

Learned Attention Effects in L2 Temporal Reference: The First Hour and the Next Eight Semesters

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This article relates adults' difficulty acquiring foreign languages to the associative learning phenomena of cue salience, cue complexity, and the blocking of later experienced cues by earlier learned ones. It examines short- and long-term learned attention effects in adult acquisition of lexical (adverbs) and morphological cues (verbal inflections) for temporal reference in Latin (1 hr of controlled laboratory learning) and Spanish (three to eight semesters of classroom learning). Our experiments indicate that early adult learning is characterized by a general tendency to focus on lexical cues because of their physical salience in the input and their psychological salience resulting from their simplicity of form-function mapping and from learners' prior first language knowledge. Later, attention to verbal morphology is modulated by cue complexity and language experience: Acquisition is better in cases of cues of lesser complexity, speakers of morphologically rich native languages, and longer periods of study. Finally, instructional practices that emphasize morphological cues by means either of preexposure or typographical enhancement increase attention to inflections thus to block reliance on adverbial cues.

This study explores adults' difficulty acquiring foreign languages (L2s) in terms of cognitive principles of transfer—in particular, attentional processes in the associative learning of form-meaning relations in linguistic constructions.

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Attention to meaning and form is necessary for successful SLA (Long, 1991), but making form-meaning connections is cognitively effortful. Because working memory limitations restrict attention to multiple cues in the input (Baddeley, 2003; Hasegawa, Carpenter, & Just, 2002; Just & Carpenter, 1992), learners have to select which aspects of the input they will process (Gass, Svetics, & Lemelin, 2003; MacWhinney, 1987; Sagarra, 2007; Schmidt, 1993). According to the associative-cognitive model (Ellis, 2007), L2 cue selection is modulated by linguistic characteristics (cue salience and reliability) and language experience (early experienced cues in the first language [L1] and the L2 affect the learning of later experienced cues and can lead to overshadowing, blocking, and transfer).

Our research considers learned attention in L2 learning of morphological cues (verbal inflections) and lexical cues (adverbs) to temporal reference. We investigate these factors in two complementary environments that support each other in their respective contributions of experimental and ecological validity. The first is the laboratory, where participants spend less than 1 hr learning a small amount of Latin from computerized instruction under experimentally controlled conditions. The second is the foreign language classroom, where English native speakers receive three or eight semesters of formal instruction on a morphologically richer L2 (Spanish). Our experiments reveal a general tendency for learners to focus on salient cues at early stages of acquisition, followed by short- and long-term learned attention effects modulated by cue salience/complexity and L1/L2 experience. We demonstrate the effectiveness of instructional practices that make morphological cues more salient in time (intensive preexposure to these cues in early learning) or in space (typographical enhancement of morphological information) in overcoming these long-term learned attentional biases.

Background

Linguistic Characteristics: Cues and L2 Processing

Adult SLA is characterized by the use of semantically richer items (nouns, verbs, adverbs, and chunks of language), with semantically poorer ones (prepositions, determiners, nominal and verbal morphology) being rare (Bardovi-Harlig, 1992, 2000; Clahsen & Felser, 2006; Perdue, 1993; VanPatten, 1996, 2006). For example, in Romance languages, temporal reference can be assigned by lexical cues (temporal adverbs, adverbial expressions, serialization, calendric reference) and morphological cues (verbal inflection) (Evans, 2003). Whereas children learn to use both cues in their L1, adult learners begin

expressing temporal relations with implicit devices, such as following a chronological order (Klein & Perdue, 1992), then use lexical cues (J. F. Lee, 1999; J. F. Lee, Cadierno, Glass, & VanPatten, 1997; Musumeci, 1989; Rossomondo, 2003), and only later they pay attention to morphological cues (Dietrich, Klein, & Noyau, 1995; Klein, 1994; Starren, 2001).

Learners' preference for lexical over morphological cues is affected by their salience (their physical magnitude and psychological significance), their reliability of interpretation (contingency of form-function mapping), and their redundancy within the discourse context. For example, lexical cues that express time are quite pronounced in the speech stream, whereas verbal inflections become phonologically fused with surrounding language because the high frequency of these morphemes yields to reduction (Bybee, 2003; Zipf, 1949; Zuraw, 2003) (compare *last week* with *walked*). Reduction processes are, in turn, responsible for the low reliability of morphological cues, as shorter words tend to be more homophonous, and homophonous words tend to be more ambiguous (Ellis, 2008). Whereas advanced and native speakers are able to perceive these changes (*walk* vs. *walked*), beginning L2 learners are not. This decreased attention to morphological cues is exacerbated when these cues compete with lexical cues that convey the same idea (e.g., *yesterday I walked*). In this case, beginning learners' limited cognitive resources forces them to only attend to the most salient and reliable cue (i.e., the adverb).

The low salience, low reliability, and typical redundancy of morphological cues tend to make them less learnable (Ellis, 2006a, 2007; Goldschneider & DeKeyser, 2001; Rescorla & Wagner, 1972) and could explain adult learners' difficulty in acquiring L2 verbal inflections (Jiang, 2004; Sato & Felser, 2008; Zobl & Licerias, 1994). Yet, if these linguistic characteristics of cues in the input are much the same for L1 and L2 learners, there must be some other factor that makes the use of morphological cues particularly difficult in adult SLA. We believe that the answer lies in their learning history.

Learner Characteristics: Experience and L2 Processing

Associative learning theory (Kamin, 1969; Kruschke, 2006; Kruschke & Blair, 2000) demonstrates that once an individual has learned that a particular stimulus (or stimulus dimension) is associated with a particular outcome, then later learning that a different stimulus (or stimulus dimension) predicts this same outcome is more difficult. The shifting of a learner's attention to certain aspects of the linguistic input as a result of language experience is called *learned attention* and may be an important reason why second-language acquisition (L2A) is less successful than first-language acquisition (L1A). In the initial

stages of acquisition, learners tend to focus on one cue at a time (e.g., L1A: MacWhinney, Pléh, & Bates, 1985; L2A: VanPatten, 1996, 2006; artificial languages: MacWhinney & Bates, 1989). Children acquiring their native language prefer available to reliable cues (MacWhinney et al., 1985) and thus initially favor verbal over adverbial cues to time (Dale & Fenson, 1996; Nelson, 1996; Pawlak, Oehlich, & Weist, 2006; Valian, 2006). Adult learners however, whatever their native language background, as a result of their experience of this L1, know that there are reliable and salient lexical cues to temporal reference (words like *gestern*, *hier*, *ayer*, *yesterday*). These might thus block the acquisition of verb tense morphology.

Late learners' initial L2 cue settings closely match those that they have learned for their L1, and they only gradually get retuned with sufficient L2 experience (Bardovi-Harlig, 1992; Bordag & Pechmann, 2007; Ellis, 2006a; Parodi, Schwartz, & Clahsen, 2004). Perceiving the L2 through the already tuned L1 processor can facilitate or hinder SLA, depending on L1-L2 similarity (Costa, Kovačić, Franck, & Caramazza, 2003; Ellis, 2005; Jiang, 2004, 2007; Liu, Bates, & Li, 1992; Sato & Felser, 2008; Tokowicz & MacWhinney, 2005). Learners' sensitivity to verbal morphology will therefore depend on the degree to which their L1 makes extensive use of it. Thus, native speakers of Chinese, for which there is no morphology, free or bound, that corresponds to tense in the language, might be particularly "inflection-blind"; native speakers of languages that make some little use of verbal inflection like English might be somewhat less so; and native speakers of languages like Spanish or Russian that make extensive use of verbal tense morphology might, in contrast, be particularly prone to attending to inflectional cues.

If overriding L1 cue preferences is difficult enough for late learners, the teachers' overuse and underuse of some L2 cues in the classroom (Goodall, 2008; Santilli, 1996; Sanz, 1999) and the other learners' overuse of lexical cues compounds this problem. For instance, L1 Spanish teachers produce more overt subject pronouns in the classroom than when talking naturally to other native Spanish speakers (Dracos, 2010). LaBrozzi, Sagarra, and Ellis (2010) have shown that exposing classroom learners to intensive amounts of morphological cues in study-abroad experiences can counter the long-term learned attention effects caused by L1 learned attention and such L2 classroom experiences. Their eye-tracking data revealed that English-Spanish immersion classroom learners attended more to verbal inflections and less to adverbs in sentences containing both cues than nonimmersed classroom learners. Because not all learners can study abroad, it is important to find alternative ways to help classroom learners focus on L2 morphological cues. Furthermore, although exposure to intensive

amounts of input is crucial at the earliest stages of SLA (Rast, 2008), it may not be sufficient to overcome learned attentional biases and it may have to be combined with pedagogical interventions such as providing feedback on error (White, 1991), pointing at pictures (Gullberg et al., this volume), or input enhancement.

Instructional Characteristics: Typographical Input Enhancement and L2 Processing

Research on the effects of textual input enhancement on adult L2A is inconclusive (see Han, Park, & Combs, 2008, and S.-K. Lee & Huang, 2008, for recent comprehensive reviews). Some studies report positive effects of typographical enhancement on L2A of morphological cues (Alanen, 1995; De Santis, 2008; Doughty, 1991; S.-K. Lee, 2007; Robinson 1995; Shook, 1994; Wong, 2003), whereas others find no effect on attention or comprehension (Izumi, 2002; Jourdenais, 2001; Leow, 1997; Leow, Egi, Nuevo, & Tsai, 2003; Wong, 2003). Possible factors modulating the effectiveness of input enhancement include cue complexity (Simard, 2008), linguistic forms (Shook, 1994), text length (Leow, 1997), assessment task (Alanen, 1995), and input level and mode (Wong, 2001, 2003). Our research therefore explores two instructional techniques—preexposure and typographical enhancement—to make morphological cues more salient to classroom learners, and it investigates the degree to which efficacy is related to cue complexity and salience.

The Studies

We investigated short-term and long-term effects of learned attention in the processing of L2 lexical and morphological cues to temporal reference, both in a laboratory and a foreign language classroom.

Laboratory Experiments

Study 1: Short-Term and Long-Term Learned Attention Effects

Do cues learned early in the L2 instructional sequence block the acquisition of later-experienced L2 cues? Additionally, do adults transfer their cue biases, acquired through experience in their L1, to the learning of a L2? Ellis and Sagarra (2010b) reported two language learning experiments. The first demonstrated short-term instructional sequence effects in adults learning temporal reference in Latin using the standard blocking experimental paradigm (Kruschke, 2006) but with linguistic content. The second illustrated long-term language transfer effects whereby the nature of the learners' L1 (+/- verb tense morphology)

CONDITION	PHASE 1 pretraining (+ feedback)	PHASE 2 Sentence Decoding (+ feedback)	PHASE 3 Reception testing (- feedback)	PHASE 4 Production testing (- feedback)
ntrials	36 randomized	36 (these x 6 = 3 x 12) randomized in blocks	48 (24 x 2) randomized in blocks	18 (9 x 2) randomized in blocks
Adverb Pretraining condition	hodie today heri yesterday		Test with Past....Present....Future 1.....2.....3.....4.....5 hodie 3 heri 1 cras 5 cogito 3 cogitavi 1 cogitabo 5	Type the Latin for:
Verb Pretraining condition	cogito I think cogitavi I thought	hodie cogito present cogito hodie present heri cogitavi past cogitavi heri past cras cogitabo future cogitabo cras future	hodie cogito 3 hodie cogitavi 2 hodie cogitabo 4 heri cogito 2 heri cogitavi 1 heri cogitabo 3 cras cogito 4 cras cogitavi 3 cras cogitabo 5 cogito hodie 3 cogitavi hodie 2 cogitabo hodie 4 cogito heri 2 cogitavi heri 1 cogitabo heri 3 cogito cras 4 cogitavi cras 3 cogitabo cras 5	I thought I think I will think Yesterday Today Tomorrow Yesterday I thought Today I think Tomorrow I will think
Control	No phase 1			

Figure 1 The design of Experiment 1.

biases the acquisition of verbal inflectional versus lexical cues to temporal reference in the same subset of Latin.

Experiment 1 had L1 English undergraduates learn a small number of Latin expressions and their English translations. There were three groups: Adverb Pretraining, Verb Pretraining, and Control. The design is schematized in Figure 1.

In Phase 1 (pretraining), Adverb Pretraining participants first learned two adverbs and their temporal reference (*hodie* = today, *heri* = yesterday). Verb Pretraining participants first learned two verb forms and their temporal reference (*cogito* = present, *cogitavi* = past). The Control group had no such pretraining. In Phase 2 (training), all participants were shown six sentences that appropriately combined an adverb and a verb (*hodie cogito*, *cogito hodie*, *heri cogitavi*, *cogitavi heri*, *cras cogitabo*, *cogitabo cras*) and had to choose whether these sentences referred to the present, the past, or the future. They were given feedback if incorrect. There were six trials of each type to consolidate learning. In Phase 3 (reception test), following the lead of Competition Model studies of cue use (MacWhinney, 1987), all combinations of adverb (*hodie*, *heri*, *cras*)

and verb tense marking (*cogito, cogitavi, cogitabo*) were combined and the participants were asked to judge whether each sentence referred to the past, present, or future on a 5-point scale ranging from extreme past (1), through present (3), to extreme future (5). Finally, in Phase 4 (production test), participants were asked to translate from English to Latin by typing in the Latin equivalents of the various elements to which they had been exposed: *I thought, I think, I will think, Yesterday, Today, Tomorrow, Yesterday I thought, Today I think, Tomorrow I will think*. There was no feedback in Phases 3 or 4.

The logic of the experiment is simple; in Phase 2 every utterance contains two temporal references—an adverbial cue and a morphological cue. If participants pay equal attention to these two cues, then in Phase 3 their judgments should be equally affected by them, and in Phase 4 they should be equally good at producing adverbs and verbal inflections. If, however, they pay more attention to the adverbial cues, then their judgments will be swayed toward these cues in Phase 3 and they will better produce them in Phase 4.

Figure 2 shows that the three groups react to the cues present in the sentences of Phase 3 in very different ways. In two-word sentences, where there is temporal information cued by both an adverb and a verbal inflection, when these cues deviate, the Verb pretraining group follows the verbal cue and the

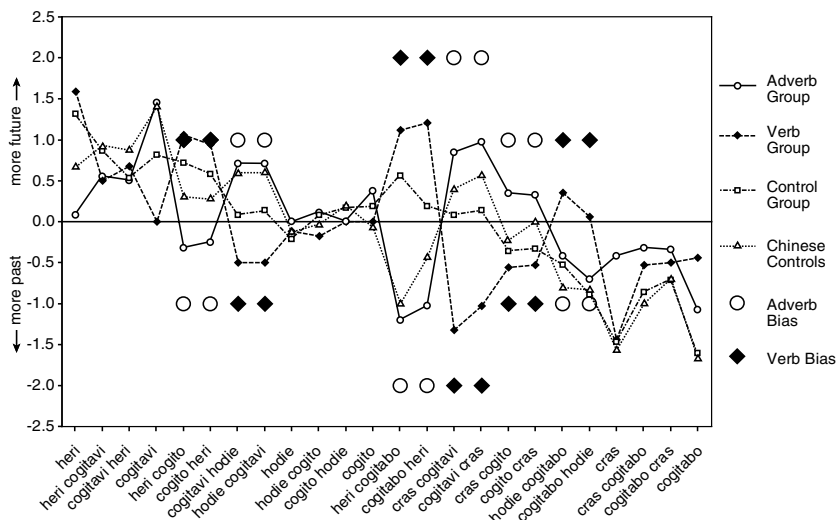


Figure 2 Group mean deviations from cue average temporal interpretations in Phase 3. The solid bias symbols mark the interpretation that would be made for the Adverbial cues only (circles) and Verb inflection cues only (diamonds).

Adverb Pretraining group follows the adverbial cue, so that these two groups move in opposite directions, as one leans to the future so the other leans to the past. In these cases of cue conflict, the Control group lies in between, seemingly attending to both cues equally rather than favoring lexical over morphological cues, a finding that will be qualified in Study 2.

These impressions are confirmed by multiple regression analyses, one for each group, where the dependent variable is group mean temporal interpretation for each of the Phase 3 sentences and the independent variables are the interpretations cued by the adverbial and verbal inflection cues. The differential cue use by each of the three groups, in standardized beta coefficients, are as follows:

$$\text{Adverb group: Time} = 0.97 \text{ Adverb} + 0.23 \text{ Verb} \quad R^2 = 0.98$$

$$\text{Verb group: Time} = 0.12 \text{ Adverb} + 0.97 \text{ Verb} \quad R^2 = 0.96$$

$$\text{Control group: Time} = 0.60 \text{ Adverb} + 0.72 \text{ Verb} \quad R^2 = 0.85$$

Phase 4 production data paralleled these trends. The Adverb Pretraining group later correctly produced 90% of adverbs but only 40% of verbs; the Verb Pretraining group correctly produced 77% of verbs but only 32% of adverbs; the Control group correctly produced 45% adverbs and 36% verbs. These results illustrate large and significant effects of blocking in the early learning. We argue that these effects are due to cue dimension rather than particular word attentional biases because the Adverb and Verb Pretraining groups react similarly to entirely new (future) constructions as they do to previously learned ones (present, past). We return to this issue in the Discussion.

Experiment 2 contrasted the performance of the L1 English and native speakers of Chinese, whose L1 does not exhibit verb tense morphology, in the control condition. Comparing their results with those from Experiment 1, it can be seen that they lie closer to those of the original Adverb group rather than the original Control group:

$$\text{Chinese L1 group: Time} = 0.91 \text{ Adverb} + 0.29 \text{ Verb} \quad R^2 = 0.90$$

In Phase 4 they produce 36% of Adverbs correctly but only 10% of verbs.

These findings confirm a long-term influence of attention to language, a processing bias, and subsequent blocking of cue learning that comes from a lifetime of prior L1 usage.

Study 2: Cue Salience/Complexity Effects

Are more complicated and less salient inflectional paradigms learned with greater difficulty than simpler ones? Does the learning of a more complicated L2

verbal inflectional system suffer even more blocking by attention to more salient and simple cues like adverbs? Can these effects be modulated by exploiting short-term blocking in the instructional sequence by giving early exposure to morphological L2 alone?

Ellis and Sagarra (2010a) extended these findings, replicating the basic design but now with a more complete and complicated verbal paradigm including first-, second-, and third-person singular (*cogito*, *cogitas*, *cogitat*, *cogitavi*, *cogitavisti*, *cogitavit*, *cogitabo*, *cogitabis*, *cogitabit*).

Experiment 1 otherwise had a design identical to that in Study 1. The findings of Phase 3 showed the following differential cue use by each of the three groups, in standardized beta coefficients:

Adverb group:	Time = 0.99 Adverb – 0.01 Verb	$R^2 = 0.99$
Verb group:	Time = 0.76 Adverb + 0.60 Verb	$R^2 = 0.94$
Control group:	Time = 0.93 Adverb + 0.17 Verb	$R^2 = 0.88$

As in Study 1, pretraining on one cue blocked the acquisition of the other cue. The results also show that, as the verbal paradigm increases in complexity, so the participants in all groups rely more on the adverbial cue.

A subsequent experiment (Experiment 2 in Ellis & Sagarra, 2010a) involved participants from four different L1 backgrounds (Chinese: no inflectional morphology in L1; English: impoverished inflectional morphology; Spanish and Russian: rich inflectional morphology). Their cue use was as follows:

No inflectional morphology:

Chinese L1 group:	Time = 0.95 Adverb + 0.02 Verb	$R^2 = 0.89$
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Impoverished inflectional morphology:

English L1 group:	Time = 0.93 Adverb + 0.17 Verb	$R^2 = 0.88$
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Rich inflectional morphology:

Russian L1 group:	Time = 0.91 Adverb + 0.22 Verb	$R^2 = 0.88$
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Spanish L1 group:	Time = 0.75 Adverb + 0.41 Verb	$R^2 = 0.71$
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As in Experiment 1, all of the participants attended more to the adverb cues. There was also a trend whereby the more participants' L1 made use of rich verbal morphology, the more they acquired knowledge of the tense inflections. It is also important to note that the L1 Russian group tended to rely more on lexical cues than the L1 Spanish group, suggesting that learned attention to

verbs in Latin is continuous rather than discrete, being based on both L1 degree of use of morphological cuing of tense and its particular means, with Spanish and Latin sharing more similarity here.

Study 3: Instructional Effects of Preexposure and Enhancement of Morphological Cues

Can intensive early exposure to, or typographical enhancement of, morphological cues increase attention to these cues and thus counter long term blocking of morphological cues?

These results have implications for instructional practices that try to optimize learning by manipulating learner attention to form. Studies 1 and 2 demonstrated that there was a tendency for L2 learners to rely on adverbial cues, especially when the morphology was complicated and when participants were coming from inflection-free or inflection-light L1s. Ellis and Sagarra (2010c) therefore investigated whether L1 Chinese and L1 English speakers could overcome these long-term learned attention effects by learning with materials that emphasize the verbal morphological cues either in time (preexposure: Experiment 1) or in space (textual enhancement: Experiment 2).

Experiment 1 investigated effects of verb pretraining on the Chinese and English native speakers following the design of Study 2. Their cue use (alongside the parallel Control group of Study 2) was as follows:

No inflectional morphology (L1 Chinese):

Control group:	Time = 0.95 Adverb – 0.02 Verb	$R^2 = 0.89$
Verb Pretraining group:	Time = 0.95 Adverb + 0.17 Verb	$R^2 = 0.94$

Impoverished morphology (L1 English):

Control group:	Time = 0.93 Adverb + 0.17 Verb	$R^2 = 0.88$
Verb Pretraining group:	Time = 0.76 Adverb + 0.60 Verb	$R^2 = 0.94$

In both cases, verb pretraining increased the use of inflectional cues in subsequent sentence processing. Pretraining interacts with L1 in that it has a considerably stronger effect for an impoverished morphology L1.

Experiment 2 addressed effects of making the verbal morphological cues salient by typographical enhancement (showing the inflections in bold and blue). The Chinese and English native speakers' cue use, otherwise following the design and materials of the control Phase 2 condition of Study 2 was as follows:

No inflectional morphology (L1 Chinese):

Control group:	Time = 0.95 Adverb – 0.02 Verb	$R^2 = 0.89$
Verb Salience group:	Time = 0.14 Adverb + 0.82 Verb	$R^2 = 0.69$

Impoverished morphology (L1 English):

Control group:	Time = 0.93 Adverb + 0.17 Verb	$R^2 = 0.88$
Verb Salience group:	Time = 0.48 Adverb + 0.89 Verb	$R^2 = 0.79$

Typographical enhancement seems to be equally effective for both L1 groups. These two experiments show that short-term refocusing of attention in time or in space can retune the effects of long-term learned attention.

Classroom Experiment

Do earlier learned L1 and L2 cues block later learned L2 cues? Does English L1 learners' experience of lexical rather than morphological cues along with L2 teachers' overuse of lexical cues in the classroom block the acquisition of later experienced L2 morphological cues?

To investigate whether the long-term learned attention effects found in these laboratory experiments replicate in real foreign language classroom experience, Sagarra and Ellis (2010) asked beginning and intermediate English-Spanish learners to read sentences in Spanish containing lexical (adverb) and morphological (verbal inflection) cues to temporal reference. They were enrolled in third- or eighth-semester Spanish courses, spoke no other L2s, began learning Spanish postpuberty, and had spent less than 3 months in a Spanish-speaking country. The Spanish and English monolingual controls did not speak any foreign language and had not lived abroad for more than 1 month. All participants had normal vision, scored 100% on tests of explicit knowledge of the relevant vocabulary and grammar in the sentences, and scored above 60% on comprehension questions about the sentences. Participants completed a language background questionnaire, a Spanish proficiency test (learners only), an eye-tracking task, a grammar test to evaluate their knowledge of verbal inflections and tenses (learners only), and a vocabulary test to assess their lexical understanding of the target verbs and adverbs (learners only).

The eye-tracking test was conducted with an EyeLink 1 machine (sampling rate: 250 Hz; spatial resolution: 0.005°; averaged calibration error: 1°). Participants read two-line sentences presented one by one at their own pace, answered a yes-no comprehension question after each sentence, and received feedback on their answer (*bien* "good" or *mal* "bad"). The learners and Spanish monolinguals read the sentences and questions in Spanish and the English monolinguals

read the English translation. Each participant received one of four sets of 146 sentences: 6 practice trials, 100 fillers, and 40 experimental sentences (10 per condition). All sentences were similar in length (9–15 words) and lexical and grammatical difficulty, and a Latin square design was employed to avoid experimental sentences appearing too closely together. The experimental sentences had four conditions (// indicates the break onto the next line):

(1) past adverb-past verb/ (2) *past adverb-present verb:

Ayer el profesor de violín practicó/practica el concierto en//el conservatorio de música

“Yesterday the violin professor practiced/practices the concert at//the music conservatory”

(2) past verb-past adverb/ (4) *present verb-past adverb:

El profesor de violín practicó/practica el concierto ayer en//el conservatorio de música

“The violin professor practiced/practices the concert yesterday at//the music conservatory”

Adverbs and verbs did not appear at the end of sentences to avoid wrap-up effects (Just & Carpenter, 1980), and verbs were two- to three-syllable high-frequency transitive regular verbs. Verb frequency was based on Alameda and Cuetos’s (1995) Spanish monolingual dictionary of frequencies and a Spanish textbook that all of the L2 learners had used in their basic Spanish courses; the latter was used as a frequency measure following studies showing that words selected from textbooks affect the earliest stages of L2 learning (e.g., McLaughlin, Osterhout, & Kim, 2004).

A series of repeated-measures ANOVAs with a 2 (Correctness) \times 2 (Adverb Location) \times 4 (Group) factorial design were carried out on the mean reading times (RTs) at the verb, the adverb, and the word before the verb and the adverb (there is no word before the adverb in conditions 1 and 2). Only sentences with correct responses to the comprehension questions were considered for statistics to minimize longer RTs due to lack of understanding, and fixations below 120 ms and above 1,500 ms were excluded following standard psycholinguistic procedures (Rayner & Pollatsek, 1989). The mean RTs analyzed were gaze duration (sum of all fixations on a word before moving to another word) and total time (sum of all fixations on a word before and after moving to another word; i.e., gaze duration + regression time).

The ANOVAs conducted at Verb-1 and Adverb-1 revealed no significant differences, apart from the logical between-group differences in reading speed

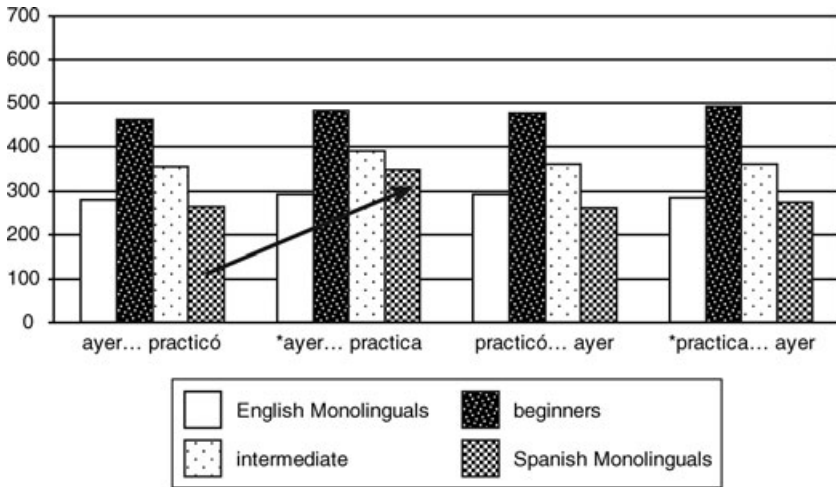


Figure 3 Group means for gaze duration on the verb. Note that English Monolinguals saw corresponding English adverbs (yesterday) and verb forms (he practiced/practices).

(beginners > intermediates > Spanish monolinguals) found also in the rest of the ANOVAs. The lack of differences between conditions implies that longer RTs at the verb or adverb in incorrect sentences were mostly due to sensitivity to grammatical incongruencies. The results of the ANOVAs conducted at Verb and Adverb were as follows (only significant differences are reported). As shown in Figures 3 and 4, Spanish monolinguals showed longer RTs at the *verb* (a) in sentences with incongruent rather than congruent adverb-verb (gaze duration, total time) and (b) in sentences with incongruent rather than congruent verb-adverb (total time).

In contrast, Figures 5 and 6 show that English monolinguals tended to show longer RTs at the *adverb* ($p = .059$) in sentences with incongruent than congruent verb-adverb (gaze duration). Additionally, both English monolinguals and intermediates showed longer RTs at the *adverb* (a) in incorrect than correct sentences regardless of adverb position (before or after verb) (total time) and (b) in sentences with incongruent adverb-verb when compared with Spanish monolinguals (total time). Thus, English monolinguals, having seen a verb in the present and upon next encountering a past tense adverb, stay at the adverb (intermediates look somewhere else and then regress to the adverb). If however, they encounter an adverb-verb disparity, they regress to the adverb (intermediates behave alike). The adverb is thus clearly their preferred cue. No

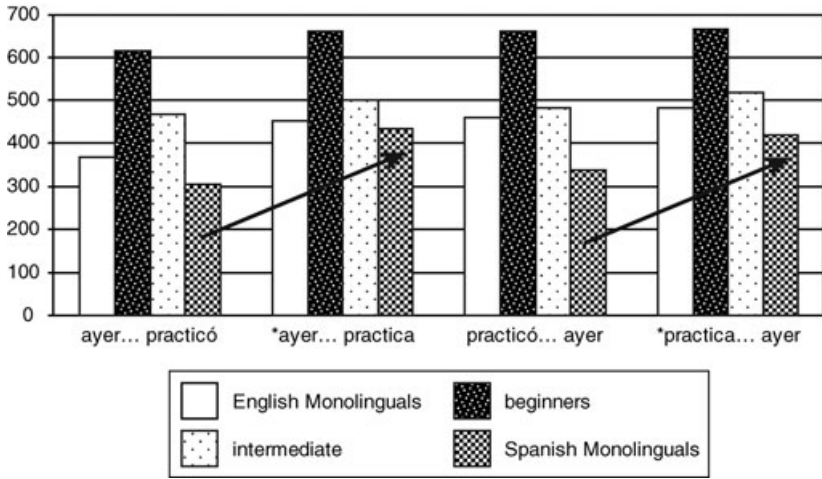


Figure 4 Group means for total time on the verb. Note that English Monolinguals saw corresponding English adverbs (yesterday) and verb forms (he practiced/practices).

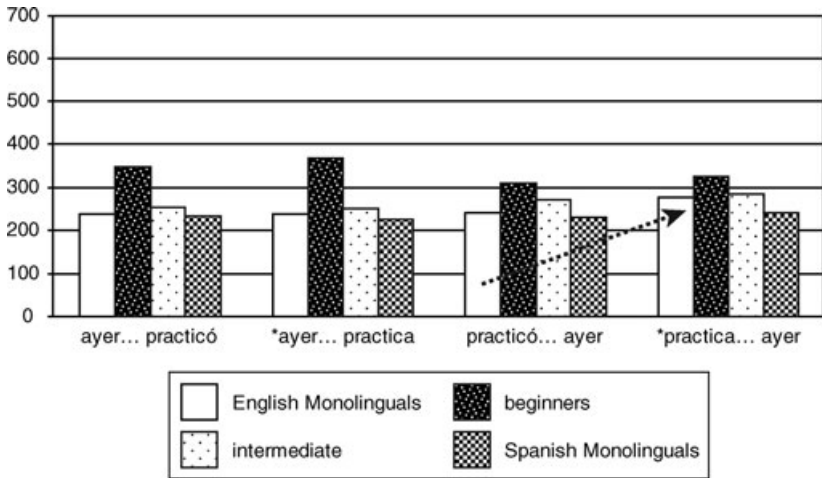


Figure 5 Group means for gaze duration on the adverb (intermittent arrow indicates $p = .059$). Note that English Monolinguals saw corresponding English adverbs (yesterday) and verb forms (he practiced/practices).

significant differences were found between beginners and intermediates in sentences with incongruent adverb-verb for total time, because the intermediates, but not the beginners, realized there was a conflict and, consequently, regressed to the adverb.

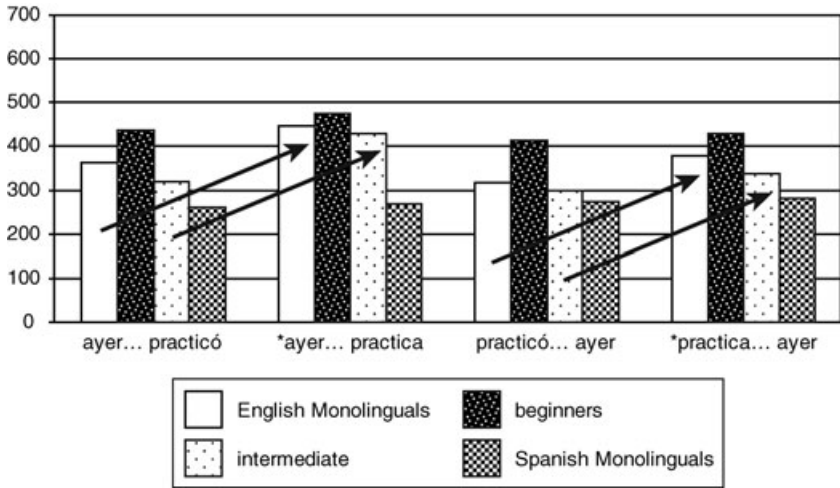


Figure 6 Group means for total time on the adverb. Note that English Monolinguals saw corresponding English adverbs (yesterday) and verb forms (he practiced/practices).

Taken together, these results suggest that native speakers of a morphologically rich language (Spanish monolinguals) rely more on morphological than lexical cues to resolve grammatical conflicts and that, contrariwise, native speakers of a morphologically impoverished language (English monolinguals and late English-Spanish learners) behave the opposite way. These findings illustrate long-term learned attention effects: L1 experience that lexical cues are simpler and more reliable in their expression than morphological ones blocks the acquisition of morphological cues in a language that more extensively uses these than lexical cues. Despite these effects of blocking, greater experience of relevant cues did result in higher levels of inflectional cue use: Also in line with associative learning theory, the intermediate students tended to regress less to the adverb than the beginners. Our future studies plan to extend the various laboratory experiments conducted with Latin to real classroom learners of various L1 backgrounds.

Discussion

These studies all examined learned attention in the acquisition of lexical and morphological cues for temporal reference by native speakers of L1s that vary in their use of inflectional morphology. We have investigated two complementary environments and time scales: a brief laboratory experiment and eight semesters

of foreign language classroom experience. Our results demonstrate short-term and long-term learned attention effects modulated by cue linguistic characteristics (cue salience and complexity), learner L1/L2 contrasts, and instructional manipulations making verbal inflections more salient through preexposure or typographical enhancement. We discuss these phenomena in turn.

Short-Term Learned Attention Effects

Study 1 (Experiment 1) and Study 2 (Experiment 1) indicated that native English speakers relied on the L2 Latin cues they had first experienced in training to resolve an adverb-verb tense conflict (i.e., the Adverb Pretraining group followed adverbial cues and the Verb Pretraining group followed verbal cues). These findings support our prediction that cues learned early in the instructional sequence block the acquisition of later experienced cues encoding the same meaning. Participants' performance on judging future time reference in Phase 3 confirms that the results are due to attentional biases to cue dimensions rather than to particular words. In Phase 1, participants in the Adverb Pretraining and Verb Pretraining groups learned constructions in the present and the past. There was no reference to future at this stage. Thus, although subsequent responses relating to past and present judgments could reflect specific prior-learned associations, responses relating to future judgments could not. Any bias in interpretation of adverb or inflectional cues to future time must have come from generalized attention to these cue dimensions, not from particular memories of specific items. As predicted, the Adverb Pretraining and Verb Pretraining groups were as unlike and dissociated in their performance on *cras* and *cogitabo* items referring to the future as they were on the other past and present reference ones.

Long-Term Learned Attention Effects

Study 1 (Experiment 2) and Study 2 (Experiment 2) illustrated long-term language transfer effects whereby the morphological richness of learners' L1 biased the acquisition of lexical and morphological cues to tense. Native speakers of Chinese (no morphology) and English (impoverished morphology) attended more to adverbs than verbs in L2 Latin (rich morphology), whereas native speakers of Russian and Spanish (rich morphology) were more sensitive to verbs. These results are especially compelling in the L1 Chinese speakers because they were already proficient in English, which must have brought to their awareness the potential productivity of inflectional cues in tense marking.

In line with the laboratory findings, the classroom experiment showed that intermediate English-Spanish and English monolinguals relied more on

adverbs than verbs to resolve tense conflicts between cues, but Spanish monolinguals preferred verbal to adverbial cues. Although these findings could be due to a general L2 trend to rely on lexical cues, the Latin data and the numerous studies showing L1 influence on the comprehension of L2 tense/aspect (e.g., Hawkins et al., 2008; Liszka, 2009; Roberts & Liszka, 2010) lead us to conclude that cues learned early in the laboratory or the L1 block the acquisition of later experienced L2 cues. Our current work comparing learners of L2 Spanish whose L1 is morphologically null (Chinese), poor (English), or rich (e.g., Rumanian) will help us strengthen our argument. Study 2 (Subsequent Experiment) indicates that this general transfer effect pertaining to L1 use of verbal inflections is complemented by a particular one where related languages (Romance Latin and Spanish) allow more focused parallel relations between the L1 and L2 (Spanish-Latin learners attended more to Latin verbal inflections than Russian-Latin learners).

Finally, because the beginning English-Spanish learners of the classroom study regressed to the adverb more often than the intermediates in sentences with an adverb-verb conflict, the results demonstrate that longer L2 exposure can allow learners to overcome their L1 cue biases.

Cue Salience and Complexity Effects

In Study 1 (Experiment 1), the Control group (L1 English) did not favor lexical over morphological cues. These learners were exposed to a simple two-word mini-language with only three adverbs and three verbs where the similarity among adverbs (*hodie, herie, crass*) was broadly the same as that among verbs (*cogito, cogitavi, cogitavo*), making them equally salient and learnable. In natural languages, however, adverbs usually differ from each other significantly more than verbs (*yesterday, today, tomorrow* vs. *I walked, I walk, I'll walk*), thus overshadowing the less salient verbal cues (Bates & Goodman, 1997; Ellis, 2006a, 2006b). When the complexity of the Latin verbal paradigms was more faithfully represented in Study 2, all Control groups favored adverbial over verbal cues, regardless of their L1 (Chinese, English, Russian, Spanish). These findings demonstrate that the more complicated the verbal inflectional paradigm, the more adult learners will rely upon salient and simple adverbial cues to time.

Instructional Effects of Preexposure and Enhancement of Morphological Cues

Study 3 revealed that verb pretraining (Experiment 1) and typographical enhancement of verb inflections (Experiment 2) increased the use of verbal

morphology in subsequent sentences in both L1 Chinese and L1 English learners of Latin. Thus, preexposure to verbal morphology (an exploitation of short-term blocking to counter long-term blocking) and salience-raising via typographical enhancement can both increase attention to morphological cues and thus promote their acquisition. The study of instructional practices such as input enhancement and feedback on error with real classroom learners (in progress) will allow us to determine whether the effects obtained in the first hour of instruction in the laboratory setting extrapolate to long-term *in vivo* classroom learning.

Conclusion

These experiments suggest that differences in success between child L1A and adult L2A reflect associative learning phenomena involving the attentional blocking of later experienced cues by earlier learned ones. Our findings reveal short- and long-term learned attention effects both in the first hour of learning in the laboratory and in the next eight semesters of foreign language learned in university classrooms. Adults tend to focus on more salient lexical cues (adverbs) during initial L2 learning. As a result of their L1 experience, they know that there are reliable and salient lexical means for expressing time (e.g., *yesterday*) that are far simpler than the nonsalient and ambiguous morphological means that vary in complex ways by person and number. These already known cues therefore tend to block the acquisition of temporal morphology.

Attention to less salient verbal inflection cues at later stages of acquisition is modulated by target language cue complexity and prior language experience: Acquisition is better in cases of cues of lesser complexity, speakers of morphologically rich native languages, and longer periods of study. Nevertheless, learners' prior attentional biases can be overcome by manipulating their current attention. As Baars (1997) put it: "Paying attention—becoming conscious of some material—seems to be the sovereign remedy for learning anything, applicable to many very different kinds of information. It is the universal solvent of the mind." Learners' difficulty in attending to morphological cues can be overcome by pedagogical interventions that make these cues nonredundant and more salient in time (verb morphology pretraining) or in space (typographical enhancement). Pretraining uses blocking to fight blocking: Long-term attentional biases from learners' L1s can be overcome by short-term blocking manipulations, which make verbal cues, in a sense, prior.

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