

# Language specific preferences in anaphor resolution: Exposure or Gricean maxims?

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## Abstract

In this paper we will present evidence for language specific preferences in anaphor resolution from two series of experiments in English, German, and French. For within sentence anaphor resolution with “before” subclauses, we will show that English and German follow the generally assumed preference for the first mentioned NP or subject of the sentence, whereas French shows a clear preference for the object of the matrix clause. We will argue that our data can most easily be explained by a usage-based account, linking comprehension preferences to production preferences.

**Keywords:** Sentence processing; anaphor resolution; crosslinguistic differences; usage-based preferences

## Introduction

It has been shown for many languages that the resolution of non-reflexive pronouns is strongly influenced by pragmatic factors such as topicality (in the sentence or in the discourse; Givon, 1983), the chain of causality, and other kinds of discourse relations (e.g. Kehler, 2002; Sanders & Noordman, 2000). On the sentence level, two of the factors that seem to play a role are a preference for the first mentioned antecedent (Gernsbacher, 1990), and a preference for the subject (Jaervikivi, van Gompel, Hyöna, & Bertram, 2005). These preferences are assumed to be valid across languages so that for subject-verb-object sentences like (1) a preference for the first noun phrase would generally be predicted, given that it is mentioned first and the subject at the same time.

(1) **English:** *The postman met the streetsweeper before he went home.*

**French:** *Le facteur a rencontré le balayeur avant qu'il rentre à la maison.*

**German:** *Der Briefträger hat den Strassenfeger getroffen bevor er nach Hause ging.*

More language specific predictions can be derived from accounts based on the availability of alternative constructions in the grammar of a particular language. According to the Gricean Maxim of Manner (Clarity), speakers should avoid ambiguous constructions in choosing unambiguous alternatives if they exist. If for an ambiguous construction an unambiguous alternative exists for one of the readings, listeners may thus assume that the speaker would have chosen this alternative for the respective reading. From this reasoning, a preference for the reading without an unambiguous alternative will result for the ambiguous construction.

In this paper, we will compare closely matched constructions in English, French, and German (see examples 2-5) to investigate cross-linguistic differences in pronoun resolution. What makes the comparison of these languages particularly interesting, is the distribution of alternative constructions for the different interpretations of an ambiguous sentence like (1): In French, a highly frequent construction exists for binding an anaphoric pronoun to the subject of the matrix clause (2) which does not exist for German.

- (2) **English:** *The street-sweeper met the postman before going home.*  
**French:** *Le balayeur a rencontré le facteur avant de rentrer à la maison.*

Following the Gricean Maxim of Manner, the existence of this alternative predicts a preference for an object antecedent in sentences with full pronouns for French in contrast to the presumably saliency based preference for the subject for German. Listeners hearing a French sentence with “avant que” followed by a full pronoun will assume that the speaker would have used the unambiguous infinitival form in (2) had she intended the temporal clause to relate to the subject of the matrix clause. The pronoun is thus preferentially interpreted as relating to the object of the matrix clause for which no such alternative exists.<sup>1</sup>

English is an interesting case for comparison, given that an alternative construction with a zero anaphor exists for subject antecedents (2). This construction is, however, used less frequently than the infinitival construction in French. Gricean accounts would thus predict that English patterns with French with respect to pronoun resolution.

An unambiguous alternative for one of the readings may also influence frequencies of usage. In a small scale corpus analyses (100 sentences per language) we established the following distribution: 77% subject antecedents for German (Frankfurter Rundschau), 64 % subject antecedents for English (Wall Street Journal) and 100 % (Le Monde) or 85% (Google News groups) object antecedents for French. Frequency based accounts would thus position English between German and French.

## Experiments

### Series 1: Visual World Experiments

In our first series of experiments, participants (32 native French speakers, 32 native English speakers, and 24 native German speakers) were presented with pictures such as in Figure 1 showing two characters while they listened to sentences such as (3-6). Their task was to judge whether a sentence presented aurally matched the picture or not. All 16 experimental trials were “match” cases. Half of the 4 practice items as well as of the 24 filler items were “mismatch” cases. Mismatches were realized by including characters in the sentence that were not in the picture (such as: “The florist prepared a bouquet for the street-sweeper”). Mismatches were realized at different positions during the sentence.

<sup>1</sup>The same pattern would be predicted by Ariel’s (1990) accessibility hierarchy: less informative anaphora are predicted to prefer more salient antecedents. The zero anaphor in the infinitival construction in French, prefers the subject as the most salient antecedent. Using a full pronoun can thus be interpreted as a cue to search for a less salient antecedent which would be the object in sentences such as (1).

**Materials:** In our experimental materials, the subclause introduced by *before*, *avant que*, or *bevor*, was semantically biased for the High Antecedent (HA, the subject of the sentence which is situated higher in the phrase structural representation of the sentence, 3,5), or the Low Antecedent (LA) the object (4,6) of the main clause as antecedent of the pronoun. To control for visual scanning preferences, the first mentioned character was either on the left (3,4) or on the right (5,6) side of the screen. As a between participants factor, we also switched the position of the characters for half of the participants, so that, for example, the postman was on the right of the screen and the street sweeper on the left.

- (3) **French:** *Le facteur a rencontré le balayeur avant qu’il ramasse les lettres.*  
**English:** *The postman met the street-sweeper before he picked up the letters.*  
**German:** *Der Briefträger traf den Straßenfeger, bevor er die Briefe einsammelte.*
- (4) **French:** *Le facteur a rencontré le balayeur avant qu’il ramasse la poubelle.*  
**English:** *The postman met the street-sweeper before he picked up the trash.*  
**German:** *Der Briefträger traf den Straßenfeger, bevor er den Abfall einsammelte.*
- (5) **French:** *Le balayeur a rencontré le facteur avant qu’il ramasse les lettres.*  
**English:** *The street-sweeper met the postman before he picked up the letters.*  
**German:** *Der Straßenfeger traf den Briefträger, bevor er die Briefe einsammelte.*
- (6) **French:** *Le balayeur a rencontré le facteur avant qu’il ramasse la poubelle.*  
**English:** *The street-sweeper met the postman before he picked up the trash.*  
**German:** *Der Straßenfeger traf den Briefträger bevor er den Abfall einsammelte.*

Eight lists were created such that each item appeared in a different condition across lists, but only once in each list. Participants were first presented with four practice items followed by one of the eight lists of experimental items mixed with 24 filler items. The lists were randomized individually. Participants received course credits for their participations. Each experiment lasted less than 30 minutes including calibration. Eye movements were recorded using the Eyelink II<sup>®</sup> system by SR research.



Figure 1: Example of the visual stimulus material

**Results:** We calculated the likelihood of a gaze on either of the two critical picture elements by time steps of 20 ms starting from 500 ms before the onset of the pronoun (*he/she*) and ending at 2000 ms after the onset of the pronoun. From these data, we calculated the *logodds* for a gaze on the first-mentioned referent at each time step. Values below zero represent more fixations on the object, values above zero more fixations on the subject. Figure 2 shows the results for English, Figure 3 for German, and Figure 4 for French. HA means High Antecedent and corresponds to the subject, LA means Low Antecedent and corresponds to the object. “Left” and “right” correspond to the position of the subject on the picture.

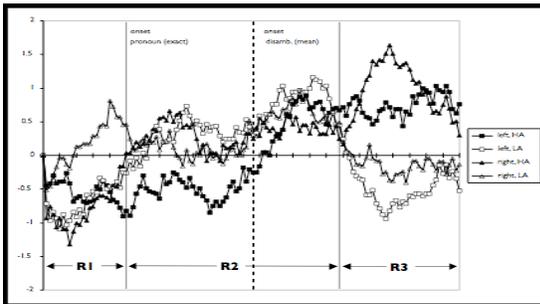


Figure 2: Time course analysis for English;  $\log_2(p(\text{sub}/p(\text{obj})))$ , HA=High Antecedent, subject; LA=Low Antecedent, object

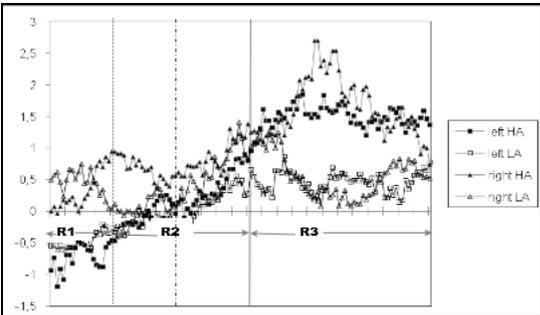


Figure 3: Time course analysis for German;  $\log_2(p(\text{sub}/p(\text{obj})))$ , HA=High Antecedent, subject; LA=Low Antecedent, object

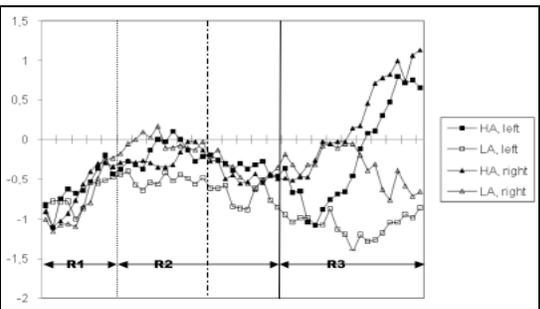


Figure 4: Time course analysis for French;  $\log_2(p(\text{sub}/p(\text{obj})))$ , HA=High Antecedent, subject; LA=Low Antecedent, object

Before the onset of the pronoun, marked by the first vertical line in Figures 2 to 4, participants had a tendency to fixate the object more often than the subject (for German speakers, this tendency is somewhat modulated by the position of the object). This is not surprising, given that the object was the last mentioned entity in the matrix clause. After the onset of the pronoun, participants did not show any preference for a short period of time. This probably reflects the time needed to process the pronoun plus the time for planning a saccade (at least 230ms + 250 ms = 480 ms). After this period, German and English speakers fixated the subject more often than the object, whereas French speakers fixated the object more often. Disambiguation can only start playing a role after the onset of the disambiguating word plus at least 480 ms (given the time needed for processing and saccade planning). The dotted vertical line reflects the mean onset of the disambiguation, the third vertical line shows the earliest point possible for disambiguation to kick in. Participants start fixating the corresponding character more often after this point. Note that the onset of disambiguating is earlier in German due to German word order.

We defined three critical time periods for each individual trial: the 500 ms period before the onset of the pronoun (R1), the time period from the onset of the pronoun until 480 ms after the onset of the disambiguating region (R2), and the remaining time steps until 2000 ms (R3). For each participant and condition, respectively item and condition, we calculated a single *logodds* value per time period. The summarized data across conditions for English, German, and French are shown in Table 1.

**Table 1:** Average log odds for gazes on the first-mentioned referent, broken down by region. Ninety-five percent confidence limits are listed in parentheses (by subjects / by items).

Language	R1	R2	R3
English	<b>-0.50</b> (±0.52 / ±0.43)	<b>+0.34</b> (±0.28 / ±0.19)	<b>+0.40</b> (±0.45 / ±0.32)
German	<b>-0.09</b> (±0.51 / ±0.32)	<b>+0.35</b> (±0.33 / ±0.34)	<b>+1.14</b> (±0.22 / ±0.32)
French	<b>-0.90</b> (±0.36 / ±0.28)	<b>-0.38</b> (±0.30 / ±0.22)	<b>-0.50</b> (±0.29 / ±0.29)

The eye movements show clear differences between the languages investigated. In the ambiguous region R2, we find a reliable preference to look at the subject of the matrix clause for English and German. In German, this extends even to the disambiguating region R3. In French, however, participants preferentially fixated the character corresponding to the object of the matrix clause.

One question remains to be answered at this point: Do the French fixation preferences reflect interpretational

preferences or possibly just differences in visual scanning patterns? Since the object of the matrix clause is at the same time the last entity mentioned before hearing the ambiguous pronoun, our French participants may have preferred to continue fixating the entity they just heard of until disambiguating information would be made available by the linguistic input. French participants did actually look at the character representing the object of the matrix clause more often than German and English participants even in Region 1. In order to test this possibility, we ran a further eye-tracking experiment with 32 native French speakers, using constructions with no structural alternative for either of the possible interpretations (7a-d). A subject preference would be predicted for these cases.

- (7) a. *Le facteur a rencontré le balayeur. Puis il a ramassé les lettres.*  
 The postman met the street-sweeper. Then he picked up **the letters**.
- b. *Le facteur a rencontré le balayeur. Puis il a ramassé la poubelle.*  
 The postman met the street-sweeper. Then he picked up **the trash**.
- c. *Le balayeur a rencontré le facteur. Puis il a ramassé les lettres.*  
 The street-sweeper met the postman. Then he picked up **the letters**.
- d. *Le balayeur a rencontré le facteur. Puis il a ramassé la poubelle.*  
 The street-sweeper met the postman. Then he picked up **the trash**.

The set up of the experiment was identical to the earlier experiments. Since the preference for the more local referent could only be established for French, we will only present the French data here (see Figure 5).

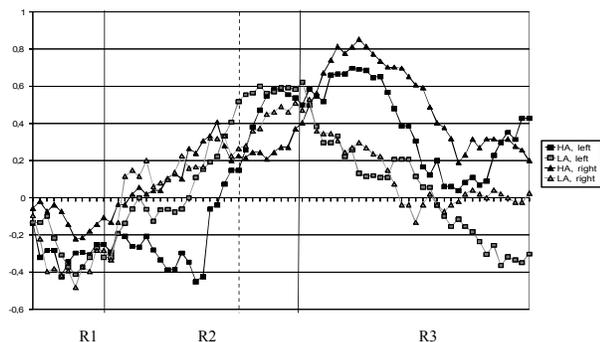


Figure 5: Time course analysis for French between-sentence anaphor resolution;  $\log_2(p(\text{sub})/p(\text{obj}))$ , HA=High Antecedent, subject; LA= Low Antecedent, object

As in the earlier experiments, the French participants started with an increased number of fixations to the object of the first sentence. However, after a short period without any preferences right after the onset of the pronoun, they look

reliably more often at the character representing the subject of the matrix clause. Note, that the pictures we used in this experiment were identical to the ones used before. Clearly, French speakers do not have different visual scanning patterns. In cases where a subject preference is predicted, they clearly look at the character representing the subject more often, although the subject is the less local entity.

Figure 6 summarizes the results of all four experiments: Remember that values above zero reflect more looks to the subject, whereas values below zero reflect more looks to the object of the matrix/first clause. The most striking differences can be found in Regions 2 and 3: For within sentence pronoun resolution the subject is preferred as the antecedent for German and English, and likewise for between sentence anaphor resolution in French. The only deviating cases are French within sentence anaphors, showing a preference for the object.

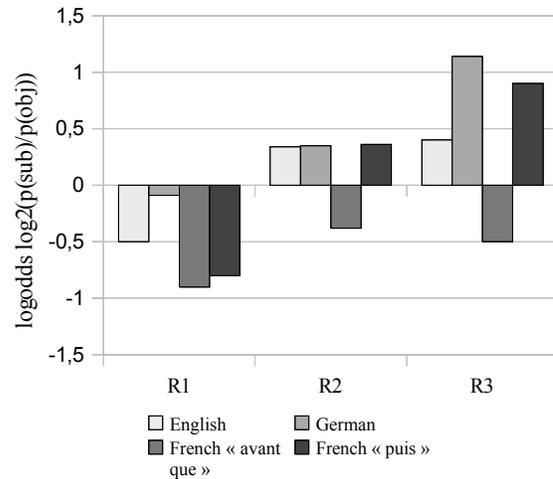


Figure 6: Average log odds for gazes on the first-mentioned referent, broken down by region.

The fixation patterns are thus far compatible with the corpus frequencies mentioned above. We can, however, not be fully sure that they really reflect interpretational preferences and not just fixation preferences. We therefore ran a series of questionnaire studies in all three languages to clarify this issue.

## Series 2: Questionnaires

**Materials and procedure.** In this series of experiments, we presented participants with ambiguous sentences derived from the materials used in the eye tracking experiments and asked them to fill a gap in a paraphrase following each sentence to indicate their interpretation of the pronoun.

- (7) **French:** *Le facteur a rencontré le balayeur avant qu'il rentre chez lui.*  
 Le \_\_\_\_\_ rentre chez lui.
- English:** *The postman met the street-sweeper before he went home.*  
 The \_\_\_\_\_ went home.

**German:** Der Briefträger hat den Straßenfeger getroffen, bevor er nach Hause ging.

Der \_\_\_\_\_ ging nach Hause.

We also included a cross-sentence condition (8), where the second sentence always started with “puis”, “then”, or “dann”.

(8) **French:** Le facteur a rencontré le balayeur. Puis il est rentré chez lui.

**German:** Der Briefträger hat den Straßenfeger getroffen. Dann ist er nach Hause gegangen.

**English:** The postman has met the street-sweeper. Then he went home.

To control for semantic/pragmatic biases, we switched the grammatical role of the characters as a between participants factor, so that, for example, the postman became the object of the matrix clause and the street sweeper became its subject. We created eight lists so that each item appeared in a different condition but only once in each list. The 16 experimental items were interspersed with 64 filler items mostly from unrelated experiments. Each list was randomized once. 32 native speakers of each language participated in the experiment.

**Results.** Figure 7 shows the results of the questionnaire experiments. All three languages showed a clear preference for the subject for between sentence pronoun resolution for sentences with “puis”, “then”, and “dann” (all ps < .01). However, whereas English and German participants chose the subject of the matrix clause more often as the antecedent of the pronoun for within sentence pronoun resolution as well, French participants chose reliably more often the object of the matrix clause.

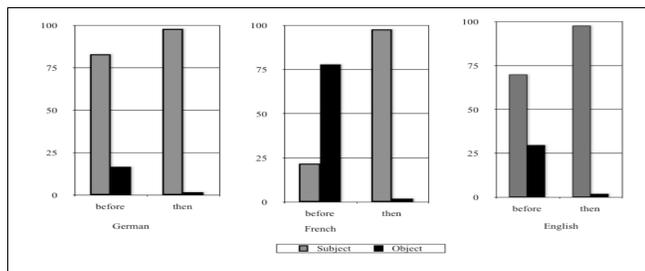


Figure 7: Decisions in % for the subject or the object of the main/first clause as the antecedent of the pronoun.

## Discussion

In our experiments, we established the following pattern:

- All three languages show a clear subject preference for between sentence pronoun resolution in sentences like (7) and (9).

- German and English, both show a subject preference for within sentence pronoun resolution (3-6, 7).
- French shows a clear object preference for within sentence pronoun resolution (3-6, 7).

An explanation of the differences between German and French before-sentences could be based on the Gricean Principle of Manner (avoid ambiguity). In French, the temporal clause can be unambiguously related to the subject of the matrix clause using an infinitival construction such as (2). In German, no such alternative construction exists. French listeners or readers might thus apply a Gricean logic taking the object of the matrix clause as the antecedent of the full pronoun in (1).

A Gricean account is, however, hard to reconcile with the English data: For English, an alternative construction relating the temporal clause to the subject is available as well (2). Still, the full pronoun in (1) consistently shows a clear preference for the subject across experiments. An experience-based account would be fully compatible with the results of the sentences with « before » as can be seen in the small scale corpus study mentioned above (see Figure 8 for a direct comparison of off-line decisions and corpus data).

The Gricean Principle of Manner neither predicts production preferences nor comprehension preferences in English. This finding is very much in line with earlier evidence showing that speakers do not follow the Principle of Quantity (they very often produce more information than necessary in referring expressions, e.g., Pechmann, 1989), neither are they generally cooperative in using unambiguous alternatives for one of the possible interpretations of an unambiguous construction (Ferreira & Dell, 2000). Arnold, Wasow, T., Asudeh, and Alrenga (2004) likewise argue against sentence production as designed to be easily comprehensible for the audience, based on a consistent lack of ambiguity avoidance. The choice of linguistic expressions seems to be more affected by cognitive pressure than by cooperativeness (Wardlow & Ferreira, in press).

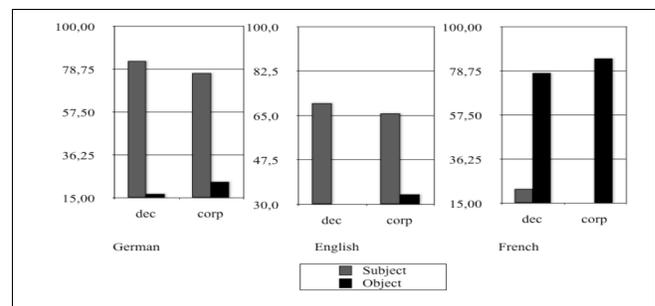


Figure 8: Decisions in % for the subject or the object of the main clause as the antecedent of the pronoun compared to corpus counts

However, we still have to explain why French and English should be different with respect to production

preferences: A reason why French speakers prefer producing an infinitival construction for subject antecedents may be the increased complexity of temporal clauses with « avant que »: The French conjunction “avant que” demands the subjunctive form as do many other conjunctions such as “puisque”, “pour que”, “bien que”, whereas others demand the indicative form, such as “après que”, “lorsque”, “parce que” and many others. The correct marking of the verb will thus have to be adapted to the respective conjunctions. Using the infinitival form avoids the necessity of checking which verb form to use in the actual utterance.<sup>2</sup> No such checking would be needed for English conjunction-plus-pronoun sentences which consistently demand the indicative form.

The results so far would thus be fully compatible with an approach linking comprehension preferences to production preferences (Cuetos & Mitchell, 1988; Gennari & MacDonalds, 2009, Konieczny, 2000). French speakers prefer using the infinitival form whenever possible, which is the case when the infinitival clause is related to the subject of the matrix sentence. “Avant que” plus pronoun will thus mostly be used in cases where the pronoun is related to a non-subject antecedent. These production preferences will result in the distributions observed in the corpora. Exposure to these distributions will consequently shape preferences in comprehension.

We do, of course, by no means imply that pronoun resolution preferences are based on exposure exclusively. Factors such as information structure, coherence relations and others are most certainly playing a role as well. An interesting question for further research will be, in how far the crosslinguistic differences established in our experiments extend to other conjunctions, and in how far they interact with factors influencing the prominence of antecedents such as first mention, topicality, prominence, and many more (Colonna, Schimke, & Hemforth, 2009; Schimke, Colonna, & Hemforth, 2009). We will also have to extend our research to other languages. Interestingly, European Portuguese provides a combination of alternatives highly comparable to what can be found in French. Recent self-paced reading experiments and questionnaire studies (Baumann, Konieczny, & Hemforth, 2010) show a clear object preference for pronouns in Portuguese constructions parallel to those under investigation in this paper.

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<sup>2</sup>French native speakers are actually not always fully sure of which form to use. A short questionnaire sent by mail to 20 doctoral students (mostly from the linguistics department) asking for the correct verb to use in sentences like “Le balayeur a appelé le facteur après qu'il \_\_\_\_\_ rentré à la maison.” (The street sweeper called the postman after he \_\_\_\_\_ gone home. ), resulted in 56 % responses using the subjunctive and 44 % using the indicative. Following normative grammar, “après que” does not demand the subjunctive.

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