



An Examination of Learners' Noticing and Processing of Complex Spanish Grammar in Authentic Input Texts

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Abstract

This study examined five instructional techniques for teaching complex grammar online and their effect on learners' ability to notice and process the Spanish subjunctive when it appeared in authentic input post experimental exposure. All participants were online learners of Spanish in their second semester of language study. Computerized visual input enhancement (VIE), operationalized as word animation, was used to increase the visual salience of the targeted grammatical form for web-based delivery. Four experimental groups – processing instruction with visual input enhancement (+PI +VIE), processing instruction without visual input enhancement (+PI -VIE), structured input with visual input enhancement (+SI + VIE), and structured input without visual input enhancement (+SI -VIE) – were compared with a group that received traditional instruction (+TI). The results indicated that the +PI +VIE group outperformed the +TI group and the two SI groups (+SI +VIE and +SI -VIE) on an awareness measure and both PI groups (+PI +VIE and +PI -VIE) outperformed the +SI -VIE group on an input processing measure.

1 Introduction

Currently, more than 5.8 million college students in the United States (or 28.4% of all students in higher education) take at least one class online (Allen, Seaman, Poulin, & Taylor Straut, 2016). Furthermore, over 2.8 million U.S. college students take their classes exclusively online (Allen et al, 2016). To meet the demand for online and hybrid courses, many textbook companies provide digital versions of their printed texts without taking into consideration the ease of use, appearance, or capabilities of the new format. Fraser (1999) described these products as 'shovelware.' However, the learning environment may be different or optimized in the online format and techniques that are suitable for web-based instruction need to be explored. Presently, many of the foreign language (FL) instructional materials that are available in digital formats adhere to the traditional instruction (TI) paradigm. With TI, learners are provided with an explicit explanation of grammar and target language examples followed by immediate output practice in the form of mechanical and/or transformational drills (Paulston, 1972). Research by Wong and VanPatten (2003) has shown that the mechanical drills that are prevalent with TI are largely ineffective. Despite its ineffectiveness as an instructional technique, TI remains the dominant instructional paradigm for foreign language textbooks at the tertiary level in the United States (Fernández, 2011; VanPatten, 2004).

An overview of the literature on visual input enhancement (VIE) and processing instruction (PI) suggests that these techniques may be a good fit for web-based FL instruction because they are input-based, as instructors have greater control over students' linguistic input in online environments. Hwu (2004) asserted that web-based instruction is superior to traditional classroom-based

instruction for input activities because grammatical forms can be enhanced by computer technology and multimedia (sound, animation, and graphics). According to Doughty and Long (2003), computer technology offers many coding options for altering the appearance of text; for example, computerized enhancements may include font changes, special effects, animations, highlighting, and pop-up windows that provide lexical or grammatical assistance. These techniques are able to shift learners' attention to specific aspects of the target language grammar when they attempt to process their input for meaning; therefore, computerized input enhancement techniques may help learners pay attention to the formal features of language that would otherwise elude their detection when they focus on meaning to understand or communicate messages in the target language (Long, 1991; Long & Doughty, 2009).

Although scant research has been conducted with PI in web-based learning environments, J. F. Lee and Benati (2009) found that PI is equally effective when delivered in class, online, or in a hybridized mode. J. Collentine and K. Collentine (2015) compared PI to TI in a computer-assisted language learning (CALL) environment (a 3D virtual world) and the researchers found that both instructional techniques were equally effective. However, J. Collentine and K. Collentine's study took place in a computer lab with classroom-based learners. More research studies are needed that examine the efficacy of PI with online language learners.

2 Review of literature

2.1 VIE

VIE is an instructional technique that is used to draw learners' attention to grammatical form through manipulation of the written input. This is typically achieved by changing the formatting of the written text. For example, a different font size or style may be used and/or the text may be bolded, capitalized, or highlighted. The purpose of VIE is to promote language acquisition by drawing learners' attention to the formal features of their input (Sharwood Smith, 1981, 1991). However, once targeted forms are noticed, there is no guarantee that they will be further processed by learners. Therefore, VIE is employed to make the written input visually salient for the learner, which should facilitate noticing.

Overstreet's (1998) study found that the presence of VIE may impede learners' comprehension of the propositional content of their input. The researcher targeted the preterit and imperfect forms in Spanish, and his participants included 50 intermediate-level undergraduate students of Spanish. He investigated VIE in combination with texts that were either familiar or unfamiliar to learners. Overstreet's study had four groups as follows: (a) VIE with a familiar text, (b) VIE with an unfamiliar text, (c) no enhancements with a familiar text, and (d) no enhancements with an unfamiliar text. Overstreet found no significant differences between the groups that received VIE and the groups that did not at posttest. Further, text familiarity did not appear to facilitate the acquisition of targeted forms. Overstreet also found that the two groups that received VIE performed significantly less well on comprehension tests than the two groups that did not receive VIE. He suggested that the presence of VIE prompted learners to focus on form at the expense of meaning. Research by S. Lee (2007) on the acquisition of the passive voice in English by Korean ESL students supported Overstreet's findings regarding VIE's potential negative effect on text comprehension. S. Lee found that VIE was able to attract participants' attention to form, but their ability to comprehend meaning was negatively affected.

Of note, while the participants in Overstreet's study had an input passage that was relatively short in length (210 words); the participants in S. Lee's (2007) study were exposed to a lengthy passage containing over 1,200 words; therefore, it appears that text length is not responsible for this finding.

Some research has found a positive effect for VIE on the learning of second language grammar (Doughty, 1988, 1991; Jourdenais, Ota, Stauffer, Boyson, & Doughty, 1995; Shook, 1994; J. Williams, 1999). However, other studies have found that VIE is ineffective for form learning (Jourdenais, 1998; J. F. Lee & Benati, 2009; Leow, 1997, 2001; Leow, Nuevo, & Tsai, 2003;

Overstreet, 1998; Russell, 2014; Wong, 2003). To further complicate matters, there have also been some studies that demonstrated a minimal positive effect for VIE (Alanen, 1995; Izumi, 2002; Robinson, 1997; White, 1998). Given these conflicting findings, S. Lee and Huang (2008) performed a metaanalysis on 12 published studies that examined VIE. The researchers found that there was a small positive effect for VIE on grammar learning ($d = .22$) and a small negative effect for VIE on text comprehension ($d = -0.26$; S. Lee & Huang, 2008). Since few studies were included in their metaanalysis, they asserted that more research needs to be conducted on VIE in order to make more definitive claims regarding its effectiveness as a pedagogical technique. It is noteworthy that all of the studies that they included in their metaanalysis were classroom-based studies that employed typographical enhancements. It is presently unclear whether exposure to computerized VIE has a positive or a negative effect on text comprehension (i.e. comprehension of the propositional content of input texts) as learners work online. More research studies are needed that examine VIE in web- and/or computer-based environments.

2.2 *PI*

According to VanPatten's model of input processing (1993, 1996, 2002, 2004), language learners often engage in processing strategies that are faulty, which can delay or impede the language acquisition process. PI is a pedagogical technique that is used to help learners make correct form-meaning connections when they initially process their input. A form-meaning connection occurs when a learner connects a grammatical form with its referential meaning; for example, the bound inflectional morpheme *-ed* encodes a past tense meaning in English. PI is a pedagogical technique or intervention that instructors can employ when their students are likely to have difficulty processing target language input. PI includes three components: (a) an explicit grammar explanation; (b) instruction on processing strategies; and (c) structured input (SI) activities. Although PI provides explicit instruction on target language grammar, only one form or structure is presented at a time; thus, it is not paradigmatic. PI also provides instruction on input processing strategies; learners are alerted to the faulty input processing strategies that they are likely to employ and they are instructed on more optimal strategies. SI is created by removing any lexical redundancies from sentences or utterances, which elevates a form's communicative value because learners must process the targeted grammatical form (rather than lexical items) in order to extract meaning from their input. With SI activities, learners must attend to both form and meaning in order to answer items correctly; therefore, learners must make form-meaning connections in order to complete SI activities. See Section 3.4.2 for a full description of PI.

Several studies found that PI is equally beneficial as traditional instruction (TI) for production tasks and that PI is superior to TI for interpretation tasks (Benati, 2001, 2005; Cadierno, 1995; Farley, 2001a; VanPatten & Cadierno, 1993a, 1993b; VanPatten & Wong, 2004). This finding is noteworthy because learners who received PI did not produce the targeted forms during the instructional treatments in the studies mentioned above, yet they performed equally well as learners in the TI groups who engaged in production practice during the experimental exposure.

2.3 *PI and the Spanish subjunctive*

Studies that examined the Spanish subjunctive had more mixed results (J. Collentine, 1998; J. Collentine & K. Collentine, 2015; Farley, 2001a, 2001b; Fernández, 2008; Russell, 2012). J. Collentine (1998) investigated PI with the Spanish subjunctive in the adjectival clause, which is a use of the subjunctive that conveys meaning (it expresses a hypothetical or unknown referent). This usage of the subjunctive has inherent semantic value and it is typically not redundant in sentences and utterances; therefore, it has a high communicative value. For example, in the sentence *Busco un restaurante que sirva comida francesa* [I am looking for a restaurant that serves French cuisine], the verb *sirva* [serves] takes the subjunctive mood in Spanish, because the speaker does not know if such a restaurant exists. Conversely, if the speaker knew of a French restaurant, then the indicative mood would be used for the verb in the adjectival clause (e.g. *sirve* [serves]). Note that this

distinction does not change the morphology of the verb in English as it does in Spanish, which is more precise in expressing hypothetical or unknown referents. J. Collentine's results indicated that both PI and TI were superior to a control group on production and interpretation tasks for the acquisition of the subjunctive in the adjectival clause. He also found that there were no significant differences between PI and TI for either type of task. While Farley (2002) criticized J. Collentine's study for failing to maintain treatment fidelity to PI, it is noteworthy that J. Collentine and K. Collentine (2015) obtained the same findings when they replicated J. Collentine's 1998 study within a CALL environment. The researchers found that PI and TI were equally effective for the acquisition of the Spanish subjunctive in the adjectival clause when the study activities took place in a 3D virtual world rather than in a traditional classroom. Their replication study lends weight to their claim that both output and input activities are beneficial for the acquisition of complex grammatical structures when the practice activities are meaningful.

Farley (2001a) examined PI with the Spanish subjunctive in noun clauses following expressions of disbelief/doubt, denial, or uncertainty. This usage of the subjunctive, which appears in the subordinate clause, is always redundant because the main clause verb also communicates the modality expressed by the subjunctive verb form (e.g. *No creo* [I do not believe], *Niego* [I deny], *No estoy segura* [I am not sure]). Therefore, this use of the subjunctive has a low communicative value. Farley (2001a) did not compare PI to TI; instead, he created a type of output-based instruction that employed meaningful rather than mechanical activities. Farley (2001a) wanted to determine whether focus-on-meaning output activities were comparable to PI tasks and activities. Therefore, he compared PI with meaning-based output instruction (MOI). Farley (2001a) found that even when output activities were meaningful, PI was still superior to MOI for interpretation tasks and PI was equal to MOI for production tasks. Since the sample size in Farley (2001a) was only comprised of 29 participants, Farley (2001b) replicated Farley (2001a) with a larger sample size (50 participants); he also included two additional instructional activities for each treatment group. The results of Farley (2001b) indicated that there were no significant differences between PI and MOI for either interpretation or production tasks. Since studies that have examined PI with the Spanish subjunctive have yielded conflicting results (J. Collentine, 1998; J. Collentine & K. Collentine, 2015; Farley, 2001a, 2001b; Fernández, 2008; Russell, 2012), more research is needed to determine the efficacy of PI with this grammatical form.

2.4 Text comprehension versus input processing

Some scholars claim that PI is not more effective than TI for either interpretation or production tasks (L. Allen, 2000; J. Collentine, 1998; DeKeyser & Sokalski, 1996, 2001; Erlam, 2003; Nagata, 1998; Salaberry, 1997). DeKeyser and Sokalski (1996, 2001) examined two grammatical forms, direct object pronouns and the conditional mood among 82 first year undergraduate students of Spanish. They had three groups: an input processing group, an output processing group, and a control group that only received a ten-minute grammar explanation. The researchers attempted to control for explicit information by providing all groups (including the control group) with the same grammar explanation. DeKeyser and Sokalski developed the SI activities for their study. The production tasks consisted of a fill-in-the-blank task and a translation task. For the acquisition of object pronouns (on the immediate posttest), they found that the input processing group performed significantly better than the control group on the comprehension task; but for both production tasks, only the output processing group performed significantly better than the control group. For the acquisition of the Spanish conditional mood, they found that the output processing group outperformed the input processing group for both comprehension and production tasks on the immediate posttest. The significant between group differences were not retained on the delayed posttests. In DeKeyser and Sokalski's study (1996, 2001), output practice appeared to be more advantageous than input practice for the acquisition of the Spanish conditional mood, which the researchers asserted is a structure that is easy to comprehend but difficult to produce. Conversely, the researchers posited that when a form is difficult to comprehend but easy to produce, then input practice would

be more advantageous. DeKeyser and Sokalski also asserted that the effect of input practice fades less quickly than output practice; therefore, delayed posttests favor input practice.

A major criticism of DeKeyser and Sokalski (1996, 2001) is that they failed to maintain treatment fidelity to PI. Wong (2004) reviewed the SI activities that were used in DeKeyser and Sokalski's study and found that they were flawed because participants were only required to focus on form and not on meaning in order to answer items correctly. In addition, DeKeyser and Sokalski measured text comprehension rather than input processing. Text comprehension refers to whether learners understand the propositional content of an input text. However, learners do not necessarily have to comprehend the meaning of targeted grammatical forms in order to understand the message of an input text (Ellis, 1995). More research studies are needed that examine both text comprehension and input processing.

2.5 *PI and authentic input*

Thus far, prior research in the PI strand has only examined the efficacy of PI with structured rather than with authentic input. J. Collentine (2004) called for research studies that examine how participants respond to authentic input once the PI treatment has concluded. He stated,

[W]e do not know if learners respond to forms constituting the targeted grammatical phenomenon in normal input conditions once they have left the processing instruction laboratory ... delayed posttests only reveal whether learners processing mechanisms remain altered as a result of the processing instruction intervention; delayed posttests do not reveal whether the learners' developing system is responding differently to authentic input. This should be a key challenge for researchers in the future. (J. Collentine, 2004, p. 179).

Therefore, research studies are needed that examine whether PI is effective when learners are exposed to authentic, rather than manipulated, input post experimental exposure. SI activities, a component of PI, require that the target language input be manipulated in order to force learners to make a form-meaning connection. Therefore, the SI activities that are a central component of PI do not represent authentic target language input. According to Canale and Swain (1980), in order for language students to achieve communicative competence, they must attain competence in three areas: (1) grammatical competence or the ability to understand and produce grammatically correct language; (2) sociolinguistic competence or the ability to understand and produce sociolinguistically appropriate language; and (3) strategic competence or the ability to solve communication problems as they arise. Knowledge of grammatical forms alone is insufficient for learners to attain communicative competence; rather, they must be able to understand and produce the target language within socially and culturally appropriate contexts, which include the appropriate use of vocabulary, register, style, and politeness in a given situation (Canale & Swain, 1980). As J. Collentine (2004) pointed out, it is presently unclear how learners who have been exposed to PI or SI process targeted grammatical forms when they appear in subsequent input that occurs within a natural social and cultural context.

2.6 *Summary of Phase I of the study*

While Phase I of the study (the experimental exposure) compared the effect of PI and SI (with and without VIE) and TI on learners' acquisition of the Spanish subjunctive mood, Phase II of the study (the present study) compared the effect of exposure to PI and SI (with and without VIE) and TI on learners' ability to notice and process subjunctive forms that appeared in authentic input after the experimental treatments concluded.

In Phase I of the study, the acquisition of the subjunctive in the adjectival clause was investigated among 92 intermediate online Spanish students. In order to increase the perceptual salience of the targeted grammatical form for web-based delivery, computerized VIE (operationalized as word animation) was combined with PI and SI. Four experimental groups (+PI +VIE, +PI -VIE, +SI +VIE, and +SI -VIE) were compared with TI, which was used as a comparison group. The

results indicated that there were no significant differences between the experimental groups and the TI group for production tasks on both the immediate posttest and the delayed posttest (Russell, 2012). With respect to interpretation tasks, the +PI +VIE group performed significantly better than the +SI -VIE group on the immediate posttest; however, there were no significant differences between any of the groups on the delayed posttest (Russell, 2012).

The findings of Phase I of this study have implications for instructing complex grammar online; namely, providing online language learners with multiple layers of input enhancement may be beneficial for the short-term learning of complex grammar (Russell, 2012). Sharwood Smith (1991) asserted that using the technical terminology to describe language (i.e. explicit grammar explanations) is an elaborate way to enhance input. Phase I found that the explicit and enhanced condition (+PI +VIE) was superior to the inductive and unenhanced condition (+SI -VIE) on the immediate posttest for interpreting the subjunctive. Learners in the +PI +VIE group were provided with four layers of input enhancement: (1) an explicit explanation of grammar; (2) information on processing strategies; (3) structured input activities; and (4) computerized VIE/word animation. Conversely, the +SI -VIE group only had one layer of input enhancement: SI activities. Therefore, the findings of Phase I indicated that highly explicit instructional techniques that contain multiple layers of input enhancement appear to be superior to inductive techniques with only one layer of input enhancement for the short-term learning of complex grammar online (Russell, 2012).

2.7 The present study (Phase II)

Phase II of the study (the present study) investigated learners' ability to notice and process targeted forms that were embedded in an authentic input text that participants received after completing the instructional treatments (Phase I of the study). Since all prior PI studies use manipulated rather than authentic target language input during the experimental exposure, it is presently unclear whether learners are able to notice and process targeted forms when they appear in linguistic input as it is spoken and/or written in its natural social and cultural context after the PI and SI interventions have concluded.

In addition, while classroom-based studies have found that VIE has a slightly negative impact on text comprehension (S. Lee, 2007; S. Lee & Huang, 2008; Overstreet, 1998), the effect that computerized VIE has on learners' ability to comprehend the messages of input texts in web- and computer-based learning environments is presently unclear and more research is needed in this area.

In response to J. Collentine's (2004) call to extend the scope of PI research by examining the effect of PI on learners' ability to process targeted grammatical forms that appear in subsequent authentic input, the purpose of the present study was to investigate whether exposure to PI and SI (with and without VIE) alter the way that learners notice and process targeted forms that were embedded in an authentic input passage that was received post experimental exposure. The present study also attempted to uncover whether exposure to VIE has a positive or a negative effect on text comprehension in a web-based learning environment. TI was used as a comparison group in the present study.

2.8 Research questions

1. What is the effect of processing instruction (with and without visual input enhancement), structured input (with and without visual input enhancement), and traditional instruction on learners' ability to notice targeted forms that are embedded in authentic target language input post experimental exposure?
2. What is the effect of processing instruction (with and without visual input enhancement), structured input (with and without visual input enhancement), and traditional instruction on learners' ability process targeted forms that appear in subsequent authentic input?
3. What is the effect of processing instruction (with and without visual input enhancement), structured input (with and without visual input enhancement), and traditional instruction on

learners' ability to comprehend the message of the authentic input text in which the targeted forms are embedded post experimental exposure?

3 Method

3.1 Research design

An experimental design was employed and participants were randomly assigned to one of the four experimental groups or to the comparison group as follows: +PI -VIE (n = 19), PI +VIE (n = 18), +SI -VIE (n = 19), +SI +VIE (n = 18), or +TI (n = 18). A stratified random assignment procedure was used to ensure that low- and high-achieving students were distributed evenly among the groups.

3.2 Sample

The sample consisted of 63 females and 29 males whose ages ranged from 19 to 45 (M = 25.94, SD = 6.86). English was the first language for 91 participants and Sinhalese was the first language for one participant. All 92 participants were online students of Spanish in their second semester of university-level language study. With respect to the number of years of high school Spanish, 23 participants (25%) indicated that they had never taken Spanish in high school, 13 (14.13%) indicated that they had taken one year of Spanish in high school, 36 (39.13%) indicated that they took two years of high school Spanish, and 20 (21.74%) indicated that they took three or four years of high school Spanish. It is important to note that all Spanish language students in the sample who completed more than two years of high school Spanish were required to take a placement exam before enrolling in their university-level Spanish course. If students were placed in second semester Spanish or lower, they did not demonstrate an understanding of the subjunctive mood in Spanish on the placement exam.

In order to ensure that high- and low-achieving students were evenly distributed between the groups, these students were identified by their test average in their Spanish class, and they were assigned to a treatment group using a stratified random assignment procedure. Furthermore, the Pretest was used as a screening device and any participant who scored 60% or higher was excluded from the study.

3.3 Targeted grammatical structure

This study examined the Spanish subjunctive mood in adjectival clauses with an unknown, uncertain, or hypothetical referent (e.g. *Busco a alguien que hable francés*. [I am looking for someone who speaks French]). Unlike Spanish, English does not use grammatical mood to mark an existential referent. Therefore, it is common for Spanish language learners whose first language is English to use indicative morphology (incorrectly) rather than subjunctive morphology, which is obligatory, when the antecedent is unknown, uncertain, or hypothetical (Terrell, Baycroft, & Perrone, 1987).

Terrell et al. (1987) found that even advanced Spanish language learners have difficulty expressing grammatical mood. J. Collentine (1995, 2000, 2003) asserted that learners must develop second language morphology and syntax in order to use the subjunctive correctly in obligatory contexts in Spanish. This requires learners to produce complex sentences containing both subordinate and matrix clauses, which is a feature that is acquired late across languages (Pienemann, 1998).

Other factors that impede Spanish language learners from acquiring the subjunctive include the difficulty of expressing abstract concepts such as hypothetical or unreal events (J. Collentine, 2003) and the similarity of present indicative morphology to present subjunctive morphology in Spanish, which is only a vowel switch for most regular verbs. J. F. Lee (1987) and J. F. Lee and Rodriguez (1997) found that learners of Spanish fail to notice present subjunctive inflections altogether.

Furthermore, according to the sentence location principle from VanPatten's model of input processing (1993, 1996, 2002, 2004), learners will have difficulty noticing items that occur in the sentence medial position. The principle states that learners first process items in the sentence initial position followed by items in the sentence final position. This occurs because learners run out of processing resources when they reach the middle of a string of input. However, some processing resources may become freed up when they reach the end of an input string, which is why items in the sentence final position are noticed before items in the sentence medial position. In natural (authentic) input, the Spanish subjunctive occurs in the sentence medial position, where it is least likely to be noticed by learners.

3.4 Instructional materials

Five instructional packages, one for each treatment group, were developed for web-based delivery via BlackBoard Courseware Management System. Each package employed a different technique for instruction on the targeted grammatical form. The instructional packages were balanced for number of tokens (either interpreted or produced), number of irregular subjunctive verb forms, lexical items, and feedback type. Only implicit feedback was provided to all five treatment groups. In other words, learners were only told if their answers were correct or incorrect and they were not provided the correct answer, if their answer was incorrect. This ensured that participants did not receive any incidental input of the targeted grammatical form.

3.4.1 TI

The +TI instructional treatment package included the following components: (1) an explicit explanation of the targeted form including its rules of use; (2) several examples of the targeted form used in sentences with English translations; and (3) ten output-based practice activities. The +TI treatment package included the full paradigm of regular and irregular present subjunctive verb forms. In addition, learners were required to engage in output practice immediately following the explicit explanation of grammar. The output activities were comprised of two communicative activities that were open-ended and eight drill activities (two mechanical, two transformational, and four meaningful drills). Eight of the activities were delivered in the written modality and two were delivered aurally. One of the aural activities required an oral response and the other employed five illustrations to facilitate learners' comprehension of the spoken language. See Russell (2012) for an example of a TI activity.

3.4.2 PI

The +PI instructional treatment packages (+PI +VIE and +PI -VIE) were designed according to J. F. Lee and VanPatten's (2003) guidelines and they included the following components: (1) a nonparadigmatic explanation of grammar (the instruction focused only on the third person—singular and plural—of regular and irregular present subjunctive verbs), (2) instruction on processing strategies (including the sentence location principle and the primacy of meaning principle), and (3) ten SI activities (five referential and five affective). For the five referential activities, participants were required to attend to the meaning of the targeted forms in order to answer items correctly. For the five affective SI activities, participants were prompted to communicate their opinions, beliefs, and other affective responses to process real world information. Eight of the SI activities were delivered in the written modality and two were delivered aurally. One of the aural activities employed five illustrations to facilitate learners' comprehension of the spoken language. See Russell (2012) for an example of a referential SI activity.

3.4.3 SI

The +SI instructional treatment packages (+SI -VIE and +SI +VIE) were identical to the +PI packages except they did not contain an explicit explanation of grammar or instruction on processing strategies. In other words, they only contained the ten SI activities described above.

3.4.4 VIE

The +VIE instructional treatment packages (+PI +VIE and +SI +VIE) were enhanced with computer animation. The five affective SI activities in each of the packages listed above contained word animation, which was designed to attract learners' attention to the targeted forms in the input sentences that were read online. Word animation was created in Flash, which enabled the targeted forms to grow larger and then smaller over a seven second period through a series of small pulses. For increased visual salience, the subjunctive inflections appeared in a different color than the rest of the verb. Participants in the VIE groups were required to play word animations sequentially rather than simultaneously because animated objects that are presented simultaneously tend to overwhelm learners, which impedes their ability to process the static information that is on the screen (Sutcliffe & Namoune, 2007). See Russell (2012) for an example of computerized VIE.

3.5 Data collection procedures

The experiment took place over a period of three weeks. On Day 1, participants completed a Pretreatment Questionnaire and the Pretest online. The Pretreatment Questionnaire elicited demographic information and information about participants' experiences with online language learning. The Pretest contained two subtests, a Production subtest and an Interpretation subtest. Participants scoring 60% or higher on either subtest were excluded from the study.

Two days after completing the Pretest, participants completed an instructional treatment package and an immediate posttest online; delayed posttests were administered approximately two weeks after participants completed the instructional treatments. Completion of the Delayed Posttest concluded Phase I of the study (The results of Phase I are reported in Section 2.6).

One to three days after the delayed posttest, Phase II of the study began when participants were asked to read the Authentic Input Text online and take notes (in a text box) on what they noticed while they read. Immediately after this reading and note-taking activity, participants completed the Comprehension Test and the Posttreatment Questionnaire online. The results of Phase II are presented in this manuscript.

3.6 Instruments and scoring procedures

3.6.1 Note sheets and authentic input text

One to three days after completing their instructional treatments, participants were asked to read an Authentic Input Text. This text reflected how the targeted grammatical form appears in colloquial usage by native speakers of Spanish. To create the Authentic Input Text, two Spanish language websites that post classified ads for homes and apartments were consulted, and five ads containing a high number of subjunctive forms in the adjectival clause were chosen to be included in the authentic input passage. The ads were not edited for vocabulary, content, or punctuation.

As participants read the Authentic Input Text, they were asked to take notes on what they noticed and perceived to be important while reading. Following each want ad, there was a text box for participants to record their observations. Participants were instructed to type only the words that would help them understand the meaning of the want ad. They were instructed not to type every single word. Each subjunctive form that was noted was worth 1 point and no points were deducted for misspelled forms. Note scores were tallied by two raters and cross checked for accuracy.

The Authentic Input Text contained 15 instances of the targeted form as it appeared in natural speech. The ads contained seven subjunctive forms as follows: *accepten* [accept], *alquilen* [rent], *desee* [wish], *está* [is], *sea* [is], *sean* [are], and *tenga* [has]. *Tenga* appeared six times and *Esté* appeared three times in the Authentic Input Text. All other verbs appeared only once or twice. Since there were a total of 15 subjunctive verb forms embedded in the Authentic Input Text, the maximum note-score was 15. There was an increased likelihood that participants would note subjunctive forms that were flooded in the input passage (*tenga* and *está*), rather than those that appeared only once (*desee* and *accepten*). The Authentic Input Text reflected how the subjunctive in adjectival clauses is actually used by native-speakers of Spanish; therefore, the number of targeted verb forms that repeated themselves could not be controlled. As some participants may not have written down subjunctive forms that appeared more than once in the passage, the interpretation of participants' note-scores was adjusted to account for forms that repeated themselves in the passage. A note-score of 6–15 was considered high and was interpreted to indicate that participants noticed subjunctive verb forms in the adjectival clause. A note-score of 3–5 was considered average and was interpreted to indicate that participants were able to partially notice subjunctive verb forms in adjectival clauses. A note-score of 0–2 was considered low and was interpreted to indicate that participants failed to notice subjunctive verb forms in adjectival clauses in the Authentic Input Text.

It is noteworthy that the subjunctive forms always appeared in the sentence medial position in the Authentic Input text. Conversely, in the SI activities that participants received during the instructional treatments, the subjunctive forms often occurred in the sentence initial position. Therefore, the participants were exposed to manipulated input during the experimental exposure (Phase I) and they were exposed to authentic input post experimental exposure (Phase II). The Authentic Input Text is presented in Appendix A.

3.6.2 Comprehension test

A Comprehension Test was created for this study and it was designed to measure two constructs: (a) text comprehension, which refers to comprehension of the propositional content of the input passage, and (b) input processing, which refers to the process by which learners connect a grammatical form with its referential meaning.

The text comprehension component of the Comprehension Test contained five multiple-choice items that were passage dependent and that tested both the main ideas and the details of the passage. The maximum score on the text comprehension portion of the Comprehension Test was five. The following is an example of an item from the text comprehension component of the Comprehension Test:

When the author of the ad states, “QUE ACCEPTEN MASCOTAS ES IMPRESCINDIBLE PARA MÍ.”
What must be allowed?

- a. children b. pets c. collectibles

The input processing component of the Comprehension Test comprised two multiple-choice and two short answer questions. The multiple-choice questions measured whether participants were able to determine the grammatical mood of the conjugated verb (present subjunctive or present indicative), and the short answer questions determined whether participants comprehended the referential meaning of the subjunctive forms (an unknown or hypothetical antecedent). The following is an example of a multiple-choice and short answer test item from the input processing component of the Comprehension Test:

In the following excerpt from a Spanish want ad: “*Busco una casa . . . que esté en buen estado.*” The author of the ad says that he or she is looking for a house that is in good condition. What form of the verb *estar* is used?

- a. present indicative b. present subjunctive

Why does the author of the ad use this form of the verb *estar*? In other words, what meaning does the verb *estar* express when conjugated this way?

Each multiple-choice answer was worth one point and each short answer question was worth two points. The maximum score on the input processing component of the Comprehension Test was six.

Each multiple-choice answer was worth one point and each short answer question was worth two points. The maximum score on the input processing component of the Comprehension Test was six.

The Comprehension Test was timed to ensure that participants only had enough time to read and answer each question without seeking assistance from their texts, notes, others, or the Web. Each item was delivered one at a time and participants were prohibited from backtracking. The multiple-choice items were scored by the computer and checked for accuracy by the researcher. The short answer items were scored by two raters. The raters were provided with an answer key and a grading rubric. Interrater reliability was computed, weighted Kappa = 0.92.

3.6.3 *Posttreatment questionnaire*

The Posttreatment Questionnaire was designed as a retrospective measure of participants' awareness of the subjunctive in adjectival clauses as it appeared in subsequent authentic input. Participants completed the Posttreatment Questionnaire immediately after reading the Authentic Input Text and completing the Comprehension Test. The Posttreatment Questionnaire measured three levels of awareness, which were adapted from Rosa and O'Neill (1999) and Rosa and Leow (2004): (a) Awareness at the level of detection; (b) Awareness at the level of noticing; and (c) Awareness at the level of understanding. If a participant was able to provide an example of a grammatical form that was present in the Authentic Input Text (e.g. *esté, tenga*), then s/he demonstrated awareness at the level of detection and was awarded 0.5 point. If a participant could name the grammatical form or structure in metalinguistic terms (e.g. name the subjunctive mood) and give an example of it, then s/he demonstrated awareness at the level of noticing and was awarded 1 point. If a participant was able to name the grammatical form, give an example of it, and state the morphological rule for using the subjunctive in the adjectival clause (e.g. when the referent is uncertain, hypothetical, or unknown), then s/he demonstrated awareness at the level of understanding and was awarded 3 points. Thus, the highest awareness score possible was 3. The instrument was printed by the researcher and scored by two raters. Interrater reliability was computed, weighted Kappa = 0.97. Two example items from the Posttreatment Questionnaire are presented in Appendix B.

3.7 *Validity and reliability of the instruments*

A logical analysis, think-aloud protocols, and item-to-total correlations were performed in order to ensure that the Comprehension Test was valid. A panel of experts that was comprised of five tertiary-level Spanish instructors completed a logical analysis of the test. Evidence of the response process was provided by think-aloud protocols, which were conducted with university students of Spanish in their fourth or fifth semester of language study. In addition, item-to-total correlations were examined for each construct that was measured by the test and any items that had significantly lower correlations were either removed or reworded.

The Comprehension Test was also checked for reliability using test-retest reliability estimates. The test was administered on two separate days to the same group of students with a two-day wait time in between testing. The stability estimate of reliability was calculated based on correlations between scores from the two administrations. For input processing, test-retest reliability was $r = .93, p < .0001$. For text comprehension, test-retest reliability was $r = .86, p < .0001$.

4 Results

4.1 Pretreatment equivalence of groups

In order to determine if group differences existed on participants' ability to interpret and produce the subjunctive prior to the experiment (Phase I), two one-way analysis of variance (ANOVA) tests were conducted on interpretation and production scores at pretest for the four experimental groups (+PI +VIE, +PI -VIE, +SI, +VIE, and +SI -VIE) and for the comparison group (+TI). The ANOVA that examined scores for interpretation of the subjunctive revealed no significant group differences at pretest, $F(4, 87) = 0.73, p > .05$. Similarly, the ANOVA that examined scores for production of the subjunctive did not reveal any significant group differences at pretest, $F(4, 87) = 0.24, p > .05$.

4.2 Time on task

The amount of time spent on task by group was subjected to a one-way ANOVA with type of instruction as the independent variable and time as the dependent variable. The results revealed that there were no statistically significant differences between the four experimental groups (+PI +VIE, +PI -VIE, +SI, +VIE, and +SI -VIE) and the comparison group (+TI) for time spent on task during the experimental exposure (Phase I), $F(4, 87) = 1.96, p > .05$.test, $F(4, 87) = 0.24, p > .05$.

4.3 Analysis of note and awareness scores (Phase II: Post experimental exposure)

Participants' note- and awareness scores were submitted to a Multivariate Analysis of Variance (MANOVA) with type of instruction as the independent between-subjects variable and note- and awareness scores as the dependent variables. The maximum note-score possible was 15. The Post-treatment Questionnaire was a retrospective measure of participants' awareness of the targeted form as it appeared in authentic input, and it required participants to provide metalinguistic information about the use of the subjunctive in adjectival clauses. The highest awareness score possible was 3. As noticing and awareness are separate but related constructs, note scores were used to assess the amount of noticing of the targeted form while reading an authentic text post experimental exposure while awareness scores were used to assess the level or depth of noticing as measured by a Posttreatment Questionnaire. The descriptive statistics for participants' note and awareness scores by group are presented in Table 1.

In order to determine if mean scores were statistically significant, the data were subjected to a MANOVA with one independent variable (type of instruction) and two dependent variables (note- and awareness scores). Prior to conducting the MANOVA, it was verified that the assumptions of the test were met¹. The MANOVA yielded a statistically significant difference in group centroids, $\Lambda = 0.83, p < .05$. The effect size was calculated, $\eta^2 = .17$, which was a medium effect size.

Table 1. Descriptive statistics on note- and awareness scores by group

Instructional Group	<i>n</i>	Type of Measure		
		Note	Awareness	
+PI -VIE	19	<i>M</i>	9.42	1.63
		<i>SD</i>	2.81	1.08
		<i>sk</i>	0.00	0.21
		<i>ku</i>	-1.13	-1.71
+PI +VIE	18	<i>M</i>	9.61	2.14
		<i>SD</i>	3.82	1.05
		<i>sk</i>	-0.47	-1.09
		<i>ku</i>	0.08	-0.17
+SI -VIE		<i>M</i>	8.42	1.03
		<i>Sk</i>	3.76	1.03
		<i>sk</i>	-0.75	1.22
		<i>ku</i>	-0.12	0.11
+SI +VIE	18	<i>M</i>	7.72	1.06
		<i>SD</i>	3.88	0.95
		<i>sk</i>	-0.19	1.08
		<i>ku</i>	-0.17	0.24
+TI	18	<i>M</i>	7.83	1.17
		<i>SD</i>	3.11	1.04
		<i>sk</i>	0.24	0.77
		<i>ku</i>	0.73	-0.88
Overall	92	<i>M</i>	8.61	1.40
		<i>SD</i>	3.51	1.10
		<i>sk</i>	-0.31	0.38
		<i>ku</i>	-0.20	-1.45

Since the MANOVA test was significant, follow-up ANOVA tests were performed on each of the dependent variables in order to determine on which of the variables the groups differed. The follow-up ANOVA with note scores as the dependent variable revealed that there was no statisti-

cally significant difference for type of instruction, $F(4, 87) = 1.15, p > .05$. However, the follow-up ANOVA with awareness scores as the dependent variable revealed that there was a statistically significant difference for type of instruction $F(4, 87) = 3.98, p < .01$. The magnitude of the treatment effect was computed, $R^2 = 0.15$, which was a small treatment effect. The results of the significant ANOVA are presented in Table 2.

Table 2. ANOVA Summary table for awareness scores by instructional treatment group

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Type of instruction (A)	4	16.61	4.15	3.98*
(S/A)	87	93.01	1.07	
Total	91	109.62		

Note. $N = 92$

* $p < .01$

Because the one-way ANOVA on awareness scores was significant, a post-hoc Tukey test was performed to determine which groups had statistically significant differences. Tukey's HSD test showed that +PI +VIE group outperformed the following groups: +TI, +SI -VIE, and +SI +VIE ($p < .05$). Of note, the Tukey test did not reveal any significant differences in mean awareness scores between the two processing instruction groups (+PI +VIE and +PI -VIE).

4.4 Analysis of text comprehension and input processing scores (Phase II: Post experimental exposure)

Two scores were obtained from the Comprehension Test that participants completed after reading an authentic input passage in Spanish (post experimental exposure) that contained 15 instances of the targeted grammatical form. The Comprehension Test measured participants' ability to comprehend the message of the passage (text comprehension) and also their ability to comprehend the referential meaning of the targeted grammatical form (input processing). Thus, the Comprehension Test yielded two scores, a text comprehension score and an input processing score. The maximum score for text comprehension was 5 and the maximum score for input processing was 6. The descriptive statistics for text comprehension and input processing scores by group are presented in Table 3.

In order to determine if the group differences were significant, the data were subjected to a MANOVA with one independent between-subjects variable (type of instruction) and two dependent variables (text comprehension and input processing scores). Prior to conducting the MANOVA, it was verified that the assumptions of the test were met². The results revealed a significant difference in group centroids, $\Lambda = 0.83, p < .05$. The effect size for the MANOVA was calculated, $\eta^2 = .17$, which was a medium effect size.

Table 3. Descriptive statistics on text comprehension and input processing scores by group

Instructional Group	<i>n</i>	Type of Measure	
		Text Comprehension	Input Processing
+PI -VIE	19		
		<i>M</i>	4.05
		<i>SD</i>	0.85
		<i>sk</i>	-0.72
		<i>ku</i>	0.37
+PI +VIE	18		
		<i>M</i>	4.11
		<i>SD</i>	0.76
		<i>sk</i>	-0.19
		<i>ku</i>	-1.12
+SI -VIE	19		
		<i>M</i>	4.32
		<i>SD</i>	0.82
		<i>sk</i>	-0.68
		<i>ku</i>	-1.13
+SI +VIE	18		
		<i>M</i>	4.44
		<i>SD</i>	0.86
		<i>sk</i>	-1.07
		<i>ku</i>	-0.70
+TI	18		
		<i>M</i>	4.17
		<i>SD</i>	1.20
		<i>sk</i>	-1.05
		<i>ku</i>	-0.58
Overall	92		
		<i>M</i>	4.22
		<i>SD</i>	0.90
		<i>sk</i>	-0.82
		<i>ku</i>	-0.40

As the MANOVA was significant, follow-up ANOVA tests were performed on each of the dependent variables to determine on which of the variables the groups differed. The ANOVA with text comprehension scores as the dependent variable did not reveal a significant effect for type of instruction, $F(4, 87) = 0.57, p > .05$. However, the ANOVA with input processing scores as the

dependent variable revealed a significant effect for type of instruction, $F(4, 87) = 3.72, p < .01$. The magnitude of the treatment effect was computed, $R^2 = 0.15$, which was a small treatment effect. The results of the significant ANOVA are presented in Table 4.

Because the one-way ANOVA test revealed significant group differences in mean input processing scores, a post-hoc Tukey test was performed to determine which groups had statistically significant differences. Tukey's HSD test revealed that the +PI +VIE and the +PI -VIE groups had significantly higher mean input processing scores than the +SI -VIE group ($p < .05$). However, the Tukey test did not reveal any significant differences between the two processing instruction groups and the following groups: +SI +VIE and +TI.

Table 4. ANOVA summary table for input processing scores by instructional treatment group

Source	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Type of instruction (A)	4	16.61	4.15	3.98*
(S/A)	87	93.01	1.07	
Total	91	109.62		

Note. $N = 92$

* $p < .01$

5 Discussion

5.1 Summary of findings for research question 1: What is the effect of processing instruction (with and without visual input enhancement), structured input (with and without visual input enhancement), and traditional instruction on learners' ability to notice targeted forms that are embedded in authentic target language input post experimental exposure?

The present study found that there were no significant differences between the groups for the amount of noticing that took place as measured by note scores. In other words, the mean number of targeted verb forms that were noted while participants read an authentic input passage post experimental exposure did not differ significantly by instructional treatment group. Therefore, there were no group differences found for the detection of targeted forms during the reading and note-taking activity.

However, when participants' depth of noticing was measured by examining their level of awareness on the Posttreatment Questionnaire (awareness at the level of detection, awareness at the level of noticing, or awareness at the level of understanding), the results revealed that the +PI +VIE group outperformed the following groups: +TI, +SI -VIE, and +SI +VIE. Of note, the +PI +VIE group did not outperform the +PI -VIE group. Level of awareness, as measured by the Posttreatment Questionnaire, was operationalized as follows in the present study: (1) participants who could provide an example of a subjective verb form that was present in the Authentic Input Text demonstrated awareness at the level of detection; (2) participants who could provide an example of a subjunctive form and describe it in metalinguistic terms (i.e. subjunctive) demonstrated awareness at the level of noticing; and (3) participants who could give an example of the targeted form, describe it in metalinguistic terms, and state the rule for using it demonstrated awareness at the level of understanding. These three levels of awareness were based on Rosa and O'Neill (1999) and Rosa and Leow's (2004) work in the area of attention and awareness in second language acquisition.

According to Schmidt (2001), noticing, by itself, is not the only necessary ingredient for SLA; he states, "SLA is largely driven by what learners pay attention to and notice in target language input and what they understand the significance of noticed input to be" (p. 4). Similarly, VanPatten (1993, 1996, 2002, 2004) claimed that in addition to noticing linguistic features of input, learners

must also be able to make form-meaning connections, or understand the relationship between a linguistic form and the referential meaning that it encodes.

Empirical research supports the facilitative effects of awareness on foreign language learning (Leow, 1997, 2000; Rosa, 1999; Rosa & Leow, 2004; Rosa & O'Neill 1999). Moreover, Leow (2000) asserts that awareness at the level of noticing is a necessary precursor for learning, but awareness at the level of understanding plays a critical role in learners' intake and subsequent processing of targeted grammatical forms. The results of the present study appear to support this claim, as the learners who demonstrated the highest awareness scores (+PI +VIE) also demonstrated the highest input processing scores.

5.2 *Summary of findings for research question 2: What is the effect of processing instruction (with and without visual input enhancement), structured input (with and without visual input enhancement), and traditional instruction on learners' ability process targeted forms that appear in subsequent authentic input?*

There were significant group differences for input processing, a construct that was measured by the Comprehension Test in the present study. The two PI groups (+PI +VIE and +PI -VIE) outperformed the +SI -VIE group, but they did not outperform the +TI group or the +SI +VIE group. It appears that exposure to TI is equally beneficial as exposure to PI for processing subjunctive forms that appear in subsequent authentic input (after the instructional treatments have concluded).

DeKeyser and Sokalski (1996, 2001) asserted that when a form is difficult to comprehend but easy to produce, then input practice would be more advantageous than output practice. Conversely, when a form is easy to comprehend but difficult to produce, then output practice would be more advantageous. The Spanish subjunctive in adjectival clauses is both difficult to comprehend and to produce for Spanish language learners whose first language is English (J. Collentine, 1995, 2000, 2003; Terrell et al., 1987). Thus, neither the output (TI) nor the input groups (PI and SI) had an advantage in the present study. DeKeyser and Sokalski also suggested that the effect of input practice fades less quickly than output practice because the delay between practice and testing favors input practice over output practice. Although learners in the present study were exposed to the targeted form as it appeared in authentic language input post experimental exposure, the output group (+TI) performed equally well on the (delayed) comprehension measure as two input (+PI) groups. This finding does not support DeKeyser and Sokalski's claim regarding testing time. Further, the two PI groups outperformed the +SI -VIE group but not the +SI +VIE group. The Spanish subjunctive in adjectival clauses is not only difficult to comprehend and to produce, it is also difficult to perceive, as subjunctive inflections typically elude learners' detection altogether (J. F. Lee, 1987; J. F. Lee & Rodríguez, 1997). It is possible that computerized VIE may have helped learners in the +SI +VIE group notice the subjunctive forms in the treatment activities. Conversely, participants who did not receive VIE (+SI -VIE) may have failed to notice the unenhanced subjunctive inflections during their instructional treatments (Phase I). Thus, if learners could not distinguish between subjunctive and indicative morphology, then the SI activities were unlikely to help learners make correct form-meaning connections, which may help explain the findings of the present study.

5.3 *Summary of findings for research question 3: What is the effect of processing instruction (with and without visual input enhancement), structured input (with and without visual input enhancement), and traditional instruction on learners' ability to comprehend the message of the authentic input text in which the targeted forms are embedded post experimental exposure?*

The results also revealed that there were no significant group differences for text comprehension. It appears that exposure to all of the instructional treatments were equally beneficial for comprehending the message of an authentic input passage that was received post experimental exposure. Therefore, the inclusion of VIE in two of the groups (+PI +VIE and +SI +VIE) did not ap-

pear to hinder participants' ability to understand the propositional content of the input texts. This finding diverges from Overstreet (1998), S. Lee (2007), and S. Lee and Huang (2008), who found that VIE has a slightly negative effect on text comprehension. However, it is important to note that all of the previous studies cited took place in a traditional classroom with simple typographical enhancements while the VIE used in the present study was enhanced by computer animation for web-based delivery.

5.4 Implications: PI and authentic input

Past studies in the PI strand have not investigated whether PI is able to facilitate how learners notice and process targeted grammatical forms when they are embedded in authentic input that is received post experimental exposure. J. Collentine (2004) asserted that it is impossible to determine if PI has a beneficial effect on the acquisition process until there is evidence of how learners' developing systems respond to authentic input following exposure to PI. Thus far, prior studies in the PI strand have utilized input that was structured, or manipulated, during the experimental treatments in order to facilitate input processing. For example, during the instructional treatments in the present study, participants in the experimental groups received input that was manipulated so that the subjunctive in the adjectival clause appeared in the sentence initial position. Learners were first presented with the subordinate clause and their task was to select the appropriate matrix clause for each subordinate clause, which depended upon whether the subordinate clause verb was in the present indicative or present subjunctive mood. This manipulation forced learners to attend to the subordinate clause verb that appeared in the sentence initial position in order to extract meaning (an unknown or hypothetical antecedent). In authentic input, the subjunctive in adjectival clauses always appears in the sentence medial position, which, according to the sentence location principle from VanPatten's model (1993, 1996, 2002, 2004), is the most difficult place for learners to notice it. Furthermore, the grammatical forms in SI activities are typically embedded within short input sentences that contain basic vocabulary items in order not to overload learners' capacity to process input. Conversely, the authentic input passage that participants received in the present study contained longer input sentences as well as more advanced vocabulary items and colloquial expressions, which the participants were unaccustomed to reading in Spanish.

By exposing participants to an authentic input text that contained 15 instances of the subjunctive in the adjectival clause post experimental exposure, the present study was able to demonstrate that PI had a beneficial effect when learners encountered targeted forms that were present in subsequent authentic input. Although the authentic input passage was more difficult for participants to comprehend than the input that they received during the experimental treatments, the results of the present study indicate that exposure to +PI +VIE facilitated a deeper level of awareness (noticing with metalinguistic awareness) of targeted forms than exposure to TI or exposure to SI (with or without VIE). Thus, PI may be superior to TI for raising learners' metalinguistic awareness of complex grammatical forms that appear in subsequent authentic input in a web-based learning environment.

While learners in the two PI groups (+PI +VIE and +PI -VIE) did not outperform the +TI group or the +SI +VIE group on the input processing measure, they did outperform the +SI -VIE group. The +TI group received explicit instruction on grammar; Sharwood Smith (1991) asserted that explicit grammar explanations are an elaborate way to enhance input using the technical terminology to describe language. While the +SI +VIE group did not receive any explicit instruction on grammar, they did receive an additional layer of input enhancement (word animation of targeted subjunctive forms). In the present study, the +SI -VIE was the least explicit and least enhanced instructional treatment (no computerized input enhancement, no explicit explanation of grammar, and no information on processing strategies), and this group had a significantly lower mean score for input processing than the two PI groups in the present study. Unlike the majority of prior studies in the PI strand, all of the participants in the present study were online learners of Spanish. This population of learners may be different from the population of learners in traditional foreign and second language classrooms. It is possible that online language learners benefit from techniques

that are more enhanced and/or explicit, which appear to help them process targeted forms correctly when they appear in subsequent authentic input. However, more research is needed with online language learners to substantiate these findings.

6 Limitations, future research, and conclusion

6.1 Limitations and suggestions for future research

As with all studies, the present study had limitations. Namely, awareness was measured retrospectively through a Posttreatment Questionnaire, the noticing/awareness measures used in the present study explicitly probed for noticing, and only one type of computerized VIE was examined. A Posttreatment Questionnaire was used to assess participants' level of awareness retrospectively in the present study. Leow (2000) criticized this technique because it is an off-line measure and it may not capture what learners actually paid attention to or became aware of during the instructional treatments.

Furthermore, the Posttreatment Questionnaire was delivered one to three days post experimental exposure; therefore, memory decay may have affected participants differentially and may have exerted an influence on the results of this study. Another limitation is that the noticing and awareness measures directed learners' attention to the targets, probing for explicit noticing in all conditions. It is possible that directing learners' attention to the targeted forms may have exerted some influence on both the noticing and awareness measures in the present study.

It is unclear whether participants noted down subjunctive forms during the note-taking/noticing activity because the subjunctive inflection itself conveyed semantic information that helped learners understand the text or whether participants noted down verb forms due to the semantic information that was contained in the root of the verb. Future studies could replicate this one but implement think-aloud protocols during this phase of the experiment to address this limitation. In addition, think-aloud protocols could be used in addition to a posttreatment questionnaire to measure learners' level of awareness. Since assessing the construct of awareness in SLA is problematic, techniques that analyze data both quantitatively and qualitatively may be better at capturing learners' internal thought processes.

In addition, participants completed the note-taking activity, the Comprehension Test, and the Posttreatment Questionnaire (Phase II of the study) one to three days after completing the delayed posttest (Phase I of the study). Participants were given a three-day window to complete these activities because the students were accustomed to having some flexibility in their deadlines for the online Spanish course and it was the end of the semester when students had numerous deadlines to meet for all of their classes. However, the vast majority of the participants (over 95%) completed these activities the third day after completing the delayed posttest. Future studies could circumvent this limitation by giving online participants firm rather than flexible deadlines.

Finally, the present study only examined one type of VIE, word animation, which was embedded in the SI activities that two groups received (+PI +VIE and +SI +VIE). It is presently unclear which types of computerized VIE are the most effective for attracting learners' attention to the formal features of their input as they work online. Moreover, VIE was not embedded in the TI activities; therefore, it is not possible to determine if the +TI group would have benefitted from exposure to it. Future studies could examine different types of computerized VIE. Word animation could take on many different forms in the Web-based environment; for example, words could spin, bounce, or flash. Future studies could compare several types of word animation to determine which techniques are the most beneficial in Web-based learning environments. Furthermore, these studies could also employ eye-tracking technology to measure and compare noticing of animated targeted forms with various types of computerized VIE.

6.2 Conclusion

The results of the present study are encouraging for the use of PI and VIE in web-based learning environments. It appears that exposure to PI with VIE helped online learners of Spanish notice subjunctive forms with a deeper level of awareness than exposure to SI (with or without VIE) or exposure to TI. Therefore, combining VIE with PI appeared to have a positive effect on learners' awareness of targeted forms that appeared in subsequent authentic input.

In addition, exposure to PI (with or without VIE) was more beneficial than exposure to +SI -VIE for correct input processing of subjunctive forms in subsequent authentic input. It is noteworthy that learners who received SI combined with VIE performed equally well as those who received full PI (with or without VIE) for processing targeted forms that were embedded in subsequent authentic input. This finding demonstrates a facilitative effect for VIE in the web-based learning environment. Moreover, the presence of VIE did not appear to hinder learners' comprehension of the propositional content of the Authentic Input text, as there were no significant group differences for text comprehension. These findings point to a beneficial effect for VIE among online language learners.

Notes

¹ Prior to submitting note- and awareness scores to the MANOVA, multivariate normality and homogeneity of covariance assumptions were assessed. In order to evaluate normality, both univariate and multivariate normality were examined. Univariate normality was assessed by checking the skewness and kurtosis values of the distributions of note- and awareness scores by group. In addition, the Shapiro-Wilk test for normality was performed on each dependent variable by group. The p values for all of the tests were higher than .05, which indicates that the assumption of univariate normality was not violated. In order to assess multivariate normality, the data were first checked for multivariate outliers by calculating the effect size for note- and awareness scores using Mahalanobis' Distance: maximum $D^2 = 7.95$. Two multivariate outliers were identified; however, the outliers were not outside the range of possible scores as indicated by the F test to check for multivariate outliers, $F(2, 89) = 4.31, p < .05$. Since the scores for the multivariate outliers were possible, the analysis was run with the scores included. Multivariate skewness was checked and found to be in the range expected for samples from a multivariate normal distribution, $X^2(4) = 4.44, p > .05$. Further, the chi-square value was not significant, which indicates that multivariate skewness was not violated. Similarly, multivariate kurtosis was checked and converted to a z -score, which fell within the normal distribution, indicating that multivariate kurtosis was not violated. Thus, the assumption of multivariate normality was met. The correlation between the two dependent variables was checked to examine the strength of the relationship. The relationship between note- and awareness scores was linear and positive ($r = .27$). In addition, the standard deviations for both dependent variables for each group were examined and found to be similar. Finally, in order to verify that the assumption of homogeneity of covariance matrices was met, the data were subjected to Box's M test. An examination of the Box's M test revealed that the chi-square value was not statistically significant, $\chi^2(12) = 6.59, p > .05$. Thus, it is reasonable to conclude that the assumption of homogeneity of covariance matrices was not violated. In addition, the degree of association was quantified by calculating η^2 . The obtained value was 0.17, which indicates that approximately 17% of the generalized variance in note- and awareness scores was accounted for by type of instructional method. The proportion accounted for in the population was estimated to be somewhat less, $\hat{\sigma}c^2 = .07$.

² Prior to submitting text and input processing scores to the MANOVA, multivariate normality and homogeneity of covariance assumptions were assessed. In order to evaluate normality, both univariate and multivariate normality were examined. Univariate normality was assessed by examining skewness and kurtosis values for each dependent variable by group. Shapiro-Wilk tests were also performed on each dependent variable by group. The Shapiro-Wilk tests revealed that the scores for both text comprehension and input processing were not normally distributed. However, the MANOVA test is robust to violations of univariate normality. Further, the data set was checked for outliers by examining box plots and there were no significant outliers. The data were also examined to determine if the assumptions of multivariate skewness and kurtosis were met. The results suggested departures from normality for both multivariate skewness and kurtosis. The data were screened for multivariate outliers using Mahalanobis' distance. The maximum D^2 value was 7.63, and two multivariate outliers were identified. The data were run without the multivariate outliers, and there was not a significant impact on multivariate skewness or kurtosis values. Therefore, the multivariate outliers were retained in the data set. Consequently, the assumption of multivariate normality was not met. However, there is evidence to suggest that the MANOVA procedure is robust against lack of multivariate normality (Stevens, 2002). To determine if the departure from normality adversely affected power, Steven's power analysis was performed using statistical analysis software (SAS). The analysis

revealed that the power of the MANOVA test was estimated to be .85. According to Stevens (2002), power of .80 is sufficient to detect group differences if they exist. Thus, it appears that the departure from normality did not adversely affect power. As the MANOVA test is robust against violations of normality and the departure from normality did not affect the power of the test, the decision was made to proceed with the analysis. The final assumption that was checked was homogeneity of covariance matrices. Box's M test was used to assess this assumption. Examination of the chi-square value from Box's M test reveals that the p value was not statistically significant, $\chi^2(12) = 7.63, p > .05$. Thus, it is reasonable to conclude that the assumption of homogeneity of covariance matrices was not violated. In addition, the degree of association was quantified by calculating η^2 . The obtained value was 0.17, which indicates that approximately 17% of the generalized variance in text comprehension and input processing scores was accounted for by type of instructional method. The proportion accounted for in the population was estimated to be somewhat less, $\hat{\omega}c^2 = .07$.

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Appendices

Appendix A

Authentic input text

Reading activity

Read the following want ads that were taken off of two websites on the Internet. As you read each ad, please note all of the words (such as vocabulary items and verb forms) in the text box that you focus on to understand the Spanish want ad. Please do not write down every single word.

1. BUSCO UNA CASA QUE TENGA UN JARDIN AMPLIO CERRADO Y POR LO MENOS 2 HABITACIONES, 2 BAÑOS EN TOLUCA O ALREDEDORES. QUE ACEPTEN MASCOTAS ES IMPRESCINDIBLE PARA MÍ. ¡ME URGE!
2. Busco una casa que no esté alejado de la ciudad, sin problemas de agua, recolección de basura, sin vecinos problemáticos, casa o departamento que esté en buen estado, que tenga línea telefónica y enrejada.
3. Busco una casa que tenga 3 dormitorios y es muy urgente porque tengo que irme de donde vivo por problema de trabajo y el colegio. Lo único que pido que sea tranquilo y los vecinos sean buenas personas y esté un colegio cerca de la casa.
4. Busco un apartamento que me alquilen para pareja sin niños. Busco que me alquilen un apartamento para pareja sin niños, con cochera, entrada independiente, que tenga 1 o 2 habitaciones, en Guadalupe o alrededores. pago máximo 100.000/mes
5. BUSCO A ALGUIEN QUE TENGA APARTAMENTO Y DESEE COMPARTIRLO. NECESARIO QUE TENGA BAÑO PRIVADO PARA MÍ, COCINA, COMEDOR, SALA Y SI ES POSIBLE 2 CUARTOS Y UN PATIOCITO. EL PRECIO MÁS O MENOS TENDRÍA QUE SER ENTRE 20.000 HASTA 50.000

NB: The five want ads above and note-sheets (text boxes) were delivered online one at a time. Participants were not permitted to back-track to a previous want ad once they filled in the text box.

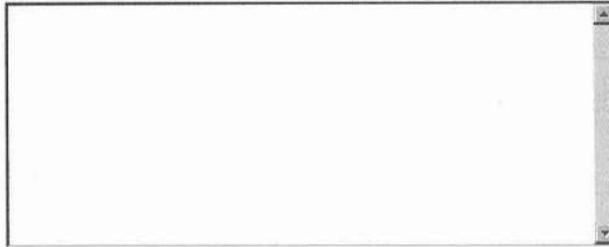
Appendix B**Example items from posttreatment questionnaire**

Preview Assessment: Posttreatment Questionnaire

Question 5**1 points** [Save](#)

5. Can you recall a specific grammatical form or structure that was present in the reading activity (the Spanish Want Ads)? If so, can you give an example of the grammatical form or structure?

Please try to answer this question to the best of your ability.



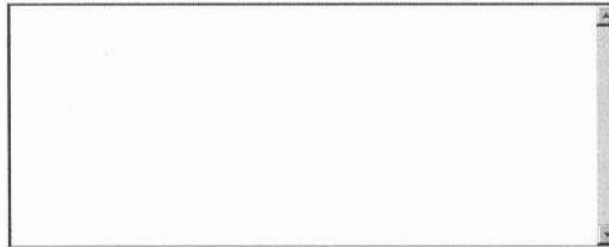
Smart Text Plain Text HTML

    Preview

Question 6**2 points** [Save](#)

6. In your own words, can you state the grammatical rule for using the form or structure that you mentioned in the previous question?

Please try to answer this question to the best of your ability.



Smart Text Plain Text HTML

    Preview

Question 7**0 points** [Save](#)

7. When you completed Posttest 1 and the Comprehension Test online, did you seek any outside assistance such as the web or your grammar book?

- Yes
 No

Question 8**0 points** [Save](#)

8. If you sought outside assistance when completing Posttest 1 and the Reading Comprehension Test, from where did you seek assistance? Please check all that apply: