SUBTITLING QUALITY BEYOND THE LINGUISTIC DIMENSION

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1. INTRODUCTION

In 1929, films with audible dialogue were introduced to audience worldwide. Since then, apart from dubbing, subtitling has also become a primary mode of film translation (Gottlieb 1995). Subtitling can be produced rapidly and is significantly low cost compared with other translation modes, such as dubbing, because of its cheap labour expenditure. These major advantages have made subtitling the most widely adopted language transfer method in translating audiovisual productions around the world. The demand for subtitles has increased owing to the proliferation and accelerated global distribution of mass media.

Subtitling has become part of people's daily life and its quality has attracted growing interest from audience, industry stakeholders and academics. Lauscher (2000: 149) states that "the growing importance of translating and translations […] has turned translation quality and translation quality assessment into topics of public interest" in the present globalised world. The opportunities to watch audiovisual programmes portraying different cultures in different languages have increased, and the role of subtitles as a powerful tool in (foreign) language acquisition and media accessibility has become evident. As a result, audience members at present are more sensitive to the quality of subtitles than those in the pre-globalised world. The emergence of social media has allowed viewers to raise their concerns about quality on online forums and other social and professional platforms. As audience members increase and their expectations on subtitling quality differ, the indicators used to measure quality also multiply. Consequently, the concept of quality becomes unclear and complicated.

Quality issues have been extensively discussed in translation studies, and various foci and parameters have been explored to determine the relationship between translation and meaning. House (1995: 982) indicates that preservation of meaning in language transfer is pivotal when assessing the quality of a translation. Such statement echoes the central problem of translation practice, that is, finding the corresponding target language translation equivalents (Catford 1965: 21). However, if such an approach is fruitful in the case of printed written texts, then the multi-semiotic nature of audiovisual programmes brings the issue of quality in subtitling beyond the fundamental concepts of 'meaning' and 'equivalence' as traditionally theorised in translation studies. The need to consider image and sound means that, apart from being subject to the linguistic dimension, subtitling is also subject to technical constraints that revolve around time and space.

Subtitling has existed as a professional practice for over a century and has been gaining ground as a sub field in translation studies in recent years; however, scholarly literature discussing the determinants of subtitling quality as a special genre is limited and incipient (Bugucki 1996; Díaz-Cintas 2001). Most studies concentrate on Roman alphabet languages and disregard the peculiarities of other alphabets. These studies also adopt a prescriptive and reductionist approach by focusing solely on cases of mistranslation that can be more or less representative. Technical parameters that determine subtitling quality are often neglected or only briefly mentioned in investigating industry practices. On the contrary, spatial and temporal constraints need to be considered prior to discussing language transfer particulars. These technical parameters are less valued in academic exchanges but are at the very core of the professional practice and must be fully considered when exploring subtitling quality.

This chapter discusses subtitling quality in details, especially the technical dimension and the tenets that foreground good practice in professional subtitling, from the perspective of the Chinese language and its characteristics.

2. TOWARDS UNDERSTANDING SUBTITLING QUALITY

Studying the definition and communicative aims of subtitling is a prerequisite to understanding subtitling quality. In the following discussion, a working definition of subtitling and an initial discussion of its aims are presented. A code for good subtitling practice is then briefly introduced, which is proposed by academics and working professionals and widely followed in the industry. Accordingly, a deeper understanding of the factors and actors that play a role in determining subtitling quality is provided. In Section 3, the parameters of subtitling quality other than linguistic transfer are discussed systematically.

2.1 Definition of subtitles

Subtitles are defined by Luyken et al. (1991: 31) as

> condensed written translations of original dialogue which appear as lines of text, usually positioned towards the foot of the screen. Subtitles appear and disappear to coincide in time with the corresponding portion of the original dialogue and are almost always added to the screen image at a later date as a post-production activity.

Concerning the working typology of this post-production activity, Díaz-Cintas and Remael (2007: 14) classify subtitles into three main categories based on linguistic parameters: (a) intralingual subtitles, (b) interlingual subtitles and (c) bilingual subtitles. Intralingual subtitling is also called vertical subtitling by Gottlieb (1998) and is also known as (closed) captioning; this practice refers to the variety of subtitling that "involves a shift from oral to written, but stays always within the same language" (Díaz-Cintas and Remael 2007: 14). Interlingual subtitling is also called diagonal subtitling by Gottlieb (1998) and refers to the variety of subtitling that "involves a shift from one language to another along with a change of mode, from oral to

written" (Díaz-Cintas and Remael 2007: 17). Subtitles in two different languages can also be simultaneously provided at the bottom of the screen; this practice is called bilingual subtitling and is observed mostly in bilingual countries or regions (e.g. Belgium, Finland, Switzerland, Jordan, Israel, Singapore, Hong Kong, and Malaysia). Bilingual subtitling is also usually practiced in international film festivals to attract a wide audience. Considering the limitation of the scope of this chapter, the focus is on interlingual subtitling.

2.2 Aim of Subtitling

Karamitroglou (1998: online) proposes that the production and layout practice of television (TV) subtitles must "provide maximum appreciation and comprehension of the target film as a whole by maximising the legibility and readability of the inserted subtitled text". This statement emphasises the basic need of the target viewer and the primary aim of subtitling. These parameters can be used in defining subtitling quality, but they are considered basic ones.

Subtitles are part of the image, and they must never complicate the viewer's experience of reading text and image. The message rather than the form must be emphasised in subtitling. McCormick (1997: 5) proposes that the ultimate aim of subtitling is

> to fashion subtitles which are attuned so thoroughly to their audiovisual environment that they appear to 'melt' into the total fabric of the [programme]. By making the linguistic sign as unobtrusive as possible, the very best subtitling seeks to foster the illusion of unmediated comprehension on the part of the viewer. When an audience stops being aware of reading the subtitles, the subtitler has achieved a major goal.

The subtitler is responsible in fulfilling this aim and must produce subtitles that are significantly in sync with the mood and rhythm of the audiovisual programme that the audience becomes unaware of actually reading them. This need for subtitles to be 'invisible' has been adhered to by many scholars and professionals

(Georgakopoulou 2009; Gottlieb 2000; Ivarsson and Carroll 1998) and heralded by some as one of the clear signs of good subtitling (Jokelainen 2009; Lindberg 1989).

2.3 Code of Good Subtitling Practice

Prior to probing the determinants and specifics of subtitling quality, one of the widely used industry standards for good subtitling practice must be examined first to gain an understanding of the large context. Jan Ivarsson, former head of development of Swedish Television, and Mary Carroll, ex-managing director of Titelbild Subtitling, proposed a 'Code of Good Subtitling Practice' ('the Code' hereinafter) (1998: 157-159) that was developed with other professionals and academics under the auspices of the European Association for Studies in Screen Translation (ESIST, www.esist.org). Since its launch, the Code has been extensively used by many companies within the industry over the years. Although many professionals argue that the Code must be revisited or updated, it is the only subtitling code that is widely accepted by professionals and academics, regardless of which language pair(s) they are working in. Díaz-Cintas and Remael (2007), Gottlieb (2004), McClarty (2012), Munday (2008) and Pedersen (2011) have also built their research upon or made reference to the content of the Code. As cited in Ivarsson and Carroll (1998), the Code is divided into two main areas: one area focuses on subtitling spotting (defined in details in Section 3.4) and translation; and the other area focuses on other technical aspects. Given the spatial limits, the full list of the Code is excluded in this chapter.

The following section comprehensively examines the determinants of subtitling quality as perceived from a technical perspective and with references to the Code and an elaboration of the rationale behind it.

3. DETERMINANTS OF SUBTITLING QUALITY: TIME, SPACE AND STYLE

Based on the definition, aims and the Code stated above, this section examines the various factors that affect subtitling quality theoretically, i.e. in an ideal situation. From existing subtitling quality literature, the three dimensions of the professional Code, namely, temporal and spatial constraints and stylistic considerations, are discussed. In addition to these parameters that focus mostly on subtitling into Roman alphabet languages, relevant Chinese subtitling practices are elaborated when appropriate.

3.1 Temporal Parameter: Duration of Subtitles

As stated in the Code, "the duration of all subtitles within a production must adhere to a regular viewer reading rhythm" (Ivarsson and Carroll 1998: 157); the reason is that viewers' comprehension and enjoyment of subtitles is closely related to their reading speed. Karamitroglou (1998: online) mentions that the reading speed of the average viewer (aged between 14 and 65 and from upper-middle socio-educational class) for a text of average complexity is approximately 150 to 180 English words per minute (wpm). Technically, a full two-liner subtitle containing between 14 and 16 English words must remain on the screen for about 5.5 s. In reality, the brain needs an extra 0.25–0.5 s to process the traced subtitle. Hence, most subtitling service providers follow 'the six-second rule'; this rule is proven to be an adequate length of time for an average viewer to read two full subtitle lines, when each line contains around 35 to 37 characters, including alphabetical letters, spaces and typographical symbols (d'Ydewalle et al. 1987; Díaz-Cintas and Remael 2007).

Karamitroglou (1998) also indicates that a full one-liner subtitle and a single-word subtitle theoretically takes slightly more time to read than a two-liner subtitle

because the visual bulk of the text signals the acceleration of the reading speed. For this reason, even the briefest subtitle, such as 'Yes' or 'No', ideally stays on the screen for about 1.5 s (Ivarsson and Carroll 1998: 64). In the industry, the minimum duration is sometimes set as short as 1 s and as low as 20 frames on certain occasions; such practice is in accordance to the first half of point 18 in the Code (Ivarsson and Carroll 1998: 159) that states no subtitle must appear for less than 1 s.

The same guideline also provides advice on the maximum duration that a subtitle must remain on the screen. Specifically, no subtitle, except songs, must stay on the screen for longer than 7 s (Ivarsson and Carroll 1998: 159). This duration cap ensures that the subtitle does not remain on the screen longer than necessary; otherwise, the viewers will automatically reread the subtitle.

The standard reading speed applied in the industry increases from 150 wpm to 180 wpm in cases where the original dialogue is delivered at high speed. Characters per second (cps) is another way of measuring reading speeds in English; 12 cps in the industry is considered rather slow, around 15 cps is normal/fast and around 17 cps is rather fast (Díaz-Cintas 2013a: 276). In terms of DVD reading speed, Díaz-Cintas and Remael (2007: 98) indicate that 180 wpm is increasingly becoming the norm and rates higher than this rate are applied by some companies.

Most discussions on reading speed focus on Western languages or the Roman alphabet (Díaz-Cintas and Remael 2007; Gottlieb 1995; Karamitroglou 1998; Pagano and Alves 2011; Pedersen 2011). Literature on Chinese reading speeds is limited, and most relevant arguments within the scope of audiovisual translation are still based on previous studies conducted for non-Chinese languages (Chen 2009; Fong 2009).

The feasibility of applying the subtitle reading speed of English viewers reading

English words to Chinese viewers reading Chinese characters is still uncertain. Nevertheless, some research results obtained in the cognitive psychology and physiology fields may provide a scientific basis for the similarities associated with reading English and Chinese. Although Chinese is radically different from English or other languages based on phonetic spelling, "the process of reading Chinese is essentially the same as for reading English" as stated by Miles and Shen (1925: 360). Sun et al. (1985) conduct eye tracking experiments and find the resemblances between reading eye movements used for Chinese and English in terms of fixation durations, recognition spans and reading rates. Concerning the latter, the reading rates of their subject group are around 385 equivalent wpm for Chinese and 380 wpm for English for the same scientific textual material (ibid.: 505). Sun (1993: 253) further elaborates the reason behind such a resemblance by indicating that "reading eye movements are controlled by the high level centre of brain," which decodes the meaning of languages "not by peripheral visual feature detectors". In terms of recognition spans, these are "determined by the linguistic information, not by the visual geometric form of the reading text" (ibid.). He concludes that language information processing capability "is limited to the brain, not by the peripheral system of vision" (ibid.). In this sense, applying the same maximum and minimum duration to subtitles in Chinese as in English, as well as the equivalent or similar number of words per minute, is reasonable.

Similar to most European countries, China and many other Chinese-speaking countries adhere to the PAL system. In other words, films in these countries are usually projected at 25 frames per second in the broadcasting arena and 24 frames per second in the cinema. The basic principles of professional Chinese subtitling accord with those of English subtitling. However, in Chinese subtitling, particularly in simplified Chinese, the rules are highly flexible because of the lack of commonly used standards. In general, the minimum duration for a subtitle is 20 frames, and ideally at least 2 s for a full line and at least 4 s for a full two-liner subtitle. The maximum duration is set at 6 s, but it can increase to 7 or 8 s on certain occasions.

Concerning reading speed, the maximum reading speed is usually set at 4 Chinese cps. In this case, a 2-s subtitle contains 8 characters at most and a 5-s subtitle contains no more than 20 characters. However, similar to subtitling in Western languages, some companies also apply high rates for Chinese subtitling and adhere to a reading speed of 5 Chinese cps.

Notably, the numbers stated above are still subject to adjustment on a case-by-case basis. These numbers are also adjusted according to a variety of parameters, such as the complexity of the language and the density of the information contained in the dialogue, the viewers' familiarity with the subject at hand, the language ability of viewers (children vs. adults), and the genre and rhythm of the film. Subtitlers sometimes inevitably face a dilemma between the constraint imposed by the maximum duration that the subtitle can remain on screen and the aim for quantitative faithfulness to the original dialogue. In this respect, the pursuit of absolute perfection may endanger the quality of the final output in one aspect or another.

With the growth of three-dimensional (3D) films, 3D subtitling also calls for some changes in the production of stereographic films, particularly from an aesthetic dimension and an appropriate way of breaking the lines. Díaz-Cintas (2013b: 127–128) observes that

> this migration to high definition and 3D in broadcasting as well as in digital cinema is bringing along fresh challenges and new ways of working in subtitling and is bound to have an impact on the time it takes to produce 3D subtitles and the skills and workflows required.

Arguably, 3D films are visually more demanding than traditional films at present because audience members are still not fully familiar with them; hence, subtitlers are faced with the need for line breaks that do not jar with the perspective of the

images and the consideration of whether a long duration is required for each of the subtitles according to their interaction with the image. Two leading subtitling companies, RuFilms LLC in Russia and Screen Subtitling in the United Kingdom, have conducted research on 3D subtitling. Their results indicate that viewers need more time "to re-focus on the subtitles at a given depth, then back to the action on a different plane" (Kozoulyaev 2011: 41). Therefore, the subtitle must be shown on screen for "an additional 3 s depending on the difference between the depth of the action and the chosen fixed position of the subtitle" (ibid.). However, such an additional time cannot be added in most cases, considering the restrictions imposed by potential shot changes and the rhythm of conversation. As a consequence, the subtitler's exquisite skill of condensation is important in retaining the meaning and flavour of the original dialogue.

3.2 Temporal Parameter: Spotting

Díaz-Cintas and Remael (2007: 88) state that spotting (also known as timing, cueing or originating) consists of "determining the in and out times of subtitles," i.e. the exact moment when a subtitle must appear on screen and when it must disappear. The golden rule for ideal spotting is that subtitles must keep temporal synchrony with utterances as closely as possible (ibid.: 88). In other words, subtitles must appear simultaneously when the person starts to speak and must disappear as soon as the person stops speaking. Similarly, Ivarsson and Carroll (1998: 158) mention that "the in and out times of subtitles must follow the speech rhythm of the dialogue". To achieve 'real' synchronisation between human auditory and visual perception, Karamitroglou (1998: online) suggests that subtitles must be inserted 0.25 s later than the initiation of the utterance because the brain needs 0.25 s to process the advent of spoken linguistic material and guide the eye towards the bottom of the screen anticipating the subtitle. Concerning the time-out code, subtitles must not remain on the image for more than 1 or 1.5 s after the end of an utterance. The reason is that viewers will be suspicious of the correspondence

between what has been said and what they have currently read on screen, thereby potentially distrusting the quality of the subtitles.

Apart from the synchronisation between auditory and visual perception, a minimum of four frames must also be left between subtitles to allow the viewer's eye to register the appearance of a new subtitle (Ivarsson and Carroll 1998: 159). Díaz-Cintas and Remael (2007: 92) explain that the absence of a slight, clear pause between two consecutive subtitles can result in the difficulty of a viewer's eyes to realise the presence of new information, and a pause shorter than two to three frames is ineffective. Hence, many subtitling programs have an automatic delay function assuring that the necessary pause is inserted between subtitles. Although professional practice differs, a gap of two to six frames is usually provided between consecutive subtitles.

Overlapping dialogue, i.e. when two or more actors speak at the same time, is always tricky for spotting. On these occasions, subtitlers must decide what information in the subtitles needs to be kept and deleted. They must also try every possible way to avoid confusing the viewers. In the profession, dashes (–) or hyphens (-), depending on house rules, are used in the same subtitle to indicate the exchange of utterances between speakers; these typographical devices also count as one character and must be considered when realising the total word limit. Below is a common example in which the first line is for the first speaker and the second line is for the second speaker.

Example 1

–晚安	[Goodnight]
–明天見	[See you tomorrow]

Practice also varies slightly from one company to another concerning the use of blank spaces between dash and text. For example, some companies prefer to leave a blank space between the dash and the first character (Example 2 - left), whilst others do not (Example 2 - right).

Example 2

– Good night	–Good night
– See you tomorrow	–See you tomorrow

The standard practice in Chinese subtitling is to not leave a space between dash and text. However, some companies prefer to use the English hyphen (Example 3 - left) whilst others prefer a dash generated by ALT 0150 (Example 3 - right). In terms of visual effect, the latter allows a certain room between dash and text without literally inserting a space, whilst the former tightly attaches the text to the hyphen.

Example 3

-晚安	–晚安
-明天見	–明天見

For short dialogue exchanges, some house rules prefer fitting the two lines into one using dashes or hyphens to indicate that the utterances belong to different speakers (Example 4).

Example 4

–明天？ –對

[–Tomorrow? –Yep]

With the prevalence of fansubbing and the lack of commonly used standards in the industry, the one-liner subtitle in Chinese subtitling has gradually been accepted by audience members and companies, particularly for simplified Chinese subtitling. However, this is practice rarely observed in subtitling conducted in languages that use the Roman alphabet. The reason is that the two-liner subtitle is usually the convention for dialogue subtitles and any diversion from this rule is perceived as a sign of poor quality.

Díaz-Cintas and Remael (2007: 111–112) suggest that a new approach that is gradually accepted in the profession attempts "to rationalise the space available in each line" by using only one dash in the second line (Example 5). This practice is also increasingly observed in Chinese subtitling.

Example 5

Tomorrow?

– Yep.

As mentioned earlier, different companies can have different house rules for subtitle presentation. The most important consideration for subtitling quality is to keep the format consistent throughout the entire production and accord the format with the client's request if they have any.

Temporal synchronisation between subtitle and soundtrack has a major influence on the viewer's appreciation of subtitling quality, as does the respect of shot changes. On this basis and from aesthetic and reception perspectives, a subtitle must not over-run shot changes to avoid causing perceptual confusion (Díaz-Cintas and

Remael 2007; Karamitroglou 1998). This approach echoes Ivarsson and Carrolls' (1998: 158) stress in the Code on the need to consider 'cuts and sound bridges' when conducting the spotting. However, in occasional cases, a shot change may occur whilst the conversation is still under way; the lack of synchronisation between subtitle and image appears more discernible in hard cuts (an abrupt change from one shot to the next shot) than in soft cuts (gradual transition). For soft cuts, the subtitle usually stays on the screen whilst ignoring the shot change. This procedure is performed because further compressing the duration to follow the shot change may result in the subtitle lasting for less than a second. In such a case, the text will not be perceived by the audience. Therefore, prioritising the soundtrack over shot changes when spotting subtitles is a sign of good quality.

Professional and amateur subtitling programs at present come with a shot change detector that eases the automation of video file analysis and shot change identification. As a result, the process of spotting becomes simple and fast. However, Díaz-Cintas and Remael (2007: 91) emphasise that when to display the subtitles before a shot change is still unclear. Some argue that displaying a subtitle at precisely the time when a shot change occurs can distract the eye and disrupt the reading of the subtitle; others prefer to cue the subtitle out exactly when the cut occurs.

The responsibility for spotting differs in theory and practice. Ivarsson and Carroll (1998: 157) assert in the Code that the subtitler is responsible for spotting the [audiovisual] production and translating. Performing spotting is advantageous for the subtitlers because doing so provides them with high flexibility in adjusting according to the production situation; they also obtain high possibilities to reflect 'the rhythm of the film' (ibid.). However, multinational companies develop clear-cut divisions of labour to improve the effectiveness and efficiency of 'the production line'. They employ the time spotter, which is not necessarily a translator and is thus less capable of noticing certain issues that may affect the way the translation is

accomplished. The subtitler then works with the spotting dialogue lists, also known in the industry as ‘master titles’ and ‘templates’. This subtitler only translates the subtitles. When faced with complex situations, such as subtitles overrunning shot changes or incorrect durations (too short or long), the subtitler cannot resort to means other than linguistic modifications that are insufficient.

The drawbacks of such an approach are evident in subtitling in Chinese when the subtitler is offered a spotting list and asked to closely adhere to the cueing of the master subtitles in English. The reason is that the grammatical structures of English and Chinese are markedly different. Compared with Chinese, English has a more complex affixation and clearer syntax. The difference in chronological sequence particularly poses a genuine challenge to the subtitler. Therefore, the resulting quality of the translation will be high if high technical flexibility is granted to the subtitler.

3.3 Spatial Parameter: Safe Area and Position on the Screen

Apart from the temporal parameters, the subtitle text must adhere also to the so-called ‘safe area’ or ‘safe zone’. This rule means that the lowest subtitle line must appear at least 1/12 of the total screen height from the bottom, with a margin of at least 1/12 of the total screen width on the left and right sides; such placement must be followed to simulate eye movement and ease the reading of subtitles (Karamitroglou 1998). Nowadays, the subtitlers can easily configure the setting of the safe area via subtitling programs (e.g. WinCAPS, SWIFT, and EZTitles). Once the setting is completed, the subtitle text will be limited to appear within the main area of the screen.

Another reason for respecting the safe area is that the written text and graphics shown on the screen may be distorted if they appear too close to the edges because

“TV manfacturers deal with the screen edges differently” (Díaz-Cintas and Remael 2007: 82).

Concerning screen position, subtitles are usually horizontally centred at the bottom of the screen. The reason is that the lower part of the picture is usually considered of less importance to the aesthetic appreciation of the audiovisual programme; hence, this positioning insignificantly affects the visibility of the image. In addition, centring the subtitles facilitates eye movement because the travel distance is short from the centre of the screen to the beginning of the subtitle.

Subtitles are also sometimes moved to other parts of the screen; in cinemas, the top of the screen is the second most possible place for subtitles. This positioning avoids overlapping with key information on screen or displays the translation of important information within an image, such as street signs and mobile texts.

Although subtitling programs allow subtitles to be positioned in different places, too many changes in their position on the screen can have negative effects on viewers. The reason is that such changes can decrease the readability of the subtitles. Apart from subtitles that translate the various dialogue exchanges, other texts can also appear on the screen, such as the title of the programme, narrative inserts (e.g. street signs, legends, and temporal indications), newspapers, placards, graffiti and restaurant names. Unlike those that give account of the dialogue exchanges, the subtitles that translate these inserts are often adjusted such that they appear close to the original texts. Nonetheless, subtitles positioned at places other than the top and bottom of the screen are observed mostly on TV programmes but remain uncommon in the cinema. In practice, some subtitling studios may argue that the subtitler has the responsibility to pay attention to and decide whether to translate inserts, i.e. additional information other than actual dialogues. Missing out important information in translated texts is deemed a sign of poor subtitling quality because what the target-language audience perceive is not equivalent to the information given to the source-language audience.

With the globalisation of audiovisual communication, the current practice for the positioning of subtitles is similar in most parts of the world, including Chinese-speaking countries. Traditionally, Chinese is written in vertical columns and read from top to bottom, right to left. However, Chinese printing has shifted to a left-to-right, horizontal-line format in the past few decades because of the influence of English and other Western languages. The format and layout of subtitles has similarly experienced several changes. Texts are initially written from top-to-down vertical to right-to-left horizontal, and then left-to-right horizontal at present. Vertical subtitles are still seen on TV as news tickers or scrolling text to date; they are also sometimes used in film festivals and theatres, particularly in Taiwan, Hong Kong and Macao. This practice is also found in non-Chinese speaking countries, such as Japan and South Korea.

When vertical subtitles are used at film festivals, they are usually presented as one liners and placed at the right side of the screen. Similarly, when the subtitles appear vertically as news tickers or scrolling text on TV, they tend to be also in one line but can be placed on either the left or right side of the screen.

The positioning of subtitles is also one of the main challenges to the burgeoning field of 3D film production because fixed positioning risks jeopardising the 3D imagery and causing visual fatigue. González et al. (2013: 17) explain that the main problem is that the subtitle and image are located at different depths or regions, thus requiring viewers to constantly switch focus between the subtitle and the scene at a fast speed whilst their “eyes converge always to the same distance”. With subtitles becoming one of the visual design elements of 3D films and regarded as an inseparable part of the artistic presentation by many, the effect that the quality of subtitles has on a 3D film can outweigh the effect that they may have on a two-dimensional film. Poor quality subtitles in the latter can lead to distraction or obstructed vision; however, subtitles that fail to meet quality standards in the former may cause viewers to suffer from motion sickness with symptoms of headaches, dizziness, fatigue and nausea (Hoffman et al. 2008). In this sense, the subtitler contributes to the production of subtitles in 3D films by bridging linguistic

barriers, creating a non-conflicting 3D environment for the interaction between images and subtitles, and avoiding unnecessary costs on ruined 3D immersion.

3.4 Spatial Parameter: Number of Lines

Subtitling conventions regarding the maximum number of lines per subtitle vary in different countries, and among those speaking the same language. Interlingual subtitling is usually limited to a maximum of two lines, as stated in the Code. However, bilingual subtitles can sometimes occupy up to four lines, i.e. two lines per language. In multilingual countries, such as Malaysia, cinemas sometimes provide trilingual subtitles: one line in Malay, one line in English and one line in Chinese. Three to four lines are also common when the subtitles are aimed at the deaf and the hearing impaired. In 3D subtitling, the maximum number of lines may no longer be limited to two, especially if the subtitles need to be short, placed in a dynamic positioning mode and considered part of the artistic composition.

Concerning Chinese language subtitling, conventions differ from one country to another and are in constant flux. For example, in Taiwan, the traditional use of one-liner subtitles is preferred to two-liner subtitles wherever possible. However, this convention has begun to change in recent years. Specifically, clients give subtitlers the freedom to make their own choices between one- or two-liner subtitles, although the final decision is usually with the client. In Hong Kong, “the subtitles are usually single-lined” (Chen 2009: 109); however, cinemas also sometimes provide bilingual subtitles (one line in Chinese and one to two lines in English) if the original language of the film is neither Chinese nor English. In China, although one- and two-liner subtitles are very common, three-liner subtitles are also acceptable sometimes. Concerning multilingual countries, such as Malaysia and Singapore where Chinese is one of the main languages, the number of lines appearing on the screen can be three to four lines as previously mentioned.

Concerning the formal presentation of two-liner subtitles, point 20 of the Code states that, wherever two lines of unequal length are used, the upper line must preferably be short to keep as much of the image as free as possible (Ivarsson and Carroll 1998: 159). Nonetheless, Díaz-Cintas and Remael (2007: 87) argue that, in terms of line distribution, the first concern must not be aesthetics but rather the syntax of the language used. In other words, a long sentence must be divided in accordance with the syntactical and grammatical logic of the sentence. However, when various possibilities exist that respect syntactic blocks, an ideal ratio of 2:3 between the first and second lines is suggested by some subtitling industry guidelines to ensure that the audience has an optimised view. Another reason introduced by Lomheim (1999: 193) is that "the viewer's eye takes less time to read subtitles with a short first and full second line than those with a full first line and shorter second line"; hence, under time pressure, the pyramid arrangement makes fast reading of text easy for the viewer.

Concerning the use of three- or four-liner subtitles, an oversized layout can obstruct the view of the audience and negatively decrease visual perception quality by occupying one-fourth to one-third of the image. Hence, although subtitles can cater for different language needs, the programme may not be as appreciated and understood by the audience as expected. Accordingly, the subtitling quality can be jeopardised.

3.5 Spatial Parameter: Line Length and Font Type

According to Díaz-Cintas (2013a: 274), the maximum number of characters per line for languages that rely on the Roman alphabet is usually between 35 and 39, including blank spaces and typographical symbols. However, cinemas may use up to

a maximum of 40 or 41 and 43 characters at some film festivals, because “the viewer is able to read subtitles more easily and quickly on a cinema than a TV screen” (Díaz-Cintas and Remael 2007: 24). The conventions may vary by country and among different media.

Technical developments have considerably loosened restrictions on the number of characters allowed per line. Díaz-Cintas (2013a) highlights that some professional subtitling programs currently work with pixels and have moved from using monospaced fonts to proportional lettering. Monospaced fonts (e.g. Courier New, Lucida Console) provide the same amount of horizontal space for each letter and character and have been used in the past. To date, the majority of professional subtitling programs allows the subtitler to choose proportional fonts (e.g. Times New Roman, Arial) in which the letters and symbols differ in size to one another; for example, an ‘I’ or an ‘l’ occupying a smaller space than a ‘u’ or an ‘m’. In this sense, many letters and characters can be accommodated in a subtitle depending on the actual letters used and the proportions of the safe area.

Concerning the Chinese language, in Taiwan, the most common standard is to allow a line length that hovers around 13 to 14 Chinese characters per line as a maximum, making a maximum total of 26 to 28 characters for a two-liner subtitle. In Hong Kong, the length can be up to 15 or 16 characters per line because the subtitles are usually single lined. In China, restrictions on the character limit vary significantly, ranging from 12 to 20 characters per line.

All Chinese characters traditionally inhabit the same perfect square shape and have the same fixed width. With respect to font types, in the case of traditional Chinese, mainly used in Taiwan and Hong Kong, lettering such as MingLiU [細明體] and MSJH.TTF [微軟正黑體] are often used in subtitling. For simplified Chinese, SimSun

[宋体] and SimHei [黑体] are two of the most commonly used font types. Among the four types, MingLiU and SimSun are monospaced, whilst MSJH.TTF and SimHei are proportional. However, the perfect square shape cannot be changed in any case and Chinese characters are double byte, even if a proportional font is used. Thus, squeezing an additional character is impossible. Accordingly, whether the used Chinese font is monopaced or proportional can only positively affect non-Chinese characters, i.e. alphabetical characters, numbers and other symbols.

Although subtitles written in proportional fonts in Roman alphabet languages can accommodate many characters in the same space, the resulting long subtitles are not necessarily given high exposure time to ensure comfortable reading by the viewer. Accordingly, Díaz-Cintas (2013a) raises the need for further empirical research "to ascertain the appropriate reading speed of today's viewers". Although the original meaning may remain virtually intact in the subtitle, failing to allow sufficient time for viewers to properly read subtitles can severely endanger subtitling quality.

A highly varied font choice has emerged in recent years in several languages. Some research projects have been conducted to ascertain the readability and legibility of fonts. An example of these fonts is Tiresias, a typeface designed for best legibility on screen by people with impaired vision and used in subtitles for digital terrestrial TV and digital satellite. However, no consensus has been reached to date on which typeface is easier to read than other fonts on screen, on whether sans-serif typefaces are truly better than serif fonts on the screen, and on whether subtitles written in proportional fonts are faster to read than those written in fixed-width fonts (Nielsen 2012; Xiang et al. 2010). Despite this situation, the clarity and simplicity of a font is usually considered the fundamental guiding principle when choosing one for subtitles.

3.6 Spatial Parameter: Font Colour and Background

The use of colours is more restricted and far less creative in interlingual subtitling than in intralingual subtitling. Specifically, the latter is aimed at the deaf and the hard-of-hearing and uses different colours to help speaker identification and indicate the tone of voice. In the profession, the most common custom font colour used in interlingual subtitling is white because "white characters are denser and more luminous" than coloured letters (Ivarsson and Carroll 1998: 45). In the cinema, subtitles are also mostly white because "they have been laser engraved on the celluloid" (Díaz-Cintas and Remael 2007: 130); hence, what the viewers see is the 'white' screen onto which the celluloid is being projected. Karamitroglou (1998: online) further stresses that the white colour must be pale not snow-bright white, because "a too flashy pigment would render them tiring to the viewer's eye". Yellow is another colour often employed in subtitling, particularly subtitles for black and white films; however, monochromatic subtitles in white are a universal trend in the cinema and on DVD and Blu-rays.

To aid legibility and avoid clashing with the images, subtitles must be presented against a fixed dark background, i.e. a 'black box'; however, the background does not necessarily need to be black. In fact, a grey subtitle background is favoured for being less intrusive (Ivarsson and Carroll 1998: 46). Subtitle legibility can also be ensured by adding sharp contours to the characters, as suggested in the technical aspects of the Code (Ivarsson and Carroll 1998: 159). 'Shadowing' is regarded as the most appropriate solution for the cinema because the audience can still see the picture behind the subtitle, and hence, shadowing is considered less intrusive and aesthetically pleasant. In Chinese-speaking countries, a 'black box' is rarely seen; a black outline around the text and a soft shadow are normally used instead to enhance the readability of subtitles.

In the context of 3D subtitling, the following effects are used to reduce the ghosting between the eyes: lighting, shades and colour gradients, as well as different colours. Ghosting is perceived crosstalk, which refers to the incomplete segregation of the two eyes' images. Moreover, ghosting is an undesired effect that appears when parts of an image intended to be seen exclusively by one eye become visible to the other eye; this situation can occur when the light leaks and reaches the unintended eye (Nojiri et al. 2004). Ghosting reduces perceived image quality while crosstalk affects depth perception. González et al. (2013: 23-4) demonstrate that using shading to reduce the contrast of colours can help decrease the ghosting effect.

In summary, temporal and spatial constraints make the task of the subtitlers more challenging than translating other types of texts because they have no room for wordy expressions, lengthy complex sentence structures or explanations for certain solutions. The condensation of the original dialogue is always inevitable for subtitles, with an average of 25% to 50% of the original information normally being lost during the diagonal shift process (Ivarsson 1992); in 3D subtitling, the percentage can be high. When redundant words have already been excluded from the translation, further condensation becomes difficult for the subtitler. Evidently, omitting one or two additional words can cause significant changes in meaning or lead to misunderstanding, thereby endangering the subtitling quality. Even when the subtitler can encapsulate all the information in one subtitle, the way the text is presented onscreen can also have an effect on its readability. Aesthetically, chromatic conflict with the background can lead to poor perception by the viewer. Content wise, incorrect line breaks within a subtitle or illogical spotting between subtitles requires the viewer to consume much time to comprehend the message. Consequently, such situation imposes large cognitive effort on the viewer, thereby decreasing the viewer's appreciation of the entire message.

3.7 Stylistic Parameter

Apart from the temporal and spatial constraints discussed in the previous sections, the style of subtitles also contributes to the subtitling quality. Halliday (1994: 61) indicates that "[w]ritten language tends to be lexically dense, but grammatically simple; spoken language tends to be grammatically intricate, but lexically sparse". Accordingly, subtitles as the condensed written form of spoken dialogue possess a higher lexical density and more structured syntax than dialogue exchanges. Typical features of spoken language are inevitably lost during transition from speech to writing. Such situation poses another difficulty to the subtitler in retaining the nuances of stylistic features contained in the soundtrack.

Bannon (2010: online) stresses that subtitles must "complement the tonal nature of language—the sounds, pauses, and stresses of an actor's on-screen performance". In his view, "tonal quality is as much a part of the aural experience of a film as its visual impact"; tonal quality is the primary concern of many actors and "subtitlers must be equally concerned" (ibid.). The audience can perceive actors' tones by their facial expressions, gestures and the way in which they speak, although certain nuances in the lines are sometimes very subtle and barely noted by people without a native command of the language. In this respect, differences in tone and intonation can have a dramatic effect on how the source audience perceive a scene, which may not be necessarily the same as the target audience. To counterbalance this mismatch, Bannon (ibid.) suggests that subtitle capitalisation can be used to echo the stress points in dialogue, thus illustrating the character's intent to the audience. He provides the following example:

Example 6

Worried: MUST you go?
Confrontational: Must YOU go?
Frantic: Must you GO?

The Chinese language does not include capitalisation in its writing system. To produce the same effect, English quotation marks (“ ”) are often used instead. Chinese quotation marks (「」) are also used in traditional Chinese, depending on the house rules of the subtitling company. As shown above, the same subtitle with different stress points can have slightly different meanings. Confusion and distraction and distrust of the translation by the audience can be avoided when the tones of delivery successfully match the original soundtrack and the written subtitle. Consequently, subtitlers must ensure that the linguistic encoding of the subtitles stylistically reflects and complements the dialogue and action on screen, thereby ensuring the quality of the entire audiovisual experience.

Similar to the case of literary translation, “the language register must be appropriate and correspond with the spoken word” in subtitling, as stated in the Code (Ivarsson and Carroll 1998: 158). However, neutral language is used rather than colloquial expressions in subtitling (Mailhac 2000: 144). This neutral register sometimes insignificantly influences audience perceptions, but an illogical mismatch may cause a negative effect on other occasions; for example, when a Mafioso sounds similar to a preacher or a bully sounds similar to a judge. Confusion may be reduced by the supplementary information given by the image and sound, but subtitlers must not neglect the importance of identifying the correct register and avoiding mixing registers; otherwise, the odd result may either distract viewers or hinder their understanding of characters’ psychology.

Concerning vulgar language, subtitlers do not always have the freedom to take certain stylistic decisions. The reason is that different clients may have different preferences and requirements. Nikolić (2005: 33) states that “the job of subtitling for clients that have different goals and organisational structures may impose even further constraints”. Public TV channels usually aim to provide educative and informative programmes, thus preferring standard language. For commercial programmes, entertainment is normally the primary concern; as a result, the flexibility of using swearwords and street language is potentially high. Even when

vulgar language is permitted, subtitlers are still constantly reminded to tone down or neutralise strong language because written foul language is "more offensive than actual oral usage" (Roffe and Thorne 1994: 258). When offensive language is prohibited, the subtitler must be imaginative when replacing these omnipresent words with other expressions without falling into the ridiculous. In essence, the stylistic quality of subtitling lies in the subtitler's ability of combining content and form and conveying the spirit of the original as far as possible but within the stylistic constraints imposed by the client.

4. FINAL REMARKS

The concept of subtitling quality has always been debated and may be defined and perceived differently according to the audience profile and depending on the user's or evaluator's standpoint. Adherence to the parameters discussed above and the linguistic parameters shared across translation studies and audiovisual translation can act as a preventive measure that helps safeguard and maintain a certain level of subtitling quality. These parameters cannot be absolute in the profession, and they can be barely applied to all languages and countries in a uniform manner. However, developing a tailored set of guidelines focusing on the main technical and stylistic parameters that regulate the formal presentation of subtitling output is crucially important. Such development can provide an objective standard against which good subtitling can be measured and ensure the production of subtitles that are consistent and homogeneous.

As stated in the introduction, growing attention has been recently drawn to the quality of subtitles within industry and academia. This development denotes the existence of dissatisfaction or concerns regarding the quality of the subtitles in circulation. This study considers this situation and focuses on the main technical parameters that impinge on the quality of subtitles. It hopes to contribute to the

debate in a meaningful manner and paves the way for further studies that can help bridge the gap between theory and practice.

5. REFERENCES

Bannon, D. (2010) 'Tonality in subtitle translation'. *Translation Journal* [Online], 14(4). Available: http://www.bokorlang.com/journal/54tonality.htm. [Accessed: 1st Januaray 2016].

Bugucki, Lukasz (1996) 'Crises of alterity: cultural untranslatability and the experience of secondary otherness', in Budick, Sanford & Iser, Wolfgang (eds.) *The Translatability of Cultures: Figurations of the Space Between.* Stanford: Stanford University Press.

Catford, John C. (1965) *Linguistic Theory of Translation: An Essay in Applied Linguistics.* London: Oxford University Press.

Chen, Chapman (2009) 'A critica evaluation of a Chinese subtitled version of Hitchcock's *Spellbound*', in Fong, Gilbert C.F. & Au, Kenneth K. L. (eds.) *Dubbing and Subtitling in a World Context.* Hong Kong: The Chinese University Press.

d'Ydewalle, Géry, Rensbergen, Johan van & Pollet, Joris (1987) 'Reading a message when the same message is available auditorily in another language: the case of subtitling', in O'Regan, J. K. & Lévy-Schoen, A. (eds.) *Eye Movements: From Physiology to Cognition.* Amsterdam/New York: Elsevier Science Publishers.

Díaz-Cintas, Jorge (2001) 'Striving for quality in subtitling: the role of a good dialogue list', in Gambier, Yves & Gottlieb, Henrik (eds.) *(Multi) Media Translation: Concepts, Practices, and Research.* Amsterdam: John Benjamins.

Díaz-Cintas, Jorge (2013a) 'Subtitling: theory, practice and research', in Millán, Carmen & Bartrina, Francesca (eds.) *The Routledge Handbook of Translation Studies.* Abingdon: Routledge.

Díaz-Cintas, Jorge (2013b) 'The technology turn in subtitling', in Thelen, Marcel & Lewandowska-Tomaszczyk, Barbara (eds.) *Translation and Meaning – Part 9.* Maastricht: Zuyd University of Applied Sciences.

Díaz-Cintas, Jorge, Orero, Pilar & Remael, Aline (2007) *Media for All: Subtitling for the Deaf, Audio Description, and Sign Language.* Amsterdam: Rodopi.

Díaz-Cintas, Jorge & Remael, Aline (2007) *Audiovisual Translation: Subtitling.* Manchester: St Jerome.

Fong, Gilbert C. F. (2009) 'Let the words do the talking: the nature and art of subtitling', in Fong, Gilbert C.F. & Au, Kenneth K. L. (eds.) *Dubbing and Subttling in a World Context.* Hong Kong: The Chinese University Press.

Georgakopoulou, Panayota (2009) 'Subtitling for the DVD industry', in Díaz-Cintas, Jorge & Anderman, Gunilla (eds.) *Audiovisual Translation: Language Transfer on Screen.* London: Palgrave Macmillan.

González, Diekus, Carrabina, Jordi & Orero, Pilar (2013) 'Evaluation of depth cues in 3D subtitling'. *Online Journal of Art and Design* [Online], 1(3): 16-29. Available: http://ojad.emu.edu.tr/articles/13/132.pdf. [Accessed: 1st Januaray 2016]

Gottlieb, Henrik (1995) 'Subtitling', in Chan, Sin-Wai & Pollard, David E. (eds.) *An Encyclopaedia of Translation: Chinese-English, English-Chinese.* Hong Kong: Chinese University Press.

Gottlied, Henrik (1998) 'Subtitling', in Baker, Mona (ed), *Routledge Encyclopedia of Translation Studies*. London: Routledge, 244-248

Gottlieb, Henrik (2000) *Screen Translation: Six Studies in Subtitling, Dubbing and Voice-over.* Copenhagen: Center for Translation Studies, University of Copenhagen.

Gottlieb, Henrik (2004) 'Language-political implications of subtitling', in Orero, Pilar (ed), *Topics in Audiovisual Translation*. Amsterdam and Philadelphia: John Benjamins, 83-100.

Halliday, Michael Alexander Kirkwood (1994) 'Spoken and written modes of meaning', in Horowitz, Rosalind & Samuels, S. Jay (eds.) *Comprehending Oral and Written Language.* San Diego: Academic Press.

Hoffman, David M., Girshick, Ahna R. & Akeley, Kurt (2008) 'Vergence-accommodation conflicts hinder visual performance and cause visual fatigue'. *Journal of Vision* 8(3). Available: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2879326/pdf/nihms202260.pdf. [Accessed: 1st Januaray 2016].

House, Juliane (1995) 'Translation quality assessment'. in Chan, Sin-Wai and David E. Pollard (eds.) *An Encyclopaedia of Translation: Chinese-English, English-Chinese*. Hong Kong: Chinese University Press.

House, Juliane (1997) *Translation Quality Assessment : A Model Revisited.* Tübingen: Gunter Narr.

Ivarsson, Jan (1992) *Subtitling for the Media: A Handbook of an Art.* Stockholm: Transedit.

Ivarsson, Jan & Carroll, Mary (1998) *Subtitling.* Simrishamn: TransEdit HB.

Jokelainen, Kari (2009) 'Translating understanding and non-understanding through subtitling: a case study of a Finnish subtitled translation of *Comme des Rois*', in Fong, Gilbert C.F. & Au, Kenneth K. L. (eds.) *Dubbing and Subtitling in a World Context.* Hong Kong: The Chinese University of Hong Kong.

Karamitroglou, Fotios (1998) 'A proposed set of subtitling standards in Europe'. *Translator Journal* 2(2). Available: http://translationjournal.net/journal/04stndrd.htm. [Accessed: 1st Januaray 2016].

Kozoulyaev, Alexey (2011) '3D Subtitling - a new deal beyond technology'. *DVD and Beyond.* Available: http://www.dvd-intelligence.com/features/feature.php?feature=126. [Accessed: 1st Januaray 2016].

Lauscher, Susanne (2000) 'Translation quality assessment: where can theory and practice meet?'. *The Translator* 6(2)**:** 149-168.

Lindberg, Ib (1989) 'Nogle regler om TV-tekstning'. Available: http://www.titlevision.dk/tekstnin.htm. [Accessed: 1st Januaray 2016].

Lomheim, Sylfest (1999) 'The writing on the screen. Subtitling: a case study from Norwegian broadcasting (NRK), Oslo', in Anderman, Gunilla and Margaret Rogers (eds.) *Word, Text, Translation*. Clevedon: Multilingual Matters, 190-207.

Luyken, Georg-Michael, Herbst, Thomas, Langham-Brown, Jo, Reid, Helen & Spinhof, Hermann (1991) *Overcoming Language Barriers in Television: Dubbing and Subtitling for the European Audience.* Manchester: European Institute for the Media.

Mailhac, Jean-Pierre (2000) 'Subtitling and dubbing, for better or worse? The English video versions of *Gazon Maudit*', in Salama-Carr, Myriam (ed.) *On Translating French Literature and Film II.* Amsterdam/New York: Rodopi.

McClarty, Rebecca (2012) 'Towards a multidisciplinary approach in creative subtitling', in Agost, Rosa, Orero, Pilar & Giovanni, Elena di (eds.) *Monographs in Translating and Interpreting.* Alicante: Publicationes de la Universidade de Alicante.

McCormick, A. (1997) 'Writ small: Subtitling for SBS television: Address to "Language and the Media"'. *Style Council Sydney* 97, 21-23 November 1997: 5.

Miles, Walter R. & Shen, Eugene (1925) 'Photographic recording of eye movements in the reading of Chinese in vertical and horiontal axes: method and preliminary results'. *Journal of Experimental Psychology* 8(5)**:** 344-362.

Munday, Jeremy (2008) *Introducing Translation Studies : Theories and Applications.* London: Routledge.

Nielsen, Jakob (2012) 'Serif vs. sans-serif fonts for HD screens'. Available: http://www.useit.com/alertbox/web-typography.html Date Access Year]|.
Nikolić, Kristijan (2005) 'Differences in subtitling for public and commercial television: The question of style'. *Translation Today* 4**:** 33-36.

Nojiri, yuji, Yamanoue, Hirokazu, Hanazato, Atsuo & Okano, Fumio (2003) ‘Measurement of parallax distribution and its application ot the analysis of visual comfort for stereoscopic HDTV’. *Proc SPIE* 5006: 195-205.

Pagano, Adriana & Alves, Fabio (2011) 'Approaching expertise in subtitling: a pilot experiment', in Serban, Adriana, Matamala, Anna & Lavaur, Jean-Marc (eds.) *Audiovisual Translation in Close-up: Practical and Theoretical Approaches.* Bern: Peter Lang.

Pedersen, Jan (2011) *Subtitling Norms for Television: An Exploration Focussing on Extralinguistic Cultural References.* Amsterdam: John Benjamins.

Roffe, Ian & Thorne, David (1994) 'Transcultural language transfer: subtitling from a minority language', in Dollerup, Cay & Lindegaard, Annette (eds.) *Teaching Translation and Interpreting 2: Insights, aims and visions. Papers from the Second Language International Conference Elsinore, 1993.* Amsterdam: John Benjamins.

Sun, Fuchuan (1993) 'Eye movements in reading Chinese: paragraphs, single characters and pinyin', in Wright, Sarah F. & Groner, Rudolf (eds.) *Facets of dyslexia and its remediation.* Amsterdam/New York: North-Holland.

Sun, Fuchuan, Morita, Michon & Stark, Lawrence W. (1985) 'Comparative patterns of reading eye movement in Chinese and English'. *Perception & Psychophysics* 37(6)**:** 502-506.

Xiang, Qian , Yang, Wang, Xingyang, Mao, Yun, Zhang, Na, Liu & Aili, Guo (2010) 'Research on font type to legibility'. Available: http://www.ie.tsinghua.edu.cn/kbwang/Downloads/courseprojects/2010DOE/3.pdf. [Accessed: 1st Januaray 2016].

6. FURTHER READING

Díaz-Cintas, J. & Remael, A. (2014) *Audiovisual Translation: Subtitling (2nd ed.).* Manchester: St Jerome.

-This book provides a solid overview of the world of subtitling and is recommended for any one who would like to further explore this area of translation studies.