Inflectional Morphology Processing in Second Language Acquisition: The Role of PI and WM in Processing Redundant English Verbal Inflections

Aljuhara Abdullah Hasan Alhussaini

Submitted in accordance with the requirements for the degree of Doctor of Philosophy (PhD)

The University of Leeds
The school of Languages, Cultures and Societies

November, 2020

Acknowledgements

I would like to express my deep and sincere gratitude to my research supervisors, Dr Clare Wright and Dr Mohammad Ahmadian for providing invaluable guidance throughout this journey. I would like to extend my deepest appreciation to Dr Clare Wright, who encouraged me to carry out this research and present it as clearly as possible. It was a great honour to work and study under her supervision.

I am extremely grateful to my parents who have supported me during every step of this process, without their encouragement, prayers and love, I would not be where I am today.

I would like to extend my thanks to my husband and my children for their love, understanding and continuous support throughout this journey. Also, to my sister Mai, for her constant support and unconditional love for me and my children.

Abstract

The variation in second language acquisition (SLA) is often found in the morphological interface and can be an issue throughout all the levels during second language learning (Lardiere, 1998). The aim of this thesis is to investigate the role of processing instruction (PI) in shifting explicit to implicit knowledge, pushing instructed L2 learners to derive intake by attending to morphological cues in the input.

This research employs instructed English learners in an L1 Saudi Arabic intermediate-level university classroom (total n=92) and it adopts a pre-test, immediate post-test and delayed post-test design, with two treatment groups and one control group. The method employs online language tests that involve differentiated processing loads (self-paced reading and elicited imitation). In addition, a new modified PI treatment was employed and compared to the original PI treatment to address previously noted challenges of processing and production of the target forms caused by the inappropriate initial form-meaning connections and the limited capacity to process the target forms in the input (VanPatten, 1996).

Two studies were employed to test how far the different PI treatments are playing a role in the processing and production of the morphological inflections: third person singular -*s*, regular past form -*ed*, and present progressive -*ing*, and to what extent the underlying linguistic knowledge is affected by these treatments. Two IP principles relevant to the phenomenon under study are The Lexical Preference Principle and The Preference of Nonredundancy. According to these principles, learners tend to spend their attentional resources to detect content words first in order to get the meaning, leading them to fail in acquiring the target form that would be automatically accessed in production, particularly if the morphological form is redundant.

The findings across all tests showed a generally significant group effect ($p < .001$), indicating that both modified PI and standard PI led to improvement in most cases compared to the control group. However, online production tests showed a significant advantage for the modified PI

treatment only, suggesting the additional elements of communicative production was the most effective for acquisition.

This research is an attempt to initiate a link between the theoretical vision of underlying representations developed within SLA model and the teaching and learning methods and activities inside second language classrooms in order to shift the processing abilities to handle input into ways that enable the integration of representations into the developing system.

TABLE OF CONTENTS

List of Tables

List of Figures

CHAPTER 1.

INTRODUCTION

The inaccurate production of inflectional morphology has long been debated in second language acquisition (SLA). Early studies revealed that the acquisition of morphemes is a long and slow process and that learners exhibit inaccurate morphological inflections in spontaneous production (e.g. Dulay and Burt, 1974; Bailey et al., 1974). However, the variation is often found in the morphological interface and can be an issue throughout all the levels of SLA (Lardiere, 1998). Such variability in functional morphology has been considered typical of adult L2 speech (Rothman, 2008; Hopp, 2010), and, in instructed L2 learners, may be potentially explained by their variable reliance on explicit vs implicit knowledge in addition to some other issues related to the special nature of the target structures, such as redundancy.

Although present and past tense verbal agreement has been extensively discussed in previous second language processing studies, there is currently no consensus as to the reasons behind their constant variability in L2 learners' production. Moreover, these morphological inflections have proven to be persistently difficult to acquire; even advanced L2 learners show variability when producing these inflections in spontaneous production. An absence of morphological inflection in obligatory contexts in L2 learners' speech has been reported and documented by a large number of SLA studies (e.g. Lardiere, 1998; Ionin and Wexler, 2002; White 2003; Hopp, 2010; VanPatten et al., 2012; Kahoul et al., 2018). The question that arises here, and is of interest to this research, is why this variability still persists after long, formal English language teaching that contains intensive drills and activities. A related question is whether there is any type of instruction that could encourage the accurate processing and production of the target structures, i.e. English morphological inflections.

In this study, I am looking at intermediate second language learners and investigate the relative effects of processing instruction (PI) intervention as a means for second language learning, specifically morphological inflections acquisition. This instructional treatment claims to be able to alter L2 learners' inappropriate processing strategies, which are assumed to impact on variability in online processing and production, and replace them with appropriate strategies that encourage and strengthen form-meaning connections that would positively affect learners' developing system and lead to accurate online processing and production. This research will also shed some light on the role of cognitive resources, i.e. working memory (WM), in processing and producing the target morphological inflections.

The first study of this research was conducted in October-November 2017, and aimed to demonstrate the degree of variability in morphological inflections existing in second language learners in an instruction-only setting, and produce a solid baseline for driving the pedagogic intervention intended for the next study. The second study was conducted in October 2018 to spring 2019, using a pre-post-delayed post-tests design and aimed to investigate the relative effects of PI on shifting the focus from the offline processing of the target grammatical forms to the automatic processing of underlying representations. The thoroughness of combining both baseline and longitudinal intervention studies is one of the main contributions of this research. Another importance of this study lies in its contribution to the existing debate about the effectiveness of processing instruction (PI) and how to compare its effect to a new modified design of PI that addresses specific points of criticism related to standard PI instructional methods.

What encourages this attempt to contribute to PI theory and method is my assumption about the current state of second language learning system in the target context for the participants in this study: Saudi Arabian English language learners. Time-restricted, mainly explicit ways of learning language in the classroom might be the only context available to such L2 learners. Even within a Generative paradigm for SLA, it seems L2 learners do not have the time or opportunity to use UG mechanisms as part of learning a second language implicitly, or naturally, similar to a child's first language acquisition, or by existing in a natural immersive environment (Sanz and Morgan- Short, 2005). Nevertheless, there remains strong evidence that such mechanisms may, to some extent, be available to L2 learners in building up appropriate processing of input, storage and ultimate success in output (Herschensohn, 2009; Hopp, 2010) and that explicit and implicit knowledge interfaces could exist with different degrees of strength in the instructed learner's interlanguage (Han and Finneran, 2014).

Hence, I am interested in pursuing a balanced relationship between the generative approach to second language acquisition and other theories underpinning interventions through language pedagogy, in order to exploit the research findings and implications to benefit practical second language teaching in the classroom (Whong et al., 2014). In a relatively rare combination of generative and cognitive views on SLA, my assumption is that a special type of instruction that is specifically designed to address these identified problems in the acquisition of second language morphology is required. In this research, the proposed instructional package; i.e. the modified processing instruction (MPI), focusses on raising the psycholinguistic readiness through employing SI activities and interactive communicative tasks in order to target the high processing load of grammatical forms and ease the cognitive pressure on attentional resources. Therefore, the process of shifting input to intake would be possible and the integration of underlying representations into the developing system would be accelerated.

This study is organized in the following order. The second chapter discusses the SLA literature that relates to the present studies of this research. More specifically, Chapter two discusses the acquisition of morphological inflections in SLA including discussions of the nature of functional morphology, the variability of morphological inflections, and explicit vs. implicit knowledge and instruction. It also analyses relevant claims for L2 acquisition arising from generative grammar and the properties of English morphological inflections. The second part of this chapter provides a review of the Input Processing theoretical model (IP) and the pedagogical intervention derived from this model, processing instruction (PI). It also evaluates the previous PI studies that employed similar target structures and investigated similar IP principles, and the role of working memory and its possible relation to inflectional morphology processing. The chapter finishes with the rationale for the two studies employed in this research and the research questions that were based on the identified gap found in the literature related to PI theory and method. Chapter 3 presents the first study employed in this research and provides a description of the methodology, testing tasks and the results. The chapter ends with a review of PI methodological issues and the contribution of this research to address them. The fourth chapter provides a description of the methodology of the second study, the instructional materials and the assessment tasks. The fifth chapter presents the results and the statistical analysis of the second study. Finally, the sixth chapter presents a discussion of the results, and the seventh chapter presents the conclusion, and the implication for future research.

-Definitions of terms

Before further discussion, for easy reference, a number of terms that are frequently used in the discussion, are defined below:

1- Mental representation: is the implicit, underlying linguistic system in a learner's mind (VanPatten & Benati, 2010)

2- Developing system: is the complex of mental representations that as aggregate constitutes the learner's underlying knowledge of the second language (phonology, syntax, morphology, etc.). (VanPatten, 1996, p.9). Some researchers refer to this as learner's linguistic competence.

3- Input: is the language to which learners are exposed to during communication inside or outside classrooms. (VanPatten, 2013).

4- Intake: as coined by Corder (1967), is the part of the input that is processed and makes its way into the developing system (VanPatten, 1996).

5- Grammatical form: is the surface features of language that include verbal and nominal morphology (i.e. inflections) and functional items such as prepositions, articles and pronouns. (VanPatten, 1996, p. 10).

6- Online task: is the task that is used to collect data in timed settings. Online tasks provide the researchers with moment by moment detection of learners' processing difficulties during comprehension (Mitchell, 2004) and measure their spontaneous and unconscious response to language stimuli (Marinis, 2010).

7- Offline tasks: is the task used to collect data in untimed settings. Offline tasks allow learners to consciously monitor their response to language stimuli (Marinis, 2010).

CHAPTER 2.

LITERATURE REVIEW

2.1 Introduction

This chapter provides the theoretical background of the issue under investigation, i.e. the inaccurate production of inflectional morphology in L2 learners, and explains the rationale for the two studies conducted in this research. The chapter is organised in the following way. First, the morphological inflections acquisition in SLA is discussed in addition to a discussion of the nature and the properties of morphological inflections within a generative linguistic approach, in order to explain the preliminary study, focusing on the extent of representational knowledge in L2 learners. Then, a discussion of L2 competence and its relationship to morphological inflection acquisition, and the types of processing adopted by L2 learners is provided. After that, a discussion of the role of Explicit vs. Implicit knowledge and instruction in addition to a discussion of the potential cognitive sources leading to the morphological variability are presented. Finally, the second section of this chapter presents literature relevant to the proposed instructional methods employed in this research, processing instruction (PI) and modified processing instruction (MPI), in addition to their relationship to working memory and major PI studies' findings which informed the theoretical and methodological design of the second study.

2.2 Morphological inflection acquisition in SLA

Generative SLA research demonstrates that L2 learners from different first languages may manage to exhibit accurate syntactic properties in their production in relation to certain phenomena, such as overt subjects, verb position and nominative case pronoun. However, they show high rates of variability in using inflectional morphology such as gender, and, as in the focus of this research, agreement, aspect and tense (e.g., Lardiere, 1998; Prevost & White, 2000; Ionin & Wexler, 2002; White, 2003). A purely theoretical account of problems in acquiring the L2 features relating in particular to Tense, Aspect and Agreement is beyond the scope of this thesis, but I am interested in investigating how such issues may manifest themselves in instructed L2 learner variability. Here is an example of such variability in subject-verb agreement from a Turkish L1 learner of English (from White, 2003, p. 134):

- And she cleans...the house. And wash the dishes. And, uh, she makes the bed.

This example shows that this L2 learner demonstrates inconsistent use of morphological inflection (omitted -s in the verb [wash]). Yet it remains unclear how to explain this in terms of acquisition (or not) of tense and agreement.

A considerable number of proposals have been introduced based on these findings, associating different factors to be responsible for this phenomenon. Examples of these proposals are: Representational Deficit Hypothesis (e.g. Hawkins and Chan 1997) for the effect of critical period on morphology acquisition, Prosodic Transfer Hypothesis (e.g. Goad and White, 2006) for the effect of L1 prosodic representation on morphological inflection production, and the Capacity Hypothesis (e.g. Hopp, 2010) for the effect of amount of L2 input on the capacity of grammatical processing. Other more theoretical discussions of constraints on acquisition include the Feature Reassembly Hypothesis (Lardiere, 2007) and the Bottleneck Hypothesis (Slabakova, 2007, 2013). Nevertheless, the factors that these proposals focus on might not be independent, but might be associated and interact with one another to lead to non-target like morphological inflection development.

In instructed second language learning, some language forms prove to be persistently hard to acquire even though they have received extensive explicit instruction and practice (Rothman, 2008; Hopp, 2010). As mentioned earlier, a number of longitudinal studies documented the absence of morphological inflections in spontaneous production (e.g. Lardiere, 1998, 2007; White, 2003). In Lardiere’s study, past tense and subject verb agreement have been inaccurately supplied by an advanced Chinese L1 learner of English language who was not expected to advance her L2 any further. Haznedar and Schwartz (1997) and White (2003) reported similar findings for Turkish L1 learners of English.

VanPatten et al. (2012) argue that the considerable number of studies which investigated the relationship between morphological inflections and underlying features of L2 learners, suggest that "abstract features such as Agreement and Tense, which in turn trigger syntactic operations when those features are strong, are fully represented in the syntax" (ibid, p. 110). However, L2 learners suffer from a retrieval/production problem caused by mapping issues when trying to access or retrieve the appropriate form from mental lexicon. Such retrieval problems are due to processing issues represented by a "temporary breakdown between the syntax and the lexicon" (White, 2003, p. 194). However, before discussing such issue, it is important to explain the nature of morphological inflection and how it is acquired.

The next section provides a brief discussion of the target forms for this research project in Generative grammar: namely, the third-person singular -*s*, the past form -*ed* and the present progressing -*ing*.

2.2.1 The nature of morphological inflections

The main linguistic theory within the generative framework considers language to be part of the natural world and is based on the assumption that children are born with an inherent predisposition to learn languages. This theory considers the human brain to be capable of understanding and using languages (Chomsky, 1995). This innate ability is termed 'universal grammar' (UG) and is assumed to possess universal features of linguistic syntax, morphology and phonology (Herschensohn, 1999). Thus, it is assumed that children are exposed to the language in their environment, and the role of UG is to facilitate this language acquisition by guiding and limiting their grammatical options.

In the recent generative theory, namely Minimalism (Chomsky 1993, 1995, 2001), Chomsky (1995) proposes a model of grammar that includes the essential grammatical elements. This model hypothesizes that grammar is “a computational system capable of generating a set of admissible derivations, computations which are not simply grammatical as determined by interpretability by PF and LF (that is, whether the derivations sound right and make sense)” (Herschensohn, 1999, p. 67). Thus, this model assumes that UG provides linguistic features and linguistic computations (Herschensohn, 1999), in addition to its main role as the provider of the universal features of language.

Chomsky (1995) proposes three main components: the lexicon, the PF and the LF, and two operations: *move* and *merge*. The lexicon provides the lexical items with their phonological, syntactic, morphological and semantic features; thus, it provides the necessary information for the syntactic structure required in order for lexical items to be checked. Then, through the computational system, the structure is built through the *merge* syntactic operation, then checked through the *move* syntactic operation. Subsequently, this input passes through two representation systems: the PF, which stands for the phonetic form of the language and represents how it is articulated, and the LF, which stands for the logical form of language and represents the meaning of language (Radford, 2004).

The linguistic theory views two different categories in relation to the syntactic structure: the lexical and functional categories. The functional categories, such as DP, TP and CP, include the function words which carry the information of the grammatical properties of certain linguistic expressions, such as the tense, person and number (Radford, 2004). These function words include determiners, complementizers and inflections. On the other hand, lexical categories, such as NP and VP, include the content words that carry the meaning of their linguistic expressions, such as noun, verb, preposition and adjective (Ibid, 2004).

These categories, i.e. functional and lexical, are assumed to be universal, with different realizations cross-linguistically. Furthermore, the functional categories with their components (grammatical morphemes and function words) connect and permit the lexical categories' combinations (Herschensohn, 1999).

In the Minimalist Program, the functional categories are responsible for checking the morphological features of the lexical items that enter the derivation. The lexical items in these derivations can be morphologically inflected and contain different features, which might be either interpretable or uninterpretable. 'Interpretable features' refers to features that play a role in semantic interpretation, while 'uninterpretable features' refers to features that do not play that role (Radford, 2004, p.287). Interpretable features, such as number and person, must be checked by the LF in order to be semantically interpreted and for the meaning to be conveyed. On the other hand, uninterpretable features, such as the morphological inflection of the verb (-*s*) cannot be checked by the LF, while still necessary to ensure agreement with the subject (Slabakova 2013). Despite the fact that uninterpretable features cannot be semantically interpreted, they must persist at PF in order to be spelled out and hence, ensure that the target structures have been integrated in the developing system; i.e. acquired.

Slabakova (2006, 2013) argues that functional morphology is a bottleneck in second language acquisition and that other properties (syntax, semantics, etc.) would flow smoothly. In other words, it is assumed that these properties come for free in UG, so the L2 learners' task is to figure out the differences between their native functional morphology and the target language functional morphology. In a recent study by Jensen et al. (2017), Jensen and colleagues concluded that learners "develop considerably faster in their knowledge of English syntax than in their mastery of functional morphology" (ibid, 2017, p.334). They attribute this problem to the fact that functional morphology and all the related features have to be learned similar to other lexical entries.

Slabakova provides the following example to explain the morphological properties that could lead to difficulties:

He often take-s the bus

Agree [3rd person, singular subject]

[Tense: present]

[Aspect: habitual]

Overt Subject obligatory

Nominative Subject Verb

Verb stays in the Verbal Phrase

Figure 1. *(Slabakova, 2013, p. 5)*

In this sentence, it is assumed that the lexicon provides the lexical items in the computational system. As discussed above, the computational system is where all of the syntactic operations take place: Merge, Select and Agree, and thus phrases are gradually formed, increasing in length. All of the feature checking and valuing take place in this working space (i.e. the computational system), and then the syntactic structure is passed to the two other systems (LF and PF) in order to be interpreted and spelled out.

Slabakova argues that, in the above sentence, the subject pronoun (he) carries a number of interpretable features which also convey the meaning of the sentence [masculine], [third person], [singular]. However, all of these interpretable features are represented by an uninterpretable feature that is represented by a small morpheme attached to the verb of the sentence (take-s). This little *-s* plays other roles in addition to ensuring agreement with the subject, which signal that the verb is in the present tense and habitual. Therefore, Slabakova's

(2006, 2013) argument is based on the fact that morphological inflection, such as the small morphemes *-s* or *-ed*, convey a lot of information, that affects the form and meaning of the sentence. Therefore, it is expected that all of the syntactic, semantic and morphological information would be acquired at different times during the L2 development and, in consequence, L2 learners must acquire all of that information first in order to properly acquire the morphological inflection.

After this brief discussion of generative grammar, the functional category TP is discussed in the following section, for the purposes of setting out the relevant issues over tense and agreement morphology for this study, and largely following standard TP explanations (such as from Adger 2003).

2.2.1.1 Properties of English verbal inflections: Third-person-*s*, Past form *-ed*, and Present progressive-*ing*

In English language, a finite verb can be categorised into two categories of tense: the present or the past. The finite verb must also agree with the subject of the sentence under certain conditions. The subject of the sentence (Person) is usually assumed to be classified into three features related to Number, [first], [second] and [third], which are usually written as 1, 2 or 3 (Adger, 2003, p. 43):

Table 1. *Singular and plural features*

I [1, singular]	We [1, plural]
You [2, singular]	You [2, plural]
He/she/it [3, singular]	They [3, plural]

In the present tense, the finite verb must overtly mark agreement with the subject of the sentence only if it is a third person singular subject. This agreement is indicated by the addition of the suffix -s to the finite verb, as in the following examples:

(1) The bear snuffles

(Adger, 2003:23)

(2) he/she/it snuffles

This agreement relationship exhibits the morphological relationship between the word form and the subject of the sentence. This only occurs with third person singular subjects and, with other subjects, the verb retains its original form. Examples include:

(3) The bears snuffle

(Adger, 2003:23)

(4) I/they/we/you snuffle

In the past tense, the finite verb is expressed in two ways: the first is by adding the suffix -ed, so that the verb becomes morphologically inflected, as in the following example:

(5) The bear snuffled

(Adger, 2003: 48)

The second way is by having a unique verb form related to the past tense in certain English verbs, which are termed “irregular verbs”. This unique form may be formed by changing the vowel, such as in run-ran, changing the vowel and adding a suffix, such as sleep-slept, or changing the stem, such as in go-went (Adger, 2003).

In English language, the verb in the past tense is not morphologically inflected for agreement with the subject. Thus, there is no occurrence for sentences that are similar to the following example:

(6) The bear snuffleds

(Adger, 2003: 48)

In the present progressive, the finite verb is preceded by the auxiliary which holds the tense marking. In this case, the auxiliary i.e. the progressive *be* is followed by the present participle (verb + *ing*). Examples include:

(7) Gilgamish is fighting Humbaba

(Adger, 2003 :174)

Based on the minimalist framework, the analysis of Adger (2003) of the syntactic procedure of assigning present and past tense inflections to verbs, i.e. the morpho syntactic features and producing them, will be discussed in the next section.

2.2.1.2 The application and production of the syntactic structures

It is assumed that the sentence has a core consisting of lexical items created from bundles of formal, semantic and phonological features (Adger, 2003). Through a number of operations, the lexical categories interact with the computational system to produce the syntactic structure.

The minimalism framework considers the T category to be one of the most important lexical categories in the sentence. T is the "the category that hosts the tense features for the whole sentence" (Ibid, 2003, p.155). Within this approach, the relationship between the category feature (T) and the verb (V) should be like an agreement relationship and the feature category (T) should match the assigned tense feature to (V). The agreement relationship undergoes checking and evaluation before the final agreement takes place. Adger argues that the verb bears an uninterpretable and unvalued tense feature, while (T) hosts the interpretable tense feature. Thus, the [past] feature on T matches the unvalued tense feature of V, in which case the unvalued tense feature on V receives the [past] tense feature on T. Adger schematically illustrates this relationship by the following example (2003, p.168):

T [tense: past] … v [*u*tense:] →T [tense: past] …v [~~*u*tense~~: past]

After that, there follows the stage where this system must be applied in order for the tense feature to be pronounced on the verb.

Adger (2003, p.170) presents the following rule for spelling out v with the uninterpretable inflection feature valued as [past] as ed:

Pronounce v [~~*u*Infl~~: past] as *ed*.

According to this rule, it is a simple morphological case to spell out the visible *ed* in the structure. However, the morphology becomes more complex when this rule is applied to irregular verbs. Another special rule is proposed by Adger (2003, p. 171) to pronounce the rule with irregular verbs:

Pronounce eat as ate when it is adjacent to v [~~*u*Infl~~: past], and in this case, do not pronounce v [~~*u*Inf~~l: past]

In regards to the agreement, we recall that verbal agreement is restricted to the present tense. Adger (2003) argues that a similar operation as for the past tense also applies to the present tense. An additional step should be applied to match the (V) in the present tense with the subject of the sentence. Thus, he illustrates that (T) bears the number feature which will value the (Infl) on v. Therefore, the T [singular] number feature will match the uninterpretable inflection [*u*Infl:] on v, giving value to it, as in [~~*u*Infl~~:singular].

After that, the v [~~*u*Infl~~: singular] will be pronounced according to the same pronunciation rule mentioned earlier, which will lead to the spelling *(e)s*.

In regards to the progressive, the progressive *be* is assumed to hold the uninterpretable categorial feature Prog which projects and values the [*u*Infl] feature for little *v*. Thus, the little v would be pronounced as -*ing*.

T *is* [Prog, ~~*u*Infl~~: sing] → *v ing* [~~*u*Infl~~: Prog]

To recap this section, we have discussed that an agreement must be established between the T features and the v, and this relationship must ensure a match between the interpretable feature of T and the morphological tense inflection assigned to the verb of the sentence. As discussed above in section (2.2.1), the fact that the morphological inflections carry a lot of information and that the L2 learner needs to have all the syntactic, semantic and morphological information related to the target forms, ready and available before they are able to spell them out, seem to offer a reasonable justification for why morphological inflections are a bottleneck for SLA (Slabakova, 2006, 2014). Hence, from a representational point of view, it is assumed that all the syntactic operations such as Merge, Select, and Agree and all the feature checking and valuing, would add a lot of pressure on the computational system that needs to work out all of that in order for the syntactic structure to be passed to the two other systems (LF and PF) and then to be interpreted and spelled out.

Hence, in addition to previous discussion of the nature of morphological inflections and potential challenges for developing appropriate feature representations, another issue might also be involved in the difficulty of morphology acquisition, which is the form-meaning mapping of functional morphology. Lardiere (2009) argues that L2 learners need to reconfigure and remap the morphosyntactic features from their L1 to the new configurations of these features in the L2. However, in this case, L2 learners need to arrange and map from features to lexical items between L1 and L2 and that reassembly could be faced by a learning problem that could lead to errors in producing the appropriate morphology (White, 2011). The next section presents the standard morphological system of the target context L1: Arabic language, in order to anticipate if the differences between the L1and L2 morphological system could be contributing to the variability found in L2 production.

2.2.1.3 L1 Arabic

Slabakova (2013) argues that mapping between the linguistic form and its meaning for functional morphology might not be straightforward, particularly for tense and agreement which are so variably marked cross-linguistically. Slabakova illustrates this through the case of the present and past tenses in English and Chinese. While English verbs can be morphologically inflected to indicate the present and past tenses, Chinese is not an inflected language, but uses temporal adverbs instead. Figuring out these differences and mapping between the form and its meaning in the target language can be complex and lead to difficulties related to acquisition.

The question that arises here, however, is why this difficulty still persists even between two languages (the native and the target) that share a similar morphological system, or where the native language (e.g. Arabic) even has a richer system. Arabic has a rich inflection system and marks the present and past tenses with morphemes at the beginning of the word. Moreover, Arabic has an additional morphological feature compared to English which is gender. Therefore, the attached morpheme of the verb in Arabic will stand for: [tense], [third person singular] and [gender]. The following section presents a brief discussion of the standard Arabic (SA) morphological system, to give a brief background of the native language of participants employed by this research.

2.2.1.3.1 Standard Arabic morphological system

Verbal agreement in SA is associated with a number of long-debated issues that have attracted attention for a long time. One of the main issues related to the current discussion, is the location of the subject of the sentence. The verb in the sentence can be either at the beginning and before the subject (VSO), making it a verbal sentence, where the verb must agree with the subject with regards to gender and person but not number, or the subject should be at the beginning of the sentence (SVO), making the sentence a preverbal nominal that must agree with the verb with regards to gender, person and number (Abdul-Hafiz, 2005). This issue has invited different hypotheses in regards to SA sentence verb agreement, Should the preverbal nominal be treated as a topic or a subject? However, it was the subject hypothesis that has proven to be the most adequate for sentence analysis (Abdul-Hafiz, 2005). Thus, in the following discussion, subject-verb agreement markers in SA are illustrated.

Arabic language has two morphological forms, the past and the present. Similar to English language, in the past or present context, the verb must agree with the subject of the sentence with regards to person, number and gender. Moreover, the morphological inflection could be either a prefix or a suffix, according to the verb tense (AlAzraqi, 1998).

The following table illustrates the subject-verb agreement in SA, based on the verb Yal'ab, 'to play'. In this table, all the morphological inflected forms of the chosen verb are illustrated in both the present and past tenses for all of the verbal agreement features (person, number and gender).

Table 2. *Examples for subject-verb agreement in SA*

Features	Past: M	F	Present: M	F
3rd p. singular	La'ab	La'ab**at**	**Ya**l'ab	**Ta**l'ab
3rd p. Dual	La'ab**aa**	La'ab**ata**	**Ya**l'ab**an**	**Ta**l'ab**an**
3rd p. plural	La'ab**uu**	La'ab**na**	**Ya**l'ab**uun**	**Ya**l'ab**na**
2nd p. singular	La'ab**ta**	La'ab**ti**	**Ta**l'ab	**Ta**l'ab**een**
2nd p. Dual	La'ab**tuma**	La'ab**tuma**	**Ta**l'ab**an**	**Ta**l'aba**an**
2nd p. plural	La'ab**tum**	La'ab**tunna**	**Ta**l'ab**uun**	**Ta**l'ab**na**
1st p. singular	La'ab**tu**	La'ab**tu**	**?**l'ab**u**	**?**l'ab**u**
1st p. Dual	La'ab**na**	La'ab**na**	**Na**l'abu	**Na**l'abu
1st p. plural	La'ab**na**	La'ab**na**	**Na**l'abu	**Na**l'abu

P=person, M=male, F=female

As demonstrated above, Arabic verbal inflection can be attached at the beginning of the verb as a prefix or at the beginning and end of the verb as a prefix and suffix in the present tense, but only at the end of the verb as a suffix in the past tense.

It might, therefore be assumed that Arab learners of English language would not face difficulties in acquiring third-person-singular or past tense inflections. This is not the case, however, and the morphological inflections -*s* and -*ed* are assumed to be the most difficult and the last inflections to be acquired by Arab learners (Kahoul et al., 2018). And therefore, this confirms that instructed L2 learners in the target context faces mapping issues when it comes to production under real-time settings.

After explaining that the target context learners have a morphological rich L1 and so they are not expected to have a gap in their representations, it seems that it could be a problem of reassembly and mapping between the morphosyntactic features of the L1 and the L2. Therefore, the next section discusses L2 learner's competence and its relationship to second language morphology acquisition.

2.2.2 L2 competence

Learner's competence in this context, refers to mental representation of the underlying abstract properties which operate in the speaker's mind without awareness and is controlled by universal constraints (Herschensohn, 1999; White, 2003). These abstract properties are not similar to formal rules used for explicit instruction but rather an internal linguistic system that comprises both universal constraints and functional features (Herschensohn, 1999). Thus, what is parsed by learners during online comprehension must meet the mental representation requirements. Similarly, what is produced by the learner is dictated by the content of the mental representation (VanPatten, 2010).

Generative approaches in SLA, consider the development of mental representation is the basis for second language acquisition and it consists of three essential elements. First, is the input which L2 learners are exposed to in meaningful communication. The second is the universal grammar (UG) which refers to the innate system that has abstract principles and properties that are common in all natural languages. This implicit system guides and controls language comprehension and production according to the universal constrains. UG functions as innate "rules" that filters the input to become processed hence, the intake (Slabakova, 2013; Rothman and VanPatten, 2014; VanPatten, 2010; 2013; VanPatten and Rothamn, 2013; Wong, 2013). The third component is the parsing and processing, which refers to "the syntactic computations made during real-time comprehension" (VanPatten, 2010, p.4). This happens when the L2 learner is able to assign certain inflectional forms to their meanings and functions in verbs and understand the relationship between nouns, verbs and phrases in the sentence. When all of the components are available to the learner, acquisition takes place (Whong et al., 2014).

When acquisition takes place, learners are free to access this knowledge at any time under different conditions. Thus, after representations are integrated in underlying linguistic system, Skill development can be targeted. From a generative perspective, skill development such as speaking is developed through engaging in opportunities that push learners to produce meaningful communication. Such perspectives about the acquisition process, and the nature of mental representation and its relationship to skills of production, have the potential to explain what really goes on in the process of second language acquisition.

With regards to L2 learner's competence, two main approaches were identified to explain the source of morphological variability issues in SLA (Jiang, 2004). The next section presents these approaches in details.

2.2.2.1 Approaches to morphological variability in SLA

These two approaches represent a classic divide between representation and performance which remains unresolved. The first approach considers the variable use of morphology is due to a deficit in L2 learner's competence or representation levels. In other words, the competence deficit approach (CDA), claims that instructed L2 learners' morphological difficulties reflect an incomplete acquisition of morphological knowledge, particularly for those who have been exposed to the L2 in a limited-input classroom setting. In this position, instructed L2 learners use explicit/learned knowledge to control their L2 output of a target form that was not acquired in the first place. This morphological variability in L2 learners' production suggests that the L2 learner learned the rule through explicit instruction but has not acquired it (Krashen, 1982).

The second approach in SLA, assumes that the variability is due to a performance deficiency. The performance deficiency approach (PDA), considers the variability issue to be related to a processing level, arguing that L2 learners face difficulties when retrieving and producing what has been internalized. In this position, it is argued that L2 learners have acquired the target rules, in the competence sense, but spend long time in order to establish full control of what they have acquired (e.g. Sharwood Smith competence/control model, 1986). Therefore, the observed variability in L2 learners' production is assumed to be due to learners' inability to control their L2 knowledge.

The two approaches, CDA and PDA differs in how they define competence and acquisition. On one hand, CDA defines competence as "the ability to use a structure correctly in spontaneous language production without paying attention to it" (Jiang, 2004, p. 606). Thus, the L2 learner needs to consistently produce the accurate target form in order to consider it acquired. On the other hand, the PDA does not include the accurate production of the target form and only considers the internalised linguistic representations in the definition of competence. It also acknowledges another important element, "control" which is needed to access, retrieve and use the knowledge that was internalised.

However, the PDA approach assumes that despite the absence of inflectional morphology in learners' output, full functional categories and features are represented in grammar and have detectable syntactic consequences (e.g. Missing Surface Inflection Hypothesis (MISH) by Prevost and White, 2000). White (2003a) argues that, having acquired the surface morphological inflections, learners face mapping issues when trying to access or retrieve the appropriate form from their mental lexicon. Such retrieval problems are due to processing issues, represented by a "temporary breakdown between the syntax and the lexicon" (White, 2003a, p. 194).

With the earlier different definitions of competence in SLA, Jiang (2004) explains that L2 competence refers to “any L2 knowledge that has been internalized and can be automatically put to use in spontaneous meaning-oriented L2 use” (Ibid, 2004, p. 606). By automatically, in this context, it means subconsciously without the use of attentional resources. He argues that the L2 knowledge can come either through implicit ways by L2 exposure, thus, it would be instantly integrated in L2 competence. Or it could be obtained indirectly, through explicit instruction and thus would take extensive amount of practice through communicative opportunities, in order to be integrated in L2 learner’s competence. A number of SLA researchers (e.g. Segalowitz, 2003; Jiang, 2004; Whong et al., 2014) stress the importance of automaticity because the goal of learning a second language is to be able to use it spontaneously in natural communication. In addition, unlike acquiring the first language, learning a second language, especially in adulthood, would take place through explicit instruction, thus, one cannot guarantee that all what learners receive will be used correctly in spontaneous production. Hence, Automaticity “is the characteristic” that would set L2 explicit knowledge and L2 competence apart (Jiang, 2004, p. 607). Thus, L2 automatic processing should be the characteristic that defines successful L2 learning, despite the method used to learn or deliver this L2; i.e., explicit or implicit. Automaticity in instructed L2 learning is discussed later in section (2.3.1) below.

As discussed earlier, L2 learners might not be able to instantly process the L2 input automatically, especially L2 learners with limited access to natural L2 exposure. L2 learners spend considerable time in developing the strong form-meaning connections needed for automatic retrieval and production, i.e. processing. Hence, non-advanced L2 learners tend to face issues in processing the L2 input, and adopt inappropriate processing strategies, which in turn lead them to the variability observed in their morphological inflections production.

After explaining the nature and the special properties of morphological inflection and that they do not come for free in UG, which could cause an issue for the mental representation development in second language acquisition, the next section presents a brief discussion of morphological inflection acquisition and productivity and the type of processing adopted by L2 learners when encountering verbal inflections in the input.

2.3 Morphological inflection processing and productivity

Establishing appropriate form-meaning connection that "explains how a real-world referent or semantic notion is encoded in a grammatical form (e.g., [ed] means [pastness], [ing] means [in progress])" (VanPatten, 2007, p.125) is essential for morphology acquisition (Hopp, 2013). L2 learners need first to establish these connections in order to be able to retrieve them and use them spontaneously and fluently in real-time tasks. The complete and strong form-meaning connection is what allows learners to fully access and process input successfully. VanPatten, et al. (2004) argue that form-meaning connection must go through multiple processes in order to be ready for comprehension and production but first, the L2 learner must understand the relationship between form and meaning and that the former encodes the later.

Encountering different words in input, and linking them to their meanings, would be the basis for learner's initial knowledge. However, it is assumed that the first connections may be incomplete or weak which could affect the mapping and cause disturbance in processing. Therefore, the second process is to build robust connections by repeated exposure to the forms in input. By exposing learners to forms frequently, L2 learners are likely to build a stronger connection or fill in incomplete form-meaning mapping. Furthermore, frequent exposure to target forms in meaningful input may lead them to be acquired naturally, despite the fact that they were taught explicitly in the first place, thus they would be integrated directly in L2 learners' developing system (Jiang, 2004).

VanPatten et al. (2012) explain that L2 learners cannot access what is not available in mental representation but can only strengthen the available form-meaning connections. Thus, the form-meaning relationship would determine learners' ability for processing morphosyntax in real-time/online tasks. Once the relationship exists and is robust enough, learners can access it automatically either in parsing (comprehension) or production. Conversely, problems with accessing these connections could be due to their weakness or lack of existence.

In case of inflectional morphology, a number of suggestions were proposed to explain L2 learners' variable production. VanPatten et al., (2012) argue that it is mostly because of weak representations – i.e. a morphosyntactic problem. On the other hand, White (2003) argues that abstract knowledge of relevant syntactic features and related morphological inflections could be available to learners (a fuller discussion of the relationship between syntax and morphology was discussed earlier in section (2.2.1). However, the problem is with accessing and retrieving this knowledge in order to map between the abstract knowledge of the feature, its syntactic requirements and its surface morphological manifestation. Similarly, Hopp (2010, p.904) argues that:

> These systematic difficulties of L2 learners to access and integrate inflectional forms with syntactic features in comprehension point to resource limitations in retrieving fully specified representations of inflection, in particular in speeded or timed tasks which limit processing efficiency.

However, it is conceivable to assume that issues of accessing and retrieving the target forms in real-time settings are essentially caused by the weak or inappropriate form-meaning connections. Moreover, recent online processing research reveals that the problem with processing inflectional morphology is not limited to learners' production but extends to comprehension as well (Hopp, 2013). Thus, determining what lies behind possible issues for instructed learners with marking morphological inflections (i.e. mental representational issues, weak or incomplete mapping) is essential to overcome L2 learners' variable performance by finding the most effective and practical treatment suitable for their L2 learning context.

Psycholinguistic research that tap into learners' processing in real time tasks through eye tracking and reading time revealed that adult L2 learners have slower reaction time and lower accuracy than native speakers and child L2 learners (Herschensohn, 2009). Herschensohn argues that what happens in adult L2 learners might be due to age of acquisition and maturation effects. However, these factors could not totally separate child learning from adult learning. She demonstrates that children start with establishing neural network for language and other abilities by establishing procedural/implicit knowledge without consciousness. On the other hand, adults come to L2 learning with a well-developed neural network that is not as flexible as in children. Moreover, adults come to L2 learning with a full capacity of consciousness that contributes to having declarative/explicit knowledge. Hence, she argues that acquisition and associated processing requirements constitute a "continuum of language knowledge storage that can range from highly proceduralised to very declarative, a gradient difference not a precipitous one" (Herschensohn, 2009, p.273). Interfaces between types of knowledge are discussed below in section (2.3.2).

In relation to the previous discussion of competence vs. performance debate in section (2.2.2) above, processing studies which tap into L2 learners' knowledge reported different findings related to the source of difficulty. VanPatten et al. (2012), found out that it was a representational problem and not a performance one in non-advanced Spanish learners, that caused learners' lack of sensitivity to inflectional morphology in online self-paced reading task. They argue that Spanish is an inflectionally rich language that is taught through explicit instruction and formal practice, so, non-advanced L2 learners with limited input and opportunities for spontaneous communication would take long time to build strong representations. They further add that morphological inflections representations could be not robust enough at the first stages of acquisition, nevertheless, this could extend to result in performance issues-with stronger representations at more advanced levels of acquisition.

Jiang (2004) reported similar findings with Japanese L1 learners of English who were tested in “broken agreement”, e.g. The key to the cabinet, vs. The key to the cabinets (Ibid, 2004, p. 609). Jiang showed that L2 learners do not show the same sensitivity in a self-paced reading task, as native speakers do when reading the ungrammatical sentences, suggesting that inflectional morphemes are not part of L2 learners’ representations. However, a major issue in Jiang’s study was raised by VanPatten et al. (2012) with regards to lexical vs. morphological forms, as all Jiang’s experimental sentences included lexical irregular forms, e.g. was/were, which are not inflected, and learned as a full lexical item instead of regular inflected verbs, e.g. walk/walks.

On the other hand, in more advanced levels, recent studies revealed that advanced learners can have similar linguistic representation and processing mechanisms as native speakers, but with less efficient processing of morphological inflection which causes the non-target like language use (Aldwayan et al. 2010; Hopp, 2010; Sagarra and Herschensohn 2010). Hopp (2010) seminal study which used a number of experiments for online and offline processing tasks, showed that advanced learners can attain subject-verb agreement and access and use this grammatical knowledge in offline processing. However, this is not guaranteed in online processing where learners seem to have difficulties accessing and applying this knowledge under real time production constraints.

In sum, taking into consideration the findings of studies which investigated advanced and non-advanced L2 learners, and the “automaticity” characteristic that should be developed in order to upgrade L2 explicit/offline knowledge to the automatic/online knowledge that is “subconscious and does not require attentional resources” (Jiang, 2004, p. 606), one could argue that instructed non-advanced L2 learners are in an early stage of acquisition, hence, most of their existing knowledge is explicit and includes newly established from-meaning connections that are not robust enough to be retrieved and used spontaneously in online production. In addition, in instructed L2 context, L2 learners receive most of their L2 input through explicit ways with limited access to natural L2 input (VanPatten et al. 2012). Moreover, the practice methods in this context, rely on formal drills and activities that do not include communicative opportunities that engage L2 learners' knowledge in meaningful interaction and encourage the spontaneous use of the target forms and thus may also serve to support acquisition.

However, generative approaches to second language posit that language learning ability is innate, and has abstract rules which interact with input in order to stimulate acquisition. In this approach, input is an essential component of the mental representations, beside two other components, UG and parsing/processing mechanisms. The establishment of the mental representations is not amenable to the influence of explicit instruction or any type of metalinguistic drills or activities because the UG- the innate ability of language learning- interacts only with processed data "intake" that went through parsing/processing mechanisms. Nevertheless, UG cannot operate on explicit data that carry information about the language (VanPatten, 2010, p.6).

Thus, considering the weak/incomplete form-meaning connections, and the lack in meaningful production practice, non-advanced L2 learners are expected to end up with weak representations that could not be accessed in real-time settings (Godfroid et al. 2015). Consequently, their L2 knowledge would only be susceptible to offline/non-automatic retrieval and production, i.e. processing, in controlled settings. In addition, in foreign language contexts, instructed language learning classes are the only available context for L2 learners, and as for the target learners in this research, Arab learners, there is ample evidence such learners may face difficulties in retrieving and producing morphological inflections in their spontaneous output (e.g. Kahoul et al., 2018).

Taking into consideration the previous discussion of the form-meaning mapping issues and Hopp's stages of morphology acquisition, it is logical to assume that L2 learners who experience variability with the morphological inflections production did not acquire the target morphological form as they are unable to automatically retrieve and use it in online production, i.e. automatic processing. Hence, L2 learners who are explicitly taught a grammatical form as a surface morphological feature (which could be assumed to equate to VanPatten's definition of surface grammatical form, see definition (Chapter 1, p. 4) with no meaningful practice, will slowly retrieve it as a part of their explicit knowledge, i.e. offline processing.

Hence, to recap the previous discussion, morphological inflection acquisition has four main steps that L2 learners must go through in order to acquire second language morphology (Hopp, 2013). First, L2 learners need to acquire and store the target inflection in mental lexicon. Second, map the form to its meaning and locate its occurrence in the grammatical context of relevant syntactic features. Third, retrieve the correct form based on the grammatical context. Finally, use and spell out the correct form in production. Hopp further adds that the first two steps incorporate the acquisition of grammatical knowledge of morphology (first step) and the morphosyntax of inflection (second step). In addition, the third and fourth steps compromise the inflection retrieval and processing in real-time.

It is important to carefully consider what happens with non-advanced L2 learners before the retrieval stage. In order to retrieve the target morphological inflection, L2 learners first need to acquire and store the target morphological form. As discussed earlier, in SLA approaches to explain morphological difficulty, the PDA approach assumes that non-advanced learners possess full functional categories and features although the inflectional morphology is absent in learners' output. Thus, one could assume that the first step of morphology acquisition should be taking place without interruption. Second, learners need to establish the connection between each target from to its meaning during the stage of morphosyntax of inflection. In this step, it is expected that these connections would be disrupted by a lack in meaningful practice opportunities, limited access to natural L2 input or both, that are needed to strengthen the target form-meaning connections. Therefore, when learners are performing a communicative linguistic task under real-time settings, they are unable to automatically access and retrieve these form-meaning connections.

Therefore, I would argue that instructed non-advanced L2 learners' problem lies primarily at the performance and not necessarily at the competence or representational level (Cf. Van Patten et al. 2012). Thus, the questions arise here, how can such input be best presented to help drive noticing for intake? And how could instruction boost the form-meaning connections and develop automaticity in language production? It is logical to assume some kind of more linguistically-focused processing may be needed for robust form-meaning connections to be made.

Before discussing the instruction role in developing second language processing and production, automaticity was emphasised by a number of SLA researchers and is considered to be essential for the accurate production under online settings. The next section discusses automaticity role in learning the second language.

2.3.1 Automaticity in second language processing

With regards to the automaticity that was emphasised by Jiang (2004) and DeKeyser (1997, 2007, 2010), Segalowitz (2003) argues that the term automatic has different technical meanings, but in psychology, it is performing a task with less effort and attention. In language learning, it is "the ability to use language rapidly, smoothly, and accurately" (Ibid, 2003, p.383). Segalowitz points out that automatic and non-automatic processing needs to be categorised according to two points.

First, the automatic processing; i.e. fast and unconscious, has to be compared with the opposite non-automatic processing; i.e. slow and conscious. This contrastive aspect of comparison between automatic and non-automatic is important because it sheds the light on other aspects that are non-automatic. An example of that could be seen in L2 learners' variability in morphology production discussed earlier (e.g. Lardiere, 1998; White, 2003; Hopp, 2010). It was found that L2 learners are accurate and fast; i.e. automatic, in using the syntactic categories such as overt subject. However, they are slow/non-accurate; i.e. non-automatic in using inflectional morphology such as, tense, aspect, and agreement in production.

Second, about it is important to consider the different ways of characterising automaticity, as it involves many questions related to the different types of automaticity, if they exist, and the relationship of automatic/non- automatic distinction, that could either be dichotomous or "as end points of a continuum stretching from very non-automatic to very automatic" (ibid, 2003, p.384) and if this automaticity should be the ultimate goal of second language acquisition. Segalowitz argues that automaticity should be more about quality than quantity. In other words, automaticity should be a characteristic to describe a positive change in the underlying mental processes in contrast to just describe the automaticity as being "fast". He explains that fast processing does not mean automatic, although the automatic processing entails fast processing as L2 learners could be performing quickly but non-automatically compared to other times where they perform automatically with less speed. The main point here, is that L2 learners need to have a better and more efficient processing that is similar to non-automatic processing settings. This automaticity is developed through frequent practice given to the mental activities underlying the second language performance, consequently, theses mental activities would be performed faster and less time would be devoted for them. Hence, the rapid operations of these mental operations would make them unavailable for conscious recall and thus they would become automatic.

After establishing that automaticity should be about qualitative change in mental processes rather than just speeding up, automaticity would obviously have implications for second language pedagogy. Segalowitz explains that the more automatic the performance becomes; the less attentional resources are allocated to processing the target forms and thus more attentional resources are available for processing other linguistic forms. Moreover, when processing becomes more automatic, L2 learners would be processing the information faster and more accurately. Therefore, Segalowitz argues that proper practice and the right conditions should be provided in order to develop automaticity in second language learning. However, he acknowledges that such development is challenged by the current conflict exits between different methods of second language learning, especially that automaticity is often associated with intensive repetitive drills and exercises with no meaningful communicative tasks which lead to inefficient and non-communicative use of the language.

In the same vein, Godfroid, et al. (2014) argue that different SLA theories, that hold different positions toward the explicit/implicit relationship, are interested in this abstract notion, i.e. automaticity. They discuss that these theories might differ in defining the way of transition from explicit to implicit, from declarative to procedural or from non-integrated to integrated knowledge, however, they all agree that automaticity is the ultimate goal of L2 learning and that "the common element that discriminates types of knowledge seems to be the presence or absence of automatic processing in learners' use of the language" (ibid, 2014, p. 2).

However, with regard to the type of knowledge employed by L2 learners, Godfroid, et al. (2015) argue that this depend on two factors: first, it depends on the extent of implicit and explicit representations available. Second, on the language use type (ibid, 2015, p. 271). For example, L2 learners who were taught through formal, traditional instruction with little or no access to natural input and communicative opportunities would be more likely to rely on their explicit/offline knowledge.

In addition, the type of tasks these learners are involved in, would also be contributing in the type of knowledge prompted by them, so if they are engaged in communicative opportunities where they have to exchange information under real-time settings, they would not be able to manage it successfully as these tasks require a specific type of knowledge; i.e. automatic/implicit. However, this knowledge would essentially rely on the representations available in these L2 leaners developing systems. Hence, Godfroid, et al. argue, that communicative pressure and real-time settings seem to be what restrict L2 learners to access only their explicit/declarative knowledge and therefore, prevent the automatic/online processing to take place.

Therefore, the next sections discuss the two factors argued by Godfroid, et al. (2015), to be responsible for automaticity development: first is the extent of implicit and explicit representations available in L2 learners' developing system, and second is the role of instruction and the types of activities employed in teaching the L2.

One of the important debates in SLA literature is related to the effectiveness of instruction and automaticity development; i.e. the issue of explicit vs. implicit knowledge and instruction. Explicit and implicit knowledge are generally taken to be distinct concepts, their role and relationship have been widely discussed in SLA (e.g. Hulstijn, 2002; N. Ellis, 2005; Han & Finneran, 2014; DeKeyser, 2015). The next section presents this issue in more details.

2.3.2 Explicit vs. implicit knowledge and instruction

The effectiveness of implicit/explicit instruction is a challenge referred to as "the instructed SLA bind" (Whong et al., 2014, p. 555), which involves conflation of claims about the types of instruction used with input and their effect on learners' mental states. However, many researchers, whether generative or not, argue that this distinction cannot happen without testing learners' knowledge, whether that is implicit or explicit (Hulstijn, 2005). More importantly, demonstrating the effectiveness of instruction cannot be done until "learners can be shown to have implicit knowledge of the linguistic phenomena under study, and not just explicit knowledge" (Whong et al., 2014, p. 556) as this implicit knowledge is acknowledged to be superior over explicit knowledge as the basis for acquisition at least in terms of favouring swift easy real-time production (ibid).

So, for the purposes of this study, the next section discusses these issues and demonstrates the limitations of each position in order to help evaluate how instruction could improve both representational and processing variability in functional morphology. In addition, the next section argues for a third position of interface that lies between the earlier two positions and is expected to be more appropriate to be adopted in teaching and learning L2 in the target context.

2.3.2.1 Explicit and Implicit knowledge definitions

There is a general agreement among second language researchers and linguists on the definitions of implicit and explicit knowledge and learning. According to Hulstijn (2005), most but not all of the literature agrees on the following definitions:

"Explicit learning is input processing with the conscious intention to find out whether the input information contains regularities and, if so, to work out the concepts and rules with which these regularities can be captured. Implicit learning is input processing without such an intention, taking place unconsciously" (p. 131).

In relation to explicit and implicit learning, explicit and implicit knowledge are distinct with regards to the degree of awareness that second language learners possess about the language system and their ability to verbalize this knowledge (R. Ellis, 2004). Explicit knowledge is the conscious linguistic knowledge, thus, a degree of awareness is necessary in order for explicit knowledge to be established, while the opposite applies to implicit knowledge (Hulstijn, 2005). While second language acquisition researchers tend to agree on this, there remains disagreement with regards to the degree of importance of consciousness to the explicit/implicit distinctions. As Paradis (2009) clarifies, implicit (acquisition) is distinct from explicit (learning), arguing that implicit linguistic competence happens incidentally when the learner's attention is focused on other aspects than what is being internalised, such as meaning. He states that this implicit competence occurs when learners are able to deliberately generate sentences by combining linguistic units that were internalised (become part) of the implicit knowledge. He draws a clear distinction between learning and acquisition, where the former can be any conscious processing of information and the latter is "the appropriation of information without awareness on the part of the acquirer of what is acquired and stored in implicit memory" (p. 4).

However, explicit and implicit knowledge can be argued as being either highly related or completely unrelated, known as the strong-interface and the no-interface positions, respectively. The relevance of this dichotomy to this study is significant as specifying the type and the level of representations; i.e. explicit or implicit, available in L2 learners' developing system and the relationship between those two types would determine L2 learners' ability to automatically process; i.e. retrieve and produce the target forms accurately under online settings.

2.3.2.2 Strong vs. No interface positions

The strong-interface position which argues that explicit knowledge can become implicit through practice. This position is mainly represented by DeKeyser (2003, 2007) who has based skill-acquisition theory on the cognitive psychology constructs (see, e.g. Anderson, 1980).

DeKeyser claims that language learning is similar to other cognitive skills and starts with declarative explicit knowledge. His skill-acquisition model claims to shift learners' knowledge from declarative knowledge taught through explicit instruction, to becoming a highly activated and automatic procedural knowledge. This upgrade is achieved through intensive practice of tasks and activities. Consequently, procedural knowledge can be accessed and demonstrated in natural, fluent communication.

One of the well-known studies that has supported the strong-interface position was DeKeyser's (1997), claiming that learning grammar of a second language in instructed settings has to begin with declarative knowledge presentation followed by extensive practice. His study tested participants learning an artificial language as a second language over a period of one semester. Three groups received the same amount of explicit instruction for different grammatical rules but each group received practice for only one of the rules. They were tested for comprehension and production for 11 weeks. DeKeyser argued that participants showed a gradual decrease in reaction time and error rate when they were tested in the same rule that was taught and practiced. However, when they were tested in the rules that did not receive any practice, they showed a slower reaction time and high error rates. DeKeyser concluded that "Declarative knowledge followed by extensive practice led to increasingly robust knowledge, learned at a rate that can best be explained by fast proceduralization followed by slow automatization" (2007, p.106).

DeKeyser's results, however, raised several issues. One of the main concerns was that this study used artificial language rules that are considered to be too simple and superficial compared to real language rules (VanPatten, 2013). Another issue was that participants had to memorise the rules and practice them without any interaction with the input. In other words, they practiced an artificial language that does not contain meaning. However, practice should be performed with meaningful input in order to push L2 learners to interact with target form information and derive intake which would be integrated, after further processing, into the developing system (Sanz & Morgan-Short, 2005).

The second position, by contrast, is the no-interface position that assumes a dichotomy between explicit and implicit knowledge. From a generative point of view, implicit knowledge, which is the basis for spontaneous, automatic and fluent language that is available for use in online settings (Ellis, 2008), is favourable and superior over the explicit knowledge which is the conscious and deliberate language knowledge that is used in controlled settings (ibid). Generative theories generally claim that instructed learning has no role in language acquisition, moreover, they distinguish implicit and unconscious (acquired) knowledge from consciously (learned) explicit knowledge (e.g. Krashen, 1985; Schwartz, 1993; Paradis, 2009).

Within UG, learners' competence is measured according to the level of their mental representations, including knowledge that can be used spontaneously in performance. These mental representations have to be acquired implicitly through Universal Grammar interacting with comprehensible target language input (Krashen, 1985). In this perspective, meaningful input containing target language words and structures will trigger acquisition if they are processed through implicit ways. Therefore, generativists claim that learning through explicit instruction cannot be the basis of automatic and spontaneous communication but might help learners' performance in controlled conditions.

The two interface positions mentioned above differ in viewing the process of deriving intake from input. On the one hand, the no-interface position assumes that input has to occur implicitly and interact with UG in order to be integrated into the learner's developing linguistic system. On the second hand, the strong-interface position assumes that input which is presented through explicit instruction then intensively practiced through repeated activities and tasks can become proceduralized and then integrated into the developing system.

One limitation in applying generative approaches to SLA is that they do not provide the language teaching profession with specific guidelines for the most effective language teaching approaches (Sanz & Morgan-Short, 2005). On the other hand, cognitive theories that assume that language learning is akin to other cognitive skills are at pains to explain how language learned through intensive and time-consuming repetitions and drills can result in fast and fluent performance, with a plethora of studies on effectiveness of explicit over the implicit types of instruction (e.g. DeKeyser, 2003; Norris & Ortega, 2000).

However, this body of research has received a number of conceptual and methodological critiques. Conceptual issues, such as the debated notion of complexity of language features that has distinguished linguistic phenomena to either be complex or simple, were raised. Some researchers argue that complexity of forms depends on the number of derivations and transformation to arrive at the correct form (Spada & Tomita, 2010), although even the definition of complex here is debatable (Whong et al., 2014). On the other hand, other researchers argue that some grammatical forms do not need any transformations, however they are still complex because learners need to establish other types of knowledge in order for these forms to be acquired, such as morphemes (Slabakova, 2013).

In addition, methodological issues such as discrete-point and declarative knowledge-based measures were used instead of measures that test automatic and spontaneous L2 knowledge (Doughty, 2003). Another issue is related to the reliability as a consequence of the relatively short time of those studies (Han & Finneran, 2014). Hence, many agree that a careful interpretation of the findings of these studies is needed (Carroll, 2001; Doughty, 2003; Sanz & Morgan-Short, 2005; Whong et al., 2014) to be able to know if "what is being tested is akin to medium term recall or some kind of task practice effect, rather than real lasting restructuring (intake)" (Wright, 2010, p. 76).

In a recent discussion by DeKeyser (2009), he points out that the implicit-explicit distinction is useful but only at a given point in time. In other words, this distinction can be useful when one would like to investigate the learner's current type of knowledge at a specific time during the process of learning the target language. This could be done through the use of a variety of measures, e.g. timed and untimed grammaticality judgment tasks (R. Ellis, 2005). However, in cases where one would like to investigate the effect of a specific instructional method, or the effect of instructed learning on acquisition in general, it is a matter of tracking continuing development rather than checking against a binary choice. Thus, DeKeyser (2009) argues that the declarative-procedural-automatized 3-part model, is a more useful distinction. He explains that L2 learners start developing their explicit knowledge by learning declarative knowledge; i.e. the knowledge about the grammatical rules, then after sufficient practice this develops into procedural knowledge; i.e. the knowledge how to use these rules automatically. During this process, the automatization of the explicit knowledge, which is a long process, takes place. Thus, different levels of automatized explicit knowledge can be found, e.g. automatized explicit knowledge, less automatized explicit knowledge, and non-automatized explicit knowledge (Suzuki and DeKeyser, 2017).

However, this automatized explicit knowledge, defined as the "automatized conscious knowledge that is partially (not fully) automatized" (ibid, 2017, p.5) can still be distinguished from implicit knowledge as it involves awareness, although it can be accessed automatically in online settings. Nevertheless, DeKeyser clarifies that suggesting that explicit/declarative knowledge turns into implicit/procedural knowledge does not indicate that if one type on knowledge develops the second type will decline. He explains that: "the presence of one is conducive to, or plays a casual role in the development of the other" (Ibid, 2010, p.126). He acknowledges that explicit learning does not necessarily lead to full automatized or even implicit knowledge but it will increase the chances that learners reach a high degree of automatization in their use of the target form.

It is important to note that his position is still representing a strong-interface, compared to no-interface position discussed above, as it implies that in some cases, explicit knowledge with sufficient practice can lead to implicit representations after full proceduralization and automatization take place.

After evaluating the previous two interface positions in SLA above, a third interface position that lies between the earlier two positions seems to offer a more logical explanation to the variability issue found in L2 learners' performance. For the purpose of this study, the next section discusses the weak-interface position and explains the reason to adopt it in this research.

2.3.2.3 The weak-interface position

This position assumes that explicit knowledge can become implicit under specific constraints (N. Ellis, 2002, 2005; R. Ellis, 2003, 2008, 2009). N. Ellis argues that second language learning occurs through frequent encounters of form-function mappings (constructions) in communication. However, explicit instruction is still required whenever implicit processes fail to support learning fully.

According to N. Ellis, explicit instruction can push learners to consciously notice the input that will aid registering constructions "that are then tuned and integrated into the system by implicit learning during subsequent input processing" (2007, p. 84). Hence, it is assumed that both explicit and implicit learning are required in second language learning, as explicit knowledge supports the implicit process of learning.

Thus, the weak-interface position argues that input may, in theory, be successfully converted to intake if presented explicitly in certain conditions where implicit learning fails to process the input and integrate it into the developing system. This particular position seems to offer a possible justification to the issue in hand. Although, it acknowledges that second language acquisition is mostly implicit and can therefore be compatible with a UG feature-based approach to implicit acquisition which is adopted in this research, it also acknowledges that certain linguistic structures require additional instruction, in order to direct learners' attention toward the problematic features/or learning strategies that might interrupt the complete acquisition of these structures.

However, in instructed second language learning contexts, L2 learners are mostly learning through explicit instructional methods which include drills and exercises for practice, leading to the accumulation of large amounts of explicit knowledge. Consequently, one cannot confirm if implicit knowledge exists or not, and in what degree, in L2 learners' developing system (R. Ellis, 2005), as implicit knowledge development is incidental and could take place anytime during explicit learning process. In addition, it is assumed that the target language learning method affects the extent and type of L2 learners' knowledge (DeKeyser, 2010). Thus, instructed L2 learners with less communicative opportunities, are expected to possess more explicit/non-automatized knowledge.

Despite that explicit knowledge is predominant in instructed L2 learners' linguistic system, it is possible to believe that L2 explicit instruction is necessary for second language learning. Doughty (2003) argues that L2 learners in foreign contexts cannot learn the target language only by being exposed to it, as L2 learners have to be occasionally instructed in grammar and provided with explanations and feedback of their incorrect learning strategies and errors. In a recent analysis, R. Ellis (2016) investigated the effect of FFI in developing implicit knowledge. He reviewed 11 studies to examine the effect of FFI on learners' free production, six of them were also included in the well-known meta-analysis of Norris and Ortega (2000) and were the only studies that included free-production. The main goal of R. Ellis's analysis was to reconcile between the two explicit-implicit interfaces discussed earlier. He argues that free production testing measures, in contrast to testing measures based on controlled production, are required to reveal evidence for acquisition. He mainly investigated the question about the effectiveness of employing form focused instruction (FFI); i.e. explicit instruction that is directed toward teaching specific grammatical properties, despite that there is a strong theoretical probability of it failing to lead to the favourable implicit knowledge (e.g. the no-interface position).

Ellis's argument is based on his analysis findings that led him to conclude that form-focused instruction can aid the implicit learning of the language, and affect the accuracy of some grammatical structures. His conclusion was based on two factors: first, is the level of learners - since the effect of FFI was clearest on the performance of above-beginners performance. He explains that this was due to the lack of reliable testing measures for beginner-level implicit knowledge, since they are in their early stages of acquisition. The second factor was related to the type of target structures. His analysis revealed that FFI is more effective in learning morphological features in contrast to more complex syntactic features. This might be because FFI makes the forms salient to the learners, hence, they can understand the form-meaning relationship and establish the mapping accurately; i.e. process it automatically in real-time settings.

However, it is important to note that Ellis's analysis was limited by the number of studies included, and that his conclusion may be compromised by the two factors mentioned earlier. In other words, his findings might be not applicable to all levels of L2 learners and all target structures. He found that implicit knowledge was clearer in above beginners' level, which could mean that these L2 learners might have picked up implicit knowledge incidentally while they were learning through explicit methods, hence, the explicit FFI should not be considered the only factor causing the improvements in L2 learners' free production.

Second, for the target structures, Ellis found out that FFI works better with forms that have complex syntactic features, thus, it is conceivable to assume that FFI is more needed for teaching some forms and not "all" forms. This point confirms the earlier discussion about the weak-interface position, specifically that explicit method is needed for learning the L2, however, it should be only recalled whenever the implicit method fails to process and integrate the target forms into the developing system.

Despite the previous argument, R. Ellis (2016) convincingly argues that "explicit knowledge can facilitate the subsequent acquisition of implicit knowledge (e.g. by helping to make forms salient to learners)" (ibid, 2016, p. 234). Furthermore, he suggests that proposals like Long's (1991) which call for teaching methods that focus on making the target forms salient and engage learners in communicative opportunities that encourage the process of form-meaning mapping, which is necessary for implicit language learning, could be offering a balanced relationship to reconcile the two contrasting views of the acquisition of second language; i.e. explicit or implicit learning methods.

Therefore, R. Ellis' (2016) analysis lend support to the weak-interface position that language learning is implicit in nature, but explicit instruction can aid the implicit learning of the target language. Hence, in this research, the weak-interface position is adopted arguing that explicit instruction accompanied by meaningful, communicative opportunities for practice, are necessary in foreign learning contexts, as support needed for triggering implicit learning modes and increasing the speed of acquisition. This could be particularly relevant for specific target structures that prove to be difficult for processing and production and thus take longer time to be acquired, such as morphological inflections.

However, it is important to note the difference between implicit knowledge and the automatized explicit knowledge. As discussed earlier, explicit knowledge cannot become implicit. However, the automatized explicit knowledge shares similar aspects with implicit knowledge as it also can be accessed automatically in online settings but still involves consciousness, thus L2 learners are aware of the target forms rules (DeKeyser et al. 2017). Therefore, it is rationale to believe that this type of knowledge, i.e. the automatized explicit knowledge, at least partial automatization, should be the target of instructional methods, as this knowledge could be accessed automatically in online communicative tasks which in turn would increase the chances for implicit learning process to take place while using the target forms in online communication; i.e. facilitate the acquisition of implicit knowledge (N, Ellis, 2005; R. Ellis, 2008; DeKeyser 2015, DeKeyser et al., 2017).

Han and Finneran (2014) elegantly address this issue by suggesting that explicit and implicit knowledge interfaces exist with different degrees of strength in the learner's interlanguage. They argue that the relationship between explicit and implicit knowledge should not occupy a single position, i.e. strong, weak or no interface. In fact, all three interfaces could exist in one interlanguage, assuming that different degrees of strength exist between the two types of knowledge. Their argument is based on a review of Han's (2000, 2006, 2010) longitudinal study, observing that specific grammatical elements are not susceptible to any degree of interface relationship, such as elements that are easy to learn but difficult to acquire, like articles and inflected morphemes, while other grammatical elements can be susceptible to instruction or input experience.

Han and Finneran's (2014) recommendation to reignite the explicit/implicit knowledge debate, by exploring the aspects of grammar which are susceptible to strong, weak or no interface, launches a new way of looking at this issue and so might validate SLA research for the benefit of second language learning. It is conceivable that certain grammatical aspects may not respond to traditional explicit instruction and formal practice and need a special instructional method to address their special nature, e.g. morphological inflections.

In sum, I argue that, instructed L2 learners can still develop the automatized knowledge required for the retrieval and production of morphological inflections in online tasks. Nevertheless, this automaticity, which is an essential characteristic to define L2 competence (Jiang, 2004; Segalowitz, 2003), has to be targeted by a special type of instruction. This instructional method should address a number of factors related to the morphology acquisition difficulty discussed in the previous sections. First, it should address the special nature and the different properties of the target forms; i.e. morphological inflection, as discussed earlier, certain morphological inflections tend to be difficult for acquisition and acquired later or more variably than their associated syntactic categories (White, 2003; Lardiere, 2007; Slabakova, 2007, 2013).

Second, it should trigger the target forms' acquisition through strengthening the target form representations and overcoming the mapping issues between abstract knowledge of features and their surface morphological manifestations, in order to allow the automatic access and retrieval in online settings (Hopp, 2010, 2013; VanPatten et al., 2012). Finally, this instructional method should offer sufficient amount of practice by employing meaningful, communicative tasks to target the forms' automaticity and encourage their use in online settings (Segalowitz, 2003; Jiang, 2004; DeKeyser, 2007, 2009).

After discussing the variability of morphological inflections in SLA and the different approaches related to the source of difficulty in acquiring and processing these inflections, I argue that non-advanced instructed L2 learners face issues during L2 input processing because of lack of control on the knowledge they have internalised (White, 2003; Hopp, 2010, 2013) and that their online variable production is related to performance not to representational deficiency (Cf. Jiang, 2004; VanPatten et al. 2012). I also discussed the required steps for morphology acquisition and showed that L2 learners cannot automatically process; i.e. acquire the morphological inflections until they establish the robust form-meaning connections that could be recalled and used under task processing demands (VanPatten et al., 2012; Hopp, 2013).

Thus, the assumption adopted here is that instructed L2 learners at early stages of acquisition have no choice but to adopt offline processing strategies due to their weak representations and non-automatised taught knowledge that could only be accessed in offline settings. However, it is possible to assume that, with appropriately focused input, learners could develop stronger representations, and process more automatically and efficiently.

The previous sections discussed the different interface positions in SLA literature, and presented the theoretical background from a UG point of view for the representations' development and the issues in the processing and production of the target morphological inflections. In the next sections, I discuss additional factors, discussed in literature, that could be contributing to morphological acquisition difficulty. These factors come from a different context than UG, however, the issue of morphological variability is not a simple one, and can be caused by factors from different perspectives that interact with each other to lead to issues in processing and production.

2.4 Cognitive perspectives on the processing load of morphological inflections

From a different perspective, cognitive theories suggest other factors leading to the same issue of functional morphology form-meaning mapping difficulty. One of the factors that might contribute to the difficulty of mastering the target language inflectional morphology is the degree of importance of these inflections with regard to the meanings they express (DeKeyser, 2005). The redundancy of the form at issue might contribute toward the difficulty of second language learning, when the morphological inflection is not semantically important because its meaning is expressed in the sentence by another element (DeKeyser, 2005). In the sentence: Yesterday, I paint the wall, for example, the verb ending *-ed*, which is supposed to be used with the verb, is redundant because it was expressed in the adverb (Yesterday).

Another factor discussed by DeKeyser is the opacity of certain morphological inflections, that might make them difficult. Opacity stands for the problematic correlation of the form-meaning relationship, when one form stands for different meanings or different forms stand for one meaning (Ibid, 2005, p. 8). The inflection *-s* is a possible candidate for such phenomenon. When *-s* is attached to a verb, it stands for the third person singular subject. On the other hand, when *-s* is attached to a noun, it stands for the plural of that noun. One explanation for this is that the morpheme *-s* has two different meanings according to which category it is attached (verb or noun).

The frequency and saliency of the form in the input could be another factor that contributes to the issue at hand (N. Ellis, 2002). An example of this phenomenon is the third-person-singular *-s* and past form *-ed*. The inflection *-s* appears in one case, which is the third person singular in the form-meaning mapping, whereas the *-ed* appears in six cases: the first person singular and plural, the second person singular and plural and the third person singular and plural in the form meaning mapping. Such repetitiveness of the inflection *-ed* in the six cases in everyday speech between two or more individuals might affect the saliency of the morpheme, enabling it to be acquired earlier and more easily than the inflection *-s*, while the inflection *-s* is only used when the individual is reporting an action that is performed by one person (animate/inanimate) in the present tense, a case that is considered to occur less commonly in everyday speech.

Therefore, frequency would have an effect if the form-meaning relationship is clear and straight, so minimum exposure would be sufficient for the form to be acquired. On the contrary, when the form-meaning relationship has little ‘transparency’, and so is neither clear nor straight, frequency is largely needed for the form to be acquired (DeKeyser, 2005, p. 11).

Despite the previous additional factors that might cause issues during L2 processing, paying attention to form and meaning together in order to establish the form-meaning connections is considered to be an effortful mental process that is constrained by limited cognitive resources (Sagarra, 2008). However, when L2 learners demonstrate variability in their production, could it mean that something else may be involved. Particularly, when individual differences of different learners from the same instructional background coming up with their ability to get to that stage of spontaneous production, could it mean that something else is going on with processing, i.e. working memory. The next section discusses the WM role and relationship to second language acquisition.

2.4.1 Working memory and second language learning

Working memory (WM), defined as “the temporary storage and manipulation of information that is assumed to be necessary for a wide range of complex cognitive activities” (Baddeley, 2003, p.198), is considered an important factor in deciding how successful language learning and processing can be. Learners with higher working memory capacity are expected to acquire language faster than those with a lower one (Sagarra, 2008; Sagarra and Herschensohn 2010; VanPatten and Benati, 2010). During second language comprehension and production, WM acts as a workspace that can store received information and retrieve previously-stored information in order to perform complex tasks that require attention (which may be explicitly monitored, particularly in less spontaneously successful L2 learning) in order to complete (Wright, 2010, 2013).

Working memory's distinction from the short-term memory (STM) is debatable. There is an existing overlap between the STM and WM which is assumed to lead to the interchangeable use of theses theoretical concepts, although they may be conceptually distinctive (Aben et al., 2012). Sawyer and Ranta (2001) argue that WM is an independent cognitive workspace that is used for cognitive processes such as comprehension and production. In addition to its ongoing processing functions, WM includes temporary storage, but other researchers (e.g. VanPatten and Benati, 2010) consider WM to be the new substitute for STM. However, this issue about the differentiation between STM and WM is still open to debate.

Numerous different models of WM have been developed over the last 50 years, but the most influential one was proposed by Baddeley and Hitch (1974). This (multi-competent) model has undergone several developments in order to reach the final version (Baddeley, 2000). The multi-competent model started with three main components. As Baddeley (2015, p.18) puts it: 'the attentionally limited control system, the central executive, aided by two temporary storage systems, one specialised for acoustic and language stimuli, and the other counterpart the visuospatial sketchpad'.

Later, Baddeley (2000) added a fourth component, which is the episodic buffer, which is considered to be a multidimensional storage system that can combine information from the two subsystems (visuospatial and verbal) and link them with information from the long-term memory.

Thus, the WM system has two memory subsystems: the phonological loop, which temporarily stores verbal information, and the visuospatial sketchpad, which temporarily stores visual information. Both subsystems are controlled by the central executive, which controls information flow and attention. In Baddeley's model, WM acts as a workspace that can store received information and retrieve previously-stored information in order to perform complex tasks that require conscious attention in order to complete (Wright, 2010). Unlike previous models of the working memory, this model is not only about storage but also includes manipulating and processing information (Kormos and Safar, 2008). Thus, this model gives the WM an essential role in the cognitive processes involved during learning.

Other researchers have opposed this model (e.g. Cowan, 2015), assuming that WM is a one storage system model that is activated by stimuli interacting with long-term information. Despite the different models of WM, they all agree that it has a limited capacity (Sagarra, 2008), which varies from person to person (VanPatten and Benati, 2010). This limited capacity, hence, will affect L2 learners' processing ability, especially when processing complex, ambiguous sentences that tax the WM and add pressure to the parser (Juffs, 2015). It is conceivable, therefore, that learners with a greater working memory capacity will be faster and more efficient when processing linguistic information than those with a smaller working memory capacity (Sagarra, 2008).

Working memory is now strongly linked to second language acquisition (Juffs and Harrington, 2011; Wen, 2015) and working memory capacity is considered to be capable of linking individual differences to L2 learners' ability, such as noticing and processing (Sawyer and Ranta, 2001). Thus, working memory can offer valuable explanations of L2 learners' processing variability and also play an important role in the L2 acquisition process, especially since learning a second language in addition to a first one adds a greater processing load to the cognitive resources (Hopp, 2007, 2010; Lardiere, 2007; Sagarra. 2008). This processing load is assumed to negatively affect the linguistic information implementation (Sagarra and Herschensohn, 2010) such as the process of mapping the grammatical form surface manifestation, e.g. *-ed* to its meaning (pastness), during sentence comprehension.

With regard to the relationship between explicit and implicit learning, considerable research findings support that explicit learning is subject to more variability in cognitive and individual differences in WM than implicit learning (Roberts, 2012). Individual differences in cognitive abilities are supported by the empirical work of Reber et al. (1991) and Robinson (2005). Robinson (2005), replicating Reber, Walkenfeld, & Hernstadt (1991) and Knowlton & Squire (1996), investigated individual differences in working memory and explicit, implicit and incidental learning of Samoan. Incidental learning, according to Robinson, “entails a variety of conscious, explicit learning, rather than simply unconscious and implicit” (2005, p. 261). Robinson concluded that individual differences in working memory positively influence immediate and post-test performance on incidental Samoan learning. However, Roberts (2012) argues that recent work of statistical and artificial learning has yielded mixed results of WM relationship with both types of knowledge, suggesting that WM might affect both implicit and explicit learning abilities, but the effect might be weaker for implicit learning.

Studies on the relationship between L2 sentence processing and WM are considered necessary in second language acquisition in order to shed light on L2 learners’ ability to process both form and meaning of the input (Juffs & Harrington, 2012). In fact, there is mounting evidence that WM plays a role in morphosyntactic processing (Sagarra, 2008; Sagarra & Herschensohn, 2010). For example, Sagarra (2008) investigated the processing of Spanish redundant verbal inflections in a self-paced reading task. She found that third-semester learners of Spanish of higher working memory were sensitive to gender agreement violations, suggesting that they were able to process redundant grammatical forms, whereas those with lower working memory showed insensitivity to these violations.

Another study by Sagarra & Herschensohn (2010) investigated WM effect on processing Spanish gender and number agreement by learners of different proficiency levels. They used self-paced reading task with beginner and intermediate L2 learners. They found that high working memory intermediate learners were more sensitive to violation of both gender and number agreement, although there were some differences between the two forms, than those with lower working memory. On the other hand, beginners were not sensitive to gender or number agreement violations. However, Sagarra and Herschensohn concluded that WM can facilitate the sensitivity to violations gained by above-beginner L2 learners.

More implications of limited or overloaded WM can be seen in, e.g. VanPatten et al. (2012) in their study of Spanish verbal inflections. They have found that L2 non-advanced L2 learners process meaning but not form in self-paced reading task, by relying on word order for comprehension but not on morphosyntactic features. These findings support the fact that WM is an important factor in deciding how successful second language learning and processing can be (Miyake and Friedman, 1998) and that it can contribute in L2 real-time sentence processing differences between native speakers and L2 learners (Roberts, 2012), and even within groups of L2 learners with otherwise similar language exposure.

After discussing the potential cognitive factors leading to variability in morphological inflection processing and production, it is important to assert that this research is adopting a rare combination of generative and cognitive views on SLA through language pedagogy, in order to exploit the research findings and implications to benefit practical second language teaching in the classroom (Whong et al., 2014). So, to recap the first part of this literature review, in the previous sections, the variability of morphological inflections in SLA was discussed and I argued that some UG representations are available in L2 learners developing system, so their issue is on the performance not on the competence level. The acquisition of morphological inflections and the mapping issues faced by L2 learners that possibly lead to the variation found in the morphological interface was also discussed and it was argued that some form-meaning connections could be available but others are not due to the properties of the target forms, so they might need a special type of instruction to address their special nature and boost their processing.

After that, the unresolved debate of explicit and implicit knowledge interface and the effectiveness of instruction were discussed, in addition to additional cognitive mechanisms that might be contributing to the issues in form-meaning mapping such as the WM. I argued that the current instructional methods are not efficient to teach the target morphological inflections because they are unable to address the special nature of these target forms or consider the limited-input classroom settings. Hence, L2 learners in the target context have no choice but to rely on their explicit/offline knowledge that cannot aid them in the production of accurate morphological inflections under online settings.

Therefore, given all the above, in the next part of the literature review, the proposed pedagogical intervention: processing instruction (PI), is presented and discussed, that could potentially address the aforementioned factors and answer the main question asked at the beginning of this chapter, how can input be best presented to help drive noticing for intake in the case of difficult-to-acquire morphosyntax. This pedagogical intervention claims to be able to alter L2 learners' inappropriate processing strategies, caused by weak form-meaning connections, with stronger connections that could be integrated into their developing system and be part of the underlying representations, which is what VanPatten argues, in line with other models of implicit knowledge and acquisition, is what should be used in automatic processing.

'Processing instruction' (PI), is a pedagogical intervention derived from the insight of 'input processing' model (IP) and it focuses on L2 learners mapping issues by manipulating the L2 input. As discussed earlier, UG operates only with processed data from the input, hence, VanPatten argues that input can be manipulated in order to encourage the processing of data and push acquisition along. He explains that such manipulation takes place through processing instruction (PI) which provides special type of activities that manipulate the input in order to push L2 learners to process the target structures that caused processing difficulty.

The next section presents the input processing model (IP), the foundation of the pedagogical intervention processing instruction (PI). Then, it presents major empirical studies testing PI in pedagogical contexts evaluating their findings and their limitations, including some key methodological issues. This chapter concludes by proposing a modified instructional method as a novel contribution by this study, alongside the research questions and predictions.

2.5 Input processing (IP)

VanPatten's input processing (IP) model is not meant to address acquisition per se but examines one set of processes (form-meaning connection) that is needed for morphology acquisition. In other words, the IP model does not suggest that L2 learners will instantly derive intake from input that can be integrated into the developing system and become acquired. However, it addresses one of many steps required for morphology acquisition to take place. IP model is concerned with situations where L2 learners make initial form-meaning connections that might be inappropriate and lead to misinterpretation of this relationship.

These inappropriate form-meaning connections are caused by the limited capacity to process the target form in the input (VanPatten, 1996), because, it is claimed, L2 learners tend to spend their attentional resources to detect content words first in order to get meaning. In English for example, L2 learners have to map between the verb inflection /t/ ([ed], in written form) and the meaning of (+pastness). However, this does not always happen from the first encounter, as some L2 learners spend considerable time to achieve the appropriate form-meaning connection.

The model of second language input processing is defined according to (VanPatten, 2007, p. 116) as:

> A model of moment-by-moment sentence processing during comprehension and how learners connect or don't connect particular forms with particular meanings. It is a model of how learners derive the initial data from input for creating a linguistic system.

Processing in this context means "moment-by-moment computations of language during real-time comprehension" (VanPatten & Jegerski, 2010, p. 5). IP model aims to explain the mental processes interaction of the L2 learners during comprehension and its main concern is how learners derive intake from input. Intake is "the linguistic data actually processed from the input and held in working memory for further processing" (VanPatten, 2005, p. 268). Thus, IP considers intake as some filtered input that has grammatical information related to the meaning that was comprehended by learners.

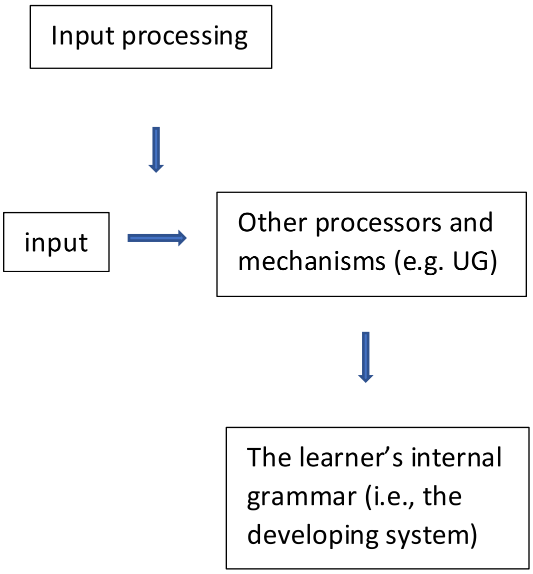


Figure 2. *Where IP fits into an acquisition scheme. (VanPatten, 2007, p. 117)*

VanPatten argues that intake is not equivalent to acquired linguistic knowledge. Nevertheless, this model investigates what might hinder the process of language acquisition when learners process input during the act of comprehension. Thus, it investigates the initial stage of form-meaning connection and what affects this stage of processing; i.e. what learners are doing in real-time processing and why they are establishing some connections but not others. However, although intake might not always become acquired, acquisition cannot take place without intake. Thus, the IP model considers intake to be distinct from other forms of input received through focus-on-form approaches and explicit instruction such as enhanced input (Sharwood Smith, 1993). Input enhancement in detail lies beyond the scope of this discussion but, briefly, alludes to attempts to make the target forms more salient either by the instructor or the instruction materials but, from an IP respective, is limited by lacking opportunities for form-meaning mapping to guarantee the processing of the input to become intake (Sharwood Smith, 1993; VanPatten, 1996).

The IP model aims to answer three fundamental questions about the following issues:

a) the conditions which the learners are under when making form-meaning connections

b) when and why they do some of these connections and not others

c) the internal strategies that L2 learners use to comprehend sentences which in turn affect acquisition.

In his recent version of IP, VanPatten (2007) has formulated a number of principles that describe what L2 learners are doing while processing the input. The following table illustrates these principles.

Table 3. *Principles of Input Processing*

Principles of Input Processing	Explanation
The Primacy of Content Words Principles	Learners process content words in the input before anything else
The Lexical Preference Principle	Learners will process lexical items for meaning before grammatical forms when both encode the same semantic information

The Preference for Nonredundancy Principle	learners are more likely to process nonredundant meaningful grammatical markers before they process redundant meaningful markers
The Meaning before Nonmeaning Principle	Learners are more likely to process meaningful grammatical markers before nonmeaningful grammatical markers
The First Noun Principle	Learners tend to process the first noun or pronoun they encounter in a sentence as the subject
The L1 transfer Principle	Learners begin acquisition with L1 parsing procedure
The Event Probability Principle	Learners may rely on event probabilities, where possible, instead of the First Noun Principle to interpret sentences
The Lexical Semantics Principle	Learners may rely on lexical semantics, where possible, instead of the First Noun Principle (or an L1 parsing procedure) to interpret sentences
The Contextual Constraint Principle	Learners may rely less on the First Noun Principle (or L1 transfer) if preceding context constrains the possible interpretation of a clause or sentence

The Sentence Location Principle	Learners tend to process items in sentence initial position before those in final position and those in medial position

(VanPatten, 2007, pp. 117-125)

It is clear that the above strategies are problematic if adopted by L2 learners when processing the input during comprehension. Two of the above principles are of interest to this research as they relate to inflectional morphology processing investigated by this study.

First is The Lexical Preference Principle which claims that learners will process lexical items for meaning before grammatical forms when both encode the same semantic information. An example of that is in the following sentence: *Yesterday, I baked a cheesecake for my family.* The IP model claims that the learner will focus on processing the content words first which prevents processing the grammatical markers that carry the same meaning. Thus, in the above example, learners are not expected to process the grammatical marker *-ed* and will derive the tense of the sentence from the adverb *yesterday*. This means that learners will start looking for lexical forms that have semantic concepts in the input before looking for the grammatical forms that have the same semantic concepts.

The second principle is The Preference for Nonredundancy, which explains that learners are more likely to process nonredundant meaningful grammatical markers before they process redundant meaningful markers. According to this principle, learners are expected to continue processing lexical forms and neglect the grammatical markers in the input. However, they are more likely to process the grammatical marker when it is nonredundant and meaningful such as *-ing*, the only marker which indicates the semantic notion (in progress) with no lexical form that has the same semantic notion. An example of that is the sentence: *She is runn**ing***, learners are expected to process *-ing* as it is the only form to express in progress, before other redundant grammatical markers such as third-person-singular -*s* which is also meaningful but redundant as in the sentence: ***She*** *runs one hour* ***every day.***

The previous examples of forms that carry semantic concepts led VanPatten (1984) to posit an important construct coined as the 'communicative value'. Communicative value refers to the contribution a form makes to the overall sentence meaning and is determined according to the presence of two features: the inherent semantic value and redundancy. The verbal morphology -*ing* is considered to have a high communicative value because it encodes a progressive notion. Second, it is nonredundant as it naturally occurs in the discourse without any lexical forms indicating the same semantic notion. Other verbal morphology can have less communicative value because they are redundant although they hold semantic value. Redundant English verbal inflections have different degrees of redundancy, such as -*ed* which has a semantic value as it encodes pastness, but can 'sometime' occur alone in the sentence or accompanied by another lexical item that encodes the same semantic meaning. In the following example, the lexical form (adverb) only occurs at the beginning of the conversation (VanPatten, 1996, p. 25):

-*Why didn't you come* ***last night****?*

-*I work****ed*** *all day and I didn't feel like it after getting off.*

The other type of morphological inflections has the least communicative value as it has semantic value but it is always redundant. The verbal inflection -*s* has "inherent semantic value since it encodes the semantic notion of third person singular" (VanPatten, 1996, p. 25) but it is 'always' redundant as it has to occur with a subject noun phrase (VanPatten, 1996, 2007; Benati & Lee, 2008). For example, it is natural to hear: ***He*** *likes coffee*, but it is unlikely to hear: *l*ikes coffee*. Therefore, all these different levels of communicative value contribute to the L2 learners input processing preferences.

The previous discussion of communicative value and the Redundancy hierarchy suggested by IP, is in line with the bottleneck hypothesis (Slabakova, 2006, 2013) discussed in section (2.2.1) and the properties of morphological inflection discussed in section (2.2.1.1). Hence, the adoption of these inappropriate strategies can explain, to some extent, the morphological inflections' incomplete acquisition documented by previous studies (e.g. White, 2003; Lardiere, 2007) and the difficulty in processing and production of the target forms (e.g. Hopp, 2010, 2013; Sagarra and Herschensohn, 2010; VanPatten et al. 2012).

One could assume that it would be more challenging for L2 learners to derive intake from input that includes forms which require high attentional resources. On the other hand, the automatic processing and production would be expected to take place smoothly with forms that do not carry such inherent characteristics. Thus, highlighting those inappropriate strategies and explaining them to L2 leaners accompanied by appropriate opportunities for practice could possibly lead to derive intake successfully and consequently a faster integration of target forms into the developing system.

The next section discusses the WM role and relationship to IP model of second language acquisition.

2.5.1 Working memory and Input Processing

Working memory (WM) is considered to have an essential role in IP (VanPatten, 1996, 2004, 2005, 2007) as it holds the filtered data that was derived from input (intake) for further processing, until this data is integrated to the developing system. However, the IP theoretical model does not discuss WM in details or its relationship with processing different target features governed by IP principles. Nevertheless, as in Hopp's and VanPatten's discussions of morphological variability and morphology-syntax mapping issues addressed earlier in section

(2.3), it is my assumption that working memory may be part of the issue under investigation here.

With regard to the IP principle for the preference of Nonredundancy, it is logical, for the purpose of this research, to assume that the more there is an increase in the grammatical form redundancy, the more WM capacity (WMC) is needed to process it. Attending redundant morphological inflections requires shifting learners' attentional resources from lexical items to these inflections; however, performing this process in real-time settings requires great mental effort and thus requires higher WM resources. Thus, it is conceivable to assume that WMC is going to be overloaded; i.e. the attentional resources would be occupied in processing lexical forms first. Hence, there would be insufficient resources left to attend the redundant target inflections, and consequently "processing will slow down and/or storage will decrease" (Sagarra, 2008, p. 134). Thus, the limited capacity of WM, which varies from person to person would be constraining learners' ability to shift their attentional resources and thus constraining their ability to spontaneously process grammatical forms.

Given that WMC is limited, Juffs and Harrington argue that "the more WM you have, presumably the more attentional resources you process and the more you can potentially learn, because you have enough memory to process form TOGETHER with meaning" (ibid, 2011, p. 147, original emphasis). Linking this to IP, VanPatten (1996, 2004, 2005, 2007) argues in his IP model, that learners will focus first on getting meaning from lexical items that have semantic notion, such as content words, however, grammatical forms such as verbal inflections might be "skipped over or partially processed" (2004, p. 8). He further explains that WM processing resources will be exhausted by the effort required to process lexical items, leaving no enough attentional resources for grammatical forms processing (ibid).

Therefore, in light of this explanation, it is plausible to argue that L2 learners who demonstrate variability in their morphological inflections production, are overloaded with processing lexical items; i.e. adverbs, which prevents WM resources from attending to grammatical forms; i.e. -*s* and -*ed*. However, if these forms are part of their mental representations, they will be automatically processed, and thus no need for WM resources to be channelled to them.

According to the communicative value suggested by IP model, the processing of the verbal inflection -*ing* should not exhaust WM resources, as it is a non-redundant inflection and thus it would be automatically/online processed with no interruption. On the other hand, the processing of the verbal inflections -*ed* and -*s* would require more attentional resources based on their degree of redundancy. The morphological inflection -*ed* is expected to not be automatically processed in some cases according to the availability of temporal adverbs in the sentence, hence, WM resources would be only occupied when the inflection is redundant. Whereas, the morphological inflection -*s*, is expected to be non-automatically/offline processed all the time, because it is always redundant, hence, WM resources would be always occupied.

The following table presents the verbal inflections according to their degree of redundancy and the type of their processing:

Table 4. *Communicative value of verbal inflections*

Independent variable	Communicative value		
	-*ing* (progress)	-*ed* (pastness)	-*s* (agreement)
The preference for Nonredundancy	-Non-redundant	-Sometimes redundant	-Always redundant
	-Automatically/online processed	-Partially processed	-Non-automatically/offline processed
WMC effect	-No WM resources needed	-WM resources occupied when the form is redundant	-WM resources occupied all the time

Despite the fact that the role of WM in processing verbal inflections is not discussed in IP model and has not been investigated by PI studies, VanPatten (2007) argues that learners' processing is constrained by their cognitive ability. He states that:

> "comprehension for learners is initially quite effortful in terms of cognitive processing and working memory, and that learners are limited capacity processors and cannot process and store the same amount of information as native speakers can during moment-by-moment processing" (p.117).

In his IP model, VanPatten explains that the aim of outlining the IP principles is to highlight the inappropriate strategies adopted by L2 learners during their comprehension. Therefore, the PI intervention was designed to direct learners' attention, during meaning comprehension, to the target forms that would help them to get the information needed for successful processing instead of other lexical items that would cause processing difficulty. Thus, one may hypothesize that WM capacity may have a role in how successfully L2 learners may exploit these strategies in order to improve the target forms processing. In other words, WMC would correlate with the extent to which L2 learners are affected by the PI intervention in favour of the automatic retrieval and production of the target forms in online settings.

Therefore, I follow Sagarra (2008) in arguing that "WM constrains the processing of redundant grammatical forms" because it "determines how well and fast learners process and store linguistic information" (ibid, p. 134). Thus, after receiving the PI intervention, one may expect that the higher WMC would positively correlate with learners' processing of redundant target forms in the online EI and SPR tasks, as PI is expected to be an appropriate cognitive approach to manage the ease of processing.

The next section discusses the role of instruction in pushing the L2 learners away from the inappropriate strategies of processing the target form and thus, is shifting the focus from the offline/non-automatic processing to the online/automatic processing of underlying representations. The next section presents the pedagogical intervention derived from the IP model 'processing instruction' (PI) and some key PI studies. Then, PI studies' limitations are presented and discussed, followed by this study's predictions and research questions.

2.5.2 Processing instruction (PI) as a means of L2 learning

Pedagogical treatments have typically been distinguished according to the type of instruction i.e. explicit or implicit, and their effectiveness in facilitating the input to become intake. However, the input itself and the type of practice involved have often been overlooked (Sanz, 2005). IP model, on the other hand considers input to be the starting point for L2 learning and that instruction should be focused on deriving intake from input which is needed for language acquisition. Thus, from the insights of IP, processing instruction (PI) was derived to enable learners to overcome the inappropriate processing strategies outlined earlier.

PI is a pedagogical intervention based on the "psycholinguistic processes occurring during learner comprehension of second language (L2) input" (VanPatten, 2005, p.267). The main goal of PI is to direct learners' attention to form or structure in the input – alongside meaning - instead of relying just on lexical forms in order to derive the meaning. Hence, such a technique is thought to be successful in deriving intake data through driving learners' attention to exclusively rely on the form or structure in the input (Benati, 2005). This aim is consistent with Doughty's (2003) claim about the need of L2 learners to develop sensitivity to language cues in the input in order to have enough processing space for more complex input. She further argues that this processing should be monitored by L2 instruction in order to enable L2 learners to notice the cues located in the input through using pedagogical interventions that focus on implicit learning mode rather than explicit learning modes that promote metalinguistic awareness. The aim of PI is also compatible with the weak-interface of explicit-implicit knowledge, adopted in this research to explain the morphological inflection phenomenon under investigation.

Input → intake → developing system → output

↑

Processing mechanisms

↑

Focused practice

Figure 3. *Processing Instruction in Foreign Language Teaching (VanPatten & Cadierno, 1993)*

This intervention has three instructional components (VanPatten 1996, 2005; Benati, 2004; Wong, 2004). First, learners are provided with an explanation of the target grammatical form. Second, learners are made aware of the processing problem they may encounter with this specific form. For example, the learners are told that English verbs are inflected with *-s* in the present tense if the subject is a third person singular (he, she, it) although the tense may be indicated by other lexical forms in the sentence such as (everyday).

Third, learners are provided with structured input (SI) activities. In order to make the forms more salient, SI activities manipulate input to help learners process it. These activities are interpretation tasks that ask learners to interpret the meaning of the stimulus by relying on the form or the structure and then choose the correct answer from the options.

SI activities include two types: first, is the referential activities which are designed to push L2 learners to process the form-meaning connections through reading and listening to sentences that include morphological inflections but stripped from adverbs, then ask them to decide the tense of the action. This activity includes both right and wrong sentences, thus L2 learners need to attend to the target inflections in order to choose the correct answer and complete the task. The second type is affective activities which require L2 learners to express their opinions and exchange information about specific events or actions. This activity includes grammatical sentences only, and encourages learners to use the target inflections without the guarantee to use them while performing the activity.

PI claims that it is different from other forms of instruction because it intervenes in real-time sentence comprehension to identify the form or the structure that may cause problems and push learners away from incorrect strategies (Benati, 2004; VanPatten, 2005). Another unique component of PI is SI activities, which are designed to push learners to process the form and use it in order to get the meaning of the sentence and provide the correct answer. Thus, learners must use both form and meaning in order to complete the task.

PI intervention is compatible with morphology acquisition stages suggested by Hopp (2013), who argues that L2 learners need to establish the mental representations of the target inflections first through appropriate form-meaning connections that will allow automatic processing to occur. After that, L2 learners will be able to automatically retrieve these inflections and use them spontaneously in communication. Therefore, PI argues that it can create the appropriate conditions for L2 learners to make these form-meaning connections in order to be automatically processed.

In regard to the weak-interface position, PI argues that it can push learners away from the inappropriate processing strategies that cause the incomplete acquisition of the target forms, and consequently cannot be accessed in online settings; i.e. offline processing. Instead, PI would encourage noticing these forms in the input, mapping the forms to their meaning and then integrating them, after further processing and sufficient practice, to the developing system as part of mental representation; i.e. online/automatic processing.

However, PI claims that SI activities -the referential and affective activities- are sufficient to cause positive change in learner's developing system, by pushing them to use the target forms in order to complete the task. Moreover, these activities are assumed to develop the automaticity needed to access the target forms freely in production (e.g. Benati, 2005; Benati and Lee, 2008).

Therefore, PI seems to be a viable technique to address the problematic issues faced by instructed L2 learners with the processing of morphological inflections, where they seem to have the knowledge of verbal inflections, yet, they were unable to retrieve it in real-time settings.

2.5.3 Research investigating PI in SLA

A considerable body of PI research has investigated the effectiveness of this type of instruction to "alter processing strategies and increase better intake for acquisition" (VanPatten et al., 2012, p. 271). The first study of PI was by VanPatten & Cadierno (1993) who conducted a study on three groups that received traditional instruction (TI), PI and control groups, of Spanish learners on the processing of accusative pronouns. The results of their study showed that PI group outperformed the other groups in interpretation and production tasks. Ever since that study, a significant body of research has been produced investigating PI effect on different languages. For example, studies have been carried out in Spanish (e.g. Van Patten & Fernández, 2004; Fernández, 2008; VanPatten & Borst, 2012; Leeser & Demil, 2013), in English (e.g. Benati, 2005; Benati & Lee, 2008) and Italian (e.g. Benati, 2004). The findings of these studies showed superiority of PI over other types of instruction that emphasise language production for acquiring the target grammatical forms.

However, most of PI studies have only focused on few principles of input processing which might affect the generalisability of their results and the claim related to PI ability to affect L2 learners' processing of different grammatical forms. The largest number of PI studies have focused on the First Noun principle which has attracted most PI research in Spanish. This might be because the first noun principle suggests that learner would process the first noun of the sentence as the subject, and in Spanish word order, the subject may not come at the beginning of the sentence and can be omitted if it is a pronoun. On the other hand, the preference for Nonredundancy has been investigated by Benati, (2004) in Italian, and Benati (2005) and Benati & Lee (2008) in English. However, Benati (2005) and Benati & Lee (2008) focused mainly on the Principle of Lexical Preference, although, the grammatical forms targeted by these two studies were also affected by the Preference for Nonredundancy. In addition, as far as I could identify, Benati (2005) and Benati & Lee (2008) are the only two studies that have investigated PI with English language instructed learning.

The next sub-sections discuss some of the key PI studies methodological design and their findings.

2.5.3.1 Benati (2005)

The first study to be discussed is by Benati (2005), who has investigated the lexical Preference Principle and the Preference for Nonredundancy Principle on English past tense. Two questions were addressed in this study (Benati, 2005, p.74):

1- What are the relative effects of PI, TI and MOI on the acquisition of English past simple tense as measured on an interpretation task at sentence level?

2- What are the relative effects of PI, TI and MOI on the acquisition of English past simple tense as measured on a production task at sentence level?

In this parallel study, two groups of Greek and Chinese learners were divided into three groups. One group received PI (explicit instruction followed by information related to the processing problem they might encounter and structured input activities). The second group received TI (explicit instruction followed by mechanical drills, where participants are asked to complete activities that do not require form-meaning connection) and the third group was exposed to MOI (explicit instruction followed by output-based activities). Each group received 6 hours of instruction (2 hours for three days) of the same amount of explicit instruction and practice, the only difference was in the type of practice. Classroom teachers served as the instructors for the three treatments and were given instructions on how to present the treatments. A pre-post-test design was adopted, the pre-test was administered few weeks before the treatments, and the post-test was immediately administered after the treatments. Two tasks were used for testing. First, the interpretation task, where participants had to listen to sentences without temporal adverbs and interpret whether the sentence was in the past or the future. Second, the written production task, where participants were asked to look at pictures then choose one verb from a list to write a sentence for each picture.

The results of this study showed that the PI group outperformed the other two groups on the interpretation task, whereas, equal improvement was achieved by the three groups in the production task. Benati (2005) concluded that PI is successful in altering learners' inappropriate processing strategies and aid learners with making the form-meaning connections for acquisition as evident in the interpretation task. He further claimed that PI has an effect on the developing system as evident by the similar performance of the three groups in the production task despite the greater amount of production practice given to the other two groups, TI and MOI.

The free written production task that was used in this study could be argued to be an unreliable measure for spontaneous production as it allowed participants to use their offline/explicit knowledge and monitor and revise their written production. This was highlighted by R, Ellis (2003) who indicates a lack of evidence in many PI studies with regards to their ability to make L2 learners use the target forms in spontaneous communication. Another issue is with the relatively short time of instruction: 2 hours for three consecutive days (total of 6 hours) of instruction and practice. This time limit does not seem to be enough for participants to learn a target form that they had no previous knowledge of. Also, this time limited instruction was not tested by a delayed post-test to know if it has a long-term effect or not. Benati justified not having a delayed post-test by the schools' systems which did not allow for it to take place.

2.5.3.2 Benati and Lee (2008)

The second study is by Benati and Lee (2008) who examined the primary effect of PI on the verbal inflection *-ed* and its secondary effect on the third-person singular inflection *-s*. This study investigated the Lexical preference and the preference for Nonredundancy principles in order to measure the extended effect of PI on other grammatical forms that are governed by the same input processing principles. In this study, they re-examined the primary effect of PI on -

ed inflection using 26 Korean participants who were assigned into two groups, one was the PI group and the second one was the TI group. The researchers made sure that all participants had no knowledge about the target inflection *-ed* and *-s* either by previous instruction or through outside exposure.

The study adopted a pre-test post-test design, and treatments started two weeks after the pre-test. The PI group received explicit information about the inflection *-ed* and additional information about the processing strategies that they should pay attention to. After that, they received SI activities that contained interpretation tasks. The TI group received explicit instruction followed by mechanical production activities. Both groups received the same amount of explicit instruction and activities, which lasted for four hours. The measuring tests used in this study were interpretation and written production tasks. After administering the interpretation and production tasks for both groups, the same tasks were used for testing the inflection *-s*. The interpretation task followed the same criteria discussed earlier in Benati (2005), however, the written production task was different. It was a fill in the gap activity that provided learners with the verb in parentheses, so all they had to do was add the inflection.

The findings of this study for *-ed* inflection, were similar to Benati (2005) which showed that the performance of the PI group was significantly better than the TI group in the post interpretation task whereas, in the post production task, both groups had significantly improved their performance. For the inflection *-s*, the PI group outperformed the TI group in both tasks. Benati & Lee concluded that PI is an effective intervention for processing and producing the target forms and can indeed alter “the internal processing mechanisms that work with primary linguistic data” (2008, p. 118).

Nevertheless, a number of issues could be raised about this study. First, although the interpretation task results showed a better performance of the PI group, the task used in the post test was similar to the SI activities employed in the PI treatment. Thus, it is clear that the PI group may have gained familiarity, especially that the participants did not have any knowledge of the target structures and only received four hours of instruction. Second, in the production tasks, it was found that both groups significantly improved in the post-test. It is obvious that testing participants at the beginning of a treatment with no knowledge at all about the target form would yield very low scores. Thus, any knowledge the participants might have picked up after treatments would naturally make a significant improvement compared to their first performance.

With regards to the claim about PI effect on learners' production, the production task had two main problems. First, it did not test learners' real and spontaneous ability to produce the target form, as it had an offline nature where learners used a pen and paper to write down the verbs inflected with the target forms in a cloze-test. Second, the verb was provided in parentheses before each blank and learners only had to add the inflection. Hence, learners did not need to understand the meaning of the words, which technically could be regarded as an exercise. This lack of meaningfulness is a problem found in many previous PI studies which claim that PI's main goal is to push learners to develop appropriate strategies of the form-meaning mapping through meaningful activities (R. Ellis, 2003; 2009). A similar point was raised by Doughty (2003) who notes that PI has to ensure the existence of meaningful form-meaning activities in order for PI to be distinguished from other traditional instructional methods. Other limitations such as the small number of participants and the lack of delayed post testing might further compromise the claims made by this study.

2.5.3.3 Marsden and Chen (2011)

The third study is by Marsden and Chen (2011), who investigated the effects of the two input activities in PI package, i.e. the referential and the affective activities on learning the past form

-ed. This study is important because it sheds the light on the type of knowledge promoted by PI. This study employed 120 Taiwanese learners of English as a foreign language at a primary school in Taiwan. They were allocated to one of four groups: 1- A referential group, 2- An affective group, 3- A referential and affective group and 4- A control group. This study investigated the regular English past tense form -ed, and the research questions were:

1-Do affective activities, either alone or following referential activities, have any impact on learning the -ed past tense inflection?

2-Does any learning observed tend to have characteristics of explicit or implicit knowledge at test?

This study employed a pre, post and delayed-post testing design and used semi spontaneous oral production tasks: a picture narration, a structure oral conversation, a timed grammaticality judgment task (GJT) and an offline written gap-fill tests for testing participants performance. The intervention was administered in four sessions, each of 40 minutes with a total of approximately 2.5 hours. The findings showed that affective activities did not have a positive effect on the learning of -ed, whereas referential activities led to learning gains in the GJT and the offline gap-fill task. However, both of activities did not lead to any learning gains in the oral production tasks.

With regards to the type of knowledge promoted by input activities, they concluded that, after running multiple statistical analyses, the observed gains in the GJT and the gap-fill tasks at the post and delayed post-tests were caused by the improved explicit knowledge of the target inflection -ed. However, they acknowledge that the limited time of the treatments and the amount of exposure might have affected the type of learning promoted by the intervention. They also acknowledge that the lack of a productions task that elicit implicit knowledge is a limitation that should be addressed in future research. Nevertheless, they suggest that affective activities are still important in order to accommodate the PI within the communicative approach, however, a re-examination of the amount of these activities is recommended in the future studies.

Similar findings of Marsden and Chen's study with regards to the type of knowledge promoted by PI was documented in a recent study by Atchley (2015). Atchley employed PI to target the noun-adjective gender agreement in learning Spanish as a second language. This study used offline interpretation task, production task and online self-paced reading task to assess L2 learners' performance. The PI group made significant gains in both offline tasks, however, the online SPR did not reveal any learning gains for L2 learners. Atchley argues that beside the unstructured nature of the SPR task and the level of the participants, PI was not able to affect learners' developing system in the limited time of the treatment.

Nevertheless, this issue was discussed by De Jong (2005) who argues that most of previous PI studies' findings are caused by practising explicit knowledge instead of acquiring implicit knowledge. The same point was also raised by DeKeyser et al. (2002) arguing that most if not all PI studies are not addressing acquisition but instead, they are addressing "the learning of monitored knowledge" (p. 819). On the other hand, VanPatten (1996, 2002, 2004) has always explained that PI intervention enables the learners to process the input and derive the intake that would automatically be accommodated in the developing system. In fact, most of previous PI studies made claims related to the ability of PI to alter learners' processing strategies, however, their findings did not reveal significant gains on the level of online tasks either because they were not employed in the first place or that they failed to make any improvements (e.g. Benati, 2005; Benati and Lee, 2009; Marsden & Chen, 2011; Atchley, 2015; Henry, 2015).

Marsden and Chen (2011) argue that VanPatten and colleagues work have always suggested that the type of knowledge promoted by PI intervention "tends to be implicit rather than explicit” (p. 1063). However, Marsden and Chen acknowledge that learners might access some explicit and implicit knowledge or both types when performing a task but that the “characteristics of a task tend to affect the nature of the language knowledge elicited” (p.1064). Hence, the design of the two studies employed in this research included online testing methods to examine the type of knowledge promoted by the interventions under investigation. These testing methods are presented and explained in the following section.

2.5.4 Methodological problems in PI studies

A number of limitations have been established in current PI research, which this study goes some way to address. PI studies claim that PI can directly affect the developing system (VanPatten & Oikkenon, 1996; Benati, 2005; Benati & Lee, 2008). Thus, it can subsequently affect L2 learners’ performance in production (Benati, 2005; Benati and Lee, 2008). Nevertheless, these claims are affected by three main points of conceptual, cognitive, and methodological limitations.

First for the conceptual issues, PI research has mainly focused on three processing principles: The First Noun Principle, the Lexical Preference Principle, and the Primacy of Meaning Principle. In addition, a limited number of studies have investigated PI effect on learning English target forms (e.g. Benati, 2005; Benati & Lee, 2008) whereas most of PI studies have investigated PI effect on learning Romance languages. Moreover, these studies which investigated English language did not investigate different features of different target forms. For example, the IP model argues that some structures have different redundancy levels which affect their processing and cause difficulty, thus, a comparison between these features is needed in order to be able to assess the efficacy of PI in changing the inappropriate processing of the target forms. However, as discussed earlier, Benati (2005), Benati and Lee (2008) and Marsden and Chen (2011), focused on investigating one English grammatical form, the past form *-ed*, which is according to the IP model has a semi-redundant level without investigating the PI effect on other nonredundant and redundant inflections. Therefore, this narrow area of research makes it difficult to conclude that PI has the ability to alter all processing strategies governed by input processing model or generalise its findings to other than Romance languages.

The second point of limitations is related to methodology and that is the proficiency level of participants involved in PI studies. VanPatten (1996, p.8) emphasises that processing instruction attempts to:

> Alter learners' default processing strategies if they do not work to create optimum intake. Processing instruction thus is beneficial when it identifies an incorrect or less than optimal processing strategy and then fashions input activities that help to circumvent the strategy.

However, most PI studies employed L2 learners who were at a very early stage of L2 learning, i.e. beginners, with no previous knowledge of vocabulary or structure of the target language. Thus, these studies assessment methods are not testing PI ability to "alter" the incorrect or non-optimal processing strategy, instead it predisposes L2 learners to new meaningful input and new method of practice that encourage the appropriate form-meaning connections at the beginning of their learning process. Nevertheless, in order to test the validity of this type of instruction, PI intervention should be used with L2 learners who demonstrate these inappropriate strategies in their L2 production.

Within the same methodological issues of previous PI studies, as discussed earlier, PI studies have relied on interpretation and production tasks that test learners' knowledge through controlled, offline conditions which allowed learners to control and monitor their response. Those testing methods are not testing learners during comprehension but they assess what learners are doing after that. In order to assess learners' processing in real-time settings, online tasks such as self-paced reading adopted in processing studies (e.g. Sagarra, 2008; Sagarra &

Herschensohn, 2010) are necessary to provide a moment by moment detection of learners' processing during the task. For example, self-paced reading tasks ask participants to read sentences in a word by word or phrase by phrase fashion through pressing a button (Marinis, 2010). During that, participants control the pace of presentation according to the time they need to read each word or phrase, each button press is recorded in order to document the reaction time (RT) needed to read each word. Thus, longer RTs at specific words or phrases indicates processing difficulty or sensitivity to ungrammaticality of the sentence (ibid).

With regards to production tasks, offline written production tasks employed by previous PI studies allowed learners to rely on their explicit/offline knowledge to monitor and revise their written production. This type of production cannot be compared to spontaneous and automatic communication which PI claims to be targeting with its current assessment methods. However, assessing spontaneous production of the target grammatical forms should be done through employing certain tasks such as elicited imitation task (EI), that has the ability to elicit the production of target forms under real-time conditions. The EI task tests participants' production of inflectional morphology under the task's processing demands. EI asks the participants to listen to a set of recorded sentences and repeat what they had heard as closely as possible. The rationale underlying the use of EI task is that it can "tap into the ability to process meaningful language receptively and productively" (Wu & Ortega, 2013, p. 683). Thus, if the grammatical forms targeted by the tasks are not part of learners' mental representations, they cannot not be recalled (Spada et al., 2015).

Spada et al. (2015) used an EI task to elicit spontaneous production of specific grammatical form. EI was used in order to assess the effects of instruction on specific grammatical forms that were difficult to learn. They compared EI with two timed grammaticality judgment tasks and one offline task, and found that EI was a valid measure for (implicit) knowledge of the target forms and the most successful task to elicit spontaneous production. Their findings support the findings of R. Ellis (2005), where he compared three online tasks designed to tap into implicit knowledge: oral narrative task, elicited oral imitation task and timed grammaticality judgment task. He reported that the oral imitation task was the best measure for implicit and automatic knowledge.

The third point of limitation is related to cognitive issues found in previous PI studies. As far as I could identify, previous PI studies did not include any WM tests to investigate the role and relationship between learners' processing and their WM capacity. As discussed in section (2.5.1), although that WM is considered to have an essential role in IP (VanPatten, 1996, 2004, 2005, 2007), the IP theoretical model does not discuss WM in details or its relationship with processing different target features governed by IP principles.

Finally, the most important limitation is that PI studies used similar testing tasks to what participants have been practising in SI activities; i.e. interpretation tasks, hence, this familiarity might affect their performance during assessments. In addition, PI interpretation tasks present the experimental sentences without temporal adverbs, thus, participants had to rely on the inflection in order to complete the task. I argue that this testing method is not similar to what learners are experiencing in everyday communication, as adverbs always exist in written, aural and oral communication. Consequently, these tasks may be unreliable for testing participant' processing of the target structures.

Moreover, R. Ellis (2003, 2009) also criticised the design of the interpretation tasks employed in many PI studies, arguing that they were used to measure discrete-item type of learning leading to no measurable gains of learners' ability to use the target structure in communicative tasks. He claims that PI used tasks that do not involve real-world processes of language use or include a focus on meaning by having a gap that needs to be fulfilled. R. Ellis distinguishes the real tasks that follow the essential criteria of a task from the ones used in PI study, and suggests to call them “structured input exercises” rather than “structured input tasks” (2003, p.162).

After discussing PI studies’ limitations, it is important to acknowledge that PI is an innovative intervention that uses explicit instruction and manipulated input to shift the focus on the explicit knowledge to focus on enhancing implicit learning modes through strengthening the form-meaning connections during the meaning comprehension of the language. Furthermore, PI is a viable solution for L2 learners, namely those with instructed language learning experience to help them from attending the morphological cues in input and derive intake that would subsequently affect their developing system. Thus, using PI in the target context is assumed to be convenient because it is not going to cause any major changes to the current teaching and learning methods, but it will tweak those traditional methods in order to shift learners’ focus from the inappropriate processing strategies and direct their attention to form or structure in the input – alongside meaning - instead of relying solely on lexical forms.

This is in line with the earlier discussion of automaticity development and the weak-interface position adopted in this research. Moreover, PI is compatible with inflectional morphology acquisition steps suggested by Hopp (2010, 2013), specifically the acquisition of the morphosyntax of inflection step. PI also considers the different properties of morphological inflections such as the redundancy hierarchy suggested by IP model. In addition, it directs learners’ attention to the mapping issues faced during processing, as discussed by Slabakova (2006, 2013) and DeKeyser (2005).

However, as discussed earlier, the methodological design of this instructional approach suffers from some flaws, which made it susceptible to criticism (e.g. DeKeyser, 2003; Ellis, 2003, 2009; Doughty, 2004; DeKeyser and Botana, 2015;). Therefore, this research is addressing these flaws by proposing a novel modified version of PI (MPI) and compare it to studies using the original instructional package (e.g. Benati, 2005; Benati and Lee, 2008). In particular, this research focuses on gains in online production that could not be documented by previous PI studies (e.g. Benati, 2005; Benati and Lee, 2008; Marsden and Chen, 2011). This novel intervention design adapts communicative tasks into the PI instructional package to allow the linguistic knowledge processed during the PI intervention to be employed in meaningful and natural production. The next section discusses this adaption in details.

2.5.4.1 Novel Modified PI Intervention (MPI)

A call for a re-examination of current SI activities was made by a number of SLA researchers in order to ensure their meaningfulness (Doughty, 2003; R. Ellis, 2003, 2009; Marsden and Chen, 2011; DeKeyser et al., 2015). On one hand, the PI intervention is an innovative instructional method that has potentials to aid L2 learners in their morphological inflections acquisition through targeting the form-meaning connections and ensure that these connections are correct and accurate. However, one could assume that the flaws found in the PI methodological design, that were discussed above, might be responsible for the unavailability of any measurable gains on the level of online processing and production documented by most of previous PI studies.

On the other hand, the current state of L2 teaching and learning in the target context calls for some necessary improvements that specifically address the morphological inflections acquisition. As discussed at the beginning of this chapter, the variation found in the morphological interface in instructed L2 learners' production was documented by a large number of studies, and until recently, there remains no consensus on the reasons behind this issue.

Hence, this research took into consideration the two points discussed above, and was encouraged to come up with a novel version of PI that would preserve the promising and innovative ideas behind PI intervention about strengthening the form-meaning connections in order to boost their processing, and in the same time address the L2 learners needs related to morphology acquisition who have limited or no access to natural input. Therefore, this new instructional method is considered to be a modified version of the PI intervention, as it maintains its main and essential characteristics. However, it adapts focused communicative tasks into its design in order to allow for a natural opportunity of processing the received input and encourage production under real-time settings. More details related to the MPI intervention design and where the communicative tasks are fitted are provided below.

The next section presents some of the possible tasks that could be tweaked and adapted into the modified PI intervention. Then, it explains the specific components of the tasks employed in this study.

A number of possible tasks could be integrated into PI in order to make certain that learners engage in natural use of the target forms in communication. For example, Pica et al. (2006) investigated three information gap tasks that require noticing, processing and producing specific forms in order to complete the task (task essential). Jigsaw, spot the difference and grammar communication tasks were used to focus on a variety of grammatical forms (i.e. articles, determiners, pronouns, connectors, modal verbs, and verb inflections). The authors found that all of the three tasks "can help learners acquire and use low-salience L2 forms that have shown little development over time" (2006, p. 329).

Another task that would be beneficial to PI and would encourage more spontaneous communication is Dictogloss. Dictogloss involves both input and output and requires learners to work together in order to reconstruct something they were exposed to either visually or aurally (Wong, 2013). This task starts with material presentation where learners hear a or see the input (i.e. scene, text, dialog). After that, learners reconstruct what they have heard or see in pairs or groups. Finally, learners produce the reconstructed scene or text. Dictogloss encourages learners to focus on the input and push them to pay attention to specific linguistic forms such as nouns and verbs, which in turn results in more input processing (Izumi, 2002).

For example, VanPatten et al. (2011) used Dictogloss with film scenes where learners had to watch a scene from a film then reconstruct its dialog. It is important to note that this reconstruction was done through written dialog and learners checked their production through watching the scene again. However, this task could be modified by asking learners to reconstruct the input through acting the scene so they are pushed to focus on input, process it then produce it. Moreover, learners could work together to check the correctness of the language used in reconstructing the dialog.

2.5.4.2 The modified processing instruction characteristics

The modified PI treatment in this study has one modification in the affective activities. This modification was done through adapting focused communicative tasks that engage learners to work in pairs to express opinions and share information into the SI activities, specifically into the affective activities step. Although the use of the target forms is not guaranteed during task's performance, the aim of this modification is to encourage participants to use their linguistic knowledge which they have processed earlier in the referential activities, in meaningful and communicative production similar to what they experience in everyday life.

The modified affective task is an adjusted version of the affective activity in order to become a task. This modification was done through adapting the critical features of tasks (Ellis, 2003) into the activity, and these are: 1) The task is a workplan which specifies the roles of the participants in the task. 2) The primary focus would be on meaning through having a gap in the task that motivate learners to use whatever linguistic and non-linguistic resources they have to close this gap. 3) The task involves real-world processes that involves real language use and not artificial language activity such as comparing two pictures or two lists for similarities or differences. 4) The task involves at least one of the four language skills: reading, writing, listening and speaking or a combination of them. 5) The task requires learners to use their cognitive resources such as reasoning and evaluating information in order to share information and express opinions. 6) The task has a clear communicative outcome.

According to the modified instructional package design, the communicative tasks are going to be supporting language teaching as in the task-supported language teaching vs. task-based language teaching (R. Ellis, 2014). As discussed earlier, the MPI is going to follow the standard PI methodological design; i.e. the same amount of explicit instruction, same processing issues explanation and same amount of referential activities and the only difference would be in affective activities. Thus, the communicative tasks would serve "as a means of providing opportunities for practising pre-determined linguistic items" (ibid, 2014, p.103). In addition, these tasks are going to focus on contexts for natural use of language and not on the language itself and will be authentic; i.e. involve real-world use such as to book a flight ticket.

Finally, and most importantly, these tasks would be focused, in contrast to the unfocused tasks. Focused tasks are designed to elicit a specific linguistic feature – for example, a certain morphological inflection. On the other hand, the unfocused tasks are designed with no particular linguistic focus and are likely to invite the use of a variety of linguistic features (R. Ellis, 2003, 2014). Hence, in order to satisfy the aim of this intervention and ensure the use of the target forms in natural production, focused tasks are chosen for this design.

Thus, after explaining the characteristics of communicative tasks that would be employed in this study, it is important to stress that affective activities main characteristics will not be changed but tweaked in order to become a task-like, to provide the L2 learners with the opportunity to express opinions and share information about certain topic or event that either takes place habitually, took place in the past or happening now based on the three target structures of this study: third-person singular -*s*, past form -*ed* and present progressive -*ing*.

This novel treatment will combine the critical features of PI along with the critical features of communicative tasks to create a unique fusion of both innovative treatments and set the right conditions to encourage the automatic retrieval and production of the target forms in meaningful and spontaneous communication. More details about these tasks are provided in the methodology chapter of the PI study (Chapter 4).

2.6 The present study significance and research questions

This research aims to add to PI research by addressing previous studies limitations discussed earlier. First, this study will address the under-researched principle, the Preference for Nonredundancy. In addition, PI will be used for the first time, to my knowledge, with Arabic native speakers learning English as a second language. English is also less researched as most of PI research has hitherto, apparently, been conducted on Romance languages. Furthermore, this study intends to employ intermediate-level participants in order to examine PI ability to alter what may be inappropriate processing strategies adopted and demonstrated by participants in their language production. Thus, this research contributes to current gaps to verify potential PI effects for different languages, more target structures and different proficiency levels.

Second, this research intends to examine the role of WM in processing redundant grammatical forms (Sagarra, 2008). As far as I could identify, PI and its relationship with WM has not been investigated by previous PI studies. I predict that WM should play a role in PI approach to second language learning, as its capacity may determine the extent to which L2 learners' processing is affected by the target treatments in this research: the PI and MPI interventions.

More importantly, SI activities will be revisited in order to examine their role in improving learners' performance in spontaneous communication (Marsden and Chen, 2011). R. Ellis

(1993, 1995, 2003, 2009) recommended that interpretation tasks should be designed in a way that encourages L2 learners to process input instead of processing output for production, which is in line with what PI calls for. This research therefore will employ communicative tasks that push learners to interpret the input, notice the target form and then choose the correct form and produce it communicatively. Nevertheless, performing these tasks would not affect the affective activities employed by PI, but it should upgrade them in order to satisfy the essential criteria of tasks.

Last but not least, this study will also employ online testing methods such as self-paced reading and elicited imitation tasks. These online tasks can provide the researcher with moment by moment detection of learners' processing difficulties during comprehension (Mitchell, 2004) and measure their spontaneous and unconscious response to language stimuli (Marinis, 2010) in order to overcome the limitations of previous PI studies' assessment methods using only interpretation tasks.

Therefore, this study intends to use two online tasks to assess the potential of PI in altering learners' processing strategies. First, following Sagarra (2008) and Sagarra & Herschensohn (2010), self-paced reading will be employed to measure learners' real-time processing of target verbal inflections in the input. Second, following Erlam (2006), Spada et al. (2015) and R. Ellis (2005), an elicited imitation (EI) task will be employed to measure learners' accurate oral production of the target verbal inflections.

To recap, this study's novelty and contribution to the field thus includes –

1) A new language focus (Arabic learners of English).

2) Addressing an under-researched principle in PI, the preference of Nonredundancy.

3) A careful comparison of standard interpretation tasks against adapted versions involving greater processing loads (online self-paced reading, online elicited imitation).

4) An investigation of potential WM effects aligned against the presumed differences in cognitive load across the different target morphemes and across the different processing tasks.

5) A thorough baseline plus experimental longitudinal approach, using a new modified PI intervention treatment (MPI) based on communicative task design principles, that would be assessed and compared to a control group using original PI treatment on the level of processing and production of the target forms.

In order to investigate the relative effects of PI and MPI on the processing of English morphological inflections, three research questions are addressed in this research, laid out below, with accompanying predictions:

RQ1-Does PI intervention targeting the verbal inflections *-ing*, *-ed* and *-s* lead to English second language learners' improved performance in:

a. Accurate judgement of verbal inflections in an interpretation task (using a standard PI task in the offline condition)?
b. Accurate processing of verbal inflections in a self-paced reading task (adapting a PI interpretation task to the online condition)?
c. Accurate production of verbal inflections in an elicited imitation task (adapting PI to the online production condition)?

Prediction 1:

For accurate judgment (a), it is predicted that learners in the PI group will improve in offline processing on interpretation tasks from pre to post-test. This improvement will be demonstrated in more accurate (target-like) judgements of the target verbal inflections. This prediction is in line with most of the previous PI research, specifically Benati (2005) and Benati & Lee (2008).

For accurate processing (b), it is also predicted that learners in the PI group will improve in online processing on self-paced reading tasks from pre to post-test. This will be demonstrated in longer RTs for ungrammatical forms while maintaining shorter RTs for grammatical target forms. This is based on claims made by PI related to its ability to affect learners' developing system and consequently affect their processing (VanPatten, 2002; Benati, 2004).

For accurate production (c), it is predicted that learners in the PI group will improve in online production on elicited imitation tasks from pre to post-test. This will be demonstrated in improvement and more accurate production of the target verbal inflections in the EI task. This prediction is in line with most of the previous PI research that compared PI with production-based instructions, specifically Benati (2005) and Benati & Lee (2008).

RQ2-Does the modified PI intervention (MPI) targeting the verbal inflections *-ing*, *-ed* and *-s* lead to English second language learners improved performance in:

a. Accurate judgement of verbal inflections in interpretation task (using standard PI task in offline condition)?
b. Accurate processing of verbal inflections in self-paced reading task (adapting PI interpretation task to online condition)?
c. Accurate production of verbal inflections in elicited imitation task (adapting PI to online production condition)?
d. Are the results of the MPI group different to the results for the PI group?

Prediction 2:

For the accurate judgment (a), it is predicted that learners in the MPI group will improve in offline processing on interpretation tasks from pre to post-test. This improvement will be demonstrated in more accurate (target-like) judgements of the target verbal inflections. This prediction is in line with most of the previous PI research, specifically Benati (2005) and Benati & Lee (2008).

For the accurate processing (b), it is also predicted that learners in the MPI group will improve in online processing on self-paced reading tasks from pre to post-test. This will be demonstrated in longer RTs for ungrammatical forms while maintaining shorter RTs for grammatical target forms. This prediction is based on the assumption that employing communicative tasks would improve the effectiveness of PI treatment on participants' performance in online settings.

For the accurate production (c), it is predicted that learners in the MPI group will improve in online production on elicited imitation tasks from pre to post-test. This will be demonstrated in improvement and more accurate production of the target verbal inflections in the EI task. This prediction is in line with most of the previous PI research that compared PI with production-based instructions, specifically Benati (2005) and Benati & Lee (2008).

RQ3- Is there a relationship between WMC and learners processing and production of the target verbal inflections *-ing*, *-ed* and *-s* after PI and MPI interventions, based on learners' performance in the online self-paced reading task and EI task?

Prediction 3:

After the PI and MPI treatments, higher WMC learners will be able to accurately process and produce the three target inflections: *-s*, *-ed* and *-ing*. This will be demonstrated in positive correlation between the WMC and the online production and processing of the target forms. This prediction is based on the processing studies that found a positive relationship between higher WMC and accurate processing of verbal agreement, specifically (Sagarra and Herschensohn, 2010).

Before outlining the main study addressing these three research questions, I needed to establish my baseline study to investigate the type of knowledge related to morphological inflections that is currently available in the developing system of the L2 learners in the target context. Checking whether that knowledge is explicit or implicit, would help to predict if the two instructional treatments, the PI and the MPI could do something about it. Hence, one research question was addressed in the first study:

Based on offline and online data, do third year English language learners accurately process verbal agreement and past tense inflection?

Therefore, the next chapter presents the preliminary study employed in this research, that aimed to demonstrate the degree of variability in morphological inflections existing in second language learners in an instruction-only setting. It also aimed to produce a solid evidence base for driving the pedagogic interventions (PI) and (MPI) intended for the second study of this research.

CHAPTER 3

FIRST STUDY DESIGN AND METHODOLOGY

3.1 Introduction

The goal of this chapter is to produce a solid baseline for driving the pedagogic intervention intended for the next stage, the main study of this project (addressing the three research questions outlined above). The main interest of the preliminary study is to create a clear evidence base on how far the current type of instruction used in the target context may lead to reliance on explicit or implicit knowledge, by testing online and offline performance as some researchers assume that "explicit instruction does not necessarily lead to explicit knowledge" (Whong et al., 2014, pp. 555-556).

The English language teaching system in Saudi Arabia depends on explicit instruction for English grammar rules and structures, accompanied by intensive practice through reading, listening, writing and speaking activities (Almohanna, 2010; Khan, 2011). This research focused on a group of Saudi female university students who specialised in English language and are considered to be intermediate in their L2 according to their university level. They are able to use full syntactic categories in their L2 output but show inflectional morphology variability in their oral production. These L2 learners have been exposed to explicit L2 instruction for 8-10 years through secondary, high school and university.

Within the context of this study one research question was addressed:

Based on offline and online data, do third year English language learners accurately process verbal agreement and past tense inflection?

The present chapter provides a discussion of the research design, participants, and the testing tasks that were employed in the study. The chapter ends with the study results and analysis.

3.2 Study design

A mixed design of offline, online and working memory tests was adopted in order to test learners' syntactic knowledge and their ability to use it under communication pressure. This method of data collection is considered one of the most innovative and effective methods in second language research and is needed to explore the relationship between L2 learners' linguistic competence and oral production (Sagarra and Herschensohn, 2010; VanPatten et al., 2010; Kahoul et al., 2018). This design helps to test the impact of the independent variables, such as time pressure, on the dependant variables, such as the accurate morphological mapping and retrieval of the target morphological inflections the third-person singular *-s*, regular past form *-ed* and irregular past form.

The study employed three timed and untimed tasks to stimulate the processing and oral production of the target structures. The first two online tasks are a timed grammaticality judgment test and an elicited imitation task. The timed grammaticality judgment (TGJT) test was used to measure the participants' automatic and unconscious response to language stimuli. For the elicited imitation task (EI), the L2 learner needs to have the phonological, semantic and morphosyntactic representations in order to be able to attend to the meaning of the sentence, store it in the short-term memory and repeat it through an oral production system (Marinis and Cunnings, 2018). These tasks are found to be resistant to metalinguistic abilities (Marinis, 2010). In other words, on-line tasks can test L2 learners' linguistic competence rather than their learned linguistic knowledge.

The third task, the untimed grammaticality judgment task (UGJT), was used to exhibit the extent of the L2 learners' mental representation rules would allow or disallow items according to their grammaticality; i.e. grammatical sensitivity. Moreover, this task would allow L2 learners to access their metalinguistic knowledge to supply the correct items under untimed and stress-free conditions.

3.3 Place of study and participants

This study was carried out in the English Language Department at King Faisal University, which is considered to be an instructed English language teaching context. At King Faisal University, the English language major has compulsory courses in the first semester of the first year (e.g. writing and reading), then, in the second semester, students follow a full timetable introductory English course (e.g. an introduction to linguistics and phonology). In the second year, students start their official specialisation, which culminates in them submitting a research project during the second semester of the fourth year.

English language students who were in the third year of their university studies were employed in this study. These students were chosen because they have completed all of the introductory and core English courses in the previous two years. In addition, they started their language learning in the first year of secondary school (in Saudi Arabia, English language teaching start after the sixth grade) (Almohanna, 2010). Thus, the participants will have experienced eight years of instructed language learning, comprising six years of English language learning in school and two years at university level. However, second language research has revealed that tutored language learners exhibit language production errors even in the highest level of L2 proficiency (Rothman, 2008; Hopp 2010).

In this study, 34 female students were tested. This number was chosen as representative of the sample size and adequate to the time allocated to conduct the study (Dornyei, 2007). Testing this number of students would allow to develop a sense of the degree of variability in morphological production between the participants through running a sophisticated statistical analysis.

All students shared the same native language (Arabic), same educational level and had studied the same elective courses at the previous levels. Their age ranged from 20-23 years old and they shared a similar educational background (they had all studied English for 8 years in secondary and high school. In addition, they studied the required English courses during the first university semester for 6 hours per week plus introductory English courses: grammar, linguistics and phonetics).

In this study, all tests were administered individually in order to control the tasks' conditions and for accurate scoring. All tasks were conducted in a quiet classroom that was fully equipped for the tasks. All procedures were designed in line with standard ethical requirements, ensuring fully informed, voluntary, confidential participation (see below), and were cleared by the University of Leeds (see appendix E).

3.4 Background data and proficiency checks

First of all, a solid background data about the participants is required, hence, a personal information sheet that asks the participants to identify herself and her experience of English language learning: number of years spent learning English, starting age, number of languages learnt and any immersion experience was designed. This background check allowed to control the variables in my study and exclude any factors that could affect the reliability of the collected data and ensure the homogeneity of the study sample. For example, the age at starting to learn English had to be after puberty, as this research focuses on adult L2 learners who had received formal language instruction. Another factor that was considered, was the availability of a third language, based on the assumption that processing a second or a third language would be more taxing in terms of memory resources than native processing (Hopp, 2014; Sagarra, 2008).

Before collecting the personal information sheets, it was essential to ensure that each participant had a clear idea about the aim and procedure of this study. All of the tests' requirements were explained and the participants were informed about the duration of each test. Instruction was given in English and Arabic to ensure full understanding. After that, the student's consent was taken. Then, the personal information sheet, contained all of the information about the study and its goal, was given to the participant to read and ask any questions before taking the test. Finally, all the information provided were checked to confirm the participation of each participant in the study, and each participant was allocated a code to allow for anonymity in further analysis.

Second, a cloze test (C-test), adopted from Spada et al. (2015), was chosen to measure the proficiency level of the students engaged in this study. In this study, the C-test was not used as a dependant variable but as part of the background checks discussed earlier. The test contained three passages, each consisting of 112-143 words. There are 50 stimuli containing blank spaces and the participants were asked to fill in the second, omitted half of the word. Each correct answer was awarded 1 point, with a maximum score of 50.

These blanks contained words that test the students' general knowledge and do not concentrate on verbal morphological agreement only. This is considered to make the C-test a more valid predictor of L2 participants' general proficiency (Spada et al., 2015). Another rationale for using the C-test was due to its practicality, as it is quick to administer, which was beneficial for the study, as there were other tests that needed to be administered subsequently.

3.5 Study predictions

Due to the participants' level, who are assumed to be intermediate L2 learners and able to use full syntactic categories in their L2 output, this study focussed on a PDA approach to second language acquisition (chapter 2, section, 2.2.2.1), that claims the variability observed in L2 learners' production is due to a performance deficiency that is related to a processing level, arguing that L2 learners face difficulties when retrieving and producing what has been internalized. In this position, it is argued that L2 learners have acquired the target rules, in the competence sense, but spend long time in order to establish full control of what they have acquired.

One of the main accounts in this approach, as mentioned in more detail in the literature review, is the missing surface inflection hypotheses (MSIH). This account suggests that, despite the absence of inflectional morphology in learners' output, full functional categories and features are represented in grammar and have detectable syntactic consequences (Prevost and White, 2000). White (2003a) argues that, having acquired the surface morphological inflections, learners face mapping issues when trying to access or retrieve the appropriate form from their mental lexicon. Such retrieval problems are due to processing issues, represented by a "temporary breakdown between the syntax and the lexicon" (White, 2003a, p. 194).

Central to the previous discussion is the working memory construct. As noted earlier in chapter 2 (section, 2.4.1), Working memory's different capacity is considered to result in different patterns of L2 processing. In other words, the capacity of the working memory will naturally decrease by having a second language besides the native one (Hopp, 2014). Thus, the effect of working memory capacity would extend to causing issues in L2 processing in real time situations. In addition, DeKeyser (2007) argues that learners' different abilities and individual differences would determine their success in reaching the high automatized procedural knowledge. Hence, working memory is considered central to these cognitive abilities that could determine those L2 learners' success in L2 processing (Sagarra, 2007).

MSIH claims that L2 learners would be able to access and retrieve the target structure (morphological inflections) in offline settings and in untimed, pressure-free contexts, whereas these learners would be unable to access and retrieve the same structure when they are in real-time settings. The same variability would be extended to the irregular past tense form, as it is considered a whole inflected morphological form, which follows the same syntactic rule of the regular past tense but with a special pronunciation rule (Adger, 2003).

This leads to two predictions based on the prediction of MSIH:

1-The production of the third-person-singular and regular and irregular past tense form inflections would be accurate in the offline task.

2-The production of the third-person-singular and regular and irregular past tense form inflections would be variable in terms of accuracy in the online task.

In regards to working memory, following DeKeyser (2005) it is logical to argue that the grammatical patterns which rely on implicit learning would be more likely to rely on memory. Implying that, participants' verbal inflection accuracy in online/timed settings would be affected by working memory capacity (WMC).

This leads to the following prediction:

3- The higher WMC would positively correlate with the accurate production and processing of the target inflections in timed and untimed tasks.

Therefore, this study employed a battery of offline, online, and WM tests to gather data that can potentially reveal any issues with their L2 processing, if these exist. It is expected that individual variations would occur between L2 learners in retrieving and mapping the morphological inflections in online and offline settings.

Three working memory tasks were also employed as follows:

The first working memory task in this study was a reading span task (RST) which requires participants to read a set of plausible and implausible sentences and store the last word of each one in the set, then write them down. The second task was a listening span task (LST), which asks the participants to listen to a set of plausible and implausible sentences and store the last word of each sentence in the set, then write them down. Finally, the third task is a backward digit span task (BDST) which was used to gauge working memory independently from lexical knowledge involved in the reading and listening span tasks (Conway et al., 2005).

The next section presents in detail the design of the three timed/untimed testing tasks in addition to the three working memory tasks.

3.6 Assessment task design

3.6.1 Timed and Untimed grammaticality judgment tasks (TGJT and UGJT)

The TGJT was used to test participants' accuracy in processing verbal morphological inflections (i.e. third-person-singular and past tense) under the pressure of limited time, and to compare this performance with that in the UGJT (Hopp, 2006). Despite the debate regarding the ability of TGJT to test learners' implicit knowledge rather than explicit knowledge, TGJT has the ability to create similar conditions of real-time communication, which might reveal L2 learners' real-time ability to retrieve and map the morphological inflections.

On the other hand, the UGJT was used to test the participants' available linguistic knowledge from any source, such as their learned linguistic knowledge and any other knowledge that was picked up incidentally. I wanted to discover if the L2 learners would be more successful in providing the correct morphological inflections under offline, untimed conditions compared to real-time conditions.

All the sentences employed in these tasks were designed to be on a topic that is familiar to the participants. A careful choice of topic was made to ensure that it is related to the participants' age and cultural background. The rationale behind this decision was to shift the participants' focus from forms to meaning (Ionin et al., 2011), as well as facilitate comprehension and information recall (Leeser, 2004). Sixty sentences were designed for TGJT and the same number of sentences for UGJT, 30 sentences were experimental and the other 30 were fillers. The 30 experimental sentences equally included grammatical and ungrammatical sentences to maintain the reliability of the results (Mackey and Gass, 2005). I ensured that all experimental and filler sentences ranged between 9-12 words to maintain validity.

All the target verbs employed in the sentences were chosen from among the most frequent and familiar verbs which were used in the course books and reference works used by the participants in this study. All of the experimental sentences were sent to the English Language Department, and checked and approved by teacher colleagues who teach English language courses for third year students. Six conditions were used to create the experimental sentences for the TGJT and UGJT, with five sentences per condition. The conditions are:

1- Third-person-singular agreement [-s]

2- Third-person-singular violation [-s]

3- Past tense agreement [-ed]

4- Past tense violation [-ed]

5- Irregular past tense agreement

6- Irregular past tense violation

For the filler sentences, ungrammatical sentences were included in order to avoid giving any indication of the target structure of this study. All of the experimental sentences were counterbalanced and the fillers were randomised in order to ensure that the grammatical sentences did not follow one another when displayed to the participants.

3.6.1.1 Administration method and Scoring

The tasks were administered using a widescreen laptop. PowerPoint slides were used to present the sentences. For the TGJT, the length of the presentation was automatically controlled. Each sentence was displayed on a separate slide for a limited time, each word was allocated 250ms of time, so the total number of words in each sentence was multiplied by 250 (Hopp, 2006). For the UGJT, the time for the presentation was unlimited. The participants were informed that they have unlimited time in which to choose their answers, however, an approximate time was given to them in order to avoid them using the extra time to repeat or revise their answers.

The TGJT scoring allocated 1 for each correct answer and 0 for an incorrect answer. This task did not require the participants to correct any errors due to the limited time, so participants had to judge only the grammaticality of the experimental sentences.

On the other hand, the UGJT scoring depended on two factors. First, the participants had to choose the right option for each experimental sentence. Second, they had to locate the error and correct it in the ungrammatical sentences. Therefore, if the correct option was grammatical, it was awarded 1 whereas, if the correct option was ungrammatical, the participant had to provide the right word in order to be awarded 1.

3.6.2 Elicited Imitation task

The third task, also online, was an elicited imitation task (EI), to test the participants' production of inflectional morphology under the task's processing demands. The EI task asked the participants to listen to a set of recorded sentences and repeat what they had heard as closely as possible. The rationale underlying the EI task was that the target feature under investigation can be deemed part of the participant's linguistic competence if it would be correctly imitated (Mackey and Gass, 2005). Thus, I selected this test to reflect the participants' ability to provide the morphological inflection in their oral production under real-time conditions.

The following six conditions were used to create the experimental sentences employed in the EI task balancing 3 grammatical and 3 ungrammatical (violation) conditions:

1- Third-person-singular agreement [-s]

2- Third-person-singular violation [-s]

3- Past tense agreement [-ed]

4- Past tense violation [-ed]

5- Irregular past tense agreement

6- Irregular past tense violation

Following Kahoul et al. (2018), the violation conditions were included as it was found in their study that L2 learners spontaneously corrected some of the sentences when they reproduced them. Conceivably, this would reveal the participants' linguistic knowledge under task processing demands.

3.6.2.1 Administration Method and Scoring

The EI sentences were recorded using a high-quality stereo handheld recording device (OLYMPUS) that has an integrated USB stick and so can be connected to the laptop to transfer the audio files. Some practice items were introduced first and imitated by me in order to ensure that the participant understood her role and check the clarity and suitability of the recordings' loudness. Participants' imitations were recorded by the same Olympus recorder which then were transferred to the recordings' file in the laptop to be saved and analysed.

A structural scoring scheme was used to analyse the participants' imitations (Marinis and Cunnings, 2018). The participants were assigned 1 when they produced the target feature and 0 if they omitted it, made an error or made a substitution for it.

3.6.3 Reading and Listening span working memory tasks

Working memory tests, such as reading (RST) and listening tasks (LST), require L2 learners to use their language knowledge to comprehend and judge the linguistic stimuli to which they are exposed. In the RST, the participant is required to read sets of plausible and implausible sentences presented at a fast pace and memorise the last word in each sentence. Then, they need to judge the plausibility of each sentence immediately after it has been displayed and write down all of the recalled words at the end of each set. In the LST, the participant had to listen to a set of plausible and implausible sentences instead of reading them, recall the last word in each sentence and judge their plausibility. Following each sentence, the participant had to choose one option (plausible or implausible) and write down the recalled words.

3.6.3.1 Test design

For the RST, the task design was adapted from Sagarra and Herschensohn (2010). The participants performed the two tasks simultaneously. First, the participant had to recall one word that would be written in bold at the end of each sentence, then assess the acceptability of each sentence that they had read on the screen. Half of the sentences were semantically plausible and the other half were semantically implausible.

For the LST, the task design was adapted from Ahmadian (2012), where each participant heard recorded sets of plausible and implausible sentences and had to perform two tasks simultaneously. First, the participant had to recall the word that she has heard at the end of each sentence and the other was to assess the acceptability of each sentence heard.

Thirty-six experimental sentences were designed for each task that were 9-12 words' long. All of the test materials were designed in Arabic (the participants' native language) to avoid any L2 knowledge deficit affecting the results. Following Hopp (2014), the plausibility of the sentences was manipulated by reversing the grammatical roles of animate and inanimate subjects. The experimental sentences were created in sets of 3, 4 and 5 sentences, following the criteria assumed to be adequate for university level students (Conway et al., 2005).

3.6.3.2 Administration method and Scoring

PowerPoint software was used to display the sentences and the recordings. The slide show started with the question slide that contained all the details and the requirements related to this task. After that, the participant needed to press the spacebar to start the task. For the RST, the slide show started with the first slide that contained the first sentence in the first set. This was displayed for only a limited time, then the next slide appeared. The participant had to judge the plausibility of each sentence.

In the LST, the first slide contained the first set of recordings and the participant had to judge the plausibility of each sentence. Each set of sentences was recorded individually at a normal speed and the PowerPoint slides was used to play the recordings in order to adjust the time and control the interval between the sentences. Using PowerPoint eliminated any interference during the task performance.

For both tasks, the partial-credit unit scoring was used to "express the mean proportion of elements within an item that were recalled correctly" (Conway et al., 2005, p. 775). Therefore, the correct recall of each word would be awarded 1 and the incorrect recall would be awarded 0. Thus, each participant's score ranged between 0 and 36.

3.6.4 Digit span task

The digit span task required the participants to listen to sets of strings of random digits then immediately repeat them as precisely as possible. The digit span depended less on language comprehension compared to the other working memory tasks. Thus, the digit span was employed as a language independent WM measurement task which could be compared with other language dependent working memory tasks, such as the reading and listening span tasks (Juffs and Harrington, 2011). The second rationale was to ensure that the results of the reading and the listening span tasks were not due to the participants' language deficiency (Harrington and sawyer, 1992).

3.6.4.1 Test design

Following Harrington and Sawyer (1992), the digit span consisted of eight sets of three strings of random digits. The shortest set consisted of three two-digit strings. Then, the following sets increased by one digit per set and the last set had three-nine-digit strings. Eight sets of random digits that had three strings per set were created and the first two sets of two and three-digit strings were assigned for practice at the beginning of the task. In addition, a backward digit span that had five sets was designed, starting from two-digit to six-digit strings.

Moreover, two exact versions of this task were created: English and Arabic versions. Despite the fact that English digits are widely used in Saudi Arabia with regard to social networks, books, magazines and everyday simple maths, the Arabic digit span was included in order to compare the participants' performance on the two versions and ensure that the results are not due to the language effect.

3.6.4.2 Administration method and Scoring

A slide show presentation using PowerPoint software was designed to present all the digit strings recordings. Each slide contained one string of digits and, at the end of each set, i.e. three slides, a new set, which was increased by one digit began.

Partial-credit unit scoring was used to score the participants' responses. The correct recall of each string was awarded 1 and the incorrect recall was awarded 0. There were 18 experimental digit span strings in total, so the score ranged from 0 to 18, while there were 12 backward digit span experimental strings, and so the score ranged from 0 12.

3.7 Results and Discussion

After ensuring that all the data were normally distributed through normality checking in SPSS, I began the analysis by drawing a comparison between the participants' scores within each morphological inflection in timed and untimed settings. Then, I compared the three inflections in timed and untimed settings.

3.7.1 Statistical analysis within inflections in timed and untimed settings

First, in regard to the comparison between timed and untimed tests within each inflection, ANCOVA was used for repeated measures in order to identify the differences between the timed and untimed tests using covariate variable (time). Namely, the aim was to see if the difference between the timed and untimed scores would change if the time effect were controlled (eliminated).

As the table below shows, for the inflection -*s*, the results showed that there was statistically highly significant difference, p <.001, between the inflection -*s* in the timed test and -*s* in the untimed test, see Table 5. However, by controlling the time, the difference became not significant, p =0.775.

For the inflection -*ed*, the results showed that there was statistically highly significant difference, p <.001, between the inflection -*ed* in the timed test and -*ed* in the untimed test, see Table 5. However, the difference between the inflection -*s* in the timed and untimed tests is larger and more significant than the inflection -*ed* in the timed and untimed tests.

For the [irregular] inflection, the results showed that there was statistically highly significant difference, p <.001, between the [irregular] in the timed test and [irregular] in the untimed test see Table 5. However, the difference between the [irregular] inflection in the timed and untimed tests is larger and more significant than the inflection -*ed* in the timed and untimed tests but the difference is still smaller than the inflection -*s*, which has the highest significant difference between the timed and untimed tests.

Table 5. *ANCOVA for statistical analysis within inflections in timed and untimed settings*

Morphological inflection	*Mean*	*(SD)*	*N*	*Effect of time F-test(p-value)*
-s =TGJT	4.8529	1.87701	34	77.027 (<.001)
-s =UGJT	8.0000	2.01509	34	
-ed=TGJT	6.7059	1.69722	34	31.839
-ed=UGJT	8.1176	2.19869	34	(<.001)
[irregular]=TGJT	5.4412	1.81227	34	44.792 (<.001)
[irregular]=UGJT	8.1176	1.82183	34	

Following the descriptive analysis of each inflection in the timed and untimed settings, the statistical analysis between the three inflections will be discussed in the following section.

3.7.2 Statistical analysis between the inflections in timed settings

In this analysis, a repeated measures ANOVA was used to examine the difference between the three timed tests regarding the inflections -*s*, -*ed* and [irregular]. Since the timed factor was fixed, only the dependent variables of judgements by inflection type needed to be compared. As table 6. shows, the difference between the three inflections in the timed test was statistically highly significant, p <.001.

Table 6. *ANOVA for the difference between the inflections in Timed settings*

Morphological inflection	*Mean (SD)*	*F-test (p-value)*
-s =TGJT	4.85+/-1.877	14.46 (<.001)
-ed=TGJT	6.70+/-1.69	
[irregular]=TGJT	5.44+/-1.81	

However, in order to find the two inflections that had the highest significant difference between them, a pairwise comparison had to be run. This test was used to detect any significant differences between any two morphological inflections.

Table 7. *Pairwise comparisons*

[s] - [ed]	p <.001
[s] - [irregular]	p =0.588
[ed] - [irregular]	p <.001

As table 7. shows, the highest significant difference was between the inflection -*s* and -*ed* whereas there was no significant difference between the -*s* and [irregular]. On the other hand, there was a significant difference between the -*ed* and the [irregular] although this was lower than the difference between -*s* and -*ed*.

3.7.3 Statistical analysis between the inflections in untimed settings

In this analysis, I used ANCOVA for the repeated measures in order to identify the differences between three untimed tests for the inflections -*s*, -*ed* and [irregular], using a covariate variable (time), namely, the aim was to see if the differences between the untimed scores can change if the time effect was controlled (eliminated).

As the table 8. shows, there was no significant difference between the three inflections in the untimed tests. However, it is important to point out that the covariate variable (time) was not calculated individually for each inflection. In other words, the time was calculated for each participant during the untimed task as a whole and not the time spent for each inflection during the task.

Table 8. *ANCOVA for the difference between the inflections in Untimed settings*

Morphological inflection	*Mean*	*(SD)*	*N*
-s=UGJT	8.0000	2.01509	34
-ed=UGJT	8.1176	2.19869	34
[irregular] =UGJT	8.1176	1.82183	34

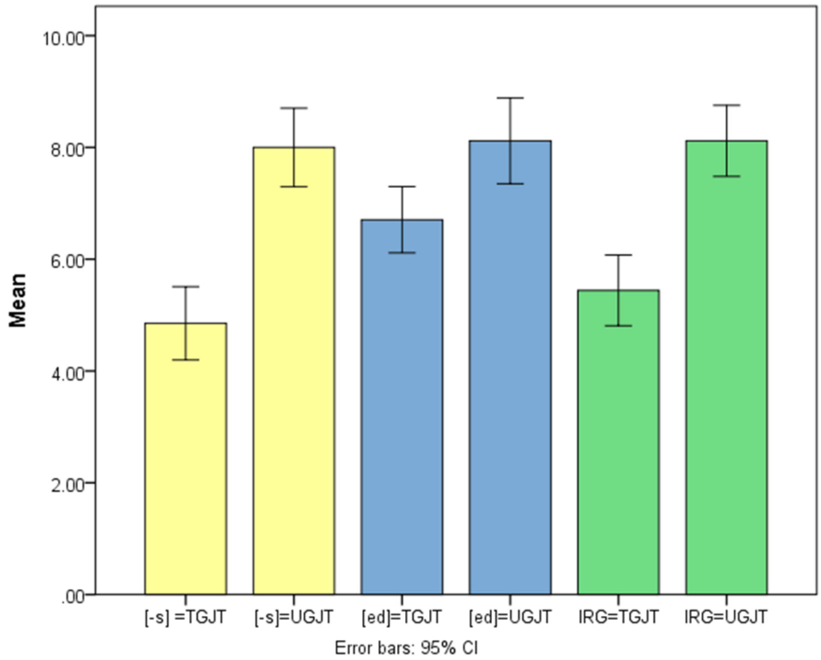


Figure 4. *The effect of (time) within and between -s, -ed and [irregular] in timed and untimed settings*

3.8 Study predictions and statistical analysis discussion

This study suggested two predictions based on MSIH account, it was predicted that there would be a significant difference between the participants' processing of the L2 morphological inflections in timed and untimed settings, arguing that the participants would perform more accurately in offline/untimed settings but display less accurate L2 processing in the online/timed tasks.

These predictions were confirmed according to the study statistical analysis. The analysis showed that there is a significant difference between the participants' performance in the timed and untimed tests when processing the inflections *-s*, *-ed* and [irregular] while in the untimed test, there was no significant difference between the participants' processing of the three target inflections. In addition, the participants' performance was significantly higher in the untimed setting for the three inflections *-s, -ed* and [irregular], respectively, whereas in the timed settings, the means were significantly lower than those in the untimed settings.

The results indicate processing issues related to the target morphological inflections in timed settings. In other words, the participants' performance in the untimed test was more accurate than that in the timed test, which suggests that the participants had knowledge related to the verbal morphological inflection, but face issues when using this knowledge in real-time settings. This lends support to the MSIH, which argues that L2 learners have acquired the syntactic nodes of the relevant features, however, issues arise when they engage in spontaneous speech and are under pressure of communication which exceeds their computational resources. Thus, they face L2 processing difficulties leading them to use the default inflectional forms (Prevost and White, 2000).

With regards to the relationship between the three inflectional morphemes, the results for the inflection *-s* were the most interesting. The morphological inflection *-s* had the lowest mean in the timed test between the three inflections and the highest significant difference within the inflection in the timed and untimed tests, $p < .001$. However, the MSIH does not predict the reasons behind such difference between the inflection *-s* and the other verbal inflections. Detailed discussion of the inflection *-s* and the other target inflections is provided in the main discussion chapter (Chapter 6).

3.8.1 Elicited imitation statistical analysis

In the EI task, two types of sentence were included: grammatical and ungrammatical sentences. Thus, the analysis of this test includes two sections. First, the EI was analysed for grammatical sentences using ANOVA for the repeated measures, to examine the difference between the three morphological inflections -*s*, -*ed* and [irregular].

As the following tables show there was a significant difference between the means of the three morphological inflections -*s*, -*ed* and [irregular] respectively, $p < .001$, with the highest mean for -*ed* and the lowest for [irregular]. In addition, a pairwise comparison was used to find any significant differences between any two inflections. The highest statistical difference was between -*ed* and [irregular], $p < .001$. Then, the second highest significant difference was between -*s* and -*ed*, $p < .001$, while there was no significant difference between -*s* and [irregular], $p > .001$.

Therefore, the previous analysis suggests that the participants encountered processing issues when imitating the grammatical sentences, with better production of the morphological inflection, that had a highest score, the regular past form -*ed*. Thus, the results lend support to MSIH, which suggests that L2 learners would produce variable morphological inflection in real-time settings. Nevertheless, MSIH does not provide any justification related to participants' consistent better performance in the inflection -*ed* compared with the inflections -*s* and [irregular].

Table 9. *ANOVA for the difference between the target inflections in the EI task*

Morphological inflections	*Mean*	*(SD)*	*F-test*	*(p-value)*
-s	6.941	.380	6.168	7.714
-ed	8.500	.325	7.839	9.161
[Irregular]	6.176	.451	5.259	7.093

Table 10. *Pairwise comparisons*

[s] - [ed]	*p <.001*
[s] - [irregular]	*p* =0.765
[ed] - [irregular]	*p* =.001

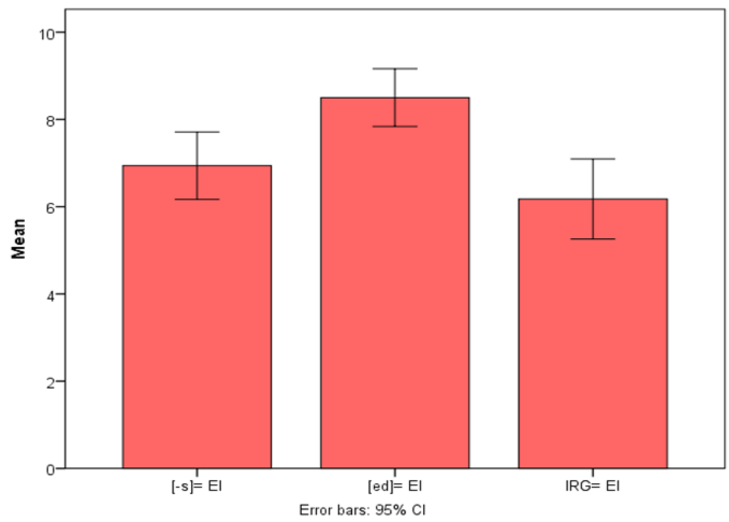


Figure 5. *Elicited Imitation of grammatical sentences*

Second, analysing the EI results for the ungrammatical sentences was done using the Friedman test, which is a non-parametric method. This test was used because the ungrammatical EI task score ranged from 0 to 2 and so it was unfeasible to use the parametric ANOVA. As discussed in section (3.6.2.1) above, in the imitation of the ungrammatical verbs, the participants were expected to correct the ungrammaticality spontaneously and produce the verbs correctly, which would reveal if the target forms were part of their linguistic knowledge or not. Accordingly, they were assigned the full score for the production of the corrected verbs; i.e. inflected, and 0 if they did not correct the non-inflected verbs.

Using the mean and median, the results presented in the table 11 below, show a higher score for *-ed* compared to *-s* and [irregular], meaning a better processing of the morphological inflection *-ed*, that had a higher score than *-s* and [irregular]. The Friedman test confirms that there was a high significant difference (p-value) between *-s*, *-ed* and [irregular]. Pairwise comparisons (Wilcoxon Signed Ranks Test) and adjusted level of significance (0.017) were used to identify any significant differences between any two inflections. The test showed that there is a significant difference between -*s* and -*ed*, $p < .001$, and between -*ed* and [irregular], $p = .001$.

Table 11. *Friedman test for the difference between the ungrammatical sentences in the EI task*

Morphological inflection	*Mean*	*Median*	*F- Test p-value*
[s]	0.500	.000	<.001
[ed]	1.353	2.00	
[irregular]	0.735	0.50	

Table 12. *Pairwise comparisons*

[s] - [ed]	$p < .001$
[s] - [irregular]	$p = 0.033$
[ed] - [irregular]	$p = .001$

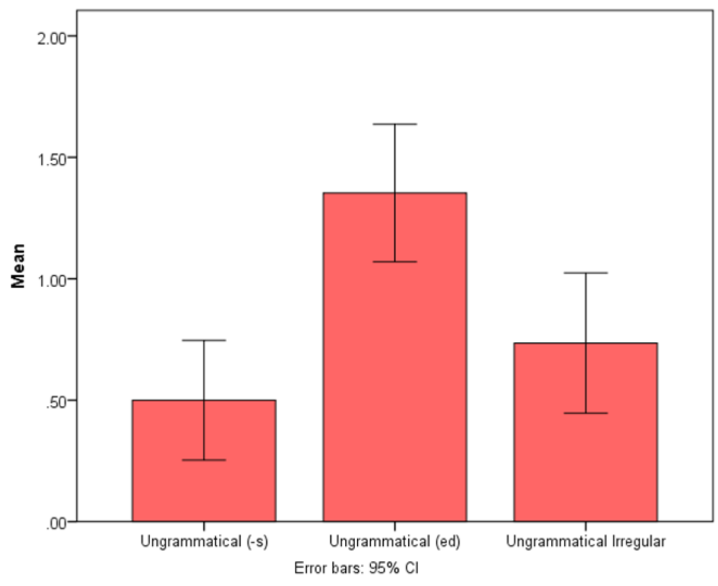


Figure 6. *Elicited Imitation of ungrammatical sentences*

Similar to the grammatical EI task, the previous analysis reveals that the participants encountered processing issues when imitating the ungrammatical sentences, with slightly more accurate production of the morphological inflection -*ed*, that had the highest score compared to -*s* and [irregular]. Therefore, the previous analysis shows that the participants were not broadly sensitive to the ungrammatical sentences in real-time settings and could not supply the correct morphological inflections in their imitations. However, the highest mean (i.e. some level of corrected production) was found in the inflection -*ed*, compared to -*s* and [irregular].

3.8.2 Working memory statistical analysis

After examining the effect of (time) on the three morphological inflections (-*s*, -*ed* and [irregular]), this section presents the statistical analysis of the working memory tests and their relationship with the three morphological inflections in both timed and untimed settings.

First, Simple correlation was used to measure the strength of the relationship between independent and dependent variables. The correlation range falls between -1 and +1. The correlation is considered positive when the value is close to +1. While the relationship signifies no correlation if the value is close to zero.

As the table shows, there was no positive correlation between the morphological inflections and the WM tasks in both timed and untimed tests except for a moderate correlation between the inflection -*s* in TGJT and DST.

Table 13. *The relationship between RST, LST and DST and the morphological inflections*

Morphological inflection	*-s TGJT*	*-s UGJT*	*-ed TGJT*	*-ed UGJT*	*[irregular] TGJT*	*[irregular] UGJT*
RST	.081	.052	.153	.107	.160	-.004
LST	.087	-.179	.083	-.079	.046	.086
DST	.407 (moderate)*	.203	.241	.110	.127	.079

Second, the statistical analysis of the effect of working memory tasks on the timed tests of the three morphological inflections is presented in the following section.

3.8.2.1 Timed task regression

Multiple regression analysis was used to examine the effect of RST, LST and DST (independent variables) on -*s*, -*ed* and [irregular] (dependent variables) in the timed tests. The total variation (R-squared) was used to define the total variation in the three inflections, which is explained by RST, LST and DST. The ANOVA test was computed to examine whether the variables RST, LST and DST had a significant effect on the three morphological inflections.

The results presented in the Table show that the total variation in -*s*, which is explained by the RST, LST and DST, was 16.9%, which is considered low. The ANOVA test shows that there was no significant effect of RST, LST and DST on -*s*, p =0.129. Similarly, the ANOVA test shows no significant effect of RST, LST and DST on -*ed* and [irregular] inflections in the timed test with, p =.509 and p =.762, respectively.

Table 14. *The results of the multiple regression for the effect of RST, LST and DST on -s, -ed and [irregular] in the timed TGJT test*

Dependent variable	*% R-squared*	*F-test (p-value)*
-s	16.9%	2.04 (0.129)
-ed	7.3%	.789 (.509)
[irregular]	3.7 %	.389 (.762)

3.8.2.2 Untimed GJT regression

Multiple regression analysis was used to examine the effect of RST, LST and DST (independent variables) on -*s*, -*ed* and [irregular] (dependent variables) in the untimed test. Total variation (R-squared) was used to define the total variation in the three inflections, which is explained by RST, LST and DST. The ANOVA test was computed to examine whether the variables RST, LST and DST had a significant effect on the three morphological inflections.

Similar to the timed regression, the untimed regression shows that the total variation in *-s* which is explained by the RST, LST and DST, was 11.4%, which is considered low. The ANOVA test shows that there was no significant effect of RST, LST and DST on *-s*, *p* =0.296. Similarly, the ANOVA test shows no significant effect of RST, LST and DST on the *-ed* and [irregular] inflections in the timed test, with *p* =.733, and, *p*=.952, respectively.

Table 15. *The results of multiple regression for the effect of RST, LST and DST on -s, -ed and [irregular] in the untimed GJT test*

Dependent variable	*% R-squared*	*F-test (p-value)*
-s	11,4	1.291 (.296)
-ed	4,1	.430 (.733)
[irregular]	1,1	.113 (.952)

3.8.2.3 Working memory statistical analysis and study predictions

This study suggested that WM capacity would correlate with the target morphological accurate processing and production in online settings. However, there was no relationship (i.e. positive relationship) between the independent and dependent variables. In addition, there was no effect of the working memory capacity on the morphological inflections in both timed and untimed settings.

As seen in the analysis above, the timed and untimed regression analyses do not support the study prediction which suggests that the higher WM capacity would affect participants' morphological inflection processing and production accuracy in online settings.

3.9 Discussion and conclusion

After presenting the methodology of the preliminary study and an analysis of its results, it is possible to conclude that there is a clear variability with regard to supplying the morphological inflection between the participants' performance in offline and online settings, respectively. In particular, the most variable performance and the lowest scores across the timed tasks were related to the morphological inflection -*s*.

The study results show that were able to draw on their explicit knowledge during the offline task, having the time to access their learned rules of the language and make judgments according to the grammaticality of the tasks' stimuli. On the other hand, the results of the online tasks indicate that learners were not able to rely on the same explicit knowledge, usually processed slower, during the time allocated for conducting the task. In other words, the participants were not able to access any knowledge they have, whether explicit or implicit while performing the tasks, which resulted in inaccurate grammatical judgments and inaccurate imitations. The findings suggest that at least as tested here, there may exist an issue related to the participants' performance but not their competence.

Despite the fact that WM was associated with inconclusive results in this study, further examination and more sophisticated software should be considered in the second study of this research in order to further test the assumption that WM is associated with L2 processing and development (e.g. Hopp, 2010; Sagarra & Herschensohn 2010; Wright 2010; Juffs & Harrington 2011; Roberts, 2012), and to explore whether improved methodologies may gain more reliable results.

Therefore, interpreting the first study findings in light of Hopp's (2013) morphology acquisition stages, discussed earlier, see chapter 2 (section, 2.3), it is suggested that the problem faced by participants in the online grammaticality judgment task was with the second step. Their difficulty was with processing the ungrammatical inflection when it was supplied in timed settings. In other words, learners could not map the grammatical form (verbal inflection) to its meaning (agreement or pastness) in the sentence in order to supply the right judgment. This means that input did not become intake yet. Therefore, L2 learners in real-time situations are considered slow and unable to perform in a native-like way when retrieving and using the correct morphological inflections (Hopp, 2010, 2013).

Taking into consideration the previous discussion of explicit vs. implicit knowledge, see Chapter 2 (section, 2.3.2) and Hopp's stages of morphology acquisition, it is logical to assume that the participants of the first study had an offline/non-automatic processing of the target grammatical form (which could be assumed to equate to VanPatten's definition of surface grammatical form, (see definition in chapter 1). In other words, L2 learners were explicitly taught a grammatical form as a surface morphological feature, then this form was non-automatically processed and slowly retrieved as a part of their explicit knowledge in the offline task. On the other hand, online/automatic processing of the underlying mental representation of this grammatical form was not available, as evident by their inability to automatically retrieve and supply the grammatical form in the online task.

To recap, this study was meant to show the degree of variability existing in intermediate second language learners in an instruction-only setting with limited exposure to the target language. As seen in the results, these L2 learners had the explicit target language knowledge but were unable to apply it in real time settings under the task's processing demands, despite having spent many years learning the target language in the only context available to such L2 learners, a time-restricted language learning classroom. This finding invites the question of the availability of any type of instruction that can shift the focus from the offline processing of the grammatical form, as seen in participants' performance in the first study, to the online/automatic processing of underlying representation.

Therefore, in order to address this phenomenon, I investigated 'processing instruction' (PI), a pedagogical intervention derived from the insight of 'input processing' model (IP). This morphosyntactic phenomenon is specifically addressed by VanPatten (1996, 2004, 2005, 2007) in his input processing model which seeks to inform pedagogical interventions. Hence, PI was chosen for investigation in this research.

The uniqueness of PI compared to other forms of explicit instruction lies in the type of output of this process. PI seeks not only the correct production of the target feature, but also learners' correct interpretation and understanding during the SI to make the appropriate form-meaning connection and so successfully process the target feature. Although PI stresses that production is not its ultimate goal, it is conceivable to assume that processing and production are connected and that reliable accurate production cannot occur without correct interpretation and accurate processing. Moreover, PI studies have produced empirical findings regarding not only better input processing but also the ability of L2 learners to develop their L2 system and successfully access the target linguistic feature when producing output (VanPatten, 2002; Benati, 2004).

PI is of interest to this research as it can be used as a pedagogical intervention to address the phenomenon under investigation, the variability of morphological inflections documented by a large number of SLA studies (e.g. Lardiere, 1998, 2007; White, 2003; Kahoul et al, 2018). PI has a balanced formula of EI and SI, which can be manipulated to test different hypotheses related to inflectional morphology variability. More importantly, PI is based on a number of principles that could potentially offer justification to the distinction found in participants' performance in the first study with the inflections *-s* and *-ed*. One of these principles is the Preference of Nonredundancy principle, adopted by participants to process a sentence. VanPatten (2002, p. 24) argues that leaners prefer processing "more meaningful" morphology before "less or nonmeaningful morphology". These different levels of meaningfulness refer to the communicative value that each grammatical form holds and its contribution to the meaning of the sentence (ibid, p.24). VanPatten (2002, p. 24) states the following:

It is the relative *communicative value* of a grammatical form that plays a major role in determining the learner's attention to it during processing and the likelihood of its becoming detected and thus part of the intake.

Hence, in this study, participants may have relied on lexical items such as *yesterday* and *every day* (adverbs) to get the meaning instead of the grammatical markers that indicate the same semantic notion.

This strategy, the Preference of Nonredundancy Principle, could be what hinders the implicit processing of mental representations from taking place. The redundancy of the verbal inflections -*s* and -*ed* could have prevented L2 learners from establishing the correct form-meaning connections. Thus, it could be assumed that the inflections were learned as surface grammatical forms and were processed explicitly and retrieved slowly as part of explicit knowledge.

As seen earlier in the statistical analysis (section, 3.8), there was a significant difference in learners' performance between the target forms of the tasks, specifically, the verbal inflections -*s* and -*ed*. In the online task, participants performed significantly better in providing accurate grammaticality judgments for the inflection -*ed* than the inflection -*s*. According to IP, this could be because some intake was derived for -*ed*, which has a semantic value but is sometimes redundant. This inconsistent degree of redundancy arguably leads to unstable mental representations that could sometimes be implicitly processed. However, the inflection -*s* in PI terms is always redundant, which could result in no mental representation being available for this form to be implicitly processed, and is assumed here to explain the poorer production of -*s* compared to -*ed*.

In order for implicit processing to occur, it is argued that L2 learners have to pay attention to the redundant grammatical form and interpret its meaning during sentence comprehension

(VanPatten, 2002). The correct interpretation will lead to establish the appropriate form-meaning connection, such as the relationship between the grammatical form *-s* and the agreement [third-person-singular]. Establishing the appropriate connection would enable L2 learners to derive the intake that would be transferred later, after further processing, to mental representation. Finally, when mental representation of the form is available, implicit processing of underlying representation will take place. Therefore, fast mapping and automatic retrieval would be possible, and the form will be correctly spelled out in spontaneous production under timed pressure.

As seen earlier in the first study findings (section, 3.8), *-ed* was associated with the best performance in timed settings across the three tasks. Moreover, there existed a significant difference between *-ed* and *-s* in the timed settings, but not in the untimed settings. Although both inflections received equivalent amount of teaching and the same type of explicit instruction and activities, a question regarding the influence of the type of instruction on each inflection arises here. In other words, *-ed* might be susceptible to explicit types of instruction so that L2 learners were able to develop this declarative knowledge into highly automatized knowledge that can be used in real time communication. However, this might not be the case with *-s*, where L2 learners were unable to employ it successfully in timed settings across the three tasks in the first study and so might be resistant to explicit types of instruction.

Recently, a number of SLA researchers issued a strong call for this issue to be investigated instead of debating the so far irreconcilable relationship between explicit and implicit knowledge (Han & Finneran, 2014). One of the first calls in this regard was made by Doughty (2003, p. 293), who argued for the importance of having both explicit and implicit learning mechanisms together taking part consequently, bearing in mind “when and for what reason explicit learning mechanisms do, or perhaps should be encouraged to override the default”.

In addition, Spada and Tomita (2010) noted the difficulty of making decisions when choosing the type of instruction through which to teach certain forms. They showed that most of recent studies depend on the feature's level of difficulty, although they noted defining level of difficulty is hard to reliably pin down. The evidence of mixed results led Spada & Tomita to urge researchers to explore further the influence of different types of instruction on various language forms.

This research is therefore interested in whether PI can encourage functional morphology development. As discussed above, PI locates the processing problem, provides explicit information about it, and then uses SI to rebuild the correct form-meaning connections. This research intends to achieve this by investigating the relative effects of PI and compare it with a new modified version of PI, to examine their effect on the processing of verbal morphological inflections during online processing and production. It is important to note that PI studies have been using offline tasks, such as written production and untimed GJT, to assess the effect of PI on L2 learners' linguistic systems. However, offline methods are insufficient to reveal learners' ability to produce the target forms in real time settings. Thus, this research attempts to extend the PI findings by examining the effect of PI on learners' processing of verbal inflections in online settings by using online testing methods.

The following chapter discusses the second (main) study of this research that investigates the relative effects of PI and MPI on the processing of English morphological inflections. As discussed in Chapter 2 (section, 2.5.4.1), this second study also revisits SI activities to examine their role in improving learners' performance in spontaneous communication (Marsden and Chen, 2011). In addition, it investigates a novel design of PI, the modified processing instruction (MPI), proposed here in order to address the criticism of the methodological design of PI instructional approach discussed earlier in Chapter 2 (section, 2.5.4).

CHAPTER 4

SECOND STUDY DESIGN AND METHODOLOGY

4. 1 Introduction

This chapter presents a description of the second study employed in this research in order to investigate the relative effects of PI and MPI on the processing of English morphological inflections. In addition, it presents a description of the instructional packets of PI and MPI interventions design, teaching materials, and assessment tasks employed in the second study of this research.

As discussed in Chapter 3, (section, 3.9), after conducting the preliminary study few assumptions were made which influenced the research design and methodology of the second study. In the first study, it was clear that participants had more explicit knowledge than implicit, as they were unable to successfully perform the timed grammatical judgment task and the online elicited imitation task compared to their performance in the offline grammaticality judgment task. Hence, it is assumed that the current types of instruction used in the L2 classrooms at King Faisal University in Saudi Arabia, affected the type of learners' knowledge related to the target forms of this study.

In a context like Saudi Arabia, explicit types of instruction and mechanical drills and activities predominate most if not all the L2 learning inside L2 classrooms, in addition to limited natural input and limited communicative opportunities. This situation represents a strong-interface position, assuming that this style of teaching the L2 would lead to successful learning; i.e., automatic and accurate use of second language in online settings. However, as seen in the first study, this did not lead to the sought-after automatic L2 knowledge. Hence, I am concerned about the claims of the strong-interface hypothesis and, therefore, I assume that the weak-interface hypothesis could be a better approach for a particular type of targeted teaching that would build up the communicative knowledge more effectively. So, instead of providing more explicit instruction and practice, the implicit system should be built up by boosting more implicit forms of teaching rather than assuming that more practice will lead to developing implicit knowledge.

Therefore, I argue in this thesis, that the weak-interface hypothesis, which asserts that L2 learning is mostly implicit but that explicit instruction is necessary in certain conditions, would be a more appropriate approach for teaching the L2 in the target context, and in similar contexts with similar conditions. The weak-interface hypothesis acknowledges the importance of both the explicit and implicit systems and balances between explicit and implicit types of instruction and activities, which in turn could be able to address the special nature of some grammatical forms that require specific attention such as morphological inflections. In addition, as discussed in Chapter 2, there is some evidence that certain linguistic forms might be susceptible to explicit types of instruction, while other forms might respond faster and better to implicit instruction (Han and Finneran, 2014). Therefore, the effects of both PI and MPI treatments are investigated in this study in order to explore further the influence of different types of instruction on various language forms (Spada and Tomita, 2010).

Furthermore, as seen in Chapter 3 (section, 3.9), the WM statistical analysis did not reveal any conclusive findings, however, WM is assumed to be an important factor in deciding how successful second language learning and processing can be (Miyake and Friedman, 1998). Therefore, it is my assumption that WM capacity would correlate with the extent to which L2 learners' processing and learning are affected by PI and MPI interventions, which is in line with findings from other research that suggest that WM is associated with L2 processing and development (e.g., Hopp, 2010; Sagarra & Herschensohn 2010; Wright 2010; Juffs & Harrington 2011; Roberts, 2012).

It is important to point out that in the second study, one WM task was employed due to time constraints and the pressure of other testing tasks that had to be administered in the same time. A Listening Span task was again chosen for the second study, as in the first study it was found to be the most practical and the least complicated for participants. Although PowerPoint timed slides were used in the first study, in the second study, Open sesame software was used for task administration in order to ensure full control of presentation time and record participants' accurate responses.

In this study, three research questions were addressed:

RQ 1-Does PI intervention targeting the verbal inflections -*ing*, -*ed* and -*s* lead to English second language learners improved performance in:

a. Accurate judgement of verbal inflections in interpretation task (using standard PI task in offline condition)?
b. Accurate processing of verbal inflections in self-paced reading interpretation task (adapting PI interpretation task to online condition)?
c. Accurate production of verbal inflections in elicited imitation task (adapting PI to online production condition)?

RQ 2-Does a modified PI intervention (MPI) targeting the verbal inflections -*ing*, -*ed* and -*s* lead to English second language learners improved performance in:

a. Accurate judgement of verbal inflections in interpretation task (using standard PI task in offline condition)?

b. Accurate processing of verbal inflections in self-paced reading interpretation task (adapting PI interpretation task to online condition)?

c. Accurate production of verbal inflections in elicited imitation task (adapting PI to online production condition)?

d. Are the results of the MPI group different to the results for the PI group?

RQ 3-Is there a relationship between working memory and learners' processing of the target verbal inflections *-ing*, *-ed* and *-s* after PI and MPI interventions, based on learners' performance in the online tasks?

The following sections provide a discussion of the research design, participants, and a description of the instructional and testing methods employed in this study. The final part of this chapter presents a description of the assessment tasks that were used in the pre, post and delayed post-tests and the instructional treatments.

4.2 Research design

This study adopted a pre-test, immediate post-test and delayed post-test design. The participants were divided into two PI treatments groups and one control group. The first one was the control group which had normal classes and English activities that were not related to the instructional treatments of this study. The other two treatment groups were:

A- The PI group received a full processing instruction package that contained explicit information about the target forms, information about the processing issues they might encounter and structured input (SI) activities: referential + affective activities. In this treatment, Benati's (2005) PI instructional intervention was replicated using similar PI components and SI activities for the three target forms.

B- The modified PI group received the same full processing instructional package that contained explicit information about the target forms, information about the processing issues they might encounter and SI activities, but the final section included referential activities + affective “tasks”. In this treatment, the PI instructional intervention was kept in its original version (VanPatten, 1996; VanPatten, 2002; Benati, 2005) for the explicit information and referential activities. However, the affective activities were modified to become affective ‘tasks’ that encourage L2 learners to use their communicative abilities through expressing opinions and sharing information.

The following tables present the design of the study, the timeline and the distribution of the interventions’ sessions:

Table 16. *Time line*

<table>
<tr><td colspan="4">Pre-tests (2 weeks before)</td></tr>
<tr><td colspan="4">Interpretation task- Self-paced reading task- Elicited imitation task</td></tr>
<tr><td colspan="4">93 students</td></tr>
<tr><td>PI group (32)</td><td>PI modified group (32)</td><td>Control group (29)</td><td rowspan="4">3 weeks
(3 hours per week)</td></tr>
<tr><td>Explicit instruction</td><td>Explicit instruction</td><td rowspan="3">Course normal classes (English speaking course)</td></tr>
<tr><td>Information about processing problems</td><td>Information about processing problems</td></tr>
<tr><td>Structured input activities: referential + affective activities</td><td>Structured input activities: referential + affective ‘tasks’</td></tr>
<tr><td colspan="4">Immediate post-test (week 6-7-8): Interpretation task- Self-paced reading task- Elicited imitation task</td></tr>
<tr><td colspan="4">Delayed post-test (after12 weeks): Interpretation task- Self-paced reading task- Elicited imitation task-WM listening-span task</td></tr>
</table>

As noted in Chapter 2 (section, 2.5.2), since PI research started three decades ago, a large number of studies has been dedicated to compare between PI, traditional instruction (TI) and meaning-based output instruction (MOI) (e.g., Farley, 2001; Benati, 2004, 2005; Benati & Lee 2008; Morgan-Short and Wood Bowden 2006; Keating & Farley, 2008). Furthermore, a considerable number of studies investigated the role of explicit instruction in PI (e.g., VanPatten & Oikkenon,1996; Benati 2004, 2005; Sanz and Morgan-Short, 2004) and concluded that explicit instruction has no important role in PI and that SI activities are sufficient to improve learners' performance in different tasks.

Despite the large number of studies that focused on these comparisons, this research intends to focus on the effect of PI as a whole instructional package, i.e. containing EI and SI activities. In addition, this research would like to extend PI research by addressing the criticism related to the similarity of SI activities to traditional methods, i.e. focus on forms, and the lack of oral gains in online testing methods (R. Ellis, 2003, 2009; Doughty, 2004; DeKeyser & Botana, 2015) discussed in Chapter 2 (section, 2.5.4).

Doughty (2004) specifies three main methodological issues with PI studies. First is the nature of the SI activities that is similar to metalinguistic activities (e.g., fill in the blank). The second issue is with the simplified content of SI activities in order to make L2 learners notice the target forms. Such simplification does not really reflect what L2 learners encounter in everyday language use. The third issue is with the offline measurement methods which are used to target the metalinguistic and declarative knowledge of the target structures. However, in a recent review of instructed second language acquisition research findings related to input manipulation, enhancement and processing, Benati (2016) acknowledges the necessity to include "online measurements" into PI to elicit L2 learners' comprehension and processing of the target structures and "measure more directly implicit knowledge" (ibid, p.82).

With regards to the criticism of PI measurement methods, the fact that the interpretation tasks that are used for assessment in PI studies are similar to what learners have been experiencing in PI treatment, could favour PI over other types of instruction. DeKeyser and Botana (2015) warn that PI studies' results should be "interpreted with caution because, as pointed out previously by several researchers, in the comprehension measures students are tested on the skill that was stressed in PI". They further add that "it is only logical that students improve more in the areas (closest to the ones) they were tested in" (ibid, p. 299).

Therefore, this study aims to address the two issues addressed earlier. First, is the 'focus on forms' instruction similarity to PI (R. Ellis 2003, 2009; Doughty, 2004) and the lack of oral production gains found in many PI studies (e.g., Keating & Farley, 2008; Marsden & Chen, 2011). By adapting communicative tasks into SI activities, this study will not change the fundamental design of SI activities but will modify one of its components (affective activities) in order to assess the effect of this modification and compare it with previous PI studies' findings. As discussed in Chapter 2, (section, 2.5.4), this modification (MPI) to add communicative tasks to PI instructional package is based on R. Ellis' (2003, 2009) criticism of the current SI activities used in PI studies. Nevertheless, this study will not change the design of the referential activities, as one of the study's aims is to replicate the PI instructional package of Benati (2005), in order to assess and compare the findings of both studies on the level of processing and production.

With regards to the lack of gains in production tasks, DeKeyser and Botana (2015) argue that the receptive measuring methods used in most PI studies and the similarity of PI treatment activities and its assessment methods are responsible for the advantage found in the PI treatment groups or the similarity of gains with production-based (PB) treatment groups (e.g., Benati, 2004, 2005; Morgan-Short & Bowden, 2006; Keating & Lee, 2008; Benati & Lee, 2009). However, DeKeyser and Botana claim that, when the measuring methods are productive, there was no advantage for PI over PB and in some studies there was an advantage for PB over PI (e.g., Morgan-Short & Bowden, 2006; Keating & Farley, 2008). And so, in order to address that criticism, this study included both receptive (interpretation tasks) and productive (elicited imitation and self-paced reading tasks). Please find all the assessment tasks details in Appendix (C).

Despite that most of PI studies used offline tasks for measuring learning gains after PI treatment (Doughty, 2004; Marsden & Chen, 2011; Atchley, 2015; Benati, 2016), this study investigated the effect of PI on learners' real-time performance through using online tasks for processing (self-paced reading) and for production (oral elicited imitation) since these measurement methods are claimed to be better at measuring learners' spontaneous and unconscious response to language stimuli (Marinis, 2010) and detect any automatic processing during comprehension that would occur after receiving the treatment (Mitchell, 2004).

In addition, this study investigated the role of WM in processing and producing the target inflections through using a listening span task. Although the role of WM in processing the target structures was not discussed in IP model and has not been investigated by previous PI studies, as discussed in Chapter 2 (section, 2.5.1), WM is assumed to be an important factor in deciding how successful second language learning and processing can be (Miyake and Friedman, 1998; Sagarra, 2008, Sagarra & Heschensohn, 2010). Therefore arguably, WM capacity would correlate with the extent to which L2 learners' processing and learning are affected by PI and MPI interventions as more capacity would mean more attentional resources and more memory to process form and meaning together (Juffs and Harrington, 2011).

The next section presents a detailed discussion of the intervention's design and methodology, target structures, and participants

4.2.1 PI and MPI instructional packages

As discussed above in (section, 4.2), both PI and MPI interventions began with explicit information about each target structure. This included grammatical explanation, information about the processing issues they might encounter and lead to inaccurate processing and information about the processing strategies of the three target verbal morphology inflections. After delivering grammatical explanations and processing strategies, SI activities were presented to participants. SI activities included equal numbers of referential and affective activities. During the activities, feedback was restricted to telling the respondent their response was either right or wrong. In these SI activities, no temporal adverbs were used in the sentences, in order to direct participants' attention to the verb endings and ensure participants processed the form in order to get meaning.

All the explanations and activities were organised and explained over the course of the 3-week period of instruction. Each week, one target inflection was explained and practised over two lectures. The next subsections present in detail the rationale and content of each instructional package.

4.2.1.1 PI instructional treatment

As discussed in Chapter 2, (section, 2.5.2), PI main goal was to direct learners' attention to form or structure in the input – alongside meaning - instead of relying just on lexical forms in order to derive the meaning. PI proponents claim that this intervention should take place in real-time sentence comprehension so learners identify the form or the structure that may cause problems and push them away from incorrect strategies. Hence, the PI instructional package included explicit instruction, explanation of inappropriate processing strategies and SI activities to achieve its goal. The following subsections present these components in detail.

4.2.1.1.1 Explicit information

Both groups, the PI and MPI, received explicit instruction and explanation about the inappropriate processing strategies they might face when encountering the target forms in the input. In this study, Benati's (2005) PI instructional intervention was replicated using similar

PI components and SI activities for the three target forms. The following section presents the explicit instruction for each target form employed in this study.

-Third-person-singular -*s*

The third-person-singular -*s* is used in the present tense to talk about singular nouns (girl, car, dog) and with the pronouns (he, she and it). It refers to habitual actions and events. All English verbs end with -*s* as the following examples:

-*Sara goe**s** to school*

-*The cat need**s** new water*

However, when you talk about a habitual action or event in the present, the present tense is often accompanied by a temporal adverb:

-*Sara goe**s** to school **everyday***

-***Every morning**, the cat need**s** new water*

DO NOT RELY ON THE TEMPORAL ADVERB TO UNDERSTAND WHEN THE ACTION TAKES PLACE AS SOMETIMES YOU CAN HEAR A SENTENCE WITHOUT THE TEMPORAL ADVERB.

YOU MUST PAY ATTENTION TO THE TENSE ENDING TO UNDERSTAND WHEN THE ACTION TAKES PLACE.

IN THE CASE OF DESCRIBING PRESENT HABITUAL EVENTS, PAY ATTENTION TO THE ENDING OF THE VERB: -*s*

-<u>Simple past tense -*ed*</u>

The simple past form -*ed* is used in the past tense to talk about singular and plural nouns and pronouns. It refers to actions and events that took place in the past. Most English past tense verbs end with -*ed* as in the following examples:

-*I call**ed** Sara three times*

-*The family lik**ed** their new car*

-*The dog need**ed** more food*

However, when you talk about an action or event that happened in the past, the past tense is often accompanied by a temporal adverb:

-***Yesterday**, I call**ed** Sara three times*

-*The dog need**ed** more food **last night**.*

DO NOT RELY ON THE TEMPORAL ADVERB TO UNDERSTAND WHEN THE ACTION TAKES PLACE AS SOMETIMES YOU CAN HEAR A SENTENCE WITHOUT THE TEMPORAL ADVERB.

YOU MUST PAY ATTENTION THE TENSE ENDING TO UNDERSTAND WHEN THE ACTION TAKES PLACE.

IN THE CASE OF DESCRIBING PAST EVENTS PAY ATTENTION TO THE ENDING OF THE VERB: -*ed*

-<u>The present progressive -*ing*</u>

The present progressive -*ing* indicates continuing action, something going on now. This tense is formed with "to be" verb (am, is, are), in the present tense. All English verbs end with -*ing* as the following examples:

- *I **am** walk**ing** to the supermarket*
- *The boys **are** play**ing** football outside*

However, it is unlikely to have temporal adverbs that accompany the present progressive tense -*ing*.

YOU MUST PAY ATTENTION TO THE TENSE ENDING TO UNDERSTAND WHEN THE ACTION TAKES PLACE.

IN THE CASE OF DESCRIBING EVENTS THAT ARE GOING ON NOW, PAY ATTENTION TO THE ENDING OF THE VERB: -*ing*

After delivering the explicit instruction and explaining the inappropriate processing strategies to participants, the structured input activities (SI) are presented next.

4.2.1.1.2 Structured input activities (SI)

As discussed above, the SI activities include two types, Referential activities, that are considered the key component of the PI treatment, and Affective activities.

First, Referential activities are designed to push L2 learners to process the form-meaning connections through reading and listening to sentences that include morphological inflections but stripped from adverbs, then ask learners to decide the tense of the action. This activity includes both right and wrong sentences, thus L2 learners need to attend to the target inflections in order to choose the correct answer and complete the task.

The following examples present a sample of what participants read and listened to and had to determine the time of the action (e.g., past-present), more examples are provided in Appendix (B):

a-The father takes his children to the dentist b-The mother cooked dinner for her family

Second, affective activities require L2 learners to express their opinions and exchange information about specific events or actions. This activity includes grammatical sentences only, and encourages learners to use the target inflections without a guarantee that they will use them while performing the activity. The following sentences are examples for what participants read and listened to and had to express their opinions:

a-The cat plays with the plants in the garden.

b-Nora started her day with fresh coffee.

With SI activities being the key component for any PI treatment (Keating & Farley, 2008), Marsden & Chen (2011) investigated the role of two components of SI activities, referential and affective activities and the type of knowledge they promote. As discussed earlier in Chapter 2, (section, 2.5.3.3) Marsden & Chen investigated the learning of the past tense inflection [ed] using 120 Taiwanese learners of English and found that referential activities were responsible for the most learning gains whereas affective activities had no significant role. Nevertheless, Marsden & Chen acknowledge the importance of the affective activities in accommodating SI activities in the communicative approach. Moreover, they acknowledge the need for improved affective activities in order to improve L2 learning gains.

To this end, I have explained that the PI group participants first received explicit instruction, then they received SI activities, However, it is important to note that the PI group received a full package of SI activities, including referential and affective activities.

4.2.1.2 MPI instructional treatment

The second treatment in this study is the modified processing instruction, the only difference between PI and MPI is that the MPI group received referential activities and affective “tasks” instead of affective activities. So, the modified PI treatment is a full PI instructional package that contains explicit information, information about the processing issues that might be encountered, referential activities and slightly different affective activities. This treatment is similar to the first one for the PI group as detailed above, in (section, 4.2.1.1) with one modification in the affective activities. This modification was done through adapting communicative tasks that engage learners to work in pairs to express opinions and share information into the affective activities. As discussed in Chapter 2 (section, 2.5.4.1), the use of the target forms is not guaranteed during task's performance, but the point of this modification is to encourage participants to use their linguistic knowledge which they have processed earlier in the referential activities in meaningful and communicative production.

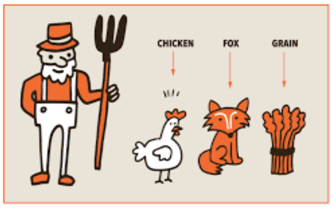
It is important to note that the modification made to the original PI package is not changing any of the critical features of PI, as the focus is still on processing and not on production as discussed in Chapter 2, section (2.5.2). The reason for using communicative tasks was to encourage more focused processing of the target forms through having appropriate and natural communicative contexts that encourage using them in a task-like way. Hence, the goal of employing communicative tasks here is assumed not to deviate from the principal goal of standard PI affective activities which also involve some communicative element and require learners to express and share their opinions about certain actions or events.

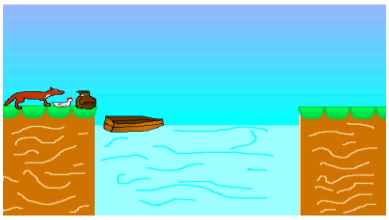
4.2.1.2.1 Affective tasks

The following example presents a sample of the tasks used for the MPI group, more examples are provided in Appendix (C).

A- Read the following puzzle and look at the pictures provided to give you a clue for the solution. Work in pairs and think about the steps that need to be taken in order to help the man. After that, you need to make a poster to show the steps with a sentence under each step explaining your solution. Copies of the pictures are available for you to use in the poster.

Chicken Crossing Solution!





-The puzzle

A man has to get a fox, a chicken and a sack of corn across a river. He has a rowboat, and it can only carry him and one other thing. If the fox and the chicken are left together, the fox will eat the chicken. If the chicken and the corn are left together, the chicken will eat the corn. **How does the man do it?**

A possible answer:

1- The man and the chicken cross the river, (the fox and corn are safe together)

2- He leav**es** the chicken on the other side

3- He go**es** back across.

4-The man then tak**es** the fox across the river.

5- Since he can't leave the fox and chicken together, he bring**s** the chicken back.

6-Again, since the chicken and the corn can't be left together, he leav**es** the chicken and tak**es** the corn across

7-He leav**es** the corn with the fox.

8-He then returns to pick up the chicken and head**s** across the river one last time.

For the sake of clarity, the following table demonstrates the content of each PI and MPI session that included the target structures explanations, the activities and the methods used for presentation.

Table 17. *PI and MPI sessions*

	Week 1	**Method**
PI group 1st session (90 min)	Third-person singular *-s* explanation and processing issues -Referential activities	-Slide show presentations -Work individually using pen + paper
PI group 2nd session (90 min)	Third-person singular *-s* affective activities	-Work individually using pen + paper
	Week 2	**Method**
PI group 3rd session (90 min)	Regular past form *-ed* explanation and processing issues -Referential activities	-Slide show presentations -Work individually using pen + paper
PI group 4th session (90 min)	Regular past form *-ed* affective activities	-Work individually using pen + paper
	Week 3	**Method**
PI group 5th session (90 min)	Present progressive -*ing* explanation and processing issues -Referential activities	-Slide show presentations -Work individually using pen + paper
PI group 6th session (90 min)	Present progressive -*ing* affective activities	-Work individually using pen + paper

	Week 1	**Method**
MPI group 1st session (90 min)	Third-person singular *-s* explanation and processing issues -Referential activities	-Slide show presentations -Work individually using pen + paper
MPI group 2nd session (90 min)	Third-person singular *-s* affective tasks	-Group work working on the communicative tasks
	Week 2	**Method**
MPI group 3rd session (90 min)	Regular past form *-ed* explanation and processing issues -Referential activities	-Slide show presentations -Work individually using pen + paper
MPI group 4th session (90 min)	Regular past form *-ed* affective tasks	-Group work working on the communicative tasks
	Week 3	**Method**
MPI group 5th session (90 min)	Present progressive -*ing* explanation and processing issues -Referential activities	Slide show presentations -Work individually using pen + paper
MPI group 6th session (90 min)	Present progressive -*ing* affective tasks	-Group work working on the communicative tasks

At the end of each session, all the grammatical explanations and processing issues were explained to all participants in order to fulfil standard PI instructional package requirements. In addition, this ensured they were aware of the possible processing issues they could face, and any inappropriate form-meaning connections that they might have formed previously and led to the incorrect processing of the target structures.

4.3 The target structures

The English verbal inflections third person singular *-s*, past tense *-ed* and present progressive *-ing* were chosen to be the target forms of PI treatments. They were chosen based on a number of reasons: first, they represent a processing problem for L2 learners based on the findings of the first study conducted in this research (see Chapter 3). Second, English inflectional verb morphologies that carry meaning for number, person and time are subject to different levels of communicative redundancy (Marsden, 2006; Marsden & Chen, 2011). For example, temporal adverbs such as *every day*, *yesterday* communicate time meaning, while overt subjects and pronouns communicate number and person meaning.

Third and most importantly, these three inflections are representative for three different abstract areas of acquisition: agreement, tense and aspect. This study does not aim to show how or why these inflections are variable, as many previous studies and research discussed this issue before. Nevertheless, it aims to investigate if PI intervention can trigger change in the processing of these target inflections which represent different abstract areas of acquisition.

Based on the discussion above, it is conceivable to consider the English system as a good candidate to assess the validity of the two input processing principles (IP) investigated in this study. The two IP principles are: The Lexical Preference Principle and The Preference for Nonredundancy. The first principle suggests that learners will process lexical items for meaning before grammatical forms when both encode the same semantic information. The second one suggests that learners are more likely to process nonredundant meaningful grammatical markers before they process redundant meaningful markers. These inflections as discussed in Chapter 2, (section, 2.5), are subject to different levels of redundancy and semantic notion (i.e. communicative value) as coined by VanPatten (1996, 2004, 2007), which in turn may affect L2 learners input processing preferences.

4.4 Participants

The participants of this study were English language female students in the third year of their university studies. These students were chosen because they have completed all of the introductory and core English courses in the previous two years. Furthermore, based on the preliminary study findings, these L2 learners are considered to have sufficient knowledge about the vocabulary and the different aspects of the language, but are still facing processing difficulty with the target forms employed in this study.

Based on a personal information sheet completed by all participants (see appendix E), all students shared the same native language (Arabic), same educational level and had studied the same elective courses at the previous levels. Their age ranged from 20-23 years old and they shared a similar educational background (they studied English for 8 years in secondary and high school, but without any additional outside exposure). In addition, they studied the required English courses during the first university semester for 6 hours per week plus introductory English courses (linguistic theory, grammar, and phonetics). They were therefore deemed to be as homogenous as possible prior to the intervention.

While previous PI studies have employed beginning L2 learners, this study aims to extend PI research findings by employing intermediate-level third-year English language learners who still have difficulty with processing and producing the target forms in real-time settings.

According to VanPatten (2004) L2 learners might sometimes derive 'incorrect' intake (the wrong form-meaning connection) during input processing and this might negatively affect the accommodation and restructuring needed for acquisition (ibid, p.7). Moreover, employing participants from intermediate levels will test PI's ability to steer these L2 learners from their non-optimal processing strategies and ensure that they adopt the appropriate processing strategies of the target structures (Benati, 2016).

4.5 Duration and administration of treatments

This intervention using PI and MPI treatments was carried out over the duration of eight weeks using a pre-test, post-test, and delayed post-test design. The two treatments had equal proportions of explicit information and activities. The delivery of the treatments took about three hours per week with an approximate total of 9 hours for each group. The control group continued its normal classes with the teacher after taking the pre-tests. Unlike most previous PI studies which had a relatively short time for delivery and testing (DeKeyser & Botana, 2015), this study allocated longer time for the delivery of the instruction in order to allow the treatments to reflect on the performance of participants. The pre-tests were administered two weeks prior to the treatments and the post-tests were at week 6, 7 and 8 after the treatments. The delayed post-tests were administered 12 weeks after the intervention.

The two PI interventions were delivered by the researcher of this study to exclude any teacher effect (Marsden, 2006). The treatments took place within a standard speaking class schedule. This was done after finalising necessary arrangements with the course instructor to ensure that this intervention looked like an addition to their course without affecting the participants' schedule and also to exclude potential Hawthorne effect.

As can be seen in table 17. above, the two PI interventions were delivered through slide show presentations for the whole class containing the explicit information of the target form, and information about possible processing issues. After that, SI activities were displayed on the screen and the participants had individual answer sheets to write down their answers. At the end of the treatment, the instructor discussed correct answers in front of the class as simple right/wrong feedback. However, in the MPI group only, participants worked together to complete the affective tasks.

The instructional treatments were conducted over the course of three weeks. Each week compromised two lectures for each target class. Thus, the first lecture was used to administer the intervention for both PI and MPI groups, and the second lecture was used to administer the intervention activities and tasks. The following timetable presents the speaking course classes during that semester:

Table 18. *Time table*

Day/Classes Speaking class(A)	Session 1 (7:30-9:00)	Session 2 (9:15-10:45)	Session 3 (11:00-12:30)	Session 4 (1:00-2:30)	Session 5 (2:45-4:15)
Sunday					
Monday		PI group	MPI group		
Tuesday					
Wednesday	MPI group		PI group		
Thursday					

PI: processing instruction   MPI: modified processing instruction

To this end, I have presented the design of this study including the time line, participants, target structures and more importantly, the instructional packages of PI and MPI interventions. I have discussed some methodological issues related to previous PI studies and how this study attempted to address them. The next section presents the assessments that were used to measure participants performance pre and post the interventions.

4.6 Assessment tasks

With regards to the assessment tasks, as noted earlier, a pre-test, post-test and delayed post-test design was adopted in this study. Following Benati (2005), the pre-tests were used to eliminate subjects who had already acquired the relevant forms, so participants who scored 60% or better on the interpretation task, self-paced reading and EI pre-tests were not included in the final pool. Following Marsden (2006), two versions of the three tests were designed: version (A) was used as the pre-test, and version (B) was used as the post-test and later on, version (A) was used again as the delayed post-test.

Three pre and post tasks were designed for processing, comprehension and production in addition to one independent variable test: the listening span task. All the tasks were administered individually except for the interpretation task which was administered to the whole class.

4.6.1 The processing task

For processing, Open Sesame software was used to design and run the self-paced reading experiment (SPR). For this task, Keating & Jegerski's (2015) recommendation of the number of critical items per condition and the number of non-critical items was followed - thus twelve sentences were designed for each inflection with a first set of four sentences for practice. Each set of sentences included six grammatical and six ungrammatical sentences. The ungrammatical sentences comprised the target missing inflections for agreement (i.e., third-person-singular *s*), for tense (i.e. regular past tense *ed*) and for aspect (i.e. present progressive *ing*). In addition, they included missing auxiliary (i.e., am, is, are) in the present progressive case.

The SPR task asked participants to read sentences word by word or phrase by phrase on a laptop screen through pressing a button (Marinis, 2010). During that, participants controlled the pace of presentation according to the time they needed to read each word or phrase, each button press was recorded in order to document the time (RT) needed to read each word. Thus, longer RTs at specific words or phrases indicated processing difficulty or sensitivity to ungrammaticality of the sentence (ibid).

SPR tasks, which were used in previous processing studies (e.g., Sagarra, 2008; Sagarra & Herschensohn, 2010; Atchley, 2015), allow for a moment-by-moment detection of learners' processing during the task. SPR could thus reveal information about learners' sensitivity to morphosyntactic information during online reading (Roberts, 2016). Benati (2016) acknowledges the importance of using SPR online tasks with PI in order to "measure more directly implicit knowledge" (ibid, p. 82).

Following Sagarra (2008), the self-paced reading task used a non-cumulative moving window task technique in order to avoid possible adverbs' regression. The first four sentences were for practice followed by 12 sentences for each inflection: *-s*, *-ed* and *-ing*. All the three inflections sentences were designed to have the target word (verb + inflection) at the fourth region of the sentence in order to unify the location of the response time recorded by the experiment. However, due to the removal of the adverb in the case of the non-redundant grammatical (inflected) verbs with -ed, the second reign in the sentence was the location of the target word and this was taken into consideration when calculating the RTs for the statistical analysis.

The minimum length of the experimental sentences was 9 and the maximum was 12 words. However, the first practice sentence was 13 words in length, because the software used in designing the task uses the first stimulus to set the maximum number of words for display. After each sentence, a truth value judgment was displayed to ensure that participants are focusing on meaning.

As mentioned earlier, there were 12 sentences for each target inflection that included 6 grammatical (inflected verbs) and 6 ungrammatical (non-inflected verbs). The following six conditions were used to create the experimental sentences employed in the SPR task:

1- Third-person-singular agreement -*s*

2- Third-person-singular violation -*s*

3- Past tense agreement -*ed*

4- Past tense violation -*ed*

5- Present progressive tense agreement -*ing*

6- Present progressive tense violation -*ing*

It is important to note that in the case of the inflection -*ed*, there were three inflected (redundant) verbs and three inflected (non-redundant) verbs in order to compare between the redundant and non-redundant cases of the inflection -*ed*. As explained in Chapter 2 (section, 2.5), the redundancy of the inflection depends on the availability of temporal adverbs in the sentence. It is important to note, that the SPR task design, unlike the EI and interpretation tasks, allows for the comparison between the redundancy of the target inflections. In other words, the sentences can either include adverbs or not according to the level of redundancy specified for the inflection, however, this cannot happen in the interpretation tasks because its design is based on the fact that adverbs are stripped from the sentence in order for the learners to determine the tense according to the inflection attached to the verb.

The same applies for the EI task, where participants need to hear the adverbs in order for them to imitate the correct target inflection or provide the missing one in their imitations. If the adverbs were not included in the experimental sentences, participants could attach any inflection to the verbs, and their imitations would be considered correct. Hence, the self-paced reading task is the only task in this study that would be suitable for comparing redundant and non-redundant *-ed*, as the sentences were organised in a way that involves events in the past tense so, adverbs could be removed from some of the sentences without affecting the experiment. Please refer to all self-paced reading experimental sentences in Appendix (D).

In addition, in the case of the inflection *-ing*, there were three ungrammatical (non-inflected) verbs missing the *-ing* inflection and three ungrammatical (non-inflected) verbs missing the auxiliary. Thus, there were six sentences representing ungrammaticality in order to have equal numbers to enable the comparison between the two cases. Please find all assessment self-paced reading task details in Appendix (D).

4.6.2 The comprehension task

For comprehension, an interpretation task adapted from Benati (2005) was used. Interpretation tasks have been used in most of PI studies to measure learners' processing of the target structures during comprehension (e.g., VanPatten & Oikkenon, 1996; Benati, 2002, Benati, 2005, Benati & Lee, 2008, Atchley, 2015). Interpretation tasks have been used to test learners' knowledge through controlled, offline conditions which allowed learners to control and monitor their response. Although the interpretation task has been criticised by a number of researchers due to its offline method (Doughty, 2004; DeKeyser & Botana, 2015) and its similarity to SI activities of PI (DeKeyser & Botana, 2015), it is employed in this study in order to assess and compare the effect of PI intervention with previous PI studies' findings.

This task was adapted from Benati (2005), where participants read some sentences and listened to others to indicate whether the action habitually occurs, occurred in the past or happening now. In Benati's study, time was not specified for the interpretation task sentences display, hence, in this study, the time allocated for displaying each sentence was determined according to the timed grammaticality judgment task (GJT) used in the first study. According to Hopp

(2006), in the timed GJT, each word should be allocated 250ms, so, in the untimed task, each word was allocated 500ms in addition to 5 seconds to choose the correct answer. This time limit was rehearsed by other L2 learners, who were not employed in this study, to ensure it was sufficient to read each sentence and provide the correct answer. It is important to point out, that even with this time control, it was still an offline task that enabled participants, to some extent, from checking and controlling their answers.

In this task, 10 grammatical sentences were designed for each inflection in addition to 10 ungrammatical sentences (distractors) and as mentioned earlier in section (4.2.2), all the sentences were designed without using adverbs in order to encourage the processing of inflections. However, it is important to note that in this testing task, Benati did not include ungrammatical sentences, but he used verbs of a different tense as he was testing only one morphological inflection *-ed*. Hence, in this testing task, I was testing three target morphological inflections so, I employed ungrammatical sentences that included missing inflections, and the only option that could be chosen for these sentences was (cannot tell) as there was no other indication of tense or aspect in the sentences. Please find all assessment self-paced reading task details in Appendix (D).

The sentences were displayed to the whole class using a slide show presentation, however, some of the sentences were written on the slides and the others were recorded and played using speakers. In Benati (2005) study, all the testing sentences were recorded and played to the participants, however, in this testing task, I added written sentences following Marsden and Chen (2011) in order to satisfy the basic characteristics of the input-based SI.

4.6.3 The production task

For production, an elicited imitation task (EI) was designed in order to test participants' production of the target forms under the task's processing demands. EI task is used to assess if a learner can manage spontaneous production of the target grammatical forms and has the ability to elicit the production of target forms under real-time conditions. EI asked the participants to listen to a set of recorded sentences and repeat what they had heard as closely as possible.

The rationale underlying the use of EI task is that it can “tap into the ability to process meaningful language receptively and productively” (Wu & Ortega, 2013, p. 683) and thus, if the grammatical forms targeted by the tasks are not part of learners’ mental representations, they cannot not be recalled (Spada et al., 2015).

Spada et al. (2015) used an EI task to elicit spontaneous production of specific grammatical form. EI was used in order to assess the effects of instruction on specific grammatical forms that were difficult to learn. They compared EI with two timed grammaticality judgment tasks and one offline task, and found that EI was a valid measure for (implicit) knowledge of the target forms and the most successful task to elicit spontaneous production. Their findings support the findings of R. Ellis (2005), where he compared three online tasks designed to tap into implicit knowledge: oral narrative task, elicited oral imitation task and timed grammaticality judgment task. He reported that the oral imitation task was the best measure for implicit and automatic knowledge.

Following Spada et al. (2015), the experimental sentences recordings were displayed using Power Point, after each sentence, a slide was displayed to ask participants to repeat what they heard. The time was calculated from the moment the recording stopped to be approximately around 6 seconds. Although it is possible that participants could keep what they heard active in memory using articulatory/subvocal rehearsal (Baddeley, 2007), this was in order to prevent them from relying on their rote memory (Spada et al., 2015). Participants were given 8 seconds to repeat each sentence they heard before moving to the next recording. The emphasis on using correct English is due to the possibility that learners might repeat the ungrammatical sentences because they follow the instructions given by the examiner (Yan, et al., 2015).

The EI task compromised 24 sentences: 8 sentences for each inflection (4 grammatical and 4 ungrammatical). With regards to the present progressive, the 4 ungrammatical sentences comprised 2 sentences with missing auxiliary and two sentences with missing inflection -*ing*. The sentences were recorded and administered using speakers and participants' imitations were recorded using a recording device (OLYMPUS) that has an integrated USB stick and so can be connected to the laptop to transfer the audio files.

The following six conditions were used to create the experimental sentences employed in the EI task:

1- Third-person-singular agreement -*s*

2- Third-person-singular violation -*s*

3- Past tense agreement -*ed*

4- Past tense violation -*ed*

5- Present progressive tense agreement -*ing*

6- Present progressive tense violation -*ing*

Following Kahoul et al. (2018) and the preliminary study findings, the violation conditions were included as it was found that L2 learners spontaneously corrected some of the sentences. This is assumed to reveal participants' linguistic knowledge under task pressure. Each condition had 4 sentences; thus, the total was 24 sentences. Please find all assessment elicited imitation task details in Appendix (D).

4.6.4 The working memory task

Finally, one independent variable test was administered: the working memory task. The working memory task was a listening span task which was administered with the delayed post-tests. It included 24 sentences: 6 sets of consecutive 3, 4, and 5 sentences, following the criteria assumed to be adequate for university level students (Conway et al., 2005). This test was administered in participants' L1 (Arabic), and Open Sesame software was used to present stimuli and record participants' answers.

A listening span task (LST) was chosen because recent research has shown that employing working memory span tasks, specifically Waters & Caplan's (1996) version, revealed a positive correlation between WM and L2 grammar learning (e.g., Sagarra, 2017). Listening span tasks require L2 learners to use their language knowledge to comprehend and judge the linguistic stimuli to which they are exposed. In the LST, the participant is required to listen to sets of plausible and implausible sentences presented at a fast pace and memorise the last word in each sentence, then judge the plausibility of each sentence immediately after it has been heard and write down all of the recalled words at the end of each set.

As discussed in Chapter 2, (section, 2.5.1), working memory capacity is limited and performing complex cognitive tasks such as storing and processing information requires great amount of cognitive resources (Baddeley, 2003, 2007). Thus, this working memory task should reveal the WMC of participants as they need to hold and store the last word of each sentences for a certain time while performing another truth value judgment in the same time.

The LST design here was adapted from Sagarra and Herschensohn (2010). The participants performed two tasks simultaneously. First, the participant had to recall the last word at the end of each sentence, then assess the acceptability and plausibility of each sentence that was heard.

Half of the sentences were semantically plausible and the other half were semantically implausible by reversing the grammatical roles of animate and inanimate subjects (Hopp, 2014). This task was conducted in participants' L1 (Arabic), as working memory is assumed to be language independent (Osaka & Osaka, 1992).

The same experimental sentences of the preliminary study were used in this study. All the sentences were 9-12 words long, using an Arabic article by a well-known author, Dr. Abdullah Almaglouth. Participants chose the correct answer during the task by pressing on T for (true) or F for (false) on the laptop key pad. However, the participants needed to write down the last word of each sentence, thus they were provided with an answer sheet to fill in with the final words after each set. Please find all assessment listening span task details in Appendix (D).

4.7 The delayed post-test

For the delayed post-test, as noted earlier, the same pre-test version of three testing tasks was used. The delayed post-tests took place on week 13 after conducting the treatments in the same educational institution - King Faisal University, English language department. The researcher kept in contact with the participants after conducting the post-test in order to arrange for the delayed post-tests timing and location, however, perhaps inevitably, it was impossible to retain 100% retention from the original study cohort. Through emails, the researcher arranged with 30 participants from the original pool of the study (15 participants from each experimental group) in order to take the delayed post-tests. Thus, the same participants of the post-tests were tested and the same scoring and testing methods were maintained in the delayed post-tests (note, no control group participants were tested, because they did not receive any treatment that could have effect on performance and thus can be tested). In addition, there was no need to compare the control group performance to the other groups' performance in the delayed post-test as the PI and MPI groups' performance in the delayed post-test was compared to their performance in the pre and post-tests.

4.8 Administration method and Scoring

All the assessment tasks were administered in the girls' campus at King Faisal University. Similar conditions to the first study were available for the second study of this research, dedicated classroom equipped with white board, projector and speakers. The interpretation task was the only test that was administered for the whole class using a slide show presentation and printed papers with multiple choice options for participants' answers. The interpretation test scoring allocated 1 for each correct answer and 0 for an incorrect answer, thus, each participant's score ranged between 0 and 40. This task did not require the participants to correct any errors and participants had to choose only the correct tense for the inflected verb they were reading. The length of the presentation was automatically controlled. Each sentence was displayed on a separate slide for a limited time and each word was allocated 250ms of time, so the total number of words in each sentence was multiplied by 250 (Hopp, 2006).

The self-paced reading test was administered individually using a wide screen laptop placed in a quiet room with the presence of the researcher in case of any technical issues. As mentioned above, the test was designed using Open Sesame software, and 12 sentences were designed for each target inflections. after reading each sentence, the participant had to answer a comprehension question related to what they have read by pressing T or F in the key board and their answers were recorded by the same software. The goal of the comprehension questions was to distract participants' attention from the main reason behind taking this test, which was testing their sensitivity toward the ungrammaticality represented by the non-inflected verbs.

The self-paced reading test focused on the reaction time spent in reading the target verbs inflected with the morphological inflections under study. In this test, participants are expected to spend longer reaction times (RTs) while reading the non-inflected verbs because they would indicate ungrammaticality that needs further processing, and shorter RTs while reading the inflected, correct verbs which would not require extra processing. Therefore, this test goal was to compare the RTs spent during reading the grammatical, inflected verbs and the ungrammatical, non-inflected verbs.

The elicited imitation test was also administered individually in a quiet room equipped with speakers and a recorder with the presence of the researcher to play and record participant's imitations. All the recordings were transferred to the recordings' file in the laptop to be saved and analysed. A structural scoring scheme was used to analyse the participants' imitations (Marinis and Cunnings, 2018). The participants were assigned 1 when they produced the correct target feature; i.e., correctly imitate the correct, inflected verb and provide the missing inflection for the (non-inflected) verbs, and 0 if they omitted it, made an error or made a substitution for it. Thus, each participant's score ranged between 0 and 24.

Finally, the listening span test was administered individually in a quiet room using a widescreen laptop to play the experimental sentences and record participants' judgment. Open Sesame was again used to play the sentences and the participants had to press T or F to answer the comprehension question that followed each sentence. The participants also used paper to write down the words they recalled after hearing each set. For scoring, the partial-credit unit scoring was used to "express the mean proportion of elements within an item that were recalled correctly" (Conway et al., 2005: 775). Therefore, the correct recall of each word would be awarded 1 and the incorrect recall would be awarded 0. Thus, each participant's score ranged between 0 and 24.

The following table recaps the methodology of the second study employed in this research:

Table 19. *Methodology*

Research questions	***Testing task***	***Testing method***	***Scoring scale***
Do PI and MPI targeting the verbal inflections -*ing*, -*ed* and -*s* lead to accurate verbal judgment?	Interpretation tasks (offline)	Slideshow presentations for the whole class (reading and listening)	Correct= 1 Incorrect=0 Total= 40
Do PI and MPI targeting the verbal inflections -*ing*, -*ed* and -*s* lead to accurate processing?	Self-paced reading task (online)	Open Sesame software Individual (online) test using laptop	Reaction time (RT) for reading inflected and non-inflected verbs
Do PI and MPI targeting the verbal inflections -*ing*, -*ed* and -*s* lead to accurate production?	Elicited imitation task (online)	Laptop, speakers and recorder. Controlled time for playing the sentences using PowerPoint	Correct production=1 Omission =0 Incorrect production=0 Total =24
Is there a relationship between WM and learners' processing of the target verbal inflections?	Listening span task Independent variable	Open Sesame software Store and recall final words + truth value judgment	partial-credit unit scoring total =24

The next chapter presents the statistical analysis of the second study results.

CHAPTER 5.

RESULTS

5.1 Introduction

In this section, I present the analyses of the three testing tasks: the offline interpretation task, the online production task, and the online self-paced reading task. As mentioned in chapter 2 (section, 2.6), there are three main questions related to PI, MPI and WM, and each question has specific tasks employed in order to address it. For the testing tasks, first, the offline interpretation task tests if PI and MPI interventions targeting the verbal inflections *-ing*, *-ed* and *-s*, would lead to accurate offline processing. Second, the online self-paced reading task tests if PI and MPI interventions targeting the verbal inflections *-ing*, *-ed* and *-s*, would lead to accurate online processing. Third, the online elicited imitation task tests if PI and MPI targeting the verbal inflections *-ing*, *-ed* and *-s*, would lead to accurate online production. Finally, the working memory listening span task tests if there is any relationship between WM and learners' processing and production of the three target verbal inflections.

The results of each task are presented by group: PI and MPI. Statistically significant differences among scores at the three pre, post and delayed post-tests were found, however, significant gains were found in two of the tasks – the interpretation task and the elicited imitation- and so the results of these tests are presented first, followed by the results of the third task, the self-paced reading. After that, I present the analyses of the working memory for both groups, the PI and MPI and its relationship with the groups' performance in each testing task. Given the complexity and details for each task analysis, there is a summary of key findings presented at the end of the chapter.

5.2 Statistical methods

In this study, the performance of participants in the pre and post-tests was compared for effect of intervention type by taking the difference between the two tests in order to measure any change that may have occurred in participants' performance after the PI and MPI treatments. As discussed in Chapter 4 (section, 4.8), the scoring methods were different for each task, SPSS was used to calculate all the assessment tasks' results and the analysis of each task is presented separately below.

In this study, two instructional treatments, the PI and the MPI were delivered to two groups in addition to the control group that did not receive any treatment. All the three groups had taken pre and post-tests in addition to a WM task for the two experimental groups. This 2×2 mixed factorial design included two statistical analyses: first, within each group, in order to assess the effect of each treatment on the three target inflections, and second, between the two groups, in order to compare between the effect of the two treatments on each target inflection.

To conduct the first analysis, within each group, repeated measures ANOVA was used to show any changes in mean accuracy on the three target inflections from the pre-test to post-test. For the second analysis which was between the groups' performance from pre-test to post-test of each target inflection, MANOVA was used first to determine in case there are any differences between two or more independent groups on more than one dependent variable. Then, One-way ANOVA for independent groups was used to compare the three groups in terms of change in participants' performance.

For the delayed post-tests that were conducted twelve weeks after conducting the two treatments, the analysis aimed to reveal which treatment had the greatest effect on participants performance in the delayed-post tests. In other words, if the change in participants' performance caused by either MPI or PI treatments still exists after 12 weeks of treatments' administration. Repeated measures ANOVA was used to show any changes in mean accuracy of each target inflections in the pre, post and delayed-post-tests. If the change from post-test to delayed post-test significantly declined, it means that the effect of the treatment did not extend or exist 12 weeks afterwards. However, if it did not change significantly from the post-test and was still significantly different from the pre-test, it means that the effect of the treatment still exists 12 weeks later.

Other descriptive statistics were also employed to validate the results of this study such as the confidence intervals (CI), standard deviation (SD), and effect size. Confidence interval is one of the least used descriptive statistics and according to Plonsky (2015), CIs are important because they "express a range of values around an observed mean score that are likely (at a given level of probability, typically 95%) to contain the true population mean" (p. 39). Thus, the main purpose of using CIs as well as SD, was to help indicate the degree of variability around a mean - since the point of this intervention is to track variability, both SD and CI are shown to give as full picture as possible, and reduce an over-reliance on a simple mean. The standard deviation (SD) is a measure used to reveal the spread of scores within a set of data (Plonsky, 2015), and is calculated through estimating the coefficient of variation (CV=standard deviation / mean). When the CV >= 1, it indicates a relatively high variation, while a CV < 1, is considered to represent a small variation in the data.

In addition, the effect size is given, because in psychological research, the statistical significance specifies that some significant results might not be referring to an effect with a high impact. In addition, the statistical significance could depend on more than one factor, for example, the sample size, the power of the statistical procedures, and the quality of the data (Plonsky, 2015). Therefore, in order to describe the strength of a phenomenon; i.e. if the effect has a relevant magnitude, Cohen's effect size measure was used.

Cohen (1988) explains that the effect size between two correlations is calculated through the denomination *q* which allows to interpret the difference between two correlations. Thus, the two correlations are transformed using Fisher's Z and then subtracted. According to Cohen's effect size measure, if the effect size is <.1, it suggests no effect, from .1 to .3, it suggests a small effect, from .3 to .5, it suggests an intermediate effect, and if the effect size is >.5, it suggests a large effect.

In the following sections, the analyses of each task's results are illustrated, and as mentioned above, the first analysis to be presented is within each group. The second analysis to be presented is between the groups, this section includes subsections that present a comparison of the treatments' effect on each target inflection. After presenting the two analyses, the analysis of the delayed post-test is presented.

5.3 The interpretation task

As discussed above, to perform the analyses, the difference between the performance in the pre-test and post-test was taken for the target inflections: *-s*, *-ed*, and *-ing*, in order to assess the effect of the PI and MPI treatments in the offline interpretation task. The two analyses are presented below.

5.3.1 The statistical analysis within each group in the interpretation task

Within each group, the change in mean accuracy on the three target inflections from the pre-test to post-test was compared, using repeated measures ANOVA. As can be seen in table 20

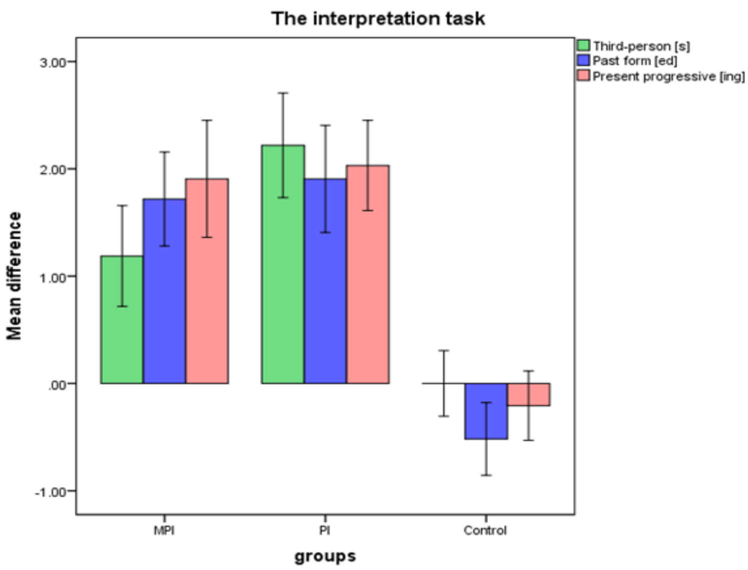
below, it shows no significant difference between participants' performance in the three target inflections within each group: the PI, the MPI and, the control group, suggesting that both treatments, the PI and MPI had affected all the inflections despite their different redundancy levels. However, in the control group, there was no improvement in performance at all for all the target inflections, which was expected as they did not receive any treatment.

The table also shows the SDs of mean scores for each target inflection in both groups. The SDs of both PI and MPI groups are considered large according to the coefficient of variation (CV) discussed earlier in (section, 5.2), indicating variation in the scores around the mean.

Table 20. *Repeated measures ANOVA for group mean scores: comparison by inflection type in the interpretation task*

Target inflections	*PI group M (SD)*		*MPI group M (SD)*		*Control group M (SD)*	
-s	2.21	2.75	1.18	2.65	.00	1.64
-ed	1.90	2.82	1.71	2.47	-.51	1.82
-ing	2.03	2.37	1.90	3.08	-.20	1.73

Figure 7. *Comparison between groups by inflection type in the interpretation task*



5.3.2 The statistical analysis between the groups in the Interpretation task

In this section, the analysis between the groups' performance from pre-test to post-test of each inflection is presented. Using MANOVA, there was a statistically significant difference between at least one of the three inflections based on the three groups, (*F* =5.049, *p* =.000), Wilk's Λ = 0.728. Hence, One-way ANOVA for independent groups was used to compare the three groups in terms of change in participants' performance.

Table 21 shows the Mean scores, SD and 95% of Confidence Interval (CI) for Mean for the change occurred in participants' performance in the three target inflections.

Table 21. *ANOVA for the three target inflections in the three groups in the interpretation task*

The groups	*N*	*Third-person -s* *M* *SD* (95%CI)	*Past form -ed* *M* *SD* (95%CI)	*Present progressive -ing* *M* *SD* (95%CI)
PI group	32	2.21 2.75 (1.36 3.07)	1.90 2.82 (1.05 2.75)	2.03 2.37 (1.16 2.90)
MPI group	32	1.18 2.65 (.33 2.04)	1.71 2.47 (.86 2.57)	1.90 3.08 (1.03 2.77)
Control group	29	.00 1.64 (-.89 .89)	-.51 1.82 (-1.41 .37)	-.20 1.73 (-1.12 .70)

As can be seen in the table, the 95% confidence interval (CI) of the mean difference was employed in the analysis to improve the assessment of the One-way ANOVA for independent groups test results. Hence, one can provide an estimate of the score mean for each inflection in each group. For example, in the PI group, we are 95% confident that the score mean of third-person singular answers is between 1.36 and 3.07.

The following subsections present a comparison of the treatments' effect on each target inflection.

5.3.2.1 The third-person singular -*s*

The ANOVA test confirmed that there was a significant difference between the three groups performance in the inflection -*s*, (*F* =7.891, *p*=.001). Using pairwise comparison, the difference was between the PI group and the control group *(p* =.001). However, in psychological research, the statistical significance specifies that some significant result might not be referring to an effect with a high impact. As discussed earlier in section (5.2), the statistical significance could depend on more than one factor, for example: the sample size, the power of the statistical procedures, and the quality of the data. Therefore, in order to describe the strength of a phenomenon; i.e. if the effect has a relevant magnitude, Cohen's effect size measure was used. With regard to the significant difference found above between the PI group and the control group for the inflection -*s*, the effect size for this analysis (d=0.9), was found to be a large effect.

5.3.2.2 The past form -*ed*

For the inflection -*ed*, the ANOVA test confirmed that there was a significant difference between the three groups performance, (F =9.237, p <.001). Using pairwise comparison, a difference was found between the PI and the control group, p <.001, and the effect size for this analysis (d=1.01), was found to be a large effect. Another difference was found between MPI and the control group, (p =.001). The effect size for this analysis (d=1.02) was also found to be a large effect.

5.3.2.3 The present progressive -*ing*

For the inflection -*ing*, the ANOVA test confirmed that there was a significant difference between the three groups (F =11.057, p <.001). Using pairwise comparison, there was a significant difference between MPI and the control group, (p=.005), and the effect size for this analysis (d=0.8), was found to be a large effect. Another significant difference was between the PI and the control group, p <.001, and the effect size for this analysis (d=1.07) was also a large effect.

5.3.3 The delayed post-test of the interpretation task

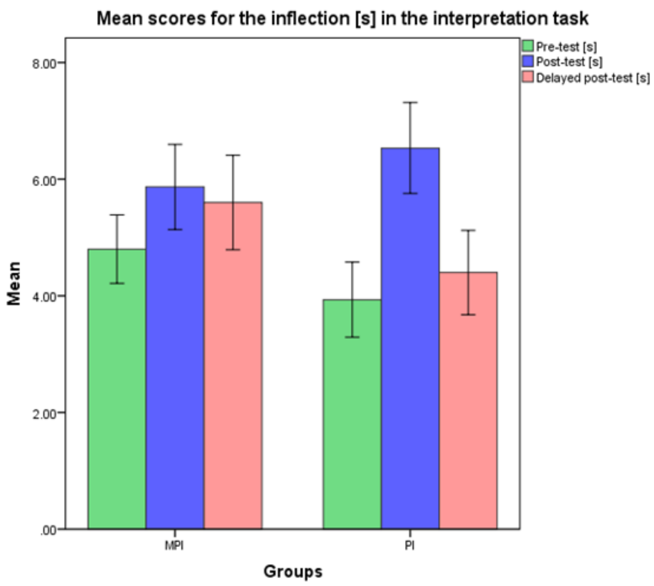
As mentioned earlier in section (5.2), this analysis aimed to reveal if PI and MPI treatments' effect, extended to participants' performance in the delayed-post tests that were conducted 12 weeks after the treatments' administration. The mean scores of each target inflections in the pre, post and delayed-post tests were analysed and compared using repeated measures ANOVA in order to measure participants' performance for each inflection in each time.

5.3.3.1 The third-person singular -s

Table 22. *Repeated measures ANOVA for the mean scores of the inflection -s in the PI and MPI groups in all tests*

The tests	*N*	*PI group* *M* (95%CI)	*SD*	*MPI group* *M* (95%CI)	*SD*
Pre-test	15	3.93 (2.55	2.49 5.31)	4.80 (3.54	2.27 6.05)
Post-test	15	6.53 (4.86	3.02 8.20)	5.86 (4.30	2.82 7.43)
Delayed-post test	15	4.40 (2.85	2.79 5.94)	5.60 (3.86	3.13 7.33)

Figure 8. *Comparison between groups in all tests for the inflection -s in the interpretation task*



In the PI group, the F-test showed that there was a significant difference between the three tests, $p < .05$, for the inflection *-s*. Pair-wise comparison revealed that the difference was between the pre-test and the post-test, $p < .05$, and the effect size for this analysis ($d = 0.9$), was considered to be a large effect. Another significant difference was between the post-test and the delayed post-test, $p < .05$, and the effect size for this analysis ($d = 0.7$), was also considered to be a large effect.

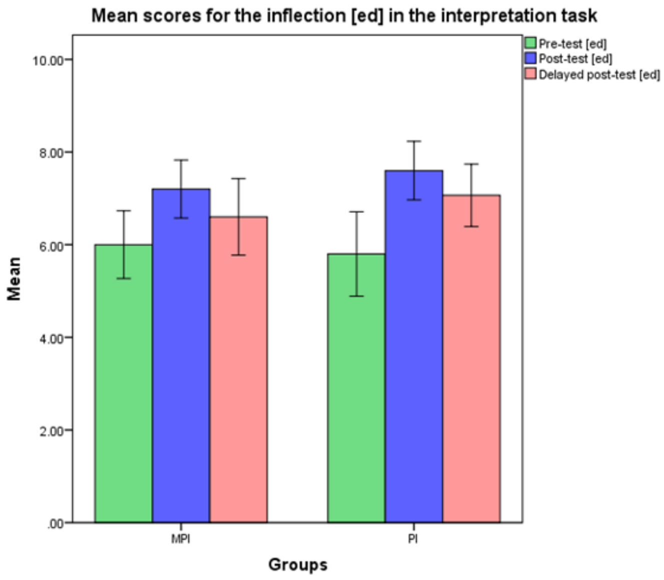
The significant difference found between the post-test and the delayed post-test with the inflection *-s* in the PI group mean scores, revealed a decline in participants' performance suggesting that PI effect did not last after 12 weeks of conducting the PI intervention. On the other hand, in the MPI group, there was no significant difference between participants' performance in the post-test and the delayed post-test, suggesting that MPI effect existed 12 weeks after conducting the intervention. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups are considered small, indicating a small variation in the scores around the mean.

5.3.3.2 The past form *-ed*

Table 23. *Repeated measures ANOVA for the mean scores of the inflection -ed in the PI and MPI groups in all tests*

The tests	*N*	*PI group*		*MPI group*	
		M	*SD*	*M*	*SD*
		(95%CI)		*(95%CI)*	
Pre-test	15	5.80	3.52	6.00	2.82
		(3.84	7.75)	(4.43	7.56)
Post-test	15	7.60	2.44	7.20	2.42
		(6.24	8.95)	(5.85	8.54)
Delayed-post test	15	7.06	2.60	6.60	3.20
		(5.62	8.50)	(4.82	8.37)

Figure 9. *Comparison between groups in all tests for the inflection -ed in the interpretation task*



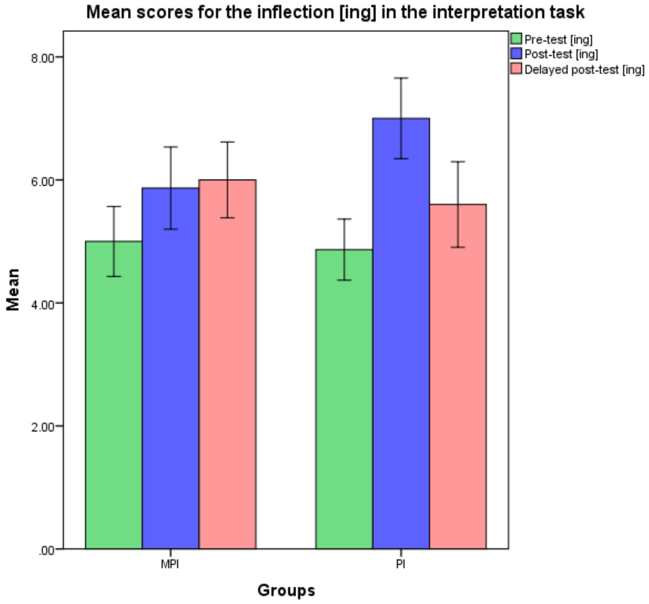
The F-test showed that there was no significant difference between the three tests in both PI and MPI groups suggesting no significant declines in participants' performance on -ed in the delayed post-tests and that intervention effects existed 12 weeks after conducting them. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups are considered small, indicating a small variation in the scores around the mean.

5.3.3.3 The present progressive *-ing*

Table 24. *Repeated measures ANOVA for the mean scores of the inflection -ing in the PI and MPI groups in all tests*

The tests	*N*	*PI group*		*MPI group*	
		M	*SD*	*M*	*SD*
		(95%CI)		*(95%CI)*	
Pre-test	15	4.86	1.92	5.00	2.20
		(3.80	5.93)	(3.77	6.22)
Post-test	15	7.00	2.53	5.86	2.58
		(5.59	8.40)	(4.43	7.29)
Delayed-post test	15	5.60	2.69	6.00	2.39
		(4.10	7.09)	(4.67	7.32)

Figure 10. *Comparison between groups in all tests for the inflection -ing in the interpretation task*



As for *-ed*, the *-ing* results also showed no decline from pre to delayed post-tests except for a marked decline from post to delayed post-test in the PI group suggesting that both intervention effects existed 12 weeks after conducting them. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups are considered small, indicating a small variation in the scores around the mean.

5.4 The elicited imitation task (EI)

As discussed at the beginning of this chapter, section (5.2), the EI task was intended to show any increase in participants' ability to produce accurate inflections in the online condition. As mentioned before, for the pre-test and post-test analysis, the difference between the two tests was taken for the six cases employed in the design of this task. As discussed in Chapter 4, (section, 4.6.3) and (section, 4.8) - two cases for each inflection were used- in order to measure the change occurred in participants' performance after the PI and MPI treatments.

The goal of including the incorrect (non-inflected) verbs was to reveal if the target forms were part of participants' linguistic knowledge, as they are expected to spontaneously correct them and reproduce them under the task processing demands. Hence, in each group, the number of correct and incorrect imitations of the target inflections from the pre-test to post-test was compared and analysed using repeated measures ANOVA.

The following subsections present the analysis within each group, in order to measure the effect of each treatment on the production of the target inflections. Then, the second analysis presented is a comparison between the groups in order to compare the effect of PI and MPI on the target inflections and assess which treatment was more affective in producing greater accuracy in morphological inflections under online conditions. Finally, the analysis of the delayed post-test is presented to check if the effect of the treatments extended to participants' performance 12 weeks after the treatments' administration.

5.4.1 The statistical analysis within each group in the elicited imitation task

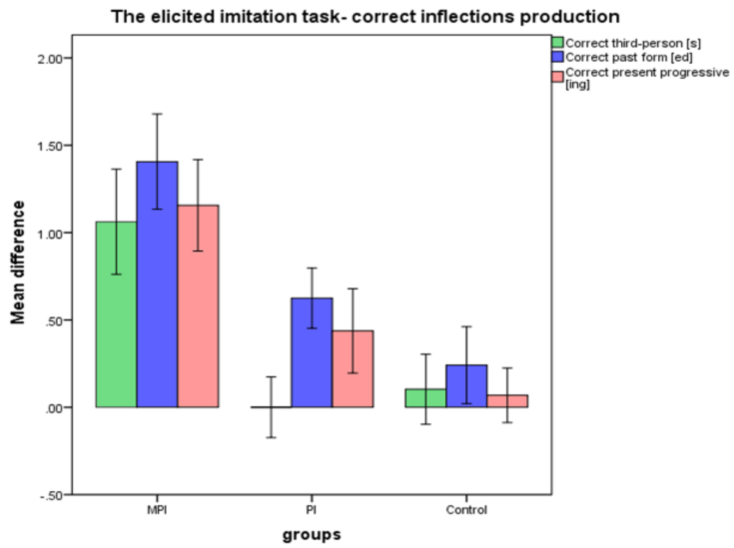
The following table presents the analysis of the correct inflection production in PI and MPI groups; i.e. the accurate imitations of the correct, inflected verbs. In the PI group, repeated measures ANOVA test confirmed that there was a significant difference between the production of the three correct inflections, (F =3.027, p =.56). Pairwise comparison showed a significant difference between the production of the correct *-s* and the correct *-ed*, (p = .013). Table 25 shows no significant difference between participants' performance in the production of the three target inflections within the MPI. However, as can be seen in Figure 11, the MPI treatment had the highest numbers of correct imitations, and there was no significant difference between the production of the three target inflections, suggesting that, the MPI treatment affected all the inflections despite their different redundancy levels. In the control group, there was no significant improvement in performance for all the target inflections, which was expected as they did not receive any treatment.

The table also shows the SDs of mean scores for each target inflection in both groups. The SDs of both PI and MPI groups are considered large according to the coefficient of variation (CV) discussed earlier in (section, 5.2), indicating variation in the scores around the mean.

Table 25. *Repeated measures ANOVA for mean scores comparison of the Correct inflections production in the PI and MPI groups in the elicited imitation task*

Target inflections	*PI group*		*MPI group*	
	M	*SD*	*M*	*SD*
Correct *-s*	.000	.983	1.06	1.70
Correct *-ed*	.625	.975	1.40	1.54
Correct *-ing*	.437	1.36	1.15	1.48

Figure 11. Comparison between groups by the correct production in the elicited imitation task



For the production of the non-inflected (incorrect) verbs which means that participants either imitated the incorrect (non-inflected) verbs without adding the missing inflections, provided the wrong inflection, or omitted it, in the PI group, the repeated measures ANOVA test confirmed that there was a significant difference between the inaccurate imitations of the three target inflections, (F =3.027, p=.56). Pairwise comparison showed a significant difference between the production of non-inflected verbs with the -*s* and -*ed*, (p = .013).

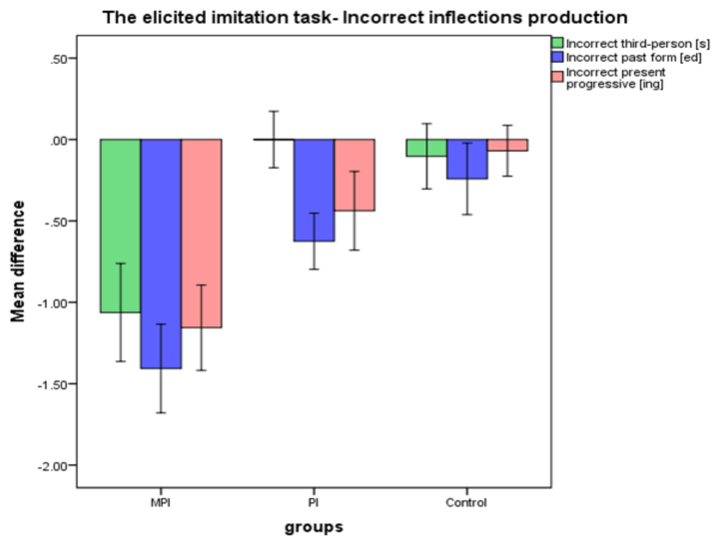
Similar to the production of the correct inflections, the MPI treatment had the strongest effect on all the inflections with no significant difference between their production, indicating that the MPI affected the three target inflections despite their different redundancy levels.

Table 26. *Repeated measures ANOVA for mean scores comparison of the incorrect inflections production in the PI and MPI groups in the elicited imitation task*

Target inflections	*PI group*		*MPI group*	
	M	*SD*	*M*	*SD*
Incorrect -*s*	.000	.983	-1.06	1.70
Incorrect -*ed*	-.625	.975	-1.40	1.54
Incorrect -*ing*	-.437	1.36	-1.15	1.48

Note that when the mean is in minus, it indicates that there was a lower number of incorrect imitations and a higher number of correct imitations. In other words, it means that participants produced a smaller number of incorrect imitations in the post-test compared to their production of incorrect imitations in the pre-test.

Figure 12. *Comparison between groups by the incorrect production in the elicited imitation task*



5.4.2 The statistical analysis between the groups in the elicited imitation task

In this section, the analysis between the groups' performance from pre-test to post-test of each inflection is presented. Using MANOVA, there was a statistically significant difference between the production of correct inflections based on the three groups, (F =5.299, p =.000); Wilk's Λ = 0.717. Hence, one-way ANOVA for independent groups was used to compare the three groups in terms of change in participants' performance. The following table shows the Mean scores, SD and 95% of Confidence Interval (CI) for Mean relating to the changed performance in the three correct target inflection.

Table 27. *ANOVA for the changes in production of correct target inflections in the three groups in the elicited imitation task*

The groups	*N*	*Third-person -s* *M SD* *(95%CI))*	*Past form -ed* *M SD* *(95%CI)*	*Present progressive -ing* *M SD* *(95%CI)*
PI group	32	.000 .983 (-.45 .45)	.625 .975 (.18 1.06)	.437 1.36 (-.01 .88)
MPI group	32	1.06 1.70 (.60 1.52)	1.40 1.54 (.96 1.84)	1.15 1.48 (.70 1.60)
Control group	29	.103 1.08 (-.37 .58)	.241 1.18 (-.22 .70)	.069 .842 (-.40 .53)

As can be seen in the table, the 95% confidence interval (CI) of the mean difference was employed in the analysis to improve the assessment of the One-way ANOVA for independent groups test results. Hence, one can provide an estimate of the score mean for each inflection in each group. For example, in the PI group, we are 95% confident that the score mean of the third-person singular correct production is between -.45 and .45.

5.4.2.1 The third-person singular -*s*

The ANOVA test confirmed that there was a significant difference between changes found across the three groups in the production of correct -*s*, (F =4.825, p =.012). Pairwise comparison showed that the difference was between the MPI and the PI group, (p =.011). The effect size for this analysis (d=0.7) was considered to be large. Another significant difference was between the MPI and the control group, (p =.03), and the effect size for this analysis (d=0.6) was also considered to be large.

5.4.2.2 The past form -*ed*

For the production of the correct -*ed*, the ANOVA test confirmed that there was a significant difference between the three groups (F =5.513, p =.006). Pairwise comparison, showed that the difference was between the MPI and the PI group, (p =.056), and the effect size for this analysis (d=0.6) was considered to be large. Another significant difference was between the MPI and the control group, (p =.005), and the effect size for this analysis (d=0,8) was found to be large as well.

5.4.2.3 The present progressive -*ing*

For the production of the correct -*ing*, the ANOVA test confirmed that there was a significant difference between the three groups, (F =6.313, p =.003). Pairwise comparison, showed that the difference was only between the MPI and the control group, (*p* =.002), and the effect size for this analysis (*d*=0.8) was found to be large.

For the comparison between changes in the production of <u>incorrect</u> inflections, using MANOVA, there was a statistically significant difference between the production of the three incorrect inflections based on the three groups, (*F* =5.299, *p* =.000); Wilk's Λ = 0.717.

The table blow shows the Mean scores, SD and 95% of Confidence Interval (CI) for Mean of the change in participants' performance in the production of the three incorrect target inflection.

Table 28. *ANOVA for the changes in the production of the <u>incorrect</u> target inflections in the three groups in the elicited imitation task*

The groups	*N*	*Third-person -s* *M SD* *(95%CI))*	*Past form -ed* *M SD* *(95%CI))*	*Present progressive -ing* *M SD* *(95%CI))*
PI group	32	.000 .983 (-.45 .45)	-.625 .975 (-1.06 -.18)	-.437 1.36 (-.885 .010)
MPI group	32	-1.06 1.70 (-1.52 -.60)	-1.40 1.54 (-1.84 -.96)	-1.15 1.48 (-1.60 -.709)
Control group	29	-.103 1.08 (-.58 .37)	-.241 1.18 (-.70 .22)	-.06 .84 (-.53 .40)

*Note that when the mean is in minus, it indicates that there was a lower number of incorrect imitations and higher number of correct imitations.

5.4.2.4 The incorrect third-person singular -*s*

The ANOVA test confirmed that there was a significant difference between the three groups in the production of the non-inflected verbs with -*s*; i.e. incorrect -*s*, (*F* =4.825, *p* =.012). Pairwise comparison showed that the difference was between the MPI and the PI group, (*p* =.011). The effect size for this analysis (*d*=0.7) was considered to be large. Another significant difference was between the MPI and the control group, (*p* =.031), and the effect size for this analysis (*d*=0.6) was considered to be large as well.

5.4.2.5 The incorrect past form *-ed*

For the production of the non-inflected verbs with *-ed*; i.e. incorrect *-ed*, the ANOVA test confirmed that there was a significant difference between the three groups, (F =5.513, p =.006). Pairwise comparison showed that the difference was between the MPI and the PI group, *(p* =.056). The effect size for this analysis (d=0.6) was considered to be large. Another significant difference was between the MPI and the control group, (p =.005), and the effect size for this analysis (d=0.8) was also considered to be large.

5.4.2.6 The incorrect present progressive *-ing*

For the production of the non-inflected verbs with *-ing*; i.e. incorrect *-ing*, the ANOVA test confirmed that there was a significant difference between the three groups, (F =6.313, p =.003). Pairwise comparison showed that the difference was only between the MPI and the control group, *(p*=.002). The effect size for this analysis (d=0.8) was considered to be a large effect size.

In the incorrect sentences of the inflection *-ing*, i.e. the non-inflected verbs, there were two types of incorrect inflection in the elicited imitation task: the missing *-ing* such as: Sara is go, and the missing auxiliary such as: Sara going. As discussed earlier in Chapter 2 (section, 2.2.1.2), the rationale behind including the missing auxiliary was to tease apart the two elements for forming the present progressive in English language. The progressive requires the verb *to be* in addition to the *-ing* inflection added to the verb. Therefore, the goal was to investigate the main cause of the processing problem of the inflection *-ing*.

Thus, four non-inflected verbs were employed, two verbs were missing *-ing* and two verbs were missing the auxiliary. Whenever the participants produced the correct, inflected verb they were assigned a point. Wilcoxon test was used to compare the correct production of *-ing* and [Aux] in each group.

Tables 29 and 30, show that the highest change in participants performance was in the production of *-ing* for both groups. However, there was no significant difference between the correct production of Aux and *-ing* in both groups.

Table 29. *Repeated measures ANOVA for the correct production of the non-inflected verbs with -ing in the PI and MPI groups*

The inflection	*PI group*		*MPI group*		*Control group*	
	M	*SD*	*M*	*SD*	*M*	*SD*
-ing	.0625	.24593	.3750	.70711	-.0345	.18570
Aux	.0000	.25400	.1875	.47093	.0345	.18570

Since there were only three categorical responses (0= no answer, 1= one right answer and 2=two right answers), the data was not normally distributed, and hence a Kruskal Wallis test was used in order to compare the groups with regard to the correct production of *-ing* and auxiliary.

Table 30. *The correct production of the -ing and auxiliary in the PI and MPI groups using the Kruskal Wallis test*

The production Of inflection	*PI group*		*MPI group*		*Control group*		*Chi-square*	*p-value*
	M	*SD*	*M*	*SD*	*M*	*SD*		
Correct production of *-ing*	.062	.24	.375	.70	-.034	.185	12.160	.002
Correct production of Aux	.00	.25	.187	.47	.034	.185	5.241	.073

The test showed that there was a significant difference between the MPI and PI groups in the production of the *-ing*, (p =.042). The effect size for this analysis (d=.00) suggests no effect. Another significant difference was between the MPI and the control group, (p =.002), and the effect size for this analysis (d=08) was considered to be large. For the correct production of the auxiliary, there was no significant difference between the MPI and PI groups' performance.

5.4.3 The delayed post-test of the elicited imitation task

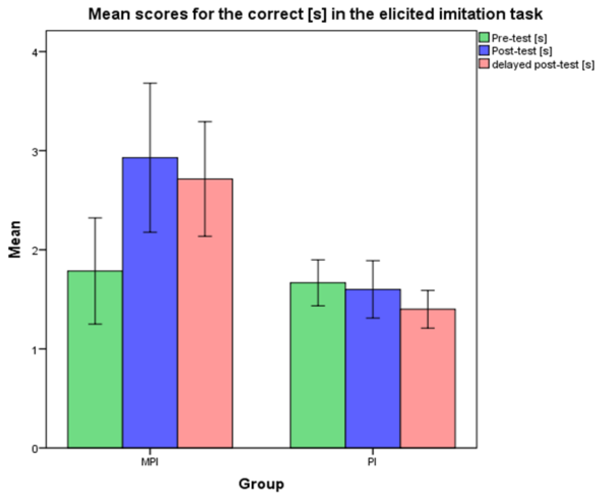
This analysis aimed to reveal which treatment had the greatest effect on participants performance in the delayed-post tests, in order to check if the change in participants' performance caused by either PI or MPI treatments existed after 12 weeks of the treatments' administration. The mean scores of the six cases of the target inflections in the pre, post and delayed-post tests were analysed and compared using repeated measures ANOVA in order to measure participants' performance for each inflection in each time.

5.4.3.1 The third-person singular *-s*

Table 31. *Repeated measures ANOVA for the mean scores of the production of correct -s in the PI and MPI groups in all tests*

The tests	*N*	*PI group*		*MPI group*	
		M (95%CI)	*SD*	*M* (95%CI)	*SD*
Pre-test	15	1.67 (1.1	.90 2.1)	1.79 (.63	2.00 2.9)
Post-test	15	1.60 (.97	1.1 2.2)	5.0 (1.3	7.3 4.5)
Delayed post-test	15	1.40 (.99	.73 1.8)	2.71 (1.4	2.1 3.9)

Figure 13. *Comparison between groups by the production of correct -s in the elicited imitation task for all tests*



The repeated measures ANOVA test confirmed that there was a significant difference between the three tests in the MPI group, (p = .033). However, the difference was between the pre and post-tests, (p = 016), as found earlier in the pre and post-tests analysis, and the effect size for this analysis (d=1.2) was considered to be large. Another significant difference was between the pre-test and delayed post-tests, (p = .004) and the effect size for this analysis (d=0.4) was considered to be a medium effect size.

For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups in the delayed post-test are considered small compared to their SDs in the post-test, indicating a small variation in the scores around the mean.

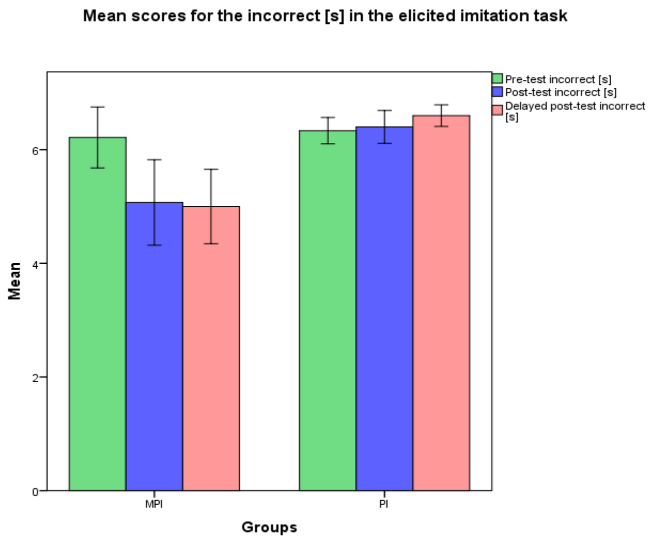
5.4.3.2 The incorrect Third-person singular -*s*

Table 32. *Repeated measures ANOVA for the mean scores of the production of incorrect -s in the PI and MPI groups in all tests*

The tests	*N*	*PI group*		*MPI group*	
		M	*SD*	*M*	*SD*
		(95%CI)		*(95%CI)*	
Pre-test	15	6.33	.90	6.21	2.0
		(5.84	6.83)	(5.06	7.37)
Post-test	15	6.40	1.12	5.07	2.8
		(5.77	7.02)	(3.44	6.69)
Delayed post-test	15	6.60	.73	5.00	2.4
		(6.19	7.01)	(3.59	6.41)

* Note that the higher the mean score is the more incorrect imitations were produced by the participants

Figure 14. *Comparison between groups by the production of incorrect -s in the elicited imitation task for all tests*



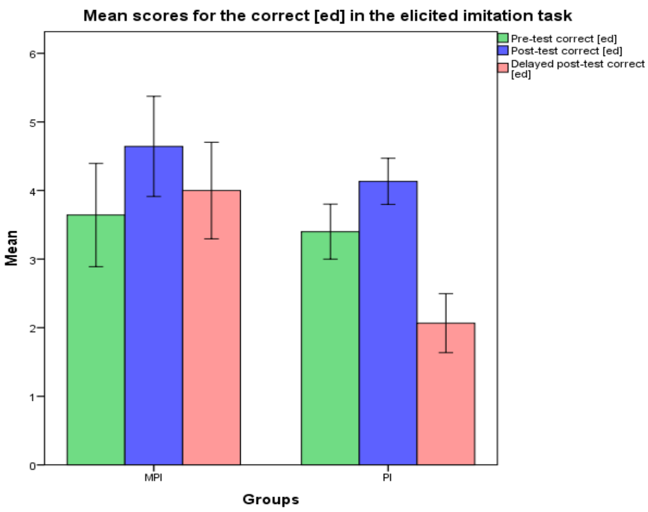
The repeated measures ANOVA test confirmed that there was a significant difference between the three tests in the MPI group, (p = .029). The difference was between the pre and post-tests, (p = .016), as found earlier in the pre and post-tests analysis and the effect size for this analysis (d= 0.4) was considered to be medium. Another significant difference was between the pre and delayed post-tests, (p = .018) and the effect size for this analysis (d=0.5), was considered to be a medium effect size. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups in the delayed post-test are considered small compared to their SDs in the post-test, indicating a small variation in the scores around the mean.

5.4.3.3 The past form *-ed*

Table 33. *Repeated measures ANOVA for the mean scores of the production of correct -ed in the PI and MPI groups in all tests*

The tests	*N*	*PI group* *M*	*SD*	*MPI group* *M*	*SD*
		(95%CI)		*(95%CI)*	
Pre-test	15	3.40	1.5	3.64	2.8
		(2.54	4.26)	(2.02	5.27)
Post-test	15	4.13	1.3	4.64	2.7
		(3.41	4.85)	(3.06	6.22)
Delayed post-test	15	2.07	1.6	4.00	2.6
		(1.14	2.99)	(2.48	5.52)

Figure 15. *Comparison between groups by the production of correct -ed in the elicited imitation task for all tests*



For the PI group, the repeated measures ANOVA test confirmed that there was a significant difference between the three tests, $p < .05$. The difference was between the pre-test and the post-test, ($p = .010$) as found earlier in the pre and post-tests analysis, and between the pre-test and the delayed post-test, ($p = .002$). More importantly, there was a difference between the post-test and the delayed post-test, $p < .05$. The later difference was a significant decline from post-test to delayed post-test, and the effect size for this analysis (*d*=2.05), was found to be a large effect size.

For the MPI group, the repeated measures ANOVA test confirmed that there was a significant difference between the three tests, (p = .059). However, the difference was between the pre and post-tests, (p = 016), as found earlier in the pre and post-tests analysis. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups in the delayed post-test are considered small compared to their SDs in the post-test, indicating a small variation in the scores around the mean.

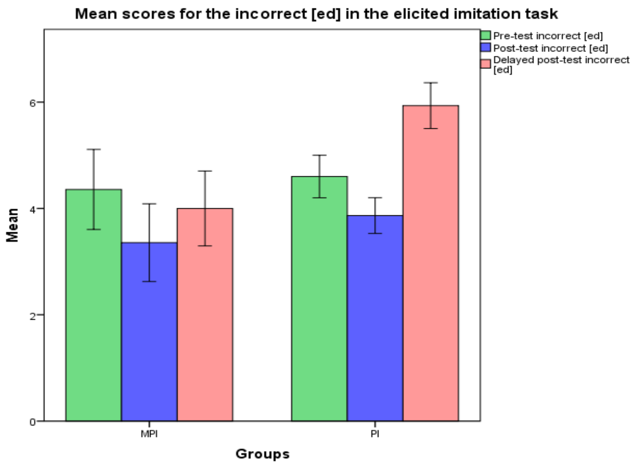
5.4.3.4 The incorrect past form *-ed*

Table 34. *Repeated measures ANOVA for the mean scores of the production of the incorrect -ed in the PI and MPI groups in all tests*

The tests	*N*	*PI group*		*MPI group*	
		M	*SD*	*M*	*SD*
		(95%CI)		*(95%CI)*	
Pre-test	15	4.60	1.54	4.36	2.8
		(3.74	5.46)	(2.73	5.98)
Post-test	15	3.86	1.30	3.35	2.7
		(3.14	4.58)	(1.77	4.93)
Delayed post-test	15	5.93	1.66	4.00	2.6
		(5.01	6.86)	(2.48	5.52)

* Note that the higher the mean score is the more incorrect imitations were produced by the participants

Figure 16. *Comparison between groups by the production of incorrect -ed in the elicited imitation task for all tests*



For the PI group, the repeated measures ANOVA test confirmed that there was a significant difference between the three tests, p <.05. The difference was between the pre-test and the post-test, (p =.010) and between the pre-test and the delayed post-test, (p =.002). More importantly, there was a difference between the post-test and the delayed post-test, p <.05. The later difference was a significant decline from post-test to delayed post-test, and the effect size for this analysis (d=0.8), was found to be a large effect size.

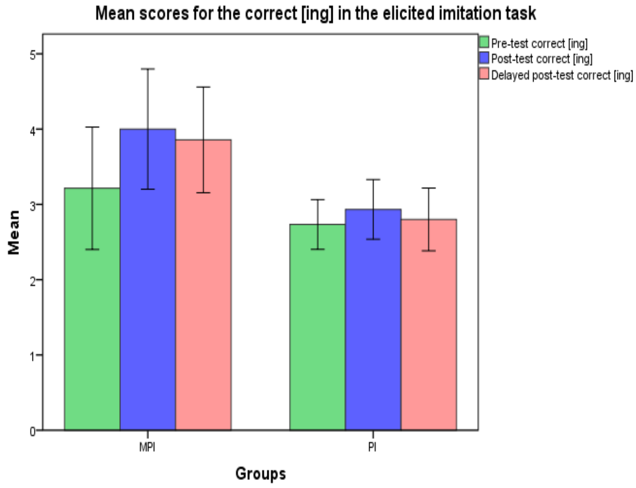
For the MPI group, the repeated measures ANOVA test confirmed that there was a significant difference between the three tests, (p = .059). The difference was only between the pre-test and post-tests, (p = 016), as found earlier in the pre and post-tests analysis. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups in the delayed post-test are considered small compared to their SDs in the post-test, indicating a small variation in the scores around the mean.

5.4.3.5 The present progressive -*ing*

Table 35. *Repeated measures ANOVA for the mean scores of the production of correct -ing in the PI and MPI groups in all tests*

The tests	*N*	*PI group*		*MPI group*	
		M	*SD*	*M*	*SD*
		(95%CI)		*(95%CI)*	
Pre-test	15	2.73	1.28	3.21	3.04
		(2.02	3.44)	(1.46	4.97)
Post-test	15	2.93	1.53	4.00	2.98
		(2.08	3.78)	(2.27	5.72)
Delayed post-test	15	2.80	1.61	3.86	2.62
		(1.91	3.69)	(2.34	5.37)

Figure 17. *Comparison between groups by the production of correct -ing in the elicited imitation task for all tests*



For both PI and MPI groups, the repeated measures ANOVA test confirmed that there was no significant difference between the production of correct *-ing* in the three tests. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups in the delayed post-test are considered small compared to their SDs in the post-test, indicating a small variation in the scores around the mean.

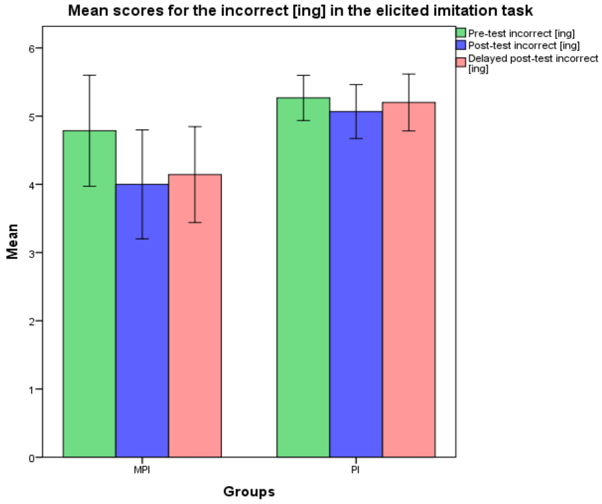
5.4.3.6 The incorrect present progressive *-ing*

Table 36. *Repeated measures ANOVA for the mean scores of the production of* <u>*incorrect*</u> *-ing in the PI and MPI groups in all tests*

The tests	*N*	*PI group*		*MPI group*	
		M	*SD*	*M*	*SD*
		(95%CI)		*(95%CI)*	
Pre-test	15	5.27	1.28	4.79	3.04
		(4.56	5.98)	(3.03	6.54)
Post-test	15	5.06	1.53	4.00	2.98
		(4.217	5.916)	(2.27	5.72)
Delayed post-test	15	5.20	1.61	4.14	2.62
		(4.31	6.09)	(2.63	5.66)

* Note that the higher the mean score is the more incorrect imitations were produced by the participants

Figure 18. *Comparison between groups by the production of incorrect -ing in the elicited imitation task for all tests*



For both PI and MPI groups, the repeated measures ANOVA test confirmed that there was no significant difference between the production of incorrect *-ing* in the three tests. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups in the delayed post-test are considered small compared to their SDs in the post-test, indicating a small variation in the scores around the mean.

5.5 The self-paced reading task

Similar to the previous two tests, the interpretation and the elicited imitation tasks, the difference between the pre-test and post-test was taken for the three target inflections *-s*, *-ed*, and *-ing* in order to measure the change occurred in participants' performance after the PI and MPI treatments. In this testing task, the participants were expected to spend longer reaction times (RTs) while reading the non-inflected verbs because they indicated ungrammaticality that needs further processing, and shorter RTs while reading the inflected, correct verbs because they did not indicate ungrammaticality.

The following subsections present the analysis within each group, in order to measure the effect of each treatment on the reading times (RTs) of the verbs inflected or non-inflected. Then, the second analysis presented is a comparison between the groups in order to measure the effect of PI and MPI on the RTs and assess which treatment was more affective in processing the target inflections during reading under online conditions. Finally, the analysis of the delayed post-test is presented to check if the effect of the treatments extended to participants' performance 12 weeks after the treatments' administration.

5.5.1 The statistical analysis within each group in the self-paced reading task

Table 5.18 below, shows the change occurred in the inflected and non-inflected verbs reaction times in both the PI and MPI groups after they received the treatments. The repeated measures ANOVA test confirmed that there was a significant difference between the two cases of each target inflection in the MPI group, (F =9,05). Pairwise comparison showed that the difference was between the correct and incorrect *-s*, p <.05, between the correct and incorrect *-ed*, p <.05 and between the correct and incorrect *-ing*, p <.05. There was no significant difference between any of the six cases of the target inflections in the PI group. Similarly, there was no significant difference between the six cases in the control group.

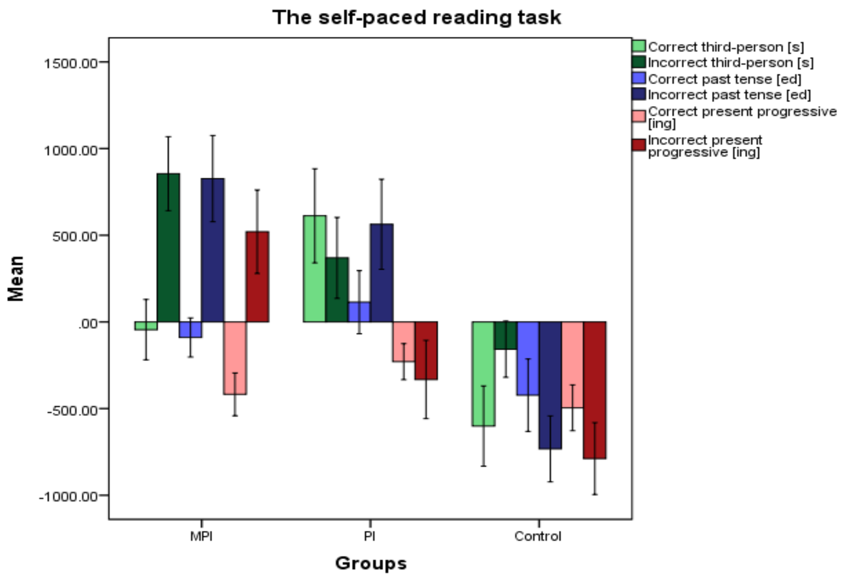
The table also shows the SDs of mean scores for each target inflection in both groups. The SDs of both PI and MPI groups are considered large according to the coefficient of variation (CV) discussed earlier in (section, 5.2), indicating variation in the scores around the mean.

Table 37. *Repeated measures ANOVA for groups mean scores comparison for the RTs of reading the six cases of the target inflections*

The inflections	*PI group*		*MPI group*		*Control group*	
	M	*SD*	*M*	*SD*	*M*	*SD*
-*s* correct	612.20	1462.25	-44.68	984.06	-600.92	1201.29
-*s* incorrect	369.51	1257.07	855.03	1205.74	-157.59	842.89
-*ed* correct	113.86	979.81	-89.62	636.52	-422.92	1085.27
-*ed* incorrect	563.48	1399.61	826.59	636.52	-732.51	989.70
-*ing* correct	-229.17	562.63	-417.87	697.17	-495.62	685.25
-*ing* incorrect	-332.00	1216.78	520.62	1362.34	-788.51	1078.06

Note that when the difference value is positive, it indicates that the participants spent longer time in reading the verbs for the three target inflections after they have received the treatment. When the differences value is minus, it indicates that the participants spent shorter time in reading the verbs after they have received the treatment.

Figure 19. *Comparison between groups mean scores for the RTs of reading the six cases of the target inflections in the SPR task*



5.5.2 Statistical analysis between the groups in the self-paced reading task

In this section, the analysis between the groups' performance from pre-test to post-test of each inflection is presented. The first section below presents the comparison between the groups for reading the correct, inflected verbs. The second section presents the comparison between the groups for reading the incorrect, non-inflected verbs. As discussed earlier in (section, 5.2), when comparing between two groups or more, MANOVA was used first to determine in case there are any differences between independent groups on more than one dependent variable.

5.5.2.1 The correct morphological inflections (inflected verbs) RTs

Using MANOVA, there was a statistically significant difference in reading the correct, inflected verbs based on the three groups, (F =3.93, p =.001); Wilk's Λ = 0.778. Hence, One-way ANOVA for independent groups was used to compare the three groups in terms of change in participants' performance.

The table shows the Mean scores, SD and 95% Confidence Interval (CI) for Mean for the change occurred in participants' performance in the three correct target inflection. As can be seen in the table, the 95% confidence interval (CI) of the mean difference was employed in the analysis to improve the assessment of the One-way ANOVA for independent groups test results. Hence, one can provide an estimate of the scores mean for each inflection in each group. For example, in the PI group, we are 95% confident that the mean score of the reaction time during reading the verbs inflected with third-person singular is between 207.7 and 1062.6.

Table 38. *ANOVA for the mean scores comparison of the RTs of reading the correct target inflections in the three groups*

The groups	*N*	*Third-person -s* *M*	*SD*	*Past form -ed* *M*	*SD*	*Present progressive -ing* *M*	*SD*
		(95%CI)		*(95%CI)*		*(95%CI)*	
PI group	32	612.20	1462.25	113.86	979.81	-229.17	562.63
		(207.7	1062.6)	(-20.8	1025.9)	(-228.1	380.5)
MPI group	32	-44.68	984.06	-89.62	636.52	-417.87	697.17
		(-472.1	382.7)	(-613.0	433.7)	(-722.2	-113.5)
Control group	29	-600.92	1201.29	-422.92	1085.27	-495.62	685.25
		(-1155.1	-257.2)	(-1275.1	-175.5)	(-879.7	-240.3)

First, for reading the correct, inflected verbs with the inflection -*s*, the ANOVA test confirmed that there was a significant difference between the three groups, (F=6.899, p =.002). Pairwise comparison showed that the difference was between the MPI group and the PI group, (p =.039). The effect size for this analysis (d=0.5) was considered to be medium. For the inflections -*ed* and -*ing*, there was no significant difference between the mean scores of their reading RTs in all the groups.

5.5.2.2 The incorrect morphological inflections (non-inflected) RTs

Using MANOVA, there was a statistically significant difference in the RTs of reading the incorrect, non-inflected verbs based on the three groups, (F =5.134, p =.000); Wilk's Λ= 0. 724. The table shows the Mean scores, SD and 95% Confidence Interval (CI) for Mean for the change occurred in participants' performance in the three incorrect target inflection.

Table 39. *ANOVA for the mean scores comparison of the RTs of reading the* <u>*incorrect*</u> *target inflections in the three groups*

The groups	*N*	*Third-person -s* *M* *SD* *(95%CI)*		*Past form -ed* *M* *SD* *(95%CI)*		*Present progressive -ing* *M* *SD* *(95%CI)*	
PI group	32	369.51 (-33.05	1257.07 813.3)	563.48 (499.1	1399.61 2053.8)	-332.00 (-693.7	1216.78 177.7)
MPI group	32	855.03 (431.8	1205.74 1278.2)	826.59 (49.2	1404.87 1603.9)	520.62 (84.8	1362.34 956.4)
Control group	29	-157.59 (-721.3	842.89 167.8)	-732.51 (-1592.3	989.70 40.8)	-788.51 (-1257.8	1078.06 -342.2)

For reading the non-inflected verbs with *-s*; i.e. the incorrect *-s*, the ANOVA test confirmed that there was a significant difference between the three groups, (F =5.925, p =.004). Pairwise comparison showed that the difference was between the MPI group and the control group, p <.05. The effect size for this analysis (d=0.9) was considered to be a large effect size.

For reading the non-inflected verbs with *-ed*; i.e. the incorrect *-ed*, the ANOVA test confirmed that there was a significant difference between the three groups (F=11.876, p <.001). Pairwise comparison showed that the difference was between the MPI group and the control group, p <.05. The effect size for this analysis (d=1.2) was considered to be large. Another significant difference was between the PI group and the control group, p <.05, and the effect size for this analysis (d=1.06) was also considered to be large.

For reading the non-inflected verbs with *-ing*; i.e. the incorrect *-ing*, the ANOVA test confirmed that there was a significant difference between the three groups, (F =8.666, p <.001). Pairwise comparison showed that the difference was between the MPI group and the PI group, p <.05. The effect size for this analysis (d=0.6) was considered to be large. Another significant difference was between the MPI group and the control group, p <.05, and the effect size for this analysis (d=1.06) was considered to be a large effect size.

As discussed in Chapter 4, (section, 4.6.1), there were some secondary analyses performed beside the main analyses in order to investigate the effect of different levels of redundancy on the past form inflection *-ed* and the effect of missing auxiliary vs missing inflection. And as discussed in the same section, these secondary analyses were only suitable to be performed within the SPR task design. So, with regards to the redundancy level of the inflection *-ed*, there were three correct sentences with the redundant *-ed* inflection and three correct sentences with the non-redundant *-ed* inflections. Redundancy was manipulated by either adding an adverb at the beginning of the sentence, so the *-ed* inflection is redundant, or non-redundant by removing the adverb of the sentence.

The table below, shows the changes of RTs that occurred in reading the redundant and non-redundant *-ed* in the PI and MPI groups. Using MANOVA, there was a statistically significant difference in reading the correct inflected verbs based on the three groups, (F =2.650, p =.035); Wilk's $\Lambda = 0.89$. The paired samples test confirmed that the significant difference was between the MPI and control groups in the redundant *-ed* case, p <.05, and there was no significant difference between the RTs of both cases of *-ed* in PI and MPI groups.

Table 40. *Paired samples test for Redundant/ nonredundant -ed in the three groups in the SPR task*

The inflection	*PI group*		*MPI group*		*Control group*	
	M	*SD*	*M*	*SD*		
Redundant *-ed*	109.06	890.82	141.12	547.77	-226.06	367.67
Nonredundant *-ed*	367.09	1282.53	-40.50	513.43	-583.55	1892.12

With regards to the *-ing* inflection, there were three incorrect sentences formed with a missing auxiliary and three incorrect sentences with a missing inflection *-ing*. The following table showed the change of the RTs that occurred in reading both cases. Using MANOVA, there was a statistically significant difference between the RTs of reading the incorrect verbs based on the three groups, (F =5.360, p=.000); Wilk's Λ = 0.797. The paired samples test confirmed that there was a significant difference between the RTs of the missing Auxiliary and the missing -*ing* in the MPI group, p=.022.

Table 41. *Paired samples test for missing -ing/missing auxiliary in PI and MPI groups in the SPR task*

The inflection	*PI group*		*MPI group*	
	M	*SD*	*M*	*SD*
Missing -*ing*	11.12	903.55	491.31	940.28
Missing Aux	-234.68	790.38	226.50	695.60

5.5.3 The delayed post-test of the self-paced reading task

Similar to the previous testing tasks, the pre, post and delayed post-tests were analysed and compared using Repeated measures ANOVA in order to measure participants' performance for each inflection in each time. As mentioned above in (section, 5.5.1), in this task, the participants were supposed to spend longer RTs reading the non-inflected verbs because they indicate ungrammaticality that needs further processing. Therefore, a comparison between the groups mean scores of their RTs for each inflection is presented below along with the pairwise comparison if there was any significant difference.

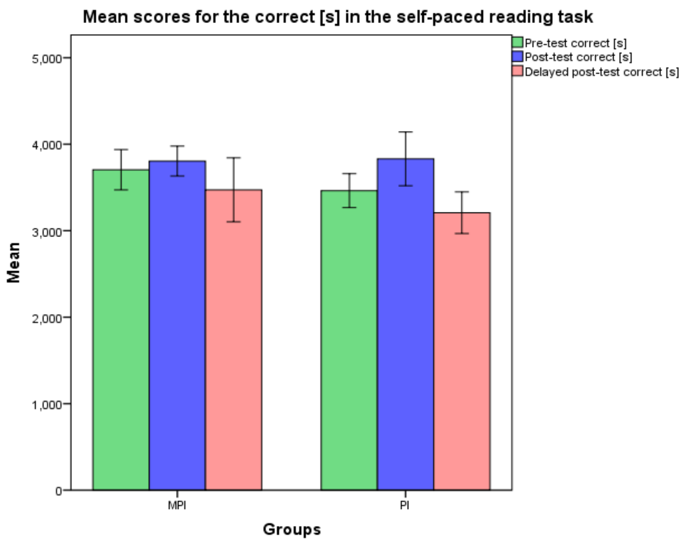
5.5.3.1 The correct Third-person singular -*s*

The table shows the Mean scores, SD and 95% Confidence Interval (CI) for the correct, inflected verbs with -*s* in the pre, post and delayed-post tests for both the MPI and PI groups.

Table 42. *Repeated measures ANOVA for groups RTs of the three tests for the correct, inflected verbs with -s*

The tests	*PI group*		*MPI group*	
	M	*SD*	*M*	*SD*
	(95%CI)		*(95%CI)*	
Pre-test	3463	759	3704	901
	(3042.4	3884.1)	(3205.2	4204.2)
Post-test	3831	1203	3805	673
	(3164.5	4497.6)	(3432.3	4177.9)
Delayed post-test	3208	933	3472	1433
	(2691.3	3724.7)	(2678.2	4266.3)

Figure 20. *Comparison between groups mean scores for the RTs of reading the correct, inflected verbs with -s in all tests*



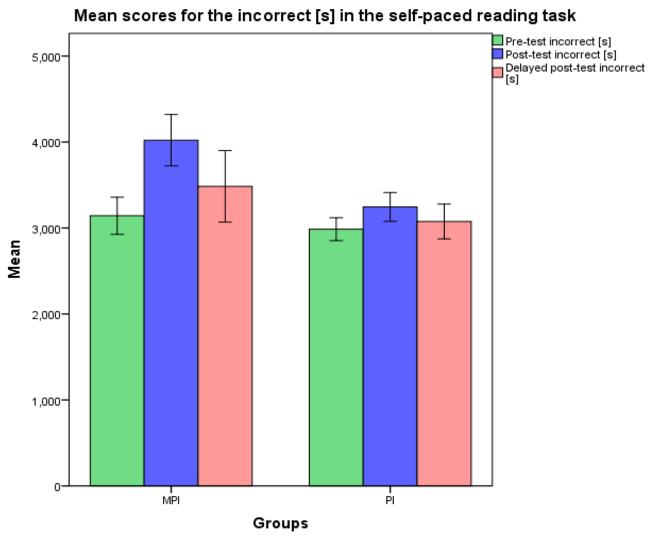
The repeated measures ANOVA revealed that there was no significant difference between the three tests in the RTs of reading the correct, inflected verbs with -s in the PI and MPI groups. For the standard deviation (SD), as can be seen in the table above, the SDs of both mean scores of the PI and MPI groups in the delayed post-test are considered small, despite that they were higher than the post-test, indicating a small variation in the scores around the mean.

5.5.3.2 The incorrect Third-person singular -*s*

Table 43. *Repeated measures ANOVA for groups RTs of the three tests for the incorrect, non-inflected verbs with -s*

The tests	*PI group* *M*	*SD*	*MPI group* *M*	*SD*
	(95%CI)		*(95%CI)*	
Pre-test	2986	516	3142	834
	(2700.4	3272.7)	(2680.3	3604.2)
Post-test	3244	649	4020	1158
	(2885.1	3604.7)	(3379.3	4662.2)
Delayed post-test	3075	783	3484	1612
	(2642.1	3509.4)	(2591.2	4377.4)

Figure 21. *Comparison between groups mean scores for the RTs of reading the incorrect, non-inflected verbs with -s*



The repeated measures ANOVA confirmed that there was a significant difference between the three tests, (p = .039), in the MPI group. The difference was between the pre and post-test, (p = .008) as found earlier in the first pre, post-test analysis. However, as can be seen in the table above, there was a decline in both PI and MPI groups' performance with reading the non-inflected verbs with -*s*, between the post-test and the delayed post-test but this decline was non-significant. For the standard deviation (SD), as can be seen in the table above, the SDs of both

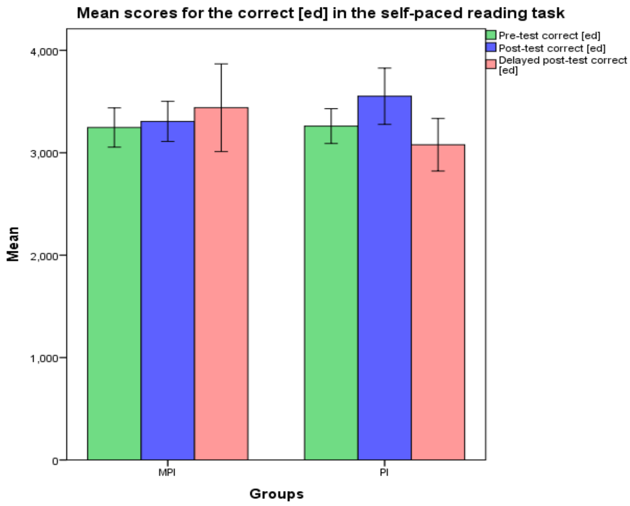
mean scores of the PI and MPI groups in the delayed post-test are considered small, despite that they were higher than the post-test, indicating a small variation in the scores around the mean.

5.5.3.3 The correct past form *-ed*

Table 44. *Repeated measures ANOVA for groups RTs in the three tests for the correct, inflected verbs with -ed*

The tests	*PI group*		*MPI group*	
	M	*SD*	*M*	*SD*
	(95%CI)		*(95%CI)*	
Pre-test	3260	658	3246	741
	(2896.1	3625.0)	(2836.3	3657.2)
Post-test	3552	1065	3306	760
	(2962.3	4142.0)	(2885.5	3727.2)
Delayed post-test	3078	994	3440	1657
	(2527.9	3629.2)	(2522.1	4358.2)

Figure 22. *Comparison between groups mean scores for the RTs of reading the correct, inflected verbs with -ed in all tests*



The repeated measures ANOVA showed that there was no significant difference between the three tests in the RTs of reading the correct, inflected verbs with *-ed* in both the PI and MPI groups. For the standard deviation (SD), as can be seen in the table above, the SDs of both

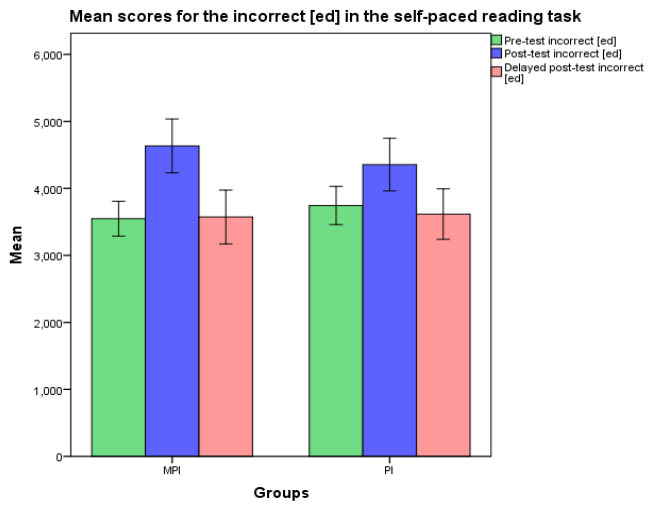
mean scores of the PI and MPI groups in the delayed post-test are considered small, despite that they were higher than the post-test, indicating a small variation in the scores around the mean.

5.5.3.4 The incorrect past form *-ed*

Table 45. *Repeated measures ANOVA for groups RTs in the three tests for the incorrect, non-inflected verbs with -ed*

The tests	*PI group*		*MPI group*	
	M	*SD*	*M*	*SD*
	(95%CI)		*(95%CI)*	
Pre-test	3744	1106	3547	1006
	(3131.6	4356.7)	(2990.3	4104.7)
Post-test	4354	1521	4632	1559
	(3512.3	5197.2)	(3769.1	5496.6)
Delayed post-test	3616	1459	3573	1556
	(2808.2	4424.7)	(2711.6	4435.1)

Figure 23. *Comparison between groups mean scores for the RTs of reading the incorrect, non-inflected verbs with -ed in all tests*



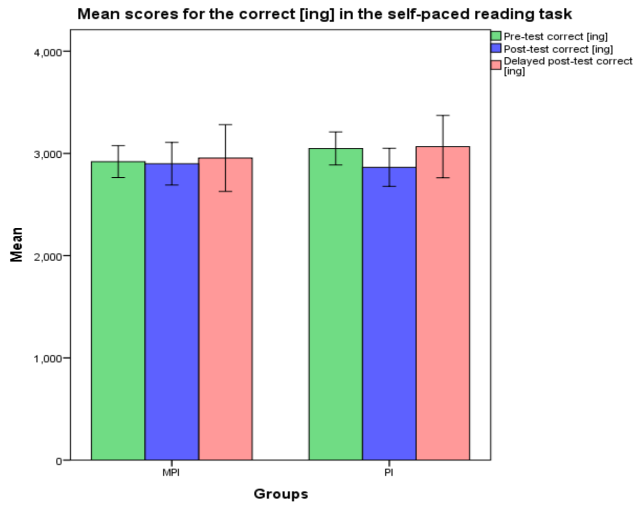
The repeated measures ANOVA confirmed that there was a significant difference between the three tests, (p = .003), in the MPI group. The difference was between the pre-test and the post-tests, (p = .004) and between the post-test and delayed post-tests, (p =.004). The later difference indicates a significant decline from post-test to delayed post-test, but the effect size for this analysis (d=0.2), was considered to be a small effect size. For the standard deviation (SD), as can be seen in the table above, the SD of both mean scores of the PI and MPI groups in the delayed post-test are considered small, indicating a small variation in the scores around the mean.

5.5.3.5 The correct present progressive -*ing*

Table 46. Repeated measures ANOVA for groups RTs of the three tests for the correct, inflected verbs with -*ing*

The tests	*PI group*		*MPI group*	
	M	*SD*	*M*	*SD*
	(95%CI)		*(95%CI)*	
Pre-test	3048	625	2919	605
	(2702.0	3395.3)	(2584.6	3255.1)
Post-test	2864	721	2899	806
	(2464.5	3263.7)	(2452.5	3346.3)
Delayed post-test	3066	1179	2955	1263
	(2413.0	3719.9)	(2255.5	3654.5)

Figure 24. *Comparison between groups mean scores for the RTs of reading the correct, inflected verbs with -ing in all tests*



The repeated measures ANOVA showed that there was no significant difference between the three tests in the RTs of reading the correct, inflected verbs with -*ing* in both the PI and MPI groups. For the standard deviation (SD), as can be seen in the table above, the SDs of both

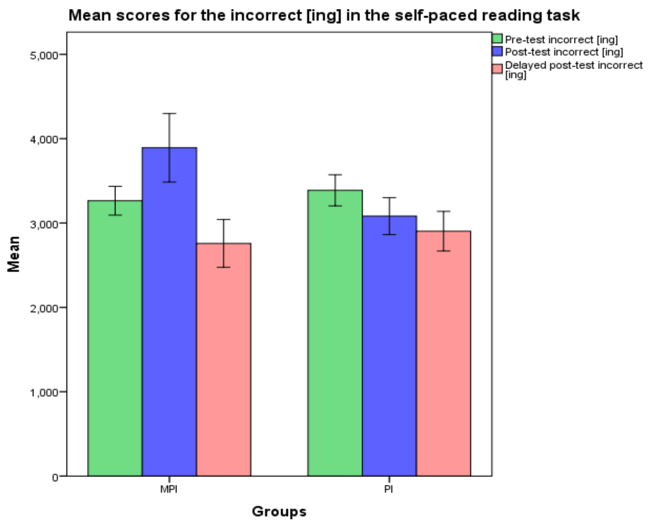
mean scores of the PI and MPI groups in the delayed post-test are considered small, despite that they were higher than the post-test, indicating a small variation in the scores around the mean.

5.5.3.6 The incorrect present progressive *-ing*

Table 47. *Repeated measures ANOVA for groups RTs of the three tests for the incorrect, non-inflected verbs with -ing*

The tests	*PI group* *M*	*SD*	*MPI group* *M*	*SD*
	(95%CI)		*(95%CI)*	
Pre-test	3387	715	3264	661
	(2991.7	3783.9)	(2897.6	3630.3)
Post-test	3081	845	3892	1575
	(2613.6	3550.2)	(3020.0	4764.7)
Delayed post-test	2903	910	2758	1097
	(2459.7	3201.9)	(2399.1	3407.9)

Figure 25. *Comparison between groups mean scores for the RTs of reading the incorrect, non-inflected verbs with -ing in all tests*



The repeated measures ANOVA confirmed that there was a significant difference between the three tests, (p = .002), in the MPI group. The difference was between the pre-test and the delayed post-tests, (p = .049), and between the post-test and delayed post-tests, (p =.002). The later difference was a significant decline from post-test to delayed post-test, but the effect size for this analysis (*d*=0.1), was considered to be a small effect size. For the standard deviation (SD), as can be seen in the table above, the SD of both mean scores of the PI and MPI groups in the delayed post-test are considered small, indicating a small variation in the scores around the mean.

Given the complexity of the research questions, a summary of key findings and a recap of all the statistical tests on the language data and their implications for the research questions is presented at the end of the chapter. Before this, however, the next section presents the statistical analysis of the working memory task and its relationship with the online testing tasks in this study.

5.6 Working memory statistical analysis

The next section of this chapter presents the statistical analysis of the WM listening span task (LST) and its relationship with the two online testing tasks: the elicited imitation task (EI) and the self-paced reading task (SPR). As discussed in Chapter 2, (section, 2.5.1), after receiving the PI and MPI interventions, the study design predicted that higher WMC would positively correlate with learners' processing of redundant target forms in the online EI and SPR tasks. Since PI is expected to be an appropriate cognitive approach to manage the ease of processing, hence, WMC's involvement in accurate production and processing in the online tasks would be expected in the post and delayed post-tests.

As discussed in Chapter 4 (section, 4.6.4), the LST task contained 24 sentences that were 9-12 words. The participants scores were calculated according to partial-credit unit scoring, so the correct recall of each word would be awarded 1 and the incorrect recall would be awarded 0. Thus, each participant's score ranged between 0 and 24. Simple correlation was used to measure the strength of the relationship between independent and dependent variables. The correlation range falls between -1 and +1 and it is considered positive when the value is close to +1. The relationship signifies no correlation if the value is close to zero. According to Cohen (1988), a correlation coefficient of .10 is assumed to represent a small association, a correlation coefficient of .30 is thought to represent a medium correlation, and a correlation coefficient of .50 or larger, is considered a strong or large correlation.

5.6.1 The pre-test and post-test analysis

The following subsections present the results of the LST, next the pre, post-tests analyses for the correlations between WM scores with scores on the SPR and EI testing task. Then, the analyses of correlations with the delayed post-tests for the same tasks are presented.

5.6.1.1 WMC results

The following table shows the descriptive analysis of the WM task results; i.e. the listening span task for the PI and MPI groups.

Table 48. *Descriptive statistics for the listing-span task*

	N	*Min*	*Max*	*mean*	*SD*
PI group	15	0	22	13.33	6.264
MPI group	15	0	20	12.13	5.97

As can be seen in the table, the two mean scores of both PI and MPI groups are close to each other with SD values that are also not too far from each other. The standard deviation (SD) is a measure used to reveal the spread of scores within a set of data and in this test, we have a sample from which we like to determine the population SD. Hence, the above two SDs of both mean scores, are consider small, according to the coefficient of variation (CV) discussed earlier in (section, 5.2), indicating that the scores are close to the mean.

Following the descriptive analysis of both groups' scores in the WM task, the next sections present the correlations between WM scores and the EI and SPR tasks.

5.6.1.2 The elicited imitation task (EI)

As the table below showed, in the PI group, there was a nonsignificant, small/medium correlation between the LST and the production of the six cases of the three target inflections tested in the EI task.

Table 49. *Correlation between the LST and the elicited imitation task in the PI group*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	-.148	.148	-.342	.342	-.247	.247
p-value	.600	.600	.213	.213.	.374	.374

On the other hand, in the MPI group, there was a significant robust correlation between the LST and the production of the correct third-person -*s* (r=0.722, p-value=0.003). Moreover, there was a significant negative correlation with the incorrect third-person -*s* (r=-0.721, p-value=0.003. However, the negative value for the correlation found in the incorrect -*s*, indicates that the participants produced a lower number of incorrect imitations in the post-test compared to their performance in the pre-test for the same case of the target inflection.

Table 50. *Correlation between the LST and the elicited imitation task in the MPI group*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	.712**	-.712**	.205	-.205	.022	-.022
p-value	.003	.003	.463	.463	.937	.937

*Note. *p-value<.05, **p-value<.01*

*Note that when the mean is in minus, it indicates that there was a lower number of incorrect imitations and higher number of correct imitations.

5.6.1.3 The self-paced reading task (SPR)

For the self-paced reading task, in the PI group, there was a significant robust correlation (*r*=-0.650, p-value=0.009) between the LST and the RTs in one case: the incorrect -*s*. However, in this correlation, as seen in the table below, the value was minus which indicates that the participants spent shorter RTs reading the non-inflected verbs after receiving the PI intervention. This implies a negative relationship between the WMC and the effect of PI on group's performance in the self-paced reading task. On the other hand, there was a non-significant correlation between the LST and the RTs for the six cases of the three target inflections tested in this task in the MPI group.

Table 51. *Correlation between the LST and the self-paced reading task in the PI group*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	-.193	-.650**	-.045	.321	-.180	.098
p-value	.491	.009	.874	.244	.522	.727

Note. **p=value<.05, **p-value<.01*

Table 52. *Correlation between the LST and the self-paced reading task in the MPI group*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	.034	.180	.104	.309	.316	.417
p-value	.903	.522	.712	.262	.251	.122

In this task, it is important to note that the goal was to have longer RTs while reading the incorrect inflections (the non-inflected) verbs.

5.6.2 The delayed post-test analysis

5.6.2.1 The elicited imitation task (EI)

As the table below showed, there was a non-significant, low/medium correlation between the LST and the production of the six cases of the three target inflections tested in the task in the PI group.

Table 53. *Correlation between the LST and the elicited imitation task in the PI group in the delayed post-test*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	.279	-.279	.142	-.142	.285	-.285
p-value	.314	.314	.613	.613	.304	.304

As the table below showed, in the elicited imitation task, there was a significant robust correlation between the LST and the production of the six cases of the three target inflections tested in the MPI group.

Table 54. *Correlation between the LST and the elicited imitation task in the MPI group in the delayed post-test*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	.616*	-.616*	.676**	-.676**	.835**	-.835**
p-value	.015	.015	.006	.006	.000	.000

*Note. *p-value<.01, **p-value<.001*

5.6.2.2 The self-paced reading task (SPR)

For the self-paced reading task, there was a nonsignificant, low/medium correlation between the LST task and the RTs for the six cases of the three target inflections tested in this task in both groups.

Table 55. *Correlation between the LST and the self-paced reading task in the PI group in the delayed post-test*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	-.158	-.186	-.060	.001	-.115	-.241
p-value	.574	.507	.833	.998	.683	.388

Table 56. *Correlation between the LST and the self-paced reading task in the MPI group in the delayed post-test*

Analysis	*Correct -s*	*Incorrect-s*	*Correct-ed*	*Incorrect-ed*	*Correct-ing*	*Incorrect-ing*
Correlation	.341	.271	.104	.169	.325	.311
p-value	.213	.328	.713	.547	.238	.260

Summary of results

The analyses related to the PI and MPI treatments effect can be summarised as follows:

1- The interpretation task

- The PI group improved their performance significantly from pre-test to delayed post-test in the target inflections except for the third-person *-s*, which has significantly decreased in the delayed post-test.
- The MPI group improved their performance significantly from pre-test to post-test in two of the target inflections: *-ed* and *-ing* with a marginal improvement in the inflection *-s* but maintained these improvements in the delayed post-test for all the target inflections.
- The large SD of the scores mean in the pre, post- tests analysis decreased in the delayed post-test, suggesting that both the PI and MPI treatments eliminated the variation found between participants scores.

2- The elicited imitation task

- The PI group made no significant gains on production of the three target inflections from pre-test to delayed post-test. Their performance decreased further in the delayed post-test for the inflection *-ed*.
- The PI treatment had no effect on the production of the three target inflections despite their differing redundancy levels.
- The MPI group made significant gains on production of all the three target inflections from pre-test to delayed post-test.
- The MPI treatment has significantly affected the production of the target inflections despite their differing redundancy levels.

- The large SD of the scores mean in the pre, post- tests analysis decreased as seen in the delayed post-test analysis suggesting that the MPI treatment eliminated the variation found between participants scores.

3- The self-paced reading task

- For the PI group, the reaction times for the non-inflected (incorrect) verbs were not significantly different from the reaction times for the inflected (correct) verbs for all the target inflections from pre-test to delayed post-test.
- The PI group showed no effect on the processing of the three target inflections despite their redundancy levels, and the non-redundant -*ing* was the most difficult inflection to process.
- For the MPI group, the reaction times for the non-inflected (incorrect) verbs were significantly different from the reaction times for the inflected (correct) verbs for all the target inflections from pre-test to post-test. In the delayed post-test, the MPI group performance decreased and the reaction times for the non-inflected (incorrect) verbs were not significantly different from the reaction times for the inflected (correct) verbs for all the target inflections.
- In the post-test, the MPI treatment has significantly affected the processing of all the target inflections despite their differing redundancy levels.
- The large SD of the mean scores in the pre, post- tests analysis decreased as seen in the delayed post-test analysis suggesting that the MPI treatment eliminated the variation found between participants scores.

4-The working memory task

- For the elicited imitation task, there was a positive correlation between the MPI group performance in the elicited imitation task and their performance in LST in both post and delayed post-tests. For the PI group, there was no correlation between the LST and the production of the six cases of the three target inflections tested in the task either on the post-test or the delayed post-test.
- For the self-paced reading task, there was no correlation between the MPI and PI groups performance in the LST and their performance in the SPR task in both post and delayed post-tests.

CHAPTER 6.

DISCUSSION

6.1 Introduction

This chapter evaluates the results from the main study of this research (Chapter five) in light of the literature reviewed in Chapter two and the predictions presented in Chapter three in relation to the three main questions presented in Chapter two and repeated here:

RQ1-Does PI intervention targeting the verbal inflections -*ing*, -*ed* and -*s* lead to English second language learners improved performance?

RQ2-Does a modified PI intervention (MPI) targeting the verbal inflections -*ing*, -*ed* and -*s* lead to English second language learners improved performance?

RQ3- Is there a relationship between working memory and learners' processing of the target verbal inflections -*ing*, -*ed* and -*s* after PI and MPI interventions, based on learners' performance in an online self-paced reading task and elicited imitation task?

To recap the overall rationale for this study, one main goal of this research was to investigate a new version of PI intervention and its potential for pedagogic value. The modified PI intervention (MPI) was designed in order to overcome the methodological flaws in the original PI intervention employed in previous PI research. As discussed earlier, in Chapter two, PI was found to have a fundamental methodological issue as it does not really test L2 learners' knowledge in online settings. In addition, PI was supposed to be the pedagogical version of IP model to help teachers make the second language learning better and more efficient. However, as far as I could identify, no pedagogical value was documented by previous PI studies.

Ellis (2003, 2009) and Doughty (2004) argue that PI design, including its activities, is testing discrete-item type of learning which does not differ from traditional instructions, and cannot lead to any measurable gains in learners' ability to use the target structures in communicative tasks. Furthermore, in Marsden and Chen (2011) study, discussed in chapter two (section, 2.5.3.3), they found that PI intervention including both its types - the referential and affective activities- prompted explicit knowledge, analysed through running multiple statistical analyses based on participants' learning gains in GJT and Gap-fill tasks, that could not be used successfully in spontaneous production tasks. Hence, PI does not, yet, seem to not reveal the sought-after automatic knowledge or intake that would be regarded as evidence for a change in the developing system and eventually lead to language acquisition.

Therefore, the main goal of this research was to propose a pedagogical intervention that would be able to help L2 learners to boost "intake". The assumption here is that the filtered input - which was presented and practised through the intervention - would establish the automatized knowledge that could be retrieved and used in online communicative tasks, and would be later integrated into the developing system through meaningful and adequate opportunities for practice.

Thus, I designed the novel MPI intervention by adapting focused communicative tasks into the PI instructional package in order to create the opportunity for participants to process the input they received; i.e. to establish the correct form-meaning connection during comprehension, and use it in meaningful communication. In addition, this new treatment should overcome the traditional instruction resemblance found in standard PI packages, and allow the opportunity for testing the type of knowledge prompted by this modified intervention. Such techniques, would help L2 teachers to make the learning of the target structures more efficient and successful and thus yield the pedagogical value sought by any mean of teaching.

The next section summarises the main findings of the study followed by subsections that present more detailed discussions of specific aspects found in each task for both interventions.

6.2 Summary and discussion of main findings

The main goal of this thesis was to test the validity of the original PI and the novel MPI interventions in reducing the morphological variability found in the production of intermediate L2 learners, particularly the verbal inflections *-s*, *-ed* and *-ing*. More specifically, I wanted to shed light on how the developing system can work in online and offline conditions by employing two versions of PI intervention to test various morphological endings based on a principle of hierarchy of redundancy, and to see if individual variation in working memory capacity may also play a role.

To this end, I conducted the main study through testing both interventions by employing three testing tasks and one working memory task. Ninety-three non advanced, Saudi female students of English language were placed into three groups, and received the testing tasks pre and after the intervention, an offline interpretation task, an online production task (EI) and an online processing task (SPR). In addition, one independent WM task, the listening span task was administered with the delayed post-test to check for any relationship between the WMC and participants' performance in the three tests.

First, the control group did not receive any treatment and was assumed it would not show any sign of acquisition. Indeed, they did not improve in any of the skills tested in the study, either in the offline or online processing and production.

Second, the PI group received the PI intervention that was assumed to help in processing the target structures in terms of the offline tasks but not the online tasks. PI proponents always claimed that PI would positively affect the developing system based on gains at the offline level (VanPatten, 2002, Benati, 2005). In fact, PI activities in this study helped with the offline processing of the target structures, see Chapter 5 (section, 5.3). The PI group showed reduced variability in the offline interpretation task in the post-test with all the target inflections, *p* <.001, with less clear results in the delayed post-test. Moreover, there was no association between participants WMC and their performance in the three testing tasks. However, in terms of accurate usage in online processing and production, PI was not able to either help the learners to produce accurate imitations in the EI task, or enable them to detect the ungrammatical structures in the SPR task.

The findings of the PI group did not reveal any evidence of acquisition as there were no significant improvements in participants' online performance, especially in relation to IP's hierarchy of redundancy. PI might be contributing to the learning of the target structures over time but in this study, the effect of PI did not extend to the online post-test and delayed post-test, suggesting that reduced variability is explained as a practice effect that was limited to the offline interpretation task.

Linking these findings to SLA approaches that explain morphological inflection acquisition difficulty discussed in Chapter 2, the PI group results confirm that non-advanced L2 learners can have issues with L2 intake processing, that was derived after the PI intervention. This is because of lack of control of their L2 knowledge that they have internalised via practice, hence, leading to a performance deficiency, not a competence one, see Chapter 2 (section, 2.2.2). Consequently, the PI group could not use their L2 knowledge in online processing and production, which was therefore restricted for using in offline conditions (Hopp, 2013; White, 2003).

Thus, in terms of acquisition, as discussed in Chapter 2, which equates to the automatic processing of the target forms that could be retrieved and used in online settings, PI seems to be unable to add anything else more than stable secure offline processing where learners show less variability and more accuracy in offline settings as they can rely on their explicit knowledge. On the other hand, when it comes to online settings, it appears that with the added time pressure variable, the PI group was only able to perform controlled processing and that declarative, explicit knowledge is the only knowledge they could have accessed during the online task (Godfroid et al., 2015). Hence, PI seems to be unable to develop the automatized knowledge that would be regarded as evidence of change in the developing system, whether this knowledge is gained through explicit or implicit methods of instruction. As discussed in Chapter 2, (section, 2.3.1), the issue related to the effectiveness of instruction and automaticity development; i.e., the issue of explicit vs. implicit knowledge and instruction is open for debate. However, it seems that, at least as tested in this study, the PI group participants did not develop implicit knowledge, hence, the strong interface position, which claims that explicit instruction and focused practice would lead to acquisition, is not supported here. In other words, PI instructional package was not able to integrate the target forms into the developing system, and consequently could not help L2 learners acquire the target forms.

Third, the MPI group received the modified PI intervention that was assumed to help in processing the target structures in terms of offline and online settings because of the addition of the communicative element in the intervention design. In fact, MPI group results showed significant improvements across most tasks indicating that the MPI had better effect across all inflections in the post-tests and the delayed post-tests, see Chapter 5, (sections. 5.3, 5.4, 5.5).

The MPI group's mostly significant results across all tasks suggest that participants had acquired the automatized knowledge that could be successfully retrieved and used under online conditions, as participants were able to produce accurate verbal inflections and provide the correct missing inflections -*s*, -*ed* and -*ing* in the online production task (p =.011, p =.056 and p=.002, respectively). Moreover, participants spent longer RTs in processing the non-inflected verbs in the SPR task compared to the inflected, correct verbs, p <.05, assuming that, in line with Sagarra and Herschensohn, (2010), ungrammaticality needs longer time for processing.

For the WM, there were positive correlations found between the LST and participants' performance in the EI task with the production of the three target inflections. This implies that the MPI treatment caused a positive change in the developing system which in turn affected what participants can access in online processing and production, though the role of WMC across all processing tasks remains a little unclear.

Therefore, it seems that, at least as tested in this study, the MPI group participants are developing implicit knowledge. So, the weak-interface position, which claims that both explicit and implicit types of instruction are required in second language learning, as explicit knowledge supports the implicit process of learning, is supported here. As explained in the MPI instructional package, the use of explicit instruction and processing strategies together with the implicit practice modes; i.e., focused tasks, encouraged the development of automatic knowledge. This is evident in participants' ability to retrieve and produce accurate and automatic responses during real-time performance after they received the MPI instructional package that includes explicit instruction and balanced formula of explicit and implicit activities to target the acquisition of the target morphological inflections.

Linking these findings to SLA approaches to morphological inflection acquisition difficulty, the findings of the MPI group confirm that the L2 learners' variable and inaccurate processing and production in this study, is mostly related to performance, not to representational deficiency (Cf. Jiang, 2004; VanPatten et al., 2012), as the MPI group participants were able to control the knowledge they had internalised after receiving the MPI and use it automatically and accurately in online settings. Therefore, MPI seems to be able to automatize, to some extent, participants' explicit, declarative knowledge proven by their ability to access and use this knowledge under time pressure (Godfroid et al., 2015).

Thus, it seems that adding communicative tasks to the PI package was the key to trigger change in participants' developing systems as it transferred whatever knowledge they had before the intervention from being explicit and slowly retrieved, as seen in the pre-tests, to an automatized and less variable knowledge after the MPI intervention, that could be employed in online tasks. This was confirmed by the large effect sizes found between the accurate online production and processing of the MPI group and the other two groups and the decrease found in the standard deviation (SD) of the scores mean for all the target inflections across the three testing tasks in the delayed pot-test, compared to the SD of the scores mean in the pre, post-tests, suggesting that the MPI treatment reduced the variability and increased the robustness in participants' performance. In addition, this modified package maintained the automatized knowledge after the end of the intervention, enabling participants to successfully retrieve it and use it in production after 12 weeks of administration, as seen in the delayed post-tests.

This change in the type of knowledge upgraded participants' processing from being slow and variable to being more accurate and automatic which I assume can be regarded as evidence of acquisition. Therefore, it seems conceivable to argue that MPI intervention would be leading to faster and more stable acquisition than standard PI intervention.

Nevertheless, more interesting details along the way for both interventions are discussed in the following sub-sections. Each sub-section discusses the results of one task for both PI and MPI groups.

6.2.1 The interpretation task

Before discussing the results of this task, it is worth reminding the reader that this task was of offline nature, so participants had time to monitor their responses and check their judgments, despite some overall time constraint, see Chapter 4 (section, 4.6.2) for more details. In this task, the participants received 40 sentences without any temporal adverbs and included 10 sentences for each target inflection, in addition to 10 distractors. The participants had to pay attention to the verbal inflections in order to provide the correct answer about the tense of the action.

6.2.1.1 The PI group

In the post-test, the prediction related to PI intervention, presented in Chapter 3 (section, 3.5), was supported. It was predicted that learners in the PI group would improve in offline processing on interpretation tasks from pre to post-test. This improvement would be demonstrated in more accurate (target-like) judgements of the target verbal inflections. The PI group made significant gains compared to the control group in the post-test for the three target inflections, p <.001, with a large effect size (d=1.07), though less clear results for the delayed post-test. This improvement was demonstrated by having more accurate (target-like) judgements of the target verbal inflections.

These findings confirm PI's main claim, discussed earlier in Chapter 2 (section, 2.5.2), that establishing the appropriate connection would enable L2 learners to derive the intake that would be transferred later, after further processing, to mental representation. However, it is important to note, that these findings were only at the level of offline, controlled settings, hence, one cannot confirm if intake was successfully derived based only on the findings of this task.

For the delayed post-test results, the predictions related to PI, presented in Chapter 3 (section, 3.5), was also supported, at least partially, in that the PI effect extended to participants' performance in the inflections -*ed* and -*ing* as there was no significant decline in the group's performance after 12 weeks of conducting the intervention. This finding is compatible with the findings of previous PI studies which investigated the same verbal inflection -*ed* (e.g., Benati, 2005; Benati and Lee, 2008). However, the PI group performance significantly decreased in the delayed post-test with the inflection -*s*, p <.05, with a large size effect (d=0.7). As previously found in the preliminary study in Chapter 3, (section, 3.7), the third-person singular -*s*, was, for these groups, the most difficult inflection for processing and production across all tasks. This is compatible with what was discussed in Chapter 2, that the third-person singular -*s*, is the most redundant and problematic morphological inflection in L2 English verbal morphosyntax, which is taken to be the cause of acquisition difficulties, consequently, it would be expected to be slowly processed until very high stages of proficiency/acquisition.

In general, these results are similar to previous PI studies e.g., Benati, (2005), Benati and Lee (2008) and Marsden and Chen (2011), which report significant improvement from pre to post-tests for groups that received PI. The third-person singular -*s*, and present progressive -*ing*, as far as I know, were not examined previously by PI research, nevertheless, Benati and Lee (2008), investigated the secondary effect of PI on -*s*, through using offline testing tasks and found that the PI group outperformed the traditional instruction group in the testing tasks. However, it is important to point out that Benati and Lee did not have a delayed post-test, thus, it is difficult to decide if the PI gains were due to the intervention effect or due to practice effect.

As discussed in Chapter 2 with regards to the IP model proposing a hierarchy of redundancy of the three target morphological inflections, the amount of explicit instruction and practice given through PI was also able to improve participants' performance for the semi or non-redundant past form -*ed* and present progressive -*ing*, on the level of offline processing in the post-test and the delayed post-test. This finding is compatible with the strong-interface position, discussed in Chapter 2, and DeKeyser's (2003, 2007) claim about the ability to automatize explicit knowledge through explicit instruction and practice. Thus, the PI package of "explicit" instruction and SI activities was able to improve participants offline processing of these two inflections under offline conditions.

However, for the redundant inflection *-s*, one possible explanation might be related to the difference found in the delayed post-test results between participants' performance in *-s* and, their performance in *-ed* and *-ing*, which is about the level of strength of the inflections' representations in participants' developing systems. As discussed in Chapter 2, functional morphology is assumed to be a bottleneck in second language acquisition due the fact that other properties, e.g. syntax, semantics, come free in UG. Hence, L2 learners needs to figure out the differences between their native language and the second language functional morphology. Slabakova (2007) argues that a small morpheme like *-s*, conveys a lot of information related to the subject of the sentences, e.g., singular, and it also signals the verb tense and aspect type in the sentence e.g., habitual, present. Thus, this complicated relationship might affect the strength of the form-meaning connection and contribute to the difficulty of morphology acquisition. This explanation is also in line with Han and Finneran's (2014) recommendation, discussed in Chapter 2, related to the amenability of different aspect of grammar to instruction, and that some forms might be susceptible to strong interface; i.e., could be learned through explicit instruction, while other forms are susceptible to weak or no interface; i.e., must be learned through implicit ways.

It seems that PI, in this study, was not able to affect the processing of *-s* in the same way it did with *-ed* and *-ing*. Recall that *-ing* is non redundant and supposed to be easy to process, and the same applies for *-ed* which is semi-redundant and is expected to be "sometimes" problematic (R. Ellis, 2002; DeKeyser, 2005; VanPatten, 2007). It is also important to note that in the design of the interpretation task used in this study, all adverbs were stripped from the testing sentences, so both *-ed* and *-ing* inflections were, here, always nonredundant. However, in the case of the inflection *-s*, removing the element that causes redundancy could not happen as verbs inflected with the third-person *-s* have to have the third person (he, she, it) in the sentence in order to be meaningful, e.g., plausible: <u>he</u> runs one hour <u>every day</u> - implausible:__runs one hour <u>every</u>

day. Therefore, it is conceivable to assume that the higher the redundancy is, the weaker the form-meaning connection will be, and thus the high redundant forms would have less susceptibility to explicit instruction and more resistance to formal practice.

Therefore, in English language, it seems that, at least as tested here, explicit/formal instruction had a limited effect based on the nature of the target structures, related to the redundancy hierarchy of English morphological inflections. This issue might be seen in other languages; however, it could be represented differently according to the specific nature of each language.

Therefore, comparing the three inflections which differ in their redundancy levels, using the offline interpretation task seems biased against finding a long-term effect of PI on the inflection -*s*. Benati (2005), Benati and Lee (2009) and Marsden and Chen (2011), tested PI with (one) linguistic feature, the past form -*ed*, and did not include other forms that have different redundancy levels in order to draw comparisons and test the efficacy of the PI intervention with various morphological forms. Thus, their findings which support the efficacy of PI in altering learners' processing strategies might be due to other factors related to the type of knowledge induced by the treatment, the type of tasks used for testing, i.e., offline/familiarity, practice effects, and the non-availability of a delayed post-test.

6.2.1.2 The MPI group

For the MPI group, it was predicted that learners would improve in offline processing on interpretation tasks from pre to post-test. This improvement would be demonstrated in more accurate (target-like) judgements of the target verbal inflections. This prediction was supported by the significant gains that were made compared to the control group in the post-test for the -*ed* and -*ing* inflections, p =.001 and a large effect size (d=1.02) implying a strong positive effect for MPI. There was marginal improvement for the inflection -*s*, though this was not significant compared to the control group with a medium effect size for the inflection -*s*.

Interestingly, in the delayed post-test, the MPI effect has extended to participants' performance in the three target inflections -*s*, -*ed* and -*ing*. Unlike the PI, the MPI effect extended to participants' performance in the inflection -*s* in the delayed post-test, as there was no difference between the group performance in the post-test and their delayed post-test for the three target inflections, suggesting that the earlier improvement caused by the treatment was still affecting participants' performance in the delayed post-test. Furthermore, there was an additional improvement in the inflection -*ing*.

Although the MPI intervention was used for the first time in this study, the MPI group results are compatible with previous PI studies (Benati, 2005; Benati and Lee, 2008; Marsden and Chen, 2011), which report significant improvement from pre to post-tests in offline tasks for groups that received PI. These findings, in line with current explanations of explicit/implicit interface positions in SLA discussed in Chapter 2, suggest that MPI was able to affect the processing of -*ed* and -*ing* in the interpretation task post-test, and all the inflections including -*s* in the delayed post-test. Thus, unlike the PI, the MPI package of "explicit" instruction, and affective "tasks" was able to improve participants' offline processing of redundant and non-redundant inflections and maintain this improvement for 12 weeks after conducting the intervention.

Similar to the findings of the PI group, the findings of the MPI group confirm PI's main claim discussed in Chapter 2 (section, 2.5.2), that PI instructional package can help with establishing the appropriate form-meaning connection that would enable L2 learners from deriving the intake that would be used in the automatic processing of the target structures under study. Nevertheless, in this task, it is an offline processing under offline conditions.

The marginal improvement in the inflection *-s* in the post-test, might be due to the same reason discussed earlier with the PI group, recall that the third-person singular *-s*, is the most redundant and problematic morphological inflection and consequently would be taking longer to be processed. Although PI does not discuss the duration needed for acquiring intake, and does not specify the stages that L2 learners go through in order to get it, it is my assumption that in the post-test, the participants might have been beginning to derive intake, which still needs further processing through frequent practice and encounters with the inflection in order to develop robust representations that could be integrated later into the developing system.

To recap this section, it was found that PI was able to assist target inflections in the offline post-test and delayed post-test with the exception of the most redundant inflection *-s* in the delayed post-test. This implies that the PI effect, observed in the post-test performance, might be related to practice and task familiarity factors. This does not restrict the validity of PI, but it indicates that PI lacks some elements in its design that lead to a faster and more accurate use of the target structures, and could pay attention to the special nature of some target forms, such as the redundancy level of morphological inflections.

On the other hand, it was found that the MPI was able to assist the offline processing of both *-ed* and *-ing* in the post-test but this effect extended to all the three inflections in the delayed post-test. This implies that the MPI package which includes communicative tasks, was the most valid version compared to PI, to reduce variability in participants' offline processing of redundant and non-redundant inflections proved by their ability to provide more accurate judgments in the post-test and maintain that improvement for all the inflections 12 weeks after conducting the intervention.

The next section discusses the results of the second, online, production task, the elicited imitation task (EI), for PI and MPI groups.

6.2.2 The elicited imitation task

Before discussing the results of the EI task, it is worth reminding the reader that this task was of online nature, where participants listened to sentences that contained inflected and non-inflected verbs and had to repeat what they heard as closely as possible in correct English language. The participants were supposed to correctly imitate the inflected verbs and provide the missing inflections for the non-inflected verbs.

The rationale behind this was to elicit the production of target forms under real-time conditions, a finding that was not documented by previous PI studies. Previous PI studies have always confirmed that PI has the ability to affect the developing system through greater accuracy in processing, including producing the target forms offline, however, PI research could not show any significant gains for PI in online tasks. In this study, to my knowledge, it is the first time to use an online "production" task for testing participants' performance after receiving the PI treatment. This was done in order to allow the comparison between participants' production in online settings and previous studies finding' that relied on offline production assessment methods.

Another goal of including this task lies in the fact that having an online production task could reveal evidence for the automatized knowledge which is considered, in some theoretical positions as discussed in Chapter 2, equivalent to acquired knowledge (DeKeyser, 2007, 2010) and an essential characteristic of L2 competence (Segalowitz, 2003; Jiang, 2004). Hence, under online conditions, producing target structures accurately and automatically, suggests that participants successfully developed that automatized knowledge which could be retrieved and used in online communication.

6.2.2.1 The PI group

In the post-test, the prediction related to PI performance in the production task, discussed in Chapter 3, was not supported. It was predicted that learners in the PI group would improve in online production on elicited imitation tasks from pre to post-test. This would be demonstrated in improvement and more accurate production of the target verbal inflections in the EI task. However, the PI group made no improvements compared to the control group in the post-test for the production of the six cases- correct and incorrect- of the three target inflections: *-s*, *-ed* and *-ing*.

In the delayed post-test, the prediction related to PI was also not supported in that the PI effect did not extend to participants' performance in the production of any of the target inflections, see Chapter 5, (section, 5.3.2). Interestingly, participants' performance significantly decreased compared to their performance in the post-test in the cases of the inflected and non-inflected verbs with *-ed*, p <.05, with a large effect size (d=0.8). This decline in the PI group performance suggests that the PI intervention did not cause any long-term change in whatever knowledge related to the target structures the participants had.

As discussed in Chapter 2, the content of learners' mental representations should dictate what is produced by them (VanPatten, 2010) and this should take place without awareness, (Herschensohn, 1999); i.e., automatically under online settings. However, this was not seen in the PI group participants' variable/non-accurate production for all the three target inflections in the post-test and the delayed post-test. In other words, the PI intervention could not automatize participants' explicit knowledge, that was evident by their variable/non-accurate production in the post-test, to an automatized knowledge that could be retrieved and used automatically and accurately in online production. In addition, the further delayed post-test decrease observed in the production of the two cases of the inflection *-ed*, suggests that the improved performance of the PI group observed in the earlier offline interpretation task was due to factors other than strong representations and automatized knowledge in the developing system such as task familiarity, temporal adverbs removal, and task's offline nature.

With regards to the assumptions about redundancy levels, related to the communicative value of IP model discussed in Chapter 2 (section, 2.5), the PI intervention in this study did not have any clear effect on the production of all three inflections despite their differing redundancy levels. Based on IP hierarchy of redundancy, it was suggested that participants would show less variability in producing the -*ing* because it is nonredundant and thus it would have stronger representation, i.e., from-meaning connection, that would enable it to be easily retrieved and produced in online production. On the other hand, participants would show more variability in producing the semi-redundant -*ed* and the most redundant -*s* because they have weaker representations that might prevent the automatic retrieval and accurate production in online settings. However, this was not the case with the PI group in the EI task. In fact, participants produced a higher number of inflected verbs with -*ed* compared to their production of verbs inflected with -*ing*, although the morphological inflection -*ed* is considered to be more redundant.

Another analysis was conducted for participants' corrected production of the inflection -*ing*, which compared between the correct supply of -*ing* and auxiliary. Recall that in the experimental sentences of EI, two types of non-inflected verbs were included for the inflection -*ing*: missing -*ing* and missing Aux. The analysis revealed that PI group participants could not provide the missing elements of any of the two cases, suggesting that the main issue with -*ing* might be not limited to providing the missing inflection, but could be due to other syntactic and processing issues especially, as discussed in Chapter 2 (section 2.2.1.2), in the progressive case, the progressive *be* is assumed to hold the uninterpretable categorial feature Prog, which projects and values the [*u*Infl] feature for little *v*. Thus, the little v would be pronounced as

-*ing* (Adger, 2003). This additional step in the progressive case, I would assume, could add to the processing load of the target inflection -*ing*.

Hence, I argue, according to the findings of this small-scale study, that L2 learners' issue with processing and producing morphological inflections might not be solely related to redundancy. As seen in the PI group performance in the production task, the EI, participants produced more accurate imitations of the inflection -*ed* than the inflection -*ing* although the latter is non-redundant. The progressive -*ing* inflection, is considered to be an easy to learn and process according to previous discussion presented in Chapter 2 (section, 2.5) and (section, 2.2.1.1), about the redundancy levels of morphological inflections and their effect on processing (VanPatten, 1996, 2007) and the learnability issues related to the nature of functional morphology (Slabakova, 2006, 2013). However, this was not seen in the PI group production of the verbs inflected with -*ing*. As discussed above, analysing participants performance in supplying the missing inflection -*ing* and the missing auxiliary showed that their issue could be related to the additional processing load caused by the progressive *be* (auxiliary) that needs to be added before any inflected verb in the progressive case. Such additional step means an extra processing load on the attentional resources paid to initiate the form-meaning connection, process it, and then integrate it to the developing system after sufficient meaningful practice.

In sum, the previous task, the EI, was used mainly for the first time to my knowledge, to assess participants' online production performance after they received the treatment. PI previous studies relied on offline production tasks to assess participants' production. For example, Benati (2005) employed an offline task that asked participants to fill in the blank and provided learners with the target words in parentheses so they just had to add the target morphological inflection to the verb. He reported significant gains for the PI group over the other two groups in the offline interpretation and production tasks and claimed that PI had a clear impact on learners' developing system. Another recent study by Atchley (2015) also used similar written production task, but asked participants to choose from word bank, add the target structure then fill in the blank and also reported significant gains for the PI group compared to the control group. On the other hand, Marsden and Chen's (2011) study findings, discussed in Chapter 2, which investigated PI effect on learning the past tense inflection *-ed*, concluded that the key component of PI, the referential activities, induced explicit knowledge. They based their conclusion on their participants' weak performance in an oral production task and the strong positive correlation between offline tasks and participants' self-reports of using the target rule.

It could be argued that PI methodological design does not ask learners to produce the target form. However, PI proponents always claimed that it could alter the way learners process the input which consequently affects their developing system that would be accessed in production (VanPatten, 2002; Benati, 2005). Hence, most previous PI studies relied on offline production tasks to confirm that PI has the ability to affect the developing system through producing the target forms, as the accurate online production of the target forms is a sign of acquisition. (e.g., Benati, 2002, 2005; Atchley 2015).

Realistically, automatic and spontaneous production cannot, I would argue, be measured by offline tasks that allow the opportunity to revise, check and control responses. These offline methods allow participants to retrieve and use their explicit knowledge that was practiced through PI activities. Nevertheless, the same conditions are not available when participants need to use their linguistic knowledge spontaneously in daily communication that requires an automatized knowledge ready for retrieval and production in online conditions.

6.2.2.2 The MPI group

In the post-test, the prediction related to MPI group performance in the production task, discussed in Chapter 3, was supported. It was predicted that learners in the MPI group would improve in online production on elicited imitation tasks from pre to post-test. This would be demonstrated in improvement and more accurate production of the target verbal inflections in the EI task. The MPI participants made significant improvements compared to the control group in the post-test for all the six cases of the three target inflections. There were significant differences between the MPI and the control groups in all the cases of the three target inflections: -*s*, -*ed* and -*ing*, (p =.03, p =.005, and p =.002, respectively), with large effect sizes for all the inflections. This suggests that the MPI intervention had a strong positive effect on improving participants' production of the inflected and non-inflected verbs in the post-test.

As can be seen in the statistical analysis of this task in Chapter five (section, 5.3.1), the MPI participants were able to correctly imitate the inflected verbs, more importantly, they were able to accurately assign the missing inflections to their verbs and produce them under online conditions. This is in line with L2 competence discussed in Chapter 2, where L2 competence is defined as the ability of the L2 learner to understand the relationship between nouns, verbs and phrases and assign the inflectional forms to their functions and meanings in verbs (Whong et al., 2014). Consequently, after acquiring all this information, the L2 learner then is free to access this knowledge at any time and under different conditions (ibid, 2014).

More importantly, in the delayed post-test, the MPI group results showed that the MPI effect extended to participants' performance in all six cases of the three target inflections -*s*, -*ed* and -*ing*, in that there was no significant difference between participants' performance in the post-test and their performance in the delayed post-test. In addition, there was no significant difference between the production of the three target inflections, although it was suggested in the IP model that the inflections -*s* and -*ed*, would cause more issues with establishing the form-meaning connection (VanPatten, 1996, 2007) and hence, would not be susceptible to strong interface (Han and Finneran, 2014). For the inflection -*ing*, it was found to be problematic for the PI group participants due to, arguably, the double processing load placed on attentional resources to form the progressive, however, this issue was not found in the MPI group performance. These findings suggest that the effect of the new element included in the MPI treatment, the focused tasks, was robust and clear on all the three target inflections despite their different redundancy levels or other processing issues such as the double processing load of the progressive -*ing*.

Nevertheless, the large effect size of the inflection -*s* in the post-test (*d*=0.6), suggests again that the most redundant inflection was significantly affected by the practice opportunities offered in the MPI package. Thus, it seems that the MPI treatment helped to establish stronger representations of the target inflections that made them ready for automatic retrieval and production in the EI task. Recall that the third-person-singular -*s*, in the offline post-test, marginally improved compared to the other inflections, but maintained the improvement in the delayed-post-test only for the MPI group. So, the fact that the MPI group maintained their performance even with the most redundant inflection -*s*, suggests that this modified instructional package has the key element that would allow participants from using the learning strategies they received through the intervention and use them successfully to produce accurate morphological inflections despite their different redundancy levels and susceptibility to instructions, in online, meaningful communication.

Therefore, linking the gains of the MPI group in the EI task to their gains in the offline interpretation task, these findings confirm that the MPI intervention was able to trigger change in participants explicit knowledge and was sufficient to cause positive change through automatizing the target forms under study. This change enabled participants to instantly retrieve and accurately produce the target forms under the EI task's processing demands. This positive change is compatible with Segalowitz's categorisation of automatic/non-automatic processing discussed in Chapter 2 (section. 2.3.1). Segalowitz (2003) argues that automatic processing should be compared to non-automatic processing in order to shed light on the difficult aspects of language that resist automaticity. In this case, comparing participants' performance in the EI task before and after receiving the MPI, is taken as evidence that MPI was able to automatize participants' knowledge related to the target forms of this study.

Another point made by Segalowitz is related to the quality of automaticity. As can be observed in this study, the MPI group was able to provide accurate judgments in the first offline task and maintained their improvement in the delayed post-test. In the second online production task, the MPI group also provided accurate and fast responses under real-time settings and maintained their accurate performance in the delayed post-test. Taken together, both performances in the offline and online tasks indicate that the MPI intervention affected the quality and the quantity of participants' knowledge. In other words, beside that participants were automatic in providing the target inflections in the EI online task, their imitations were also accurate and grammatical in both the offline interpretation and online EI tasks. Hence, under online settings, MPI group participants were able to automatically produce accurate, inflected verbs similar to what they provided in the offline task under offline, controlled settings, which reflects a positive change in the underlying mental processes (Segalowitz, 2003).

Thus, I can argue that the addition of communicative tasks to the PI package contributed to a faster establishment of the strong form-meaning connections, i.e. representations, compared to the standard PI intervention. This addition allowed the opportunity to exploit the appropriate learning strategies developed after receiving the PI instruction, i.e. explicit instruction, processing issues, and referential activities. Then, the processing of this knowledge took place through participating in meaningful communicative tasks that were designed specifically to trigger the use of the target structures; i.e. focused tasks, where each participant had a role that required verbal communication with other colleagues in order to complete the task. More importantly, as explained in Chapter 2 (section, 2.5.4.1), this modified PI intervention was able to specifically target the special nature of the most redundant morphological inflection, third-person singular -s, and positively and equally affect the production of all the target inflections under investigation.

On the other hand, the PI group did not have the same opportunity for practising through meaningful tasks for communication. As discussed in Chapter 2 (section, 2.5.4), the PI instructional package relied on the referential activities as the key element to process the target linguistic input, where processing takes place through presenting sentences containing the target structures but stripped from the element that causes the disruption, e.g. the temporal adverbs, in a multiple choice, offline design. The PI set of activities (the referential and affective activities), that were used in most PI studies, are similar to metalinguistic activities that cannot arguably lead to measurable learning gains (R. Ellis, 2003, 2009; Doughty, 2004). In addition, after receiving those activities, participants performance is judged based on offline interpretation and production tests that also presented the testing sentences without temporal adverbs in order to test participants performance and confirm the ability of PI instructional package to affect the developing system. Hence, the strong form-meaning connections, that are supposed to be established after the PI intervention, were restricted to be practiced in "structured input exercises" (Ellis, 2003,2009) and were tested through offline, unreliable tests.

The point of restating these methodological issues, discussed earlier in Chapter 2 (section, 2.5.4) is not to underestimate the value of referential activities, the key component of the PI instructional package, which are essential to shed the light on the relationship between the form and the meaning and initiate the connection between them. But I argue, that referential activities alone are not enough to integrate those strong form-meaning connections into the developing system and cause positive change in L2 learners' knowledge- as claimed by many previous PI studies- based on the fact that none of previous PI studies including this study was able to document any improved performance under online settings.

For example, Marsden and Chen (2011), after discussing several previous PI studies including theirs, found out that referential activities were mostly responsible for the observed learning gains, the improved explicit knowledge of the target inflection. In their study, which was reviewed in Chapter 2 (section, 2.5.3.3), they acknowledge that GJT and gap-fill gains were associated with explicit knowledge according to their self-report data analysis, and that the lack of oral production gains in their study were likely due "to a lack of readily accessible and relevant knowledge about the target feature during interactive oral production" (ibid, 2011, p. 1087), i.e. the automatized knowledge of the target features. Hence, the question that arises here is: what is the point of establishing robust and correct form-meaning connections and reinforce the accurate processing if those connections cannot be integrated into the developing system and then employed in natural and spontaneous communication. Such findings suggest that PI instructional package might be an unreliable method for instruction when the goal is to develop learners' L2 competence that requires automatized knowledge that is ready to be recalled in real-time settings (Jiang, 2004; Segalowitz, 2003).

To recap this section, it was found in the EI task, that the PI intervention could not aid participants in retrieving and producing the target inflections in online settings in post and delayed post-tests. The observed variable performance suggests that PI did not trigger any change in participants' existing knowledge as they were unable to imitate the correct inflected verbs or provide the missing inflections in the non-inflected verbs. The reason behind this issue with the PI group, I would argue, lies in the lack of the meaningful communicative opportunities that would allow participants to process the intake they established after receiving the PI, and thus use it in online settings.

In contrast, the MPI group participants proved successful in performing this task which suggest that the MPI was able to trigger a clear positive change in participants' existing knowledge compared to their variable performance in the pre-test. This automatized knowledge that would be integrated into participants' developing system and thus support participants in such high processing load online tasks, is the goal of designing the modified PI intervention and any instructional method that seeks the development of learners L2 competence. Therefore, I would argue that MPI intervention could be leading to faster and more successful establishment of automatised knowledge related to inflections with different redundancy levels, compared to the standard PI intervention.

The next section discusses the results of the third online processing task: the SPR task, for PI and MPI groups.

6.2.3 The self-paced reading task (SPR)

For the third testing task, I decided to include a new method of testing participants' automatized knowledge in online settings, checking sensitivity to grammatical and ungrammatical forms, in order to confirm the earlier findings of the previous two tasks. The SPR task was originally used in L2 research, to complement participants' performance in grammaticality and acceptability judgment tasks (Jegerski, 2014), because it requires a memory-stored grammatical knowledge. Hence, this task was chosen as it should mainly reflect the acquired online target structures in L2 learners' developing system.

As discussed in chapter 4 (section, 4.6.1), this task was designed using a special software: Open Sesame, that asked participants to read sentences in a word by word or phrase by phrase fashion through pressing a button. Participants controlled the pace of presentation according to the time they needed to read each word or phrase and each button press was recorded in order to document the reaction time (RT) needed to read each word. Sentences were designed to balance grammatical or ungrammatical versions in the same way as the EI task. The rationale behind this was to reveal information about learners' sensitivity to morphosyntactic information during online reading, hence, longer RTs at specific words or phrases indicated processing difficulty or sensitivity to ungrammaticality represented in the sentence (Marinis, 2010).

The next section discusses the results of each group and concludes with a recap of both groups' results in the three testing tasks.

6.2.3.1 The PI group

In the post-test, the prediction related to the PI group performance in the SPR task, discussed in Chapter 3, was not supported. It was predicted that learners in the PI group will improve in online processing on self-paced reading tasks from pre to post-test. This will be demonstrated in longer RTs for ungrammatical forms while maintaining shorter RTs for grammatical target forms. However, the PI group made no significant improvements compared to the control group in the post-test for reading the six cases- correct and incorrect- of the three target inflections, -*s*, -*ed* and -*ing* as there was no difference between the RTs while reading the inflected (correct) verbs and reading the non-inflected (incorrect) verbs.

Similar to the post-test results, in the delayed post-test, the prediction related to PI, discussed in Chapter 3, was also not supported as there was no difference between participants' RTs of the inflected and non-inflected verbs for the three inflections. For the incorrect inflections, the PI group had shorter RTs while reading the incorrect -*s* than the correct -*s* and almost the same RTs while reading the correct and incorrect -*ing*. The only exception was while reading the incorrect -*ed* which might be due to chance, however, there was no significant difference between the RTs of the PI group and the control group that could be regarded as an effect of the PI on processing the incorrect inflections.

According to the assumption related to the redundancy hierarchy of IP model, PI intervention was expected to reinforce the processing of -*ing* by raising participants' awareness towards ungrammaticality so they were supposed to have longer RTs while reading the non-inflected verbs, and shorter RTs (faster processing) of the grammatical, inflected verbs. However, this was not the case with the PI group as there was no significant difference between the RTs of the inflected and non-inflected verbs of the three inflections despite their redundancy levels, which suggests that the participants were not aware that the target morphological inflections were stripped from the verbs.

All of these findings imply that the PI intervention could not trigger any change in participants' knowledge that would enable them from paying attention to the ungrammaticality represented by non-inflected verbs in the sentences. This insensitivity was observed in both post and delayed-post tests. Thus, the fact that the PI group participants were processing most of the target inflections quickly with no difference in RTs between the inflected and non-inflected verbs does not support the claim of PI about its ability to cause change in the developing system through establishing the strong form-meaning connection that participants could rely on in such online processing tasks.

These findings are similar to recent PI studies which employed the SPR online task, but failed to reveal any significant gains (e.g. Atchley, 2015, Henry, 2015). Henry (2015) employed SPR and found no significant differences between PI group and traditional instruction group performance in processing the German accusative case markers. Similarly, Atchley (2015) used SPR and an offline production task to compare between PI and traditional instruction on the processing of gender morphology in Spanish. The SPR task revealed no differences in RTs between the grammatical and ungrammatical sentences for both the PI and control groups although the PI group made significant gains in the offline production task.

The contrast between the PI group offline and online tasks' performance, found in Atchley's study, are similar to the PI group's performance in this study, where they made significant gains in the offline interpretation task but failed to make any gains in both EI and SPR online tasks. This similarity confirms again the ability of PI to provide only a secure offline knowledge that could be retrieved and used in controlled/offline settings but cannot upgrade participants' processing further than that. Therefore, it is conceivable to consider PI helpful in establishing the essential form-meaning connection needed to process the input, however, PI cannot achieve more than that because of its current methodological design that does not provide the appropriate communicative practice needed to automatize learners' existing knowledge to the required level of automaticity discussed earlier in Chapter 2 (Segalowitz, 2003; Jinag, 2004; DeKeyser, 2010).

6.2.3.2 The MPI group

For the MPI group results, the prediction related to MPI, discussed in Chapter 3, was partially supported. It was predicted that learners in the MPI group will improve in online processing on self-paced reading tasks from pre to post-test. This will be demonstrated in longer RTs for ungrammatical forms while maintaining shorter RTs for grammatical target forms. This prediction was based on the assumption that employing communicative tasks would improve the effectiveness of PI treatment on participants' performance in online settings.

In this task, the MPI group's participants significantly spent shorter RTs while reading the inflected verbs compared to the RTs of reading the non-inflected verbs for the three target inflections. In addition, the MPI group significantly spent longer RTs than the control group while reading the ungrammatical, non-inflected verbs of all the target inflections: *-s*, *-ed* and *-ing*, $p < .05$. The effect size of this analysis was considered to be large (d=0.9), (d=1.2) and (d=1.06) respectively, which suggests a strong effect of MPI on participants' online processing performance in the SPR task. However, in the delayed post-test, the MPI effect extended to only one inflection, which was while reading the non-inflected verbs with *-s*, the most redundant morphological inflection (IP model; Slabkova, 2007; Han and Finneran, 2014). On the other hand, the effect significantly decreased while reading the non-inflected verbs with -*ed* and -*ing*, as there was no significant difference between the RTs of reading inflected and non-inflected verbs.

With regards to the assumption related to the communicative value of IP model discussed in Chapter 2 (sec. 2.6), in the SPR task, two types of grammatical verbs; i.e. inflected, for the inflection -*ed* were included. First, the redundant -*ed*, where there was an adverb at the beginning of the sentence, and second, the non-redundant -*ed*, where there was no adverb at the beginning of the sentence. The analysis showed that there was no difference between the RTs of reading the redundant and non-redundant -*ed* for both PI and MPI groups. However, because these sentences were already grammatical, participants were not expected to spend longer RTs reading them. In addition, only two sentences for each case were employed which might affect the result of this analysis.

Moreover, two cases for the inflection -*ing* were employed in the SPR task in order to compare between the RTs spent on reading the missing -*ing* and missing auxiliary. Although a limited number of experimental sentences were included, two for each case, the analysis showed that there was a significant difference between the RTs of the missing Auxiliary and the missing -*ing* in the MPI group, (p=.022), suggesting that the MPI group spent longer time in reading the non-inflected verbs with -*ing* which reflected their sensitivity to the ungrammaticality. Although the MPI group were not sensitive to the missing auxiliary, it is conceivable to assume that the MPI effect was clear on participants' processing performance while reading the non-inflected verbs with -*ing*. In other words, the MPI participants derived some intake related to the -*ing* inflection and were able to employ it successfully in the post self-paced reading task.

Despite the observed improvement of the MPI group in the post-test, the delayed post-test analysis showed that the MPI effect did not extend to all inflections, however, some factors other than participants' knowledge per se might be contributing to such performance decline for both PI and MPI groups. Considering both groups performances in the online processing task, it is important to note that the self-paced reading is a relatively new way of testing L2 learners' implicit knowledge and reveal information about learners' sensitivity to morphosyntactic information (Benati, 2016; Roberts, 2016; Sagarra and Herschensohn, 2010). Factors such as the novelty of the SPR task might be involved in the decline seen in participants' performance, as the design and the style of presentation of the experimental sentences are different from what participants are used to experience in their classrooms. In addition, the SPR task places the participants under high processing load, as they have to read, comprehend and answer a question at the end of each sentence testing their comprehension of what they have read.

As mentioned above in (section, 6.2.3), Jegerski (2014) explains that the grammatical processing in the SPR task, mainly relies on the existing grammar knowledge stored in memory, thus, the SPR data should be considered as an indirect measure of grammatical competence rather than a tool to measure L2 learners' processing which is still under development. Other factors should be also considered such as the working memory capacity of these participants, as this task places a high processing load where individual variations in WM could limit the general managing of the task itself.

Therefore, the SPR may be appropriate for more advanced L2 learners at higher levels of acquisition or who have high WMC, and stronger representations that could be reflected by showing sensitivity to the ungrammaticality targeted by the SPR. However, the participants in this study, are expected to have newly established representations which were mainly received through explicit types of instruction. As discussed in Chapter 2, Jiang (2004) argues that the goal of L2 learning is to have automatic linguistic knowledge regardless of the method that was used to develop it; i.e. explicit or implicit. In the same vein, DeKeyser (2009), reviewed in Chapter 2 (section, 2.5) explains that L2 learners can have different levels of automatized knowledge and hence, the automaticity in acquisition should be looked at as a continuum that start from a non-automatized knowledge where learners begin developing their explicit knowledge by learning declarative knowledge. Then, after sufficient practice, this knowledge is upgraded to a less or semi automatized knowledge. And finally, after a long process, it becomes a fully automatized knowledge (Suzuki and DeKeyser, 2017).

Hence, according to the SPR task's findings in this study, it could be argued that participants' knowledge after receiving the treatment remained not fully automatized to a degree that allows it to be reflected in advanced tasks like the SPR. In other words, participants are still in the process of developing new form-meaning connections of the target inflections, which need frequent communicative opportunities that allow the target forms to be processed and become automatized, then ready to be integrated in the developing system; i.e. become acquired. However, because the SPR is a high processing load task, I argue that the SPR could not reflect participants' partial automatised knowledge they had established after the treatment. On the contrary, the elicited imitation task, a less complicated task with lower processing load, was an adequate online task that reflected participants' automatized knowledge related to the target forms. In the EI task, participants were able to accurately provide correct production of the target inflections under online conditions, which suggests that the automatised knowledge the participants had might be reflected differently according to the type of task and the level of its design and requirements.

Similarily, Atchley (2015), argues that SPR might be too advanced to measure the beginner participants in her study, and might be more appropriate for use with learners who had reached high levels of proficiency/acquisition and thus, SPR can reflect the change in their developing system. She argues that the reason for the weak performance of the PI group on SPR in her study might be because they were just beginning to derive intake data which was not enough to enable them from performing the task successfully.

Therefore, one could assume that the weak performance of the PI group in both tests and the declined performance of the MPI group in the delayed post-test in the SPR task, might be due to a number of factors that interact with each other to cause such weak performance. Nevertheless, it is important to acknowledge the improvement observed in the MPI group performance in the post-test, which suggests that the MPI group was able to manage representational judgments more robustly than the PI group in the post-test and adds to the probability that the weak performance in the delayed post-test might be due to the novelty and the high processing load of the SPR task and not to the weak effect of the MPI intervention.

After analysing the results of the three testing tasks and discussing their findings, one can notice that participants face most difficulty when they are under online settings as seen in the PI group performance in both online tasks and the MPI group in the second online task. Hence, it is important to locate the most probable factor leading to such issues by considering both groups' performance across all three testing tasks.

First, considering the PI group's performance, it is clear that the effect of PI encouraged participants' existing knowledge of the target forms, to some extent, and strengthened the form-meaning connection to a degree that enabled participants to recall and use this knowledge in providing accurate judgments in the offline interpretation task even after 12 weeks of the PI treatment. However, this accurate performance was restricted to the nonredundant inflections -*ed* and -*ing*, and did not extend to the redundant inflection -*s*.

For the PI group performance in the online tasks: EI and SPR, the results are compatible, where participants made no improvement in the post-test and produced less accurate production of the target verbal inflections in the delayed post-test. Participants' performance in the EI and SPR tasks suggests that the PI intervention did not lead to any acquisition as there was no clear effect on learners' developing system because the target inflections representations were not automatized enough to the level that allows them to be automatically retrieved and produced in online tasks.

It is important to point out that, if the novelty and the difficulty of the SPR task were responsible of the observed weak performance of the PI group (e.g. Atchley, 2015; Henry, 2015) and the SPR and EI tasks (in this study), it would be the same case for the MPI group. Moreover, if the length of the PI treatment and the amount of practice were insufficient to raise the awareness of ungrammaticality (e.g. Atchley, 2015), again it would be the same case for the MPI group as both groups had the same amount of activities and the exact length of treatments. Therefore, it is conceivable to conclude that the main reason leading to PI group weak performance in online tasks, is the unavailability of the automatized representations that are essential for the successful performance in online settings (DeKeyser, 2010; Godfroid, 2015; Segalowitz, 2003).

On the other hand, considering the MPI group's performance in the three testing tasks, the effect of MPI was observed in participants' accurate offline processing in the interpretation task, and was also observed in the online EI task, as participants made significant improvements in producing the target inflections. Those improvements suggest that the MPI treatment was helping in terms of automatic and accurate production even with the most redundant inflection. Similarly, but with a weaker effect, in the SPR task, the participants spent longer RTs while reading the non-inflected verbs and shorter RTs while reading the inflected verbs in the post test which suggests that they were aware of the mismatch represented. Although their performance declined in the delayed post-test for the inflections *–ed* and *–ing*, it was probably due to the novel and complicated design of the task that required strong and fully automatized representations that can handle the SPR high processing load.

The observed improvement of the MPI group is compatible with steps required for morphology acquisition discussed in Chapter 2. Recall it was suggested that the initial knowledge of L2 might have weak or incomplete form-meaning connections, and that L2 learners must be exposed to frequent meaningful input in order to develop robust representations (VanPatten et al., 2004) and engage in meaningful communicative practice in order to automatize these representations and use them automatically in production (Jiang, 2004; Segalowitz, 2003).

Hence, in this study the MPI group seems to have successfully gone through these steps in that participants initial weak or incomplete representations (according to pre-test results) were strengthened after receiving MPI instructional strategies; i.e. explicit instructions, processing issues explanation, and referential activities. Once these representations were robust enough, they were automatized through engaging in meaningful communicative tasks. Finally, the MPI participants were able to automatically access what was available in their mental representations and successfully use it in production under the online tasks demands (according to participants significant gains in the EI task). In contrast, the PI group seemed to have problems accessing these connections which is probably due to weak or incomplete connections because of lack in meaningful practice needed to automatize those representations.

In sum, in line with the weak interface hypothesis discussed in Chapter 2, (section, 2.3.2.3), the MPI treatment proves to be more successful than the PI treatment in achieving a faster and more reliable automatization of L2 learners' knowledge of all three target forms. This is due to the specific design of the MPI treatment that combines both explicit and implicit types of instruction. The difference observed in the susceptibility of the target inflections to the two instructional methods is taken here to confirm Han and Finneran' suggestion (2014), discussed in Chapter 2 (section, 2.5), that different grammatical aspects of language might have different interface levels within the same language, so that communicative collaborative task-based activities can help benefit some forms more than others.

To recap this assumption briefly, the communicative collaborative task-based activities can help benefit some forms more than others. For example, from a generative point of view, the abstract acquisition of the underlying features and the functional requirement like agreement is required for the successful retrieval and production of the target form. Nevertheless, this can be very hard to teach explicitly as seen in the different redundancy levels between the morphological inflections. However, some redundant forms like the third-person singular *-s*, which are hard to be mastered explicitly and rely on the underlying abstract features, can be managed more successfully when learners have more collaborative pushed processing communicative type of exposure. On the other hand, other forms which are less redundant can be mastered through explicit instruction and practice such as the regular past form *-ed*. However, mastering the regular past form *-ed*, which has low processing load and relatively low redundancy, is not always guaranteed as documented by previous research.

Thus, based on the findings of this study, one could assume that the features required for agreement and the features required for tense seem to be acquired differently. Tense-based morphology can be explicitly presented and successfully mastered by L2 learners. This is certainly true for the irregular past-tense forms which has to be presented through explicit instructions. Whereas agreement-based morphology can be hard to acquire if it is presented through explicit instruction and seems to be more susceptible to communicative collaborative activities that boost the underlying implicit system.

Therefore, while the relationship between the explicit and implicit knowledge in SLA theories remain irreconcilable, it seems that combining two types of instruction; i.e., explicit and implicit, is crucial in certain L2 contexts especially with teaching morphology, as explicit instruction provides support for the implicit process to develop. So, unless we have an explicit guide for teaching the target language including the suitable type of instruction and activity, we should provide a balanced combination of both explicit and implicit types of instruction to satisfy the criteria of both generative and cognitive approaches to SLA, and ensure the successful second language learning as both approaches are contributing differently but significantly in second language acquisition. Hence, I argue that one does not have to incline toward supporting one side, instead, one could adopt a new approach that combines both sides, in order to exploit the innovative research findings to benefit the pedagogy and language teaching profession (Whong et al., 2014).

Therefore, the MPI treatment, proposed in in this study, might be a good candidate to fulfil the need for such special type of instruction. Of course, further research is needed, particularly in relation to the extent to which different redundancy levels of verbal inflections are affected by the MPI treatment, and also to assess its effect on the processing of different grammatical forms other than the ones tested in this study.

To that end, the modified processing instruction package including standard PI instruction in addition to communicative focused tasks, is proved to be a practical and applicable L2 teaching method that could fit into any L2 teaching context. As mentioned in Chapter 3 (section, 3.3), the English language teaching system in Saudi Arabia relies on explicit instruction for English grammar rules and structures, accompanied by intensive practice through reading, listening, writing and speaking activities. However, as seen in the first study of this research, this teaching system resulted in participants having more explicit knowledge than implicit, and so input did not become intake and participants were not able to successfully perform linguistic tasks under real-time pressure.

Therefore, with some tweaking to lesson plans, I assume that MPI could be easily integrated in the target context L2 classes without causing any issues or disruption to participants' timetables. The MPI instructional package could potentially be a very useful and practical teaching method to many L2 teachers and learners in L2 contexts that are constrained by curriculum requirements and an explicit approach to instruction.

After discussing the results of the testing tasks related to the first and second research questions, the next section discusses the results of WM task related to the third question of this research.

6.2.4 The WM results

RQ3 asks whether there was a relationship between working memory capacity (WMC) as measured by a listening span task (LST) and learners' processing and production of the target verbal inflections *-ing*, *-ed* and *-s* after PI and MPI interventions based on learners' performance in the two online testing tasks.

Based on the discussion of WM discussed in IP model presented in Chapter 2 (section, 2.5.1), the following prediction was laid out:

> After the PI and MPI treatments, higher WMC learners would be able to accurately process and produce the three target inflections: *-s*, *-ed* and *-ing*. This would be demonstrated in positive correlation between the WMC and the online production and processing of the target forms.

However, it was found that there was a groupwise difference. First, for the PI group, the prediction was not supported, in that the WMC did not correlate with participants production in the EI task, either in the post-test or the delayed post-test. Similarly, in regard to the SPR task, WMC did not correlate with PI group reading performance in both times of testing.

Second, for the MPI group, this prediction was partially supported, in that the higher WMC and the accurate production in the EI task were positively correlated. This correlation was limited in the post-test to just one inflection, the correct -*s* and incorrect -*s*. For the SPR task, the prediction was not supported, in that WMC did not correlate with participants reading performance in both times of testing. However, in the delayed post-test, higher WMC and accurate production were positively correlated for all the six cases of the target inflections, suggesting that WMC does indeed play some role in aiding acquisition and retrieval of inflections, however, this is a tentative claim given the limited impact of WMC across all tasks.

The implications of the results for each task are briefly discussed in more detail below.

6.2.4.1 The elicited imitation task (EI)

As mentioned above, in the PI group, there was no association between the WMC and the accurate production of the three target forms in the EI task either in the post or the delayed post-tests. In fact, according to the statistical analysis of the EI task discussed above in (section, 6.2.2.1), the PI intervention was unable to trigger any change in participants' existing knowledge, as they were unable to recall and produce the target structures automatically in the EI task.

As presented in Chapter 5, the statistical analysis of the PI group performance in the online production task, showed that there was no improvement in the accurate production of the target forms in the PI group performance, which is in line with previous PI studies that could not document any online production gains (e.g. Benati, 2005; Benati and Lee, 2008; Marsden and Chen, 2011). Hence, the goal of PI instructional method, to direct learners' attention to the grammatical forms such as verbal inflections which might be "skipped over or partially processed" (VanPatten, 2004, p. 8), was not achieved in this study. Consequently, the higher WM participants could not exploit the PI intervention to improve their online production performance. In other words, it might be that the PI instructional package was insufficient to trigger any change in the developing system, thus could not integrate the target form representations, which in turn prevented the correlation of high WMC with the accurate production of the target forms in the post and delayed-post EI task.

Second, for the MPI group, in the production of the morphological inflection -*s*, in the post-test, it was found that higher WMC positively correlated with the online accurate production of the third person -*s*, (*r*=-0.721, p-value=0.003), in both cases - the inflected and the corrected non-inflected verbs - in support of the earlier prediction which predicted that higher WMC would correlate with participants accurate production. However, for the morphological inflections -*ed* and -*ing*, it was found that there was no correlation between WMC and the production of these inflections after receiving the MPI intervention.

Interestingly, by comparison, in the delayed post-test, there were strong positive correlations between the MPI group performance and the LST for the production of all the six cases of the three target inflections, suggesting that WMC and the accurate production under the effect of the MPI intervention, are positively correlated. One possible explanation to the difference between the limited correlation found with the inflection -*s* in the post-test, and the large consistent correlations found with all the inflections in the delayed post-test might be related to the fact that the MPI treatment had a longer-lasting effect that was clearer in the third time of testing; i.e. the delayed post-test.

Recall the form-meaning mapping issues, discussed in Chapter 2, which are assumed to be due to the weak representations (VanPatten, 2007), the special nature and properties of the target forms (Slabakova, 2007; DeKeyser, 2005), and the insufficient natural input and communicative practice in foreign contexts. All these factors could be contributing to the delay in establishing the strong form-meaning connections that has to be held in the WM in order to be retrieved in online settings. Hence, as seen in the post-test, the correlation was limited to the correct -*s* and incorrect -*s*, but was stronger and clearer for all the cases in the delayed post-test, which I assume, was due to the robustness of the form-meaning connections which encouraged the correlation found between participants' accurate productions and WMC, especially with the most redundant inflection: -*s*, which is linked with those who have higher WMC. In other words, as WM is responsible for holding the filtered data that was derived from input (intake) for further processing (VanPatten, 1996, 2004, 2005, 2007), therefore, it is suggested that the higher WMC participants were able to exploit the MPI effect; i.e., the appropriate processing strategies and the communicative task's practice, in producing accurate morphological inflections in the online EI task. However, this correlation was only clear in the delayed post-test, when participants have developed the robust form-meaning connections in contrast to the newly established connections of the post-test.

6.2.4.2 The self-paced reading task (SPR)

First, for the PI group, there was no positive correlation between participants' performance in the post and delayed post-tests and their LST task scores. Thus, the prediction for processing the three target inflections was not supported. A correlation was found between WMC and reading the incorrect third-person -*s* in the post-test, but it was a negative one; i.e., the WMC capacity correlated with shorter RTs of reading non-inflected verbs that were in fact supposed to invite longer RTs. This correlation was probably a mere one-off coincidence as the statistical analysis in Chapter (5) showed no significant gains either in the post-test or the delayed post-tests, suggesting that the PI group participants were not aware of the ungrammaticality represented by the missing inflections of the verbs used in the SPR task.

For the MPI group, findings were generally similar to the PI group, -there was no consistent positive correlation between participants' performance in the post and delayed post-tests and their LST task performance. Thus, the prediction for processing the three target inflections was not supported. A possible explanation for these findings of both MPI and PI groups performance, compared to the EI task, is related to the SPR task itself. The task seemed to have high processing demands which overreached the capacity of individual WM differences for processing the target structures, as highlighted in a number of previous SLA studies which used online SPR tasks (e.g., Atchley, 2015). The SPR task design required participants to read and comprehend then answer a question related to what they have read. As discussed earlier in Chapter (2), meaning comprehension is an effortful process and L2 learners have limited capacity processors, thus they cannot process and store large amount of information (VanPatten, 2007, p. 117). In addition, Jegerski (2014) explains that in the SPR task, grammatical processing relies on the existing grammar knowledge stored in memory, which in the case of participants of this study, is still under development and not fully integrated into participants' developing system; i.e., acquired. Hence, this high processing load and pressure placed on attentional resources might render the SPR too complicated and advanced to reflect the newly established form-meaning connections in participants' developing system.

In sum, the strong correlation found between the WMC and the MPI group performance in the EI task delayed post-test, confirms the strong positive effect of the MPI intervention that encouraged and enabled the higher WMC participants to employ the appropriate strategies to improve their online production, but only in this specific task. In other words, the MPI automatised the linguistic processes, so when participants performed the EI task, the WM was not overwhelmed with the linguistic processes load and was capable of holding the linguistic information in memory until it was correctly produced during the online task.

Therefore, one could assume that in any task, for example the EI, there are two types of performances. First, is the task performance which includes the cognitive processes of the task. Second, is the linguistic performance where participants need to understand what they hear, recreate the sentences and then produce it correctly. Participants who have lower WMC cannot handle both performances, whereas participants with higher WMC can manage the task more successfully as the linguistic elements are automatised. So, the MPI was arguably able to automatise the linguistic processes which enabled participants with higher WMC to manage the EI overall task demands.

On the other hand, in the SPR task, the task management processing load overwhelmed the participants, so the linguistic trade-off was no longer playing a role. The SPR task had a heavy cognitive processing load which made the WMC irrelevant, as the SPR task demands overreached the capacity of individual WM differences for processing. Therefore, further research would be needed to explore the idea of having a task management threshold rather than a linguistic proficiency threshold.

It is important to point out, that this study findings might be compromised by the fact that the WM task was administered with the delayed post-tests due to time constraints, so only 15 participants from each group were employed. Hence, replicating the WM task with a larger number of participants might reveal more precise information about the WM role and its relationship to second language processing and production. Nevertheless, this could be challenged by suggesting that WM might have no role in this process, thus it is important to clarify that WM role and capacity is a relatively new area of research and like a lot of literature in SLA, more research is needed for better empirical validity.

In conclusion, I argue that both PI and MPI interventions would help in improving participants performance most clearly in the offline interpretation task. However, PI alone could not sufficiently trigger the change this research was seeking to bring out in the participants' developing system, which is to automatize the target form representations and thus enable the participants to retrieve and use them automatically under real-time settings. As discussed earlier, PI methodological design lacks some essential elements that could boost the automatization of the target forms for accurate and automatic retrieval and production in online settings. Nevertheless, the newly proposed modified package of PI; i.e., the MPI intervention showed a robust effect on participants developing system as proven by their accurate and automatic performance in online production and processing, from pre to post-tests in the three testing tasks for all the target inflections.

CHAPTER 7

CONCLUSION

After discussing the results of the PI and MPI groups' performance in the three testing tasks in addition to the relationship found between the WMC and participants' performance in online tasks, a few reflections are presented here to support the claim for the MPI effect, as a significantly effective instructional treatment for boosting morphology acquisition.

In this study, the MPI effect triggered a noticeable change in participants' existing knowledge; i.e. automatization of knowledge related to the target forms, which in turn is argued to foster the target inflections' successful integration into the developing system and therefore, is considered to be the most effective for acquisition. More importantly, MPI intervention equally affected all the target inflections although they had different redundancy levels, suggesting that this unique intervention could be applied to teach different target structures that have special or inherent nature, such as the third-person singular.

Another evidence for the MPI effect is the correlation found between the WMC and the online production of the three target inflections. This correlation indicates that WMC correlated with the extent to which L2 learners are affected by the MPI intervention in favour of the automatic and accurate retrieval and production of the target forms in online settings. However, we note that this correlation was restricted to the EI task, as the capacity of individual WM differences for processing the target structures was overreached in a higher processing demands task; i.e. the SPR task, hence, no correlation was found.

In addition, MPI treatment had more retention value than PI in that its effect has extended to all three target inflections in the delayed post-test in both the interpretation and the EI tasks. All these findings indicate that this novel instructional package proved to be an adequate instructional method that is compatible with the weak-interface position adopted in this research and discussed in Chapter 2. This position assumes that making the target forms salient through explicit instruction, and engage learners in communicative opportunities that encourage the form-meaning processing, would increase the chances for implicit learning processes to take place; i.e. facilitate the acquisition of implicit knowledge (N, Ellis, 2005; R, Ellis, 2008).

Finally, as mentioned in the introduction of this thesis, the MPI intervention addresses proposals that call for a balanced relationship to reconcile between the two contrasting views of second language acquisition; i.e. explicit or implicit learning methods (e.g. Long, 1991; Ellis, 2016). More importantly, this research is an attempt to initiate a link between the theoretical vision of underlying representations developed within SLA model and the teaching and learning methods and activities inside second language classrooms (Long and Rothman, 2013; Whong et al., 2014), in order to derive the most important element in second language acquisition, intake.

Therefore, I propose the modified processing instruction (MPI) as special method for teaching the second language which is specifically designed to address the acquisition of morphology. In fact, this new treatment could be a possible substitution to PPP, which has been criticised for a long time at a linguistic, psychological, psycholinguistic, and pedagogical levels (Criado, 2013), however, PPP is still considered the dominant EFL style (Cook, 2008) and favourable to many L2 teachers for several reasons such as its practicality in terms of lesson planning and applicability to different contexts. Hence, adding a fourth P, that stands for processing, could be an approach to addresses criticisms, and in the same time, it would not change the original identity of the popular PPP strategy.

This instructional package creates a unique fusion of SI activities and interactive communicative tasks in order to raise the psycholinguistic readiness through targeting the high processing load grammatical forms and easing the pressure on attentional resources. Hence, the processing abilities would be shifted to handle input into ways that enable the integration of representations into the developing system.

6.1 Limitations and directions for future research

One limitation of the present study is that it was limited by choice of target language. The two instructional treatments were tested with one language: English, and that might affect the generalizability of the results to other languages. I have argued that English morphology processing is affected by the redundancy caused by temporal adverbs. In addition, small morphemes such as *-s* or *-ed*, convey a lot of information that affects the form and meaning of the sentence. Hence, all of the above might be particularly challenging to process explicit input into intake. In regard to other languages, they might have similar or different issues with the processing of morphosyntactic features, thus more investigation is required to reveal if MPI treatment could be applied to other languages morphological inflections and yield robust, positive effect on their processing.

However, there are other specific limitations related to the design of the study and the testing tasks that I would like to address. First, the limited time of instruction due to participants' exams schedule and the time frame given by the educational institution. Longer time of instruction, such as a whole semester, would offer, I assume, more robust results that allow for a better comparison between the two instructional treatments. In addition, for the modified PI treatment, the MPI, the longer time given for communicative practice through focused tasks, should offer stronger results that could show the extent of the treatment effect on the target inflections under online settings.

With regards to the testing tasks, another aspect to be improved in future studies, is the inclusion of high processing load tasks such as the SPR. I argued earlier that SPR task might be suitable for advanced L2 learners, but in the case of participants in this study, SPR might be too complicated and advanced to reflect the newly established form-meaning connections in participants' developing system. Thus, I would like to replicate this study with a less complicated online processing task which might better reflect participants' abilities for online processing after receiving the instructional treatments. In addition, I would consider adding more testing items for the non-inflected verbs (incorrect items) in the SPR task, to allow for stronger comparison between the three target inflections, especially the comparisons between the redundant and non-redundant infections, such as the case of the inflection *-ing*, which had some interesting findings as it is considered to be easy learned, non-redundant inflection, but as found in this study, it was problematic on the level of online processing and production.

A final limitation had to do with the working memory task. This task was administered with delayed post-tests, hence, only a small number of participants were employed. However, it would be interesting to see if employing a larger number of participants would reveal clearer relationship between WMC and participants performance. Therefore, future research is needed to address the limitations mentioned here. Nevertheless, this study provides some evidence for the effectiveness of the modified processing instruction (MPI), which it is hoped can have useful wider effects in improving connections between SLA and pedagogy.

List of References

Aben, B., Stapert, S., and Blokland, A. 2012. About the Distinction between Working Memory and Short-Term Memory. *Frontiers in Psychology*. **3** (301). pp. 1-9.

Abdel-Hafiz, A. 2005. Verb agreement in standard Arabic: An analysis in the minimality program. *Journal of Language and Linguistics*. **4** (1), pp. 100-120

Adger, D. 2003. *Core syntax: a minimalist approach.* Oxford University Press.

Ahmadian, M.J. 2012. The Relationship Between Working Memory Capacity and L2 Oral Performance Under Task-Based Careful Online Planning Condition. *TESOL Quarterly*. **46** (1), pp.165-175.

Al-Azraqi, M. 1998. Aspects of the Syntax of the Dialect of Abha (South West Saudi Arabia). PhD Thesis. University of Durham, Durham, UK.

Aldwayan, S., Fiorention, R. and Gabriele, A. 2010. Evidence of syntactic constraints in the processing of wh-movement: A study of Najdi Arabic learners of English. In: VanPatten, B. & Jegerski, J. ed. *Research in second language processing and parsing*. John Benjamins Publishing Company.

Almohanna, A. 2010. English language teaching in Saudi Arabian context: How communicatively oriented is it? . *King Saud University. Language and Translation.* **22**, pp.69-88.

Anderson, J. 1980. *Cognitive psychology and its implications*. Richmond Worth Publishers.

Atchley, P. 2015. Processing Instruction and Redundant Morphology in Spanish as a Second Language. PhD Thesis. Florida State University.

Baddeley, A. 2000. The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences*. **4** (11). pp. 417-423.

Baddeley, A. 2003. Working memory and language: an overview. *Journal of Communication Disorders*. **36**, pp.189–208.

Baddeley A., and Hitch, G. 1974. Working memory. In: Bower, G. ed. *The psychology of learning and motivation*. **8,** pp. 47–89. New York: Academic Press.

Bailey, N., Madden, C. and Krashen, S.D. 1974. Is there a 'Natural Sequence' in adult second language learning? *Language Learning*. **24** (2), pp.235-243.

Benati, A. 2002. The Effects of Processing Instruction and its Components on the Acquisition of Gender Agreement in Italian. *Hispania*. **13** (2), pp. 308-323.

Benati, A. 2004. The Effects of Processing Instruction and its Components on the Acquisition of Gender Agreement in Italian. *Language Awareness*. **13** (2), pp. 67-80.

Benati, A. 2005. The effects of processing instruction, traditional instruction and meaning À output instruction on the acquisition of the English past simple tense. *Language Teaching*. **1**, pp. 67-93.

Benati, A., and Lee, J. 2008. *Grammar Acquisition and Processing Instruction: Secondary and Cumulative Effects*. Clevedon. Multilingual Matters.

Benati, A. 2016. Input manipulation, enhancement and processing: Theoretical views and empirical research. *Studies in Second Language Learning and Teaching*. **6** (1). pp. 65-88.

Carroll, S. 2001. *Input and evidence: The raw material of second language acquisition*. Amsterdam. Benjamins.

Chomsky, N. 1995. *The minimalist program*. The MIT Press.

Cohen, J. 1988. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Conway, A.R.A.K., Michael, J., Bunting, Michael. F., Hambrick, D., Zach, Wilhelm., Oliver, Engle., Randall, W. 2005. Working memory span tasks : A methodological review and user' s guide. *Psychonomic Bulletin & Review: A Journal of the Psychonomic Society, Inc.* **12** (5), p. 769.

Cook, V. 2008. *Second Languge Learning and Teaching*. 4th ed. London. Hodder Education.

Cowan, N. 2015. Second language use, theories of working memory, and the Vennian mind. In: Wen, Z., Mota, M., and McNeill, A. eds. *Working memory in second language acquisition and processing*. pp. 29–40. Bristol: Multilingual Matters.

Criado, R. 2013. A critical review of the Presentation-Practice-Production Model (PPP) in Foreign Langaueg Teaching. In: R. Monroy. ed. *Homenaje a Francisco Gutierrez Diez*. pp. 97-115.

Daneman, M. and Carpenter, P.A. 1980. Individual differences in working memory and reading. *Journal of Verbal Learning & Verbal Behavior.* **19**, pp.450-488.

De Jong, N. 2005. Can second language grammar be learned through listening? An experiment study. *Studies in Second Language Acquisition*. **27**, pp. 205–234.

DeKeyser, R. 1997. Beyond explicit rule learning: Automatizing second language morphosyntax. *Studies in second language acquisition*. **27**, pp. 205-221

DeKeyser, R. 2003. Implicit and explicit learning. In: C. Doughty. and M. H. Long. eds. *Handbook of second language acquisition*. Oxford. MA. Blackwell.

DeKeyser, R. 2005. What makes learning second-language grammar difficult? *Language Learning*. **55**, pp. 1-25.

DeKeyser, R. 2007. Skill acquisition theory. In: VanPatten, B. and Williams, J. eds. *Theories in Second Language Acquisition*. Mahwah: NJ: Erlbaum.

DeKeyser, R. 2009. Cognitive-psychological processes in second language learning. In: H. M. Long & C. J. Doughty. eds. *The handbook of language teaching*. Oxford, UK: Wiley-Blackwell.

DeKeyser, R. 2015. Skill acquisition theory. In: B. VanPatten and J. Williams. eds. *Theories in Second Language Acquisition: An Introduction*. 2nd edition. Routledge.

DeKeyser, R., and Botana, G. 2015. The Effectiveness of Processing Instruction in L2 Grammar Acquisition: A Narrative Review. *Applied Linguistics*. **36** (3). pp. 290–305

Doughty, C. and Long, M., 2003. *Handbook of Second Language Acquisition*. Blackwell, Malden, MA/Oxford

Dulay, H.C. and Burt, M.K. 1974. Natural sequences in child second language acquisition. *Language Learning*. **24**. pp.37-53.

Ellis, R. 1995. Interpretation Tasks for Grammar Teaching. *TESOL Quarterly*. **29** (1), pp. 87-105.

Ellis, N. 2002. Frequency effects in language processing: A review with implications for theories of implicit and explicit language acquisition. *Studies in Second Language Acquisition*. **24**, pp. 143–88.

Ellis, R. 2003. *Task-based Language Learning and Teaching*. Oxford University Press.

Ellis, R. 2004. The definition and measurement of explicit knowledge. *Language Learning*. **54**, pp. 227–75.

Ellis, N. 2005. At the interface: dynamic interactions of explicit and implicit language knowledge. *Studies in Second Language Acquisition.* **27** (2), pp. 305–52.

Ellis, R. 2005. Measuring implicit and explicit knowledge of a second language: A psychometric study. *Studies in Second Language Acquisition*. **27** (2), pp. 141–72.

Ellis, R. 2008. Investigating grammatical difficulty in second language learning: Implications for second language acquisition research and language testing. *International Journal of Applied Linguistics*. **18** (1), pp. 4-22.

Ellis, R. 2009. *The Study of Second Language Acquisition.* Oxford University Press.

Ellis, R. 2016. DOES FORM-FOCUSED INSTRUCTION AFFECT THE ACQUISITION OF IMPLICIT KNOWLEDGE? A Review of the Research. *Studies in Second Language Acquisition*. **24** (2), pp. 223-236.

Farley, A. 2001. Authentic Processing Instruction and the Spanish subjunctive. *Hispania*. **84** (2), pp. 289-299.

Fernandez, C. 2008. Re-examining the role of explicit information in Processing Instruction. *Studies in Second Language Acquisition*. **30**, pp. 277-305.

Godfroid, A. and Lim, H. 2014. Automatization in second language sentence processing: A partial, conceptual replication of Hulstijn, Van Gelderen, and Schoonen's. *Applied psycholinguistics.* **36** (5), pp. 1-36.

Godfroid, A., Loewen, S., Jung, s., Park, J., Gass, S., and Ellis, R. 2015. Timed and Untimed Grammaticality Judgments Measure Distinct Types of Knowledge: Evidence from Eye-Movement Patterns. *Studies in Second Language Acquisition*. **37** (2), pp. 269-297

Goad, H. and White, L. 2006. Ultimate attainment in interlanguage grammars: A prosodic account'. *Second Language Research*. **22**, pp. 243-268.

Han, Z. and Finneran, R. 2014. Re-engaging the interface debate: strong, weak, none, or all? *International Journal of Applied Linguistics*. **24** (3), pp.370-389.

Harrington, M. and Sawyer, M. 1992. L2 working memory capacity and L2 reading skill. *Studies in Second Language Acquisition*. **14** (1), pp. 25-38.

Hawkins, R. 2001. *Second Language Syntax: A Generative Introduction*. Oxford: Blackwell.

Hawkins, R. and Chan, Y.C. 1997. The partial availability of Universal Grammar in second language acquisition: the 'failed functional features hypothesis'. *Second Language Research*. **13**, pp. 187–226.

Haznedar, B., & Schwartz, B. D. 1997. Are there optional infinitives in child L2 acquisition?. In: Hughes, E. and Greenhill, A. eds. *Proceedings of the 21st Annual Boston University Conference on Language Development.* Sommerville, MA: Cascadilla Press.

Henry, N. 2015. Morphosyntactic processing, cue interaction, and the effects of instruction: An investigation of Processing Instruction and the acquisition of case markings in L2 German. (Unpublished doctoral dissertation). Pennsylvania State University.

Herschensohn, J. 1999. *The Second Time Around – Minimalism and L2 Acquisition*. John Benjamins Publishing Company.

Herschensohn, J. 2009. Fundamental and Gradient Differences in Language Development. *Studies in Second Language Acquisition.* **31**, pp. 259– 289.

Hopp, H. 2006. Syntactic features and reanalysis in near-native processing. *Second Language Research.* **22** (3), pp.369–397.

Hopp, H. 2010. Ultimate attainment in L2 inflection: Performance similarities between non-native and native speakers. *Lingua*. **120** (4), pp.901 - 931.

Hopp, H. 2014. Working Memory Effects in the L2 Processing of Ambiguous Relative Clauses. *Language Acquisition: A Journal of Developmental Linguistics*. **21**(3), pp.250 - 278.

Hulstijn, N. 2002. Towards a unified account of the representation, processing and acquisition of second language knowledge. *Second Language Research* .**18** (3), pp. 193–223

Hulstijn, J. 2005. Theoretical and empirical issues in the study of implicit and explicit second language learning. *Studies in Second Language Acquisition*. **27**, pp. 129–40.

Ionin, T. and Wexler, K. 2002. Why is ‘is’ easier than ‘-s’: Acquisition of tense/ agreement morphology by child second language learners of English. *Second Language Research*. **18** (2), pp.95-136.

Ionin, T., Montrul, S., Kim, J. and Philippov, V. 2011. Genericity distinctions and the interpretation of determiners in L2 acquisition. *Language Acquisition*. **18**, pp.242-280.

Izumi, S. 2002. Output, input enhancement, and the noticing hypothesis: An experimental study on ESL Relativization. *Studies in Second Language Acquisition*. **24**, pp. 541-577.

Jegerski, J. 2014. Self-paced reading. In: Jegerski, J., and VanPatten, B. eds. *Research methods in second language psycholinguistics*. New York: Routledge

Jiang, N. 2004. Morphological insensitivity in second language processing. *Applied Psycholinguistics*. **25**, pp. 603–634.

Juffs, A. 2015. Working memory and sentence processing: a brief overview. In: Wen, Z., Mota, M., and McNeill, A. eds. *Working memory in second language acquisition and processing: theory, research and practice*. Bristol, UK: Multilingual Matters.

Juffs, A. and Harington, M. 2012. Aspects of working memory in L2 learning. Language Teaching. **44** (2), pp. 137-166.

Kahoul, W., Vainikka, A. and Young-Scholten, M. 2018. The Mystery of the Missing Inflections. In: Wright, C., Piske, T. & Young-Scholten, M. eds. *Mind Matters in SLA*. Multilingual Matters.

Keating, G., and Farley, A. 2008. Processing Instruction, Meaning-Based Output Instruction, and Meaning-Based Drills: Impacts on Classroom L2 Acquisition of Spanish Object Pronouns. *Hispania*. **91** (3), pp. 639-650

Khan, I. A. 2011. Role of applied linguistics in the teaching of English in Saudi Arabia. *International Journal of English Linguistics.* **1** (1), pp.105-114.

Kormos, J., and Safar, A. 2008. Phonological short-term memory, working memory and foreign language performance in intensive language learning. *Bilingualism: Language and Cognition.* **11,** pp. 261–71.

Krashen, S. 1985. *Principles and practice in second language acquisition*. New York: Pergamon.

Lardiere, D. 1998. Dissociating syntax from morphology in a divergent end-state grammar. *Second Language Research*. **14**, pp.359-375.

Lardiere, D. 2007. *Ultimate attainment in second language acquisition: a case study*. Mahwah, NJ: Lawrence Erlbaum.

Leeser, M.J. 2004. The effects of topic familiarity, mode and pausing on second language learners' comprehension and focus on form. *Studies in Second Language Acquisition*. **26** (4), pp.587 - 615.

Leeser, M. and Demil, A. 2013. Investigating the secondary effects of processing instruction in Spanish: From instruction on accusative clitics to transfer-of-training effects on dative clitics. *Hispania*. **96** (4), pp. 748-762.

Long, M. 1991. Focus on form: A design feature in language teaching methodology. In: de Bot, K., Coste, D., Ginsberg, R., and Kramsch, C. eds. *Foreign-language research in cross-cultural perspective*. Amsterdam: Benjamins.

Long, M., and, Rothman, J. 2013. Generative approaches and the competing systems hypothesis Formal acquisition to pedagogical application. In: W. Schwieter, J. ed. *Innovative Research and Practices in Second Language Acquisition and Bilingualism.* John Benjamins Publishing Company.

Mackey, M and Gass, S. 2005. *Second language research: methodology and design*. Lawrence Erlbaum.

Marinis, T. 2010. Processing methods in typical and atypical populations. In: Unsworth, S. & Blom, E. eds. *Experimental Methods in Language Acquisition Research*. John Benjamins.

Marinis, T. and Cunnings, I. 2018. Using psycholinguistic techniques in a second language teaching setting. In: Wright, C., Piske, T. & Young-Scholten, M. eds. *Mind Matters in SLA*. Multilingual Matters.

Marsden, E. 2006. Exploring Input Processing in the Classroom: An Experimental Comparison of Processing Instruction and Enriched Input. *Language Learning*. **56** (3), pp. 507–566

Marsden, E., and Chen, H. 2011. The roles of structured input activities in processing instruction and the kinds of knowledge they promote. *Language Learning*. **61** (4). pp. 1058-1098.

Mitchell, D. C. 2004. On-line methods in language processing: Introduction and historical overview. In: M. Carreiras & C. Clifton Jr. eds. *The on-line study of sentence comprehension: eye tracking, ERP and beyond*. Brighton. Psychology Press.

Miyake, A. and Friedman, N. 1998. Individual Differences in Second Language Proficiency: Working Memory as Language Aptitude. In: Healy, A. and Bourne, L. eds. *Foreign Language Learning.* Lawrence Erlbaum Associates, Publishers.

Morgan-Short, K. and Wood Bowden, H. 2006. PROCESSING INSTRUCTION AND MEANINGFUL OUTPUT-BASED INSTRUCTION: Effects on Second Language Development. *Studies in Second Language Acquisition*. **28**, pp. 31–65

Norris, J. M., and L. Ortega. 2000. Effectiveness of L2 instruction: a research synthesis and quantitative meta–analysis. *Language Learning*. **50** (3), pp. 417–528.

Osaka, M., and Osaka, N. 1992. Language-independent working memory as measured by Japanese and English reading span tests. *Bulletin of the Psychonomic Society*. **30**, pp.287–89.

Paradis, M. 2009. *Declarative and procedural determinants of second languages*. Amsterdam, John Benjamins.

Pica, T, Kang, H. and Sauro, S. 2006. Information Gap Tasks: Their Multiple Roles and Contributions to Interaction Research Methodology. *Studies in Second Language Acquisition.* **29**, pp. 301-338

Plonsky, L. 2015. ed. *Advancing Quantitative Methods in Second Language Research.* Routledge. New York.

Prévost, P. and White, L. 2000. Missing Surface Inflection or Impairment in Second Language Acquisition? What mental representation does an L2 learner. *Second Language Research*. **16** (2), pp.103-133.

Redford. A. 2004. *English Syntax: An Introduction.* Cambridge University Press

Reber, A. S., Walkenfeld, F. F., and Hernstadt, R. 1991. Implicit and explicit learning: Individual differences and IQ. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. **17**, pp. 888–896.

Roberts, L. 2012. Individual Differences in Second Language Sentence Processing. *Language Learning*. **62** (2), pp. 172-188

Robinson, P. 2005. Cognitive abilities, chunk-strength, and frequency effects in implicit artificial grammar and incidental L2 learning. *Studies in Second Language Acquisition.* **27**, pp. 235–268.

Rothman, J. 2008. Aspectual selection in adult L2 Spanish and the competing systems hypothesis: When pedagogical and linguistic rules conflict. *Languages in contrast*. **8** (1), pp.74-106.

Rothman, J., & VanPatten, B. 2013. On multiplicity and mutual exclusivity: The case for different SLA theories. In: García-Mayo, et al. eds. *Contemporary Approaches to Second Language Acquisition*. pp. 243–256. Amsterdam, The Netherlands, and Philadelphia: John Benjamins Publishing

Sagarra, N. 2008. Working memory and L2 processing of redundant grammatical forms. In: Han, Z. ed. *Understanding second language process*. Clevedon: UK: Multilingual Matters.

Sagarra, N. and Herschensohn, J. 2010. The role of proficiency and working memory in gender and number agreement processing in L1 and L2 Spanish. *Lingua*. **120** (8), pp. 2022 - 2039.

Sawyer, M., Ranta, L., and Robinson, P. 2001. Aptitude, individual differences and L2 instruction. *Cognition and Second Language Instruction*. Cambridge University Press

Snaz, C. 2005. *Mind and context in adult second language acquisition*. *Methods, theory, and practice*. ed. Washington, DC. Georgetown University Press.

Sanz, C. and Morgan-Short, K. 2005. Explicitness in pedagogical interventions: Input, practice and feedback. In. Sanz, C. ed. *Mind and context in adult second language acquisition*. *Methods, theory, and practice*. Washington, DC. Georgetown University Press.

Segalowitz, N. 2003. Automaticity and Second Languages. In: Doughty, C. & Long, M. eds. *The Handbook of Second Language Acquisition.* Blackwell Publishing Ltd.

Schwartz, B. 1993. On explicit and negative data effecting and affecting competence and linguistic behavior. *Studies in Second Language Acquisition*. **15** (2), pp.147–63.

Sharwood Smith, M. 1993. Input enhancement in instructed SLA: Theoretical bases. *Studies in Second Language Acquisition.* **15**, pp.165-180.

Sharwood Smith, M. 2017. Working with working memory and language. *Second Language Research.* **33** (3), pp. 291 –297.

Slabakova, R. 2006. Learnability in the L2 acquisition of semantics: A bidirectional study of a semantic parameter. *Second Language Research*. **22** (4), pp. 1-26.

Slabakova, R. 2013. The Bottleneck of Second Language Acquisition (short version of t is easy and what is hard in second language acquisition: A generative perspective. *Contemporary Approaches to Second Language Acquisition*. **46** (4), pp.543 - 559.

Spada, N., Shiu, J.L. and Tomita, Y. 2015. Validating an Elicited Imitation Task as a Measure of Implicit Knowledge: Comparisons with Other Validation Studies. *Language Learning*. **65** (3), pp.723-751.

Suzuki, Y. and DeKeyser, R. 2017. The Interface of Explicit and Implicit Knowledge in a Second Language: Insights from Individual Differences in Cognitive. *Language Learning*. **67** (4). pp. 1-44

Ullman, M. T. 2005. A cognitive neuroscience perspective on second language acquisition: The declarative/procedural model. In: Sanz, C. ed. *Mind and context in adult second language acquisition*. *Methods, theory, and practice*. Washington, DC. Georgetown University Press.

Van Patten. B and Fernández, C. 2004. The long-term effects of processing instruction. In: B. VanPatten ed. *Processing Instruction: Theory, Research and Commentary.* Mahwah. NJ. Erlbaum.

VanPatten, B. .2002. Processing instruction: An update. *Language Learning*. **52**, pp.755–803.

VanPatten, B. 2003. Input processing in SLA. In: B. VanPatten. ed. *Processing Instruction*. Mahwah, NJ: Lawrence Erlbaum.

VanPatten, B., and Cadierno, T. 1993. Explicit instruction and input processing. *Studies in Second Language Acquisition*. **15**. pp. 225-243.

VanPatten, B. 1996. *Input processing and grammar instruction: Theory and research*. Westport, CT: Ablex.

VanPatten, B. 2004. *Processing instruction: Theory, research, and commentary*. Mahwah, NJ. Erlbaum.

VanPatten, B. 2005. Processing instruction. In: Sanz, C. ed. *Mind and context in adult second language acquisition*. *Methods, theory, and practice*. Washington, DC. Georgetown University Press.

VanPatten, B. 2007. Input Processing in Adult Second Language Acquisition. In: VanPatten, B. and Williams, J. eds. *Theories in Second Language Acquisition*. New York. Routledge.

VanPatten, B. and Borst, S. 2012. The roles of explicit information and grammatical sensitivity in the processing of clitic direct object pronouns and word order in Spanish L2. *Hispania*. **95** (2), pp. 270-284.

VanPatten, B. and Jegerski, J. 2010. Second language Processing and parsing: The issues. In: VanPatten, B. and Jegerski, J. eds. *Research in Second Language Processing and Parsing.* John Benjamins Publishing Company.

VanPatten, B., and Oikkenon, S. 1996. Explanation vs. structured input in processing instruction. *Studies in Second Language Acquisition*. **18**, pp. 495–510.

VanPatten, B., Gregory D; Leeser, Michael J. 2012. Missing verbal inflections as a representational problem: Evidence from self-paced reading. *Linguistic Approaches to Bilingualism*. **2** (2), pp.109-140.

VanPatten, B., Wong, W. and Weber-Feve. S. 2011. Beyond soda and popcorn: Using film to promote language development. *Annual Convention of the American Association of Teachers of French*. Montreal. CA.

VanPatten, B., & Rothman, J. 2014. Against "rules". In: Laval, C. & Arche, M. J. eds. *The grammar dimension in instructed SLA: Theory, research, and practice*. pp. 15–36. London: Continuum Press

VanPatten, B. & Jegersky, J. 2014. *Research Methods in Second Language Psycholinguistics.* New York. Routledge.

Vainikka, A. and Young-Scholten, M. 1996. Gradual development of L2 phrase structure. *Second language research.* **12** (1), pp.7-39.

Waters, S., and Caplan, D., 1996. The measurement of verbal working memory capacity and its relation to reading comprehension. *Quarterly Journal of Experimental Psychology*. **49,** pp. 51–79.

Wen, Z. 2015. *Working Memory and Second Language Learning: Towards an Integrated Approach*. Multilingual Matters.

White, L. 2003a. Fossilization in steady state L2 grammars: Persistent problems with inflectional morphology Bilingualism. *Language and Cognition*. **6** (2), pp.129 - 141.

White, L. 2003b. Second language acquisition and universal grammar. Cambridge University Press.

Whong, M., Gil, K., Marsde, H. 2014. Beyond paradigm: The ‘what’ and the ‘how’ of classroom research. *Second language research*. **30** (4), pp.551-568

Wong, W. 2013. Input and Output in SLA. In: Schwieter. J. ed. *Innovative Research and Practices in Second Language Acquisition and Bilingualism*. John Benjamins Publishing Company.

Wright, C. 2010. *Role of working memory in SLA*. VDM Verlag Dr. Muller

Wright. C. 2013. An investigation of working memory effects on oral grammatical accuracy and fluency in producing questions in English. *TESOL Quarterly*. **47** (2), pp.352-374

Wu, S., and Ortega, L. 2013.Measuring global oral proficiency in SLA research: A new elicited imitation test of L2 Chinese. *Foreign Language Annals*. **46**, pp. 680–704.

Yan, X., Maeda, Y., and Ginther, A. 2016. Elicited imitation as a measure of second language proficiency: A narrative review and meta-analysis. *Language Testing*. **33** (4), pp. 497 –528

APPENDIX A

Explicit information:

-Third-person-singular -*s*

The third-person-singular -*s* is used in the present tense to talk about singular nouns (girl, car, dog) and with the pronouns (he, she and it). It refers to habitual actions and events. All English verbs end with -*s* as the following examples:

-*Sara goe**s** to school*

-*The cat need**s** new water*

However, when you talk about a habitual action or event in the present, the present tense is often accompanied by a temporal adverb:

-*Sara goe**s** to school **everyday***

-***Every morning**, the cat need**s** new water*

DO NOT RELY ON THE TEMPORAL ADVERB TO UNDERSTAND WHEN THE ACTION TAKES PLACE AS SOMETIMES YOU CAN HEAR A SENTENCE WITHOUT THE TEMPORAL ADVERB.

YOU MUST PAY ATTENTION THE TENSE ENDING TO UNDERSTAND WHEN THE ACTION TAKES PLACE.

IN THE CASE OF DESCRIBING PRESENT HABITUAL EVENTS, PAY ATTENTION TO THE ENDING OF THE VERB: -*s*

-Simple past tense -*ed*

The simple past form -*ed* is used in the past tense to talk about singular and plural nouns and pronouns. It refers to actions and events that took place in the past. Most English past tense verbs end with -*ed* as the following examples:

-*I call**ed** Sara three times*

-*The family lik**ed** their new car*

-*The dog need**ed** more food*

However, when you talk about an action or event that happened in the past, the past tense is often accompanied by a temporal adverb:

-***Yesterday**, I call**ed** Sara three times*

-*The dog need**ed** more food **last night**.*

DO NOT RELY ON THE TEMPORAL ADVERB TO UNDERSTAND WHEN THE ACTION TAKES PLACE AS SOMETIMES YOU CAN HEAR A SENTENCE WITHOUT THE TEMPORAL ADVERB.

YOU MUST PAY ATTENTION THE TENSE ENDING TO UNDERSTAND WHEN THE ACTION TAKES PLACE.

IN THE CASE OF DESCRIBING PAST EVENTS PAY ATTENTION TO THE ENDING OF THE VERB: *-ed*

-The present progressive *-ing*

The present progressive *-ing* indicates continuing action, something going on now. This tense is formed with "to be" verb (am, is, are), in the present tense. All English verbs end with *-ing* as the following examples:

- *I **am** walk**ing** to the supermarket*
- *The boys **are** play**ing** football outside*

However, it is unlikely to have temporal adverbs that accompany the present progressive tense *-ing*.

YOU MUST PAY ATTENTION TO THE TENSE ENDING TO UNDERSTAND WHEN THE ACTION TAKES PLACE.

IN THE CASE OF DESCRIBING EVENTS THAT ARE GOING ON NOW, PAY ATTENTION TO THE ENDING OF THE VERB: -*ing*

APPENDIX B

Teaching materials

- Structured input (SI) activities

a- Third-person-singular -*s*

1- Referential activity

You will read 10 sentences and hear another 10 sentences and you need to determine whether the action takes place every day (present) or has already taken place (past).

	Present	Past
1-	( )	( )
2-	( )	( )

Instructor's script: (10 correct sentences that match the present tense and 10 incorrect sentences)

1-Sara takes the bus to her school

2-The car needed gas

3-The boy delivered the package

4-The cat drinks milk

5-The family goes to the beach to enjoy the weather

6-Nora walked to the library to borrow some books

7-She likes to read English novels

8-The father takes his children to the dentist

9-The mother cooked dinner for her family

10-Sara eats salad for lunch at her school

11-The baker baked fresh pastries

12-The boy jumped high to catch the ball

13-He exercises in the school playground

14-The school closed the playground for maintenance

15-He needs to find another place to exercise

16-The girl used her pocket money to buy new books

17-She collected a large number of novels

18- The family planned their summer vacation

19-The mother prefers warm places and sea

20-The father plans everything in advance to avoid stress

2- Affective activity

Read the following sentences, and indicate to what extent you agree or disagree. Then compare your views with your partner.

strongly agree	agree	disagree	strongly disagree
( )	( )	( )	( )

Instructor's script: (20 correct sentences)

1-Ahmad drinks Coke Cola.

2-Ahmad boy cleans his room.

3-The cat plays with the plants in the garden.

4-Nora starts her day with fresh coffee.

5-The family plans early for their holiday.

6-The father teaches his son boxing.

7-The mother takes her daughter to a cooking class.

8-Nora eats fast food and drinks soft drinks.

9-The dog sleeps with the boy in his bedroom.

10-Nora invites her friend without her mother permission.

11-The mother cleans her daughter bedroom

12-The father exercises with his son

13-Nora plays with her iPhone during lunch

14-Ahmad spends three hours playing video games

15-The mother prepares breakfast for children

16-The father drives the children to their schools

17-Ahmad attends the school football club

18-Nora joins her friend in the after-school clubs

19-The mother irons the uniforms of her children

20-The father buys groceries from the local market

More activities will be provided and will follow the same criteria. Explanations and discussions will be provided for the participants whenever it is needed.

b- The simple past tense *-ed*

1- Referential activity

You will read 10 sentences and hear 10 sentences and you need to determine whether the action takes place in the present or has already taken place (past).

Present Past

1- ( ) ( )

2- ( ) ( )

Instructor’s script: (10 correct sentences that match the past tense and 10 incorrect sentences)

1-Nora liked the new café near her house.

2-I listen to classic music.

3-The postman delivered the package on time.

4-The company created new space for customers.

5-The family goes to the local market to buy grocery.

6-The father used his savings to build the new house.

7-The mother arranges her children bedrooms.

8-The cat ruined the plants in the garden.

9-the boys play football at the playground.

10-Nora invited her friends for her birthday.

11-The family booked 4 tickets to watch the new movies

12-The mother packs lunch for her children

13-The father called the restaurant to reserve a table

14-The restaurant takes reservation for large groups only

15-Ahmad kicked the ball very high

16-Ahmad tried to get the ball from the neighbour’s house

17-Nora takes cooking lessons at her school

18-She cooks very delicious cakes and pastries

19-The mother attends physical therapy sessions

20-The father drives the mother to her sessions

More activities will be provided. Explanations and discussions will be provided for the participants whenever it is needed.

2- Affective activity

Listen to the instructor making a series of statements and indicate whether you did the same thing at the weekend.

Me too I did not

( ) ( )

Instructor’s script: (20 correct sentences)

1-I visited my grandparents.

2-I watched a movie.

3-The family visited the museum.

4-Ahmad worked on his school project.

5-Nora invited her friend to her house.

6-I watched a new movie at the cinema.

7-Ahmad played football with his friends.

8-I listened to classic music.

9-I exercised in my garden.

10-The family hosted a family and friends gathering.

11-I planted some flowers in my garden

12-I washed the laundry and arranged my bedroom

13-Nora borrowed some books from the library

14-The family tried a new restaurant

15-Nora attended a new show at the theatre

16-Ahmad finished his school project

17-The family travelled for three days

18-The family booked a city tour

19- Nora relaxed during the weekend

20-Ahmad rehearsed his presentation

More activities will be provided. Explanations and discussions will be provided for the participants whenever it is needed.

c- The present progressive -*ing*

1- Referential activity

You will read 10 sentences and hear 10 sentences and you need to determine whether the action is happening now (present) or has already taken place (past).

Present (now)	Past
1- ( )	( )
2- ( )	( )

Instructor's script: (10 correct sentences that match the present progressive and 10 incorrect sentences)

1-The cat is sleeping quietly.

2-I had fresh orange juice before school.

3-The family is enjoying their vacation.

4-Ahmad liked to watch action movies

5-Nora is planning her summer vacation activities.

6-She decided to join a cooking class.

7-Ahmad is thinking about his next semester courses.

8-He is taking six courses next year.

9-I borrowed three books from the city library.

10-I am going to the library to return the books.

11-I am walking from the office to the library

12-Ahmad discussed his summer plans with his family

13-Nora is joining her school summer clubs

14-The father is taking some time off his job

15-The mother started to pack the bags

16-Ahmad talked to his friends about his plans

17-Nora learned a lot of new recipes

18-She is cooking delicious food for her family

19-The mother prepared delicious sandwiches for her family

20-She baked pies and cakes for their family trip

More activities will be provided. Explanations and discussions will be provided for the participants whenever it is needed.

20- Affective activity

Watch the clips, then listen to the instructor describing the clip and making a series of statements. Indicate whether you agree or not, then compare your views with your partner.

Strongly agree	agree	disagree	strongly disagree
( )	( )	( )	( )

Instructor's script: (20 correct sentences)

1-The waiter is laughing out loud.

2-The cat is sleeping on the couch.

3-Nora is eating a lot of sugar and processed food.

4-Ahmad is exercising in his room.

5-The restaurant is serving new menu for the summer.

6-I am taking a summer job instead of a vacation.

7-The family is planning their budget for next year.

8-Ahmad is adding a lot of vegetable and fruit to his diet.

9-I am swimming three times a week.

10-Nora is sleeping all day.

11-Ahmad is jogging in the park

12-Nora is reading a new book

13-The mother is cooking food without using oils

14-The father is driving fast to get to his job on time

15-The waiter is eating from the customers plates

16-The cat is playing with garden plants

17-Nora is adding a lot of sugar to her tea

18-The mother is using healthy ingredients in her recipes

19-The restaurant is offering a special discount for students

20-The waiter is cleaning the tables with a dirty towel

More activities will be provided. Explanations and discussions will be provided for the participants whenever it is needed.

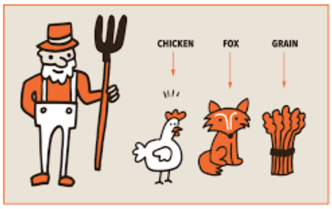
APPENDIX C

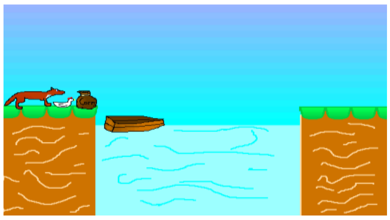
PI modified instructional Affective tasks

1- Third-person-singular -*s* affective task

A- Read the following puzzle and look at the pictures provided to give you a clue for the solution. Work in pairs and think about the steps that need to be taken in order to help the man. After that, you need to make a poster to show the steps with a sentence under each step explaining your solution. Copies of the pictures are available for you to use in the poster.

Chicken Crossing Solution!





-The puzzle

A man has to get a fox, a chicken and a sack of corn across a river. He has a rowboat, and it can only carry him and one other thing. If the fox and the chicken are left together, the fox will eat the chicken. If the chicken and the corn are left together, the chicken will eat the corn. **How does the man do it?**

The answer:

1- The man and the chicken cross the river, (the fox and corn are safe together)

2- He leav**es** the chicken on the other side

3- He go**es** back across.

4-The man then tak**es** the fox across the river.

5- Since he can't leave the fox and chicken together, he bring**s** the chicken back.

6-Again, since the chicken and the corn can't be left together, he leav**es** the chicken and tak**es** the corn across

7-He leav**es** the corn with the fox.

8-He then returns to pick up the chicken and heads across the river one last time.

B- Read the following paragraph about what the class teacher did last year to improve her class grades. The teacher needs advice of how to improve her plan in order to encourage her students to attend all classes and get better grades.

After reading the paragraph, work in pairs, discuss and share opinions about the teacher's work plan, then work together to fill in the form. You need to decide what the teacher needs to improve and what she needs to keep doing. This form is important to the teacher in order to review and improve her work for this year.

The sixth-grade school teacher decided to change some of her class rules to encourage students to work harder and get better grades. Her work plan included the following points:

First, every semester the teacher give**s** a prize for the student who does not miss classes unless it is because of sickness. Second, every week, she take**s** the class to a gelato shop if all students complete their weekly homework. Third, at the end of each month, she check**s** the reading records, announce**s** the best reader of the class and assign**s** her a job of her choice. Finally, at the beginning of each month, she divide**s** the students into groups and assign**s** each group a job. At the end of the month, the teacher check**s** their work and award**s** the best group with extra grades for homework.

The form

What the teacher needs to improve, please give suggestions	What the teacher needs to keep
Every week, 1- 2-	 1- 2-
Every month, 1- 2-	 1- 2-
Every semester, 1- 2-	 1- 2-

2- Past tense form *-ed* affective task

A- The police are investigating an incident that happened last week. They asked for help from people who live in the area. Watch the clip, then work in pairs in order to decide who was the suspect and what could have happened. After you discuss the crime with your partner, work in pairs to fill in the police form in order to help them with their investigation.

YouTube clip: 4 minutes

North police department			Investigation form
Name:			Address:
Please provide the police with the possible suspect and scenario for the murder that happened on Wednesday afternoon, 11/09/ 2018			If you know any other information or people who might help the investigation, please provide their names.
The suspect:			
Scenario: what do you think happened on that day?			
What did happen at 9:00 a.m?	What did happen at 12: 00 p.m?		What did happen after the murder?
e.g. suspect 1 called his secretary to book him a return ticket.			

B- A holiday magazine is offering a prize for the best holiday activity plan!

They magazine is asking the readers to enter the competition and submit a family summer holiday plan for 2019 and the winner wins a free trip to a tropical destination! The readers need to follow the link provided to listen to a recording about a family holiday plans that took place last summer.

Listen to the recording about a family activity plan for last summer. After that, work in pairs and discuss with your partner if you had similar activities or different ones. Work together to fill in the summer activity form in order to come up with the best summer activity plan that could win the prize of the travel magazine. Write as many activities as you can remember.

The schedule

What the family did last summer?	What student (1) did last summer?	What student (2) did last summer?
1-		
2-		
3-		
4-		
5-		

-Now, work together to decide what is the best holiday activity plan during summer vacation?

1-

2-

3-

3- Present progressive [ing] affective task

A- Role-play: Guess who?

In order to get the leading role in the school play, you need to get the highest score!

Work in pairs, you will have 6 cards, three for each student. Each card has a role that you need to act silently to your partner and she needs to describe what you are doing to guess who are you. You have to hide your cards from your partner. You need to fill in the table with sentences of your description and the student who gets all the correct descriptions will win the challenge.

1st role: a busy chef in a popular restaurant

2nd role: a busy taxi driver caught in traffic

3rd role: a famous Hollywood actress

4th role: a journalist in an important interview

5th role: a busy mom feeding her children and changing their clothes

6th role: a famous fashion designer in a fashion show

	Role 1 description	Answer	Role 2 description	Answer	Role 3 description	Answer
Student A	e.g. she is cutting the vegetables					
Student B						
Total points						

B- Who is the best commentator?

In order to be the commentator for your school match, you need to get the highest score!

Watch the football clip (2 minutes clip of a popular football teams) you can play it for a second time, take some time to prepare, then act as a commentator for you partner. Your partner needs to record you while commenting, in order to compare both recordings and decide the best commentator. Please fill in the form while listening to the recordings to help you making your decision, then present the from to your colleagues and teacher in order to get the final decision.

	Comments
Commentator 1	e.g. player 1 is passing the football to player 3
Commentator 2	

APPENDIX D

Assessment tests

A- Processing tasks (self-paced reading)

-The author of this story needs your help!

The author needs an editor to check her story. She sends her sentences to you and she will be waiting for your response. **Can you help her!**

First, read this short introduction of her story, then the sentences will follow:

Sara and Nora are best friends. They are in their third year of university. They knew each other since high school. At their first year of university, each one of them chose a different major. Sara chose to study chemistry and Nora chose to study English language. With study pressure and full schedules, they could not spend much time together. Thus, they ended up having their individual activities.

-Read the sentences on the laptop screen. You will read in a word by word fashion; you need to press the space key to display the following word. After you read the whole sentence, you will have a truth value judgment that you need to answer by choosing one of two options true or false. You need to press **T** for true **or F** for false on the key pad. You have to read in a fast pace, then choose immediately the correct option. The following sentences will follow the same procedure.

The first four sentences are for practice. If you have any question please ask the instructor before you start the task.

-Practice sentences

1-Every morning, Sara have to arrange her bedroom before going to the university.

2-Last night, Nora had to cook dinner for her family.

3-Yesterday, Sara's family has a big family gathering.

4- Nora is the eldest daughter in her family.

A- Third-person-singular -*s* (Agreement):

√	×

Stimuli	Inflection	Truth-value judgment	Condition
1-Every day, Nora start her day with fresh coffee.	Third-person-singular [s]	Q1: Nora starts her day with fresh orange juice. T or F	Third-person-singular/subject-verb disagreement/present/habitual/singular
2-But sometimes, she begins her day with fresh orange juice.	Third-person-singular [s]	Q2: Nora drinks orange juice.	Third-person-singular/subject-verb agreement/present/habitual/singular

		T or F	
3-On Monday, she arranges her bedroom before leaving.	Third-person-singular [s]	Q3: She cleans her toilet on Monday. T or F	Third-person-singular/subject-verb agreement/present/habitual/singular
4-Every Morning, she <u>hire</u> a taxi to go to the University.	Third-person-singular [s]	Q4: Nora takes the bus to the university. T or F	Third-person-singular/subject-verb disagreement/present/habitual/singular
5-But sometimes, she takes the bus if she is not late.	Third-person-singular [s]	Q5: She takes the bus when she is late. T or F	Third-person-singular/subject-verb agreement/present/habitual/singular
6-On Tuesday, Nora <u>meet</u> her best friend Sara after class.	Third-person-singular [s]	Q6: Mariam is Nora's best friend. T or F	Third-person-singular/subject-verb disagreement/present/habitual/singular
7-On Saturday, Nora <u>cook</u> lunch for her family.	Third-person-singular [s]	Q7: Nora cooks lunch every Saturday. T or F	Third-person-singular/subject-verb disagreement/present/habitual/singular
8-But sometimes, Sara helps Nora with the cooking.	Third-person-singular [s]	Q8: Mariam helps Nora with the Saturday lunch. T or F	Third-person-singular/subject-verb agreement/present/habitual/singular
9-On Friday, Nora <u>watch</u> her favourite TV show with her family.	Third-person-singular [s]	Q9: Nora watches her favourite show with her friends. T or F	Third-person-singular/subject-verb disagreement/present/habitual/singular
10-Every evening, Nora reads some books before bed time.	Third-person-singular [s]	Q10: Nora likes reading in the night. T or F	Third-person-singular/subject-verb agreement/present/habitual/singular
11- Every morning, Sara drinks coffee before her breakfast.	Third-person-singular [s]	Q10: Sara likes drinking coffee in the morning. T or F	Third-person-singular/subject-verb agreement/present/habitual/singular
12- Every afternoon, Sara <u>prepare</u> lunch for her family.	Third-person-singular [s]	Q9: Sara prepares lunch for her friends every afternoon T or F	Third-person-singular/subject-verb disagreement/present/habitual/singular

B- Regular past tense form *-ed* (Tense):

Stimuli	Inflection	Truth value judgment	Condition
1-Last weekend, Nora planned a graduation party for Sara.	Regular past tense form [ed]	Q1: Nora planned a birthday party. T or F	past tense/adverb-verb agreement/Redundant
2-Last Thursday, Nora needed to shop for the party.	Regular past tense form [ed]	Q2: Nora went shopping last Thursday. T or F	past tense/adverb-verb agreement/Redundant
3-Last Wednesday, she decide to pick a party theme.	Regular past tense form [ed]	Q3: Nora decided on the theme after the party. T or F	past tense/adverb-verb disagreement
4-Last weekend, she select a Victorian theme for the party.	Regular past tense form [ed]	Q4: Nora chose a fairy tale theme for Sara's party. T or F	past tense/adverb-verb disagreement
5-Last Friday, Sara search for a new Victorian novel.	Regular past tense form [ed]	Q5: Sara likes Victorian novels. T or F	past tense/adverb-verb disagreement
6- Nora called Sara to check if she is available.	Regular past tense form [ed]	Q6: Nora did not check if Sara is available. T or F	past tense/adverb-verb agreement/Non-redundant
7- Sara said she was free in the weekend.	Regular past tense form [ed]	Q7: Sara was not free in the weekend. T or F	past tense/adverb-verb agreement/Non-redundant
8-Last Sunday, Sara change her weekend plans.	Regular past tense form [ed]	Q8: Sara had new plans in the weekend. T or F	past tense/adverb-verb disagreement
9-Last Sunday, Nora manage to convince her to change her plans.	Regular past tense form [ed]	Q9: Nora succeeded in changing Sara's plans. T or F	past tense/adverb-verb disagreement
10-Last Saturday, Nora checked the cake shop.	Regular past tense form [ed]	Q10: Sara checked the cake shop. T or F	past tense/adverb-verb agreement/Redundant
11- Sara agreed on Nora's plans for the weekend	Regular past tense form [ed]	Q11: Sara could not join Nora in the weekend	past tense/adverb-verb agreement/non-Redundant
12-Last Friday, Nora's sister join Nora in her visit to the cakeshop.	Regular past tense form [ed]	Q9: Nora's sister did not agree to join Nora to visit the cakeshop. T or F	past tense/adverb-verb disagreement

C-Present progressive tense *-ing* (Aspect)

Stimuli	Inflection	Truth value judgment	Condition
1-Sara: I am calling to check on you.	Present progressive tense form [ing]	Q1: Nora is asking about Sara. T or F	present continuous/auxiliary + ing form of the verb agreement
2-Nora: I am doing fine thanks what about you.	Present progressive tense form [ing]	Q2: Nora is fine. T or F	present continuous/auxiliary + ing form of the verb agreement
3-Sara: ok, I <u>watching</u> a new movie on Channel 4.	Present progressive tense form [ing]	Q3: Sara is watching the news. T or F	present continuous/missing auxiliary-ing form of the verb (disagreement)
4-Nora: I am cooking dinner for my family tonight.	Present progressive tense form [ing]	Q4: Nora is busy preparing dinner. T or F	present continuous/auxiliary +ing form of the verb agreement
5-Nora: I am <u>prepare</u> chicken curry and Jasmin rice.	Present progressive tense form [ing]	Q5: Nora is cooking lamb curry. T or F	present continuous/auxiliary + missing [ing] form of the verb (disagreement)
6- Sara: Delicious, we <u>planning</u> a trip to the beach, can you join us.	Present progressive tense form [ing]	Q6: Sara's family are going to the desert. T or F	present continuous/missing auxiliary + ing form of the verb (disagreement)
7- Nora: I am working on my project; sorry I can't come.	Present progressive tense form [ing]	Q7: Nora can't go because of her project. T or F	present continuous/auxiliary + ing form of the verb agreement
8- Sara: I am <u>do</u> nothing tomorrow, do you need help?	Present progressive tense form [ing]	Q8: Sara is offering her help to Nora. T or F	present continuous/auxiliary + missing [ing] form of the verb (disagreement)
9- Nora: Maryam is helping me out, thanks dear.	Present progressive tense form [ing]	Q9: Nora's mother is helping her with the project. T or F	present continuous/auxiliary + ing form of the verb agreement
10- Nora: Maryam is look for participants for my project.	Present progressive tense form [ing]	Q10: Nora's sister is shopping for her project. T or F	present continuous/auxiliary+ missing [ing] form of the verb (disagreement)

11-Sara: great, I going to the market to shop for the trip.	Present progressive tense form [ing]	Q11: Sara is going to the library to read some books. T or F	present continuous/ missing auxiliary+ [ing] form of the verb (disagreement)
12-Nora: I am planning to go to the market tomorrow.	Present progressive tense form [ing]	Q12: Nora is going to the market today. T or F	present continuous/auxiliary + ing form of the verb agreement

B-Comprehension tasks (Interpretation task)

-Read the following sentences and indicate whether the action habitually occurs, occurred last week or is happening now (Benati, 2005):

Listen to each sentence and indicate whether the action habitually occurs, occurred last week or is happening now.

Last week Habitually occurs Right now Cannot tell

( ) ( ) ( ) ( )

√	×

ID	Stimuli	Inflection
1_ed	1-I visited my best friend	[ed]
1_s	2-He plays chess with his father	[s]
1_dis	3-She need the library	Distractor
1_ing	4-The cat is sleeping quietly	[ing]
2_dis	5- They are swim in the pool	Distractor
2_s	6-Sara drinks fresh orange juice	[s]
2_ed	7-Nora started her course	[ed]
2_ing	8-Nora and Sara are swimming in the pool	[ing]
3_dis	9-Sara clean her room	Distractor
3_ed	10-The family planned the weekend activities	[ed]
3_ing	11-The family is going to the beach	[ing]
3_s	12-Sara joins the book club at her university	[s]
4_ed	13-The boy kicked the ball very high	[ed]
4_dis	14-Three girls playing in the garden	Distractor
4_s	15-The boy needs to take his medicines	[s]
4_ing	16-I am going to the new supermarket	[ing]
5_s	17-The dog runs to the neighbours	[s]
5_ing	18-We are helping the school in the event	[ing]
5_dis	19- The baby cry for a long time	Distractor

5_ed	20-The girls learned a new song for the event	[ed]
6_s	21-Sara takes the bus to her university	[s]
6_ed	22-Nora watched the new movie at the cinema	[ed]
6_ing	23-Sara is taking Nora to watch the new movie	[ing]
6_dis	24-The girls are have fun time together	Distractor
7_ed	25-I talked to Sara about next week plans	[ed]
7_ing	26-Sara is thinking to join me on my trip	[ing]
7_dis	27-She seem excited about my plans	Distractor
7_s	28-Sara visits her grandmother at the hospital	[s]
8_ed	29-I joined Sara in her visit to her grandmother	[ed]
8_ing	30-Her grandmother is staying there for three weeks	[ing]
8_s	31-Sara cares about her grandmother health	[s]
8_dis	32-She looking after her	Distractor
9_s	33-She organises her medications and her meals	[s]
9_ed	34-I decided to help Sara with her grandmother	[ed]
9_ing	35- I am enjoying my time when helping other people	[ing]
9_dis	36- Sara thank me for helping her out	Distractor
10_s	37-The family leaves their house early	[s]
10_ing	38-I am working on my final project	[ing]
10_dis	39-Nora ask Sara for help with her homework	Distractor
10_ed	40-Sara helped Nora with her homework	[ed]

C- Production tasks (elicited imitation)

√	×

-Listen to the following sentences and repeat what you have heard as closely as possible in correct English:

ID	Sentence	Inflection	Condition
1_s	1- Every Saturday, Sara plays games with her family	[s]	Third-person-singular agreement
1_s*	2- Sara <u>watch</u> a scientific documentary every Monday	[s]	Third-person-singular violation
1_ed	3-Sara played chess with her father last Sunday	[ed]	Past tense agreement
1_ed*	4-Yesterday, Nora <u>borrow</u> two books from the library to get ready for her exam	[ed]	Past tense violation
1_ing	5- Nora is studying for her grammar exam	[ing]	Present progressive tense agreement
1_ing*	6- Nora is think about meeting her best friend Sara tomorrow	[ing]	Present progressive tense violation/missing inflection
2_s	7-Sara chats with Nora for a long time when they are free.	[s]	Third-person-singular agreement
2_s*	8-Every month, Nora study hard for her grammar exam.	[s]	Third-person-singular violation
2_ed	9-Last weekend, Sara and Nora enjoyed the birthday party.	[ed]	Past tense agreement
2_ed*	10-Last weekend, Sara <u>ask</u> Nora for help in her English language assignment	[ed]	Past tense violation
2_ing	11-Nora is helping Sara with her difficult homework	[ing]	Present progressive tense agreement
2_ing*	12-They working together in order to finish before the deadline	[ing]	Present progressive tense violation/missing auxiliary
3_s	13- Every week, Nora brushes her cooking tools before the cooking class	[s]	Third-person-singular agreement
3_s*	14-Every week, Nora pack a lot of ingredients for her cooking class	[s]	Third-person-singular violation
3_ed	15-Last night, Sara talked to Nora for 30 minutes on the phone	[ed]	Past tense agreement
3_ed*	16- Yesterday, Nora help Sara during her first cooking lesson	[ed]	Past tense violation
3_ing	17-Nora is cooking dinner for her family	[ing]	Present progressive tense agreement

3_ing*	18-Sara is read a new novel to prepare for her class	[ing]	Present progressive tense violation/missing inflection
4_s	19- Nora owns a large number of cooking books	[s]	Third-person-singular agreement
4_s*	20-Nora clean the kitchen top at the end of each class.	[s]	Third-person-singular violation
4_ed	21- Yesterday, Sara called Nora three times to discuss their weekend plans	[ed]	Past tense agreement
4_ed*	22-Last Friday, Nora join Sara in a chess game at the chess club	[ed]	Past tense violation
4_ing	23-Sara and Nora are taking chess classes	[ing]	Present progressive tense agreement
4_ing*	24- They enjoying the chess club activities	[ing]	Present progressive tense violation/missing auxiliary

D- Listening span working memory task (LST)

The following instructions were displayed at the beginning of the test and the task started with 4 sentences for practice.

- ستقومين بسماع بعض الجمل من مقال، بعض الجمل منطقية و صحيحة و بعضها غير منطقية و غير صحيحة.

يرجى التركيز في سماع الجمل مع حفظ اخر كلمة في الجملة ، و من ثم اختيار (T) أو (F) من على لوحة المفاتيح. بعد الانتهاء من كل مجموعة ، يرجى كتابة الكلمات التي تم سماعها والواردة في اخر الجمل بسرعة خلال الوقت المتاح بين كل مجموعة (15) ثانية.

المجموعة الأولى ستكون للتدريب فقط ، يرجى الاستفسار عند وجود أي غموض.

First set:

1- أسس المهاجران الايطاليان برونو و شقيقه سيرجيو كوستا العاطلان عن العمل

2- في عام 1971 مقهى لندن العاصمة البريطانية في كوستا

3- إثر عدم استطاعتهما الحصول على كوب قهوة بسعر مناسب

Second set:

1- كان معونة اجتماعية يتقاضيان برونو و سيرجيوللعاطلين من الحكومة البريطانية

2- ويريان أن دفعهما مبلغا كبيرا في كوب قهوة سيودي براتبهما

3- واتفقا أن يفتتحا قهوتهما المفضلة يوفر لهما ولأصدقائهما مقهى صغيرا

4- بسعرمناسب في متناول أصحاب ذوي الدخل المحدود

Third set:

1- كان الأمر في غاية التمويل، فكيف سيجلبان الصعوبة لشراء الأدوات؟

2- وكيف سيسددان إيجار المحل؟ ومن سيعلمهما أصول صناعة القهوة الإيطالية؟

3- نشرا اعلانا: عاطلان نحن مهاجران إيطاليان عن العمل

4- نعمل على افتتاح في إعداد القهوة بسيطة لكن خبرتنا مقهى صغير

5- ولا نملك تمويلا و نريد مساعدتكم ، تلقيا أربعة اتصالات تعرض عليهما المساعدة

Fourth set:

1- أهمها من الايجار إيطالي عرض عليهما أن يسدد عنهما لعامين مهاجر مقدما

2- ويتكفل بإرسالهما وإقامتهما في إيطاليا لمدة شهر للعمل على إتقان صناعة القهوة

3- شريطة أن يلتزما بتقديم القهوة الايطالية بتكلفة منخفضة

Fifth set:

1- وأن يعيدا إليه ما دفعه متى ما حقق المقهى أرباحا

2- سافرا إلى متخصصين ايطاليين وتعلما ما تيسر على أيدي ميلانو

3- وعادا الصغير جدا ، وشرعا في الترتيبات لافتتاح المقهى الى لندن

بمساعدة أصدقائهما الذين أقرضوهما حتى يبصر المقهى النور-4

Sixth set:

تردد على المقهى الزبائن من أصول إيطالية ليس طمعا في قهوة متميزة-1

بل تعاطفا ومساعدة لهما و دعما لمشروعهما الصغير-2

وكبر المقهى قليلا إثر حرص القهوة على تناول الجالية الايطالية في المقهى-3

يقول سيرجيو: لم نكن نبيع أفضل قهوة، لكن الناس تفضل القهوة من إيطاليين-4

كما تهوى أيضا تناول متخصصين ايطاليين من البيتزا-5

English translation:

First set:

1- Unemployed Italian immigrants, Bruno and Sergio Costa founded
2- In 1971, British Capital London in Costa
3- Because they could not get an affordable cup of coffee

Second set:

1-Social aid received Bruno and Sergio for unemployed from the UK government
2-They thought that paying too much money for a cup of coffee will waste their aid
3-They agreed to open up their favourite coffee provided them and their friends small coffee shop
4- For unaffordable price suitable for low-income individuals

Third set:

1- It was very funding, so how will they bring difficult to but supplies
2- How will they pay rent and who will teach them the principles of Italian coffee making?
3- They posted an advertisement: Unemployed we Italian immigrants
4- We are working on opening in making simple coffee but our experience small coffee shop
5- And we do not have funding and we want your help, they received four phone calls

Fourth set:

1-The most important offer was from rent Italian who offered to pay two years immigrant in advance
2- He offered to fly them to Italy and pay for their stay for a month to master coffee making
3-Provided that they commit to serve affordable Italian coffee

Fifth set:

1- And that they would pay him back once the coffee shop making profits
2- They travelled to Italian experts and learned everything they could from Milan
3- They returned the very small and began preparations to open up the coffee shop to London
4- With the help of their friends who lens them money to open up the coffee shop

Sixth set:

1- Italian customers visited the coffee shop not only to but goof coffee
2- But in solidarity and support of their small project
3- The coffee shop grew slowly because of insuring coffee to have Italian people in the coffee shop
4- Sergio says: We were not selling the best coffee but people prefer buying coffee from Italians
5- As they like having Italian experts from Pizza

APPENDIX E

The Secretariat
University of Leeds
Leeds, LS2 9JT
Tel: 0113 343 4873
Email: ResearchEthics@leeds.ac.uk

UNIVERSITY OF LEEDS

Aljuhara Alhussaini
Linguistics and Phonetics
SLCS
University of Leeds
Leeds, LS2 9JT

Faculty of Arts, Humanities and Cultures Research Ethics Committee
University of Leeds

30 May 2021

Dear Aljuhara

Title of study	**Processing instruction and working memory in processing morphological inflections: The case of [s], [ed] and [ing]**
Ethics reference	**PVAR 17-129**

I am pleased to inform you that the above research application has been reviewed by the Faculty of Arts, Humanities and Cultures Research Ethics Committee and following receipt of your response to the Committee's initial comments, I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

Document	Version	Date
PVAR 17-129 Ethical_Review_Form_ Aljuhara Alhussaini (Main study).doc	2	01/08/18
PVAR 17-129 Participant information sheet.docx	2	01/08/18
PVAR 17-129 Participants background information.docx	1	01/08/18
PVAR 17-129 Consent form.docx	1	19/07/18
PVAR 17-129 Fieldwork_Assessment_Form_low_risk Aljuhara Alhussaini (Main study).docx	1	19/07/18

Please notify the committee if you intend to make any amendments to the information in your ethics application as submitted at date of this approval as all changes must receive ethical approval prior to implementation. The amendment form is available at http://ris.leeds.ac.uk/EthicsAmendment.

Please note: You are expected to keep a record of all your approved documentation and other documents relating to the study, including any risk assessments. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at http://ris.leeds.ac.uk/EthicsAudits.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

Yours sincerely

Jennifer Blaikie
Senior Research Ethics Administrator, the Secretariat
On behalf of Prof Robert Jones, Chair, AHC FREC

CC: Student's supervisor(s)

School of Languages, Cultures and Societies
University of Leeds
Leeds
LS2 9JT
United Kingdom

UNIVERSITY OF LEEDS

Participant's information sheet

Research title: Processing instruction and working memory in processing morphological inflections: The case of [s], [ed] and [ing]

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form and you can still withdraw at any time up to the point when the work is published without it affecting any benefits that you are entitled to in any way. You do not have to give a reason.

This research aims to investigate English language learning development at university students' level at Saudi Arabia. In this project, you will participate in classroom activities and oral and written tasks and some of the tasks will include audio recording. The written tasks will be about reading and listening to English language sentences and judge their grammaticality. The oral tasks will be asking you to repeat some English language sentences and numbers and your imitations will be recorded.

All of the tasks would be conducted individually inside a quite classroom. There will be no risks in taking part in this project and all of your personal information would be anonymous and code names will be used for the written and recorded information. All the audio recordings and written information would be confidential and will be will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. After the analysis, the Audio recordings will be uploaded to the University of Leeds drive and then deleted form the researcher's personal hard drive.

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will positively affect second language teaching and learning at King Faisal University and Saudi Arabia. Your cooperation would be greatly appreciated by the researcher.

If you need any further information or would like to change your mind about your participation, please contact me via my email

mlaaha@leeds.ac.uk

Thank you.

Aljuhara A. Alhussaini

School of Languages, Cultures and Societies
University of Leeds
Leeds
LS2 9JT
United Kingdom

UNIVERSITY OF LEEDS

Consent to take part in Processing instruction and working memory in processing morphological inflections: The case of [s], [ed] and [ing].

This research aims to investigate the current issues with English language learning in university students' level at Saudi Arabia.	Add your initials next to the statements you agree with
I confirm that I have read and understand the information above dated explaining the above research project and I have had the opportunity to ask questions about the project.	
I agree for the data collected from me to be stored and used in relevant future research **or** I agree for the data I provide to be archived at the University of Leeds and King Faisal University archive.	
I understand that relevant sections of the data collected during the study, may be looked at by auditors from the University of Leeds or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change during the project and, if necessary, afterwards.	

Name of participant	
Participant's signature	
Date	
Name of lead researcher	Aljuhara Abdullah H Alhussaini
Signature	
Date*	

*To be signed and dated in the presence of the participant.

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

School of Languages, Cultures and Societies
University of Leeds
Leeds
LS2 9JT
United Kingdom

UNIVERSITY OF LEEDS

Date:

Please complete the following information prior to your participation in this research

1- Full name: ……………………………………………
2- Age: ……………………………………………………..
3- University Dept.: …………………………………..
4- University level: ……………………………………
5- Number of completed hours: …………………

Please answer the following questions:

1- When did you start learning English language?

2- How many years have you been learning English language?

3- Did you live or study abroad?

4- How many languages do you speak?

Thank you for your participation!

Aljuhara Alhussaini

mlaaha@leeds.ac.uk