

Review

A Review of Thirty Years of Research on Processing Instruction

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Abstract

Dozens of studies published on processing instruction (PI) make it one of the highly investigated areas within the field of second language acquisition (SLA). This review article provides an overview of 30 years of research in this area. The article first provides a brief account of the theoretical underpinnings of PI, its features, and the guidelines for devising structured input (SI) activities, which are the main causative factor accounting for the effects of PI. It then proceeds with a review of empirical studies carried out across six strands of research on PI and offers a detailed synthesis of the key findings emerging from each strand. The article ends with a general conclusion based on the findings of research to date and outlines directions for future research.

Keywords: processing instruction; structured input; second language acquisition; review

1. Introduction

Processing instruction (PI) is a pedagogical intervention based on VanPatten's (1996, 2004, 2007) input processing (IP) theory in second language acquisition (SLA), which accounts for how learners make form–meaning connections during processing input for comprehension. Inaccurate processing of input, according to VanPatten (2018), is a major inhibitor of second language (L2) acquisition, and instruction should, thus, facilitate the occurrence of accurate processing of input (i.e., making accurate form–meaning connections). As VanPatten (1996, 2015) argues, input provided to learners does not directly enter their minds for two main reasons: (1) the limited capacity of the mind to process information, and (2) the internal processing strategies of the learners, which are universal. From an input processing perspective then, instruction, while being cautious of the limited capacity of the mind to process information, should assist learners to make accurate form–meaning connections in the input they receive. It is only then that accurate intake is drawn from input for L2 acquisition. PI, in this regard, has been proposed as a pedagogical intervention that aims to foster the formation of accurate form–meaning connections in the course of processing input for comprehension (VanPatten, 2015).

Originally reported in VanPatten and Cadierno (1993), PI has stimulated extensive theoretical discussion and generated a substantial body of empirical research across a wide range of linguistic structures, learner populations, instructional contexts, and languages. Beyond the theoretical discussions and empirical studies, PI has also been repeatedly presented as a pedagogically viable approach for designing meaning-oriented, comprehension-based grammar instruction, most notably in publications explicitly intended to inform instructional practice and curriculum design (e.g., Benati, 2019; Farley, 2004b;

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Lee & VanPatten, 2003). Findings generated from three decades of research on PI have challenged traditional assumptions that grammar instruction must primarily involve rule explanation followed by production-based practice, demonstrating instead that instruction that systematically targets learners' input processing strategies can lead to substantial gains in accuracy and development of grammatical competence. Collectively, this sustained body of work has contributed to broader pedagogical discussions about the role of input, the viability of comprehension-based grammar instruction, and the ways in which grammar teaching can be aligned with communicative principles. This article aims to provide a review of the studies carried out on PI to date. It identifies the main strands of research on PI and provides an overview of research within each strand. This article is an addition to previous review articles, including a recent one by Wong (2024), in that it provides a more comprehensive and detailed review of studies on PI. Furthermore, each section of the review concludes with a synthesis of the findings, identifies key patterns, and proposes possible explanations for conflicting findings in the literature, features largely absent in Wong (2024).¹ Before reviewing the literature, an overview of the theoretical foundations of PI is in order.

2. Theoretical Foundations of PI

As noted earlier, PI is theoretically grounded in VanPatten's (1996, 2004, 2007) model of input processing (IP) in SLA, which is considered as the first stage in SLA (Leow, 2015; VanPatten, 2004, 2015). This model of IP is basically about what psycholinguistic strategies L2 learners employ to comprehend input. It is specifically concerned with parsing and analysing sentences into their elements (i.e., computing sentence structure) and assigning linguistic meaning to each element (i.e., form–meaning connection). For example, the *-ed* form at the end of verbs in English signals “pastness”, or the *-s* at the end of verbs in English shows “third person singular present tense”. Another example would be the passive verb form (e.g., *was chased*) meaning that the first noun in the sentence is the patient rather than the agent. What is important in the IP model is that the assignment of meaning to grammatical forms is done during attempts to comprehend input and that learners' less-than-optimal strategies in processing input for comprehension acts as one of the main obstacles in L2 acquisition (VanPatten, 2018). The model consists of two main principles with some subprinciples to account for how L2 learners derive intake from input. These principles, as VanPatten (2004, 2015) argues, are mainly universal and independent of learners' first language (L1).

The first principle, the Primacy of Meaning Principle (PMP), is based on the limited capacity model of attention, which states that the amount of information the human mind can take in and process is constrained by the limited capacity of attentional resources. As a result, humans adopt (or perhaps are born with) a mechanism to be selective in attending to the information surrounding them (Lee & VanPatten, 2003). The limited information processing capacity poses particular challenges for L2 learners. As VanPatten (2020) argues, L2 learners cannot store and process information to the same extent as native speakers during real-time processing due to the limited input processing capacity. This, in turn, makes it challenging for learners to attend to both form and meaning simultaneously, and, thus, depending on the requirements of the task, they choose to attend to either of them. With tasks which require comprehension, it is the meaning that L2 learners primarily attend to in the input. This, in turn, makes the learners not process the form accurately and, thus, the form–meaning connection is not established in their mind. The PMP has a number of subprinciples as listed below:

- Principle 1a: The Primacy of Content Words Principle: Learners process content words in the input before anything else.
- Principle 1b: (Revised) Lexical Preference Principle: If grammatical forms express a meaning that can also be encoded lexically (i.e., that grammatical marker is redundant), then learners will not initially process those grammatical forms until they have lexical forms to which they can match them.
- Principle 1c: The Preference for Nonredundancy Principle: Learners are more likely to process non-redundant meaningful grammatical forms before they process redundant meaningful forms.
- Principle 1d: The Meaning before Nonmeaning Principle: Learners are more likely to process meaningful grammatical forms before nonmeaningful forms irrespective of redundancy (VanPatten, 2020).

IP is not, however, only about the primacy of meaning. It is also concerned with word order and assigning functions to different elements of a sentence. According to VanPatten (2004, 2015), learners tend to assign the role of agent to the first noun or pronoun they encounter in the sentence. This, in turn, poses a challenge to them when processing a non-canonical word order such as OVS. In such cases, the learner tends to interpret the object as the subject in the sentence. Thus, an English passive sentence such as *Mary was chased by Robert* would be misinterpreted as it was *Mary* who did the action of chasing. This is known as the First Noun Principle (FNP), with the following subprinciples, which may attenuate its force:

- Principle 2a: The Lexical Semantics Principle: Learners may rely on lexical semantics, where possible, instead of word order to interpret sentences.
- Principle 2b: The Event Probability Principle: Learners may rely on event probabilities, where possible, instead of word order to interpret sentences.
- Principle 2c: The Contextual Constraint Principle: Learners may rely less on the First Noun Principle if preceding context constrains the possible interpretation of a clause or sentence (VanPatten, 2020).

In addition to the two main principles that are about factors affecting the formation of form–meaning connections as well as sentence structure computation, VanPatten (2020) proposes a third principle, the Sentence Location Principle (SLP), which is about processing the different elements of a sentence depending on where they appear in the sentence. According to this principle, learners tend to process items in the initial sentence position before those in the final position, which in turn are processed before the elements appearing in the medial position (VanPatten, 2020).

Drawing on the tenets of IP, PI was first devised and used by VanPatten and Ca-dierno (1993) as an input-oriented pedagogical intervention, which aimed at facilitating the accurate processing of the L2 input. PI is a pedagogical intervention which pushes the learners away from their less-than-optimal input processing strategies in order to help them make accurate form–meaning connections and compute sentence structure correctly during online comprehension. It is a pedagogical response to the learners' non-optimal strategies and preferences in processing input which, as predicted by the principles of IP, would negatively impact the acquisition of grammatical forms. PI, as VanPatten (2018, p. 3) states, has the following features:

- “It is predicated on what learners do (and don’t do) during input processing (i.e., sentence-level processing strategies);
- It is input-oriented (learners don’t produce targeted structures during the treatment);
- Input is manipulated in particular ways to alter processing strategies and increase better intake for acquisition (structured input);

- It includes explicit information for the learner on both grammatical structure and processing problems (although the research has shown this is not necessary for its success);
- It follows certain guidelines for the creation of structured input activities."

It should be noted that the provision of explicit information as stated in the fourth feature of PI should not be viewed in a traditional sense of explicit teaching of forms for the purpose of rule internalization. As Benati (2019) and Leeser and Pesce (2023) state, the explicit information provided in PI aims at making the learners aware of the processing problem so that they can pick up the form during comprehension more readily. It is actually "only through the correct processing of input that new representations and new links between form and meaning are created" (Leeser & Pesce, 2023, p. 7). Indeed, there is now ample evidence (as reviewed in subsequent sections) that structured input (SI), and not explicit information, is the main causative factor accounting for the effectiveness of PI (e.g., Benati, 2004a, 2004b; Benati & Lee, 2015; VanPatten & Oikkenon, 1996; Wong, 2004). Lee and VanPatten (2003, p. 154) provide the following guidelines for constructing SI activities:

- "Present one thing at a time.
- Keep meaning in focus.
- Move from sentences to connected discourse.
- Use both oral and written input.
- Have the learners do something with the input.
- Keep the learners' processing strategies in mind."

SI activities are generally composed of two types: referential and affective activities (Lee & VanPatten, 2003). Referential activities refer to those SI activities that require responses that can clearly be evaluated as either correct or incorrect. In other words, in referential SI activities, there is only one correct response, which can be figured out only if the input is processed accurately for meaning. Example 1 below provides a sample referential SI activity for the English passive structure:

Example 1: Sample referential SI activity

The horse was kicked by the donkey.

- (a) The donkey is hurt.
- (b) The horse is hurt.

John is loved by Emily.

Who loves?

- (a) Emily
- (b) John

Affective activities, on the other hand, require a response which is based on the learners' real-life experiences or opinions. As such, there is no correct or incorrect response in these activities and responses may vary from learner to learner. Example 2 below provides a sample affective SI activity for the English passive structure. According to Lee and VanPatten (2003), SI activities should start with a set of referential activities and then continue with some affective activities.

Example 2: Sample affective SI activity

Read the sentences and determine whether they are true or false about yourself.

- | | | |
|---|-------------|--------------|
| 1. I am helped by my friends when I have a problem. | True | False |
| 2. I am admired by my family. | True | False |

PI is fundamentally different from other instructional approaches. What distinguishes PI from other approaches is its focus on learners' processing strategies rather than rule internalization. Unlike enriched input, for instance, which primarily increases the frequency or salience of a target structure in the input with the assumption that greater exposure will facilitate acquisition, PI is designed to directly alter learners' default processing strategies. Through carefully designed SI activities, PI requires learners to make form–meaning connections during comprehension, thereby ensuring that grammatical forms are not only noticed but also correctly interpreted. Similarly, although task-based instruction is also meaning-focused, its primary emphasis is on successful task completion and communicative outcomes, meaning that attention to specific linguistic forms is incidental and not guaranteed or required for successful task completion. By contrast, PI maintains a meaning-oriented orientation while systematically making particular grammatical features essential to interpretation. In this sense, PI occupies a unique position among input-based approaches: it is input-oriented but instructional rather than incidental, and, more importantly, it explicitly targets the cognitive processes underlying input processing rather than simply increasing learners' exposure to linguistic forms.

3. Empirical Studies

The proposition of the IP theory and PI as an instructional intervention based on its principles has led to the emergence of a large number of empirical studies over the last 30 years. These studies can be generally categorized into six strands of research: (1) research on the efficacy of PI/SI versus other types of instruction, (2) research on the effectiveness of the two main components of PI (i.e., SI vs. explicit information), (3) research on the transfer (secondary) effects of PI/SI, (4) research on the role of individual differences in the effectiveness of PI/SI, (5) research examining the effectiveness of PI/SI through online measures, and (6) research on the role of input modality. In what follows, empirical studies carried out within each of these research strands are reviewed. Before that, however, a note is in order. There is generally a misunderstanding in the literature about PI. Some researchers have mistakenly interpreted PI as a type of instruction that aims at developing learners' knowledge of L2 rules (e.g., Aghaei Aghdam et al., 2022; Erlam, 2003, 2005; Liang & Zhang, 2025; Marsden & Chen, 2011; Mostafa & Kim, 2021). It should, however, be noted that PI is not about rule learning or rule use (Leeser et al., 2021). Rather, it is about assisting learners to process input accurately in order to drive accurate intake, which is necessary for L2 development (Benati, 2023b; VanPatten, 2015). In other words, PI does not view L2 acquisition as learning a set of rules as provided in textbooks. Rather, it views L2 acquisition as the development of a complex, abstract system which is qualitatively different from rule internalization (VanPatten & Rothman, 2014). Therefore, the effects of PI should not be measured through the commonly used knowledge tests such as grammaticality judgement tests. The more reliable tests to measure the effects of PI would be tests that tap into learners' processing of input, particularly in real time (Benati, 2023a, 2023b; VanPatten, 2015). Thus, in what follows, only studies which have used appropriate tests and have targeted structures which are affected by one of the IP principles are reviewed. Initially, studies published between 1993 and 2024 were identified through searches of major academic databases, including *Scopus*, *Web of Science*, *ERIC*, *Linguistics and Language Behavior Abstracts (LLBA)*, and *MLA International Bibliography*. The keywords that were used were *processing instruction*, *structured input*, *input processing*, *input processing theory*, *processing-based instruction*, *input-based instruction*, *form-focused instruction*, *focus on form*, *form–meaning connection*, *First Noun Principle*, *Primacy of Meaning Principle*, *Primacy of Content Words Principle*, *Lexical Preference Principle*, *Preference for Nonredundancy Principle*, *Meaning before Nonmeaning Principle*, *Lexical Semantics Principle*, *Event Probability Principle*, *Contextual Constraint Principle*, and *Sentence Location Principle*. The search yielded a total of

96 empirical studies on PI. However, studies were excluded if they (1) did not operationalize PI as specified in the guidelines, (2) used inappropriate tests for measuring instructional effects (e.g., grammaticality judgement tests), (3) focused on grammatical structures not affected by a processing principle, or (4) were not published in peer-reviewed outlets (e.g., dissertations, conference papers). It should be noted that unpublished studies, including dissertations and conference papers, were excluded to ensure the methodological rigor and reliability of the reviewed evidence. However, because the review was limited to peer-reviewed publications, the potential influence of publication bias cannot be fully excluded. Following the screening process, a total of 73 studies were included in the final review.

3.1. Research on PI/SI Versus Other Instructional Interventions

This strand of research, which marked the beginning of PI studies, was launched by VanPatten and Cadierno's (1993) study on the effectiveness of PI. VanPatten and Cadierno aimed to find out whether PI would be effective in improving learners' interpretation and production of Spanish direct object pronouns, which occur in the OVS word order, and thus are affected by the FNP. Two groups of learners participated in the study: the PI group and the traditional instruction (TI) group. Instruction for the PI group was delivered through providing explicit information on the target structure, which was followed by some SI activities. The TI group, on the other hand, was required to produce the target structure in each activity. The study found that while both groups improved in producing the target form, only the PI group gained significant improvement in the interpretation task. The results of the delayed post-test run after one month showed no change in this pattern. What made the study more interesting was the PI group's improvement in the output production task, although they did not engage in any output production of the target feature. This double interpretation/production effect of PI was also found in subsequent studies with different linguistic features framed under both the FNP and the PMP (e.g., Benati, 2001, 2005, 2015, 2016; Benati & Lee, 2010; Cadierno, 1995; Cheng, 2004; Farley, 2004c; Marsden, 2006; Uludag & VanPatten, 2012; VanPatten & Wong, 2004; Wong, 2010, 2015).

The effectiveness of PI has also been compared to other instructional interventions such as enriched input-based instruction (e.g., Marsden, 2006), dictogloss (e.g., Uludag & VanPatten, 2012; VanPatten et al., 2009b), and meaning-based output instruction (e.g., Benati, 2001, 2005; Benati & Batziou, 2019a, 2019b; Farley, 2001, 2004c; Kirk, 2013; Morgan-Short & Bowden, 2006; Morgan-Short & Bowden, 2006; VanPatten et al., 2009a). Altogether, these studies revealed that PI is either as effective as or more effective than other types of instruction. The effects of PI have also been shown to be durable as tested in a number of studies which included delayed post-tests ranging from one week (e.g., Cadierno, 1995; Lee & Benati, 2007b; Morgan-Short & Bowden, 2006) to fourteen weeks (e.g., Marsden, 2006) and to eight months (VanPatten & Fernández, 2004) after instruction. Table 1 below provides a summary of the studies on PI/SI versus other types of instruction.

Table 1. Studies on PI/SI versus other types of instruction.

Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability
VanPatten and Cadierno (1993)	PI (27) TI (26) *C (27)	Spanish direct object pronouns	FNP	Sentence-level interpretation and production tests	*Pre/*post + 1 *wk + 1 *mon	<i>Interpretation</i> PI > TI = C <i>Production</i> PI = TI > C	Maintained 1 month
Benati (2001)	PI (13) *OBI (13) C (13)	Future tense in Italian	PMP (1b)	Sentence-level interpretation and production tests	Pre/post + 1 wk + 3 wk	<i>Interpretation</i> PI > OBI > C <i>Production</i> PI = OBI > C	Maintained 3 weeks
Benati (2005)	Chinese L1: PI (15) TI (15) OBI (17) Greek L1: PI (10) TI (10) OBI (10)	English simple past tense	PMP (1b)	Sentence-level interpretation and production tests	Pre/post	<i>Interpretation</i> PI > TI = OBI; Chinese L1 = Greek L1 <i>Production</i> PI = TI = OBI; Chinese L1 = Greek L1	N/A
Benati and Batziou (2019a)	SI (22) OBI (22) SI + OBI (24)	English passive causatives	FNP	Discourse-level interpretation and production tests	Pre/post + 3 wk + 24 wk	<i>Interpretation</i> SI = SI + OBI > OBI <i>Production</i> SI = SI + OBI > OBI	Maintained 24 weeks
Benati and Batziou (2019b)	*Ex. 1 SI (13) OBI (15) SI + OBI (16) C (10) Ex. 2 SI (10) OBI (10) SI + OBI (10)	Ex. 1 & 2 English passive causatives	Ex. 1 & 2 FNP	Ex. 1 Sentence- and discourse-level interpretation as well as sentence-level production tests Ex. 2 Discourse-level interpretation and production tests	Ex. 1 & 2 Pre/post + 3 wk	Ex. 1 <i>Interpretation (sentence-level)</i> SI = SI + OBI > OBI = C <i>Interpretation (discourse-level)</i> SI = SI + OBI > OBI = C <i>Production (sentence-level)</i> SI = OBI = SI + OBI > C Ex. 2 <i>Interpretation (discourse-level)</i> SI = SI + OBI > OBI <i>Production (discourse-level)</i>	Ex. 1 Maintained 3 weeks Ex. 2 Maintained 3 weeks

SI = SI + OBI > OBI							
Benati (2016)	Ex. 1 PI (13) TI (13) C (10)	Ex. 1 Japanese Past tense markers	Ex. 1 PMP (1b)	Ex. 1 Sentence-level interpreta- tion and production tests	Ex. 1 Pre/post	Ex. 1 <i>Interpretation</i> PI > TI = C <i>Production</i> PI = TI > C	Ex. 1 N/A
	Ex. 2 PI (15) TI (15)	Ex. 2 Japanese passive structure	Ex. 2 FNP	Ex. 2 Sentence- and discourse- level interpretation and production tests	Ex. 2 Pre/post + 2 wk	Ex. 2 <i>Interpretation (sentence-level)</i> PI > TI <i>Interpretation (discourse-level)</i> PI > TI <i>Production (sentence-level)</i> PI = TI <i>Production (discourse-level):</i> PI > TI	Ex. 2 Maintained 2 weeks
	PI (10) TI (9) C (10)	English simple past tense	PMP (1b)	Sentence- and discourse- level interpretation tests	Pre/post	<i>Interpretation (sentence-level)</i> PI > TI = C <i>Interpretation (discourse-level)</i> PI > TI = C	N/A
	PI (7) C (3)	Japanese passive structure	FNP	Sentence- and discourse- level interpretation as well as sentence-level produc- tion tests	Pre/post	<i>Interpretation (sentence-level)</i> PI > C <i>Interpretation (discourse-level)</i> PI > C <i>Production</i> PI > C	N/A
Benati et al. (2010b)	PI1: L1 English speakers (15)	Spanish subjunc- tive after the ad- verbial <i>cuandi</i>	PMP (1b, 1c, & 1d) & SLP	Sentence-level interpreta- tion as well as sentence- and discourse-level pro- duction tests	Pre/post + 1 wk	<i>Interpretation</i> PI1 = PI2 = PI3; no effect for lan- guage background	N/A
	PI2: L1 English speakers with background in other languages (14)					<i>Production (sentence-level)</i> PI1 = PI2 = PI3; no effect for lan- guage background <i>Production (discourse-level)</i> PI1 = PI2 = PI3; no effect for lan- guage background	

PI3: Non-English speakers (7)							
Cadierno (1995)	PI (22) TI (19) C (20)	Spanish past tense	PMP (1b)	Sentence-level interpretation and production tests	Pre/post + 1 wk + 1 mon	Interpretation PI > TI = C Production PI = TI > C	Maintained 1 month
Cheng (2004)	PI (29) TI (28) C (26)	Spanish copular verbs <i>ser</i> and <i>estar</i>	PMP (1b)	Sentence-level interpretation and production tests	Pre/post + 3 wk	Interpretation <i>ser</i> and <i>estar</i> combined: PI = TI > C <i>estar</i> only: PI > TI = C Production <i>ser</i> and <i>estar</i> combined: PI = TI > C <i>estar</i> only: PI > TI = C	Maintained 3 weeks
Farley (2001)	PI (17) OBI (12)	Spanish subjunctive of doubt	PMP (1b) & SLP	Sentence-level interpretation and production tests	Pre/post + 1 mon	Interpretation Gains for both groups, but PI > OBI Production PI = OBI	Maintained 1 month
Farley (2004c)	PI (24) OBI (26)	Spanish subjunctive of doubt	PMP (1b) & SLP	Sentence-level interpretation and production tests	Pre/post + 2 wk	Interpretation PI = OBI Production PI = OBI	Maintained 2 weeks
Marsden (2006)	PI (14) *EnI (13)	French verb inflections	PMP (1b)	Sentence-level interpretation as well as sentence- and discourse-level production tests	Pre/post + 16 wk	Interpretation PI > EnI Production (sentence-level) PI > EnI Production (discourse-level) PI > EnI	Maintained 16 weeks
VanPatten and Wong (2004)	PI (29) TI (20) C (28)	French causative	FNP	Sentence-level interpretation and production tests	Pre/post	Interpretation Gains for both PI and TI, but PI > TI > C	N/A

							Production PI = TI > C	
							Interpretation Gains for all groups, but PI > OBI > C	Maintained 6 weeks
VanPatten et al. (2009a)	PI (38) OBI (37) C (43)	Spanish direct object pronouns	FNP	Sentence-level interpreta- tion and production tests	Pre/post + 6 wk		Production PI = OBI > C	
							Interpretation Gains on both posttests, but *PT1 > PT2	Maintained 8 months
VanPatten and Fernández (2004)	PI (45)	Spanish direct object pronouns	FNP	Sentence-level interpreta- tion and production tests	Pre/post + 8 mon		Production Gains on both posttests, but PT1 > PT2	
							Interpretation PI = OBI > C	Maintained 1 week
Morgan-Short and Bowden (2006)	PI (15) OBI (14) C (14)	Spanish direct object pronouns	FNP	Sentence-level interpreta- tion and production tests	Pre/post + 1 wk		Production PI = OBI > C	
							Interpretation Gains for all groups, but G1 = G2 = G3 > G4	Maintained 1 week
Kirk (2013)	*G1: PI + PI + PI (14) G2: PI + PI + OBI (16) G3: PI + OBI + PI (13) G4: PI + OBI + OBI (14)	Spanish subjunc- tive	PMP (1b) & SLP	Sentence-level interpreta- tion and production tests	Pre/post + 1 wk		Production Gains for all groups, but G1 = G2 = G3 > G4	
							Interpretation Gains on for all groups, but PI > DG = C	Maintained 6 weeks
VanPatten et al. (2009b)	PI (38) *DG (27) C (43)	Spanish direct object pronouns	FNP	Sentence-level interpreta- tion as well as sentence- and discourse-level pro- duction tests	Pre/post + 6 wk		Production (sentence-level) PI > DG = C Production (discourse-level) No Gains for any of the groups; PI = DG = C	

Uludag and VanPatten (2012)	PI (22) DG (22) C (16)	English passive voice	FNP	Sentence-level interpretation as well as sentence- and discourse-level production tests	Pre/post + 8 days	<i>Interpretation</i> PI > DG > C <i>Production (sentence-level)</i> PI = DG > C <i>Production (discourse-level)</i> PI = DG > C	Maintained 8 days
Wong (2010)	*+SI (19) *-SI (15) Control (13)	French causative	FNP	Sentence-level interpretation and production tests	Pre/post + 1 wk	<i>Interpretation</i> +SI > -SI = C <i>Production</i> +SI > -SI = C	Maintained 1 week
Wong (2015)	SI (19) *TR (14) *COMP (15) C (12)	French causative	FNP	Sentence-level interpretation and production tests	Pre/post + 1 wk	<i>Interpretation</i> SI > TR = COMP = C <i>Production</i> SI > TR = COMP = C	Maintained 1 week
Benati (2015)	PI (20) PI-*R (17) C (18)	Japanese passive structure	FNP	Sentence- and discourse-level interpretation as well as sentence-level production tests	Pre/post + 4 wk	<i>Interpretation (sentence-level)</i> PI = PI-R > C in PT1 PI-R > PI > C in PT2 <i>Interpretation (discourse-level)</i> PI = PI-R > C in PT1 PI-R > PI > C in PT2 <i>Production</i> PI = PI-R > C in PT1 PI-R > PI > C in PT2	Maintained 4 weeks

Notes: Pre = Pretest; Post = Posttest; PT = Posttest; Ex.: Experiment; OBI: Output-based instruction; EnI = Enriched input; G = Group; C = Control; DG = Dictogloss; +SI = Written story with SI embedded; -SI = Written story without SI embedded; TR = Text reconstruction; COMP = Comprehension; R = Re-exposure to SI activities; wk = Weeks (after instruction); mon = Months (after instruction).

Main Takeaways

- In cases where PI has been compared to TI (mechanical drills plus meaning-oriented output practice), it has been found to be more effective. However, in cases where it has been compared to more meaningful output-based instruction (OBI), PI has not always been more effective than OBI. The relative effects of OBI have been linked to the availability of abundant incidental meaningful input (i.e., the output of some learners acting as input for others) for the OBI group rather than the output practice itself (e.g., Benati, 2001; Farley, 2001, 2004c; cf. Morgan-Short & Bowden, 2006). Significant effects in such cases have also been argued to be partly due to the similarity in the structure of incidental input in OBI to that in PI (Farley, 2004c; VanPatten et al., 2009a). In cases where OBI did not involve incidental input similar in structure to that in PI, PI was shown to be more effective (Benati & Batziou, 2019a, 2019b; Uludag & VanPatten, 2012; VanPatten et al., 2009a, 2009b).
- In cases where PI/SI has been compared to other types of meaning-oriented input-based instruction (e.g., Wong, 2015), PI/SI has been found to be more effective for it does not drain the available processing resources.
- Re-exposure to PI seems to be further beneficial than receiving PI only once (Benati, 2015). Similarly, when combined with OBI, more exposure to PI has been found to be more beneficial than more exposure to OBI (Kirk, 2013), which may be taken as evidence suggesting that (structured) input has more to play in terms of L2 acquisition compared to output practice.
- The observation that, in addition to interpretation tasks, learners receiving PI/SI also perform well on production tasks at both sentence and discourse levels provides evidence that PI/SI is not only effective in making L2 learners better processors of input, but it is also helpful in developing their underlying L2 system in a way that it is available for speech production in less controlled conditions.

3.2. Research on the Components of PI

Another line of research which embarked after observing the positive effects of PI was exploring the causative variable of the effectiveness of PI. VanPatten and Oikkenon's (1996) study was the first attempt in this regard. In this study, VanPatten and Oikkenon sought to find out which of the components of PI (SI or explicit information) was the main causative factor accounting for the effectiveness of PI. The target form under investigation was Spanish object pronouns, which follow the OVS sentence pattern. Three groups of learners were formed: the PI group, which received both explicit information and SI practice on the target form; the SI group, which only received SI practice; and the explicit information group, which only received explicit information. Learners' performance was assessed through comprehension and production tasks. The results indicated that SI was the main causative factor of the effectiveness of PI. Further studies conducted within this framework have also consistently revealed that SI practice is the main component of PI accounting for its effectiveness (e.g., Benati, 2004a, 2004b; Farley, 2004a; Lee & Benati, 2007a, 2007b; Sanz, 2004; Sanz & Morgan-Short, 2004; Wong, 2004). Some effects, however, have been found for the provision of explicit information in particular conditions by studies employing a trials-to-criterion design (e.g., Culman et al., 2009; Fernández, 2008; Henry et al., 2009, 2017, 2024; VanPatten et al., 2013).

In the trials-to-criterion design, researchers gauge the point at which learners respond correctly to a series of target items and distractors consecutively during the treatment (e.g., accurate interpretation of three sequences of OVS and one SVO sequence). Researchers employing a trials-to-criterion design have provided different explanations for finding some effects for the provision of explicit information. Upon finding effects for explicit information for some structures (Spanish subjunctives following expressions of doubts affected by PMP) but not others (Spanish word order/object pronouns affected by FNP), Fernández (2008), for example, argued that the effects of explicit information may depend on the processing problems associated with the structure. Using a similar design, VanPatten et al. (2013) also found some effects for the provision of explicit information for some structures (word order and case markings in German and causative structures in French) but not others (word order and case markings in Russian and word order and object pronoun clitics in Spanish). As the acquisition of all the structures was affected by the same processing principle (FNP), VanPatten et al. (2013) argued that the effectiveness of explicit information may “depend on the nature of the explicit information and whether it is easy enough and portable to use during real time comprehension” (p. 521). Table 2 below provides a summary of the studies on the components of PI.

Main Takeaways

- SI is the main causative factor accounting for the effectiveness of PI.
- Provision of explicit corrective feedback during SI activities does not offer additional benefits (Sanz, 2004; Sanz & Morgan-Short, 2004). Similarly, adding visual or aural enhancements to SI does not make it more effective (Lee & Benati, 2007a, 2007b). Thus, SI alone is sufficient to bring about effects.
- Explicit information provided in PI may only be helpful in reaching criterion faster for some particular structures (Culman et al., 2009; Fernández, 2008; Henry et al., 2009, 2017, 2024; VanPatten et al., 2013). However, it is not essential or routinely beneficial as both learners receiving and not receiving explicit information perform similarly on the posttest (Henry et al., 2017; VanPatten et al., 2013).
- The only study showing PI to be more beneficial than SI is Farley (2004a). In this study, although both SI and PI groups improved significantly after instruction, the PI group achieved significantly higher gains. This may suggest that although explicit information may not be necessary for PI to be effective, it may offer additional benefits for some linguistic structures which have less transparent form–meaning connections. This is further supported by studies employing a trials-to-criterion design, which found explicit information to be further facilitative in reaching criterion for these linguistic features (Fernández, 2008; Henry et al., 2024).
- The only study showing PI/SI not to be effective, particularly in the long run, is Henry et al. (2024). The limited effects of PI/SI in this study, however, may be due to the limited training provided rather than the inefficacy of instruction.

Table 2. Studies on the components of PI.

Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability
VanPatten and Oikkenon (1996)	PI (17) SI (20) *EI (22)	Spanish object pronouns	FNP	Sentence-level interpretation and production tests	*Pre/*post	<i>Interpretation</i> PI = SI > EI <i>Production</i> PI = SI > EI	N/A
Benati (2004b)	PI (14) SI (12) EI (12)	Future tense in Italian	PMP (1b)	Sentence-level interpretation and production tests	Pre/post + 4 *wk	<i>Interpretation</i> PI = SI > EI <i>Production</i> PI = SI > EI	Maintained 4 weeks
Benati (2004a)	PI (10) SI (11) EI (10)	Gender agreement in Italian	PMP (1d)	Sentence-level interpretation as well as sentence- and discourse-level production tests	Pre/post	<i>Interpretation</i> PI = SI > EI <i>Production (sentence-level)</i> PI = SI > EI <i>Production (discourse-level)</i> PI = SI > EI	N/A
Farley (2004a)	PI (23) SI (31)	Spanish subjunctive of doubt	PMP (1b) & SLP	Sentence-level interpretation and production tests	Pre/post + 2 wk	<i>Interpretation</i> Gains for both groups, but PI > SI <i>Production</i> Gains for both groups, but PI > SI	Maintained 2 weeks
Sanz (2004)	SI + *EF (12) SI + *IF (16)	Spanish object pronouns	FNP	Sentence-level interpretation as well as sentence- and discourse-level production tests	Pre/post	<i>Interpretation</i> SI + EF = SI + IF <i>Production (sentence-level)</i> SI + EF = SI + IF <i>Production (discourse-level)</i> SI + EF = SI + IF	N/A
Sanz and Morgan-Short (2004)	PI + EF (21) PI – EF (15) SI + EF (13) SI – EF (20)	Spanish object pronouns	FNP	Sentence-level interpretation as well as sentence- and discourse-level production tests	Pre/post	<i>Interpretation</i> PI + EF = PI – EF = SI + EF = SI – EF <i>Production (sentence-level)</i> Significant gains for all groups; PI + EF = PI – EF = SI + EF = SI – EF	N/A

							Production (discourse-level) Significant gains for all groups; $PI + EF = PI - EF = SI + EF = SI - EF$
Wong (2004)	PI (26) SI (25) EI (22) C (21)	Negation with <i>du/un</i> in French	PMP (1b)	Sentence-level interpretation and production tests	Pre/post		Interpretation $PI = SI > EI = C$ Production $PI = SI > EI > C$
Lee and Benati (2007a)	SI (10) SIE (10)	Italian future tense	PMP (1b)	Sentence-level interpretation and production tests	Pre/post		Interpretation $SI = SIE$ Production $SI = SIE$
Lee and Benati (2007b)	SI (9) SIE (10) C (7)	Japanese past tense markers	PMP (1b)	Sentence-level interpretation and production tests	Pre/post + 1 wk		Interpretation $SI = SIE > C$ Production $SI = SIE > C$ Maintained 1 week
							Ex 1. Performance during training $PI = SI$ Ex 2. Performance during training significantly more participants from the PI group reached criterion than the SI group; $PI > SI$ participants in the PI group took significantly fewer trials to reach criterion; $PI < SI$ participants in the PI group responded significantly faster than the SI group; $PI < SI$
Fernández (2008)	Ex. 1 PI (42) SI (42) Ex. 2 PI (42) SI (42)	Ex. 1 Spanish object pronouns Ex. 2 Spanish subjunctive of doubt	Ex. 1 FNP Ex. 2 PMP (1b) & SLP	Ex. 1 & 2 Performance during tasks designed to promote acquisition (number of participants reaching criterion, trials to criterion, and response time)	Ex. 1 & 2 Trials-to-criterion		N/A
Culman et al. (2009)	PI *L-prof. (16) PI *H-Prof. (14)	German case marking	FNP	Performance during tasks designed to promote acquisition (trials to criterion)	Trials-to-criterion		Performance during training Participants in the PI group took significantly fewer trials to reach criterion; $PI < SI$

	SI L-Prof. (15) SI H-Prof. (14)					No effects for proficiency level; L-prof. = H-prof.	
Henry et al. (2009)	PI (19) SI (19)	German case marking	FNP	Performance during tasks designed to promote acquisition (number of participants reaching criterion as well as trials to criterion)	Trials-to-criterion	<i>Performance during training</i> significantly more participants from the PI group reached criterion than the SI group; PI > SI participants in the PI group took significantly fewer trials to reach criterion; PI < SI	N/A
Henry et al. (2017)	*PI + P *PI - P SI + P SI - P	German case marking	FNP	Sentence-level interpretation and production tests as well as performance during tasks designed to promote acquisition (trials to criterion)	Trials-to-criterion & Pre/post + 4 wk	<i>Interpretation</i> PI + P = PI - P = SI + P > SI - P <i>Production</i> Gains only on posttest 1 <i>Performance during training</i> Participants in the PI groups took significantly fewer trials to reach criterion; PI + P = PI - P < SI + P = SI - P	Maintained 4 weeks (only interpretation)
Henry et al. (2024)	PI (28) SI (30) C (30)	Spanish subjunctive of doubt	PMP (1b) & SLP	Sentence-level interpretation test as well as performance during tasks designed to promote acquisition (number of participants reaching criterion, trials to criterion, accuracy after criterion, and response time)	Trials-to-criterion & Pre/post + 4 wk	<i>Interpretation</i> Gains only on posttest 1 and PI > SI = C <i>Performance during training</i> significantly more participants from the PI group reached criterion than the SI group; PI > SI No significant difference between PI and SI in the number of trials taken to reach criterion; PI = SI Participants in the PI group were significantly more accurate than the ones in the SI group after reaching criterion; PI > SI	No long-term effects

					No significant difference between PI and SI in response time; PI = SI					
					Ex 1. <i>Interpretation</i> PI = SI <i>Performance during training</i> No significant difference between PI and SI in reaching criterion; PI = SI					
					Ex 2. <i>Interpretation</i> PI = SI <i>Performance during training</i> Participants in the PI group took significantly fewer trials to reach criterion; PI < SI					
VanPatten et al. (2013)	Ex. 1 PI (23) SI (19)	Ex. 1	Ex. 1, 2, 3 & 4 FNP	Ex. 1, 2, 3 & 4 Sentence-level interpretation test as well as performance during tasks designed to pro- mote acquisition (trials to cri- terion)	Ex. 1, 2, 3 & 4 Trials-to-crite- rion & Pre/post	N/A				
	Ex. 2 PI (24) SI (22)	Spanish object pronouns Ex. 2 German case marking								
	Ex. 3 PI (23) SI (21)	Ex. 3 Russian case marking Ex. 4 French causative								
	Ex. 4 PI (23) SI (25)									
							Ex. 3 <i>Interpretation</i> PI = SI <i>Performance during training</i> No significant difference between PI and SI in reaching criterion; PI = SI			
							Ex. 4 <i>Interpretation</i> PI = SI <i>Performance during training</i> Participants in the PI group took significantly fewer trials to reach criterion; PI < SI			

Notes: EI = Explicit information; EF = Explicit feedback; Pre = Pretest; Post = Posttest; IF = Implicit feedback; SIE = SI-Enhanced; L-Prof. = Lower proficiency; H-Prof. = Higher Proficiency; PI + P = PI with focused prosody in SI activities; PI – P = PI with monotone prosody in SI activities; C = Control; wk = Weeks (after instruction).

3.3. Research on the Transfer (Secondary) Effects of PI/SI

Transfer-of-training (secondary) effects of PI/SI refers to development in making accurate form–meaning connections for linguistic forms as a result of receiving PI/SI on another linguistic feature (Benati & Lee, 2015). In other words, it occurs when learners receive PI/SI on a particular form (e.g., English past tense) and, as a result, improve not only on that form but also on other linguistic features (e.g., English third person singular -s). Research in this area basically aims to answer VanPatten’s (1996) query “Does processing instruction actually affect the acquired system, what is called in the general model, the developing system?” (p. 154). In other words, it attempts to find out whether PI alters the learners’ non-optimal processing behaviour in such a way that they process not only the target form of instruction accurately but also other structures as well (White, 2015). Benati and Lee’s (2008) study is one of the first attempts to examine whether PI would have such effects. In their study, Benati and Lee (2008) provided PI on Italian noun-adjective gender agreement and found that PI had also secondary effects on Italian future tense as measured by interpretation and written production tasks. Other studies also found similar results with other structures, including secondary effects on the English third person singular -s in interpretation and written production tasks (Benati et al., 2008a), subjunctive forms and the causative with *faire* in French in interpretation and written production tasks (Benati et al., 2008b), gender-cued, null subjects in Spanish in interpretation tasks (Lee, 2015, 2019), dative clitics in Spanish in interpretation tasks (White & DeMil, 2013b), and dative clitics in Spanish in interpretation tasks but not in production tasks (Leeser & DeMil, 2013; White, 2015; White & DeMil, 2013a). The inconsistency in the secondary effects of PI/SI when tested in production tasks may be due to the nature of the secondary target form itself. The secondary target form in studies failing to show transfer effects was Spanish dative clitics. As White and DeMil (2013a) state, “dative clitics are a late emerging structure, and learners’ correct use of this target form may not happen until more advanced proficiency levels” (p. 83).

There is, however, some evidence that PI does not always come with positive secondary effects in interpretation tasks either. Wong et al. (2021), for example, found that PI provided on French causatives had a positive effect on processing this structure, but it did not have any transfer effects on processing the French passive structure. The researchers argued that PI delivered on the causative structure might not have been sufficient to reduce the FNP bias in processing the passive structure as well, probably due to the low number of SI tokens used during training. Similarly, in another study, Lee (2019) found that while PI delivered on the Spanish passive structure had positive primary effects on processing this structure as well as positive secondary effects on processing null subjects in Spanish, it did not have any secondary effects on processing Spanish object pronouns. He argued that the secondary effects observed for null subjects would probably be due to the applicability of the information provided for the passive structure on null subjects. The information and practice provided for the passive structure cued the learners to use a gender marker to interpret agent/patient relations. The learners might have used the same information to resolve null subjects as well. This, however, was not observed for the object pronouns, although both the passive structure and object pronouns (OproVS) placed the agent in the postverbal position, indicating that the learners did not adopt a strategy to interpret all postverbal nouns as agents. Lee argued that this was most likely due to the verb form being active in the object pronoun sentences with no gender markers, which is unlike the passive structure. Similar results were found by Lee (2015), which showed that while participants receiving PI on the Spanish passive structure transferred training to their processing of sentences with gender-cued, null subjects, only a subgroup of them transferred training to processing sentences with object pronouns. Based on these

findings, it may be suggested that factors such as learners' proficiency level as well as the pertinency of instruction provided on the primary target structure to processing other structures may affect learners' ability to transfer training to their processing of other structures. Research on secondary effects of PI/SI, however, is still in its infancy and more research is required in this regard (Benati, 2023b). Table 3 below provides a summary of the studies on the secondary effects of PI/SI.

Main Takeaways

- Receiving PI on a particular linguistic feature may have secondary effects on processing other (although not all) structures as well, suggesting that PI may at least partially affect L2 learners' developing linguistic system. This effect, however, is more significant in interpretation tasks than in production tasks.
- Similar to studies showing SI to be the main causative factor accounting for the effectiveness of PI, there is some evidence suggesting that SI is the main factor responsible for the secondary effects of PI (White, 2015; White & DeMil, 2013b).
- The transferability of the effects of PI/SI to other structures may depend on factors such as learners' proficiency level, the relevance of instruction provided on the primary target structure to processing other structures, and the number of tokens of the primary target structure in SI activities (e.g., Lee, 2015, 2019; White, 2015; Wong et al., 2021).

Table 3. Studies on the transfer (secondary) effects of PI/SI.

Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability
Benati and Lee (2008)	PI (9) TI (10) *C (6)	Primary: Italian noun-adjective gender agreement Secondary: Italian future tense	Primary: PMP (1a, 1c, & 1d) & SLP Secondary: PMP (1b)	Sentence-level interpretation and production tests	*Pre/*post	Primary effects <i>Interpretation</i> PI > TI = C <i>Production</i> PI = TI > C Secondary effects <i>Interpretation</i> PI > TI = C <i>Production</i> Significant, but modest, gains for both PI and TI; PI > C ; PI = TI ; TI = C	N/A
Benati et al. (2008a)	PI (12) TI (14)	Primary: English past tense marker <i>-ed</i> Secondary: English third person singular <i>-s</i>	Primary & secondary: PMP (1b & 1c) & SLP	Sentence-level interpretation and production tests	Pre/post	Primary effects <i>Interpretation</i> PI > TI <i>Production</i> PI = TI Secondary effects <i>Interpretation</i> PI > TI <i>Production</i> PI > TI	N/A
Benati et al. (2008b)	PI (13) TI (10) C (7)	Primary: French imperfect Secondary: (1) French subjunctive (2) French causative	Primary: PMP (1b) Secondary: <i>French subjunctive:</i> PMP (1b, 1c, & 1d) <i>French causative:</i> FNP	Sentence-level interpretation and production tests	Pre/post	Primary effects <i>Interpretation</i> PI > TI = C <i>Production</i> PI = TI > C Secondary effects <i>Interpretation (French subjunctive)</i> PI > TI = C	N/A

						<i>Production (French subjunctive)</i> PI > TI = C	
						<i>Interpretation (French causative)</i> PI > TI = C	
						<i>Production (French causative)</i> PI > TI = C	
White and DeMil (2013b)	PI (50) SI (46) *FREI (55)	Primary: Spanish accusative clitics Secondary: Spanish dative clitics	Primary & secondary: FNP	Sentence-level interpretation test	Pre/post + 3 *wk	Primary effects <i>Interpretation</i> PI = SI > FREI Secondary effects <i>Interpretation</i> SI > PI > FREI	Primary effects Maintained 3 wk Secondary effects Maintained 3 wk only for SI
White and DeMil (2013a)	PI (50) TI (64) C (20)	Primary: Spanish accusative clitics Secondary: Spanish dative clitics	Primary & secondary: FNP	Sentence-level interpretation and production tests	Pre/post + 3 wk	Primary effects <i>Interpretation</i> PI > TI = C <i>Production</i> PI = TI > C Secondary effects <i>Interpretation</i> PI > TI = C <i>Production</i> No gains for any of the groups; PI = TI = C	Primary effects Maintained 3 wk Secondary effects Maintained 3 wk
Leeser and DeMil (2013)	PI (28) TI (36) C (28)	Primary: Spanish accusative clitics Secondary: Spanish dative clitics	Primary & secondary: FNP	Sentence-level interpretation and production tests	Pre/post + 1 *mon	Primary effects <i>Interpretation</i> <i>Posttest 1:</i> PI > TI > C <i>Posttest 2:</i> PI > TI = C <i>Production</i> PI = TI > C Secondary effects <i>Interpretation</i> PI > TI > C <i>Production</i>	Primary effects Maintained 1 month only for PI Secondary effects Maintained 1 month only for PI

						No gains for any of the groups; PI = TI = C	
						Primary effects Interpretation 40-tk = 60-tk = 80-tk = 100-tk = 120-tk = 140-tk > C Production 60-tk = 80-tk > 40-tk = 100-tk = 120-tk = 140-tk = C Secondary effects Interpretation 60-tk = 80-tk = 100-tk = 120-tk = 140-tk > 40-tk = C Production No gains for any of the groups; 40-tk = 60-tk = 80-tk = 100-tk = 120-tk = 140-tk = C	
White (2015)	SI	Primary: Spanish accusative clitics Secondary: Spanish dative clitics	Primary & secondary: FNP	Sentence-level interpretation and production tests	Pre/post + 3 wk	Primary effects Maintained 3 weeks	
	40-*tk (71)					Secondary effects Maintained 3 weeks only for 80-, 120-, & 140-tk	
	60-tk (57)						
	80-tk (48)						
	100-tk (111)						
	120-tk (69)						
	140-tk (66)						
	C (38)						
						Primary effects Interpretation PI > C Secondary effects Interpretation (object pronouns) Gains only for a subgroup of PI Interpretation (null subjects) PI > C	
Lee (2015)	PI (n = 31) C (20)	Primary: Spanish passive structure	Primary & secondary: FNP	Sentence-level interpretation test	Pre/post + 2 wk	Primary effects Maintained 2 weeks	
		Secondary: (1) Object pronouns in Spanish				Secondary effects Maintained 2 weeks	
		(2) gender-cued, null subjects in Spanish					
						Primary effects Interpretation Significant gains for PI after instruction PI pretest vs. LE posttest PI < LE PI posttest vs. LE posttest PI > LE Secondary effects Interpretation (object pronouns)	
Lee (2019)	PI (38) *LE (21)	Primary: Spanish passive structure	Primary & secondary: FNP	Sentence-level interpretation test	Pre/post	N/A	
		Secondary: (1) Object pronouns in Spanish					
		(2) gender-cued, null subjects in Spanish					

						No gains for PI after instruction <i>PI pretest vs. LE posttest</i> PI < LE <i>PI posttest vs. LE posttest</i> PI < LE <i>Interpretation (null subjects)</i> Significant gains for PI after in- struction <i>PI pretest vs. LE posttest</i> PI < LE <i>PI posttest vs. LE posttest</i> PI = LE		
						Ex. 1 Primary effects <i>Interpretation</i> SI > TI – EI <i>Eye movement patterns</i> Reduction of looks to the incorrect picture SI < TI – EI Secondary effects <i>Interpretation</i> No gains for any of the groups; SI = TI – EI <i>Eye movement patterns</i> Reduction of looks to the incorrect picture No gains for any of the groups; SI = TI – EI Ex. 2 Primary effects <i>Interpretation</i> Gains for both groups, but SI + EI > TI + EI <i>Eye movement patterns</i>		
Wong et al. (2021)	Ex. 1 SI (31) Ex. 2 TI – EI (33) SI + EI (25) TI + EI (25)	Ex. 1 & 2 Primary: French causatives Secondary: French passive structure	Ex. 1 & 2 Primary & secondary: FNP	Ex. 1 & 2 Online sentence-level interpretation test (Eye tracking used to examine improvement in eye movement pat- terns)	Ex. 1 & 2 Pre/post		N/A	

Reduction of looks to the incorrect picture
Gains for both groups; **SI + EI = TI + EI**
Secondary effects
Interpretation
No gains for any of the groups;
SI +EI = TI + EI
Eye movement patterns
Reduction of looks to the incorrect picture
No gains for any of the groups;
SI + EI = TI + EI

Notes: FREI = Form-related explicit information; Pre = pretest; Post = posttest; tk = Tokens (number of target items in SI activities); LE = Language experience (learners with higher language experience); C = Control; wk = Weeks (after instruction); mon = months (after instruction).

3.4. Research on the Online Effects of PI/SI

Historically, PI research has been characterised by two broad methodological approaches: the use of offline measures and the use of online measures. Offline measures, such as interpretation and production tests, have traditionally been used to assess learning outcomes and post-instructional gains (see Ruiz & Rebuschat, 2024, for a methodological review of offline PI/IP research). While these measures provide valuable information about learners' ultimate performance, they offer limited insight into the real-time cognitive processes that underlie input processing during comprehension. In contrast, online measures, such as eye-tracking or self-paced reading tests, allow researchers to examine learners' moment-by-moment processing behaviour as language input unfolds. As a result, research on PI and the components thereof has recently witnessed a methodological shift, moving away from an exclusive reliance on offline outcome measures toward the adoption of online measures that capture real-time processing dynamics.

Using online measures to investigate the effects of PI/SI has the advantage of providing us with a better picture of learners' moment-by-moment sentence parsing and processing of language in real time, which would reflect their input processing behaviour (Benati, 2022a, 2022b; Henry, 2022). Moreover, learners' comprehension of sentences gauged through online measures may also reflect their implicit knowledge of the target feature, which could be taken as evidence of authentic L2 development (Benati, 2022a; Benati & Chan, 2023; Henry, 2022; Leiser, 2014; see Leiser (2014) and Jegerski (2014) for more on this topic). Thus, a number of studies have now delved into examining the effects of PI/SI through online measures, addressing a wide range of questions (Benati, 2020, 2021b, 2022a, 2022b; Chiuchiù & Benati, 2020; Henry, 2022; Issa & Morgan-Short, 2019; Lee & Doherty, 2019; Lee et al., 2020; Leiser & Pesce, 2023; Malovrh et al., 2020; Wong & Ito, 2018). Table 4 below provides a summary of the studies on the online effects of PI/SI.

Main Takeaways

- Overall, PI/SI has been shown to be more effective compared to other types of instruction. Learners receiving PI/SI are generally both more accurate and more efficient in processing of the input in real time. There is some evidence indicating that attention alone is not sufficient for the acquisition of the target form (Chiuchiù & Benati, 2020; Issa & Morgan-Short, 2019), which may suggest that without effective processing of the input and the formation of form–meaning connections, learners do not fully abandon their non-optimal input processing behaviour.
- Similar to offline studies, research using online measures has revealed that explicit information does not seem to add any further beneficial effects in terms of accuracy as long as SI activities are provided (Wong & Ito, 2018). Some effects, however, have been found for explicit information in terms of input processing speed (Leiser & Pesce, 2023). This may suggest that although explicit information may not offer further benefits in terms of developing accuracy, it may be beneficial in enhancing input processing efficiency.
- Involving learners in deeper processing of form during PI treatment may offer further benefits. However, these benefits are only short term as learners receiving PI both with and without activities leading to deeper processing of form ultimately perform similarly in the long run (Malovrh et al., 2020).
- Learners receiving PI may reach a native level of accuracy. However, their cognitive input processing behaviour may not reach the same level, although it becomes more nativelike (Lee & Doherty, 2019).

Table 4. Studies on the online effects of PI/SI.

Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability
Wong and Ito (2018)	Ex. 1 SI (30)	Ex. 1 & 2 French causative	Ex. 1 & 2 FNP	Ex. 1 & 2 Online sentence-level interpretation test (Eye tracking used to examine improvement in eye movement patterns)	*Pre/*Post	Ex. 1 <i>Interpretation</i> SI > TI <i>Eye movement</i> Reduction of looks to the incorrect picture SI < TI	N/A
	Ex. 2 TI – EI (32) SI + EI (24) TI (25)					Ex. 2 <i>Interpretation</i> SI + EI > TI <i>Eye movement</i> Reduction of looks to the incorrect picture Gains for both groups, but SI + EI < TI Ex. 1 vs. Ex. 2 <i>Accuracy</i> No significant effects for EI <i>Eye movement</i> Reduction of looks to the incorrect picture Significant effect for EI only in the TI group	
Issa and Morgan-Short (2019)	Ex. 1 *IE (21) *C (14) Ex. 2 SI (20)	Ex. 1 & 2 Spanish direct object pronouns	Ex. 1 & 2 FNP	Ex. 1 & 2 Offline sentence-level interpretation test Also, eye tracking used to measure the amount of attention paid to the target structure during the treatment	Ex. 1 & 2 Pre/Post + 2 *wk	Ex. 1 <i>Interpretation</i> No significant gains for any of the groups; IE = C <i>Allocation of attention</i> IE led to an increase in allocation of attention to the target structure. Ex. 2 <i>Interpretation</i> significant gains <i>Allocation of attention</i>	Maintained 2 wk

							SI led to an increase in allocation of attention to the target structure.	
							Interpretation Significant gains after instruction; PI = NS	
Lee and Doherty (2019)	PI (22) *NS (11)	Spanish passive structure	FNP	Online sentence-level interpretation test (Response time measured and eye tracking used to examine the input processing behaviour)	Pre/Post		Response time Shorter response time after instruction; PI = NS	N/A
							Input processing behaviour More nativelike input processing behaviour after instruction, but PI < NS	
							Interpretation GI > PI > C	
Malovrh et al. (2020)	*GI (17) PI (18) C (19)	Spanish passive structure	FNP	Online sentence-level interpretation test (Response time measured)	Pre/Post + 8 wk		Response time Shorter response time after instruction; PI < GI < C	No long-term gains
							Reading time Longer reading time in reading sentence segments violating the subjunctive of doubt only for SI, showing sensitivity to violations of the subjunctive of doubt; SI > IE	
ChiuChiu and Benati (2020)	SI (9) IE (9)	Italian subjunctive of doubt	PMP (1b, 1c, & 1d) & SLP	Online sentence-level interpretation test (Reading time)	Pre/Post			N/A
							Interpretation SI > TI	
Benati (2020)	SI (32) TI (32)	English passive forms	FNP	Online sentence-level interpretation test (Eye tracking used to examine improvement in eye movement patterns)	Pre/Post		Eye movement Reduction of looks to the incorrect picture SI < TI	N/A
							Interpretation SI > OBI	
Benati (2021b)	SI (21) OBI (21)	Italian passive forms	FNP	Online sentence-level interpretation test (Eye tracking used to examine improvement in eye movement patterns)	Pre/Post		Eye movement Reduction of looks to the incorrect picture SI < OBI	N/A
							Interpretation SI > TI	
Benati (2022b)	SI (26) TI (26)	English passive causative forms	FNP	Online sentence-level interpretation test	Pre/Post			N/A

				(Eye-tracking used to examine improvement in eye movement patterns)		Eye movement Reduction of looks to the incorrect picture SI < TI	
						Interpretation SI > OBI Response time Shorter response time after instruction only for SI; SI < OBI Reading time Shorter reading time after instruction only for SI; SI < OBI	
Benati (2022a)	SI (29) OBI (24)	English passive forms	FNP	Online sentence-level interpretation test (Reading time & response time measured)	Pre/Post		N/A
						Interpretation Significant gains for both groups; PI = SI Performance during training Shorter response time only for PI; PI < SI No significant difference between PI and SI in reaching criterion; PI = SI	
Leeser and Pesce (2023)	PI (16) SI (16)	Clitic object pronouns in Italian	FNP	Sentence-level interpretation test as well as performance during tasks designed to promote acquisition (response time in correct responses and trials-to-criterion)	Pre/Post & trials-to-criterion		N/A
						Offline effects Interpretation PI > TI Production Significant gains for both PI and TI; PI = TI Online effects Interpretation PI > TI Reading time Longer reading time in reading the first noun phrase in <i>Masculine-First</i> sentences only for PI, showing sensitivity to case marking in German; PI > TI No significant increase in reading time in reading the second noun phrase in	
Henry (2022)	PI (25) TI (26)	Accusative case markers in German	FNP	Offline sentence-level interpretation and production tests as well as online sentence-level interpretation test (Reading time measured)	Pre/Post		N/A

						Masculine-Second sentences for any of the groups; PI = TI	
						Interpretation	Interpretation
						PI > Control	Maintained 8 wk
						Response time	Response time
						PI < Control	No long-term effects
						Reading time	Reading time
						Shorter reading time only for PI; PI < Control	Maintained 8 wk

Notes: Pre = Pretest; Post = Posttest; IE = Input enhancement; C = Control; wk = Weeks (after instruction); NS = Native speakers; GI = Guided-inductive instruction.

3.5. Research on the Role of Individual Differences

Individual differences encompass differences in a range of traits including working memory capacity, language analytic ability, motivation, anxiety, learning styles, age, etc. A great deal of research has addressed the role of individual differences in instructed second language acquisition (ISLA), suggesting that L2 acquisition may be more or less influenced by learners' individual differences (Li, 2022; Martin & Ellis, 2012; Rassaei, 2015a, 2015b; Williams, 2012). Within PI/SI realm, research on individual differences has revolved around traits such as working memory (Benati, 2023a; Issa, 2019; Leeser & Pesce, 2023; Santamaria & Sunderman, 2015; Sanz et al., 2016), language analytic ability (VanPatten et al., 2013), age (Benati, 2013; Benati & Angelovska, 2015; Mavrantoni & Benati, 2013), motivation (Benati & Chan, 2023; Farhat & Benati, 2018), and field in/dependence (Naami & Sahragard, 2022). Table 5 below provides a summary of the studies on the role of individual differences in the effectiveness of PI/SI.

Main Takeaways

- PI/SI is effective regardless of the learners' individual differences, suggesting that it creates an optimum learning condition benefitting all learners. Some effects have been found for working memory in some studies (e.g., Issa, 2019; Leeser & Pesce, 2023; Sanz et al., 2016). However, these effects have been either minimal or only in relation to performance during receiving treatment.
- The only case where PI was found to be more effective for adults than for children was when tested in a cognitively complex task, which may indicate that the cognitive complexity involved in the task, rather than PI, may draw on age-related factors (Benati & Angelovska, 2015). Thus, it may be concluded that PI is also effective regardless of the age of the learners.

Table 5. Studies on the role of individual differences in the effectiveness of PI/SI.

Working Memory							
Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability
Santamaria and Sunderman (2015)	PI-*HS (21) PI-*LS (30)	Clitic object pronouns in French	FNP	Sentence-level interpretation and production tests	*Pre/*Post + 2 *wk	<i>Interpretation</i> Gains for both groups; PI-HS = PI-LS <i>Production</i> Gains for both groups, but PI-HS > PI-LS	Maintained 2 wk
Sanz et al. (2016)	Ex.1 PI (23) Ex. 2 SI (21)	Ex.1 & 2 Latin Case marking	FNP	Ex. 1 Sentence-level written and aural interpretation tests Ex. 2 Sentence-level written and aural interpretation tests as well as sentence-level written production test	Pre/Post + 2 wk	Ex. 1 <i>Interpretation</i> Significant gains after instruction WM No role for WM Ex. 2 <i>Interpretation</i> Significant gains after instruction <i>Production</i> Significant gains After instruction WM Significant positive correlation between WM and gains in aural interpretation (immediate posttest) and written interpretation (delayed posttest)	Maintained 2 wk
Issa (2019)	SI (14) *C (10)	Spanish object pronouns	FNP	Sentence-level interpretation test (also, eye tracking used to examine the relationship between WM and attention during treatment)	Pre/Post + 2 wk	<i>Interpretation</i> SI > C WM Significant negative correlation between WM and allocation of attention during treatment only for SI	Maintained 2 wk
Leeser and Pesce (2023)	PI (16) SI (16)	Clitic object pronouns in Italian	FNP	Sentence-level interpretation test as well as performance during tasks designed to promote acquisition (response	Pre/Post + 2 & trials-to-criterion	<i>Interpretation</i> See Table 4. <i>Performance during training</i> See Table 4. WM	See Table 4.

				time in correct responses and trials to criterion)	Nor role for WM Significant negative correlation between WM and trials to criterion for PI							
Benati (2023a)	SI-HS (21) SI-LS (23) C (17)	English causative forms	FNP	Sentence-level interpretation and discourse-level production tests	Pre/Post + 4 wk	<i>Interpretation</i> SI-HS = SI-LS > C <i>Production</i> SI-HS = SI-LS > C	Maintained 4 wk					
Language Analytic Ability												
Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability					
VanPatten et al. (2013)	Ex. 1 PI (23) SI (19)	Ex. 1 Spanish object pro-nouns	Ex. 1, 2, 3 & 4 4 FNP	Ex. 1, 2, 3 & 4 Sentence-level interpretation test as well as performance during tasks designed to promote acquisition (trials to criterion)	Pre/Post & trials-to-criterion	<i>Interpretation</i> See Table 2.	N/A					
	Ex. 2 PI (24) SI (22)	Ex. 2 German case marking				<i>Performance during training</i> See Table 2.						
	Ex. 3 PI (23) SI (21)	Ex. 3 Russian case marking				LAA						
	Ex. 4 PI (23) SI (25)	Ex. 4 French causative				Significant, but weak, negative correlation between LAA and the trials-to-criterion only for the PI group in Ex. 2						
	Motivation											
	Study	Groups (n)				Target Structure		IP Principle	Measures	Design	Major Findings	Effects Durability
	Farhat and Benati (2018)	PI-*HM (29) PI-*LM (12)				Gender agreement in Arabic		PMP (1c)	Sentence-level interpretation and production tests	Pre/Post + 1 *mon	<i>Interpretation</i> Significant gains for both PI groups; PI-HM = PI-LM	Maintained 1 mon
											<i>Production</i> Significant gains for both PI groups; PI-HM = PI-LM	
Benati and Chan (2023)	SI-HM (20) SI-LM (15) C-*MM (15)	English passive causatives	FNP	Sentence-level interpretation test	Pre/Post + 3 wk	<i>Interpretation</i> SI-HM = SI-LM > C	Maintained 3 wk					
Field in/Dependence												
Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability					

Naami and Sahragard (2022)	PI (28) TI (28)	English passive forms	FNP	Sentence-level interpretation test	Pre/Post + 2 wk	<i>Interpretation</i> PI > TI <i>FI/D</i> No role for FI/D	Maintained 2 wk
Age							
Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major findings	Effects durability
Benati (2013)	PI-Adults (12)	English passive forms	FNP	Sentence-level interpretation and production tests	Pre/Post + 3 wk	<i>Interpretation</i> Significant gains for both PI groups; PI-Adults = PI-Teens	Maintained 3 wk
	PI-Teens (17)					<i>Production</i> Significant gains for both PI groups; PI-Adults = PI-Teens	
Mavrantoni and Benati (2013)	PI-Children (10)	English third person -s	PMP (1b & 1c) & SLP	Sentence-level interpretation and production tests	Pre/Post	<i>Interpretation</i> PI > TI; PI-Children = PI-Teens	N/A
	TI-Children (10)					<i>Production</i> PI = TI; PI-Children = PI-Teens	
	PI-Teens (7)						
	TI-Teens (7)						
Benati and Angelovska (2015)	PI-Adults (13)	English past tense marker -ed	PMP (1b & 1c) & SLP	Two sentence-level interpretation tests (one less and one more cognitively demanding) as well as sentence-level production test	Pre/Post + 2 wk	<i>Interpretation (less demanding)</i> Significant gains for both PI groups; PI-Adults = PI-School age	Maintained 2 wk
	PI-School age (36)					<i>Interpretation (more demanding)</i> Significant gains for both PI groups, but PI-Adults > PI-School age	
						<i>Production</i> Significant gains for both PI groups; PI-Adults = PI-School age	

Notes: WM = Working memory; HS = High span; LS = Low span; C = Control; Pre = Pretest; Post = Posttest; LAA = Language analytic ability; HM = High motivation; LM = Low motivation; MM = Moderate motivation; FI/D = Field in/dependence; wk = Weeks (after instruction); mon = Months (after instruction).

3.6. Research on the Role of Input Modality

Another stream of research which has grabbed some attention in recent years concerns the role of input modality in PI/SI effectiveness. This line of inquiry aims to find out whether PI/SI provided in aural or written mode would have any differential effects. Research in this area is basically premised on the research findings in cognitive psychology showing that the modality of the presentation of stimuli affects recalling those stimuli (e.g., Beaman, 2002; Penney, 1980, 1989; Penney & Butt, 1986). Within SLA, one of the earliest studies on the role of input modality in processing language was carried out by Wong (2001). In a partial replication study of VanPatten (1990), Wong (2001) aimed at finding whether auditory input and written input would differentially affect processing of meaning and forms simultaneously. The study found that participants receiving auditory input had difficulty attending to both form (English article *the*) and meaning, while those receiving written input did not show such difficulty. This finding echoed VanPatten's (1990) findings that processing auditory input for both meaning and form simultaneously is challenging for L2 learners. Based on the same grounds, two recent studies, namely Ito and Wong (2019) and Angelovska and Roehm (2020), investigated whether input modality in PI/SI would make a difference in its efficacy. Table 6 below provides a summary of these studies.

Main Takeaways

- There are conflicting findings regarding the role of input modality in the efficacy of PI/SI. While Ito and Wong (2019) found that only written SI resulted in a reduction of the FNP bias, Angelovska and Roehm (2020) found no effects for input modality in PI. While this conflicting finding could be partially due to differences in testing measures (i.e., eye movement patterns in Ito and Wong (2019) and response time in Angelovska and Roehm (2020)), other factors such as learners' developmental readiness to acquire the form might have also had some roles. As Angelovska and Roehm (2020) argued, the participants in their study were not developmentally ready to acquire the form (English third person -s), which could in fact account for the lack of significant differences in gains between the PI groups and the control group.

Table 6. Studies on the role of input modality.

Study	Groups (n)	Target Structure	IP Principle	Measures	Design	Major Findings	Effects Durability
Ito and Wong (2019)	*A-SI-same voice (26) A-SI-different voice (27)	French causative	FNP	Online sentence-level aural interpretation test (Eye-tracking used to examine improvement in eye movement patterns)	Pre/post	<i>Interpretation (aural test)</i> Gains for both groups after instruction; A-SI-same voice = A-SI-different voice <i>Eye movement</i> No reduction of looks to the incorrect picture for any of the groups A-SI-different voice (Ito & Wong, 2019) vs. *W-SI (Wong & Ito, 2018, Ex. 1) <i>Interpretation</i> A-SI = W-SI <i>Eye movement</i> Reduction of looks to the incorrect picture only for W-SI; W-SI < A-SI	N/A
						<i>Interpretation (aural test)</i> Gains for both W-PI and A-PI, but no significant differences between any of the treatment groups and the control group; W-PI = A-PI = C <i>Response time (aural test)</i> Shorter response time on both posttests only for W-PI group, but no significant differences between the groups; W-PI = A-PI = C <i>Interpretation (written test)</i> Gains for both W-PI and A-PI, but no significant differences between any of the treatment groups and the control group; W-PI = A-PI = C <i>Response time (written test)</i> Shorter response time for all groups; W-PI = A-PI = C <i>Production (written test)</i> Gains only for W-PI, but no significant differences between the groups on any of the posttests; W-PI = A-PI = C	
Angelovska and Roehm (2020)	W-PI (35) A-PI (34) *C (20)	English third person -s	PMP (1b & 1c) & SLP	Online sentence-level aural and written interpretation tests (response time measured) Offline sentence-level written production test	Pre/post + 2 *wk	<i>Interpretation (aural)</i> Maintained 2 wk Response time (aural) Maintained 2 wk Interpretation (written) Maintained 2 wk Response time (written) Maintained 2 wk Production (written) No long-term gains	

Notes: A= Aural; W = Written; C = Control; wk = Weeks (after instruction).

4. Conclusions and Directions for Future Research

This review article aimed to provide an overview of 30 years of research on PI. There is now ample evidence suggesting that PI is a highly effective instructional intervention and, in most cases, even more effective than other instructional interventions. Research has also revealed that the main causative factor accounting for the effects of PI is SI, with explicit information having minimal impact if any. This finding provides some support for the argument that explicit grammatical rules do not correspond to the implicit mental representations the mind relies on for language development (Benati, 2021a; Paradis, 2004; VanPatten, 2016). Moreover, the fact that PI/SI has been found to be a superior pedagogical intervention compared to output-based types of instruction highlights that L2 acquisition requires the provision of high-quality input (i.e., input which assists learners to make form–meaning connections). This of course does not rule out the importance of output in the process of L2 acquisition. Rather, it means that instruction should avoid pushing the learners to produce output too prematurely before they have been provided with ample input and opportunities to process the input accurately (Benati, 2021a). Output practice, as Benati (2023b) states, may contribute to the development of fluency and accuracy in production, but it does not lead to the acquisition of grammatical rules in itself. Finally, evidence coming from online studies reveals that PI/SI changes learners' input processing behaviour in a way that they become more efficient processors of input through abandoning their non-optimal input processing strategies. As noted earlier, research on processing input in real time is more promising as it provides a better picture of L2 acquisition. This strand of research, however, is still in its initial stages, and more research should be carried out along this stream (Benati, 2022a).

Future research, utilising online measures, may investigate learners' processing of the target form when tested in written and auditory modes. There are some arguments and evidence to suggest that processing auditory input may generally be more challenging than processing written input (e.g., Hama & Leow, 2010; Leow, 1995; Park, 2004; Wong, 2001). Yet, surprisingly, little research has addressed the role of input modality in testing learners' processing of input. This is despite the fact that PI is basically about making learners better processors of input, which further highlights the pertinency of input modality in testing learners' input processing. Therefore, future research may address the question of whether/how input modality may affect the learners' processing of language after receiving instruction in the form of PI. This requires administering online tests in auditory and written modes.

Further research should also be carried out on the role of individual differences in the effectiveness of PI. While there has been some research on the relationship between individual differences and the primary effects of PI, suggesting that PI is effective regardless of learners' individual differences, no research has addressed the relationship between individual differences and the secondary effects of PI. The fact that PI has been found to have some transfer effects in some studies (e.g., Benati & Lee, 2008; Benati et al., 2008a, 2008b) but not in others (e.g., Lee, 2015, 2019; Wong et al., 2021) has made some researchers to postulate that individual differences may at least partially account for the positive effects of PI for some but not all learners (Benati, 2023b; Lee, 2015, 2023). To date, however, no research has empirically tested this speculation.

Future research may also investigate whether explicit information may offer any further benefits when processing input in real time. There is abundant evidence suggesting that explicit information does not offer any further benefits over and above SI. However, this evidence is mostly based on offline studies, which only focus on accuracy rather than moment-by-moment processing of input. When measured via online tests, Leiser and Pesce (2023) found some effects for explicit information in enhancing input processing

speed as reflected by learners' response time in picture selection. No research to date, however, has examined whether explicit information provides any additional facilitative effects on learners' moment-by-moment input processing behaviour as reflected by their eye-movement patterns or reading time while reading different segments of the sentence.

Another promising area of research concerns the adaptation of SI activities to contemporary digital learning ecologies. Given the increasing prevalence of online, mobile, and AI-mediated learning environments, research should explore how SI can be implemented, personalised, and scaled in technology-rich contexts, and whether digitally delivered PI produces comparable, superior, or distinct effects relative to traditional face-to-face delivery. Such research would not only modernise PI, but also speak to broader questions about digital literacies and pedagogical design in SLA.

Beyond these lines of inquiry, a key direction for future work would be to investigate how SI activities may interact with language-specific parsing strategies across typologically different languages. Research in psycholinguistics reveals that processing strategies are modulated by language-specific morphosyntax. De Simone et al. (2025), for instance, found morphology processing to be modulated by the orthographic transparency of the language, with readers of orthographically less transparent languages (e.g., English) engaging in greater morphological processing than readers of orthographically more transparent languages (e.g., Italian). In a similar vein, Darzhinova and Luk (2024) demonstrated that the Recency Preference (a bias to attach incoming information into the most recently processed phrase or clause), which is present in many languages (e.g., English, Arabic, Swedish, Norwegian) is very weak when processing relative clauses (a structure that may be affected by some of the IP principles, such as the Sentence Location Principle and the First Noun Principle in the case of object relative clauses) in Russian. Together, the findings of these studies as well as some others (e.g., Requena & Berry, 2021; Saldana et al., 2021) suggest that while certain L1 processing principles (e.g., late closure, morpheme proximity, scope-isomorphism) appear universal, their strength and manifestation differ across languages depending on orthographic transparency, morphological richness, or syntactic structure. Although these studies are based on L1 processing strategies, their findings may extend beyond L1, with implications for SLA research. Research on PI, for example, may investigate whether L1 readers of orthographically less and more transparent languages would involve in L2 morphological processing differently and whether/how SI activities would interact with parsing strategies across languages. Research has provided clear evidence that PI is effective irrespective of learners' L1 or L2. However, to date, no research has directly compared learners from languages with different orthographic characteristics or L1 processing preferences. Such research would be valuable in clarifying how universal cognitive biases interact with language-specific orthographic and morphosyntactic properties, thereby situating PI more firmly within broader psycholinguistic models of sentence processing and parsing.

Finally, although not directly linked to PI, future research may address the role of input/intake in the acquisition of other subsystems of language (e.g., lexis, phonology, pragmatics) from an IP perspective. This research may more specifically investigate how L2 learners process input for the acquisition of different components of language. Research of this nature may not only be insightful on a theoretical level, but it may also lead to the development of sound instructional interventions for the acquisition of different components of language, which are informed by how input is processed for different linguistic subsystems.

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Abbreviations

The following abbreviations are used in this manuscript:

A	Aural
AMS	Academic Motivation Scale
AMTB	Attitude Motivation Test Battery
C	Control
COMP	Comprehension
DG	Dictogloss
EF	Explicit feedback
EI	Explicit information
EnI	Enriched input
Ex.	Experiment
FID	Field in/dependence
FNP	First Noun Principle
FREI	From-related explicit information
G	Group
GEFT	Group Embedded Figures Test
GI	Guided-inductive instruction
H-Prof.	Higher proficiency
HM	High motivation
HS	High span
IE	Input enhancement
IF	Implicit feedback
IP	Input processing
ISLA	Instructed second language acquisition
L-Prof.	Lower proficiency
LAA	Language analytic ability
LE	Language experience (learners with higher language experience)
LM	Low motivation
LS	Low span
MM	Moderate motivation
MLAT	Modern Language Aptitude Test
mon	Months (after instruction)
NS	Native speakers
OBI	Output-based instruction
OVS	Object-verb-subject
P	Prosody
PI	Processing instruction
PMP	Primacy of Meaning Principle
Post	Posttest

Pre	Pretest
R	Re-exposure
SI	Structured input
SIE	SI-Enhanced
SLA	Second language acquisition
SVO	Subject-verb-object
TI	Traditional instruction
tk	Tokens (number of target items in SI activities)
TR	Text reconstruction
W	Written
wk	Weeks (after instruction)
WM	Working memory

Note

1. The review by Wong (2024), however, covers important issues such as how the input processing theory interfaces with other theories and provides some recommendations for practice. Interested researchers are therefore encouraged to refer to Wong (2024) for further information in this regard.

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