Priming of verb inflections in L1 and L2 French: A comparison of 'redundant' versus 'non-redundant' training conditions

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Abstract

There have been several calls to adopt more implicit techniques for investigating how input is processed by second language (L2) learners. This study tested for aural repetition priming using a lexical decision test to establish whether a French verb inflection (-ons*) can be primed amongst beginner classroom learners of L2 French during activities that broadly reflected two types of aural instructional activities. Fifty one school learners of French were randomly assigned either to an exposure activity which directed their attention to the target inflection or to an activity in which they were asked to try to understand sentences which contained the target inflection. The input was designed to simulate learning situations in which learners find aural comprehension effortful. All participants then did a lexical decision test, to measure the activation of representations of the French verb inflection during the exposure conditions. The results from this preliminary study indicated that greater priming effects followed the instructional activity that focused attention on the inflection than the activity that focused attention on sentence meaning. This is compatible with acoustic word priming research that suggests an orientation to meaning inhibits priming for some learners, and also with pedagogical research that suggests that focusing learners' attention to some features of the input is helpful. Our findings in the aural domain seem to run counter to recent research suggesting that regardless of the orientation of attention during training,* orthographic *representations of suffixes* can *be primed during visual word recognition. Future applications of this technique for investigating the allocation of attention in L2 input processing are discussed.*

1. Introduction

There is a considerable body of research into the effects of different ways of focusing learners' attention on grammatical form in the input and/or on the mean-

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ing of the input. A few such studies have suggested that treatments which simply provide many exemplars of a target form in the input and require learners to try to understand meaning at sentence or discourse levels, such as enhanced input and input floods, can result in learning the target form (Jourdenais et al. 1995; Lee 2002; Leeman et al. 1995; Shook 1994). Other studies have shown that simple exposure to forms without focal attention on them does not result in gains on behavioural tests of learning (e.g. DeKeyser 1995; Marsden and Chen 2011, and evidence from experimental psychology such as Jiménez and Méndez 1999; Logan and Etherton 1994). Other SLA studies have suggested that positive effects of input-only exposure were limited to certain language forms or proficiency levels, or were dependent on the L1 (Alanen 1995; Marsden 2006; Robinson 1997; Trahey 1996; Williams J.N. 1999; Williams and Evans, 1998) (for reviews see Ellis 1999; Izumi 2002). See also recent studies using semi-artificial languages that suggest that following exposure in which attention was focused on a target form and one associated meaning, learning of another meaning associated with the same target form can occur implicitly (Williams 2004, 2005; Hama and Leow 2010). VanPatten (1990, 1996, 2002, 2004) argues that learners, particularly in the early stages, do not tend to process grammatical form when trying to comprehend sentences. Broadly similar notions have been proposed over the last few decades, such as the existence of tensions between semantic and syntactic processing (Swain 1995), semantic and syntactic comprehension (Gass 1997), processing for communication and for acquisition (Sharwood Smith 1986), top-down meaning processing and noticing formal features (McLaughlin and Heredia 1996). VanPatten and colleagues (e.g. VanPatten 2004) have provided evidence that learning is helped by focusing learners' attention on certain features via input tasks in which learners must ascertain the meaning or function of the target form.

Empirical studies in this line of research generally measure learning using off line tests such as language comprehension or production tests, or, in a few of the studies mentioned above, think-aloud procedures. Critically, however, these measures do not necessarily tap into cognitive processes that are *not* observable by language performance or by introspection. Other, more implicit, techniques may be able to give us additional insight into the effects of manipulating the focus of attention. Indeed, there have been several calls to adopt more implicit techniques for investigating how L2 input is processed. For example, Segalowitz (2006) recommended "finely grained cognitive and perceptual measures" (p. 137) and Robinson (2003) suggested that "measures such as those adopted in implicit memory studies ... may be more sensitive measures than those requiring on- or off-line production and verbalisation of the contents of awareness" (p. 639) (see also Izumi 2002; Jiang 2004). For example, Graf and Mandler (1984) found *deeper processing* did not show benefits for learning when the memory tests were implicit. Recently a small number of L2

input processing studies have used more implicit techniques, such as Fernandez (2008), Henry et al. (2009), VanPatten et al. (2012), all using self-paced paradigms, to investigate on-line processing of input *during* comprehension. They found little sensitivity to subject-verb agreement. On the other hand, Leung and Williams (2011, 2012), using a novel reaction time technique, found that learners can be sensitive to morphosyntax, again *during* comprehension. However, another area to be investigated is whether different input based activities, which orient learners' attention to the input in different ways, lead to observable differences in how learners *subsequently* respond to target features i.e. *after* the comprehension task. It is this area that the current paper addresses.

Clearly, there are many ways of orienting a learner's attention, many aspects of the input that can be the focus of that attention, and many methods for eliciting more implicit measures of where attention is allocated. The current study adapts one technique from priming research to compare the activation generated for a verb inflection in two different exposure conditions that were broadly based on instructional events: when learners' attention was directed to the verb inflection in sentences compared to when learners were asked to try to understand the meaning of sentences containing the verb inflection. Although we do not set out to test any models of attention, we briefly describe how we use the term 'attention', as this is used in the discussion of our findings. We refer to the model proposed by Cowan (1999) in which external stimuli or internally generated associations can activate brief memory representations (see also Robinson 1995; Williams 2004, 2005 for reference to this model). Focal attention boosts the activation level of certain representations, allowing them to remain active for longer and, in the case of external stimuli, attention increases the detail of encoding or the quality of the representation. We also follow Dehaene and Naccache's (2001) proposal that the attention makes information available to a wider range of processes e.g. to be manipulated to accomplish a task. In line with both Cowan (1999) and Dehaene and Naccache (2001), we assume that only a limited amount of information can benefit from attentional enhancement at any one time (see e.g. Cowan 1999: 89). Similar notions of limited capacity processing resources are assumed by cognitive psychologists Pashler 1998), psycholinguists (Hawkins 2004; O'Grady 2005; Tomasello 2003), and SLA researchers (Towell and Hawkins 1994; Pienemann 2003; Robinson 2003; Schmidt 2001; VanPatten 2004). Also of relevance to the current study is that, according to Cowan's model, the selection of representations that will receive focal attention is partially under voluntary control, but selection can occur involuntarily through the attentional orienting system.

2. Purpose of the study

Little SLA research has investigated whether activation of representations of certain features during input processing is observable shortly after exposure, and if so, which factors affect learners' capacity to activate these representations.[1] If a factor such as orientation of attention during different activity types[2] impacts on activations during input processing, then by varying this factor we would expect to see evidence of greater activation of a particular representation in some activities, and less activation of it in other activities. In the current study, we measured priming effects to detect the activation of representations of a language feature (a French verb inflection) immediately following activities in which attention was oriented to that feature compared to when participants were asked to try to understand sentential meaning (specifically, the meaning of the host verb and its complement, described below in Methods). The use of priming to detect such activation is discussed next.

3. Priming and second language learning

Priming techniques can be used as an implicit measure of the extent to which features in the input are activated within the mind of the hearer/reader (Priming 2004; Reber 1995). Priming effects are regarded as evidence of an activation model of storage and access to language representations (Harley 2001; see McNamara 1992 for discussion). As listeners are exposed to a certain feature (including a syntactic pattern, a lexical item, or an affix), the neurological representations of that feature are activated via the resources available in working memory (are given "energy", Harley 2001: 417). Over the course of time, a representation may receive increasing amounts of activation, and this is thought to lower its activation threshold i.e. it can be activated with less energy. As a particular representation of a feature (e.g. a verb inflection) is more activated, the more likely it is that this activation will persist and be detectable in priming effects. Wessells (1982) likened this to the effect of dropping a stone into water, as the magnitude of the disturbance (the strength of the priming effects) is determined by, amongst other things, the intensity of the original stimulus (e.g. the amount of activation received in the exposure phase). Priming effects show

1. We use the term 'process' to refer to the activation of information in working memory as a result of focal attention (along the lines of Tomlin & Villa's 1994, term 'detection'. This is more general than VanPatten's use of the term, which refers to making a form-meaning connection.
2. We use the term *orient*, and its derivatives, simply to refer to the instructions the participants were given. The term does not relate to Tomlin & Villa's (1994) fine-grained analysis of the components of attention.

that the time taken to read, recognize or make a decision about a feature is affected when that feature has been preceded, or primed, by a feature that shares some of its features. In some studies priming effects can also be observed in different accuracy rates or preferences when responding to a feature that has been preceded by a related feature.

Activation is thought to occur at different levels of linguistic representation: semantic, syntactic, morphological and phonological (Pickering and Branigan 1998). For example, activation has been demonstrated via priming effects at the semantic, syntactic, word (auditory and visual), phonological (or phonemic) and phonetic (or feature) levels of representation. Priming effects have also been found for morphology. For example, Marslen-Wilson et al. (1996) and Kazanina et al. (2008) have demonstrated that derivational morphology can be primed (see also Marslen-Wilson's 2007 overview). Such evidence is in line with the decompositional view of lexical retrieval (see Taft 1979 for early proposals of this view), whereby words are accessed via their morphological constituents, as derivational and inflectional morphemes are organisational units within the lexicon. We could not, however, locate any research which has yet demonstrated, specifically, the priming of French inflectional verb morphology.[3]

Critical for the broader implications of the current study, priming effects have been found to be persistent, and it is widely considered that they are a window into implicit memory and learning processes (Bock and Griffin 2000; and for reviews see McDonough 2006; McDonough and Trofimovich 2009; Schacter and Tulving 1994). For example, auditory word priming has been demonstrated via a range of memory, repetition and identification tasks (Trofimovich 2005) and priming effects have been found to last over delays of minutes (Church and Schacter 1994), days, and weeks (Goldinger 1996), suggesting that such effects have a long-term memory component likely to be used for language learning (Church and Fisher 1998). If, therefore, priming effects could be found in our study that suggest that orientation of attention to either an inflection or sentence meaning influences what is activated during L2 aural input processing, this could then help to develop predictions about related mechanisms that may influence L2 learning, such as how the role of orientation of attention in different activity types might change with proficiency.

Some priming research is indirectly related to the current study as it has investigated the extent to which processing is sensitive to whether attention is oriented to meaning or to physical form during an exposure phase. In L1 speech processing, Church and Fisher (1998) and Church and Schacter (1994)

3. Corroborated by personal communications with William Marslen-Wilson, Fanny Meunier, Mike Ford and Mary Hare.

(see also Trofimovich 2005; Trofimovich and Gatbanton 2006) found that auditory word priming was relatively insensitive to whether listeners' attention was directed to the meaning or the form of spoken words, and that this was a developmentally constant phenomenon, including amongst 2 year olds.

In L2 within-language processing, Trofimovich (2005) and Trofimovich and Gatbanton (2006) investigated the effects of different exposure conditions on the auditory priming of known lexical items amongst intermediate L1 English learners of L2 Spanish. In one exposure condition participants had to rate the clarity of a word, considered to promote perceptual processing, and in the other condition they had to rate the pleasantness of the meaning of the word, considered to promote semantic processing. At test, they had to listen to a word and then repeat it as quickly as possible. Half of these test words had been primed and half were unheard during the exposure phase. Trofimovich (2008) carried out a related experiment with L1 Chinese learners of English allocated either to a control (no orientation) condition or a semantic condition (as above). Although isolating semantic from perceptual processing is difficult, these studies point to a number of observations. Auditory repetition lead to word priming effects *regardless* of the orientation of participants' attention to meaning during exposure for certain types of participants: for L2 learners with better phonological skills (Trofimovich and Gatbanton 2006) and for intermediate L2 learners when the exposure and test were in the same voice (Trofimovich 2005, 2008). A semantic orientation towards the input did, however, reduce or eliminate word priming effects for L2 learners with lower phonological accuracy (Trofimovich and Gatbanton 2006), and for intermediate learners when the study and test phases were in different voices (Trofimovich 2005, 2008).

Given that the learners in the current study are beginners, these findings could suggest that focusing their attention on sentence meaning may reduce any observable priming of verb inflections. However, the current study takes this line of work in several new directions. Briefly, research to date has used language that the participants are familiar with (McDonough and Trofimovich 2009: 53), and it has tended to focus on lexical items presented in isolation. As learners are often unfamiliar with considerable amounts of the input, it is of interest to see whether priming effects are observable with beginner learners in contexts where sentence comprehension is effortful, to investigate the extent to which L2 *verb inflections* (rather than lexical items) can be primed in such contexts.

4. Detecting priming effects

Investigating priming involves exposing participants to a lexical item or morphosyntactic form or structure (henceforth, feature), and then monitoring par-

ticipants' reactions to that feature (see Marsden 2009; McDonough and Trofimovich 2009 for overviews). Comprehension priming techniques ask participants' to make decisions about, for example, the feature's pleasantness, whether it was heard before, or whether it is real. Differences are sought in the nature and speed of processing of the previously encountered feature (i.e. the primed or heard feature) compared to new features (i.e. unheard or nontarget features). Contrasts can also be drawn between different exposure conditions, or other variables of interest.

There is no unequivocal agreement that particular priming tests, such as lexical decisions, word repetitions or identifications, must be used for measuring specific processing and priming phenomena, such as semantic or perceptual. For example, Arnotta et al. (2005) used lexical decision tests to investigate syntactic, not semantic, priming. Also, the existence of a neat separation between semantic and perceptual processing (and, therefore, their associated methodologies) remains unclear (see VanPatten et al. 2004; Williams 2004, 2005 for discussion about the integrated processing of form and meaning). In the current study, a lexical decision test was used in which participants were asked whether each test word is real or nonce. This is a well-established method of ascertaining whether participants have a processing advantage or a response bias towards previously encountered stimuli (e.g. Blumstein et al. 1991; Field 2004; Marslen-Wilson et al. 1994; Marslen-Wilson et al. 1996). Measuring the speed and nature of responses to *nonce* words with heard versus unheard inflections was appropriate for the current study for several reasons. First, we wished to examine inflection priming, not priming of holistic *stem+inflection* constructions. As nonce verbs + inflection *cannot* already be stored holistically in the participants' memory, any priming effects found could suggest activation at some level of morphological representation, in line with decompositional models of access and storage (Clashen and Felser 2006; Pinker 1999; Taft 2004; see Kazanina et al. 2008 for similar arguments regarding their finding that pseudo-derived words underwent decomposition). Thus, using nonce verbs eliminated the possibility that the test tapped into existing formulaic knowledge of inflected verbs (see Myles et al. 1998 for evidence of such knowledge amongst similar learners).[4] Second, as the participants have very small L2 lexicons,

4. Several points suggest that the beginners' lack of familiarity with the test verb stems enhanced, rather than threatened, the validity of the observed differences in priming effects between conditions. Learners at this level have, in any case, a very limited lexicon (e.g. Milton and Meara 1998, found that learners with more than twice the amount of instruction as our learners had a passive vocabulary of only about 800 words, and Marsden and David 2008 have shown that learners about at the level of those in the current study have a lexical knowledge heavily dominated by nouns, and a relatively weak lexical knowledge of verbs). Critically, there were no differences observed between our beginners' 'word' and 'nonword' reaction times, whereas it is well observed that natives take longer to respond 'nonword' in

which can vary significantly between individuals, using nonce words eliminated the extraneous effects of such individual differences. Third, the online nature of the test reduced time to access any explicit knowledge about the target feature. Finally, as the test is comprehension-based it reduced extraneous effects of individual differences in productive skills.

Many priming studies report both actual responses (e.g. accuracy or preference) and the speed of those responses. There is some debate, however, as to whether these two data types reflect the same constructs. For example, there is some evidence that constraints in online processing are observable via reaction times, whereas actual decisions about target features may reflect prior competence or representations in long term memory (e.g., Juffs 1998; Roberts et al. 2008). It was of interest, therefore, to ascertain whether priming effects were observable for verb inflections in both reaction times and actual responses.

5. Research questions

In view of the above, this study had one main research question with two subquestions:

Can we observe priming of French verb inflections amongst beginner L2 learners using a nonce-word lexical decision paradigm? (i) are any such priming effects influenced by the type of task learners were trained on? (ii) are any such priming effects observed both in reaction times and the nature of the responses?

The study measured whether a prior exposure condition (orientation of attention to a verb inflection *versus* trying to understand sentence meaning) had an effect on the speed of subsequent access to the verb inflection and the nature of responses towards it. Following the ideas reviewed above, that orientation to sentence meaning would reduce focal attention on the verb inflection amongst beginner L2 learners, it was predicted that we would find greater priming effects (faster responses and response biases) amongst the participants whose attention had recently been focused on the verb inflection compared to those who had been exposed to an input flood of verb inflections whilst trying to comprehend sentential meaning.

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lexical decisions. Thus the test provided a 'level playing field' in terms of knowledge and prior exposure to the verb stems and any differences in reaction times or preferences were more likely to be due to priming of the *-ons*. In addition, when the current lexical decision test was used with Natives in another study, about a quarter of the Natives' decisions were that the nonwords were real, suggesting that the decision task was sufficiently 'genuine' for the Beginners in the current study.

6. Method

6.1. *Participants*

The participants were fifty-one beginner L1 English learners of French as a foreign language, with approximately 100-200 hours exposure to classroom instruction. None of the learners had native French parents or had ever lived in a Francophone country. The learners had studied French for between two and three years, for between one and two hours a week, and were from five local secondary schools; about half were selected by the teachers (on behavioural grounds, and to include a range of abilities from a class, as perceived by the teacher); the remaining half were self-selected.

6.2. *Design*

Individuals were randomly allocated to either a focus on verb inflection exposure task (henceforth focus on form) or a focus on sentence meaning exposure task. In the focus on form task, attention on the verb inflection was essential for completing the task, whereas it was not in the focus on sentence meaning task. Following their exposure task, each participant did a Lexical Decision test, to investigate whether one group had a processing advantage or a preference for the verb inflection they had just heard in the exposure task. The Lexical Decision test took approximately three minutes. All the tasks and tests were presented via E Prime software (Version 1.1) and were run on a portable computer with Windows, logging responses and reaction times via the keyboard. The order of items in each exposure task and in each test was randomly generated for each participant.

6.3. *Target structure*

The target inflection in the tasks and tests was the French first person plural verb inflection *–ons*. Previous research has shown that learners with instruction of a similar length and type to that of the participants in the current study (and, in fact, that some learners with considerably more experience and/or instruction) do not produce this target inflection in semi-spontaneous oral production or in written production (Harley and Swain 1978; Myles 2005; Page 1999; Perdue 1993; Rule and Marsden 2006). Instead, they tend to produce non-finite verbs or default uninflected short forms in finite contexts. However, research has shown that some learners with 50–100 *more* hours of French instruction than the learners in the current study (i.e. one school year later), having undertaken an intervention that focused on inflectional verb morphology *can* use the

-ons inflection in certain writing and oral production tests (Marsden 2006). So, as the learners in the current study were unlikely to have incorporated the target inflection into their developing systems, at least not sufficiently for productive use following Myles (2005) and Rule and Marsden (2006), the *-ons* inflection was a good candidate for investigating activation of a new or emerging feature during different kinds of instructional tasks at a sensitive point in development.

Another reason for selecting the *-ons* inflection was that it has relatively high saliency, as it is syllabic and has relatively reliable one-to-one mapping between its form and function, unlike many other French verb inflections that are either homophonic with (or very similar to) other person/number/tense agreements or with the non-finite form, or are realised only orthographically. As saliency is known to be one factor that facilitates acquisition of morphemes (Goldschenider and DeKeyser 2001), the *-ons* inflection is likely to be one of the earliest to emerge amongst the beginners in our study, and be a more likely candidate to show priming effects. In addition, it has been demonstrated that phonological realisation of inflectional morphology affects how morphology is processed in the input. That is, compared to silent (i.e., orthographic-only) inflections, phonologically realised morphosyntactic agreements are more likely to cause measurable brain activity, when anomalies are detected as measured by ERPs, amongst both natives and L2 learners (Frenck-Mestre et al. 2008). Again, this suggests that *-ons* may be a good candidate to test whether priming can be observed.

6.4. *Procedure and Materials*

The two exposure conditions, Focus on Form (FF) and Focus on Sentence Meaning (FSM), had an equal number of target inflections (thirty in each). Frequent regular verb stems were used. The same lexical items were used in both conditions. Vocabulary was taken from text books and activities normally used by this level and age of classroom learner (e.g. McNab 1994, 2001), and its selection was informed by previous research (e.g. Marsden 2006; Marsden and David 2008; Mitchell and Hogg 2001) and the personal experience of the first author. For the Lexical Decision test, the stems were nonce but the inflections were real, as described below.

6.4.1. *The FF task.* This task shares some characteristics with structured input (referential) activities within Processing Instruction (Marsden and Chen 2011; VanPatten 1996, 2004). Participants heard, through headphones, forty sentences recorded by a native French speaker. Thirty of the sentences included a verb with the target inflection. The other ten sentences had a range of different verb inflections, such as *-a (jouera)*, *-iez* (*mangiez*). Participants had to

decide if the sentence referred to something the speaker does with other people. After each sentence the participants pressed one of three keys on the laptop, labelled *Speaker with others*, *Not* or *Don't know*. The presence or absence of the target inflection was the only cue for completion of the task because the subject was removed. In the on-screen instructions before the task began the participants were told, once: "if the speaker is talking about what they do with other people, the verb ends in *-ons*". For the first six sentences participants received feedback from the computer (correct or incorrect). After each item, there were four seconds before the onset of the next sentence. Table 1 shows example sentences.

6.4.2. *The FSM exposure task.* This was an illogicality judgement task, similar to those used previously to encourage learners to comprehend sentential meaning (Daneman and Carpenter 1980; Walter 2004). The task also shares characteristics with some classroom activities used with this population of learners, each sentence providing an example of the verb inflection yet the task requiring only the comprehension of lexical items (e.g. McNab 1994: 113; McNab 2001; see Marsden 2005 for discussion). Participants heard thirty sentences recorded by the same native speaker as in the FF exposure task. Every sentence contained a verb with the *-ons* inflection. Half of the sentences were semantically odd and half were semantically acceptable, as judged by the authors. Participants were instructed to listen and to try to understand each sentence. After each sentence they had to press one of three keys on the laptop labelled *makes sense*, *odd* and *don't know*. Critically, the incongruity of the odd sentences was always due to a lexico-semantic anomaly between the verb stem and its complement. The participants' attention was, therefore, directed to the meaning of the verb and its complement. There were no morphosyntactic anomalies, and the incongruities were never linked to person or number values. Four seconds was allowed for responses before onset of the next sentence. See Table 1 for example sentences.

Note, the target sentences were not identical in each condition as some sentences had to be 'odd' (FSM) and some without the inflection (FF). Another important difference was that the FSM sentences all had subjects, whereas the subjects had been removed from the FF sentences so that inflection was the only cue to being able to carry out the task. This intentional manipulation of the input was in line with the design of referential activities in Processing Instruction and maintained some ecological validity. However, we acknowledge that this is a limitation of the study, and address this in the Discussion.

6.4.3. *The lexical decision test.* Participants were told they would hear twenty French words, and that they had to determine whether the words were made-up.

Table 1. *Examples of Focus on Form and Focus on Sentence Meaning exposure sentences*

FF (30 target inflections + 10 other inflections)	FSM (30 target inflections)
Parlons avec les parents	Alex et moi parlons avec les parents (makes sense)
Nageons à la plage	Ma soeur et moi nageons à la plage (makes sense)
Achetons le CD	Nous achetons dans la mer (odd)
Ecoutons de la musique	Nous écoutons le fromage (odd)
Mange les légumes (nontarget)	Nous mangeons les légumes (makes sense)
Visitera la France (nontarget)	Julie et moi visitons la France (makes sense)

The words were recorded by the same native French speaker as the exposure tasks. The twenty words were derived from ten nonce, but phonotactically legal, verb stems. Each verb stem (e.g., *arrich*) appeared twice: once with the target inflection which had been heard repeatedly in the exposure phase (e.g., *arrichons*), and once with another grammatical inflection which had not been heard repeatedly in the exposure phase (e.g., *arrichait*). Each of these 'unheard' inflections appeared once (see Appendix 1). The words were presented in a random order. Participants were given a maximum of four seconds to press one of two keys labelled *made-up* and *real* (the length of time used in other lexical decision tests, e.g. Arnotta et al. 2005). Note, all stimuli, for both the exposure conditions and the tests, were presented aurally only.

6.5. *Scoring*

Scoring is first described for the exposure phase (FF or FSM), and then the test phase (the Lexical Decision test).

For the FF exposure, one point was given for correctly deciding that the speaker was talking about doing something with other people if the target inflection was present, and one point for correctly answering *not* if the target inflection was absent; zero points were given for an incorrect answer or pressing the *don't know* key. Sentences with target inflections and sentences without target inflections were analysed separately.

For the FSM exposure, one point was given if the participants' answer coincided with our judgment as to whether a sentence *made sense* or was *odd*. No points were given if the participants' answer differed from our judgment, or if they pressed *don't know*. This was not intended to be a subtle measure of comprehension, but gives a broad indication of the level of the learners and the extent to which comprehension was effortful, as planned.

From the Lexical Decision test, two types of data were obtained: reaction times and actual responses. Reaction times were collected to test for a processing advantage for words with the target (heard) inflection compared to the words with the nontarget (unheard) inflections, as a function of exposure condition. Reaction times were of four types: time to decide a nonword + target inflection, or a nonword + unheard inflection, was a real word (an incorrect response, as all stimuli were nonwords); and time to decide a nonword + target inflection, or a nonword + unheard inflection was a nonword (a correct response). Reaction times were computed from the end of the stimulus to the key press.

Actual responses were collected to test for preferences for deciding that words with the target inflection were real words compared to the words with the unheard inflections, as a function of exposure condition (and the inverse of this, i.e., *not* responding that target inflected words were made-up). The participants' lexical decision scores were calculated as the number of decisions that the nonword + target inflection was a real word as a proportion of all nonword + target inflection items (ten, in total). The inverse of this proportion is a measure of how often participants decided that the nonword + target inflection was a nonword. The responses to the nonword + unheard inflection items were calculated as a proportion of all nonword + unheard inflection items (also ten in total).

7. Results

7.1. *Exposure tasks*

To give some indication about whether the participants had attended to the presence and absence of the target inflection in the FF condition, a one-tailed one sample t test was used to test whether their scores were greater than a chance score of 50 %. This is probably a conservative indication of the extent to which the participants processed the verb inflection, as it only gives a measure of their correct responses, rather than a precise measure of the amount of processing each inflection received regardless of the accuracy of the final response. The participants responded correctly to the presence and the absence of the target inflection at an above chance rate for items with target inflections, 68.40 % ($SD = 25.30$), $t(21) = 3.409$, $p < .01$ and for items with non-target inflections, mean 63.2 % ($SD = 32.9$), $t(21) = 1.881$, $p = .074$.[5] The results provide some

5. When the score from one participant who scored 0 % on non-target sentences (and 40% on target sentences) was eliminated, the mean score for the non-target sentences was: 66.2 % ($t = 2.440$, $p < 0.05$).

behavioural evidence that the participants processed the target inflection, at some level. In the FSM condition, participants agreed with our judgements of logicality 45.2 % of the time ($SD = 14.3$ %).[6] As the aim of the study was to investigate whether different instructional activity types can affect the priming of verb inflections when comprehension is effortful, the precise level of successful comprehension was not critical. The issues of comprehension difficulty will be raised again in the discussion.

7.2. *Lexical decision test*

To assess whether the two groups (FF and FSM) were comparable at the outset, baseline performance rates were established (Trofimovich 2008). This was done by comparing the two groups' responses to unprimed i.e. unheard material. Independent t tests were used to compare the FF and FSM groups' reaction times, for 'real word' and 'nonword' responses, and their actual responses. No statistically significant differences between the two groups' baseline performances were found: the speed of responses to words with unheard inflections was the same in both groups (responding "real word", $t(21) = .481$, $p = .633$; responding *nonword*, $t(21) = .361$, $p = .719$); and the nature of the responses to words with 'unheard' inflections was statistically the same in the two groups, $t(21) = .461$, $p = .647$. See Tables 2 and 3 for the descriptive statistics for responses to unheard inflections. These analyses, therefore, confirmed baseline parity between the groups.

The reaction times and responses were both analysed using repeated measures ANOVAs, with 'target *versus* unheard inflection' as a within-subject variable, and 'FF *versus* FSM condition' as a between-subject variable. We tested the directional (one-tailed) hypothesis that there would be faster reactions to and greater preference for the words with the target inflection compared to unheard inflections amongst the FF group only. The reaction times are presented in Table 2. In line with predictions, statistically significantly faster reactions to target inflections compared to unheard inflections were found in the FF group only. This was the case both for *real word* responses, $F(1,50) = 5.082$, $p < .05$, *nonword* responses, $F(1,50) = 2.823$, $p < 0.05$, and the pooled responses, $F(1,50) = 14.666$, $p < 0.001$. There was no overall difference (i.e. regardless of exposure condition) for heard *versus* unheard inflections for *real word* responses, $F(1,50) = .030$, $p = .864$, for *nonword* responses, $F(1,50) = 1.249$,

6. In a separate study using the *same* FSM task, 21 French adult natives scored 81.8 % (st. dev. 12.3 %) and 57 Intermediate learners scored 80.5 % (st. dev. 19.2 %). This suggests beginner learners' scores in the current study (45.2 %) partly reflect non-alignment with the authors' illogicality judgements.

Table 2. *Reaction times in lexical decision test*

Test item	Participants' response	FF condition (n=22) mean ms. (SD)		FSM condition (n=28) mean ms. (SD)[a]	
target ('heard') inflection	"real word"	832.3	(435.5)	1102.0	(377.9)
	"nonword"	813.4	(339.5)	1031.4	(333.6)
	pooled	798.9	(292.4)	1079.9	(342.0)
nontarget ('unheard') inflections	"real word"	931.5	(442.8)	986.4	(364.7)
	"nonword"	959.4	(457.0)	1002.1	(378.6)
	pooled	918.7	(384.0)	998.3	(340.8)

a. One outlier was excluded with a mean response time for responding nonword to nontarget inflections of 2112.33ms, 2.5 standard deviations above the mean. The procedure for eliminating outliers in reaction time studies seems to vary e.g. Zevin and Balotta (2000) and Arnotta *et al.* (2005) eliminated responses over 1500 ms; Juffs (1998) excluded outliers 3 standard deviations or more above the mean.

$p = .269$), or for the pooled responses, $F(1,50) = .529$, $p = .471$).

The response scores are given in Table 3. Both *real word* responses and *nonword* responses are given (although one response type is the inverse of the other). Repeated measures ANOVAs showed that the actual responses to the lexical decision had a similar pattern of results to the reaction times. There was no statistically significant difference overall (i.e., regardless of condition) between target *versus* unheard inflections, $F(1,51) = .779$, $p = .382$, only as a function of condition $F(1,51) = 3.508$, $p < .0.05$. As can be seen from Table 3, this difference is due to the predicted greater preference for the target inflection amongst learners from the FF condition compared to learners from the FSM condition i.e. they were more likely to say that a target inflection word was a real word (and less likely to say that a target inflection word was a nonword).[7]

The scores in Table 3 could suggest a random clustering of scores around 5, the mean score obtainable if participants were randomly guessing. Therefore, the responses to the target and unheard inflections were compared to a score which could have been obtained by guessing (50 %). Repeated measures ANOVAs were carried out, with exposure condition as a between-subject variable, and planned contrasts to compare responses to words with target inflections and words with unheard inflections to a 'chance' score of 50 %. There

7. A similar pattern of results was found when we analysed responses to the target inflection only, as done by some researchers, showing a statistically significant difference between the two conditions ($t = -2.521$, $p < 0.01$).

Table 3. *Responses in lexical decision test*

Test item	Participants' response	FF condition mean (n=22) Total 10 (SD)		FSM condition mean (n=29) Total 10 (SD)	
Target (heard)	*real word*	5.68	(1.25)	4.69	(1.49)
inflections	*nonword*	4.32	(1.25)	5.31	(1.49)
Nontarget (unheard)	*real word*	4.82	(1.40)	5.00	(1.39)
inflections	*nonword*	5.18	(1.40)	5.00	(1.39)

was a significant interaction between condition and the scores in the predicted direction, $F(1,51) = 3.407$; $p < 0.05$.[8] The planned contrast showed that only the FF group responded *real word* to target inflected words at a greater than chance level, $F(1,51) = 6.353$, $p < 0.05$; *real word* responses to words with unheard inflections were no different to a chance score of 50 % for both groups, $F(1,51) = .213$, $p = .647$).[9]

8. Summary of findings

These results show that only the FF condition, in which the activity required participants to attend to the verb inflection, lead to reaction time and response bias priming effects when responding to words with the target inflection compared to words with unheard inflections. The FSM condition, in which participants were asked to try to understand sentences containing the target inflection, led to similar reaction times and responses to the words regardless of whether the words were with target or unheard inflections.

The findings suggest that the answer to the main research question is a qualified yes, a verb inflection was primed amongst beginner learners of L2 French. In answer to the first subquestion, the inflection was only primed when the activity oriented learners' attention on the verb inflection, not when learners were asked to try to understand sentences containing the verb inflection. The answer to the second subquestion was yes, priming effects were observed both in reaction times and response data.

8. As sphericity was violated, Greenhouse-Geisser's correction was used (Field 2005: 430).
9. For *nonword* responses, the inverse of this data, the pattern was obviously the same ($F(51,1) = 3.560$, $p < 0.05$), and the planned contrast showed that only FF learners were less likely than chance to respond "nonword" for the target inflected words ($F(51,1) = 7.201$, $p = 0.01$). "Nonword" responses to the nontarget inflection were at chance for both conditions ($F(51,1).001$, $p = .972$).

9. Discussion

Two characteristics of the experiment increase our confidence in the observed differences. First, the experiment was carried out on the computer keyboard, which takes less frequent sweeps of responses than a response box, making differences in reaction times more difficult to detect. Second, even though the beginners did not always respond correctly in the FF exposure task, the FF condition still produced observable priming effects.

Our findings appear to contribute something to our understanding of L2 input processing. Our data suggest that for beginner learners a representation of a verb inflection was activated more when learners' attention was oriented to the verb inflection in the absence of a subject than when learners were required to process the meaning of the verb and its complement when a subject was present. Whether the representation was at an abstract, modality-independent morphological level, or at a more 'surface', phonological level remains to be determined. Nevertheless, following Cowan's (1999) model, our findings suggest that focal attention was not *involuntarily* allocated to a representation of the inflection when the task did not require learners to do something with the inflection and where a subject was present, to the same extent as in the FF condition in which representations of the inflection seemed to be enhanced by the focal attention allocated to them. One explanation for this could be that the focal attention required to judge the meaning of the verb and its complement in the FSM condition meant that focal attention could not be allocated to features in the input that were not essential for the task. This explanation could be in line with those reviewed above who posit the notion of limited capacity processing resources in L2 learning (e.g. Just and Carpenter 1992; VanPatten 2002, 2004). Our data could also support arguments, reviewed above, that limited processing resources are deployed selectively on the basis of the type of L2 feature i.e. that representations of particular morphosyntactic features are less likely to be activated if attention is not oriented towards them (e.g. Sharwood Smith 1986; Swain 1995; VanPatten 2004). As we did not have a control condition in which the participants did not experience the verb inflections, to provide a baseline for comparison with the FSM condition, we cannot say the extent to which our results are compatible with the idea that particular features are unlikely to be implicitly induced from the input (DeKeyser 1995).

Nevertheless, our evidence is broadly compatible with pedagogical recommendations that orienting learners' attention to segment relevant features of the input stream and making them essential to the task is beneficial (e.g. Doughty and Williams 1998; Marsden 2006; VanPatten 2002, 2004). Although several characteristics of our study enhance the study's applicability to the beginners' classroom learning context (e.g. genuine classroom language learners, exposure conditions that were broadly based on teaching interventions, and the use

of novel, unfamiliar and emerging language), we are cautious about making generalizations due to several limitations in the study.

One issue is the presence of subjects in the FSM condition as this renders comparisons between the FF and FSM conditions difficult. There are several reasons why the presence of the subject in the FSM condition, *in particular*, may not fully explain the greater priming effects in the FF group compared to the FSM group. First, in the FSM task the illogicalities were only related to the semantic anomalies between the verb stem and its complement (see Table 1). Assuming that processing demands are minimised during effortful comprehension (the scores from the FSM exposure task show that comprehension was indeed effortful), following Cowan's (1999) model of attention and working memory discussed earlier, only representations of the verb and its complement would have been maintained under prolonged focal attention in order to make the illogicality judgement. If so, it is unlikely that the subject, specifically, was held in focal attention *in preference to* the verb inflection in the FSM condition. Second, other studies, as reviewed above, have shown that for learners with just a couple of hundred hours exposure to instruction, like those in the current study, overt co-indexation between subjects and verbs is not part of their interlanguage and, critically, they do not tend to produce clitic pronouns (Myles 2005; Perdue 1993; Rule and Marsden 2006). It is therefore not obvious that the activation of a verb inflection would have decreased just because a subject was overt, given that subject-verb inflection co-indexation was probably not reliably established. That is, it is possible that regardless of the presence of the subject in the FSM sentences, the verb inflection would be less likely to be primed amongst beginners when comprehension was effortful and when attention was oriented to comprehending the verb and its complement, compared to when the activity required focal attention on the inflection. Clearly, further research is needed to establish this, and also any influence of the position of the target feature (after *versus* before a co-indexed lexical item), and of other characteristics, such as boundedness and prosodic salience.

The findings from the current study could relate, albeit indirectly, to findings from auditory word priming research on the effects of orientation of attention to lexical items, although it is emphasized that the current study had different objectives to that line of research. Our findings are broadly compatible with Trofimovich and Gatbanton's (2006) and Trofimovich's (2005, 2008) findings that for certain types of learners (in their studies, those with low pronunciation accuracy and those for whom exposure and test were in different voices, respectively), a semantic orientation to the input *did* have an adverse affect on priming. On the other hand, our findings appear to be in contrast to Trofimovich's (2005) low-intermediate learners, for whom, when the exposure and test were in the same voice, priming effects were not affected by the orientation of attention. However, several key differences between the research aims and

design of the current study and these previous studies render any comparisons tentative. For example, most previous L2 auditory priming studies focused on words and orientation to word meaning, used a repetition production test, and focused on language that was familiar to the participants, whereas the current study focused on a verb inflection and orientation to the meaning of a verb and its complement, used a lexical decision test, and focused on processing when comprehension was difficult.

Interestingly, our results run counter to some research that also used lexical decision tests containing non-words with familiar suffixes in. For example, Taft and Forster (1976) observed that written nonce words with existing affixes, e.g., PLOFER, are responded to more *slowly* than nonce words without such endings, e.g., PLOFET (see also Caramazza et al. 1988; Laudanna et al. 1994; Duñabeitia et al. 2007; and see Meunier and Longtin 2007, for a review). This observation is thought to be because PLOFER is felt to be more meaningful or more orthographically familiar because it ends with an existing morpheme (*-er*) and so participants take longer to reject it as a non-word (see Affix Stripping Hypothesis, Taft and Forster 1976; and more recently, Rastle and Davis 2008; Post et al. 2008; Marsden et al. in press). Why, in the current study, we found *faster* reactions to nonce words with familiar inflections compared to unheard inflections is probably due to the fact that *all* the words in the current study were unfamiliar to our participants (Note that, overall, their reaction times were slower and rejection rates higher than in the studies cited above). The only cue that a word *might* have been real was the familiarity of the inflection, and so this probably sped up their decision to accept some of the non-words as real words. In contrast, in the studies cited above, participants' well-established lexical knowledge meant that their generally accurate and speedy rejection of the non-words, from amongst known real words, was slowed by orthographically familiar suffixes.

We also consider how the current findings compare to a recent study that investigated priming effects during novel word learning (Marsden et al. in press). Findings in that study suggested that suffixes *were* primed to an equal extent regardless of whether participants were oriented towards the meaning of the suffix, the meaning of the lexical host, or simply to the number of syllables. This indicated priming at an orthographic-form level that was not influenced by the orientation of attention, in contrast to the current study where the different activity types led to differences in priming effects. Note however that this was during *visual* word recognition; Marsden et al. did not observe *cross-modal* priming, finding that representations were morpho-orthographic only, dependent on visual word recognition processes. The current study was carried out entirely in the oral modality and this could be one cause of the difference in findings, potentially indicating a greater influence of the orientation of attention in the oral mode compared to the written mode. In addition, and perhaps more

critically, the exposure conditions oriented attention in different ways in the two studies: in the current study the comparison condition oriented attention to the verb and its complement, whereas in Marsden et al. the comparison condition oriented attention to the meaning of only the host word (a lexical verb). Other differences such as the use of real *versus* artificial language, and sentence *versus* word stimuli must be considered. Clearly these issues warrant further investigation.

10. Limitations and future research

The most significant limitation, as noted above, is that the difference between the two conditions was not solely that of attentional orientation. Future studies must test whether the presence of the subject pronoun in the FSM condition influenced the priming effects, using a four way design to manipulate both presence/absence of subject, and attention to inflection/sentence meaning. Such a study would inform us about the possible roles of redundancy and sentence length on priming effects, and whether the current findings do indeed suggest that orienting beginners' attention to a verb inflection may have primed a representation of the inflection more than asking learners to try to understand the meaning of sentences containing the inflection.

Another limitation is that we cannot claim on the basis of these findings that the processes engaged by the FF condition lead to *learning*. Longitudinal research is required to test whether the priming effects observed in the current study actually reflect learning processes.

Related to this is that it is not known whether priming of verb inflections would be observed amongst more advanced learners, and whether similar differences as a function of these task types would be observed. The notion that what can be processed from the input is influenced by the stage of the developing system has been evoked by several SLA researchers (Carroll 2001; Corder 1978; Randall 2007; Schmidt 2001; Towell and Hawkins 1994), and there is evidence that more advanced learners can process grammatical features to a greater extent than less proficient learners from, for example, meta-talk (Williams 1999), dual task studies (VanPatten 1990), classroom experiments (Marsden 2006), and an eye-tracking study (Bernhardt 1987). More proficient learners, with their less effortful comprehension due perhaps to better lexical storage and access, may release processing resources which could enhance the activation of representations of grammatical features, in line with 'perceptual bootstrapping' views of the relationship between lexical and morphosyntactic development (Bates and Goodman 1997; Thordardottir et al. 2002; VanPatten 2004; VanPatten and Houston 1998). In addition, learners at higher proficiency levels may have an existing representation of a feature that could be activated

without the task explicitly orienting their attention to it, in line with accounts of implicit, data-driven learning (Ellis 2002; Robinson 1995; Schmidt 1990, 2001). Higher proficiency may also affect our current findings because communicatively redundant features (such as *-ons* co-indexed with a lexical item) may be more likely to be processed as sentential comprehension becomes easier (for discussion see Aylett and Turk 2004; Just and Carpenter 1992; Mellow 2004; Sagarra 2008; VanPatten 1990, 2004, 2007).

Finally, we acknowledge that we do not know whether the priming effects observed indicated that representation of *–ons* was at a morphological level. It is possible that the results could reflect phonological representations that were activated by the FF condition more than the FSM condition. Future research is required to investigate whether, and how, such priming effects relate to the development of abstract, modality-independent morphological representations (see Marsden et al. in press). In addition, future studies using repetition inflection priming would need to take into account the potential role of different routes of morphological storage and access, which could change with proficiency. For example, more proficient learners may access holistic representations of high frequency inflected verbs (Clashen and Felser 2006; Pinker 1999; Marslen-Wilson 2007), which could influence observations of priming effects.

11. Conclusion

The main contribution of this study has been the finding that priming effects measured by a lexicon decision test can provide evidence of differences in focal attention to verb inflections during input processing amongst beginner learners. These differences were observed in both the reaction times and the actual responses. This is significant as it indicates that lexical decision tests can add to the methodological toolkit of L2 researchers seeking evidence of more implicit attentional mechanisms. It is also significant in that very little L2 research has documented the priming of inflections. In addition, as the study used real beginner learners, unfamiliar language, and input tasks that were based on instructional events, this research informs us about priming under conditions that are comparable in some ways to classroom learning environments.

Several directions for future research are indicated by the study. First, a follow-up study must test whether the same results would be found with an FSM condition without subjects. Following this, replication research should be carried out to assess the generalisability of the findings to, for example, different proficiency levels, the written modality, different voices at exposure and test, and different L1-L2 pairings. Also studies with other target features are required to investigate the influence of redundancy, linear ordering, boundedness, and lexical status on priming. Future research could also engineer different ex-

posure conditions to measure whether other types of orientation of attention affect priming. Another potential avenue would be to combine the techniques from the current study with measures of conscious awareness, to inform our understanding of possible interactions between awareness and priming. Finally, it would be of interest to explore more precisely how the findings from the current study correlate with learners' ability to produce the inflections. This would improve our understanding of the relationship between productive knowledge and the conditions under which activation of representations of features from the input occurs.

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Appendix 1: Stimuli for lexical decision test

Instructions, on screen and read out to participants.

> You will hear a word which you won't know in French!
>
> You have to tell us whether you think the word is a real word or a made up word.
>
> Press the "b" key if you think it's a real word, and the "m" key if you think it's a made up word.

(Labels were also placed on the keyboard to remind participants which key was which. Items were presented randomly).

Words with heard (target) inflection

1 glaffrons
2 arichons
3 crichlons
4 farons
5 macrons
6 jarrons
7 lupons
8 oritons
9 pronçons
10 sicrons

Words with unheard (non-target) inflection

1 glaffré
2 ariche
3 cricherais
4 faraient
5 macreras
6 jarrez
7 luperez
8 oriteriez
9 pronçer
10 sicrait

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