

## **An Investigation of Cognitive Processes of Interpretation from Persian to English**

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Received: 2017.2.14

Accepted: 2017.9.2

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Online publication: 2017.12.10

### **Abstract**

This study examined the cognitive processes in interpretation through employing Think-aloud Protocols (TAPs) among Iranian translators. The participants included 10 professional and nonprofessional translators selected through Nelson Proficiency Test. TAP and retrospective interview were used as the major instruments in order to collect the data from self-reports protocols. In order to assess the translators' mind activity in the flow of interpretation, they were administered a translation test of approximately 150 words concerning a general subject. Then, the applied cognitive processes (attention, comprehension, memory processes, and problem solving) by the participants were determined and examined. Also, for identifying the significance of differences between the translators concerning the cognitive processes, a chi-square nonparametric test was run. Analyzing the translators' performance during think aloud activity of interpretation revealed that both professional and nonprofessional translators have used the same cognitive processes and the results of the chi-square test revealed there was no significant difference between them at the level of comprehension, memory processes, and problem solving. However, significant difference was observed at the attention level. The findings can help the instructors to become aware about mental abilities and are beneficial for students and translators to improve their translation ability.

**Keywords:** cognitive psychology, interpretation, think-aloud protocol, retrospective interview

### **Introduction**

Throughout history, translation has played a crucial role in connecting different cultures and languages and has made communication possible across societies. According to KuBmaul (1991, as cited in Miremadi, 1993), the aim of translation is to provide an acceptable translated text with accurate and reliable information for readers. Thus, a translator needs to have adequate knowledge, great skill as well as remarkable mental abilities. Also, Waddington (2001) stated that translation ability includes two different features, the ability of understanding the content of SL, and the ability to express the content in a TL. In both above mentioned definitions, the importance of mental ability and cognitive process in translation is clear, an important feature which is ignored in the most of studies and researches.

"The mental activity of translation is a constancy of all human translation processes" (Angelone & Shreve, 2010, p. 19). Over the last decades many observational studies have been conducted in order to discover what happens in the mind of the translators and interpreters, when they translate hence, participants are asked to describe what is happening in their mind while they are completing a translation task; this process is called *verbal protocol* (Bernardini, 2001).

According to Munday (2008), "Apart from being an act of communication and a textual operation, translation/interpreting is also the result of the cognitive processing carried out by translators /interpreters" (p. 54). Cognitive approach is a branch of psychology which attempts to study human behavior through understanding the thinking processes. Cognitive psychology is the study of how people perceive, learn, remember, and think about information. The main focus of cognitive psychologists is on the mental processes that affect behavior. These mental processes include but are not limited to attention, memory, comprehension, language, problem solving, and metacognition (Sternberg & Sternberg, 2012).

Asch (2002) argued "Cognitive psychology is concerned with information processing and includes a variety of processes such as attention, perception, comprehension, memory, learning, and problem solving; it is also concerned with the structures and representations involved in cognition" (p. 1). Meanwhile, Asch (2002) discussed that cognitive psychology during 1960s and 1970s was influenced by the theory of Broadbent (1958). In essence, it was

accepted that there are important relationships among the phenomena of attention, perception, Short-term Memory (STM), and Long-term Memory (LTM). All of them could be understood by assuming that information flows through a complex cognitive system consisting of many interdependent processes.

Seeber (2011) is one of the first scholars who emphasized the importance of cognitive studies in interpretation and directed the researchers' attention toward the cognitive studies in interpretation. Seeber (2013) points out the importance of cognitive studies in interpretation, he argued that the notion of cognitive load generated by the interpreting task or the amount of cognitive effort which is necessary to perform it, has created a substantial amount of interest and has been addressed by scholars who believe that such investigation might be very fruitful. Also, he declared some researchers like Gerver (1976), Gile (2009), Moser-Mercer (2000) and others have studied cognitive processes in interpreting and their studies led to new models, but such research studies had focused on a limited scope of cognitive processes, for instance, Bajo and Padilla (1999) limited their study to comprehension and memory processes in translation and interpreting. Meanwhile, these studies had explored cognitive processes from L2 to the L1. Risku (2013) declared that "Cognitive translation research is closely related to the ever-increasing process research in translation studies, which uses different methods to observe the actual chronological activity of translating by different groups of participants with different text types and different contexts" (p.1). She also declared an understanding of cognition is a prerequisite for explaining many of the practical tasks relevant in translation, since these tasks are based on thinking, learning, and understanding.

Translators and interpreters obviously play an important role in the whole process of translation and investigating peoples' mind has always been one of the problematic issues. "Cognitivism was the position that complex mental processes played an important role in shaping human behavior, and much of the field shifted to studying these mental processes" (Anderson, 1995, p. 3).

According to Poyatos (1997), interpretation is one of the most difficult and problematic issues for the learners, and fluency and automaticity in translating have encountered the interpreters with serious problems. He defined interpretation as the relaying from speaker to a listener of verbal and nonverbal

messages and stated: "Through the years, I have pondered various issues and problems that I realized appeared in any formal or informal live translation between at least two people" (Poyatos, 1997, p. 249).

Accordingly, one of the most important problems is the study of translators' mind during the process of translation. In addition, there is a rigorous lack of attention to the examination of the translation process in the flow of translation. According to Lorsch (1991), translation theory is product and competence-oriented, and there has been little attention toward its process. On the other hand, most studies in the field of Translation Studies have focused on the translation from L2 to the L1, and a few have focused on oral interpretation from L1 to L2.

During 1970s, Toury (1995) argues a new perspective on translation, which gave rise to what we now know as *Descriptive Translation Studies* (DTS), developed. As the name suggests, DTS aims to describe rather than prescribe how translations should be done. Unlike prescriptive translation studies DTS is target text oriented. In Toury's (1980) own words, DTS is "target-(rather than source-), solution- (rather than problem-) oriented", and its main aim is to "describe and explain empirical phenomena about translation and come up with a pure theory of translation" (Toury, 1980, p. 6). In addition, he argues that DTS is goal-oriented and that the translation is judged from the point of view of the target text, and not from the source text.

After the prominence of linguistic and cultural approaches of translation studies, the cognitive paradigm was in full swing during 1990s, whereas the focus of research has shifted from translation product to translation process. There has been a long history for the studies on translation process. As Jääskeläinen (1999) stated, interest in the *black box* of translation, i.e., the thought processes which take place when someone is translating a text, is probably as old as translating itself (Bo & Yuan-Yi, 2015). Lorsch (1992) discussed that translation theory has been concerned with two phenomena: with translation as a product and translation competence. Translation as a product, i.e. a written text in a TL as the result of translation process has been describe and analyzed by a comparison with the source language text. Translation theory was mainly competence-oriented and focused translators internalize knowledge. He also asserted since translation theory is product and competence-oriented, any attention has been hardly given to the process by

which a translation is produced and to the translators' performance; in fact, he directed the scholars' attention toward the process of translating.

According to Shiffrin and Schneider (1977, as cited in Dekeyser, 2007), cognitive theory considers "skill development in terms of a broader, information-processing framework in which performance is examined in the light of limitations on the amount of effort humans can allocate to any particular cognitive task" (p. 147). As the result, two modes of processing have been proposed: automatic and controlled. Dekeyser (2007) believes practice has an important role in the development of performance. Meanwhile, Dekeyser states specificity of practice and memory load independence are characteristics of automatization process.

Cognitive approach is a branch of psychology which attempts to study human behavior through understanding the thinking processes. Cognitive psychology is the study of how people perceive, learn, remember, and think about information. A cognitive psychologist might study how people perceive various shapes, why they remember some facts but forget others, or how they learn language. The main focus of cognitive psychologists is on the mental processes that affect behavior. These mental processes include but are not limited to attention, memory, comprehension, language, solving problem, and metacognition. (Sternberg & Sternberg, 2012).

According to Risku (2010), "the cognitive translation process studies contribute to the knowledge of how the translator's mind functions when, performing the task of translation" (p. 94). Kussmaul and Tirkkonen-Condit (1995) assert that some of the scholars have worked on cognition and metacognition during last decades. Most of these studies have compared professional versus non-professional translators with regard to problem-solving and decision making. An increasing number of research address cognitive process in both translation and interpretation. For instance, Lee- Jahnke (2015) conducted a study focused on cognitive approaches in process-oriented translation training.

Gambier, Gile, and Tylor (1994) accordingly draw attention to LTM and STM, memory capacity, and the role they play in product quality. "Memory very generally defined, is the capacity to retain information over time. Memory is of course very important to any information processing system, animal or

machine because, it underlies the ability to learn" (Friedenberg & Silverman, 2006, p. 125). As earlier mentioned, some researchers such as Asch considered STM and LTM as the crucial factors in cognitive psychology. Chastain (1988) also emphasized the crucial roles of memory and provided a comprehensive definition for STM and LTM. He stated "STM is the limited, conscious memory that individuals use to work with newly received or recalled information. LTM refers to that aspect of memory in which information stored for long periods of time" (p. 40).

Bajo and Padilla (1999) declared that for over a decade teachers and practitioners of translation and interpreting have witnessed the appearance of many studies using cognitive approach in their experiments, virtually since 1982 when for the first time Toury discussed the mystery and importance of the processes taking place in the *black box* of the language mediator. This cognitive approach has focused primarily on the different stages and phases of processing involved in the task of language mediation.

Bajo and Padilla mentioned cognitive processes of translation and interpretation are different from the cognitive processes of other skills such as speaking, reading, writing, and other ones, and these processes should be studied and understood in the context of the society, culture, and psychological backgrounds. They investigated cognitive theories of translation and interpreting and they attempted to analyze the processes involved in the flow of translation.

Christensen (2011) focused on the concept of cognition and the process of translation and declared:

Theories within cognitive science deal mainly with the internal processes that occur during human action. The human action carried out by a translator is generally speaking the action of producing a target text based on a source text. This activity is covered by the notion of translation process. Research investigating the translation process has generally focused either on the workflow and cooperation or on translators' mental processes. (p. 2)

Risku (2013) also tried to have an analysis on cognitive processes in translation and to establish a deeper understanding of how translations are produced. She discusses that cognition is made up of parallel processes like bodily movements, action and perception, externalization and internalization inside and outside the mind.

Human cognitive processes and particularly the mental process of translation can be investigated in different ways such as observing reactions to specific stimuli, analyzing the errors and the results of a task performance, and etc. Over the last three decades, however, TAPs have become a widely-used method to investigate the complex process of translation. This method allows data collection about the translator's thoughts at the same time he/she verbalizes them (Eftekhari, 2012).

Mental constructs and processes in general and translation processes in particular have been the focus of much research in the past three decades (Jääskeläinen, 1999; Jensen, 1999; Künzli, 2007; Kussmaul & Tirkkonen-Condit, 1995; Pöntinen & Romanov, 1989). *Protocol analysis* or *think-aloud* has been extensively employed in the fields of psychology and cognitive science as a verbal-report method of producing concurrent verbalization. Think-aloud require participants to tell the researchers what they are thinking and doing while performing a task (Yoshida, 2008).

According to Sun (2009), "think-aloud-based translation process research emerged in the mid-1980s. In this kind of research participants are requested to speak out their thoughts while, translating a text" (p. 2).

TAP studies, as it was mentioned earlier, have been imported from the cognitive science and applies to translation studies in order to study the mental processes the translators applied while they are carrying a task of translation. This method of data collection is known as TAP. Most early TAP studies were conducted on foreign language learners or translator trainees. However, a hypothesis was also put forward that the verbalizations produced by professionals would be less informative than those produced by non-professionals, due to their more *automatized* processing style (Bernardini, 2001). While some studies have been conducted in the field of translation, apparently and to the best knowledge of the researcher, in Iran, there is a considerable lack of research in the study of mental processes of interpretation from L1 to L2. Accordingly, this study was an attempt to investigate the cognitive processes involved in interpretation from Persian to English by two groups of novice and experienced Iranian translators. The researchers employed think aloud and retrospective protocols to gather verbal report data on cognitive

processes of translation that used by translators. With regard to the objectives of the study, the following research questions have been proposed:

1. What cognitive processes do novice and professional translators use during Persian to English interpretation?
2. Is there any significant difference between these two groups of translators with regard to the applied attention processes?
3. Is there any significant difference between these two groups of translators with regard to the applied comprehension processes?
4. What significant differences exist between these two groups of translators with regard to the problem solving?
5. What significant differences exist between these two groups of translators according to memory processes?

In the present study, video and voice recorder were also used to capture the participants' performance and behaviors, the verbalizations were recorded and transcribed into textual form, coded, and finally analyzed by the researchers.

## **Method**

### **Participants**

The sample of the present study included two groups of MA and BA Iranian English translators. To select the participants, the researchers first administered a Nelson Proficiency Test to 18 translators and only 10 translators whose scores were between one standard deviation above and below the mean were chosen as the participants of this study. All the participants' first language was Persian and their age range was between 25 and 35.

### **Instrumentation**

In order to collect the required data, Nelson Proficiency Test, observation, a translation test, a retrospective interview, and TAP were used as the main tools for collecting data.

**Nelson Proficiency Test.** In order to homogenize the sample, a 50-item Nelson Proficiency Test was used. It was adopted from Fowler and Coe (1978). "The validity and reliability of the Nelson Test have been estimated several times before, by other researchers and it is considered as a highly valid and reliable test of English proficiency" (Shahivand & Pazhakh, 2012, p. 18). It was administered to 18 English translators among whom 10 people were selected to participate in this investigation. The scoring of the test was calculated out of 50,

one score for each question. The group mean was estimated and translators who scored between one standard deviation above and below the mean (19-35) were chosen as the participants of this study.

**Translation test.** In order to measure the translator's mental ability, a translation test was administered to all the participants. According to Gile (2009), "simultaneous interpreting with text is a very common interpreting modality, inter alia in speeches at international conferences, when speakers read a text which has also been given to interpreters" (p. 181). Thus, a Persian text that dealt with a general subject was selected from a website. It included 150 words about family and its different aspects. The reason for this selection was that this topic was one of the most common and popular dealt topics, and therefore, no participants could have any advantages over the others in processing specialized knowledge related to a specific area.

**Interview.** Immediately after the translation, the subjects were interviewed in face-to-face interaction with the researchers in order to seek out the goals of the study and prevent any forgetting. The interview was semi-structured and included some fixed and open-ended questions based on the participant's performance during their thinking aloud performance. The researchers played the related video for each participant and asked him/her some questions directly addressing the participants' behavior, performance, and problems in the flow of interpretation. Each interview was recorded by using an audiotape recorder while the researchers were taking note of anything necessary. At the end of each session, the researchers signaled the end of the interview and allowed the interviewee to ask questions or raise issues, if any. The interview took 10 minutes for each interviewee and was conducted in a quiet room at the researchers' or interviewee's house.

**Observation.** Since this study aimed to investigate the translators' mental processes, the process of oral interpretation was recorded by an audio device and these records were transcribed into textual forms. Furthermore, one camera was used to record the process of translation for a better and more detailed analysis. During the translation task, the researchers asked the participants to express their thought, ideas, and anything that arrived into their mind about the text and translation while they were taking notes about the interviewee's gestures and feelings that could not be completely captured through recording.

**Think-aloud protocol.** The researchers used TAP as the major instrument for investigating the students' mental processes by asking them to express anything that comes into their minds during interpretation even in their L1. It involved the vocalization of respondents' *inner speech* without offering any analysis or explanation. As TAP is not a natural process, participants were previously instructed about its procedure by the researchers before conducting the study.

### **Procedure**

The major purpose of this study was investigating cognitive processes during oral interpretation from Persian to English. Thus, the researcher initially selected a Persian text that dealt with a general subject in order to prevent the probable effects of topic unfamiliarity on the research results. The sample included both MA and BA translator students selected through Nelson Proficiency Test. At first, a training session was held by the researchers for all participants to inform them about the goals, process, and the detailed procedure of the study. The process of oral interpretation and TAP were also described for the participants, and they practiced TAP and were informed about their performance and responsibility during the interview session.

Then, the participants were asked to do oral interpretation task separately during one session, which followed by an interview immediately after the accomplishment of the task. One room either in the researchers' or the translators' house was equipped by video and audio recording tools. The researchers stayed in the room in order to take notes and remind the students about thinking aloud procedure as well as answering the questions; they also provided any help required.

The video and voice recorder were turned on to record the process of interpretation. Whereas, TAP was a new phenomenon for the participants, they sometimes forgot to report and express their inner thought, and the researchers permanently asked them to think aloud and verbalize their thought. In situations where the participants were silent or paused, the researcher asked some questions directly addressing the goals of the study, such as 'what are you thinking about now'. Immediately after accomplishing the interpretation task, the researcher asked some questions and allowed the participants to express their thoughts and feelings. After collecting the data, the video and audio records were transcribed into textual forms. As transcription is only possible for

verbal output, some non-verbal output might be missed and ignored by the researchers. However, it was tried to transcribe some paralinguistic features such as pause, laughter, and etc.

### **Design**

As the nature of this study dealt with investigating the processes of oral interpretation and the researchers used observation, retrospective interview, and TAP as the main instruments to investigate the students' mental processes during oral interpretation, it fell into qualitative exploratory research design. Anderson (1998) declares that in qualitative research, the researcher is the principal data collection instrument; whereas in quantitative research, scientifically designed data collection tools are developed (e.g., attitude survey, IQ test).

The qualitative analysis of the translators' mental processes was followed by calculating the frequencies of each process applied by the participants when translating Persian text into English. Meanwhile, the significant difference between the translators with regard to their use of the translation processes in the flow of interpretation was calculated by means of using Chi-Square formula.

**Theoretical Framework.** There are a wide range of models attributed to translation and cognitive processes. Whereas, the present study dealt with the cognitive processes in the flow of interpretation and the researchers came to the conclusion that all the suggested models had some deficiencies that did not meet all the purposes of the study, therefore, *Translation Processes Cognitive Load Method* which is a combination of Angelon and Shreve (2010) *Translation Process theory* and Seeber (2013) *Cognitive Load Model (CLM)* formed the theoretical basis of the present study. This model deals with both translation and cognitive processes which were the central cores of the present study.

Cognitive processes, according to Asch (2002), are concerned with information processing and include a variety of processes such as attention, comprehension, memory, and problem solving.

Attention refers to the ability to sustain concentration on a particular object, action, or thought; "it is the means by which we actively process a limited amount of information from the enormous amount of information available

through our senses, our stored memories, and our other cognitive processes" (Sternberg & Sternberg, 2012, p. 137). Broadbent (1958) argued that generally there are two types of attention used in our daily life: Selective attention and divided attention. *Selective Attention* refers to the situation that we block out some features of the environment and focus on one specific feature, known as focused attention. *Divided Attention* takes place when we attend to more than one thing or action at the same time. In order to identify a particular attention type from among the other types, we can consider students inability to ignore distraction and multi-task.

In translation and interpretation, the comprehension is directed toward the source text and translators' comprehension can be studied through direct indicators (e.g., I can't understand this sentence) or indirect ones (e.g. pauses on ST or rereading and repeating the source text). For analyzing the comprehension, this study has benefitted from the local strategies of Block's Model of TAP which included: Paraphrase, reread, question meaning of a clause or a sentence, question meaning of a word, and solve vocabulary problem.

According to Angelone (2010), the problem-solving cycle includes problem identification, solution proposal, and solution evaluation. Problem recognitions are those behaviors that reveal some form of direct or indirect knowledge assessment. These behaviors can be direct articulations such as: 'I do not know the meaning of this word' or indirect articulations such as: 'hmm' and also non-articulation behavior can be observed by dictionary look-ups pauses keyboarding. Solution proposal is a behavior which proposes possible solutions for those problems that happen during the task of translation (Angelone, 2010). Finally, in the solution evaluation phase, the translator evaluates the optional equivalents in solution proposal stage.

Meanwhile, theories of the architecture of human memory make a distinction between LTM and STM. LTM is that part of memory where large amounts of information are stored permanently whereas STM is the memory system where small amounts of information are stored for a very short duration (Jong, 2010). As it was already discussed, it is only possible to verbalize the data stored in STM and its capacity can be extended through chunking and rehearsal. *Chunking* is the organization of materials in shorter meaningful

groups and *rehearsal* or repetition can increase capacity of STM, either by loud reading or mental simulation. (Sternberg & Sternberg, 2012).

Sternberg and Sternberg (2012) also discussed that two main processes are used in order to retrieve information from LTM: recognition and recall. *Recognition* involves comparing a current stimulus (e.g., a sight, sound, or smell) to something sensed in the past; in recognition, you select or otherwise identify an item as being one that you have been exposed to previously. *Recall* involves directly accessing information in LTM, in recall; you produce a fact, a word, or other item from memory.

### Results

This section deals with the analysis of cognitive processes which included attention, comprehension, STM, and problem solving applied by translators in order to overcome the translation problems during the translation task.

#### Analysis of Cognitive Processes Applied during Oral Interpretation

In order to study the cognitive processes in oral interpretation, analyzing the translators' behavior and classifying the data as being articulated or non-articulated was essential, therefore, as the initial step the investigator tried to find out and classify these data. Table 1 displays a summary of these results.

Table 1  
*A Synopsis of the Cognitive Phenomena Observed Among the Participants*

Participants	Cognitive phenomenon	Artic.	Non artic.	Cognitive	
				% Artic.	% No-Artic.
Professional	88	66	22	75%	25%
Nonprofessional	99	73	26	74%	26%

There are some significant findings in Table 1. As it can be observed, nonprofessional translators produced more cognitive options than the professional translators and among professional translators less nonarticulatory behaviors were observed which means that professional translators produced less nonverbal behaviors (25%). In contrast, 26 percent of nonprofessionals' behaviors were attributed to the nonarticulatory ones such as pauses.

In order to find the answer to the first question of the study, 'what cognitive processes do the novice and professional translators use in Persian to English oral interpretation?', the frequencies of each cognitive process were calculated with regard to the Asch model. The analysis was carried out in terms of attention, comprehension, problem solving, and memory processes.

Since in this study any probable distraction was removed, the translators' attention was focused on type, but some multi-task indicators which are the main features of divided attention were observed which were analyzed in Table 2.

Table 2  
*A Synopsis of the Attention among the Participants*

<b>Participants</b>	<b>Divided Attention</b>	<b>Focused Attention</b>
Professional	2	43
Nonprofessional	16	39
<b>Total</b>	<b>18</b>	<b>82</b>

Table 3 indicates the total number of comprehension strategies applied by the participants which included 105 by the professional translators and 133 by nonprofessionals. Rereading was the most dominant strategy used by professional translators in order to increase comprehension (n=34), on the other hand, asking the meaning of a word had the higher frequency for nonprofessional ones (n=79). In both groups, the least frequent strategy was asking the meaning of a clause or sentence (n= 5).

Table 3  
Comprehension Strategies Applied by the Participants

Comprehension strategies	Professional translators	Nonprofessional translators	Total
Paraphrasing	19	18	37
Rereading	34	27	61
asking the meaning of a clause or a sentence	3	2	5
asking the meaning of a word	28	51	79
Solving vocabulary problem	21	35	56
<b>Total</b>	<b>105</b>	<b>133</b>	<b>238</b>

In order to make comprehension level more clear, some examples are presented as follows:

#### a. Paraphrasing

همانگونه که از منابع دیگر هم بر می آید

With regard to the underlined phrase one participant asserted:

بر می آید یعنی پیداست , مشخص میشود , همانطور که منابع دیگر پیشنهاد میکنند

#### b. Asking the meaning of a word

- بعضی روابط خویشاوندی و همخونی را اساس تشکیل خانواده تلقی کرده اند

With regard to the underlined words one translator asserted:

تلقی کرده اند؟ روابط رو یادم نمیداد . تلقی چی میشد؟

#### c. Solving vocabulary problem

- بعضی روابط خویشاوندی و همخونی را اساس تشکیل خانواده تلقی کرده اند

Translator's explanation:

خویشاوندی, همخونی , اصلا به ذهنم نمیداد . خوب رابطه همخونی همون رابطه خویشاوندی میشه . همیشه نسبی دیگه . سببی داریم و نسبی همیشه نسبی . نسبی رو چک کنم .

The next step of analysis dealt with problem solving level. As it was discussed in the previous chapter according to Angelone (2010), the problem-solving cycle includes: 1. Problem identification, 2. Solution proposal, and 3. Solution evaluation.

Concerning the results of the study, among the three layers, the most dominant one was problem identification (n=173). The high frequency of problem recognition revealed that both professional and nonprofessional translators have had a tendency to recognize the indicators in the text that reveals the translation difficulty. Table 4 provides a summary of the results attributed to problem solving behaviors applied by both professional and nonprofessional translators:

Table 4  
*Problem Solving Behaviors among the Participants*

<b>Participants</b>	<b>Problem identification</b>	<b>Solution proposal</b>	<b>Solution evaluation</b>
Professionals	73	33	30
Nonprofessionals	100	48	29
<b>Total</b>	<b>173</b>	<b>81</b>	<b>59</b>

Table 5 presents different strategies used by professional and nonprofessional translators in order to enhance the capacity of their STM. As the data revealed, the dominant option was chunking (n=82) applied by both groups of translators in order to enhance the capacity of their memory. The least frequent strategy was recognition which is totally 33 for both groups.

Table 5  
*Memory Strategies Applied by the Participants*

<b>Participants</b>	<b>Memory Strategies</b>			
	<b>Chunking</b>	<b>Rehearsal</b>	<b>Recognition</b>	<b>Recall</b>
Professionals	43	36	15	26
Nonprofessionals	39	41	18	19
<b>Total</b>	<b>82</b>	<b>77</b>	<b>33</b>	<b>45</b>

### **Analysis of significant difference between professional and nonprofessional translators**

The second, third, fourth, and fifth research questions dealt with the significant difference between professional and nonprofessional translators with regard to cognitive processes. To this aim, a chi-square test was run. Table 6

presents the results of this analysis with regard to the second question of the study.

Table 6  
*A Synopsis of the Attention among the Participants by Chi-square*

<b>Attention Strategies</b>	<b>Professional</b>	<b>Nonprofessional</b>	<b>X<sup>2</sup></b>	<b>Sig P&lt;.05</b>
Divided Attention	2	16	10.889	.001
Focused Attention	43	39	.195	.659

Concerning the level of significance (Asymp.sig<.05), the results revealed that there was statistically significant difference (sig = .001) between professional and nonprofessional translators with regard to the frequencies of the applied divided attention strategies.

To find out an answer for the third research question concerning what significance differences exist between professional and nonprofessional translators with regard to applied comprehension strategies, another chi-square test was used. The final results, as presented in Table 7, revealed that there was only a significant difference between the translators at the level of *asking the meaning of a word* (sig.= .010). Among the other strategies, no significant difference was observed.

Table 7  
*Comprehension Strategies as analyzed by Chi-square*

<b>Comprehension strategies</b>	<b>Professional translators</b>	<b>Nonprofessional translators</b>	<b>X<sup>2</sup></b>	<b>Sig P&lt;.05</b>
Paraphrasing	19	18	.027	.869
Rereading	34	27	.803	.370
Asking the meaning of a clause or a sentence	3	2	.200	.655
Asking the meaning of a word	28	51	6.696	.010
Solving problem	21	35	3.500	.061

The fourth research question dealt with the significant difference between professional and nonprofessional translators with regard to problem recognition, solution proposal, and solution evaluation, therefore, another chi-square test was run. As Table 8 reveals, there was only a significant difference between the translators at the level of problem identification (sig.= .040) and no significant difference was observed with regard to other options.

Table 8  
*Problem solving behaviors as analyzed by Chi-square*

<b>Problem Solving Behaviors</b>	<b>Professionals</b>	<b>Nonprofessionals</b>	<b>X<sup>2</sup></b>	<b>Sig P&lt;.05</b>
Problem identification	73	100	4.214	.040
Solution proposal	33	48	2.778	.096
Solution evaluation	30	29	.017	.896

Regarding the last research question concerning the significant differences between professional and nonprofessional translators with regard to the memory processes, another Chi-square test was applied. With reference to Table 9, the results of the Chi-square test at the level of STM demonstrated that there is no significance difference among options such as chunking, rehearsal, recognition, and recall.

Table 9  
*Memory strategies as analyzed by Chi-square*

<b>Memory strategies</b>	<b>Professional</b>	<b>Nonprofessional</b>	<b>X<sup>2</sup></b>	<b>Sig P&lt;.05</b>
Chunking	43	39	.195	.659
Rehearsal	36	41	.325	.569
Recognition	15	18	.273	.602
Recall	26	19	1.089	.297

## **Discussion**

In seeking to find the answer for the first research question: ‘What cognitive processes do the novice and professional translators use in Persian to English oral interpretation’, the examination and analysis of the major cognitive strategies (attention, comprehension, problem solving, and STM) applied by professional and nonprofessional translators indicated that at the attention level nonprofessional translators were more dedicated to divided attention while professional ones were more clinched to focused attention and the translation itself. According to Sternberg and Sternberg (2012), different factors such as anxiety, arousal, task difficulty, and skills can influence our ability to pay attention. They also emphasized to the important role of intelligence.

As for the second layer of cognitive processes concerning the comprehension, it was found out that the major attempt of the translators devoted to understanding and comprehension of ST. With this regard, the results of this study are in line with Waddington (2001) who mentioned that translation includes two different phases, the ability to understand and transfer the content of the source text and the ability to express this content in the target language. As he mentioned, understanding the content of the source text is one of the most important features in the translation process.

Meanwhile, in order to study the comprehension strategies applied by translators, the researchers used the Block's model of comprehension. The findings of the study showed that rereading was the dominant strategy applied by professional translators (n=34), however, asking the meaning of a word was the major strategy applied by nonprofessional ones (n=51). One justification for this result is that most nonprofessional translators might not be able to guess the meaning of a particular word from the text and they resort to dictionaries or other sources. However, with regard to professional students, most of them know the strategies and techniques to guess the meaning of unclear words. These findings are in line with that of Barani and Karimnia (2014) whose study drew on the field of reading comprehension skills and strategies.

As for the cognitive processes which were related to the problem solving process, it was found out that both groups of translators had a tendency toward problem recognition. The frequencies revealed that nonprofessional translators were more involved with problem identification (n=100), while this frequency

for professional translators was 73. According to Bloom and Broder (1950, as cited in Sternberg & Sternberg, 2012), better students are more likely than other students to spend more time in the initial phase, deciding how to solve a problem, and less time for solving it, that is in line with the results of the current study. Meanwhile, they asserts that weak students spend more time on solution evaluation, however, the results of the present study did not confirm this issue and revealed that both groups of translators were engaged in problem identification and solution evaluation had the least importance for both groups. One possible justification for the greater tendency of nonprofessional translators to problem identification may be that in addition to experience, other factors could affect the performance of translators at the level of problem solving. Sternberg and Sternberg (2012) expressed factors such as participants' background knowledge, type of problem, and mental set as effective factors.

Investigating the memory and access to what runs in the mind of translators was another purpose of this study. "In studying memory, researchers have devised various tasks that require participants to remember arbitrary information (e.g., numerals or letter strings) in different ways" (Sternberg & Sternberg, 2012, p. 187). This study benefited from TAP to investigate the cognitive behavior of the translators during oral interpretation.

In order to study memory processes, various features were studied and it was concluded that there was no significant difference between the professional and nonprofessional translators concerning the memory strategies applied. In sum, the findings indicated professional translators had a tendency toward chunking, while for the nonprofessional translators it was rehearsal used with more frequency. So far, there are no similar studies performed to examines the memory strategies that applied by translators in order to enhance the capacity of their STM.

To answer the second research question: "Is there any significant difference between translators with regard to the cognitive processes?", several Chi-square analyses were conducted.

Having analyzed the translators' behavior at the level of attention, the researchers concluded that there was a significant difference between the two groups of translators. The justification is that professional translators are more dedicated to translation and this ability allows them to devote themselves more to focused attention activities. One possibility for nonprofessional translators is

that it may be their lack of experience and their low cognitive abilities which led them to be less focused. According to Sternberg and Sternberg (2012), the type of attention is the matter of skill and it can be concluded that nonprofessional translators are less skillful.

With regard to the third research question, the results of the Chi-square test revealed that there was no significant difference between professional vs. nonprofessional translators at the comprehension level which is in line with the findings of Dillingner (1989) that studied comprehension processes between experts and bilingual non-interpreters. This finding is also in agreement with the results of Barani and Karimnia (2014).

With regard to the fourth research question which dealt with the significant difference between the translators at the level of problem identification, solution proposal, and solution evaluation, the results showed that there was only a significant difference between professional and nonprofessional translators at the level of problem identification ( $\text{sig.} = .040$ ) which is in line with that of Angelone (2010) who investigated the problem recognition, solution proposal, and solution evaluation as the management stages. He also mentioned that experience plays a role in the variation observed among professional and nonprofessional translators. Mengelkamp (2008) argued there are other factors besides experience that can have significant effect on cognitive processes. He put emphasis on factors such as translator's background knowledge, the L2 similarity or differences with the L1 structure, and nature of the text.

Similar findings were also obtained concerning the difference between the translators with regard to the memory processes and the results of the Chi-square test indicated that there was no significant difference between the translators. So far, there were no similar studies performed to examine the difference between the translators' memory processes with regard to chunking, rehearsal, recognition, and recall.

In sum, this study was conducted to investigate the cognitive processes in interpretation during the think aloud activity. The researcher studied the major cognitive strategies that were applied by two groups of professional and nonprofessional Iranian translators which included: attention, comprehension, memory processes, and solving problem. Having analyzed the students'

behaviors concerning oral interpretation of a Persian text, the researcher came to the conclusion that both professional and nonprofessional translators applied the same cognitive processes which are in line with the studies of Bajo and Padilla (1999), Tommola and Hyonà (1990), and Risku (2013).

The next research questions dealt with the significant differences between professional and nonprofessional translators, in order to find an answer for these questions the researcher utilizing the SPSS version 16 in order to calculate the Chi-square. Having analyzed the translators' behavior at the level of attention, the researcher came to the conclusion that there is a significant difference between translators.

The results of the chi-square test revealed there was no significant difference between translators at the level of comprehension, and memory processes.

With regard to the difference between the translators at the level of problem identification, solution proposal, and solution evaluation, the results of the Chi-square test showed there is only a significant difference between professional and nonprofessional translators at the level of problem identification (sig=.040).

The findings of this study can help the instructors to become aware of the concept of mental abilities and cognitive processes and can be beneficial for students and translators in order to improve their translation ability by being more aware of what is happening in their mind during interpretation. Meanwhile, the results can present a clearer image of interpretation process to translation teachers which helps them improve their teaching methodologies and syllabuses, which in turn can result in improving the students' ability in translation and applying correct translation strategies in the process of interpretation.

### References

- Anderson, G. (1998). *Fundamentals of educational research*. UK: Falmer Press.
- Anderson, J. R. (1995). *Learning and memory: An integrated approach*. New York: John Wiley & Sons, Inc.
- Angelone, E. (2010). Uncertainty, uncertainty management and metacognitive problem solving in the translation task. *Translation and Cognition*, 17-40. doi: 10.1075/ata.xv.03ang.

- Angelone, E., & Sherve, G. M. (2010). *Translation and cognition*. New York: Benjamin.
- Asch, M. (2002). *Text book of cognitive psychology*. New Delhi: Sarup & Sons.
- Bajo, M. T., & Padilla, F. (1999). Proposal for a cognitive theory of translation and interpretation. A methodology for empirical research. *The Interpreter's Newsletter*. Retrieved July 2015 from [/www.openstarts.units.it/dspace/bitstream/10077/2213/1/04Padilla.pdf](http://www.openstarts.units.it/dspace/bitstream/10077/2213/1/04Padilla.pdf).
- Barani, M., & Karimnia, A. (2014). An investigation into translation students' English reading comprehension skills and strategies: A cross-sectional study. *Applied Linguistics*, 73, 26257-26262.
- Bernardini, S. (2001). Think-aloud protocols in translation research. *Target International Journal of Translation Studies*, 13(2), 241-263. doi: 10.1075/target.13.2.03ber.
- Broadbent, D. E. (1958). *Perception and communication*. London: Pergamon Press.
- Chastain, K. (1988). *Developing second-language skills theory and practice*. USA: Harcourt Brace Jovanovich, Inc.
- Christensen, P. T. (2011). Studies on the Mental Processes in Translation Memory-assisted Translation- the State of the Art. *Trans-kom*, 4 (2), 137-160.
- Dekeyser, R. M. (2007). *Practice in a second language: Perspectives from applied linguistics and cognitive psychology*. New York: Cambridge University Press.
- Dillinger, M. (1989). Comprehension during interpreting: What do interpreters know that bilinguals don't? *The Interpreters' Newsletter*, 3, 41-58. Retrieved in June 2015 from <https://www.researchgate.net/publication/245736477>
- Eftekhari, A. A. (2012). Investigating the use of think-aloud protocols in translation of literary texts. *Theory and Practice in Language Studies*, 2 (5), 1039-1047. doi:10.4304/tpls.2.5.1039-1047.
- Fowler, W. S., & Coe, N. (1978). *Nelson English language tests*. London: Butler & Tanner Ltd.
- Friedenberg, J., Silverman, G. (2006). *Cognitive science*. London: Sage Publications, Inc.
- Gambier, Y., Gile, D., & Taylor, C. (1994). *Conference interpreting: Current trends in research, proceedings of the interpretational conference on interpreting- what do we know and how?* Amsterdam/Philadelphia: John Benjamins Publishing Company.

- Gile, D. (2009). *Basic concepts and models for interpreter and translator training*. Amsterdam/ Philadelphia: John Benjamins Publishing Company.
- Jääskeläinen, R. (1999). *Tapping the process: An explorative study of the cognitive & affective factors involved in translating*. Joensuu: University of Joensuu.
- Jankhe, H. L. (2015). New cognitive approaches in process-oriented translation training. *Meta: Translators' Journal*, 50(2), 359-377. doi: 10.7202/010942ar.
- Jong, D. T. (2010). Cognitive load theory, educational research, and instructional design: Some food for thought. *Instr Sci*, 38,105–134. doi: 10.1007/s11251-009-9110-0.
- Kusmaul, P., & Tirkkonen-Condit, S. (1995). Think-aloud protocol analysis in translation studies. *Traduction, Terminologie, Rédaction*, 8 (1), 177-199. doi: 10.7202/037201ar.
- Lorsher, W. (1991). Translation performance, translation process, and translation strategies. *A psycholinguistic investigation*, 5(1), 271-275. doi: 10.7202/014625ar.
- Lorsch, W. (1992). Investigating the translation process. *Meta*, 3, 426-439. doi :10.7202/003517ar.
- Mengelkamp, M. B. (2008). Assessment of metacognitive skills by means of instruction to think aloud and reflect when prompted. Does the verbalization method affect learning? *Metacognition and Learning*, 3, 39-58.
- Miremadi, S. A. (1993). *Theories of translation and interpretation*. Ghom: Mehr Press.
- Munday, J. (2008). *Introducing translation studies: Theories and applications*. (2<sup>nd</sup>ed.). New York: Routledge.
- Poyatos, F. (1997). *Nonverbal communication & translation*. Amsterdam/Philadelphia: John Benjamins Publishing Company.
- Risku, H. (2010). A Cognitive scientific view on technical communication and translation. Do embodiment and situations really make a difference? *Target*, 22 (1), 94-111. doi: 10.1075/target.22.1.06ris.
- Risku, H. (2013). Cognitive approaches to translation. *The Encyclopedia of Applied Linguistics*, doi: 10.1002/9781405198431.wbeal0145.
- Seeber, K. (2011). Cognitive load in simultaneous interpreting: Existing theories-new models. *Interpreting*, 13 (2), 176-204. doi: 10.1075/intp.13.2.02see.
- Seeber, K. (2013). Cognitive load in simultaneous interpreting: Measures and methods. *Target*, 25 (1), 18-32. doi: 10.1075/target.25.1.03see.

- Shahivand, Z., & Pazhakh, A. (2012). The effects of test facets on the construct validity of the tests in Iranian EFL students. *Higher Education of Social Science*, 2 (1), 16-20. doi:10.3968/j.hess.1927024020120201.452.
- Sternberg, J. R., & Sternberg, K. (2012). *Cognitive psychology*. USA: Wadsworth.
- Sun, S. (2009). *Think aloud based translation process research: Some methodological consideration*. USA, Kent state: University of Kent.
- Tommola, J., & Hyonà, J. (1990). Mental load in listening, speech shadowing and simultaneous interpreting: A pupillometric study. *Speeches/Conference Papers*, 150. Retrieved September 2015 from <http://files.eric.ed.gov/fulltext/ED327061.pdf>
- Toury, G. (1980). *In search of a theory of translation*. Tel Aviv University: The Porter Institute for Poetics and Semiotics
- Toury, G. (1995). *Descriptive translation studies and beyond*. Amsterdam/Philadelphia: John Benjamins
- Waddington, C. (2001). Different methods of evaluating student translations: The question of validity. *Meta*, 46 (2), 311-325.
- Yoshida, M. (2008). Think-aloud protocols and type of reading task: The issue of reactivity in L2 reading research. *Selected Proceedings of the 2007 Second Language Research Forum*, ed. Melissa Bowles et al., 199-209. Retrieved October 2015 from <http://www.lingref.com/cpp/slrf/2007/paper1745.pdf>.

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