The limits of syntax in inversion

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Introduction

It is well known that *wh*-movement is often accompanied by a change in word order in the area between the moved *wh*-phrase and the gap. Specifically, a verbal element often shows up in a non-canonical position to the left of the subject, a phenomenon known as 'inversion.' Examples are given in (1) for English and (2) for Romance.

(1)   What will Mary say?
(2)   a. *Che cosa   ha detto   Maria*?   [Italian]
           what   said
           'What did Mary say?'
        b. *Qu'   a dit   Jean*?   [French]
           what   said
           'What did Jean say?'
        c. *Onde   foi   a Maria*?   [European Portuguese]
           where   went
           'Where did Maria go?'
        d. *Què   farà   en Joan*?   [Catalan]
           what   will do
           'What will Joan do?'
                                (Examples from Hulk & Pollock (2001))

The study of this phenomenon has a long history in generative grammar, where it has generally been taken to be a quintessentially syntactic phenomenon (see, for example, Kayne and Pollock (2001), Pesetsky and Torrego (2001), Rizzi (1996), and Zubizarreta (2001) for some recent analyses). Here I will argue that in at least some types of Romance inversion, the explanation for why inversion occurs seems to lie not in syntax alone, but in the interplay between universal properties of sentence processing and language-particular syntactic properties, with the result that the syntactic mechanisms needed to account for inversion are greatly reduced over what has previously been assumed.[1]

Some properties of sentence processing

Wh-movement produces a filler-gap structure, and it is known that these structures pose special difficulties for the processor (Fodor (1978)) due to the need to

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[1] This paper has benefited enormously from comments from students in my Spring 2005 graduate seminar at UCSD and from audiences at the University of Maryland, the Universitat de Barcelona, the University of Hawai'i, and of course CLS. All errors remain my own.

process the filler (the *wh*-phrase), process the intervening material while holding the filler in working memory, and integrate the filler to the gap position when the subcategorizing verb is encountered. Thus the more intervening material there is between the filler and the gap/subcategorizing verb, the harder the sentence is to process. Notice that we then expect that Romance *wh*-questions without inversion, as in Spanish (3a), will be harder to process than those with inversion, as in (3b) (or (2)).

(3)   a. **Qué   *Juan*   *compró*?
            what   bought
        b. *Qué*   *compró*   *Juan*?
            what   bought
            'What did Juan buy?'

The idea that I pursue in this paper is that (3a) is not just harder, but is in fact so hard to process that it is perceived as unacceptable. This is only plausible if the intervening material in (3a) (i.e., the preverbal subject) poses an unusually large processing burden. This idea is not obviously true, given that the preverbal subject may, as in (3a), consist of just a single word, so first we must see whether subjects in Spanish have any properties that might make them particularly disruptive when they intervene between a filler and a gap.

Some properties of subjects in Spanish

Unlike the general case in English, subjects in Spanish may be either overt or null, and either preverbal or postverbal. As we would expect, each possibility carries a certain discourse value or information load. Overt subjects, for instance, are widely taken to be (very roughly) contrastive or emphatic. The consequences of the choice of position of the subject are more subtle, but one possibility is that judgment type is involved, with the default interpretation of preverbal subjects being that of categorical judgment, in which the subject is presented as a distinct individual, separate from the predicate. Bare plurals, for instance, are thus generally excluded as preverbal subjects, since they are typically incompatible with a categorical judgment (Byrne (1998)):

(4)   a. **Estudiantes   *llegaron.*
             Students   arrived
        b. *Llegaron*   *estudiantes.*
            Arrived   students
            'Students arrived.'

Important details aside, it seems clear that the choice of a subject which is overt (vs. null) and preverbal (vs. postverbal) results in a subject with a high information load and significant discourse value (see also Hornstein (1999) and Rizzi (2004)).

Notably, intervening material that has strong links to discourse or that is highly individuated has been claimed to be especially disruptive to the processing of filler-gap dependencies (Frazier and Clifton (2002), Kluender (1998), Warren and Gibson (2002)), so there is indeed plausibility to the idea that overt, preverbal subjects in Spanish can interfere with the processing of a *wh*-question to such an extent that the sentence is perceived as unacceptable.

Evidence from the nature of the filler

One piece of evidence in favor of this idea is that the acceptability of sentences like (3a) varies depending on the nature of the filler/*wh*-phrase. D-linked *wh*-phrases, for instance, yield substantial improvement, as seen in the contrast between (5a) and (b).[2]

(5)   a. ***Cuáles de esos libros***   *Ana*   *leyó*?   3.885[a]
           which of those books   read
           'Which of those books did Ana read?'
      b. ****Qué*   *Ana*   *leyó*?   2.192[b]
           what   read
           'What did Ana read?'   N = 26

This is expected under this account, since D-linked *wh*-phrases are processed differently than bare *wh*-phrases and can survive better in working memory while intervening material is processed (De Vincenzi (1991), Frazier and Clifton (2002), Kluender (1998)). An intervening preverbal subject is thus more easily tolerated without causing an unacceptable processing strain overall.[3]

We also find that the choice of *wh*-word greatly influences the level of acceptability of the sentence. *Wh*-words that clearly need to be associated with a gap show a very poor tolerance for an intervening preverbal subject, while those that are less clearly linked to a gap show greater tolerance:

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[2] In examples (5), (6), and (8), the numbers to the right of each sentence are the mean ratings of subjects in experiments on a scale from 1 "very bad" to 5 "very good". Before beginning the experiment, subjects were given an instruction sheet and 4 practice test sentences, followed by group discussion of the task and of their ratings of the practice sentences. An appropriate context was provided for each sentence. Forward and backward presentation of the test sentences was balanced across subjects. All subjects were native speakers of (Mexican) Spanish; native bilinguals and early bilinguals were excluded. Means with different superscripts differed significantly ($p = .03$ by Tukey HSD). Traditional notation for acceptability judgments are given as well ('*', '?', etc.), but these are intended as a rough guide only. The number of subjects, which ranges from 23 to 26, is also indicated.

[3] Note that as we would expect, (5a) is still not perfect. Its rating is significantly lower than standard, fully acceptable examples of *wh*-movement, such as (6e).

(6) a. *_**Qué**_ _Juan_ _leyó en la biblioteca?_ 2.130[a]
          What   read in the library
        'What did Juan read in the library?'
     b. *_**A quién**_ _María_ _vio en el parque?_ 2.478[a]
          Who   saw in the park?
        'Who did María see in the park?'
     c. ?*_**Dónde**_ _Ana_ _compró el periódico?_ 2.957[b]
          where   Ana   bought the newspaper
        'Where did Ana buy the newspaper?'
     d. ?*_**Cuándo**_ _José_ _escribió la carta?_ 3.043[b]
          when   wrote the letter
        'When did José write the letter?'
     e. _**Por qué**_ _Miguel_ _trabaja tanto?_ 4.783[c]
          Why   work so much
        'Why does Miguel work so much?' N = 23

The general principle, that the more there is a clear filler-gap dependency that must be processed, the more disruptive an intervening preverbal subject is, makes sense, in that preverbal subjects can only be disruptive if there is something to disrupt.

Notice that the crucial factor is whether the _wh_-phrase is clearly linked to a gap. If we put _por qué_ 'why' in an environment where it clearly links to a gap (e.g., when it is extracted from an embedded clause), then it too disallows an intervening preverbal subject, as seen in (7) (from Ausín and Martí (2001)).

(7) *_Por qué_ _Juan_ _dice_ _que_ _beberá_ _cerveza?_
       Why   say that will-drink beer
     'Why does Juan say that he will drink beer?'
                              (OK with matrix extraction reading)

We have seen, then, that the inversion requirement in _wh_-questions in Spanish is highly sensitive to the nature of the _wh_-phrase, in a way that is predicted if inversion is driven by processing considerations. We now turn to the effect that the nature of the preverbal subject has on inversion.

Evidence from the nature of the preverbal subject
One general result from the processing literature is that entities that are already present in the discourse are easier to process than those that aren't. One consequence of this is that pronouns are easier to process than full DPs, and among pronouns, 1st- and 2nd-person are easier than 3rd-person (see Gibson (2000), Kluender (1998), and Warren and Gibson (2002)). We then expect these distinctions to affect the relative acceptability of intervening preverbal subjects in Spanish _wh_-questions, with full DP subjects being more disruptive than 3rd-person

pronouns, which in turn should be more disruptive than 1st- and 2nd-person pronouns. Some speakers do report perceiving these distinctions, although only the 2nd-person vs. full DP contrast reaches statistical significance:[4]

(8)   a. ?*_Qué_ **_tú_**   _leíste_   _en la biblioteca?_   2.174[a]
          what   you   read   in the library
       'What did you read in the library?'
       b. *_Qué_ **_ellos_**   _leyeron_   _en la biblioteca?_   1.957[a,b]
          what   they   read   in the library
       'What did they read in the library?'
       c. **_Qué_ **_el niño_**   _leyó_   _en la biblioteca?_   1.913[b]
          what   the child   read   in the library
       'What did the child read in the library?'   N = 23

More robust contrasts may be produced by varying the information load of the preverbal subject. This may be done by comparing standard Spanish with related languages/dialects in which the status of the preverbal subject differs significantly. In Caribbean Spanish, for instance, neither null subjects nor postverbal subjects are available as freely as in standard Spanish, and as a result, overt preverbal subjects are more the default, without a special information load or discourse value (see, e.g., Toribio (2000)). We then expect intervening preverbal subjects to be more easily tolerated in filler-gap dependencies in this variety of Spanish, and that is in fact the case, as has been widely observed. Moreover, the sort of distinctions seen in (8) above are more detectable in this variety. Ordóñez and Olarrea (to appear) show that speakers of Dominican Spanish (one type of Caribbean Spanish) have clear contrasts among sentences like those in (8). Unlike in standard Spanish, where even the "best" of (8) (i.e. (8a)) is still quite bad, in Dominican Spanish (8a) is virtually perfect, and acceptability drops off perceptibly from there, with sentences of type (8c) being worse than those of type (8b), as we would predict.

Brazilian Portuguese appears to be similar, in that overt subjects do not have the contrastive or emphatic status that they do in standard Spanish and postverbal subjects are not as freely available. Overt preverbal subjects thus do not have a heavy information load (see, e.g., Duarte (2004)), and as we would expect, they are well tolerated when intervening in a filler-gap dependency:

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[4] Notice that significance aside, the distinctions do go in the predicted direction. It may be that a measure more sensitive than a judgment task would be able to reliably detect the relevant distinctions here. More careful work is also needed to know whether the distinctions are due to discourse accessibility, as I have suggested here, or phonological heaviness. In either case, (8) provides evidence that _wh_-questions are sensitive to the nature of the intervening subject, as is expected under the analysis pursued here.

(9)   *Quem   a Maria   viu*?
         Who   saw
        'Who did Maria see?'

Caribbean Spanish and Brazilian Portuguese thus appear to confirm in dramatic fashion the basic idea being pursued here: that the inversion effect results from a preverbal subject having properties that disrupt the processing of a filler-gap dependency. Preverbal subjects in standard Spanish generally have such properties, while those in Caribbean Spanish and Brazilian Portuguese do not. We have seen additionally that a preverbal subject may have these properties to a greater or lesser degree, yielding the gradience in judgments seen in (8) in standard and, especially, Caribbean Spanish.

Even within "standard Spanish," of course, it is unrealistic to expect that all varieties will have exactly the same information load for overt preverbal subjects, given that rates of overt subject use, for instance, are known to vary from region to region. We would thus expect the degree to which an overt preverbal subject disrupts a filler-gap dependency to vary subtly from speaker to speaker. One way to probe this variation is to consider it in conjunction with the differing behavior of particular *wh*-words that we saw in (6). Recall that *wh*-words appear to vary in the extent to which they establish a filler-gap dependency and consequently, in the extent to which an intervening preverbal subject is disruptive. We saw that the equivalents of the *wh*-words on the left in (10) were most sensitive to the presence of an intervening preverbal subject (resulting in unacceptability for the *wh*-question), while that on the right was the least (resulting in full acceptability).

(10)   WHAT   >   WHERE   >   WHY
        WHO   WHEN

If a speaker has a relatively low information load for overt preverbal subjects, we would expect to see the results of this most readily in the intermediate case of *wh*-questions with 'where' or 'when', since a preverbal subject should be able to survive there more easily for this speaker than for those with a more difficult-to-process preverbal subject and the sentence should thus approach full acceptability. Only if the speaker has an extremely light information load for preverbal subjects (as in Caribbean Spanish) will the non-inversion pattern also be possible with 'what' or 'who'. It should be impossible, though, for a speaker to allow non-inversion with 'what' but not 'where' or 'why', for instance, since if the preverbal subject is easy enough to process that it does not interfere with a filler-gap dependency with 'what', the same should also be true with 'where' and 'why', which have a much weaker filler-gap dependency.

Interestingly, these are just the results that are found in Baković (1998). Based on a survey of a large number of speakers, he shows that dialects draw the line

between acceptability and unacceptability in different places in (10), but they all obey this basic hierarchy. That is, speakers differ as to whether they allow a preverbal subject with 'where' and 'when', for example, but if they do, they also allow it with 'why'. This sort of constrained variation is what we expect if speakers vary in the information load associated with a preverbal subject and the extent to which it disrupts a filler-gap dependency. Overall, then, the evidence we have seen so far supports the idea that the non-inversion pattern in *wh*-questions is ruled out in Spanish just when the preverbal subject is particularly difficult to process.[5,6]

Evidence from satiation

Snyder (2000) has suggested that the phenomenon of satiation, in which unacceptable sentences start to sound better upon repeated exposure, may affect only those sentence types that are unacceptable for processing reasons, while those that are unacceptable for purely syntactic reasons are immune. In work in preparation, I show that *wh*-questions with preverbal subjects in Spanish (for speakers of standard Spanish, for whom such sequences are generally unacceptable) do seem to be susceptible to satiation, thus supporting the idea that it is processing, not syntax itself, that excludes non-inverted *wh*-questions.

In the experiment, 59 native speakers of Spanish were given a set of 50 test sentences and asked whether each sounds acceptable. Among these 50 sentences were 5 *wh*-questions without inversion such as (6a), which would typically be judged unacceptable. Forward vs. backward presentation of the set of test sentences was balanced across the subjects. On the first two presentations of the non-inverted *wh*-questions, 40.5% of the judgments were 'yes' (i.e., 'acceptable'), whereas on the final two presentations, the 'yes' judgments rose to 49.5%, a marginally significant increase ($p = .0674$ by paired *t*-test). Another way to

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[5] Some additional relevant data are discussed in Goodall (2004), where this idea is presented in a very preliminary form.

[6] Another factor that remains to be explored fully is the difference between matrix and embedded clauses. Although embedded questions in Spanish behave just like main questions with respect to inversion for most speakers (as we would predict, since the filler-gap dependency is essentially the same), extraction of a *wh*-phrase out of an embedded clause into a higher clause does not behave entirely as expected. There appears to be a slight preference for a postverbal subject in the embedded clause in such cases, but a preverbal subject is clearly possible and thus apparently does not interfere unduly with the processing of the filler-gap dependency. This suggests that perhaps (i) the filler-gap dependency within the embedded clause (where the filler is null) behaves differently than what we have seen in matrix clauses with overt fillers, (ii) there is not as heavy an information load associated with the preverbal position in the embedded clause as there is in the matrix clause, or (iii) the overt filler-gap dependency is less susceptible to disruption by a preverbal subject once the filler has been held in working memory over the course of the matrix clause. I do not know at this point which, if any, of these ideas has merit. Note, incidentally, that the matrix subject is required to be postverbal in these environments, just as we would expect. It is only the embedded subject which has this curious ability to be either preverbal or postverbal.

analyze the results is to count the number of subjects who switched their judgment from 'yes' to 'no' over the course of the 5 presentations versus those who switched from 'no' to 'yes'. Only one subject fell into the former group, while 12 were in the latter, a significant difference (p = .00171 by sign test). Under either form of analysis, the results suggest that *wh*-questions without inversion are susceptible to satiation in Spanish. If satiation is a trait of sentence types that violate processing constraints, then this conclusion supports the general analysis of inversion that I am proposing here.

Evidence from English

Given the logic of what we have seen so far, we would expect that English would be like Caribbean Spanish and Brazilian Portuguese and not require inversion in *wh*-questions. The reason is that overt preverbal subjects are clearly the default in English, i.e., null subjects are not allowed, and postverbal subjects are not generally possible. One would thus not expect preverbal subjects to have a particularly heavy information load or discourse value, and they should not interfere with the processing of a filler-gap dependency. This is correct: overt preverbal subjects are perfectly able to intervene in a filler-gap dependency, as seen in (11), without any degradation in acceptability.

(11)   What will John buy?

On the other hand, though, it is clear that the auxiliary must appear to the left of the subject:

(12)   *What John will buy?

Whatever the explanation for the contrast in (11)/(12) is, though, it cannot be the same as that proposed here for Spanish (3), despite the superficial similarity. We saw that in Spanish (3), there was a clear processing advantage for (3b) (the case with inversion), and there were reasons to think that the preverbal subject in (3a) disrupts the processing of the filler-gap dependency to such an extent that the sentence is perceived as unacceptable. Neither of these considerations holds true in the English case, however. (11) and (12) seem to be equal in their processing difficulty (the distance between *what* and *buy* is the same in both), and in any event, the preverbal subject should not be particularly disruptive.

The logic of the Spanish case, then, suggests that the English case is not a pure processing effect. This in turn predicts that English inversion will not display the characteristics that we have been observing in Spanish, and this seems to be true. The need for inversion in English *wh*-questions is not alleviated by a D-linked *wh*-phrase, as seen in (13) (cf. Spanish (5)), nor does it vary depending on the *wh*-word used, as seen in (14) (cf. Spanish (6)):

(13)   *Which of those books John will buy?

(14)   a. *What John will buy?
        b. *Who John will see?
        c. *Where John will buy those books?
        d. *When John will buy those books?
        e. *Why John will buy those books?

Acceptability also does not seem to be affected by the nature of the intervening subject (cf. Spanish (8)):

(15)   a. *What you will buy?
        b. *What they will buy?
        c. *What the child will buy?

Moreover, the same sort of test for satiation described earlier for Spanish was performed with 45 native speakers of English, and no evidence for satiation with non-inverted *wh*-questions (such as (12)) was found. On the first two presentations of the non-inverted *wh*-questions, 32.2% of the judgments were 'yes' (i.e., 'acceptable'), while on the final two presentations, the 'yes' judgments rose to only 34.45%, a non-significant increase ($p = .6879$ by paired *t*-test). Under the alternative analysis of the results, 4 subjects switched their judgments from 'yes' to 'no', while an equal number switched from 'no' to 'yes'. We thus see no sign of satiation in this construction in English.

Overall, then, the processing considerations that we made use of for Spanish do not look promising in explaining the need for inversion in English. Instead, English inversion shows every sign of being a purely syntactic process, impervious as it is to the nature of the *wh*-phrase or the subject and insusceptible to satiation. Although it is not clear why this syntactic process occurs (but see some comments on this below), the claim that this is what is responsible for inversion in English fits nicely with the general idea developed here regarding the status of the subject and how this affects filler-gap dependencies. English subjects do not appear to have properties that would interfere with a filler-gap dependency, so we would not expect the inversion effect in English to be driven by processing considerations.

Child language acquisition: Romance vs. English
The contrast that we have developed so far between inversion in English and in Spanish (and perhaps in Romance more generally) makes an interesting prediction with regard to the acquisition of *wh*-questions in the two languages. If sentences such as (3a), repeated here as (16), are ruled out because they pose too much of a processing burden, they should not be any easier for children (in fact if anything, they should be harder).

(16)   *_Qué   Juan   compró_?
       what   bought
       'What did Juan buy?'

We thus do not expect children to produce sentences like this at any stage, since they should be difficult to process from the very beginning. In English, on the other hand, we might expect children at some point to produce superficially similar sentences such as (12), repeated here as (17), because these do not pose any special processing difficulties.

(17)   *What John will buy?

Not producing (17) involves learning that there is a syntactic process that requires the auxiliary to be to the left of the subject, and until that is learned, the child might very well produce (17).

The development of _wh_-questions in children has been extensively studied, and the basic facts turn out to be just what we would predict. In Spanish (and Italian and Catalan), children never produce sentences like (16) (see Grinstead (2001), Guasti (2000), Serrat & Capdevila (2001), and Soares (2003)). All children correctly invert in _wh_-questions from the start; there appears to be no individual variation.

The developmental pattern in English is quite different, in that many children do produce uninverted _wh_-questions such as (17) (see, for example, Klima & Bellugi (1966), Labov & Labov (1978), and Stromswold (1990)). In fact, many go through a long period of unstable development, sometimes inverting and sometimes not, and in general, there is considerable individual variation. This is just what we expect if there is something that must be learned in order to avoid (17), and especially so if what must be learned is not forced by other considerations.

Conclusion
This paper has argued that the phenomenon of inversion in _wh_-questions in Spanish (and presumably in some other Romance languages) is the result of processing constraints, not the syntax _per se_. Overt preverbal subjects are especially difficult to process in Spanish, and this interferes with the processing of the dependency between the _wh_-phrase and the gap. Evidence for this idea has come from the following observations about Spanish: the overall acceptability of _wh_-questions is affected by the nature of the filler and the nature of the intervening preverbal subject, unacceptable _wh_-questions with a preverbal subject become significantly more acceptable upon repeated exposure (i.e. they are

susceptible to satiation), and children show a uniform and error-free course of development with regard to inversion in *wh*-questions.

This result is significant in that it shows that this instance of inversion, which was previously thought to involve relatively complex syntactic mechanisms, can now be reanalyzed as the interaction between universal properties of processing (e.g. how the processor deals with filler-gap dependencies and what can interfere with this) and very basic syntactic and other properties of the language (e.g. where subjects can appear and what information load is associated with each subject position). On the syntax side in particular, all that needs to be said is that the language has *wh*-movement and that both preverbal and postverbal subjects are possible (see, e.g., Olarrea (1996) and Ordóñez (1998)).

Many researchers have concluded from the pervasive co-occurrence of *wh*-movement and inversion cross-linguistically that this must follow from UG principles. Rizzi (1996), for instance, has proposed that the co-occurrence results from the *wh*-criterion, and Pesetsky and Torrego (2001) suggest that it follows from universal constraints on extraction.[7] The results that have been presented here, however, suggest caution in pursuing such an approach. First, at a very general level, we have seen that the term 'inversion', though useful descriptively, lumps together phenomena that in fact appear to be fundamentally different, such as the inversion effects in Spanish and English. The apparent pervasiveness of the co-occurrence of *wh*-movement and inversion is thus deceiving, in that what is co-occurring with *wh*-movement is not always the same thing. Second, at a more specific level, if *wh*-movement forces T-to-C movement to occur for principled reasons, it is then not clear how Spanish can be accommodated, since we have seen that T-to-C movement apparently plays no role in deriving the inversion effect in this language.

The general picture that emerges here is that the syntax forces no connection between *wh*-movement and inversion. Instead, *wh*-movement with a non-inversion order may result in a structure which is prohibitively difficult to process, as in Spanish (or which is not, as in Caribbean Spanish, Brazilian Portuguese, or English), or the language may require that *wh*-questions trigger T-to-C movement, as in English. This latter option appears to be a language-particular property which must be learned separately by the child. Although learning T-to-C movement is not trivial (and as we have seen, some children take a long time to fully acquire it), it does not appear to pose any problem of principle.

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[7] This is of course just a thumbnail sketch of Rizzi (1996) and Pesetsky and Torrego (2001) which cannot do justice to either. Both allow for a significant amount of parametric variation, but both also attempt to show that T-to-C movement occurs in English *wh*-questions for principled reasons.

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