Is Non-Redundant Inflectional Morphology Easier to Learn? An Investigation of Processing Instruction Role in Processing Redundant English Verbal Inflections

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RESEARCH

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ABSTRACT

The present study investigated the effects of processing instruction (PI) on the processing and production of verbal inflectional morphology in English with varying redundancy: third person singular *-s*, regular past form *-ed*, and present progressive *-ing*. Ninety-three adult L2 English classroom learners in Saudi Arabia were divided into three groups receiving different teaching interventions over eight weeks: one based on standard PI, another with a novel modified PI approach including communicative activities (MPI), and a control group. Participants completed an offline interpretation task, an online self-paced reading (SPR) task and online elicited imitation (EI) task before and after intervention, then 12 weeks later in a delayed post-test. Results showed that both groups had similar performance in the offline interpretation task, but the MPI group outperformed the PI group on both online SPR and EI tasks The SPR task results also showed that the MPI intervention equally affected all the target inflections despite their differing redundancy levels. We therefore claim that MPI can be an effective classroom method for acquisition of L2 English verbal morphology.

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Morphology; processing; instruction; variability; redundancy; explicit; implicit; processing instruction; online production; offline production

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1. INTRODUCTION

Variation in production of inflectional morphology has long been a cause for debate in second language acquisition (SLA), particularly in classroom settings. The absence of morphological inflection in obligatory contexts in L2 learners' speech has been reported and documented by many SLA studies (e.g., Lardiere, 1998; Ionin & Wexler, 2002; White, 2003; Hopp, 2010; VanPatten et al., 2012; Kahoul et al., 2018). The question for instructed SLA is why this variability persists, even after lengthy exposure to language teaching. A related question, relevant to this study, is whether there is any type of instruction that could encourage the accurate processing and production of the target structures, i.e., in this case, English morphological inflections. VanPatten's Input Processing model IP (e.g. VanPatten, 1984, 1996, 2007) and its instructional application, Processing Instruction PI (VanPatten, 2004) claims to be able to alter L2 learners' inappropriate processing strategies. Such strategies, e.g., in identifying a lexical subject, or handling redundant forms, are assumed to impact on variability in online processing and production; PI aims to replace them with appropriate strategies that encourage and strengthen form-meaning connections that would positively affect the learner's developing system of underlying linguistic knowledge, which in turn would lead to accurate online processing and production. 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 and 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 the PI group outperformed the other groups in offline interpretation and production tasks. Ever since that study, a significant body of research on PI interventions has found, in general, positive effects across different languages, illustrated in more detail in the background section below. However, some PI research, using online methods such as self-paced reading tasks and eye tracking (Benati, 2022; Henry, 2022), has not found robust positive results, suggesting that processing context or load (offline vs online) may be important to investigate more closely, particularly in relation to lexical identification or handling redundant forms, captured in two IP principles – The Lexical Preference Principle and The Preference of Non-redundancy. The research presented here focuses on these two principles investigating the effect of PI-led teaching for three inflections in English – third person singular *-s*, regular past form *-ed*, and present progressive *-ing*, which are argued to have differing levels of lexical interpretability and redundancy. The study employs offline and online language tests that involve differentiated processing loads (self-paced reading and elicited imitation). In addition, a new modified PI treatment is employed to test PI's value in boosting target-like production in online communicative tasks, which has, to our knowledge, not been incorporated in mainstream PI interventions before now. This study tests how far different PI treatments play a role in the processing and production of the target morphological inflections, and aims to shed light on the extent to which developing linguistic knowledge is affected by these treatments.

2. BACKGROUND

Variability in functional morphology, i.e., surface marking of grammatical properties, such as tense, person and number (Radford, 2004), has been considered typical of adult L2 speech production (Rothman, 2008; Hopp, 2010). Instructed L2 learners in foreign language classrooms may often experience explicit teaching approaches such as "PPP" (Presentation, Practice, Production) (Criado, 2013), where the lack of authentic interaction impedes implicit acquisition and development of automatised processing capacities. Thus, L2 variability may be potentially explained by learners' over-reliance on explicit linguistic knowledge, or lack of ability to produce target forms in real time, as well as issues related to the special nature of the target form, such as redundancy. Redundancy in functional morphology means when the morphological inflection is not semantically important because its meaning is expressed in the sentence by another element (DeKeyser, 2005). Functional morphology in particular is argued to require more attentional processing resources compared to other linguistic forms, due to the high syntactic information it often carries (Sagarra, 2008; Slabakova, 2013). Therefore, functional morphology production is seen as vulnerable in processing terms – overt morphological marking may be avoided, particularly in L2 learners' real-time or online production, when learners may depend instead on pragmatic techniques to convey meaning as a strategy to cover gaps in underlying knowledge preventing accurate morphosyntactic production (VanPatten, 2007).

In a recent study by Gardner et al. (2021) of high-school Chinese learners of English, their results raise interesting questions about the type of knowledge needed for morpho-syntactic production in real-time speech. They argue that their learners may have developed syntactic representations and their associated morphological forms through explicit instruction. They also acknowledge that this does not necessarily mean that these representations can be directly or reliably activated during real-time production. Hence, instructed L2 learners' explicit knowledge could support the development of 'competence' at representational level but does not necessarily lead to proficient 'performance' at a processing level (ibid, 2021). Learner competence in this context, refers to generative-based views of implicit linguistic knowledge – mental representations of underlying abstract properties which operate in the speaker's mind without awareness and are controlled by universal constraints and functional features (Herschensohn, 1999; White, 2003). Thus, what is parsed by learners during online comprehension must meet the mental representation requirements, or lead to breakdown in processing. Similarly, what is produced by the learner is dictated by the extent of the mental representations available (VanPatten & Jegerski, 2010).

Generative approaches in SLA consider the development of mental representations as the basis for second language acquisition, consisting of three essential elements. First is the input which L2 learners are exposed to in meaningful communication. The second is Universal Grammar (UG) – the innate system that has abstract principles and properties that are common to all natural languages. This implicit system guides and controls language development, comprehension, and production according to universal constraints. UG functions as a set of innate rules that filters the input to become processed as intake (Slabakova, 2013; Whong et al., 2014). The third component is the parser itself, handling "the syntactic computations made during real-time comprehension" (VanPatten & Jegerski, 2010, p.4). The parser and other components of the language faculty are required for the L2 learner to assign (map) certain morphological forms to their meanings and functions, e.g., for verbal inflections, and to successfully connect syntactic and semantic relationships between nouns, verbs and connecting phrasal structures – i.e., for acquisition to take place (Whong et al., 2014). For L2 learners, it can be assumed that the established L1 parsing system will take precedence – the job for the L2 parser is therefore to be able to build up sufficient power to successfully compete against L1 systems to process and assign L2 form-meaning mappings from the input. Failure to develop suitable processing strategies may make certain target structures hard to acquire, such as functional verbal morphology. VanPatten's Input Processing model identifies certain processing strategies that can impede L2 form-meaning mapping, but argues that learning more effectively from the input can be enhanced through processing instruction (PI) – special pedagogical activities that manipulate the input in order to push L2 learners to process the target structures differently, and thus overcome processing difficulty. Both IP and PI will now be explained in more detail.

2.1 INPUT PROCESSING AND PROCESSING INSTRUCTION

VanPatten's input processing (IP) model aims to explain the mental processes of L2 learners during comprehension; its main concern is how learners derive intake from input. The 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.

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.

IP is thus not meant to address acquisition *per se*; rather, it examines specific processes (form-meaning connection) that are needed for morphology acquisition. IP does not suggest that L2 learners will instantly derive intake from input that can be integrated into the developing system and become fully acquired. However, it addresses a key element of the various processing steps which are argued to be required for morphological acquisition to take place.

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IP has identified a number of principles claimed to govern how input is usually processed, including the Lexical Preference principle – here, 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 would focus on interpreting the lexical content meaning of a verb and may miss the importance of the verb inflection /t/ ([ed], in written form) to signal the meaning of (+pastness). Many L2 learners may spend considerable time getting past this stage, to achieve the appropriate form-meaning connection.

Another IP principle, which to the authors' knowledge is one of the least researched, is The Preference for Non-redundancy. This principle explains that learners are more likely to process non-redundant meaningful grammatical markers before they process redundant meaningful markers. According to this principle, allied to the Lexical Principle explained above, learners are expected to prioritise 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 running*, 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.*

Considering the different weights carried by different semantic concepts and morpho-syntactic forms 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. In English, the verbal inflection *-ing* is considered to have a high communicative value because it encodes progressive aspect. Second, it is non-redundant 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 sometimes 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 in the initial part of the conversational dyad, and is not required in the response (VanPatten, 1996, p. 25):

- *Why didn't you come last night?*
- *I worked all day and I didn't feel like it after getting off.*

Other kinds of morphological inflections have little communicative value if they have semantic value but are 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: **likes coffee*.

These different levels of communicative value contribute to L2 learners' cognitive preferences during input processing. According to IP 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.

Applying these ideas to English verbal morphology, according to the communicative values suggested by the IP model, processing the verbal inflection *-ing* should not exhaust attentional resources, as it is a non-redundant inflection and thus it would be automatically/online processed with no interruption. On the other hand, processing 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, attentional resources would be only occupied when the inflection is redundant. On the other hand, the morphological

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inflection -*s* is expected to be non-automatically/offline processed all the time, because it is always redundant; hence, attentional resources would be always occupied. Table 1 presents the verbal inflections according to their degree of redundancy and the type of their processing:

Table 1 Communicative value of verbal inflections in English.

INDEPENDENT VARIABLE	COMMUNICATIVE VALUE		
The preference for non-redundancy	-*ing* (progress)	-*ed* (pastness)	-*s* (agreement)
	-Non-redundant	-Sometimes redundant	-Always redundant
	-Automatically/online processed	-Partially processed	-Non-automatically/ online processed
Attentional resources	-No attentional resources needed	-Attentional resources occupied when the form is redundant	-Attentional resources occupied all the time

IP therefore foregrounds the input and the learner's ability to parse the input as a key element of acquisition. Relating this to teaching interventions is not, however, straightforward. Many research studies have typically focused on the value of types of instruction, related to creating different types of knowledge – i.e., explicit or implicit, without necessarily considering how the instructional input was processed; interventions manipulating the processing requirements of the input itself, and the type of practice involved, have often been overlooked (Sanz, 2005).

Following IP principles, processing instruction (PI) has been derived as a pedagogical intervention based on the "psycholinguistic processes occurring during learner comprehension of second language (L2) input" (VanPatten, 2004, p.267). A typical PI instructional package is designed to direct learners to shift from inappropriate processing strategies and direct their attention instead to processing the form or structure in the input – alongside meaning – instead of relying solely on lexical forms (Benati, 2005, 2020). In this sense, PI is not an explicit type of teaching instruction, but aims to build appropriate processing mechanisms through carefully planned input activities.

PI-based intervention has three instructional components (VanPatten, 1996, 2004; Benati, 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. 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 if they feel capable, but without forcing production (e.g., as a structured output activity might do) while performing the activity.

Recently, PI-informed activities, particularly the standard SI task, have been re-evaluated for their meaningfulness and value for building communicative abilities (Doughty, 2003; Ellis, 2003; Marsden and Chen, 2011). Concerns have been raised that a typical SI task did not test learners' spontaneous ability to produce the target form, given its 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, so the task technically could be regarded as a decontextualised exercise. This lack of meaningfulness is a problem found in many previous PI studies despite the claims that PI's main goal is to push learners to develop appropriate strategies for form-meaning mapping through meaningful activities (Ellis, 2003). A similar gap has been identified by Doughty (2003) who noted that PI should include meaningful form-meaning activities in order for PI to be distinguished from other traditional instructional methods such as PPP. There is a further gap in applying PI research to a wider range of languages. To date, there seems to be robust instructional value for PI in acquiring morphological forms in relation to Romance languages. However, studies which investigated L2 English forms (e.g., Benati, 2005; Benati and Lee, 2008; Marsden and Chen, 2011) have not specifically tested the predictions of PI in relation to morphological inflections with different redundancy levels, or in relation to producing morphological forms under pressure of real-time communicative interaction. Therefore, further research is needed to validate the claims that PI can reliably impact processing and production strategies governed by the Input Processing model in more communicative conditions, and to generalise its findings beyond Romance languages.

3. THE PRESENT STUDY

The goal of this study is to investigate the effects of different PI treatments on the processing and production of certain redundant and non-redundant target inflections in L2 English (third person singular *-s*, regular past tense *-ed*, and present progressive *-ing*). Two instructional methods were employed: one standard PI method of instruction, and the other as a newly modified method of PI that combines both explicit and implicit types of instruction. This study employed a cohort of Saudi female students, testing instructed English learners in an L1 Saudi Arabic intermediate-level university classroom (total n = 93). It adopted a pre-test, immediate post-test and delayed post-test design, with two treatment groups and one control group. Groups were assigned to each condition as intact classes, to comply with institutional teaching practices. The method employed offline and online language tests that involved differentiated processing loads (interpretation task, self-paced reading, and elicited imitation). In order to analyse the teaching methods to investigate their effect on the susceptibility of the target forms and ground claims about the impact of redundancy empirically, two research questions are addressed in this research, laid out below, with accompanying predictions.

RQ1-Do PI-informed interventions targeting the verbal inflections *-s, -ed* and *-ing*, lead to English second language learners' improved performance in offline and online production?

It is predicted that learners in both PI and MPI groups will improve in offline and online processing from pre-, post- and delayed post-test on all three inflections. This is based on claims made by PI related to its ability to affect learners' developing system and consequently affect their processing even for the most redundant morphological inflections (VanPatten, 2004; Benati, 2004).

RQ2-Is there a difference between PI and MPI intervention type?

For offline production, it is predicted that learners in the MPI group may not be different to the PI group from pre- to post- and delayed post-test. For online tasks, it is predicted that learners in the MPI group will improve more than the PI group in the online production on elicited imitation tasks and online processing on self-paced reading tasks, particularly in relation to different levels of redundancy between the three target inflections. This prediction is based on the claims for modifying PI to include online production as explained in the literature review above.

4. METHODOLOGY

4.1 PARTICIPANTS

Participants were drawn from the third year of studies in the English language department at King Faisal University (*N* = 93). Students met the following requirements: 1- native speakers of Arabic, 2-they completed all of the introductory and core English courses in the previous two years, 3-their age ranged from 20–23 years old, 4- they shared a similar educational background to ensure homogeneity between groups prior to treatment (they had studied English for 8 years in secondary and high school, without any previous immersion experience). Participation was voluntary and complied with ethical procedures from the researchers' institution.

4.2 PROCEDURE

4.2.1 Materials

The 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. All the materials used in the PI and MPI treatments are available on the Open Science Framework site (www.osf.io/xfcmh). 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. The other two treatment groups were given the following interventions:

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 (e.g. VanPatten, 1996; VanPatten, 2004; 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. This solo but crucial modification was done through adapting communicative tasks that engage learners to work in pairs to express opinions and share information into the affective activities. The use of the target forms is not guaranteed during task 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. 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. The process and timeline for carrying out the project is summarised in Table 2.

Table 2 Project Timeline.

PRE-TESTS (2 WEEKS BEFORE) INTERPRETATION TASK- SELF-PACED READING TASK- ELICITED IMITATION TASK		
93 STUDENTS		
PI GROUP (32)	**PI MODIFIED GROUP (32)**	**CONTROL GROUP (29)**
Explicit instruction	Explicit instruction	Course normal classes (English speaking course)
Information about processing problems	Information about processing problems	
Structured input activities: referential + affective activities	Structured input activities: referential + affective 'tasks'	
Immediate post-test (week 6–7–8): Interpretation task- Self-paced reading task- Elicited imitation task		
Delayed post-test (after 12 weeks): Interpretation task- Self-paced reading task- Elicited imitation task		

5. ASSESSMENT MEASURES

Three testing tasks were used to triangulate participants' performance in processing and production for the three target morphological forms, using an offline interpretation task, an

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online self-paced reading task, and online production task (elicited imitation). 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 were not included in the final pool. Different versions were used for the pre-post-tests to avoid test familiarity (Marsden, 2006).

For offline comprehension, the interpretation task was used to test learners' knowledge through controlled conditions which allowed learners to control and monitor their response. 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. For online comprehension, a self-paced reading task (SPR) was designed, using Open Sesame software, following Keating & Jegerski (2015). In this test, twelve sentences were created for each inflection. Each set of sentences included six grammatical and six ungrammatical sentences. 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 reaction 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). For online production, an elicited imitation task (EI) was designed in order to test participants' production of the target forms under the task's processing demands. The task aimed to assess if learners could manage spontaneous production of the target grammatical forms and had the ability to elicit the production of target forms under real-time conditions. The participants had to listen to a set of recorded sentences and repeat what they had heard as closely as possible. Again, all tests and instructions are available as supplementary materials in the Open Science Framework (www.osf.io/xfcmh).

6. DATA ANALYSIS

The testing tasks used were the offline interpretation task, the online EI task and the online SPR task. Residual changes in mean test scores of participants from the pre-, post-, and delayed post-tests were calculated as the basis for comparison to identify any differences in participants' performance over time in the different inflections (to address research question 1), and if there were specific intervention effects between the PI and MPI group (research question 2). SPSS was used to analyse the results, using within-group and between-group analysis for all three groups. Tests for normality confirmed that parametric tests could be used.

Repeated-measures ANOVA was used to conduct the first within-group analysis on the interpretation task comparing pre-test to post-test changes in each group, to show any significant changes in mean accuracy on the three target inflections after the intervention treatment. For the second between-group analysis, further ANOVAs were run to compare changes between the three groups, again comparing pre- to post-test residual change scores. Repeated-measures ANOVA using delayed post-test results was only run for the two experimental groups, to evaluate if either treatment had more sustained effect on participants performance. Other descriptive statistics were also employed to validate the results of this study, given our interest in tracking potential variability; we thus show both standard deviation (SD) and confidence intervals (CI), to give as full a picture as possible, and reduce over-reliance of claiming results from a simple mean.

7. RESULTS AND DISCUSSION

7.1 THE INTERPRETATION TASK

Results for the offline interpretation task are presented in Table 3. This task provided data for part of both research questions – to see if PI-informed interventions targeting the verbal inflections *-s, -ed* and *-ing* would lead to improved performance in offline processing, and if there would be a difference in outcomes between PI and MPI intervention type.

It was anticipated that learners in both PI and MPI groups would improve in offline processing from pre-, post- and delayed post-test on all three inflections, but that *-s* may be the least improved. Further, it was anticipated that the MPI group may outperform the PI group in sustained performance through to delayed post-test.

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

Table 3 Residual mean change scores in the three target inflections in the three groups in the interpretation task (pre- to post-test).

According to ANOVA analysis of changes between pre-post scores, there was a significant difference between the three groups in performance in all three inflections, *-s, -ed, and -ing.* Using post-hoc pairwise comparison, the difference was found between the control group and both PI and MPI groups. For the PI group, the difference was significant (p = .001) with large effect sizes (d = 0.9), (d = 1.01), and (d = 1.07) across 3 inflections, respectively. For the MPI group, the difference with the control group in the post-test for the *-ed* and *-ing* inflections was significant (p = .001), with large effect sizes (d = 1.02), and (d = 0.8), respectively. To see if the treatment effect found in both groups was sustained, we also compared the PI and MPI groups across all three times of testing including the delayed post-test results; see scores at each time of testing in Table 4.

INFLECTION		-s				-ed				-ing			
THE TESTS	N	PI GROUP		MPI GROUP		PI GROUP		MPI GROUP		PI GROUP		MPI GROUP	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)	
Pre-test	15	3.93	2.49	4.80	2.27	5.80	3.52	6.00	2.82	4.86	1.92	5.00	2.20
		(2.55	5.31)	(3.54	6.05)	(3.84	7.75)	(4.43	7.56)	(3.80	5.93)	(3.77	6.22)
Post-test	15	6.53	3.02	5.86	2.82	7.60	2.44	7.20	2.42	7.00	2.53	5.86	2.58
		(4.86	8.20)	(4.30	7.43)	(6.24	8.95)	(5.85	8.54)	(5.59	8.40)	(4.43	7.29)
Delayed-post-test	15	4.40	2.79	5.60	3.13	7.06	2.60	6.60	3.20	5.60	2.69	6.00	2.39
		(2.85	5.94)	(3.86	7.33)	(5.62	8.50)	(4.82	8.37)	(4.10	7.09)	(4.67	7.32)

Table 4 Mean scores of the inflections *-s*, *-ed*, and *-ing* in the PI and MPI groups in the interpretation task from pre to delayed post-test.

The results in the PI group showed that the benefit at post-test found for all three inflections was more mixed at delayed post-test; *-ed* remained similar, with a marginal non-significant drop-off for *-ing*. However, for the inflection *-s,* performance significantly decreased in the delayed post-test ($p < .05$), with a large effect size (d = 0.7). So, it seems that PI-based intervention, in this task, was not able to affect the processing of *-s* in the same way it did with *-ed* and *-ing.* This outcome was anticipated in line with VanPatten's IP model, that the third-person singular *-s* is the most redundant and problematic morphological inflection in L2 English verbal morphosyntax. If redundancy is a core factor in acquisition difficulties, *-s* may not become reliably processed until very high stages of proficiency using PI treatment alone.

By contrast, the MPI group outperformed the PI group at the delayed post-test, showing sustained improvements for the *-s* and *-ing* inflections; there was a marginal drop-off in *-ed,* which was not significantly different to the PI group. Thus overall, there was a clearer beneficial MPI effect on all three target inflections over time, compared to the PI or control groups, even in an offline processing task.

7.2 SELF-PACED READING TASK

The SPR online task online measured reading times for sentences containing both grammatical inflections and ungrammatical non-inflected verb forms. Participants were expected to show longer reaction times (RTs) while reading the non-inflected verbs, which require further

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processing of ungrammaticality, and to show shorter RTs while reading the inflected, correct verbs. It was anticipated that intervention would assist improvement particularly in speeding up in processing grammatical forms; it was also anticipated that the more redundant *-s* form may show the least change, in line with similar patterns found in offline processing above.

Table 5 shows the residual mean scores of changes between pre- and post-tests for all three groups measured in milliseconds. A positive score indicates that participants spent a shorter time in reading the verbs for the three target inflections after they received the treatment, while a negative score indicates that participants spent a longer time in reading the verbs after the treatment. In general, the MPI group showed marked positive improvements over time on many inflections, while the PI group showed some positive improvements; both groups were a little slower on grammatical *-ing*, and the PI group was also slower on ungrammatical *-ing*.

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

Table 5 Residual mean scores in the reading reaction times for correct and incorrect target inflections by group in the SPR task (pre-to post-test).

Group scores were then analysed using ANOVA to test for any significant differences, first for grammatical, then for ungrammatical forms. The PI and MPI scores were further evaluated for sustained change over time, comparing pre-, post- and delayed post-tests (shown in Tables 6 and 7). Again, ANOVA tests were used to check for any between-group significant differences.

INFLECTION		-s				-ed				-ing			
TESTS	N	PI GROUP		MPI GROUP		PI GROUP		MPI GROUP		PI GROUP		MPI GROUP	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)	
Pre-test	15	3463	759	3704	901	3260	658	3246	741	3048	625	2919	605
		(304.4	388.1)	(320.2	420.2)	(289.1	362.0)	(283.3	365.2)	(270.0	339.3)	(258.6	325.1)
Post-test	15	3831	1203	3805	673	3552	1065	3306	760	2864	721	2899	806
		(316.5	449.6)	(343.3	417.9)	(296.3	414.0)	(288.5	372.2)	(246.5	326.7)	(245.5	334.3)
Delayed-post-test	15	3208	933	3472	1433	3078	994	3440	1657	3066	1179	2955	1263
		(261.3	372.7)	(267.2	426.3)	(252.9	362.2)	(252.1	435.2)	(241.0	371.9)	(225.5	365.5)

Table 6 Mean reading time scores on correct forms for *-s*, *-ed*, and *-ing* in the PI and MPI groups in all tests.

First, for correctly inflected verbs, ANOVA scores showed a significant group difference in residual mean RTs (F = 6.899, p = .002), but only for the inflection *-s*. Post-hoc comparison showed that the difference was between the MPI group and the PI group, (p = .039) with a medium effect size (d = 0.5). For the inflections *-ed* and *-ing*, there was no significant difference on residual mean RT scores between groups.

For non-inflected verbs, ANOVA showed a significant group difference in residual mean RTs (F = 5.925, p = .004) for *-s* and (F = 11.876, p < .001) for-*ed*; post-hoc comparison showed a difference for both inflections between the MPI group and the control group (p < .05). The PI group also was significantly different to the control group (p < .05) for the *-ed* inflection.

For non-inflected verbs with *-ing*, the ANOVA test confirmed that there was a significant difference between the three groups (F = 8.666, p < .001). Post-hoc comparison showed that the difference was between the MPI group and the PI group (p < .05) with a large effect size (d = 0.6).

INFLECTION		***-s***				***-ed***				***-ing***			
THE TESTS	***N***	***PI GROUP***		***MPI GROUP***		***PI GROUP***		***MPI GROUP***		***PI GROUP***		***MPI GROUP***	
		M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
		(95%CI)		***(95%CI)***		***(95%CI)***		***(95%CI)***		***(95%CI)***		***(95%CI)***	
Pre-test	15	2986	516	3142	834	3744	1106	3547	1006	3387	715	3264	661
		(270.4	327.7)	(268.3	360.2)	(313.6	435.7)	(299.3	410.7)	(299.7	378.9)	(289.6	363.3)
Post-test	15	3244	649	4020	1158	4354	1521	4632	1559	3081	845	3892	1575
		(288.1	360.7)	(337.3	466.2)	(351.3	519.2)	(376.1	549.6)	(261.6	355.2)	(302.0	476.7)
Delayed-post-test	15	3075	783	3484	1612	3616	1459	3573	1556	2903	910	2758	1097
		(264.1	350.4)	(259.2	437.4)	(280.2	442.7)	(271.6	443.1)	(245.7	320.9)	(239.1	340.9)

Table 7 Mean reading time scores on incorrect forms for *-s*, *-ed*, and *-ing* in the PI and MPI groups in all tests.

Therefore, in answer to research question 1, for online processing, there was a less clear effect of intervention using PI at post-test, compared to offline processing, since there were no significant improvements compared to the control group except the ungrammatical *-ed* forms. For the MPI group, there were significant differences from the control group's scores in all the three target inflections; these were seen particularly for the ungrammatical *-s*, *-ed* and *-ing* with large effect sizes (d = 0.9, 1.2, 1.06) respectively, suggesting this group was able to benefit from the intervention in processing at the post-test.

We also compared the changes over time including the delayed post-tests for the two intervention groups to address research question 2. Overall, RTs for all three inflections were generally quicker on grammatical than ungrammatical forms as anticipated. In both groups, RTs were quicker for grammatical *-ed* and *-ing* than for *-s*. The MPI group had faster RTs on ungrammatical *-ed and -ing* compared to the PI group. However, these differences were generally non-significant, and in some instances, RTs became slower again at the delayed post-test.

In principle, intervention had been intended to improve participants' abilities under pressure of a timed online task to process grammatical items more quickly and show greater awareness of ungrammaticality. Such effects would be seen through shorter RTs (faster processing) for inflected verbs, and longer RTs (slower processing) for non-inflected verbs, though with some difference for redundancy. However, for the PI group, there was no systematic improvement over time, suggesting the PI treatment was not sufficient for triggering sustained changes in participants' developing linguistic systems, when under the pressure of online processing. There was more evidence of improvement in the MPI group, but not significantly so across all grammatical and ungrammatical forms.

The lack of expected development, particularly in the PI group, either at post- or delayed post-test, or between different forms, suggests that participants were either not yet aware of the difference between grammatical and ungrammatical forms, or of different levels of redundancy. Equally they may not yet be able to systematically process grammaticality and redundancy information in real time if they are still in the process of developing new form-meaning connections for the target inflections.

Methodological factors such as the novelty of the SPR task may also be implicated in the failure to sustain improved performance, as the design and the style of presentation of the experimental sentences are different from what participants were used to experience in their classrooms. In addition, the SPR task created a high processing load for participants, as they had to read, comprehend, and answer a question at the end of each sentence testing their comprehension of what they had read. In other words, participant performance may have hit a ceiling effect on this task, due to its unfamiliarity and high task load.

Nevertheless, even allowing for task effects while processing inflections online, there was still some benefit for the MPI group at post- and delayed post-test, particularly in slower RTs on ungrammatical forms as predicted. We suggest the MPI intervention provided more opportunities for focused communicative interaction which we argue can boost processing in more target like ways, compared to the PI intervention.

7.3 THE ELICITED IMITATION TASK (EI)

Moving now to productive knowledge, the EI task was intended to examine any increase in participants' ability to produce oral accurate inflections in an online condition. Two types of stimuli for each inflection were used, correct and incorrect, in order to measure any change in participants' performance after the PI and MPI treatments. The purpose of including incorrect (non-inflected) verbs in the stimuli to be imitated was to reveal if the target forms were part of participants' linguistic knowledge (whether explicit or implicit). If so, the speaker would be expected to spontaneously provide the missing form; if not, they would be repeated in incorrect form. Comparing different forms after intervention, based on the IP hierarchy of redundancy, it was predicted that participants would show less variability in producing *-ed* and *-ing*, as the forms are semi and non-redundant respectively. Intervention was intended to build stronger representation, i.e., form-meaning connections, to enable them to be easily retrieved and produced in online production. Mean scores of the changes over time on correct production between the three groups and for each inflection form is shown in Table 8. Positive scores show increased production of correct inflections.

Table 8 Residual mean scores in the production of the correct target inflections in the three groups in the elicited imitation task (pre-to post-test).

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

All groups showed similar or improved performance on producing correct forms, especially for *-ed,* but there was some variation across the groups; using MANOVA, this was statistically significant (F = 5.299, p = .000; Wilk's Λ = 0.717). Hence, a one-way ANOVA for independent groups was used to compare the three groups in terms of change in participants' performance. For 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). Using post-hoc comparison, the difference found was between the MPI and the PI group (p = .011), with a large effect size (d = 0.7). For the regular past form-*ed*, the ANOVA test confirmed that there was a significant difference between the three groups (F = 5.513, p = .006). Post-hoc comparison showed that the difference was between the MPI and the PI group (p = .056), with a large effect size (d = 0.6). For the present progressive *-ing*, post-hoc comparison showed a difference only between the MPI and the control group (p = .002), with a large effect size (d = 0.8).

Turning now to the production of incorrect forms, mean scores of change in production from pre- to post-test are shown in Table 9. Negative residual mean scores suggest an improvement – i.e., fewer incorrect forms were repeated.

Table 9 Residual mean scores in the production of the incorrect target inflections in the three groups in the elicited imitation task (pre-to post-test).

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

Using MANOVA, a statistically significant difference was found between the production of the three incorrect inflections across the three groups (*F* = 5.299, *p* = .000; Wilk's Λ = 0.717). Like the production of the correct inflected verbs, an ANOVA test confirmed that there was a significant difference between the three groups in the production of the non-inflected verbs needing *-s*, (*F* = 4.825, *p* = .012). Post-hoc comparison showed that the difference was between the MPI and the PI group (*p* = .011) with a large effect size (*d* = 0.7). For the non-inflected verbs missing *-ed*, the ANOVA test confirmed that there was a significant difference between the three groups (*F* = 5.513, *p* = .006). Post-hoc comparison showed that the difference was between the MPI and the PI group (*p* = .056) with a large effect size (d = 0.6). For the non-inflected verbs missing *-ing*, post-hoc comparison showed that the difference was only between the MPI and the control group (*p* = .002) with a large effect size (*d* = 0.8).

To answer research question 1, overall, it seems that in this online production task, the expected PI group improvement was not found, as there was no significant difference between the PI group and the control group performances from pre- to post-test, particularly on the production of incorrect forms. On the other hand, for the MPI group, the prediction that learners would improve was supported, given the significant differences between the MPI and the control group 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 (*d* = 0.6, 0.8 and 0.8) respectively. Indeed, the large effect size of the inflection -*s* in the post-test (*d* = 0.6) suggests a clear benefit even for the most redundant inflection from the practice opportunities offered in the MPI package.

Moving to answer research question 2, to see if there is a sustained effect of group type, we turn to the pre-post-delayed post-test scores for the PI and the MPI groups. Mean scores are shown for production of grammatical and ungrammatical forms in Tables 10 and 11, and results of ANOVA tests are discussed below.

INFLECTION		-s				-ed				-ing			
THE TESTS	N	PI GROUP		MPI GROUP		PI GROUP		MPI GROUP		PI GROUP		MPI GROUP	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)	
Pre-test	15	1.67	0.90	1.79	2.00	3.40	1.50	3.64	2.80	2.73	1.28	3.21	3.04
		(1.1	2.1)	(.63	2.9)	(2.54	4.26)	(2.02	5.27)	(2.02	3.44)	(1.46	4.97)
Post-test	15	1.60	1.10	5.00	7.30	4.13	1.30	4.64	2.70	2.93	1.53	4.00	2.98
		(.97	2.2)	(1.3	4.5)	(3.41	4.85)	(3.06	6.22)	(2.08	3.78)	(2.27	5.72)
Delayed-post-test	15	1.40	0.73	2.71	2.10	2.07	1.60	4.00	2.60	2.80	1.61	3.86	2.62
		(.99	1.8)	(1.4	3.9)	(1.14	2.99)	(2.48	5.52)	(1.91	3.69)	(2.34	5.37)

Table 10 Mean scores of the production of correct -*s*, -*ed*, and -*ing* in the PI and MPI groups in all tests.

In the delayed post-test, again there was no consistent evidence of PI improvement, nor a clear effect of varying redundancy; in fact, participants' performance showed most change on verbs with *-ed* (semi-redundant). ANOVA tests showed this measure significantly decreased from post-test performance (*p* < .05), with a large effect size (*d* = 0.8). This decline in the PI group performance on *-ed* for production can be compared to improved performance on *-ed* in the interpretation task seen earlier (section 7.1), perhaps due to the offline nature of that task; it also shows the value of triangulating processing and production data to reveal ongoing difficulties for learners in developing strong form-meaning representations and automatized processing.

For the MPI group in the delayed post-test, however, the results showed significantly better performance compared to the PI group in terms of higher levels of grammatical production of the most redundant target inflections: *-s* (*p* = .004), and lower levels of ungrammatical production (*p* = .018). These findings suggest that the effect of the new element included in the MPI treatment, the focused communicative tasks, was robust and sustained across post-and delayed post-test on all the three target inflections including on *-s*, the most problematic in terms of redundancy. 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.

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INFLECTION		-s				-ed				-ing			
THE TESTS	N	PI GROUP		MPI GROUP		PI GROUP		MPI GROUP		PI GROUP		MPI GROUP	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)		(95%CI)	
Pre-test	15	6.33	0.90	6.21	2.00	4.60	1.54	4.36	2.80	5.27	1.28	4.79	3.04
		(5.84	6.83)	(5.06	7.37)	(3.74	5.46)	(2.73	5.98)	(4.56	5.98)	(3.03	6.54)
Post-test	15	6.40	1.12	5.07	2.80	3.86	1.30	3.35	2.70	5.06	1.53	4.00	2.98
		(5.77	7.02)	(3.44	6.69)	(3.14	4.58)	(1.77	4.93)	(4.21	5.91)	(2.27	5.72)
Delayed-post-test	15	6.60	0.73	5.00	2.40	5.93	1.66	4.00	2.60	5.20	1.61	4.14	2.62
		(6.19	7.01)	(3.59	6.41)	(5.01	6.86)	(2.48	5.52)	(4.31	6.09)	(2.63	5.66)

Table 11 Mean scores of the production of incorrect *-s*, *-ed*, and *-ing* in the PI and MPI groups in all tests.

To sum up the results and their implications, it seems that PI, in this study, was not able to support consistent improvement in processing all three inflections, particularly for *-s*. In the offline task, there was a PI effect on *-ed* and *-ing* but this was not seen for *-s*, nor was the effect carried across to the EI production task. By contrast, the MPI group showed more evidence of improvement across all tasks, but not always significantly or consistently. We note that all three morphological structures may be learnable from explicit/formal instruction, but even so, there seems to be variation in processing and production which may at times be related to the redundancy hierarchy of English morphological inflections. The IP redundancy hierarchy suggests that *-ed* is semi-redundant and may be sometimes problematic, while *-ing* is non-redundant and therefore should be easy to process (Ellis, 2003; DeKeyser, 2005; VanPatten, 2007). In view of the variation found here, particularly in the PI group data, we suggest there was some shift in processing abilities from the PI treatment to aid performance in the offline task, but it was not sufficient to improve the automatization of learners' knowledge needed in online conditions across all redundancy levels (Segalowitz, 2003; Jiang, 2004; DeKeyser, 2010). However, further research is needed to evaluate how far the lack of PI effect here relates to the choice of these specific morphological forms in L2 English, compared to potential interaction between redundancy levels and task effects on performance between offline and online conditions.

The novel adaptation of PI here by adding communicative tasks in the MPI group seemed to be more consistently effective. The adaptation required learners to participate in focused meaningful communicative tasks that were designed specifically to prompt the use of the target structures, where each participant had a role that required verbal interaction with other colleagues using the target forms in order to complete the task. This modified PI intervention in our study triggered a noticeable change in participants' processing performance. We suggest this is due to growing automatization of the target forms as the target inflections become successfully integrated into the developing linguistic system. The MPI intervention also aided successful production of all the target inflections, despite differing redundancy levels. Finally, MPI had more retention value than PI in that its effect extended to all three target inflections in the delayed post-test in both the interpretation and the EI tasks. We argue here therefore that this kind of modified productive PI treatment is the most effective for acquisition of L2 English inflections.

8. CONCLUSION

This study into production of L2 English inflectional morphology is an important contribution to PI-based research into online processing and production in classroom settings. Our research shows the value of using focused tasks to aid production of morphology, despite varying levels of redundancy. Our findings provide evidence that the standard PI package of structured input activities can help in improving participants' performance, at least in offline interpretation tasks. However, PI alone, in this study, could not sufficiently trigger sustained changes in the participants' developing system, which would enable participants to retrieve inflectional forms accurately in real-time production. Our study suggests that PI's methodological design lacks essential elements for boosting automatization. By contrast, we argue that modified PI (MPI) – by adding communicative tasks to the PI package, as we did here – contributed to participants' abilities to develop automatised form-meaning connections, compared to the standard PI intervention. Our MPI design creates a unique fusion of structured input activities and interactive communicative tasks, raising psycholinguistic readiness to learn morphological forms with high processing load by easing the pressure on attentional resources. Hence, using MPI can help in shifting processing demands to handle input in ways that build accurate and more easily retrievable representations in the developing L2 system.

Therefore, we propose MPI as a novel method for second language instruction which is specifically designed to address problems in acquisition of morphology. In fact, this new treatment could be a possible substitution to PPP, which has been criticised for a long time at linguistic, psychological, psycholinguistic, and pedagogical levels (Criado, 2013). Despite this criticism, PPP remains favoured by many L2 teachers for several reasons, such as its practicality in terms of lesson planning and applicability to different contexts (DeKeyser, 2017). Hence, we suggest adding a fourth P, that stands for processing. Our proposed PPPP model, which includes interactive MPI activities, could be an approach to addresses criticisms of both PI and PPP models, without changing their essential and valued core rationale, and maintaining a bridge between research-based validity and practical convenience for teaching which can benefit researchers, students, and teachers alike.

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