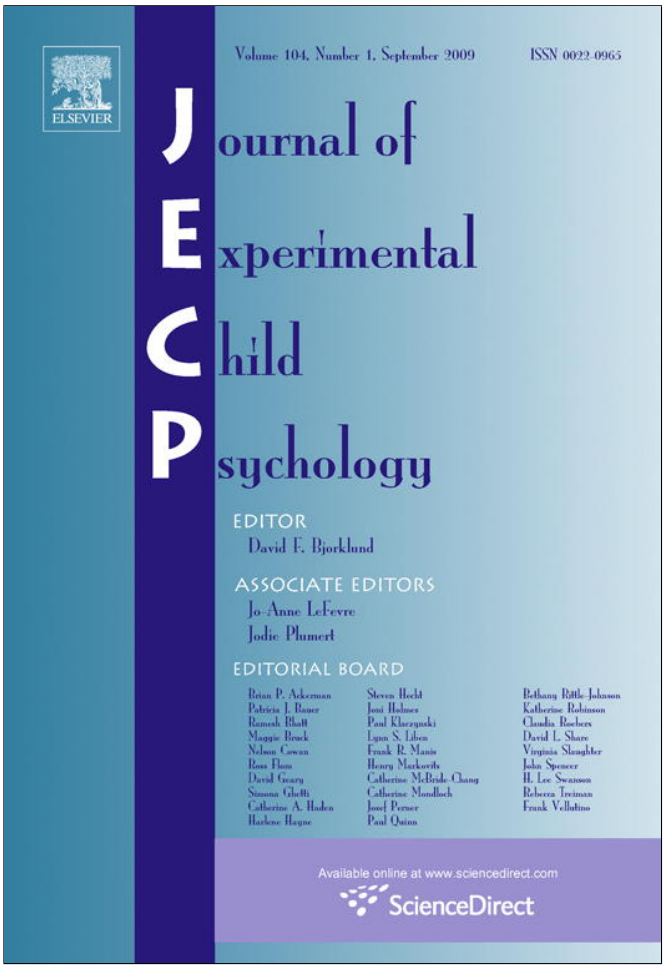

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Vocabulary teaching strategies and conceptual representations of words in L2 in children: Evidence with novice learners

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ABSTRACT

A controversial issue in bilingual research is whether in the early stages of L2 learning, access to the conceptual system involves mediation of L1 lexical representations [Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language, 33,* 149–174] or a direct route from the L2 word [Altarriba, J., & Mathis, K. M. (1997). Conceptual and lexical development in second language acquisition. *Journal of Memory and Language, 36,* 550–568; Finkbeiner, M., & Nicol, J. (2003). Semantic category effects in second language word learning. *Applied Psycholinguistics, 24,* 369–383]. The main goal of this paper is to study, in a child population, whether the creation of conceptual representations for L2 words is possible, even after only one session of learning of the L2 vocabulary. Furthermore, we do so by examining the efficacy of two different L2 learning methods: L2–L1 association learning vs. L2-picture association learning. A translation recognition task was employed to test whether there was a difference between a semantically related pair and an unrelated pair across conditions (i.e., a *semantic interference* effect). Results showed a significant semantic interference effect—a conceptual effect—in children after just one vocabulary learning session. Importantly, the L2-picture method produced a greater semantic interference effect than the L2–L1 method. The implications of these findings for models of bilingual memory are examined.

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One important and controversial issue in research on bilingualism is whether the initial learning of a second language is primarily mediated by the lexical representations of the first language (e.g., see Kroll & Linck, 2007; Kroll & Stewart, 1994; Talamas, Kroll, & Dufour, 1999), or whether it may involve direct access to the conceptual system (see Altarriba & Mathis, 1997; Finkbeiner & Nicol, 2003).

Research on adult second language (L2) acquisition suggests that, in the initial stages of L2 learning, learners have access to the conceptual system via their first language (L1). Only when the learners have a high degree of proficiency is there direct conceptual processing from L2. This is a basic idea of the influential model of Kroll and colleagues (the Revised Hierarchical Model; Kroll & Stewart, 1994; see also Kroll & Tokowicz, 2001, 2005; Sunderman & Kroll, 2006). According to this model, fluent speakers, but not novice learners, would be affected by effects at a conceptual level of processing, whereas novice learners would rely mostly on links at the lexical level. One way to tap conceptual processes with bilinguals is via a translation recognition task, in which the participant sees a word in one language followed by a word in the other language and then decides whether the second word is the correct translation of the first word. To illustrate, the participant would say "yes" after the English-Spanish pair *chair-silla* (note that *silla* is the Spanish for *chair*) and "no" after the pairs *table-silla* or *mouse-silla*. Interestingly, incorrect translations in this paradigm are of particular interest for the Revised Hierarchical Model. As stated above, this model predicts that because fluent speakers of L2 have developed strong links between the L2 lexicon and the conceptual system, they would be affected by interference at a conceptual level of processing. Thus, fluent speakers would have more difficultly rejecting the pair table-SILLA as a correct Spanish–English translation than the pair mouse-SILLA—a semantic interference effect. Indeed, Talamas et al. (1999) found that the magnitude of the semantic interference effect was substantially greater for more fluent adult bilinguals than for less fluent adult bilinguals (124 vs. 20 ms, respectively).

The issue under scrutiny in the present study is that, in the Revised Hierarchical Model, a novice learner would not be influenced by conceptual interference of L2 words because he/she would not have formed strong conceptual links between the L2 lexicon and the conceptual system. Hence, according to this model, conceptual interference would occur only for relatively fluent bilinguals (see Fig. 1). As Talamas et al. (1999) indicated, "during early stages of L2 acquisition, the salient form of interconnection between the two languages appears to be lexical; word associations between L1 and L2 mediate second language performance in tasks such as picture naming and translation" (p. 45). However, this assumption of the model has been challenged by the findings of several studies that support the idea that even learners at the earliest stages have direct access to the meaning of words in the L2 (e.g., see Altarriba & Mathis, 1997; de Groot & Poot, 1997; Frenck-Mestre & Prince, 1997, for data with adults). For instance, in a translation recognition task, Altarriba and Mathis showed that when novice adult learners learned a series of words in L2 (Spanish), they showed longer response times for English words which were semantically related to the correct translations than unrelated words—a semantic interference effect. Altarriba and Mathis (1997) concluded that "novices also encode conceptual information when learning second language words" (p. 563). Furthermore, Finkbeiner

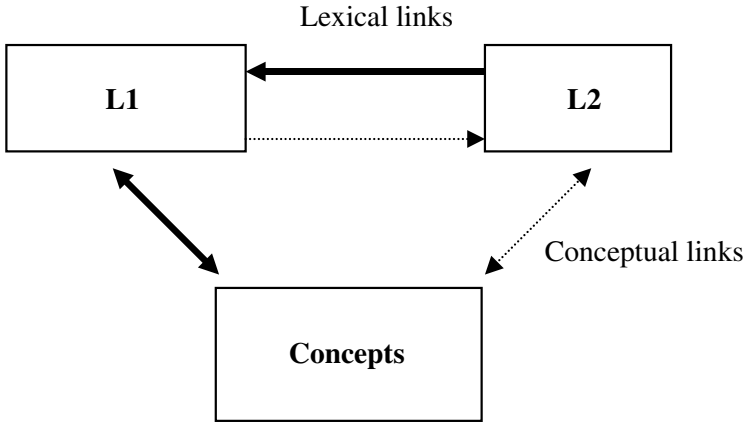

Fig. 1. Hierarchical Revised Model (adapted from Talamas et al., 1999). The thin lines represent weak links.

and Nicol (2003), see also Ferrè, Sánchez-Casas, & García, 2001) found a semantic interference effect for L2–L1 translations with incipient L2 adult learners who had learned a set of L2 words. Indeed, we should note here that in the Talamas et al. (1999) study, the magnitude of the semantic interference effect in the translation recognition task for the less fluent adult bilinguals was small and nonsignificant in the latency data (20 ms), but was rather large in the error data (an 18% semantic interference effect).

The present study had two main goals. The first aim was to examine the role of the vocabulary training paradigm in acquiring conceptual links using a semantic interference paradigm similar to that used by Altarriba and Mathis (1997). The second aim was to examine the presence of the semantic interference effect for novice learners of L2 in a child population. It is important to bear in mind that, although most of the research in the field of bilingualism in cognitive psychology involves adult populations, it is critical for the models—and for the models' educational implications—to examine the process of learning a new vocabulary in children.

Clearly, a critical issue for vocabulary learning research is whether there is a training paradigm that involves a more efficient vocabulary instruction. Unfortunately, this has been a rather neglected area in the literature of cognitive psychology, and there is scarce empirical evidence supporting a specific method of vocabulary learning (e.g., see Barcroft, 2004a, 2004b, for review; see also de Groot & van Hell, 2005; Kohnert & Kan, 2007). As Finkbeiner and Nicol (2003) suggested, the training paradigm of the new vocabulary may play an important role in creating links between the L2 words and the conceptual system. In the experiments of Altarriba and Mathis (1997), the training paradigm for novice learners of L2 had involved associating L2 words with L1 words (i.e., a word–word association method). In contrast, Finkbeiner and Nicol used a training paradigm that involved associating L2 words with pictures rather than with L1 words (i.e., a picture–word association method). As Finkbeiner and Nicol (2003) indicated, it may well be the case that "the strong lexical link between L2 words and L1 words arises when L2 vocabulary is taught via translation" (p. 379).

Indeed, there is empirical evidence supporting the important role of non-verbal stimuli (i.e., pictures) in free recall (e.g., Paivio & Csapo, 1973), in L2 processing (e.g., Kroll, Michael, & Sankaranarayanan, 1998), and across a variety of paradigms for both children (e.g., Ferro & Pressley, 1991; Peeck, 1974; Pressley, 1977) and adults (e.g., Barcroft, 2005; Craik & Lockhart, 1972; Kellogg & Howe, 1971; Underwood, 1989). Given the implications of the way the training paradigm influences the creation of early links between L2 and the conceptual system, we used two training paradigms: One consisted of associating L2 words with L1 words (i.e., via L2–L1 translations, as in the Altarriba & Mathis, 1997, experiments), and the other consisted of associating L2 words with pictures (as in the experiment reported by Finkbeiner & Nicol, 2003).

Importantly, the use of two different vocabulary training procedures also had an additional methodological goal. Talamas et al. (1999) criticized the implications of the Altarriba and Mathis (1997) methodology on the basis that participants after a single training session might show "some effects of semantic interference because the semantic distractor itself had been primed by virtue of the semantic conditions used during the training procedure" (p. 53). In the present experiments, the training conditions were exactly the *same* for the two vocabulary strategies. Thus, if there were an effect of semantic interference for, say, the L2-picture vocabulary method and not for the L2–L1 vocabulary method, this finding could not be explained by the arguments of Talamas et al. (1999). Instead, this finding would suggest that second language learners with the "L2-pictures" method create conceptual links between L2 and the conceptual system. Furthermore, the presence of a semantic interference effect that varies across the training paradigms would be evidence against any potential limitations of the translation recognition task as a "conceptual" task—the reason being that the task remains constant and it is only the vocabulary training method that is manipulated.

With respect to the second goal of the present study, second language research with children has been a rather neglected area in cognitive psychology and psycholinguistics (e.g., see Paradis, 2007). The majority of recent psycholinguistic theories relate to adult processing. As Francis (2005) indicated, most second language research with children "shed virtually no light on the cognitive processes underlying the observed effects" (p. 262). When we consider the literature on bilingual children, there are only a limited number of studies examining the conceptual processing of L2—most of this research has focused on orthographic and phonological processing (e.g., Comesaña & Fraga, 2006; Fraga,

Comesaña, Franco-Grela, & Teijido, 2002; Zhong, McMride-Chang, & Ho, 2002), lexical processing (e.g., van der Linden, 2001), and syntactic processing (e.g., Müller & Hulk, 2001). However, the recent developments in neuroscience, especially those using neuroimaging techniques, have revealed important differences in the brain between individuals who acquired two languages when they were children and those individuals who learned a second language as adults. For instance, there is evidence that suggests that the children have just one cerebral area to store and interpret the two languages, whereas adult learners of a second language have a different area for each language (e.g., see Kim, Relkin, Lee, & Hirsch, 1997), and there is also evidence that classroom learning of L2 affects the functions of precortical cortex (see Sakai, 2005). As Paradis (2007) indicated, "understanding child SLA [Second Language Acquisition] is crucial to developing a complete understanding of children language development in the school years because dual language children are the majority globally" (p. 401). Thus, data comparing children and adults who were starting to learn a second language are of prime importance to understand the conceptual and lexical development of an L2.

Experiment 1 examined the semantic interference effect in a translation recognition task with highly fluent Basque–Spanish bilingual children from the Basque Autonomous Community in Spain. The Basque language is an ancient pre-Indo-European language with no demonstrable genetic relationship with other living languages. Basque has—as Spanish—a very transparent orthography with only five vowel sounds (see Perea, Duñabeitia, & Carreiras, 2008). None of the experimental words were cognates (e.g., the Basque for "silla"—*chair*—is "mahaia"). To anticipate the results, we obtained a semantic interference effect, thus generalizing the effect to a child population. In Experiment 2, Spanish-speaking children with no prior knowledge of Basque had to learn a set of 36 Basque words. (This set of items was the same as that in Experiment 1.) If L2 words have early access to conceptual representations, response times to semantically related foils in a translation recognition task should be longer (and/or percentage of error higher) than response times to unrelated words (i.e., a pattern of conceptual interference; see Altarriba & Mathis, 1997). But the most important feature of Experiment 2 was that, to examine the effect of the vocabulary learning method on the semantic interference effect, we employed two training paradigms: half of the participants learned a set of Basque–Spanish translations (L2–L1 pairs), whereas the other half learned a set of L2 words via the pictures of their corresponding concepts (i.e., each word was associated with a picture, and individuals were *not* presented words in L1). The rationale was that links between L2 and the semantic system would be more fully developed and/or the access to the conceptual system would be easier when participants learned the L2 on the basis of L2-picture pairs than on the basis of L2–L1 pairs (see Finkbeiner & Nicol, 2003; Wimer & Lambert, 1959). Furthermore, to assess the stability across time of the effect of the vocabulary training method, we tested the children both immediately and after one week of the training session (see also de Groot & Keijzer, 2000, for a similar approach).

Experiment 1

Method

Participants

Fifty-seven sixth grade Basque–Spanish bilinguals (of ages 10–11) from Durango (Basque Autonomous Community, Spain) participated in the experiment. For all of them, Basque was the teaching language at all academic levels. All the participants completed a questionnaire to assess their usage of Basque (adapted from Weber-Fox & Neville, 1996). This questionnaire included questions regarding the frequency of usage of each of the two official languages in the Basque Country, Basque and Spanish. On a 1–5 Likert scale, the participants rated the regularity with which they used each language in the family and in other contexts. Despite the fact that the teaching language was Basque, the ratings of use frequency of Spanish were slightly higher than of Basque (4.0 vs. 3.5, respectively).

Stimuli

We selected thirty six common Basque nouns from the EuskalHitzak (*E-Hitz*) database (Perea et al., 2006). Each Basque word was paired with three types of Spanish words: the correct Spanish transla-

tion, a semantically similar Spanish word, or an unrelated Spanish word. Words in the semantically related condition were chosen from the Spanish association norms of the Snodgrass and Vanderwart pictures collected by Fernández, Díez, Alonso, and Beato (2004). For instance, the Basque word *AULKIA* was paired with *SILLA* (the correct Spanish translation; *chair* in English) or *MESA* (a semantically related Spanish word, *table* in English). The unrelated words were matched to the semantically related words in both length and word frequency (using the Spanish word count, *B-Pal*; Davis & Perea, 2005). All the translations were non-cognates. Matching was done on a pair-by-pair basis—on the basis of length and word frequency. The mean word length and word frequency (per million) for the unrelated words were 5.0 and 79.2, respectively, the corresponding means for the semantically related words were 5.0 and 78.0. The concreteness values of the target words, the semantically related words, and the unrelated words were 5.9, 5.7, and 5.6, respectively, (on a 1–7 scale; Davis & Perea, 2005). The stimuli are presented in the Appendix.

The word pairs were counterbalanced across three experimental lists, so that a given pair appeared in only one condition in each list. That is, each list consisted of 9 translation pairs, 9 semantically related word pairs, and 9 unrelated word pairs. The remaining 9 word pairs were used as practice trials, specifically, 3 translation pairs, 3 semantically related word pairs, and 3 unrelated word pairs. The practice list was the same for all participants. Note that the present design mimicked the design used by Altarriba and Mathis (1997). The difference was the fact that from the 36 trials, Altarriba and Mathis used only 6 practice trials and 30 experimental trials, whereas we employ 9 practice trials and 27 experimental trials. We increased the number of practice trials slightly to have more stable data points on the experimental trials.

Procedure

Participants were tested individually in a quiet room. Presentation of the stimuli and recording of response times were controlled by a PC computer. The program was created using the SuperLab software. On each trial, a fixation point (+) was presented for 1000 ms in the center of the screen. A Basque word appeared for 250 ms, and it was immediately replaced by a Spanish word until the participant's response. Participants were told that pairs of correct/incorrect Basque/Spanish translations would be displayed on the monitor in front of them, and that they should press one of two buttons to indicate whether each pair was a correct translation or not, responding as rapidly as possible while maintaining a reasonable level of accuracy. Stimuli were presented in lower case. As indicated above, each participant received a total of 9 practice trials prior to the 27 experimental trials.

Results and discussion

Incorrect responses were excluded from the latency analysis. The data from three participants were discarded from the analyses because two participants did not have any data in one of the conditions and a third participant showed extreme response times (over 3 s). Therefore, the final sample was composed of 54 children. Participant ($F1$) and item ($F2$) analyses of variance (ANOVAs) based on the subjects' and items' median response latencies and percentage error were conducted based on a 2 (Prime-target relation: semantically related vs. unrelated) $\times$ 3 (List: list 1, list 2, list 3) design.[1] The dummy factor List was included in the analyses to exclude the variance due to the lists (Pollatsek & Well, 1995). We did not include the "translation" condition into the analyses, since the critical comparison was the presence of a semantic interference effect (i.e., the difference between the semantically related foils and the unrelated words), and because these two condition had the same response ("no").

The ANOVA on the latency data showed that responses to semantically related words were slower than the responses to unrelated words (1633 vs. 1560 ms, respectively), although this effect only occurred in the analysis by subjects, $F1(1,51) = 4.6$, $p < .04$, $\eta^2 = .08$; $F2(1,27) < 1$, $p > .15$, $\eta^2 = .02$. The AN-

[1] For the analyses of the latency data, we chose the median (and not the mean) response time per subject and condition. The reason is that there is both theoretical (Ratcliff, 1993) and empirical evidence that shows that the median is a more robust choice than the arithmetic mean when dealing with distributions with extreme response times (e.g., see Acha & Perea, 2008, and Duñabeitia & Vidal-Abarca, 2008, for recent examples of the use of the median with beginning/intermediate readers). In any case, the overall pattern of response time data was essentially the same using medians and means.

OVA on the error data showed that participants made more errors on semantically related words than on unrelated words (14.2% vs. 7.4%, respectively), $F1(1,51) = 11.1$, $p < .002$, $\eta^2 = .17$; $F2(1,27) = 5.4$, $p < .03$, $\eta^2 = .18$. The mean response time and error percent for the correct translation condition was 1243 ms and 7.4%, respectively.

The results of the present experiment are straightforward: In a translation recognition task, highly fluent bilingual children responded more slowly, and made more errors, to semantically related foils than to unrelated words. The results replicate the findings of Altarriba and Mathis (1997), Talamas et al. (1999), and Sunderman and Kroll (2006) with highly fluent (adult) bilinguals.

The question now is whether semantic interference can be obtained with novice learners of an L2, and whether this effect is modulated by the word training paradigm (L2-pictures vs. L2–L1 associations). This is the aim of Experiment 2. Furthermore, we also examined whether the training vocabulary had differential effects in an immediate and a delayed test. The rationale was the advantage of using non-verbal materials (i.e., pictures) in free recall (e.g., Paivio & Csapo, 1973), in the processing of L2 (e.g., Adepoju & Elliot, 1997; Kroll et al., 1998), in children's learning (e.g., Ferro & Pressley, 1991; Peeck, 1974; Pressley, 1977), and in the likeliness of establishing relationships between form and meaning (Barcroft, 2005). For instance, a recent study by Jones (2004), in the context of multimedia learning, showed that the type of information available (pictures, words) had an effect in a delayed testing condition but not in an immediate testing condition. Accordingly, we believe that adding a temporal lag between learning and test may maximize the effect of the vocabulary training method. In sum, participants underwent an immediate test (as in Experiment 1) and, one week later, they underwent a delayed test.

Experiment 2

Method

Participants

Forty-eight sixth grade students (of ages 10–11) from public schools in Baiona and Vigo (Galicia, Spain) took part in the experiment. All were native speakers of Spanish with no previous knowledge of Basque. Although all the participants had Spanish as their L1, in most cases they were also proficient in Galician. (Galician is a Romance language which is an official language—with Spanish—in the Galician Autonomous Community.) Likewise, most of them had taken English in school. The children were assigned randomly to the L2–L1 group or to the L2-picture group (24 children in each group).

Table 1
Sample test used during the acquisition phase in Experiment 2

Please, let me know the Spanish words which correspond to the newly learned Basque words		
hegazkina	orrazia	zuhaitza
aulkia	ilargia	gerrikoa
giltza	edalontzia	gezia
txakurra	erlea	gazta
zubia	sugea	beribila
sagarra	arraina	arrautza
artaziak	kutxa	ispilua
alkandara	olagarroa	urtxintxa
sagua	gutuna	kapela
sardexka	leihoa	txoria
behia	eliza	ohea
suziria	eskua	marrubia

Table 2
Mean translation recognition times (in ms), standard deviations (in parentheses), and percentage of errors in Experiment 2

		Type of relation			
		Translation	Sem.related	Unrelated	Interference
Teaching method					
L2–L1 assoc.—immediate	RT	1289 (352)	1344 (416)	1357 (367)	13
	%E	6.9 (8.6)	5.1 (9.8)	4.6 (8.0)	−0.5
L2–L1 assoc.—delayed	RT	1102 (312)	1124 (319)	1077 (336)	−47
	%E	20.4 (12.1)	5.6 (8.0)	4.6 (9.2)	−1.0
L2-Picture assoc.—immediate	RT	1258 (243)	1333 (316)	1279 (314)	−54
	%E	6.9 (10.8)	3.7 (7.8)	5.1 (8.0)	1.4
L2-Picture assoc.—delayed	RT	1157 (347)	1233 (304)	1073 (218)	−160
	%E	14.8 (13.8)	13.4 (16.0)	6.0 (11.0)	−7.4

Note. Interference refers to the difference between the Unrelated condition and the Semantically related condition.

Stimuli

They were the same as in Experiment 1.

Procedure

Participants were tested in a quiet room individually. For the initial test, the experiment was composed of two phases. The first portion of the experiment was the acquisition phase. Half of the participants were presented with four sheets of paper; each of them had nine Basque words and their corresponding Spanish translations, and the other half of the participants were presented with four sheets of paper; each of them had nine Basque words and their corresponding pictures (i.e., no Spanish words were presented in the acquisition phase for this group of participants). For the L2–L1 group, the experimenter read each pair of words four times (or, in the picture-L2 group, the experimenter read the Basque words four times). After the four sets of nine words had been presented, the experimenter read the 36 Basque words again. Once the set of Basque words had been learned, the children took a vocabulary test which consisted of translating a set of Basque words, which was the same for the L2–L1 and picture-L2 groups (see Table 1).[2]

The words were presented in blocks of nine words. During the translation test, the experimenter corrected any errors and again went through the list of words. The criterion to pass Phase 1 was a score of 85% or better in a maximum time of 60 min. The total time spent in Phase 1 was the same for the children in the L2–L1 and picture-L2 groups (50 min, on average). Only the data from those participants who scored 85% or better on the overall test were included in the analyses. Six children in the L2–L1 group and four children in the picture-L2 group did not pass the 85% accuracy criterion; all these individuals were replaced by new participants. It is important to note that the percentage of accuracy was virtually the same for the children in the L2–L1 and picture-L2 groups (92 vs. 93%, respectively, $p > .80$).

The second phase of the experiment was the test phase, and it started 10 min after the first phase had concluded. This second phase was exactly the same as the Procedure phase in Experiment 1. That is, on each trial, a fixation point (+) was presented for 1000 ms in the center of the screen. A Basque word appeared for 250 ms, and it was immediately replaced by a Spanish word until the participant's response. Participants were told that pairs of correct/incorrect Basque/Spanish translations would be displayed on the monitor in front of them, and that they should press one of two buttons to indicate whether each pair was a correct translation or not, responding as rapidly as possible while maintaining a reasonable level of accuracy. Stimuli were presented in lower case. Each participant received a total of nine practice trials prior to the 27 experimental trials.

[2] To maximize the differences between the two training methods, we chose not to use the written quizzes employed by Altarriba and Mathis (1997) (Note that the presence of these written quizzes would have made more similar Phase 1 in the L2–L1 and picture-L2 methods.).

Results and discussion

Incorrect responses were excluded from the latency analysis. Participant ($F1$) and item ($F2$) analyses of variance (ANOVAs) based on the subjects' and items' median response latencies and percentage error were conducted based on a 2 (Prime-target relation: semantically related vs. unrelated) × 2 (Training method: L2–L1 associations, L2-pictures associations) × 2 (Time of test: immediate, delayed) × 3 (List: list 1, list 2, list 3) design. The mean latencies for correct responses and the percent error are presented in Table 2.

The ANOVA on the latency data showed that responses to semantically related pairs were slower than the responses to unrelated pairs, $F1(1,42) = 6.7$, $p < .015$, $\eta^2 = .13$; $F2(1,24) = 5.9$, $p < .025$, $\eta^2 = .19$, and that response times were faster in the immediate test than in the delayed test, $F1(1,42) = 56.4$, $p < .001$, $\eta^2 = .57$; $F2(1,24) = 53.7$, $p < .001$, $\eta^2 = .69$. The interaction between Training method and Time of test was significant in the analysis by items, $F1(1,42) = 3.3$, $p = .07$, $\eta^2 = .07$; $F2(1,24) = 4.9$, $p < .04$, $\eta^2 = .17$. More important, the interaction between Prime-target relationship and Training method was significant in the analysis by items, $F1(1,42) = 3.5$, $p = .06$, $\eta^2 = .07$; $F2(1,24) = 4.4$, $p < .05$ $\eta^2 = .14$. This interaction reflected a semantic interference effect in the picture-L2 group, $F1(1,21)=6.9$, $p < .02$, $\eta^2 = .24$; $F2$ $(1,24) = 8.4$, $p < .01$, $\eta^2 = .25$, but not in the L2–L1 group, $F1(1,21) < 1$, $p > .25$, $\eta^2 = .02$; $F2(1,24) = 1.6$, $p > .25$, $\eta^2 = .06$.

The ANOVA on the error data showed that participants made more errors to semantically related pairs than to unrelated pairs in the analysis by subjects, $F1(1,42) = 4.1$, $p < .05$, $\eta^2 = .08$; $F2(1,24) = 2.1$, $p = .15$, $\eta^2 = .08$, and that participants made more errors on the delayed test than on the immediate test, $F1(1,42) = 4.1$, $p < .05$, $\eta^2 = .08$; $F2(1,24) = 8.7$, $p < .01$, $\eta^2 = .26$. The interaction between Prime-target relationship and Time of test was significant in the analysis by subjects, $F1(1,42) = 5.4$, $p < .025$, $\eta^2 = .11$, $F2(1,24) = 2.4$, $p = .13$, $\eta^2 = .09$. More important, the three-way interaction between Prime-target relationship, Time of test, and Training method was significant, $F1(1,42) = 4.4$, $p < .05$, $\eta^2 = .09$; $F2(1,24)=4.5$, $p < .05$, $\eta^2 = .15$. That is, the interaction between Prime-target relationship and Time of test varied along the two Training methods. To examine this interaction in depth, we separately examined the L2-pictures Group and the L2–L1 Group. For the L2-pictures Group, the interaction between Time of test and Prime-target relationship was significant, $F1(1,21) = 9.2$, $p < .01$, $\eta^2 = .30$; $F2(1,24) = 6.9$, $p < .02$, $\eta^2 = .22$: there was a semantic interference effect for the delayed test, $F1(1,21) = 9.7$, $p < .01$, $\eta^2 = .31$; $F2(1,24) = 8.5$, $p < .01$, $\eta^2 = .26$, but not in the immediate test, both Fs < 1, both $\eta^2 = .02$. For the L2–L1 translation Group, we failed to find any significant effects.

The results of the present experiment are clear. As was the case with highly fluent bilinguals (Experiment 1), children who were novice learners of a new L2 responded more slowly, and made more errors, to semantically related foils than to unrelated words in a translation recognition task. More importantly, even though the overall performance was similar for the L2–L1 and picture-L2 groups, the training method had an impact on the magnitude of the semantic interference effect—the effect being present only for the picture-L2 group.

General discussion

The main findings of the present experiments can be summarized as follows. First, the semantic interference effect in a translation recognition task (Altarriba & Mathis, 1997; Talamas et al., 1999) can be easily replicated in a population of children with no previous knowledge of L2. These data are consistent with the view that the lexical representation of the L1 does not always mediate vocabulary acquisition of a new L2, this time with primary school children. Second, the choice of a vocabulary learning method (the L2-picture method vs. the L2–L1 pairing method) plays a key role in eliciting a semantic interference effect, with a greater effect for the L2-picture method and a nonsignificant effect for the L2–L1 method. (Note that this was the case even when the *overall* performance was very similar with the two vocabulary training methods.) This suggests that conceptual mediation is—to some degree—dependent on the vocabulary training method. That is, the connections between L2 words and the conceptual system may be a function of the way the words have been learned.

As indicated in the Introduction, the goal of the present experiments was to examine the semantic interference effect in Spanish children after just one vocabulary learning session in a completely new L2 (Basque). More specifically, our goals were to investigate: (i) whether the results from other authors (Altarriba & Mathis, 1997; Chen, 1990; Ferrè et al., 2001) concerning the creation of conceptual connections in the early stages of the acquisition of a new language could be generalized to children, and (ii) whether the vocabulary training method plays a role at establishing these conceptual connections. Based on the observed findings, the answer to these two questions is "yes".

In Experiment 2, we studied the performance of children who were native speakers of Spanish (L1) and with no prior knowledge of Basque. They were taught Basque vocabulary (in just one session) using two different learning methods: the word association method (L2 words with L1 words) and the word-picture method (L2 words with pictures) (Experiment 2). We found a significant semantic interference effect in the word–picture method Group. Importantly, the presence of a semantic interference effect with children is consistent with the idea of a similar development of semantic processing of newly learned words regardless of age. Thus, models of bilingual memory should echo the presence of early links from L2 to the conceptual level (see also Finkbeiner & Nicol, 2003, for a similar view). Although one might argue that the semantic interference comes after L1 forms have been activated, this reasoning cannot explain the interaction between Semantic interference and Training Method obtained in Experiment 2—note that, if anything, this explanation would predict a greater interference effect in the L2–L1 association group.

As reviewed in the Introduction, the vocabulary training paradigm—at least for adults—is a factor that modulates the type of links that are created in the initial stages of L2 learning (Kroll et al., 1998; see also Chen, 1990; Lotto & de Groot, 1998; Pressley, 1977). Indeed, several authors proposed that the use of pictures is a better method to learn the new vocabulary than an L2–L1 translation (e.g., Barcroft, 2002; Wimer & Lambert, 1959). However, the advantage of the picture–word association method with an adult population has not always been consistent (see Lotto & de Groot, 1998). As de Groot and van Hell (2005) suggested, the apparent divergences may be due to the fact that in the Lotto and de Groot study, they used experienced foreign language learners—unlike, for instance, the Wimer and Lambert study. The present findings stress the importance of the choice of the vocabulary training paradigm for children: Even though the *overall* performance (in terms of response times and error rates) was very similar in the L2–L1 and in the picture-L2 groups (i.e., the children had correctly learned the L2 words with the two methods), the semantic interference effect (i.e., the conceptual effect) only occurred for the picture-L2 group. This strongly suggests that, unlike the participants in the picture-L2 group, the children in the L2–L1 group did not have initial access to the conceptual system.

Interestingly, the semantic interference effect had a greater effect in a delayed testing condition than in an immediate testing condition, which extends the findings of Jones (2004) in the context of multimedia learning. Thus, the present findings suggest that conceptual information from recently learned words may be enhanced in long-term memory (i.e., the L2 words are more likely to activate their "semantic neighbors" in the conceptual system). We should indicate here that, in a sample of college students, Altarriba and Mathis (1997) found a semantic interference effect with the L2–L1 training method in an immediate test. In contrast, we failed to obtain a semantic interference effect with the L2–L1 training method in an immediate test with six-grade children. This difference is probably due to the fact that in the Altarriba and Mathis (1997) experiments, participants performed a series of written matching tests, a sentence completion task, and a definition task before engaging in the translation recognition task. Note that all these tasks probably reinforced conceptual links. Indeed, Comesaña (2007) conducted an experiment with six-grade children with exactly the same procedure as Altarriba and Mathis (1997), and found a significant semantic interference effect with the L2–L1 training method in an immediate test. Future research should examine in greater detail how the lexical/conceptual system changes with time. We must keep in mind that the ultimate goal of a vocabulary training program is not temporary but permanent storage of the new vocabulary (see de Groot & Keijzer, 2000). Therefore, it is critical to examine how the processes underlying the production/recognition of L2 words in novice learners change with time.

What are the implications of the present data for the Revised Hierarchical Model? In this model, non-fluent L2 learners start off the acquisition process by relying on their knowledge of L1 and, as they become more proficient, they access conceptual representations directly, presumably in the same way as monolinguals. In contrast, the present findings support the view that novices encode conceptual information when learning second language words (see Altarriba & Mathis, 1997; Ferrè, Sánchez-Casas, & Guasch, 2006; Finkbeiner & Nicol, 2003, for a similar suggestion). As such, the present data are somewhat problematic for the Revised Hierarchical Model (Kroll & Stewart, 1994; Kroll & Tokowicz, 2001, 2005). Furthermore, there is empirical evidence that shows a Stroop effect in novice learners of an L2 (e.g., Altarriba & Mathis, 1997; Ferrè et al., 2006), which again suggests that connections between L2 and the conceptual level could be established even at the very early stages of L2 acquisition. Nonetheless, as Kroll and Tokowicz (2005), see also Kroll & Linck, 2007) acknowledged, the presence of robust semantic interference effect with novice learners of L2 demonstrates "the capabilities of the language learning situation under unique circumstances—when a small number of items are learned with extensive training, the results mimic those of proficient bilinguals. This finding provides evidence that individual items can become conceptually mediated" (p. 540).

We acknowledge that the experimental paradigm employed in the present experiments (cf. Altarriba & Mathis, 1997)—as in *any* other paradigm—is not free from shortcomings. As Kroll and Tokowicz (2005) pointed out, it remains to be seen if the present results (or the results of Altarriba & Mathis, 1997, and Finkbeiner & Nicol, 2003) can be obtained in a more typical learning situation (i.e., using more word pairs studied over a longer period of time). We must keep in mind that lexical development in the second language may be quite different from lexical development in the first language (see Perea et al., 2008). Nonetheless, the empirical evidence suggests that the obtained findings may occur beyond the specific constraints of a single-session of learning. For instance, in a recent series of experiments, Comesaña, Perea, and Fraga (2005) found semantic interference effects with Spanish children and adults with low fluency level in L2 (English), which again seems to suggest that learners of L2 encode conceptual information. Likewise, in a developmental study, Fraga, Comesaña, and Perea (2006) found that the semantic interference effect in Spanish-speaking children learning English as a second language showed the magnitude of the effect of semantic interference increased with the proficiency of L2 (extending the findings of Talamas et al., 1999). Clearly, to further generalize these findings, it would be important to employ a task that does not require explicit translation (e.g., using an event-related brain potential technique; see Alvarez, Holcomb, & Grainger, 2003, for evidence with beginning bilinguals).

To sum up, the present study has shown that the initial learning of a second language may involve early access to the conceptual system for children—using a translation recognition paradigm. Furthermore, the choice of a vocabulary training method had an impact on the magnitude of the "conceptual" effect: the semantic interference effect was greater—and more stable in time—when the teaching method was based on picture-L2 associations than when the teaching method was based on lexical associations (see Barcroft, 2002, 2004b, 2005; de Groot & van Hell, 2005, for a discussion of vocabulary learning methods). Furthermore, we have also shown that it is important to test L2 learning in different moments in time—here it was tested immediately after initial learning and one week later (see Jones, 2004, for a similar point). Further research, possibly using a longer training procedure in a more realistic environment (e.g., use of orthography, phonology, morphology, and syntax) or manipulating lexical variables such as word frequency or age of acquisition, is needed to shed more light on how children learn new words in L2.

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Appendix *Experimental. prime-targets pairs in Experiments 1–2*

The items are arranged in quadruplets in the following order: L1 word, L1 associate, unrelated control, and L2 word.

flecha, arco, beso, gezia; vaso, agua, país, edalontzia; avión, alas, barba, hegazkina; árbol, hojas, hielo, zuhaitza; silla, mesa, niño, aulkia; cinturón, pantalón, párpados, gerrikoa; llave, puerta, cuerpo, giltza; peine, pelo, jefe, orrazia; luna, sol, rey, ilargia; perro, ladrar, pincel, txakurra; huevo, gallina, anillo, arrautza; manzana, pera, rana, sagarra; abeja, miel, rayo, erlea; puente, río, oro, zubia; queso, cabra, cañón, gazta; serpiente, veneno, helado, sugea; pez, mar, pie, arraina; coche, rueda, sudor, beribila; mano, dedo, isla, eskua; tenedor, cuchara, sordera, sardexka; cama, dormir, región, ohea; fresa, nata, joya, marrubia; ventana, cristal, deporte, leihoa; pájaro, jaula, bruja, txoria; iglesia, misa, caza, eliza; cohete, espacio, estudio, suziria; vaca, leche, línea, behia.

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