Translation, attention and cognition

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15.1 Introduction: Attention as a cognitive process

When we attend to something, we focus our conscious awareness on a certain object while we “filter out” information by suppressing and ignoring non-relevant information. In psychology, the study of attention dates back to the 1890s, when American psychologist William James proposed a definition of attention:

[Attention] is the taking possession by the mind in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others.

William James, 1890, p. 403

Attention involves focusing on specific environmental stimuli while ignoring other stimuli. Attention to specific aspects of a person’s environment is necessary to perform tasks: when we read, we pay attention to the book’s letters and words, possibly ignoring or suppressing sounds that could grab our attention, and when we engage in spoken conversation, we listen to the person’s words while we ignore other non-relevant sounds. While there is a relationship between attention and cognition, they are different: attention is a type of cognitive process by which the mind engages cognitive resources on a specific object. Cognition concerns the mental processing of sensory information and information already held in a person’s memory:

cognition refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. [Cognition] is concerned with these processes even when they operate in the absence of relevant stimulation.

Ulric Neisser, 1967, p. 4

Thus, attention can be construed as a behavioural and sometimes observable cognitive process that is intimately linked with underlying cognitive processes. In empirical translation research, experimental studies of attention and cognitive processing assume such a link between
manifestations of attention (for example eye movements, typing events, verbalizations from think-aloud protocols and EEG signals) and the “invisible” cognitive processes that are involved in the manipulation of written and spoken source-language input that is to be written or spoken in the target language.

Few translation and interpreting studies have explicitly concerned attention as an isolated cognitive process, but a large number of studies have had an indirect interest in attention as a gateway to studying the underlying cognitive processes. Concerned specifically with attention, empirical translation studies have covered a range of issues and topics. For instance, the term attention unit has been used as an indicator of a cognitive translation unit or processing unit based on verbalized think-aloud data (e.g. Bernardini, 2001; Jääskeläinen, 1990, 1996) and combined eye-tracking and keylogged data (e.g. Hvelplund, 2011, 2016). The related activity unit (Carl & Schaeffer, 2017) similarly uses behavioural eye-tracking and keylogged data to describe underlying cognitive processes. The coordination of attention to source text and target text has been studied from a combination of eye-tracking and keylogged data (Dragsted, 2010; Dragsted & Hansen, 2008), and the role of attentional division in translation has been discussed in both translation research (Hansen, 2005; Hvelplund, 2011, 2016; Jensen, 2011) and interpreting research (Darò & Fabbro, 1994; Lambert, 2004; Mizuno, 2005). Related to attention, working memory has been considered central to understanding the processing mechanisms associated with translation (e.g. Dragsted, 2004; Englund Dimitrova, 2005; Hvelplund, 2011, 2016; Kosma, 2007; Rothe-Neves, 2003) and even more extensively in interpreting (e.g. Darò & Fabbro, 1994; Gile, 1995; Jin, 2010; Köpke & Signorelli, 2012; Mizuno, 2005; Moser-Mercer, 2010; Padilla et al., 1999; Padilla et al., 2005; Timarová et al., 2015).

In addition to these studies, which have explicitly concerned attention or working memory theory in relation to translating or interpreting, a large body of translation and interpreting studies has been indirectly interested in attention as a proxy to understanding the underlying cognitive processes. This chapter will not concern these many studies, since that would involve virtually all experimental translation and interpreting research that uses behavioural data as an indication of cognitive processes. Instead, the chapter will consider examples of research that in some way are helpful to the characterization and discussion of attention in relation to translation and interpreting. Readers are referred to overviews of translation process research using think-aloud (Bernardini, 2001, Jääskeläinen, 2002), keylogging (Jakobsen, 2006) and eye tracking (Hvelplund, 2017a).

The following sections will introduce attention as a fundamental cognitive process that is necessary for translating. While the overall focus is mainly on written translation, interpreting will also be given some consideration in comparison with translation. Section 15.2 presents three experimental research methodologies, which are often applied in translation process research to study attention and cognition: think-aloud protocols, keylogging and eye tracking. Drawing on models and concepts from psychology and cognitive psychology, Section 15.3 will outline and discuss working memory and attention theory in relation to translation and interpreting and review relevant translation and interpreting research. Finally, Section 15.4 will take a look to the future and outline other methods that could be used to examine the translator’s object of attention.

15.2 Core topics

15.2.1 Measuring attention in translation

Various methods are used to gain access to the translator’s object of attention during translation. Three important methods are eye tracking, which captures the location of a person’s eye movements, keystroke logging, which registers typing events during a writing task, and
think-aloud protocol, which is a method to collect verbal data during the execution of a task. These three methods have had a defining impact on our current understanding of translation as a cognitive process. These three research methods are presented in the following, with brief consideration given to their advantages and applicability in translation (and interpreting) research, but the emphasis will be placed on eye-tracking methodology, which is currently very much in vogue as a way to record attention (and thus cognitive processes) during the execution of translation.

Think-aloud protocol (TAP) analysis was brought over from psychology (e.g. Ericsson & Simon, 1984) to Translation Studies in the 1980s (e.g. Jääskeläinen, 1990; Jääskeläinen & Tirkkonen-Condit, 1991; Krings, 1986) as interest in translation as a cognitive activity accelerated (Jakobsen, 2017, p. 24). The principle behind the method of TAP is that a person verbalizes thoughts related to a specific task while she carries out that task. The assumption is that a person’s verbalized thoughts reflect attention to the item being verbalized and thus, the invisible ongoing cognitive processes associated with that task. In the late 1990s, keylogging was proposed as a method to complement TAP in order to “gain better knowledge about cognitive processes by adding a technological, behavioural, and therefore less subjective supplement to introspective ‘tapping’” (Jakobsen, 2017, p. 28). Keylogging, also known as keystroke logging, is the process of registering keystroke typing events on a computer using a keylogging program, which records the key that was pressed and the time that key was pressed. Popular keylogging programs for translation research are Translog (Jakobsen & Schou, 1999) and its successor Translog II (which also captures eye movements) (Carl, 2012; Jakobsen, 2011). Analyses of keylogging data rest on the assumption that writing events reflect ongoing cognitive events:

the idea [is] that the process of writing a translation constitutes behaviour that can be studied quantitatively—across time—and interpreted as a correlate of mental processing. The assumption is further that it will be possible to triangulate qualitative and quantitative data and test hypotheses derived from analyses of qualitative data against quantitative data, and vice versa.

Jakobsen, 1998, p. 74

Keystroke logging has been used in multiple studies as an indicator of cognitive processing (e.g. Dragsted, 2004; Immonen, 2006; Jakobsen, 1998, 2003, 2005; Jakobsen & Schou, 1999; Jensen, 2001) using typing events as an attention proxy. With respect to the cognitive process attention, registration of keystroke output can provide an estimation of the translation item that was at the translator’s focus of attention just prior to typing it. Keylogging has the advantage that typing events are registered without interfering with the translation process, and it is therefore a non-intrusive alternative to TAP. A disadvantage of keylogging, however, is that the focus of the translator's attention is not available during writing pauses. Measures often reported in translation process research include pause duration and typing speed (e.g. Dragsted, 2004; Immonen, 2006; Jakobsen & Schou, 1999). However, other combinatory measures, such as eye-key span (measuring the time lag from source-text reading to target-text typing) (Dragsted, 2010; Dragsted & Hansen, 2008; Timarová et al., 2011), are emerging. In fact, an increasing number of studies combining keylogged and eye-tracking data are being carried out (e.g. Carl & Schaeffer, 2017; Hvelplund, 2011, 2016; Jakobsen, 2011; Martínez-Gómez et al., 2014) to achieve a higher degree of completeness in the description of the translation process.

Eye tracking is the most recent method among the three main methodological trends in translation process research, dating back to O’Brien’s (2006) study on translation memory matches using pupillary data. For several decades, eye tracking has been a key method in psychology and the cognitive sciences to explore attention and cognitive processing. In the last
decade, eye tracking has become a very popular research method to get insight into translators’ focus of visual attention and the underlying cognitive processes that are associated with translation. Eye movement data are collected with a device known as an eye tracker, which is a piece of hardware that can register the relative position of eye movements with reasonable precision. Video-based eye trackers, which are the preferred type of equipment in empirical translation research, use near-infrared illumination produced by diodes located on the eye tracker to identify the location of the eyes relative to the content on the computer monitor. The infrared light is reflected on the participant’s cornea, and this reflection is captured by a high-resolution camera that is located in the middle of the eye-tracking device. Different types of trackers exist, including head-mounted systems (such as eye-tracking glasses) and head-fixating trackers (where the head is strapped to the eye tracker for better precision). However, in translation process research, remote video-based trackers are by far the most popular eye-tracking system. Remote eye trackers come in two different designs: older designs, where the diodes and camera are built into a computer monitor, and newer designs, where diodes and camera are built into a device that is mounted onto a regular computer monitor. There are three main reasons why remote systems are preferred over other systems. Firstly, remote trackers are less intrusive, as they allow free head movement. Translators often need to monitor typing activity and consult offline dictionaries, and this is complicated by head-fixation trackers. Secondly, temporal and spatial precision is considerably higher for remote eye trackers than for eye-tracking glasses. And finally, data recorded in a two-dimensional static display environment with the remote setup is much easier to analyse than data collected in a three-dimensional dynamic environment, such as with the eye-tracking glasses. See Hvelplund (2014) for a presentation of different kinds of eye trackers and their advantages and drawbacks, and Alves et al. (2009), O’Brien (2009) and Hvelplund (2014) for useful guidelines concerning the use of eye tracking in translation experiments.

15.2.1.1 Eye movements and assumptions

In psychology, cognitive sciences, psycholinguistics, translation process research and other fields using eye tracking, eye movements are assumed to reflect ongoing mental processing. In other words, manifested visual attention is assumed to correlate with underlying cognitive attention. This relationship between visual focus and cognitive focus rests on two basic assumptions formulated by psychologists Just and Carpenter (1980). The primary assumption is the eye-mind assumption:

*the eye-mind assumption posits that there is no appreciable lag between what is being fixated and what is being processed.*

*Just & Carpenter, 1980, p. 331*

A traditional interpretation of this assumption is that the eyes will focus on the item that is currently the object of cognitive processing. For instance, during reading, the eyes will fixate on words for precisely as long as it takes to comprehend those words. The second important assumption proposed by Just and Carpenter is the immediacy assumption:

*interpretations at all levels of processing are not deferred; they occur as soon as possible.*

*ibid.*

The typical interpretation of the immediacy assumption is that cognitive processing of an item starts right when that item comes into visual focus and processing continues until the item leaves visual focus, at which point cognitive processing ends.
These basic assumptions seem reasonable, but reservation has been expressed with regard to a straightforward interpretation (e.g. von der Malsburg & Vasishth, 2011). We are not always mentally engaged in the object our eyes are looking at, and thus, disagreement between observed focus of attention and actual cognitive focus of attention can make it difficult to rely blindly on the eye-mind assumption. Posner (1980, p. 5) points out that “it is important to distinguish between overt changes in orienting that can be observed in head and eye movements, and the purely covert orienting that may be achieved by the central mechanism alone”. Overt orienting reflects the behavioural, manifested focus of visual attention, and not necessarily covert orienting, which concerns the actual object of attention. With respect to the case of translation, eye-tracking analysis is complicated by these potentially covert changes in attention: although the translator is looking at the source text, he may well be considering possible target language equivalents of that specific source text word, and when looking at the target text, the translator may well be constructing meaning hypotheses based on source text content (Hvelplund, 2014, p. 210).

Another weakness of a strict interpretation of the immediacy assumption concerns asynchrony between manifested orientation of the eye and the mind’s object of orientation. Holmqvist et al. (2011, p. 379) point out that the eye is roughly 250 ms ahead of the mind, so for translation, this means that the translator will not cognitively process an item until a quarter of a second after it has entered into visual focus. Another kind of asynchrony is of a mechanical nature: drift (ibid.). Drift occurs when the registered eye position and the reader’s actual eye position become gradually asynchronous during the course of the data collection session process. Despite these concerns, eye tracking is still considered a viable method for observing manifested attention in translation: while covert attention is a factor to consider, we cannot ignore the many instances during the translation process where ST [source-text] words have been read for the purpose of translating them into the TL [target language]. During those instances, visual focus will have been overt manifestation of cognitive focus (Hvelplund, 2014, p. 211).

15.2.1.2 Eye-tracking measures
In translation process research, eye fixation is a very popular indicator of visual attention and the underlying cognitive processes. A fixation is a kind of eye movement where the eye is kept relatively still in order to extract visual information from a specific item or object (Duchowski, 2007, p. 46). A range of quantifiable eye-tracking measures are used to register the object of visual attention, including fixation count, fixation duration, time-to-first fixation, first and second fixation durations, and other less frequently used measures such as pupil size (Hvelplund, 2014, p. 212) and blink rate (Chang, 2009). Eye movement measures are typically interpreted as correlates of mental processing (in line with Just and Carpenter’s eye-mind and immediacy assumptions); more specifically, changes in fixation duration, count, pupil size, etc. indicate changes in the workload that is placed on working memory. Longer fixations and larger pupils indicate more cognitive effort, while shorter fixations and smaller pupils indicate the opposite.

15.2.2 Attention, cognition and translation
As introduced at the beginning of this chapter, behavioural indicators of attention such as eye movements, typing and thinking aloud can be interpreted as correlates of ongoing cognitive processing in a person’s mind. But how do these attentional manifestations tie in with the underlying cognitive processing system? What are the cognitive mechanisms that guide
attentional selection, focus and coordination, and how can the study of attention and memory improve our knowledge of the translation and interpreting processes? This section will consider these questions against the backdrop of psychology research, and cognitive psychology in particular.

15.2.2.1 The human memory system

The human memory system is a network of specialized memories that are responsible for the manipulation, storage and retrieval of information. As an information processing system, the human memory system is proposed to consist of a sensory memory (or registers), working memory and long-term memory (Baddeley, 2007). Sensory memory is responsible for the initial automatic filtering of environmental input, such as visual, auditory and haptic information, before actual cognitive processing takes place. In psychology, there has been an ongoing debate about whether and how sensory information is filtered by the perceptual system before reaching working memory. An early selection filter theory proposed by Broadbent (1958) suggests that sensory information is selected based on shared physical properties, such as colour, shape or tone, rather than semantic properties. According to this theory, the human memory system is simply not equipped to process all sensory information registered by the sensory organs, and pre-attentive selection ensures that only relevant information is forwarded to working memory for semantic analysis. The late selection theory proposed by Deutsch and Deutsch (1963) suggests that information is selected at a higher stage and that there is no limited capacity when processing sensory information. According to this theory, all incoming sensory information is evaluated for its semantic properties by the response system (e.g. working memory).

Working memory (WM) is a cognitive system that is involved in the conscious retrieval, temporary storage and manipulation of information. Where sensory memory is considered to be outside cognitive control, working memory content may be consciously manipulated in accordance with specific tasks and goals (Baddeley, 2007). Working memory is a key part of attentional processing in translation and interpreting, and we shall return to working memory and attention in Section 15.2.2.2.

Long-term memory (LTM) is a permanent storage system, which can retain seemingly unlimited amounts of information for years (Anderson, 2000, p. 205). In terms of the relationship between attention and LTM, Baddeley (1999, p. 294) points out that: “nothing is likely to get into long-term memory unless you attend to it”. LTM is often said to consist of two types of memory: procedural memory and declarative memory (Eysenck & Keane, 2020). Procedural memory (also known as implicit memory) retains knowledge of how to perform automatically specific tasks, for instance walking, reading, typing, etc. Declarative memory (also known as explicit memory) contains factual knowledge and memory of previous experiences. The procedural and declarative memory systems are closely connected, and as in other cognitive information processing tasks, both memories are involved in the translation process (Alves, 2005). Procedural knowledge involves the “ability to carry out the transfer process from the comprehension of the source text to the re-expression of the target text, taking into account the purpose of the translation and the characteristics of the target text readers” (PACTE, 2005, p. 58). Thus, procedural knowledge involves knowledge of how to carry out translation as well as the specific task-dependent sub-competences associated with translation. During the translation process, declarative knowledge is activated when the translator identifies possible meanings of lexical units during language comprehension and evaluates potential target-language equivalents during language reformulation.
15.2.2.2 Working memory and attention in translation and interpreting

As noted earlier, working memory is a cognitive system involved in the retrieval, temporary storage and manipulation of information to perform complex tasks (Baddeley, 2007, p. 1). Working memory theory has been used in translation process research (e.g. Dragsted, 2004; Englund Dimitrova, 2005; Hvelplund, 2011, 2016; Kosma, 2007) and in interpreting research (e.g. Darò & Fabbro, 1994; Jin, 2010; Köpke & Signorelli, 2012; Mizuno, 2005; Padilla et al., 1999; Padilla et al., 2005; Timarová et al., 2015) as a framework to evaluate attention and the underlying cognitive processes associated with translation and interpreting activity.

A central aspect of working memory is capacity. Working memory capacity is limited in terms of storage and information decay: working memory can only retain a small amount of information, and that information will disappear from working memory within seconds. Early working memory span tests demonstrated that between five and nine memory items can be held in working memory (Miller, 1956, p. 81), and information can only be held in working memory for a short while (Peterson & Peterson, 1959, p. 193), such that 50% of items can be recalled after 3 seconds and only 5% after 18 seconds. Working memory storage and processing capacity have not been studied in isolation in translation process research; however, there is indication from TAP studies and keylogging research that professional translators tend to work on larger translation units than non-professionals (e.g. Dragsted, 2004; Lörscher, 1991). In interpreting, the overall indication from empirical studies is that interpreters’ basic storage capacity is not different from those of interpreting students and non-interpreters (Timarová et al., 2014, p. 140). However, in terms of processing capacity, there is indication that interpreters outperform the latter two groups in so-called free recall tasks with articulatory suppression (Köpke & Signorelli, 2012, p. 183). In this type of test, the participant is asked to remember and recall items after a few moments while speaking at the same time. This observation indicates that interpreters are better able to focus attention while inhibiting irrelevant information than non-interpreters are.

Attention and working memory are closely connected (Fougnie, 2009), and according to Deutsch and Deutsch’s (1963) late selection theory, working memory is, to some extent, involved in focusing attentional resources on a specific task or object. In their multi-component model introduced earlier, Baddeley & Hitch (1974) outline three key components of working memory: the central executive and two slave-systems, the phonological loop and the visuospatial sketchpad. The central executive is responsible for directing attentional resources to the phonological loop and the visuospatial sketchpad (Baddeley, 2007, p. 7). These two slave-components temporarily store and process aural information (i.e. sound) and visual and spatial information, respectively. A third slave-system was suggested by Baddeley (2000, p. 421), the episodic buffer, which is responsible for the integration of sensory information held in the phonological and visuospatial components with information from LTM to create “a form of temporary representation” (ibid.).

In translation and interpreting, working memory is responsible for efficiently directing attention to tasks such as language comprehension and language production, and sub-tasks such as reading and writing (Hvelplund, 2011). Taking a closer look at working memory from a translation- and interpreting-oriented perspective, the visuospatial sketchpad plays a central role in text-based translation due to the mainly visual input of this modality (ibid.), while the phonological loop is critical to the activity of interpreting, which involves the processing of aural information (Timarová, 2012). This means that translation skills and interpreting skills are not necessarily transferrable, since the modalities tap into different working memory components. It should be noted that the visuospatial sketchpad is likely to play some role in interpreting, since the interpreting situation most often involves visual attention to the speakers and possibly also to the interpreter’s notes.
An efficient translation and interpreting process is related to the central executive’s ability to process attentional input in the slave-systems and integrate that information with information from LTM in temporary episodes in the episodic buffer—quickly and with few attentional and cognitive resources. According to Baddeley (2007, p. 124), there are four executive processes that are governed by the central executive: the ability to focus attention (attentional focus), the ability to divide attention between concurrent tasks (attentional division), the ability to switch attention between tasks (attentional switching), and the ability to integrate information from working memory and from LTM (memory integration). The three attention processes outlined here are discussed in the following in relation to translation and interpreting.

15.2.2.3 Attentional focus

Attentional focus is the ability to maintain cognitive resources directed to one specific task for as long or as short a time as necessary to complete the task. During attentional focus, task-irrelevant and potentially interfering information is inhibited or ignored. This ability to keep attention focused is related to expertise (Baddeley, 2007, p. 124), and activity exposure is likely to improve the ability to focus attention.

During translation, source-text interpretation, target-language reformulation and related tasks such as dictionary consultation and using parallel texts compete for attentional resources: the translator has to sustain attention to the source text for as long as it takes to arrive at a plausible meaning hypothesis (see Gile, 1995). Similarly, attention to target-language reformulation must be sustained for as long as it takes to formulate a qualified rendition of that meaning hypothesis in the target language (Hvelplund, 2011, p. 45). During comprehension and reformulation, attention may be directed to relevant aids that are necessary to either comprehend source text or produce target text. Premature attentional disengagement from these activities may result in translation error. While it is the privilege of the translator to decide how much time is spent on the individual translation sub-tasks, the interpreter has to follow the pace of the speakers and arrive at a plausible meaning hypothesis during or shortly after the speaker’s utterance. In simultaneous interpreting, this urgency is even more acute, and the interpreter has to focus attention on source-language comprehension and target-language reformulation optimally by focusing only on the relevant task and ignoring irrelevant information. In addition, a source-language item is presented only once during simultaneous interpreting, and therefore the load on working memory is likely to be high, since the aural content held in the phonological loops needs to be refreshed and this item must be recreated in the target language in a short time. In fact, without this urgency, source-text items held in the interpreter’s working memory would probably disappear within seconds (see Mizuno, 2005 for an elaborate model of simultaneous interpreting and working memory).

15.2.2.4 Attentional division

Attentional division refers to the ability to attend to multiple tasks more or less simultaneously (Baddeley, 2007, p. 133). Divided attention is involved in many activities that require the mind to attend to two or more different stimuli at the same time. In a learning environment, the student needs to attend to the teacher’s lecture while writing down notes, and when driving, the driver has to attend to other traffic while operating the car. Attentional division is possible, as “tasks could [...] be run using highly practised existing schemata” (Baddeley, 2007, p. 124). In other words, some tasks are automated and rely on habitual processing (ibid.), while controlled processing occurs when habitual processing is insufficient or unavailable. In accordance with this framework, experience has an impact on a person’s ability to divide attention to multiple stimuli, and successful attentional division is the result of activity exposure, by which a certain level of automaticity has been achieved for one or more tasks.
In translation and interpreting, attention is divided between multiple tasks more or less simultaneously. The translator allocates attention to source-text reading while at the same time writing the target text, and the (simultaneous) interpreter splits attention between source and target languages when listening to the speaker’s output and verbally producing a translation at the same time. In translation process research, manifestation of parallel attention has been described in a number of studies. In a comparison of experienced professional translators and less experienced non-professional translators, Hvelplund (2011, p. 129) observed that the former group were engaged in parallel source-text reading and target-text writing during 12.1% of the task. The corresponding rate for the student group was 7.3%. This finding points to two conclusions: 1) split attention to simultaneous tasks occurs in translation and 2) the ability to divide attention to multiple tasks is a function of experience. This kind of manifested split attention in translation is possible because one activity occurs automatically: “the activity of typing can become partly automatised […] and will not demand many attentional or cognitive resources” and “[reading] […] is an inherently automated activity. Automatic identification of meaning occurs as soon as words enter visual focus, and this process can be interrupted only when looking away from the words” (Hvelplund, 2016, p. 152). A later study revealed that cognitive effort is higher when the translator attends to the source text and the target text at the same time: fixations are significantly longer during simultaneous reading and writing, and pupils are significantly larger (Hvelplund, 2017a). This means that, although one process runs automatically, the load on working memory is higher compared with translation activity where only one task is attended to.

15.2.2.5 Attentional switching

Attentional switching concerns the activity of intentionally reallocating working memory capacity from one task to another. Switching of attention between tasks is not cost free: cognitive effort increases during attentional switching tasks, as indicated by slowing of performance, and this slow-down effect is associated with task complexity and expertise, such that attention switching costs are higher during difficult tasks and higher for less experienced individuals (Baddeley, 2007, p. 130ff).

Translation is an activity that consists of at least two tasks: source-text comprehension and target-text reformulation, and often also auxiliary tasks such as dictionary consultation and parallel text consultation, as noted earlier. It could be argued that there are two kinds of attention switching between source text and target text: switching where attention shifts overtly (see Posner, 1980)—the eyes move from source text to target text and vice versa—and that where attention shifts covertly—e.g. the eyes fixate on source-text content, but the translator is in fact considering target-text rendition. While overt attention shifting between source text and target text occurs every 0.8 seconds on average (Hvelplund, 2011, p. 143), covert attention shifts are probably more frequent. Research has demonstrated that lexical access of the target language occurs automatically during source-text reading (Balling et al., 2014; Ruiz et al., 2008; Schaeffer et al., 2015) and thus not only when the translator looks at the target text. A pertinent question is whether it makes sense at all to distinguish between source-text processing and target-text processing as separate categories of attentional focus, or whether attention is directed only to one ongoing activity, namely mapping of target-text content based on a source-text template. The role of working memory and the attention switching mechanisms associated with translation processing is still unclear, and future research may examine this relationship more closely. There is some indication that overt attentional switching may incur some cognitive cost during translation, as indicated by fixation count increase (Jakobsen & Jensen, 2008, p. 120) and larger pupils (Hvelplund, 2011, p. 192). In translation process research, attentional switching and switching costs have not been the object of systematic investigation, and in interpreting research, where
covert attentional switching is likely to occur frequently throughout the interpreting task, there
is no research so far concerned with this aspect of attention.

15.2.2.6 Distribution and coordination of attention in translation

Distribution of attention during translation has been examined with eye-tracking data (e.g.
Sharmin et al., 2008) and eye-tracking data in combination with keylogged data (e.g. Hvelplund,
2011; Jensen, 2011). Sharmin et al. (2008) were interested in differences between source-text and
target-text reading during translation, and they observed significantly larger fixations during target-
text reading. Hvelplund (2011) similarly observed different pupil sizes, as pupils were significantly
larger for target-text fixations than for those on the source text. The higher complexity of target-
text processing is proposed as an explanation for this difference, as it involves integration of source-
text and target-text information (see Baddeley’s memory integration construct presented earlier) as
well as concurrent typing. Concerning the amount of visual attention during translation, Jakobsen
and Jensen (2008, p. 114) noticed that professional translators looked at the target text nearly twice
as much as they looked at the source text. In addition, in a study of 24 translators (12 professionals
and 12 students), data from Jensen (2011, p. 223) show that around 71% of the professionals’ gaze
time and 63% of the students’ gaze time were allocated to the target-text area of the screen. The
remainder (29% and 37%, respectively) was allocated to the source text (with and without concur-
rent typing). The same distribution pattern emerges irrespective of translation direction (Pavlović
& Jensen, 2009): source-text / target-text processing in L1 translation, 36% / 64%, respectively, and in
L2 translation, 31.5% / 68.5%, respectively. Going beyond the binary division of the translation task
into source text and target text processing, dubbing translation has been examined as an example
of a translation with multiple areas of attention (Hvelplund, 2017b): the source-text area attracted
26% of visual attention, the target text 47.5%, the film area 21.6% and the dictionary area 4.9%.

Concerning the coordination of attention to both source and target texts, Dragsted and
Hansen (2008) propose the eye-key span to measure the time lag from first or last fixation on
a source-text word to the first typing event associated with the translation of that source-text
word. Dragsted and Hansen examined the eye-key span in 16 MA translation and interpreting
students and detected eye-key spans (from last fixation) ranging from 0.5 seconds to 32 seconds.
The authors draw a comparison with the ear-voice span in simultaneous interpreting (ibid.,
p. 14) and point out that the ear-voice span of 2–3 seconds indicates “closer integration of the
comprehension and the production phase, and thus a more condensed coordination effort of
shorter duration” (ibid.).

15.2.2.7 Attention units

Originating in psychology (Newell & Simon, 1972, p. 313), the concept of attention unit has been
the object of interest in translation process research at least since the 1990s (e.g. Bernardini, 2001;
Jääskeläinen, 1990, 1996). The attention unit may be considered the manifestation of attention to
a specific item or object. In think-aloud studies, an attention unit has been defined as the marked
processing during translation:

Those instances in the translation process in which the translator’s “unmarked processing” is
interrupted by shifting the focus of attention onto particular task-relevant aspects.


Concerning eye-tracking and keylogged data, Hvelplund (2017a, p. 251) defines an attention unit
as “a unit of uninterrupted source and/or target text attention indicated by successive fixations,
saccades and typing events”, and the variation in attention unit duration can be used as an indicator
of cognitive management (Hvelplund, 2011). Carl and Schaeffer’s (2017) *activity unit* similarly uses eye-tracking and keylogged data to record the focus of the translator’s attention into units. The duration of attention units varies according to the research methodology used. In translation process research using eye tracking, attention units have an overall average duration of around 0.8 seconds: more specifically, source-text (reading) attention units are 846 milliseconds, target-text (reading or writing) attention units are 1141 milliseconds, and parallel source-text (reading)/target (writing) units are 429 milliseconds (Hvelplund, 2011, p. 143). In addition to variation according to activity, attention unit duration is also sensitive to expertise and time pressure.

15.2.2.8 Attention and cognitive efficiency

Attention and working memory are important for efficient cognitive performance. The ability to process selectively relevant sensory information and to retain information relevant to a specific task is central to efficient task performance (Fougnie, 2009). In translation process research, the term *cognitive efficiency* has been used to describe this ability to focus attentional resources and to select, implement and manipulate relevant information (Hvelplund, 2016). Cognitive efficiency is suggested to be a composition of *cognitive flexibility* and *cognitive automaticity*, cognitive constructs which are both thought to be controlled by working memory and the attentional processes governed by the central executive. Cognitive flexibility is important for the efficient interpreting and translating process: “the efficiency of the interpreting process rests, in part, on the interpreter’s ability to flexibly focus attention on, switch attention to and divide attention between those efforts”¹ (Hvelplund, 2016, p. 153) and “the translator’s ability to adjust allocation of [attentional] resources codetermines overall processing efficiency” (ibid.). Eye-tracking data indicate that experienced translators are better than less experienced translators at allocating attention to relevant parts of the translation process: attention shifting between source and target texts is performed more efficiently by the former group. While that study does not concern the oral modality, a similar outcome might be hypothesized for interpreting, as interpreters—even more acutely—are compelled to perform cognitively in an efficient way due to the temporal confines of the interpreting situation. Within the context of cognitive efficiency, cognitive automaticity is the execution of a task with little attention and few cognitive resources allocated to its completion (Anderson, 2000, p. 98). Automated task execution requiring little or no attention and cognitive processing has been considered a correlate of expertise in translation (Dragsted, 2004; Hvelplund, 2016; Jääskeläinen & Tirkkonen-Condit, 1991) as well as in interpreting (Lambert, 2004).

15.3 Looking ahead: Translation Studies, attention and beyond

In the years to come, we are likely to see an increasing number of studies that embrace other technologies to collect data about the translator’s and interpreter’s focus of attention. MRI (magnetic resonance imaging) is one promising technology, which has already received some attention in translation research (Chang, 2009) and interpreting research (e.g. Ahrens et al., 2010; Hervais-Adelman et al., 2015; Hervais-Adelman et al., 2017). Using functional MRI, measurements of changes in blood flows in the brain may be helpful to determine the object of overt as well as covert attention during translation and interpreting. Studies using this imaging technique may help us to better understand the relationship between a) attention and executive control in translating and interpreting and b) those areas of the brain that are typically associated with attention, such as the prefrontal cortex. Other methods that might also be helpful to the exploration of attention as a key cognitive mechanism in translation and interpreting include electroencephalography (EEG), electrodermal activity (EDA) and heart rate monitoring.
Unlike the methods of eye tracking and keylogging, discussed in the sections above, the behavioural and psycho-physiological methods outlined here are far more intrusive, and this intrusiveness may impact the reliability of the process data, as it is very likely that the observing process will attract some attention away from the translation and interpreting process. A method yet to be introduced in translation process research is mouse tracking, which is used to collect information about the mouse cursor position on the computer monitor. Mouse tracking is an inexpensive and non-intrusive tracking alternative compared with eye tracking and MRI. It is substantially less intrusive compared with other methods that would require the participant to lie still in an MRI scanner, work in front of an eye tracker or produce text with a heart rate monitor attached. Mouse tracking is a popular research method in usability testing and web designing. In translation research specifically, mouse tracking could be used to enrich keylogged data and eye-tracking data, and thus provide an even better resolution in terms of the location of the translator’s attention, without compromising the reliability of the recorded data as a reflection of the translator’s focus of attention.

Note
1 Gile’s four ‘Efforts’ include listening and analysis, memory, production, and coordination (Gile, 1995, p. 186).

Further reading


Eysenck, M. W., & Keane, M. T. (2020). Cognitive psychology: A student’s handbook (8th ed.). New York: Psychology Press. A thoroughly researched and easily accessible handbook in cognitive psychology. With its strong focus on human cognition, the handbook is a highly useful companion that outlines the fundamentals of cognitive psychology as well as recent developments within the field.


References


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