Trabajo Final de Máster

Your attention, please

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Resumen:

Este Trabajo de Fin de Máster presenta el estado de la cuestión en la investigación cognitiva del proceso de traducción e interpretación relativa a memoria y atención. Muchas investigaciones están aún bajo el influjo del paradigma del procesamiento de la información que, desde los años 50, ha contemplado la mente como un programa informático compacto y aislado que gestiona datos almacenados y los combina con información que obtiene por medio de los sentidos. Los enfoques cognitivos tradicionales en traducción e interpretación—y, en consecuencia, la investigación sobre los procesos cognitivos— se ha apoyado mucho en la memoria, pues su concepción metafórica como un enorme almacén de datos se ajusta perfectamente al modelo computacional. Este Trabajo de Fin de Máster esboza algunas objeciones al paradigma computacional y propone un cambio de enfoque que confiere mayor importancia a los mecanismos de atención al traducir o interpretar. Para ello, se resumen y comparan estudios que han abordado la memoria y los mecanismos de atención, tanto en monolingües como (después) en bilingües. Finalmente, se ofrece un panorama de los enfoques cognitivos sobre la memoria y la atención en traducción e interpretación.

Palabras clave: **atención, memoria, cognición, traducción e interpretación**

Abstract:

The aim of this MA final paper is to provide a summary of the state of the art of research within cognitive approaches to the translation and interpreting processes that focus on memory and attention. Many current approaches to translation and interpreting still adopt the Information-Processing Paradigm that, since the 1950s, portrays the mind as an isolated and compact software package to manipulate stored data and to combine them with new information collected through the senses. Traditional cognitive approaches to Translation and Interpreting (and therefore also the Cognitive Research of such tasks) have mainly hinged upon memory, because it is metaphorically conceived of as a massive data store and such view perfectly suits the computational model. This paper sketches some challenges and objections to the IPP model and suggests a switch of focus in order to underscore the role of attentional mechanisms in translation and interpreting. To do so, research carried out on memory and attention is reviewed and compared, both in monolinguals and in bilinguals. Finally, an overview is offered of the cognitive approaches on memory and attention in translation and interpreting.

Keywords: **attention, memory, cognition, translation and interpreting**

Index

Motivation for this paper....6
A memory reminder....7
2.1 The fractionation of memory....9
2.2 Memory models....11
2.2.1 Atkinson & Shiffrin....11
2.2.2 Working memory: memory at work....12
2.2.3 Alternative models of working memory....15
Your attention, please....17
3.1 Attention as an object of study....19
3.2 Contemporary research: when attention was paid to attention....21
3.2.1 Selective attention: a bottleneck perspective....21
3.2.2 Kahneman's Capacity model of attention....27
3.2.3 Feature integration theory....29
3.2.4 Neuropsychological and neuroscientific approaches to attention....30
Attention to Translation and Interpreting....34
4.1 Cognitive control and attention in bilingualism....34
4.2. A special kind of bilingual....35
4.3. Mind your head, people translating!....36
4.3.1. Simultaneous interpreting....38
4.3.2 Translation....41
Final remarks: peeking inside the translating mind....42
References....44

List of Figures

Fig. 1. The different types of memory 10

Fig. 2. Atkinson & Shiffrin's multi-store model...11

Fig. 3. Baddeley's revised model of working memory (2003) 13

Fig. 4. James' structure of passive attention 20

Fig. 5. James' structure of active attention 20

Fig. 6. A visual representation of Broadbent's filter theory 22

Fig. 7. A visual representation of Deutsch & Deutsch theory 25

Fig. 8. A visual representation of Kahneman's capacity model (1973)......29

Motivation for this paper

The purpose of this study is to review the state of the art of an area of research in cognitive and experimental psychology and in Translation Studies, in order to lay the foundations for a future PhD research project where the roles of attentional mechanisms in translation and interpreting processes will be screened. The rationale behind this text is that, in order to properly analyze what happens in the mental translation process, it is first crucial to understand their nature. Cognitive Translation Studies have so far been highly influenced by the information-processing paradigm. However, there is a developing research paradigm in translation studies, cognitive translatology (Muñoz, 2010a,b), that suggests an embodied, embedded, extended, enactive and affective approach to the mind (4EA cognition; see, e.g., Wheeler, 2005), where the mind is not (only) seen as a software storing and manipulating information any longer. Among the cognitive processes we should understand, memory—as a storage and data-manipulating mechanism easily comparable with a computer device—has seemed to be the most suitable mental ability for the information-processing approach. Nevertheless, empirical evidence has challenged the view of the brain/mind as a hardware/software and researchers have been forced to reformulate the model and design a growing number of types of memory to adequate to the new findings, which, in some cases, have also underlined that the distinction between memory and attention might not be always clear (e.g., Engle et al., 1999; Lebedev et al., 2004). As a consequence, while it is undeniable that memory plays very important roles in cognitive activities, the present study proposes a switch of focus to attentional mechanisms, for they entail goals, priorities and monitoring, and are therefore much more sensitive to personal and environmental changes over short periods of time (Muñoz, personal communication). This is by no means an attempt to jump into the pool of cognitive architecture, but rather an attempt to contribute to a paradigm shift to enlarge and improve research approaches within Cognitive Translation Studies. To do so, research on memory models is reviewed, including their suitability to the growing questioning evidences. Then, a brief summary of research on attention from the 19th century to current studies with neuroimaging is provided. Finally, different research approaches on attention within psychology that used translation and interpreting tasks to understand the mind are summarized, and also translation and interpreting research efforts focusing on attentional mechanisms to explain translation and interpreting processes.

A memory reminder

Providing an accurate definition of memory is a tall task, but memory is no doubt a vital cognitive ability that determines decisions, social behavior and even dreams. We use memory to time-travel and link past experiences and events to keep a coherent narrative of our selves and prepare for immediate events related to the past (Schachter, Addis & Buckner, 2007; Suddendorf & Corballis, 2007). On popular belief, memory is usually considered as a single storage device, a Stasi headquarters-like mechanism inside our brain where we can save information from our daily life experiences and pick it up whenever we need it again. Maybe—all credit to the information-processing paradigm—the most popular analogies of memory depict it as our computer's data storage or our smartphone memory card, which allow us to easily manipulate a huge amount of stored data. However, what we call *memory* does not seem to be simply a massive database collecting information and storing it in particular shelves. Rather, it appears to involve several processes: we can remember how to play chess, how the dishwasher works, and how to socialize when we meet new people. Furthermore, we may also remember that Joyce's *Ulysses* was first published entirely in 1922, that Brunei's capital city is Bandar-Seri-Begawan, or that Pythagoras' theorem proves that the square of the hypotenuse is equal to the sum of the squares of the other two sides. Nevertheless, we may fail to remember the letter of the parking spot where we parked the car at the mall, our old e-mail's password or the arcane place where we left the keys this morning. On the issue of memory and forgetfulness, James (1890:643) remarked that:

> The stream of thought flows on; but most of its segments fall into the bottomless abyss of oblivion. Of some, no memory survives the instant of their passage. Of others, it is confined to a few moments, hours, or days. Others, again, leave vestiges which are indestructible, and by means of which they may be recalled as long as life endures.

The complex heterogeneity of memory processes has a history of raising headaches to philosophers and psychologists alike. Dudai (1997) names Aristotle, Thomas Aquinas, St. Augustine and Helvetius as some of the pre-contemporary theoreticians who attempted to tackle the issue of memory. He also marks the beginning of the modern era in the experimental approach to human memory capacity at the introspection experiments carried out by the British anthropologist Francis Galton (1879, 1907). In the mid-20th century, the first cognitive revolution set the grounds to the convergence of different disciplines that crossed their paths to provide new approaches to the topic, and this certainly enlarged the concept of memory.

In the 1980s and 1990s, cognitive and developmental psychology developed the notion that remembering was a constructive process, instead of mere retrieval. This diverted from the connectionist computational model inherited from the first cognitive revolution, which portrayed memory as an unaltered information manager. Markowitsch (2000:781) notes that "memorizing information usually is an active and complex process that may include attentive and emotional factors that depends on the constellations and availability of essential and supporting variables". Context and emotions may affect what and how we remember, so the same stimulus will not be processed twice in (exactly) the same way. The evidence, mainly from neurobiology or psychiatry, provided the anatomical bases of the workings of memory, suggesting that "contrary to some traditional views, there is little doubt that memory is represented in many widely distributed areas of the brain" (Markowitsch, 2000:781). Memory systems are often classified according to three functions: encoding, storage, and retrieval.

On the other hand, researchers working within distributed and extended cognition frameworks have also studied memory. In their view, memory can also be "externalized": our agenda "remembers" telephone numbers and e-mails for us, and the calendar "organizes" our social and professional life. We also use photos or videos to remind ourselves of special moments of our existence. J.K. Rowling provides a brilliant phantasy of this externalization in her Harry Potter's saga: in his office, Professor Albus Dumbledore has a *Pensieve,* a stone basin that can store clear and vivid memories to relieve the mind and review them later. This externalization has its consequences too. Donald (1991:10) argues that offloading memory in cognitive technologies has "direct effects upon individual cognition". Andy Clark (1997:180) goes beyond and states: "our brains make the world smart so that we can be dumb in peace."

2.1 The fractionation of memory

PrimarySecondarySensoryIconicSensoryEchoicSensoryhapticShorttermUltrashort WorkingLongtermDeclarativeorExplicitEpisodicPropositionalAutobiographicalSemanticRecollectiveLongtermWorkingNondeclarativeorImplicitPerceptualPriming

As pointed out above, popular belief usually conceives of memory as a single mechanism that allows storing and remembering. However, memory processes have turned out to be heterogeneous; hence, many researchers split memory in their attempt to cover all processes. One of the first fragmentations is credited to William James (1890) in his *Principles of Psychology*. James broke up memory into ‘primary’, which holds thoughts for a short time, and ‘secondary’, a permanent and unconscious store. Baddeley (2003:189-190) points out that Hebb (1949) suggested the distinction between ‘long-term’ and ‘short-term memory’ in his classic book *The Organization of Behavior*. Hebb binds long-term memory with durable changes in the nervous system, and short-term memory with temporary electrical activity. Brown (1958) and Peterson & Peterson’s (1959) tests on the rapid loss of data when no repetition of the information was made supported the existence of a short-term memory system in contrast with a long-term store. Also, studies on memory deficits in neuropsychological patients with brain lesions provided evidence to support the dual system of memory. Patients with damage to the temporal lobes and hippocampi seemed to suffer impairments in learning and remembering new information (Milner, 1966). However, their ability to repeat an unfamiliar sequence of numbers was not affected. In contrast, Shallice & Warrington (1970) tested patients with damage to the perisylvian region of the left hemisphere who were not able to remember more than two numbers and found that their long-term memory seemed to work properly. These results appeared to settle the idea that, regarding memory, the brain was divided into two areas responsible for long-term memory and short-term memory systems.

Short-term and long-term memory systems were also fractioned into separate components. Short-term memory was divided on the basis of how long the data stays in the system. On the contrary, long-term memory was divided according to the kind of stored information and the neuronal mechanisms involved. These two resulting categories are the ‘declarative’ or ‘explicit’ memory and the ‘non-declarative’ or 'implicit' memory. Anatomical evidence through PET and fMRI studies were used to support this division, for it seems that implicit memory systems are related to diverse brain areas*,* whereas explicit memory appears to depend on the Papez circuit, which involves the hippocampus and the temporal and frontal lobes (Markowitsch, 2000).

Implicit or procedural memory is associated with learning new motor and cognitive skills. It is divided into 'procedural' memory to various skills (perceptual, motor, cognitive), and 'priming', or the ability to re-identify previously perceived stimuli. However, Willingham & Preuss (1995) and Roediger (2003) view implicit memory as a range of heterogeneous phenomena, and prefer to think of it as a label for a set of memory tasks, rather than a distinct memory system. As regards explicit memory, Tulving (1972) proposed a division for explicit memory into two separate systems: 'episodic' and 'semantic'. Episodic memory—also known as 'event' or 'autobiographical' memory—involves our capacity to identify and reconstruct specific events from the past. On the other hand, semantic memory (the knowledge system) refers to our epistemic knowledge: the acquired notions of context-free facts.

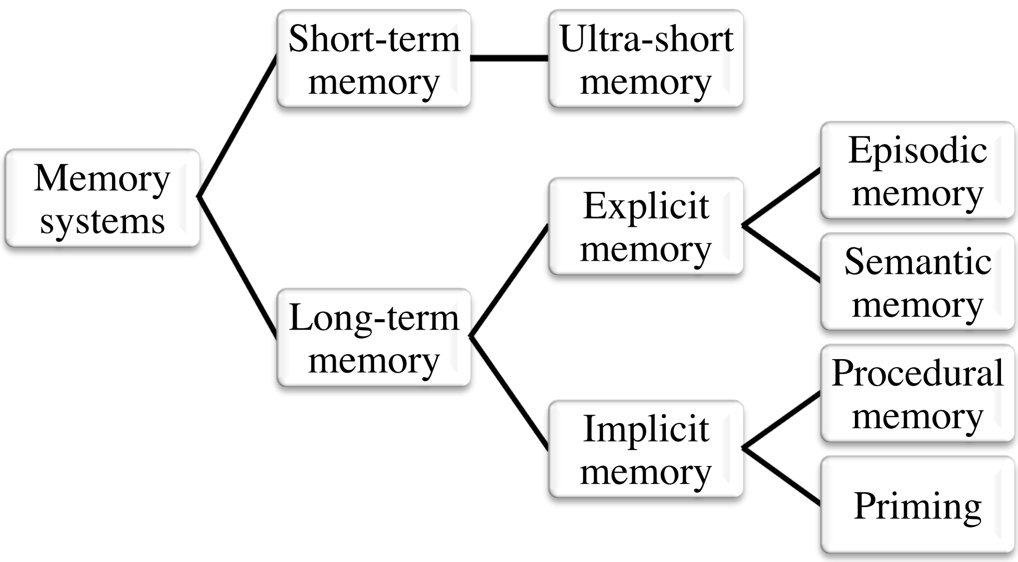

Fig. 1. The different types of memory

2.2 Memory models

2.2.1 Atkinson & Shiffrin

With the above evidences leading to a memory system divided into short-term and long-term subsystems, Atkinson and Shiffrin developed their multi-store or modal model in 1968, which additionally included a sensory register as well as control processes regulating the transit of information from one subsystem to the other. Thus, this model divides memory into three basic components: a sensory register, a short-term store, and a long-term store.

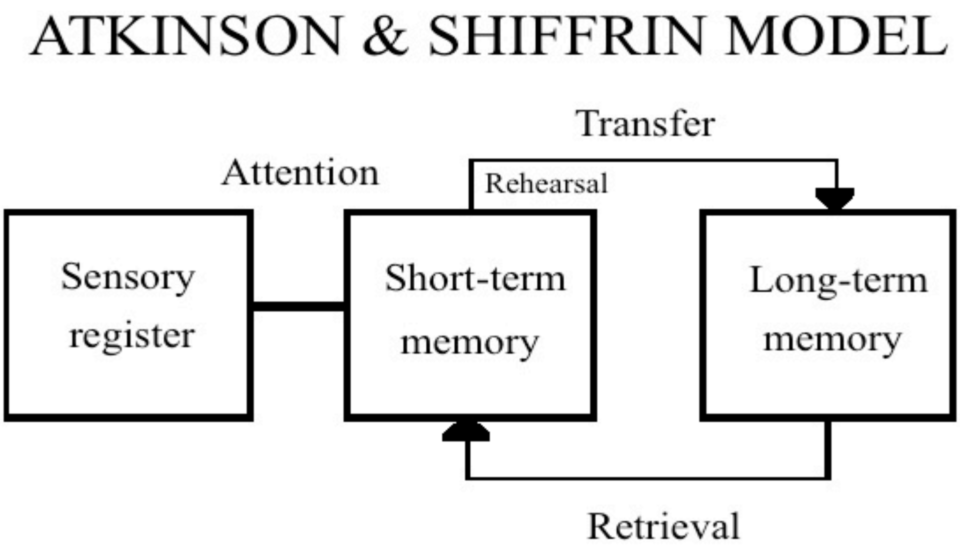

Fig. 2. Atkinson & Shiffrin's multi-store model

As portrayed in the image above, the sensory register system is responsible for detecting and briefly holding environmental stimuli without processing their information, which is transferred to the short-term memory only when attention is paid to it. Sensory memory is actually a composition of various registers or types of memory assigned to each sense, e.g. iconic memory for sight, echoic memory for hearing or haptic memory for touch. According to Atkinson and Shiffrin, information has an approximate duration in short-term memory of 18–20 seconds when it is not *refreshed*. However, when the information is rehearsed, its sojourn on the short-term memory can be enlarged, allowing it to be eventually stored in the long-term memory. This latter system is considered an almost infinite warehouse, only limited by deterioration. It stores information permanently and transfers it back to the short-term memory so it can be attended to and manipulated.

Nevertheless, this model came under close scrutiny and received a lot of criticism. For instance, Baddeley (1977) questioned the so-called *learning assumption,* since evidence suggested that the presence of an item in the short-term memory did not guarantee learning (1977). Therefore, researchers turned their focus onto how the information was processed. Craik & Lockhart (1972), explaining their *levels-of-processing framework,* suggested that the probability of subsequent recall or recognition depended on the depth to which an item was processed. Thus, according to their view, some examples of these levels of processing are visual characteristics of a word, the rhyme with a specified target word, and the semantic relationship with a specified sentence or the subject's own experience (1972). The second major problem concerned the assumption that short-term memory was vital for long-term memory and other cognitive activities. This was based on data from anatomical studies, but patients with short-term memory impairment appeared to have normal long-term memory and most of them had very few everyday cognitive problems (1972). In 1974, Baddeley & Hitch carried out a series of experiments in an attempt to provide an explanation to the relationship between short-term and long-term memory. In these experiments, subjects with no brain damage were required to repeat digit sequences while performing other cognitive tasks that are supposed to depend upon short-term memory. Although performance decrements occurred—which suggested that short-term memory and long-term memory actually did interact— the effect was far from conclusive. Therefore, Baddeley & Hitch proposed an alternative and more complex system to short-term memory called "working memory".

2.2.2 Working memory: memory at work

Although Baddeley & Hitch have the credit for the popularization of the term, the fact is that other researchers had already used the term *working memory*. As Baddeley himself notes (2002), Miller, Galanter & Pribram (1960) coined the term in their classic book *Plans and the Structure of Behavior*. A decade later, Newell & Simon (1972) applied it to animal learning studies. In 1974, Baddeley & Hitch recycled the term to refer to a multicomponent and functional system reviewing Atkinson & Shiffrin's unitary concept of short-term storage system. From then on, their model has been the research topic of many cognitive psychology and cognitive neuroscience investigations (Conway et al., 2008:7).

Regarding the nature of working memory, Baddeley states that "within cognitive psychology, the term has been adopted to cover the system or systems involved in the temporary maintenance and manipulation of information" (2002:3). Basically, what Baddeley & Hitch initially proposed was a division of the unitary short-term memory into three separable components. These components work together as a unified system involving the temporary storage and manipulation of information necessary to perform a wide range of cognitive tasks (Baddeley, 2003). These components are a central executive, which is a limited capacity controller of attention, aided by two subsystems: the phonological loop and the visuospatial sketchpad. However, the need to integrate information from the subsidiary systems, and from long-term memory allowing active maintenance and manipulation of data led the authors to propose an additional component, i.e., the episodic buffer (Baddeley, 2000). Let's have a quick review of the working memory components:

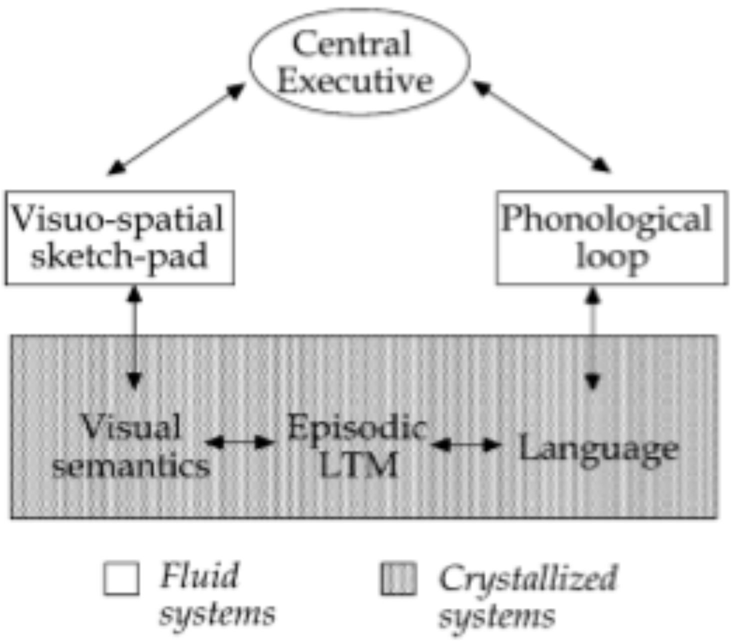

Fig. 3. Baddeley's revised model of working memory (2003:196)

The phonological loop

This system is assumed to comprise two subcomponents: the phonological store and an articulatory rehearsal system. The phonological store acts as an 'inner ear', remembering speech sounds in their temporal order, whilst the articulatory process acts as an 'inner voice' and repeats the series of words (or other speech elements) on a loop to prevent them from decaying.

The visuospatial sketchpad

This system is responsible for the temporary maintenance and manipulation of visual and spatial information and also has a major role in spatial orientation (Baddeley, 2003). Logie (1995) proposed a subdivision for the visuospatial sketchpad between the visual cache, a visual store for color and form, and the inner scribe, which is responsible for spatial and movement information.

The central executive

The central executive plays a crucial role in the working memory framework as it is supposed to bind dispersed data into coherent events, coordinate the phonological loop and the visuospatial sketchpad, shift between tasks, and select some inputs while inhibiting others. Implicitly, the central executive functioned as a homunculus, a little man who took the important decisions as to how the two slave systems should be used.

The episodic buffer

The initial model of Baddeley and Hitch presented some problems: amnesia patients, who were supposed to posses a reduced ability to encode new information in long-term memory, had an unexpectedly excellent short-term recall (Baddeley & Wilson, 2002). Therefore, Baddeley (2000) included the ‘episodic buffer’, which links information in chronological order to form integrated units of visual, spatial, and verbal information with chronological order.

2.2.3 Alternative models of working memory

Working memory is not a unitary conception. Some researchers have proposed alternative models to Baddeley & Hitch's. For instance, Cowan (1995, 2005) considers working memory as a part of long-term memory and organizes it into two embedded levels: activated long-term memory representations and the focus of attention. On the other hand, Oberhauer (2002) adds a third component to Cowan's model: a narrower focus of attention that holds only one chunk at a time for processing. This means that when various chunks of information are retained and some operation to be performed on each of these chunks, this attentional component does it one by one, shifting immediately to the next until the process is finished.

On the other hand, Ericsson & Kintsch (1995) proposed a long-term working memory model, which is based on the assumption that complex cognitive tasks need to maintain more chunks of information in memory than working memory can sustain. They suggested that, in order to perform these complex cognitive operations we store most of the information in the long-term memory, which links it through retrieval structures. Therefore, only a few concepts are held in working memory, which serve as cues to retrieve everything associated to the information by the retrieval structures. Gobet (2000) categorized these retrieval structures into three kinds: (1) generic retrieval structures, (2) domain knowledge retrieval structures, and (3) the episodic text structures.

Research models presented so far show that memory has enjoyed a prominent role in cognitive approaches to the mind. Perhaps one of the reasons for this is that the current conception of memory might be easily (metaphorically) thought of as computer's data store, in line with the information-processing paradigm. However, as shown above, empirical evidence and neuroimaging data have compelled researchers to develop a large and growing list of subcategories and models to cover all cognitive phenomena supposedly related to memory. What is more, the different models do not seem to share the same tenets on the relationships and interactions of comparable components of each model, and, in some cases, the divide between memory and attention has been quite blurred. Hence, in order to overcome the problems memory pose, this work proposes a shift of paradigm substituting a memory-based model for a study of attention therefore challenging the idea of the brain/mind analogy to hardware/software. As Muñoz states (personal communication), "attention can be subject to changes due to personal and environmental factors over short periods of time, so it is more amenable to study". The next chapter summarizes the historical development of research on attention.

Your attention, please

Attentionalattentiveinattentionattentionattendfocuseddividedexecutivecontrolin
tegrationoffeaturesbottleneckfilter**attention**attenuatorendogenousexogenouspas
siveintellectualsensoryderivedactiveimmediatepreattentivemechanismeffortless

We live in a technological era in which we are constantly bombed with breaking news, social network notifications and invasive advertising blitzes. Against this massive raid of inputs and stimuli, our capacity of attention has become the last barricade before mental collapse. We cannot attend to and process all flashing and smartphone whistles at the same time. Attention must be paid; however, we have a limited attentional budget to spend.

Discussions of attention etiology date back to William James (1890), who assumed that *everybody knows what attention is*. However, there is yet no agreement as to what it is and where it works. Anatomical evidence has shown that attention is neither a physical part of the brain nor is it located in a particular brain area. The old idea of the homunculus —that little man before a panel full of buttons and joysticks deciding what to do with stimuli— has also been discarded, as it cannot answer the question of who's controlling the homunculus brain (this is a dualistic fallacy known as the endless regression of homunculi). Perhaps a quick and basic definition of attention would be the *neglecting of stimuli to allocate limited processing resources to a particular event, thought or action.* To enrich this definition, we may go back to James presupposition (1980: 404-405):

> Everyone knows what attention is. It 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.

We can easily contemplate the workings of attention in everyday situations. The heel of a violinist rhythmically rebounding on the floor like a telegraph while reading the pentagram, the teacher walking from side to side while giving a lecture, or the pen

Your attention, please

dancing with the fingers of a student presenting her thesis. James (1890:458) recalls an anecdote of Sir Walter Scott that represents well this phenomenon:

> […] when a boy, rising to the head of his class by cutting off from the jacket of the usual head-boy a button which the latter was in the habit of twirling in his fingers during the lesson. The button gone, its owner's power of reciting also departed.

Attention is a wonderful ability that allows us to carry out different operations, but it also limits us. We can drive while having a conversation, but we may need to stop chatting when facing a troublesome driving event; we can examine in detail the architectural features of a specific building, but we may fail to see a huge ape back-flipping at the top of the next building. We can also switch attention between different pans and pots when cooking but fail to control them if some unexpected contingency occurs. Actually, the effects of inattention are much more surprising: picture yourself storing the spoon you just used in the garbage bin or driving to the office when going to the park on Sunday. Finally, attention also prepares us to respond and anticipate a target item—a drop of water from a tap dripping regularly— or to note when a stimulus is finished, as for instance an MP sleeping in his seat while the leader of his party is giving a speech. As soon as the stimulus (i.e., the leader's babbling) ceases, the MP wakes up and applauds zealously. To sum up, attention is probably a crucial mechanism or ability to perform cognitive tasks, as it catalyzes the elaborate chains of inferences we use to construct "readings" of the world (Oakley, 2004:3). Inspired by the rhetorical gradation of attention proposed by Parasuraman (1998:3), Oakley (2004:1) suggests:

> When human beings attend and perceive, they remember. When human beings attend, perceive, and remember, they learn. When human beings learn, they can act deliberately and with forethought.

That is why attention remains a major area of research for disciplines such as education, psychology, (cognitive) neuroscience, neuropsychology, and also cognitive translatology.

3.1 Attention as an object of study

The attempts to explain attention can be traced way back to Aristotle's *De Anima,* but it was not until the 19th century that introspection researchers actually made their first steps towards the contemporary empirical study of attention. Wilhelm Wundt measured mental processing speed by likening it to differences in stargazing measurements. His experiments can be considered a crucial step towards the development of the study of attention in psychology. His work inspired other researchers, such as Münsterberg, Donders, and von Helmholtz, to continue the same line of research. However, there seems to be a general agreement to consider the work of William James (1890) the pillar of the study of attention. James was an empiricist who believed that an individual could consciously and moment-by-moment determine what perception or idea would dominate his/her cognition simply by the act of voluntarily choosing to attend to a particular perception or idea. This is recalled in his assumption that attention was "the taking by the mind, in an active and vivid form" (1890:403). According to James, humans have the capability to control their experiences and are not a passive actor *with* the inputs they receive from the environment:

> Millions of items of the outward order are present to my senses which never properly enter into my experience. Why? Because they have no interest for me. My experience is what I agree to attend to.
>
> (James, 1890:402)

James also states that attention can make us: (a) perceive; (b) conceive; (c) distinguish; (d) remember; (e) shorten 'reaction-time.' For James, attention is not as a single system; rather, he suggests several, interrelated kinds of attention: first, he distinguishes between *sensorial* (objects of sense) and *intellectual* attention (ideally represented objects); then he establishes another category of *immediate* (when the topic or stimulus is interesting by itself, without relation to anything else) and *derived* or *apperceptive* (when it owes its interest to an association with some other immediately interesting thing); lastly, he points out that it can also be *passive, reflex, involuntary, effortless* or *active* and *voluntary*.

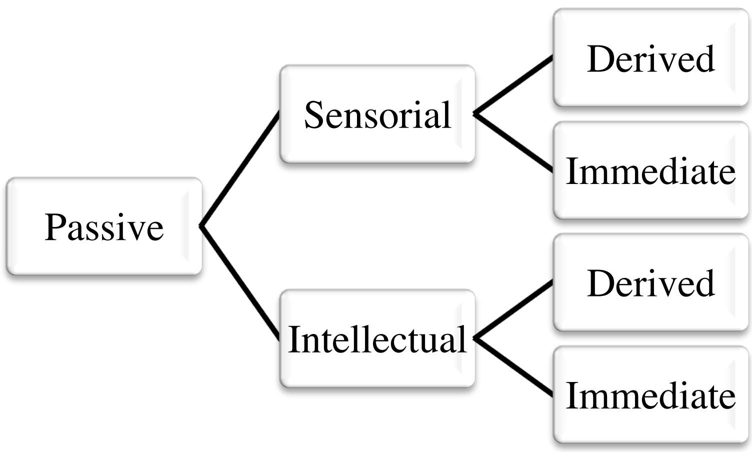

Fig. 4. James' structure of passive attention

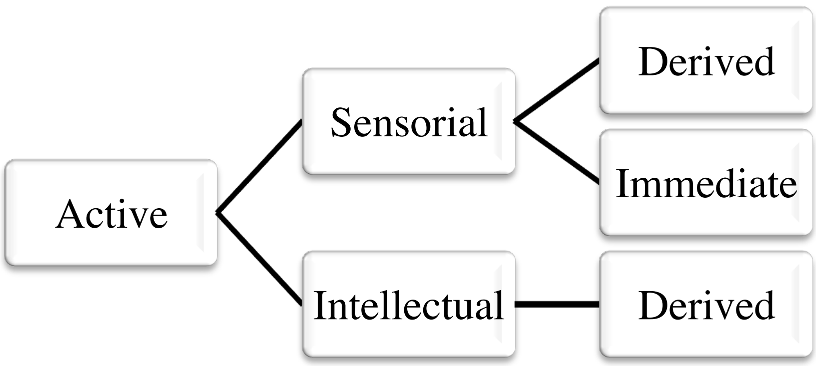

Fig. 5. James' structure of active attention

To explain the relationship between the different kinds of attention, James points out that *voluntary attention is always derived*—i.e., when images are interesting only as means to a remote end, or merely because they are associated with something which makes them dear (1890:418). Both sensorial and intellectual attention may be either passive or voluntary. On the other hand, in passive immediate sensorial attention, the stimulus may be either a sense-impression—very intense, voluminous, or sudden—or an *instinctive* stimulus, i.e., a perception. As for passive sensorial attention, James explains that it is *derived* when the impression—without being either strong or of an instinctively exciting nature—is connected by previous experience and education. Finally, *passive intellectual attention* may be *derived* or *immediate,* when a train of images exciting or interesting *per se* is followed in thought.

Your attention, please

James (1890) also described two "physiological" processes of attention that some scholars consider *avant la lettre,* for they correspond to current views of the research of attention. The "accommodation or adjustment of sensory organs" is similar to Broadbent's selective attention (1958) and to Posner's orientation of attention (1980). The "anticipatory preparation from within of the ideational centers concerned with the object to which the attention is paid" seems to correspond to the effects produced by cuing and priming (e.g., LaBerge, Van Gelder & Yellott, 1970; Posner & Snyder, 1975). LaBerge (1990a,b) maintains that much of the attention research in psychology over the past century can be classified under these two manifestations of attention.

3.2 Contemporary research: when attention was paid to attention

In the first half of the 20th century, both Gestalt and Behaviorist psychologists ostracized the concept of *attention* because they considered that a simple and straightforward set of rules conditioned response to stimulus operations (Kahneman, 1973). Kahneman (1973:1) states that "the concept of attention was unpopular because it is most applicable where simple rules break down". However, after WWII, in the eve of the first cognitive revolution, attention became a central topic in the emergent cognitive psychology, especially within the information-processing approach (Shannon & Weaver, 1963), where computers were suggested to provide a valid and unbiased means to study mimicked human processes for they entailed no introspection. From then on, a rich variety of approaches and models were offered to explain attentional processes. In the following pages, I will try to synthesize the most popular models to provide a panoramic view on the contemporary study of attention.

3.2.1 Selective attention: a bottleneck perspective

Early research on attention was concentrated on explaining why and how humans can focus on certain stimuli and ignore or attenuate others. Early psychologists as Donald Broadbent observed that the responses elicited by the perceived stimuli were made in succession rather than at the same time. Therefore, the suppression or queuing of the responses suggests the image of a bottleneck, “a stage of internal processing which can only operate on one stimulus or one response at a time” (Kahneman, 1973:5). Drawing from the dichotic listening and shadowing experiments carried out by the British psychologist Edward Colin Cherry in 1953, the first experimental studies on selective attention and input selection used auditory stimuli. Cherry, still influenced by the behaviorist school, attempted to contribute to the study of speech recognition; in his experiment, the subject received one spoken message to its right ear and a different message to its left. The subject was then instructed to repeat one of the messages concurrently while listening. Cherry concluded that the message in the rejected ear was poorly recognized, but the participants still were able to detect relevant information such as their own name from the unshadowed channel. This experiment would be later described as *the cocktail-party problem* (Cherry, 1957:278).

Filter

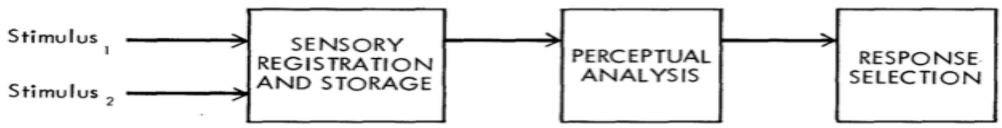

Fig. 6. A visual representation of Broadbent’s filter theory (Kahneman, 1973:6)

Broadbent carried out his research in parallel with the development and availability of computers to the academic community, and he was also among the first researchers to use information-processing analogies to make serious contributions to the analysis of human cognition. In fact, Kahneman (1973) considers Broadbent the natural starting point for any discussion of modern theories of attention. Built upon Cherry’s experiments, Broadbent’s filter model of attention (1958) attempted to test the selective filtering of auditory inputs through dichotic listening.

Broadbent's model was based upon a sequence of three elements: a short-term store (S-system), a selective filter, and a limited capacity channel (P-system). Stimuli enter into the S-system in parallel, where their physical features (location or tonal quality) are analyzed. Broadbent thought that meaning processing could only occur on the P-system, for he considered semantic features too complex to be processed at an early stage. After analyzing the physical features, the selective filter allows the accepted stimuli into the P-system, where more elaborate perceptual analyses are carried out serially. As the P-system has to clear before the filter allows a new stimulus to enter, the bottleneck effect occurs. This implies that two stimuli presented simultaneously cannot be processed at the same time. This feature of Broadbent's theory explains the common experience of the "double take", in which one returns to a stimulus that was ignored or not fully processed at the instant of its presentation. Broadbent's model implicitly suggests that attention affects perceptual analysis.

Filter theory received a lot of criticism. Moray (1959) observed that subjects were much more likely to notice a message on the rejected ear if it was preceded by their own name. These results contradict Broadbent's assumption that the sounds arriving at the rejected ear are not analyzed as speech. Moray also observed that a significant number of participants stopped shadowing when they heard "you may now stop" in the unattended ear.

On the other hand, Neisser (1969) developed a visual analogue to the auditory shadowing situation, in which subjects were required to read coherent text aloud and ignore words printed in red. Neisser's results showed that subjects did not recognize the words presented on the ignored lines, although the same word was repeated several times, but two-thirds of them noticed their own name. Anne Marie Treisman, a former PhD student of Broadbent's, was one of the most critical voices against the filter theory. In dichotic listening experiments, Treisman (1960) occasionally switched messages from one ear to the other. On a substantial number of cases, subjects followed the attended message into the other ear for one or two words before reverting to the designated ear. Most of the subjects were unaware of their transition errors. With these results, Treisman demonstrated that continuity of meaning could briefly overcome the effect of channel selection in determining the subject's shadowing response. This is incompatible with Broadbent's early version of filter theory, because the message to the neglected ear is not necessarily rejected at an early stage of processing.

Attenuation

Treisman (1960; 1964a) proposed her own theory to accommodate the evidence against Broadbent's filter theory. She sustained that the rejected message is merely attenuated and not fully ignored. Her attenuation theory basically proposes that all information is intentionally or unintentionally processed. Treisman's modification of filter theory retained the essential notion that attended and unattended stimuli are treated differently from a very early stage of perceptual analysis. This differential treatment causes a reduction of sensitivity for unattended stimuli. The 'filter' identifies messages based on their physical properties or by higher-level characteristics such as meaning, and after the identification is made, it intensifies pertinent information and attenuates the intensity of irrelevant inputs. Then information is passed on to a hierarchy of analyzers that perform higher-level processes to extract more meaningful content (Treisman, 1964b).

Treisman introduced a threshold to explain how some words could be heard in the unattended channel with greater frequency than others. According to her (1960), a sensory message activates hypothetical "dictionary units" in memory. Based on Moray's (1959) discovery that subjects often recognize their name spoken on one ear while they shadow a message on the other ear, Treisman suggested that each unit has a threshold that must be exceeded for perception to occur after attenuation (Treisman, 1969). However, the thresholds for highly significant stimuli, such as one's name or the word 'stop', are permanently lowered. That would explain why a word of high significance presented in an irrelevant channel can be perceived in spite of attenuation. Furthermore, the threshold for a word that the context makes probable can be lowered temporarily. In general, unattended items do not activate the corresponding dictionary units, except when the threshold of one of these units is exceptionally low.

As Kahneman (1973) recalls, in 1969, Treisman published a more inclusive treatment of the entire field of selective attention with two basic observations: (1) people can easily focus attention on one input, while they have great difficulty in dividing attention between two inputs; and (2) people can easily divide their attention between various aspects or attributes of a ‘particular input (La Berge & Winokur, 1965; Lappin, 1967), but they encounter great difficulty in focusing on one aspect of a stimulus and ignoring the others (Stroop, 1935; Treisman & Fearnley, 1969).

Deutsch & Norman

Treisman’s criticism of Broadbent's selection criteria as being based exclusively on the physical characteristics of the stimulus inspired the Deutsch & Deutsch’s late selection model from 1963. This model poses that all stimulus features are fully processed via their physical properties: “a message will reach the same perceptual and discriminatory mechanisms whether attention is paid to it or not” (Deutsch, 1963:83). Nevertheless, the crucial difference with the previous models is that the filter is placed in the information processing routine, at or just prior to the stage of response selections, so that information passes through the filter on the basis of semantic characteristics. The selected items of information are incorporated into short-term memory; hence it is the second selection mechanism, rather than the filter, which is responsible for deciding which information is to be attended to. Then, at a given time, only one stimulus can be selected, resulting in the *attentional bottleneck,* which prevents the application of more than one response at a time, and selects the response that best fits the requirements of the situation.

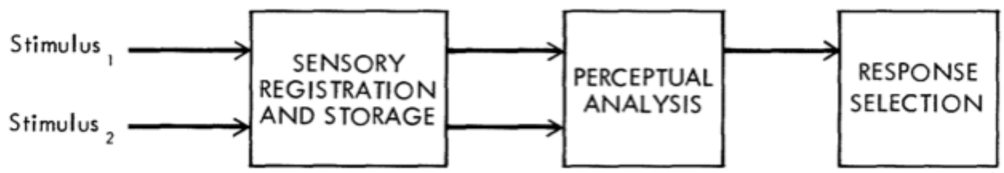

Fig. 7. A visual representation of Deutsch & Deutsch theory (Kahneman, 1973:6)

Deutsch & Deutsch (1963) proposed central structures, equivalent to Treisman's dictionary units. However, these central structures have a preset weighting of importance, which reflects momentary intentions (this is relevant now) or permanent dispositions (my name). The central structure with the highest weighting of importance will be selected among the competing structures to produce responses. For Deutsch and Deutsch, the importance parameter was a criterion bias that conditioned the selection of items.

Norman (1968) would later declare that personal relevance is not the only factor impacting attention, but also the strength of the stimuli. Norman offered a review to Deutsch & Deutsch (1963) theory and assumed central units that accept two types of inputs: (1) sensory inputs; and (2) pertinence inputs. The magnitude of the pertinence input reflects the criterion level for the elicitation of activity in each central unit. At any moment of time, the unit with the highest total of sensory and pertinence inputs dominates perception, awareness, and memory. In brief, Norman's revision attempted to explain the operation of stimulus set by assuming that the activation of a recognition unit is a gradual and recursive process.

Neisser and Hochberg: pre-attentive mechanisms

Neisser (1967, 1969) and Hochberg (1970) proposed alternative theories to the filter/attenuator. According to Neisser's model, perception is an active process of analysis by synthesis, i.e., a spoken message is understood by covertly reproducing it, and visual percepts are produced by a similar activity of synthesis. In sum, perception is an act of construction and the role of attention is to select the percepts that will be constructed or synthesized. Neisser (in Kahneman, 1973:126) summarized his point of view by the following instance:

> If a man picks up a sandwich from a dozen offered to him on a tray we do not ordinarily say that he has blocked or attenuated the others; he simply hasn't picked them up. Naturally he finds out a good deal more about the one he has selected, because he must shape his hand to fit it, to hold it together and so on.

Along with the active process of analysis by synthesis, Neisser assumed the existence of passive systems to perform a preliminary sorting and organization of sensory data. These are “silent” systems whose operation is not represented in awareness. Their function is grouping, localizing and routinely watching for critical features of stimulation that may require a redirection of focal attention. For instance, the sudden motion of an object is such a feature, and the responsiveness to it is probably innate.

Hochberg (1970) described perception as the confirmation of a changing set of expectations, concerning future phonemes when one listens to speech or the foveal image that would be produced by possible movements of the eye when one looks at a picture. He also assumed that the perceiver normally stores in memory only sets of confirmed expectations, whereas stimuli not matched to prior expectations are immediately forgotten, unless they are exceptionally salient. The production of expectations, of course, is very similar to Neisser’s active synthesis, but Hochberg implies a separation of detailed perceptual analysis from awareness. This detailed perception is dependent on the generation of confirmed expectations, but awareness of what one perceives also depends on whether the results of perceptual analysis are stored in memory. Before perception, Hochberg provides a preliminary organizational stage through a process of grouping and segmentation. He assumes that it is easy to focus attention on a single object and difficult to divide attention among several objects. However, whereas it is not hard to notice several features of an object, preventing the perceptual analysis of irrelevant attributes is almost impossible. This explains that we cannot see the shape of an object separately from its color.

3.2.2 Kahneman’s Capacity model of attention

Daniel Kahneman took a different approach to describe attention, by focusing on describing its division, rather than its selection mechanisms. His capacity model offers “an alternative theory to those that explain human limitations by assuming the existence of structural bottlenecks” (1973:7). Kahneman drops the idea of bottlenecks and views attention as a limited pool of resources that can be allocated with considerable freedom among simultaneous activities. The intensive aspect of attention is identified with effort, and selective attention is viewed as the selective allocation of effort to some mental activities in preference to others. The two central elements of the model are an *allocation policy* and the *evaluation of demands* on the limited capacity. The evaluation of demands is the governor system that causes capacity to be supplied, as needed by the activities selected through the allocation policy. Kahneman suggests that the policy itself is controlled by four factors: (1) enduring dispositions which reflect the rules of involuntary attention (e.g., allocating capacity to any novel signal; to any object in sudden motion; to any conversation in which one's name is mentioned); (2) momentary intentions (e.g., listening to the voice on the right earphone, looking for a redheaded man with a scar); (3) the evaluation of demands: there appears to be a rule so that, when two activities demand more capacity than is available, only one is completed; (4) effects of arousal.

Variations of physiological arousal, according to the author, accompany variations of effort, which suggests that the limited capacity and the arousal system are closely related. Kahneman explained that momentary capacity, attention, or effort is controlled by feedback from the ongoing activities, which implies that the changing demands of current activities determine the increase or decrease of the arousal and capacity, second by second. Finally, Kahneman explains the existence of a *spare capacity:* the continuous monitoring of our surroundings that occupies some capacity even in the most relaxed conscious state.

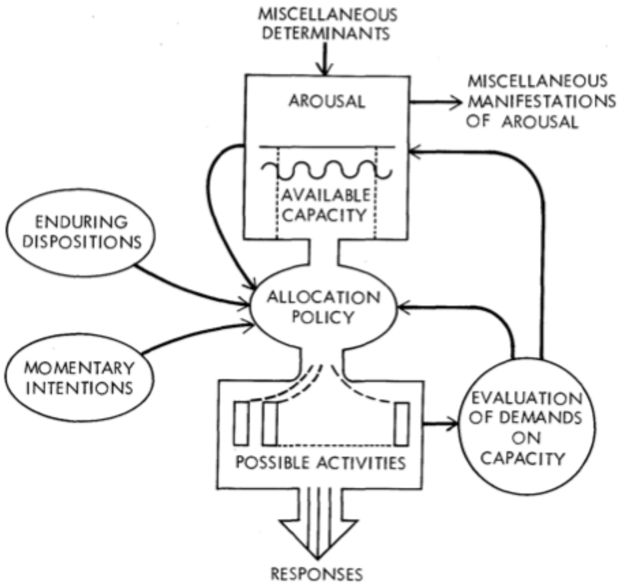

Fig. 8. A visual representation of Kahneman's capacity model (1973:10)

3.2.3 Feature integration theory

Based on Wiesel and Hubel findings on the relationship between some areas of the primate visual cortex with different selective features, Treisman & Gelade (1980) elaborated a feature-integration theory to explain how distinct features are combined into a unified whole: This was called the *binding problem*. Treisman & Gelade provided a theoretic and experimental basis to define how information is selected and integrated to form meaningful constructs. The feature-integration theory divides the perception process in two stages: (a) a pre-attentive stage and (b) a focused attention stage. Firstly, in the pre-attentive stage, the object is broken down into its elementary features, which are processed in different areas of the brain. According to Treisman & Gelade, the processing of features is unconscious, automatic, and effortless. Secondly, in the stage of focused attention, focal attention acts as a kind of magnet that integrates the disperse features into a unitary object to give a correct perception of the whole. Finally, feature-integration theory also contemplates top-down processing to become aware of unitary objects. It posits that both routes operate together, but that in extreme conditions they can operate almost independently from each other.

3.2.4 Neuropsychological and neuroscientific approaches to attention

As shown above, after WWII cognitive psychology developed a great deal of the concepts and behavioral tasks aiming to understand the underlying mental architecture that supports cognitive functions. However, almost concurrently, other emerging disciplines as neuroscience and neuropsychology studied brain lesions in humans and other animals through new experiments covering some features of attention. Abdullaev & Posner (2009) agree to mark the beginning of the "neuroanatomical" study of attention at Moruzzi & Magoun's (1949) experiments on the role of the brain stem reticular system in maintaining alertness, and Hebb's (1949) studies of cell assemblies linking widespread systems of neurons from different brain areas to build conscious representations of stimulus input (Posner & Rothbart, 2007b). About ten years later, the development of new tasks to explore the attentional states of the visual system of primates (humans included) fostered a wide variety of areas of study into the psychology and functions of brain processes. This certainly outlined the need to link cognition to specific brain systems, which yielded the convergence of cognitive psychology and neuroscience. Sperry (1988) wrote that the importance of attention is "its unique role in connecting the mental level of description of processes used in cognitive science with the anatomical level common in neuroscience".

Indeed, in the mid-1980s, new developments (Wurtz et al., 1980; Raichle, 1983; Hillyard & Picton, 1987) paved the way to combining experimental paradigms from cognitive psychology with brain imaging techniques. These new techniques revealed a system of anatomical areas that appear to be basic to selecting information for conscious processing. In the following decade, the work headed by Marcus Raichle with Positron Emission Tomography (PET) and the use of functional magnetic resonance imaging (fMRI) helped to establish neuroimaging as a powerful way of exploring brain activity during cognitive tasks including those involving attention (Posner & Raichle 1994, 1998). Perhaps one of the most surprising findings of the combined application of cognitive tasks with these revolutionary techniques is the activation of a small number of widely scattered neural areas subserving attention networks. This led researchers to get off the information-processing paradigm framework, which dominated the scientific approach for almost fifty years.

Michael Posner

The neuroscientific approach to attention has given birth to many different models and studies. Perhaps one of the most relevant and productive researchers in the last decades is cognitive neuropsychologist Michael Posner. Known as one of the founders of the cognitive science of attention, Posner focused on visual attention and developed very simple and innovative behavioral tasks with normal adults and patients with different kinds of brain injuries to study the attention mechanisms. He formulated the "Posner cueing-task", a well-known test to study attentional shifts and the orienting of attention. His adaptation to the new technical advances and approaches from different disciplines yielded a long professional career (his work spanned for more than 50 years), which offers an optimal framework to describe the evolution of the field in the second half of the 20^{th} century.

Although Posner's first steps date back to the 1960s, maybe one of his first most relevant contributions to the study of attention came out in 1976 with *Chronometric Explorations of Mind*. Inspired by the mental chronometry studies developed by Franciscus Donders *more than a century before,* Posner applied subtractive techniques to measure mental operations decomposing complex cognitive tasks in sequences of simpler ones. Posner & Petersen (1990) co-authored *The Attention system of the human brain,* where they built their attention system theory upon three basic assumptions: (I) the attention system is anatomically separate from processing systems, which handle incoming stimuli, make decisions, and produce outputs; (II) attention utilizes a network of anatomical areas: it is neither the property of a single center nor a general function of the brain operating as a whole (Mesulam, 1981; Rizzolatti et al., 1985); (III) the anatomical areas involved in attention carry out different functions that can be specified in cognitive terms (Posner et al. 1988). The attention system was thus split into three networks representing different but interrelated attentional processes, namely *alerting,* *orienting,* and *target detection* (Posner & Petersen, 1990), the latter being eventually substituted by *executive control* (Posner & Petersen, 2012).

With the development of the neuroimaging techniques, Posner revised some aspects of his original model but continued to apply the same subtractive principle to the study of attentional networks. In *Images of Mind,* published with Raichle in 1994, Posner investigated brain localization of cognitive functions with PET in order to look at the patterns of brain activation by presenting a set of progressively more complex tasks to the subjects. Neuroimaging revealed brain networks involved in many of the cognitive and emotional tasks. Posner & Raichle (1994) argued that each node of these networks carries out its own operation. This approach challenged previous theories that regarded attention as a largely uniform concept, and replaced it by the notion of independent brain networks (Raz & Buhle, 2006). Other neuroscientists, such as Parasuraman (1998) also reject the idea of attention as a single entity or mechanism and support the idea of different, autonomous networks.

Posner (2012) worked with patients presenting different kinds of brain injuries and studied the influence of drugs in attention. He also paid a great deal of attention to the development of attentional networks in infants and young children, discussing the influence of the difference in the upbringing, environment, and early experiences on the individual building of attentional networks (2012). His contributions have influenced other disciplines, such as education, psychotherapy, and IT.

All of the above shows that mostly cognitive psychologists and neuroscientists have approached research on attention. As translation researchers, it is definitely not our task to unveil the cognitive architecture of our minds and brains, but we need to secure the most solid foundations for our research. This presents us with at least a set of choices between competing options and different architectures. In order to reorient Translation Process Research, Occam's razor invites us to use a smaller set of attentional mechanisms and to abandon the old computational model that ignores environmental factors affecting the mind. In order to explore the attentional mechanisms of the mind, researchers have employed bilingual tasks such as translation or interpreting in which

Your attention, please

attention must be divided or switched among various stimuli. In the next section, a review of cognitive studies of attention and memory on bilingualism is provided. This is complemented by a summary of the roles of attention and memory in Cognitive Translation Studies.

Attention to Translation and Interpreting

Atenção >

Atención >

Attention >

Attenzione >

Aufmerksamkeit >

4.1 Cognitive control and attention in bilingualism

In the last quarter of the 20th century, many psychologists and neurologists have concentrated their research efforts on bilinguals, because the ability to speak more than one language is assumed to imply control mechanisms in order to speak them properly. Also, surprising findings, such as both languages being active during comprehension as well as production with no interference have deepened the interest on bilingualism, so that a vast number of experiments have been carried out in order to decipher how bilinguals manage their languages both in monolingual and bilingual tasks.

Maybe one of the first major contributions to these studies is Green's Inhibitory Control Model (1998), which he divided into three levels: (1) the language task schemas, allowing existing routine schemas *that underlie automatic performance of certain skills stored in long-term memory to compete to control behavior by altering their activation levels*; (2) word selection and the use of language tags; (3) the inhibitory and reactive nature of the control at the lemma level. In 1998, Dijkstra & Van Heuven proposed their Bilingual Interactive Activation model, which posed that an interactive process of activation and inhibition determines language selection. In this model, inhibition is implemented by two mechanisms: (a) lexical candidates inhibiting other candidates from the same language and (b) language nodes inhibit the activation of lexical candidates from another language.

Bialystok et al. (2004) distinguished between control (including selective attention to relevant information, inhibition of irrelevant information and switching between competing alternatives) and representational processes. Also in 2004, Paradis presented a *neurofunctional model* supporting the assumption that each language possesses independent networks (subserved by different neural circuits although they share the same cortical areas) in the brain. De Groot & Christoffels (2006:195) bring back Paradis' assumption that:

> when a bilingual intends to speak in one language only, the activation threshold of the non-selected language is raised sufficiently (inhibited) to prevent interference from that language during production.

Finally, Grosjean (1997a,b; 2001) assumed that bilinguals balance the activation levels of the two language systems to meet the goals of the communicative situation, so they choose a base language that is maximally activated to the detriment of the other language, which is inhibited as best as possible.

4.2. A special kind of bilingual

Despite various scholars having addressed the issue of bilingualism, in many cases they do not seem to agree to provide a definition of a 'bilingual' that is generally agreed upon. Grosjean (2003) defines a bilingual as "someone who uses of two languages regularly, regardless his/her proficiency in both languages". Hence he concludes that:

> bilinguals are an heterogeneous group and there are several factors that define their diversity, such as language proficiency, "language history, language stability, the functions of each language, and language mixing habits".
>
> (Grosjean, 2003:163)

Researchers of bilingualism used translation and interpreting tasks to study it, and some found that translators and interpreters cut across the notion of inhibition as envisioned for untrained bilinguals, since they are required to maintain and continually switch between input and output languages in order to understand messages in the original language, reformulate them, and convert them to another language. Thus, cognitive psychologists and psycholinguists used translation and specially on simultaneous interpreting in order to understand cognitive processes. Additionally, many translation and interpreting scholars started to approach the T&I process from cognitive perspectives. Among the reasons to do so there stand out (a) the influence of generative linguistics (which can be said to have been the first cognitive approach to language); (b) the influence of the aforementioned cognitive psychologists and psycholinguists, who were developing models and research methods to pin down aspects of the simultaneous interpreting process; (c) the obvious need to explain the workings of human translation and interpreting, if only to try and implement such workings in computers; (d) the budding tradition represented by both the Leipzig School and the Paris School; (e) the growing need to ground translator and interpreter training in empirical facts. The following section reviews some of the main approaches.

4.3. Mind your head, people translating!

With WWII and the beginning of the Cold War, both sides of the Iron Curtain deemed rapid code-deciphering and natural language translation a matter of state security. However, the huge amount of documents to be translated would require a terracotta army of translators; hence, inspired by the achievements of Alan Turing with *Enigma,* the USA and the USSR funded research groups to develop Machine Translation. These efforts would yield results when Warren Weaver published the basic assumptions of early MT in 1949. However, in 1966 the Automatic Language Processing Advisory Committee (ALPAC), that had been created in order to evaluate Machine Translation achievements, declared that machine translation was *less accurate, slower and twice as expensive as human translation,* and concluded that:

> In order to have an appreciation either of the underlying nature and difficulties of translation or of the present resources and problems of translation, it is necessary to know something about human translation and human translators.

The ALPAC report may then be seen as the first step to modern Translation Studies. In relation to this, Shreve (2009) comments that:

> One of the ground-breaking movements in modern Translation Studies was the idea that we could conceive of translation as more than just a straightforward linguistic process driven by correspondence rules and producing a more or less 'source-bound' copy of the original text in another language.

The trinity of (a) Shannon & Weaver’s mathematical theory of communication applied to human communication (1963), (b) Chomsky’s generative grammar, and (c) the cognitive revolution’s analogy of human mind and computer would merge into the information-processing paradigm, which influenced translation research during the second half of the 20th century. Many researchers, such as Vinay & Darbelnet, Mounin, Nida or Catford approached the study of human translation, sometimes attempting to solve the problems of Machine Translation. Germany and France gave birth to the big two schools of translation: on the one hand, the Leipzig school proposed a model in which translation was viewed as a matter of code-switching and ignored the cultural and social aspects of translation as they were inadequate for generalization. On the other hand, the Paris School questioned some Leipzig school’s tenets, but did not challenge their views on mind, language and meaning. Rather, the Paris School led by Danica Seleskovitch (1968, 1975) favored observation and introspection, and attempted to study translation as a cognitive activity (Hurtado Albir, Alves & Lacruz, 2015).

By the mid-1980s, inspired by Holmes’s and Toury’s, many translation scholars abandoned the linguistic framework to study translation and interpreting. They did so by integrating some concepts from psychology and sociology and also by favoring empirical research. However, still influenced by the information-processing paradigm, these studies conceived of the mind as an isolated, mechanical manipulator of symbols, and translation was simplified as a problem-solving matter. Ericsson & Simon (1980) developed a data collection technique known as think-aloud (TA) in order to get access to an individual’s chain of thoughts through introspection. In 1982, Ursula Sandrock applied this technique to the study of the translation process and inspired other scholars as (among others) Gerloff (1987), Séguinot (1989), and Lörscher (1991) to do so. Think-aloud protocols narrowly focused on problem solving and decision-making. However, soon was clear that the probability to access to the translator train of thoughts was blatantly implausible, so researchers began to search for alternative methods as retrospective interviews.

The advent in the 1980s and 90s of cheaper personal computers changed radically the translation process and made possible new methods of data acquisition. Jakobsen's keystroke logging software application *Translog* and eye-tracking devices are good examples of these new methods, which are usually combined to improve the quality, validity, and reliability of research findings (e.g., Alves et al., 2003). Translation process researchers also incorporated other data elicitation tools such as interviews or questionnaires. These research efforts pushed by such notorious technical advances were still within the information-processing framework. However, as Muñoz (2015) points out, a new cognitive paradigm for translation and interpreting is in the work that draws from the second cognitive revolution in the 1990s (4EA paradigm) and makes it possible to study:

> a whole new range of research topics as the role of feelings (Laukkanen 1996), intuition (Hubscher-Davidson 2013), and metacognition (Shreve 2009) in cognitive processing; the interaction with other people (Risku & Dickinson 2009) and with computers (O'Brien 2012). Research is now getting out of the lab and going into the workplace (e.g., Massey & Ehrensberger-Dow 2011).
>
> (Muñoz, [in preparation] 2015:10-11)

4.3.1. Simultaneous interpreting

Simultaneous interpreting is commonly considered a complex task where a few demi-gods can decipher the meaning of the message in the input language, somehow decompose it, and restructure it on the basis of the interpreter's own knowledge into a new piece of information which is uttered in the code of the target language. As Moser-Mercer (2005) suggests, controlled attention is a crucial element in the achievement of this heroic deed and, as a matter of fact, either in the form of cognitive control or Baddeley's executive control, it has been a very important mechanism in the frameworks of many a researcher. In the following paragraphs, an overview of some relevant models is provided (for a proper review see, e.g., Jiménez & Pinazo, 2013).

In 1967, Goldman-Eisler approached the way interpreters can perform various demanding tasks at the same time and, along with Cohen (1974, 9-10), rejected the *stricto sensu simultaneity* of interpreting in favor of a sequential model in which monitoring and decoding may be simultaneous, but recoding and must represent a second phase (Jiménez & Pinazo, 2013). In the same line, Barik (1973; 1975) argued that pauses to speak were made to favor a sequential processing and prevent the system to collapse, although Gerver (1976) maintained that pauses are too short to be of any real use for the interpreter. Moser-Mercer (1978) proposed that input has to be fully comprehended before output is produced. She stressed that comprehension is a constructive process in which information from the input is combined with information from long-term memory in order to create meaning structures and therefore permit interpreting. Darò & Fabbro (1994) dug into the importance of the different memory systems for simultaneous interpreting, although they did not specify their roles in the different processes involved in interpreting. Gile (1988) addressed the issue and proposed his renown efforts model, where he assumed three basic efforts for interpreting, which act simultaneously *and need attention*: (1) the Listening and Analysis Effort; (2) the Speech Production Effort; and (3) the Memory Effort. He eventually introduced a sort of central executive named the *Coordination Effort* to explain attention allocation and attentional shifts between the three efforts. Gile sustained that to avoid overloading the sum of the three efforts must be harmonized. Finally, within efforts model, Gile developed the tightrope hypothesis: since the interpreter has limited cognitive resources and works close to saturation most of the time, any increment on task requirements may cause an overload or an attentional deficit. This may explain why interpreters make mistakes or omit information although the input quality is adequate.

Conversely, Padilla & Bajo (1998) offered a model in which the interpreter distributes attention among multiple tasks according to his/her temporary intentions and permanent dispositions. They assumed that comprehension required a greater attentional capacity whereas rephrasing was semiautomatically developed and therefore required less cognitive resources. Timarová (2008) attempted to apply Conway & Engel's (1994) control-of-attention model of working memory and outlined the importance of the central executive as an attentional mechanism. In her PhD work, Yudes-Gómez (2010) explored how interpreters develop control processes to distribute attention and change priorities according to task demands in order to avoid overloads derived from comprehension and production tasks. Christoffels & De Groot (2004) approached the similarities between interpreting, shadowing, and paraphrasing, and concluded that they require simultaneous comprehension and production of speech. Christoffels & De Groot (2005) drew from Ericsson & Smith's (1991) concept of expertise, to suggest how translation and interpreting expertise determines the nature and activation of the resources that are activated in different communicative tasks. Finally, like in other disciplines, neuroscientists, cognitive psychologists and interpreting scholars used neuroimaging techniques to examine the neural networks and brain areas involved in interpreting tasks (Setton, 2013).

Consecutive and remote interpreting have also been approached from a cognitive point of view. Interesting research projects have been carried out by Jin (2010), Macizo & Bajo (2004, 2006), Ruiz, Paredes, Macizo & Bajo (2008) and Riccardi, Marinuzzi & Zecchin (1998). However, up to now, it seemed that simultaneous and consecutive interpreting were the only kinds of interpreting approached from a cognitive point of view. Englund-Dimitrova & Tiselius (2015) propose to turn the focus onto community interpreting, a discipline that has steadily gathering momentum since 1990's. To do so, they assume that discourse and conversation analysis are vital for studying community interpreting and sustain that it entails different cognitive processes and difficulties from simultaneous conference and consecutive interpreting, such as the alternation of listening to and speaking in two different languages or the correct selection and switching of languages for production. Although they reject the idea of the interpreter as a "translation machine", and claim that many other scholars have refuted it, the authors lament that cognitive abilities leading to understand the interpreter's "black box" have been neglected. Regarding these cognitive abilities, attention seems to play a crucial role in order to explain the community interpreting process as the interpreter's attention must be divided into a number of tasks such as perception, comprehension, transfer and production, but also note-taking and monitoring the interaction process with the conversation participants (Englund-Dimitrova & Tiselius, 2015).

As evidenced in this summary, simultaneous interpreting has been a central concern for bilingualism research. In contrast, written translation seems to involve different cognitive processes: due to the immediacy of the task, simultaneous interpreters usually need to get access to relevant information beforehand and their output does not pass through a filter. Instead, written translators can use dictionaries, turn to an expert and their final version of the text is reviewed by and editor before is presented. According to Hatim & Mason (1990:224), "processing [in translation] is likely to be more thorough, more deliberate than that of the ordinary reader."

4.3.2 Translation

Shreve's model of metacognition or Dragsted's study of pauses are additional research examples of Translation Process Research. Dragsted (2005) put the emphasis on pauses both in monolingual text production and in translation to approach cognitive processing and notes: "in translation research, pauses have similarly been shown to signal a segmentation pattern reflecting the preparation of new production units in the target text" (Dragsted, 2005:64). The combination of Translog (Jakobsen & Schou, 1999) and eye-tracking technology has enriched quantitative analysis, as information on the translator's behavior can be obtained both from reading and writing processes. Pauses have been associated with translation problems but Muñoz (2009:167) argues that "time analysis has its limitations, since we find intersubject variation as a result of differences in both mental processing speed and typing skills." Muñoz hypothesized that typos might be partly *motivated by attentional lapses* (2009:167), in which cognitive resources are reallocated to support other mental activities, such as evaluating and problem solving. Muñoz (2009:170) suggests that typos can be used to characterize subjects as they usually hint at different typing skills and cognitive styles.

On the other hand, metacognition is defined as "the ability to reflect upon, understand and thereby modulate one's own cognition" (Shreve, 2009:257). Shreve focused his study on metacognitive regulation and metacognitive control. The first is cognition coordination, i.e. the allocation of cognitive resources, attention, and memory and the application of other cognitive strategies via monitoring and control. Actually, monitoring, which Delclos & Harrington (1991) link to higher levels of proficiency, is a very important process as it permits the translator to detect errors, and become aware of the success or failure of the task. On the other hand, metacognitive control involves planning, evaluation, and regulation (Jacobs & Paris, 1987).

Final remarks: peeking inside the translating mind

Cognitive Translation Studies have been both strongly fostered and implicitly constrained by the use of new techniques of quantitative data acquisition such as keystroke logging and eye tracking. However, borrowing such means has sometimes entailed an acritical acceptance or at least the influence of the information-processing paradigm. Much of the current research continues to view the mind as a computer. Such view confers memory a central role in cognitive research, for it seems to suit the computational model: Memory is assumed to work as one or several isolated stores that contain information or let such information be merged and manipulated with new sense inputs. Nevertheless, some research results and evidences from neuroimaging have questioned the validity of the cognitive approach from 1950s. Starting the 1990s, many research efforts seem to be converging into an alternative model to the information-processing paradigm.

In the last years, many researchers have walked onto Gregory Shreve's footsteps and his pioneering work has been enlarged by a wide variety of research efforts questioning different tenets of the traditional cognitive approach. Neurological evidence has also challenged the classical view of translating as a unitary task that can be divided into reading, transfer, and writing. García (2015: 9) states that "[…] translation, in any of its modalities, involves a myriad cognitive processes", and opening up to such processes with a finer-grained analysis appears to have some promise.

As a way to complete this change of paradigm, Muñoz (in preparation) proposes *reembedding* Translation Process Research into both its physical basis—the brain—but also personal, social, and cultural matters within a coherent but renewed cognitive paradigm. Such change points to the emergence of a new paradigm called *Cognitive Translatology,* which is inspired by an embodied, embedded, extended, enactive, affective approach to the mind (see, e.g., Wheeler 2005). Within this new scope on the cognitive processes of translation and interpreting tasks, attention may become a major topic, because it is a mental ability subject to changes due to environmental factors over short periods of time. Attentional behavior also shows wider personal variations. Thus, it is more amenable to study and may, in consequence, let us finally peek into translators' and interpreters' black box.

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