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A Review Study of The Relationship between EFL learners' Working Memory and EFL Listening Comprehension: Metacognitive Intervention (MI)

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Abstract

This article is an examination of the history of the relationship between English as a Foreign language (EFL) learners' Working Memory and EFL Listening Comprehension through Metacognitive Intervention (MI). This paper explores various models of Working Memory and the effect of metacognitive intervention on different aspects of listening comprehension and working memory. The results from this study might help in better understanding of the WM and metacognitive intervention during language processing employed by EFL learners, which could guide their instructors through finding appropriate methods of teaching listening skill to the learners. In addition, the results may contribute to assisting ELT instructors of English by adopting the innovative approaches in language structures teaching and other language skills in order to help in solving some problems in teaching and learning English.

Keywords: Working Memory Capacity- Listening Comprehension- Metacognition- Metacognitive strategies- Metacognitive Intervention.

1.1 Background

The concept of Working Memory (WM) which was first put forward by Baddeley and Hitch in 1974, and later it was modified in 1986, can be considered as the memory system utilized for the temporarily keeping and modifying information while the cognitive activities and tasks are conducted. One of the earlier models of WM was introduced by Baddeley and Hitch (1974). Later, Baddeley revised the model in 1986 and 2000. Baddeley (1986) argues that this model is a multi-component system. Figure 1 shows the developed model. As presented in the model, central executive consist of three main systems as visuo-spatial sketchpad, episodic buffer, and phonological loop. There are also direct interactions among the components of the systems.

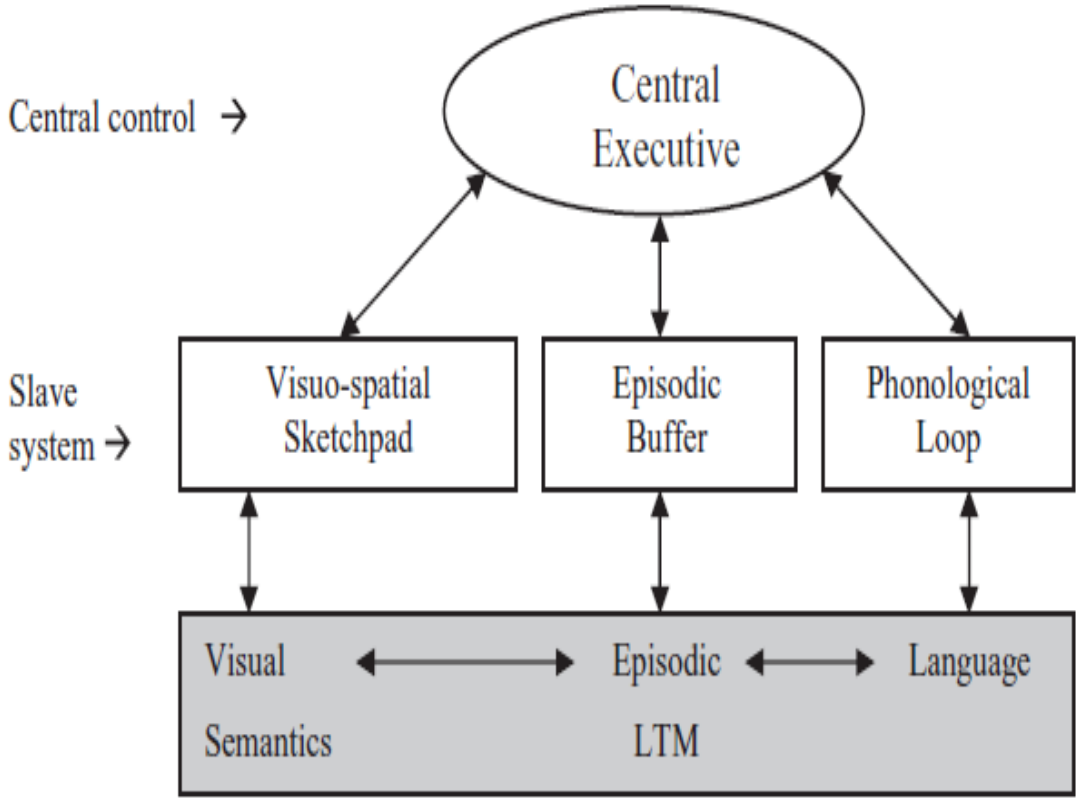

Figure 1. *Development of the Working Memory Model (adapted from Baddeley, 2000, p. 23)*

Baddeley (1992) argues that WM has a limited capacity when dealing with high level cognitive activities. Actually, Engle (2001) also believes that the WM capacity refers to activities that refer the relationships among different tasks in WM, including higher level cognitions, such as reasoning. In order to measure the capacity of WM, three types of tasks including reading span, operation span, and counting span are mainly used. In addition, according to Engle (2001), these tasks indicate some main aspect of cognition. Subsequently, scores obtained from such tasks may represent various cognitive functions. Nevertheless, a number of studies were conducted on the link between WM measures and higher level cognitive skills measures (Just & Carpenter, 1987, 1992). However, it is generally argued that WM is considered as a memory system which has a significant effect on different cognitive tasks.

A huge body of research (e.g. Mousavi, Low, & Sweller, 1995) confirmed that high capacity of WM may assist people to use more cognitive abilities and enhance their learning skills. On the one hand, some of these studies (e.g. Daneman & Carpenter, 1980), revealed the close nexus between learners' reading skill and their WM capacity, In addition, Daneman and Merikle (1996) confirmed the relation between reading comprehension and

WM capacity. Concerning the mathematics performance and verbal arithmetic the study conducted by Bull and Scerif (2001), verified the significant role of WM on mathematics performance.

Various models of WM show that there is close link between attention and WM. Based on these models, WM capacity can be mainly determined through attentional abilities. According to Atkinson and Shiffrin (1986), attentional control is regarded as one of the major components in the data processing theory. In fact, recent studies have shown the significance of attentional control on conducting various WM tasks and activities. Kane and Conway (2007) maintain that WM capacity theories which are based on attentional control, indicate that attentional control abilities are regarded as the major elements of individual differences concerning the WM capacity. Thus, these theories demonstrate that the more WM capacity, the more attentional control abilities. Mayes and Calhoun (2007) believe that attention is taken into account as one of the significant elements in academic success along with general intelligence. In the same vein, Barkley (1988) points out that attention is significantly switching the learners' potential abilities of to practicing and obtaining academic success.

2.1 Theoretical Background

2.1.1 The Atkinson-Shiffrin Memory Model

Atkinson and Shiffrin (1968, p. 90) distinguish between two different parts of the human memory: one that is categorized by "permanent, structural features of the system", and one that is subject of modification by the individual. The first entails what Atkinson and Shiffrin call fixed "built-in processes", whilst the second entails control processes which are actively used by the individual, and may as such vary significantly from one task to another. A further distinction is made between sensory register, short-term store and long-term store – all of which are a part of both the permanent features of human memory as well as the modifiable control processes. In terms of sensory register in the permanent, structural features of the memory system, one automatically registers sensory stimuli: there is a more or less immediate response to the stimuli by the appropriate sensory dimension. Put differently, the sensory stimuli enter our memory via the sensory register after being detected by our senses.

Moreover, each sensory modality arguably has its own register, consequently rendering the sensory register to comprise of multiple registers. No matter the type of stimuli and register, the stimuli is not, however, immediately stored in our long-term memory. Atkinson and Shiffrin (1968, p. 95) argue that the sensory registration of a visual image leaves a photographic trace in our memory, though it decays "during a period of several hundred milliseconds" in addition to being subject of replacement by successive stimulation. As such, fresh input appears to be temporarily stored in the short-term store, though not necessarily processed in the sensory register. However, the rate of decay is difficult to estimate due to a great influence by subject-controlled processes.

Though much of the registered stimuli is neither processed nor actually remembered, some of it may be further attended to by the short-term store. In the short-term store, information retrieved via the senses can be processed, such as in recollection exercises. Without any form of rehearsal, the information is lost quite rapidly (15-30 seconds), whilst the adding of a rehearsal element greatly increases the duration of the memory (Atkinson & Shiffrin, 1968). Such a rehearsal element would include intentional repetition of the stimuli, whether in the sense of repeating uttered linguistic information, or a more abstract form of for instance visual memory. Furthermore, the rehearsal as such need not be in the same modality as the sensory input: one can, for instance, create a mental image so as to better remember a sequence of words. Once the information stored in the short-term store is no longer of use for the individual, the information may well be lost – or it can be transferred to the long-term store. According to the Atkinson-Shiffrin memory model, transfer from the short-term to the long-term store takes place throughout the period that the information resides in the short-term store. As such, logic dictates that the longer a piece of information resides in the short-term store, the more likely it is for this specific information to transfer to the long-term store. Moreover, "long term memory exists in each of the sensory modalities; this is shown by subjects' recognition capability for smells, taste, and so on" (Atkinson & Shiffrin, 1968, p. 104). It should further be mentioned that not all long-term information originates from any of the sensory modalities. Nonetheless, long-term memory is "the final store component" in which, inter alia, "all the words a speaker knows are stored" (Vulchanova et al., 2014, p. 87).

2.1.2 The Baddeley-Hitch Memory Model

Baddeley and Hitch suggested adding working memory to the Atkinson-Shiffrin model, and described it as the part of the short-term memory system "which is involved in the temporary processing and storage of information" (Gathercole & Baddeley, 1993, p. 2). Consequently, the working memory arguably plays an important role in numerous cognitive activities such as reasoning and language comprehension. They originally found the working memory (WM) to consist of three components, which was later extended to four. The original three are the central executive, the phonological loop, and the visuo-spatial sketchpad, whilst the episodic buffer was added by Baddeley some years later.

The central executive (CE) regulates the information flow within WM and also the retrieval of information from other parts of the human memory system. Put differently, the CE has "overall attentional control of the working memory system" (Henry, 2012, p. 21). As such, the CE arguably has the most important functions in WM, and, in fact, Baddeley and Hitch refer to the phonological loop (PL), the visuo-spatial sketchpad (VSS), and the episodic buffer (EB) as the CE's slave systems. The capacity of the CE is limited, however. Its efficiency and capacity depends on how many demands are placed on it at the same time, and consequently its efficiency decreases with the number of demands. Though the CE has attentional control of the WM, it does in fact not have any capacity for storage. Consequently, the CE merely allocates attention within the WM via for instance dividing, focusing and switching attention. This enables us to carry out tasks we have never encountered before, where we must utilize potentially new approaches and new behavior. 8

One of the so-called slave systems of the central executive is the phonological loop (PL). Put simply, the PL system is specialized for storing verbal material and, unlike the CE, it does not have "any capacity for controlling attention or decision-making" (Henry, 2012, p. 5). The PL stores short-term phonological information and enables us to remember smaller portions of heard information for a short time. Furthermore, the PL comprises two components: the phonological store and the subvocal rehearsal. The first represents the heard information in a phonological code which fades over time. Such fading is commonly referred to as "trace decay", as the information in the phonological store is designated as "memory trace". According to Henry (2012, p. 6), the trace decay is so rapid that only "around two seconds' worth of speech based material can be held", which is about enough time to remember a phone number before dialing it.

The second component, the subvocal rehearsal, "serves to refresh the decaying representations in the phonological store" (Gathercole & Baddeley, 1993, p. 8), which means that memory items can indeed be maintained. Put differently, the subvocal rehearsal extends the time for which we can hold phonological information via repetition which enables us to hold the phone number for several more seconds. Such repetition is, nonetheless, not the only role of the subvocal rehearsal as it also recodes non-phonological input – such as printed words and pictures – into their respective phonological form (2014.). In other words, information perceived by the senses as being non-phonological is transformed into phonological information and stored as such in the phonological short-term memory (PSTM).

Yet another "slave system" of the central executive is the visuo-spatial sketchpad (VSS). Whereas the phonological loop is specialized for storing verbal material, the VSS processes and stores visual and spatial information in addition to verbal material encoded as some form of imagery (Gathercole & Baddeley, 1993, p. 17). Put differently, the VSS scaffolds the remembrance of "what" and "where": the visual characteristics of an object and where in space this object was located (Henry, 2012, p. 16). As such, there is according to Gathercole and Baddeley (1993) little indication that the VSS plays any significant role in language. However, recent research has revealed a potential relationship between bilingualism and selective attention during visual search tasks (Friesen et al., 2015). Such tasks arguably greatly rely on 9 processing in the VSS, thus challenging Gathercole and Baddeley's 1993 hypothesis. Nonetheless, the VSS is described in this section in the interest of providing an overall account of working memory. Moreover, an individual's competence in the VSS affects the competence on the WM in total – thus rendering the VSS significant in terms of a hypothesis of the total capacity of WM affecting language aptitude.

As mentioned, the episodic buffer (EB) is the most recent addition to the WM model. The EB provides "temporary storage of information held in a multimodal code, which is capable of binding information from the

subsidiary systems" (Baddeley, 2000, p. 417). As such, the EB integrates information from a number of sources, and it is episodic in the sense that "it holds episodes whereby information is integrated across space and potentially extended across time" (2014, p. 421). The EB is thus a slave system which provides some sort of temporary interface between the other slave systems (the PL and the VSS) and long-term memory, and it deals with information from different modalities. Put simply, different information about a scene may be both visual, spatial and auditory; it is the EB that joins this information together into a coherent memory episode (Henry, 2012). In addition to uniting pieces of information from different parts of the human memory, the EB acts as a link between the CE and long-term memory. Such a linkage enables us to access and actively use previously stored knowledge while doing memory and processing tasks. The process of binding and long-term memory activation may either be controlled by the CE, or it may occur rather automatically. Nonetheless, the EB can arguably act as a "backup store" to supplement the other slave systems as well as providing a linkage to long-term memory. To provide a concrete example: individuals often find it easier to remember strings of words if the words share some relation of meaning, than if they do not – or if they are non-words. As such, semantic information may scaffold remembrance. According to Henry (2012), the mechanism through which information such as semantics can improve recall, is hypothesized to be the episodic buffer: we utilize previously stored information (here semantics) during memory and processing tasks. Put down the link between the reviewed literature and the purpose of the thesis at the end of the main sections in this chapter

2.3 Working Memory and Language Skill Correlation

As described in the previous section on working memory, the phonological loop is largely responsible for the temporary maintenance of acoustic or verbal-based information, and one may thus suggest phonological memory to be a part of language aptitude, given the sub-components defined by Carroll (1965). Several studies have expressed a support for the notion of phonological memory playing a role in L2 vocabulary and grammar learning, and some even suggest that working memory is foreign language aptitude. In terms of working memory playing a role in language aptitude, Sáfár and Kormos (2008, p. 82) refer to a study conducted by Robinson in 2002 in which a moderately strong correlation was found between working memory and language aptitude. Moreover, in 2006-2007, O'Brien and colleagues found PM to be linked to L2 vocabulary use and oral narrative productive skill, as well as PM being associated with increases in function word use. However, PM does not seem to have the same effect at the different stages of learning. In O'Brien et al.'s results, the linkage to L2 vocabulary use and oral narrative productive skill applied to less proficient learners, whilst the association between PM and an increase in use of function words was found in more proficient learners.

Hummel (2009) on the other hand, found significant correlations between PM and L2 proficiency in relatively advanced learners, though a more scrutinized analysis of the results revealed the effect to only remain in the lower proficiency subgroup. It appears that studies investigating the role of phonological memory in language aptitude are more abundant than equivalent research on complex working memory. One of their hypotheses involved the relationship of WM and language aptitude, and was directed at finding support for the aforementioned hypothesis of working memory as language aptitude. Their results support such a hypothesis, as they found a moderate relationship between backward digit span scores and the total HUNLAT score (measures of respectively complex working memory capacity and language aptitude). Moreover, the specific pattern of correlations indicated that "the ability to maintain and manipulate verbal information in working memory influences the efficiency with which students can deduce linguistic rules from the input in a language unknown to the students" (Sáfár & Kormos, 2008, p. 22). They use these results, along with a regression analysis, to further argue for an important role of WM capacity in language learning, and indicate that "working memory is a better predictor of language learning success than the traditional construct of language aptitude" (2014, p. 23).

Nonetheless, some components of the HUNLAT were related to working memory capacity, though they did not overlap. As such, their findings arguably lend support to a hypothesis of language aptitude being componential; working memory being related to one or more of these components. Like Sáfár and Kormos (2008), Wen and Skehan (2011) also argue that the construct of WM should be incorporated as a component of language aptitude. Through an analysis of previous findings, Wen and Skehan discuss empirical results regarding WM and a

number of L2 skills: listening, reading, speaking, writing, and bilingual interpretation. Their discussion lends support to an argument of WM as language aptitude, as there exists empirical evidence of WM affecting all of the L2 skills mentioned above.

In terms of listening, Wen and Skehan refer to Gu and Wang (2007), who found that working memory was an "effective predictor of the participants' listening comprehension performance" (Wen & Skehan, 2011, p. 27). Such a result adds to an argument of a higher level of working memory being more conducive to listening comprehension. Regarding speaking, Wen and Skehan refer to the aforementioned study by O'Brien and colleagues, in which one found that WM contributes differently to the development of L2 speaking depending on the L2 stage of the learner. Similar research is being referred to throughout the discussion, before they finally conclude that there are three (pre)conditions to allowing "WM to be the best candidate component of foreign language aptitude" (2014, p. 35), namely that there are variations in WM capacity that are specific to individual L2 learners and these variations can be measured […]; second, WM plays a very important role in various SLA stages and cognitive processes and such effects are constant and pervasive; third, different components of WM […] have been found to be highly correlated with different aspects of L2 performance and developments and specific L2 skills development […] (Wen & Skehan, 2001, p. 35).

Working Memory Capacity (WMC)

The concept of working memory refers to the memory system used for the temporary holding and manipulation of information during the performance of a range of cognitive tasks such as comprehension, learning, and reasoning. The most influential model of working memory was proposed by Baddeley and Hitch (1974), and then revised by Baddele (1986, 1992). The major feature of this model is that working memory is conceived as a multi-component system, consisting of three main components, i.e. the central executive, the phonological loop and the visual－ spatial sketch pad (Baddeley 1986). The concept indicates that working memory has a limited capacity when dealing with high level cognitive tasks. The working memory capacity, according to Engle (2001), refers to mechanisms that account for the covariation between a variety of working memory tasks, on the one hand, and tasks of higher level cognition, such as listening comprehension and reasoning, on the other hand, there are three tasks that have been frequently used to measure working memory capacity: reading span, operation span, and counting span tasks.

Engle (2001) demonstrates that these tasks clearly reveal some fundamental aspect of cognition. Scores on these tasks can predict a range of cognitive functions. Meanwhile plenty of investigation concerns the relationship between measures of working memory and measures of higher level cognitive skills and abilities (Engle, Cantor & Carullo, 1992; Daneman & Carpenter, 1980; Just & Carpenter, 1987, 1992, Turner & Engle, 1986, 1989). It can be universally accepted that working memory is a general memory system, which plays a role in a wide variety of cognitive tasks. Working memory is a part of the mental system, which has responsibility for data processing and interim storage needed for complicated cognitive activities like learning, understanding and reasoning. Working memory focuses not only on data storage and processing, but also on the active manipulation and using the data (Daneman & Carpenter, 1980).

Many surveys have shown that high capacity of working memory helps individuals to utilize more cognitive resources and improve their learning skills (Daneman & Carpenter, 1980; Mousavi, Low, & Sweller, 1995). Many studies showed the significant relation between reading and working memory capacity (Daneman & Carpenter, 1980), reading comprehension (Daneman & Merikle, 1996), mathematics performance and verbal arithmetic (Bull & Scerif, 2001), learning sciences (Johntson & El-Banna, 1986) and scholastic aptitude (Turner & Engle, 1989). These studies also demonstrate a close relationship between the low scores in working memory and poor performance in all fields of education. According to these findings as well as metaanalysis studies (Daneman & Merikle, 1996; Akerman & Beier, 2005) it could be inferred that working memory affects cognitive competence resulted from processing requirements and necessary storage for solving mental issues (Hoffman & Schraw, 2009) and enjoys considerable predictive power in measuring many cognitive functions (Unsworth & Spillers, 2010) and educational progress.

According to many models of working memory, attention and working memory are closely linked. The models also reveal that the predictive power of working memory capacity is mainly determined through attentional abilities. Attentional control as a main element in the basic theory of data processing (Atkinson & Shiffrin, 1986) relates to the central administration of working memory (Baddeley, 1986). Most of the recently conducted surveys agree on the importance of attentional control in the implementation of different kinds of standard tasks of working memory including separating components of processing and storage.

According to the theories of working memory capacity based on attentional control, attentional control abilities are considered as the main differentiating elements of personal differences in terms of working memory capacity in addition predictive power of working memory capacity in performance (Kane & Conway, 2007). In accordance with this theory those with high capacities of working memory who possess more attentional control abilities could manage to store data in chaotic conditions more active than those with low capacities of working memory (Unsworth & Spillers, 2010). Attention is considered as one of the important and influential factors in academic achievement alongside general intelligence (Mayes & Calhoun, 2007). Attention plays an intermediary role in turning potential abilities of student to function and achieving academic achievement (Barkley, 1988).

Listening Skill

The concept of listening comprehension has been defined by authors such as Andrade (2006) who states that listening comprehension is the ability to hear and to understand what others say. Some other authors agree with this definition but they add some characteristics that are relevant for the final definition of this skill. Bakan (2006) considers listening comprehension as the relationship between the speaker, the listener and the message. That relationship is important due to the fact that when we listen, there is a message and a person involved. The meaning of the message depends on the understanding and the intention that each of them has in the moment. Rost (2002) mentions that this skill is the result of experimenting contextual events; this refers to the fact that our understanding of listening input is really affected by the context. The message can be interpreted in a different way depending on the situation. Another important aspect that this author presents is the relevance of sharing a context. If the speaker and the listener do not share at least some knowledge of the situation, this can be a cause for misunderstanding.

Finally, Wilson (2008) explains that listening involves the decoding of a message but differently from reading, where the reader can go back and read again. Listening does not give that opportunity since it is a process that takes place in the exact moment and require full attention from the listener. Besides, the listeners need to use their knowledge in order to get the appropriated intention from what they listen. It is not enough to listen, it is required to analyze what is the intention of the speaker. There are some other authors that go beyond just defining the listening comprehension and explain that there are some stages in the listening process that should be completed in order for the message to be understood. The most complete and clearest definition is Steinberg's, which describes the process of listening as follows:

> "Listening is more complex than merely hearing. It is a process that consists of four stages: 1) sensing and attending, 2) understanding and interpreting, 3) remembering, and 4) responding ... The stages occur in sequence but we are generally unaware of them." (Steinberg, 2007, p. 66)

2.6.1. Types of Listening

Since listening is involved in many activities that we carry on in daily life and that have different requirements, usually we adapt the form in which we listen to a particular purpose and needs Sayikumar (2013), describes five different types of listening:

- *Informative Listening*, whose purpose is that the listener can get some information from the message; it can be specific or general information.
- *Relationship Listening*: "The purpose of relationship listening is either to help an individual or to improve the relationship between people". (Sayikumar, 2013). This type of listening is relevant taking into consideration that each participant pays careful attention to what is said in order to avoid misunderstandings. Another example can

be the conversations between store managers, whose intention is to develop a relationship so they should listen carefully in order to get to an agreement.

-*Appreciative Listening* is the kind of listening that we do when we listen for pleasure or enjoyment, without a necessity of understanding particular information. Think about when you listen to a song, your intention is to enjoy the rhythm more that getting information from it.

- *Critical Listening* refers to the ability to listen critically and generate a decision based on that.

- *Discriminative Listening* may be the most important type of listening, for it is basic to the other four. By being sensitive to changes in the speaker's rate, volume, force, pitch, and emphasis, the informative listener can detect even nuances of difference in meaning. By sensing the impact of certain responses, such as "uh huh," or "I see," relationship listening can be strengthened." (Sayekumar, 2013). On the other hand, Wilson (2002) suggests a different classification based on the purpose of listening and he distinguishes the following categories:

Listening for gist: in some occasions, we want to get the general idea of what is said as well as who are the participants and why they are talking.

Listening for specific information: as the name indicates it happens when the listeners are focusing their attention in specific information. According to Wilson, this is the type of listening that we do when we don't need to understand everything.

Listening in detail: it is defined as the kind of listening that humans do when they need to find an error or to determine differences between passages.

Inferential listening: it is the type of listening in which we use the content of what the interlocutors say, the intonation and speed of participants, their use of the language and extra linguistic information (sounds, ambience…) to deduce information that is not specifically stated.

According to Giovannini, Martin Peris, Rodríguez and Simón Blanco (1997), the purpose of the listening comprehension training is to develop the learner's ability to comprehend oral messages. They states that in order to acquire this objective, teachers perform different activities that allows the learners to arrive to that objective. The authors mention some micro skills that teachers should consider in order to arrive to the listening comprehension purposed already mention.

- Recognize this skill can be summarized in the ability to distinguish sound, words and specific information.

- Selecting: this skill refers to the ability to detect key words from a discourse (names, verbs and phrases) and differentiate them from the ones that are not relevant.

2.5 The Concept of Metacognition

The ability to reflect on one's own thoughts and experiences is probably a unique human capability; humans can reflect on their lives, thoughts and actions, whereas animals cannot. Furthermore, humans are the only species that can plan their future, think about their past and learn from their experiences, and to some extent also foresee what will happen to them. They can also imagine what it is like to be someone else; that is, they can feel empathy for others. Metcalfe (2008) argues that people's ability to reflect on their own thoughts, or metacognition, is a recent result of evolution; whereas animals are purely instinct and stimulus bound, metacognition allows humans to exert self-control over their actions.

Most researchers attribute the concept of metacognition to Flavell (1976). He defines metacognition as "one's knowledge concerning one's own cognitive processes and products or anything related to them" (1976, 232). Flavell (1979) suggests three domains of metacognition, namely metacognitive knowledge, metacognitive experiences and metacognitive strategies. In the domain of metacognitive knowledge, person knowledge refers to knowledge of oneself and others as cognitive processors. It includes knowledge and beliefs about what people think they can and cannot do well. Further, it includes knowledge and beliefs about how and to what extent factors like age, gender, intelligence, motivation, personality and educational background influence learning. Task knowledge refers to an understanding of how a task should be managed and "how successful you are likely to be in achieving its goal" (1979, p. 907). Strategy knowledge refers to beliefs about which strategies are effective to achieve a goal. Flavell states that metacognitive knowledge typically involves a combination of these

three types. Furthermore, Flavell (1979, p. 906) defines metacognitive experiences as "any conscious cognitive or affective experience that accompany and pertain to any intellectual enterprise".

Additionally, metacognitive strategies refer to the deliberate use of strategies to control one's own cognition. Flavell (1987) later expanded the concept of metacognition to explicitly include not only cognitive but also affective variables. He also makes clear that the different domains of metacognition are often not easy to separate from each other. Veenman, van Hout-Wolters, and Afflerbach (2006, p. 4) rightly state "while there is consistent acknowledgement of the importance of metacognition, inconsistency marks the conceptualization of the construct". In fact, recent decades have seen a proliferation in attempts at defining and classifying metacognition. General and short definitions like "thinking about one's own thoughts" (Hacker, 1998) and "reflections on cognition" (Schoenfeld, 1987) are often cited, but definitions related exclusively to learning are also common. Thus, the field uses the concept of metacognition in a variety of ways and with different superordinate and subordinate categories depending on researchers' backgrounds and research interests. A further complicating factor is that other terms are also used for metacognitive knowledge, experiences and strategies, and it is therefore hard to set clear boundaries for the field. Examples of such concepts are belief, reflection, theory of mind, meta-memory, critical thinking, awareness, cognition, autonomy, learning strategies, self-regulation and self-efficacy, and it is not always clear how these concepts relate to metacognition (Veenman, van Hout-Wolters, & Afflerbach, 2006).

Also in the field of language learning and language teaching, several terms are used, partly interchangeably. However, it is not the goal of this chapter to provide an overview of the various usages (Tarricone, 2011), nor is it to conclude that one understanding of metacognition is better than another. Rather than taking an essentialist approach to research on metacognition, I argue that researchers should aim at providing a clear presentation of their understanding of the concept in their respective studies (Janicki 2006).

2.5.1 The Concept of Metacognition in Language Learning and Teaching

Wenden (1987) was probably the first researcher to call attention to the importance of metacognition in language learning and teaching. In her review of research on metacognitive knowledge, she sets out to clarify how this research field relates to already established theories and research on language. Wenden understands metacognitive knowledge as knowledge about one's own learning. Drawing on Flavell, she acknowledges three categories of metacognitive knowledge, namely person knowledge, task knowledge and strategy knowledge. Furthermore, Wenden distinguishes between metacognitive knowledge and metacognitive strategies. Metacognitive strategies are defined as "general skills through which learners manage, direct, regulate, guide their learning, i.e. planning, monitoring and evaluating" (Wenden 1998, p. 519).

In accordance with cognitive psychology, Wenden categorizes planning, monitoring and evaluation as the three components of self-regulated learning. She refers to what learners already know about a subject as domain knowledge. Consequently, domain knowledge is viewed as separate from metacognitive knowledge, but Wenden underscores that both these knowledge types are necessary when solving a task. Prior knowledge is regarded as one of the most important contributors to subsequent learning (Weinstein & Mayer, 1986). Thus, reflecting on what is needed to master a task also involves reflecting on learners' prior knowledge of similar tasks and subjects. Thus, learners' and teachers' reflections on what they know and what they do not know comprise a central component of their metacognition. This understanding remains in agreement with general definitions of metacognition, such as "thinking about one's own thoughts" (Hacker, 1998, p. 45) and is in line with researchers like Tobias and Everson (2002) and Paris and Winograd (2013). Tobias and Everson (2002) refer to this component as knowledge monitoring, a fundamental or prerequisite process for further learning. Thus, a conscious analysis of what one knows about—for example, certain language structures or the city of London—is necessary for realizing what still must be learnt and planning how learning can be achieved. Furthermore, an awareness of one's emotions is increasingly seen as a central component of metacognition (Fisher, 2018; Hiver & Whitehead, 2018; Papaleontiou-Louca, 2008). Metacognition thus refers to an awareness of and reflections about one's knowledge, experiences, emotions and learning in the contexts of language learning and teaching.

Included in this definition are all aspects of thinking about language, language learning and teaching; for example, what learners and teachers know or do not know about languages and language learning (Vold, 2018;

Hasselgård, 2018, ; Hiver & Whitehead, 2018), what they think about their own abilities to learn and/or teach languages (Knospe, 2018; Fisher 2018), reflections on emotions concerning experiences related to language learning and/ or teaching (Arntzen & Eriksen, 2018; Fisher, 2018) and how to learn and teach as well as monitor one's own learning and/or teaching (Forbes, 2018; Hiver & Whitehead, 2018). Following from this definition, the concept of language awareness covers my understanding of metacognition to a large extent. On its website, the Association of Language Awareness (ALA) defines language awareness as "explicit knowledge about language, and conscious perception and sensitivity in language learning, language teaching and language use" (p. 54). Consequently, the superordinate category, Metacognition, relates to an awareness of and reflection on one's knowledge, experiences, emotions and learning in all domains, whereas its subordinate category, Language awareness, relates to reflections on one's knowledge, experiences, emotions and learning in three subdomains: Language, Language learning and Language teaching.

Obviously, these domains are closely related, and metacognition in language teaching, for instance, typically involves reflection in all three domains simultaneously. Furthermore, each of these three subdomains can be divided into several new categories depending on the theoretical viewpoints and interests of the researchers. A consequence of this quite general understanding of metacognition is that many related research fields fit under the heading of metacognition. For example, investigations of teachers' and learners' beliefs, the teaching and use of learning strategies, metalinguistic and multilingual awareness, intercultural awareness and self-efficacy can be claimed to belong here.

2.7 Empirical Studies

2.7.1 Empirical Studies on WMC

Adams and Shahnazari-Dorcheh (2013) examined the role of working memory capacity in the development of second language reading ability. 55 L1 Persian EFL learners at three proficiency levels from a private language school participated in this study. They completed a battery of reading and working memory measures. Memory measures included phonological short-term memory, and reading span test (RST). Reading measures included two expository reading comprehension tests. Multiple regression analysis was applied to determine whether there are any significant relationships between working memory capacity and reading measures. Results of this study indicated a significant relationship between working memory capacity (as measured by RST) and reading ability at lower levels of proficiency.

Christiansen (2016) provided further insight into the somewhat mysterious relationship between language aptitude, working memory and attentional control. As such, a group of Norwegian university students of English were quantitatively tested in English proficiency, working memory and attentional control. A total of eight different tests were conducted, and all participants were tested individually under calm and controlled circumstances so as to prevent any intervening input. The results were subsequently analysed and checked for correlation in the open source software R. Surprisingly, the analysis did not yield any statistically significant results, though some trends were detected. These trends revealed an interesting relationship between one of the measures of phonological short-term memory and L2 proficiency, as well as between attentional control and L2 proficiency. Consequently, the findings of the present study conform to previous research and add weight to hypotheses of working memory, attentional control and language somehow being interconnected.

Wen (2012) introduced a principled approach to incorporating the construct of working memory (WM) into second language acquisition (SLA) research. Towards that end, she argued for an integrated framework of WM for SLA that draws on insights from established WM research in cognitive psychology as well as initial findings from SLA studies looking into the effects of WM. Within the framework, she also proposed a set of general principles that serve as a basis for further studies probing the WM-SLA nexus. Applying some tenets from this framework, she reported on an empirical study investigating the differential effects of WM constructs on L2 task-based speech planning and performance, culminating in forged links bridging WM components and their corresponding L2 speech performance measures. Further implications of this integrated framework of WM for SLA were also discussed in the context of "WM as foreign language aptitude".

Santacruz and Ortega (2018) examined how working memory training could contribute to retaining vocabulary studied in English lessons through the implementation of a set of strategies. Two intact groups of beginners: one experimental, with 28 students, and one control group, with 22 students, belonging to undergraduate English as a foreign language courses at a Colombian university were involved in the study. After being exposed to a series of memory strategies for a period of 10 weeks, it was evident that most learners in the experimental group benefited from the intervention and showed gradual progress in the retention and retrieval of the words studied in the lessons; thus, improving their overall competence in the foreign language.

In a review article on the relationship between working memory and language, Baddeley (2003) mentioned two other possible contributions of working memory to language understanding. He thought it likely that visuospatial working memory would be involved in maintaining a representation of the page and its layout during reading. Readers are amazingly accurate at localizing previously read words. This can be seen, for instance, when they make regressions upon encountering a comprehension problem in text reading. These regressive eye movements are usually remarkably accurate (Kennedy, Brooks, Flynn, & Prophet, 2003) and seem to require access to a spatial map of the text. Baddeley (2003) further hypothesized that visuospatial working memory may also be involved in the understanding of spatial information (e.g., grammatical structures involving spatial terms such as above, below, shorter, and so on).

Bozorgian and Pillay's (2013) study on sixty lower intermediate female participants from two EFL classrooms in an English language institute divided into an experimental and a control group showed that the five listening strategies of guessing, making inferences, identifying topics, repetition, and note-taking which were taught over 14 weeks during a semester delivered in L1 led to a statistically significant improvement in the experimental group's listening scores compared with the control group. Thus, the experimental class received more support from L1 listening strategy instruction, and improved their listening ability in foreign language learning suggesting that instruction of complex listening strategies through L1 allows the learners to better comprehend and take in the listening strategies.

2.7.2 Metacognition Intervention Studies

Hosseini, Izadpanah and Fasih (2020) examined the metacognitive strategy training on improving Iranian EFL learners' listening performance and the differences and similarities at three levels of elementary, intermediate, and advanced levels. Few studies have been conducted to investigate three levels. So, 348 third grade female senior high school students of Zanjan/Iran were selected through multistage cluster random sampling method and based on Cambridge placement test (2010), 116, 132, and 100 students in 3 elementary, advanced, and control groups participated in this experimental study. During two months and over period of nine forty-minute sessions, students in experimental groups received metacognitive and listening instructions. To address the research question, ANOVA test was conducted and the results showed that there were meaningful differences between students' performance and the students of experimental advanced group showed more improvement than students in experimental intermediate and elementary groups, and students of intermediate experimental group showed more improvement than students in experimental elementary group. The implication of the study is that metacognitive strategy training should be incorporated into the regular listening teaching programs to help students become more effective listeners.

Taheri and Taki (2015) analyzed the effect of dictogloss on EFL learners' listening comprehension as well as on their use of metacognitive listening strategies and they focused on the effects on male and female learners. For this aim, a total number of 50 female and male Iranian EFL learners, aged between 12 and 15 years old, at the intermediate proficiency level in a private language school in Iran were selected and randomly assigned to experimental and control groups with 25 male and female learners in each group. Dictogloss was used to teach the learners in the experimental group in the 12 instructional sessions. Participants' listening comprehension was determined through a pre/posttes that was adapted from the listening section of the standard test of PET and their use of metacognitive listening strategies via the Metacognitive Awareness Listening Questionnaire (MALQ), a questionnaire developed by Vandergrift, Mareschal, and Tafaghodtari (2006). The information obtained were submitted to the t-test and results revealed significant improvement in the experimental group's listening comprehension with no remarkable difference between male and female learners. Finally, the results

demonstrated that the listeners in the experimental group made significant enhancements in their choice of metacognitive strategies through using the dictogloss technique. Findings are considered in light of recent theories of language learning and teaching.

Wong (2012) focused on how university students in Hong Kong self-regulate their academic learning. Two factors were focused for their self-regulation: the utilization of metacognitive skills and the punctuality for learning. Three hundred and fourteen students from two universities participated in this study by filling out a self-administered questionnaire, which consists of three instruments measuring metacognitive awareness, procrastination, and academic performance. The results demonstrated that 'high metacognitive awareness' and 'low procrastination tendency' had positive effects on academic learning. In order to analyze the data, the data were divided into four categories by using the mean scores of each variable: students with high level of metacognitive awareness and high level of procrastination; students with low level of metacognitive awareness and low level of procrastination; students with high level of metacognitive awareness but low level of procrastination; students with low level of metacognitive awareness but high level of procrastination. The results demonstrated that the students with none of these positive factors are considerably lower in G.P.A. than students from the other three groups; however, it is surprising to find that the students who have two positive elements do not get a higher G.P.A. than those who have only one of these positive elements.

Altuwairesh (2016) investigated the metacognitive listening strategies used by Saudi EFL female students when listening to texts in English. Two main research questions were explored in the study: (1) which of the five major types of metacognitive strategies do the participants use most when listening to English texts? and (2) what are the metacognitive listening strategies used most by the target group when listening to English texts? The MALQ was used to arrive at answers to the two research questions. The participants were 82 students from the same cohort. Results reveal that the participants reported using problem-solving and directed attention strategies more frequently than the other metacognitive listening strategies; mental translation and personal knowledge strategies are the least used by the participants. The results give insight into the metacognitive listening strategies used by effective L2 listeners, with ample evidence provided from the literature available on the subject. Results of this study also demonstrate that many L2 learners do in fact perceive listening as difficult, thus, investing classroom time in developing learners' strategies is worthwhile.

Chou (2017) in his study about a task-based language teaching approach to developing metacognitive strategies for listening comprehension, aimed to investigate how well a task-based teaching framework was able to develop intermediate Chinese English as a Foreign Language (EFL) university students' metacognitive awareness of listening comprehension. Eighty-eight sophomores participated in the study, which used a quasi-experimental design. The experimental group received strategy-embedded task-based listening instruction for 18 weeks, whereas the control group received only strategy-based instruction. Listening tests and questionnaires were used in the pre-test and posttest stages. The results showed that the experimental group improved their metacognitive awareness of strategies for listening and outperformed the control group in the listening test. The students in the experimental group considered tasks to be an important medium of input enhancement for improving listening ability.

Similarly, Gagen-Lanning (2015) investigated the impact of MST on students' self-directed use of assisted technology in ESL listening. Gagen-Lanning delivered two 60-min sessions, including metacognitive strategies and TED Talk videos, to three participants, and then encouraged them to use self-directed TED Talk videos for their listening improvement. The study utilized the MALQ, a listening worksheet, screen casting software, and a follow-up survey to collect data. The screencast analysis showed what the participants actually did during the listening task. It is important to check what learners actually do after MST instead of only relying on questionnaire responses, but the sample size (three participants) was too small to draw a reliable conclusion from the findings. The study also found that MST could promote self-directed learning, but whether metacognitive strategies can be learned more effectively with the self-directed method in MST remains unanswered.

Vandergrift and Tafaghodtari (2010) investigated the effects of a metacognitive, process-based approach to teaching second language (L2) listening. The participants were 106 students of French. 59 students were assigned to experimental group. They listened to a variety of texts and were taught metacognitive processes including prediction, planning, monitoring, evaluating, and problem solving. The control group included 47

students who listened to the same texts without metacognitive instruction. The experimental group outperformed the control group in the listening comprehension measure. Less skilled listeners in the experimental group made greater gains than their more skilled ones.

Mevarech and Fridkin (2006) investigated about metacognition training in mathematics class that can improve the metacognitive awareness of the students and their mathematic knowledge and performance. The instrumentation of their research was MAI to measure metacognition, and the result shows that metacognitive awareness is positively correlated with the academic performance. Although the samples are from pre-college mathematics classes, the experimental design may give a cause-and-effect conclusion for their study.

Rezvan, Ahmadi, and Abedi (2006) demonstrated that the rise of metacognition can improve the students' academic performance, especially for the university students who are on margin or called conditional students. The study also showed that metacognitive training can be a reason of the change in the emotional state of the students, reducing their level of anxiety and improving their academic work. The results demonstrated that the use of metacognitive strategies had a significant effect on the weaker learners. It can be mentioned that a low level of metacognition is one of the causes of poor academic performance.

Bozorgian and Fakhri Alamdari (2018) attempted to investigate the effect of metacognitive instruction through dialogic interaction in a joint activity on advanced Iranian EFL learners' multimedia listening and their metacognitive awareness in listening comprehension. The data were collected through (N=180) male and female Iranian advanced learners ranging from 16 to 24 years of age in three groups. The first two groups were experimental (n=60), trained through a structured intervention program focusing on metacognitive instruction through dialogic interaction (MIDI) and metacognitive instruction (MI) for 10 sessions. The learners in the experimental group were involved in 60 minutes of practice twice a week. The third group was a control group (n=60), trained through regular classroom listening activities without receiving the structured intervention program. Multimedia listening tests and the MALQ were used to track the advanced learners' multimedia listening comprehension and metacognitive awareness. The results showed that metacognitive instruction through dialogic interaction did improve both the advanced learners' multimedia listening comprehension and their metacognitive awareness in listening.

Ko (2019) analyzed English-learners' metacognition when engaged in reading and listening tasks, to determine if there was a correlation between their reading metacognition and listening metacognition, and to determine if metacognition levels differed between students of basic, intermediate, and advanced English levels. One class of 50 nursing students in a 5-year nursing program was assigned to participate in this study for one semester. The learners were divided into three groups (high, intermediate, and low) based on their score on an English listening test. At the beginning of the semester, they listened to a lesson called "Dangerous Dining." Five months later, the students were presented with the same lesson, though this time in written form rather than spoken form, and their reading comprehension was tested using the same questions. Then the learners were asked to fill out two online questionnaires: a 21-question questionnaire about their reading strategies, and a 30-question questionnaire about their listening strategies. The surveys were designed to gauge the participants' metacognitive awareness. The results showed that there was a positive and strong significant correlation between the learners' listening metacognitive strategy and reading metacognitive strategy. The results revealed that there was a positive significant correlation between reading comprehension and listening comprehension for low-level learners. The intermediate and advanced language learners reported applying fewer listening metacognitive strategies to reading metacognitive strategies than the low-level language learners because they had internalized the listening/reading metacognitive strategies to experience them automatically and didn't report the automated process. They thus used fewer metacognitive strategies.

Tan, Chen, and Lee (2019) studied the effectiveness of a digital pen-based learning system with a reward mechanism to improve learners' metacognitive strategies in listening and developed a digital pen-based learning system with a reward mechanism that guides learners through the metacognitive processes effectively use available help options to develop listening skills. Two experiments were performed to evaluate the effects of the proposed system on learners' listening achievement, motivation, and metacognitive awareness. The experimental results indicated that the proposed system improved learners' listening comprehension, learning motivation, and metacognitive awareness. A lag sequential analysis was conducted to infer learners' behavioral patterns to

explore how learners used the help options to perform listening tasks. Several interesting behavioral patterns were found and discussed.

Fathi and Hamidzadeh (2019) investigated the contribution of listening strategy instruction to improve listening comprehension of EFL learners in Iranian context. In so doing, a number of 52 English literature students of two intact classes at Islamic Azad University, North Tehran Branch, in Iran served as the participants of the study. The two classes were randomly assigned to an experimental group and a control group. The experimental group received the listening strategy instruction according to the approach proposed by Yeldham and Gruba (2014), whereas the control group was taught with regular method with no strategy instruction. The listening section of the IELTS was administered to measure the listening comprehension ability of the students before (i.e., as pre-test) and after (i.e., as post-test) the strategy instruction. Oxford Placement Test (OPT) was also administered to ensure the homogeneity of the participants with regard to their general English proficiency. The findings revealed that the experimental group significantly outperformed the control group on the listening performance test, suggesting that the listening strategy instruction was effective in enhancing listening comprehension of the participants.

Maftoon and Fakhri Alamdari (2016) explored the effect of metacognitive strategy instruction on the listening performance and metacognitive awareness of EFL learners in Iran. It also strove to investigate how various aspects of learners' metacognitive awareness, as measured by each of the five MALQ factors, were affected by metacognitive strategy instruction. The participants were 60 intermediate EFL listeners in two groups, ranging in age from 20 to 26. The experimental group (N = 30) went through a guided lesson plan in metacognition for 10 weeks, which focused on planning, monitoring, and evaluation. The control group (N = 30) was taught by the same teacher and listened to the same texts without any guided attention to process. The MALQ and a listening test were also used before and after the intervention to track the changes in metacognitive awareness and listening performance. The results showed that metacognitive strategy instruction led to a considerable variance in overall listening performance and metacognitive awareness of learners. Furthermore, the analysis of the five MALQ factors revealed a significant impact of metacognitive strategy instruction on the metacognitive awareness of listeners.

Bozorgian , Yaqubi and Muhammadpour (2020) investigated the effect of the Metacognitive Intervention (MI) on the listening performance and metacognitive awareness of upper intermediate learners of English as a Foreign Language (EFL) with low Working Memory Capacity (WMC). The participants were given the visual Digit Span Test (DST). The experimental group received the MI through the pedagogical cycle for 10 sessions, whereas the control group followed a traditional approach. The findings showed that the experimental group had a higher gain with a moderate effect size in terms of listening performance than the control group. In addition, the MALQ revealed the significantly higher use of directed attention, mental translation, and person knowledge by the experimental group.

Fiani, Suherdi, and Musthofa (2019) investigated the effect of the instruction on listening comprehension and metacognitive awareness of EFL undergraduate students. The participants were guided through the process of planning, monitoring, and evaluating in their listening activities. The instrumentation for this study included the use of a listening test, a questionnaire, and semi-structured interview. The results showed that the metacognitive pedagogical cycle might has a considerable impact on enhancing EFL undergraduate students' listening comprehension. Moreover, the EFL students were able to benefit from the instruction in listening strategies to assist them in their language learning success.

Alavidoost and Bozorgian (2021) utilized a fuzzy logic analysis as a remedial approach in order to equalize these scales. They compared between less- and more-skilled L2 listeners to find out which group would logically benefit more from metacognitive intervention. A quantitative approach and quasi-experimental design were used to address the research questions. Iranian students were selected including 31 more-skilled and 34 less-skilled . The instruction was based on metacognitive intervention in eight sessions. The result, which was based on a Fuzzy logic analysis approach, indicated that less-skilled L2 listeners benefited more than more-skilled L2 listeners from metacognitive intervention.

Discussion

According to Temple's (1997) WM plays an especially important role in early L2 learning. It is in line with the findings of the previous study conducted by Lesser (2007) that WM plays an important role in beginning Spanish learners' comprehension as well as Walter's (2004) findings that for lower proficiency L1 French ESL learners the transfer of comprehension skill from L1 to L2 relies on verbal working memory. She suggested that success of higher-proficiency learners relied more on language skills than on WM. For her, it seemed that for higher level learners, with greater language knowledge and greater automaticity in the learning process, the learning tasks presented less of a burden on WM than for lowerlevel learners who relied more on memory capacity. At this point then, differences in WM capacity no longer lead to differences in comprehension. Rather, as proficiency develops, language knowledge takes the major role in extracting the text information (Grabe & Stoller, 2002; Koda, 2005; Leslie & Caldwell, 2009), perhaps because of the greater automaticity in language processing at higher levels of proficiency. This suggests a dual view of individual comprehension in a L2; at the beginning levels of proficiency, learners with greater cognitive capacity may be better readers while at higher levels, learners with greater language knowledge may be better readers. The more fluent the learners are, the more automatic their processes, and the less memory demanding L2 will be.

Mevarech and Fridkin (2006) investigated metacognition training that improved the metacognitive awareness of the students and their mathematic knowledge, performance and the results show that metacognitive training is positively correlated with the academic performance. Likewise, the results of Rezvan, Ahmadi, and Abedi (2006) also demonstrated that the rise of metacognition can improve the students' academic performance, especially for the university students and the results demonstrated that the use of metacognitive strategies had a significant effect on the weaker learners. On the other hand, Maleki (2005) investigated the effect of cognitive and the metacognitive strategies on improvement of different school subjects such as English, but failed to find significant difference in the effect of metacognitive strategy training on learning English. He found that cognitive strategies were useful in learning physics and metacognitive strategies were only useful in social lessons but neither cognitive strategies nor metacognitive strategies were found to be useful in learning English (Maleki, 2005 as cited in Rahimi et al., 2012). Engel de Abreu and Gathercole (2012) argue that providing learners with opportunities to store and rehearse auditory information may play a key role, especially at early stages of learning.

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