



## Music, Modularity and Syntax

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### ABSTRACT

First generation cognitive science has always maintained that the mind/brain is a modular system. This has been especially apparent in linguistics, where the modularity thesis goes largely unquestioned by the linguistic mainstream. Cognitive linguists have long disputed the reality of modular architectures of grammar. Instead of conceiving syntax as a computational system of a relatively small set of formal principles and parameters, cognitive linguists take the notion of grammatical construction to be the basic unit of syntax: syntax is simply our repertoire of form-meaning pairings. On such a view, there is no a-priori reason to believe that semantics and phonology cannot affect syntax. In the present paper, we want to take things a step further and suggest, more generally, that language is not a module of cognition in any strict sense.

We present preliminary results from research in progress concerning the effect of music on grammatical constructions. More specifically, our experiment compares reaction times between two grammatical constructions that differ in semantics and intonational curves but share lexical material. Our data so far suggests that subjects take less time reading the construction when the semantic bias and intonation match than in non-matching cases. This, we argue, suggests not only that semantics, phonology and syntax form an information bundle (i.e. a construction in the cognitive linguistic sense), but that perceived similarity of music can influence linguistic cognition.

**KEYWORDS:** construction grammar, psychological reality of constructions, modularity

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## I. INTRODUCTION

Work on syntax by the cognitive linguistics movement has tended to focus on how semantics can constrain grammatical constructions. This has been in fact been one of the landmarks of this approach; contrasting with purely formal and combinatorial approaches to syntax in which semantics plays little or no role, in cognitive linguistics, meaning is seen as attendant and operational in every linguistic structure, even in the more schematic patterns combining morphosyntactic place-holders. Thus, many grammatical phenomena can be described by including this neglected side of the Saussurean coin, thus obtaining more complete and coherent explanations. For example, construal operations such as the selective focus of attention in figure and ground alignment have been insightfully incorporated in the explanation of the active-passive syntactic alternation; the influence of information structure (that is, the difference between old and new information) has been shown to play an all-important role in the organization of grammatical elements within the clause. These are but two small examples of how meaning-related information is a crucial factor in influencing the formal structure of a linguistic message.

While acknowledging the usefulness of “semantocentric” approaches, we want to focus on yet another formal factor of the Saussurean coin to show how phonology can act as a constraint on grammatical constructions. While the influence of phonology on syntax is at odds with truly modular approaches to language in which each linguistic level is informationally encapsulated, in cognitive linguistics, a completely different tack is taken. Constructions are seen as the basic units of language; they are complex amalgams formed by the accrual of information from different sources in repeated usage-based events. These different types of information can interact simultaneously in these units. By using these complex structures as basic descriptive templates, grammatical behaviour can better be described and explained.

One of the central interests of cognitive linguistic approaches, therefore, is to verify whether such units do have a real psycholinguistic existence in the minds of speakers/ hearers, and whether they are really at work when language is understood or produced. While the theoretical advantages of using constructions in language studies have been thoroughly discussed in many places (e.g., Goldberg, 1996; Hilferty, 2003), empirical studies on their existence are less frequent. Some studies that have advocated the existence of constructions in language processing (Bencini & Goldberg 2000; Goldberg & Bencini 2005; Ahrens 2003; Kaschak & Glenberg, 2000), and in language production (Chang, Bock & Goldberg 2003); their role in first language acquisition has also been investigated (e.g., Abbott-Smith & Behrens, 2006; Tomasello, 2003). In this work, we want to contribute to this debate by showing how the tight integration of different sources of information in a constructional amalgam can be presented as an argument in favor of the psychological reality of construction and *contra* modular approaches to grammar.

Drawing on previous work (Valenzuela, Hilferty & Garachana, 2005), we will use the Spanish *Hay X y (hay) X'*-construction, which is similar, though not identical, to its English counterpart in (2):

- (1) *Hay mentiras y (hay) mentiras.*
- (2) *There are lies and ((then) there are) lies*

Specifically, we will try to show how the intonational part of this construction can affect its syntax, influencing the speed with which subjects process this structure. The idea that phonology can exert influence on syntax is by no means new; thus, before explaining the experiment itself, we turn our attention on a brief revision of some studies that show that this is indeed the case.

### **I.1. Some ways in which phonology correlates with syntax**

We are hardly the first to speak about the interactions between phonology and morphosyntax; in this section, we briefly review some of the reported relationships.

*a. Phonological complexity:* It is a well known fact that grammatical words tend to be phonologically less complex cross-linguistically than lexical words in terms of tonic accents, vowel duration, and syllabic structure (see, e.g. Kelly, 1992, Morgan *et al.*, 1996, Shi *et al.*, 1998, 1999). One example of this phenomenon is that complex clusters of consonants tend to be more common in lexical words than in grammatical words. For example, three consecutive consonants can be found in items such as *text* or *exactly*, but not in, say, determiners or conjunctions.

*b. Regularity in morphophonology:* Morphophonological cues correlate often very well to grammatical classes and features (see, e.g. Kelly, 1992, MacWhinney, 1998, Maratsos, 1988). For instance, in Spanish nouns ending in *-o* or *-a* tend overwhelmingly to be masculine and feminine, respectively.

*c. Intonation units and prosodic cues:* In a corpus study, Croft (1995) has shown that intonation units correspond very closely to grammatical units.

the units employed for spoken communication are basically the units stored as constructions in the mind [. . .]. This seems to be a natural hypothesis, because the G[rammatical] U[nit]s occurring in a single I[ntonation] U[nit] are all that a speaker needs to rely on perhaps 97% of the time in using his/her language (based on the evidence from our corpus). (Croft, 1995: 872–873)

Furthermore, prosody and intonation-unit segmentation seems to provide parsing cues that help indicate and disambiguate grammatical structure (see, e.g., Gilboy & Sopena, 1996, Morgan *et al.*, 1987, Schafer *et al.*, 2000). This can be seen by a sentence such as *Bill insulted Hillary on Channel 9 and Ken on Channel 7*. If, for instance, *Hillary* and *Ken* receive contrastive stress, then *Ken* is interpreted as a direct object; if, on the other hand, *Bill* and *Ken* are contrastively stressed, then *Ken* is interpreted as a grammatical subject.

d. *Grammaticality judgments*: Intonation can dictate whether a given syntactic string is well-formed or not. That is the case of so-called *Incredulity* or *Mad Magazine*-sentences. These sentence show a lack of agreement between subject and verb, and allow also subjects in accusative case (vs the default nominative).

- (3) a. *HIM, finish his thesis?*  
 b. *\*Him finish his thesis.*

Without the associated intonation (interrogation upward curve), the sentence is not complete, and not only is not its constructional meaning not activated (that of incredulity) but the result would be ungrammatical.

Montolío (1999) has observed a similar behaviour in some Spanish construction, such as the Spanish *pero si-* construction (Montolío, 1999). In example (4), intonational emphasis falls on the third work (“ya” – already):

- (4) a. *Pero si YA lo he hecho.*  
*But if already it have-I done*  
 ‘What are you talking about: I’ve already done it’  
 b. *\*? Pero si ya lo he hecho.*  
*But if already it have-I done*  
 ‘But if I’ve already done it’

In (4b), no emphasis is placed on this word; were this sentence read with a flat intonational curve, this construction would not be activated.

Having established the plausibility of a direct connection between phonology and syntax, we now move on to the description of the construction which will figure prominently in our experimental setting.

## 1.2. The *Hay X y Hay Y* construction

For the present study, we are interested in structures of the form [*Hay X y Hay Y*]. This construction consists of the existential verb “haber”, in third person singular present tense, combined with a nominal. There are two instances of the same verb, each of them combining with a different nominal. For convenience, we will label these nominals with the variables X and Y, respectively. Both structures, “hay X” and “hay Y”, are joined by the copulative conjunction “y” (*and*); since in Spanish, existentials are impersonal, there is no subject. The examples in (5) below illustrate this [*Hay X and Hay Y*] construction:

- (5) a. *Hay vida y hay calor* (from “Viva España”)

- ‘There’s life and there’s warmth’
- b. *Hay crimen y hay injusticia*  
‘There’s crime and there’s injustice’
- c. *Hay infraestructura y hay tecnología*  
‘There’s infrastructure and there’s technology’

In all these examples, each instance of the verb predicates the existence of a given nominal; the function here is just to select members from a list of items, which are thus added together. We could term this function *enumerative*, since it enumerates a number of items of an unspecified list. Thus, in (5a), we are told that there is life and there is warmth, and this is not meant to exhaust the list of possibilities.

On the other hand, the same structure is found with exactly the same morphosyntactic form, but with a different use. Some of these new uses are listed in (6) below:

- (6) a. *Hay ricos y hay pobres*  
‘There’s the rich and there’s the poor’
- b. *Hay alegrías y hay tristezas*  
‘There are happy times and and there are sad times’
- c. *Hay frío y hay calor*  
‘There’s coldness and there’s warmth’
- d. *Hay riesgos y hay oportunidades*  
‘There are risks and there are oportunities’

In all the examples in (6), the two variables, X and Y, are not random elements of a list containing an indeterminate number of items. Rather these variables are construed as two extremes of a continuum. In this sense, they name elements that are put into contrast, and we will accordingly call this function of the construction *contrastive*. For example, in (6a), the scale to which both elements belong is that of ‘wealth’ and these variables signal the two extreme points in the continuum: the rich and the poor. Examples (6b) and (6c) are also prototypical antonyms, thus having quite similar behaviour. Example (6d) is perhaps more interesting, because ‘risks’ and ‘opportunities’ would not be so immediately considered antonyms in all contexts. Yet, in this sentence, they are construed as two extremes of the same continuum: a *risk* suggests that the result of situation can lead to the loss of something, and a *opportunity* indicates that it is also possible to gain something. Hence, this construction would normally be used to indicate that, instead of a uniform state of affairs in the world, there exist a whole range of different possibilities.

Moving closer to the focus of our study, this construction has a special case; a variant in which both elements, X and Y, are identical. We could call this construction the *Hay X y (hay) X'* construction. This version of the construction drops the second instance of the verb 'haber' quite frequently, thus taking the form [Hay X and X']. Again, this single structure can be linked to two different interpretations:

- (8) a. *Hay días y días*  
 'There are many days'
- b. *Hay hombres y hombres*  
 'There are many men'

On the one hand, we can interpret the examples in (8) as adding items from an unspecified list. Here, the reduplication brings forth a specific function which is to highlight the great number of items that a given list contains<sup>1</sup>; we could paraphrase it as "there are a lot of X". We shall therefore classify this as a specific version of the *enumerative* construction.

On the other hand, a contrastive reading of this reduplicated variable construction is also possible; some examples are listed in (9):

- (9) a. *Hay marxistas y marxistas* (Che Guevara)  
 'There are marxists and marxists'
- b. *Hay lágrimas y lágrimas*  
 'There are tears and tears'
- c. *Hay clientes y clientes*  
 'There are customers and customers'
- d. *Hay comentarios y comentarios*  
 'There are comments and comments'
- e. *Hay libros y libros*  
 'There are books and books'

In all these examples, the two instances of the variable X are put into some kind of contrast. As opposed to the two nominals in the contrastive [Hay X & Hay Y], which signalled two opposite points within a continuum, in this version of the construction (i.e., [Hay X y X']), the two variables point to different areas within a single category. The intended meaning associated with this construction is that not all elements belonging to the same category should be considered as equivalent along every possible dimension; in fact, there are dimensions that distinguish among different items of the category and the two contrasting elements should be located at the two extremes of one of them.

Again, as in the [Hay X & Y] contrastive version, the intent is to predicate against a uniform view of the world, pointing out differences among items for some reason. A reasonable paraphrase of this construction's meaning might be "not all Xs are the same" (e.g., not all marxists/tears/comments/customers/books are the same). As for the precise dimension along which both elements are contrasted, it is context-dependent. For example, a possible interpretation of (9e) could well be that there are (*good*) books and there are (*bad*) books. However, as we have just mentioned, there are other many contextual possibilities, to wit:

- (10) a. There are (*interesting*) books and there are (*boring*) books  
 b. There are (*expensive*) books and there are (*cheap*) books  
 c. There are (*well-written*) books and there are (*poorly-written*) books  
 d. There are books (*appropriate as a present for your grandmother*) and books (*inappropriate as a present for your grandmother*)

Another way to look at this construction is to think of as a 'hedging' construction. 'Hedging' constructions inform hearers that a given item should not be considered as a prototypical element of the category in question:

- (11) a. *Loosely speaking*, an ashtray is a piece of furniture  
 b. *Technically speaking*, a tomato is a fruit  
 c. Bill Pullman is *kind of, but not really*, Philip K Dick

As Barsalou has shown, the prototypical center of a given category is itself context dependent (Barsalou, 1987), sometimes giving rising even to "ad-hoc" categories (Barsalou, 1983). We believe this what is happening in the case we are discussing. For example, if two speakers are looking for a book to buy for their grandmother's birthday, and then one suggests *The Vampire Chronicles* by Anne Rice, the other might well answer, "Well, I'm not so sure; there are books and books". The meaning of such an utterance would probably correspond to the meaning suggested in (10d).

### 1.3. Brief phonological description of the [Hay X & X'] construction

Having already commented upon one of the characteristics of the construction that will play a part in our experiment, the semantics of the [Hay X and X'] construction, we now turn to the other element we will be using: the phonological information associated with each version of the construction. The two basic parameters involved are rhythm and intonation, which we take up in turn.

a. *Rhythm*. Both the enumerative and the contrastive versions of the [Hay X & X'] construction differ in their rhythmic structure. In the contrastive version, there is often a pause (however slight) between the first nominal and the conjunction 'y'; for instance:

- (10) *Hay mentiras / y mentiras*

‘There are lies / and lies’

The insertion of a pause anywhere else would render the sentence odd, and the contrastive reading would not be activated:

- (11) a. ??*Hay / mentiras y mentiras*  
 b. ??*Hay mentiras y / mentiras*

In the enumerative version, no separation or alteration of the rhythm is found

- (12) *Hay mentiras y mentiras*  
 There are lies and lies

*b. Intonation.* Again, the two structures show a marked difference in their intonational curve. Thus, in the contrastive version, the first conjunct has a rising tone, while the second is falling:

- (13) *Hay mentiras* ↑ *y mentiras* ↓  
 There are lies and lies

In the enumerative version, both conjuncts have a rising tone

- (14) *Hay mentiras* ↑ *y mentiras* ↑  
 There are lies and lies

As we shall see in what follows, the phonological patterns associated to both structures will play a big role in disambiguating the two constructions.

#### **I.4. Research questions.**

Having briefly described the construction we will be using in our experiment, we are now in a position to pose our research questions:

- (1) Since phonology (specifically, intonation) is often basic to syntactic constructions (see sections 1.1 and 1.3), can we use intonation to prime syntax?
- (2) *Contra* the modularity thesis (see section 1), could this intonational priming be done through another domain of cognition, namely, musical notes (i.e., can music prime syntax?)

In order to answer these questions, in what follows, we present an experiment in which participants read a text that can bias them to either an enumerative or a contrastive reading of the target sentence (which takes the form “*hay X y X*”). Immediately prior to reading this sentence, participants hear a musical phrase that resembles the intonational curve of one of the



two structures. The idea is that congruence or incongruence (i.e. matching or non-matching of context and intonation) will affect the reading times of the target sentence.

## II. MATERIAL AND METHODS

### II.1. Participants

Sixteen native Spanish speakers agreed to participate in the experiment. Eight of them were women and the rest were men.

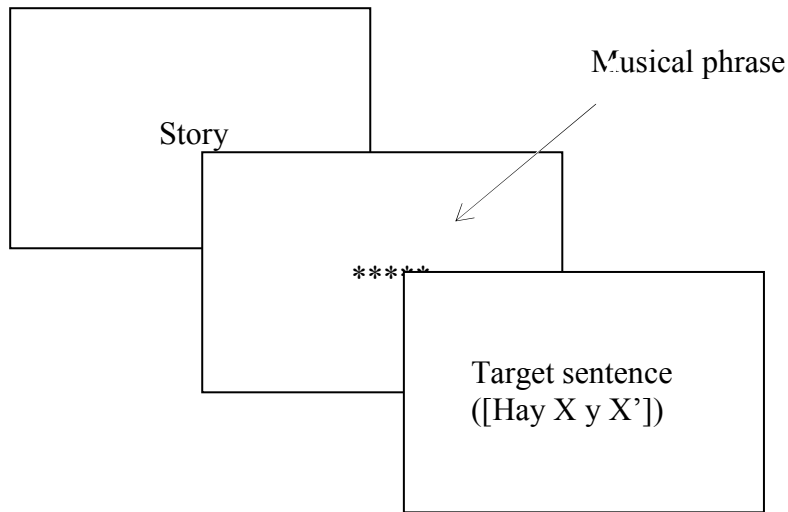
### II.2. Materials

A set of ten enumerative-biasing texts and ten contrastive biasing texts, all of them ending with the target sentence “Hay X y X”, was created for the experiment (see Appendix 1 for some examples). We also created another set of ten enumerative and ten contrastive biasing stories that ended with similar endings (e.g., “there were many Xs” or “not all Xs are the same”). Thus, there were a total of forty texts, which had a mean length of 30.77 words (SD: 3.53).

Additionally, a number of musical phrases (with a violin sound) were created by means of a Roland D-50 synthesizer in which the rising and falling intonations were created by manipulating the bend so that increases in pitch lower than a semitone could be created, trying to mimic a little more closely the human pitch curves of intonation. Four musical phrases were created to match two-syllable and three-syllable nouns in enumerative or contrastive versions. The phrases were further manipulated using Steinberg’s *Cubase* musical software so that they would match the stress patterns of the key words in the target sentence (Hay X y X), all of which had the same stress pattern.

### II.3. Procedure.

The experiment involved a self-paced reading task carried out using the E-prime software. Participants were told that their task was just to read the stories presented to them and to understand them. To make sure that they were in fact paying attention to the stories, occasionally they were asked a question about the story; questions appeared randomly. Initially, subjects saw a text (enumerative or contrastive), which remained on screen until they pressed the spacebar. After this, there was a fixation point which lasted 2000 ms, during which they heard a musical phrase (enumerative or contrastive). Then, the target sentence would be presented, and participants had to press the spacebar once they had read it. This reaction time was our dependent measure. It must be mentioned that since the target sentences contained two and three syllable nouns, the musical phrases were of different durations. That is, with three syllable nouns, the musical phrases lasted a bit longer than the 2000 ms interval between text and target sentence, and so there was a small degree of overlap between the musical phrase and the presentation of the target sentences in those cases.



### III. RESULTS

Our results show that participants did take longer to read the target sentences in incongruent conditions (i.e., when text and intonation did not match) than in congruent conditions (see Figure 1).

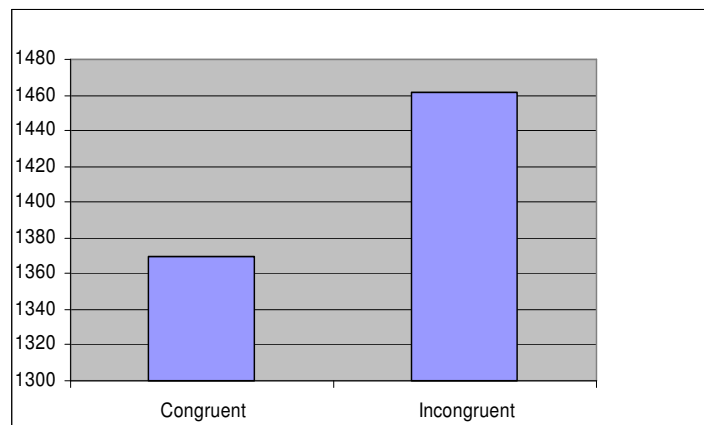


Figure 1. Reading times (RTs) of congruent vs incongruent cases

We also analyzed results separating enumerative and contrastive texts, to see whether the effect showed up only in one of the versions. This was not the case; the effect was present in both types of texts to the same degree approximately (see Figure 2).

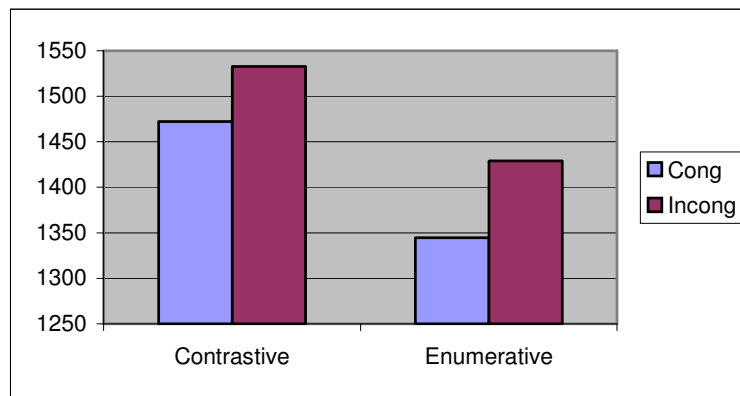


Figure 2. Congruent and incongruent RTs by contrastive and enumerative version

In analyzing the results, we further divided stimuli into two syllable and three syllable nouns, to check whether word length might have an impact on the size of the effect. Once again, the difference between congruent and incongruent conditions held constant for all nouns (see Figure 3).

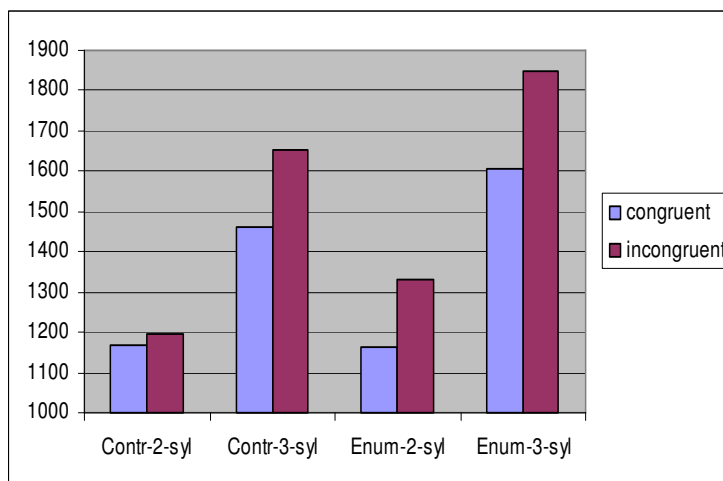


Figure 3. Congruent and incongruent RTs by syllables

#### IV. DISCUSSION

Being a pilot study in which the small number of participants used does not allow for significant effects, the tendencies are though quite clear. One of the explanations which is consistent with these results is that hearers have in their minds a stored representation of a construction in the cognitive-linguistic sense. That is, speakers store information about the syntactic form that the construction has along with its associated phonology (i.e., intonational curve) as well as its semantic/pragmatic use. In this way, if one takes constructions as amalgams of heterogeneous information, in which phonology-morphosyntax and semantics are interrelated, one would expect that activating one of the facets of the construction would prime the rest of the construction. Thus, given a constrained context in which only one of the semantic values is possible (i.e., either enumerative or contrastive), when the participants hear

a musical phrase of a given type and then read the morphosyntactic form of the sentence, they can integrate all these parameters smoothly in congruent cases. If these parameters do not match, as in incongruent cases, some sort of clash is produced, and the reader takes longer to make sense of the sentence.

Such results are difficult to explain if one adopts a modular approach to grammar. In that case, no delay in understanding the target sentence would be expected. Strictly speaking, a modular framework would posit encapsulated syntax, phonology and semantics. As such, we should never see priming across these linguistic domains. However, things are even worse than that, since in our results, it is musical notes, not just language, which seems to be producing this priming effect. Needless, our evidence is at this point merely suggestive. A fuller version of the experiment is forthcoming, in which we have enough subjects. Nonetheless, we feel that our results are interesting enough.

## V. CONCLUSION

Semantics is of course the “holy grail” of linguistics and cognitive science in general. As such, focusing on the semantics of a given grammatical construction strikes us as a worthwhile endeavour. Nonetheless, as our pilot study seems to suggest, the importance of the phonology of grammatical constructions should not be neglected. Our data are consistent with the idea that intonational patterns are bound up with syntactic patterns. This, in turn, is consistent with the notion of grammatical construction. It does not cohere very well with the notion of syntax as a modular system in which syntactic, phonological and semantic patterns are not directly connected. This is especially evident in our case because our paradigm is cross-modal (music to syntax). We realize that defenders of modular syntax will be critical to our study but we suggest that actually our study should be music to their ears.

## NOTES:

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<sup>1</sup> The iconic connections between reduplication and factors such as plurality or repetition, which could be at work here, are analyzed in Regier (1998).

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## Appendix

Some examples of enumerative and contrastive biasing context with their target sentence

	Texts	Target sentence
C O N T R A S T I V E	Pero mujer, no puedes tratar a la Duquesa de Alba como si fuera una cliente cualquiera. Ya sé que le cobramos lo mismo que a todo el mundo, pero es una cuestión de prestigio,	[hay clientes y clientes]
	Aunque la mayoría son inofensivos, tienes que mirarte los lunares del cuerpo, porque algunos son debidos a cáncer de piel. Con eso hay que tener cuidado porque	[hay lunares y lunares]
E N U M E R A T I V E	No te preocupes lo más mínimo por encontrar por dónde salir por la noche en Murcia. Hay cien mil sitios donde tomártelas. Si prácticamente es lo único que hay allí,	[hay bares y bares]
	Yo creía que a Pepe no le gustaba leer, pero cuando entré en su casa, me sorprendí, porque en todas las paredes y casi por donde quiera que miraras	[hay libros y libros]