

# Syntactic satiation and the inversion effect in English and Spanish *wh*-questions

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**Abstract:** Both English and Spanish exhibit an inversion effect in *wh*-questions: a verbal element must appear to the left of the subject. Analyses differ, however, as to whether this effect is due to similar syntactic mechanisms in the two languages or not. The phenomenon of judgment satiation, in which certain unacceptable sentence types improve upon repeated exposure, is used here to provide new evidence addressing this issue. It is shown that unacceptable *wh*-questions in Spanish are susceptible to satiation, but their counterparts in English are not, thus suggesting that different mechanisms are responsible for the inversion effect in the two languages. In addition to providing new evidence regarding the nature of inversion in *wh*-questions, this study also constitutes a test case for using satiation in the service of comparative syntax.

## 1. Introduction

In a number of languages with canonically preverbal subjects, a verbal element must be to the left of the subject in *wh*-questions, among other environments. This phenomenon, known generally as inversion, is most famously exemplified by the case of Subject-Auxiliary Inversion

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in English:

(1) What **will** Mary say?

Inversion in *wh*-questions has also been extensively documented in several Romance languages

((2a-d) from Hulk and Pollock 2001):

(2)a. Che cosa **ha detto** Maria? [Italian]

‘What did Maria say?’

b. Qu’**a dit** Jean? [French]

‘What did Jean say?’

c. Onde **foi** a Maria? [European Portuguese]

‘Where did Maria go?’

d. Què **farà** en Joan? [Catalan]

‘What will Joan do?’

e. Adónde **fue** María? [Spanish]

‘Where did María go?’

As will be discussed below, there has been continuing disagreement in the literature as to whether the English and Romance cases of inversion are to be accounted for with the same basic grammatical mechanisms, or whether the similarities between them are more superficial.

In this paper, I examine English and one of these Romance languages, Spanish, and argue that the inversion phenomenon seen in the two languages must be due to different mechanisms. In doing this, I will make use of evidence that is not just new, but of a new type, in that it will be based on the phenomenon of syntactic satiation discussed in Snyder 2000, in which certain unacceptable sentence types become more acceptable upon repeated exposure. The evidence presented will thus be of use not only in resolving the question of the proper analysis of inversion in English and Romance, but also in demonstrating how the phenomenon of satiation can be put to use in the service of comparative syntax.

This paper is organized as follows. In section 2, I give an overview of why the analysis of inversion in *wh*-questions has important implications for syntactic theory, and I give a more detailed picture of the facts in both English and Romance. Section 3 presents background information on the phenomenon of satiation and how it has been approached experimentally. Inversion and satiation come together in section 4, where I present an experiment exploring the possibility of satiation effects in English and Spanish *wh*-questions in which the inversion requirement is not observed. The implications of the experiment are discussed in detail in section 5, and concluding remarks are given in section 6.

## 2. Inversion in *wh*-questions and syntactic theory

The phenomenon traditionally known as Subject-Auxiliary Inversion in English is standardly taken to be the result of T-to-C movement (den Besten 1983), and I will adopt that analysis here (see, e.g., Radford 1997). One question which then arises is why this particular variety of head movement is forced to co-occur with movement of a non-subject *wh*-phrase into the matrix SPEC of CP, though not with movement of a subject *wh*-phrase, as in (3), or with movement into an embedded SPEC of CP, as in (4).

(3) \*Who does go to school? (\* with non-emphatic *do*)

(4) \*I wonder what will Mary say.

One influential response to this question is from Rizzi (1996), who proposes that these facts are ultimately due to the *Wh*-Criterion, given in (5).

### (5) The *Wh*-Criterion

A. A *wh*-operator must be in a SPEC-head configuration with  $X^0_{[+wh]}$ .

B. An  $X^0_{[+wh]}$  must be in a SPEC-head configuration with a *wh*-operator.

(Rizzi 1996)

If we assume that in matrix questions, a [+wh] feature is specified on T, then (5) requires that the

*wh*-phrase and T be in a SPEC-head configuration. If the *wh*-phrase is a non-subject, then this requirement can only be satisfied if both the *wh*-phrase and T move into a higher projection.

This then accounts for why *wh*-movement and T-to-C movement co-occur, but what about cases where they do not, as in (3) and (4)? In the case of *wh*-movement of the subject, as in (3), Rizzi proposes that T-to-C movement is prohibited by the ECP. (5) is nonetheless satisfied, however, because of coindexing of C and T. In the case of embedded *wh*-questions, as in (4), the matrix verb selects an embedded C marked [+*wh*], and (5) is thus satisfied without T-to-C movement.

Analyses of this general type (see Pesetsky and Torrego 2001 for another influential example) thus offer an explanation for why *wh*-movement and inversion co-occur in many cases (e.g., (1)), but not in all (e.g., (3) and (4)), and their explanations rest mostly on fundamental principles of the grammar (e.g., (5)) that are unlikely to be language-particular.<sup>1</sup> As we examine *wh*-movement in other languages and find similar inversion patterns, we should thus be understandably attracted to finding an analysis which is consonant with fundamental principles of this type. Initial appearances suggest that there is promise in pursuing such an approach. As we saw in (2), Romance languages also display an inversion phenomenon in *wh*-questions, and all things being equal, we would expect this inversion to be the result of T-to-C movement and to satisfy the *Wh*-Criterion or a similar principle. In fact, an account in terms of T-to-C movement looks plausible, since it has been argued for many Romance languages (see Suñer 1994 for Spanish) that main verbs raise to T, so T-to-C movement would result in the main verb appearing

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<sup>1</sup> In Pesetsky and Torrego 2001, T-to-C movement follows from Attract Closest X and the Principle of Minimal Compliance, both of which are taken to be fundamental principles of UG.

in C, just as appears to be the case in (2). The apparent contrast between English (1), with an auxiliary to the left of the subject, and Romance (2), with a main verb to the left of the subject, can thus be reduced to the well-known difference between English and Romance in terms of what is allowed in T (modals and auxiliaries in English, main verbs in Romance).

Even restricting ourselves to the most basic properties of *wh*-questions, however, unexpected differences do emerge between English and Romance. Most striking, perhaps, is the fact that the prohibition against inversion in embedded questions seen in (4) largely disappears in Romance, with Spanish (along with Catalan and Romanian) even requiring inversion in this environment:

(6)a. \*No sé [qué Juan compra]

NEG know-1s what buy

b. No sé [qué compra Juan]

NEG know-1s what buy

‘I don’t know what Juan buys.’

Nonetheless, this difference does not appear to be fatal for accounts of the type we have been examining. Rizzi suggests the [wh] feature is on T in embedded questions in these languages (as opposed to English, where it is on C), thus necessitating T-to-C movement to satisfy the *Wh*-criterion. This account does not offer an explanation for why English and Romance should contrast in just this manner, but there at least appears to be a way to account for the contrast while still maintaining the proposed universal principles.

At this point, then, we have seen that there is promise in developing a principled analysis of the inversion effect in *wh*-questions in English and Romance which would allow us to achieve some understanding of why inversion is observed in these environments while still allowing for some language-particular differences. Nonetheless, an analysis along these lines still faces some significant empirical hurdles, particularly in Spanish. Whereas there is broad consensus that inversion in English results from T-to-C movement, a number of arguments have been put forward that this is not the case in Spanish (see, e.g., Goodall 1993, 2001, Gutiérrez Bravo 2002, Olarrea 1996, Ordóñez 1997, Suñer 1994, and for recent dissenting views, Bok-Bennema 2006 and Gallego 2006). Perhaps the strongest of these comes from the fact that in Spanish, adverbs that typically appear in the area between the preverbal subject and the verb in declarative sentences, such as *jamás* ‘never’, remain preverbal in *wh*-questions (Goodall 1993, Suñer 1994):

(7) A quién jamás ofenderías tú con tus acciones? (Suñer 1994)

*whom never offend you with your actions*

‘Who(m) would you never offend with your actions?’

Assuming that these adverbs cannot appear to the left of C, examples like (7) suggest that the verb has not raised higher than T (and that the subject has remained in a position to the right of this, as is independently possible in Spanish). Note that in the English gloss, it is the modal which has moved to C and the adverb remains adjacent to the *in situ* verb, as would be expected.

If it turns out to be true that verbs in Spanish *wh*-questions remain in their canonical position and T-to-C movement does not occur, we would then be faced with two questions, which I will consider here very briefly. First, what then forces the subject to remain in a postverbal position in *wh*-questions? A number of answers have been proposed in which it is claimed that the obligatory postverbal subject position in this case follows from other properties of the syntax of Spanish (see the references cited above for examples). A recent alternative analysis is that processing considerations, rather than the syntax *per se*, contribute to the low acceptability of preverbal subjects in *wh*-questions in Spanish (Goodall 2004, forthcoming). The central idea is that a preverbal subject, unlike its postverbal counterpart, intervenes in the filler-gap dependency, resulting in significantly increased processing difficulty and a concomitant decrease in acceptability.<sup>2</sup> With either of these two types of analysis, we are then led to the second question: How can the lack of T-to-C movement in Spanish be reconciled with principles like the *Wh*-Criterion? There are a number of ways one might approach this (for instance, one might propose that the [+wh] feature is already specified on C in Spanish for some reason, thus rendering T-to-C movement superfluous) but here the important point is simply that there do appear to be ways one could make the apparent lack of T-to-C movement in Spanish *wh*-questions compatible with accounts such as Rizzi 1996 (and others of the same general type) without dismantling the principles which they claim force T-to-C movement in *wh*-questions in English.

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<sup>2</sup> Notice that this analysis does not carry over directly to English. There is strong evidence for T-to-C movement in English, and in any event, the subject intervenes in the filler-gap dependency regardless of inversion.



Nonetheless, if T-to-C movement does not occur in Spanish *wh*-questions, this is clearly at odds with the spirit of analyses of the Rizzi type. These attempt to explain the partial co-occurrence of T-to-C movement and *wh*-movement observed in some languages, and it would seem strange from this perspective if a language like Spanish were to mimic the effect of T-to-C movement (by displaying an inversion effect in just those environments where T-to-C movement would produce it), without actually using that process.

The discomfort that one might feel with this state of affairs becomes more concrete from the viewpoint of acquisition. Children hear large numbers of questions of the form (2e) in the everyday environment, and on the face of it, nothing prevents them from making the reasonable assumption that (2e) results from T-to-C movement, given that (2e) is perfectly consistent with the *Wh*-Criterion, assuming that the verb is in C. For children not to adopt such an analysis, they would require evidence, and it is not clear if they receive this, given that examples such as (7) are very infrequent.

The question of whether Spanish *wh*-questions exhibit T-to-C movement is thus much more than a difficult descriptive question for Spanish syntax; there are issues of larger import at stake. If T-to-C movement occurs in this environment, it offers confirming evidence for analyses of the Rizzi 1996 type which claim that T-to-C movement follows directly from certain fundamental principles of the grammar, and at a broader level, it supports the view that universal principles of this general type exist. If T-to-C movement does not occur, on the other hand, one might question this approach, since the principle forcing T-to-C movement in English might be

expected to have the same effect in Spanish, and it is not clear what would cause children to think otherwise.

In what follows, I will not fully resolve the question of the proper analysis of inversion in Spanish *wh*-questions, but I will offer new evidence that T-to-C movement is unlikely to be involved, suggesting that the problems just discussed are thus real. Apart from being new, the evidence to be presented is also of a new type, relying on the phenomenon of syntactic satiation discussed in Snyder 2000, and thus constitutes a demonstration case of the use of satiation in comparative syntax. The section that follows is devoted to a brief overview of satiation.

### **3. Syntactic satiation**

The phenomenon in which initially unacceptable sentences become increasingly acceptable upon repeated exposure has come to be called “syntactic satiation” or “judgment satiation.” Although this phenomenon is familiar to syntacticians anecdotally, it was not explored systematically until Snyder (2000), who made two important findings: (i) that syntactic satiation can be induced in subjects in an experimental setting, and (ii) that not all sentence types are susceptible to satiation.<sup>3</sup>

Snyder reached these conclusions by performing an experiment in which 22 subjects were

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<sup>3</sup> For further discussion of the phenomenon of judgment satiation, see Braze 2002, Hiramatsu 2000 and Sprouse 2007. For discussion of possibly related phenomena, see Kaschak 2006, Kaschak and Glenberg 2004, Kaschak, Loney, and Borreggine 2006, Luka and Barsalou 2005, and Tabor, Galantucci, and Richardson 2004.

presented with 50 test items, where each item consisted of a context (e.g., “Maria believes the claim that Beth found a \$50 bill.”), a test sentence (e.g., “What does Maria believe the claim that Beth found?”), and a request for a yes/no judgment of the test sentence. These 50 items were composed of 5 blocks, where each block consisted of 3 fully acceptable sentence types and 7 unacceptable sentence types in random order. Forward/backward presentation of the 50-item list was balanced across subjects. The 7 unacceptable sentence types, together with example sentences, are given in (8).

(8) a. **Want-for**

Who does John want for Mary to meet \_\_\_?

b. **Whether-island**

Who does John wonder whether Mary likes \_\_\_?

c. **That-trace**

Who does Mary think that \_\_\_ likes John?

d. **Subject island**

What does John know that a bottle of \_\_\_ fell on the floor?

e. **Complex NP Constraint**

Who does Mary believe the claim that John likes \_\_\_?

f. **Adjunct island**

Who did John talk with Mary after seeing \_\_\_?

g. **Left branch**

How many did John buy \_\_\_ books?

The test sentences varied from block to block, but the sentence types remained the same. Moreover, the *whether*-island violations always used the verb *wonder*, and the Complex NP Constraint violations always used *believe the claim*.

Snyder found that subjects exhibited satiation effects with the *whether*-island and Complex NP Constraint violations, but no such effects were found with the *want-for*, *that*-trace, adjunct island or left branch violations. Subject island violations showed a marginally significant satiation effect. These results confirm anecdotal reports that violations of *whether*-islands and the Complex NP Constraint are particularly susceptible to satiation. Importantly, Snyder also found that susceptibility to satiation does not appear to correlate in any straightforward way with degree of initial acceptability, given that *whether*-island and Complex NP Constraint violations differ significantly in this regard. Both anecdotally and in a separate test reported by Snyder, *whether*-island violations are perceptibly more acceptable than CNPC violations, and neither is either the most or least acceptable among the sentence types in (8).

As Snyder points out, if one unacceptable sentence type is satiation-inducing and another is not, it is unlikely that their unacceptability is attributable to the same underlying principle. This suggests, for instance, that violations of *whether*-islands, which are susceptible to satiation, and *that*-trace violations, which are not, must be due to different underlying principles, in accord with the general consensus in the literature about these two phenomena. This same line of thinking can be applied to the inversion phenomena in English and Spanish being explored here.

If failing to do inversion violates the same principles in both languages (e.g., the *Wh*-Criterion), we would then expect such unacceptable sentences to have the same status with regard to satiation, either both being susceptible or not.

The experiment to be described in the following section exploits this fact by testing for satiation in English and Spanish in a variety of sentence types, but crucially including *wh*-questions without inversion, as in (9) and (10).

(9) \*What Mary will say?

(10) \*Qué María dijo?

what      said

‘What María said?’

If this sentence type behaves similarly with regard to satiation in the two languages, this would not be informative for our present purposes, since it would be compatible either with an analysis in which (9) and (10) both violate the same principle or with one in which they violate different principles that happen to have the same status regarding satiation. If, on the other hand, this sentence type shows differing satiation effects in the two languages, this would be difficult to reconcile with an analysis attributing their unacceptability to a single common principle.

#### **4. An experiment**

## 4.1 Method

45 native speakers of English and 59 native speakers of Spanish (all undergraduate students at the University of Texas at El Paso) participated in this study. The native speakers of English were all raised in the U.S., attended primary and secondary schools where English was the language of instruction, and declared English to be the language that they were most comfortable using. Similarly, the native speakers of Spanish were all raised in Mexico, attended primary and secondary schools where Spanish was the language of instruction, and declared Spanish to be their most comfortable language. Ten of the native speakers of English had had significant childhood exposure to Spanish; none of the Spanish speakers had this with regard to English. The experiment was carried out in full compliance with the university's requirements regarding the protection of human subjects in research. Subjects received course credit in compensation for their participation.<sup>4</sup>

Subjects were told that each item in the experiment would consist of a situation and a test sentence, and that they would then have to decide whether the test sentence “sounds right or not” (“se oye bien o mal”). They were instructed to give their initial reaction to each test sentence, not to try to analyze the sentence, to judge each sentence on its own without trying to remember previous judgments and to refrain from turning back to look at their previous responses.

Subjects were first presented with a set of 4 practice items. The above instructions were then

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<sup>4</sup> Because all students in selected courses were allowed to participate, the number of participants in the two groups is not evenly matched.

repeated and 50 experimental items were given. Each consisted of a context (the “situation”), a test sentence, and a request for a yes/no judgment on the test sentence. A sample in each language is given in (11).

(11)a. Situation:

Alice will write the letter at home.

Test sentence:

What will Alice write at home?

Does this sound good?

YES NO (Circle one)

b. Situación:

Héctor vendió una mesa en la escuela.

Oración a prueba:

¿Qué vendió Héctor en la escuela?

¿Se oye bien?

SI NO (Encierre uno)

The 50 experimental items were presented in 5 blocks of 10 items each, each block containing 4 fully acceptable sentences and 6 unacceptable sentences, based on standard judgments in the literature. Though each block contained the same set of sentence types, the tokens were different, with the result that no sentence was repeated within the list of 50. The order of the sentence types within blocks was randomized, and forward/backward presentation of the entire list was balanced across subjects. The items were presented on paper, with one item per page.

The 6 unacceptable sentence types presented to English-speakers are shown in (12), with an example of each.

(12)a. **No inversion**

\*What John will buy at the store?

b. **Subject island**

\*What does Jane know that a bottle of fell from the table?

c. **Complex NP Constraint**

\*What does Brenda accept the idea that Tom should sell?

d. **Adjunct island**

\*Who did Alice speak with Tim after seeing?

e. **Left branch**

\*How many did Jill buy books?

f. ***that*-trace**

\*Who does Jake think that is at work?



Two examples each of the following two acceptable sentence types completed the block of 10:

(13)a. **Matrix object extraction**

What will Jeff see in the park?

b. **Embedded object extraction**

What does Mike think that Cindy will read?

The 6 unacceptable sentence types presented to Spanish-speakers are largely similar to those of English and are shown in (14), with an example of each.

(14)a. **No inversion**

\*Qué Juan compró en la tienda?

what bought in the store

‘What did Juan buy in the store?’

b. **Subject island**

\*De qué sabe María que una botella se cayó de la mesa?

of what know that a bottle REFL fell from the table

‘Of what does María know that a bottle fell from the table?’

c. **Complex NP Constraint**

\*Qué acepta Carmen la idea de que Héctor venda?

what accept the idea of that sell

‘What does Carmen accept the idea that Héctor sells?’

d. **Adjunct island**

\*A quién habló José con Irma después de ver?

whom spoke with after of see

‘Whom did José speak with Irma after seeing?’

e. **Left branch**

\*Cuántos compró Mario libros?

how-many bought books

‘How many did Mario buy books?’

f. **Double psych-fronting**

\*A nadie la música le gustó.

to nobody the music 3s-IO pleased

‘The music pleased nobody.’ (= ‘Nobody liked the music.’)

The two sets of sentence types in (12) and (14) are mostly the same, but in place of the *that*-trace violation in (12f), the equivalent of which is fully acceptable in Spanish, (14f) is substituted.

The 4 acceptable sentence types for Spanish are shown in (15), together with examples.

(15)a. **Matrix object extraction**

¿Qué vendió Héctor en la escuela?

what sold in the school

‘What did Héctor sell at school?’

b. **Embedded subject extraction**

¿Quién cree Silvia que está en el trabajo?

who believe that is in the work

‘Who does Silvia believe is at work?’

c. **Embedded object extraction**

¿Qué quiere Jesús que Laura venda?

what want that sell

‘What does Jesús want Laura to sell?’

d. **Single psych-fronting**

A nadie le dio miedo la película.

to nobody 3s-IO gave fear the movie

‘The movie frightened nobody.’ (= ‘Nobody was scared by the movie.’)

## 4.2 Results

Two methods were used to determine whether a given unacceptable sentence type induced satiation among subjects. In the first, the number of subjects showing a pattern of judgments indicating satiation was compared to the number who showed a reverse pattern. Satiation patterns were taken to be those where a subject initially gives a *no* response, switches to a *yes* response at some point, and then consistently responds *yes* thereafter. These patterns are shown in (16) (where Y and N indicate *yes* and *no* responses across the five presentations of the given sentence type), and the reverse patterns are given in (17).

(16)a. NYYYY

b. NNYYY

c. NNNYY

d. NNNNY

(17)a. YYYYN

b. YYYN

c. YNNN

d. YNNNN

If the number of subjects with a response pattern as in (16) is significantly greater by sign test than the number with a pattern as in (17), this suggests that that sentence type is susceptible to satiation. Since the test items were balanced for forward/backward presentation across subjects,

such an effect cannot be due to differences in the acceptability of individual sentences.

The results using this method for the English-speaking subjects are given in Table 1.

	Satiation pattern (16)	Reverse pattern (17)	$p =$
No inversion	4	4	.635
Subject island	2	2	.690
<b>Complex NP Constraint</b>	<b>10</b>	<b>3</b>	<b>.046</b>
Adjunct island	1	1	.750
Left branch	0	2	.250
<i>that</i> -trace	5	6	.500

Table 1: Number of English-speakers with satiation pattern and reverse pattern (N=45)

As in Snyder 2000, there is a significant satiation effect for the Complex NP Constraint, but not for the other violations. Unlike Snyder, there is not even a marginally significant effect for Subject island violations. Of particular interest is the fact that there is no satiation effect for the No Inversion sentence type.

Using this same method for the Spanish-speaking subjects yields the results in Table 2.

	Satiation pattern (16)	Reverse pattern (17)	$p =$
<b>No inversion</b>	<b>12</b>	<b>1</b>	<b>.002</b>
Subject island	6	2	.145
Complex NP Constraint	9	4	.134
Adjunct island	1	1	.750
Left branch	0	1	.500
Double psych-fronting	8	3	.114

Table 2: Number of Spanish-speakers with satiation pattern and reverse pattern (N=59)

Here there is a significant satiation effect for the No Inversion sentence type.<sup>5</sup>

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<sup>5</sup>Snyder used a more lenient definition of what constitutes a satiation pattern, allowing any pattern in which the number of *yes* responses in the final two presentations exceeds the number in the first two presentations to count as satiation. Patterns YNNYY, NYNYY, NNNYN, YNYYY, NNYYN, and NNYNY thus count as satiation, in addition to the patterns in (16). Likewise, patterns NYYNN, YNYNN, YYYNY, NYNNN, and YYNNY count as the reverse, in addition to (17). Reanalyzing the data using this definition, the results for English remain essentially the same: Only the Complex NP Constraint violation shows a significant effect (18 subjects show satiation, 5 the reverse,  $p = .005$ ). For Spanish, there are some differences: The effect with No Inversion becomes only marginally significant (14 show satiation, 7 the reverse,  $p = .095$ ), and the effect with Double psych-fronting becomes marginally significant (12 show satiation, 5 the reverse,  $p = .072$ ). Snyder's definition is intuitively less appealing than the more restrictive definition adopted here, in that it allows unclear patterns such as NNYYN to count as

The results so far indicate that satiation obtains in the case of the Complex NP Constraint for English speakers and in the case of No Inversion for Spanish speakers. The method used to obtain these results has the advantage of looking only at individual subjects and counting only those cases that appear to be clear satiation, but one might object that only a small number of subjects exhibit either the satiation pattern or the reverse, and that many subject responses thus go uncounted. A way to address these concerns is to compare the overall number of *yes* responses on the first two presentations of a given sentence type to those on the final two presentations by paired *t*-test. Given the balanced forward/backward presentation of test items, subjects see one of two possible sentences on the first presentation, and on the fifth presentation they see the other of these same two sentences. Likewise, the two sentences that are possible for the second presentation are also those possible on the fourth. By comparing the first two presentations to the final two, we are thus comparing judgments (albeit by different subjects) on the same four sentences, differing only in early vs. late presentation. The third presentation is the same sentence for all subjects and is omitted from the comparison.

Using this second method yielded results that largely corroborate those obtained by the first method. The results for English speakers are in Table 3.

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satiation. Still, it is roughly in line with the results obtained using the other two methods discussed here.

	Presentations 1 and 2	SD	Presentations 4 and 5	SD	$p =$	Cohen's $d$
No inversion	32.20	37.15	34.45	41.05	.688	.05
Subject island	11.10	23.55	14.45	27.45	.473	.13
<b>Complex NP Constraint</b>	<b>23.35</b>	<b>36.3</b>	<b>41.1</b>	<b>38.85</b>	<b>.008</b>	<b>.47</b>
Adjunct island	7.80	18.35	8.90	22.1	.710	.05
Left branch	7.80	23.75	5.55	19.15	.486	-.10
<i>that</i> -trace	24.45	36.34	24.45	37.88	1.00	0

Table 3: English speakers' percentage of *yes* responses in early and late presentations (N=45)

There is a significant increase in acceptability (and a medium effect size, as indicated by Cohen's  $d$ ) with the Complex NP Constraint, but not with the other violations, suggesting that this is the only constraint among those considered here that is susceptible to satiation. This is the same conclusion reached by using the first method (Table 1).

The results for Spanish speakers are shown in Table 4.



	Presentations 1 and 2	SD	Presentations 4 and 5	SD	$p =$	Cohen's $d$
<b>No inversion</b>	<b>40.50</b>	<b>43.35</b>	<b>49.50</b>	<b>45.45</b>	<b>.067</b>	<b>.20</b>
Subject island	12.05	25.15	18.10	34.45	.180	.20
Complex NP Constraint	25.00	35.20	31.05	39.30	.209	.16
Adjunct island	0.86	6.50	0.86	6.50	1.00	0
Left branch	1.72	13.0	0	0	.322	-.19
<b>Double psych- fronting</b>	<b>11.20</b>	<b>26.56</b>	<b>21.55</b>	<b>37.60</b>	<b>.033</b>	<b>.32</b>

Table 4: Spanish speakers' percentage of *yes* responses in early and late presentations (N=59)

There is a significant increase in *yes* responses for the Double-Psych Fronting case, and a marginally significant increase in the case of No Inversion. This is similar, but not identical, to the results obtained with the first method (Table 2). In that method, Double-Psych Fronting did not show satiation, whereas No Inversion did show a fully significant satiation effect.

Combining the results of both methods, we see that there is strong evidence that the Complex NP Constraint induces satiation in English, just as in Snyder 2000. Spanish differs from English in not showing such an effect for the Complex NP Constraint, but some evidence for satiation does

obtain with No Inversion (and with Double Psych-fronting, a constraint that is not relevant to English). Spanish and English coincided in not showing a significant satiation effect for any of the other sentence types.

## 5. Discussion

### 5.1 Implications for inversion

As discussed in section 3 above, the satiation phenomenon is potentially of use for analyzing inversion in English and Spanish, since if *wh*-questions without inversion are susceptible to satiation in one language but not the other, that would provide evidence against an analysis for the two languages in which the lack of inversion violates the same principle in both.

Interestingly, this is largely the result that obtains. In English, *wh*-questions without the required inversion had exactly the same number of subjects showing a satiation pattern of responses as the reverse, as seen in Table 1, and there was only a slight increase in acceptance in the final two presentations compared to the first two, as seen in Table 3. In short, there is little reason to think that No Inversion sentences in English are susceptible to satiation. In Spanish, on the other hand, there are indications that this sentence type is susceptible to satiation. A significantly higher number of subjects exhibited the satiation pattern than the reverse, as seen in Table 2, and there was a marginally significant increase in *yes* responses, as seen in Table 4.

This result is difficult to reconcile with the idea that inversion in *wh*-questions is forced by the same principle (e.g., the *Wh*-Criterion) in the two languages, since if this were the case, we

would expect that principle to be either susceptible to a satiation effect or not, but not to produce the effect in one language and not in the other. The result is consistent, on the other hand, with the idea that inversion follows from different principles in English and Spanish.

Snyder (2000) notes two possible explanations for why only certain sentence types are susceptible to satiation. First, it could be that differences in satiation stem from differences in the formal properties of the grammatical principles underlying the unacceptability (an approach developed further by Hiramatsu (2000)). Second, it could be that satiation occurs only with those sentence types that violate limitations of processing, whereas unacceptable sentence types that are not susceptible to satiation violate properties of the grammar itself (an approach developed further by Braze (2002)).<sup>6</sup> Intriguingly, this second possibility is in accord with what has been suggested independently for inversion, i.e. that it is forced by processing considerations in Spanish, but by purely grammatical constraints in English, as we saw in section 2 (following Goodall 2004, forthcoming). I will not pursue this further here, but it is worth noting the potential role that satiation could play in determining the source of unacceptability in cases like these.

One might speculate that the satiation difference between English and Spanish that has been

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<sup>6</sup> A more nuanced view, following a suggestion by Braze (2002), is that satiation-inducing sentence types violate temporally bounded processing constraints which the processor can learn to overcome with experience by allocating additional resources to the critical region of the sentence. Sentence types that do not induce satiation, however, either violate a grammatical constraint or violate a processing constraint from which the processor is not able to recover even with additional resources.

observed here somehow follows from the fact that No Inversion sentences have a higher level of acceptability in the first two presentations in Spanish than in English, as may be seen by comparing Tables 3 and 4. Recall, however, that Snyder shows that there seems to be no correlation between initial level of acceptability and susceptibility to satiation. This conclusion is corroborated by the results obtained here. Table 3 shows that the Complex NP Constraint and *that*-trace violations are almost identical in their acceptability for English speakers in the first two presentations (23.35 and 24.45, respectively), yet only the Complex NP Constraint violation shows evidence of satiation in the final two presentations. Moreover, if we look just at the first presentation, as in Table 5, we see that the acceptability of the No Inversion sentences is virtually identical in English and Spanish.

	Presentation 1
English	33
Spanish	34

Table 5: Percentage of *yes* responses for No Inversion in first presentation

It thus appears that speakers' initial judgment on *wh*-questions without inversion is remarkably similar in the two languages, but that only Spanish shows the notable increase in acceptability upon subsequent presentations.

It should be noted also that although there are varieties of Spanish in which inversion in *wh*-

questions is not required (primarily in the Caribbean; see Ordóñez and Olarrea 2001, Suñer 1994, Toribio 2000), there is no reason to think that any of the subjects in this experiment were speakers of such a variety. All were from northern Mexico, where *wh*-questions without inversion are strongly unacceptable, and where there does not appear to be significant contact with varieties that permit non-inversion.

## 5.2 CNPC

One initially puzzling result of this study concerns the differing behavior of Complex NP Constraint violations in English and Spanish. In English, this sentence type induced a clear satiation effect, whether measured by the number of individual subjects showing a satiation pattern of responses (Table 1) or by the overall increase in acceptability among the subjects as a group (Table 3). In Spanish, on the other hand, we find no evidence for such an effect (see Tables 2 and 4). Why would there be a difference like this between English and Spanish?<sup>7</sup> There are a number of possibilities, but the most likely is that it is due to a small, but potentially important structural difference between complex NPs in the two languages. In Spanish, the head noun takes a PP complement, which in turn contains a clausal complement, as illustrated in (18) (cf. (14c)).

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<sup>7</sup> As an anonymous reviewer points out, if the effect size for satiation in the English CNPC were small, then the lack of satiation with the Spanish CNPC could very likely be due to a “type II” error of inference (failure to detect an effect when one is, in fact, present). The effect size for CNPC satiation in English does not appear to be small, however (as seen in Table 3, Cohen’s *d* is .47, and for the results shown in Table 1, Cohen’s *g* is .27 for the CNPC). Though it cannot be ruled out, it thus seems unlikely that the Spanish results are due to a type II error and I will pursue another possible explanation here.

- (18) [DP la idea [PP de [CP que Héctor venda \_\_\_ ]]]  
 the idea of that sells  
 ‘the idea that Héctor sells’

In English, the head noun takes its clausal complement directly, without the mediation of the PP, as in (19) (cf. (12c)).

- (19) [DP the idea [CP that Tom should sell \_\_\_ ]]]

Given the additional structure present in Spanish, and in particular given the fact that extraction out of PPs is strongly disallowed in Spanish, it is perhaps not surprising that Complex NP Constraint violations appear to behave differently in the two languages. Despite the common label, the two cases may not be directly comparable.

### 5.3 Double Psych-fronting

Another area of interest concerns Double Psych-fronting in Spanish, an unacceptable sentence type that we saw in (14f), repeated here as (20).

- (20) \*A nadie la música le gustó.  
 to nobody the music 3s-IO pleased  
 ‘The music pleased nobody.’ (= ‘Nobody liked the music.’)

This sentence type presented some evidence of being susceptible to satiation. There was no significant difference between the number of subjects showing the satiation pattern and those showing the reverse (see Table 2), but subjects overall did show an increase in acceptability between the first two presentations and the final two (see Table 4). There is no correlate to this sentence type in English, so this was not part of the stimulus set for English-speaking subjects.

The fact that Double Psych-fronting displays at least a mild satiation effect is perhaps not completely unrelated to the case of inversion in *wh*-questions, the more central concern of this study. The term “double psych-fronting” is used here to describe cases where both arguments of a psych-verb appear to the left of the verb, but not through clitic left-dislocation. In (20), for instance, both the experiencer *a nadie* ‘to nobody’ and the theme *la música* ‘the music’ are to the left of the verb. This is what is ruled out, even though either of these arguments may be fronted alone, as in (21).<sup>8</sup>

(21)a. A nadie le gustó la música .

to nobody 3s-IO pleased the music

‘The music pleased nobody.’ (= ‘Nobody liked the music.’)

b. La música no le gustó a nadie.

the music NEG 3s-IO pleased to nobody

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<sup>8</sup>(21b) exhibits the well-known phenomenon of negative concord in Spanish. See Zagona 2002 for an overview.

‘The music pleased nobody.’ (= ‘Nobody liked the music.’)

Bare quantifiers such as *nadie* ‘nobody’ are well-known to resist clitic left-dislocation, but they are easily fronted as focused phrases, which is apparently the case in (20). When an experiencer is used that accepts a clitic left-dislocation interpretation, the counterpart of (20) is fully acceptable:

(22) A Juan, la música le gustó.

to the music 3s-IO pleased

‘The music pleased Juan.’ (= ‘Juan liked the music.’)

If (20) is in fact the result of focusing the experiencer *a nadie* ‘to nobody’, the question then becomes why the theme *la música* ‘the music’ cannot be fronted at the same time. A full answer to this question would take us beyond the scope of this paper, but it is worth noting that there are significant similarities between this double psych-fronting constraint and the phenomenon of required inversion in *wh*-questions that we have been examining in this paper. In both cases, what is disallowed is a quantified expression (i.e., the bare quantifier or the *wh*-phrase) followed by a DP and the verb. If their unacceptability has a common explanation, as their superficial resemblance might suggest, the fact that they both show some similarity with regard to satiation would not be surprising (see Hernanz and Brucart 1997 and Zagona 2002 for more comprehensive reviews of the similarities between focus movement and *wh*-movement in Spanish).



#### 5.4 Implications for the study of satiation

With regard to the experimental investigation of satiation more generally, the results reported above confirm the basic findings of Snyder (2000) in a number of ways. They show that satiation can indeed be induced experimentally, that not all sentence types are susceptible, and more specifically, that the Complex NP Constraint is one of the types that is susceptible (at least for English speakers).<sup>9</sup> The only possible conflict concerns subject island violations, where Snyder found marginally significant satiation effects, a result that was not replicated here.

One important difference between Snyder's study and the present one concerns the repetition of particular lexical items. In the two sentence types that clearly induced satiation in Snyder's study, *whether*-islands and the Complex NP Constraint, the former always had the string *wonder whether* and the latter always had *believe the claim that*. It is at least imaginable that the increasing acceptability of these sentence types was due to the presumed increasing familiarity with these collocations. Snyder addressed this point by including a post-test at the end of the 50-item questionnaire in which subjects were presented with an additional *whether*-island violation, but with *ask* instead of *wonder*, and an additional CNPC violation, but with *accept the idea* instead of *believe the claim*. Results from this post-test suggest that there was a significant carryover effect for satiation across lexical items. Nonetheless, the question remains whether satiation can be induced entirely on structural grounds, i.e. when the lexical items are varied

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<sup>9</sup> Compare this result, however, with Hiramatsu (2000) and Sprouse (2007), who did not find a satiation effect for English with the Complex NP Constraint.

from the very beginning. In the present study, then, the five test sentences for the Complex NP Constraint involved a variety of verbs and head nouns (*accept the fact, reject the idea, make the suggestion, propose the hypothesis, accept the idea*), but there was nonetheless a clear and significant satiation effect that was just as robust as that obtained in Snyder 2000, where *believe the claim* was used in all five initial presentations of this sentence type. This suggests that the satiation effect that we are observing is indeed due to subjects' perceiving structural similarities across presentations, not just lexical repetition.

A concern in interpreting satiation effects is that the results might be due to factors not directly related to structural properties of the sentences. For instance, one could speculate that whether or not a sentence type is susceptible to satiation follows from its level of acceptability relative to other sentence types, with higher levels of acceptability leading to a greater likelihood of satiation. As we saw in section 3, however, Snyder did not find a correlation between acceptability and satiation, and the results obtained here corroborate this finding. Table 3 shows that in English, the most acceptable sentence type on the first two presentations is No Inversion, yet this sentence type was not susceptible to satiation. CNPC violations, on the other hand, were susceptible to satiation, even though they are less acceptable than No Inversion. Similarly in Spanish, as shown in Table 4, Double-Psych showed some evidence of satiation, but it is less acceptable than CNPC violations, which did not. Overall, then, the initial level of unacceptability in and of itself is not able to predict susceptibility to satiation.

Sprouse (2007) suggests that acceptability may do a better job of predicting satiation when sentence types that are easily correctable (i.e. when subjects could plausibly detect the source of the violation without difficulty) are excluded, and in fact this is true for the English sentence types examined here. Both No Inversion and *that*-trace appear to be easily correctable (the former by changing the word order, the latter by deleting *that*), and when these are no longer considered, CNPC becomes the most acceptable sentence type. As we have seen, it is also the type susceptible to satiation. In Spanish, however, correctability predicts that we would get exactly the same results as in English, and we have seen that this is clearly not the case. Both No Inversion and Double-Psych are easily correctable (by changing the word order in both cases), and eliminating these again leaves CNPC as the most acceptable. Unlike English, though, this sentence type was not susceptible to satiation in Spanish. Correctability thus does not appear to be able to account for the contrasts in patterns of satiation that we have observed across the two languages.

Sprouse (2007, 2009) also suggests that the satiation effect may be an artifact of experimental design in which the number of acceptable and unacceptable sentence types is unbalanced. He points out that in Snyder's experiment, each block consists of 7 unacceptable and 3 acceptable sentences, with the result that at the end of block 3, subjects have seen 21 unacceptable sentences and only 9 acceptable sentences. If subjects are disconcerted by this imbalance, they might then adopt an equalization strategy in the later presentations, attempting to increase the number of 'yes' responses and thus creating a satiation effect. Although this possibility of an equalization strategy playing a role in the outcome of the present study cannot be excluded, it seems unlikely.

Each block consists of 6 unacceptable and 4 acceptable sentences, so that by the end of the third block, subjects have seen 18 unacceptable and 12 acceptable sentences. This is an imbalance, of course, but it is not clear if subjects would perceive this as sufficiently different from a perfectly balanced ratio (15 unacceptable vs. 15 acceptable) to trigger an equalization strategy. Moreover, even if we were to attribute the satiation effect to this type of strategy, this would still not explain why only certain sentence types are affected and why English and Spanish appear to show different results.

## **6. Conclusion**

As we have seen, initially unacceptable *wh*-questions without inversion appear to differ in English and Spanish with respect to the stability of judgments upon repeated exposure, with evidence for increasing acceptability only in Spanish. This argues against attributing the unacceptability to the same constraint (or cluster of constraints) in the two languages, since that would leave this difference in susceptibility to satiation unexplained, and strengthens arguments that processing factors may play a role in explaining inversion effects. At a more general level, the present study suggests that satiation can be a useful new source of evidence in comparative syntax.

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