different technologies: speech recognition, machine translation and speech production. They must first convert the spoken word into written text (speech recognition), then produce the translation from

[8] It is worth noting, however, that interpreters do use written language and signs in their notes to help them deliver their translations. This is another example of the blurring of the lines between the written and the spoken.

this written word (machine translation), which is then converted into the spoken word in the target language (TL) (speech production), as shown in **Figure 1.1.**.

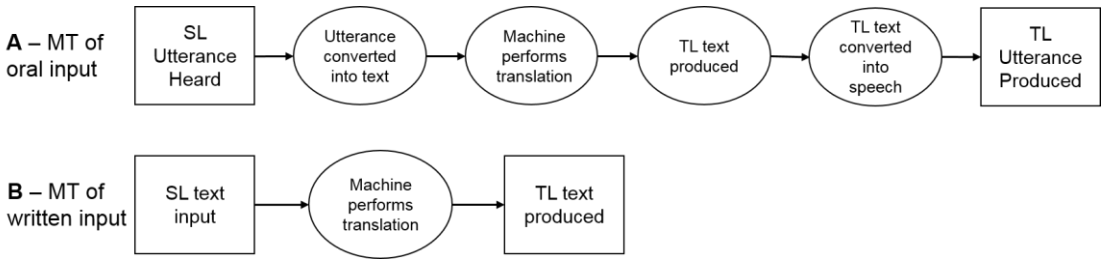


Figure 1.1 A simplified model of the MT of oral input and written input

Such systems are known as cascaded systems, as they use a combination of different technologies and systems to produce the final product. Evidently, they are at risk of errors compounding throughout the system, i.e., an error in the speech-to-text conversion of the source language (SL) could propagate and cause further error in the translation phase (Jia and others 2019). However, it is worth noting that the need for a system to convert speech to text may not always remain, as recent research has demonstrated the possibility and feasibility of direct speech-to-speech translation, i.e., a system that does not first convert the spoken utterance into written text in order to produce the translation.[9]

In the scientific realm, the terms ‘speech translation’ and ‘spoken language translation’ are used to refer to technologies that facilitate oral communication or change oral communication into a written one, e.g., in producing subtitles in English for a video containing Spanish audio or in using a translation app on a

[9] Jia and others (2019) demonstrate a proof of concept for a direct speech-to-speech translation system which directly translates spectrograms from Spanish to English. Although the system does not perform as well as cascaded systems, it does prove that such systems are possible and presents an avenue for future research.

mobile phone to mediate a conversation between two people. So, although the skills needed for human translators and interpreters may differ, the difference between translation and interpreting in this modern hybrid world, particularly when technology is taken into account, may better be described as one of context rather than medium. Although translation and interpreting are often separated for purposes of clarity, the reality is that the border between the two of them is often blurred, both for humans and machines, or at least more porous than the labelling of the two by academia and the industry would suggest. For machines, this is true as interpreting would not be possible, with current MT systems and architectures, without recourse to the written word in the MT process, although this may not always be the case as previously mentioned with the development of systems that can perform direct speech-to-speech translation. For humans, this blurring has, since the invention of writing, always existed, and the idea of hybridity is not without precedent, as the boundaries between translation and interpreting were not so well defined, as **Figure 1.2** demonstrates.

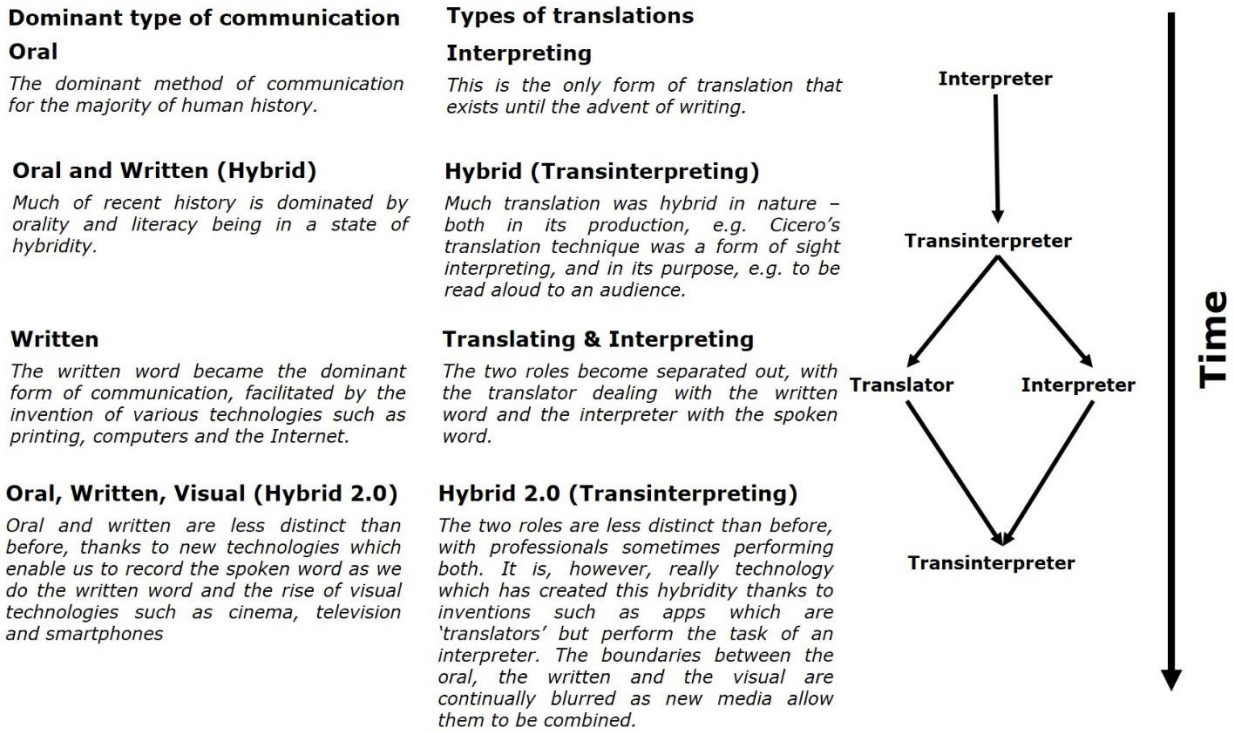


Figure 1.2 Transinterpreter Model

The model shows that prior to the development of writing, the principal form of communication was oral and the only type of translation that could exist was interpreting. The invention of writing then caused a shift in communication, both medially and conceptually, resulting in a hybrid world, where the written and oral coexist and coincide. Indeed, Raible (2015: 241) states that they are 'dialectical' and are 'mutually dependent, […] "literacy" cannot be conceived of without "orality", "orality" not without "literacy"'. It is, then, inconceivable to think of the two as mutually exclusive. Rather, society, or a society, may prioritise and place more prestige on the oral form or the written form and this is not static – the relative importance of the forms varies over time (Ong 1982). Writing was originally perceived as an extension of the oral form and subservient to the oral form. For translation, writing meant that the interpreter now became the transinterpreter, fulfilling the role of both a translator and an interpreter as they

are understood today, producing written translations that were designed for oral delivery.

The roles then became more distinct as there was separation between the written and the oral, with the written becoming dominant. This was largely due to a key property of writing: permanence, as with writing 'words can be transmitted through space and over time in permanent and unchanging form' (Finnegan 1988: 17). The written thus became a tool for record keeping, exosomatic memory and codification. This longevity and power to disseminate is something which did not become possible with the oral until much later in time with advances in technology allowing, for example, a speech to be recorded and listened to by someone not present.[10] That is, further technological developments were needed to enable the older, oral form of communication to be memorialised and able to easily travel vast distances through time and space. However, the distinction between oral and written is now less pronounced again thanks to the ways in which technology is blurring the lines between the oral, the written and the visual. The permanence of writing is now in flux thanks to the ease with which it can now be edited, changed and interacted with on computers. Similarly, 'the divorce between audience and speaker, reader and author' (ibid.: 18) brought about by writing, which reduced the immediacy of contact and engagement, is challenged thanks to new technologies such as the internet. Authors can actively engage with their readers via blogs, email or social media, by responding to their questions or

[10] The first ever audio recording was created on April 9th 1860 by the French inventor Édouard-Léon Scott de Martinville (Wilkinson 2014), but the means for playing back sound were not invented until the end of the 19th century when Thomas Edison invented the phonograph in 1877 (Millard 2005; Wilkinson 2014).

listening to their positive and negative criticisms. Hybridity 2.0 may, then, be different from the past, but certain elements which were inhibited by previous technological developments are re-facilitated by newer technological developments.

In addition, it has been found (Brown 2001; Kelly and others 2010) that the majority of interpreters also work as translators, showing that the people who work in these industries themselves blur the line of translator and interpreter and quite comfortably jump from one to the other. We are, then, living in a new age of hybridity, although hybridity has always been the case since the inception of writing, and this hybridity has a new shape, hence the name hybridity 2.0. Now, this hybridity incorporates not just the oral and written, but also the visual and auditory, with all forms of communication increasingly intertwined and interrelated. Furthermore, this hybridity is now more evident than ever, and more present in our lives thanks to the ubiquity of technology. As has been discussed, the line between translation and interpreting has always been blurred and newer technologies are only increasing the blurriness between the two.

If technology in general is underrepresented within translation studies literature, then specific areas, such as the mobile translation applications discussed in this thesis, are currently completely absent. As technology increasingly pervades our lives, studying its effects and how exactly humans interact with these new technologies will be key to understanding how they change and shape our society. TS must, then, continue researching the relationship between translation and technology as technological developments, such as MT, relate directly to translation, the practice of translation, the translation

industry and have direct and indirect impacts on both translators and translation studies scholars, all of which are the focus of TS. This would not represent a radical new venture for TS, rather it would be a return to Holmes's originally stated aims.

1.2 Users of MT

It is, first, worth reflecting on the terminology of 'end user', terminology which can be very loaded, and 'use' when related to MT to establish what exactly is meant by these terms. In a special edition of the journal 'Machine Translation' in 2019, entitled 'Human Factors in Neural Machine Translation', the editors maintain that 'little is known as yet about how humans—especially translation professionals, translation students, and end-users—engage with NMT output' (Castilho and others 2019). They do not, however, define who an end-user is, but it seems that their focus is on professional use of MT or MT use in the translation workflow, rather than non-professional or non-translator use, as most articles in the issue focus on post-editing. That said, their end-user category may refer to non-professional use, as it implies this is a separate category to translation professionals, which would include translators. The idea is, then, that 'end user' refers to non-translator users of MT or 'lay users', another term which is sometimes used to refer to this group in the literature (see, for example, Laurenzi (2013), Aranberri (2014), Asscher (2021) and the International Symposium on Lay Use and Perceptions of Machine Translation held in May 2021[11]). This lack of clarity around the definition is perhaps due to

[11] This was held by the Department of Translation and Interpreting Studies at Bar-Ilan University: https://www.biu.ac.il/sites/default/files/inline-files/BIUMachineTranslationAd.pdf [accessed 19 March 2022].

the fact that the term is commonplace in today's computerised and digital society and the authors believe that readers will understand the term and know exactly to whom they are referring. Similarly, it is difficult to identify or define a single group of 'users', which might also explain the fuzziness surrounding the term.

In Translation Studies (TS), the idea of an 'end user' is perhaps not the usual terminology. That is, the word 'user' seems to be more common in the world of business and digital technology or when people are making use of a tool, rather than with the reception of a text, which has traditionally been the focus of TS. However, the term could be equated to the concepts of audience, reader or receptor which have been used widely within translation theory. That is, they all refer to the people who will be interacting with and relying on the translation, whether that translation is a novel, an instruction manual or subtitles in a movie. For example, Nida's (1964) concepts of formal and dynamic equivalence concern the relationship between 'receptor and the message' and Venuti's (2008) concepts of foreignization and domestication, building on Schleiermacher's (Lefevere 1992) work, refer to the 'reader'. The difference is that in TS the audience, reader or receptor has largely been perceived as passive or as a consumer of translation. In other words, it has really been concerned with the translation of written texts, and translation as a product and professional process. This is unsurprising given that MT is still a relatively new technology, and it is only with the advent of large-scale, online, free, accessible MT that people can begin using it in new ways and have new interactions with translation.

An ‘end user’ can simply be defined as ‘the person who actually uses a particular product’ (Lexico.com [n.d.]) or as ‘the person ultimately intended to use a product, as opposed to people involved in developing or marketing it’ (Barron’s Business Guides 2009: 171). However, such definitions are rather wide and encompass all different types of ‘end users’ who might use a system or product for very different purposes. For example, with MT, the ‘end user’ could equally be a translator using an MT system as part of their workflow (whether this is a bespoke or domain-specific system or a generic one with a plugin) or a non-translator using MT for some other purpose, such as communicating whilst on holiday abroad. In this instance, and according to the definitions provided, both could be considered ‘end users’ of the MT system, although they would be using the system in completely different ways.

However, there is another layer to consider here in that whilst both are ‘end users’ of the MT system, they are not necessarily both ‘end users’ of the translation, the product of the MT system. Translators may produce the product, the translation, whilst using an MT system to facilitate this, but the ‘end user’ would be the person or organisation which commissioned the translation and intends to use it or the people to whom they choose to disseminate it. For example, if a translator translates a webpage for a clothing company, the actual ‘end users’ of that translation would be the clothing company and its customers or people who visit its webpage. As such, it is possible to distinguish three categories here:

a) End users referring to those who use the MT system but not the product (i.e., the translation).

b) End users referring to those who use both the MT system itself and the translation it produces.
c) End users referring to those who only use the translated product, such as the customers of a website that has been translated with MT, but who have no interaction with the MT system as such.

Complementing the notion of ‘end users’ of MT and what type of ‘end user’ they are, it is also useful to establish two categories of ‘professional’ use of MT and ‘non-professional’ use of MT. After all, it is impossible to categorise definitively individuals as certain types of ‘end user’, as this may change depending on the context, the situation in which the individual is using MT, and on their purpose. For example, a professional translator may make ‘professional use’ of MT if they translate from French and Spanish in their working life and use MT to help them do so. However, when that translator then goes on a leisure trip to China and uses MT to communicate with people there, they would then be making ‘non-professional use’ of MT. As such, categorising in terms of ‘professional use of MT’ and ‘non-professional use of MT’ can also be more useful, as users can fall into both categories depending on the situation and the intended use, the purpose, of their translation. Furthermore, this distinction is not always clear cut, as a professional translator using MT, even outside of their work context, is still a translator with a more sophisticated understanding of translation, its difficulties and pitfalls, and of MT as well. That is, the professional translator may have a greater degree of understanding and literacy of MT and be better equipped to use the tool.

In the traditional translation process, a variety of agents (both companies and individual people) are involved in the production of a translation at different

stages – requesting, producing and using the translation. This is shown visually in **Figure 1.3**, with the different colours identifying different entities within the process.

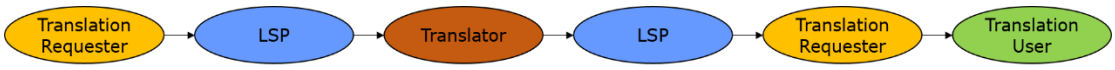


Figure 1.3 A simplified model of the translation workflow in the human translation process

However, with MT it is possible for everyone in this process to be the same person, i.e., the requester, producer and 'end user' of the translation. In addition, there may also be a second person involved once the translation has been produced by MT, who could be described as more of a 'passive user', and they would be the other person involved in the communicative act. For example, if a tourist in a restaurant uses MT on a mobile device to give the waiter their order, that tourist is the translation requester, translation producer and translation user, as shown in **Figure 1.4**.

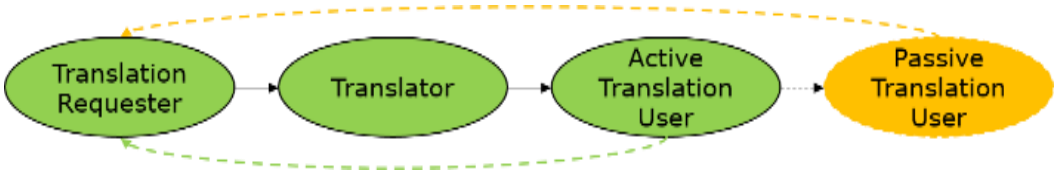


Figure 1.4 A model of the translation workflow in the translation process with MT

However, the waiter is also a user of the translation in that they receive the translation (the communicative act) and then act on this – they are interacting with the translation, but this may be in a passive way. The tourist is the active user as they are the one instigating the use of MT and the waiter is the passive user as they are taking part in a social interaction, hopefully benefitting from MT, but may not be actually using the tool themselves. This situation could then develop and both parties could be considered active users if the waiter then

uses MT to respond to the tourist and they have a conversation in this way, as shown in **Figure 1.5**.

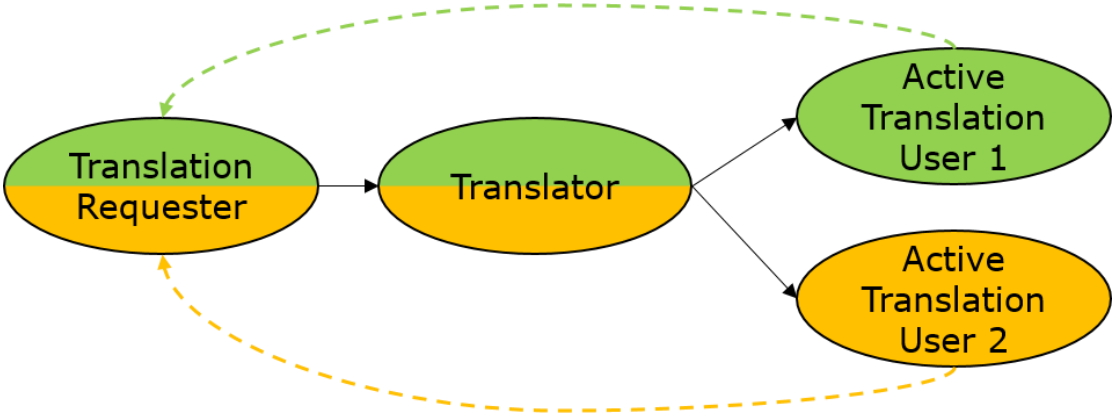


Figure 1.5 A model of the translation workflow in the MT translation process with more than one active user

These new translation flows and processes are only possible thanks to the technology of MT and as O'Hagan (2019: 1) notes, 'the influence of technology, ranging from translation-specific technologies such as MT to more general-purpose speech technologies and cloud computing, is far-reaching and calls into question some of the assumptions about who should translate, how and to what level of quality.' In addition, these new technologies also create and enable new possibilities for translation and uses of translation, calling into question not just who should translate, but also what exactly constitutes translation, what the act of translation involves and what it means to be involved in the act of translation.

With MT, then, it is possible for the term 'end user' to take on new meanings, depending on the exact context in which the MT is used and the purpose of the original 'end user'. This is particularly true of MT on a mobile device, the focus of this thesis, as it enables increased access to the technology in more situations, as will be explained throughout. Furthermore, the term 'user' may also be more useful and applicable when focussing on users of one specific MT

platform, e.g., Google Translate, rather than on people making use of general-purpose MT.[12] Having looked at the idea of 'user' and what this term means, it is also important to examine why users use MT, that is, their purpose for doing so, which is elaborated on in the next section.

1.3 Yang and Lange's (2003) five purposes

In their 2003 study, Yang and Lange explore the use of the *Babelfish* online MT system and, although their focus is only this one particular MT system,[13] they establish five functions of MT as a tool based on the findings in their study. However, these functions could equally be described as purposes for which users use MT, rather than as five functions of a tool. That is, they are descriptive of the reasons why users use MT. These five purposes, summarised and synthesised from Yang and Lange's work, are detailed below:

- **Assimilation** – to obtain information from or gain an understanding of a text that is in another language.
- **Dissemination** – to share something in a language or languages beyond the one(s) in which it was originally produced. In this case, there is not always a specific audience in mind, but the MT use is enabling other people to understand the work, e.g., through translating a website.
- **Communication** – to interact with other people who do not share a common language with you. In this case, the audience is specific and targeted and a degree of interactivity is expected through a response or dialogue.
- **Entertainment** - using MT for non-communication purposes, e.g., because the translations are funny.

[12] General-purpose MT refers to free, online systems such as Google Translate and Bing Translator that are not made for a specific domain and are designed to allow a person to input any kind of text and receive a translation.
[13] Their focus was on the system produced by their company and at a time when there were not so many online MT systems available.

- **Education/learning** – using MT to practise a foreign language.

These five purposes are central to the exploration of the ways in which users use MT and will be drawn upon, challenged and elaborated on throughout this thesis as a way of categorising and discussing use of MT. They are also fundamental to the approach and methodologies taken, being used as a lens through which to analyse MT use and to consider the research questions discussed in the next section.

1.4 Research questions

There are three overarching questions for this thesis and each of these is detailed and explained below. These questions are discussed and threaded throughout the thesis, but the methodologies employed, a survey of people's use of MT on a mobile device and analysis of reviews left by users of MTAs on the Google Play Store, will generate new data and insights that can directly address these.

1. In what ways are users engaging with MT on mobile devices?

This question is the broadest ranging of all the questions and seeks to provide insights into MT use. Specifically, this thesis will provide information regarding when, where and why users use MT on a mobile device. As O'Brien and Saldanha (2014: 150) note, 'ever since the publication of Douglas Robinson's *The Translator's Turn* (1991) there have been calls for more attention to be paid to the human agents in the translation process, in particular, to translators and interpreters.' However, in addition to the human agents involved in the production of the translation, there are also human agents who then use the translation (and these two categories may overlap). Indeed, since 1991 many more possibilities have emerged for translation thanks to technological

developments and there are now more possibilities than ever before for different human agents to be involved at different stages of the translation process.

To date, very little research has been conducted on the ways in which users make use of MT outside of the context of translators or students of translation (Dorst and others 2022). Indeed, O'Brien notes that 'research on how end users interact with unedited or edited MT is still in its early stages' (O'Brien 2017: 327/328). Although discussing translation in the traditional business sense, with a client, Language Service Provider (LSP) and translator, O'Brien's statement could also be applied when considering end users outside of this context, such as those discussed above. Nurminen and Papula (2018: 207) further highlight this point when they state that 'after the first study in 1979, very little insight has been gained as to how people have integrated MT into their daily lives'. If this is true of MT more widely, then even less research has been done in the specific area of MT use on a mobile device, particularly since this has only become available in more recent times. Antonini and Chiaro Chiaro (2009) noted in the context of Audiovisual Translation (AVT) that there was a lack of research about the ways in which 'end users' perceive and engage with AVT and, more recently, O'Brien (2017) and Castilho and others (2019) have noted that this is true for MT as well. That is, the ways in which 'end users' engage with translation on a practical level is an under-researched area within TS and MT. As such, this represents a gap in the research and thus gives rise to this first research question, which will be useful for developers of MT and also more broadly to understand the ways in which users depend on and make use of the technology.

2. In what ways is MT on a mobile device changing users' perceptions of translation?

This question explores users' perceptions of translation, what kinds of effects MT is having on these and how it may cause them to think differently about translation and language. For example, do users generally think that translation is an easy task, perhaps because it can be 'performed' by a computer? This question can be explored specifically through a survey by explicitly asking participants for their thoughts regarding translation and MT, but also implicitly through their answers to the questions. This is important in an increasingly globalised world that relies on cross-cultural communication and translation increasingly permeates aspects of society through technological developments. It also allows for an insight into users' views and uses of technology and translation and the extent to which they have become embedded into their lives.

3. What implications might MT on a mobile device have for the language barrier?

Firstly, it is worth exploring what is meant by the term 'language barrier'. This is not a concept, but a metaphor, and is defined by the Oxford English Dictionary (2021a) as 'a barrier to communication between people resulting from their being unable to speak a common language.' Really, then, the question seeks to address the implications that MT has on communication between users who do not share a common language, but the term language barrier acts as a useful metaphor which sums up this difficulty in communication more succinctly. Furthermore, the relationship between translation and the language barrier is somewhat confused in that translation[14] only exists because of the language

[14] In its common meaning of changing text from one natural language to another.

barrier, as something that enables cross-language communication despite this barrier. So, the aim of translation is to overcome, or, at least, reduce the impact of, the language barrier. Conversely, if there were no language barrier, there would be no need for translation.

In addition, the term ‘language barrier’ is widely used in science communication around translation and languages, in a more general context by people when discussing communication[15] and also within MT research. Indeed, although he does not explicitly mention a language barrier, Weaver (1949: 1) does implicitly refer to it in his memorandum when discussing MT and its possibilities, highlighting ‘the obvious fact that a multiplicity of language impedes cultural interchange between the peoples of the earth [sic]’[16] and that there is a ‘translation problem’ to be overcome. This does demonstrate that one of the original aims of MT was to reduce, overcome or eliminate the language barrier. More recently, Franz Och, one of the main architects of Google Translate, discusses the progress made in ‘breaking down the language barrier’ through the development of Google Translate (Och 2012). Ahrenberg (2017) highlights that ‘the aim of MT research and development is often phrased as “overcoming language barriers”’ and even goes on to say that:

> to a large extent this aim has been achieved with many systems producing texts of gisting quality for hundreds, perhaps even thousands

[15] This can be evidenced by people having a lived experience with this barrier, having encountered someone who does not share the same language or encountered something in another language that they do not understand.
[16] This does, however, gloss over the fact that cultural interchange is only possible due to the fact there are cultural and linguistic differences between peoples across the world.

of language pairs, and (albeit fewer) systems that enable conversations between speakers that do not share a common language.

However, this claim is something of an overstatement. Whilst it may have been achieved technologically for a minority of languages, it is not true of all languages. Another important factor is the fact that MT is only available for a small percentage of the world's languages. Google Translate, the most popular free, online MT service currently translates 108 languages.[17] The languages offered are principally the larger, most widely spoken languages, which implies unequal access to MT across the globe depending on a person's location and languages spoken. Moreover, although the technology exists, it is worth exploring whether this claim is true in practice. That is, do users of MT in their day-to-day life feel that it enables them to communicate and, for their practical purposes, renders the language barrier unimportant and inconsequential?

This thesis engages with the complexity and epistemological difficulties of these questions, primarily through surveying users of MT on a mobile device, as to provide these insights it is necessary to gather data from users of MT on a mobile device to explore the ways in which they use the technology. It makes a foray into these questions, the ways in which users use MT on a mobile device, the purposes they are trying to achieve and what this means for conceptualisations of the language barrier and how future technological developments may affect or address it.

[17] This is correct as of 15/2/2022 – Google Translate provides a list of the available languages here: https://translate.google.com/intl/en-GB/about/languages/. It is worth noting that if the low estimate of 6000 languages in the world is used, these 109 languages amount to just under 2% of all languages, although they do cover the majority of the world's population.

1.5 Thesis outline

Chapter 2 builds upon this introduction, which has explored the relationship between translation and technology more widely, by focussing in on the specific technology of MT and how it has developed. It provides a historical overview of the technology and the various architectures and systems that have been available since its inception in the 1950s up to the modern systems in use today. It then discusses the ways in which the quality of MT has been evaluated and the problematic nature of quality evaluation, as well as reflecting on the relationship between TS and MT. The chapter continues seeking to explain technological developments through the lens of mobility and that technology is often an expression of this desire for mobility. It explores different kinds of mobilities, how these relate to translation and how mobility is leading to a state of ubiquitous connectivity. It also touches upon the role of Artificial Intelligence (AI), of which MT is an example, and the ethical and legal considerations that arise with these new technologies. The chapter then proceeds to discuss the emergence of mobile devices and apps, before examining previous studies on Mobile Translation and explaining the importance of studying MT on a mobile device specifically.

Chapter 3 presents and discusses the methodologies used to generate and gather data to understand how people are engaging with MT on a mobile device. It explores the roles of surveys, the type of research they can be used for and how they have been used to study translation and technology before. It then introduces the survey used in this thesis, explaining how the survey questions were developed, originally in collaboration with an industry partner, to be focussed on one particular Mobile Translation Application (MTA).

However, this relationship did not come to fruition and the focus of the survey and the thesis (through the findings from a survey of use of MT on a mobile device more generally, rather than of a specific app) changed to focus on use of MT on a mobile device. This chapter also explores the methodologies employed to study more qualitative and unstructured data sources regarding MT use through the collection and analysis of reviews left on the Google Play Store of two MTAs, Google Translate and Microsoft Translator. The comments left by users were tagged, using tags constructed based on the survey questions and generated from the data, to explore what insights can be gained from such a dataset.

Chapter 4 presents the findings from the survey used to explore the research questions of this thesis. It does this through an analysis of the findings from the survey, through a question-by-question discussion and analysis of participants' responses, detailing and discussing their use of MT on a mobile device and similarly does the same for users who do not use MT on a mobile device.[18] The chapter then ends by providing analysis, conclusions and questions for further research across a variety of categories that have emerged from the survey.

Chapter 5, building upon the previous two chapters, then explores other sources of qualitative data on MT on a mobile device. It presents the findings from tagging the reviews of MTAs left on the Google Play Store and draws comparisons and correlations with the findings from the survey results analysed

[18] As will be explained in more detail in the chapter, participants who stated that they did not use MT on a mobile device were still asked some questions to gain insights about the MT platforms (if any) they do use and why they do not use MT on a mobile device.

in the previous chapter. The chapter ends by exploring detailed case studies of examples of MT use on a mobile device through stories about MT collected on the MT Stories blog.

Chapter 6 draws upon all of the previous chapters, particularly chapters 4 and 5, to provide overall findings and conclusions for this thesis and avenues for further research. It does this through presenting tools that could be used for further research, that have been developed throughout the process of writing this thesis due to a lack of pre-existing tools and the need for increased study of MT use and comparability across studies and over time. The chapter also highlights the directions in which research could go, the direction that MT is currently moving, and it also discusses the effects that this increased usage is having on translation, leading to translation becoming increasingly democratised.

Chapter 2 Translation Technology: Machine Translation and Mobile Translation

This chapter seeks to provide the historical and contextual information necessary to understand the emergence of mobile translation applications and MT on a mobile device. It begins by exploring MT as a translation technology, with sections **2.1 -2.4** focussed on explaining this particular technology. Section **2.1** explores the automation of translation, what MT is and its history and the original vision when the technology first emerged. Building on this, section **2.2** presents and discusses the different architectures of MT systems that have been employed to actually produce the translations. It does this by explaining the development of each system, from the earliest rule-based ones to the modern neural systems. For accessibility and conciseness purposes, this section uses language that is understandable for non-specialists who do not have a background in computational linguistics, natural language processing or computer science. Section **2.3** then discusses how the quality of MT can be and has been evaluated and research within this area and section **2.4** discusses the relationship between TS and MT, highlighting that there is significant opportunity for further collaboration between the two fields.

Section **2.5** then builds on the previous discussion, seeking to ground the rise of MT more widely by exploring Artificial Intelligence (AI) and mobility as the driving force behind the development of MT to provide a theoretical grounding for the study of MT on a mobile device. It introduces the notion of mobility, defining and discussing it as the central driving force behind many technological developments, such as AI, but particularly as the force behind the development of mobile technologies and MT. It also discusses the idea that society is moving beyond mobility to a state of ubiquitous connectivity, where people, devices and

infrastructure are constantly connected to the internet. Section **2.6** discusses what AI is, its purpose and how MT is an example of AI in a world in which humans increasingly use and rely on AI to complete tasks and section **2.7** explores the rise of and growth of mobile devices. Sections **2.8** and **2.9** build on this examination of mobility and AI and MT as an expression of this mobility, examining the rise of mobile devices and mobile apps and explores existing studies on mobile translation, and explaining why studying MT on a mobile device is pertinent and timely.

2.1 Machine Translation

This section explores the technology of MT. focussing on the automation of the translation process, explaining what the technology is and aims to do. It then discusses the history of MT, focussing particularly on its emergence in the 1950s and the expectations of the technology.

2.1.1 Translation and automation – the automation of translation

The first machine age, which began with the industrial revolution, 'allowed us to overcome the limitations of muscle power, human and animal, and generate massive amounts of useful energy at will' (Brynjolfsson and McAfee 2014: 6/7). In other words, it allowed for the mechanisation and automation of principally physical tasks, of primary and secondary sector activities. The current era, which has been described as the second machine age (ibid.), is an age in which more cognitive tasks are being automated. As Cronin (2017b: 95) states, 'translation is one of those higher-level cognitive activities which is the target of advanced automation' and MT is an example of this automation, displacing the role of the human agent in the translation process. Whereas previously the

human agent was involved in the creative element of translating the text, increasingly translators are required to be post-editors of MT.

Kenny (2016: 13) notes that ‘this is one of the supreme ironies of contemporary machine translation. In some cases, at least, it has resulted in a division of labour between human and machine that assigns the most mechanical of tasks to the human’. However, it could be argued that this is not true and that since the machine simply follows protocol and formulae which produces output that is not very good, thereby requiring human input, it facilitates the creativity of humans. It enables them to think about the minutiae and the creativity could, arguably, lie in the detail, in the post-editing, rather than in the task of translating the text, depending on where one places the creativity in the translation process. Does the creativity lie only in the act of moving the text from language A to language B? Or does it also lie in the subsequent editing which ensures the quality and presentability of the text? Indeed, as O’Brien (2012: 113) questions, ‘can we really argue that improving or correcting what an author has written is “less creative” than translating another author’s words?’ The main issue seems to be that post-editing often involves improving and correcting not another author’s work, but work produced by a machine, not a human. Perhaps this is the element that perturbs people as, although technology pervades the world, humans are only just beginning to interact with machines capable of responding and with output produced by machines, meaning that such

interactions still produce a feeling of discomfort or foreignness for many people.[19]

This automation has also led to a democratisation in translation, as translations are now more accessible to people than ever before, largely thanks to MT. Anybody with an internet connection is able to use an MT provider, such as Google Translate, to translate from or into a foreign language.

2.1.2 What is machine translation?

Machine translation, also known as automatic translation and computer translation (and previously as mechanical translation), 'is translation performed automatically by a computer with different degrees of human involvement' (Palumbo 2009: 73).[20] For example, some machine translations are used directly in their raw form, whereas others are then post-edited by humans to improve and assure the quality. It is used primarily 'when instant translations are needed' and 'human translators are not able to supply them fast enough' (Quah 2006: 57). Machine translation, expressed as fully automatic high-quality translation (FAHQT) sits at one end of the Hutchins/Somers spectrum of translation, as shown in **Figure 2.1** below, with 'traditional human translation', in the sense of translation without computer or technological aid, at the opposite end of the spectrum.

[19] Many other examples can be used here to illustrate this point: difficulties in using self-checkout machines in supermarkets, difficulties using online chatbots and difficulties with automated menus on the phone, to name but a few.
[20] It is worth highlighting that Palumbo firmly includes the human in this definition of machine translation, showing that it does not mean the loss of the human element.

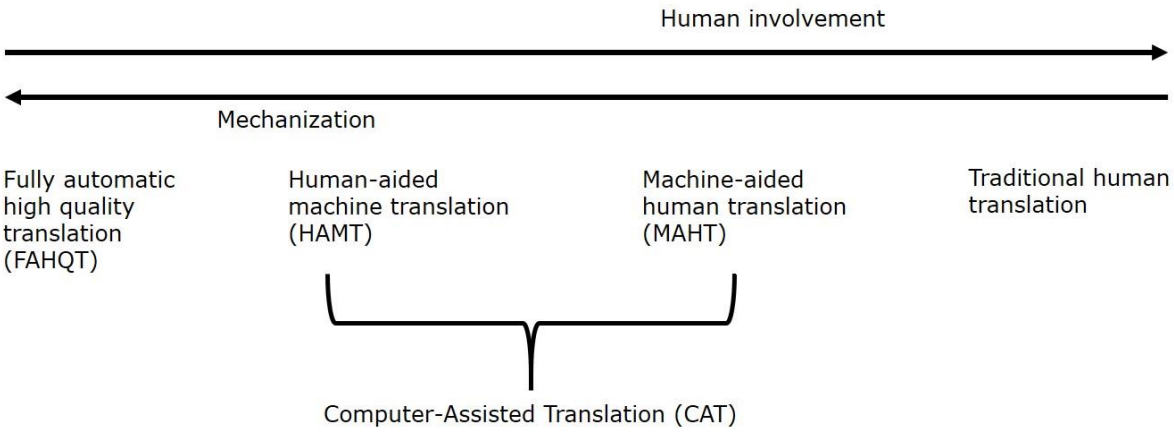


Figure 2.1 Human and Machine Translation Spectrum (Hutchins and Somers 1992: 148)

Nevertheless, it is not entirely clear what 'traditional human translation' is, as dictionaries, which are themselves a technology and rely on many technologies, such as writing, have been used by translators for centuries. Indeed, human translators relied on the technologies of the pen and the typewriter and now the computer to carry out their work. The original authors describe human translation as 'involving no mechanical aids whatever as it has been practised for centuries' (Hutchins and Somers 1992: 147), but even so what a 'mechanical aid' constitutes is not mentioned and 'human translation' is the only area not discussed afterwards in their analysis, presumably because it was thought to be self-explanatory. It is important to emphasise that neither of the two ends of the spectrum currently exist. In the modern world, no translation is entirely human produced, as, at the very least, a word processor will need to be used or email to communicate with others and 'pure' human translation has likely only existed very anecdotally. Likewise, no translation is entirely machine produced, as humans still currently create the texts for translation and are 'end users' of the products, whether using MT as part of their translation workflow, post-editing MT output or using the raw MT output. It is also interesting to note that 'quality' is only mentioned at the MT end of the spectrum – is it implied that

quality is inherent in all of the other forms of translation along the spectrum due to human involvement? That surely cannot be the case, given that quality remains a central issue for both TS and the translation industry and also that there are undoubtedly translations produced by humans which are incorrect and not good quality. Indeed, quality assessment is in itself a field that continues to be of interest for TS and the translation industry alike.[21] If it can be accepted that the quality of human translation varies, then why not accept the same of MT? Especially since it is only in very rare and specific circumstances that unedited, unchecked raw MT will be used without a human first checking it.

The Hutchins/Somers spectrum was produced in 1992, just as translation was beginning to incorporate more modern digital technologies, such as CAT tools and computers, into its workflows and the state of translation at the time was very different to now. There have, as such, been calls for the model to be updated (Christensen and others 2017: 17) to better represent translation in the modern world. One of the main issues is the distinction made between human-aided machine translation (HAMT) and machine-aided human translation (MAHT), as Christensen and others (ibid.) comment when they suggest it 'is becoming blurred'. This is, in fact, something which was acknowledged by Hutchins and Somers (1992: 147) when the model was produced, suggesting that this blurring is something that has been happening for a long time. Perhaps this is due to them appearing as two separate parts of the spectrum in the

[21] This is a field that often features in conference panels and is still very active, so it is worth noting, but there is not space for further discussion of this here and it is outside of the scope of this piece.

original model, when in reality they are two sides of the same coin and far more interrelated and indistinguishable than the visual representation suggests. Another problem may be the use of the label ‘mechanization’ by Hutchins and Somers which, while appropriate at the time, might be better expressed as ‘level of automation/technological involvement’, with FAHQT being the ultimate expression of this. ‘Mechanization’ implies an almost analogue aspect to the technology, invoking images of gears and cogs or computers which operated based on the input of punched cards, wholly unlike the digital computers in use today. **Figure 2.2** is an updated version of the Hutchins/Somers spectrum which attempts to address some of the issues that have emerged since the first version and a brief analysis explaining the rationale for the changes.

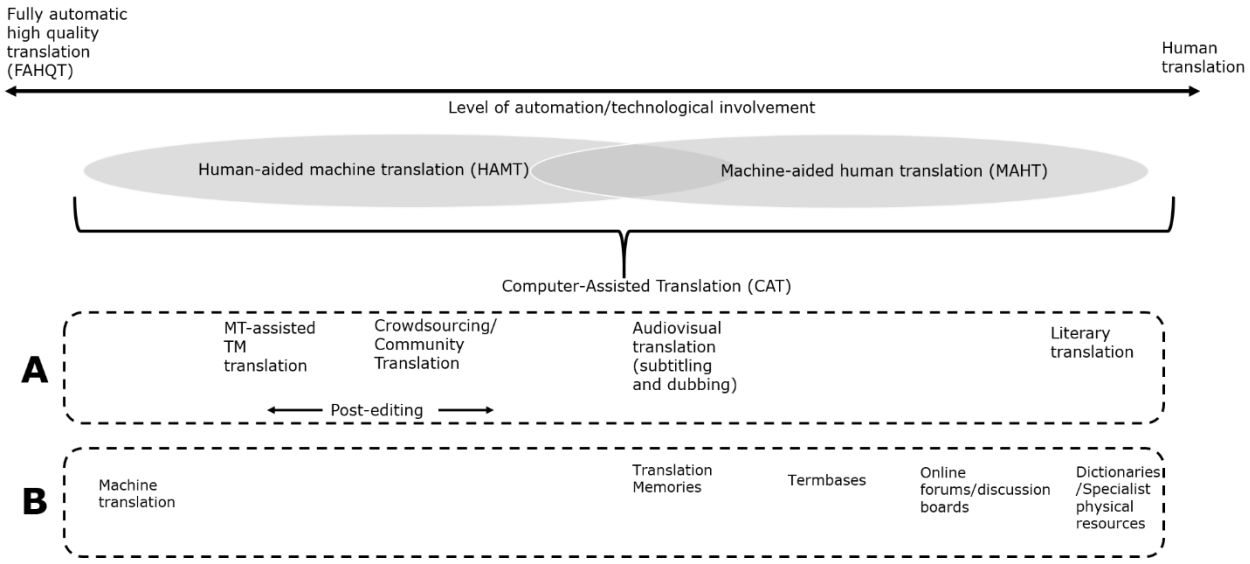


Figure 2.2 An updated version of the Hutchins/Somers spectrum

The axes and ends of the spectrum

The two arrows have been replaced by a bidirectional arrow which refers to the ‘level of automation/technological involvement’, rather than the analogue idea of mechanization. The arrow also logically implies that as the level of automation/technological involvement increases, human involvement

decreases. However, human involvement here only refers to the actual act of translating, moving the words from language A to language B, as humans are still currently involved prior to and after the act of translating, i.e., levels of automation are not the same at all stages of the translation process. It is also worth highlighting that as the 'level of automation/technological involvement' increases, it makes it increasingly possible for non-translators to become involved in translation, through crowdsourcing and monolingual post-editing. FAHQT sits at one end, with human translation at the other. In the original model, it was 'traditional human translation', but the 'traditional' has been removed as it was not clear what this meant, and the same idea is still conveyed without this distinction due to it being in opposition to FAHQT at the other end of the spectrum, that is, a human translating with as little technological involvement as possible. Although FAHQT was the original aim of MT, most proponents of MT recognise that it will never replace human translators (Forcada 2010: 222; Way 2012: 261) but will complement it, providing translations in instances where there otherwise may be no translation. As such, it has been established in this section that translation and technology are always already intertwined, and therefore very little, if any, translation activity has ever sat at either end of the spectrum, but the ends serve to qualify and better understand what comes in-between.

The CAT grouping

The overall CAT label has been significantly expanded to include nearly all of the spectrum, to represent the fact that it essentially represents all translation nowadays (Pym 2011: 77). The MAHT and HAMT labels have been altered to no longer be two separate categories, but rather are presented in the form of a

Venn diagram, with significant overlap between the two and as something which could be presented as a spectrum in its own right. Although it could be argued that they are no longer distinguishable, there are certain instances where the labels are useful, such as with monolingual post-editing which is carried out by non-translators who do not, therefore, translate, which is clearly an example of HAMT. The CAT grouping was the last aspect of the original model, but it has now been expanded with two new categories, designed to help understand the model better and provide specific translation examples mapped along the spectrum, as discussed below.

Types of translation along the spectrum

Category A provides examples of types of translation, such as literary translation and crowdsourcing, and attempts to roughly map them along the spectrum. It is not an exhaustive list and can only be a rough indication as the exact level of automation/technological involvement and human effort will likely vary on a case-by-case basis. Post-editing is difficult to place as sometimes only a light amount of post-editing is required, whereas in other instances MT output might require large amounts of post-editing and thus involve more human effort. As such, depending on the level of post-editing required, it could be placed more towards the FAHQT end, thus implying high levels of automation, or more towards the human translation end, thus implying more human effort. For this reason, it has been placed underneath the other types with arrows indicating its potential to move along the scale.

Specific technologies along the spectrum

Category B provides examples of specific technological tools employed by translators and attempts to situate them along the spectrum. Older or more traditional technologies, such as dictionaries and specialist physical resources are located at one end, as they still completely rely on a human to use them and produce a translation. MT, which aims to automate the translation process is at the other end of the spectrum.

Whilst the original goal of and furore around MT may have been to make FAHQT readily available to everyone, the primary users of MT systems became translators themselves and LSPs as MT became a tool in the translator's toolbox 'as part of the increasingly technology-embedded workflows of translation in the 2000s' (Doherty 2016: 953). This form of machine translation, which may be better understood as machine translation for professional purposes, may be offline, desktop-based systems or online systems hosted by a company or LSP which translators and/or clients can access. This type of machine translation is, then, still a specialised tool, one used by people working within the translation industry. There is also another distinction to be made: online machine translation, here referring to the free online systems, such as Google Translate, which were developed in the 1990s. Quah (2006: 85–87) discusses this second type briefly and includes online systems held on servers by a company or LSP which translators and/or clients can access.

However, the use of MT has expanded since then and it seems more useful to separate systems not by whether they are online, as the world is increasingly online and interconnected, but by whether they are designed for professional

or non-professional purposes. When Quah published her book in 2006, what would become the biggest and most well-known online MT service, Google Translate, had scarcely launched (launching in April 2006 (Och 2006)) and this type of online MT was not as widely known and used. The second category, MT for non-professional purposes, had barely begun, but it is now perhaps the most widely used type with a plethora of usage types, as mentioned below. MT for non-professional purposes, e.g., Google Translate, is not domain specific, so it is thus designed to translate a text regarding any topic or field, whereas MT for professional purposes, MT systems used by the translation industry, is often bespoke, created by developers and researchers for a specific LSP and/or a specific domain.

MT for non-professional purposes is an example of a truly democratised and democratising technology as it brings the possibility of translation to anyone with an internet connection. This has led to a variety of little-studied uses of the technology. People use MT to communicate and interact with people in a foreign country whose language they do not speak. For example, a waitress in a restaurant in China who speaks no English can use MT on her mobile phone to communicate with a client who speaks no Mandarin Chinese. MT facilitates the exchange as it means users can express themselves with words and not simply gestures or pointing. This represents a smoothing of the communication process and brings it closer to a communicative exchange between two people who share a language. There are, however, other uses of the technology, some of which fall into the category of entertainment and amusement. There are, for example, various websites dedicated to MT ‘fails’ (often produced by Google Translate) and the YouTuber Malinda Kathleen Reese produces videos entitled

'Google Translate Sings…'[22] in which she takes a popular song's lyrics, puts them through various layers of Google Translate and sings the principally nonsensical lyrics that are returned.

In a basic sense, MT is, then, translation carried out by automatic means, translation in which the conversion from language A to language B is carried out not by a human, but by a computer.[23] To understand how modern MT systems work, it is first prudent to consider the history and development of MT during the latter half of the twentieth century.

2.1.3 The early years of Machine Translation

In order to provide some context and history to the emergence of MT on a mobile devices and MTAs, a very brief description of the history of MT is provided below. The aim is not to produce an exhaustive history of MT or an in-depth discussion of how the systems work, but rather to provide contextual information. Various scholars have produced detailed histories of MT and explanations of MT systems – see, for example, Yvon (2014) for a detailed bibliography of texts around MT; Hutchins (1986, 2010) for a detailed history of the development of MT around the globe; Lennon (2014) for a brief history of MT and Poibeau (2017) for a general introduction to MT and a non-specialist explanation of how MT systems operate. Hearne and Way (2011) in their paper entitled 'SMT for Linguists and Translators' provide an excellent, albeit still maths heavy, introduction to Statistical Machine Translation (SMT) for non-

[22] Malinda Kathleen Rose is a YouTuber whose channel, Translator Fails (https://www.youtube.com/c/twistedtranslations), has 985,000 subscribers as of February 2022.

[23] However, humans are still involved in developing MT systems and producing the data that trains modern systems, as will be explored more in **2.2.2 Corpus-based systems (1980s-Present).**

specialists interested in learning more about the field and Forcada (2017) provides an excellent overview of Neural Machine Translation (NMT) systems, how they work and differ from SMT systems, as well as an overview of what translators can expect from NMT.

Firstly, as (Hutchins 2010: 29) notes, ‘we may trace the origins of machine translation (MT) back to seventeenth century ideas of universal (and philosophical) languages and of “mechanical” dictionaries’, that is the idea that there are universals in the world, concepts shared by all humans. It was not, however, until the twentieth century that research into MT began. This is primarily due to technological limitations, in that it was only when computers were developed that this area could be explored in greater depth, but also due to the complexity and ambiguity of natural languages, something which is only more evident in the case of translation which involves not only one, but at least two languages. MT is not, then, an easy task, but it is a complex one as ‘processing natural languages (as opposed to processing formal languages, such as the programming languages used by computers) is difficult in itself, mainly because at the heart of natural language lie vagueness and ambiguity’ (Pym 2012). Computer or programming language is, by design, precise and unambiguous, designed to be interpreted without any ambiguity by different people, unlike natural language.

At the end of the 1940s, Warren Weaver, one of the early pioneers of MT, released his influential memorandum in which he suggested using computers to help overcome the ‘world-wide translation problem’ (Weaver 1949), giving impetus to a wave of research in the field. It is worth pointing out the use of the word ‘problem’ here, since it is a word which appears repeatedly in the literature

and indicates that linguistic diversity is a challenge which needs to be overcome, something which is causing difficulties for humanity in the current budding global context, and not something which should be embraced. Whilst it may be true that linguistic diversity is a problem economically speaking in that it can prevent trade, culturally speaking it has profound benefits as it enables increased diversity and languages are inherently linked to culture and people. Problem may also be understood more in its scientific and mathematical sense of something that is to be solved, particularly since Weaver was interested in cryptography and thought of translation as a process of decoding.

The period that followed, which Lennon (2014: 140) refers to as 'the golden age', began in 1954 with 'the first public demonstration of a machine translation system […] the Russian-English Georgetown University System, a collaborative effort between IBM and Georgetown University' (Quah 2006: 60). Research into MT was conducted across the globe in places such as the Soviet Union, Italy, France, Belgium, West and East Germany, Czechoslovakia, Hungary, Romania, Japan, China, and Mexico, while expanding in the United States and the United Kingdom. The focus in both the Soviet Union and the USA was English-Russian and Russian-English translation respectively for political and military reasons (Hutchins 2010: 31).

2.1.3.1 The problem of FAHQT and the end of the golden age

As previously stated, the original aim of MT was to produce a system capable of FAHQT; a system capable of producing human-quality translation without a human translator. That is, something akin to the babelfish from the Hitchhiker's Guide to the Galaxy or the universal translator from Star Trek. As Lennon (2014: 136) notes, 'from 1949 to 1966, both enthusiasts and sceptics described

fully automated high-quality translation (FAHQT) in mythic terms, as a “holy grail”’. This ‘golden age’ was, then, short lived, largely due to Bar-Hillel’s observations at the end of the 1950s and the publication of the Automatic Language Processing Advisory Committee (ALPAC) report in 1966 which was ‘clearly a follow-up to Bar-Hillel’s observations’ (Poibeau 2017: 75). The report ‘crushed MT in the United States, cutting off funding and destroying its reputation for quite some time’ (Way and Hearne 2011: 230). Whilst research into MT did continue both inside and outside the United States, it was not with the level of interest, funding and intensity seen beforehand. Bar-Hillel (1960: Appendix III) used a simple but powerful example to demonstrate the infeasibility of FAHQT:

‘Little John was looking for his toy box. Finally he found it. The box was in the pen. John was very happy.’

The word ‘pen’ has at least three meanings in English: a writing utensil, an enclosure where animals are kept and an enclosure where children can play. As Bar-Hillel (1960: 161) notes, it is ‘conceivable though extremely unlikely [...] that the target-language contains a word denoting both the same writing utensil and an enclosure where children can play.’ In French, for example, a closely related language to English, each meaning of the English word ‘pen’ has a different translation – *un stylo, un enclos* and *un parc pour bébé* respectively. Bar-Hillel argued that it was only through the context and logical deductions made automatically by competent humans that the meaning of the word can be grasped, i.e., that, as a box is significantly larger, it cannot mean ‘a writing utensil’ in this case. As such, no computer systems would be able to deduce this and produce the correct translation. The example sentences he used, even

when put through modern MT systems such as those shown in **Table 2.1** below, all of which use NMT, still produce incorrect translations when translating from English into French. Yellow highlighted text represents an error/issue with the translation, and these are discussed below the table.

Online MT Provider	**Translation of Bar-Hillel's example** *(all translations retrieved on 6 December 2017)*
1. Google Translate[24]	Little John cherchait sa boîte à jouets. Finalement, il l'a trouvé. La boîte était dans le stylo. John était très content.
2. Microsoft Translator[25]	Le petit John cherchait sa boîte à jouets. Enfin, il l'a trouvé. La boîte était dans le stylo. John était très heureux.
3. DeepL[26]	Le petit John cherchait sa boîte à jouets. Finalement, il l'a trouvé. La boîte était dans le stylo. John était très heureux.
4. Systran[27]	Petit John recherchait son coffre à jouets. Enfin il l'a trouvé. La boîte était dans le stylo. John était très heureux.
5. Yandex[28]	Petit Jean est à la recherche de son coffre à jouets. Enfin, il l'a trouvé. La boîte était dans le stylo. Jean a été très heureux.

Table 2.1 Translations of Bar-Hillel's example by modern MT systems

Firstly, all five systems use *stylo* for the translation of 'pen', which is incorrect for the aforementioned reasons. Furthermore, there are other problems with the translations produced in addition to the principal problem that all five systems choose '*stylo'* as the translation for 'pen' in this context:

A. The word 'trouvé' should be 'trouvée' as the direct object pronoun 'la' (here contracted with the auxiliary verb to 'l'a') proceeds the verb and is feminine. However, the tense is also arguably incorrect as the sentences likely come from a novel or an

[24] https://translate.google.com/
[25] https://www.bing.com/translator
[26] https://www.deepl.com/translator
[27] http://www.systranet.com/translate/
[28] https://translate.yandex.com/

anecdote and as ‘found’ is a completed action in the past, entirely detached from the present, the past historic (trouva) should be used.

B. Example 5 changes the tense of the first sentence – the original English sentence is in the past tense and the French translation is in the present tense. Similarly, in the last sentence, the translation would be better with the imperfect ‘était’ rather than ‘a été’, as in the other four examples.

In Wu and other’s (2016) description of Google’s NMT system, they provide example translations produced by Google’s phrase-based machine translation (PBMT) and NMT systems using the source and target sentences from the WMT[29] English-to-French newstest2014 dataset. An example taken from these translations further evidences the problem which Bar-Hillel highlighted in 1960, using a real-world example, as opposed to the example Bar-Hillel created to specifically highlight the issue.

Source	She was spotted three days later by a dog walker trapped in the quarry.	
PBMT	Elle a été repéré trois jours plus tard par un promeneur de chien piégé dans la carrière	6.0
GNMT[30]	Elle a été repérée trois jours plus tard par un traîneau à chiens piégé dans la carrière	2.0
Human	Elle a été repérée trois jours plus tard par une personne qui promenait son chien coincée dans la carrière	5.0

Table 2.2 An example of translations produced by different Google MT systems, alongside their ratings given by a human rater (taken from Wu and others (2016: 23)***)***

[29] Workshop on Machine Translation (WMT) is an annual event (since 2006) in which teams of researchers test and benchmark their MT systems against others.
[30] Google Neural Machine Translation

To evaluate the sentences, 'the raters were asked to grade the translations on a scale from 0 to 6, with '0 meaning *"completely nonsense translation"'* and '6 meaning *"perfect translation: the meaning of the translation is completely consistent with the source, and the grammar is correct"'* (Wu and others 2016: 14). The authors disagree with the rating given for the sentence produced by GNMT in **Table 2.2** in particular, as the PBMT translation which 'contains grammatical mistakes and changes semantics, and is still scored 6' (ibid.: 23) received a higher score than the GNMT translation. However, the authors do not mention what semantics are changed, as it does not appear that any have been, nor that the GNMT system commits the same grammatical error with *'piégé'*, which should be *'piégée'* as, like *'repérée'* it agrees with *'elle'* as the verb is in the passive voice. Although the PBMT system does make a grammatical error, its translation of 'dog walker' as *'promeneur de chien'* is closer to the original English than the GNMT system's – *'traîneau à chiens'* means 'dog sled'. However, why the human raters have given the PBMT sentence a score of 6, representing a perfect translation, is unclear, especially given that the criteria for a six explicitly mention correct grammar and this sentence contains two grammatical errors. It is evident that the authors prioritise grammar in the sentences, as they specifically mention it in the evaluation criteria for the human raters and in their complaint at the scores. However, this may be erroneous as grammatical errors are often less likely to hinder comprehension than word-choice errors.

Furthermore, the only way of knowing that *'piégée'* should agree with *'elle'* is through context and logic as the English source sentence is ambiguous – the fact that it is the dog which is trapped in the quarry rather than the dog walker

is not linguistically evident, it is only logically and contextually evident. The human translation, which does retain this ambiguity as *'coincée'* could agree with both *'elle'* and '*personne'*, does not receive a perfect score of 6, probably because it translates 'by a dog walker' as *'par une personne qui promenait son chien*' [by a person walking their dog], implying that the dog belonged to the person walking it, something which is not clear in the source sentence. This issue stems from the fact that 'dog walker' in English can refer to somebody walking their own dog(s), somebody walking a dog or several dogs which do not belong to them and somebody whose job it is to walk dogs. In French, *'promeneur de chien'* is only used to refer to somebody whose job it is to walk dogs and so using the verbal construction of *promener* + *chien* requires some qualification of *chien*, such as with a possessive adjective or (in)definite article. The most suitable translation would probably be '*par une personne qui promenait un chien'*, but even this is not perfect as it determines the number of dogs, in this case one, something which it is impossible to determine in the English sentence. This sentence is a clear example of when context and inference must be used in order to determine the meaning of a sentence and fully understand it and that a 'perfect' translation is not possible due to the rules of different languages and their form of expression. Translation is always a matter of finding the best compromise.[31] This substantiates Bar Hillel's assertion regarding the inadequacies of MT at performing this task, at least when it involves fragmented word order which can produce ambiguities, although more modern systems, such as those that will be discussed in **2.2.2**

[31]What constitutes 'the best' is, of course, subjective and that is the point – translation is inherently subjective.

Corpus-based systems (1980s-Present), are able to take some context into account and are continually being improved to take larger amounts of context into account.

It was only once this unrealistic goal of FAHQT was relinquished that more practical research could begin. The goal was unrealistic principally due to the technological limitations at the time, with access to computers not widespread and computational power still relatively limited, and the state of the field at the time, with the rule-based systems employed producing low-quality translations. Both Bar-Hillel and the ALPAC report emphasised that FAHQT was an unrealistic and unachievable aim, at least in the short term. How short this 'short term' was is unclear, especially given that over 50 years later researchers still see this aim as something which will not be achieved soon (Koehn 2017). Both did, however, advocate research into producing computer tools to aid human translators, rather than into machines to replace them. The foresight of both Bar-Hillel and the ALPAC report was cemented in the 1990s with the development of CAT tools and the rise of the translator's workstation, in which a variety of technological tools such as TMs, TBs, dictionaries, internet resources and, increasingly, MT are used.

2.2 Types of MT

As research into MT was carried out, new technologies were developed and computing power increased, the systems used in MT also developed over time. This section provides a chronological overview of the different types of MT systems that have been used over the years, explaining how these systems produced translations. It is interesting to note that the development of machine translation is comparable to the development of translation in general, with the

earliest approach of direct translation ‘mirror[ing] early translation approaches of word-for-word translation’ (Quah 2006: 69). This is hardly surprising given that the dichotomy of word-for-word translation and sense-for-sense translation were proposed by Cicero and St. Jerome (Munday 2016: 31) during Antiquity and occupied translation for the next two millennia. Indeed, although there has largely been no dialogue between translators or translation studies scholars and MT developers over the years (Quah 2006: 61; Pym 2012), the development of MT systems largely reflects the development of translation theories over the same period of time, as shown in **Figure 2.3**, with both moving from the micro level (e.g., words) to the macro level (e.g., culture). Whilst translation theories have developed to consider larger concepts such as culture, machine translation systems have now moved from the word to the sentence level. What both trends show is that context is increasingly taken into account over time. So, although some MT systems, as will be seen below, may translate in very different ways to human translators, e.g., transfer and SMT systems, the principles of other systems, e.g., example-based machine translation (EBMT) and NMT systems, seek, to some extent, to mirror the translation process used by humans.

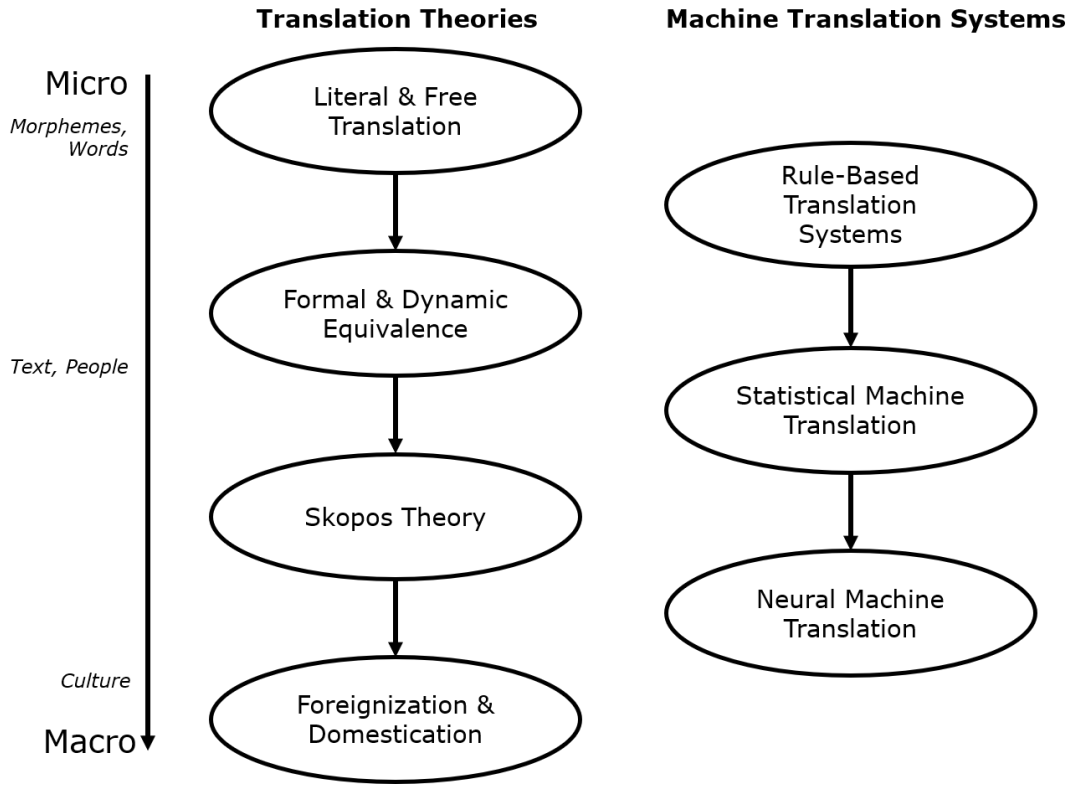


Figure 2.3 The development of translation theories and machine translation, from micro to macro

In the discussion of each type of system, the heading for that section also includes a rough date for the emergence of these systems. It is difficult to give an exact date for each of these and will depend on what criteria are used – is it when someone first had the idea? When someone first proposed a system? When someone first developed a working system of that type? The dates given here correspond to roughly when research into that type of system began and systems started to be developed.

2.2.1 Rule-based systems (1950s)

Rule-based systems were the first type of MT systems to be developed and work by supplying a computer with rules which it can then use to transform the ST in language A into the TT in language B. As Poibeau (2017: 26) states, 'translation can be direct, from one language to the other (i.e., with no intermediate representation), or indirect, when a system first tries to determine

a more abstract representation of the content to be translated.' There are, then, three approaches to MT under the umbrella of rule-based systems:

1. Direct
2. Transfer
3. Interlingua

When considering rule-based systems, it is often helpful to use Vauquois' Triangle, shown in **Figure 2.4**, to help visualize the approach taken by the three architectures involved in this paradigm. These three approaches 'can be considered to form a continuum' (Poibeau 2017: 28) and as the level of analysis conducted increases, so does the computational power needed and the complexity of the system required to then produce a TT.

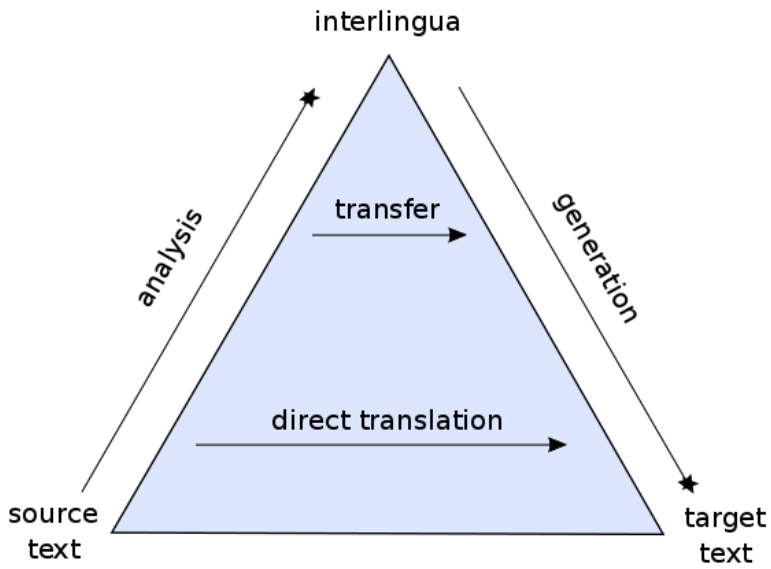


Figure 2.4 Vauquois' Triangle[32]

[32] Image source: https://en.wikipedia.org/wiki/File:Direct_translation_and_transfer_translation_pyramid.svg.

The Vauquois Triangle was developed by the French researcher Bernard Vauquois in the 1960s during his work in Grenoble as a researcher and developer of MT systems. Although this work was entirely separate from the work conducted in TS at the time, it is worth highlighting the similarities between the triangle and the analysis-transfer-restructuring model proposed by Eugene Nida (Nida 1969: 33), a prominent figure in the field of TS, shown below in **Figure 2.5**.

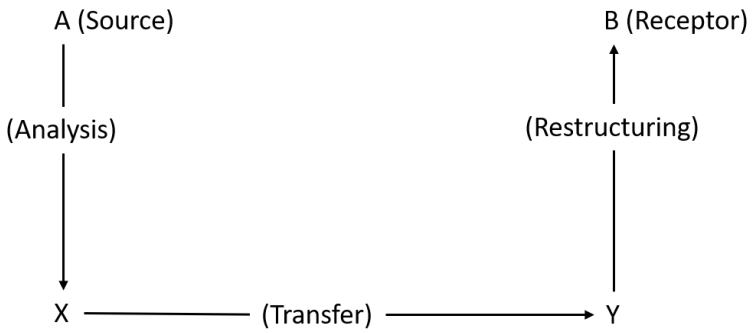


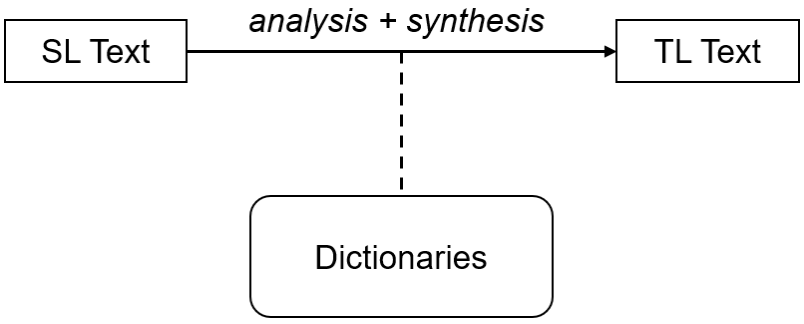
Figure 2.5 Nida's Analysis-Transfer-Restructuring model (Nida and Taber 1969: 33)

Both the Vauquois triangle and Nida's model suggest analysis of the text to reach the deeper meaning, the interlingua, from which the translation can then be produced. Although there appears to have been no dialogue between the two, their models are indicative of contemporary linguistic theories from structuralist linguistics, and both draw upon the work and ideas of Noam Chomsky. He is one of the 'main contributors' according to Vauquois (Vauquois 1968) and is also referenced in Nida's bibliography and Munday (2016: 62–65) notes the influence that Chomsky had on Nida's work. As such, it seems that although there was no direct dialogue between the two disciplines, they were both inspired by the field of linguistics and developed similar ideas regarding translation and the translation process.

2.2.1.1 Direct Translation

Direct translation, the first generation of machine translation systems, is the oldest form of machine translation. This approach involves a computer simply replacing a source language string with a target language string by using a bilingual dictionary (Quah 2006: 69), after which 'simple reordering rules can apply, for example, for moving adjectives after nouns when translating from English to French' (Jurafsky and Martin 2008: 904). The approach was designed for a single language pair and to translate into additional languages a new dictionary would have to be supplied.

Figure 2.6 provides a visual representation of direct translation, showing the relative simplicity of these early systems.



SL = source language; TL = target language

Figure 2.6 Direct Translation Model (Quah 2006: 70)

However, although overall these systems and the process visualized in **Figure 2.6** may now appear relatively simple, this is to be expected given the computing power available at the time and the nascent nature of the field. Furthermore, the dictionary entries which determined the translation of the word could be quite complicated and looked nothing like a traditional dictionary entry which provides a word and its definitions or a printed bilingual dictionary which provides the word in one language and corresponding words in another

language. In fact, entries in these dictionaries resemble computer code more closely than a traditional dictionary definition, particularly since they are more like an executable command, as shown in

Figure 2.7.

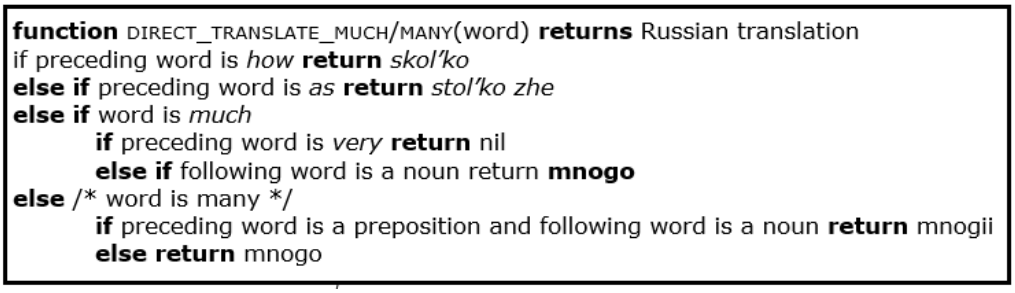


Figure 2.7 A procedure for translating much and many into Russian (taken from Jurafsky and Martin (2008: 905) ***adapted from Hutchins' (1986:133) discussion of Panov (1960)***

The rule is designed to take into account contextual factors, principally collocation, to try to account for the fact that 'much/many' are often preceded by other words, such as 'so' or 'as'. Evidently, in order to produce these rules an in-depth knowledge of both the SL and TL is required, as well as linguistic knowledge about parts of speech. The rules must also be written on a language-pair by language-pair basis, that is one set of rules must be written for English to French and a different set for English to Spanish. So, significant human effort, from people with expert knowledge of both languages, would have to be expended to produce a dictionary for every language pair desired.

2.2.1.2 Transfer

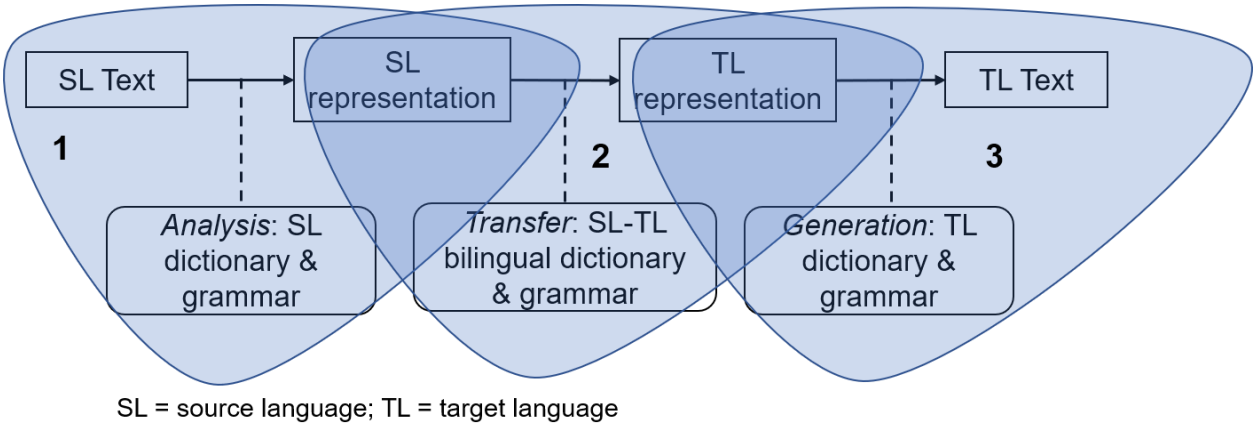


Figure 2.8 Transfer model (taken and adapted from Quah (2006: 74)***)***

The model shown above in Figure 2.8 is the transfer model, the next system to be developed after direct translation systems. It builds on the direct translation approach and is a more complicated model, as can be seen by the fact that there are more steps in the process between the ST and TT. The model works by parsing the ST before it is translated in order to produce an abstract SL representation of the text (stage 1 in **Figure 2.8**). An equivalent abstract representation in the TL is then produced using bilingual dictionaries for the lexical transfer, just as for direct MT (stage 2 in **Figure 2.8**). This abstract TL representation can then be used to produce the final TT (stage 3 in **Figure 2.8**). An abstract SL representation can be produced using a parsing tree from which subsequent parsing trees can be separated, e.g., with initial reordering from adjective + noun to noun + adjective and then with the TL words, as shown in **Figure 2.9**.

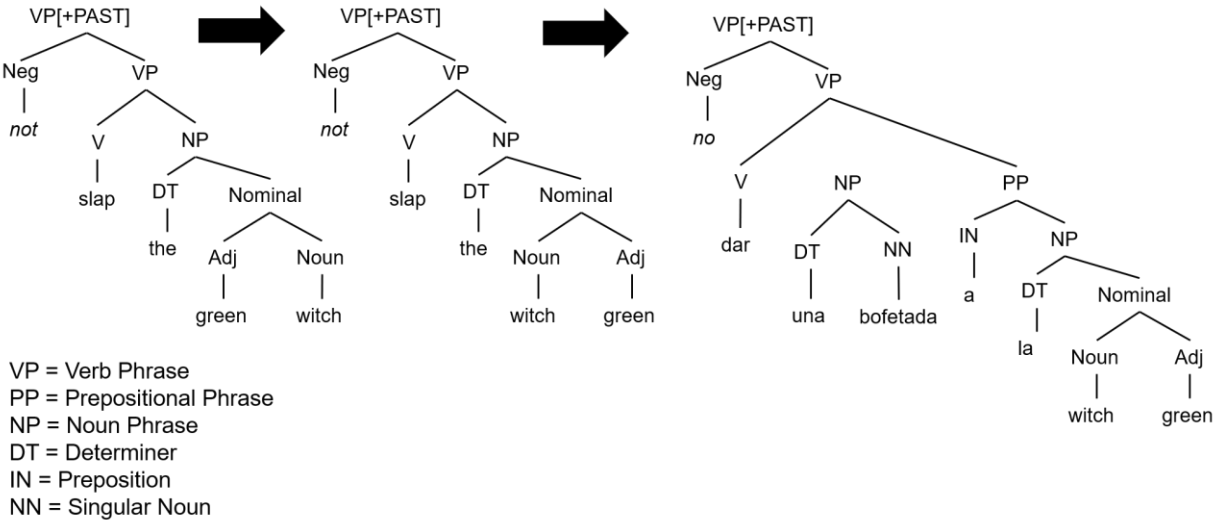


Figure 2.9 Parsing tree for the phrase 'did not slap the green witch' used in transfer systems (taken and adapted from Jurafsky and Martin (2008: 907)***)***

Whilst deeper analysis allows for better quality translations to be produced than by direct translation systems, the transfer approach also has limitations, particularly in that 'failure at the analysis stage may result in zero output because the transfer process cannot take place' (Quah 2006: 74). The reality was that many commercial systems tended to be hybrids, including elements of both direct translation systems and transfer systems, in order to produce better quality translations (Jurafsky and Martin 2008: 908).

2.2.1.3 Interlingua

The interlingua approach is the most advanced of the three rule-based architectures discussed. As opposed to transfer approaches, which involve producing an abstract SL representation, interlingua approaches involve producing an abstract language-independent representation from the ST, which can then be used to produce the TT, as shown in **Figure 2.10**.

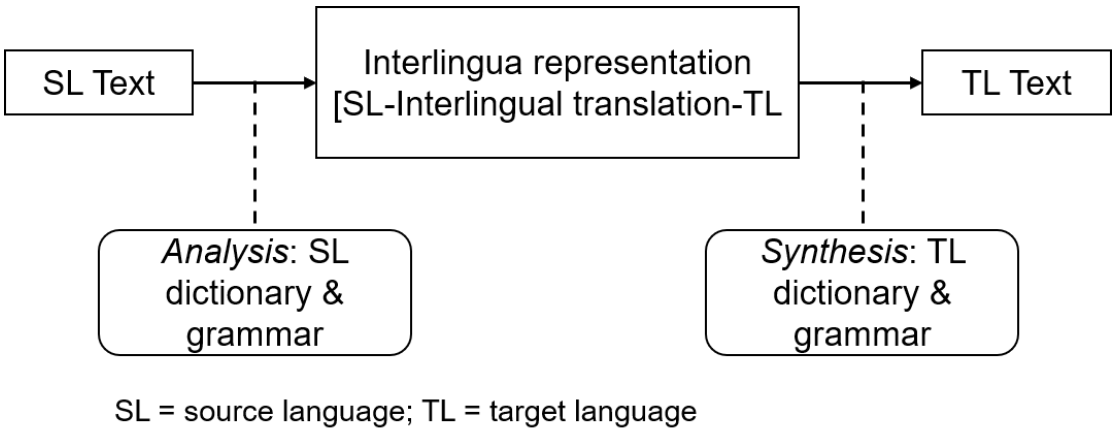


Figure 2.10 Interlingua model (Quah 2006: 72)

The idea of using an interlingua is reminiscent of Nida's (1969) analysis of the translation process by human translators (Quah 2006: 74) and Weaver's (1949: 11) notion of towers of languages[33] which may be descended 'to the common base of human communication - the real but as yet undiscovered universal language - and then re-emerge by whatever particular route is convenient.' The benefit of this approach is that, unlike the direct translation and transfer approaches, both of which require 'a distinct set of transfer rules for each pair of languages' (Jurafsky and Martin 2008: 909), the interlingua model does not as it can 'do without contrastive knowledge, merely relying on the same syntactic and semantic rules used by a standard interpreter and generator for the language' (ibid.).

It is worth highlighting that some systems have used English as an interlingua. That is, if a translation was needed from Arabic to Slovene, the Arabic would first be translated into English and the Slovene translation then produced from

[33] Weaver uses the metaphor of individual towers (and tower metaphors are often used when considering languages and translation), built on shared foundations, to explain his concept of a universal language. If each individual simply communicates by shouting from their tower, it is difficult even for the closest towers, but if they were to descend their towers to the common foundations (i.e., the universal language), communication would be much easier.

the English version. This is not without precedent in human translation, particularly for uncommon language pairs, as translators can find themselves translating from a text which is itself a translation of the original ST. However, as Poibeau (2017: 28) emphasises, it is erroneous to refer to English as an interlingua in this case and it is 'better to speak of a "pivot language" or simply a "pivot," when the interlingua is a specific natural language'; an interlingua is artificial and natural-language independent. The approach of using a pivot language also exists with human translators, who may translate from a text which is not the original ST and is already a translation. For example, on a large project a text may first be translated into English and then this English translation used as the ST from which other language translations are produced.

Interlingua approaches, although first hypothesized at the very beginnings of MT research, as can be seen in the Vauquois triangle, were not developed until later on with improved computing power. They 'have never been deployed on a very large scale' (Poibeau 2017: 32) and 'are generally only used in sublanguage domains' (Jurafsky and Martin 2008: 910). Having said that, the newest advances in MT have potentially made use of interlinguas. For example, Google (Johnson and others 2016) has described its own NMT system as using an interlingua to produce translations, suggesting that the newest paradigm has finally achieved an interlingua approach deployable on a large scale. The interlingua in this case is the vector representation which the neural networks use to produce the translations, something which, in their raw form, are not interpretable by humans. This represents a departure from the original idea of an interlingua being a *human* universal, rather in this case it is the tools, the

computers, which can convert this vector representation into a natural language. Indeed, this is also a departure from the rule-based systems in that it is no longer a machine executing commands written by a human expert, but rather the machine learning from the data and producing its own system of translating.

2.2.2 Corpus-based systems (1980s-Present)

Throughout the 1980s, access to electronic versions of texts continually increased and large corpora of texts became available (Poibeau 2017: 91). Corpora can be monolingual, such as the British National Corpus, or can take the form of parallel corpora (which are at least bilingual, but can be multilingual), such as the Canadian Hansard.[34] This increased accessibility to pre-existing translations facilitated the development of new approaches to MT which, rather than using linguistic rules as previously seen, are capable of producing translations by using the text available in the corpora. Under this paradigm, three new approaches have been developed: EBMT, SMT and NMT, all of which will be discussed in more detail further on.

These new approaches, particularly SMT, broke with earlier traditions as the field of MT diverged from linguistics and treated translation as more of a mathematical or statistical problem to be solved, arguably more in line with Weaver's view of translation as a cryptographic or statistical problem (Hutchins 2014: 128). Furthermore, rather than trying to build systems which could produce translations from scratch as in previous paradigms, these corpus-

[34] The Hansard is an official record containing the transcripts of the parliamentary debates held in the UK and many other Commonwealth countries. As Canada is a bilingual country, all records are available in both French and English, thus making it a natural parallel corpus.

based approaches relied on data provided by human translators; data in this case referring to aligned sets of human-produced translations. Thus, in the more modern MT systems, it is translators, albeit indirectly and perhaps unknowingly, rather than linguists, who provide the data or information upon which the systems are built. As such, as Way and Hearne (2011: 238) emphasise, 'the role of the translator in SMT is a crucial one: they provide *all* the knowledge upon which our models are based'. This is also true of the newer NMT systems which still require data, generated by humans, in order to learn and function.

2.2.2.1 Alignment

In addition to the availability of large corpora, there was another condition which needed to be met in order to enable corpus-based MT – alignment. Alignment is the process of matching or pairing sentences, paragraphs or words within two or more texts in order to label a translation relationship. This process developed during the 1980s and 1990s when the corpora became available and to function 'it is assumed that the translation generally follows the structure of the original text and that the sentences are usually chained in the same way in the source text and target text' (Poibeau 2017: 101). It is also possible to define a length ratio between languages, e.g., for English and French, French texts are often 1.2 times longer than their English equivalents (ibid.). Once aligned at sentence level, it is then possible to align at word or phrase level and there can be 1-to-1 relationships, 1-to-many relationships or many-to-many relationships, an example of each is given in **Figure 2.11**.

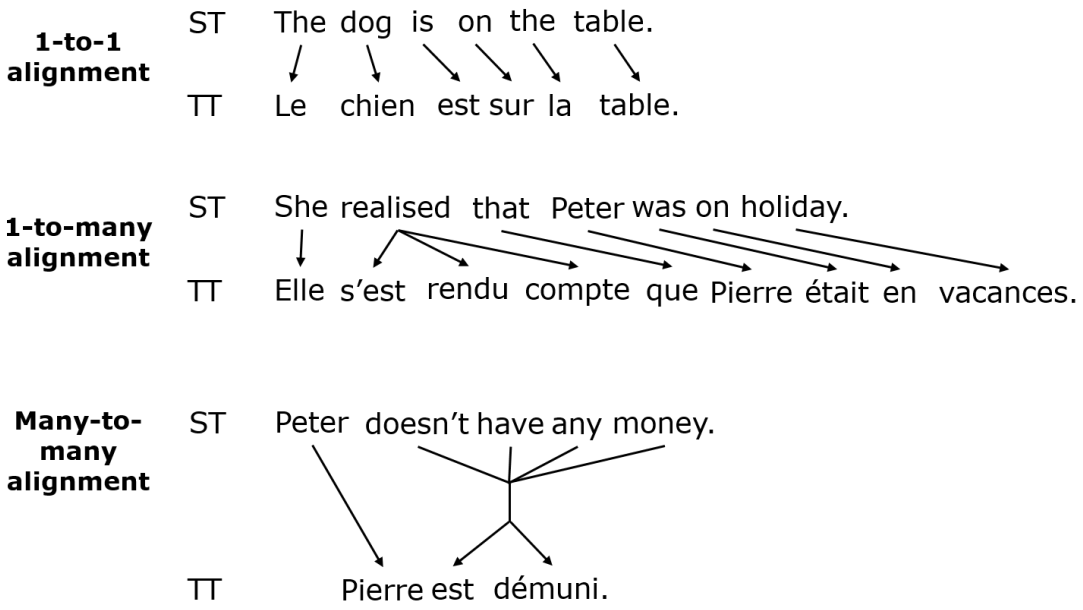


Figure 2.11 Types of alignment

Once texts have been aligned, MT systems using corpus-based approaches can be developed and trained as they need the translation relationship established during alignment to build translation models (SMT/NMT) or select parts of a text as translation (EBMT). In a way, this is comparable to RBMT, but rather than the rules being as explicit or programmed by a human, they can be automatically inferred from the data. Alignment is not exclusive to MT and may be one area of MT with which translators are most accustomed as it is also an option in many CAT tools. According to SDL Trados,[35] 'translation alignment is a way of making use of existing translation materials' and allows the translator to 'match the source and target language files, meaning you can build up your translation memory database'. In addition, alignment is also used when translating a text from scratch – the translation units of the ST presented by the CAT tool for translation then correspond to, i.e., are aligned with, the translation

[35] Available here: https://www.sdltrados.com/solutions/translation-alignment/ [accessed 26 March 2022].

unit in the TT and can be added to TMs and used as part of corpora for developing MT systems.

2.2.2.2 Example-Based Machine Translation (EBMT, Late 1980s)

Example-based machine translation was proposed in 1984 by Makoto Nagao in Japan (Poibeau 2017: 109). EBMT sought to replicate more closely the way that humans translate, as RBMT systems produced translations in a manner completely different to human translations – humans do not go through a text applying rules to words to translate them into another language. EBMT systems use bilingual corpora to produce a translation in a three-stage process (ibid.: 110):

- The system tries to find fragments of the sentence to be translated in the corpora available for the source language. All the relevant fragments are collected and stored.
- The system then looks for translation equivalences in the target language, thanks to the bi-texts used for translation.
- The system finally tries to combine fragments to obtain a correct sentence in the target language.

These stages have been mapped onto **Figure 2.12** below in order to further elucidate the process in EBMT.

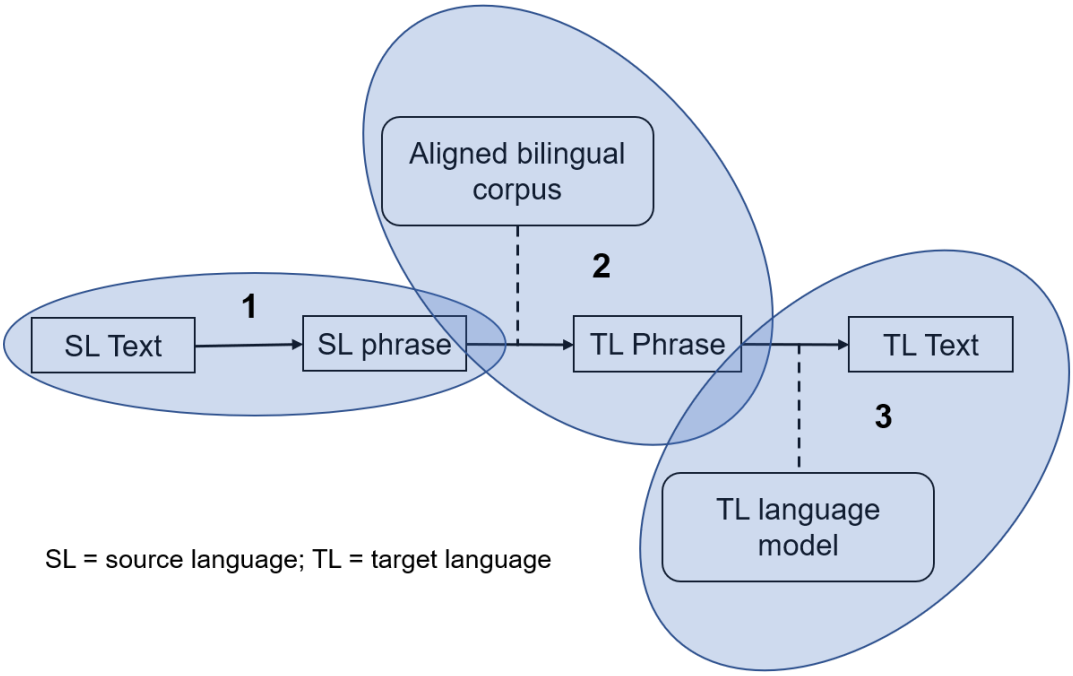


Figure 2.12 Example-based model (Quah 2006: 81)

The 'fragments' can operate at different linguistic levels, such as at word level or sentence level, and are found through the system using an 'algorithm to match the closest example of a source-language segment to its target-language segment' (Quah 2006: 81). Exact matches at sentence level are extremely rare (Poibeau 2017: 113), so the system usually has to look for matches within sentences, on a phrase or word level. A simplified example can be used to illustrate the translation process of an EBMT system. **Table 2.3** contains example sentences from a Spanish-English bilingual corpus in an EBMT system.

	Spanish	English
1	El río Támesis **se ubica en** el Reino Unido	The Thames river **is located in** the United Kingdom
2	**España** es un país europeo	**Spain** is a European country

3	**Madrid** es la capital de España	**Madrid** is the capital of Spain

Table 2.3 An example of Spanish-English sentences from a bilingual corpus

The system could then be asked to translate the previously unseen sentence '*Madrid se ubica en España*' into English. It would do this by identifying the various fragments, highlighted in bold in **Table 2.3**, from which it could then construct the English translation of 'Madrid is located in Spain'.

2.2.2.3 Statistical Machine Translation (SMT, Late 1980s/early 1990s)[36]

Statistical Machine Translation (SMT) emerged at the end of the 1980s and would become the dominant paradigm within MT for the next twenty-five years and is also predicated on the availability of large mono- and bilingual corpora. The explanation provided here is intended to provide a brief and simplified overview of the way that SMT operates and to be understandable for a none-specialist in the field.

SMT systems 'employ two distinct and separate processes: *training* and *decoding*' (Hearne and Way 2011: 206), represented by sections A and B respectively in **Figure 2.13**.

[36] Hearne and Way 2011 provide an excellent summary of SMT for non-specialists.

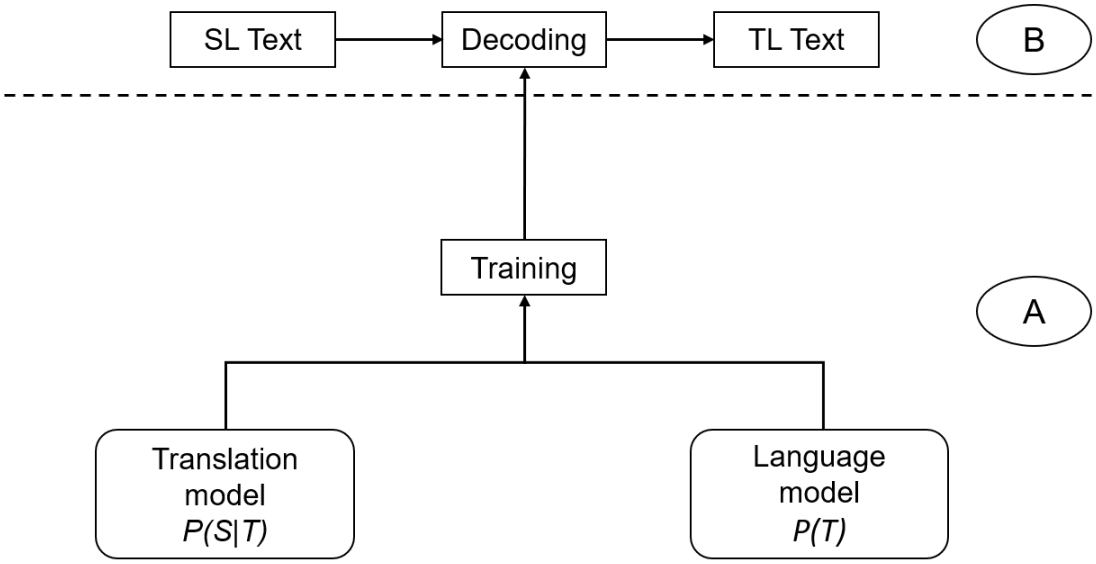


Figure 2.13 Statistical machine translation architecture

A – Training

The training phase occurs behind the scenes, in that it must be carried out beforehand in order for users to be able to query the system and request a translation as 'when translating new input, the system will access the models but *not* the original training data' (ibid.:208). That is, during stage B, the decoding or translation phase, the actual bilingual and monolingual corpora, which underpin the system and from which the data are obtained, are not accessed. In the training process, SMT systems are essentially trained by analysing the bilingual corpus to generate a 'statistical model of translation' (ibid.) and a monolingual corpus to produce a language model. 'SMT focuses on generating many thousands of hypothetical translations for the input string, and then working out which one of those is most likely' (ibid.: 206). SMT systems employ, therefore, methods which 'are not intended […] to be either linguistically or cognitively plausible' (ibid.) but are '*probabilistically* plausible' (ibid.) and will consider even non-sensical or evidently incorrect translations as possibilities. That is, the system will consider it a possibility that the sentence

'je m'appelle Matt et j'ai 25 ans' could be translated by [A] 'I am the president of the United States' rather than [B] 'my name is Matt and I'm 25'. However, the probability of [B] generated by the system will be much higher than the probability of [A], which is likely to be much closer to zero and the system can be optimised to not generate translations which are not probabilistically plausible.

The equation given below is the fundamental equation in SMT:

$Translation = argmax_T P(S|T) \cdot P(T)$

So, the most probable translation is the probability (*P(S|T))* 'that the source sentence *S* and the candidate translation *T* are translationally equivalent, i.e., that the meaning expressed in *S* is also captured in *T*' (Poibeau 2017: 153) (the translation model, obtained from the bilingual corpus) multiplied by the probability (*P(T))* 'that the candidate translation *T* is actually a valid sentence in the target language' (ibid.: 207) (the language model, obtained from the monolingual corpus).

B – Decoding

The decoding phase, which produces the TT, 'essentially treats translation as a search problem' (ibid.: 205) and is the phase that end-users actually interact with when requesting a translation from an SMT system. After the system has been trained, it can be asked to provide a translation for a previously never-before-seen ST by 'simply matching substrings from the input sentence against the translation model and, where available, retrieving their translations' (ibid.: 221).

Originally, SMT systems operated at the word level – they translated word-for-

word, based on which word in the TL was the most probable word for the SL word. However, over time, systems were improved and Phrase-based (Statistical) Machine Translation (PBMT or PBSMT) was developed. Phrase here does not refer to a phrase in the linguistic sense, but rather the common sense of the word meaning any group of words as they can often 'correspond to frequent but fragmentary groups of words (for example, "*table of*" or *"table based on"*)' (Poibeau 2017: 153).

2.2.2.4 Neural Machine Translation (NMT, 2010s)

NMT is the newest type of MT, emerging in the mid-2010s, with 'the deployment of the first online systems based on this approach' in 2016 (Poibeau 2017: 194). Many large providers of online MT, such as Google and Microsoft, have now adopted NMT over SMT for many of the languages for which they offer translations. However, the new name and excitement over NMT do, specifically to a non-specialist in the field, blur the fact that it does not represent a completely new architecture or system structure, as the change from rule-based systems to EBMT or SMT did. NMT is still a corpus-based approach as the systems are trained on large bilingual corpora, just as SMT and EBMT systems are. NMT also still treats translation as a probability problem, but the way in which an NMT system calculates the probability of a translation is different to SMT systems.

NMT uses neural networks, which, 'like the brain, are supposed to be able to build complex concepts from different pieces of information assembled in a hierarchical manner' (ibid.: 181) and are able to learn and improve over time from large datasets in order to perform the task required of them. These neural networks are artificial and often come in the form of a Graphics Processing Unit

(GPU), but operate in a manner similar to the body's nervous system, hence the name. They 'are composed of thousands of artificial units that resemble neurons in that their output or activation […] depends on the stimuli they receive from other neurons and the strength of the connections along which these stimuli are passed' (Forcada 2017: 292). In addition to MT, neural networks are used in a variety of fields such as image recognition, speech recognition and text-to-speech production, many of which are closely related to or integrated with MT, as services such as Google Translate are able to use Optical Character Recognition to translate images and text-to-speech technologies to 'speak' the translations.

Just as EBMT aimed to bring MT closer to the manner in which humans translate, it could be argued that NMT is doing the same. To illustrate this, Microsoft provide a useful example in a post on their Microsoft Translator Blog (2017a):

> One way to think about neural network-based translation could be to think of a fluent speaker in another language that would see a word, say "dog". This would create the image of a dog in his or her brain, then this image would be associated to, for instance "le chien" in French. The neural network would intrinsically know that the word "chien" is masculine in French ("le" not "la"). But, if the sentence were to be "the dog just gave birth to six puppies", it would picture the same dog with puppies nursing and would then automatically use "la chienne" (female form of "le chien") when translating the sentence.

This description is remarkably similar to the way in which humans might think or translate a concept. That is, we have an idea in our mind and associate words in different languages to that idea. However, while for humans the concept is an abstract idea or thought, for NMT systems it is a mathematical representation, a vector, to which the system can relate words. Forcada (2017: 295) provides an excellent description of how exactly vectors can be used to encode information:

> Imagine a rectangular room perfectly aligned with the compass points. Any point inside the room could be located from the southwest corner of the room ("the origin") using three numbers: how many centimeters far north, how many centimeters far east, and how many centimeters high above the floor. For instance, the position of the light bulb of the lamp on the nightstand could be represented with a three-dimensional vector, for example "(70, 150, 87)". Now imagine that, like the bulb, concepts (words, sentences) could be placed in the space inside that room: two similar concepts would ideally be close to each other and therefore have similar coordinates; very different concepts would be far apart from each other and therefore have different coordinates. Three dimensions are not enough for the richness observed in language: encodings of words and representations of sentences need many more dimensions to accommodate them and their mutual relationships, usually hundreds of them.

Just as with SMT systems, an NMT system must first be developed and trained from aligned bilingual corpora before a user can ask it to produce a translation. NMT systems are usually more expensive than SMT systems as they require

greater processing power, thus requiring better hardware and increased power consumption, and the time required to train the system can vary from days to months (Forcada 2017: 295). NMT systems employ an encoder which creates a vector representation of every word in the ST and a decoder which can use this vector representation to produce a translation in the TT.

In the encoding phase, the neural network in an NMT system will use the source sentence to produce a vector representation of each word in the sentence and combines these vectors to produce a vector representation for the whole sentence. The vectors can also be configured to provide information about the word within the context of the other words in the sentence, as Microsoft describes for their system.[37] This is possible because of recurrence within neural networks where:

> neurons also have connections to neurons in the same layer (including themselves) […] Each synapse causes a certain delay so the neuron activations through the recurrent connections act as a *short-term memory* for contextual information and let the network remember the past (Alpaydin 2017: 92)

This concept is visualized below in **Figure 2.14** which has been produced based on the written example Alpaydin (2017: 93) provides.

[37] Microsoft provides this description in their pages about machine translation. Available here: https://www.microsoft.com/en-us/translator/mt.aspx [accessed 8 January 2018].

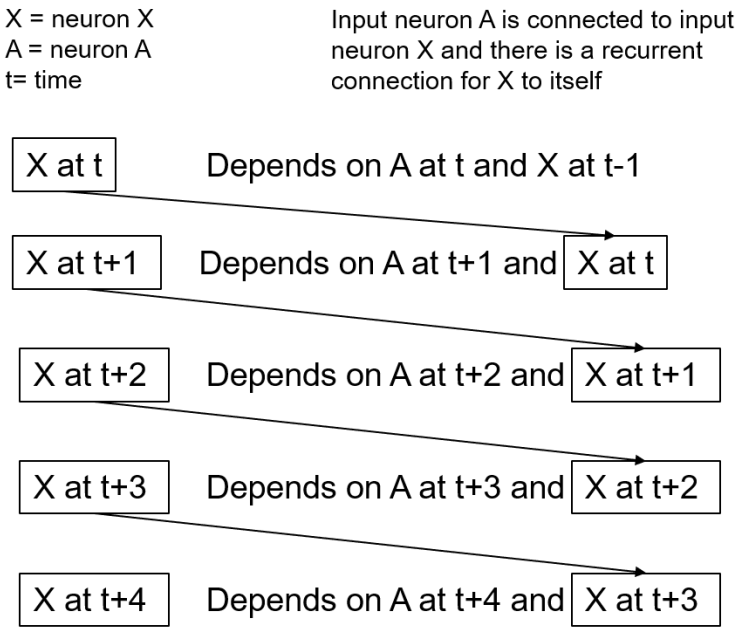


Figure 2.14 A visual example of how neural networks can take into account whole sentences. Adapted from Alpaydin (2017: 93)

This approach 'allows the previous words in the sentence to be kept in this short-term memory in a condensed and abstract form and hence taken into account while processing the current word' (ibid.). In other words, it allows NMT systems to translate at a sentence level, rather than at a word or phrase level as SMT systems do.[38] During the decoding phase, the system takes the vectors which represent the source sentence and produces a new vector, which represents the source sentence and a blank target sentence and one other vector, the 'vector of probabilities for all possible words *x* in the first position of the target sentence' Forcada (2017: 298), then selecting the most probable word. This is then repeated for each word in the sentence until the whole sentence has been translated, e.g., the next vector created will be for the

[38] There are, however, systems which do not take into account the whole sentence.

probabilities of all possible words in the second position of the sentence, given the source sentence and the first word vector previously calculated.

2.3 MT Quality Evaluation

Quality is a challenging and complex issue across society, due to its inherently subjective nature and that everybody differs in what they like and dislike, and it can become an even thornier issue in more creative fields and areas. To illustrate this, a recent example from popular culture is useful. The much-anticipated release of Star Wars: Episode VIII – The Last Jedi was met with two contrasting sets of reactions and reviews. It was well-received by critics, with overwhelmingly positive reviews, whilst audience reviews and reactions were not so positive.[39] Two groups of people have, in this instance, judged the work to be wildly different in quality and this simple anecdote highlights the complex and differing nature of quality to different groups of people. Turning to translation, quality is also a complex matter in this area and differs depending on perspective – quality differs for TS, the translation industry and MT. Academic models for quality have been suggested, most famously the model developed by Juliane House in 1977 (and subsequently revisited in 1997 and 2015), but these models are not applied or even mentioned by the translation industry (Drugan 2013). It comes as no surprise, then, that quality is a central issue within the field of MT and that there have been different ways of measuring quality.

[39] The furore around the movie largely comes from the fact that it received a positive rating from 92% of critics, but only 49% from the general audience on the movie-rating website Rotten Tomatoes (ratings available from https://www.rottentomatoes.com/m/star_wars_the_last_jedi/ [accessed 16 January 2018]).

As Hutchins (2010: 14) notes, ‘initially, most measures of MT quality were performed by human assessments of such factors as comprehensibility, intelligibility, fluency, accuracy and appropriateness.’ A variety of different approaches involving humans performing the evaluation were taken.[40]

- Comprehension evaluation: human analysts were asked multiple choice questions about texts produced by MT systems. The number of questions answered correctly determined the quality of the output.
- Evaluation panel: Translation experts were called together to evaluate the output of MT systems, in the same way they would evaluate translations produced by humans. They were originally asked to consider the ‘lexical, grammatical, semantic, and stylistic aspects of the translated texts’ (Poibeau 2017: 201), but this proved difficult given the different weight of importance that different experts attached to different types of errors.
- Adequacy and fluency: Subsequently, in order to reduce the differences in scores attributed and the logistics of organising an evaluation panel, only two aspects, adequacy and fluency, were criteria to be considered. The evaluators in this case were no longer translation experts, but literate, monolingual English speakers. Adequacy was calculated by the evaluators ‘determining the degree to which the information in a professional translation can be found in an MT (or control) output of the same text’ (White and others 1994: 196). For fluency, ‘the same evaluators are asked to determine, on a sentence-by-sentence basis, whether the translation reads like good English (without reference to the "correct" translation, and thus without knowing the accuracy of the content)’ (ibid.). However, the scores assigned by the evaluators still varied significantly.

[40] This is a short synthesis of the different approaches explored in more detail in Poibeau (2017:199-204) based on White and other’s 1994 paper ‘The ARPA MT Evaluation Methodologies: Evolution, Lessons, and Future Approaches’.

- Human-assisted translation: This approach sought to evaluate how effectively automatic systems were able to help a human translator translate a text. Texts produced exclusively by MT, by human-assisted MT (novice translators were used) and manually were compared in order to demonstrate how this type of translation was faster and the speed would arguably increase over time as the systems improved. The main problems with this approach were that it was difficult to control for the novice status of the translators and analyse how exactly the tools contributed to producing better translations.

However, these approaches were costly, time-consuming, difficult to organise and unfeasible given the large volume of MT output which needed evaluating. Combined with the statistical methods which emerged in the 1990s, researchers began to develop the automatic evaluation methods, also based on statistical analysis, which are now commonly used to evaluate MT output.

2.3.1 Automatic Metrics

There are several different automated systems for evaluating MT quality which have been developed over the years. Their benefits, compared to the earlier approaches based on human evaluation described above, are their lower cost, scalability, repeatability and objectivity. The most common of these automated systems is the Bilingual Evaluation Understudy (BLEU)[41] metric (Hearne and Way 2011: 219), proposed by Papineni and others in 2002. BLEU essentially compares a translation produced by MT with a reference translation, produced by a human and it is also possible to compare the output with several reference

[41] This metric was first proposed by Papineni and others at the 40th Annual Meeting of the Association for Computational Linguistics, available here: https://aclanthology.org/P02-1040 [accessed 9 February 2002].

translations. It does this by breaking the two texts down into n-grams[42] of varying length, 1 to *n*, with four being the number generally used to obtain the best results (Poibeau 2017: 205). The metric also includes a brevity penalty 'to prevent the output of single-word utterances like 'the', which would otherwise score highly' (Hearne and Way 2011: 220). The BLEU score is based on a scale of 0 to 1, with a score of 0 being obtained for a translation in which 0 n-grams are present in the reference and a score of one being obtained for a translation in which all n-grams are present in the reference. In short, the more n-gram matches there are, the closer the score is to 1, the closer the MT output is to the reference translation and, consequently, the better the theoretical quality of the MT output.

The NIST metric, named after the National Institute of Standards and Technology which developed it, is very similar to BLEU. However, this metric applies different weights to n-grams such that 'the rarer a segment is, the higher its weight becomes' (Poibeau 2017: 206). Another metric is Metric for Evaluation of Translation with Explicit Ordering (METEOR) which is designed 'to better account for semantics' (ibid.) and in the original authors' own words 'to explicitly address the weaknesses in BLEU' (Banerjee and Lavie 2005: 67). It works by identifying words which are present in both the MT text and the reference text and from this then identifies longer sequences which are shared between the two, a score can then be computed and, as with BLEU, the closer the score to 1, the more segments matching. This method can also incorporate

[42] An n-gram is a term used in Natural Language Processing to refer to a sequence of words (these can be of varying length, e.g., a 2-gram is a bigram and a 3-gram a trigram).

‘semantic resources (such as Wordnet)’ (Poibeau 2017: 207) to allow, for example, synonyms to be used. This system is said to produce scores which are closer to human evaluations (Banerjee and Lavie 2005: 69), but its adaptability (incorporating semantic resources) is also a limitation as it limits the scalability and repeatability of the evaluation.

2.3.2 Human-based evaluation

Whilst much work has been done on producing automatic measures for evaluating the quality of MT output, using human evaluators to assess the quality has also continued. This approach is taken, for example, at the WMT, with the exact nature of tasks varying over time. There are, essentially, two strategies for evaluating the quality of the translation using human evaluators: ST-based evaluation and reference-based evaluation. The former involves a comparison of the MT output to the ST, checking the equivalence of the two texts, thus requiring bilingual speakers. The latter involves comparing the MT output to a reference human translation, thus requiring monolingual speakers. There are, within these two broad strategies, different approaches that can be taken, such as ranking different outputs from best to worst or providing a score on a Likert scale for each output. As Fomicheva and Specia (2016: 77) note, ‘reference-based evaluation is an attractive practical solution since it does not require bilingual speakers’. In other words, given practical constraints such as budgetary concerns, time and resources, reference-based evaluation is often easier and more efficient to organise. However, the same authors also illuminate the bias that occurs when a reference translation is provided. MT outputs can receive lower scores because they differ from the reference translation provided, in spite of the fact that they may render the ST adequately,

exemplifying the fact that 'this approach has a strong conceptual flaw: the assumption that the task of translation has a single correct solution' (ibid.). Those evaluating the quality of the output often come from within the MT research community itself or can be crowdsourced via services such as Amazon Mechanical Turk.[43] In both instances, what appears absent is the presence of linguists or translators, both of which are experts in language, at this evaluation stage.

2.3.3 Some problems with MT quality evaluation

Firstly, it is important to highlight that quality evaluation is an issue in all aspects of translation – in the industry, in translator training and in language learning – as well as for MT. The quality of a translation is subjective and there is no consensus on what makes a good translation and how to evaluate the quality of a translation (Drugan 2013; House 2015; Poibeau 2017), particularly given that makes a translation good or not is extremely context sensitive. So, whilst MT evaluation metrics, such as BLEU, uphold the human reference translation as 'the perfect translation', this is not the case as a perfect translation does not exist. One immediate implication of this is that the human reference translation(s) against which the MT translations are compared may not always be of the highest quality and also contain mistakes themselves. This could be either beneficial or detrimental to the MT systems: it could produce inflated evaluation scores which overestimate the quality of the MT or deflated evaluation scores which underestimate the quality of the MT. This is accounted

[43] This is a crowdsourcing platform provided by Amazon which connects people to a distributed workforce who can carry out tasks that have been broken down into smaller micro tasks.

for somewhat by using several reference translations, but this does not always happen and the limitations of automatic MT evaluation measures have been recognised by those working within the field (Way 2012: 264; Poibeau 2017: 209).

What is evident is that context is also a key element for translation quality and, just as MT systems struggle to take into account context, so too do their evaluation metrics. For instance, unedited, raw MT output which provides a gist translation may be perfectly acceptable for certain situations, such as a company identifying calls for tender that they might want to respond to and deciding which to invest the time and resources.[44] However, in other contexts, such as with materials to be published by a company, this type of output would not be at all acceptable. To elucidate these points, it is worth returning to the earlier example, discussed in **2.1.3.1**, of Wu and other's (2016) paper and the example translations provided (shown here again for ease of reference):

Source	She was spotted three days later by a dog walker trapped in the quarry.	
PBMT	Elle a été repéré trois jours plus tard par un promeneur de chien piégé dans la carrière	6.0
GNMT	Elle a été repérée trois jours plus tard par un traîneau à chiens piégé dans la carrière	2.0
Human	Elle a été repérée trois jours plus tard par une personne qui promenait son chien coincée dans la carrière	5.0

Table 1.2 An example of translations produced by different Google MT systems, alongside their ratings given by a human rater (taken from Wu and others (2016: 23)***)***

[44] This example was given by Chris Durban, a professional high-end translator in her panel presentation at the Translation Quality Event held at University of East Anglia London. Available to view here: https://www.youtube.com/watch?v=zv3GxLTdedc&feature=youtu.be [accessed 16 January 2018].

Firstly, the authors refer to human raters, not translators, who evaluated the sentences produced by the different types of MT systems and the reason they were able to do this was the fact they were 'fluent in both languages' (Wu and others 2016: 14). However, whether they had any experience of working with translations or in the evaluation of translations is not mentioned and is called into question by the questionable ratings of sentences they provide, as previously mentioned in **2.1.3.1**. Furthermore, it also neatly highlights the issue of working with a single reference translation as this reference translation is incorrect, changing 'a dog walker' to *'une personne qui promenait son chien'* [someone walking their dog]. Although there is not a huge difference in meaning, the French translation assumes that it was someone walking their dog and that they only had one dog, information which simply cannot be ascertained from the source sentence (the person could be walking more than one dog, or could also be working as a dog walker and not be the owner of the dog). This is not something which can, in fact, be determined from the whole of the original ST.[45]

The search for the metrics needed to evaluate the quality of a translation is an ongoing one, both within TS, the translation industry and MT. In all areas there is an absence of agreed metrics or standards which can be used to evaluate translations, and the fluidity and context-sensitive nature of translation makes the development of metrics or standards difficult. It would be interesting for

[45] The source sentence comes from a Daily Mail article entitled 'Fire crews called to rescue lost puppy after she got stuck 50ft above the ground on precarious ledge in a quarry' (available here: http://www.dailymail.co.uk/news/article-2482311/Fire-crews-called-rescue-lost-puppy-got-stuck-50ft-ground-precarious-ledge-quarry.html [accessed 16 January 2018]).

scholars and researchers from these areas to work together improving the quality metrics available – perhaps an automatic evaluation system could be produced that could then be applied in TS and the translation industry, prior to or combined with human evaluation. If MT is designed to augment the human translation process, to facilitate the work done by translators, then MT evaluation tools could fulfil the same remit for quality evaluation purposes.

The aim of MT is not, currently, to replace human translators and their work, and likely never will be. In fact, replacing human translators would be detrimental to current state-of-the-art MT systems, as they are trained on data created by human translators. As languages are not static and constantly evolve, replacing translators would, over time, lead to systems trained on data not representative of contemporary language use which would produce poor quality and outdated translations. The quality of MT does, then, depend on human translation and exploring better ways of evaluating quality in both human and machine translation could be beneficial for both.

2.4 Translation Studies and Machine Translation

As discussed in **1.1 The relationship between translation and technology**, translation and technology have always had a closely intertwined relationship and that relationship has continued to grow in recent years. However, despite this growth, there is still space for closer study of MT within the field of TS. Indeed, Pym (2012: 13) recognises that there are essentially three groups within research into MT:

A. The people developing technologies in private companies
B. The engineers, linguists, mathematicians and computer scientists who do research within university environments, with some crossovers and joint projects with industry
C. University researchers within the humanities, with backgrounds in linguistics, communication studies, or translation

He also highlights the fact that 'there has been even less concern with addressing the third research community, the "soft" linguist and trainers, who have themselves abandoned any hope of understanding what is happening in the MT systems' (Quah 2006: 61). This abandoning seems to stem from a phenomenon that has existed for a long time in this context, at least since the beginning of MT research, as noted by (Bassnett 2016: 110) when she states that 'it was arguably a grave error when, in their enthusiasm to build the perfect system, machine translation researchers failed to seek the views of translators.' In other words, they did not consider the opinions and views of expert translators (who would also become a large user group of MT) or TS scholars. Traditionally, then, translators and TS scholars have not been very involved in the development and creation of MT – this has been the domain of computer scientists, engineers and mathematicians. Nevertheless, end-user perspectives and what effects these apps are having on translation, translators and TS – the more humanistic side of this technology - is something which needs further research (O'Brien 2012; Pym 2012) and represents an area in which TS and translators can actively engage, particularly under the umbrella of the technological turn.

An underlying assumption with MT is ‘that it’s possible to separate the informational content of a sentence from its style’ (Lewis-Kraus 2015). The fact that this is a problem should come as no surprise, given that separating meaning or content from style is commonplace in computing and particularly with translation and computing. On the web, for instance, the content of a page may be held in an XML document and the style of the webpage is determined by its HTML or CSS. Similarly, when localization of software first began in the 1980s and 1990s, ‘the translatable text was embedded in the software source code’ (Dunne 2014: 149), which created problems as a different copy of the source code had to be kept for each locale for which it was to be localized. It was in the early 1990s when it was realized that ‘certain steps could be performed in advance to make localization easier: separating translatable text strings from the executable code, for example. This was referred to as *internationalization* or *localization-enablement*’ (Cadieux and Esselink 2002). This enabled the separation of the translatable content from the source code – the style is held separately from the content. Separation of elements is, then, common practice in the world of computing. Therefore, it is easy to understand why the same principles are applied to translation by MT developers, even though separation of style and content is a position to which translators and linguists do not generally subscribe, thus exemplifying this disconnect and distance between the groups described by Pym (2012). Generally, translators are taught to read the whole text first and consider textual cohesion and meaning. Perhaps this discord between perspectives is part of the reason that technology is underrepresented within TS and that TS scholars and translators have been absent from MT research.

Other TS scholars, such as Bassnett (2016: 110), have highlighted the need to avoid a fracturing of the discipline of Translation Studies, of a split emerging 'with research into translation, literature and culture being viewed as entirely separate from research into translation and technology' (ibid.). So, whilst it is important that TS scholars work together to study issues currently facing translation and do not see themselves in separate disciplines because they focus on technology, for example, they also need to work with researchers from other disciplines to fully understand the ways in which technology and translation are interacting. TS emerged as an interdiscipline, so should be accustomed to working with other fields. MT is now a well-established technology accessible to billions of people: it represents an innovative area in which TS scholars can engage to understand one way in which technology is changing translation. If TS is to fulfil its remit, it must engage with MT and study the ways in which translators and society are engaging with this new form of translation. Indeed, as part of a more sociological approach to TS, as O'Brien and Saldanha (2014: 150) discuss, one which seeks to explore and explain the role of translators and translation in society, research into 'users' of translations and MT would also be necessary.

2.5 The driving forces: mobility, speed, immediacy and efficiency

Before examining the emergence of mobile devices and, more specifically, of MT on a mobile device, it is worth first considering the underpinning concepts and driving forces that have led to their emergence. As such, this section will attempt to define and discuss the ideas of mobility, speed (but also acceleration), immediacy and efficiency as the principal driving forces behind

the majority of technological development and the development of MT on a mobile device and MTAs.

2.5.1 What is mobility?

Mobility has many forms and definitions, which are not static over time, evolving with newer instances arising with new developments in human society and technologies. As a starting point, The Oxford English Dictionary (2021b) defines mobility as 'the ability to move or to be moved; capacity for movement or change of place; movableness, portability'. This definition does not restrict mobility to movement in a physical sense and it is, thus, possible to consider various types of mobility or movement, such as those proposed below:

Spatial mobility refers to changing geographical location in the physical world, i.e., moving from point A to point B. Humanity has always been on the move, dating back to our nomadic nature as a species. In recent times our ability to move and travel has increased thanks to technological developments enabling more of us to traverse longer distances in shorter times (see Urry 2007, 2010 for further discussion of the increasing movement of humanity).

Temporal mobility refers to moving knowledge and data through time, i.e., through the creation, collation and storage of this knowledge and data. In this context, this is achieved through humans producing artefacts that enable knowledge to be passed on through time, expanding the limits of human possibilities. The development of physical records, largely through the technology of writing, and more recently the evolution of this to allow the digital storage of information and data, greatly facilitated the temporal movement of knowledge.

Virtual mobility is movement achieved without actually moving in the physical world, i.e., movement in a more metaphorical or digital sense, where a person's physical body does not need to necessarily move. It is now realised primarily thanks to and through digital communications technologies that enable people to engage and communicate with other people all around the world, from almost any place and at almost any time, in a way that transcends space and time. Equally, it could be argued that virtual mobility is not a new phenomenon, since it has long been possible for people's ideas or words to be mobile through the artefacts they have created being mobile around the world. However, what virtual mobility refers to here is the newer phenomenon of the actual person being able to 'travel' via the internet. That is, being able to see and hear new places, to communicate with people via live video, to explore the world through the medium of a screen[46] and the internet. Cronin (2017a: 94) suggests that 'in the late twentieth and twenty-first centuries, the emergent modes [of circulation] are predominantly virtual', indicating that the importance of this form of mobility has grown in the modern era. Furthermore, in light of the recent Covid-19 pandemic, virtual mobility has seen a massive expansion, with many more people forced by the pandemic to rely on digital technologies to enable them to interact, communicate, work and even travel in the form of virtual reality tourism.[47]

[46] Although even the medium of the screen is becoming blurred, with current developments in VR and AR blurring the boundaries between the physical and virtual worlds, such as with road sign translation using a mobile device's camera.
[47] The pandemic saw an increased focus on the possibility of virtual travel or tourism through VR and AR technologies, with many countries and companies exploring this option when spatial mobility was no longer an option (Debusmann Jr 2020). This is not a new phenomenon, with museums and other cultural institutions having explored this possibility for a while, but the scale of it has grown recently. Furthermore, as VR and AR technologies improve, and with a growing emphasis on individuals becoming more conscious of their carbon footprints, climate change may be a further impetus that drives this virtual mobility.

Linguistic mobility refers to movement between or within languages, i.e., translation. It is often a product of and precondition for the other types of mobility discussed, as Cronin (2017a: 95) highlights when he states that:

> ‘There is no connectivity, however, without connection. The digital may deliver information to the other side of the planet in seconds but if the language is different, the virtual letters are dead letters. In a multilingual world, translation is the necessary companion for the global outreach of the virtual.’

Nevertheless, linguistic mobility is also dependent on other types of mobility in that if people were not physically or virtually mobile, i.e., interacting with other people, there would be no need for linguistic mobility.

In short, these mobilities are heavily interlinked and co-dependent on one another, in that they cannot exist without each other – if there were spatial mobility but no linguistic mobility, then the spatial mobility could be rendered pointless as information would be unintelligible to others, communication would not be possible, and people could not interact. It is clear from these interpretations of mobility that it is a concept which can be applied throughout history and in the modern era as an explanatory driving force behind many developments. However, whilst all forms of mobility coexist, the relative importance and prevalence of each is not fixed. Over time, the importance of these mobilities to human society may vary and the nature of these mobilities may themselves change. In nomadic times, spatial mobility was, clearly, the most important and dominant form as groups of humans moved around together. Indeed, spatial mobility itself is not a static concept, with most humans over time abandoning a nomadic life and settling into villages, towns and cities.

Therefore, whilst spatial mobility may have previously been interpreted as the physical movement of people, it has increasingly been about reducing the time it takes to traverse a particular distance, through technological developments such as railways and cars.

Nowadays, whilst spatial mobility still plays an important role and there are more people making more journeys than ever before (Elliott and Urry 2010: ix), newer forms of mobility, principally virtual mobility, are becoming increasingly present, important and prevalent in our lives, increasingly facilitated by mobile technologies, such as smartphones or tablets. Indeed, the technology which so often facilitates mobility is often itself mobile and a precursor for facilitating human mobility. As Cronin (2017a: 95) states, 'information, connectedness, globality, these would, indeed, seem to be part of a re-orientation of knowledge and the economy towards the mobile, the supra-national, the immaterial.' In the modern era, then, it is virtual mobility which is playing an increasingly important role and is increasingly the driving force behind many technological developments.

Considering these definitions of mobility, human society has been undergoing large changes over recent years, principally enabled by technological developments and a drive to be increasingly mobile through greater virtual mobility. Indeed, it is possible to interpret many technological developments as emerging from a desire to increase mobility – the printing press, (re)invented by Johannes Gutenberg in the 15th century, greatly increased the circulation and mobility of books and other printed texts. Nowadays, people increasingly expect to be able to do more whilst on the move or regardless of geographical location using digital, mobile devices, giving rise to the idea of portable or

mobile offices (Elliott and Urry 2010: 33). With an internet connection, a smartphone user can check their bank account wherever they are in the world in one instant and then in the next upload a photo at a monument to instantly share a photo of a trip abroad with friends and family through social media and messaging platforms. It is no longer necessary, for example, for travellers to wait until they get back from a trip away to remain in contact with friends, family and colleagues or to share their experiences – thanks to digital technologies it is possible to stay in contact and follow a trip in real time if one so chooses.

2.5.2 Translation, mobility and technology

When considering the link between translation and mobility, it is obvious that linguistic mobility is essential for translation in that there is no translation without linguistic movement of some kind. All three types of translation identified by Roman Jakobson (1959) – interlingual, intralingual and intersemiotic – involve a form of linguistic mobility, whether that be from one language to another or from one form of a certain language to another form of that language or from a verbal sign to a non-verbal sign. Mobility and translation are inherently linked – linguistic mobility underpins translation as it involves changing language from one form to another in order to render a text accessible to someone who would not understand the SL, i.e., moving the text closer to that person. This movement is in a metaphorical sense, as discussed by Schleiermacher when he states that ‘either the translator leaves the author in peace, as much as possible, and moves the reader toward him. Or he leaves the reader in peace, as much as possible, and moves the author toward him’ (Lefevere 1992: 149). Indeed, it is worth noting that metaphors and descriptions of movement are often used when discussing translation, probably as the difference between the

SL and TL is often perceived of as distance. Indeed, languages are often thought of in terms of how far apart they are from one another and this is most likely a result of spatial mobility, i.e., of languages, or those who use them, being separated by distance in the physical world. However, translation is also necessary to facilitate other types of mobility. Although there can be spatial mobility without translation, translation can facilitate spatial mobility. The simple example of a tourist moving through a foreign city illustrates this succinctly - having signs and materials (e.g., maps or tourist leaflets) available in more than one language, i.e., having translations available, certainly facilitates the tourist's spatial movement around the foreign city. Indeed, temporal mobility is only possible with translation as languages and cultures evolve over time. It is not always possible for modern speakers of languages to read a text from hundreds of years ago without the aid of extensive footnotes or a translation, thus interlingual and intralingual translation both play important roles in the memorialisation of texts (Brownlie 2013: 49) and the movement of these texts through time. It is, then, evident that these mobilities are not isolated concepts, but that they are interwoven and affect one another, with translation playing an important role for all of them.

2.5.3 Mobility and speed

Coupled with the driving force of mobility, is, then, the driving force of speed. The two driving forces have a symbiotic relationship in that increased speed often leads to increased mobility and vice versa. Moreover, rather than simply speed, which can be fast or slow, it is more specifically the idea of increased speed, or acceleration, that has been a driving force behind technological developments. Speed both enables and complements the mobilities discussed.

The sociologist John Tomlinson discusses the idea that the notion of speed has become increasingly important in modernity and is giving rise to the even faster concept of immediacy. There is increasingly an expectation of immediacy in everything that people do, as Tomlinson (2007: 1) underlines when he states that 'acceleration rather than deceleration has been the constant leitmotiv of cultural modernity'. Indeed, Wiseman (2007: 270) concluded that the pace of living is increasing after conducting an experiment to monitor the speed at which people walked in various cities around the globe. Rosa (2013, 2019) also highlights the fact that the pace of the world, of modern life, is accelerating thanks, in large part, to technological developments. More anecdotally, there is also evidence of this focus on speed and immediacy with the rise of next-day and same-day delivery services, the emergence of streaming services for music and video content, allowing users to instantaneously watch TV shows or movies or listen to any song. This all attests to the centrality of immediacy in the modern world – humanity is constantly striving for acceleration, to reduce the time spent waiting for things to happen and to be able to do more in a shorter time.

The ideas of speed and immediacy also have great implications for translation. Human translation is neither an immediate process, as it takes time for a human to produce a translation, nor particularly mobile, in the sense that most translators work at a stationary workstation.[48] Having said that, it has been possible to increase the speed and efficiency of human translation through technological tools available, such as TMs and TBs, as well as non-specialised

[48] That said, there has been at least one study been a study (O'Brien and others 2014; Moorkens and others 2016) exploring the possibility of post-editing, just one part of the translation process, through an app.

tools such as spellcheckers. Furthermore, the speed of delivery of translations produced by humans has also increased thanks to the communicative power of the internet. Nevertheless, although tools and technology can facilitate and accelerate the human translation process, it is still labour intensive and cannot be made any faster than the person can work. As such, the emergence and evolution of MT can be explained in one way as the expression and delivery of the desire to increase the speed and mobility of translations. In addition, an analysis from this perspective may explain the development of MT on a mobile device in that it increases access to MT, the speed at which users can access and use MT and increases the mobility of MT, allowing users to use it in various situations in which they encounter other languages. Indeed, MT is another example which adds credence to the idea of immediacy as it essentially provides translations instantly to users, or at least at a speed that appears instant from a human perspective. Technology can, then, function and carry out tasks at speeds which essentially render them instantaneous for humans.

Closely intertwined with the ideas of speed and immediacy is the idea of efficiency, which can be defined as striving for maximum productivity, in the shortest time possible, to achieve an outcome of the same effect, standard or quality. Clearly, in order to achieve the shortest time possible, an increase in speed is needed, so acceleration is a prerequisite for increased efficiency. Efficiency, then, also implies a maintenance of or improvement in quality that is not necessarily inherent in the idea of speed. In other words, humans want to be able to do more, to do it more easily and more quickly and to the same or an improved standard, thus they constantly seek increased efficiency. It also needs to be mentioned that in a capitalist world increased efficiency will likely

lead to increased profit, so it is in the interest of capitalism to pursue speed and efficiency. That is, the faster and more easily something can be done to the same standard, the better, largely because of the cost and time saving gained from such an approach.

2.5.4 Beyond mobility and speed

Whilst both mobility and speed have played extremely important roles in the development of society and technology, they are now developing into new iterations more suited for the modern world and enabled by technological enhancements. For example, it is possible that speed is being superseded by immediacy and mobility is being superseded by ubiquitous connectivity, both of which enable the idea of doing anything from anywhere through technology. Indeed, this trend towards ubiquitous connectivity and increasing mobility has accelerated over recent years and 'the diskette which can be slipped into a coat pocket' (Cronin 2003: 123) is now an outdated piece of technology, which is unrecognisable to young people today (Smith 2018). Indeed, these physical technologies are increasingly being replaced by devices which use cloud technologies to store and access information and perform functions and this can be done from anywhere in the world provided the device has an internet connection. So, with cloud-based devices, it is no longer necessary for technology to be physically mobile or for a person to have physical access to specific technologies, rather we are moving towards a state of ubiquitous connectivity, where the mobility is virtual through the internet. It is no longer always necessary to have physical access to purchases, content or exosomatic memories, rather they are stored on servers thousands of miles away and accessed virtually through a (mobile) device with an internet connection.

Indeed, Urry (2002: 268) suggested that 'the distinction between online and offline may gradually dissolve' and if this distinction is not already completely gone, it is progressing at a rapid rate. Few people remain unconnected to the internet – in the UK, for example, as of 2018, 92% of adults were internet users (Prescott 2021) and this is principally due to the increased availability of the internet, its integration with mobile technologies and rapid improvements in the speed of internet connections over the last 20 years. Furthermore, in addition to the actual number of devices connected to the internet constantly increasing (Statista 2019a), it is increasingly possible to connect different types of devices to the internet thanks to the growth of the internet of things – phones, watches, TVs, fridges – to name but a few devices. These devices are constantly generating data and interacting with other devices thanks to the internet and enabling new social practices and activities such as taking a phone call on a smartwatch or asking the TV to play a favourite programme. The internet is no longer a place somebody goes to, rather it is simply there, permeating many aspects of people's lives and increasingly used to provide services and access information. In other words, mobility is not towards the internet, rather that the internet is the field that enables mobility and the world is moving towards a state of being constantly online and connected, a state of hyper virtual mobility, enabled by ubiquitous connectivity. All of this is enabled by the ability to communicate and act through the internet, and connectivity, the ability of devices to form a connection and interact with each other via the internet.

2.5.5 The importance of infrastructure

Intertwined with all of the ideas of mobility, immediacy and ubiquitous connectivity is the idea of infrastructure. Spatial mobility relies on the

infrastructure of the physical world, whether natural or human-made. Temporal mobility relies on having infrastructures and systems in place to enable record keeping and safe passage through time, i.e., that items are not destroyed by either natural disasters or by human actions. Virtual mobility relies on the infrastructure provided by the internet and telecommunications systems that facilitate contact and communication between people in different geographical places. Linguistic mobility relies on the infrastructure of language, in having shared languages between people in order to communicate and infrastructures and systems in place to enable people to learn other languages. Whilst infrastructures may at first only be basic, e.g., a road or path between point A and point B in order to facilitate travel, over time humans have established and developed complicated, intertwined infrastructures without which it would not be possible to live in the way we do or produce the technologies we do. The scale and complexity of these infrastructures is constantly increasing and they are increasingly becoming interdependent on one another.

This dependence on infrastructure and systems can also be described as entailment. Just as 'the car can exist *only* within a modern globalized industrial system' (Taylor 2010: 51), MT on a mobile device can only exist in a modern, globalized, digitally connected and mobile world. This entailment is often implicit rather than explicit (Cronin 2013: 12), unless one takes the time to reflect on it. MT on a mobile device is, like many modern technologies, highly entailed technology – there would be no MT on a mobile device without smartphones, which themselves could not exist without various other hardware components and telephone networks enabling people to make phone calls or the internet or infrastructure to provide the translations which are not actually done in the app

or on the device itself (and all of these rely on other industries and technologies such as mining, manufacturing and transport). It is through this combination, or entailment, of technologies that MT has been democratised to large numbers of users around the world.

This combination, so inherent in many modern technologies and tools, may, however, exist in a rather fragile state, particularly as our reliance and dependence on certain technologies becomes greater over time as they are integrated into an ever-increasing number of aspects of human life and society. For example, as cloud-computing becomes increasingly popular, dependence on the internet is growing as it is relied upon to provide access to services, information and products that people may have physically possessed in the past. Should access to the internet be lost, even temporarily, our ability to work, listen to music or watch movies may become comprised at best or completely lost at worst and the loss of even one company's services can cause chaos and make headline news.[49] Similarly, access to the internet may not always be there, depending on the geopolitical and military situation in the world, as has been seen with disruptions to the internet in Ukraine in light of the Russian invasion (Pearson and Satter 2022).

2.6 Technology as an expression of mobility

As has been discussed, the concepts of mobility, immediacy and efficiency have acted as driving forces behind many changes and developments in human society. This section focusses specifically on technological developments and

[49] For example, the fact that Facebook, Whatsapp and Instagram all suffered an outage at the same time in October 2021 made headline news, with the outage leaving people who relied on those platforms to communicate unable to do so and businesses that rely on the platforms also suffered problems and losses (Milmo and Anguiano 2021).

explores them as emerging from a desire for increased mobility, speed, immediacy and efficiency.

2.6.1 Why do we use technology? Technology as an enabler

Urry (2007: 119) writes that 'cars extend where people can go to and hence what they are literally able to do', but the same can be said of almost all human technologies and tools. Translation, itself predicated on the technology of writing, extends what humans are able to do in extending the knowledge and people with which we are able to interact. Humans develop tools to allow us to overcome physical challenges or carry out activities that would otherwise be impossible for the human body or that make activities easier or quicker (i.e., more efficient) for humans. Even a tool as simple as a knife allows us to cut things in ways which would be impossible with only our bare hands or in hunter-gatherer times a spear allowed humans to catch prey that would otherwise easily have escaped us. Given this analysis of technology, it is not the fact that cars 'extend where people can go to and hence what they are literally able to do' (ibid.) that is revolutionary, but the spread, ubiquity and accessibility of the technology. This revolutionary nature is further enhanced by the fact that 'very few people cannot learn to drive provided they have sight' (Dant 2004: 73) and the relative novelty of cars in human history.

Indeed, new technologies are more visible and noticeable when they are first developed and adopted by people, primarily due to the fact that they are new, novel, innovative and often represent a change. That is, they alter the status quo and change our relationship with the world and the way we interact with one another. However, as the newness and novelty of this technology fades, i.e., as the technology becomes increasingly commonplace and prevalent in

our lives over time, it becomes increasingly less visible and 'the embedding of the technology in the matrix of our lives makes it invisible. In fact, the greater its integration into daily practices, the less it is seen as a technology at all' (Bruce and Hogan 1998: 297). Rather than seeing something as a technology, it simply becomes accepted as part of the world and society and something of which is implicitly understood and accepted. They (ibid.) also provide the examples of writing, floors and stairs, technologies that are so fundamental to and integrated in our lives that the fact they are a technology is invisible to us. This can also be expressed through the idea of seamlessness, in that as technologies improve and humans become accustomed to them, the experience of using them should become so seamless that the technology is invisible.

Relating this to mobile technology, the earliest mobile phones extended our communication abilities, as users were able to call people whilst outside of a building with a landline connection and 'mobile telephony […] is emblematic of wireless technology, international roaming, spatial fluidity' (Elliott and Urry 2010: 30). Mobile phones capable of sending text messages then further increased our ability to communicate on the move and changed human behaviour, as demonstrated by the rise of text speak. Although text speak perhaps did not originate on mobile phones,[50] it is mobile phones that have democratised its use and increased the number of users through their ubiquity. It could be argued that the latest iterations of mobile phones – smartphones –

[50] Modern text speak may date back to the abbreviations used by telegraph operators, as described in this 1890 article in the New York Times: https://timesmachine.nytimes.com/timesmachine/1890/11/30/103283189.pdf [accessed 15 August 2018].

have had an even greater revolutionary effect through their ability to connect users to another revolutionary phenomenon, the internet. Indeed, fluidity and mobility have contributed to the erosion of 'the dichotomies of professional/private, work/home, external/internal and presence/absence' (Elliott and Urry 2010: 28), redefining our understanding of these concepts and the way we live our lives in the modern world. This erosion has been further accelerated by the Covid-19 pandemic, when the separation of work/home and professional/private was suddenly eradicated for a large number of people due to the lockdowns required around the world to deal with the pandemic.

Technology is, then, enabling for humans, allowing us to achieve more in a faster, more efficient way. However, it is worth nothing that the enabling nature of technology is not the same for everyone and can vary over time and space and technology that is enabling for one person may be alienating for another. That is, the accessibility of technology is not the same for everyone who uses it and will depend on the user's skills at using the technology and awareness of the technology. To provide a simple example, a supermarket self-service checkout may be enabling (i.e., highly accessible) for a 25-year-old, non-disabled individual, but highly disabling (i.e., highly inaccessible) for a 75-year old wheelchair user who cannot reach the screen and does not know how to use the machine (or have the digital skills or willingness to learn how to use it) and is unfamiliar with the technology. Furthermore, Krakauer (2016) introduces the idea of complementary and competitive cognitive artefacts. Complementary cognitive artefacts are artefacts or technologies which augment human cognitive abilities both when they are available to a person and also when they are not, e.g., an abacus. Conversely, competitive cognitive artefacts are

artefacts or technologies which replace human cognitive abilities, e.g., a calculator. These notions are useful for highlighting our dependence on technology and the risks that may be associated with this should that technology no longer be available. Indeed, over time, as technology has become more sophisticated and integrated into human lives, this dependence on competitive cognitive artefacts could be growing. The computer keyboard, for example, does not augment our ability to write, but replaces it and we are likely to be worse at writing with a pen and paper. Relating this to translation, MT is an example of a technology that is enabling in different ways for different groups of users. For translators, for example, MT enables them to carry out their work in a quicker and more efficient manner,[51] as a tool aiding them in the translation process, or creates completely new forms of work for them in the form of post editing. Outside of the context of professional or even non-professional translation, MT can be an enabling technology for users in that it may be the only way they can communicate. For example, if two people are conversing using MT on a mobile device and do not share any languages or other ways of communicating, they are entirely dependent on that device, on that technology for their communication. Technology is, then, an enabling tool for humans and the optimised form is seamless technology, technology that works so well the user can forget that it is a technology, thus maximising efficiency.

[51] This may not be true for all translators or forms of translation, but it is true generally speaking in that MT is a tool like a TM that a translator can employ as part of their workflow.

2.6.2 Translation's place in the world – translation's invisibility?

The notion that a state of ubiquitous connectivity is superseding mobility coincides with another idea – translation's invisibility. Indeed, as discussed in **2.6.1 Why do we use technology? Technology as an enabler**, technology becomes more invisible the more integrated it becomes, so it is unsurprising that translation, as a form of technology, may also be invisible or at least less visible at times. It would not currently, however, be appropriate to describe translation as invisible, unlike the technology of writing,[52] from which it emerged. Translation, despite the fact that it is not a new phenomenon at all, is evident in many ways, whether that be because a book has a foreign author or because we are actively or passively informed that the text with which we are engaging is a translation. In addition, translation is most present when two people interact who do not share a common language and may become most visible when there are problems with the translation which leads to a communication issue or failure, with such problems often leading to reflections on translation as the source of the communication issue. In these instances, translation is evidently visible. This may be explained by the fact that literacy rates have increased and the vast majority of people engage with writing throughout their lives on a daily basis, whereas the same is not necessarily true of translation.

Translation, paradoxically, both facilitates and hinders efficiency. Without translation, communication between people who do not share a common

[52] Although writing is clearly visible and needs to be visible to function, this refers to a more metaphorical sense of invisibility, in that writing is not seen as a technology due to how integrated into society it is. That is, the fact that writing is a technology is, essentially, invisible, due to how embedded it has become, which usually happens as Bruce and Hogan (1998) highlight.

language would be much slower in person and practically impossible by virtual means. Yet, in many cases, translation is perceived as a problem which hinders efficiency, slowing down communication between people in a world of instantaneity. Translation is, once again, seen as an obstacle or problem that must be overcome in order for successful communication, in much the same way that Weaver perceived it, as discussed in **2.1.3 The early years of Machine Translation**. This is particularly true of human translation, the efficiency of which has been increased through various technological developments from email to TMs. The problem of instantaneity is severely diminished or even eliminated by using MT, but this creates another problem in that the quality is not currently on par with human translation, thereby also reducing efficiency. This is probably why there is an increasing demand for post-editing (O'Brien and Simard 2014), as the most efficient translation process is, at present, a hybrid human-machine process.

Expanding on this notion of efficiency, the most efficient form of translation would be invisible, seamless translation, to the extent that a user is not even aware they are engaging with a translation. On the other hand, although it is possible to devise many scenarios when this efficient, invisible translation is useful, it is also possible to devise scenarios in which it is not, such as for those who are interested in seeing original language versions of texts or works, or in comparing versions of texts in different languages. What is important is the element of choice – it should be up to the user to decide when, where, how and why they do or do not interact with translation. Nevertheless, recent years have seen the emergence of automatic translation. This is not to be confused with machine translation, often referred to as automatic translation in other

languages and occasionally in English. Rather, in this case it refers to translation occurring, usually via MT, without a user requesting it. It is similar to the notion of localization, but rather than the content already being translated and the webpage simply surfacing that language based on user request or through determining the user's location, the content is translated live via an MT system.

For example, a webpage may be automatically translated as a user has previously configured their browser to automatically translate pages not in their native tongue. Social media, such as Facebook have begun experimenting with automatically translating posts on the site into the user's native language. This is, currently, true for posts in a language that the user has specified that they speak or understand on their profile, thus highlighting the unintuitive nature of a technological development still in its early stages. It also raises ethical questions, similar to those discussed in **2.6.4 The ethics of AI and MT**, regarding choices in how users consume content and the control they have over this. An important implication of such automatic translation is that it masks the translation process and, potentially, the fact that a user is engaging with a translation. This contributes to the idea of translation's invisibility and the idea of translation being a mechanical process in which languages neatly map onto each other. It is also a further example of the driving forces of speed and efficiency as it allows users to interact with material faster than requesting the translation themselves or changing the language of a webpage. Indeed, Venuti (2008) introduced the idea of the invisibility of the translator in depth, the suggestion here is that it is not only worth considering the translator's invisibility, but that translation itself is becoming, or at the very least may become, invisible,

thanks to the proliferation of MT. This could happen thanks to the ubiquity of MT, with billions of people around the world now engaging with translation more frequently and also because MT may create seamless experiences where translation becomes so transparent it is invisible.

2.6.3 The role of Artificial Intelligence

One example of a growing area of technology that is becoming more integrated into human society and upon which an increasing number of human activities are becoming dependent is AI. Indeed, AI is an example of a technology that is an explicit manifestation of the notions previously discussed, as it is a technology that enables increased mobility, efficiency, speed and immediacy. It is also one way in which humans can outsource work or tasks and this is often done to increase efficiency. AI does not have an agreed definition, nor is there consensus about what constitutes AI (Crawford and Calo 2016: 312; Campolo and others 2017: 6). However, broadly speaking, the purpose of AI can be categorised into four goals (Russell and Norvig 2010: 2):

- Thinking humanly
- Acting humanly
- Thinking rationally
- Acting rationally

MT, which seeks to emulate the human translation process and produce human-quality translations, is considered to be an example of AI (Russell and Norvig 2010: 29; Brundage and others 2018).

AI is suited to tasks (a) which can be mathematically modelled, (b) for which short-term signals of progress are available and (c) which have large quantities of human-produced data (Brundage and others 2018: 13). For translation and

MT, it is evident that (c) is relevant, given the large corpora of human-produced translations that exist. It is also fairly evident that (b) is relevant, given that the quality of MT has been improved over time and this has been, to some extent, measurable, although to what degree this is measurable and this increase in measurable quality can continue is subject to debate and discussion. However, (a) is the area which is arguably the most contentious, as only the latest MT architectures, SMT and NMT, based on corpora and probabilistic models, could be described as mathematical modelling of translation. These models are certainly not, however, applicable to the human translation process, so do not mathematically model the task of human translation (HT) in itself, but instead mathematically model the task of translation, producing the output through a different process to that of a human.[53] Overall, it is evident that translation is a task that fulfils these three criteria and that MT is an example of AI.

Since its inception, MT has been viewed as a positive development and something that humans need to develop to continue with progress. It is a tool which will help with overcoming the proverbial language barrier, enabling better and faster communication at a lower cost, both in terms of money and time, which will, in turn, produce economic efficiencies and gains. MT, and AI in general, like all technology, are tools that enable increased productivity for humans and enable things to be done more quickly and on a larger scale. Arguably, MT provides translations to users in instances when they otherwise

[53] This is true of many modern AI systems built on large quantities of data and using neural networks, in that the process they go through to produce an output differs drastically from what a human would do.

would have not received a translation, and this is even more likely with MT on a mobile device that can be used anywhere and anytime.

2.6.4 The ethics of AI and MT

However, Crawford and Calo (2016: 311) underline the fact that 'there is a blind spot in AI research' as 'there are no agreed methods to assess the sustained effects of such applications on human populations'. Similarly, they highlight that even when developers seek to consider people's views and insights when designing AI systems, it is often 'on the assumption that the system will be built' (ibid.: 312) and we rarely think about whether such systems incur changes that are beneficial or desired. Similarly, Brundage and others (2018: 4) call for a wider variety of people to be involved in the development of and research into AI. In the context of MT, translators, who are arguably those most at risk from MT but also those who might benefit the most,[54] were not consulted in the development of MT and they do, in fact, sometimes unknowingly provide the information on which modern MT systems are built (as discussed in **2.2 Types of MT**). Furthermore, it seems that MT is another example of the underlying assumption being that this type of tool and AI will be built regardless, without first considering whether it is something that should be built.

Mittelstadt and others (2016: 1) state that 'how we perceive and understand our environments and interact with them and each other is increasingly mediated by algorithms' and this is especially true for MT, where even the language we

[54] Although this seems somewhat paradoxical, translators are arguably most at risk as they are the obvious candidates, at first glance, to be "replaced" by MT and this is the popular rhetoric that often surrounds MT and other types of AI, with discussion about replacing human jobs. However, translators have also benefitted from MT through having it integrated into their CAT tools which aids them in their work.

use to communicate can be mediated by algorithms computing the most probable translation. This raises some ethical questions, such as who is responsible for what is being said when MT is being used. Parr (2017) discusses a court case from Holland in 2015 in which a client sued an LSP for the poor quality of the translation. In this case, it was the LSP who was liable as the service provider (although the court ruled in favour of the LSP, due to the terms and conditions). Similarly, in 1980 in the USA a hospital was sued for $71m for the misinterpretation of the Spanish word *intoxicado* by a hospital employee.[55] However, when MT is used the matter of liability becomes more complicated and unclear. If going through an LSP, it is likely to be that LSP which assures quality and is thus liable. However, in other situations it may be less clear, e.g., if MT mistranslates a website and a customer files a complaint due to a translation issue, there are a variety of actors who could be liable, such as the company or the MT developers (who most likely do not speak/understand the languages that the MT can translate between and cannot themselves be sure of quality beyond checks like BLEU scores for systems and human evaluation campaigns). This would likely lead to an unprecedented legal situation in which liability is not clear and must first be established. Indeed, such questions around who is legally responsible for translations are not always hypothetical and are already having real consequences for users. For example, in 2017 a man was arrested in Israel after Facebook's MT mistranslated his post in Arabic saying 'good morning' as 'attack them' in Hebrew (Hern 2017).

[55] This example is the case of Willie Ramirez, more details about it can be found here: http://blogs.bmj.com/bmj/2010/09/15/nataly-kelly-the-value-of-a-single-word/ [accessed 20 February 2018].

Ethical and legal questions concerning AI more broadly are becoming increasingly important as AI becomes more integrated into people's lives and the everyday. For example, in 2018, Google announced Google Duplex, a new AI system which is capable is capable of calling on behalf of a smartphone user to make reservations at a restaurant or a hairdresser. Such technologies raise important ethical questions such as whether people have a right or not to know whether they are communicating with a person or an AI that is increasingly capable of emulating human speech (Vincent 2018). Another example of this is the advent of driverless cars – in this case, humans are not simply trusting machines to perform an action such as making a restaurant reservation, they are trusting them with their lives. Society is just beginning to grapple with the ethics and legalities of driverless cars and research has found that attitudes vary around the world and that this is a complicated situation that will require more consideration and research (Awad and others 2018; Bigman and Gray 2020). Humans have relied on tools, machines and technology for a long time, the difference with AI is that rather being a tool which can aid a human or over which a human has oversight, the machine is independent and responsible for the human.

In addition, with the rise of AI and technologies such as MT, and humans increasingly outsourcing tasks to technology and becoming dependent on technology, the question about what is being or may be lost must also be asked. With MT, for example, users can choose to use this technology to communicate, but could be in a situation where they are entirely reliant on the technology for their communication and if this communication goes wrong, there could be serious consequences for that individual, as discussed above.

Similarly, as Krakauer suggests, some technologies may diminish our abilities to perform actions for ourselves, which if the technology were taken away could leave us worse than before. With MT, for example, it is worth considering if it is reducing or could reduce our ability to learn foreign languages and what the consequences of that might be, or at the very least considering how MT can be used in a responsible way. This may involve informing people about situations where MT is suitable and how it is best used. Or, in other words, increasing users' MT literacy, an idea suggested by Bowker (2019b) and which is being explored in her MT Literacy Project.[56]

2.7 Mobile Devices Everyware

Evidence of this drive towards mobility is the fact that recent years have seen the rapid proliferation and uptake of mobile devices, meaning that the world we inhabit is now more mobile than ever. If the car is revolutionary as discussed in **2.6.1 Why do we use technology? Technology as an enabler**, then there can be no doubt that mobile phones have become equally revolutionary in that they have altered human interaction with the world, with other humans, and have also revolutionized our abilities. Indeed, there are a far greater number of mobile phones in use in the world than cars, with the number of vehicles in the world in 2015 estimated to be around 1.2 billion (Statista 2017) and the number of mobile devices estimated to reach just under 16 billion in 2022 (Statista 2021) and the number of smartphones estimated to reach around 6.6 billion (Statista 2022). Just like a car, very few people in the world cannot learn to use a

[56] This is a project to inform people about how MT works, how it uses information people put into it and how MT can be used as a tool to support them. For more information, see https://sites.google.com/view/machinetranslationliteracy/ [accessed 28 February 2022].

smartphone to realize a variety of activities. Furthermore, there are even fewer people who cannot learn to use a mobile phone than who cannot learn to drive – using a mobile phone is not a skill reserved by law to a group of people over a certain age who have acquired a licence through passing a test.

In the UK, for example, the percentage of households with mobile phones has increased from only 16% in 1996-97 to 95% in 2017-18 (Statista 2019b). Focussing specifically on smartphones, recent years have seen a rapid increase in smartphone ownership amongst the UK population, increasing from 27% in 2011 to 76% in 2017 (Ofcom 2017: 165). Similarly, tablet take-up increased over the same period from 2% to 58% and laptop take-up increased slightly from 55% to 64%, whereas by 2017 desktop ownership had fallen to 29% (Ofcom 2017: 164–65). These data indicate the growing prevalence of mobile devices as people use them increasingly over desktop devices due to their versatility, ease of use and portability. In addition, the functionality of mobile devices has increased greatly since the advent of smartphones, with activities or software traditionally used on desktop devices becoming increasingly available on mobile devices. Furthermore, with the growth in the number of mobile phones able to use 4G and 5G, reaching 77% of all mobile connections in the UK in 2020 (Ofcom 2021), people are able to use their mobile devices for more tasks in more places. All of this combined is contributing to the notion of the smartphone as a central device, from which many services can be accessed and other devices controlled, as discussed below.

An important feature of modern mobile devices is their connectivity and ability to perform a variety of tasks. Alan Turing (Turing 1950: 441) stated that ‘this special property of digital computers, that they can mimic any discrete state

machine, is described by saying that they are *universal* machines.' That is, rather than having different machines for different purposes, only the computer is needed and it can then be programmed to perform the function of other machines. The same can now also be said of mobile phones as they 'have evolved from single-purpose communication devices into dynamic tools that support their users in a wide variety of tasks' (Böhmer and others 2011); they are essentially portable computers that can be held in the hand. Users can perform a myriad of tasks using their device. Making phone calls, browsing the internet, shopping online, using it as a personal assistant, watching videos (including movies and TV shows), playing games and editing documents are just a few examples of what is possible. For the desktop computer, it is the software which enables the computer to fulfil many of its functions and for mobile devices it is the apps which can be downloaded that make it a 'universal machine' – rather than needing a pocket translator as might have been used in the past, nowadays one simply needs to tap on the appropriate app for a translation.

A report by GSMA Intelligence (2017: 4) indicates that there are now over five billion people using a mobile device, with the number of mobile devices continually increasing, although the rate of growth is slowing down. This slowdown may be due to a saturation point being reached, resulting in a plateauing of the graph for mobile device uptake. This is to be expected as the rate cannot perpetually increase due to the natural limit, i.e., the population, and the fact that those who have not yet purchased a mobile device are likely the most reticent to do so. Nevertheless, the growth and spread of mobile devices to date is undeniable and something which needs to be studied, as

people increasingly interact with these devices as they pervade our daily lives, societies, cultures and languages. Indeed, it is thanks to the spread of mobile devices, and smartphones in particular, that many people now have access to MT on a mobile device and can access this through a dedicated app on their device, as is discussed below.

2.7.1 A brief history of mobile apps

The history of apps on mobile devices can be traced back to the late 1980s and early 1990s when they were first developed to run on PDAs and to the development of games such as Snake on Nokia phones (AVG Technologies 2015). Apps as they are now understood, as programs which can be easily installed and uninstalled with the tap of a finger on the device itself, did not exist until the emergence of app stores in the late noughties. Apple opened its app store, the first of its kind, in July 2008 (Apple Inc. 2008) and Google opened Android Market (now Google Play) in October of the same year (Android Developers Blog 2008). Prior to these innovations, apps would still be downloaded on a computer, the device then connected to the computer and the app installed on the device via a (wired) connection between the device and a computer. The app stores, particularly Apple's, revolutionized this as they came built into the device and allowed users to download and install apps directly onto the device, without an intermediary computer, when connected to the internet, via Wi-Fi or 3G (Rowinski 2012). They increased the mobility of mobile devices by removing one of the last tethers, the wired connection previously

required to install apps and the only remaining physical tether for a mobile device is the power cable to charge the device.[57]

Apps and software, from a popular perspective, essentially serve the same purpose at the fundamental level in that they are installed on a device in order to allow a user to perform a certain function. However, perceptions of the two may differ slightly, with the idea of software now becoming slightly archaic. Software brings to mind the practices of old, of purchasing a disk or CD which could then be used to install the program on a computer with the help of a paper user manual, and the CD would often subsequently need to be in the CD drive for the program to work. Apps may have first emerged on mobile devices, but the term is becoming more widespread with a great breadth of meaning, with app stores now becoming available on desktop devices and users installing these apps, as opposed to software. This is probably in part due to the more fluid idea of what constitutes a desktop or mobile device, thanks to technology which blurs the two such as laptops, 2-in-1 laptop/tablets and tablet and phone docks. Another contributing factor may be that the immediacy of software nowadays, in that it can be installed in a matter of seconds or minutes or accessed through the cloud, renders it closer in form to apps. Apps are a result of a drive towards increased mobility and then themselves fuel this mobility by increasing expectations of it.

The latest step in this trend of increased mobility is the development of cloud-based services, which rely on a device being used to access information

[57] Even this may soon no longer be a barrier with the rise of wireless charging.

remotely via the internet. So, rather than having everything held locally on a device as was the case in the past, the bulk of information is stored in data centres and computational functions, such as MT, are carried out remotely through the cloud rather than using the local device's computing power. These processes or information can then be accessed by the use of an interface such as an app on a mobile phone. MT on a mobile device, for example, relies on using an internet connection to perform the translation – the device itself does not perform the translation. Rather, the device is the interface which allows the user to request the translation from cloud-based servers or computers.

Apps are, then, still a relatively recent development in the history of mobile phones, intrinsically linked to the development of smartphones, and represent a vibrant area for study, to examine how users engage with them and the effects they are having on users and society. In the case of translation and interpreting, a mobile phone is arguably the perfect interface for these activities. It is a portable device which has a built-in microphone, built-in speaker and the ability to input, display and now read text, all of which indicate that the hardware itself lends itself well to the activities of translation and interpreting. Thus, the mobile phone is the perfect interface for translation - both translation and mobile devices are inherently linked to mobility, whether that be linguistic mobility, i.e., moving between and across languages, or physical mobility, i.e., moving around in the physical world.

2.8 Mobile Translation

Although translation is inherently tied up with mobility and the desire to move, the interaction between translation and modern mobile devices, such as smartphones and tablets, has so far been limited and studies of this area are

limited. As this is a new and emerging area of translation, there is not a single, standard, accepted definition of mobile translation. Nevertheless, there are common uses of the term, which are succinctly summed up by Miguel A. Jiménez-Crespo (2016) when he provides three definitions of mobile translation:

A. The localization of mobile apps or any other textual genre associated with cell phones
B. Mobile MT apps
C. Mobile apps which are designed for professional translators, allowing them to translate on the go

The first definition refers to the actual practice of translating content for mobile devices and is outside the scope of this study. The second two definitions, on the other hand, may slightly overlap and are both within the scope of the study. Indeed, ‘mobile MT apps’ may fall under definition three and there is no reason why these apps could not be used by professional translators to facilitate their work. The distinction between the two may be due to the fact that mobile MT apps are not specifically aimed at translators, but rather provide general-purpose MT for anyone, and the fact that it is unlikely that many translators use these apps in their workflow. However, the primary focus of this thesis is definition two, mobile MT apps, so will exclude apps which are designed specifically for professional translators, such as post-editing apps, and focus on those MT apps which are designed to provide translations outside of the translation process.

Furthermore, it may be useful to expand the definition of mobile translation as the definitions discussed so far only focus on apps. This would, then, exclude users accessing MT through a browser[58] and other interplays between translation and mobile devices such as mobile technologies being used in translator education (as will be seen in section **2.8.1 Existing studies on mobile translation**). As such, a broader definition, such as the study of the relationship between translation, mobility and mobile devices may be more useful and all encompassing.

2.8.1 Existing studies on mobile translation

Despite the novelty of the field of mobile translation, some small-scale studies have been conducted, exploring the relationship between mobile devices and translation and how mobile devices may be used in the translation process and to translate in a variety of contexts such as healthcare, translator training and in post-editing. These studies have been summarised and examined in greater depth, focussing specifically on the user experience, in Liu and Watts (2019), which explores the current state of the mobile translation experience and future research directions, but a short overview is presented here.

Arnáiz-Uzquiza and Álvarez-Álvarez (2016) employ a survey to explore the use of technology in the learning process for 280 undergraduate translation and interpreting students across 13 different Spanish universities. They found that 55% of respondents used a smartphone and 10% used a tablet/iPad and that device usage increased as students progressed through their course. Similarly,

[58] In the survey conducted for this thesis, discussed in Chapter 3, the main way in which people access MT on a mobile device is, in fact, through the browser.

perceptions of advantages and disadvantages varied over the years, with ‘limited access to information’ being the main disadvantage for first years, whereas for fourth years it was the fact that using mobile apps was distracting and did not create an ideal learning environment. The authors recognise the relatively small sample size of the study and the fact that not all institutions in Spain were represented in the findings. Similarly, they call for further research to investigate if there would be any differences in the findings if undergraduates and postgraduates were compared. They report that smartphones were used for communication, social media and managing work, whilst laptops were used for taking notes and doing work, accessing the virtual learning environment, carrying out searches, checking email and carrying out homework and classroom tasks. The study does not, however, go into depth on how students specifically use these technologies for translation or interpreting activities, rather than usage that students of any discipline would make of them. As well as having a larger sample size, it would be useful to gather more qualitative data to understand better people’s reasons for using or not using certain devices and to repeat this study in other countries to enable international comparison.

Similarly, Bahri and Mahadi (2016) investigate the usage of mobile devices in the translation classroom through a mixed-methods approach. They gather qualitative data through a focus group/interview with four translator trainers and use these findings to inform the design of a quantitative survey, which primarily employs a Likert scale, sent out to 65 translator trainers, of which 26 completed the survey in its entirety. They find that generally instructors encourage students to use mobile devices to complete tasks, assignments, perform

searches or discuss relevant content on social media, but discourage and found less useful using such devices for tasks not related to the lesson or learning content. In this study as well, the mobile devices under consideration included laptops, tablets and smartphones and a preference was expressed by students for laptops over other kinds of mobile devices. Again, most of the tasks described in the study are not specific to translation students and are employed by a wide range of students. However, in this case too, they found that more advanced students were encouraged to search terminology databases using their mobile devices and it was highlighted by one focus group participant that students rarely carry paper dictionaries anymore and instead rely on digital dictionaries accessible through mobile devices. The authors recognise the limited nature of their study, in that it was only sent out to instructors for one language pair (English ⇔ Persian) and that the findings may not be generalizable and also call for further research to verify their findings.

There is relatively little research in around how professional translators may user mobile apps in their workflow, i.e., definition 3. Currently, translators still work primarily at a desktop workstation, using CAT tools which are only available in desktop versions, although there has been some initial work to investigate the possibility of completing translation jobs on mobile devices. For instance, the ADAPT centre at Dublin City University developed the Kanjingo post-editing app, initially available through a browser and then developed into a native iOS app, in order to investigate the viability of translating and post-editing machine translation on mobile devices (Torres-Hostench, Moorkens, O'Brien, & Vreeke, 2017, p. 139). The researchers have carried out three rounds of testing which provide insight into the way that users experience such

an app. O'Brien, Moorkens and Vreeke (2014) describe the first round of testing in which five users from different backgrounds (including one professional translator) were asked to evaluate the app by Think Aloud Protocol and were quite positive about the app in general. Their main concerns were practical, relating to problems with punctuation and auto-capitalisation, retention of work if the user stops half way through, insufficient help available and input problems due to the speed of typing on a keyboard on a mobile device. Moorkens, O'Brien and Vreeke (2016) describe the subsequent round of testing based on improvements made after the first round, with 13 people completing a feedback survey. In this round, users were again positive about the app, with most respondents liking the app's interface and some of the issues, such as problems with accented characters and spellcheck could have been dealt with in a controlled-testing environment. Users generally stated they preferred desktop applications for post-editing due to ease of use, but the app would be useful in situations where desktop software is unavailable. They also provided several suggestions for improvements to the app, such as clicking words to see other possible translations or editing segments after they have been submitted and the ability to view the finished translation at a level longer than the sentence level. Torres-Hostench and others (2017) then describe another round of user testing in which five participants used the app while five observers watched them testing the app. The testers highlighted problems with the ergonomics of inputting text via a small keyboard on a smartphone device, indicating that this would be a major limitation for using the app for professional purposes, but that it might be more useful for not-for-profit projects. They also reviewed using voice input for the app and found that it was more useful when re-translating

longer sentences and discussed the usability of the app suggesting two major improvements - changing the location of the accept button and allowing a user to edit anywhere within a tile. The researchers themselves also call for further research and testing to explore different uses of the app.

Another area in which mobile translation has been explored is in a medical context. For example, Albrecht and others (2013) conducted a study in Hannover Medial School to examine nurses' opinions of a specific mobile medical translation app called xprompt. This study was conducted as part of a wider project called 'iPads in Nursing', examining more generally how such technology could be integrated into a nurse's workflow. The app used is not an MT app as such, as users are not able to freely input text or speech to be translated, instead they use the menu to navigate to a certain situation and select the phrase and the TL and the device can then show or speak this translation to the patient or the user can enter a word and search for a phrase for translation. The app is, then, more like an electronic phrasebook rather than a translation app, but still falls under the umbrella of mobile translation. The nurses were generally happy to use the app, but highlighted the need for training and awareness of the app and that they did not have time to commit to learning to use the app due to their already intensive workload.

However, as O'Brien (2017: 327/328) highlights, 'research on how end users interact with unedited or edited MT is still in its early stages' and she also calls for more research in this area. Although she is discussing translation in the traditional business sense, with a client, LSP and translator, the statement also applies to general-purpose MT. Moreover, research into how users are engaging with and experiencing MT specifically on mobile devices is an area

that is an even more nascent stage. MT is now open to anyone and it is likely that that its usage will increase due to its ubiquity and availability across mobile devices. Just considering one platform, for example, Google Translate translated over 140 billion words per day and had 500 million monthly users in 2016 (Lewis-Kraus 2016). And yet, whilst there is some research on how translators interact with MT in their workflows and during post-editing, there is little research on how the potentially far larger number of 'end users' or 'lay users' (those who are not translators), are interacting with MT. This is, then, a gap in our current understanding which cannot be ignored and is worthy of further study, as it represents a potentially far larger use of MT than the professional uses which have received some study.

2.9 Why study MT on a mobile device?

As previously mentioned, apps, as we now understand them, are a relatively recent phenomenon and, within mobile apps, a newer development still is mobile translation apps. Google launched the Google Translate app for Android in January 2010 (Verma 2011) and the iOS version in February 2011 (Zhu 2011). MT on a mobile device differs from desktop-based versions because it can be used anywhere and will, arguably, fulfil the greater purpose of allowing communication between two or more people who do not share a language as it is able to facilitate in-person conversations on a scale hitherto never seen. In short, it is the mobility of MT on a mobile device which principally distinguishes them from other ways of accessing MT. MT, as previously discussed, has now existed for over 50 years, although for a large proportion of this time it remained available only to a small number of people such as researchers and companies developing the technologies. Access to MT online, through sites such as

Google Translate and Microsoft Translator, emerged at the end of the 1990s with the release of the first systems of this type such as Babelfish by Altavista. It is, then, the internet that has facilitated a democratised access to MT due to its distributive power. MT on a mobile device, and particularly MTAs, represent the next step in increased access to and usage of MT as they continue this trend towards mobility which has been ongoing in the world in general and within translation for hundreds of years. Thanks to newer technologies humans increasingly expect to be able to do more on the move and regardless of location.

The ability to use MT apps originally depended on access to an internet connection which meant that their practical applications may have been somewhat inhibited. This is because, for the large majority of users, they were more likely to need them when travelling in a foreign country whose language they did not speak, but roaming charges prohibited this. In the past, it could be extremely expensive to use your mobile abroad, but these costs have been reduced or eliminated thanks to the growing proliferation of roam-like-at-home options, which allow people to either use their existing minutes, texts and mobile data allowances abroad at no extra cost, or to be charged for making calls, sending texts and using mobile data at the same rate as they would at home. These roam-like-at-home options have emerged both from offers by mobile network operators[59] and political intervention. The EU, after gradual decreases in the price caps for roaming abroad, fully abolished roaming

[59] In the UK, for example, many of the large mobile network providers, such as EE, Three and Vodafone offer roam-like-at-home plans which include roaming in destinations other than EU countries.

charges for its member countries on 15 June 2017 (European Commission 2017). However, it is worth noting that such changes are not necessarily permanent – this was before Brexit and since then many UK mobile operators are now reintroducing roaming charges for their customers when they roam in the EU (Reuben 2022). This highlights the new and precarious nature of this increased access to the internet and mobility.

In addition, popular apps such as Google Translate and Microsoft Translator allow users to download language packs to perform translations in the app offline, on the device, when an internet connection is not available. This is, usually, provided under the caveat that the quality of these translations produced by offline language packs is not comparable to that of the online-produced translations. However, recent developments might enable the quality of offline translations to increase, with the advent of Neural Processing Units (NPUs), which are designed for machine learning tasks, on mobile devices. In October 2017, for example, Microsoft partnered with Huawei to announce that the Huawei Mate 10, which has an NPU, would come with Microsoft Translator pre-installed and thus users would be able to download language packs and have access to neural translation even without an internet connection (Microsoft Translator 2017b). At the time of writing, this functionality is only available on this one device and one translation app, but it is likely that other mobile devices will be able to offer this feature in future, as NPUs become more common on mobiles, and translation app developers can use the NPUs to provide neural-quality translation without an internet connection.

So, there is an increasing usage of mobile devices and MT on a mobile device, with growing possibilities for how and when this technology is used. As such, it

is important to understand and research how and why people are using these technologies, the difficulties they face and the effects that the technologies are having. Furthermore, MT and mobile devices are constantly further integrated with other devices, as will be discussed in the next section, enabling even more instances of interaction with translation.

2.9.1 Integration with other technologies

In addition to representing new possibilities for translation, MT on a mobile device also allows for increasing integration with other technologies, thanks to the fact that it is a mobile device. That is, these devices increasingly interact with, control and are integrated with other technologies, enabling new interactions with and experiences of technology that have never been seen before.

As previously discussed in **2.5.4 Beyond mobility and speed**, we are moving towards a state of ubiquitous connectivity and connectivity and the Internet of Things, an example of the interconnectivity afforded by the cloud and connected devices, plays a large role in this. Recent years have seen the proliferation of smartphones, smartwatches, smart ovens, smart washing machines, and smart lighting to name a few devices, which demonstrates a growing interest in ‘smart’ devices, particularly for devices in homes. In a 2017 report (Bothun and Lieberman 2017), PwC found that 26% of the 1,000 US residents surveyed owned a smart home device and 81% of respondents were aware of smart devices. The list could even be extended to include other technologies such as cars, which are also increasingly interconnected, but are not usually described as smart cars, perhaps because the term already existed, referring to the German car company smart and because ‘self-driving’ or

'driverless' cars seem to be the buzzwords in the area. What this essentially refers to is the rise of the Internet of Things (IoT) which is 'a proposed development of the Internet in which many everyday objects are embedded with microchips giving them network connectivity, allowing them to send and receive data' (Oxford English Dictionary Online 2020). Essentially, an increasing number of devices, often used on a frequent or daily basis, and activities are becoming interconnected and generating data – smartwatches, for example, enable us to have a historical log of the number of steps taken or our heart rate.

In addition to being able to control such devices with direct, manual input, many of these devices are designed to be controlled from a smartphone, often using an app. It is worth mentioning one type of device in particular from a translation perspective[60] – smart headphones. These are headphones which often connect to a smartphone and enable the user to utilise the smartphone's computing power to perform tasks. One set, Google Pixel Buds, is especially relevant to translation as they were specifically marketed as being able to perform translation at the launch event.[61] They do this through connecting to the Google Translate app on the Pixel phone, which provides the translation which the Pixel Buds can then speak in to the user's ear. Whilst this does not represent a change in the quality of MT, it does represent a change in the way users can interact with and produce MT, with the idea being to make communication as

[60] Another device from Google, Google Glass, is also of interest from a translation perspective, and would offer new ways of integrating translation into people's lives, such as by automatically translating signs and menus in front of the user, but their uptake has been minimal and smartglasses do not seem to be popular.
[61] Google launched this product on 4 October 2017. The launch included a demonstration of the translation capabilities which can be seen here: https://www.youtube.com/watch?v=oQVQVt5H2QM [accessed 23 January 2018].

seamless as possible. It is another step towards the translation provided by Douglas Adams's Babelfish. The Pixel Buds are, then, another new interface which one can use to interact with MT – in a way they are an interface to an interface (the app). So, whilst MT itself is not a new phenomenon, what is happening is an increase in the ways of accessing MT and the number of people accessing MT. In just over 60 years, we have gone from MT only being accessible on huge mainframes the size of a room, used by specialists, to MT being accessible to anyone, almost anywhere in the world with a device that fits in the palm of the hand or into the ear.

So, MTAs also enable integration with other smart devices and thus make translation increasingly available in our lives, whether using the app directly to produce a translation, using it over the top of other apps to engage in multilingual conversation or linking it with smart headphones to facilitate a face-to-face conversation with someone speaking a foreign language. The focus of this thesis is to further the understanding of how people use MT on a mobile device, but they also enable new ways of interacting with translation and new forms of human-computer interaction and human-human computer-mediated conversation, both in themselves and through integration with other technologies.

2.10 Conclusion

This chapter has provided a brief history of MT, an explanation of MT architectures and MT quality evaluation have been provided in order to understand the way in which MT more generally contributes to and shapes the translation ecosystem. It ended by discussing the current state of research in the field of MT and highlighting the need for TS to turn its attention to this field,

to better understand the ways in which it is impacting on and changing translation and society. This thesis focusses specifically on MT accessed through a mobile device, termed MT on a mobile device here. The chapter then examined the driving forces behind the emergence of MT and MT on a mobile device, exploring the emergence of mobile technologies and MT as an expression of the desire for increased mobility and speed. It has also considered why technology is used and the ethical implications and effects of new technologies. Building on this, the next chapter presents the methodologies employed in this thesis, a survey of use of MT on a mobile device and analysis of reviews of MT apps left on the Google Play Store.

Chapter 3 Methodology

The main focus of this chapter is to present the approach taken in this thesis to gathering and analysing data regarding use of MT on a mobile device. Section **3.1** discusses the research questions of this thesis, how surveys are useful as a research tool and why one can be employed as a tool to provide answers or insights into these questions. Section **3.2** examines how surveys have been previously used within TS to explore translation and translation technologies, before focussing more specifically on studies of MT that have employed surveys. Section **3.3** then discusses the survey used in this thesis to explore how people use MT on a mobile device, presenting a broad overview of the questions, how they were designed, how the survey was distributed and the limitations of the approach. Finally, section **3.4** explores the other data gathering and analysis approach employed in this thesis, which involves studying reviews of MT apps left on the Google Play Store to explore what insights can be gathered from such a dataset.

3.1 Why a survey for exploring the research questions of this thesis?

This thesis engages with the complexity and epistemological difficulties of these questions primarily through surveying users of MT on a mobile device, as to provide these insights it is necessary to gather data from users of MT on a mobile device to explore the ways in which they use the technology. This thesis makes a foray into these questions, the ways in which users make use of MT on a mobile device, the purposes they are trying to achieve and what this means for the conceptualisations of the language barrier and how future technological developments may affect or address it. Although it would also be possible to speak with the developers of MT systems, they would not necessarily know how

and why users are using MT beyond the text or speech that they input into the system unless they have done their own research into how users are using their systems. A survey, as discussed next, is a powerful tool for gathering data from large groups of people, especially when those people are not an easily defined category or are a potentially large pool of people.

The two terms ‘questionnaire’ and ‘survey’ are closely related, but technically the former refers to the actual set of questions whilst the latter refers to the overall methodological approach (Dillman 2000: 149). However, the two terms are often used interchangeably (Lazar and others 2017), and this is true in this thesis. Questionnaires can be used as a research tool to collect data, particularly where these data constitute opinions, beliefs or attitudes from a large number of people (Langdridge and Hagger-Johnson 2009: 87/88). In the case of MT on a mobile device, it is impossible to provide exact figures or even reasonable estimates on the number of people using it, as anyone who has a mobile device capable of connecting to the internet (e.g., a smartphone or a tablet) could potentially use MT, whether through a web browser or through an app.[62] As such, the potential pool of respondents is large and not an easily defined group.

Furthermore, as ‘surveys are one of the most commonly used research methods, across all fields of research, not just human computer interaction’ (Lazar and others 2017), it is appropriate to use a survey when studying the ways in which people interact with a piece of translation-related technology,

[62] Indeed, as discussed in **2.7.1 A brief history of mobile apps**, apps, by their very nature, can be ephemeral, with users easily able to install or uninstall them within seconds.

particularly since it can be argued that ‘the field of professional translation is, without a doubt, a form of human-computer interaction (HCI)’ (O’Brien 2012). Indeed, if this is true of professional translation, then it is even more true of non-translator use of MT and MT use on a mobile device. This is because in this instance translation would not be possible or would not take place without this form of HCI, as the human is almost entirely dependent upon the technology to provide the translation. This form of HCI differs from that described by O’Brien in that although it is also a case of humans using technological tools to aid them, in this case the machine performs the act of translating rather than helping the person perform this act. Thus, if translation can be perceived as an example of HCI, and surveys are a commonly used method in HCI as they can easily provide data from a large group of people, then it would also be an appropriate method to study MT use on a mobile device.

Müller, Sedley and Ferrall-Nunge (2014) discuss instances where questionnaires are particularly useful and these are presented in **Table 3.1**, mapped to the research questions.

Instance when a survey is a useful tool		Research Question
1	Gather information about people's habits, interaction with technology, or behavior	1
2	Get demographic or psychographic information to characterize a population	-
3	Get feedback on people's experiences with a product, service, or application	1
4	Collect people's attitudes and perceptions toward an application in the context of usage	2
5	Understand people's intents and motivations for using an application	1
6	Quantitatively measure task success with specific parts of an application	-
7	Capture people's awareness of certain systems, services, theories, or features	1/2
8	Compare people's attitudes, experiences, etc. over time and across dimensions.	-

Table 3.1 Instances when surveys are a useful tool mapped to the research questions of this thesis

As **Table 3.1** shows, a survey can provide useful information in a variety of areas to answer the research questions. It is only number six that is not at all relevant.[63] Although numbers two and eight are not covered by the research questions here, it would be possible to cover them in similar studies in the future or with a large enough sample size to extrapolate to the population more generally. Number eight in particular, which is concerned with tracking changes over time, may become more pertinent in the future as further surveys of MT use on a mobile device could be conducted and compared to previous iterations. Similarly, number two might also become more relevant with repeated studies and more studies to establish typical types of use or usage patterns.

[63] Although it could be relevant in other instances if, for example, a study were conducted to explore specifically how successfully people achieved communication using MT in a controlled experiment.

Sun (2016: 276) notes that 'the survey method can be used alone or with other methods in a study' and it is worth noting that surveys are often combined with focus groups or interviews in order to solicit more qualitative information about a topic. However, in this case, due to the nature of the participants and the fact that a user group is not easily definable or accessible, as it would be in the case of exploring fansubbing of a particular TV show or audience response to subtitling of a film,[64] the survey is the principal method of data collection. That said, it is also possible to gather information from other sources, but through collating and exploring data that already exists, rather than actively gathering information or data from users. For MT on a mobile device, such data exists in the form of reviews that users leave for MT apps on app stores and by exploring anecdotal use of MT on a mobile device, both of which are explored in more detail in **Chapter 5**.

3.2 The use of surveys to study translation

In *Research Methodologies in Translation Studies,* O'Brien and Saldanha provide an overview of common methodologies employed within the field. They group the methodologies into four chapters based on whether they are employed for researching 'the texts that are the **product** of translation (Chapter 3), the translation **process** (Chapter 4), the **participants** involved in that process (Chapter 5) and the **context** in which translations are produced and received (Chapter 6)' (O'Brien and Saldanha 2014: 5). Questionnaires are discussed in Chapter 5, focussing on the participants involved in the translation

[64] TV shows often spawn wikis, forums or other online spaces where people discuss them, and this would represent a useful field for data collection. Similarly, the audience of a movie could be asked for their views on the subtitles on the way out of a screening or a screening could be arranged specifically for the research and data collection. There is not such a community of MT users who could provide such insights.

process and they note that ‘questionnaires have been used to some extent in research on translation, most notably to research topics on the translation profession, technologies or to survey translation student opinions on teaching and learning’ (ibid.: 151). Questionnaires have, then, been used when seeking opinions and thoughts from human agents involved in translation – ‘translation profession’ refers to agents[65] engaged in the translation process, ‘technology’ refers to those agents’ relationships with and use of technology in a fast-evolving ecosystem and ‘translation students’ refers to how to train those future agents in the context of such a fast-evolving ecosystem. In short, they are used to gather opinions, thoughts and behaviour patterns from humans involved in translation and are a useful tool when collecting exploratory data (ibid.: 152).

Looking more specifically at where surveys sit within Translation Studies, rather than just the broader area of translation, it is worth considering Holmes’s Map of TS and how surveys can be plotted on to this map. Generally, surveys will be most useful when engaging with the human agents involved in translation. That is, in those areas in which the study of the translator, their process and the translation as a product fall, rather than in theoretical areas seeking to provide general theories of translation or explaining how to translate. It is clear, then, that questionnaires are employed most appropriately in TS when studying the more practical, rather than theoretical, and when seeking to understand the perception and role of translation and translations in society. To visually demonstrate the areas in which surveys might be employed most usefully,

[65] For example, translators, project managers, post-editors editors, proofreaders, LSPs, clients.

Figure 3.1 highlights the areas of 'applied' and 'descriptive' translation studies, which focus on the output and process of translation and on training and the tools used for translation. Indeed, at the time of producing the map, it was probably inconceivable that a human translator would not need to be involved to produce a translation, hence the label translation aids (which MT was and still is), which is where MT might fall generally. However, the specific area of MT on a mobile device, being used outside of professional translation, falls within the 'applied' branch, but with a person using a tool to produce a translation, rather than the tool acting as an aid to help them produce a translation. That is, rather than the tool aiding the human to achieve the outcome, the human is almost entirely reliant on the tool achieving the outcome for them.[66]

[66] Note, however, that the overarching aim/outcome is the same – translation is a tool or process that facilitates communication.

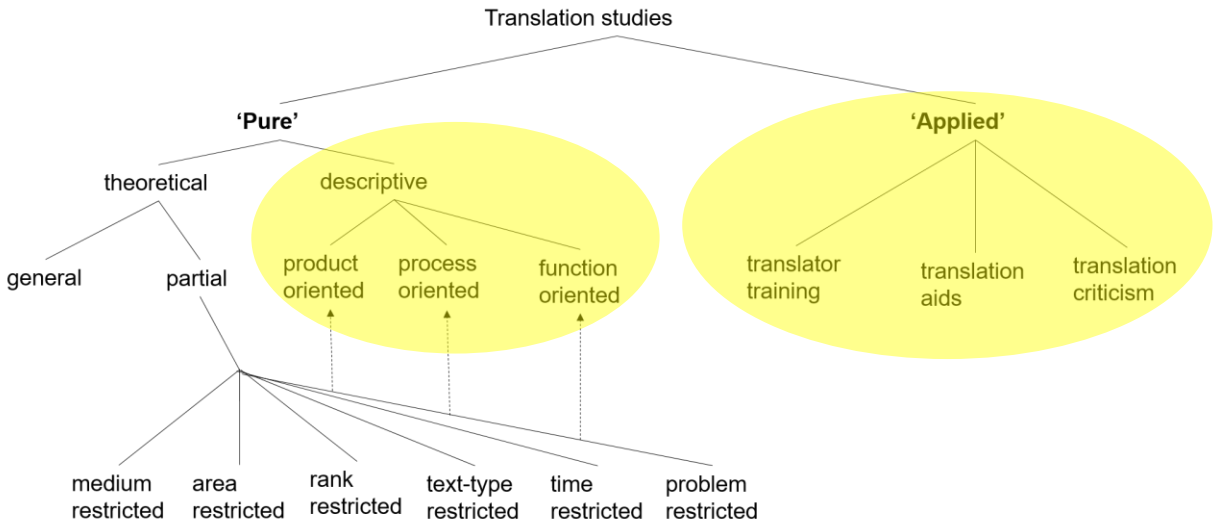


Figure 3.1 Holmes's Map of TS

Nevertheless, surveys might feed into theories which are sourced from empirical data from translators explaining their process and how they translate. Researchers can also use surveys to explore how translators feel about and apply theory in their working lives as Hao (2019) does. Ultimately, surveys are used in TS as a way of generating data regarding the translation profession and as providing the empirical evidence that may both underpin or challenge the theories.

Another area of research within TS which links closely to this field is the study of the reception of translations. However, this research usually focusses on the consumption of translations, on the readers of translations, their views of the translation and on levels of understanding of a text. In short, this approach has focussed on the reactions, opinions and emotions triggered in the reader by the translation and not how they have used the translation to fulfil a communicative function. This can be explained by the fact that reception within TS has tended to focus on translations of literary texts and how they have been reviewed and received by audiences in the TL. For example, in Jeremy Munday's *Introducing*

Translation Studies, the section on 'the reception and reviewing of translations' (2016: 241–45) only deals with translations of literature. This is understandable given that reviews of literary works and translated literary works are published and made available to a wide audience as part of the review process of a literary work and are designed for public consumption in order to promote the work. This is unlike other forms of professional translation which will originate from a client or commissioner, who predetermines the use of the translation, and may be private to that company. In this case, the readers are not using the text for a communicative act, but for other purposes such as entertainment or studying. Thus, whilst related to reception studies, this thesis focuses more on how users actively use translations provided by MT, specifically how they use them to fulfil their needs or purposes.

3.2.1 Examples of surveys studying HCI in TS

This section provides a brief overview of examples of research in areas of TS which have employed surveys as a data-gathering tool to study HCI in translation. However, it should be noted that surveys, because of their flexibility and ability to generate both quantitative and qualitative data, have been used for a long time and in a variety of contexts in TS. There is not sufficient space in this thesis to explore all of these contexts and nor is it this thesis's aim. That said, what follows is a summary of some recent studies employing surveys in contexts that relate closely to the context of the topic of this thesis.

As mentioned, surveys have been used in a wide variety of contexts within translation and TS to study HCI within these areas. In translator education, for example, Arnáiz-Uzquiza and Álvarez-Álvarez (2016) use a survey to explore the use of technology in the learning process for 280 undergraduate translation

and interpreting students across 13 different Spanish universities. They found that 77% of respondents used a laptop in the classroom and 55% used a smartphone, whilst only 10% used a tablet/iPad, with usage increasing as students progressed through their course. They acknowledge the relatively small sample size of the study and the fact that not all institutions in Spain were represented in the findings.

Surveys have similarly been employed to study how translators use technology as part of their workflow. Gough (2011: 197) used a survey 'to examine professional translators' awareness of the new open and collaborative tools and processes, establish to what degree translators use these tools and participate in the processes, and investigate what is their perception of these tools and processes'. Katan (2009) presented his findings from a survey of 890 translation professionals around the world, gathering views on translator training courses, the importance of translation theory in translator education and the status of the profession and also their use of and training in e-tools for translation. Similarly, Gough and Perdikaki (2018) use a survey of translators who use the Smartcat platform to explore the idea of concurrent translation[67] and the technological tools which enable this as 'little is known about how they work, who uses them, how they impact the translation process and product, and what their adoption level is' (ibid.: 79). Heinisch and Iacono (2019) combine interviews with professional translators and a survey of 86 students on a Master's programme in translation, 30 of whom were already working as

[67] They define concurrent translation as 'as a mode of translation where multiple individuals work on a text collaboratively and simultaneously in a cloud-based environment' Gough and Perdikaki 2018: 80.

translators, to explore their attitudes to order management and translator platforms.

Another field within TS which has also frequently made use of surveys is Audiovisual Translation, which studies screen-mediated translation, that is translation which takes place in a multimodal context where a combination of factors (e.g., image, dialogue, music, subtitles, audiodescription) are combined to convey meaning. AVT is, then, also a technologically mediated area of TS in that it considers the technology of the screen and translation. As such, it is interesting to explore ways in which this field has also studied the audience of its translations. In his chapter on research methods in audiovisual translation, Pérez-González (2014) explores the ways in which research is conducted within the field, including through questionnaires as an example of naturalistic enquiry that enable researchers 'to gain a better understanding of translation practices or the use of translated material from the point of view of observed participants' (ibid.: 147). In the field of AVT, 'eliciting views and gauging perceptions of audiences, practitioners and scholars are common ways of securing data' (Pérez-González 2014: 151) and one example of how these data can be generated is through employing a questionnaire. Of particular interest is the fact that audiences can often be the focus of research and that questionnaires can be used to solicit their opinions. Indeed, an additional parallel can be drawn with AVT in that according to Antonini and Chiaro (2009: 99)

> the emphasis of research in audiovisual translation, and translation studies in general, has been on actual texts, the translations themselves and their translators rather than on readers and viewers. In other words,

the people who essentially make use of these translations seem to have been largely ignored by researchers.

However, it is worth noting that in the intervening ten years the situation has changed somewhat and that within AVT 'reception is steadily coming to the fore in academic research' (Di Giovanni and Gambier 2018: x). The same is true of research into MT usage and reception of MT – the focus has been largely on translators and use of MT in the translation workflow, rather than on how non-translators, most probably the larger user group of MT, have used and are using MT (O'Brien 2017; Castilho and others 2019). If questionnaires can commonly be used in AVT to increase understanding of the audience, i.e., the people who make use of the translation, then the same method could be employed in other areas, such as in exploring ways in which people use translation technologies, such as MT, to produce translations and communicate.

In summary, questionnaires have been widely employed within TS as a means of investigating the agents involved in the translation process and have often also been employed as a way of exploring translators' use of technology. This has, however, tended to focus on translators, students, teachers and LSPs, i.e., those involved in the process of producing a translation, rather than those who actually use the end product, the translation, or use of MT by non-translators. As this section has demonstrated, surveys are a powerful and useful tool when studying the relationship between people, translation and technology.

3.2.2 How has MT use been studied before?

Focussing specifically on the area of MT, evaluations of MT in general and of specific MT systems have been conducted using a questionnaire as the data-gathering tool. However, as the bulk of research into MT has traditionally sat

outside the sphere of TS,[68] many of these have not necessarily been included within TS research, even though they clearly do fall under its umbrella. To date, research on use of MT has tended to focus primarily on translators as users of MT and how they integrate it into their workflow. Despite the first research into MT usage including non-translators in end-user research, over time the focus seems to have shifted to translators and their usage of MT and other related technologies as part of their workflow. This is understandable given the developments in the 1990s that led to technology and MT becoming more deeply integrated into the translator's workflow and translators primarily working in ITEs employing a range of technological aids, including MT systems developed for a specific field and MT systems supporting human translators in their work. This change in focus framed MT much more as a tool to support translators rather than as a tool for achieving FAHQT, which would eliminate the need for human translators. Such changes in the use of MT systems understandably led to research into MT usage and quality acceptance focussing on translators and their usage of MT tools as part of their workflow.

Indeed, the first research into MT use employed a fifty-one-question questionnaire (administered orally through interviews) as its principal method for generating data regarding people's thoughts on MT systems (Henisz-Dostert 1979). This first exploration of MT usage is also notable as it included non-translator users of MT systems, who, at the time, were the main users of such systems. In this study, the majority of participants were scientists at

[68] As discussed in more detail in **2.4 Translation Studies and Machine Translation**.

various research organisations and their mains reasons for using MT was to obtain translations of literature and papers in Russian through a service that was faster and cheaper than human translation or due to a lack of availability of human translation. At the time, MT was a much slower process than it is today, and people did not actually interact with the MT systems themselves, but sent a request for the translation to the office responsible for it, such as the library.

Smith (2003) presents the MT system developed by PwC and SYSTRAN for PwC employees to translate text, documents and webpages. Smith acknowledges that the system was not designed to produce publishable or high-quality translations, rather it served to provide fast translations where quality was not essential, i.e., it provided a gist translation. The users of the system were also able to offer feedback via a form on the webpage and Smith also solicited feedback through a survey in the Spanish firm using the same format. On both the feedback form and the survey of users, respondents were asked to tick boxes to indicate whether they agreed with the following statements or not:

- I could basically understand the translation
- I found the translation suitable for my requirements
- I am still favourable to using this technology to help in my comprehension needs on FL[69] text

[69] FL = foreign language.

Based on this, Smith was able to surmise that 57% of respondents had a positive view of the translations provided by the system (they ticked one or more of the boxes) and 43% had a negative view (they did not tick any of the boxes).

Yang and Lange (2003) provide an overview of the development of the Babelfish online MT service, the very first of its kind at the end of the 1990s. As part of this, they present and discuss the feedback provided by users of the system through a form on the webpage. Of note are the usage figures, showing that on two randomly selected days, 22/06/1998 and 10/11/1999, the system performed 370,990 and 740,218 translations respectively. Although only two days over a one-year period, this does suggest that usage of the system was increasing over time and it is worth noting the impressive nature of these figures, given that the number of translations practically doubled in just under 17 months.[70] They also discuss the feedback provided by users, noting that it was 95% praise and that many users were commenting on the novelty of the system, although it is not clear how connected the level of praise and the novelty of the technology are, i.e., whether users are simply so enthusiastic and positive due to the novelty. They identify five uses of online MT: as an assimilation tool, as a dissemination tool, as a communication tool, as an entertainment tool and as a learning tool. They also comment on the fact that over 50% of the translations are of one or two words, thus identifying a trend of

[70] These figures are, nevertheless, insignificant when compared to the figures of modern MT systems. As previously mentioned, as of 2016, Google Translate, translated over 140 billion words per day and had 500 million monthly users (Lewis-Kraus 2016). However, it is worth noting that the scales used for reporting differ. Yang and Lange (2003) refer to “translations”, not specifying the number of words or size of these translations, whereas the figures for Google Translate are given in words. The figures for today are definitely higher given that each translation on 10/11/1999 would have to have been on average 189,133 words long and it seems from screenshots provided by Yang and Lange of the front page of Babelfish in 2002 that the size of translations was capped at 150 words.

using online MT as a dictionary, a trend that Gaspari (2007) also identifies and discusses in further detail. Indeed, as discussed in the introduction to this thesis, the five categories identified by Yang and Lange provide a useful framework and lens through which to analyse the use of MT and this is employed in both the analysis of the survey data in **Chapter 4** and the analysis of reviews in **Chapter 5**.

Gaspari's (2007) PhD thesis included a survey on the use of free online MT which consisted of questionnaires answered by students at his university. In total, the questionnaire had 280 respondents, 104[71] of whom had experience of using free online MT. The questionnaire also explored how people used free online MT at the time and found that most either manually typed or copied and pasted text into the MT system and a proportion of users had also used the engine to translate webpages, by either inputting a URL or clicking a link provided by a search engine to translate a page. The survey also provided an insight into what kind of texts users were translating on the MT systems, with the most popular choice being '*technical texts, business/commercial documents, academic papers, scientific articles*'. This is, perhaps, to be expected given that the respondents were university students, primarily studying languages.

Burgett (Burgett 2015) employed a survey of users to gather their views on Intel's support pages which, in large part, relied on MT to produce translations.

[71] Of the 280 respondents, 194 claimed they had used free online MT, but Gaspari (2007: 95/96) narrowed this down to 104 respondents by excluding those who had misclassified online dictionaries as free online MT and those who had said 'don't know' when asked the names of the services they had used. This was done to ensure the relevance and reliability of the data.

This was due to the volume of content and the budget available for translation. The survey found that users were generally satisfied with the quality of the MT and that it enabled them to use the help pages.

Nurminen and Papula (2018) used a short survey to gather data from users of Multilizer PDF Translator to conduct a snapshot of usage of one particular MT platform. They focussed on users who 'just want a basic understanding of the information (or gist) of the text, we term them *gist MT* users' (ibid.: 199). However, the focus of the current study is different in that whilst it may also encompass gist MT users, i.e., users who want to gain a quick understanding of a text, it is also focussing on users who may be using MT for a communicative action. These users, in addition to gaining an understanding of a text, may also wish to produce an utterance in a foreign language and communicate a point.

In some of the most recent research involving end use of MT systems, Heinisch and Lušicky (2019) conducted a study involving 47 postgraduate students on a translation master's program to explore user expectations towards MT. They asked participants to complete a questionnaire regarding their expectations of MT and also to perform an error analysis of a text translated by MT. The authors asked participants to identify 'whether they use MT for professional, study or private purposes, which MT systems they use and for which types of text' (ibid.: 43). The results showed that 62% of participants had experience in using MT and **Table 3.2** shows their findings in terms of the percentage of respondents using MT for each purpose identified by the authors and the frequency with which they report using MT.

	Percentage of respondents who use MT in this way	Frequency of use				
		Daily	Weekly	Several times a month	Several times a year	Never
MT for study purposes	93%	-	41%	15%	19%	-
MT for private purposes	69%	3%	21%	-	31%	14%
MT for professional purposes	31%	14%	7%	17%	7%	55%

Table 3.2 Heinisch and Lušicky's findings regarding MT usage and frequency

This high percentage of users using MT for study purposes is consistent with Gaspari's (2007) findings. In this study, the most popular MT systems that participants reported they used were DeepL (69%) and Google Translate (59%). Understandably, given the location of the authors of the study (Vienna), most students used MT for translating between German and English in both directions. They report that 'those experienced in MT use translated documents, e.g., reports or files (79%), ahead of web- sites (34%) or correspondence, e.g., e-mails (24%)' (ibid.: 45). They also asked students about their reasons for using MT, which are as follows:

- saving time (69%)
- getting the gist of a text (66%)
- consulting a reference (55%)
- avoiding repetitive work (31%)
- avoiding typing (21%)
- avoiding research (3%)

They also asked students what their priorities were for MT and found that 'draft translations were more important in a study context, whereas gist purposes (to

understand the meaning of the text) and final translations were more relevant in a private context' (ibid.: 45). Respondents were also asked to rank their expectations when working with an MT system and they found that '81% of the respondents ranked fast translation first. Proper functioning and intuitive use of the MT system ranked second among 60% of the respondents, whereas intuitive use still ranked third among 28% of the respondents' (ibid.: 45). Interestingly, participants in this study prioritise speed and efficiency of MT and these aspects seem to be the primary benefit of using the technology. This is evidence of the notions of speed and efficiency, detailed in **Chapter 2**, in the context of translation.

All of the above examples show that surveys have often been employed as a data collection method when evaluating MT systems, although they have often focussed on a specific MT system and have often been conducted by the system providers themselves. This is probably due to the system providers being interested in improving their product and also the fact that they can more easily access their users or have access to user feedback obtained through forms on the system's webpage that would naturally only be accessible to the developers of the systems. This does, then, signify an opportunity for further research into users of MT through questionnaires and there is significant opportunity for the establishment of a continuous survey to see how users' habits, usage and opinions are evolving over time.

3.3 Designing the questions for a survey of people's use of MT on a mobile device

The original plan for the survey was for it to focus on one specific MT app and be designed in conjunction with an industry partner (i.e., the developer of that

platform). Although I did engage with an industry partner through several online meetings and collaborating on the questions for the survey, the partnership did not come to fruition. Ultimately, the survey had to be launched without a focus on a specific platform and focus just MTA use more generally. Indeed, the original focus was on MTAs, but the data from the survey do indicate that the focus should have been MT use on a mobile device, and this is the terminology used going forward.

The survey was broken down into separate sections, which are also used in **Chapter 4** to present the analysis of the responses[72]. Firstly, participants responded to questions in the 'Demographic Information' section, in order to be able to draw comparisons relating to age and mother tongue. The next section, 'Your MT app(s)', asked participants about the MT app that they use (for example, Google Translate or Microsoft Translator) and how they access it. Participants were then asked questions about how they used MT (for example, frequency of use, type of content translated) on a mobile device in the 'Using the app section', and questions which focussed specifically on use of speech or text translation functionalities in the 'Speech & Text Translation' section. There was then a section entitled 'Quality & Priorities' that asked participants for their views on the quality of the translation provided by MT and finally a section called 'Extra questions' that asked participants about their overall thoughts on MT and how it works.

[72] Screenshots of how the survey appeared to participants are available in **Appendix A – the survey of MT use on a mobile device**.

3.3.1 Distribution of the survey

Firstly, it is worth noting that an online survey excludes 'potential respondents who do not have access to a computer and a network' (Lazar and others 2017), which is why it is sometimes preferable to distribute the survey using a mix of paper-based questionnaires and online. Similarly, paper-based surveys might also ensure better coverage and response rate, particularly if the target population can be accessed when they are all in the same place (e.g., if the participants in a survey will be undergraduate students on a particular course, it is possible to get a good response rate by distributing a paper survey in a lecture). However, for this thesis, a paper-based survey approach is not appropriate as the participants are geographically dispersed, not an easily defined or accessible group and there is not a space (physical or digital) where they congregate. Furthermore, having a smartphone and an internet connection are prerequisites for people to participate fully in this survey and the technology itself is only available via the internet (even used offline, it must first be downloaded). Therefore, in this instance, only distributing the survey online is viable and does not exclude any potential respondents, as all respondents are internet users.

The survey was designed and hosted on the Online Surveys platform.[73] This platform produces responsive surveys which participants can answer on both desktop and mobile devices. For a survey exploring use of MT on a mobile device, it was particularly important for the survey to be responsive and

[73] This was formerly Bristol Online Surveys and is a platform, hosted by Jisc, commonly used for performing surveys for academic research in the UK.

accessible on a mobile device. Before distributing the survey, a small group of people piloted the survey to check for typos, understanding of questions and comprehension difficulties. They reported that the survey was understandable and noted a couple of typos for correction. In addition, based on their feedback, an option was added for participants who do not use MT on a mobile device, with a single question asking why this is the case, thus enabling data to be captured from people who would otherwise be excluded from participating in the survey.

The survey was distributed to potential participants in autumn 2019 by a variety of channels: emails, mailing lists, social media (Facebook and Twitter, including posting on groups within social media) and a listing on the Callforparticipants website.[74] It should be noted that due to the ease with which links and materials can be shared via the internet, it is not known where the survey was shared by other people.

3.3.2 Limitations of this survey

It is important to note that there were some limitations and weaknesses to this study. Firstly, the survey was originally designed to focus on MTAs and, as it was designed with an industry partner to focus on their app, the majority of the questions referred to using an app. This did cause some confusion amongst participants. However, the fact that the majority of participants do not access MT via an app is also a finding of this survey and has shaped the usage of the term ‘MT use on a mobile device’. In future surveys, it would be useful to branch

[74] Callforparticipants is a platform, also hosted by Jisc, which researchers can use to create a listing for their research, which is then sent out to a potential pool of respondents.

participants out after the question asking how they access MT so that the questions then reflect their means of access, i.e., participants who have said they mainly or only access through the browser do not see questions asking about an app.

The sample size for the survey is relatively small and so cannot be used to provide data representative of the population. That said, it does provide some initial, small-scale insights into the ways in which participants use MT on a mobile device and could be used to facilitate the design of future surveys or research that seek to explore MT use. Similarly, the survey was spread through networks that I had access to, and, coming from a background in languages and being based at a university, the people it was spread to might have been more familiar with or interested in this survey and its topic and the population sample was more heavily skewed towards young people. It should be noted, however, that the aim of this survey was never to be representative – it was the first of its kind and exploratory in its nature, aiming to provide some insights and questions for further study.

3.4 Other sources of data on MT use and how to explore them

As Sun (2016: 276) notes, 'the survey method can be used alone or with other methods in a study' and they are often combined with focus groups or interviews in order to solicit more qualitative information and deeper insight about a topic. This is particularly true in cases where people are providing the data or when exploring people's perceptions of technology or services. However, as previously mentioned**,** in the case of MT on a mobile device, users are not a defined group of people as would be the case in researching audience reception of the fansubbing of a particular TV show or response to the subtitling

of a movie. Furthermore, with the principal method of data collection being an online, anonymous survey, respondents were located all around the globe and trying to organise a focus group or further research with them would not have been feasible.

Nevertheless, rather than actively soliciting further information regarding MTAs, it was instead possible to access existing repositories of information and collate and explore these data to compare to and expand on the results of the survey. One such source of data, specifically for MTAs, is the reviews of MTAs that users have left on app stores. There are no studies which have explored the comments that users make about MT and MT use in the reviews left on app stores, so this represents a novel source of data. Similarly, there is also more anecdotal evidence available in the form of stories of MT use on the MT stories blog run by the researcher Mary Nurminen, as well as in some papers exploring how refugees use mobile technologies when they arrive in the UK. These reviews and stories are presented together in this chapter as they are more qualitative in nature and provide potentially more detailed accounts of how users use MT on a mobile device. As such, these sources of information could also provide an insight, through anecdotal and empirical evidence, into the ways in which users are using MT, in greater depth and on a more personal level. This chapter first discusses the approach taken to extract the reviews left on the Google Play Store, the analysis and findings from this process and then discusses an analysis of the more anecdotal evidence, whilst bearing in mind the findings from the survey, exploring areas of correlation and contradiction.

3.4.1 User reviews of MT apps

It is common for developers of any service to request feedback and input from users as part of the ongoing development process. This is true of apps on mobile devices, with the largest app stores, Google Play and Apple's App Store, both allowing users to give apps a rating out of five stars (with five being the best and 1 being the worst) alongside a free-text reviews of the apps. As such, these free-text reviews of MT apps could provide a valuable source of data regarding the ways in which users use MT on a mobile device, and more specifically MTAs in this case. However, these reviews are qualitative and unstructured in nature, so the aim is not to draw any representative conclusion from this dataset, but to provide greater and richer insight into actual use cases of MT on a mobile device. Nevertheless, such reviews might provide an insight into what users like about MTAs and the challenges they face when using them, as well as some ways in which they use them. This complements the findings from the survey, providing a richer narrative that can explore how MT is used on a mobile device.

3.4.1.1 Methodology

A sample of 300 one-star reviews, 300 three-star reviews and 300 five-star reviews was taken from the Google Play Store for Google Translate and Microsoft Translator on October 14 2019.[75] These are two of the most popular MTAs more generally, but also on the Google Play Store. As of October 14 2019, when this analysis was conducted, Google Translate had over 500,000,000 installs and just under 6,000,000 reviews and Microsoft Translator

[75] Reviews were not taken from Apple's App Store due to the reviews being unavailable and inaccessible from a desktop browser. As such, it was not possible to take the content of the reviews and analyse them.

had over 10,000,000 installs and just over 300,000 reviews. The Google Play Store allows users to order the reviews in three ways (newest, rating or most relevant)[76] and to filter them by the type of device and/or by the number of stars given.

The reviews were sampled using the following approach: ordering them by most relevant, ignoring the device filter[77] and then selecting the star rating and taking the first 300 reviews that appeared for each star rating. The only information taken was the date posted and the text of the review. This was done for Google Translate and then Microsoft Translator, providing 900 reviews for each app and a total of 1,800 reviews for analysis, with reviews dated between September 12 2018 and October 13 2019.

3.4.1.2 Why not use a representative sample?

Another sampling approach is a representative sample which is sampling 'that has strong external validity in relationship to the target population the sample is meant to represent' (Lavrakas 2008: 720). For example, on a basic level, if the overall population is split 60% male and 40% female, the sample taken could also reflect this proportion, with 60% of responses from male participants and 40% from female participants. In the case of reviews on the Google Play Store, it could also be possible to reflect this by accounting for what percentage of all reviews are five-star, three-star and one-star. However, there is no way of accurately determining this percentage as the only information regarding the

[76] It is unclear what 'most relevant' means – it seems to prioritise more recent reviews, since the latest update to the app, as well as some of the most popular reviews (users can mark other reviews as helpful and a total for the number of people who have done so is given for each review).
[77] The device filter does not appear to refer to the devices that users have, but rather the devices owned by the person looking at the reviews.

number of reviews is the total reviews for an app. It is not possible to determine the percentage of reviews for each star rating from the bar chart that purports to display the proportion of reviews for each star rating. The bars do not provide a number or percentage value and in the webpage's underlying code the five-star review bar is 100% (of its container on the webpage) and, to take an example, the four-star bar is 17% (of its container on the webpage). As such, this could mean that that the number of four-star reviews is equal to 16% of the number of five-star reviews or of the total number of reviews. Considering this lack of clarity around the number or proportion of reviews that exist for each star rating, and the aim not to be representative of the population, but to be an exploratory study into this dataset, a representative approach was not used. This study will provide directions for further research and potential focuses or hypotheses for representative studies.

3.4.1.3 How the reviews were analysed

To analyse the data contained in these reviews, I created a database on Microsoft Access and imported the data in its raw form from Microsoft Excel spreadsheets into this database. Microsoft Access provided an easy way in which to tag these reviews to analyse their content. Firstly, in the data table, I added a new field for each tag that I might want to use for the reviews. The tags for the review data were initially designed based on the questions asked in the survey discussed in **Chapter 4**, as this survey was originally designed with an industry partner to solicit information that might be useful to MTA developers. As such, it was sensible to approach the reviews in the same way, so that the

findings might prove useful to MTA developers. **Figure 3.2** shows a blank version of the form that I created to tag the data.

Furthermore, one approach that can be used with qualitative data is grounded theory. This is a research method centred on two basic principles: 'the first is that the data analysis should be based on empirical findings (grounded) and follow a specific sequential coding system. The second is that the analysis should produce some "theory" as an outcome of the investigation' (O'Brien and

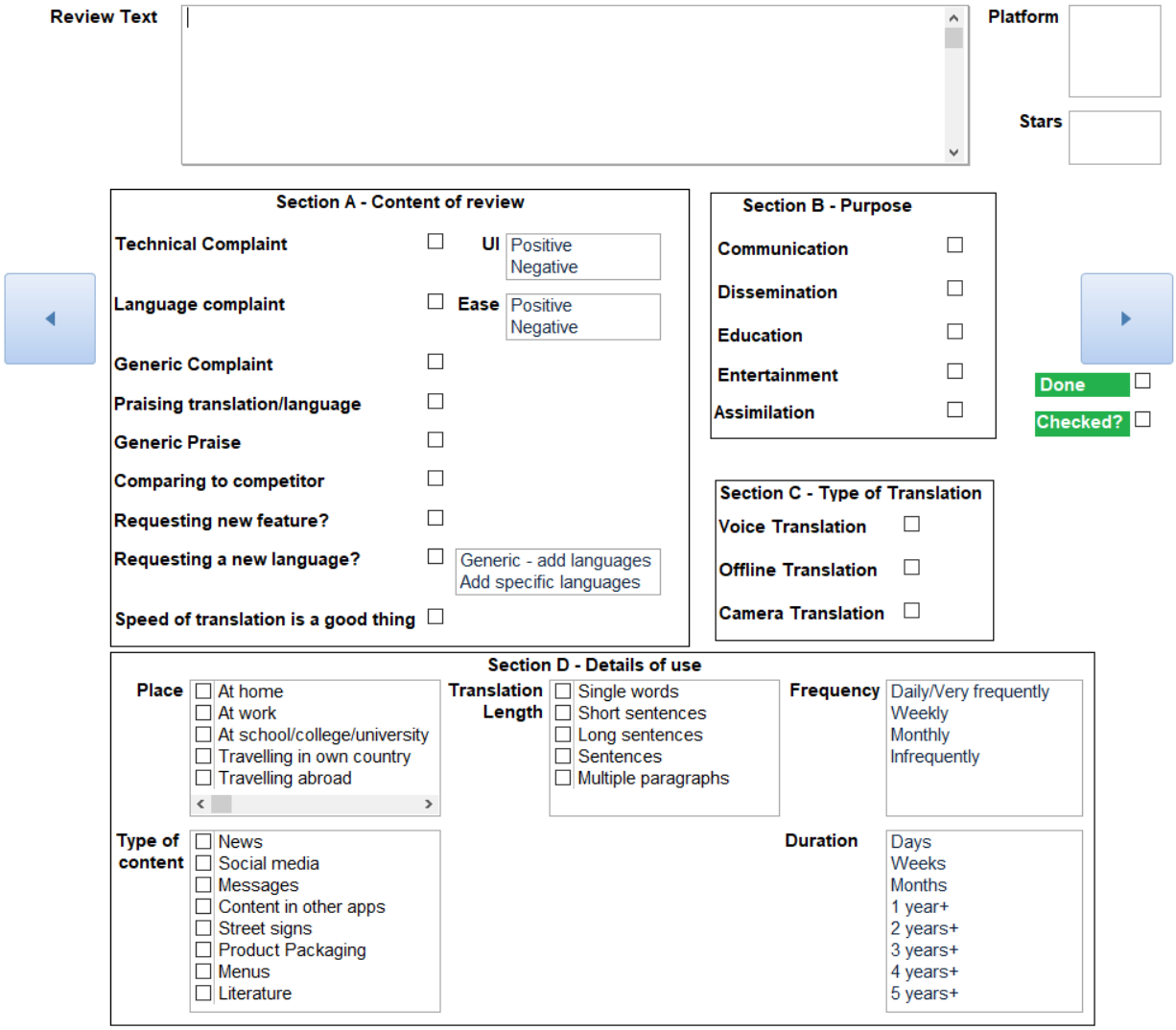


Figure 3.2 An example of the form used within the database to tag the review data

Saldanha 2014: 191). The methodology employed in this thesis draws primarily on the grounded element of this approach in two ways. Firstly, whilst being

grounded in empirical findings through additional tags being devised based on the data, it is also grounded in a different sense in that the tags emerge from the questions to which industry developers of MTAs would like information about. After the first tagging of the data, I performed a second tagging of the data including tags which had been created based on evidence for them being present in the findings. For example, the ‘requesting a new feature’ and ‘speed of translation is a good thing’ tags were added after I noted that many reviews requested new features and commented on how fast the app provided a translation. This approach is thus also grounded in using tags emerging from the dataset.

Table 3.3 provides an explanation of what is meant by each of the tags and examples of reviews that were tagged using each tag to demonstrate why a review would be tagged in that way.

Table 3.3 The tags used to tag the data, what is meant by each tag and an example of content that would fit this tag

Review Tag	Explanation	Example(s)[78]
Section A – Content of review		
Technical Complaint	Reviews that complain about the app due to a technical problem, such as a bug or glitch, i.e., a feature not working or a language pack not downloading.	• 'didn't tranlate anything. just flickering green dots' • 'When images are imported to translate they rotate 90 degrees, please fix this.'
Language Complaint	Reviews that complain about the quality of translation (in general and for particular languages) or about the quality of a particular language (e.g., the comprehensibility of the spoken translation).	• 'Terrible Japanese translation which i would not recommend' • 'Image translated was bad. It gave very wrong translation.'
Generic Complaint	Reviews that are negative in nature and do not fit into the other two categories of complaint.	• 'Please dont download it. its not working.' • 'Quite good. But needs Improvement'
Praising Translation/Language	Reviews that are positive about the quality of the translation. This could be in general or for a specific language/language pair.	• 'Love this app, everything about. Super accurate translation. I would appreciate if you could do a night mode because it would be quite helpful, my eys hurt me when I try to translate something in the dark because it's so bright.'

[78] All examples randomly chosen from the reviews tagged with that particular tag. Any errors in the text in this column were present in the original comment and no corrections have been made here.

Review Tag	Explanation	Example(s)[78]
Generic Praise	Reviews that are positive in nature, but not focussed on the quality of the translation/language.	• 'This app is awesome...' • 'It works great. The language files are to large to download. It could be better if the app would translate your text mssgs as you receive them rather than using copy/paste .'
Comparing to competitor	Reviews that compare the app to a competitor app. This could be in a positive (i.e., this app is better than competitors) or a negative (i.e., this app is worse than competitors) way. They could also be explicit or implied, e.g., by stating 'this is the best translation app'.	• 'it really sucks. Google translate is much better.' • 'A very nice application. it is the best translation app that I know'
Requesting a new feature?	Reviews that state they would like to see a new feature or functionality added to the app.	• 'Dear Developer Please improve the scanning system for PDF file also.' • 'plz make a EDIT option in translation history for translating easily without type any full sentences one more time .... thank you'
Requesting a new language?	Reviews that are requesting a language or languages to be added to the app. This might be an explicit request, e.g., 'add language X' or implicit, e.g., 'language Y is missing'. In addition, a sub-tag was used to indicate whether the review was requesting a specific language or just requesting that more languages are added to the app.	• 'There is no kannada language. That's why i am uninstaling this app..' • 'You guys need to add more languages.'

Review Tag	Explanation	Example(s)[78]
Speed of translation is a good thing	Reviews that comment on the speed of the app and/or translation being a positive or reviews that comment on slowness being a negative (i.e., it can be assumed that the opposite (speed) would be a positive)	• 'The ability to translate easily and quickly is useful and much appreciated.' • 'Love this app !!! Very fast translation !!!'
UI (User Interface)[79]	Reviews that comment on the UI of the app or on the aesthetic appeal of the app. Reviews could be classed as making positive or negative comments on the UI.	• 'awkward to use....won't work in horizontal position' • 'Easy to use and much better than most other usual alternatives. Interface is really the best!'
Ease[79]	Reviews that comment on how easy or difficult the app is to use. Reviews that comment on the ease are classed as positive and reviews that comment on the difficulty are classed as negative.	• 'Easy to use. Large text for visually impaired folks.' • 'wont stop running. if it would just stop running when I am not using it, I would give it good rating. but i cant even see how to stop it. needs to be more user friendly about that issue.'

[79] These are two closely related and interlinked ideas and there is often a direct correlation between the two. However, a system can have an appealing user interface but still be difficult to use (perhaps in part due to the UI).

Review Tag	Explanation	Example(s)[78]
Section B - Purpose		
Purpose	Where reviews mentioned the ways in which they used the app, the purpose was tagged according to the five purposes identified by Yang and Lange (2003). This purpose, if not clear from an explicit statement such as 'I use this to practise words in French', could often be discerned from their description of their use.	• 'my polish friends had no idea when i said a few things from the translations. it was completely different words. then when i used google translation it was spot on.' (Communication) • 'It is really usefull in study' (Education)
Section C – Type of translation		
Voice Translation	Reviews that mention using the text-to-speech, speech-to-text or conversation features of the apps.	• 'Useless. If it can't do voice translation without a high speed data connection it does me no good in foriegn countries with slow cell data.' • 'it doesn't work all the time. or it works for half a conversation then stops working. when it works it is good.'
Offline Translation	Reviews that mention using the app offline by downloading language packs or reviews that mention they would like certain languages to be available for offline download, thus indicating that they would use the app for offline translation.	• 'Overall its good app for translation but..google needs to improve its offline language version..sometimes its shows wrong translation....perhaps when we are online its show complete translation. .so...overall good but need improvement' • 'Excellent and fast. Love that you can download languages offline.'

Review Tag	Explanation	Example(s)[78]
Image Translation	Reviews that mention translating images via the app. In the case of Google Translate, this could be both via using the device's camera and also via importing an image from the device's gallery. For Microsoft Translator, it is only possible to translate via the device's camera.	• 'What a great technology and that camera is really very helpful Thanks!!!' • 'I use Microsoft Translator when dealing with German or French electrical schematics and it is really useful. Also works well with the camera to translate entire paragraphs. Excellent tool!'
Section D – Details of use		
Place	If a review mentions a specific place where they use the app, such information can be captured by using these tags.	• 'I'm 60 yrs. old. Educated but never learned Spanish. My fault for being lazy. I'm working on a construction site with my Spanish speaking Associates. This appears to be an amazing answer to my communication issues! I have a Google Pixel 2. Seems to work okay despite the software company differences.' • 'Easy to use. Usefull when travelling'
Type of content	If a review mentions what type of content they use the app to translate, such information can be captured using these tags.	• 'I use this app often, as I'm living and working in China. Until recently, though, I was able to take a screenshot or a picture and then scan and translate from that. I mostly used that option when trying to translate online menus from screenshots. The option to load a photo to scan seems to be gone. What's up with this?' • 'Use it every day to translate Chinese product and news pages.'

Review Tag	Explanation	Example(s)[78]
Translation length	If a review mentions whether they use the app to translate single words, sentences or paragraphs, such information can be captured using these tags.	• 'I'm not sure if I did something wrong, but I downloaded the Japanese folder and still couldn't get any proper translations. I tried photographing a full sentence, a single word, and typing one in, both hiragana and romanji and got gibberish for the translation result.[…]' • 'The translating of one word is okay. But if you translate sentences, they don't have any sense.'
Frequency	Some reviews commented on how frequently they used the app. The way in which users did this varied, e.g., 'all the time' (which could be interpreted as every day, every other day, once a week etc.) or 'always in use' (which could equally be interpreted in different ways). As such, generic tags of 'frequently' or 'infrequently' were applied.	• 'Awesome translator! I use it all the time.' • 'This app is very helpful for me.I have learned many English language from this app. And I use this in my daily life'
Duration	If a review mentions how long they have been using the app, such information can be captured using these tags.	• 'Very Helpful when you need something translated fast 💯 i been using this app for almost 5 years Thank you for creating this 💯 😄' • 'Wow , it's a great service of Google . It's very very useful for all . I use this apps more than last one year . I am very happy about the service .'
Misc		
Done?	The 'done' and 'checked' tags were added to facilitate the tagging of the data. On the first tagging of the data, a review was marked as 'done' once I had finished tagging it. On the second tagging of the data a review was marked as 'checked' once I had finished tagging it. These tags enabled me to apply a filter to exclude all entries that had	

Review Tag	Explanation	Example(s)[78]
Checked?	been marked as ‘done’ or ‘checked’. This facilitated the tagging process as it meant I did not have to click through all reviews each time and could simply start again at the point I had reached last time. This was necessary as, due to the large sample size, the tagging process was not completed in one sitting, but rather in several sittings over a period of time.	

Finally, it should be noted that not all reviews generated tags in all categories, due to the free nature of the reviews. That is, when a user chooses to submit a review, there is no requirement beyond selecting a star rating for the app. As such, users provide information in a non-facilitated and unstructured manner and, as the reviews are free-text based, are able to include comments (or not) on anything that they choose.

3.5 Conclusion

This chapter has discussed the research methodologies used in this thesis to gain an insight into the way in which MT is used on a mobile device. It started by exploring surveys as a research tool and how they have been used to study translation and translation technology before. It then discussed how the survey questions were designed, how it was distributed and the limitations of the approach. Building on this, it then discussed the methodology employed to collate data from another source, reviews of MT apps, explaining the number of reviews and how they were extracted, tagged and analysed. The following two chapters expand on this through presenting and discussing the findings from these approaches.

Chapter 4 Analysis of a survey exploring use of MT on a mobile device

Having explored the methodologies used in this thesis to examine use of MT on a mobile device in the previous chapter, this chapter builds on this, employing these to generate new data and insights. It presents the findings from the first data collection method, a survey. Firstly, section **4.1** provides an overview of the responses received to the survey and discusses the two principal subsets of participants identified – those who use MT on a mobile device and those who do not. Section **4.2** provides a question-by-question analysis of the responses received, broken down into two sub-sections, one for each of the two principal groups of participants. Finally, section **4.3** synthesises the overall findings from the survey, and draws out some questions for further research.

4.1 Survey responses

In total, 212 participants provided usable responses to the survey.[80] Questions 1 - 5 simply involved participants providing their consent to participate in the survey and demographic information, so were answered by every participant. Questions six and seven then asked participants which MT service they use and how they access it on a mobile device or whether they do not use MT on a mobile device. This allowed for the establishment of two subsets of participants, as is detailed in section **4.1.1**.

[80] There were, in fact, 177 responses in the category "A. Participants who use MT on a mobile device". However, two of these did not answer question Q7, so their responses were excluded from the dataset as many questions are broken down by the way in which the participant accesses MT on a mobile device.

4.1.1 Subsets of participants

Table 4.1 shows the split between participants who do use MT on a mobile device and participants who do not use MT on a mobile device.

	#	%
Participants who **use** MT on a mobile device	175	82.5%
Participants who **do not use** MT on a mobile device	37	17.5%
Total	**212**	**-**

Table 4.1 The number and percentage of participants who use/do not use MT on a mobile device

In this survey, just over 80% of participants use MT on a mobile device, indicating a high level of exposure to, awareness of and use of MT on a mobile device. As this is, to the author's knowledge, the first survey of its kind, specifically focussing on MT use on mobile devices, although not representative of a population, it does verify the hypothesis that use of MT on a mobile device does represent a large, understudied area of MT usage.

Based on **Table 4.1**, there are two distinct principal subsets of participants:

A. participants who use MT on a mobile device
B. participants who do not use MT on a mobile device

This research focusses on how people use MT on a mobile device, so subset A forms the bulk of the data and discussion in this chapter. However, participants who fall in subset B, after answering question 7, were then routed to question 29. This question asked them why they do not use MT on a mobile device, in order to not completely exclude them from the survey and to gain some insight into what stops them using MT on a mobile device. The findings from those who do use MT on a mobile device are presented and analysed first. There then follows a short section on the findings from participants who do not use MT on a mobile device. Whilst the responses show there is interest in MT,

the proportion of participants that fall in categories A and B is not representative of anything.

As only the first five questions of the survey were mandatory, the exact number of participants who responded to each question varied. As such, for each question, a count table is provided, detailing the total number of participants who answered that question. As such, the percentages for each question are calculated using these counts, not as a percentage out of the overall number of participants who responded to the survey.

4.2 Question-by-question analysis

This section presents the findings from the survey on a question-by-question basis, for both subsets of participants. It begins with the large subset, those who do use MT on a mobile device, and ends with the smaller subset, those who do not use MT on a mobile device.

4.2.1 Participants who use MT on a mobile device

This section explores the responses from those who fall into dataset ‘A. participants who use MT on a mobile device’ and represents the bulk of the data obtained as these participants had the most questions to answer and were also the most numerous, with 177 participants falling in this category.

4.2.1.1 Demographics (Qs 1-5)

The first questions of the survey, involved collecting permission to participate, demographic information - age, nationality, mother tongue and other languages spoken. This may allow some conclusions to be drawn about the profile of users of MT on a mobile device and explore any differences based on these characteristics.

Q1 Agreement to participate

This first question of the survey asked participants whether they agreed to participate in the survey or not. All 214 respondents agreed to participate in the survey.

Q2 Age

The survey was open to anybody over the age of 18 and participants were asked to input their age by typing it in. Two results were excluded from this question as participants either mistyped their age or did not wish to disclose their actual age.[81]

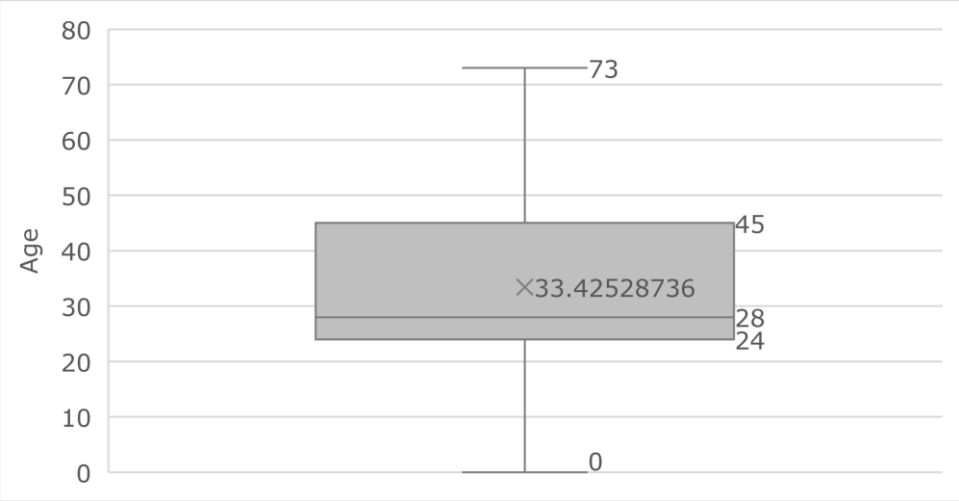


Chart 4.1 Ages of participants who have used MT on a mobile device

These data suggest that use of MT on a mobile device is much higher among younger participants, with the upper quartile at 45 showing that 75% of participants in this survey were under 45 and the median at 28, indicating that 50% of participants were 28 or under. It seems, then, that usage of MT on a mobile device is less common among older participants or that older people did not respond to the survey. This does correlate with the fact that smartphone use in the UK is lower among older age groups (Statista 2020a) and that internet access via a mobile phone is lower amongst older age groups (Statista 2020b).

[81] One stated their age was 213 and one stated their age was 277.

Q3 Nationality

The survey did not focus on a particular nationality or location and had an international reach, with participants from 31 different countries, although the majority of participants (56.6%) were from the United Kingdom (this is to be expected given that I am located in the UK, that the majority of the ways in which the survey was distributed was via UK links and that the survey was in English). **Chart 4.2** shows the nationalities of the participants and the number of participants for each nationality.

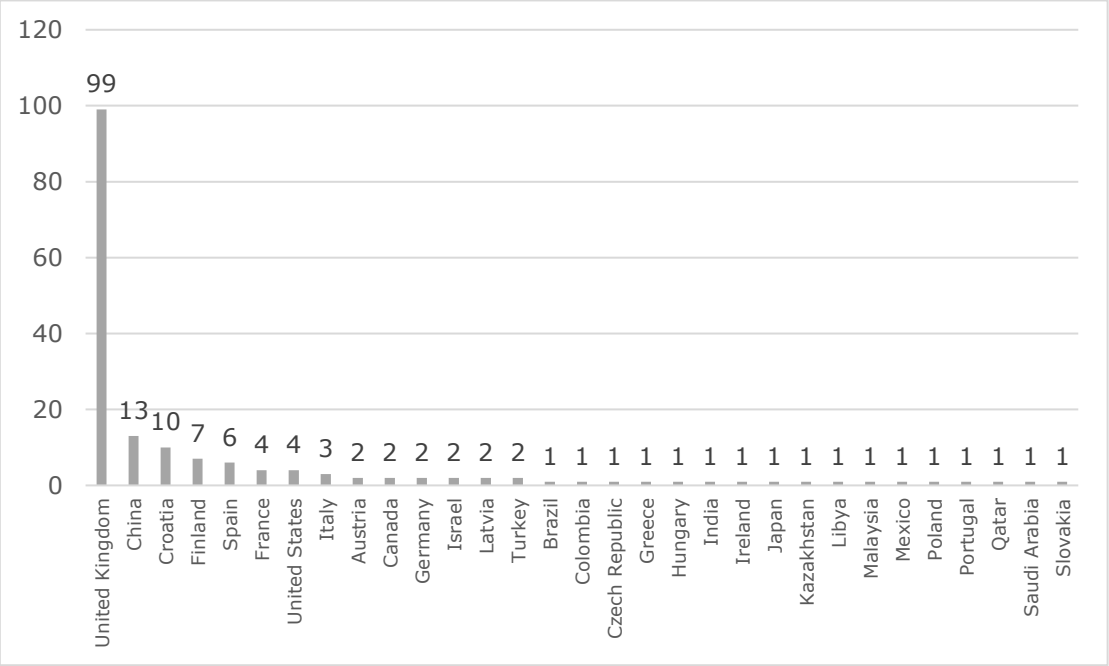


Chart 4.2 Nationality of participants who have used MT on a mobile device

Q4 Mother Tongue

Unsurprisingly, given the nationality of the majority of respondents, English was the most common mother tongue among the participants of the survey (60.0%). **Chart 4.3** shows the mother tongues of all the participants and the number of participants for each mother tongue.

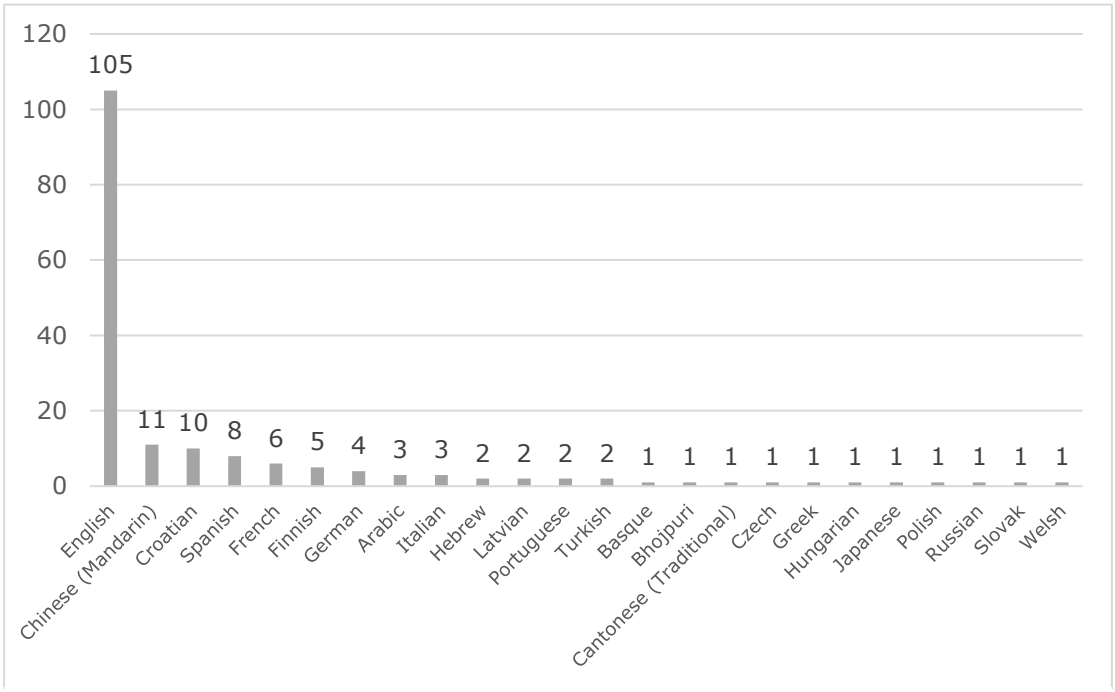


Chart 4.3 Mother tongue of participants who have used MT on a mobile device

The chart does indicate a good spread of native languages, with 25 different mother tongues among the participants, despite the number of participants with English as a mother tongue (henceforth Anglophones) being much greater than those whose mother tongue is not English (henceforth non-Anglophones). This question allowed for the creation of two subsets:

Anglophones	105
Non-Anglophones	70

Q5 Other languages

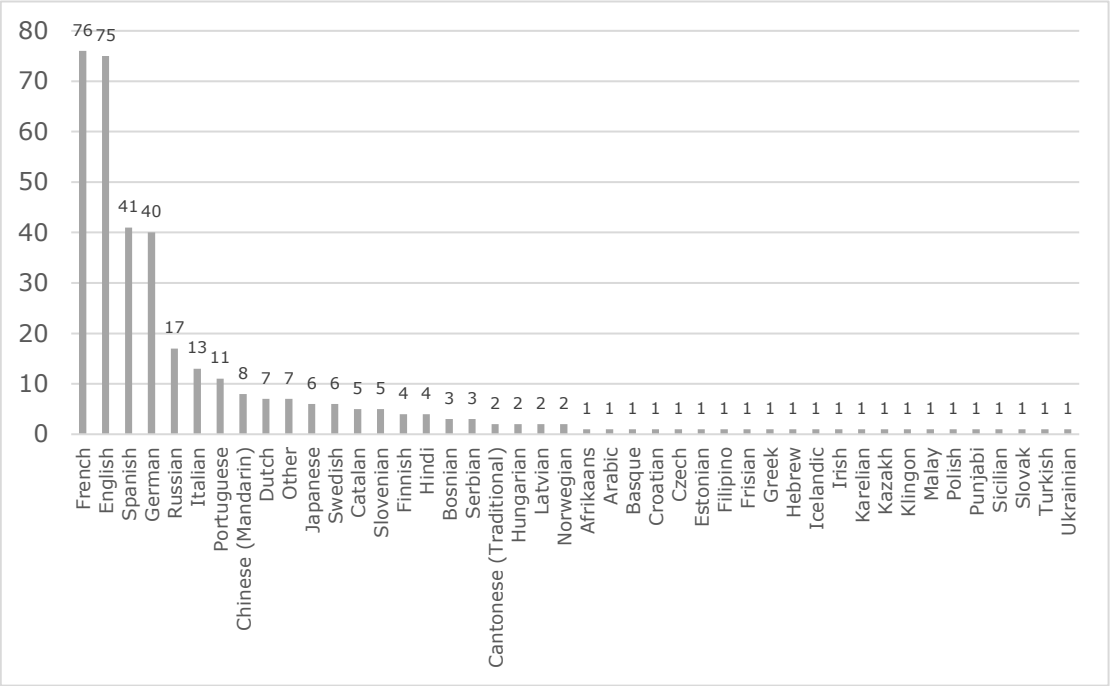


Chart 4.4 Other languages spoken by participants who use MT on a mobile device

All of the languages spoken by survey participants and the number of participants who speak each language are shown in **Chart 4.4**. Overall, there were 44 languages spoken by the participants. The most common other language spoken was French, which is unsurprising given that the majority of respondents are from the UK and, as of 2019, French remains the most popular L2 to study at school in the UK (Tinsley 2019). English was the next most common other language and this is also unsurprising given its worldwide usage as a lingua franca and the number of people who have it as their L2 (Eberhard and others 2022). In total, 146 (82.5%) out of the 177 participants who use MT on a mobile device speak more than one language. This suggests that the survey participants might be overly representative of people who speak one or more language. This could especially be true given that in the UK (the nationality of the majority of participants, see Q3 Nationality) the country is largely composed of people who do not speak more than one language. In

2016, for example, only 34.6% of people aged 25-64 in the UK reported they knew one or more foreign language (Eurostat 2019), which contrasts with the 106 participants in this survey from the UK who do use MT on a mobile device, of whom 69 (65.1%) do speak more than one language.

4.2.1.2 MT service and means of access (Qs 6-7)

Q6 Which machine translation service do you use?

This question offered participants a list of common MT platforms[82] and also provided an 'other' option which then asked participants to specify the service they use.

Platform	Number	Percentage
Google Translate	169	95.5%
Other	41	23.2%
Microsoft Translator	17	9.6%
iTranslate	5	2.8%
Speak & Translate	1	0.6%

Table 4.2 The number and percentage of participants who use different MT services

From this question, it is evident that participants use a wide variety of MT services, as **Table 4.2** and **Table 4.3** show. **Table 4.2** shows that Google Translate is by far the most popular MT service, with over 95% of those who use MT on a mobile device using this platform. In fact, only eight participants (4.6%) did not use Google Translate at all, as all the users apart from these eight used Google Translate alongside other MT services. In short, in this study,

[82] At the time of the survey, these were some of the most downloaded MT apps on the Google Play Store.

Google Translate is by far the most popular MT platform among participants who use MT on a mobile device.

Table 4.3 shows the answers that participants gave for ‘other’, along with the number of participants who stated they use that platform and whether it is actually an MT service or not. This was done as some answers provided by participants are not actually MT, but are online dictionaries or other online language resources.

Platform	Number	MT
DeepL	12	Y
Word Reference	6	N
Yandex	4	Y
Baidu	4	Y
Linguee	4	N
Youdao	2	Y
Sogou	2	Y
Bing Translator	2	Y
Tilde Translator	1	Y
eTranslation	1	Y
Facebook Translation	1	Y
Instagram Translation	1	Y
Reverso	1	Y
Spanish Dict[83]	1	N
Leo Dictionary	1	N
Traductor de voz[84]	1	N/A
Apertium	1	Y
eTranslation	1	Y
ItalianTranslation Offline	1	Y
Babel	1	Y
Neuronal translator eu<>es[85]	1	Y

Table 4.3 The MT services used by participants who selected 'other'

There are perceptions that certain MT platforms are better for certain languages. For example, users may believe that as Yandex is a Russian company it will be better at translating Russian. This may be due to brand

[83] This is a dictionary/language learning tool. If you type in longer sentences, it does have MT available, powered by Microsoft Translator by default, although you can choose other platforms (such as SDL or PROMT) as well.
[84] This is an app which allows the user to choose from 4 other MT services to perform the translation (Google Translate, Microsoft Translator, Yandex and Baidu).
[85] This is an MT service by provided by the Basque regional government, only available for Basque-Spanish.

familiarity or a belief that a certain platform will be better for certain languages based on where the company that has developed it is from. The data here suggests that some users are being quite literate with MT, choosing the app that works best or is perceived to be best for their language pair(s) or specific needs or purposes. For example, five of the Yandex users have Russian as one of their languages and so have chosen the app that is best for one of the languages they speak.

Conversely, these data do indicate that there remains some misunderstanding around what MT is and what constitutes an MT service as 12 participants (6.9%) stated they use something which is not, in fact, MT. Rather, they are all online dictionaries that enable the user to look up words or phrases, apart from Linguee which allows users to search pre-existing translations, functioning essentially like a TM.

Indeed, a lack of awareness around the distinction between MT and a dictionary or when one should be used and the other should be used has been recognised by Yang and Lange (2003) and Gaspari (2007). These findings indicate that the issue of users knowing whether something is MT or a dictionary still persists, but is perhaps less prevalent. This is because, in this case, only eight

Figure 4.1 Screenshot of Linguee accessed through a mobile browser on 15/5/20

participants mentioned online dictionaries when asked what MT service they use and only one of those said they exclusively use that dictionary (the other seven participants, although mentioning a dictionary, also responded that they used an MT service). Similarly, there is further confusion with Linguee which, despite being more akin to a TM, advertises itself as an online dictionary, as shown in **Figure 4.1**.

It is possible, then, that although these tools are different from a technological perspective, functionally and operationally for the user there is not always such a distinct difference. That is, users can employ different tools to achieve the same outcome and as long as their purpose is fulfilled, it does not matter whether they are aware exactly what sort of tool they are using. It could also show a different kind of engagement and literacy among users in that they find the best tool for their needs, as of those who mention they use dictionaries (Wordreference, Spanish Dict and LeoDictionary), 6 out of 7 (85.7%) also most frequently translate single words. As dictionaries offer different options when compared to MT, this shows a level of engagement and understanding on the part of the user as they have identified the better tool for their purpose.

Q7 Do you access machine translation...?

Chart 4.5 shows the number and percentage of participants who use the browser, use an app, or both, to access MT on a mobile device. The findings of this question were key to changing the overall focus from MTAs to MT on a mobile device, given that most participants access MT on a mobile device through a browser and/or an app, rather than exclusively through an app.

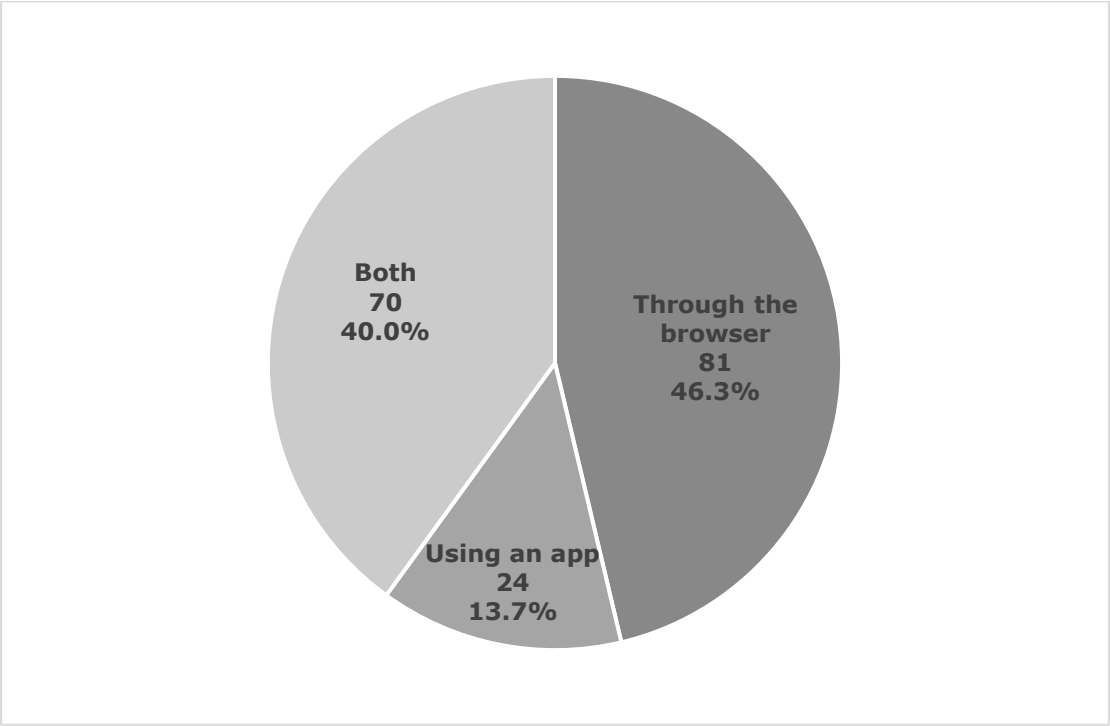


Chart 4.5 Participants who access MT through the browser, through an app or both

Table 4.4 provides a further analysis of these figures, showing the total number of participants who access MT through the browser or through an app.

	Only	%	Total	%
Through the browser	81	46.3%	151	86.3%
Using an app	24	13.7%	94	53.7%

Table 4.4 Total number of participants who access MT through the browser or through an app

From these data, it is evident that participants mainly access MT on a mobile device through a browser, with 86.3% of participants in total accessing MT in

this way and 46.3% of participants only accessing MT in this way. However, a significant percentage of participants, 53.7%, also access MT through an app, whilst the number accessing MT exclusively through an app is not as high at only 13.7%. Therefore, in this study, participants mainly access MT on a mobile device through the browser rather than through an app. Further research is needed to understand why users choose to access MT in this way, but a working hypothesis could be that as it is so simple to access and use through the browser, there is no need to install a dedicated app for it.

4.2.1.3 Use of MT (Qs 8-12)

Q8 How frequently do you use your machine translation app? (Single answer)

All	175
Browser	81
App	24
Both	70
Anglophone	105
Non-Anglophone	70

Chart 4.6 shows how frequently participants use MT on a mobile device.

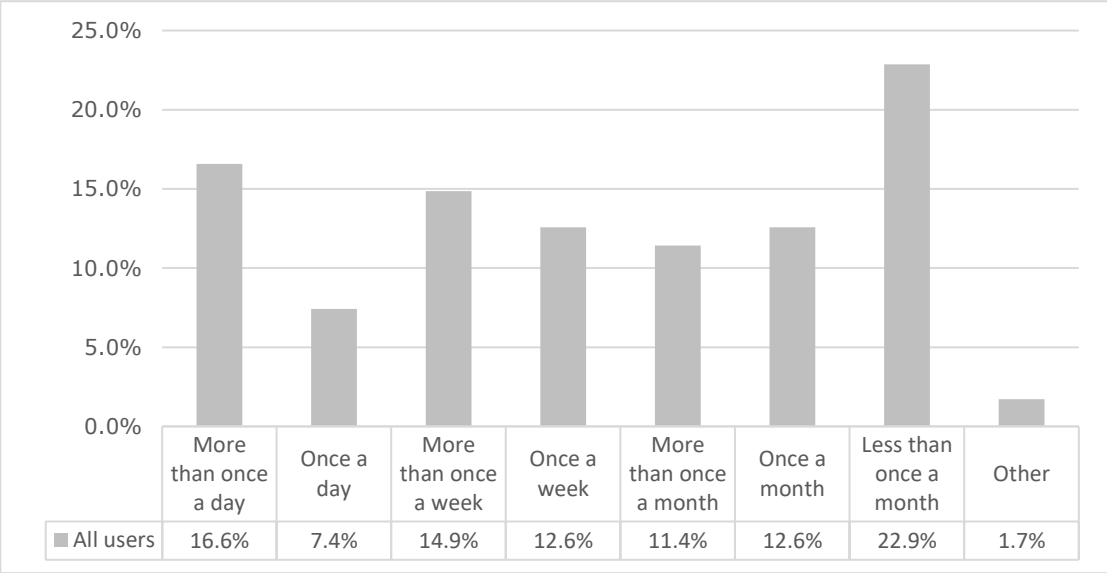
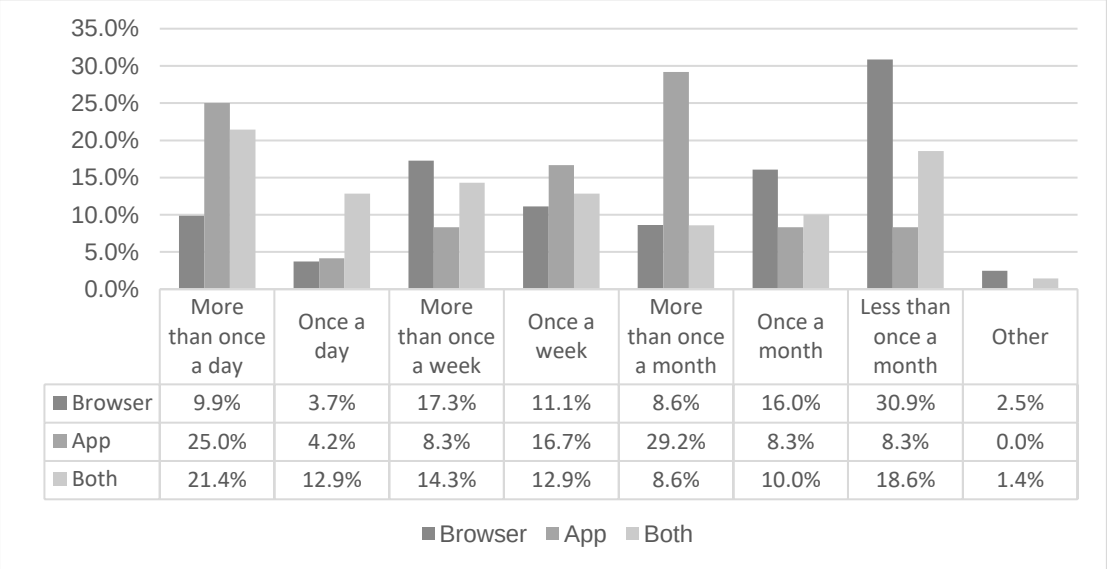


Chart 4.6 How frequently participants access MT on a mobile device

The most frequent response to this question for all participants who use MT on a mobile device was ‘less than once a month’ (22.9%), indicating that nearly one quarter of participants are infrequent users of MT on a mobile device. The chart shows that frequency of use is quite spread out, however looking at the data cumulatively most participants (51.4%) use MT on a mobile device once a week or more.

However, it is possible to further break down this information, based on whether participants access MT through an app, browser or both, as shown in **Chart 4.7**.



	More than once a day	Once a day	More than once a week	Once a week	More than once a month	Once a month	Less than once a month	Other
Browser	9.9%	3.7%	17.3%	11.1%	8.6%	16.0%	30.9%	2.5%
App	25.0%	4.2%	8.3%	16.7%	29.2%	8.3%	8.3%	0.0%
Both	21.4%	12.9%	14.3%	12.9%	8.6%	10.0%	18.6%	1.4%

Chart 4.7 Frequency of use separated by whether participants use MT through a browser, an app or both

As the chart shows, the subset which uses MT most frequently, i.e., ‘more than once a day’, are participants who use an app (25.0% vs 9.9% for browser and 21.4% for both). Indeed, cumulatively, app users use MT on a more frequent basis than browser users, with 54.2% of app users using MT at least once a week compared to 42.0% of browser users. However, this figure is even higher for participants who access MT through a browser and an app, at 61.4%.

Generally, then, participants who install an app to use MT are more likely to use MT more frequently than participants who do not install an app. Installing an MT app indicates a level of preparedness and a greater need for MT on a mobile device. Furthermore, and based on the analysis of the reviews left on MT apps on the Google Play Store (see **Chapter 5**), it is only possible to access MT offline by installing an app, and this may be of particular concern for participants with limited access to internet or caps on their mobile data usage.

Additionally, as English is currently one of the world's major lingua francas, with more L2 speakers than L1, it is also interesting to examine frequency of use for Anglophones and non-Anglophones, as shown in **Chart 4.8**.

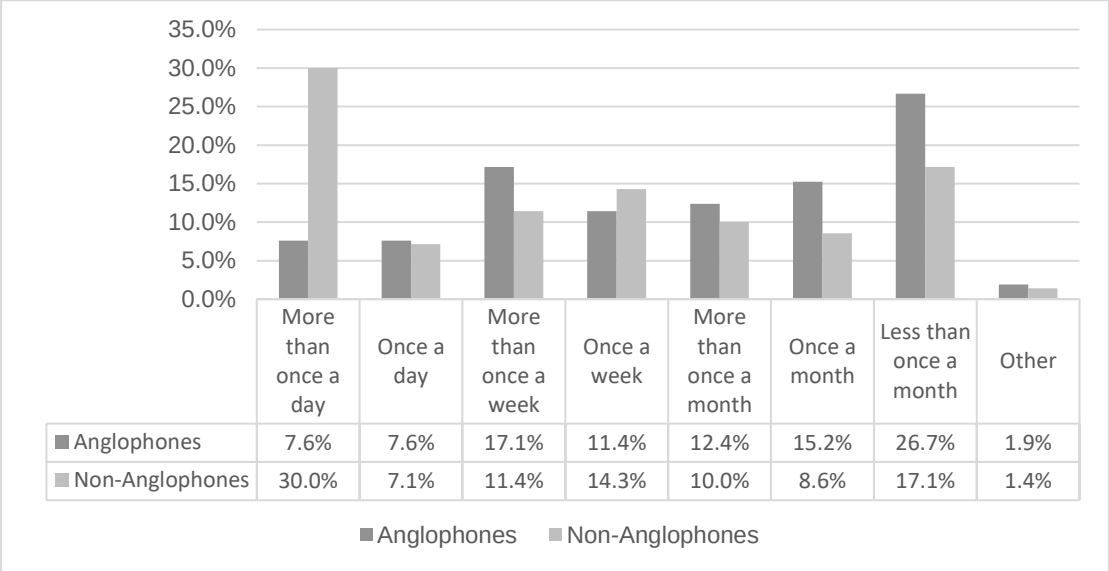


Chart 4.8 Frequency of use of MT on a mobile device for Anglophones/non-Anglophones

This chart indicates that non-Anglophones use MT on a mobile device much more frequently than Anglophones. This could be explained by the dominance of English as the language of tourism and international business, so speakers of English may be less likely to need to use MT to communicate. This provides an interesting avenue for further research, to explore whether a person's native language affects how frequently they use MT, both on a mobile device and

more generally. In this survey then, non-Anglophones are much more frequent users of MT on a mobile device than Anglophones.

Q9 When do you use your machine translation app? (Multiple answer)

All	171
Browser	77
App	24
Both	70
Anglophone	103
Non-Anglophone	68

This question was designed to gather information about where participants use MT on a mobile device, working on the hypothesis that participants might use MT most frequently when travelling and encountering other languages.

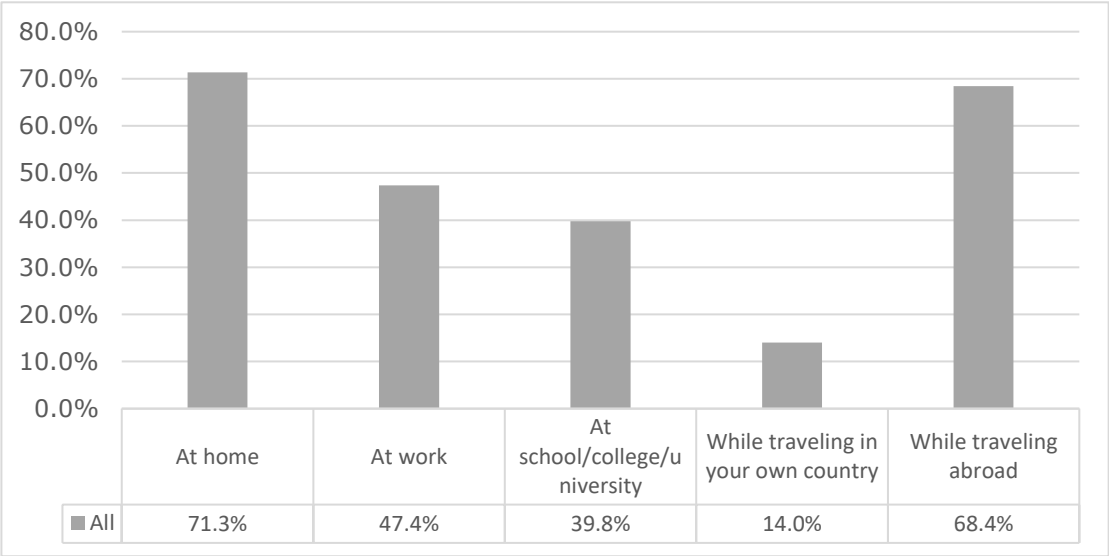


Chart 4.9 Where participants use MT on a mobile device

As **Chart 4.9** shows, the places where participants use MT on a mobile device most are ‘at home’ (71.3%) and ‘while traveling abroad’ (68.4%). The latter is unsurprising and coincides with the hypothesis, given that it is when travelling abroad that users are likely to encounter other languages and so need to use MT to communicate. The former is somewhat surprising given that users are unlikely to encounter languages unknown to them in their own home on a

regular basis, but this could be indicative of the role that mobile technologies now play in our lives, having largely displaced desktop devices and being the first device we use when we need to do something digital (e.g., a calculation, information search, message somebody). Furthermore, it could be linked to the fact that many participants in this survey use MT as a language learning tool and much of this learning might take place in their home.

Q10 What type of content do you usually use your machine translation app to translate? (Multiple answer)

All	173
Browser	79
App	24
Both	70
Anglophone	104
Non-Anglophone	69

As might be expected, the responses to this question, as shown in **Chart 4.10**, highlight that participants use MT on a mobile device to translate a wide variety of content, in many different areas.

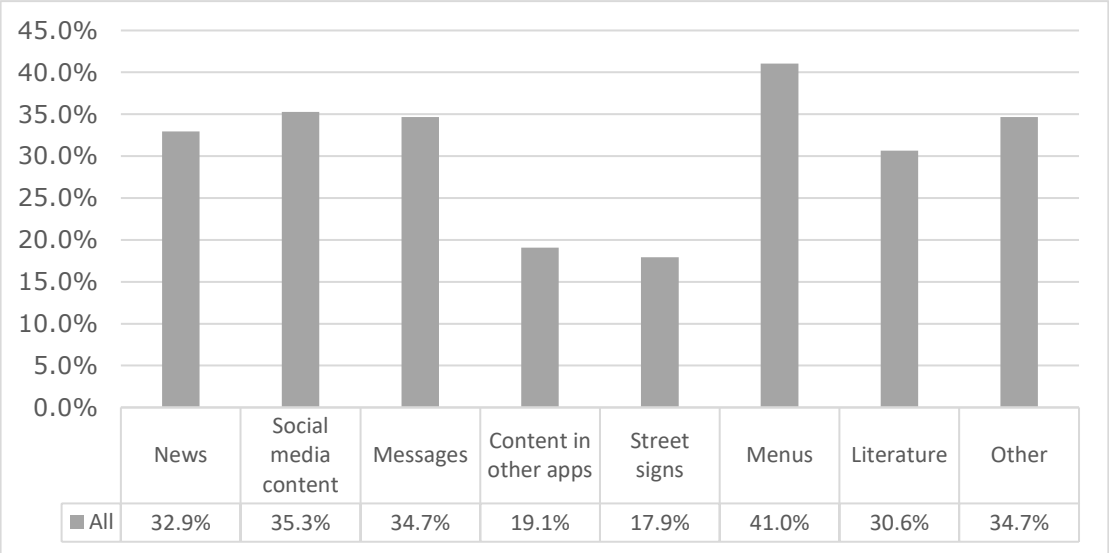


Chart 4.10 The percentage of participants who translate different types of content

The most popular type of content, by a small margin, is ‘menus’ and the least popular are ‘street signs’ and ‘content in other apps’. Those who chose ‘other’ were asked to specify and all of the responses to this option are summarised in **Table 4.5** which shows the type of content (or the way/instances in which they use MT, as not all responses discussed content specifically) and the number of participants who mentioned that content.

Type	Number
Words/expressions	15
Work content/material	11
Products in a shop	5
As part of foreign language study	4
Websites	4
Academic content	3
Conversations	3
Letters/Emails/Reports	3
Speech	3
Documents	2
Technical	2
Help with homework	2
Online shopping	1
Song lyrics	1
Historical documents	1
Directions	1
Museum literature	1
Watching foreign films	1
Legal/admin texts	1
Instructions	1
Craft patterns + posts	1
Text	1
Tweets	1

Table 4.5 Summary of the responses by participants who chose ‘other’ as an option for Q10

This question does, then, show that the content translated by participants is wide and varied and includes a mixture of different types, from content that they might be consuming on the same device, to content in the ‘physical world’ such as menus.

Q11 What do you use your machine translation app to translate most frequently? (Single answer)

All	172
Browser	78
App	24
Both	70
Anglophone	103
Non-Anglophone	69

It is possible to translate texts of a variety of lengths with MT, from single words to multiple paragraphs. For this question, participants were asked to choose what length of text they translate most frequently. **Chart 4.11** shows what percentage of participants use MT on a mobile device to translate most frequently.

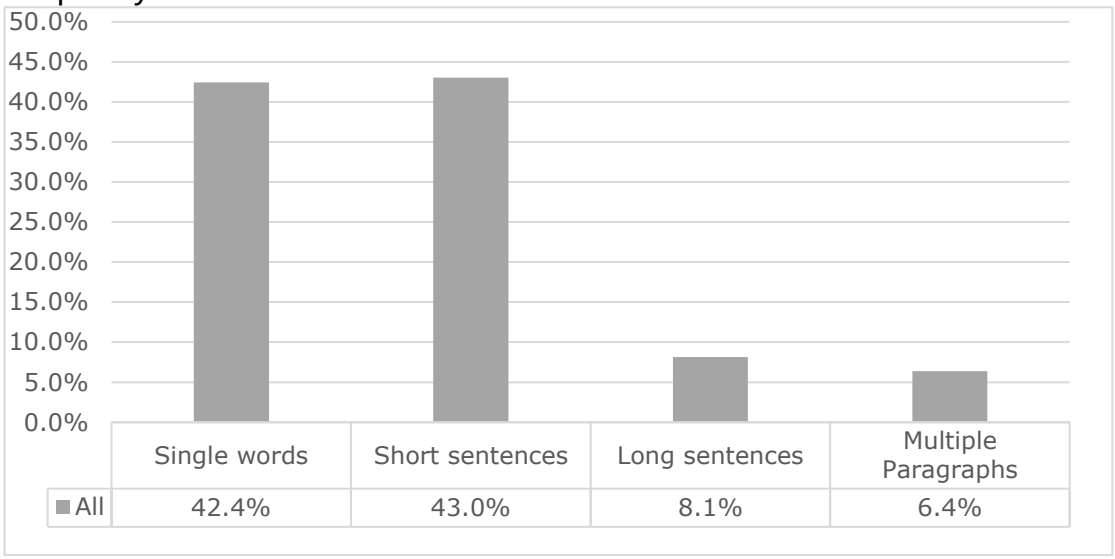


Chart 4.11 Percentage of participants who translate different lengths of text

Clearly, in this study, participants are using MT on a mobile device to translate shorter texts rather than longer ones. In total, participants showed a tendency to translate shorter length texts, with 85.4% of participants translating short sentences or single words (with almost the same percentage translating single words and short sentences) most frequently, with only 14.5% translating long sentences or multiple paragraphs most frequently.

Comparing this to previous studies, Yang and Lange (2003), studying use of one particular platform, Babelfish, found that 'more than 50% of translations are of one- or two-word phrases'. Gaspari (2007: 108), in a survey exploring how people use free online MT, found that 62.5% of his respondents had used a free online MT system to translate a single word. In this study, of users of MT on a mobile device, 42.4% of participants use MT most frequently to translate single words. This could potentially indicate a shift from translating single words most frequently to users starting to use MT for longer texts (although still tending to favour shorter sentences). However, it should be noted that these are not like-for-like comparisons, thus making it difficult to state with any certainty that the use of MT to translate single words has plateaued between 2007 and 2020, but does indicate a potential trend that is worth further investigation. Furthermore, it also highlights a lack of longitudinal studies on how MT use might be changing over time.

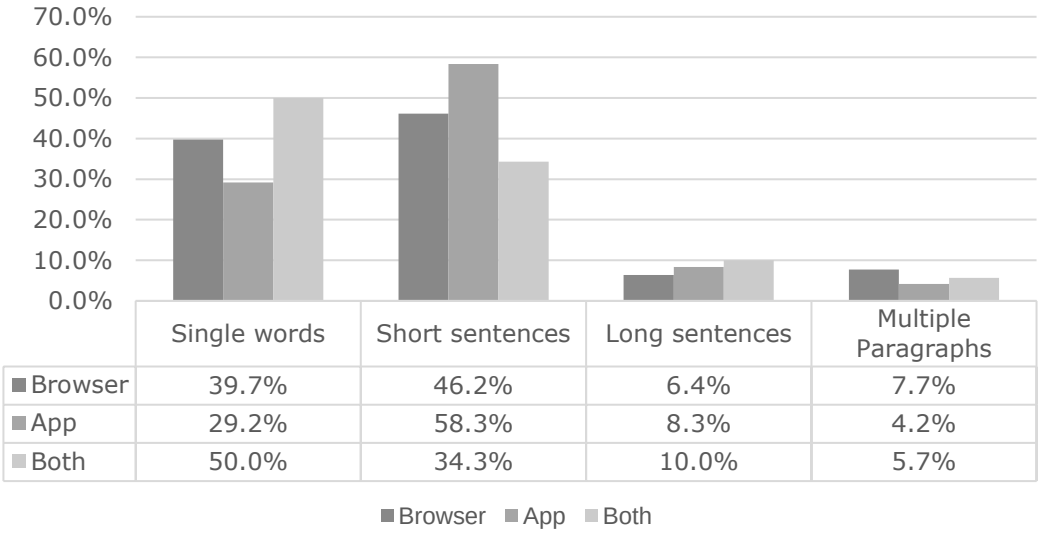
Some potential hypotheses for this observation are:

- The 'novelty factor' has faded – in the past, users may have been putting words in to just test out a technology that is new to them. They may now be using it to perform more complex functions, thanks to familiarity with the technology and the fact that the technology has improved.
- Users appreciating the improving quality and capabilities of MT over the years and increasingly using it to translate longer content. Indeed, it is now possible to translate longer content.
- The level of MT literacy among users has increased and users are now aware that the best use of MT is not as a lookup tool (i.e., a dictionary) for single words.

- Using MT on a mobile device to look up single words is not as good as using MT on a desktop device to do this. The desktop version of Google Translate, for instance, provides more information about a word, e.g., synonyms, other potential translations, definitions, examples of use, when a user inputs it for translation.

These explanations are, at this point, speculative, and further, ideally longitudinal, research is needed to confirm this observation and explore the reason why it has happened.

The data also suggest that app users might be more MT literate, as they do not translate single words as frequently as those who access MT through the browser, as shown below in **Chart 4.12**.



	Single words	Short sentences	Long sentences	Multiple Paragraphs
Browser	39.7%	46.2%	6.4%	7.7%
App	29.2%	58.3%	8.3%	4.2%
Both	50.0%	34.3%	10.0%	5.7%

Chart 4.12 Percentage of participants who translate different text lengths broken down by browser, app and both

In short, this question provides useful angles for future research and raises some interesting questions:

- Are participants now using MT to translate longer texts?
- Did the percentage of participants using MT principally to translate single words plateau at some point between 2007-2020?

- Is there a link between MT literacy and use of MT to translate single words? If so, are app users of MT generally more literate than non-app users?

Q12 Why do you use your machine translation app? (Multiple answer)

All	171
Browser	77
App	24
Both	70
Anglophone	103
Non-Anglophone	68

The possible responses for this question are based on the purposes identified by Yang and Lange (2003) and participants were able to select all the answers that were applicable for them. The corresponding purpose to each response is identified in bold text and parentheses below for this thesis, but was not visible on the survey itself. The options were as follows:

A. To understand something in another language **(assimilation)**
B. To enable someone else to understand me **(communication)**
C. To practise a foreign language **(education/learning)**
D. For entertainment (e.g., because the translations are funny) **(entertainment)**

As **Chart 4.13** shows, the most popular purpose for using MT on a mobile device is assimilation, with 92.4% of participants using MT in this way.

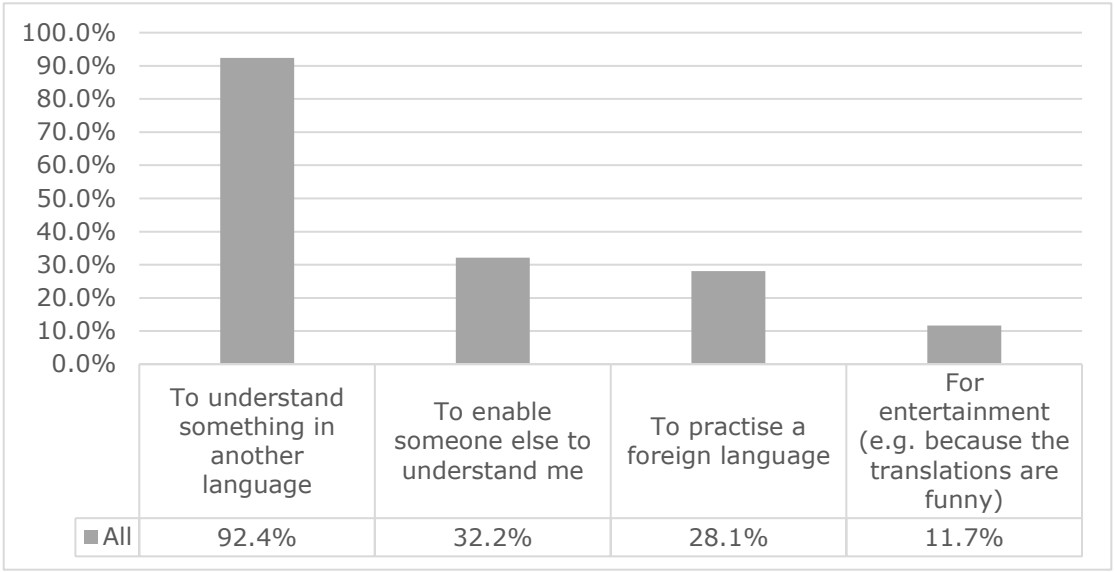
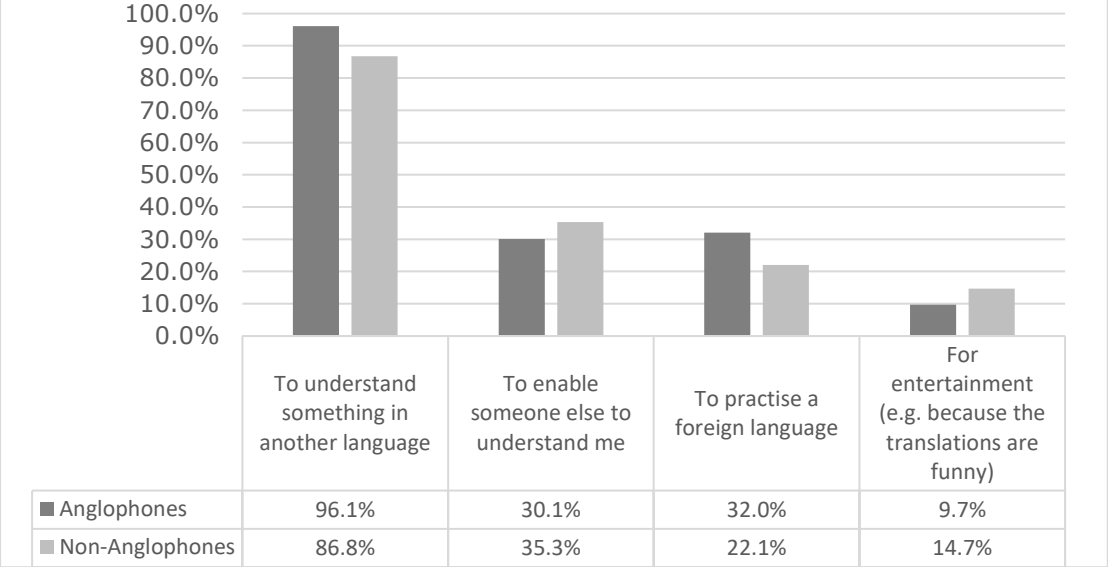


Chart 4.13 The percentage of participants who use MT for different purposes

This corroborates Gaspari's (2007: 103) findings that 'the vast majority of the respondents (96.1%) took advantage of free web-based MT for assimilation purposes' and suggests that the most popular purpose for using MT on a mobile device is also assimilation. One principal difference between these two surveys is that Gaspari (2007) focussed on the two purposes of assimilation and dissemination, whereas dissemination was not explicitly included in this survey. This is because mobile technologies lend themselves more to these four purposes and not to dissemination, i.e., they are much more likely to be used for in-the-moment interaction than for producing a document or text using MT for dissemination (which would be more likely using MT on a desktop). However, it is not necessarily possible to clearly distinguish the line between communication and assimilation/dissemination as the latter two arguably form part of communication. That is, to communicate, a person assimilates the

content of a text (written or spoken) and disseminates their own response to this.

In short, in this study, whilst assimilation (92.4%) is by far the most popular purpose for which participants use MT on a mobile device, communication (32.4%) and education (27.7%) are also important purposes. Interestingly, there is some indication, as shown in **Chart 4.14**, that non-anglophone participants use MT on a mobile device for communication purposes more than anglophone participants. Again, it is worth noting that this is just an indication and could be down to the sample, but does provide an interesting avenue for further research.



	To understand something in another language	To enable someone else to understand me	To practise a foreign language	For entertainment (e.g. because the translations are funny)
Anglophones	96.1%	30.1%	32.0%	9.7%
Non-Anglophones	86.8%	35.3%	22.1%	14.7%

Chart 4.14 The percentage of participants who use MT for different purposes broken down by anglophone vs non-anglophones

This question does raise some interesting points for further research:

- Are these five purposes still suitable for analysing modern-day MT systems which are now multi-modal in nature?
- Do anglophone and non-anglophone users of MT on a mobile device (and MT more generally) use it primarily for different purposes?

4.2.1.4 Speech and Text Translation (Qs 13-19)

This page of the survey contains questions relating to text and speech translation, exploring whether participants use MT on a mobile device to translate and/or produce written or spoken language. Due to the multimodal nature of mobile technologies, in that they all have a speaker and a microphone, and advancement in other technological areas such as text-to-speech and speech-to-text technologies, it is now more possible than ever before to use MT to translate both speech or text. This question was also of interest to the industry partner with whom the survey was developed, so may prove useful to other MT developers.

On this page of the survey, prior to answering the questions, participants were provided the two following definitions:

A. ‘Text translation’ is defined as ‘using the app to either enter text for translation by typing it in, copying and pasting it in, using a mobile device's camera to translate text in images (e.g., in street signs) and using the app to translate text whilst in another app’.
B. ‘Speech translation’ is defined as ‘using the app to translate spoken language, e.g., to facilitate a spoken conversation between you and another person.’

The questions in this section are designed to gather information from participants to understand whether they use primarily speech or text translation, how they input content to be translated and their reasons or purposes for using one type or the other, as well as the difficulties they may face. These questions emerged principally from the industry partner’s desire to understand whether users were making use of the speech translation functionality. Although the

survey was not ultimately run in collaboration with the industry partner, these questions still provided useful data about participants's usage of these features.

Q13 Do you mainly use your machine translation app for speech translation or text translation? (Single answer)

All	173
Browser	79
App	24
Both	70
Anglophone	104
Non-Anglophone	69

As **Chart 4.15** shows, the vast majority of participants (86.7%) use mainly text translation, with only a very small percentage (2.3%) using mainly speech translation and a small percentage (11.0%) using mainly both.

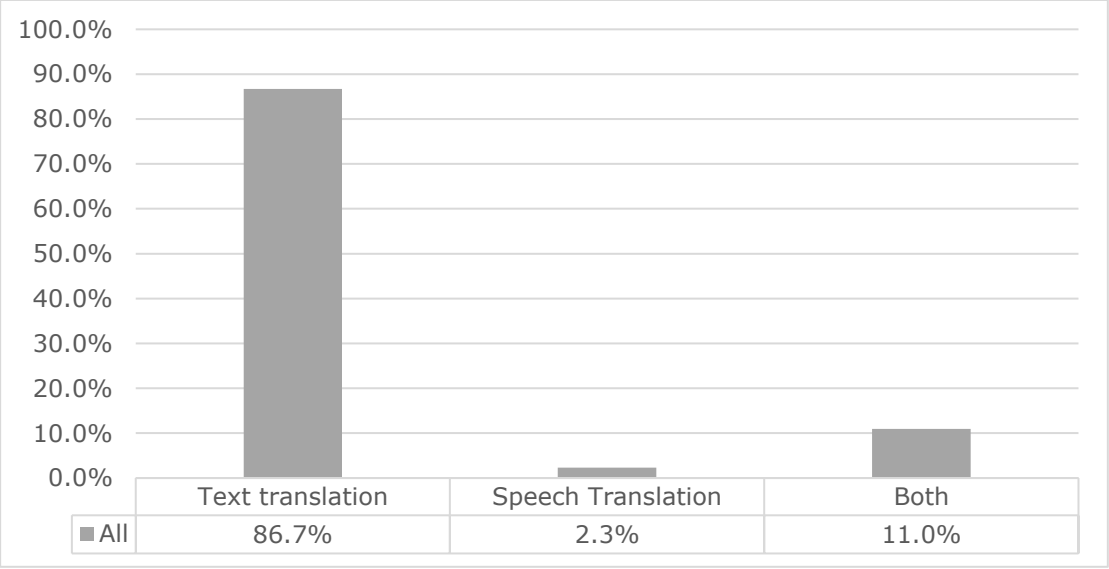


Chart 4.15 Percentage of participants who use text translation, speech translation or both

The fact that text translation is the main way in which participants input text is unsurprising given that it has long been the primary way in which users can input content into MT and a lot of communication on a mobile device will be written. Indeed, as the technology is newer and there are fewer applications

that give the option to input speech, this will naturally result in fewer users using the technology this way.

Q14 Thinking about text translation, do you mainly...? (Single answer)

All	174
Browser	80
App	24
Both	70
Anglophone	105
Non-Anglophone	69

This question asks participants to choose whether they mainly:

- Type text in
- Copy and paste text in
- Use their machine translation app to translate whilst in another app

As **Chart 4.16** shows, there is a relatively equal split between the percentage of participants who 'copy and paste text in' (48.6%) and those who 'type text in' (44.6%), with only 6.3% using their app to translate whilst in another app.

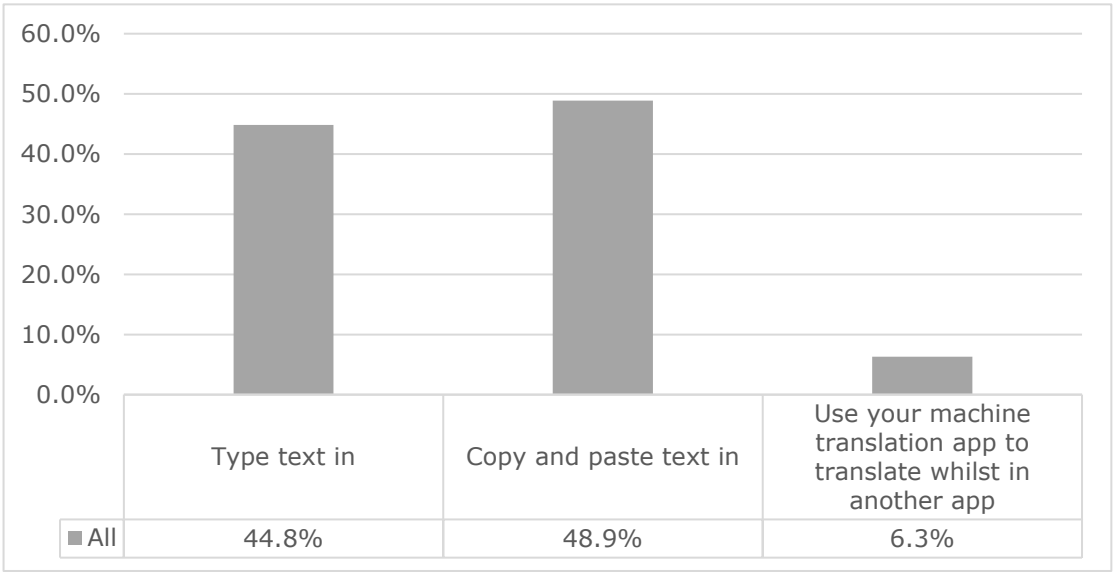


Chart 4.16 How participants enter text for translation on a mobile device

However, the fact that participants frequently copy and paste text in suggests that one of their primary uses for MT on a mobile device is to translate content from other apps on that device, i.e., that they are not generating the content for translation themselves, but that they are using the app to understand something else. This finding coincides with that of Q12 where assimilation is found to be the main purpose for which participants use MT on a mobile device. However, typing text in could involve producing content that the user wants to translate for somebody else, or it could be typing text in for assimilation purposes. As such, further research is needed to explore the relationship between the manner of input and the user's purpose. The third option of 'use your machine translation app to translate whilst in another app' was chosen by a low percentage of participants, indicating that this is not the main way in which participants use MT on a mobile device and may also indicate a lack of clarity regarding the difference between copying and pasting text into MT and using an MTA whilst in another app.[86]

[86] This feature, commonly known as 'Tap to Translate' on Google Translate, enabled people to select text in another app and as part of the menu of options (e.g., copy, cut etc.), they would be able to request a translation. The functionality of this feature was reduced in an Android update in 2019, as discussed in more detail in **5.1.1.1 Complaints about the apps**.

Q15 Thinking about speech translation, do you usually...? (Single answer)

All	142
Browser	66
App	18
Both	58
Anglophone	88
Non-Anglophone	54

Given that Q13 showed that only a small number of participants mainly use speech translation, the response rate to this question (142 out of a possible 175 users, 81.1%) was surprisingly high. However, this would seem to indicate that while speech translation is not the main way in which participants use MT on a mobile device, participants are making use of the speech translation functionality to some degree, to the extent that they feel able to answer this question. This question asked participants to choose the language direction in which they usually use speech translation, as shown in **Chart 4.17**.

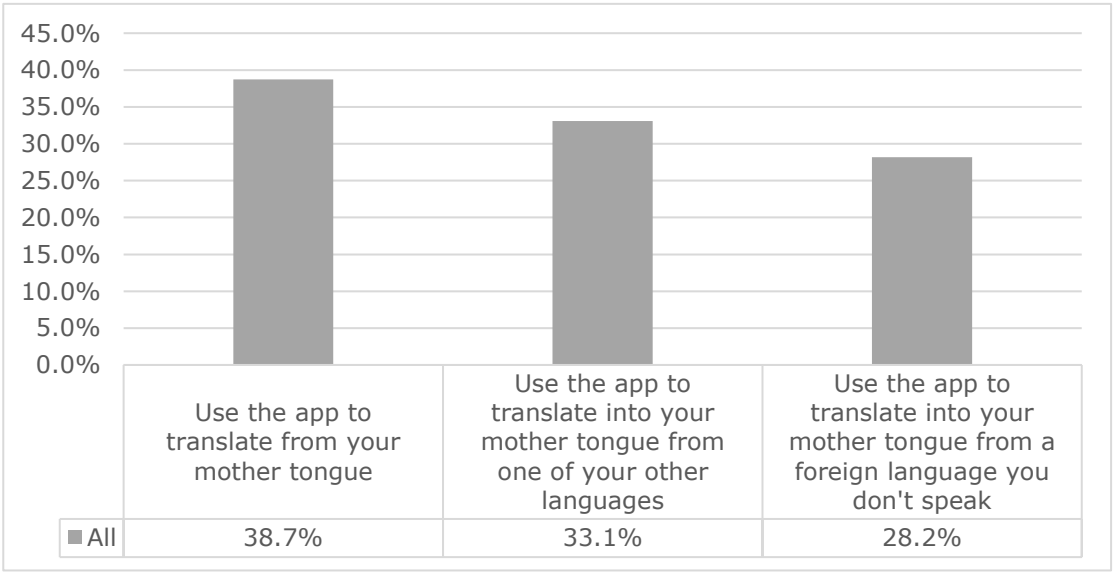


Chart 4.17 How participants use speech translation

This chart shows that on the whole participants usually translate **into** their mother tongue when using speech translation, with 61.3% of participants either translating from another language they speak or do not speak into their mother

tongue. Again, this result coincides with and reinforces the findings of Q12, that assimilation is the main purpose for which participants use MT. However, over a third of participants also usually translate using speech translation out of their mother tongue, showing that dissemination and communication are also important purposes. Therefore, it may be useful to explore whether there are differences between the purposes for which users use speech translation vs text translation, e.g., whether they are more likely to use speech translation than text translation for communication.

Q16 In what cases do you choose to translate text vs. speech? (Multiple answer)

All	162
Browser	76
App	21
Both	65
Anglophone	100
Non-Anglophone	62

This question aimed to explore whether there are differences in the language direction of translation when participants use speech or text translation and participants' responses are shown below in **Chart 4.18.**

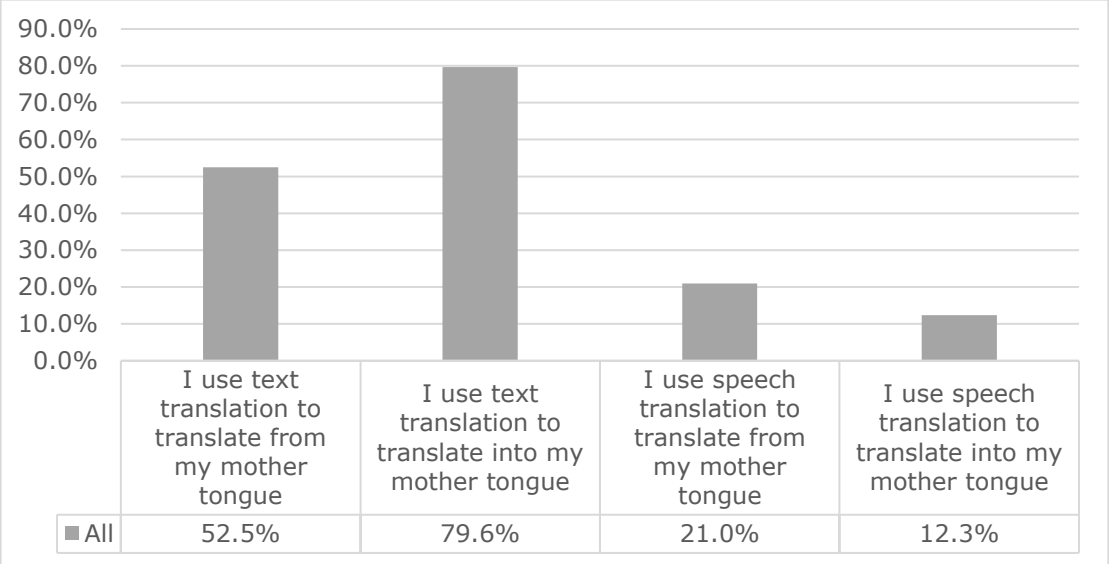


Chart 4.18 The language direction that participants translate in when using speech translation and text translation

The findings for this question also reinforce the idea that assimilation is the most popular purpose for using MT as participants most frequently translate into their mother tongue, i.e., to understand something which is in another language. These findings do somewhat contrast with Q15 as here more participants state they use speech translation to translate from their mother tongue, which is the opposite of the findings of Q15. There may have been some confusion around speech and text translation, and it would perhaps have been advisable to split

these questions into separate sections or provide the option of ‘I do not use speech translation’ to allow participants to skip the questions pertaining to it.

Q17 What difficulties do you have when using speech translation? (Free text)

This free-text question was answered by 85 participants (48.6%), although 22 of these responses were ‘don’t use it’, ‘N/A’, or responses to that effect, and a further two were also responses in this vein, but explained why they do not and one response was excluded as it did not answer the question. As such, there were 64 usable responses to this question that provided data for analysis. To analyse them, I first read through the responses, creating tags based on the data, thus resulting in grounded data. These tags were then grouped into the following categories:

A. Speech Recognition – comments which specifically commented on difficulties with speech recognition, e.g., incorrect transcription of what was said. Most of these were general comments, but some specifically commented on issues due to their accent.
B. Speech Production – comments which mentioned difficulties with understanding the speech produced by the MT service.
C. Translation/Language – comments which commented on the quality or accuracy of the translations provided, or on grammatical issues (in either the SL or TL). These comments could be applicable to MT generally and do not explicitly focus on speech translation.
D. General – comments which do not fit into the previous categories.

These headings are used in **Table 4.6**, with the number of comments that were tagged, the percentage (out of the 62 responses that generated data) and the number for each of the tags which constitute that category are then presented.

Difficulty	Number
Do not use	24
None	2
Speech Recognition	**30 (46.9%)**
General	21
Accent	9
Translation/Language	**17 (26.5%)**
Grammatical Issues	6
Accuracy	11
General	**12 (20.3%)**
Did not work	1
Technological Problems	1
Accuracy (general)	7
Effort	1
Unsuitable for situation	2
Speech Production	**5 (7.8%)**
Pronunciation Issues	5

Table 4.6 The types of difficulties participants have when using speech translation

As **Table 4.6** shows, 46.9% of responses to this question had difficulties with speech recognition, mainly commenting on it not working properly or accurately, not picking up what was being said, the quality of the speech recognition or on issues with surrounding noise. In addition, nine responses commented specifically that their difficulties with the speech recognition element of speech translation is due to their accent making it more difficult for the technology to understand them. As such, these comments show that, at the moment, the most common difficulty with speech translation is the speech recognition stage of the process. This is not, then, actually an issue with translation or MT, but another technology and stage in the process. This is, perhaps, to be expected given that the technology is newer and still has large scope for improvement, although

it has improved dramatically since its inception and AI can help to speed up development, especially with accent perception and understanding.

The next most common area (26.5% of responses to this question) where participants encountered difficulties was with the translation or quality of the language. Participants commented on grammatical issues with translations, spelling issues and also on the accuracy of the translation provided. This indicates that one of the wider issues with MT, the quality and accuracy of the translation, remains an important issue for speech translation, second to issues with speech recognition.

The third area was categorised as ‘general’ (20.3% of responses to this question) and covered participants’ comments which did not mention a specific element of speech translation, but, for example, commented simply on issues with ‘accuracy’ without specifying whether this was the accuracy of the speech recognition or the translation itself. The participant who commented on technological problems stated it was due to the age of their mobile phone and the person for whom it did not work simply stated that it did not work at all when trying to have a conversation with a taxi driver, without specifying whether this was due to a particular element, e.g., speech recognition. Similarly, for one participant it was too much effort to use the technology and two participants commented on it not being appropriate for use when out and about.

Finally, another area of difficulty for participants (7.8% of responses to this question) was speech production, with participants commenting that the spoken translation was difficult to understand due to the way it was pronounced. One

participant specifically mentioned that the robotic voice made it difficult to understand the translation into their mother tongue.

Overall, this question has highlighted that participants encounter a variety of issues when using speech translation, but that these issues are not necessarily related to the translation, but to other technologies such as a speech recognition.

Q18 Have you used speech translation when talking in real-time to another person, either face to face or remotely?

All	170
Browser	77
App	23
Both	70
Anglophone	102
Non-Anglophone	68

This is a simple yes/no question that seeks to explore whether participants are actually using speech translation to communicate with somebody else, rather than simply playing the translations out loud.

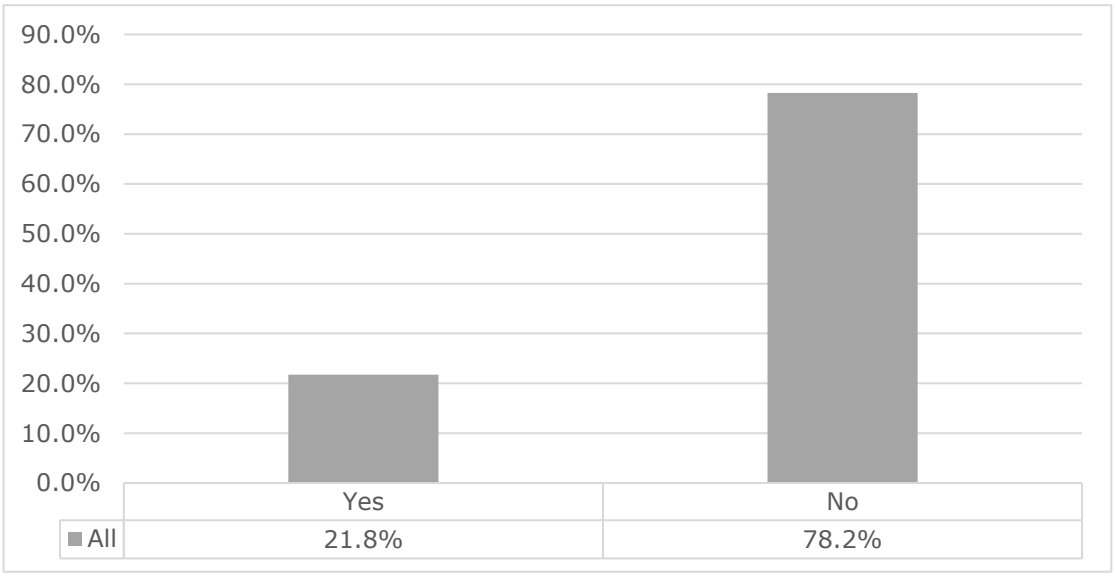


Chart 4.19 Percentage of participants who have and have not used speech translation to communicate with another person

As **Chart 4.19** shows, the vast majority of participants (78.2%) have not used speech translation to communicate with another person. Combined with the findings of Q15, that participants mainly use speech translation into their mother tongue, this also highlights that the primary use for participants is assimilation, to understand something in another language.

Q19 Do you use the text-to-speech (TTS) functionality (playing out the audio for the translation)?

All	170
Browser	78
App	22
Both	70
Anglophone	102
Non-Anglophone	68

This question focuses on a particular facet of speech translation, of the user having the device speak the translation to via text-to-speech functionality.

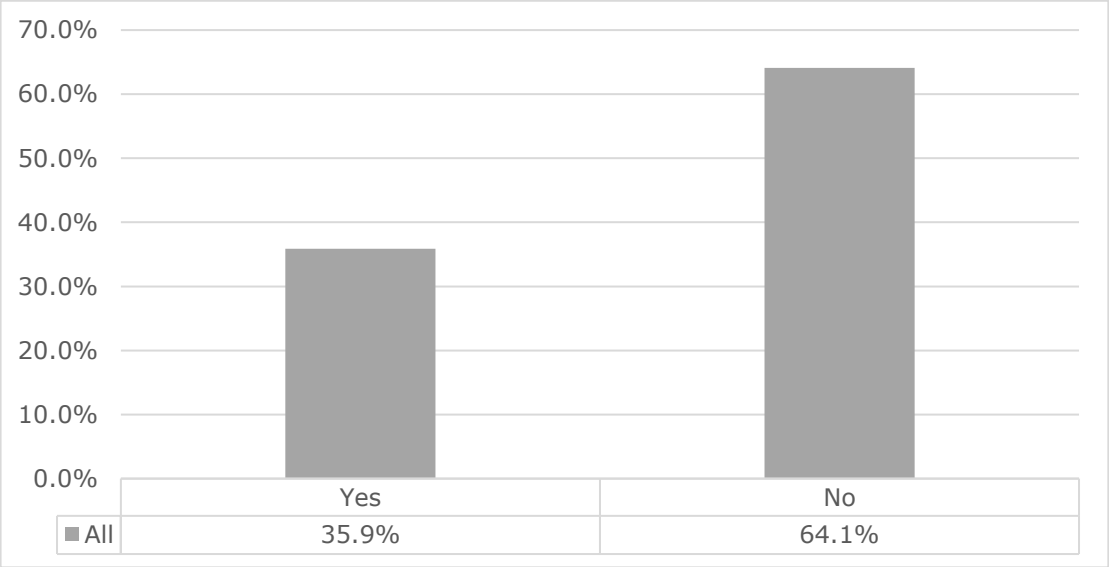


Chart 4.20 Percentage of participants who use and do not use the text-to-speech functionality

As **Chart 4.20** shows, most participants (64.1%) do not use this functionality, which coincides with previous questions regarding the percentage of

participants who use speech translation. However, for those who do use this functionality (35.9%), there was an additional question which explored how exactly they made use of it.

Q19a If so, how do you use this functionality? (multiple answer)

All	61
Browser	27
App	8
Both	26
Anglophone	39
Non-Anglophone	22

Participants who do use the text-to-speech functionality were then presented with this additional question exploring how they use it more precisely, as shown in **Chart 4.21**.

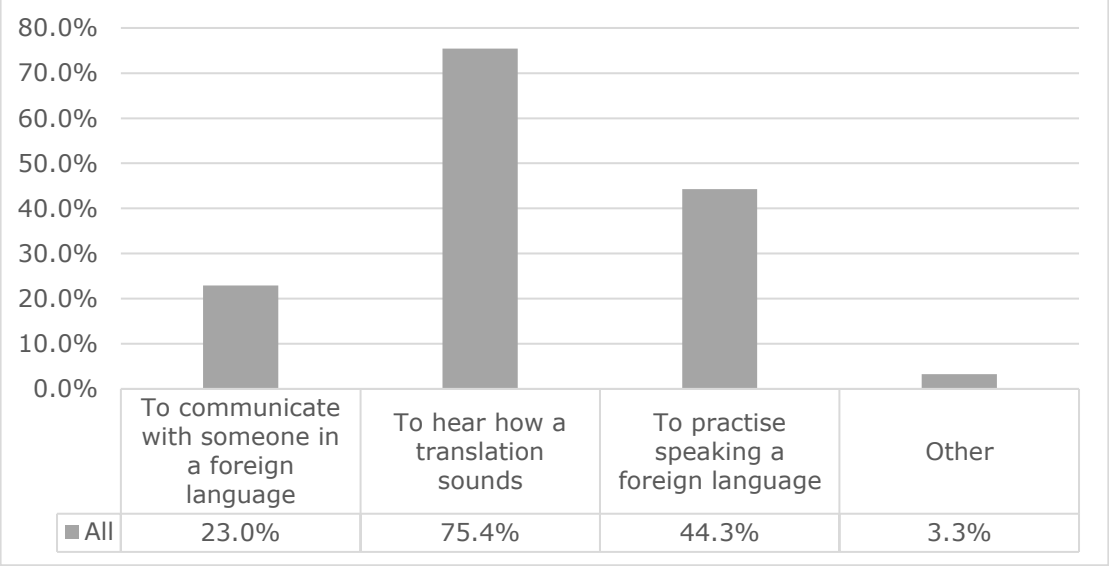


Chart 4.21 How participants use the text-to-speech functionality

The most popular usage of this functionality is to simply hear how a translation sounds, indicating that users are interested in engaging with the translation and/or the language it is in and not simply in the recipient receiving the translation. This may also relate to the significant percentage of participants who use this functionality (44.3%) to practise speaking a foreign language, as

part of their learning process for the foreign language may involve hearing how a translation or utterance sounds in a foreign language. Just under one quarter of respondents to this question use the functionality to communicate with someone else. It would also be interesting to ask participants whether they are actually using this functionality as part of the translation process, or to help with language learning.

4.2.1.5 Quality and Priorities (Qs 20-25)

This section focussed on understanding participants' thoughts on the quality of the translations provided by MT and on their priorities for features. It includes a number of free-text questions, the analysis of which was performed in the same manner in each time. The comments were read and then tagged according to their content, with the tags emerging from the data itself, based on previous answers to the survey and these free-text answers themselves.

Q20 The quality of the translation provided by your machine translation app is generally... (Single answer)

All	172
Browser	78
App	24
Both	70
Anglophone	104
Non-Anglophone	68

As discussed in **2.3 MT Quality Evaluation**, quality is a major point of research in MT, but what exactly is meant by quality is not always clear. As such, it would not have been feasible to provide participants with a definition or definitions of quality. Nevertheless, it is likely that users will have an opinion about the quality of the MT and this question allows for a broad gauge of whether users are generally positive or negative about the quality of MT that they use.

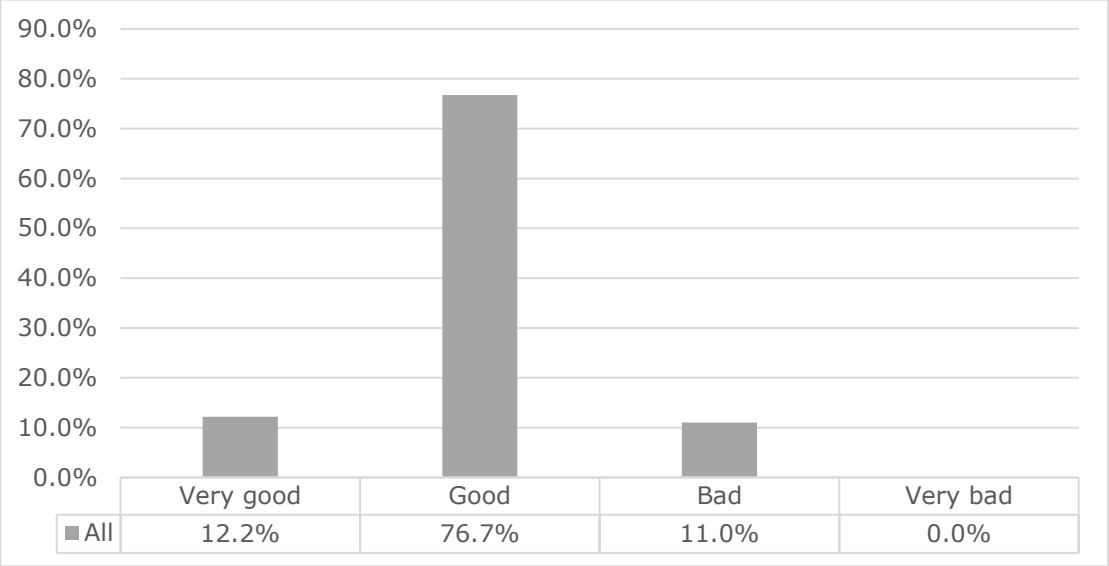


Chart 4.22 What do participants think of the quality of MT

Overall, **Chart 4.22** shows that the vast majority of participants (88.9%) are positive ('Good' or 'Very good') about the quality of the MT service they use. This result may be somewhat surprising given the reputation for poor translations of free online MT services, but is indicative of the improvements that have been made in all elements of MT. From this question, it is evident that participants are generally happy with the translations provided by their MT service. It can be inferred from this that the translations are of sufficient quality to fulfil the users' needs.

Q21 The quality of the translation provided by your machine translation app has improved over time (Single answer)

All	173
Browser	79
App	24
Both	70
Anglophone	104
Non-Anglophone	69

This question was designed to see whether participants are thinking about or engaging with the quality of MT over time. Although the quality of MT has undoubtedly improved with newer architectures, and this can be attested to quantitatively by the higher BLEU scores of systems, user perceptions can also allow us to gain a more qualitative understanding of the quality of MT and whether participants are finding it of sufficient quality to meet their needs and purposes.

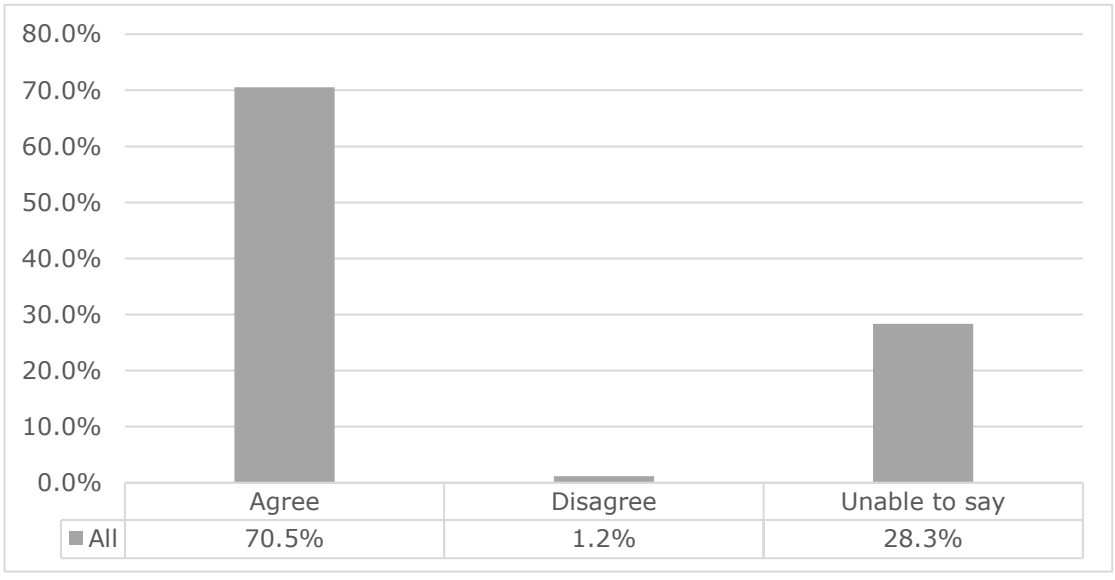


Chart 4.23 Participant perception of quality of their MT service over time

As **Chart 4.23** shows, the vast majority of participants, 70.5%, do agree that the quality of their MT service has improved over time, compared with only 1.2% who disagree. This demonstrates that, in this study, there is a general perception that the quality of MT is improving over time. Nevertheless, there is

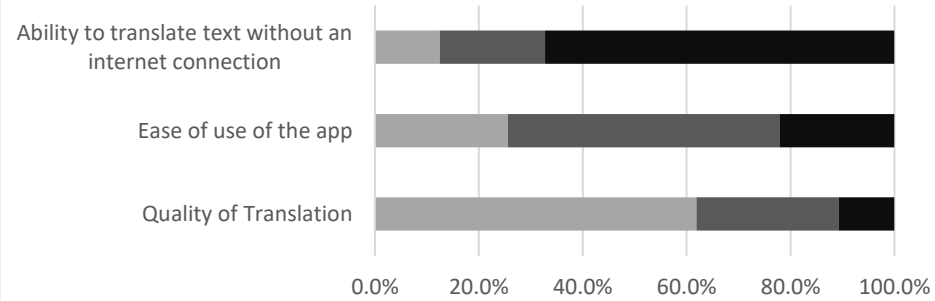
still a significant percentage, 28.3%, who are 'unable to say', thus demonstrating that not all participants are able to make a judgement or monitor the quality of MT over time. This may be because they have only recently begun using MT or because they do not feel able or qualified to judge the quality.

Q22 Please rank the following in order of importance for you when you're using the app:

All	168
Browser	74
App	24
Both	70
Anglophone	102
Non-Anglophone	66

This question, originally developed alongside the industry partner, asked users to rank the following elements in terms of importance when using MT:

- Ability to translate text without an internet connection
- Ease of use of the app
- Quality of Translation



	Quality of Translation	Ease of use of the app	Ability to translate text without an internet connection
1	61.9%	25.6%	12.5%
2	27.4%	52.4%	20.2%
3	10.7%	22.0%	67.3%

Chart 4.24 Participants' ranking of importance of elements of use

From **Chart 4.24**, it can be surmised that the order of priority for participants is:

1. Quality of translation
2. Ease of use of the app
3. Ability to translate text without an internet connection

This order is understandable as the higher the quality of the translation, the more likely it is to fulfil the user's needs and purpose (unless that purpose is to produce a poor translation for entertainment). Indeed, an MT platform that is easy to use and/or able to work without an internet connection, but does not provide translations that meet the user's needs would fail to fulfil its primary purpose. This order holds true across all the different categories of participants (browser, app, both, anglophone and non-anglophone) and thus shows that the principal priority should be to improve the quality of translations provided.

Q23 Human translation (i.e., not translation done by a machine) is...

All	172
Browser	78
App	24
Both	70
Anglophone	104
Non-Anglophone	70

This question was designed to gain a better understanding of how participants perceive translation more widely, that is, whether they see it as a difficult task or think that it is easy, perhaps because it can be done by a computer.

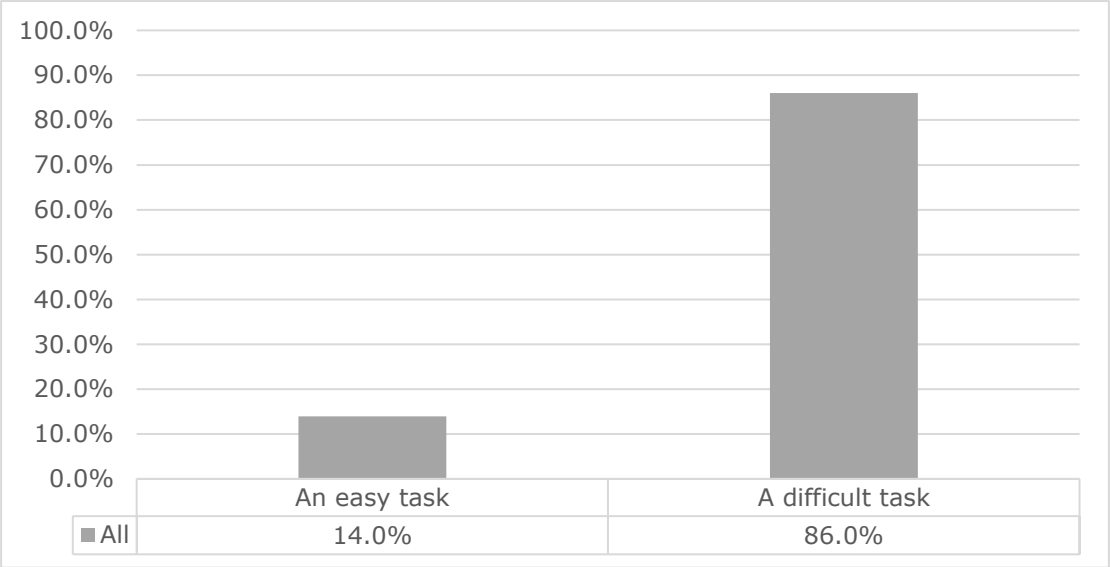


Chart 4.25 Percentage of participants who believe human translation is an easy task or difficult task

Chart 4.25 shows that the vast majority of participants, 86.0%, believe that human translation is a difficult task, with only 14.0% believing it to be an easy task. This question does, then, demonstrate that participants in this survey are aware of the difficulty involved in translating.

Breaking this down, 17.5% of the surveys' participants were monoglots, but of the 24 participants who responded 'easy' to this question, seven of them, 29.2% were monoglots. Perhaps the lack of having learnt another language and

working between languages accounts for the reason why these participants think human translation is an easy task.

In order to better understand why participants thought the way they did, a sub-question, 23a, asked them to explain their answer and 140 participants did so. Of these, 15 responses came from those who had selected that human translation is ‘an easy task’. However, these responses do not all answer the question, and some seem to be answering whether HT or MT is better. The responses from these 15 participants are summarised below in **Table 4.7**.

Humans better understand deeper meaning/context	**3**
Three responses focussed on the fact that humans can understand deeper meaning or context in translation, which a machine cannot. It is not clear why, then, they answered that HT is ‘easy’ – perhaps this is down to different interpretations of ‘easy’ and it is easier for humans as they have access to knowledge or interpretations that machines do not.	
Speed of translation	**2**
Two responses mentioned speed and immediacy of translation, presumably in relation to MT rather HT. These responses do not, as such, answer the question asked.	
Other translation resources	**3**
Three responses mentioned ‘other translation resources’, with two suggesting that other resources, such as dictionaries, are better and one simply stating that there are many other resources ‘e.g., dictionaries, phrase books’	
Other	**7**
Of the responses categorised as other, one thought the question was unclear, one stated they ‘have practiced it at uni’ and one ‘can understand’, thus not providing information for analysis. The other four in this category stated that: • it depends on fluency • non-verbal communication is important (presumably implying that a machine cannot account for this) • they have practised it at uni • people can understand easier than an app (whether this means implicit meaning or literally that people are better at understanding than TTS technology is unclear)	

Table 4.7 Summary of responses to Q23a for participants who answered ‘easy’ to Q23

In addition to these responses, there were another 124 that came from those who chose ‘a difficult task’. The responses from these participants are summarised in **Table 4.8**, with the number of responses for each category identified and analysis of this information provided below.

Deeper meaning/context (within and outside the text)/nuance	**59**
The most common response from participants was that machines are unable to deal with context (both intra- and extra-textual) or deeper meaning beyond the literal meaning of the word. These responses identified that humans are able to do this and this is one of the elements that makes translation a difficult task.	
Knowledge/Expertise (Explicit)	**34**
Of languages **General**	**27** **7**
These responses recognised the importance of knowledge or expertise required to produce a translation, with 27 specifying that this is of languages (both SL and TL) and seven simply stating expertise more generally, without specifying exactly what.	
Knowledge/Expertise (Implicit)	**25**
The responses in this category did not explicitly mention knowledge or expertise, but this is implied by the sub-categories. For example, with 'languages change', the implication here is that unless somebody keeps abreast of the two languages (knowledge), the task of translation will be harder.	
Languages change	**2**
These participants identified that translation is difficult as languages are not static, they change over time and the meaning of words change.	
Differences between languages	**12**
Twelve responses recognised that differences between languages, especially not closely related ones, make it difficult to translate between them. There may be certain words or concepts in the SL that do not exist or are not easily expressed in the TL.	
Difficult as do not know other languages	**8**
These responses stated that translation is difficult as they themselves do not have knowledge of another language to be able to translate. As such, this is closely related to the 'knowledge/expertise' category.	
Human translation needs (continuous) training	**5**
Five responses mentioned that human translation is something which requires a lot of training/education, both initially and in the form of continued professional development, as translators need to keep up to date in their languages and specific fields.	
Accent	**2**
Two participants' responses mentioned 'accent', with one commenting that there are different accents and another that it is hard to understand due to accent. It is not clear whether they are referring to MT having difficulties with accent, or whether they do in fact mean that human translation (or, really, interpreting) is difficult due to speakers' varied accents.	

It is my profession; I know it is difficult	**4**
These responses came from translators who stated that as it is their job, they know it is a difficult task. In addition, one participant also felt that people who do not know about translation think that it is an easy task.	
Human translation is time consuming	**11**
These responses identified that HT is time consuming or not a quick process and that is why it is difficult. However, this is not necessarily the case – just because something takes a long time does not necessarily mean it is difficult, although there may be a correlation between the two.	
Other	**20**
The responses identified as 'other' were varied and diverse and are those which do not fit into the previous categories and for which there is only one occurrence. A summary of these responses is provided below: Seven responses referred to challenges faced in their own experience of translating: • that it needs references • people speak fast in replying • they cannot understand many words • rare languages pose challenges • they do not always grasp what is being said and miss words that are key • it is difficult on the spot and you have to improvise • it usually ends up being hand gestures and speaking slowly Three responses focussed on the role of the translator/translation: • That they add their own twist • It is not always easy to find someone to translate and they may misinterpret things • It is costly Three responses discussed difficulty explicitly: Communication • Communication between human individuals is difficult per se. • It requires a lot of brain energy • That translation is one of the most difficult cognitive activities because you need to be simultaneously a great reader and a great writer. Seven other responses provided completely independent comments: • Previous instances/examples of usage are not always available • I do not have the knowledge. • colloquial forms • It does not depend upon an internet connection and if you have a phrase book handy, can always be consulted for basic phrases - if you know what you're looking for. • Long winded Error prone • Accessibility	

Table 4.8 Summary of responses to Q23a for participants who answered 'difficult' to Q23

As **Table 4.8** shows, participants identified a wide variety of reasons as to why human translation is a difficult task. However, in this instance, the most common reason identified by participants is that texts have deeper meanings and nuances that are difficult to convey in a translation and that translation is a specialised task requiring the accumulation of knowledge and expertise in at least two languages. This question does, overall, strike a positive tone for translation in that participants do generally identify it as being a difficult task.

Q24 Is there anything else you'd like to add about your machine translation app?

This was a free-text question designed for participants to be able to add any additional comments about the particular MT platform or app that they use. In total, there were 54 responses to this question, with 17 of them being ‘no’ (or equivalent) and two that were not usable, resulting in 35 responses for analysis. Responses were categorised based on their content, as shown in **Table 4.9** below. Comments were grouped together in categories, represented by the heading rows in grey and bold, with the sub-categories for that category, where there were any, shown below them.

Requests	**4**
Feature	1
Language	3
Explanation: One comment was a language request, requesting better support for Croatian speech (TTS and automatic speech recognition) in iOS. Three comments were requests for features: language games, personalized choices and the ability to save translations for future reference to learn from (although this feature does already exist on some MT platforms)	
Positive Comments	**10**
General	7
Language	1
Feature	2
Explanation: Seven responses were general positive comments, with four praising Google Translate specifically with comments such as it is amazing or good and three highlighting more generally that MT is useful. One response highlighted that Google Translate is very good at translating between English and Romance languages, but not so good with other languages, dialects and slang terms and that it only serves a handful of minority languages. Two responses were positive about specific features – automatic language detection and the ability to see alternative translations and use them as part of the learning experience.	
Negative Comments	**8**
General	2
Length limitation	2
Languages	1
Usage limitation	3
Explanation: Two responses were generally negative, stating that it translates too literally and needs to be updated to understand words in every context. Three responses focussed on the length limitations of MT, with one stating that it struggled with paragraphs into their mother tongue, one stating that it is useful for single sentences max and one response (which was also mentioned as a positive response) was negative regarding Google Translate's ability to translate outside of English-Romance Languages. Three responses focussed on the usage limitations, with one highlighting that the translation changes depending on whether an uppercase or lowercase letter is used, one stating that Google Translate is useful for gist translation and awful for anything else and one stating that intonation cannot be accounted for when using a machine.	
Usage example	**9**
Positive	2
Negative	3

Explanation: Nine responses provided examples of ways in which they use MT on a mobile device: • When travelling • Image translation to translate signs and menus • For single words, not full texts, then use their knowledge of the TL to use it in the correct context • To speed up work when translating a text or when not sure how to express an idea when writing an academic text • As a tool for literary translation, when they cannot find a phrase in online dictionaries • One participant uses it with English as a TL rather than their mother tongue (Italian) as it is more accurate and they use it very rarely for languages they know nothing about. • One participant stated they use Microsoft Translator app for languages they speak but do not master, and Google Translate through the browser for languages they do not speak at all • One participant stated they do not use the app but use desktop versions to translate long documents	
Image translation	**4**
Explanation: Three responses mentioned image translation directly, with one simply stating that they use it, another stating that it is useful for languages with a completely different alphabet and the third describing that they use Yandex's photo translate facility and that it is particularly useful for menus and signs quickly. A fourth response stated that it was difficult to focus on words to make a good translation (this focus is presumably the focussing of the camera).	
Other	**4**
Explanation: Four responses were categorised as 'other'. One highlighted the need for correct translation, one mentioned that they did not know that phrase translation (presumably translation of more than a word) was possible, but the survey made them aware it is, one mentioned that Yandex is better for Russian than Google, but that they had not found one developed by French speakers that was as good as Google. This is indicative of the fact that users are able to identify and choose MT systems which work best for the languages for which they need to use them. Finally, one response commented that they preferred MT systems pre-NMT, when they were able to see alternative translations for phrases in a sentence.	

Table 4.9 Analysis of free-text responses for Q24 grouped into categories

Q25 Is there anything else you'd like to add about machine translation apps generally?

This was a free-text question designed for participants to be able to add anything else they wanted to about MT apps in general. In total, there were 53 responses to this question, including 18 which were ‘no’ (or equivalent) and three that were not usable as they did not answer the question. As such, this left 32 responses for analysis. Responses were categorised based on their content, as shown in **Table 4.10**. Comments were grouped together in categories, represented by the heading rows in grey and bold, with the sub-categories for that category, if there were any, shown below them.

Requests	**5**
Feature	3
Language	2
Explanation: Four comments mentioned requests, two of these for features (better understanding of syntax and domain-dependent translation models which the user can then choose), one for language (more languages, as some TTS ones are funny) and one for both (provide multiple ways of saying things, e.g., formal or informal).	
Positive Comments	**4**
Explanation: Four comments were general positive comments about MT apps, mentioning the speed of use, that they are generally helpful, a good tool in the modern business environment and one going so far as to say they are an 'astonishing cultural accomplishment'.	
Negative Comments	**7**
General	3
Translation	2
Usage limitation	2
Explanation: One comment was a general negative comment, stating they 'need improvement', two commented on the quality of the translations, stating they are not always correct and sometimes are stunted and unnatural. A further two comments were generally negative and focussed on usage limitation, with one commenting that they focus too much on one aspect of language to the detriment of others (e.g., good vocabulary, but poor syntax) and one commenting that English people use them rather than learning a foreign language and even used them in professional contexts (i.e., implying that they should not be doing this).	
Language learning	**5**
Positive	2
Negative	3
Explanation: Two responses commented positively on MT's usefulness for language learning, with one noting they use it to hear pronunciation. Three commented negatively with regards to language learning, commenting that people become reliant on MT rather than learning a language and one highlighting that they prefer a physical dictionary.	
Usage	**13**
Type of app	2
Type of translation	3
Usability	7

Explanation: Two responses commented on the type of app they use, with one saying that they sometimes use the in-built translation features in Facebook and Twitter and the other stating they use a different app (which is more like a dictionary) when looking up single words. Three responses commented on the type, or length of translation they perform, highlighting that they are useful for gist translation, checking understanding, informal translations and short translations. Seven responses commented on usability: one stated they prefer a browser as an app takes up too much space, two noted that they are more useful when employed by somebody who has knowledge of the languages they are using MT for, one commented that the accuracy depends just as much on the user's input, one commented that they are useful as a memory aid for simple words, but not for longer texts, one commented on their limitation when compared to humans who can also process the context meaning of a word alongside its literal meaning and one noted that (presumably for speech translation) intonation and accent can affect the translation.	
Other	**2**
Explanation: One participant, having worked on a post-editing app, commented on the difficulty of building apps. Another commented on the difficulties of teaching MT that certain things in a language 'feel right/better/more natural' and so recognises that MT and machines are 'disadvantaged' in this sense.	

Table 4.10 Analysis of free-text comments for Q25 grouped into categories

This question demonstrates the variety of ways that participants engage with and think about MT and the breadth of priorities for MT that they have.

4.2.1.6 Extra questions (Qs 26-28)

Q26 How does machine translation work?

This is a free-text question that asks participants how machine translation works in order to gauge whether there is a high or low level of user understanding of MT. This is important at a time when there are calls for increased MT competence among translators and students of translation (O'Brien 2012; Pym 2013; Guerberof Arenas and Moorkens 2019) and for machine translation literacy in the academic community more widely (Bowker and Buitrago Ciro 2019). Indeed, it also raises the question of whether increased literacy of MT systems would be beneficial to users in improving their user experience and the ways in which they use MT. Indeed, to the author's knowledge, it is the first time this question has been asked to a non-specific audience of MT users. In total, 96 participants responded to this question, with their responses grouped as shown below in **Table 4.11**.

Cannot explain	**28**
No/Don't know (no information)	25
No/Don't know (with information)	3
Explanation: The three responses which provided some information stated that they cannot explain NMT (which would indicate that they can maybe explain how some systems work, or at the very least they have awareness of different architectures), had no idea beyond straight vocabulary connection (i.e., word-for-word translation), and the last saying they did not know but that they assume systems become more accurate as users use them and rate the quality of translation.	
Can explain	
The responses categorised as 'can explain' are further broken down based on the type of explanation offered by participants, grouped into three overall categories of 'General' (i.e., those who simply say they can or that it depends on the type of MT), 'Computing' (i.e., those who offer an explanation based on some sort of computational technology) and 'Other explanations' (i.e., responses which do not fit into the previous two categories).	
Can explain - General	
Yes (no explanation)	4
Depends on type of MT	13
Four participants stated that they can explain how MT works without offering an explanation and 13 recognised that how it works depends on the system (e.g., RBMT, SMT, NMT). These participants clearly have a high level of understanding of MT, including those who stated it depends on the system as the implication is that they would be able to explain if the system had been specified.	
Can explain - Computing	
Artificial Intelligence	2
Algorithms	6
Databases	11
Statistical models	6
VR	1
Neural Networks	6
Transformers	1
Aligned text/corpora	12
In fact, MT works (depending on the exact system) through a combination of all of these, so participants here are able to explain some of how MT works, even if they cannot explain it fully or only know about one particular type of technology that it involves.	
Other types of explanation	**12**
Explanation of what a user has to do to get a translation	7
Dictionaries	3
Learn from user suggestions	2

These responses show that some participants misinterpreted the question and thought it was asking how a user actually solicits a translation from MT. As such, seven participants provided responses that detailed how a user does this, i.e., by entering text into the MT platform and it provides a translation. Three participants mentioned that they thought MT would use databases of dictionaries or dictionaries with algorithms. This is not wrong per se (and is more reminiscent of RBMT), and many MT platforms also incorporate dictionary modules, but this is not how they perform the translation. Two participants' responses detailed that they believe MT improves over time from users suggesting improvements to translations. Again, this is not wrong per se (depending on the platform), but is not the primary way in which MT provides a translation.	
Other	10
Ten responses were categorised as 'other', not fitting into the previous categories. These responses included a range of different topics, including comments on the quality of MT, on data analysis, using software, MT's inability to understand context and that it searches for a translation.	

Table 4.11 Summary of participants responses' to Q26

This question was difficult to answer, in that the exact answer will depend exactly on the MT platform and type of MT (e.g., RBMT, SMT, NMT) being used. However, that said, it has shown that understanding of MT is a broad spectrum. There are a small number of participants who have a 'full understanding' of how MT works and a number of participants who have 'no understanding' of how MT works and a number of participants who do have some understanding or can make educated guesses about the way in which MT produces the translation. Indeed, this is evidence of the fact that different users have different levels of familiarity with the technology and that the technology is enabling in different ways for different users, as discussed in **2.6.1 Why do we use technology? Technology as an enabler**.

Q27 'In my view, machine translation will...'

All	171
Browser	77
App	24
Both	70
Anglophone	102
Non-Anglophone	69

This question explores participants' beliefs regarding the viability of MT to further displace the human agent in the translation process in the future. The responses to this question can be mapped onto a spectrum from the most technophilic to the most technophobic, as shown below in **Figure 4.2**.

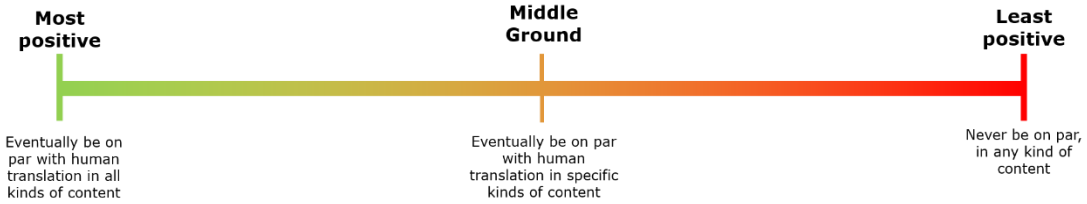


Figure 4.2 Spectrum of responses from technophobic to technophilic

Indeed, this spectrum coincides with spectra that consider attitudes towards AI more generally as proposed by Tegmark (2017: 31), drawing on work by Tim Urban. **Chart 4.26** shows the percentage of participants for each of the possible responses to this question.

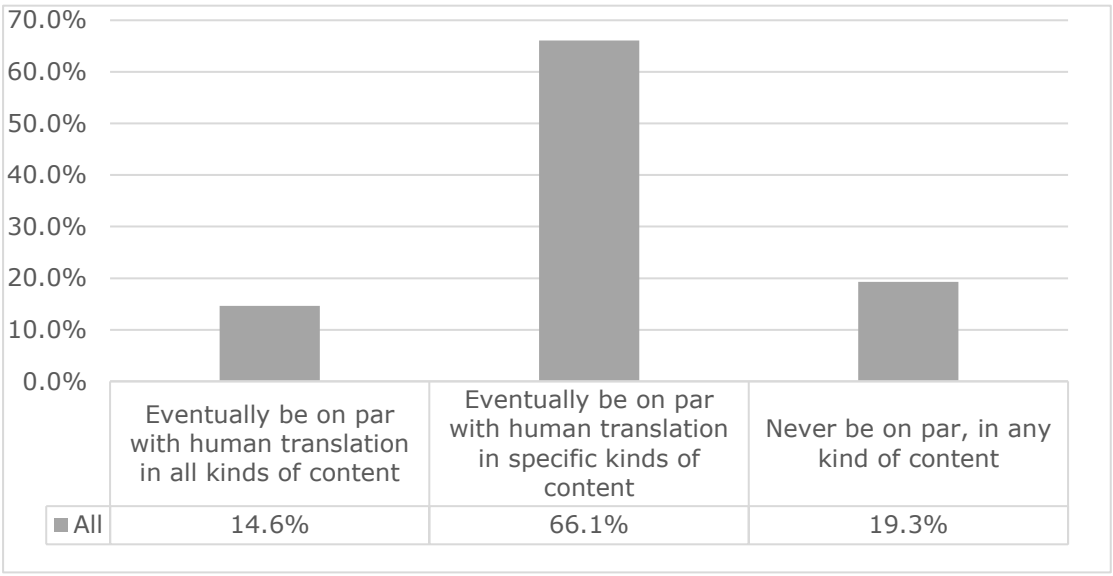


Chart 4.26 Participant views on the future of MT in regards to achieving parity with Human Translation

The majority of participants (66.1%) are in the middle, in that they believe MT will eventually be on par with human translation in specific kinds of content, with smaller percentages believing it will reach parity in all content (14.6%) and never reach parity in any kind of content (19.3%).

Q28 Does Machine Translation make you think differently about translation? (Free text)

The last question was designed to solicit participants' opinions on whether MT has made them think differently about translation. In total, 106 (60.6%) participants responded to this question, although not all responses provided usable data, as 31 answered 'no' (or words to that effect) and 22 answered 'yes' without providing an explanation, thus leaving 53 participants who provided free-text comments explaining how MT made them think about or think differently about translation. Overall, then, in this survey, for 75 participants (42.9%) MT makes them think differently about translation or at least think about it. As such, it is possible that MT is increasing the prevalence of translation and causing participants to think more about it.

Translators/Translation Profession

Six participants' responses discussed the impact of MT on the translator or translation as a profession, four of which were neutral in nature and two of which were negative.

Negative

- Two participants commented that it had been part of the reason why they gave up on entering the profession or left the profession

Neutral

- One commented that it makes the job go from 'translator' to 'corrector'
- One commented that it highlights the challenges translators face
- One wondered what the profession will be like in ten years' time (presumably as a result of MT)
- One, a translator, commented that it makes them realise that their job is underrated, but that MT is a tool which helps them in their job

Translation

The bulk of the responses to this question mentioned a variety of issues concerning translation. From the data, several subcategories have been identified and the number of responses for each of these is detailed below:

Need/Importance of HT	11
Appreciate HT	2
Inaccuracy of MT	3
What translation is (e.g., art or craft)	4
MT as tool/role in translation process	5
Ease/convenience of MT	4
Speed of MT	7
Complexity/difficulty of translation	5
MT/HT different uses	4
Importance of context/social information/extra-textual knowledge	6
Other (translation)	3

- One participant commented that a text should be clearly marked for the reader as either being translated by a human or by a machine. (This is an example of participants considering the ethics around MT, as discussed in **2.6.4 The ethics of AI and MT**)
- One participant commented that it makes them think that literal/word-for-word translations are of little value in many language pairs

Language learning

Six participants' responses also mentioned language learning and the impacts that they feel MT is having on it:

MT might replace need to learn languages	2

- One participant commented that MT may replace the need to learn languages and another commented that it may be an excuse for not learning languages

MT cannot replace need to learn languages	1

- One participant commented that MT cannot replace the need to learn languages

MT has a negative effect on ability	1

• This participant specified that the negative effect is on their confidence in speaking other languages and remembering vocabulary	
Process of learning a language	2
• One participant commented that it shows them why beginners in a foreign language make the mistakes they do and another commented that it has made them reflect on the process and elements of learning languages (syntax, morphology, conjugation)	
Other	
This category includes two sub-categories of 'Language' and 'Technological advances' as more than one comment could be categorised as such. There is another category of 'Other' for comments of which there was only one of this nature and as such a category could not be established.	
Language	4
• One participant commented that MT, when deployed widely, will have an impact on language in general • One participant commented that it makes them think more about how to phrase things they ask • One participant commented it makes them think differently about language in general • One participant commented that it has made them think about language less in terms of romanticism and more in terms of sociology, as there is evidently some patterns and logic as machines can learn them	
Technological advances	2
• One participant commented that MT highlights how advanced applied mathematics and AI have become • One participant commented that it makes them think how technology can be used in other translation practices (e.g., audiovisual and literary)	
Other	9

- One participant commented that it raises questions about how everyday users of MT make the output work in a given situation
- One participant commented that it is a great way to communicate with the world
- One participant commented that they had not thought about it before, but would do now
- One participant commented that MT can serve up a prevailed biscuit, but not a three course Michelin star meal
- One participant commented that they wonder if anything is 'lost' in translation by a machine (this is about trust in technology, as discuss in **2.6.4 The ethics of AI and MT**)
- One participant commented that they do occasionally, when translating short words or phrases
- One participant commented that quality of MT is poor, perhaps because they know/speak languages that are not the 'big' languages
- One participant commented that it makes them think differently about cognition and intelligence in general
- One participant commented that when it gives a silly answer or says it cannot translate a word, it makes them feel lazy for not using their dictionary instead.

Table 4.12 Summary of participants responses' to Q28

These varied responses to this question show that participants who use MT on a mobile device think about MT and its impacts and consequences on a variety of different elements of life and society. Furthermore, some interesting questions emerge:

- Is MT having an impact on users ability to learn a foreign language? (both inside and outside the classroom, i.e., in formal contexts and informal contexts)
    - How can this be studied? Is there a need to study this? Is it simply a new tool to which we will become more accustomed over time?
    - Is this negative or positive?
    - Are there strategies that need to be employed, by teachers or others, to instruct students on how to successfully use MT to enhance and complement learning a foreign language?

4.2.2 Participants who do not use MT on a mobile device

This section explores the responses from those who fall into dataset 'B. participants who do not use MT on a mobile, with 37 participants falling in this category. They answered the same demographic questions as participants who do use MT on a mobile device and the survey then branched them to a 29th question, only accessible to this subset of participants, which asked why they do not use MT on a mobile device.

4.2.2.1 Demographics (Qs 1-5)

Q1 Agreement to participate

This first question of the survey asked participants whether they agreed to participate in the survey or not. All 214 respondents agreed to participate in the survey.

Q2 Age

The age range of those participants who do not use MT on a mobile device is shown below in **Chart 4.27**.

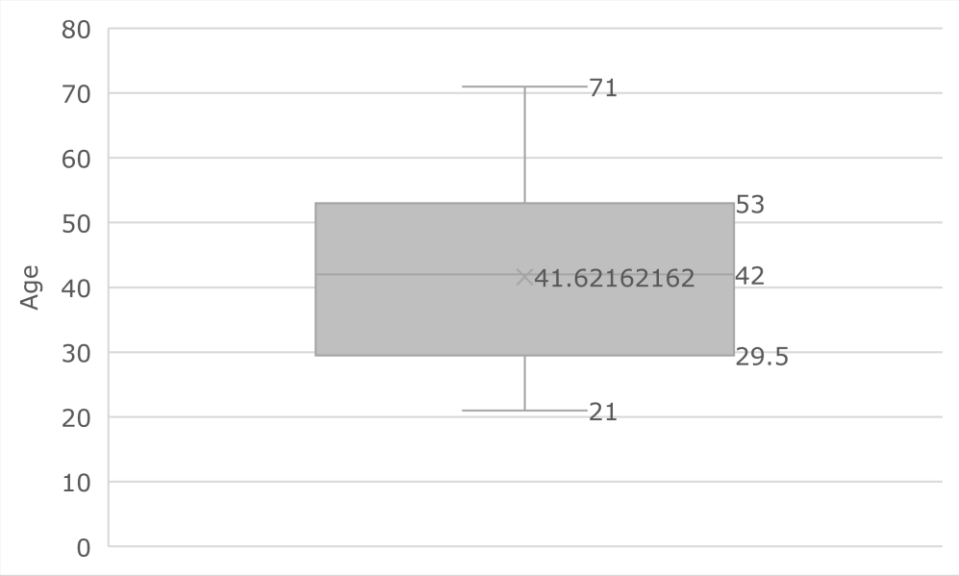


Chart 4.27 Ages of participants who do not use MT on a mobile device

These data, when compared with the ages of participants who do use MT on a mobile device, suggest a tendency for the use of MT on a mobile device to

decrease with age. This finding correlates with data suggesting that older people are less likely to access the internet via a mobile device (Statista 2020b) and the data for participants who do use MT on a mobile device that indicate that the majority of MT users are under 45 years old.

Q3 Nationality

Among this group of participants who do not use on a mobile device, there were 15 different nationalities, as shown in **Chart 4.28**.

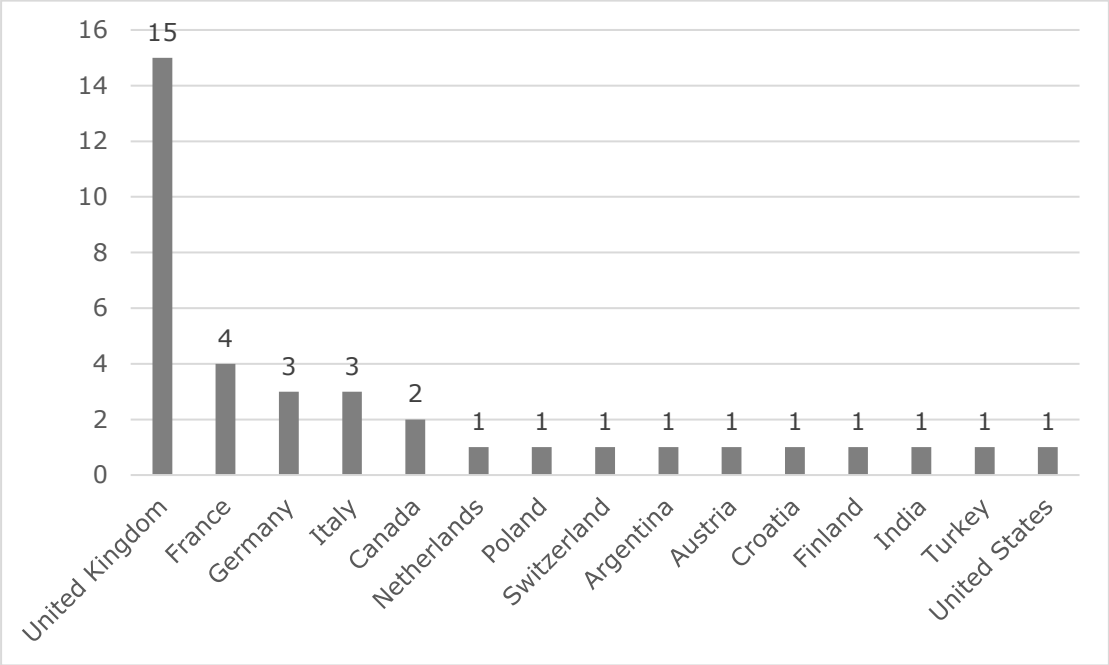


Chart 4.28 Nationality of participants who do not use MT on a mobile device

Just as with the participants who use MT on a mobile device, the majority (43.2%) of these participants who do not use MT on a mobile device were from the UK.

Qs 4 + 5 Mother Tongue + other languages

These two questions have been addressed together in **Table 4.13** below.

Mother Tongue	
Language	**#**
English	16
French	7
German	3
Italian	3
Croatian	1
Dutch	1
Finnish	1
Hindi	1
Polish	1
Serbian	1
Spanish	1
Turkish	1

Other Languages	
Language	**#**
English	22
French	13
Spanish	13
German	10
Portuguese	3
Swedish	3
Norwegian	2
Russian	2
Bosnian	1
Dutch	1
Italian	1
Kiswahili	1
Punjabi	1
Sardinian	1
Serbian	1
Slovenian	1
Turkish	1

Table 4.13 The mother tongue and other languages spoken of survey participants who do not use MT on a mobile device

There are 12 different languages that participants have as a mother tongue and 17 languages that participants can speak as an additional language, with English being the most common mother tongue and additional language. Overall, nine (24.3%) participants in this subset were monolingual, which is in contrast with the 17.7% of participants who were monolingual in the subset of participants who do use MT on a mobile device. This is somewhat surprising

given that it could be assumed that monoglots might have more use for MT than participants who speak more than one language.

Q2. Which machine translation service do you use?

Among this group of participants, Google Translate remained the most popular MT service, with 15 (40.5%) participants using this MT platform and only two (5.4%) using Microsoft Translator and two (5.4%) selecting other.[87] Indeed, all of those participants who chose Microsoft Translator and other also chose Google Translate, indicating that all 15 participants of this subset who use MT in some form (but not on a mobile device) use Google Translate.

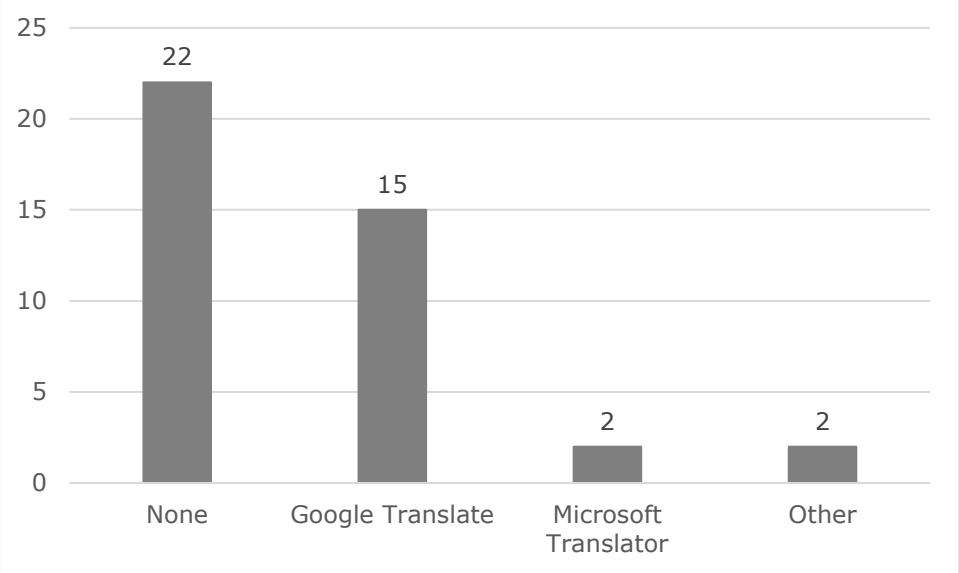


Chart 4.29 The MT services used by participants who do not use MT on a mobile device

Furthermore, from these data, it is evident that of these 37 participants who do not use MT on a mobile device, 22 (59.4%) have not used MT at all, as they answered 'none' to this question. As such, these data would indicate that a small percentage of participants, around 10% of the overall number of

[87] These 2 participants used DeepL and Amazon Translate.

participants, do not use MT at all. This is something which would need to be verified through larger scale surveys, and more representative and longitudinal studies.

Q29. Why don't you use machine translation on a mobile device?

In this question, participants were allowed to select as many responses as applicable, although most opted for a single choice, three did select more than one response. **Chart 4.30** shows the number and percentage of participants who chose each of the responses.

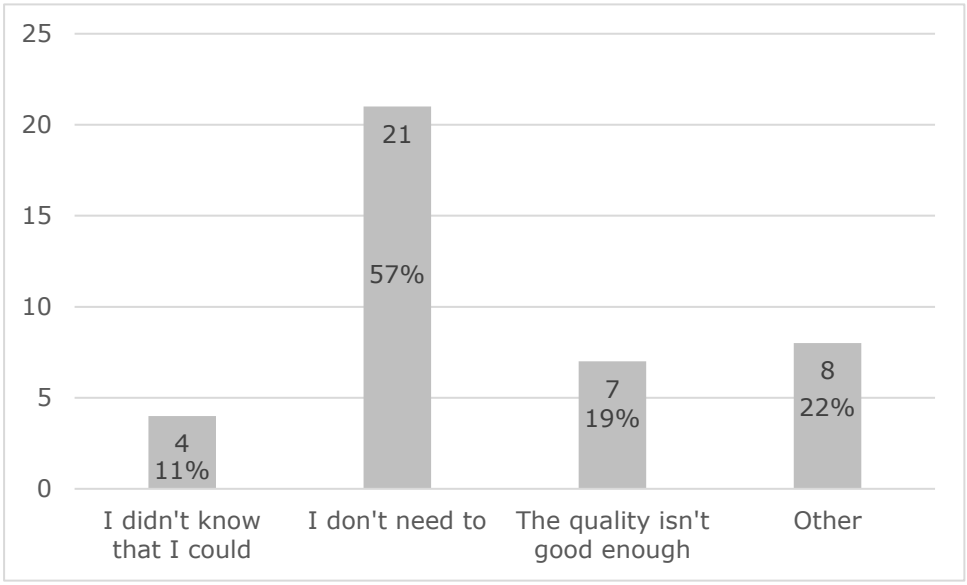


Chart 4.30 Reasons why participants do not use MT on a mobile device

This evidence suggests that most participants are aware of the possibility of using MT on a mobile device, but that the main reason they do not use it is because they have no need to. However, there are participants who refrain from using MT because the quality of it is not good enough or for other reasons. The five respondents who chose other were asked to specify their reason and these reasons are shown below, as all five are different. Their responses are presented in **Table 4.14**.

Reason	Category
I only ‘use’ it when it is integrated in specific apps (Facebook, amazon,...) for languages I don't speak and/or if it's too much of a bother to switch it off.	Practical
I am a translator, I don't need machine translation.	Ethical
I use MT on my desktop computer	Practical
Most countries I have travel to have spoken English	Practical
Don't agree with machine translation, as it takes work away from human translators	Ethical
I Just find it easier to Copy and paste the text portion	Practical
The user interface sucks and is not as intuitive as the web browser UI on a laptop. Plus I dislike writing, copying and pasting on a mobile device.	Practical
I have no internet on my phone, just phone and SMS.	Practical

Table 4.14 Other reasons why these participants do not use MT on a mobile device

Furthermore, these responses can be categorised into practical (e.g., somebody not using MT on a mobile device because there are reasons to do with the functionality, ease of use, availability or the need to use MT) or ethical (objecting to use of MT due to a dislike of the technology). As **Table 4.14** shows, six of these responses can be categorised as practical reasons why these participants do not use MT on a mobile device. The other two responses are more based around ethical objections relating to translators and MT. Indeed, the participant who said that they are a translator so do not need MT is most likely objecting to the technology, probably because they see it as a threat, as their statement cannot possibly be true unless they can translate between every possible language pair.

This chapter presented the data from this exploratory survey study into the ways in which participants use MT on a mobile device. It firstly explored how a survey can be used a research tool and how they have been used to study translation and to study MT use. It then described the design and distribution of this survey, followed by a discussion of the results for each question. The main

findings of this survey are summarised below, grouped together by sections of the survey.

4.3 Overall findings from the survey

This section presents and discusses overall findings from the survey, drawing upon and synthesising the findings from across the different questions of the survey. This then enables some questions for further research to be devised that will be of use in future studies.

4.3.1 General

Firstly, this survey is indicative that MT use on a mobile device among participants is widespread, with 82.5% of participants having used or using MT on a mobile device, to the extent that they were able to respond to the questions in the survey. The original focus of this survey and, indeed, this entire thesis was MT apps. However, the findings from this survey, that 46.3% of participants access MT on a mobile device exclusively through a browser, vs 13.7% who access MT exclusively through an app, suggest that it is more appropriate to refer to and research MT on a mobile device, incorporating both access through a browser and an app. As such, based on the data from the survey, the remit of this section changed to focus instead on ‘MT on a mobile device’. It would be possible and interesting in future research to repeat this question to examine the trend over time, to explore whether this is a shift to or away from using MT via an app or mobile browser.

This survey has raised many more questions about people’s use of MT on a mobile device (and, potentially, MT more generally) that could form the basis of future research. The principal findings of this survey and questions for further

research, broken down into the different sections for which participants answered questions are summarised below.

4.3.2 MT service and means of access

Despite the wide variety of MT platforms used by participants (over 20 in total), Google Translate is, by far, the most popular MT platform, with over 95% of participants in this study using it. Similarly, as previously mentioned, most participants in this study access MT on a mobile device through the browser, rather than through a dedicated app. As such, the following questions would be useful to explore in future research:

Questions for further research

A. Why is Google Translate so popular?
   - Is it because it is one of the oldest MT platforms?
   - Is it because it is provided by a large technology company that has become very embedded in people's everyday lives?

B. Why do people use a browser rather than a dedicated app?
   - It would also be useful to explore this trend over time and on a much larger scale

4.3.3 Use of MT

The main aim of this section was to explore the ways in which people are using MT on a mobile device and the settings in which they might do so. The findings are summarised below, followed by avenues for further research.

- Participants use MT on a mobile to varying frequencies, but cumulatively 51.4% of participants use it at least once a week, thus demonstrating that MT is quite a frequent feature in participants' lives.
- In this study, participants who are non-Anglophones seem to be more frequent users of MT on a mobile device than Anglophones.

- Participants most frequently translate shorter texts rather than longer texts. However, there has potentially been a shift from translating simply single words to translating short sentences.
- Assimilation is the most popular reason why participants use MT on a mobile device, in-line with previous research.
- In this survey, it is evident that participants are using MT to help them with language learning. However, the ways in which they use MT remains a little-researched area and there is even less research on the implications that MT use may have on language learning.

Questions for further research

A. Are people now using MT to translate longer texts?
    - Did the percentage of people using MT principally to translate single words plateau at some point between 2007-2020?
    - Is there a link between MT literacy and use of MT to translate single words?

B. Is there a link between whether somebody accesses MT via an app or browser and the way in which they use it/their level of MT literacy (if such a concept can be measured)?

C. Are there differences in the way in which people use MT depending on their native language?

D. How can we categorise MT use?
    - Are the five purposes still suitable for analysing MT?
    - Do they need to be expanded on?

4.3.4 Speech and Text Translation

The findings in this section demonstrated that:

- Text translation remains the most popular form of input by far when compared to speech translation.
- With both text and speech translation, participants mainly translate into their mother tongue, thus corroborating the finding that assimilation is the most popular reason why participants use MT.
- The biggest difficulty that participants encounter with speech translation is speech recognition, suggesting that this might be an area for developers to focus their attention.
- Most participants are not using speech translation to communicate directly, in real-time, with another person.

If MT providers capture data about the type of input from users, text or speech, they would be able to confirm whether the data corroborates the self-reported way in which participants input content for translation. In addition, if historical data is available, they would be able to analyse whether there has been any change over time, e.g., if the number and/or proportion of translations solicited with speech input has increased over time. For instance, as speech translation is a newer functionality, it may be increasing in popularity and over time more users might use the technology. Indeed, new functionalities in general will always be something to assess and research further and will also present how developers have interpreted their users' needs and wants.

Questions for further research

A. Why is text translation used so much more than speech translation?
    - Is it because speech translation is a newer technology and so fewer people are aware of it and using it? Or is the technology having problems with quality or usability?
    - Is it because speech translation is not as useful or needed as text translation?

4.3.5 Quality and Priorities

- Most participants are happy with the quality of the translations provided by MT and most also agree that the quality has improved over time.
- The quality of translation is one of the most important aspects for participants and more important than other elements such as ease of use and ability to translate without an internet connection.
- Participants recognise that human translation is a difficult, skilled task that requires knowledge and expertise.

Questions for further research

A. What is quality in this context?
    a. Is it simply fulfilling the purpose/need of the person using the MT?

4.3.6 Extra questions

- There is a spectrum of understanding of MT, with users who have a full understanding of how it works, users who have no understanding at all and users who some idea how it works.
- Most participants are in the middle of the technophilic/technophobic spectrum, believing that MT will eventually reach parity with human translation in specific contexts.

Questions for further research

A. How can a person's level of understanding of how MT works be measured?
   - Is there a relationship between level of understanding of MT and MT literacy?
   - Do users need or want to know how MT works? Would this enable them to use it better?

B. What do users understand by "be on par with"?
   - Human translation is not perfect and may contain errors, will the same acceptance of errors apply for MT or does MT have to reach a higher threshold to be considered on par?
   - What types of content do users see MT reaching parity with human translation?
   - For those who believe it will eventually reach parity in all kinds of content, why do they believe this? Do they believe that human translation will no longer be necessary?
   - For those who believe it will never reach parity in any kind of content, why not? What is it about human translation that makes it special (at least in the eyes of the end user) that a machine will never reach parity in any content?

C. More widely, and linked back to the idea of quality, what does parity mean for MT researchers and developers?

One final and important point to make is that it would be useful to have more repeated studies on MT use over time. There are currently, to the author's knowledge, no studies of MT use that have been repeated over an extended

period or examined how the use of MT has evolved over time. Such studies would also allow for examination of topics in more depth and from different angles, such as exploring whether there are differences in use depending on the native language of the user. This may lead to findings which could shape the ways in which developers design the systems for the ‘end users’ or highlight areas that need improving for certain user groups. They would also enable a much clearer picture of usage and usage patterns, and particularly how these develop over time, to be gathered.

4.4 Conclusion

This chapter has presented It then expanded on this by presenting the survey used as the principal data collection tool for this thesis, providing a question-by-question analysis of the findings and drawing out conclusions, insights and directions for future research. The next chapter builds on this by providing qualitative and anecdotal insights into the ways in which users use MT on a mobile device, specifically MTAs, for a richer overall picture of MT use.

Chapter 5 Analysis of other sources of data on MT use on mobile devices

The chapter builds on the previous chapter and focuses on exploring other, pre-existing sets of data on MT use and how they can be analysed to gain insight into the ways in which people use MT on a mobile device. Section **5.1** focusses on the reviews left on the Google Play Store and what can be determined about the type of content that is translated, which elements of the technology users employ and details about how and what they translate. Section **5.2** then explores more anecdotal and qualitative evidence of the ways in which people use MT on a mobile device, thus moving from larger, more quantitative data to richer, more qualitative data and drawing out commonalities and correlations between the different sources of data.

5.1 Gathering insights from reviews of MT apps

This section presents the findings of the approach taken to gather data and insights from the reviews that users of MT apps left on the Google Play Store.

5.1.1 Section A – Content of the reviews

5.1.1.1 Complaints about the apps

Out of the 1800 reviews analysed, 1013 (56%) of them were complaints, the breakdown of which is shown in **Table 5.1**. The fact that over 50% of the reviews were complaints, and thereby negative in nature, is unsurprising given the well-established notion that negative experiences are more powerful than positive ones (Baumeister and others 2001) and that consumers are more likely to share a negative experience than a positive one.

Platform	Language Complaint	Technical Complaint	Generic Complaint	Overall Number of Complaints
Google Translate	158 (25%)	433 (67%)	54 (8%)	606[88]
Microsoft Translator	125 (30%)	178 (42%)	120 (28%)	407[89]
Overall	283	611	174	1013

Table 5.1 Types of complaints about the MT apps

In the case of Google Translate, the complaints about the app were mainly technical in nature and focussed on the changes to the 'Tap to Translate' feature made in the Android 10 OS update. Prior to this update, users of the Google Translate app were able to select a sentence and the 'Tap to Translate' icon, in the form of a floating bubble, would appear and allow users to translate the selected text. However, this feature relied on a function of the Android OS that allowed apps to monitor the text on the clipboard. This was a security issue and disabled in Android 10 as explained in more detail in a thread on the Google Translate Help forum and linked to by Google on the reviews on the Play Store complaining about this change in functionality.[90]

5.1.1.2 Comments on User Interface and ease of use

The two tags of 'UI' and 'ease of use' both emerged from the data as, when first tagging the data, it was noticed that reviewers were commenting on these elements. As such, during the second phase of tagging it was noted which

[88] NB, this number does not equate to the total of the three types of complaint for GT. This is due to some reviews being more than one type of complaint – there were: 29 reviews that were both Technical and Language complaints; one review that was both a Generic and Technical complaint; nine reviews that were both Generic and Language complaints.
[89] NB, this number does not equate to the total of the three types of complaint for MS Translator. This is due to some reviews being more than one type of complaint – there were: 11 reviews that were both Technical and Language complaints; one review that was both a Generic and Technical complaint; 4 reviews that were both Generic and Language complaints.
[90] See https://support.google.com/translate/thread/13522087 [accessed 12 January 2020].

reviews were positive or negative about the UI and ease of use of the apps. The findings are summarised in **Table 5.2**.

Platform	**UI**		**Ease of use**	
	Positive	Negative	Positive	Negative
Google Translate	2	18	18	3
Microsoft Translator	20	19	63	8
Total	22	37	81	11

Table 5.2 Number of reviews commenting on UI or ease of use being positive or negative

Firstly, it is worth noting that only a relatively small proportion of reviews commented on UI (3.8%) and ease of use (5.1%). This potentially indicates that these are not primary concerns for users using MTAs or that their experiences of these elements are neither sufficiently negative, positive, or even noticeable for users to comment on them. Interestingly, of the 92 reviews that mentioned ease of use, 81 were positive, which could be interpreted as a contradiction of the previously mentioned idea that people are more likely to leave a review based on a negative experience. However, another explanation could be that MTAs have one principal function – to provide a translation – and that there is not a steep learning curve involved in using the app. As such, users are not likely to have difficulties using the app unless it is a technical difficulty, which in this analysis is classed as a 'technical complaint'.[91]

For UI, the findings show that more reviews in the MS Translator (39) data sample commented on UI than for Google Translate (20). MS Translator had a nearly 50:50 split of positive and negative reviews, whereas Google Translate

[91] This is done as technical complaints mostly centred on bugs or glitches, rather than struggling to use the app because it was too technical to use or too hard to navigate.

had a 10:90 split of positive and negative reviews. This could be explained by the fact that MS Translator has a more complicated UI, whereas Google

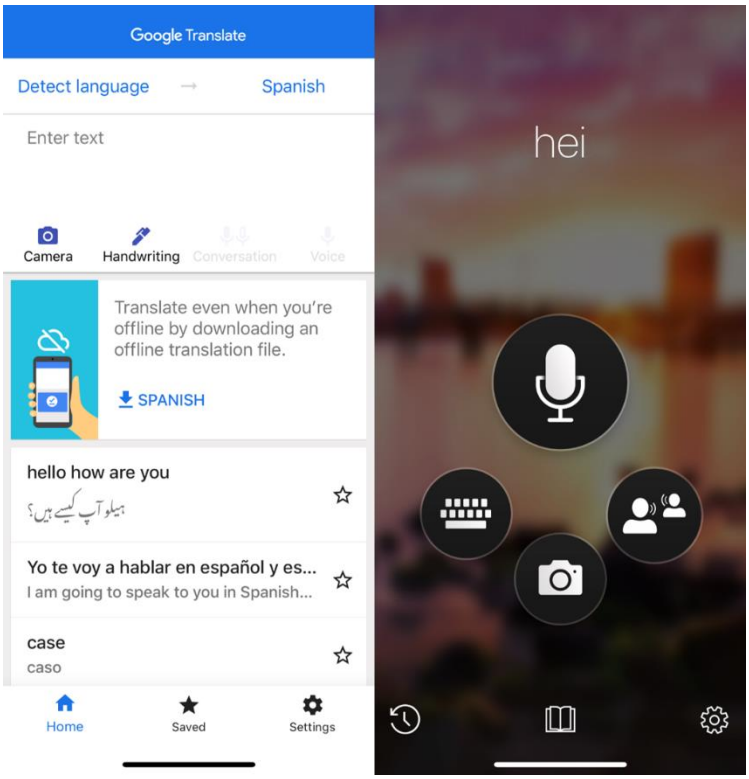


Figure 5.1 Screenshots of the home pages of the Google Translate and Microsoft Translator apps

Translate opts for a simpler UI, as shown in **Figure 5.1**.

That is, there are more steps involved in actually commissioning a translation with Microsoft Translator, as users must first click on the icon for the type of translation they would like, whereas Google Translate starts by allowing users to input text immediately and also includes words titles for each icon, whereas Microsoft Translator relies only upon the icons. Indeed, although Google Translate has a simpler UI, several reviews called for it to be updated, refreshed and modernised in line with other Google apps.

Of the 92 reviews that mentioned ease of use, 71 (77.2%) of these were MS Translator users and 21 (22.8%) were Google Translate users. Similarly, of the 59 reviews that mention UI, 39 (66.1%) of these were MS Translator users and

20 (33.9%) were Google Translate users. These findings indicate that having a more complicated UI,[92] and therefore user experience, means that users are more likely to comment on the UI or ease of use in a review. This is not necessarily for negative reasons, as the reviews of MS Translator show.

5.1.1.3 Generic Praise and Praising translation/language

In total, 729 (40.5%) reviews included praise of the MT app, the breakdown of which is shown in **Table 5.3**. This praise is broken down into two types:

- Language: reviews that are positive about the quality of the translation. This could be in general or for a specific language/language pair.
- Generic: reviews that are positive in nature, but not focussed on the quality of the translation/language.

Type of Praise	Number	%
Generic	618	84.8%
Language	36	4.9%
Both	75	10.3%
Total	729	

Table 5.3. Reviews which praised the MT app, broken down by type of praise

Interestingly, 11 of the reviews that praise language specifically praise the 'accuracy' of the translation. However, it is unclear what the users mean by 'accuracy' and what they understand it to be. This is an area worth exploring more, particularly in relation to MT literacy and even translation literacy more widely.

[92] That is, a UI which contains more steps to use the app, with functions requiring you to click on them before being able to use them, whereas Google Translate opens on a screen for inputting text.

5.1.1.4 Comparing to a competitor

160 reviews (8.9%) included a comparison to a competitor app, often claiming that the app was better or worse than a competitor, or the best app available. This shows that users are aware of other apps available and do have preferences and favourites amongst the apps in this sphere.

5.1.1.5 Requesting a new language

In total, 200 reviews (11.1%) included a request for a language or languages to be added to the app. Of these reviews, 35 were requesting a language to be added for voice translation and 28 were requesting a language to be added for offline translation.[93] As such, these 60[94] reviews were not necessarily requesting that the app support an additional language, but rather that a certain feature of the app support an additional language. This is because not all features are available for all languages. For example, a user may be able to use the app to translate text from Urdu to English (in both directions), but not use the voice translation or camera translation for this language pair, or only be able to use voice translation in one direction.[95]

Table 5.4 displays the number of reviews which requested more languages to be added to the app, broken down by platform and whether they were requesting specific languages (add specific language(s)) or simply requesting that the app have more languages available (generic – add languages).

[93] Offline translation involves downloading language packs enabling the user to translate to/from that language when their mobile device is not connected to the internet.
[94] 60 as three reviews overlapped requesting new languages be added for both voice translation and offline translation.
[95] NB, this is merely an example and not necessarily representative of the features available in the apps for this language combination.

Platform	Add specific language(s)	Generic - add languages	Total
Google Translate	58	10	68
Microsoft Translator	122	20	142
Total	180	30	210

Table 5.4 Number of users requesting new languages in their reviews

MS Translator had the greater number of reviews requesting languages be added to the app for both categories. This can be explained by the fact that MS Translator only has 60+ languages available, whereas Google Translate has 103 languages.[96]

For the 'generic – add languages' category, these reviews consisted simply of statements such as 'not enough languages' or 'you guys need to add more languages', as well as statements which were slightly more specific in highlighting the need to add more African or Indian languages. These requests were in a minority, with users tending to request specific languages. For the reviews categorised as 'add specific language(s)', **Table 5.5** provides a list of all the languages requested by reviewers. Following the table, there is an explanatory section which discusses the data presented in the table, the analyses done and the findings and implications of this.

Key to Acronyms used in Table 5.5

GT - Google Translate
MS - Microsoft Translator
G - Generic
V - Voice
O - Offline
C - Camera
Σ - Total

[96] MS Translator does not specify which features are available for which languages in its description, but Google Translate does specify that text translation is available for 103 languages.

Table 5.5 The languages requested by users in reviews of the Google Translate and Microsoft Translator apps on the Google Play Store

Section I				Section II											Section III									
Language	Where Spoken[97]	Continent	Country Classification	Number of reviews requesting language											Text		Voice		Image		Camera		Offline	
				MS					GT					Σ	MS	GT	MS	GT	MS	GT	MS	GT	MS	GT
				G	V	O	C	Σ	G	V	O	C	Σ											
Kannada	India	Asia	Developing Economy	20	-	-	-	20	1	1	-	-	2	22	N	Y	N	N	-	Y	N	N	N	Y
Malayalam	India	Asia	Developing Economy	11	-	-	-	11	-	-	3	-	3	14	N	Y	N	N	-	Y	N	N	N	N
Irish	Ireland	Europe	Developed Economy	6	-	-	-	6	-	1	-	-	1	7	N	Y	N	N	-	N	N	Y	N	Y
Urdu	Pakistan	Asia	Developing Economy	1	1	1	-	3	-	4	1	-	5	8	Y	Y	N	N	-	N	N	Y	Y	Y
Pashto	Pakistan	Asia	Developing Economy	3	-	-	-	3	-	-	2	-	2	7	N	Y	N	N	-	N	N	Y	N	N
Sanskrit	India	Asia	Developing Economy	1	-	-	-	1	5	-	-	-	6	7	N	N	N	N	-	N	N	N	N	N
Hebrew	Israel	Asia	Developing Economy	2	-	1	1	4	1	1	-	-	2	6	Y	Y	TS	N	-	Y	N	N	Y	Y
Marathi	India	Asia	Developing Economy	6	-	-	-	6	-	1	-	-	1	7	N	Y	N	N	-	Y	N	Y	N	Y
Punjabi	India/Pakistan	Asia	Developing Economy	1	-	-	-	1	-	3	2	-	5	6	N	Y	N	N	-	Y	N	N	N	N
Telugu[98]	India	Asia	Developing Economy	-	3	2	-	5	-	1	-	-	1	6	Y	Y	TS	Y	-	N	N	N	N	Y

[97] All countries taken from Eberhard, David M., Gary F. Simons, and Charles D. Fennig (eds.). 2019. Ethnologue: Languages of the World, 22nd edn (Dallas: SIL International) <http://www.ethnologue.com/> [accessed 21 January 2020].
[98] Tamil and Telugu did not have camera translation available at the time the reviews were obtained. However, in an update on 5/12/19 instant camera translation was made available for these languages for Google Translate (Gu 2019).

Section I				Section II											Section III									
Language	Where Spoken[97]	Continent	Country Classification	Number of reviews requesting language											Text		Voice		Image		Camera		Offline	
				MS					GT					Σ	MS	GT	MS	GT	MS	GT	MS	GT	MS	GT
				G	V	O	C	Σ	G	V	O	C	Σ											
Gujarati	India	Asia	Developing Economy	5	-	-	-	5	-	-	-	-	0	5	N	Y	N	N	-	Y	N	N	N	Y
Khmer	Cambodia	Asia	Developing Economy	5	-	-	-	5	-	-	-	-	0	5	N	Y	N	Y	-	N	N	N	N	N
Myanmar	Myanmar	Asia	Developing Economy	5	-	-	-	5	-	-	-	-	1	5	N	Y	N	N	-	N	N	N	N	N
Hindi	India	Asia	Developing Economy	3	1	-	-	4	-	-	-	-	0	4	Y	Y	Y	Y	-	Y	N	Y	Y	Y
Persian	Iran	Asia	Developing Economy	2	1	-	-	3	-	-	-	-	1	4	Y	Y	N	N	-	N	N	Y	Y	Y
Albanian	Albania	Europe	Economy in Transition	3	-	-	-	3	-	-	-	-	0	3	N	Y	N	N	-	N	N	Y	N	Y
Arabic	N/A	N/A	N/A	1	-	-	3	4	-	-	-	-	0	4	Y	Y	Y	Y	-	Y	N	Y	Y	Y
Bulgarian	Bulgaria	Europe	Developed Economy	1	1	-	1	3	-	-	-	-	1	3	Y	Y	TS	N	-	Y	N	Y	Y	Y
Cantonese	China	Asia	Developing Economy	1	-	-	-	1	2	-	-	-	2	3	Y	N	Y	N	-	N	N	N	N	N
Latin	N/A	N/A	N/A	2	-	-	-	2	1	-	-	-	1	3	N	Y	N	N	-	N	N	Y	N	N
Serbian	Serbia	Europe	Economy in Transition	1	-	-	-	1	-	-	2	-	2	3	Y	Y	N	Y	-	Y	N	Y	Y	N
Sindhi	Pakistan	Asia	Developing Economy	-	-	-	-	0	-	-	3	-	3	3	N	Y	N	N	-	N	N	Y	N	N
Bengali	Bangladesh	Asia	Developing Economy	2	-	-	-	2	-	-	-	-	0	2	N	Y	N	Y	-	Y	N	Y	N	Y
Haitian Creole	Haiti	North America	Developing Economy	1	-	-	-	1	-	-	-	-	0	1	Y	Y	N	N	-	N	N	Y	N	Y
Malay	Malaysia	Asia	Developing Economy	-	1	-	-	1	-	-	-	-	0	2	Y	Y	TS	N	-	Y	N	Y	Y	Y
Nepali	Nepal	Asia	Developing Economy	1	-	-	-	1	-	-	1	-	1	2	N	Y	N	Y	-	Y	N	Y	N	N

Section I				Section II											Section III									
Language	Where Spoken[97]	Continent	Country Classification	Number of reviews requesting language											Text		Voice		Image		Camera		Offline	
				MS					GT					Σ	MS	GT	MS	GT	MS	GT	MS	GT	MS	GT
				G	V	O	C	Σ	G	V	O	C	Σ											
Sotho	Lesotho	Africa	Developing Economy	2	-	-	-	1	-	-	-	-	0	2	N	N	N	N	-	N	N	N	N	N
Swahili	Tanzania	Africa	Developing Economy	2	-	-	-	2	-	-	-	-	0	2	Y	Y	N	Y	-	N	N	Y	N	Y
Ukranian	Ukraine	Europe	Economy in Transition	-	-	-	-	0	-	2	-	-	2	2	Y	Y	N	N	-	Y	N	Y	Y	Y
Vietnamese	Viet Nam	Asia	Developing Economy	1	1	-	-	2	-	-	-	-	0	2	Y	Y	TS	Y	-	Y	N	Y	Y	Y
Xhosa	South Africa	Africa	Developing Economy	2	-	-	-	2	-	-	-	-	0	2	N	Y	N	N	-	N	N	Y	N	N
Zulu	South Africa	Africa	Developing Economy	2	-	-	-	2	-	-	-	-	0	2	N	Y	N	N	-	N	N	Y	N	N
Assamese	India	Asia	Developing Economy	1	-	-	-	1	-	-	-	-	0	1	N	N	N	N	-	N	N	N	N	N
Baluchistan[99]	Pakistan	Asia	Developing Economy	-	-	-	-	0	-	-	1	-	1	1	N	N	N	N	-	N	N	N	N	N
Bangla	Nigeria	Africa	Developing Economy	1	-	-	-	1	-	-	-	-	0	1	Y	N	N	N	-	N	N	N	Y	N
Belarusian	Belarus	Europe	Economy in Transition	1	-	-	-	1	-	-	-	-	0	1	N	Y	N	N	-	N	N	Y	N	Y
Darija	Algeria	Africa	Developing Economy	-	-	-	-	0	1	-	-	-	1	1	N	N	N	N	-	N	N	N	N	N
Faroese	Faroe Islands	Europe	Developed Economy	1	-	-	-	1	-	-	-	-	0	1	N	N	N	N	-	N	N	N	N	N
Georgian	Georgia	Europe	Economy in Transition	1	-	-	-	1	-	-	-	-	0	1	N	Y	N	N	-	N	N	N	N	Y

[99] Baluchistan is not a language, but is a region divided between Pakistan, Iran and Afghanistan. The user is likely referring to Balochi.

Section I				Section II											Section III									
Language	Where Spoken[97]	Continent	Country Classification	Number of reviews requesting language											Text		Voice		Image		Camera		Offline	
				MS					GT					Σ	MS	GT	MS	GT	MS	GT	MS	GT	MS	GT
				G	V	O	C	Σ	G	V	O	C	Σ											
Hausa	Nigeria	Africa	Developing Economy	-	-	-	-	0	1	-	-	-	1	1	N	Y	N	N	-	N	N	Y	N	N
Igbo	Nigeria	Africa	Developing Economy	-	-	-	-	0	1	-	-	-	1	1	N	Y	N	N	-	N	N	Y	N	N
Indonesian	Indonesia	Asia	Developing Economy	1	-	-	-	1	-	-	-	-	0	1	Y	Y	TS	Y	-	Y	N	Y	Y	Y
Levantine Arabic	Syria/Jordan	Asia	Developing Economy	1	-	-	-	1	-	-	-	-	0	1	-	-	Y	N	-	-	-	-	N	N
Lithuanian	Lithuania	Europe	Developed Economy	-	-	-	-	0	-	1	-	-	1	1	Y	Y	N	N	-	Y	N	Y	Y	Y
Mandarin[100]	China	Asia	Developing Economy	1	-	-	-	1	-	-	-	-	0	1	Y	Y	Y	Y	-	Y	Y	Y	Y	Y
Montenegrin	Montenegro	Europe	Economy in Transition	1	-	-	-	1	-	-	-	-	0	1	N	N	N	N	-	N	N	N	N	N
Oriya	India	Asia	Developing Economy	-	-	-	-	0	1	-	-	-	1	1	N	N	N	N	-	N	N	N	N	N
Shona	Zimbabwe	Africa	Developing Economy	1	-	-	-	0	-	-	-	-	0	1	N	Y	N	N	-	N	N	Y	N	N
Tamil[98]	India	Asia	Developing Economy	-	-	-	-	0	-	-	1	-	1	1	Y	Y	TS	Y	-	N	N	N	Y	Y
Uzbek	Uzbekistan	Asia	Economy in Transition	-	-	-	-	0	-	-	1	-	1	1	N	Y	N	N	-	N	N	Y	N	N
Yoruba	Nigeria	Africa	Developing Economy	-	-	-	-	0	1	-	-	-	1	1	N	Y	N	N	-	N	N	Y	N	N

[100] This MS Translator reviewer simply states that Mandarin is not available, even though it is available in the app for all features. It is possible that translation between Mandarin and the language they would like to translate is not supported, or that the user is simply mistaken.

Explanatory Notes to Table 5.5

Section A of **Table 5.5** shows a list of all of the languages requested by users, the primary country (and, consequently, continent) where that language is spoken[101] and that country's classification according to the World Economic Situation and Prospects Report (United Nations 2019).[102] In sum, users requested 51 unique languages, from 31 different countries and four continents around the world. India is the most frequently occurring country in the dataset, with users requesting 11 languages from the country, followed by Nigeria and Pakistan, with users requesting four languages from each of these countries. Indeed, this is to be expected given that both India and Nigeria are two of the most multilingual countries in the world, as shown in **Figure 5.2**.

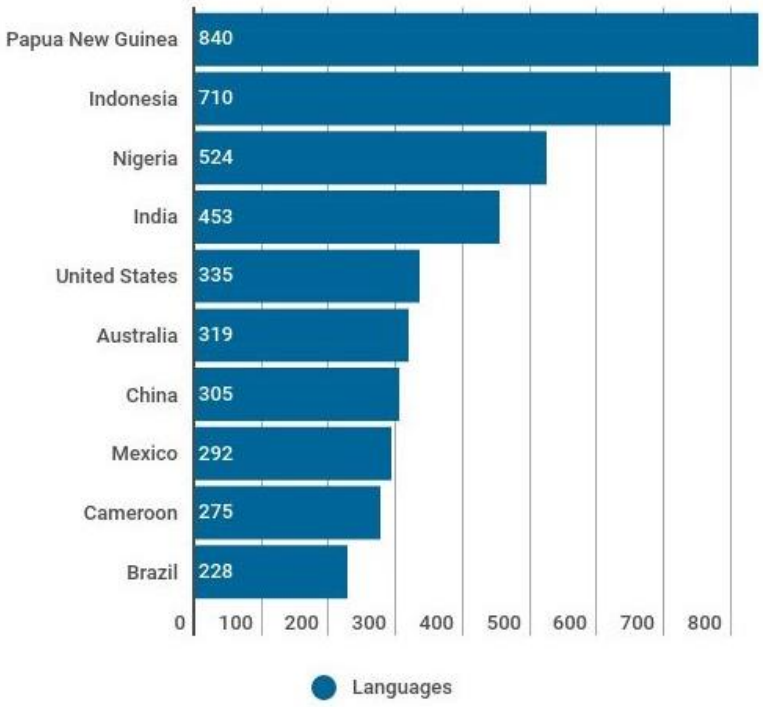


Figure 5.2 Top 10 countries with the most languages, 2019 (taken from Ethnologue (Eberhard and others 2019)***)***

[101] All countries taken from Eberhard, David M., Gary F. Simons, and Charles D. Fennig (eds.). 2019. Ethnologue: Languages of the World, 22nd edn (Dallas: SIL International) <http://www.ethnologue.com/> [accessed 21 January 2020].

[102] The classification of each country can be found in the Statistical Annex section, starting on page 167 of the report. The 2019 version of the report was the most up to date at the time of writing and reflects the country's classification at the time the review data were obtained.

As such, the findings here indicate that the more multilingual a country is, the more likely users of MTAs are to request languages that are spoken in that country to be added to the app.

Furthermore, it is perhaps unsurprising that a large number of reviews are requesting Indian and African languages when mobile phones are the principal means of accessing the internet in both India and Africa. As of January 2020, mobiles had a 73.04% market share in India (compared with a 26.64% market share for desktops and 0.33% for tablets) and a 59.83% market share in Africa (compared with a 37.74% market share for desktops and 2.43% for tablets).[103] Users from these areas are not just, then, digital natives, but they are also mobile natives. As such, there could be a higher usage rate of MTAs in these countries, and this is something which further research could explore. That is, how the usage and usage rates of MTAs vary around the world.

Of these 51 languages, eight (15.7%) of them are not available across either of the apps for any types of translation, i.e., they are completely unavailable on these apps. These eight languages are Sanskrit, Sotho, Assamese, Baluchistan, Darija, Faroese, Montenegrin, and Oriya.

		Percentage
Africa	8	25.8%
Asia	12	38.7%
Europe	10	32.3%
North America	1	3.2%

Table 5.6 The continents where the languages requested are spoken

[103] According to figures from StatCounter: https://gs.statcounter.com/ [accessed 12 February 2020].

From **Table 5.6**, it is evident that the vast majority of requested languages are languages which have fewer speakers around the world, are in less economically developed areas and primarily non-Western languages. This demonstrates that, currently, MT is serving to reinforce the power dynamics of languages in the world. For example, **Chart 5.1** shows that 71% of the languages requested by users are spoken in countries classed as a 'Developing Economy' by the UN, 16.1% are spoken in countries classified as an 'Economy in Transition' by the UN and 12.9% are spoken in countries classified as a 'Developed Economy'.

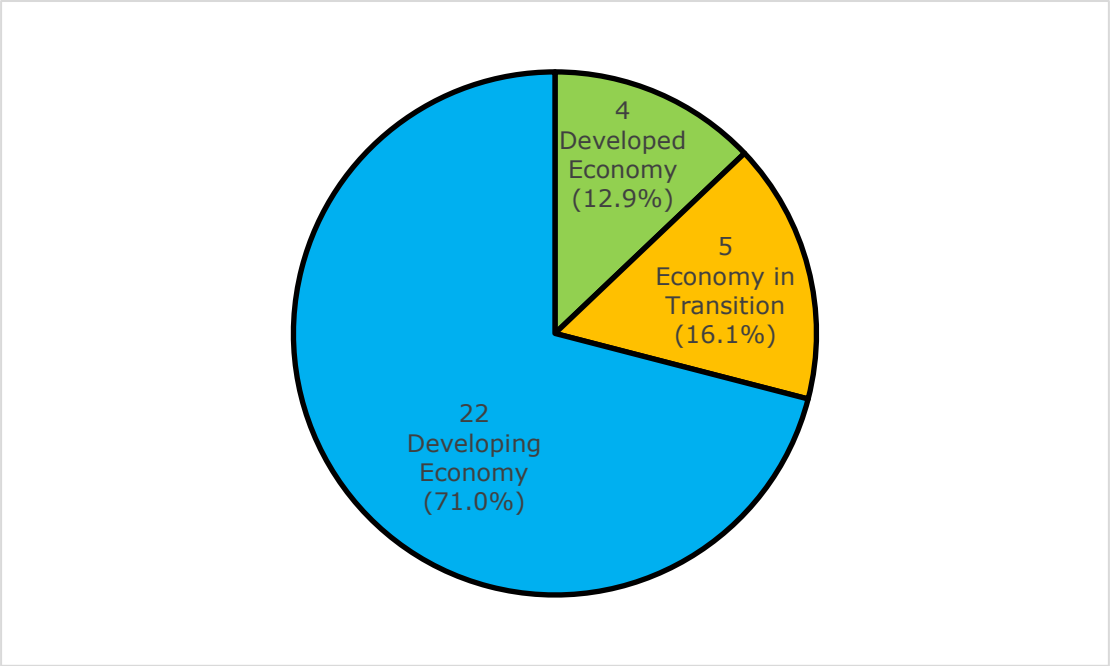


Chart 5.1 Raw Number and Percentage of Countries that are 'Developed Economies', 'Economies in Transition' or 'Developing Economies'

The range of languages available in these MTAs can provoke strong feelings and reactions among users. For example, two reviewers complain that the

apps[104] are racist – one states that the app is racist as it does not have any black languages despite there being a billion black people and another as the app is good for European languages but poor for Asian languages. Similarly, one review labels the app 'disgusting' due to its inability to translate between Sanskrit and Hindi and another labels the app 'pathetic' as it has the constructed language Klingon, but not Irish. Whilst such reviews are scarce, they do highlight the impact that these apps, and technology more widely, can have and the feelings that they can evoke in users. These findings serve as further emphasis of the well-known imbalance within MT, where only a small percentage of the world's languages are available on MT platforms. However, attention is turning to developing new systems capable of translating more languages, with recent issues of the journal *Machine Translation*[105] focussing on developing MT for low-resource languages. Furthermore, it would seem that there is a hierarchy of needs/wants relating to MT and languages. Some users are simply requesting that a language is available in an app, but once a language is available, users then become more concerned about the features available for the language and the exact variety of the language being closer to their own.

In addition to the language requests made summarised in **Table 5.5**, reviewers also made some other requests, which are not strictly speaking requests for new languages:

[104] One of these reviews is for Google Translate and one is for MS Translator.
[105] Volume 34, issue 4 and Volume 35, issue 1 were special issues of the *Machine Translation* journal focussing on the topic of Machine-Translation for Low-Resource Languages.

- One reviewer requested the ability to have language variations, e.g., European Portuguese and Brazilian Portuguese, available for translation. This would be similar to adding a new language, but could potentially be done by post-translation as well by analysing the text and changing to the language locale selected.
- One reviewer requested the ability to enter Pin Yin in offline mode.
- One reviewer requested that MS Translator add the ability to translate sign language and suggest that this could be done by using the camera to detect the sign and translate the sign into words and also translate words into a video of the sign. They state that this functionality will help communication with disabled people.[106]

5.1.1.6 Requesting a new feature

There were 130 (7.2%) reviews in which users requested a new feature for the app and **Table 5.7** breaks this down by platform.

Platform	Number of reviews
Google Translate	82
Microsoft Translator	48
Total	130

Table 5.7 Reviews requesting a new feature

The majority (63%) of requests for new features were from Google Translate users, the app with the simpler UI and fewer features available. However, the majority of these were single reviews requesting a new feature, with only 21 new features having more than one review requesting them, as shown in **Table 5.8**.

[106] This is a useful aim for the technology and research into this is just beginning, with Google (Bazarevsky and Zhang 2019; Moryossef 2020) exploring how AI can be used to enhance accessibility, particularly in relation to sign language. Other companies are exploring this area as well, with a Dutch company developing an app to translate American Sign Language into spoken language (The Economic Times 2018).

Feature	#
Voice translation offline	7
Translate PDFs	5
Tap to translate	5
Build into messenger like whatsapp/translate messages directly in the messaging app	5
Dark mode[107]	5
Translate an app/translate in other apps	5
App on external storage	3
More information about words (e.g., formality, gender or meaning)	3
Autocorrection of errors you type	2
Copy and paste	2
Add antonyms/synonyms	2
Change gender of voice	2
Dictionary available offline	2
Improve the look of the app	2
Camera translation offline	2
Ability to share image from translator to another app/save image to gallery	2
Add same language translation (e.g., English to English or Tamil to Tamil)	2
Everything available offline	2
Ability to understand handwriting	2
Direct keyboard translation	2
Add local dialects and accents of the language	2

Table 5.8 Features with more than one review requesting them

Whilst these numbers are rather small, they do indicate that users would like all types of translation and all functionalities to be available offline for the languages that they use, and many see the MT app as a language learning tool and would like the app to provide more detailed information on the languages involved in the translation.

5.1.1.7 Comments on speed

After the initial data tagging, it became apparent that some reviewers were commenting on the speed affordances of MTAs. As such, a new field of 'speed

[107] Dark mode is a feature that allows for white/lighter text on a dark background, as opposed to dark text on a light background.

of translation is a good thing?' was added and when tagging the reviews a second time all reviews that commented on speed being a positive or on the lack of speed being a negative (and, therefore, the opposite would be true, i.e., that speed would be a positive) were tagged. As such, 38 reviews were identified as commenting on the speed of MTAs being a positive element. They primarily commented on the fact that it provided a translation so quickly and was efficient. These comments, although small in number, provide empirical evidence of the analysis behind the emergence of MT on a mobile device and MTAs in Error! Reference source not found. and for the constant drive for acceleration and efficiency.

5.1.2 Section B – Purpose of using the app

Purpose	Number of reviews
Assimilation	294
Communication	104
Education	94
Entertainment	7
Dissemination	0

Table 5.9 The purposes of MT use and the number of reviews that use the MT app for that purpose

Of the five purposes, assimilation was by far the most popular, with 294 reviewers using MT apps for assimilation. This is most likely explained by the technology lending itself to assimilation due to the ability to use the phone's camera to perform translation. This functionality allows users to translate both images from their phone and to live translate any text in front of them, such as a restaurant menu. As such, if a review stated that they used the camera translation function, it was then surmised that their purpose was assimilation, as this is likely to be the only practicable function of this feature. In fact, out of the reviews that used MT for assimilation purposes, 253 (86%) of these used camera translation. However, it is worth noting that it would be possible to use

camera translation in other ways, such as for optical character recognition (OCR), then use the translation provided by MT to produce a document to send out to somebody else (dissemination), but this was assumed to be unlikely.

The least popular purpose was dissemination. In fact, of the reviews analysed, none of them used MT for the purpose of dissemination, which is understandable given that they are unlikely to be using an app to spread their work. However, some users did request functionalities that might enable them to use the app for the purpose of dissemination. For example, several users requested the ability to upload documents, such as PDFs, to the app and have it translate them. Hypothetically, this could be a document that they have produced and then wish to send out to other people, thus fulfilling the purpose of dissemination.

Finally, it is worth noting that in both the survey and this app review analysis, the most common purpose identified is assimilation and, in fact, the order is the same across both, as shown below:

1. Assimilation
2. Communication
3. Education
4. Entertainment[108]

5.1.3 Section C – Type of translation

This section focusses on the types of translation that users are using the apps to perform. **Table 3.3** provided definitions of voice translation, offline translation

[108] Dissemination is not included here as it was not explicitly included in the survey as an option.

and camera translation and **Table 5.10** provides a breakdown of the number of reviews, by platform and in total, which indicated they use a specific type of translation.

Platform	**Voice Translation**	**Offline Translation**	**Camera Translation**
Google Translate	127	132	197
Microsoft Translator	136	70	57
Total	263 (14.6%)	202 (11.2%)	254 (14.1%)

Table 5.10 The number of reviews in which users mention performing different types of tranlsation

For this dataset, the most popular type of translation is voice translation, followed by camera translation and finally offline translation. This information suggests that users are making use of the different types of translation available on the apps and that these are features they value. This is further validated by the fact that some reviews were specifically requesting a language be added for voice translation or offline translation, as discussed in **Requesting a new language**. These figures are interesting when compared with the figures from the survey in that use of voice translation is much lower among the survey participants, as discussed in **4.2.1.4 Speech and Text Translation (Qs 13-19)** and **4.3.4 Speech and Text Translation**. This difference could be explained by the fact that some of these functionalities (offline translation, camera translation) are only available on MTAs. Similarly, for voice translation, this feature is available in the app, but not may be available for all browsers

depending on the MT platform. Google Translate, for example, only fully supports voice translation when accessed via the Chrome browser.[109]

5.1.4 Section D – Details of use

5.1.4.1 Place

A working hypothesis for this research was that users would use MT apps when travelling abroad as the technology, being mobile, lends itself to this and it is, potentially, more likely that a person would need an app when traveling and encountering different languages. As such, I tagged reviews that included mention of where they were using the MT app. Overall, 89 reviews mentioned were tagged in this way, the breakdown of which is shown in Figure 4.

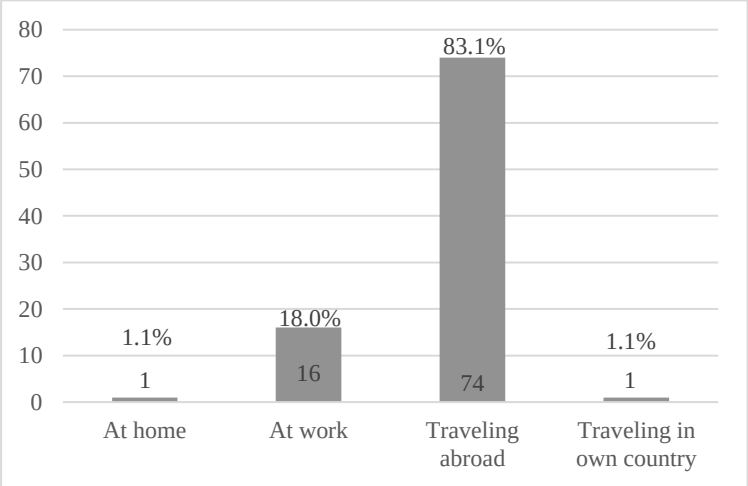


Chart 5.2 Where MT apps are used

As **Chart 5.2** shows, the vast majority (83.1%) of the reviews that mentioned where they used their MT app used it while traveling abroad. These data do, then, suggest that the main time users need MT apps is when travelling abroad, when they are most likely to encounter a language they do not speak. The one

[109] https://support.google.com/translate/answer/6142468?hl=en&co=GENIE.Platform%3DDesktop&oco=0#zippy=%2Cvoice-input-isnt-supported-on-this-browser [accessed 10/03/2022].

review tagged as using MT while ‘traveling in own country’ is from Canada, which the reviewer recognizes as a multilingual country and implies this is why they use the app. Combined with the findings in **Table 5.10**, that offline translation is a feature many users find valuable, this information indicates that users are willing to invest time in preparing their MT app to maximize its functionalities and usefulness when they are travelling and without a data connection.

5.1.4.2 Type of content

In sum, 44 distinct reviews mentioned what type of content they use their MT app to translate.

Type of content	Number	%
News	1	2.3%
Social Media	0	-
Messages	12	27.3%
Content in other apps	19	43.2%
Street signs	3	6.8%
Product packaging	9	20.5%
Menus	9	20.5%
Literature	0	-

Table 5.11 Number and percentage of reviews translating different types of content with their MT app

The fact that the two types of content users mostly translate are content in other apps and messages is to be expected. Google Translate specifically offers the ability to translate content in other apps through its ‘Tap to Translate’ feature and messaging is one of the main ways in which users can communicate using mobile devices. The fact that nobody uses the app to translate social media content is perhaps indicative of the fact that many social media platforms have in-built MT that functions automatically without the user requesting it and that, as a translation is already provided, there is no need to use their app to translate the content.

5.1.4.3 Translation length

In total, 83 reviews mentioned the length of text they use MT apps to translate. **Table 5.12** shows the number of reviews mentioning that they translate single words, sentences and paragraphs.

Platform	Single Words	Sentences	Paragraphs+
Google Translate	20	30	10
Microsoft Translator	6	15	2
Total	26	45	12

Table 5.12 Reviews mentioning the length of the texts they translate in the app

These findings reinforce the findings from the survey in **Q11 What do you use your machine translation app to translate most frequently? (Single answer)** as users here are also indicating that they mainly use MT to translate shorter chunks of text, usually single words of sentences. That is, relatively few users are using MT on a mobile device to translate longer chunks of texts such as paragraphs.

Due to the nature of the dataset, reviews, it is understandable that there is more data that comments on features than on how they use the app (by its very nature, a review is requesting a comment on it from its user, and not necessarily looking at how that user uses the tool).

5.1.4.4 Frequency

Twenty-one reviews (1.2%) commented on the frequency with which they use the app, with the breakdown by platform and frequency shown in **Table 5.13**

Platform	Frequently	Infrequently
Google Translate	14	2
Microsoft Translator	4	1
Total	18	3

Table 5.13 Reviews mentioning the frequency with which they use the app

Although grouped under the terms ‘frequently’ and ‘infrequently’, due to the variety of ways in which users could describe how often they use the app, some users commented on the fact that they use the app every day or almost every day. Such a level of frequent use implies a high dependence on the app for communication for that user.

5.1.4.5 Duration

Only six reviews, all of Google Translate, commented on the length of time that they had been using the app and all had been using the app for over a year, as shown in **Table 5.14**.

Duration	Number of reviews
Days	0
Weeks	0
Months	0
1 year+	2
2 years+	1
3 years+	1
4 years+	0
5 years+	2

Table 5.14 Number of reviews that mentioned how long they had been using the app

Although only small in number, these reviews do demonstrate that users are choosing an app to fulfil a need and are then sticking with that MT app for a long period to fulfil their communicative needs. Indeed, one review commented on the fact that the Spanish version had greatly improved over the last three years and implies that some users are considering and assessing the quality, both in the moment and over time, of the translations provided by the MT app.

5.1.5 Unexpected and creative uses of MT

Whilst tagging the data, I also made a note of any use cases of the MT apps that were unexpected and/or creative. These use cases underscore and provide evidence for the fact that although technology may be designed to be

used in a certain way, users will always find new and innovative applications for technologies. Analysis of the reviews of MT apps also resulted in a variety of unexpected and creative uses of MT emerging, as summarised below:

- One person attempts to use the app for watching TV in Russian and Chinese.
- One person tries to use the app as a subtitle replacement for watching foreign movies, but it keeps stopping after seven seconds (technical complaint) they think to let them catch up.[110]
- One person plays music from their phone and uses the app to translate what was playing.
- One person comments that they use it to translate Spanish to English on their TV.
- One person takes screenshots of a game in Japanese and uses the image translation function to understand the game. So, while not using MT itself for an entertainment purpose (i.e., the MT/translation is not the entertainment), it is facilitating entertainment, so its purpose is primarily assimilation, but also entertainment. Another user downloaded a game in Russian and then uses the Google Translate app to help navigate through the settings to change the language to English.

These use cases demonstrate the fact that users of MTAs have found creative, innovative and unintended ways of using them for an identified need. These

[110] This may, in fact, simply be the limit for a speech utterance or that the device thinks the speaker has finished speaking and so provides the translation.

uses may go well beyond the perceived boundaries or intended design of the MTA, such as by using an MTA to watch television programmes or movies, but they seem to be covering two main purposes – entertainment and assimilation.

5.1.6 General findings

When considering this dataset as a whole, some general conclusions can be drawn, with the caveat that this is not a representative study. These conclusions only relate to this study and are not generalisable to MT more generally or MT use on other devices beyond apps. They may, however, provide direction for further research or investigation in MT more generally:

- This study further highlights the fact that economically powerful languages are much more likely to be available on MT apps. Nevertheless, users are requesting that other languages, many that are non-Western and are from the Global South, be made available or have more features available for them.
- Assimilation seems to remain the most common purpose for using MT across all interfaces, including MTAs.
- Now that MT is accessible via many different devices (e.g., desktop PC, smartphone) research is needed to explore how, if at all, users are using MT differently across different devices. Different types of devices will have different possibilities and affordances, allowing users to use MT differently and find new, creative ways for using MT, such as to watch TV shows or translate games.
- Users are using MT apps for a wide variety of purposes and in both their professional and personal lives. Some of these use cases involve the app being the only method users have to communicate

with family members with whom they do not share a language, communicating at work to patients in a medical context or even using the app to scan packaging for allergens. This all indicates users at times having a high dependence on the app and placing a large degree of trust in the hands of MT, as reflected on previously in **2.6.4 The ethics of AI and MT**.

5.2 Qualitative and anecdotal evidence of use of MT on a mobile device

In addition to the survey and app review analysis conducted for this thesis, it is also possible to find more individual, anecdotal examples of users using MT on a mobile device. This section discusses some of these examples, with an example of Syrian refugees using MT on a mobile device and stories from a blog on MT use, and the insights that can be gained from them.

5.2.1 Refugees using MT

For example, Vollmer (2018), in a study on the digital literacies of Syrian refugees in the UK, cites the example of Rojan[111] who uses Google Translate on his smartphone to use another app, iTheory.[112] This is a clear example of an individual using MT on a mobile device for assimilation and the MT app is fundamental in enabling Rojan to assimilate the information in the other app and practise for his UK driving test. Vollmer (2021) further discusses this example and how Rojan explains that he always uses the app during his English for speakers of other languages classes.

[111] This name is a pseudonym.
[112] This is an app which helps people practise for their driving theory test and is only available in English.

5.2.2 The MT Stories Blog

Machine Translation Stories is a website developed by the researcher Mary Nurminen in which she chronicles examples of users using MT in their everyday lives. In this blog, the focus is on MT use in general, rather than specifically on MT use on a mobile device. Nevertheless, it is possible to infer[113] from the stories when users are using a mobile device and, in personal correspondence,[114] the author of the webpage gave permission for the stories to be mentioned here and confirmed that at least two of the people in the stories, Eeva and Nora, used MT on a mobile device. What follows is a short summary of the stories of users who use MT on a mobile device and an analysis of how their use fits the taxonomy of MT uses.

Gus (Nurminen 2017a), a Scottish man who lives in Finland, describes how he combined two apps, Text Fairy (an OCR text scanning app) and Google Translate to translate notices, documents, or signs from Finnish into English so that he could get an understanding of them. He gives the examples of insurance documents, bank letters and a notification about voting as times when he used his MT app to gain an understanding of texts. This is an example of somebody using MT for assimilation with quite important documentation. The author of MT stories herself, Mary Nurminen, has a blog entry (Nurminen 2017b) in which she describes how she used the Google Translate app. She used the camera translation function to translate the contents page of a book written in Russian

[113] For example, this could be from screenshots, or descriptions of using a phone or app.
[114] Via Facebook Messenger between 17/10/19-18/10/19.

to see if the article she needed was in said book. This is again an example of using MT on a mobile device for assimilation purposes.

Eeva (Nurminen 2019a) describes how she used Google Translate to communicate with her son when they first adopted him from China at four years old. Although the use was temporary until he learned to communicate in Finnish, she explains that it was very effective and that it essentially bridged the two-month gap between his arrival in the country and his ability to communicate in Finnish. She would type out sentences in Finnish into the app and have the app speak out the translations in Chinese in order for her son to understand. Eeva also makes use of the different functionalities and modalities of the app, as she inputs written text for translation and then uses the output as speech translation. She states that they did also consider using the Finnish speech input, but felt that this would lead to more mistakes being made, so she instead spoke out what she was typing so that her son could hear the Finnish as well. This is a clear example of MT on a mobile device being used to facilitate communication, and in this case in quite an intimate context, between a parent and a young child, during a formative phase of their relationship, when they first became parent and child.

Nora (Nurminen 2019b) is somebody who works within the international travel industry and uses Google Translate as she travels abroad frequently for work. She was inspired to use MT after once struggling to work something out in China and seeing a colleague use their phone to translate. She also does describe how it is commonplace in restaurants in China for people to use MT on a smartphone when they realise that they do not share a language and

subsequently explains how she uses Google Translate on her phone in several different ways and for several different purposes:

- buying tickets and communicating with waiters in China.
- using the image translation function when shopping in stores abroad.
- at work with customers who speak a language or dialect she does not know.

Furthermore, she also highlights the fact that she tends to translate into English rather than her native language and sees English as the key to MT, as she feels that her own language is not a good one to translate with. This is some indication that whilst English may sometimes act as a pivot language in MT systems, MT users also recognise the differences in its capabilities with different languages. In this instance, it could be stated that Nora is demonstrating a degree of MT literacy, understanding that it will work better with English and adapting her usage based on this. In addition, she uses the multimodal functionalities of the app, sometimes translating speech or using camera translation to translate labels and signs. She reports varying levels of success with MT, stating that her success rate when communicating using the app was 80-100%, although this dropped to 50% when using camera translation.

Examining these anecdotes using Yang and Lange's (2003) categories, **Figure 5.3** shows the various purposes for which these individuals use MT.

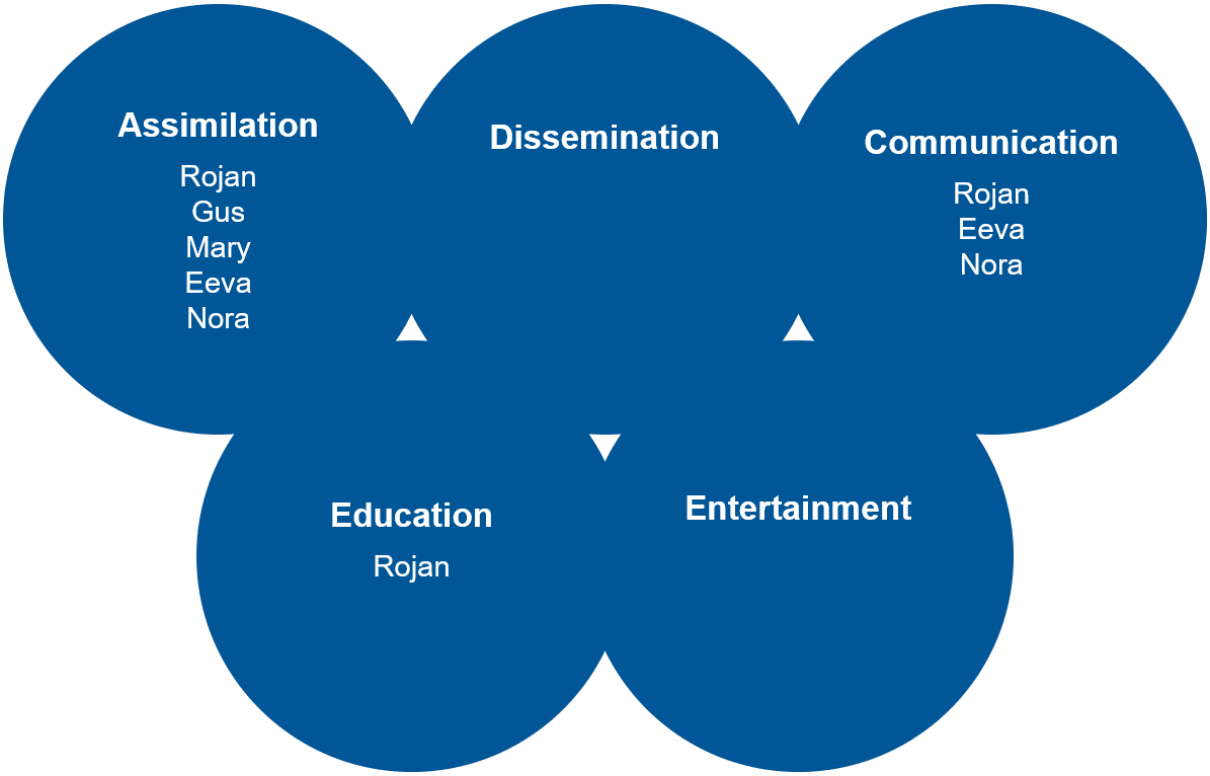


Figure 5.3 Use cases from these stories mapped to the purposes of use

From **Figure 5.3**, it is clear that in these very small qualitative examples, assimilation is the purpose most commonly reported on, occurring four times, and highlights the need these individuals have to access information in a language outside of their own. Communication, occurring three times, is also one of the most often reported about purposes. It is interesting to note that these anecdotal examples correlate with the findings of the survey and app review analysis that assimilation and communication are the two most common purposes for which users use MT on a mobile device. These examples also demonstrate that MT can be a truly transformative technology, enabling communication for users in challenging circumstances and where translation would have otherwise been extremely difficult if not impossible to access. MT is another step in the democratisation of information and communication.

Although these are only a few examples of users using MT on a mobile device, they are rich narratives which provide further insight, detail and colour, beyond that which a survey can provide, of how users are integrating MT, and MT on a mobile device, into their lives. It is evident that for these users MT plays an important role in many aspects of their lives, ranging from using it to get the gist of a text to facilitating (or even, at first, enabling) communication between a parent and child. These examples highlight the potentially lifechanging importance of these technologies and how important they can be to individuals, as well as how they are increasingly integrated into the lives of those who use them and enable us to carry out activities which would have previously been much more difficult, slower or even impossible. These examples show that MT, particularly on a mobile device, can act as an enabling technology and at times be the only way through which communication can be achieved, even in very important, intimate contexts.

Furthermore, drawing on Bowker's ideas of MT literacy and fit-for-purpose translation (2019a), all the users discussed here demonstrate a level of MT literacy. For example, Nora recognises that it is probably better when using English than her own language, whilst Eeva identifies that it is best to use MT with simple and short sentences. This is true, given that one of the main challenges for NMT is longer sentences (Koehn and Knowles 2017) and a common misuse of MT is to use it as a dictionary and translate individual words (which would be a case of the input being too short to be optimal).[115] Indeed,

[115] However, developers have integrated dictionary lookup functionality into MT and it can provide dictionary-like functionality such as synonyms, usage examples and definitions.

beyond the stories on Machine Translation Stories which focus specifically on MT on a mobile device, many users acknowledge the limitations of MT (e.g., not to be used for published documents or anything that needs to be particularly polished) or that it is better at translating into English than their own language. There is also indication here that stories about assimilation and communication are the ones which capture the imagination, perhaps as they are the ones which are the most impactful on users.

5.3 Conclusion

This chapter has presented a study into qualitative sources of information regarding the ways in which users use MT on a mobile device and, specifically, how they use MTAs. Whilst the findings are not representative or generalisable, they provide greater insight and depth into the ways in which users actually make use of MT and how it impacts their lives. Combined with the information obtained from the MT stories blog, this chapter has presented rich, qualitative insights into the sometimes profound and intimate ways in which users make use of MT and how it can act very much as an enabling technology. The next chapter builds on this chapter and the others to provide overall findings for the thesis and a general direction of travel for MT, as well as further areas for research.

Chapter 6 Overall findings

This chapter draws upon the previous chapters to provide overall findings for this thesis. It firstly presents tools that may prove useful for future research exploring how users use MT on a mobile device and how they use MT more generally, as well as a hierarchy of wants for MT. Such tools, particularly a taxonomy of MT uses that allows for categorisation of ways in which users use MT, have not been available to date and would allow for a more consistent approach over time. The chapter then focuses on general overall conclusions regarding MT and translation, as well as potential implications for translation and society more generally.

6.1 Tools for future research

The research undertaken throughout this process has demonstrated that it is increasingly evident that there is a need for further study of the ways in which users use MT more generally, as well as the ways in which users use MT on a mobile device. Humans are encountering translation and the possibility or option of translating more than ever before, thanks to technology and the internet increasingly permeating all aspects of society and life. Moreover, the speed at which users can interact with and obtain translations is also constantly increasing, as explored in previous chapters. However, there are no tools that can be applied to study the ways in which users, particularly outside of the context of professional translation, use MT, particularly general-purpose MT. This is, perhaps, partly due to the changing nature and affordances of the technology, as well as the explosion in access to MT over recent years, as well as the fuzziness surrounding exactly what MT is, particularly for the general

public.[116] As such, this section proposes and develops two general-purpose tools which could be used to help study MT use, enable comparisons over time and across platforms, and to explore further users' needs and wants with MT.

6.1.1 Towards a Taxonomy of MT uses

6.1.1.1 Why a taxonomy?

A taxonomy is a way of classifying and grouping together information or data into categories. A comprehensive taxonomy which classifies the basic, most common uses of MT would enable replicability and comparability over time and across different MT platforms, enabling both researchers and developers to study their own and other MT platforms. Carrying out research into the ways in which users use MT on a mobile device has highlighted the lack of an established classification system and the need for such a taxonomy for MT use. As such, the development of this taxonomy is designed to serve as a starting point, upon which further work can be developed.

As MT and other technologies have developed, they have enabled users to use MT in new and creative ways, such as to translate TV shows or to facilitate a live conversation as seen in **Chapter 5**, which were not previously possible or envisaged. As such, the taxonomy is designed in such a way that it can be expanded in future, to take into account new technologies and developments in the field. This is, then, a dynamic taxonomy that can reflect the changing nature of the technology it studies and classifies. The taxonomy is not designed to be and cannot, therefore, be all-encompassing – it is designed to be

[116] Evidence of this is borne out in the survey used in this thesis, with participants including free online dictionaries as examples of MT systems they use.

changed, expanded and adapted in the future, adding further use cases and levels of granularity where they become necessary or possible based on new technologies and uses.

6.1.1.2 Where does this taxonomy come from?

The idea for this taxonomy of MT uses is founded on the 'five functions for the online translation service' identified by Yang and Lange (2003) and discussed in more detail in the **Yang and Lange's** (2003) **five purposes** section of the introduction of this thesis. These overarching categories, grounded in data, form the basis of the taxonomy, but the aim of the taxonomy is to provide a greater level of detail of use, providing more nuance and examples of MT use that could be identified for each category. Furthermore, nearly 20 years have passed since Yang and Lange proposed these five functions, during which time the number of MT systems available to people, and what they can achieve, has increased significantly.

Similarly, the ways and situations in which users can access and use MT have changed dramatically, thanks to the development of new technologies and the ability to use these technologies in a mobile manner thanks to mobile devices and the growing ubiquity of the internet as highlighted in previous chapters. As such, there are now use cases that simply were not technologically possible when Yang and Lange identified these five functions, such as a person placing a mobile in front of a TV to translate the audio of a TV programme as seen in **Chapter 5**. In 2003, such mobile and speech-to-text technologies were not readily available, as they are now to anybody with a smartphone. The

framework established through their work is rather rudimentary in nature[117] and was not originally intended to be a framework, rather reporting on what they had found from the data obtained in their study. As such, this taxonomy builds upon this framework to develop it in greater detail and add new ways in which users use MT.

6.1.1.3 The taxonomy

The proposed taxonomy of MT use is presented overleaf, followed by an explanation of its conception, design and content.

[117] This is not a criticism – their intention was never to create a classification system or establish such a framework. In fact, this is the opposite – an unintended positive consequence of their work is that it spawned analysis through these lenses.

Taxonomy of MT uses

Professional use

A. Assimilation		
	"Using MT to understand something in a foreign language"	
A1	Assimilation of a foreign language of which the user has no knowledge	A person with no knowledge of Spanish decides to use MT to understand what the options are on a menu whilst on holiday in Spain.
A2	Assimilation of a foreign language of which the user has some knowledge	A person with some knowledge of French decides to use MT to understand or check their understanding of the options on a menu whilst on holiday in France.
B. Dissemination		
	"Using MT to translate content into another language for people to use/consume"	
B1	Producing content for a specific audience	
B2	Producing content for a non-specific audience	
C. Communication		
	"Using MT to facilitate communication (i.e. a conversation/dialogue) between two or more people"	
C1	Using MT for a synchronous, live conversation	A son-in-law speaks to his mother-in-law (they do not share a language) through an MT app.
C2	Using MT for an asynchronous conversation	A lecturer at a university is having a discussion via email with a colleague in the field and drafts their emails in their mother tongue before running them through an MT system into a foreign language to send to this colleague.
D. Education		
	"Using MT to learn or to enable learning"	
D1	Using MT to help with learning a foreign language	A person is learning a foreign language and uses MT as a tool to help them do this.
D1.1	Using MT as a dictionary	A person wants to know how to say a word in another language and so puts this word into an MT service, essentially using it as a dictionary.
D1.2	Using MT to check an utterance	
D1.3	Using MT to hear how to pronounce something	Somebody learning Spanish uses the text-to-speech functionality to hear the pronunciation of a word.
D1.4	Using MT to check understanding	Somebody believes they have understood a text in a foreign language, but uses MT to translate the text into their mother tongue to check they have understood it.
D2	Using MT in an educational context to enable or facilitate the learning process, where the primary focus is not language learning per se	A person uses MT during a class (e.g. a lecture) to understand what the teacher is saying.
E. Entertainment		
	"Using MT for entertainment, e.g. because it is funny"	
E1	MT itself is the entertainment, e.g. back and forth translation for amusement	Putting text through various different language combinations and then using/performing these resulting "translations" (e.g. the YouTube channel "Translator Fails").
E2	MT is not itself the entertainment, but enables or facilitates the entertainment	A person uses MT to watch a foreign-language TV show by placing their phone in front of the TV and having an MT app translate the dialogue.
F. Translation workflow		
	"Using MT as part of the process of producing a translation"	
F1	Using MT as a supportive tool to help the translator produce the translation	A translator employs MT as a tool, much like a Translation Memory, Termbase or dictionary, to help them when producing a translation.
F2	Using MT to translate with a human translator post-editing the MT output	Somebody uses MT to produce a translation, which is then post-edited (e.g. by a translator, or by a native speaker).

Non-professional use

The taxonomy contains the two descriptors of ‘professional use’ and ‘non-professional use’ spanning the whole length of each side, to highlight that each of the examples of use (A-F) could be used in both a professional or non-professional context. For instance, a person could use MT to understand a menu in a restaurant (assimilation, in a non-professional context), but a patent professional may also use MT to understand a patent submission request (Nurminen 2019c) (assimilation, in a professional context).

The taxonomy contains six uses down the centre:

A. Assimilation
B. Dissemination
C. Communication
D. Education
E. Entertainment
F. Translation workflow

These are based on the five identified by Yang and Lange and an additional use of ‘translation workflow’. This sixth use case, which has arguably been the most studied to date, as ‘research into the usability and acceptability of MT by end users is still in its nascent stages’ (O’Brien 2017: 313), has been added to allow for a separate category of use into how users can employ MT as part of the process of producing a translation. That is, in this case, MT is a tool which helps the person produce the translation and is not producing the translation that the person uses, i.e., it is part of the process. In short, MT has most frequently been studied as a tool to help a translator complete a translation (Nurminen and Papula 2018: 207), i.e., in the context of HAMT and MAHT and their increasingly blurred boundaries, and it is likely that this study will continue

thanks to the increasing integration of MT into the suite of tools employed by translators since the 1990s (Gaspari and others 2015; Christensen and others 2017). However, there is a growing need to study MT use outside of this context, as this is likely to be by far the largest use case of MT – Google Translate alone translated over 140 billion words per day and has 500 million monthly users (Lewis-Kraus 2016) – so having the two separate options allows for this.

These six categories then have descriptors of use cases, or sub-categories, that may fit into this overall category, which allow for a greater depth in understanding of how MT is being used. For example, in certain cases it may only be necessary to know that users are using MT for assimilation, whereas in others it may be necessary to explore this further, to understand whether they are using MT to assimilate from a language of which they have some knowledge or no knowledge. However, it is also possible to simply use the taxonomy at a higher level, simply categorising the uses from A-F.

It should also be noted that these examples have been obtained from real data and use cases from the data generated by the survey and app review analysis conducted as part of this thesis. That is, they are not invented, potential examples, rather they are actual, real-life use cases of ways in which users use MT. As such, the use cases and examples provided in the taxonomy are not exhaustive and could and should be added to over time. However, they may serve as a useful starting point when conducting research into how users use MT – it would be possible to approach the research with the categories or sub-categories in mind, and then add any other categories/sub-categories that emerge from the findings. The taxonomy is, then, grounded in the data and

going forward allows for flexibility and further development, should new use cases emerge from studies.

These categories are not completely separate and there is overlap between each of them. Furthermore, it is not designed around the idea of the 'user' as a user could fall into any or all of the categories, depending on the exact context in which they are using MT. Rather, the taxonomy is designed around 'use' to help with establishing patterns of use of MT. For instance, if somebody uses MT to understand a lecture, they are using it for both education and assimilation purposes, or in this instance assimilation for education (MT is not the educational tool, rather it enables that person to understand something for education purposes). Similarly, the purpose of communication could potentially be a super-purpose, in that it must incorporate two other purposes – assimilation (understanding what the other person says) and dissemination (enabling the other person to understand what the user says) – in order to function.

In addition to this permeability between the purposes, their prevalence and importance may vary over time,[118] particularly with technological developments. For example, in the earlier days of the internet, before the levels of personalisation seen available today, dissemination may have been a much more prevalent and important purpose, to make sure a message had as wide

[118] In the taxonomy, they are not sorted in order of importance, but simply by the order that Yang and Lange reported on them in 2003.

a reach as possible. However, the rise of personalisation[119] may lead to a decrease in dissemination, as rather than disseminating a message in multiple languages, it is possible for the recipients to convert the message into their language using MT, thus shifting use cases from dissemination to assimilation.

6.1.1.4 Example flowchart for a survey using the taxonomy

This taxonomy can be used on a broad level, much in the same way that Yang and Lange's functions can, to identify use cases of MT. However, the taxonomy can also be used on a more granular level if the study is interested in exploring the use deeper than just identifying the category. That is, some studies may only need to establish that a use is, e.g., 'C. Communication', whereas some studies may need to further granularize and categorise this and establish that a use is, e.g., 'C2. Using MT for an asynchronous conversation'. Furthermore, a study may focus on only one element of this taxonomy, e.g., 'F. Translation Workflow', in which case the other elements may not be useful, but it would still be interesting to note that they are excluded from the study and state whether it is a study on professional or non-professional use or both. For example, there may be a study looking exclusively at how professional translators use MT in their workflow or how non-professional translators producing a fan-sub of a TV show use MT to help them to do this.

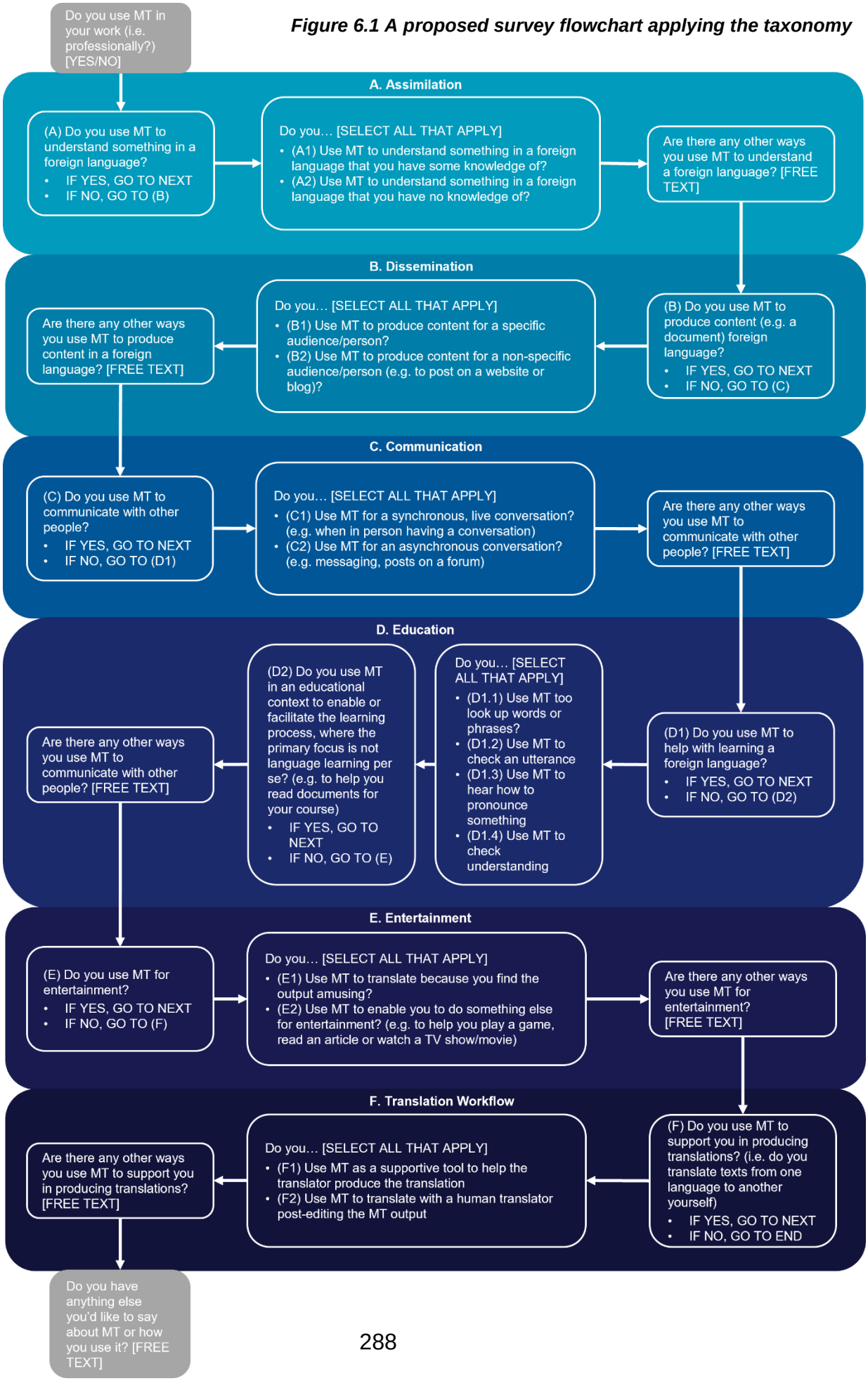
This taxonomy has been developed due to a lack of pre-existing tools to categorise MT use and it did not exist in its current form when the data collection

[119] For example, on Facebook it is not necessary to provide a translation as other users can use Facebook's built-in MT system to translate the post into their own language if needed (assimilation). Similarly, modern browsers such as Google Chrome allow users to specify the languages they use and then offer built-in translation services if the browser detects the user is visiting a page in a language they have not told it they can understand.

for this thesis was done. Rather, only the broader categories identified by Yang and Lange (2003) existed and were mapped to the data. While these broad categories were a useful starting point it is hoped that the taxonomy can become a basis for analysing use of MT to enable comparability and replicability over time in studying how users of different MT systems and of MT generally interact with the technology and the affordances it provides. Indeed, this taxonomy is a starting point and can be expanded on as technology evolves and as new use cases are identified from data and the ways in which users are using MT. In other words, the current taxonomy represents a snapshot of current MT use based on the findings in this thesis and building upon the framework laid by Yang and Lange (2003).

What follows in **Figure 6.1** is an illustrative flow of how a short survey could be conducted using the taxonomy to explore the different ways in which users use MT. The survey in this example would be a general one, not focussing on one particular use case or purpose and would allow for identifying the relative popularity of each of the different purposes and for comparison across different studies if it were repeated over time. This survey flowchart has been designed to proceed through all the categories in the taxonomy, hence its presentation as a flowchart. It provides an example of how a study could simply apply the taxonomy as is needed or wanted.

Figure 6.1 A proposed survey flowchart applying the taxonomy



6.1.1.5 Explanatory notes to the survey flowchart

It is, first of all, worth highlighting that the questions in the flowchart do not use the language of the taxonomy itself, to enable participants to understand the questions. That is, participants should not require any knowledge of MT or this taxonomy to answer the questions, to ensure that as many people as possible can respond to the survey. However, in this example flowchart the categories and subcategories of the taxonomy are mapped to the questions using the same coding as in the taxonomy, e.g., A, A1, D1, D1.1 etc., and suggested branching questions are depicted by questions with yes/no options.

Question about professional use

The first question, if asked, would allow for exploration of differences in how users use MT in a professional context and in their private, personal lives and the porosity between the two. It would be possible to ask participants to answer the same set of questions twice, once thinking about how they use it in a personal capacity and once thinking about how they use it in a professional capacity. Or, if not needed, this question could simply be removed and this distinction not made in the study.

Assimilation, Dissemination, Communication, Entertainment and Translation Workflow

The questions for these five categories are essentially the same, starting with an initial yes/no question that will provide a top-level figure for how many participants are using MT for that purpose, and also functioning as a branching question to only show the following questions for that category to participants who do use it for that purpose. The second question enables the participant to

provide greater detail about their use for each purpose and provides a level of granularisation and differentiation. It would be possible to add to these with further use cases or go into further detail, e.g., for assimilation it would be possible to explore how proficient participants are in the languages they use MT for. Finally, the free text question allows for any additional use cases to be captured and for sub-categories to be added to the taxonomy.

Education

The questions in this category vary slightly, based on the findings that there are two principal ways in which users use MT in an educational context – as a language learning tool or to facilitate learning more generally. This relationship between MT and language learning probably stems from the close relationship between language learning and translation. The first question in this category allows for a top-level figure for how many participants are using MT to help with learning a foreign language and the following question allows for further detail of how exactly they use MT as a language learning tool. The third question allows for a top-level figure for how many participants are using MT to help them in learning that is not specifically learning a foreign language. A further question could be added with some use cases if further detail is needed, e.g., do you use MT to understand a session being delivered? Do you use MT to read text in another language that are useful for your studies (e.g., journal articles)? The final free-text question in this category allows for any additional use cases to be captured and for sub-categories to be added to the taxonomy.

Final free-text question

This is a simple free-text question that would allow the participant to add anything else about MT or how they use MT, in case they had not been able to express everything beforehand. This would ensure that there is a space for everything they would like to say and also serve as a way to capture new use cases.

Adapting questions

These questions are only one possible set of questions and not an exhaustive list of possibilities. Researchers could, and are encouraged to, adopt the taxonomy and tailor it to their needs, rephrasing the questions or use cases as needed. For example, a research study looking at how professional translators integrate MT into their workflow might not ask the first question about professional use and might only include questions about assimilation, dissemination and translation workflow to see whether they use it more to understand the ST more quickly or to aid in the production of the TT.

As previously mentioned, this set of questions simply represents one way in which the taxonomy can be directly applied to and studied through a survey. They have been provided to illustrate the usefulness of the taxonomy and also offer a set of questions that could be easily and readily applied to a study.

6.1.2 Hierarchy of wants/needs for MT

In addition to the taxonomy, which builds on categorising MT use cases, it has become evident from the findings in Chapters 4 and 5 that users' concerns and priorities for MT may change over time. As such, it is also worth proposing a model that suggests how these needs and wants may develop over time, based

on the findings from the data obtained from this thesis and MT research more widely. The model developed draws directly on the hierarchy of human needs, which can be visualized as a pyramid, developed in the field of Psychology by Maslow (1943). The more basic needs (deficiency needs) are at the bottom and the more advanced needs (growth needs) are at the top, with the idea being that once the more basic needs are fulfilled, it is possible to start fulfilling the more advanced needs. There is generally a linear progression, although Maslow does note that a need does not necessarily need to be 100% fulfilled before the next need emerges. It is possible to devise a similar hierarchy of wants/needs for MT, based on the findings the survey, app reviews and qualitative story analysis. Such a hierarchy of wants/needs for MT is proposed in **Figure 6.2**.

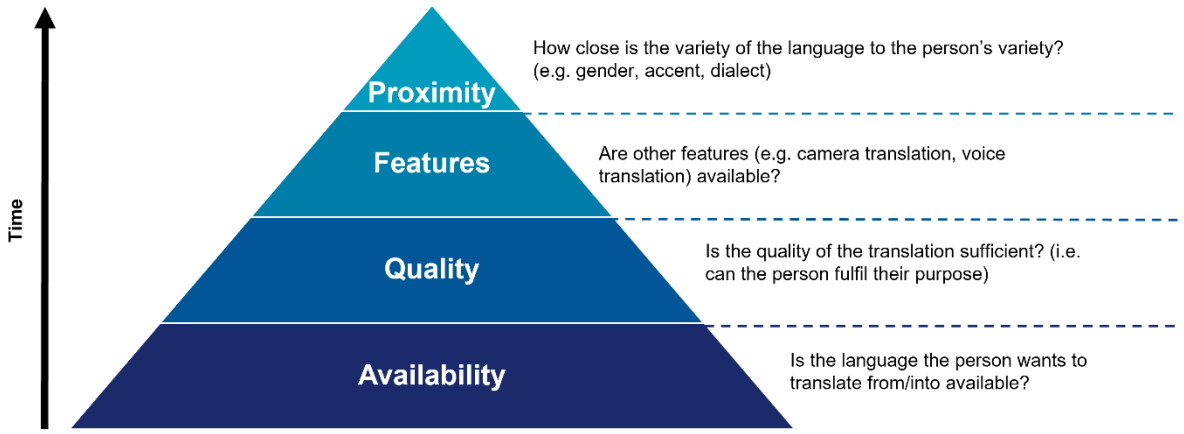


Figure 6.2 A proposed hierarchy of wants/needs for MT[120]

The pyramid starts with the most important and basic need, availability, at the bottom, and the time axis demonstrates how users' needs or wants may and

[120] This is a hierarchy of "wants/needs" as these are not really "needs" in the sense that Maslow uses them in the pyramid, in terms of needs for humans to survive.

can develop over time as the more basic needs are fulfilled. Furthermore, the pyramid's structure (with the more basic wants/needs at the bottom) is also indicative of the fact that there are currently more languages and users at these levels, and fewer languages have reached the top of the pyramid currently. Each step of the pyramid is explained in more detail below, from the bottom of the pyramid, the most basic level, to the top, the most developed and complicated level.

Availability

This refers to the language(s) which the person needs to translate to and/or from being available on the MT platform they are wanting to use. This is the most basic need, which underpins all the others. In fact, for MT, this need must be fulfilled before the higher levels of the pyramid can be – if the language is not available, then it is not possible to worry about quality, features and proximity. Therefore, this need is the primary need and a prerequisite for all the others, and must be completed first. Indeed, this was the most common request in the analysis of MT app reviews, and this is unsurprising – if the language(s) a user wishes to use MT for are not available on the platform, then they cannot engage with the MT platform or any of the higher levels of the pyramid.

Quality

Does the person requesting the translation rate the quality of the translations provided? Quality in MT, and of translation more generally, is a nebulous concept, as discussed in **2.3 MT Quality Evaluation**, but on a basic level this can be ascertained through whether the MT provided by the system is of sufficient quality that the person is able to fulfil their purpose or reason for using

MT. Once a language is available on an MT platform, users may then consider quality more of an issue and expect that the quality of the translations provided for the language would improve over time. Conversely, users may also initially be impressed at the quality of the translation due to the novelty of the technology and initially having low expectations and then, as they become accustomed to it, they may expect higher standards and have lower satisfaction. Quality was also a pertinent issue that emerged in the analysis of MT app reviews and in the survey participants rated it as more important than ‘ease of use’ or ‘ability to use without an internet connection’ (which would be categorised as features). So, once the quality is of a sufficient standard, users may then become more concerned with the features available for their language(s).

Features

This level of the pyramid refers to the availability of different features or functionalities for a language. For example, a language might start off being available only for text-to-text translation and over time users would expect further features, such as text-to-speech and speech-to-text or camera translation to be added as features for their language. Indeed, in the MT app review analysis users requested new features such as voice translation, offline translation and camera translation. This is indicative that once the language(s) a person needs are available and the translations are of a good enough quality, that person then wants to be able to use the MT platforms and translations in different ways and circumstances.

Proximity

This is the top level of the pyramid and refers to how close the variety of language used by the MT platform is to the speaker's own. It could be categorised as another feature, but is here placed as a separate step as even fewer languages have this kind of option available. For example, does the platform allow users to select whether they want Brazilian Portuguese or European Portuguese? However, proximity also goes beyond this and refers to whether the platform allows for the spoken voice to be close to the person using the MT platform. For example, does it allow for selection of a male or female voice? Or for the selection of a certain accent or dialect? Such features are only available for relatively few languages or not available at all yet (e.g., accent), but may develop in the future in line with the increasing drive towards personalisation.

Once at the top of the pyramid, the MT system provides translations of a quality that allow the person to fulfil their purposes for using the MT and would be as close as possible to the user's variety of language and their own voice. However, it is worth noting that current MT technologies only take into account one aspect of communication, particularly with verbal communication, that is the words that are spoken. There are other elements to communication, such as tone of voice and body language that technologies do not yet take into consideration. Indeed, the role of nonverbal communication in the communication process is vital (Mehrabian 1972; Hall and Knapp 2013; Burgoon and others 2016), despite there being varying agreement about how much of a role verbal or nonverbal communication plays. Indeed, with advances in voice recognition and reproduction technologies, it may be possible in a few

years for MT systems to actually produce translations in the voice of the original speaker. Research into this has just begun, with researchers at Google providing a proof of concept in Translatotron and Translatotron 2 (Jia and others 2019, 2021), a system capable of translating speech to speech, without recourse to text, and producing translations in the original speaker's voice. There is further proof of concept of this idea with the development of AI that can produce increasingly realistic photos (of people who may or may not actually exist) and deepfake videos (in which it can be made to seem that people have said or done things that they have not, which is another example of ethical issues surrounding AI, as discussed in **2.6.4 The ethics of AI and MT**) (Brundage and others 2018).

The difference between deepfakes and Translatotron (and other similar future technologies) seems to be one of intentionality, with deepfakes usually made by somebody else (potentially for malicious purposes) and technologies such as Translatotron enabling users to actualise themselves through the technology. These are further examples of ways in which modern digital technology can become further integrated into human lives and the blurring of the digital and physical worlds. This blurring is gathering pace, with Facebook announcing the launch of its Metaverse at the end of 2021 (Paul 2021), Microsoft purchasing Activision Blizzard to expand its vision of a gaming Metaverse (Frier and Bass 2022) and with Neuralink set to begin human trials of chips embedded into humans to allow interaction with technology (Neate 2022). Indeed, this is not something new with modern technologies, but rather technology is and always has been one of the ways in which humans survive and shape the natural world and it in turn shapes us and is part of us (Taylor

2010: 5/6). In short, when such technologies as described above are readily available, the MT system would allow the user to actualize themselves through the system – the technology acting almost as an extension of the self, and would be frictionless for the person and the other person(s) with whom they are communicating. That is, the dream of FAHQT, of frictionless translation, which was the original end goal of MT (Lennon 2014) would be realised.

On a practical level, this may involve full integration of the technology into smart devices so that users have always-on MT with them that activates when needing to communicate with somebody with whom the person does not share a common language. Although this does sound like the realm of science fiction, of the universal translator from Star Trek, there are technologies currently available that move us further in this direction. For example, the Google Pixel Buds work in conjunction with the Google Translate app on an Android device to provide MT directly into the person's ear.[121] Similarly, there have been developments in smartglasses technology that allow wearers to make use of MT and translation technologies. For example, the now discontinued Google Glasses allowed wearers to use the Word Lens app to translate written text that they saw through their glasses (Gannes 2013). More recent developments in the area of smartglasses allow wearers to make use of MT to provide real-time translations in the form of AR subtitles for people speaking different languages (Young 2019; Oppo 2021). Indeed, unlike with HT where there is concern regarding the invisibility of the translator (Venuti 2008) and calls for the

[121] As Google explains in this 'Translate with Google Pixel Buds' Google Pixel Buds Help article: https://support.google.com/googlepixelbuds/answer/7573100?hl=en [accessed 13 December 2021].

translator to be more visible, the opposite is almost true of MT. That is, the end goal for MT, or rather MT manufacturers, would be to have a system that is, for all intents and purposes, invisible, so that those who rely on it for communication are not perturbed by its presence and almost forget that it is there. There would be, however, ethical considerations for such a system – what happens when the power is in the hands of one individual, if they are the one with the technology, and interacting with someone without this technology? Who is responsible for the quality and/or accuracy of what is being communicated? They would, to an extent, control the communication and be in a greater position of power. Similarly, would a person have the right to know that even though it may seem like it, they are not actually communicating directly with the other person, but that a machine is moderating and facilitating this communication?

6.2 General conclusions

What follows in this section are some broader conclusions and reflections emerging from the work carried out in this thesis on MT, MT on a mobile device and the implications for translation. These build upon the tools proposed and other findings from the studies carried out in this thesis, with the aim of providing a general direction for future research and studies. These conclusions are directional, based upon the current situation and technological developments, and are indications of current social and technological trends in translation and TS.

6.2.1 Translation as a purpose-driven activity

An activity can be described as purpose-driven if it is being done for a specific reason and its outcome fulfils a goal and it is worth first highlighting that on

some level translation has always been a purpose-driven activity, in much the same way as any human activity, or any activity, is a purpose-driven activity. That is, there is always a purpose for doing something, whether that purpose is more abstract such as ‘to have fun’ or more specific such as ‘to construct a wall in the garden to create a barrier between this house and the next’. In the context of translation, this purpose could be quite specific and measurable such as ‘to complete this translation of a perfume advert for a client’ (the purpose is more easily defined or measurable) or more abstract such as ‘to enjoy oneself by translating this text’ (the purpose is less easily defined or measurable). That is, there can be both very broad or very narrow purposes and translation remains open-ended, with a heuristic element remaining.

This is also true of MT, where the user will have a purpose when using MT to perform a translation. Indeed, with MT, more people can use translation in ways that they could not before, as in the past they would have been consumers of the translation, rather than users of it to communicate, or to learn or to entertain. In this instance, MT is the tool that provides the translation for a person who cannot themselves produce the translation and the purpose of that individual is essential to the translation and the translation process and for determining whether the use of MT has been a success. In short, the purpose of the individual becomes the barometer by which the usefulness and success of a translation can be measured, as if it has not enabled them to fulfil their purpose or if communication fails to happen, then it has not been useful or successful. This differs from HT or from the use of MT in a professional context (when the main purpose may be as a tool to support the HT process), as the purpose of the individual is of vital importance to the translation and the translation

process. With MT, particularly on a mobile device, the purpose and nature of translation may become more fleeting and ephemeral and closely linked to the individual who used the MT platform for the translation, due to the speed at which these translations are done and used. Furthermore, this idea of purpose links to the ideas of speed and efficiency discussed earlier in this thesis and is another example of how they are the driving forces behind translation, as MT facilitates fast use of translation. MT is a tool that humans can employ, and tools, by their very nature, either enable us to do something (i.e., a purpose) that we could either not otherwise do or that would be much more difficult or slower without the tool.

6.2.2 MT & democratisation

Translation Studies often talks of turns, such as the cultural turn or the technological turn, as discussed in **1.1 The relationship between translation and technology**. The technological turn in TS is now well documented (Cronin 2010; O'Hagan 2012) given the increasing integration of technology and translation over recent years. Indeed, this is unsurprising as this technological turn within TS is part of a much larger digital turn in society at large, with digital technologies becoming increasingly embedded across all aspects of human lives in both private and professional contexts. The world of work has transformed over the last 30 years to become digital and interconnected and the Covid-19 pandemic further accelerated this change through enforced homeworking and hybrid working models. Indeed, there is a close and symbiotic relationship with technology in that whilst it has enabled certain practices, such as homeworking, these phenomena have also then shaped technology and the development of new technologies and features in response

to the situation. Similarly, technology has become more integrated into aspects of our personal lives thanks to smartphones and smart technology that we can wear and use around the house and the increasing number of devices connected to the Internet of Things (PwC 2018; Juniper Research 2020). So, whilst humans have always used technology to some extent, when referring to the technological turn we are really referring to something of a digital turn, with digital technologies becoming increasingly embedded throughout society.

The increasing integration of translation and technology, studied within the technological turn, is enabling the increasing democratisation of translation and of MT. This democratisation is occurring on many levels, with the act of translation no longer the domain of only language professionals, but also the reach of translations being expanded and people's ability to use translations greatly increased. This is comparable to the increase in book and translation production and usage seen with the (re-)discovery of the printing press (Gauger 1994; Febvre and Jean-Martin 2010; Hosington 2013). MT on a mobile device is a further instance of this democratisation, with more people than ever before having access to translation and translations simply through a handheld device. This enables users who do not have access to desktop devices to access MT and everybody to access MT in a greater variety of situations, thus cementing the notion of MT functioning as a democratising technology and democratisation being a key element of the technological turn. Nevertheless, it should be noted that access to these technologies, as with all technologies, is not equal, so the technology is not democratising for everyone, but for those

who have access to it.[122] MT can, therefore, be described as an enabling technology for these users, helping them achieve purposes and interact with translation more. It is also worth noting that it is not only MT that is being democratised, but HT as well, principally enabled again by the technological turn, thanks to the growth in fansubbing and self-publishing enabled by the internet.

What is more, there has been a change as to what constitutes translation or who or what can carry out a translation. Indeed, these changes are happening in society more widely, with self-driving cars changing who or what can drive a car, with the human no longer essential to the process. That is, for the first time in history, non-humans are carrying out the act of translating.[123] Whilst MT as a technology per se is largely responsible for this democratisation, MT on a mobile device further augments this. This is because it expands MT beyond only those with a computer, allowing its use in more situations and by more people around the world. In addition to this change in the nature of the process of translation, there is also an increasing democratisation of translation as a product, with more people than ever before able to interact with translations (both HT and MT) thanks to the increasing proliferation of translations afforded by the internet.

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[122] This technology is largely, but not universally, affordable and available, so there is a limit to how democratising it can be. That said, the technology per se is democratising and is likely to become increasingly available as internet access and smart device ownership rates increase around the world. Indeed, technology can be both enabling and disabling at the same time and for different people – it may make a task easier for certain individuals, but then act as an entry barrier for other individuals who do not have access to or cannot afford that technology.

[123] Even if this is done through machine learning based on human-produced translations, it is still the machine which produces the translation in this case.

There are, however, contrasting elements with HT and MT. Human translators, and HT as a whole, are wanting to become more visible and receive recognition for their work to help overcome the problem of the translator's invisibility as Venuti (2008) has described it and as discussed in more detail in **2.6.2 Translation's place in the world – translation's invisibility?.** This is in direct contrast with MT which aims to be as fluent as possible and as invisible as possible, as the best experience for human communication being moderated by technology is when that moderation is seamless and almost unnoticeable. Although, there is a caveat to this with recent calls for humans to be made aware of when they are interacting with machines or machine-produced output (Bay 2018; Nature 2021).

6.3 Conclusion

This chapter has presented some tools that have been developed in this thesis to enable comparability and replicability across studies and over times. It has explained the need for such tools and explored where they have emerged from in relation to the findings presented in this thesis. It has ended by providing some general conclusions and directions for translation and TS moving forward, based on the findings from this thesis. The next chapter is the final conclusion to the thesis as a whole, synthesising what it has examined and the direction in which MT on a mobile device is moving.

Chapter 7 Conclusion

7.1 The 22nd century tourist: a thought experiment

John steps down from the plane, heading for the terminal building, following the directions and signs that appear superimposed over the walkways and buildings in front of him. The neural implant in his brain is communicating with chips embedded throughout the airport, directing him in his own language, using AR technology to combine digital text and directions with the physical world. On the way, he is greeted by airport staff. They speak to him in Spanish, their own language, but he hears English, his neural implant automatically translating what they say and their own neural implants automatically translating his responses, spoken in English, into Spanish. He receives a notification in the corner of his eye that his bag will be available for collection from belt D3 in five minutes and so sends a request for a driverless car to meet him outside the airport in ten minutes' time.

Whilst the above might currently sound like science fiction, it is indicative of the direction in which the world is currently moving. Indeed, thinking about the representation of translation in science fiction is useful for imagining how translation might function in the future, as 'one of the most important premises of science-fiction is to create a more or less *plausible* vision of the future, based on *rational* presumptions and hypotheses about the shape of possible worlds and societies' (Wozniak 2014: 345). And yet, in science fiction, 'usually the

translation problem is either passed over in silence or dispensed with in one of three ways that reflect received ideas: telepathy, lingua franca and machine translation' (Mossop 1996: 2). Similarly, science fiction often relies on devices which are essentially magical, such as the Babelfish or the Universal Translator, in that they are so far removed from our current technological capabilities and understandings that their functionalities are essentially magical in nature and inexplicable. Nevertheless, whilst most science fiction depictions of translation are concerned with communication with aliens, the ideas presented in them are useful when considering how communication on earth may take place in the future. The above example is, then, based on currently available technologies and ideas from science fiction that seem plausible given the current trajectory of technological developments. Taking this exercise retrospectively, in 1954 somebody could equally have written a piece such as the above about a person disembarking a plane, taking out their portable computer and using it to communicate with the people of that country. This would have been within the realm of science-fiction at the time, based on contemporary technological trends and developments. The example of John given here is similarly based on the current trends in mobility and MT on a mobile device and its increasing integration with other technologies.

For technophiles, it is not impossible, nor at all difficult, to conceive of a world in which the tourist's translation experience when travelling abroad is seamless and invisible. Such a tourist would wear technology, or would have technology incorporated into their body, as in the example given above, which would automatically detect their location, the language of the country and translate the written language (encountered in the street, on menus, in museums etc.) into

that person's language without them ever seeing the original text or actively knowing that they are interacting with a translation. Spoken language would also be automatically translated for people, with participants in a conversation hearing everything in their own language. The chosen time, the 22nd century, is an arbitrary future date, not a prediction for a time by which such technology will be available. Although such an experience may not be too far off for certain areas, people and languages of the world, a situation where this is possible for anyone still belongs, essentially, to the realm of science fiction. Indeed, as explained previously, wearable tech which facilitates translation is beginning to emerge and there are plans for the first experiments involving neural chips in humans (Neate 2022). Furthermore, one of the world's largest companies, Meta, has announced two new projects around MT (Edunov and others 2022). The first is 'No Language Left Behind', a project to create MT for an increased number of languages, based on systems that learn from fewer examples and the second is to create a Universal Speech Translator, which translates spoken language without need to convert it into written text. Nevertheless, the fact that it is possible to conceive of practical, real applications of current technologies that would make this possible, and not rely on fictional, magical devices such as the Universal Translator or the Babelfish, shows how far the development of MT has progressed. Conversely, for technophobes, such worlds and technologies are still a distant dream, with these areas full of unrealised hype and promises and could even be considered something of a dystopic future. The reality is that the developments will find themselves somewhere between the technological dystopias and utopias proposed by technophobes and technophiles.

7.2 Research questions

RQ1 - In what ways are users engaging with MT on mobile devices?

The evidence in this thesis shows that users are using MT in a wide variety of ways and in ways that the technology was never envisaged to function. Nevertheless, the data here indicate that assimilation remains, by far, the most popular purpose for which users use MT on a mobile device. More research over time and across different systems, building upon previous research and using tools to facilitate replicability and comparability, such as the taxonomy proposed in this thesis, is needed to enable greater understanding of how use of MT on a mobile device, and MT more widely, varies across time, platform and location. Similarly, this would allow for further granularity in distinguishing whether users are making different uses of different functionalities such as text translation, speech translation and camera translation and whether they have different purposes when using different functionalities. It would also allow for further examination of whether users are making use of the integrated nature of the technology (that is, using it with other technology such as smartglasses or headphones) and the ways in which this technology is changing and shaping users' interactions and lives.

RQ 2 - In what ways is MT on a mobile device changing users' perceptions of translation?

MT on a mobile device is increasing the accessibility of MT, enabling more people to use it in more situations. As such, users can engage with MT, and thus translation, in a constantly growing number of situations. The evidence in this thesis indicates that most users believe MT will be on par with HT in certain contexts, but it also makes them appreciate the value of HT as well. Moreover,

users are able to state the quality of the MT has improved over time, thus indicating that they do think about, or at least can engage with when questioned, the quality of a translation. As such, further research into what quality means to end users is needed. This relates to the idea of translation as purpose-driven activity and fit-for-purpose translation, i.e., that the quality of a translation, at least in certain situations, can be judged by whether it fulfils the user's purpose or needs. Moreover, at the very least, the technology of MT is making users think about and interact with translation on a much larger scale than ever before.

RQ3 - What implications might MT on a mobile device have for the language barrier?

It is impossible to state categorically that the language barrier has been overcome and statements making such claims are currently hyperbolic. Rather than completely overcoming or eliminating the language barrier, MT on a mobile device can reduce the impact that a language barrier may have on a person and its visibility, thus potentially contributing to the invisibility of translation, as discussed in **2.6.2 Translation's place in the world – translation's invisibility?**. As such, MT facilitates communication and reduces the impact of the language barrier – it is still there, but a technological tool enables users' communicative acts to function, and this is something which could fail should this technological tool be removed. MT on a mobile device is, then, reducing the significance of the language barrier, for certain languages, and facilitating communication across this barrier in instances where it would have previously been much more difficult.

7.3 Where do we go from here?

This thesis is an exploratory study into the use of MT on a mobile device and sought to address the three principal research questions discussed above. MT has undergone significant transformations since the development of the first system in Georgetown in 1954, from a large, room-sized machine to being accessible on handheld or even wearable mobile devices. Indeed, many of these transformations have only increased in scope and speed in more recent years since the advent of the internet, SMT in the 1990s, NMT in the 2010s and the rise of mobile technologies capable of accessing the internet, enabling people to use them as computers on the go.

However, this expansion in availability and use has not been accompanied by a large expansion in research that examines how the technology has been used and its implications and effects on society. There is a lack of longitudinal data on MT use, both of specific platforms, perhaps because these have changed substantially over the years,[124] and also of MT use more generally. Furthermore, there have been no studies repeated over time, either on an ad-hoc basis or on a regular basis such as an annual or five-yearly study. It can, therefore, be very difficult to compare findings to previous work, but it is evident that the use of MT has increased thanks to improvements in the technology, its increasing integration into translators' workflows and into other technologies, as well as an increasing level of personalisation. As such, this highlights a need for further and continuous study in this area, and a need for some agreed

[124] The dominant platforms of the 1990s, for example, either no longer exist or have been combined with other platforms. That said, Google Translate has now been around for nearly two decades and continues to remain a prominent MT system.

standards or frameworks to allow for replicability and comparisons across platforms and over time. It is hoped that the taxonomy provided in this thesis might serve as an example of use contexts and a means by which researchers could, to some extent, standardise the way they examine MT use to enable more comparisons across platforms and over time. At the very least, it could spark discussion of how repeated research could and should be carried out, to enable patterns to be mapped over time.

Although the original aim of this thesis was to focus on MT apps and how users use them, it became increasingly apparent that it focussing exclusively on MT apps would severely limit the possible pool of participants who use MT. This is because of the different ways in which users can access MT on a mobile device as demonstrated by 86.3% of participants surveyed for this thesis using both the browser and an app. It is, therefore, perhaps more useful to focus on the idea of 'MT on a mobile device' rather than trying to focus exclusively on MT apps (although this would also be possible, especially for smaller scale studies or studies that wish to focus specifically on MTA usage, but the data here suggest that the potential pool of participants would be much smaller). Such a categorisation encompasses those who use MT on a mobile device via an app and those who access it through their device's browser. Indeed, it is possible to ask, as was done in the survey for this thesis, for participants to state how they access MT on a mobile device, and it would be interesting to perform larger-scale studies to look for differences in use dependent on whether users are accessing MT on a mobile device through an app or the browser.

Further study of the ways in which users are using MT, both on a general basis and specific platforms, is needed to understand how users are engaging with

the technology and how it is affecting and shaping human behaviour and communication. This study would ideally involve collaboration between academia, the MT industry and the translation industry, as the bodies who study translation and are responsible for developing MT systems and using them. Furthermore, the developers of MT systems will have access to the data that the systems generate about their usage, which could be used in conjunction with user- and use-focussed studies. These studies need to approach several different angles, examining not simply how users are using the technology, but what the implications of this are and any potential ethical ramifications. There is also an increasing need to study and promote MT literacy across all fields of society (Bowker 2019b; Vieira and others 2021)[125] to enable users to make better use of the technology and informed decisions about when it is appropriate to use or not. For example, MT is sometimes used in healthcare settings, and medical professionals need to be made aware of the limitations of the technology to help them communicate with patients and a decision about whether using the technology is appropriate or not depending on the nature and immediacy of the medical situation.

The role of translation and the translator has always been important throughout history, enabling cross-cultural communication and technology has been an important element in this process and will actively and continually contribute to shaping translation. However, the idea of what translation is and who or what can be a translator is changing, thanks to advances in technology. Indeed, this

[125] This coincides with an increasing need for AI literacy across society, to understand better the limitations of the computational tools available to us.

is part of a wider change in human society as we create technologies that increasingly take on tasks that we used to do as humans and the boundaries around roles and who or what is able to carry out tasks and roles are becoming increasingly porous.[126] The use of MT on a mobile device is, then, another form of interaction with translation and technology and represents an increasing integration of translation into human society and lives. Rather than MT spelling the end of translation and the translator, it is an exciting time for translation and translators, with humanity on a broader scale interacting with translation more than ever before and generating more translation than at any point in human history. This represents an exciting opportunity for changes and growth in the way in which we use translation and opportunities for further study to understand how the role of translation is changing and adapting. Indeed, whilst there have been experiments involving MT systems designed for translating literature (Toral and Way 2018), this is one domain in which HT still far exceeds MT and is likely to remain so for the foreseeable future due to the artistic and aesthetic nature of this kind of translation. Furthermore, with the increasing amount of audiovisual content being produced and consumed around the world, there are new opportunities for translators to be engaged in translating this more creative content. It would seem for now likely that these kinds of more creative translation will remain firmly in the realm of human translators and purpose-driven translation will increasingly be carried out by MT. MT, rather

[126] For example, driverless trains have been around for a while now and driverless cars are being trialled around the world. Similarly, there are trials taking place assessing the feasibility and effectiveness of the roles of robots in care homes (https://www.theguardian.com/society/2020/sep/07/robots-used-uk-care-homes-help-reduce-loneliness [accessed 30/08/2021]).

than replacing HT, expands upon and complements HT, creating new instances where users can use and engage with translation.

7.4 A post-Babel world 2.0? Not quite

The title of this thesis – Mobile translation applications: On the verge of a post-Babel world 2.0? – is a large, overarching question to which there is no simple answer. However, it would be remiss not to attempt to provide a response to this question. Firstly, it has been noted previously that it is too soon to focus solely on apps, as this narrows the scope of studies too much and it would be better to focus on MT on a mobile device, as users access MT on a mobile device in a mixture of ways. As such, the question would currently perhaps be better phrased around 'MT on a mobile device' rather than 'mobile translation applications'. In order to provide a response to the question, it is first necessary to consider what the question means and what a post-Babel world would constitute. There are, essentially, two possibilities for a post-Babel world:

A. A common shared language for all human beings on the planet. This would be an as yet undiscovered universal natural language or a constructed language (such as Esperanto). This would, in a certain sense, be a reversion to Babel 1.0, in that in the Tower of Babel narrative humans shared a common language, i.e., they had a universal language, before angering God and being forced to speak separate languages.
B. A technological solution that converts utterances or texts in another language into a language that the individual can understand, with such seamlessness that the person is not

necessarily even aware that the other person has spoken in a different language.

The only feasible possibility, grounded in current society and technological possibilities, is option B. One might, however, argue that this would not technically be a post-Babel world, in that technology would simply be providing an illusion that the language barrier has been overcome or circumvented in this case. It would still be there, but human technology and tools would render it essentially invisible, as long as that technology remained available and functioning. This technophilic and techno-determinist view is now a much more distinct possibility than it was even only 70 years ago, just before the invention of the first MT system. Although a post-Babel world 2.0 still remains only a remote possibility, current technologies, such as MT, and MT becoming more integrated with smart technology and the rise of ubiquitous connectivity, are moving human society further in this direction and towards this possibility.

This thesis has explored the rise of MT on a mobile device and the ways in which users are using this technology. **Chapter 2** provided the broaded context for the study. It explored the emergence and history of MT and how the technology has developed over time, examined the concepts of mobility and speed and how they underpin many technological developments, including the development of MT on a mobile device. **Chapter 3** discussed the methodologies employed in this thesis as a way of gathering data and insights into the use of MT on a mobile device. **Chapter 4** and **Chapter 5** provided data for analysis of how users are using MT on a mobile device through a survey and the collection of reviews left of MT apps. **Chapter 6** then highlighted the overall findings of this thesis, building on the work of the previous chapters.

To answer the title of this thesis, in short, we are not on the ‘verge’ of a post-Babel world 2.0, but MT on a mobile device moves humanity a step closer to such a world and makes it more possible than ever before. Nevertheless, there are important considerations, particularly the ethical ramifications, of the technology and its development that need to be considered. MT on a mobile device is the latest way of accessing MT and represents an exciting, growing area that is ripe for further research, with constant technological developments enabling new and innovative ways to interact with MT and translation.

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Appendices

Appendix A – the survey of MT use on a mobile device

Survey of Machine Translation Apps

About this survey

This page provides you with important information about this research. Before beginning the survey, please read the information on this page and then tick the box at the end of the page to confirm your participation and begin the survey.

About this research

Matthew Watts, a PhD researcher at the University of Nottingham, UK, is conducting this research. It aims to explore user perceptions of machine translation apps and understand how people are using such apps. It forms part of Matthew Watts' PhD work.

Supervisors: Pierre-Alexis Mével (Pierre-alexis.Mevel@nottingham.ac.uk) & Yvonne Lee (Yvonne.Lee@nottingham.ac.uk)

School Research Ethics Officer: Rui Miranda (Rui.Miranda@nottingham.ac.uk)

Who can take part?

Anyone who is over the age of 18.

Participant information

- Participation in this survey is completely voluntary
- You are free to opt out of the research at any time without prejudice by contacting the researcher and asking to withdraw
- All data will be stored securely and anonymously
- Data will not be used in a way that can be linked to you – demographic data is being obtained to better understand the users of the apps and will not be used to identify you at a personal level

Who should I contact for further information?

If you have any questions about this research that have not been answered on this page, please contact Matthew Watts (matthew.watts1@nottingham.ac.uk).

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By ticking the box below, you confirm that:

(a) You are over 18

(b) You have read this information sheet and understood the purpose of this study

(c) You understand that all data are anonymous and that there will not be any connection between the personal information provided and the data

(d) You understand that there are no known risks or hazards associated participating in this study.

(e) By submitting this questionnaire, you agree that your answers, which you have given voluntarily, can be used anonymously for research purposes.

I confirm that I consent to participate in this survey: ✱ *Required*

- ○ Yes
- ○ No

Demographic Information

Age: * *Required*

More info

Please enter a whole number (integer).
The number should be 18 or greater.
Your answer should be no more than 3 characters long.

Nationality: * *Required*

Mother tongue: * *Required*

If you selected Other, please specify:

Please select any other languages that you speak.

Afrikaans	Arabic	Bangla
Bosnian	Bulgarian	Cantonese (Traditional)

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- [ ] Catalan
- [ ] Chinese (Mandarin)
- [ ] Croatian
- [ ] Czech
- [ ] Danish
- [ ] Dutch
- [ ] English
- [ ] Estonian
- [ ] Fijian
- [ ] Filipino
- [ ] Finnish
- [ ] French
- [ ] German
- [ ] Greek
- [ ] Haitian Creole
- [ ] Hebrew
- [ ] Hindi
- [ ] Hmong Daw
- [ ] Hungarian
- [ ] Icelandic
- [ ] Indonesian
- [ ] Italian
- [ ] Japanese
- [ ] Kiswahili
- [ ] Klingon
- [ ] Klingon (plqaD)
- [ ] Korean
- [ ] Latvian
- [ ] Lithuanian
- [ ] Malagasy
- [ ] Malay
- [ ] Maltese
- [ ] Norwegian
- [ ] Persian
- [ ] Polish
- [ ] Portuguese
- [ ] Queretaro Otomi
- [ ] Romanian
- [ ] Russian
- [ ] Samoan
- [ ] Serbian
- [ ] Slovak
- [ ] Slovenian
- [ ] Spanish
- [ ] Swedish
- [ ] Tahitian
- [ ] Tamil
- [ ] Thai
- [ ] Tongan
- [ ] Turkish
- [ ] Ukrainian
- [ ] Urdu
- [ ] Vietnamese
- [ ] Welsh
- [ ] Yucatec Maya
- [ ] Other

If you selected Other, please specify:

Your MT app(s)

This survey is about machine translation on mobile devices. Machine translation refers to services which you can use to translate automatically from one language to another.

Which machine translation service do you use? (Please tick all the services that you use)
Optional

- [ ] Google Translate
- [ ] iTranslate
- [ ] Speak & Translate
- [ ] Microsoft Translator
- [ ] Other
- [ ] None

If you selected Other, please specify:

Do you access machine translation...?
(Please select one)

- ( ) Through the browser (e.g. Microsoft Edge, Google Chrome) on your mobile device
- ( ) Using an app
- ( ) Both of the above
- ( ) I'm not sure
- ( ) I don't use machine translation on a mobile device

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Using the app

How frequently do you use your machine translation app?
(Please select one)

- ○ Once a day
- ○ More than once a day
- ○ Once a week
- ○ More than once a week
- ○ Once a month
- ○ More than once a month
- ○ Less than once a month
- ○ Other

If you selected Other, please specify:

When do you use your machine translation app?
(Please select all that apply)

- ☐ At home
- ☐ At work
- ☐ At school/college/university
- ☐ While traveling in your own country
- ☐ While traveling abroad

What type of content do you usually use your machine translation app to translate?
(Please select all that apply)

- [ ] News
- [ ] Social media content
- [ ] Messages
- [ ] Content in other apps
- [ ] Street signs
- [ ] Menus
- [ ] Literature
- [ ] Other

If you selected Other, please specify:

What do you use your machine translation app to translate most frequently?
(Please select one)

- ○ Single words
- ○ Short sentences
- ○ Long sentences
- ○ Multiple paragraphs

Why do you use your machine translation app? (Please select all reasons that apply)

- [ ] To understand something in another language
- [ ] To enable someone else to understand me
- [ ] To practise a foreign language
- [ ] For entertainment (e.g. because the translations are funny)

Speech & Text Translation

Speech translation refers to using the app to translate spoken language, e.g. to facilitate a spoken conversation between you and another person.

Text translation refers to using the app to either enter text for translation by typing it in, copying and pasting it in, using a mobile device's camera to translate text in images (e.g. in street signs) and using the app to translate text whilst in another app.

Do you mainly use your machine translation app for speech translation or text translation?
(Please select one)

- Speech translation
- Text translation
- Both

Thinking about text translation, do you mainly...?
(Please select one)

- Type text in
- Copy and paste text in
- Use your machine translation app to translate whilst in another app

Thinking about speech translation, do you usually...?
(Please select one)

- Use the app to translate from your mother tongue
- Use the app to translate into your mother tongue from one of your other languages
- Use the app to translate into your mother tongue from a foreign language you don't

speak

In what cases do you choose to translate text vs. speech? (Please select all that apply)

- [ ] I use text translation to translate from my mother tongue
- [ ] I use text translation to translate into my mother tongue
- [ ] I use speech translation to translate from my mother tongue
- [ ] I use speech translation to translate into my mother tongue

What difficulties do you have when using speech translation?

Have you used speech translation when talking in real-time to another person, either face to face or remotely?

- ○ Yes
- ○ No

Do you use the text-to-speech (TTS) functionality (playing out the audio for the translation)?

- ○ Yes
- ○ No

If so, how do you use this functionality? (Please select all that apply)

- [ ] To communicate with someone in a foreign language
- [ ] To hear how a translation sounds
- [ ] To practise speaking a foreign language
- [ ] Other

If you selected Other, please specify:

Quality & Priorities

The quality of the translation provided by your machine translation app is generally... (Please select one)

- ○ Very good
- ○ Good
- ○ Bad
- ○ Very bad

The quality of the translation provided by your machine translation app has improved over time (Please select one)

- ○ Agree
- ○ Disagree
- ○ Unable to say

Please rank the following in order of importance for you when you're using the app: (1 = most important, 3 = least important)

Please don't select more than 1 answer(s) per row.

Please don't select more than 1 answer(s) in any single column.

	1	2	3
Quality of the translation	☐	☐	☐
Ease of use of the app	☐	☐	☐
Ability to translate text without an internet connection	☐	☐	☐

Human translation (i.e. not translation done by a machine) is...

- an easy task
- a difficult task

Please explain why:

Is there anything else you'd like to add about your machine translation app?

Is there anything else you'd like to add about machine translation apps generally?

Extra questions

How does machine translation work?

"In my view, machine translation will..."

- Eventually be on par with human translation in all kinds of content
- Eventually be on par with human translation in specific kinds of content
- Never be on par, in any kind of content

Does Machine Translation make you think differently about translation?

Non-users of machine translation on mobile devices

Why don't you use machine translation on a mobile device?

- [ ] I didn't know that I could
- [ ] I don't need to
- [ ] The quality isn't good enough
- [ ] Other

If you selected Other, please specify:

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Finished

You have now completed this survey. Please click the "Finished!" button below to submit your responses.