Navigating the web: a study on professional translators' behaviour

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Abstract:

Despite the importance of online information seeking behaviours being recognised by researchers (Enriquez Raido 2011, 2014, Gough 2015, Hvelplund 2017, 2019), there are only a handful of studies focusing on them. This study therefore sets out to investigate how professional translators conduct their primary action (i.e. query behaviour) and secondary action (i.e. browsing and clicking behaviour) in navigating the web. Unlike previous studies, it adopts a qualitative eye tracking methodology, i.e. eye tracking stimulated think-aloud with ten professional translators. A model of translators' primary and secondary actions is presented as well as how these actions interact with one another as a result.

Keywords: Information seeking behaviour, eye tracking, web search, browsing and clicking behaviour

1. Introduction

Some mere 30 years ago when Timothy Berners-Lee invented the WorldWideWeb while working at CERN, he may not have foreseen that it would become such a prevalent part of most people's life today and translators are no exception. The nature of WWW means that masses of documents, images, and videos are interconnected via hyperlinks and become easily accessible to anyone. Yet, with an explosive volume of data and information available online, to locate relevant information requires skilled navigation from its users. Search engines are supposed to facilitate this navigation process, and yet for translators, navigating and locating precise bilingual/multilingual information (despite the help of search engines) can still feel like searching for a needle in a haystack. The importance of being able to navigate the web successfully cannot be under-estimated, since it serves as a key (input) in shaping translators' inference in comprehending the source text (ST) and/or rendering the target text (TT). (Chang, 2018, p. 198).

Despite being acknowledged as an important translator competence (e.g. EMT Competence Framework, 2017) and professional translators spending a substantial amount of time on web search (e.g. Hvelplund, 2017, 2019), there are still relatively few studies focusing on these phenomena. This study therefore aims to shed further light on professional translators' web search behaviours, particularly with respect to their 'primary action' and 'secondary action' (White, 2016, pp. 21-37), why and in what circumstances such behaviours occur, and how primary action and secondary action relate to one another. The dichotomy of primary action and secondary action was first adopted from Information Retrieval Studies by Shih (2019, pp. 912-913) to largely illustrate translators' interaction with search engines and other online resources. Primary action indicates query-related behaviours, such as entering queries in search boxes, whereas secondary action indicates browsing and clicking behaviours that are associated with search engine result pages (SERPs). Table 1 below provides a schematic overview of the aims and their corresponding research questions.

Table 1 Schematic overview of research questions

Types of web search behaviours	Corresponding research questions
Primary action	
Query-related behaviours	• What types of queries do professional translators tend to use? • What are their query intent? • How and in what circumstances do queries relate to query intent?
Secondary action	
Browsing and clicking behaviours	• What are the potential patterns of professional translators' browsing and clicking behaviours? • When and in what circumstances is a hyperlink clicked at a search engine result page (SERP)?

Interaction between primary and secondary action	
	• What is the interplay between primary and secondary actions in professional translators' behaviour?

This paper is structured as follows. Section 2 introduces web search studies in translation, particularly in terms of their findings in relation to primary and secondary actions. Section 3 focuses on the methodology adopted in the present study, i.e. a qualitative approach to eye tracking. Section 4 discusses its findings and presents a model of translators' web search behaviour. Section 5 concludes the study and its wider implication in translation studies and beyond.

2. Previous Studies

A number of previous studies on translators' web search behaviours focused on student translators. For example, Enriquez Raido's study (2014) focuses on four student translators translating two separate texts in the Spanish-English language combination. Similarly, Shih (2017, 2019) first investigated the web search process of six student translators translating a scientific text and then 18 student translators translating three medical texts on three separate occasions in the English-Chinese language combination. In contrast, Gough (2015), focused more specifically on professional translators working from English into many different languages. All these studies adopted a mixed-method approach, primarily using screen recording as their main data collection method supplemented by other methods, such as surveys, questionnaires, search reports, or concurrent verbal reports, etc. Most recently, Hvelplund (2017, 2019) conducted an eye tracking study with 18 professional translators exploring their overall visual attention, cognitive efforts and 'processing flow', defined as the eye movement transition between the ST, TT and the web resources. His results showed that translators' visual attention (and hence cognitive efforts spent) on web resources during drafting stage are much more substantial than during the revision stage, highlighting the importance of web searching during the early/drafting stages of the translation process. (For a broader overview of studies on web search in translation, see Shih 2019: 908-911).

It is important to build on this existing work while also focusing on the certain specifics of translators' web search behaviours that have received scant attention so far. In the following section, I will focus specifically on primary action (query) and secondary action (browsing and clicking behaviours) in these existing studies.

2.1 About primary action in translation

Query was probably one of the most overt aspects of investigation in existing studies, probably due to the use of screen recording as the main data collection method (since what is typed in the search box is clearly visible on the computer screen). However, related concepts and definitions about the use of the term, query, such as 'query type', 'query (re-)formulation' and 'query intent' are worth clarifying, as they are not only prominent features of primary actions in translators' web search behaviour, but also the focus of the present study. Shih's (2017, pp. 50-66) examined query types (i.e. categorisations of different types of queries) in her study of six Chinese student translators. She reported that ST terms, or occasionally tentative TT terms were the primary queries undertaken by her student translators working on a semi-specialist text. However, four other variations of query types were also noted, which included: 1) ST term and its (partially) corresponding TT equivalent (e.g. LNG + 燃料船), 2) ST term and [natural language] questions (e.g. gt + 是什么单位), 3) ST term and the name of the TL (e.g. owner operator + 中文), 4) provisionally translated sentence/title of the ST (Shih, 2017, pp. 57-59). Partly due to the limitation of the subject population and the focus on a single language combination (English-Chinese), as noted by Shih, the list of query types employed in the above-mentioned study was non-exhaustive. Shih's (2019, pp. 912-913) subsequent study also partially focused on 'query re-formulation', a term she adopted from the field of Information Retrieval (IR) studies to indicate how queries were constructed and (re)formulated over time during the course of a web search episode. Findings confirmed that student translators' queries were largely homogeneous and the author concluded that query (re)formulation did not appear to contribute to the success or optimisation of a search episode. What contributed to student translators' success or optimisation of web search lied in their secondary actions, rather

than primary actions (ibid), implying that student translators should probably shift their focus on utilising their SERPs rather than worrying about their queries.

Nevertheless, somewhat in contrast to Shih's study, one of the conclusions of Enriquez Raido's (2014, p. 183) study still centres around query, indicating that successful query construction seemed to depend on clear analysis of web search purposes. This brings us the concept of 'query intent'. In fact, it is imperative to elucidate the concept of 'query intent', not least because this is one of the research questions of the present study, but also because there is some level of terminological confusion in the field. In previous literature, a number of related terms were used, such as 'information needs', 'information goals' and 'information seeking triggers'. In Enriquez Raido's study (2011, p. 152), 'information needs' were described as 'the desire to solve a translation problem' and found to be primarily 'lexical', whereby problematic ST terms or lexis often prompt a search on the web, or 'thematic', thus requiring a search for background information (Enriquez Raido, 2014, pp. 112-171). The scholar further clarified that there were two possible 'information goals', either for ST comprehension purposes or for both comprehension and production purposes (ibid, 118). Enriquez Raido therefore appeared to consider 'information needs' as a more overt drive for different types of information, while 'information goals' were deemed to be a more generic purpose for translation. In addition to 'information goals' and 'information needs', Wang (2018, pp. 49-52) also used the term 'information seeking trigger', which was defined as a particular point in the ST triggering an information need. This appeared to be comparable to the notion of 'Rich Point' as delineated in Shih's study (2019, p. 914; cf PACTE, 2011, p. 41). Notwithstanding the potential overlap and confusion of the terms mentioned above, previous scholars' efforts seem to focus on studying translators' general information needs or their purposes when embarking on a web search episode. However, translators' web search intent more specifically at the query level has largely been ignored in the literature thus far. In other words, query intent in the present study relates to the reasons why certain query types were used or constructed by professional translators and how or in what circumstances query types relate to their query intent. It may be worth pointing out here that similarly to 'query intent', the concept of 'search intent' (Broder, 2002) is commonly referred to in IR studies as either 'navigational' (i.e. locating a particular site), 'informational' (i.e. acquiring information) or 'transactional' (i.e. performing an

activity). However, this taxonomy is very vague and holds limited value for translation, as presumably web search for translation is largely 'informational'. Therefore, perhaps from the point of view of IR studies, one of the contributions of the present study is to offer further insights into query, query intent and secondary action for a very specific group of web searchers, i.e. professional translators.

2.2 About secondary action in translation

Unlike primary actions, secondary actions did not appear to attract too much attention in previous studies. Although not specifically focusing on secondary actions, Gough's (2015) study tapped into a broader view of how professional translators (regardless of language combinations) interact with online resources, which involved browsing and clicking behaviours to some extent. Gough collected her data initially from a large-scaled translators' survey (N=540) and subsequently with a screen recording translation task in conjunction with post-task questionnaires (N=16). The scholar analysed the number of search episodes, their length and the types of online resources used. Professional translators' web search behaviour were deemed to be a reflection of translators' idiosyncrasies (2015, p. 31). The participants' web search behaviours were characterised by five different user styles: 'explorer', 'prolific translator', 'methodical translator', 'economical translator' and 'understated translator'; with the 'explorer' spending the most amount of time and efforts on researching on the web and at the opposite end of the scale, the 'understated translator' spending the least amount of time and efforts[1] on the web in their translation process.

Similar to Gough, secondary actions did not appear to be Enriquez Raido's (2011, 2014) prime focus in her study, although the scholar reported that two of her subjects had a style of 'interactionistic browse searching' (2014, p. 140), whereby certain websites were investigated further and internal hyperlinks were clicked. Such style of behaviours seemed to contribute to search success.

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[1] In Gough's study (2015), efforts largely indicate the number and variety of online resources used, and the number of queries made.

Following onto previous scholars' work, Shih focuses on her student translators' (N= 18) secondary actions more specifically and found that the success or optimisation of a web search episode could be pinned down to the adoption of a more 'explorer' approach, especially when attempting to locate a harder-to-find TL terminology (2019, pp. 919-920). This finding suggested that in certain circumstances (as in the case for harder-to-find terminology), a more persistent and profound engagement in secondary actions, i.e. browsing and clicking, rather than the primary actions, may pay off. The present study can be seen as a further attempt to gauge into translators' secondary actions, particularly in terms of the patterns of browsing and clicking behaviours, in what circumstances a hyperlink is clicked, and perhaps more importantly, the interplay between primary actions and secondary actions.

3. Research methodology: a qualitative approach to eye tracking

3.1 Methods

As mentioned previously, so far existing web search studies in translation have mostly adopted screen-recording as a main data collection method, in conjunction with other data sources, such as pre- or post-task interviews, questionnaires, think-aloud protocols, and online search reports. To the best of my knowledge, apart from Hvelplund's (2017, 2019) study, the present study does not just represent one of the earliest attempts to use eye tracking to investigate professional translators' web search behaviour but it is also one of the first studies that adopts a qualitative approach to eye tracking data in translation studies.

Eye tracking as a research method in translation studies is nothing new. In fact, it has increasingly become a customary data collection method in many sub-fields of translation process research (TPR) (O'Brien, 2010, pp. 251-266). Yet, currently eye tracking research in TPR almost exclusively focuses on analysing statistical aggregated data on fixations, saccades and occasionally pupil dilation. This results in a very granulated view of various

aspects of translator behaviour, which does not align with the aims of the present study. In order to provide a more holistic and contextualised overview of translators' web search behaviour, an alternative eye tracking methodology was adapted in the present study. Essentially, this methodology exploited the screen-recording component of the eye tracking data where translators' eye movements (i.e. gazes) were superimposed in real time onto the screen recording. This eye-tracked screen recording was then used as a video cue to prompt translators to verbally report on their web search immediately after completing the translation task. Part of the reasons for adopting this methodology was the decision to maintain a slightly more naturalistic design[2] for the present study, which entailed that translators were able to translate and use any online resources as they wished with minimal restrictions on their screen setup. This constraint made it virtually impossible to plot aggregated eye tracking data (using AOI for example), as no two translators were using online resources in exactly the same way. Nevertheless, the advantage of this methodology was two-fold. On the one hand, it provided a far richer and less fragmented illustration of translators' behaviours compared to the numerical analysis of eye tracking data (see Van Gog et al, 2010). On the other hand, it also offered more precise and accurate screen-based data (due to the gaze being superimposed on the screen) than the traditional screen recording that had previously been used in the study of web search in translation.

Despite its novelty in translation studies, this qualitative methodology has been widely used in marketing research commercially and by academics in the field of Human-Computer Interaction (HCI). In a sub-field of HCI, known as User Experience (UX) research, this methodology is commonly referred to as 'Eye-tracking Stimulated or Cue-based Retrospective Think Aloud' (RTA) (See Guan et al, 2006). By adopting a combination of real-time eye tracking gaze and RTA in this study, it is hoped that data such as translators' inferences and strategies can be elicited, which in turn will enhance our understanding of not just specific aspects of translators' web search behaviours (i.e. query, browsing and

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[2] It has to be pointed out here that the more naturalistic design refers to the screen setup (i.e. the use of Mircosoft Word and the web browser, Google Chrome) rather than the location of the data collection.

clicking behaviours) but more importantly the interplay and potential reasons why such interplay occurs.

3.2 Participants

A group of professional translators (n=10) were recruited (using open call and snowball sampling technique) to translate a short piece of medical text from English into their respective mother tongues, including (in alphabetical orders) Arabic (n=1), Chinese (n=5), German (n=1), Japanese (n=1), Russian (n=1), and Spanish (n=1). These professional translators are all freelance translators based in the UK, with their experiences ranging from 2 to 30+ years, in their respective language combinations working in different fields (see Appendix 2 for more details). While due to the sampling technique, the language combinations, years of experiences and specialism are not deliberate, the participants do represent a good selection of varied experiences for the cohort of freelance translators in the UK.

3.2 Data collection procedures

Participants were asked to translate their English source text in Microsoft Word (font size 18) and use the browser, Google Chrome (zoom at 150%) for their web search. Shortly after their translation, the eye-tracked screen recording were replayed, participants' retrospective think-aloud on their web search and translation process were recorded (using the RTA function in SMI's BeGaze software). The replay of the recording was paused intermittently if necessary during the RTA. After the RTA, participants completed a questionnaire containing questions related to their demographic information, and translation and web search experiences. The whole process from start to finish took approximately 2 hours. Upon completion of the study, each participant received a voucher as a thank-you token for participating. Consent was sought and ethical approval was obtained at the researcher's academic institution.

The source text was a medical case report (word count: 136 words) from a website, Medical Protection Society (See Appendix). It was slightly abridged so that it is not too long and yet consists of a good selection of medical terminologies and concepts which are considered to be suitable (based on pilot study) to elicit relevant data in the present study.

The eye tracker, SMI RED250 Mobile (sample rate of 250 Hz) and a laptop with 15-inch screen were set up at the researcher's office and used to record participants' web search and translation process. Participants' sitting position was roughly 60 cm from the laptop screen. Calibration via SMI's iView software (with 6-point calibration) were conducted prior to the data collection and repeated if necessary. Subjects were all able to touch-type and either had normal vision or were vision corrected wearing their own glasses. The experiments took place under natural daylight with blinds pulled down wherever possible.

4. Results and Discussion

4.1 Query types

Prior to reporting the findings in the present study, it is important to delineate an operational definition of 'query' for the purpose of analysis, i.e. what constitutes a query in the analysis of the typologies as illustrated below. Query in the present study is defined as words or symbols typed in a search field, which may include any search fields outside search engines. This wider definition is crucial because professional translators may choose to use a variety of different online search tools other than search engines, such as online dictionaries, glossaries, corpora, or MT tools, etc. Overall speaking, it was found that the use of a (sole) ST or TL term (i.e. keyword-based query) appeared to be a prominent feature of many queries, although the degree of its prominence very much depended on each individual translator, as the types of online resources preferred can also dictate the types of queries being used. For example, it was pointless for translators to construct complex queries in online dictionaries since most online dictionaries did not support complex queries. Query types illustrated below show common queries being used by translators,

apart from the keyword-based queries as mentioned earlier. These query types were largely categorised based on their linguistic features. Table 2 shows the typologies of such queries and their corresponding online resources.

Table 2 Typologies of non-keyword queries and their corresponding online resources

Query type code	Query types	Types of online resources
Type 1	The use of natural language	Search engines
Type 2	The use of 'casting-a-net' approach	Search engines Online encyclopaedia
Type 3	The use of literal translation or potential 'false-friend'	Search engines Online corpora/concordancer Online dictionaries
Type 4	The use of collocation in search engines and/or other specialised online resources	Search engines Online dictionaries Online corpora/concordancer
Type 5	The use of a ST term, a ST sentence or even a whole ST paragraph	Online Machine Translation tools (e.g. Google Translate)

Query type 1: The use of (non-keyword) natural language in search engines

This study found that many professional translators regularly used natural language sentences or clauses in their queries in search engines, as opposed to using keyword-based query. Such natural language can be found either in the form of a statement or a question.

For example, while researching the term, 'triple coronary artery bypass graft', subject P14 posed the following query in Google, '心脏搭桥可以几个?' (Literal translation: How many heart bypass are there?). Subject P14 reported that he was trying to find which Measure Word to use for the translation of 'triple'. Measure Word is a common grammatical feature in many oriental languages, where each noun has a corresponding Measure Word. In this case, even though Subject P14 had already located the TL equivalent for 'coronary artery bypass graft', he was not familiar with how to translate 'triple' or whether 'triple' was directly linked to bypass, artery or even graft, as association with different nouns might require different Measure Words. By typing the question in the TL, he was hoping to locate a correct Measure Word in this context. Another example can be found with Subject P05 where she posed the following query: '心脏手术词汇' (Literal translation: heart surgery glossary). Subject P05 described this query as her strategy to pull together relevant glossaries or terminologies related to the ST and partly as a way to familiarise herself with the field.

Interestingly, the use of natural language was also found in Shih's (2017, pp. 57-59) study. However, in contrast to the present study, the natural language used in Shih's study was largely used in conjunction with a specific ST term and appeared as an answer to such questions, such as 'what is this?' or 'what does this mean?'. This was linked to Shih's (ibid) finding that student translators tended to use ST keyword-based queries in search engines as if they were using a paper-based dictionary. In a wider context, search engines are increasingly developing their capability to understand natural language queries, as opposed to the traditional keyword-based queries. In fact, it was reported that Google has recently rolled out a new AI algorithm specifically designed for enhanced understanding of sophisticated natural language[3]. This means that for translators the use of natural language in queries is likely to become a more efficient and probably more prevalent query type in the future.

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[3] See (https://searchengineland.com/welcome-bert-google-artificial-intelligence-for-understanding-search-queries-323976)

Query type 2: The use of 'casting-a-net' approach in search engines or in online resources (e.g. Wikipedia)

Professional translators in the present study used a wide array of query techniques to narrow down their search. In fact, Subject P05 labelled this as the 'casting-a-net approach', as if she was trawling the internet to 'fish' for specific information in the open water. However, she was not just casting a net or indeed any net blindly but meant to use different nets to catch different types of fish. For instance, Subject P16 posed the query, 'revision surgery site:es' in Google, as it was reported that he was consciously aware of regional variations of Spanish being used in different countries and it was imperative to narrow down the search for this purpose. This type of query serves a similar purpose to Boolean operators (e.g. AND, OR) or advanced search functions in search engines. However, 'casting-a-net' approach does not necessarily have to include Boolean operators. For example, Subject P09 posed the query, 'weaning, 中文, 医学' (Literal translation: weaning, Chinese, Medicine). According to Subject P09, she was trying to narrow down the search for the ST term, weaning, in the field of medicine and in Chinese. In other words, simply entering the name of the language and the name of the field (or possibly other terms) alongside a ST term is also a possible 'casting-a-net' approach.

Query type 3: The use of literal translation or potential 'false-friend' (as a keyword) in both search engines and/or in other online resources (e.g. Linguee.com, Cosnautas.com)

At first glance, this finding may appear to resemble the provisional TL equivalent (i.e. a rough translation of a ST sentence or title) as seen in Shih's study (2017, pp. 57-59). However, unlike Shih's study, this query type was often not attached to a ST sentence or title but more specifically appeared to be habitually used by translators working between European languages, probably due to the fact that 'false friends' exist among such languages and translators were very aware of them. For example, Subject P07 (working in the language combination of English to German) indicated that she often typed a literal German translation based on a ST terminology as the query. According to Subject P07, this was a strategy to check whether a literal equivalent existed in German, or whether such

literal translation was merely a 'false-friend'. This strategy was used both in search engines and in online concordance tools, such as Linguee.com or cosnautas.com/es.

Query type 4: The use of collocation in search engines and/or other specialised online resources

This was probably one of the most interesting query types found in the present study, as often professional translators did not just pose the terminology by itself but also its collocated verb as their query. In fact, some professional translators reported that locating a TL equivalent for a ST term was often the easier part of their web search process, as frequently, the thorny issue they encountered was to locate the collocated verb in the TL, or to determine whether a collocation existed at all in the TL. A typical example of this could be found in the query behaviour relating to translating the following ST passage, '… the graft had gradually become blocked'. Many translators painstakingly searched a combination of 'graft' and 'block' in an attempt to find a collocation in the TL. Similarly, the collocation of 'evacuation' and 'haematoma' in the ST passage, as in 'evacuation of the haematoma were performed', was also frequently posed together in a query. This probably demonstrated professional translators' acute awareness of possible polysemy and mis-match of collocation in translating specialised texts.

Query type 5: The use of a ST term, a ST sentence or even a whole ST paragraph in online Machine Translation (MT) tools (e.g. Google Translate)

Shih (2017, p. 59) has previously reported the phenomena of MT tools being used by student translators. Gough (2015, p. 163) also had similar findings among her professional translators in her study. In the present study, Subject P01 was found to copy and paste the whole paragraph of the ST in a MT tool and effectively conducted post-editing in the present study. Other translators used it as a terminology tool to verify possible TL equivalent for a ST term. The present study therefore further confirmed this finding that posing a ST term or a longer ST passage (as queries) could be found in professional translators' behaviour, even when CAT tools were not used. It also illustrated that, increasingly, translation, MT post-

editing and possibly web search should not be seen as separate entities but as an integral part of the whole translation process.

4.2 Query intent and its relationship with query types

Largely based on the RTA data, seven different types of query intent were reported by professional translators in the present study. They were:

1) locating a TL term
2) locating further background information (about a specific term or about a field in general)
3) validating a TL term or expression
4) seeking inspiration for alternative terms or expressions
5) locating TL collocation
6) post-editing intent
7) language-specific intent

The first two query intents (i.e. locating a TL term and locating further background information) were probably the most common intents. In fact, as previously mentioned, Enriquez Raido (2014, pp. 112-140) described them as 'information needs' being either 'lexical' or 'thematic'. Query intent 3 and query intent 4 were often found to be linked to query intent 1, as they often centred around terminology. The difference was that query intent 1 was often found to precede query intent 3 and query intent 4, since often a TL term needed to be located before it could be verified or before alternative terms could be sought. Query intent 3 and query intent 4 may also exist independently, however, as sometimes translators already had a good idea about a particular terminology without locating it first online.

As demonstrated in Section 4.1, many query intents were shown to be closely linked to the query type and the resources being used. In other words, different query types could be

tailored to suit each query intent and, in turn, query intent could also dictate which query types were used by professional translators. On the one hand, certain query types were closely associated with certain query intents. For example, query type 4 (i.e. the use of collocation) was clearly linked to query intent 5 (i.e. collocation purposes). The same applied to query type 5 (i.e. the use of ST terms, sentences in online MT) and query intent 6 (i.e. the intent of post-editing). On the other hand, certain query types appeared to be more generic (or even open-ended), as they could be adapted for many different purposes. Both query type 1 and query type 2 belong to this category. In addition, query intent could also be language-specific (e.g. query intent 7), as shown in the example mentioned above in Section 4.1 whereby Subject P14 intended to locate a Measure Word for a specific ST term. Finally, it is important to stress that query intents are not mutually exclusive. In fact, it is a dynamic process where query intents could co-exist or even evolve over time probably as a result of the contents presented in the search engine result pages (SERPs).

4.3 Browsing and clicking behaviours

To explain and elaborate on the model of translators' browsing and clicking behaviours in search engines (see Figure 1), it is important to clarify two concepts first. These are: 'scanning action' and 'reading action'. In eye tracking IR research (see Cole et al, 2011, Holmqvist et al., 2011), specialised algorithms tended to be used to analyse fixation and saccade data in order to establish the starting point and ending point of 'reading fixation' and 'scanning fixation'. 'Scanning fixation' was defined as web users' eyes being fixated at the foveal (i.e. smaller) visual field, whereas 'reading fixation' referred to the larger parafoveal region (see Rayner and Fischer, 1996, Rayner at al, 2003). This means that merely isolated words or phrases can be processed visually and cognitively at one time during 'scanning fixation' but longer stretches of texts (such as clauses or sentences) can be processed during 'reading fixation'. These concepts were adapted for the purpose of the present study. However, instead of directly relating to the aggregated fixations and visual fields, in the present study, such concepts were used to refer to the observable orientations of eye movement (i.e. gaze). 'Scanning action' indicated rapid eye movements that largely

travel vertically. 'Reading action' indicated slower eye movements that largely travel horizontally. 'Scanning action' and 'reading action' must be understood as a more holistic overview of translators' behaviour in the present study rather than at the granulation level. Related to the concept of 'scanning', in a wider context of IR research, it was generally recognised that web-based information behaviour often featured quick scanning and browsing, a potentially very different behaviour to the traditional paper-based information behaviour (Walsh, 2006, pp. 160-173). In fact, Rowlands et al. (2008) dubbed this as information behaviour of the 'Google generation'.
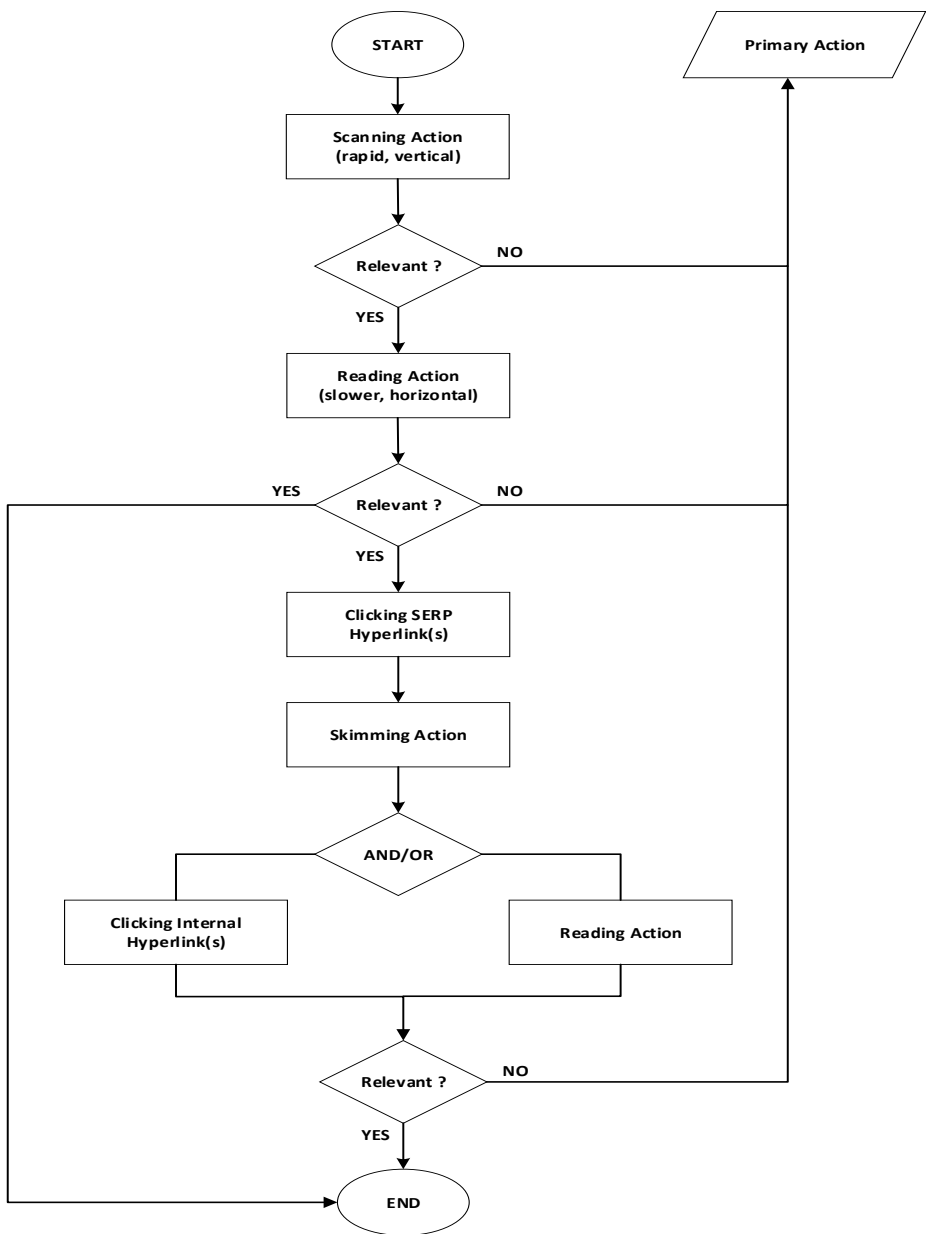
Figure 1 Professional translators' browsing and clicking behaviours (in search engines)

As seen in Figure 1, professional translators' secondary actions (or browsing and clicking behaviours) commenced after a query was posed. After posing queries, professional translators were found to process the SERPs with 'scanning action', largely scanning of the title of the SERPs and their corresponding snippets (i.e. a short descriptor of the webpages in SERPs). Essentially, their eyes were found to move quickly up-and-down along the SERPs. These rapid eye movements only slowed down (at which point the translator's eyes appeared to 'fixate' on a specific search result) if the translator decided that something relevant might have been found. During the 'scanning action', the translator appeared to be constantly making judgements on SERPs and their relevance in relation to query intent so that they could slow down the rapid eye movements. If none of the SERPs were deemed to be relevant, the translator might decide to go back to the drawing board (i.e. primary action) to pose a new query. But, once relevance was identified, the browsing behaviours would turn from 'scanning action' to 'reading action'. 'Reading action' was characterised by horizontal eye movements that were much slower than the 'scanning action'. Crucially, at this stage 'reading action' was restricted to snippets. In other words, the translator only read snippets and did not necessarily click on any of the SERP hyperlinks. For instance, Subject P09 reported that often reading snippets themselves has already satisfied her query intent; therefore, there was no need to click on them. This represented an interesting phenomenon, which will be elaborated upon later on in this Section. However, if the translator judged from the snippets that a hyperlink might provide further relevant information, she would then click on the SERP hyperlink to investigate further. After clicking on the hyperlink, the translator tended to commence the 'skimming action', typically characterised by rapid eye movements that could be vertical, horizontal or even diagonal, presumably depending on how information was displayed on the website. According to the RTA, this serves the purpose of having an overview of the site. This initial 'skimming action' may be accompanied by a cycle of further clicks of hyperlinks and/or further 'reading action' within the site; alternatively, the translator may decide to abandon the whole site altogether and pose a new query instead.

As mentioned earlier, hyperlinks resulting from the SERPs were often browsed (via 'scanning action' and 'reading action') but not clicked. Translators in the present study claimed that

this was often the norm (rather than the exception) because there was no point in clicking hyperlinks when snippets alone were considered to be sufficient enough to answer their query. Upon a closer examination, it was found that such phenomena tended to be associated with queries (intent) that were predominately terminology-based, such as query intent 1, 3 and 4. For instance, Subject P01, Subject P07, and Subject P09 all reported (via RTA) that they rarely clicked on hyperlinks, particularly because, most of the time, they were merely scanning the snippets for relevant terminologies and their usage. It could be argued that each search engine result was akin to a dictionary entry and snippets were sample sentences or thesaurus results for translators. It is also worth pointing out here that such phenomena tended to occur when translators did not seem to have any habitual online glossaries or specialised dictionaries they normally turned to in their web search process. In other words, there was evidence to suggest that query intent (in this case, terminology-based query intent) directly influenced the browsing and clicking behaviours of translators. As for those translators who used habitual glossaries or dictionaries, their first ports of call were often these trusted resources, rather than search engines. For them, search engines were used to supplement their first ports of call or used for more generic information-seeking purposes, should such glossaries or dictionaries fail to provide satisfactory results.

4.4 Interplay between primary and secondary actions

Undeniably, the present study showed an interplay between translators' primary actions and secondary actions (as seen in Figure 1 where secondary actions may end at multiple points and a new primary action may resume). First of all, within the primary action, query type and query intent themselves also have an interdependent relationship. On the one hand, certain query types were more specific and can be associated with particular query intent (i.e. a collocation query is closely related to a collocation intent). On the other hand, there were also other query types that appeared to be more generic. As a result, the latter can be adopted for the purpose of many different query intents and possibly in many different language combinations. In other words, the relationship between query type and query intent appeared to be either one-to-one or one-to-many.

As shown in Section 4.3 and in Figure 1, query intent appeared to guide translators' secondary action via their judgement of relevance in SERPs. It was as if there was a spectrum of different degrees of relevance. Such relevance may be factored in with regard to how much time and effort the translator was willing to invest and hence resulted in either further or minimal browsing and clicking behaviours in SERPs.

In fact, it was shown that if query intent was clearly terminology-based, then translators' secondary action could be restricted to browsing (i.e. a combination of 'scanning action' and 'reading action') of snippets only. However, if the query intent was for general background information, translators were probably more likely to explore further afield by clicking the SERPs. Interestingly, in Shih's (2019, pp. 908-923) study, it was shown that students' over-reliance on snippets alone could be problematic, as without clicking on hyperlinks or having further engagement in secondary action, the chances of locating harder-to-find terminology could be hindered. This finding appears to be in contradiction with that of the present study. However, it is worth reiterating that whilst Shih's study focused on student translators' (more) optimised web search behaviours particularly for harder-to-find terminology and it essentially contrasted students' successful and unsuccessful web search behaviour, the present study focused on professional translators' web search behaviour exclusively. Although the two studies differed in their focus, it may be mooted that relying on snippets is something that professional translators can do due to their increased experience in identifying reliable sources, a skill that students may not yet have.

5. Conclusion

This study set out to find out professional translators' primary action, secondary action and the interplay between them. It was found that there were at least five different types of queries. Among these five query types, one of them was potentially more language-specific, i.e. query type 3, as 'literal translation' or 'false-friend' is used frequently between European languages. Nevertheless, other query types appeared to be more universal among all languages. Seven types of query intent were also found. Among the query intent, many of

them appeared to be terminology-based specifically. In terms of how and in what circumstance query type relates to query intent, it was found that certain query types distinctly match with certain query intent but there were also clear indications that other query types could be adapted to suit many different query intents. This finding may have potential pedagogical implications, as it advocates that students could be taught which query types are more generic, i.e. can be adapted or customised, which ones are more specific, and how different query types and query intents could be utilised so as to optimise their web search. Likewise, language-specific queries could also be taught to students working in specific language combinations.

With regard to professional translators' secondary action, a pattern of browsing and clicking behaviours was observed. In sum, their browsing behaviours started with 'scanning action', 'reading action', subsequently 'skimming action' and possible 'reading action'. These browsing actions were partly punctuated with clicking actions which was monitored and guided by the judgement of relevance to query intent. Interestingly, the sequence of professional translators' secondary action could be limited to browsing action exclusively. In fact, for some professional translators, particularly when the query intent was for terminology purposes, it was deemed unnecessary to click on any of the hyperlinks, as clicking on hyperlinks could be potentially time-consuming. They did, however, take full advantage of snippets in search engines. The action of reading snippets therefore became a vantage point in translators' secondary actions as it was a decision point whether there was enough information in the snippets to justify no clicking, whether further clicking was required, or even whether it was worth abandoning the whole sequence of secondary actions and returning to the primary actions. The strategy of 'no clicking' could be seen as a minimax strategy (Levy, 1967/2000, pp. 148-159) that professional translators apply in the sense that they would usually aim for the maximum effect with minimum cognitive effort. This strategy also revealed a key feature of professional translators' web search, that is, the fact that search engines themselves were often used as if they were vast online dictionaries.

These findings about professional translators' web search behaviours have their limitations, as they may not apply to all professional translators translating all genres, given the limited number of subjects and the specific translation task being employed in the present study. Indeed, the list of query types and query intents was never intended to be exhaustive. Therefore, similar studies should be duplicated in the future on a larger scale with different translation tasks, different search engines, and potentially with a focus on linking web search behaviours with translation quality or web search optimisation.

One of the main contributions of the present study, however, lies in its methodology, as it challenges the quantitative approach to eye tracking in TPR and in translation studies. It demonstrated that the use of qualitative methodology for eye tracking research is not only feasible but also an effective way of eliciting inference data in web search for translation and possibly beyond. It also shows that there is a potential to triangulate qualitative RTA data with quantitative eye tracking data in future TPR studies, as this way the granulated and holistic levels of translators' behaviour can both be accounted for.

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Appendix 1

Source Text (136 words)

Mrs M was admitted to a hospital's cardiac surgery unit. Six years ago, a triple coronary artery bypass graft had given her a new lease of life, but since then the grafts had gradually become blocked. She was offered revision surgery.

Dr E, a consultant anaesthetist, went to assess Mrs M prior to the surgery. Dr E told her that he would insert a thoracic epidural to provide good postoperative analgesia and support weaning from the ventilator. The epidural was placed and the operation took place uneventfully.

At lunchtime the next day, Mrs M complained that she was unable to move her legs. An emergency CT scan revealed a large haematoma in the epidural space in the mid thoracic spine, compressing the cord. Later that evening, an emergency laminectomy and evacuation of the haematoma were performed.

Abridged from https://www.medicalprotection.org/hongkong/casebook-resources/case-reports/case-reports/paraplegia-follows-epidural

Appendix 2

Translators' background and experiences

Subject code	Gender	Years of experiences	Specialised domains	Language combinations
P01	F	35 years	Legal Business translation/interpreting	English-Japanese
P02	F	9 years	Audio-visual translation Localisation	English-Chinese Chinese-English
P05	F	24 years	Media/news reports Medical translation Advertisement/marketing	English-Chinese Chinese-English
P06	F	2-3 years	Literary translation Business translation/interpreting	English-Russian Russian-English
P07	F	25 years	Technical/scientific translation Localisation	English-German
P08	F	2-3 years	Audio-visual translation Economics and finance	English-Chinese
P09	F	26 years	Legal translation Technical/scientific translation	English-Chinese Chinese-English
P14	M	7 years	Legal Translation Official documents Conference interpreting	English-Chinese Chinese-English French-Chinese
P16	M	4 years	Audio-visual translation Legal translation Tourism	English-Spanish Spanish-English
P23	F	15 years	Technical/scientific translation Business interpreting/translation	English-French French-English English-Arabic Arabic-English