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

Barbara Hemforth (barbara.hemforth@parisdescartes.fr)
Laboratoire de Psychologie et de Neuropsychologie Cognitives, CNRS, Université Paris Descartes,
71 ave Edouard Vaillant, 92100 Boulogne-Billancourt, France

Lars Konieczny (lars@cognition.uni-freiburg.de)
Center for Cognitive Science, University of Freiburg, Friedrichstr. 50, 79098 Freiburg, Germany

Christoph Scheepers (c.scheepers@psy.gla.ac.uk)
Department of Psychology, University of Glasgow, 58 Hillhead Street, Glasgow, Scotland

Savéria Colonna (Saveria.Colonna@univ-paris8.fr)
Laboratoire Structure Formelles du Langage, CNRS, Université Paris 8, 59-61 rue Pouchet, 75849 Paris Cedex 17

Sarah Schimke (sarah.schimke@sfl.cnrs.fr)
Laboratoire Structure Formelles du Langage, CNRS, Université Paris 8, 59-61 rue Pouchet, 75849 Paris Cedex 17

Peter Baumann (p.bau@web.de)
Center for Cognitive Science, University of Freiburg, Friedrichstr. 50, 79098 Freiburg, Germany

Joël Pynte (joël.pynte@parisdescartes.fr)
Laboratoire de Psychologie et de Neuropsychologie Cognitives, CNRS, Université Paris Descartes,
71 ave Edouard Vaillant, 92100 Boulogne-Billancourt, France

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.¹

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.

**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 participation. Each experiment lasted less than 30 minutes including calibration. Eye movements were recorded using the Eyelink II® system by SR research.

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¹The 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).

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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.

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>
<thead>
<tr>
<th>Language</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>-0.50</td>
<td>+0.34</td>
<td>+0.40</td>
</tr>
<tr>
<td>German</td>
<td>-0.09</td>
<td>+0.35</td>
<td>+1.14</td>
</tr>
<tr>
<td>French</td>
<td>-0.90</td>
<td>-0.38</td>
<td>-0.50</td>
</tr>
</tbody>
</table>

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).

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.](image)

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 Straßen- 
feger 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”.

French: Le facteur a rencontré le balayeur. 
Puis il est rentré chez lui.

German: Der Briefträger hat den Straßen- 
feger getroffen. Dann ist er nach Hause 
gegangen.

English: The postman has met the street- 
sweper. 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 where 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.

- German and English, both show a subject 
  preference for within sentence pronoun resolution 
  (3-6, 7),
- French shows are 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 then 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 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).
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. 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 (Cueto & 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.

References

2French 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.


Acknowledgements
This work was partially funded by the bilateral research grants “Alliance” and “Procope” attributed to the first three authors. We would like to thank the “Linglunch” participants at Paris Diderot as well as our colleagues from the FRIAS in Freiburg for many helpful discussions.