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Emotional nouns affect attachment decisions in sentence completion tasks

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Short title: Emotional nouns and attachment decisions

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Abstract

We report three sentence completion studies in which we manipulate the emotional dimension of the nouns in a complex noun phrase (NP) which precedes a relative clause (RC), as in the classic ambiguity in *Someone shot the servant of the actress who was on the balcony*. The aim was to see if nouns such as *orgy* or *genocide* affect the well-established preference of Spanish to adjoin the relative clause high in the tree (to *servant* instead of *actress* in the example above). We manipulated the valence and arousal of the lexical entities residing in the NP. Our results indicate that: a) the inclusion of either pleasant or unpleasant words induces changes in the usual NP1 preference found in Spanish; b) the effects of high arousal words are specially clear, in that they pull RC adjunction towards the NP where they are located, be it the NP1 or the NP2; and c) in the context of sentence production, these kinds of words seem intense enough to promote changes in (and even reverse) a solid syntactic bias. We discuss these findings in the light of existing theories of syntactic ambiguity resolution.

Keywords: Syntactic ambiguity, relative clauses, sentence completion task, emotional words.

Author's note

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INTRODUCTION

Ordinary language use involves the interaction of principles and biases that exceeds by far, both in number and complexity, the ideally simple architectures designed in the last decades of the last century, and mere common sense. Most modern researchers still view grammar as the by-station between thought and sound, but the interaction between grammar and the cognitive routines that implement actual language use is now seen to be extremely intricate. One of the basic ideas that recent research has had to re-evaluate is that of the locality of syntactic operations. When thoughts become language, they must be linearised, so in principle it makes sense to expect something akin to Kimball's (1973) *principle of right association* to be basically correct (hence Frazier's (1979) and Frazier & Rayner's (1982) idea of a *late closure* preference for phrasal packaging). Intuitively, locality is certainly very strong in language: in *John said that Eve will come yesterday*, it is almost impossible to avoid the garden path precisely because of the reflex that forces us to bind the adverbial *yesterday* to the most recent predication (*will come*) instead of to the distant one (*said*). Here we intend to focus on the attachment of relative clause (RC) modifiers to adjacent or non-adjacent head nouns, as such clauses may be ambiguous in their attachment preferences. We intend to subject such adjunction operations, which are, in principle, formal in nature, to a rather extraneous kind of interference: the emotional dimension of the nouns to which the relative clause modifier must be attached.

In a sentence like (1) below, it is impossible to know for certain who was given the award, as the RC can attach locally to NP2 *the doctor* but also non-locally to NP1 *the daughter*:

(1) I once met the daughter of the doctor who was given the award.

Till Cuetos & Mitchell (1988), it was merely assumed that the processing system would favour the local adjunction on grounds of computational economy. When the Anglo-Spanish team showed that Spanish behaved in the opposite way (by preferring the non-local tie), psycholinguists were surprised. Only a review article can do justice to the research done on RC attachment ambiguities since then. This research took two directions: first, it increased the number of languages where RCs after complex NPs (i.e. NPs made up of two nouns instead of just one) were experimentally tested. In the second place, new processing parameters (besides recency) emerged and were closely examined.

As far as the cross-linguistic dimension goes, Spanish has generally corroborated the initial NP1 bias ([Carreiras, 1992](#); [Carreiras & Clifton, 1993, 1999](#); [Cuetos, Mitchell & Corley, 1996](#)), and so has French ([Frenck-Mestre & Pynte, 1997](#); [Zagar, Pynte & Rativeau, 1997](#)), European Portuguese (Soares, Fraga, Comesaña, & Piñeiro, 2010), German (Hemforth, Konieczny, Scheepers, & Strube, 1998), and Dutch ([Brybaert & Mitchell, 1996](#)). Some more recent results have suggested a local (NP2) adjunction preference in Arabic, Romanian, Swedish and Norwegian (Abdelgany & Fodor, 1999; Ehrlich, Fernández, Fodor, Stenshoel, & Vinereanu, 1999). The fact is that there is no consensus on the RC attachment problem in the crosslinguistic literature, although the evidence is stronger for the anti-local pattern of adjunction, irrespective of language type. Given the sound logic of *right association* (late closure), if anything the opposite trend would have been more predictable.

Research on relative clauses also led to the discovery of hidden processing parameters. Prosody was an obvious one to study (Fernández & Bradley, 2004; Fodor, 1998, 2002; [Gilboy & Sopena, 1996](#); Lovrić, Bradley, & Fodor, 2000). In turn, prosody has to do with the size of the modifying clause relative to the host NP. This was also seen to interact with recent work on memory ([Swets, Desmet, Hambrick, & Ferreira, 2007](#)). Additionally, [Gilboy, Sopena, Clifton, & Frazier \(1995\)](#) tested the role of the preposition bridging the two NPs and managed to show that when the theta-marking (i.e., predicative) properties of the preposition were controlled, English and Spanish basically aligned their choices. Taking a different line, a lexical frequency line, [Pynte & Colonna \(2001\)](#) have shown that when NP1 is of lower frequency than NP2, French readers prefer to attach the RC non-locally. By contrast, when NP2 is less frequent than NP1, NP2 is the most likely host for the modifying clause. Still exploiting the lexical dimension, [Gibson, Pearlmutter & Torrens \(1999\)](#) showed that the very same noun could attract RCs more or less depending on the other words it co-occurred with, even while keeping its own position constant. [Deevy \(2000\)](#) showed that when the second NP is plural (*the niece of the actors who ...*), attachment to that noun was increased. Plurals have also been shown to attract adjunction of the RC in corpus studies of Dutch ([De Baecke, Brysbaert, & Desmet, 2000](#)) and Galician ([García-Orza, Fraga, Teijido, & Acuña-Fariña, 2000](#)). [Hemforth, Konieczny, & Scheepers \(2000a\)](#) and [Hemforth, Konieczny, Seelig, & Walter \(2000b\)](#) observe that complex noun phrases followed by RCs must also be seen as a process of anaphor resolution, and that the anaphoric binding of the relative pronoun is open to manipulations of both focus and visibility (in English, but not in Spanish for instance, the pronoun can often be dropped). This is not a comprehensive survey, but the mere consideration of how the interaction of locality, prosody, preposition type, attachee size, lexical bias, lexical frequency, information

focus, contextual referentiality and grammatical number might actually work in actual comprehension and production surely serves to illustrate how complex the issue of modifier attachment has become.

The impact of some of the above cited factors in RC attachment shows interference of non-syntactic forces upon syntactic operations like adjunction (e.g., lexical frequency, grammatical number). Work over the past few years on the animacy of NPs has constituted one of the strongest pieces of evidence for interference of semantics in RC attachment. Desmet et al.'s series of studies on Dutch (Desmet, Brysbaert, & DeBaecke, 2002; Desmet, DeBaecke, Drieghe, Brysbaert, & Vonk, 2006) is particularly relevant. In an attempt to verify the Tuning hypothesis, which considers that adjunction preferences depend on the occurrences of those structures in the language (Mitchell, Cuetos, Corley & Brysbaert, 1995; Cuetos et al., 1996), they found that corpus counts did not match on-line measures in that language. When they explored their materials more carefully, they discovered that when animacy was controlled, the match was much greater. Specifically, they uncovered a strong propensity to attach the RC high to the first NP when this coded an animate referent (animacy was not so strong in the second site). In a more recent study (Desmet et al., 2006), they found that when the first noun was both animate and concrete (doctor, boy, nurse) as opposed to animate and abstract (government, staff, committee), attraction of the RC was strongest. This is consonant with knowledge that comes from the world of linguistics, where the role of animacy in shaping grammatical form is indeed well-known. Animacy is very strong in most agreement systems based on morphological features (Corbett, 2006), and agreement systems are (together with word order) major clause-building devices. Animacy is also linked to the grammar of topicality in that topics are mostly animate and definite (Goldberg, 2006; Lambrecht, 1994).

Acuña-Fariña, Fraga, García-Orza, & Piñeiro (2009) followed up Desmet et al.'s work and extended it to Spanish. Focussing on animacy alone, they conducted a large corpus study (1.5 million words) and two-self-paced reading experiments. As in Dutch, animate-animate NPs were a very rare sight (3.2%). Taken together, there was a significant preference for high adjunction, as 59% of all sentences were attached to the NP1 site. The on-line studies basically aligned with the corpus data. The inanimate-animate configuration was read faster than its mirror image, the animate-inanimate pattern, and this was in line with the corpus counts. The most interesting finding was that the general NP1 preference disappeared precisely when an animate second referent occupied the NP2 slot. There was also a numerical trend towards NP2 in the inanimate-animate condition, which indicated that the adjunction preferences which are solid across the various experiments in Spanish carried out to date ([Carreiras, 1992](#); [Carreiras & Clifton, 1993, 1999](#); [Cuetos et al., 1996](#)) can actually be modulated by semantic constraints that reside in the lexical units. Interestingly, when animacy fell on the first site, they found the highest differences between sentences disambiguated to NP1 and those disambiguated to NP2 (see Experiment 2). This seemed to indicate a coalition of forces.

However, neither in the Dutch series of experiments nor in the Spanish one could the match between the corpus and the on-line data be shown to be perfect. For instance, in Dutch, the inanimate-abstract NP1 + animate NP2 should in all logic show the most robust of the NP2 adjunction preferences, but Desmet et al. (2006) could only register a non-statistical trend in that direction in their eye-tracking data. This is surprising given the fact that the inanimate-animate condition is also the predominant configuration in the corpus analysis (not in Spanish: inanimate-inanimate). In the second place, the animate-animate type draws adjunction to the first NP despite overall

corpus preference for NP2. For that category specifically, it is true that a match was reported between the corpus and the reading data but we still need to know how the general attachment bias and the specific one for each category interact. If animacy/concreteness is the key, one would expect no robust biases there, and given the overall NP2 corpus preference of Dutch, maybe even a slight NP2 bias. The fact that animacy seems to be strong on NP1s only is therefore not entirely clear. In that respect, the preference for NP1 in Spanish animate + animate phrases may indeed be attributed to coarse-grain level frequency effects, as indeed, overall, NP1 *is* preferred in Spanish. It is noteworthy that when animacy is absent (in the doubly inanimate pattern), the Spanish corpus data show a sturdy NP1 preference. At that level of analysis, it is the Dutch data that remain mysterious, therefore.

One possible reason for the failure to find perfect production/comprehension matches is that the lexical units that make up the entire complex NP may house other properties besides the ones which have been subjected to experimental investigation. By now this would not be too surprising. We propose that the emotional dimension which stems from the nouns that make up the entire NP is another powerful force at play. Nouns like *orgy* or *genocide* are emotionally loaded (see below). The question we ask here is: does such emotionality –expressed in the lexical units- interfere with the formation of phrasal packages involving relative clauses? More bluntly: do emotional nouns affect preferred tree geometries (at least for RCS)? One should bear in mind that, even though attachment *per se* is a syntactic process in nature, the attachment of RCs in particular may be ‘partly non-syntactic’, since the relative pronoun is subject to binding conditions that relate it to a referential antecedent. Binding is subject to topical visibility ([Hemforth et al., 2000a, b](#)) and this is obviously sensitive to lexical salience. We chose to study the role of emotional nouns because, when it comes to pitting syntactic vs

semantic forces, in principle nothing can be farther away from syntax. At least, we are not aware of any grammatical biases in any language that may be sensitive to this lexical dimension (unlike other lexical dimensions, such as animacy, for which there is abundant evidence in linguistics). Indeed, only encyclopaedic views of semantics (i.e., *Cognitive Semantics*; see for instance [Lakoff, 1987](#); [Talmy, 2003](#)) can accommodate such connotative information inside the lexicon of a language. In traditional terms, and definitely in formal semantics terms (of the Montague type; see [Cresswell, 2006](#)), whether a noun scores high or low in arousal or valence, the two dimensions that characterize emotional words (see below), does not even belong with semantics proper. No standard dictionary contains such information. In sum, if there is interference here, it would be of a very different kind to what we are used to.

Emotional nouns

Although research on the emotionality of isolated words is abundant, little is known about the role such words play (if any) in sentence contexts. For instance, it is well-established that emotional words tend to capture attentional resources relative to neutral words, in such a way that they interfere with on-line cognitive tasks ([Anderson, 2005](#); [Dresler, Mériaux, Heekeren & Van der Meer, 2009](#); [Pratto & John, 1991](#)). Recently it has also been shown that emotional words affect performance in typical psycholinguistic tasks, such as lexical decision (e.g., [Carretié et al., 2008](#)) and naming ([De Houwer & Randell, 2004](#); [Hermans, de Houwer & Eelen, 2001](#); [Spruy, Hermans, de Houwer, Vandekerckove, & Eelen, 2007](#)).

From the bidimensional perspective of emotion ([Lang, 1995](#)), the affective structure or space is defined by two main bipolar dimensions: valence (which ranges from pleasant to unpleasant) and arousal (which ranges from calm to excited). The

former would refer to affective value and the latter to physiological activation, the common underlying factor being a motivational system prepared to approach pleasant stimuli and to move away from unpleasant ones as a function of their intensity. Emotional stimuli would then capture attention because they would be more distinctive than non-emotional ones. However, many authors maintain that distinctiveness is rather a function of valence than of arousal (e.g., Herbert, Kissler, Junhöfer, Peyk, & Rockstroh, 2006), suggesting that the role played by each dimension in sentence processing might differ substantially.

The studies

As summarized above, Spanish generally shows a high-attachment preference. However, in line with the results obtained in a large corpus study ([Acuña-Fariña et al., 2009](#)), in a sentence completion study, Piñeiro, Fraga, García-Orza, & Acuña-Fariña (2007) found that people tend to use a low-attachment strategy in one specific condition: when there is an inanimate-animate NP. The main aim of the following studies was to test whether the typical Spanish preference for NP1 is also reversed when the emotional value of the nouns that precede the RC is manipulated. In our first study we manipulated the affective valence of the nouns preceding the RC, exploring also whether pleasant (versus unpleasant) words are preferentially chosen as subjects of the RC. Our hypotheses are tentative as, on the one hand, negative stimuli seem to receive a processing advantage relative to neutral and positive ones ([Hansen & Hansen, 1988](#); [Mogg & Bradley, 1999](#); [Öhman, Lundqvist, & Esteves, 2001](#)). This has been interpreted in terms of biological (evolutionary) adaptation, since it is highly useful to rapidly detect (and avoid) stimuli that imply a threat for survival. On the other hand, given this natural tendency to avoid negative stimuli, positive ones would be preferred and, therefore,

could receive more lasting attention. In any case, it is conceivable that if one of the two antecedents of the RC captures more attention because it contains an emotional noun, its *topicality* may increase (Frazier & Clifton, 1996). This may make it a more likely subject for the RC (Lambrecht, 1994). Moreover, it is also conceivable that if negative words (such as *death*) are quickly detected but also rapidly discarded, they would remain activated in working memory for a shorter time than positive words (such as *love*), thus increasing the probability of pleasant nouns to become subjects of the RC.

As regards the arousal dimension, it has been argued that the corresponding word for an emotional stimulus (e.g., the word *kiss* for a kiss) is less affectively loaded (i.e., less intense) than the stimulus itself (e.g., [Gibbons, 2009](#); [Kensinger & Schacter, 2006](#); [Kissler, Assadollahi, & Herbert, 2006](#)). However, this might be true of isolated words, but not of words in a broader context. Besides, it is also well-known that both pleasant and unpleasant nouns tend to be highly arousing (see the boomerang shape of the affective space, [Bradley & Lang, 1999](#); [Redondo, Fraga, Padrón, & Comesaña, 2007](#)). Given these premises, in Studies 2 and 3 we also intend to test whether high arousal nouns are indeed arousing enough to attract the RC more than low or neutral arousal ones.

STUDY 1

In the following study we explored the impact on the proportion of completions towards NP2 when the complex NP contains emotional words. In particular, we were interested in the possible effects of affective valence, so the nouns' pleasantness was manipulated whereas arousal was kept constant (high). It remains to be seen whether pleasant or unpleasant names may attract the RC differently, and whether this could change the NP1 preference usually reported in Spanish.

METHOD

Participants

Sixty-one students from the Universities of Santiago de Compostela, Vigo, A Coruña and Barcelona enrolled in this study voluntarily. Their ages ranged from 18 to 29 years old ($M = 22.35$; $S.D. = 4.57$) and all of them were native speakers of Spanish. None of them had previous knowledge about the process under study.

Design and variables

A 5X3 factorial design was employed. One of them was Valence, with 5 levels: neutral-neutral (N-N), neutral-pleasant (N-P), neutral-unpleasant (N-U), pleasant-unpleasant (P-U), and unpleasant-pleasant (U-P). The other factor was the List, with three levels (A, B and C). This factor was included with the aim of excluding the error variance due to lists ([Pollatsek & Well, 1995](#)). The dependent variable (DV) was the number of adjunctions towards NP2 divided by the sum of unambiguous adjunctions to either NP1 or NP2 made when completing the RC. From now on this variable will be referred to as “proportion of NP2 adjunctions”.

Materials

Fifty inanimate-inanimate experimental sentences with the structure NP-V-NP1-de-NP2-*que...* (NP-V-NP1-of-NP2-*which...*) were elaborated (see Appendix). Those sentences correspond to five experimental conditions, established via the manipulation of the valence of the nominal heads. Thus, 10 sentences contained two neutral (i.e., non-emotional) NPs (N-N), 10 a neutral NP1 and a pleasant NP2 (N-P), 10 a neutral NP1 and an unpleasant NP2 (N-U), 10 a pleasant NP1 and an unpleasant NP2 (P-U), and,

finally, another 10 sentences contained an unpleasant NP1 and a pleasant NP2 (U-P). All sentences were incomplete, as they stopped at the word *que* (*which*), and they were previously evaluated in plausibility by a different group of subjects (averaging above 4.5 in all cases in a 1-7 scale). The questionnaire also included 100 distractor sentences with other kinds of structures.

The emotional nouns were selected from the Spanish adaptation of the ANEW (Redondo et al., 2007). Given the difficulty to select enough low arousal unpleasant words (see Redondo et al., 2007), all the pleasant and unpleasant words selected were high arousal ones. Thus, from a previous selection of 90 words, 42 words were assigned to one of three sets: the neutral words set (N), composed by 13 neutral arousal and valence (non-emotional) words; the pleasant words set (P), composed by 14 high arousal pleasant words; and the unpleasant words set (U), composed by 15 high arousal unpleasant words. In order to confirm that there were the expected significant differences among the three sets, two one-factor analyses of variance were run. Results showed significant effects both for Valence ($F(2,41) = 628.53; p < .001$) and Arousal ($F(2,41) = 176.12; p < .001$). Post-hoc tests showed significant differences among the three words sets for Valence (all $ps < .001$), and between N and P sets, and N and U sets for Arousal (in both comparisons, $ps < .001$). Moreover, length, frequency, neighbourhood, imageability, and concreteness indices were registered from B-Pal (Davis & Perea, 2005). The corresponding analysis of variance revealed there were no significant differences among the three sets of words in any of these variables (all $ps > .05$; see Table 1).

(Table 1 about here)

Task

The questionnaire was composed by 150 sentences that were incomplete. Participants had to complete them in a grammatically correct and plausible way. They were randomly assigned to one of three lists which were composed by the same sentences, although they were in a different order in each list.

Procedure and correction

The questionnaire was displayed individually in a suitable soundproof room. Participants were told they should complete every sentence with the first words that came to their minds, forming meaningful sentences. They were also told not to go back to previous sentences and to complete all the sentences in the questionnaire. Two judges evaluated the participants' performance separately. There were three responses: when the RC had been completed making reference to NP1, it was computed as "1"; when reference was meant to NP2, it was computed as "2"; and, finally, when completion referred to neither NP1 nor NP2, or it was grammatically incorrect, it was computed as "3". Also, in case judges had initially evaluated the sentence differently, they were instructed to force consensus. If this proved not possible, the item was computed as "3".

RESULTS

In this and the following studies we followed the same procedure for the analyses of results. As the number of '3's was low in general, they were discarded from the analyses. The dependent variable was the number of NP2 choices divided by the number of NP1 choices plus the number of NP2 choices. Analyses of variance (ANOVAs) were performed for participants (*F1*) and items (*F2*) on proportion of NP2 adjunctions. In those cases where the condition of sphericity was not met, the

Greenhouse-Geisser correction was applied to degrees of freedom. In addition, we conducted planned comparisons to compare the different preferences in each level of the independent variable (in this study: valence). For the planned comparisons, α values were corrected using the Bonferroni adjustment. Finally, with the aim of evaluating whether participants showed preferences to complete the sentences making reference to one site more than to another, one-sample t-tests were used for testing whether the mean proportion of NP2 choices in each level of the independent variable differed significantly from 0.5.

Sixty-one participants took part in the Study. One of them was eliminated because in 26.2 % of the cases s/he did not produce grammatical sentences, or did not complete them fully. Thus, the final sample was composed by 60 participants. Two-way ANOVAs were performed with List (A, B, C) and Valence (neutral-neutral (N-N), neutral-pleasant (N-P), neutral-unpleasant (N-U), pleasant-unpleasant (P-U), and unpleasant-pleasant (U-P)) as factors. List was considered a between-subjects factor in the analysis over participants and a within-subjects factor in the analysis over items; Valence was considered a within-subjects factor in the analysis over participants and a between-subjects factor in the analysis over items. ANOVAs revealed no principal effects of the List factor ($F_1(2,57) = .195; p > .05; F_2(2, 90) = .26; p > .05$). These results showed that participants' preferences did not differ significantly across the lists. Also, there was not a significant interaction between the two factors, List and Valence, over participants ($F_1(5.84, 166.52) = 1.55; p > .05$), although it was significant over items ($F_2(8,90) = 2.79; p < .05$). The effect of Valence was significant both by participants and items ($F_1(2.92, 166.52) = 68.39; p < .001; F_2(4,45) = 38.44; p < .001$), showing differences in the percentages of NP2 elections across experimental conditions. Planned comparisons showed significant differences between N-N and N-U pairs, N-N

and P-U pairs, and N-N and U-P pairs, both by participants and items (all $p_s < .001$). The comparison between N-P and P-U pairs was significant in the analysis over participants ($p_1 < .05$). T-tests for one sample revealed that the proportions of NP2 elections were always significantly different from chance (50%) (p_1 values $< .001$; p_2 values $< .05$, in all conditions). In fact, participants tended to complete the RC pointing to NP2 significantly more than to NP1 in all those conditions where there were one or two emotional NPs. On the contrary, when both NPs were neutral (i.e., when both nouns were non-emotional) there was a significant preference for NP1 (see Figure 1).

(Figure 1 about here)

Given the preference for NP2 found in all the experimental conditions where emotional words were included, we decided to proceed with a second analysis of variance. In this case conditions with one and two emotional nouns were grouped, giving place to a within-subjects factor with three levels: non-emotional words (N-N condition), one emotional word in NP2 (i.e., N-P+N-U conditions), and two emotional words (P-U+U-P conditions). Results showed significant effects of this factor ($F_1(1.67, 98.53) = 116.42, p < .001$; $F_2(2,49) = 12.27, p < .001$). The most relevant result here is that planned comparisons showed significant differences, not only between the non-emotional words condition and the other two (both $p_1 < .001$; both $p_2 < .05$), but also between the one emotional word condition and the two emotional words condition in the analysis over participants ($p_1 = .041$). Thus, the percentages of elections towards NP2 were significantly higher in the latter.

DISCUSSION

The main goal of Study 1 was to test whether typical Spanish high-attachment preferences can be reversed as a function of the emotional characteristics of the heads of the NPs. Specifically, we manipulated affective valence of the words, given the traditional relevance conferred on affective valence. It is worth noting that both positive and negative nouns were high arousal words, in order to maintain this factor constant across conditions. Only in the control condition (N-N), antecedents to the RC were neutral in valence as well as arousal.

Firstly, results confirmed that, in the absence of any other factor, the preferred strategy to complete ambiguous RCs in Spanish is high-attachment. Thus, in the N-N condition, the percentage of NP1 elections was significantly higher than the percentage of NP2 ones. This is a well-established finding, in line with previous results from comprehension (e.g., [Acuña-Fariña et al., 2009](#); [Carreiras & Clifton, 1993](#); 1999; [Cuetos & Mitchell, 1988](#)) and production studies ([Piñeiro et al., 2007](#)). Secondly, and more importantly, when a neutral word was in the NP1 and an emotional word occupied the NP2, the abovementioned habitual NP1 preference was reversed, and this happened irrespective of the affective valence of the words in the NP2. Thirdly, this study also included two types of sentences in which both NPs contained emotional words. In one of them the first noun was pleasant and the second was unpleasant (P-U), and in the other it was the other way round (U-P). These conditions were initially established with the aim of testing whether pleasant and unpleasant nouns behave differently in the context of ambiguous sentences. Results revealed that there were no significant differences between P-U and U-P conditions, since participants preferred the NP2 as subject of the RC in both cases, reversing the usual preference in Spanish again. Thus, late-closure was the preferred strategy, and it was a solid one. This is somewhat

surprising, since it is in principle easier to understand NP2-driven choices when the emotional charge resides in the NP2 only. In the general discussion we will try to provide an explanation for that.

STUDY 2

In Study 1 it has been shown that the inclusion of pleasant or unpleasant nouns in the NP2 leads to a change in the participants' usual preference for the high-attachment strategy (as they now opt for the low-attachment one). Since all those emotional words were highly arousing, it is possible that arousal –rather than valence– could explain that change. To test this hypothesis, two new completion studies were carried out. In both of them arousal was manipulated, and valence was kept constant. Specifically, pleasant words which varied in their level of arousal were selected. This was not an arbitrary decision; rather, it was due to the fact that the affective space ([Redondo et al., 2007](#)) is poor in unpleasant words which are, at the same time, low or neutral in arousal. Additionally, it is not easy to find high arousal words neutral in valence. For these reasons, low, neutral and high arousal pleasant words were selected.

Study 2 had two main goals. Leaving aside valence effects, we were primarily interested in isolating the role of arousal in attracting an incomplete RC. Thus, the key issue in Study 2 was to test whether there are differences between low arousal and high arousal words in their ability to become subjects of the RC. As we will see below, the main difference between studies 2 and 3 was that in Study 2 low and high arousal words were always placed in NP2, whereas in Study 3 two new experimental conditions were added, in which high and low arousal words interchanged their positions in NP1 and NP2.

A second perhaps more minor objective was to see the possible effects of valence in neutral arousal conditions. Since it is possible to select words which are neutral in arousal but pleasant in valence, besides a control condition with non-emotional nouns (as in the previous study), we included two pairs of experimental conditions where we manipulated the head of the NP1. This could be either a non-emotional word (neutral both in arousal and valence (N; say *street*)) or a noun that is neutral in arousal but pleasant (N⁺; say *snow*). This allowed us to see if, in the absence of emotional arousal, affective valence has an impact on RC disambiguation, as well as to see if the effect of pleasant words is therefore different from that of non-emotional words.

METHOD

Participants

Twenty-four students from the Universities of Santiago de Compostela and Vigo took part voluntarily in this study. Their ages ranged from 18 to 29 years old (M = 21.65; S.D. = 3.93) and all of them were native speakers of Spanish. None of them had previous knowledge of the process under study.

Design and variables

A factorial design was employed. This was Arousal, with five levels: neutral-neutral (N-N), neutral-low arousal (N-L), neutral arousal/pleasant-low arousal (N⁺-L), neutral-high arousal (N-H), and neutral arousal/pleasant-high arousal (N⁺-H), the first element corresponding to the word in the NP1 site, and the second one corresponding to the word in the NP2 site. The DV was again the proportion of adjunctions towards NP2 made when completing the RC.

Materials

As in Study 1, 50 Spanish sentences with the structure NP-V-NP1-of-NP2-*which...* were selected (see Appendix). Besides the control condition already used in the previous study (N-N), there were four experimental conditions, each of them containing 10 sentences. Thus, 10 sentences included a neutral word in the NP1 and a low arousal word in the NP2 (N-L), 10 a pleasant/neutral arousal word in NP1 and a low arousal word in NP2 (N⁺-L), 10 a neutral word in NP1 and a high arousal word in NP2 (N-H), and, finally, another 10 sentences included a pleasant/neutral arousal word in NP1 and a high arousal word in NP2 (N⁺-H). Therefore, with the exception of words included in the N-N condition, all the words were positive, pleasant nouns. Again, all these words were taken from the Spanish adaptation of the ANEW (Redondo et al., 2007), resulting in four sets of 13 neutral words (N), 18 neutral arousal pleasant words (N⁺), 16 low arousal words (L), and 14 high arousal words (H). As regards affective variables, two one-way factor analyses of variance were run, showing significant effects for both Valence ($F(3,60) = 59.96; p < .001$) and Arousal ($F(3,60) = 192.99; p < .001$). Post-hoc analyses showed significant differences between N and N⁺ word sets, N and L word sets, and N and H word sets (all $ps < .001$), for Valence; and between N and L sets, N and H sets, N⁺ and L sets, N⁺ and H sets, and L and H sets (all $ps < .001$), for Arousal. As regards psycholinguistic variables, the analyses of variance showed no differences in length, frequency, neighbourhood, familiarity, imageability, and concreteness among the four sets of words (all $ps > .05$; see Table 2). All sentences were previously evaluated in plausibility and averaged above 4.5 in a scale of 1 to 7.

(Table 2 about here)

Procedure

The procedure was the same as in Study 1, although this time only one list was used, since no order effects were found in the previous study.

RESULTS

One-way ANOVAs were performed on proportion of NP2 adjunctions, with Arousal as factor. Arousal was considered a within-subjects factor in the analysis over participants and a between-subjects factor in the analysis over items. The analyses showed significant effects for Arousal, ($F_1(4,92) = 41.87; p < .001; F_2(4,49) = 19.65; p < .001$). Planned comparisons also showed significant differences between the N-N condition and all the others, both in the analysis over participants and items (all $p_s < .001$), and between the N⁺-L and the N-H conditions in the analysis over participants ($p_1 < .05$), due to a significantly higher percentage of adjunctions to NP2 in the latter. Also in the analysis over participants the difference between the percentage of NP2 elections between conditions N-L and N-H approached significance ($p_1 = .097$).

Finally, t-tests for one sample revealed that percentages of NP2 elections were different from chance (50%) in all conditions over participants and items (all p_s values $< .001$, except for the N⁺-H condition in the analysis over items, p_2 value $< .05$), leaving aside N-L and N⁺-L conditions which were only marginally significant in the analysis over items (p_2 value = .089 and p_2 value = .080, respectively). These analyses revealed that the N-N condition was the only one with a significant preference for NP1 while there were preferences for NP2 in all the other conditions (see Figure 2).

(Figure 2 about here)

DISCUSSION

The main goal of Study 2 was to explore the role of arousal in the completion of RCs with a double antecedent. Results have shown that, in line with results from the previous study, NP1 was preferred only in the N-N condition, i.e., when the nouns that precede the incomplete RC are non-emotional words. Once again, NP2 was the preferred noun in the remaining experimental conditions. Thus, whenever there is an emotional noun in NP2 or two emotional nouns in NP1 and NP2, a significantly higher preference for NP2 is attested. Nevertheless, a few aspects of the data deserve closer attention. Firstly, there were no significant differences between either the N-L and N⁺-L conditions or between the N-H and N⁺-H conditions. Therefore, pleasant/neutral arousal words (N⁺) placed in the NP1 slot do not seem to be able to attract the RC whenever there is an emotional word in NP2, even if this is a low arousal word. Thus, at least in this experimental context, N⁺ words seem to behave similarly to N words. As will be seen below, this lack of differences will allow us to get rid of one of these conditions in each pair in Study 3. Secondly, it is worth noting that significant differences were found between the N⁺-L and N-H conditions in the analysis over participants, showing a higher preference for NP2 in N-H sentences. Also along the same line, differences between N-L and N-H conditions approached significance. This could be indicating, on the one hand, that both low and high arousal words tend to attract adjunction towards NP2 if there is a neutral arousal word in NP1, and, on the other hand, that high arousal words pull RC-adjunction towards NP2 more than low arousal words. With the aim of exploring this possibility, we carried out an extra analysis collapsing together those conditions with one neutral arousal word in NP1 and a low arousal word in NP2, i.e., N-L and N⁺-L (neutral-low set), and comparing it with those conditions with one neutral arousal word in NP1 and a high arousal word in NP2, i.e., N-H and N⁺-H (neutral-high

set). Results showed significant differences among these two pairs of conditions ($F_1(1,23) = 7.195; p < .05; F_2(1,39) = 19.42; p < .001$), thus confirming our expectations: high arousal words pull adjunction to NP2 more than low arousal words. Besides, t-tests for one sample showed that percentages of NP2 elections were different from chance (50%) in the analysis over participants in both conditions (p_1 values $< .001$ in both cases), and in the analysis over items in the neutral-high condition (p_2 value $< .001$). Nonetheless, this analysis was not significant in the neutral-low condition (p_2 value = .144).

STUDY 3

The main objective of this study was to analyse whether the arousal level of NP nuclei modulates disambiguation in a sentence completion task. Particularly, in this study sentences with low as well as high arousal words located in NP1 were included, i.e., we used L-H and H-L conditions. The specific prediction we intended to put to the test here is that high arousal words –as opposed to low arousal ones- will attract the RC independently of the place they take in the complex NP: if situated in the first NP, early closure will be the preferred disambiguation strategy; if on the second, late closure should prevail. Together with the mentioned conditions we include: i) the usual control condition N-N, ii) an additional control condition where nouns in both sites were neutral in arousal but pleasant, $N^+ - N^+$, and finally, iii) a N-L and N-H condition, with the aim of confirming the results found in the previous study, where a stronger preference for NP2 was found when high (as opposed to low) arousal words were presented in that site.

Participants

Fifty-eight students from the Universities of Barcelona and Málaga enrolled voluntarily in this Study. All of them were native speakers of Spanish. Their ages ranged from 18 to 29 years old ($M = 21.14$; $S.D. = 3.41$) and none of them had previous knowledge of the process under study.

Design

A factorial design was employed, the factor being Arousal, with six levels: neutral-neutral (N-N), neutral arousal and pleasant-neutral arousal and pleasant ($N^+ - N^+$), neutral-low arousal (N-L), neutral-high arousal (N-H), low arousal-high arousal (L-H), and high arousal-low arousal (H-L). Once more, the DV was the proportion of adjunctions towards NP2.

Materials

Sixty sentences were employed starting from the word sets used in Study 2 (see Appendix). All of them were pleasant, except those labelled 'N', which were neutral both in valence and arousal. In fact, the N-N, N-L, and N-H conditions were the same as in the previous study. Besides, three new types of sentences were constructed. Thus, 10 sentences included two NPs with neutral arousal and pleasant words ($N^+ - N^+$), 10 included a low arousal word in NP1 and a high arousal word in NP2 (L-H), and 10 included a high arousal word in NP1 and a low arousal word in NP2 (H-L). As in previous studies, new sentences had an average above 4.1 in plausibility (in a 1-7 scale). Both the procedure and the correction protocols were the same as in Studies 1 and 2.

RESULTS

One-way ANOVAs were performed on the proportion of NP2 adjunctions, with Arousal as factor. Arousal was considered a within-subjects factor in the analysis over

participants and a between-subjects factor in the analysis over items. Analyses showed significant effects of Arousal ($F_1(5,285) = 48.51; p < .001; F_2(5,59) = 8.76; p < .001$), revealing that the percentage of NP2 elections was significantly different across experimental conditions. Planned comparisons showed that there were no significant differences between N-N and H-L conditions (p_1 and $p_2 > .05$), and that both conditions behave clearly differently from the other ones, showing a lower proportion of NP2 elections. Thus, the N-N condition was significantly different from all the other in the analysis over participants (all $p_1 < .001$) and from the N-L and the N-H conditions in the analysis over items (both $p_2 < .05$). Also, the comparisons between the H-L condition and all the other were significant both in the analysis over participants and items (all $ps < .001$), with the exception of the comparison with the N^+-N^+ condition ($p_2 < .05$) and the N-L condition ($p_2 = .051$). Similarly, in the analysis over participants both N-H and L-H (with no differences between them) showed differences with the N^+-N^+ and the N-L conditions (all these $p_1 < .05$), that did not differ between themselves.

T-tests for one sample showed no differences from 0.5 in the the N^+-N^+ and the N-L conditions. The percentage of adjunctions towards NP2 was significantly different from chance (50%) both by participants and by items in the N-N (p_1 value $< .001$, p_2 value $< .05$), the N-H (p_1 value $< .001$, p_2 value $< .05$) and the H-L (p_1 and p_2 values $< .001$) conditions. In the L-H condition differences were significant only by participants (p_1 value $< .001$, p_2 value $> .05$). To sum up, both in the control condition (N-N) and the one where a high arousal word was located in the NP1 (H-L) there was a preference to adjoin high in the tree (an early-closure strategy), whereas the reverse result was found in conditions where a high arousal word was located in NP2 (conditions N-H and L-H; a late-closure strategy). In the other two conditions, where

either a neutral arousal or a low arousal word was located in NP2 (N⁺-N⁺ and N-L), there were no significant preferences (see Figure 3).

(Figure 3 about here)

DISCUSSION

The main goal of Study 3 was to specifically compare the effects of high arousal nouns relative to low arousal ones. Unlike Study 2, where all these words were located in NP2, two new conditions in which low and high arousal words interchanged their positions were included here. In this way we were able to confirm not only that high arousal words tend to attract RCs significantly more than low arousal ones when emotional words are located in the NP2, but also that high arousal words –as compared to low arousal ones- are preferred as subjects of the RC, be they either in the NP2 or the NP1 position. Therefore, high arousal words led to a preference for a late-closure strategy whenever they were in NP2 (regardless of whether NP1 contained a word low in arousal or an emotionally neutral word), whereas they led to an early-closure strategy when they were in NP1 (and there was a low arousal word in NP2). It is worth noting that for the first time in this series of studies, we have found a preference for the noun located in NP1 when both nouns in the complex NPs are emotional words.

Finally, there were no significant differences between the percentages of elections towards NP1 and NP2 either in the N-L condition or in the N⁺-N⁺ condition. As regards the first case, this is also the first time that an NP2 containing an emotional noun is not the preferred site for attachment -something remarkable in view of the fact that the competing noun in NP1 is a neutral one. In the general discussion we will speculate on possible reasons for this. As regards results found in the N⁺-N⁺ condition,

the lack of differences between preferences for NP1 and NP2 might be revealing the effects of affective valence, which would in any case be lower than that of arousal: whereas high arousal words always attract the RC, when arousal is neutral, pleasant words only manage to neutralize preferences.

GENERAL DISCUSSION

As noted in the introduction, Desmet et al. (2002, 2006) realised that comprehension and production results were much better aligned when the lexical properties of the nouns residing in complex NPs were taken into account. In particular, animacy and concreteness were shown to be very active in attachment decisions. [Acuña-Fariña et al. \(2009\)](#) added evidence of the strength of the lexical dimension by showing that the rather robust early closure bias of Spanish can be at least counterbalanced by the presence of an animate referent in the late closure position (NP2) together with an inanimate referent in the early closure position (NP1). Here we have taken the lexicalist hypothesis one step further. Assuming that the *connotative* properties of the lexical units are a part of the most peripheral layer of their meaning, we have manipulated the emotional connotation of the nouns in complex NPs in order to see if such manipulations had an impact on a syntactic attachment decision. Note that whether a noun scores high or low in arousal, for instance, is not the kind of information that figures in dictionaries. It is clearly not a part of *denotative* semantics, nor of syntax. However, the most conspicuous finding we have made is that such connotative, lexical information does have an effect on the resolution of syntactic ambiguities involving RCs in production.

Several authors have pointed out that the properties of lexical stimuli are not so pronounced as the properties of visual stimuli ([Gibbons, 2009](#); Kensinger & Schacter,

2006; [Kissler et al., 2006](#); [Spruyt et al., 2007](#)). However, our results suggest that words which are embedded in a context elicit greater intensity than when they are presented in isolation. This, in turn, may have to do with the superior *referentiality* of nominal phrases, as nouns alone are not referential (Frazier & Clifton, 1996; see also Hemforth et al., 2000a, b). The fact that, in a completion task, meaning must be the first cycle of processing (see below) may have contributed to this as well. Our results bear directly on research carried out in the lexical context, where it has been shown, for instance, that the emotionality of a word drives early lexical processes (Scott, O'Donnell, Leuthold, & Sereno, 2009), or that emotional words are disruptive enough to interfere with on-line cognitive operations ([Anderson, 2005](#); [Dresler et al., 2009](#); [Pratto & John, 1991](#)). These works have used different methodologies. According to Scott et al. (2009), most studies have employed a lexical decision task or some version of this task (e.g., [Carretié et al., 2008](#)), but others have employed naming ([De Houwer & Randell, 2004](#); [Spruyt et al., 2007](#)), self-referential judgments (e.g., [Lewis, Critchley, Rotshtein, & Dolan, 2007](#)), masking (e.g., [Windmann, Daum, & Güntürkün, 2002](#)), or lateralized presentation (e.g., [Kanske & Kotz, 2007](#)). All involve the manipulation of words in isolation. Here, however, we wondered what would happen if we manipulated the valence and arousal of the nouns of a language in the middle of a resolution of a classic syntactic ambiguity.

In the first of our studies, where affective valence was explored, the pattern of preferences was reversed, since NP2, the local referent, was chosen as the subject of the RC in any condition which included one or two emotional nouns, be they pleasant or unpleasant. This reversal is less surprising in those sentences which contained a neutral NP1 and an emotional NP2, for after all in such an asymmetric configuration this is exactly what was already found in studies exploring animacy ([Acuña-Fariña et al., 2009](#); [Desmet et al., 2002, 2006](#)). A surprising aspect of our findings is the fact that,

whenever an emotionally-charged word filled the NP2 slot, that slot attracted adjunction regardless of whether the first slot contained a neutral word (see Study 2), an emotional word with high arousal (see Study 1) or an emotional word with low arousal (see Study 3). Given that, other things being equal, Spanish has always shown a sturdy NP1 bias, at least in those conditions where two emotional words were included, an early closure strategy would have been a safer prediction. In fact, that prediction *is* confirmed when animacy is manipulated ([Acuña-Fariña et al., 2009](#)).

Previous research using words as stimuli points to the modulating role of the emotional valence in word processing. For instance, Most, Smith, Cooter, Levy, & [Zald \(2007\)](#) found that sexual stimuli may come to attract attention in the same degree as certain negative stimuli. The results of Kousta, [Vinson, & Vigliocco \(2009\)](#) also show that positive and negative words are processed faster than neutral words. Finally, Scott et al. (2009) found that response times to both positive and negative words were significantly faster than those to neutral words. So, a prediction that could have made some sense is to expect that positive words would join forces with the structural bias to prefer NP1 precisely in the P-U condition. But it was not. Alternatively, another logical prediction would be to contend that the presence of a negative word in the NP1 slot and a positive one in NP2 would lead to a late-closure strategy or, at least, to an absence of preferences in the U-P condition. However, results revealed that there were simply no significant differences between the P-U and U-P conditions, since participants preferred the NP2 as subject of the RC in both cases. One explanation for this is that, since emotional nouns capture attention preferentially, they would remain activated in working memory, and since the second nominal is the more recent word, this would attract the clause with greater ease, resulting in late closure. However, we believe finally another explanation is more likely. Since both nouns are emotionally incongruent

(pleasant-unpleasant and viceversa), they may create a sort of inhibitory affective priming state ([Hermans et al., 2001](#)), that is, a momentary increase in processing difficulty, thus making recourse to a general recency default the easiest escape route out of the momentary disturbance. By ‘general recency default’ we mean the role that recency plays outside the domain of RC processing, which, in more neutral circumstances, is famous precisely for flouting such a default. This is in line with work by [Papadopoulou \(2006\)](#), where she found some evidence of low attachment in L2 even when native speakers of both L1 and L2 show high attachment preferences.

We should not rule out the possibility that these results are due more to interference from the arousal dimension than to valence per se. This is suggested by the fact that no differences could be found between pleasant and unpleasant words, and that all these words scored very high in arousal. This is the reason why we devised two other completion tests with arousal manipulations (Studies 2 and 3). Taken together, results indicate that arousal strongly modulates the syntactic disambiguation process. In Study 2, including only pleasant words, the noun in the second site was always the preferred one, be it a low or a high arousal word. Study 3 showed that highly-arousing nominals significantly pull adjunction towards the slot they are located in, be that the first or the second in the complex NP. By contrast, the effects of those words with low arousal scores are much more inconsistent across the studies. This, however, does not mean that the role of valence in affecting the syntactic decisions examined should be discarded. In fact, in those sentences which contained two nouns neutral in arousal and pleasant in valence (N⁺-N⁺, Study 3), no preferences for either a late or an early closure strategy could be attested. Since the default bias of Spanish is a solid high-attachment preference, only valence can account for that.

If, as noted in the introduction, the interaction of locality, prosody, preposition type, attachee size, lexical bias, lexical frequency, information focus, contextual referentiality and grammatical number made a unified theory of comprehension untenable, the addition of production data like ours complicates the issue of RC adjunction even more. In this context, only models with some flexibility may be malleable enough to account for very disparate facts. Construal (Frazier & Clifton, 1996), for instance, allows variation in the processing of non-primary constituents (such as RCs) by differentiating between true *adjunction* and *association*. Modifiers are simply *associated*, not adjoined on syntactic rails, and such looser connections take place at a stage in processing when even Gricean principles may be at work. Construal might thus make room for emotional words to influence the association preferences of the RC by increasing the focus or the salience of the referents. In this framework, cross-linguistic differences could be accounted for by claiming that it is precisely the insufficiently tested interaction of such parameters as animacy and emotionality that may unite results, once the parameters in question are adequately controlled. However, it is necessary to recognise that this is only part of the story as, in the absence of such manipulations, Spanish is a solid NP1 language, and English is not. What we believe is going on in Spanish is something we observed in our research on animacy: namely, that there is a rather solid architectural bias to go up in the tree, as well as a concurrent solid habit of modulating that bias in the face of potent lexical information. This appears to indicate that a formal reflex (not recency, but a preference for a certain tree anyway) has a certain default status, but is not the kind of inexcusable step that is usually considered to be in formal models.

The attachment-binding model proposed in [Hemforth et al. \(2000a, b\)](#) and [Konieczny, & Hemforth \(2000\)](#) states that relative clauses are syntactically attached on

the one hand, but, at the same time, the relative pronoun has to be bound to an antecedent. While the attachment process is most probably determined by syntactic parameters, the binding process will be determined by whatever plays a role in pronoun resolution. Since pronouns in general are often assumed to have a tendency to be tied to the most salient antecedent, a preference for highly emotional hosts can be predicted, as well as a preference for animates, low frequency nouns, etc. Arousal surely plays a central role here, since this can clearly make the antecedent particularly salient. In this flexible framework, syntactic and non-syntactic processes compete, with final preferences depending among other things on the rapidity of each process. Since highly salient hosts can be detected very quickly, pronoun resolution preferences can override syntactic preferences.

In general, lexicalist models of a constraint-satisfaction type, such as [MacDonald, Pearlmutter, & Seidenberg \(1994\)](#), are also in line with our results as well, but often these models do not make room for some syntactic biasing (which we have observed) in a clear way. The dualism [early/late closure + lexical effects] is underscored also in [Papadopoulou & Clahsen \(2006\)](#), where both syntactic tree preferences and early access to lexical information have been attested (and late access to extrasentential (discourse) information in on-line tasks; see below). The fact is that in the present series of three completion studies, the most surprising result was to see that, regardless of a solid NP1 bias in Spanish at large, when the NP2 is a high arousal word, language-users stay low in the tree, preferring locality. In short, wherever new research on RC attachment may lead us, it is now clear that both default structural biases and fine-grain lexical information compete (possibly in parallel) to determine the final outcome, and that neither of these two forces alone is likely to be a magic bullet. Here we have provided evidence that strengthens the lexical force. What seems to be needed

at this stage is an account of why, say, Spanish has an early closure bias in the first place but, say, English does not, other things being equal.

Finally, a word is in place regarding the way the results of our completion tests relate to results in the same language in comprehension. The [Acuña-Fariña et al. \(2009\)](#) study on animacy is the most comparable source of information. The most noteworthy conclusion of that comprehension test was that the robust NP1 bias of Spanish was neatly modulated by the animacy dimension in the sense that only in the condition where an animate referent was housed in the second NP did the NP1 bias disappear. As already noted, this means that there was no bias towards NP1: it does not mean that a preference for NP2 was statistically significant. However, in the present series of completion studies involving emotional words, the NP1 bias of the language at large was completely obliterated, as we obtained significant preferences for NP2 in all conditions which included high arousal words in the second slot. That such clear anti-trend biases have been obtained by manipulating a lexical variable that can only be defined as ‘peripheral’ is worthy of notice, especially given the fact that on each and every occasion that emotional neutrality was reinstalled, the NP1 bias was quickly back in place. The emotionality that stems from the nominal heads is certainly a lexical feature which is not –in principle– of the same grammatical calibre as animacy (see our introduction). In view of this, we suspect that the task employed, or rather, the direction of encoding that the task imposes, is responsible for the superior role of emotionality over animacy that is evident in the comparison of the two studies. In particular, since we are manipulating semantic biases and the task we used here starts with conceptual structure, the role of semantics was made more potent. In fact, we have found similar robust effects of animacy in a previous completion study ([Piñeiro et al., 2007](#)). In comprehension, it is form that reaches language-users first, so attention to form biases is

privileged (and meaning is made to wait a little more; see Fernández, 2002 and [Papadopoulou & Clahsen, 2006](#) on the idea that off-line tasks make room for post-syntactic strategies). This would naturally explain why our semantic manipulations were completely successful in the completion studies but only half so in our previous comprehension study. Recall that in Dutch, the inanimate-abstract NP1 + animate NP2 condition registered only a non-statistical trend in that direction -in comprehension (Desmet et al., 2006). However, the preference for NP2 in the inanimate-animate condition was statistically significant in two completion -i.e., production- studies (Desmet et al., 2002). Naturally, a fact that makes this conclusion only provisional is that in off-line tasks such as completion only final interpretations (but not the fine details of a temporal course) can be attested, so the strong effects we have registered may simply be due to the task itself, and not to the direction of encoding imposing constraints on the time course of processing. For the moment, an adequate discrimination between these two different hypotheses will have to wait for on-line evidence in production studies to become available.

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Table 1

Mean values for affective and psycholinguistic variables in the three sets of words (the ANEW scale for Valence and Arousal ranges from 1 –low arousal and valence- to 9 - high arousal and valence) selected for Study 1.

Words	Variables							
	Valence	Arousal	Length	Freq.	Neighb.	Familiarity	Imageability	Concreteness
Neutral	5.01	4.83	6.08	75.25	1.85	6.02	4.95	4.57
Pleasant	7.84	7.32	6.13	78.16	1.21	6.00	4.97	3.92
Unpleasant	2.01	7.02	6.70	57.54	0.73	5.55	4.76	4.48

Table 2

Mean values for affective and psycholinguistic variables in the four sets of words (the ANEW scale for Valence and Arousal ranges from 1 –low arousal and valence- to 9 - high arousal and valence) selected for Studies 2 and 3.

Words	Variables							
	Valence	Arousal	Length	Freq.	Neighb.	Familiarity	Imageability	Concreteness
Neutral	5.01	4.83	6.08	75.25	1.85	6.02	4.95	4.57
Neutral ⁺	5.18	7.06	6.42	38.19	2.21	5.81	5.01	4.69
Low arousal	3.67	7.28	6.28	53.06	3.50	5.81	4.65	4.58
High arousal	7.78	7.27	6.25	82.67	1.33	6.04	4.93	4.28

Figure 1.

Percentages of NP1 and NP2 elections in each experimental condition (Study 1).

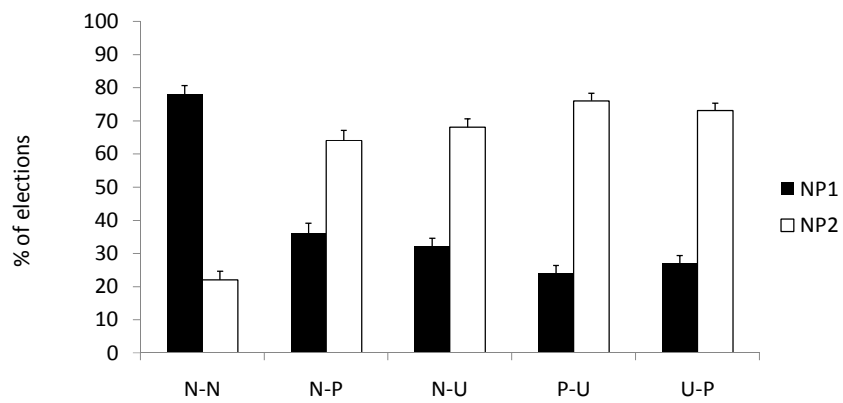


Figure 2.

Percentages of NP1 and NP2 elections in each experimental condition (Study 2).

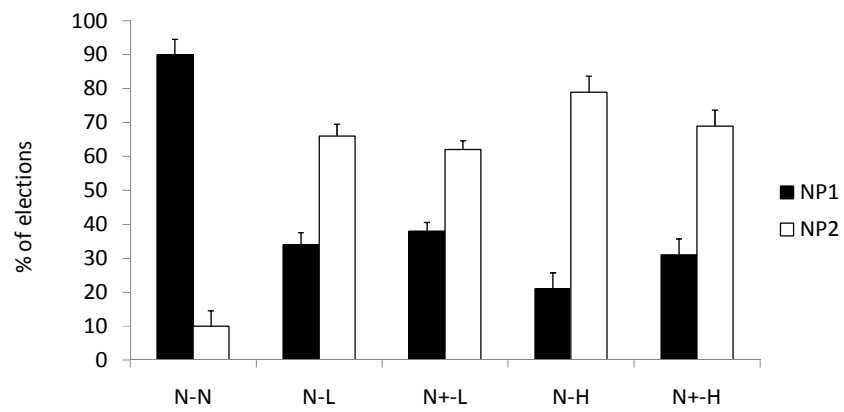
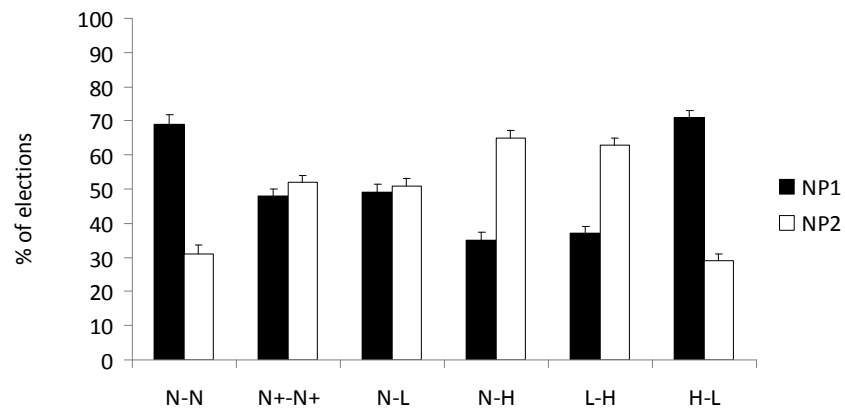


Figure 3.

Percentages of NP1 and NP2 elections in each experimental condition (Study 3).



Appendix

Example of sentences in Study 1

- N-N: Los nuevos trabajadores cuestionaban **el método del banco** que...
[The new employees questioned *the method of the bank* that...]
- N-P: El profesor explicaba **la fase del orgasmo** que...
[The teacher explained *the phase of the orgasm* that...]
- N-U: El asesino siguió **el método del crimen** que...
[The assassin followed *the method of the crime* that...]
- P-U: Los terroristas celebraron **el triunfo del crimen** que...
[The terrorists celebrated *the victory/triumph of the crime* that...]
- U-P: Aquel joven evitó **el peligro del éxito** que...
[That young man avoided *the danger of the success* that...]

Example of sentences in Study 2

- N-N: The same as those in the N-N condition in Study 1.
- N-L: La abuela de Juan no quería ver de nuevo **la máquina del reposo** que...
[Juan's grandmother did not want to see again *the machine of the rest* that...]
- N⁺-L: Los niños encontraron jugando **la nieve del árbol** que...
[The children found, playing, *the snow of the tree* that...] or [Playing, the children found the snow of the tree that...]
- N-H: The same as those in the N-P condition in Study 1.
- N⁺-H: Su novia quería pasear por **el jardín del deseo** que...
[His girlfriend wanted to walk by *the garden of the desire* that...]

Example of sentences in Study 3

- N-N: The same as those in the N-N condition in Study 1.
- N⁺-N⁺: La familia de Ana disfrutaba **el perfume del hogar** que...
[Ana's family enjoyed *the perfume of the home* that...]
- N-L: The same as those in the N-L condition in Study 2.
- N-H: The same as those in the N-P condition in Study 1.
- L-H: Las revistas destacaban **la sencillez del campeón** que...
[The magazines enhanced *the simplicity of the champion* that...]
- H-L: El pueblo vasco lucha por **el triunfo de la paz** que...
[The basque people fight for *the triumph of the peace* that...]