NOTES

1 We will not discuss the further possibility that no syntactic structure building takes place at all.

2 The preference for a nominative marked NP is position dependent. In positions following the main verb, accusative marked NPs are easier to process than nominative NPs if a case-ambiguous NP preceded the verb.

3 Since the determiner was the first word in the sentence, potential effects at the very beginning of this NP may have been obscured by noise.

4 Here a special kind of verb-second sentences in German examined where the “Vorfeld”-position (roughly the so called topic position before the verb in verb-second sentences) is occupied by an adverbial and both arguments remain in the “Mittelfeld” (roughly the area following the verb in these cases).

5 The predictions of most-recent head attachment compare to those of late closure in the garden-path model. However, it is only applied if the other principles fail to provide a decision. This has been expressed in the unified parametrized-head attachment principle, PHA (29), which furthermore serves the purpose of emphasizing the fact that attachment ambiguities are resolved on the basis of certain parameters of lexical heads, such as relative position and lexical preferences.


CHALLENGES TO RECENT THEORIES OF CROSSLINGUISTIC VARIATION IN Parsing:
EVIDENCE FROM DUTCH

DON C. MITCHELL

MARC BRYSBAERT

*Department of Psychology
University of Exeter
Exeter, England

† Department of Psychology
University of Ghent
Ghent, Belgium

1. INTRODUCTION

The last quarter century has seen a burgeoning of systematic and controlled experimental studies of language processing. In this program of studies, 90% of the work has been based on a single language (English) with just a tiny portion of the research effort being devoted to the other 6000 or so languages of the world. Given these circumstances, it is sensible to ask whether the outcomes of this enterprise offer insights into language processing in general or whether researchers have just been formulating dubious generalizations based on idiosyncratic features of individual languages. The present chapter provides a case study of an area of psycholinguistic research in which investigators may have been in danger of overgeneralizing from a narrow evidence base. We shall examine an aspect of parsing in which widely accepted generalizations have turned out to be inaccurate or incomplete and in which languages other than English appear to operate according to principles previously unexplored in mainstream research. The work raises questions about the possibility that different languages are analyzed by
means of qualitatively different procedures. If this turns out to be the case, then a full account of language processing will have to cover more than a description of the general procedures that might be shared by all language-processing systems. It will also have to say something about the special-purpose operations that occur only in individual languages or in subclasses of languages.

2. BACKGROUND

Our discussion will focus on the aspects of syntactic analysis that are responsible for deciding whether a word, phrase, or clause should be associated with one of two or more competing “attachment sites” within a sentence. Classic examples include (1) and (2).

(1) The man saw the spy with binoculars.

(2) Barbara said the politician died yesterday.

In both cases an ambiguous constituent (italicized) can be linked to either of two attachment sites in the sentence (marked in bold). A central challenge for parsing theories is to set out the principles which form the basis for resolving ambiguities of this kind (together, of course, with numerous other examples).

Our treatment of the issue will concentrate exclusively on examples like (2), in which the two potential hosts are both from the same word-class. Although both are verbs in this particular illustration, the two attachment sites will both be nouns in all of the examples considered after this. A decade ago there was, in essence, a complete consensus about the broad principles underlying attachment decisions of this kind. The operating principles were based uniformly on the relative positions of the as-yet-unattached constituent and the competing head sites, and all accounts posited that the new constituent would be attached to the nearest or most recent site. The principle underlying this choice was given a variety of sobriquets, but the claim was essentially the same. In (2) the proposal was that ‘yesterday’ is attached to the nearby ‘died’ rather than the more distant ‘told’ following principles dubbed Late Closure, Right Association, Local Association, and numerous other terms. Thus, in the terminology of the most influential parsing model of the time, Frazier’s (1979, 1987) garden-path model, the relevant operating rule (Late Closure) was “attach new items . . . into the phrase or clause postulated most recently.” Attach ‘yesterday’ to ‘died’ in preference to ‘told.’

Given the theoretical statements current in the mid-1980s it seemed perfectly clear that the same operating principles should apply to sentences like (3).

(3) Someone shot the servant of the actress who was on the balcony.

As before, the ambiguous constituent can be attached to one of (at least) two different sites—again represented by words of the same class (both nouns). Here, as before, the prevailing “recency” or “locality” principles stipulated that the new constituent should be preferentially attached to the closer site (i.e., to ‘actress’).

Indeed, at the time one of us (DCM) conducted a questionnaire study at the University of Exeter confirming that this was true (in the study reported as Experiment 1B in Cuetos and Mitchell, 1988). Thus, the evidence seemed to be entirely compatible with the prevailing theoretical frameworks.

There the story might have ended had Fernando Cuetos not been on an extended research visit to Exeter at the time (Fall, 1986). It was his clear intuition that in a Spanish equivalent of Sentence (3) the relative clause is preferentially attached to ‘el criado’ (‘the servant’) rather than actriz. As we elaborate below, this observation has subsequently been confirmed not only in numerous studies in Spanish, but also in several other languages as well. Much of the subsequent work has tried to explain why it is that the attachment biases of language processors seem to vary from language to language. In the course of this work, researchers have proposed a wide variety of new parsing principles in their attempts to capture the data. Arguably, none of these developments would have come about if the focus of research had not shifted away from the one language that (it turns out) is highly idiosyncratic when it comes to relative clause attachment.

Scientific developments of this kind make a strong case for studying processes in different languages. However, the evidence on crosslinguistic differences raises numerous new problems at the same time. It seems that the machinery for sentence processing and parsing must vary from language to language. This raises several important questions. Does the machinery alter in systematic ways depending on the specific “niche” within which attachment processes have to operate in different languages? Are the fine details of site selection influenced by subtle variations in grammar from language to language? Are they influenced by statistical variations in the frequencies with which different “solutions” turn up in different languages? If we had full answers to all of these questions we could be confident that we have a good understanding of the way in which these parsing choices are determined in different languages.

In this chapter we outline evidence showing how the characteristics of site selection vary from language to language, and we review a variety of theoretical proposals that have been put forward in attempts to explain these differences. We then proceed to examine these proposals and discuss their status in the light of recent psycholinguistic work. In particular, we outline a number of new studies in Dutch and spell out the theoretical implications of these data.

3. A CLOSER LOOK AT THE CROSSLINGUISTIC DIFFERENCES

As we have already indicated, the core questions for present purposes are:
(a) What are the processes by which a modifier like a relative clause is attached to an appropriate noun-head? and (b) Do these processes vary from language to language and if so why?
As we have already noted, intuitive judgments by native speakers suggest that the relative clause is linked to the earlier of the two competing noun phrases in Spanish and to the later one in English. This was confirmed in questionnaire studies carried out by Cuetos and Mitchell (1988). Informants in Spain and England were asked to read sentences like (3) in their own language. Each sentence was followed by a question designed to probe whether the Relative Clause (RC) had been understood as being attached to the first Noun Phrase (NP1) (i.e., 'the servant' or el criado) or the second (NP2: the actress or la actriz). In Example (3) the question was simply 'Who was on the balcony?' or its Spanish equivalent. The results confirmed that NP2 attachment was preferred in English while NP1 attachment predominated in Spanish. The attachment preference in Spanish was examined more closely by conducting a series of self-paced reading studies in which an extra phrase or clause was added to the RC to force NP1 or NP2 attachment. Confirming an existing bias in favor of NP1 attachment, the results showed that people took longer to read phrases that forced the alternative NP2 attachment than those resolved in favor of NP1.

There have been at least five different kinds of theoretical explanations of this crosslinguistic difference, and these will be set out at length in the next section. However, before embarking on this, it is important to establish that the crosslinguistic differences are genuine.

Since the Cuetos and Mitchell study, NP1 preference has been reported in numerous other Spanish studies (e.g., Carreiras, 1992; Carreiras and Clifton, 1993; Gilboy, Sopena, Clifton and Frazier, 1995; Gibson, Pearlmutter, and Torrens, 1997; see Cuetos, Mitchell, and Corley, 1996, for a review). Comparable findings have also been obtained in French (Mitchell, Cuetos, and Zagar, 1990; Pynte and Frenck-Mestre, 1996; Pynte, this volume; Zagar, Pynte and Rativeau, 1997); German (Hemforth, Konieczny, and Scheepers, 1994, in press; Hemforth, Konieczny, Scheepers, and Strube, this volume; Konieczny and Hemforth, 1996); Dutch (Bryshaert and Mitchell, 1996a); Russian (V. Kempe and R. Radach, personal communication, 1993); Afrikaans (P. Swanepoel, personal communication, 1995); and Thai (V. Robertson, personal communication, 1996).

In contrast with these findings (and in line with the original Cuetos and Mitchell results), English appears to show a bias against attaching the RC to NP1. Apart from an early study reported informally by Clifton (1988), all questionnaire studies with monolingual English speakers have shown a bias in favor of NP2 attachment (e.g., Corley, 1996; Cuetos and Mitchell, 1988; Mitchell and Cuetos, 1991b; Gilboy et al., 1995. cf. Type B Kinship Relations; J. Ganger, personal communication, July 1996). Clifton's (1988) questionnaire showed a small NP1 bias—an outlying and arguably aberrant result that has never been fully explained. One possible explanation for this finding could be that bilingual subjects were not systematically excluded from the study. Fernandez (1995) has recently reported evidence that, even when tested only in English, the attachment preferences shown by bilingual Spanish–English readers is different from that shown by monolingual English readers. The normal English NP2 preference seems to be swapped by NP1 biases that presumably come from the competing language. These findings stress the importance of either screening bilinguals from studies or using populations in which bilinguals are rare. Where these conditions are met, questionnaire results show that English readers display attachment biases that are different from those that show up in all other languages tested to date. The evidence considered so far has concerned attachments that end up prevailing once the sentence has been read. It is less certain that these effects exert their influence while the person is still reading the RC under examination. Support for an early NP2 bias of this kind seems to be confirmed in some on-line studies (e.g., Clifton, 1988; Corley, 1996, Section 5.3; Frazier and Clifton, 1996, pp. 79–80). However, the NP2 advantage sometimes fails to reach significance (e.g., Carreras and Clifton, 1993; Mitchell and Cuetos, 1991b; see Cuetos et al., 1996, for a review). In another recent study Henstra (1996) has suggested that these differences may be due to variations in the sensitivity of different experimental tasks. She reports two eye-tracking studies showing clear NP2 attachment effects, whereas the third experiment, using self-paced reading, showed no reliable bias. Perhaps the best interpretation of these results is that for English the initial NP2 bias is real, but relatively weak and therefore difficult to pick up reliably.

Overall, these results seem to confirm that there is a genuine crosslinguistic difference between the attachment preferences in English and (it seems) almost every other language that has been investigated to date. Before moving on to the theoretical accounts of these findings it may be worth commenting on one or two possible exceptions to the apparent generalization that all languages other than English favor NP1 attachment.

The first concerns the pattern of findings in Japanese. Kamide and Mitchell (1997) provided evidence that in this language the relative clause is briefly attached to NP1 as the sentence is being processed but that an NP2 preference eventually prevails by the end of the sentence. However, there are problems in interpreting this finding. Japanese is not directly comparable with any of the other languages studied to date. The RC appears before either of its potential host sites. It is followed by NP1, which for a brief period remains the only legitimate attachment site. The subsequent arrival of NP2 then provides an alternative (and, eventually, preferred) host site. Thus, Japanese contrasts markedly with languages in which two or more attachment sites are available as soon as the relative clause arrives. The analysis is also complicated by the fact that syntactic (phrase-marker) analysis for Japanese places NP2 higher than NP1 (rather than the reverse, as for the other languages discussed so far). Given the differential status of the two potential hosts in Japanese, it is not at all surprising that attachment preferences differ.

There has also been a good deal of debate about the possibility that NP2 attachment might prevail for a brief period during sentence processing in other languages—particularly Italian. Vincenzi and Job (1993, 1995) have carried out
several self-paced reading experiments that appear to show that early reanalyses times were longer in sentences forcing attachment to NP1 than to NP2 (suggesting early NP2 linkage). Questions at the ends of sentences, however, indicated that there must subsequently have been a shift to NP1 preference. At present it is not entirely clear that these results provide solid support for an initial NP2 attachment preference. Pynte and French-Mestre (1996) have recently argued that this non-standard pattern of results may be due to methodological idiosyncrasies of the de Vincenzi and Job studies (see also Pynte, this volume). In particular, the Italian experiments differ from most others in the field in that complex NPs other than genitives (e.g., NP-con-NP; i.e., NP-with-NP) were included in the same on-line sessions as the genitive forms that are the subject of the present crosslinguistic comparisons. Pynte and French-Mestre (1996) present evidence that the presence of alternative complex forms in the experimental materials can shift the initial bias from its normal NP1 preference. The role of such artifacts will have to be examined before it is safe to argue that attachment biases alter over time in languages like Italian.

Before moving on to consider the theoretical interpretations of the crosslinguistic findings, it is perhaps worth noting that studies of modifier attachment have not been restricted to genitive NPs. Nor is it true that RCs are the only modifiers that have been examined. However, the present discussion focuses largely on the attachment of RCs to complex NPs consisting of a NP followed by a genitive prepositional phrase. Readers who are interested in finding out about the findings with other types of NP and modifier are referred to other studies and surveys (e.g., Cueto et al., 1996; de Vincenzi and Job, 1995, 1993; Frazier and Clifton, 1996; Gibson, Pearlmuter, Canesco-Gonzalez, and Hickok, 1996; Gilboy et al., 1995; Hemforth et al., 1994; in press; Konieczny and Hemforth, 1996).

What lies behind the differences in RC attachment? If they result from different parsing procedures, what does this say about the constraints and pressures that shape parsing mechanisms in different languages?

4. THEORETICAL INTERPRETATIONS

Before moving on to consider possible explanations for these crosslinguistic differences, it should be pointed out that the empirical findings on RC attachment are not handled well by all mainstream accounts of parsing. Several proposals billed as relatively comprehensive models of human parsing simply offer no explicit account of RC ambiguity resolution (e.g., Crocker, 1992; Lewis, 1993; McClelland, St. John and Taraban, 1989; see also St. John and McClelland, 1990; Pritchett, 1992; Tanenhaus, Carlson, and Trueswell, 1989). Such accounts are perhaps best viewed as theories of verb-centered aspects of sentence processing rather than full accounts of parsing processes more generally. Other models make incorrect predictions (i.e., NP2 preference) for the majority of the languages investigated so far (e.g., Frazier, 1987; Kempen and Vosse, 1989; see also Kempen, 1996; Konieczny, Hemforth, and Scheepers, 1994). The following paragraphs will be restricted to theories that offer explicit accounts of RC attachment and do a reasonable job of accounting for the basic findings.

Five main theoretical accounts will be considered in the following paragraphs. These are (a) an account based on the Tuning Hypothesis (Mitchell and Cueto, 1991a; Cueto et al., 1996); (b) an account based on parameter setting (Gibson et al., 1996); (c) a constraint-satisfaction lexicalist account (MacDonald, Pearlmuter, and Seidenberg, 1994; Thornton, Gil, and MacDonald, 1995); (d) an account based on Construal Theory (Frazier and Clifton, 1996); and (e) a dual-mechanism explanation proposed by Hemforth and Konieczny (1996).

4.1. The Tuning Hypothesis

Arguably the simplest account of crosslinguistic differences in attachment is that the preference in any language is determined by the frequency with which the alternative attachments are used in comparable structures in that language. For example, the Linguistic Tuning hypothesis maintains that initial parsing choices are made exclusively on the basis of the relative frequencies with which the reader or listener has resolved an ambiguity each way in the past (Brysbaert and Mitchell, 1996a; Cueto et al., 1996; Mitchell and Cueto, 1991a; Mitchell et al., 1995).

According to the Tuning account, there is some kind of mechanism for keeping track of statistical frequencies (see Mitchell et al., 1995, for further discussions of this procedure). These statistical records are then accessed and used whenever the parser encounters a related structural ambiguity. The crosslinguistic differences arise because the statistical records have different entries for different languages (as determined by the exposure to differing language samples). In other words, NP2 attachment dominates in English because the relative clause is most often attached to this site when NP1-of-NP2-RC structures are used in the language. NP1-attachment prevails in other languages for precisely the same reason—because RCs are predominantly linked to the corresponding site in the languages in question.

4.2. Predicate Proximity/Recency Theory

A second theory that offers an explanation of the crosslinguistic differences is the Predicate Proximity/Recency Theory put forward by Gibson et al. (1996). The basic proposal here is that two competing factors play a role in selecting an attachment site for a modifier. These are (a) the structural proximity of each potential host site to the head of the entire predicate phrase (Predicate Proximity), and
(b) the relative distances between the modifier and each of the potential heads. The suggestion is that there are processing tendencies favoring attachments that are close to the head of the predicate phrase, together with biases pushing for attachment to closer or more recent sites (Recency Preference). The model generates its predictions by combining these tendencies in a series of simple formulae to give a numerical measure of "Processing Load" for each of the potential attachment sites. The site associated with the lowest processing load is the one selected as the preferred host.

In a sentence like (3), the Recency mechanism would favor attaching the RC to the nearest potential head ("actress," in this case), whereas PredProx would push to attach the clause to the competing site ("servant"). The preference for attachment to "actress" is explained by Recency being stronger than PredProx (in English). To account for crosslinguistic differences, the model assumes that the PredProx (but not Recency) weights vary from language to language. In particular, it is assumed that the PredProx values are high enough to outweigh Recency in most languages, but that in English the weights are low enough to be swamped by Recency. The model proposes that the value of the PredProx weights is set as a result of exposure to the language in question (in a manner similar to that proposed in tuning accounts). Gibson et al. (1996) speculate that a possible determinant of this measure is the "average distance from the head of a predicate (verb) to its arguments" (p. 49).

A useful feature of the model is that it can easily be adapted to provide explanations for the pattern of attachment preferences in three-site ambiguities like (4).

(4) The lamp near the painting of the house that was damaged in the flood.

Recency favors attaching the RC to 'house' rather than 'painting' and means that both are preferred to interpretations in which the word 'lamp' is the one modified by the clause. PredProx produces exactly the opposite pattern of preferences, and Gibson et al. (1996) have used the theory to account for findings with sentences of this kind. However to return to the crosslinguistic findings, the crucial point is that the theory accounts for the findings by parametrically adjusting the PredProx weights in the model's calculations. Beyond the precise details of the model, it seems that the parameter is assumed to be set by some kind of averaging mechanism that integrates head–argument distances on the basis of exposure to sentences of the language.

4.3. Constraint-Satisfaction Lexicalist Accounts

In the PredProx/Recency model the degree of competition between different tendencies is rather circumscribed. However, other models propose much more open-ended competition. For example, the crucial feature of the Constraint Satis-

faction model (e.g., Boland, Tanenhaus, and Garney, 1990; MacDonald et al., 1994; Tanenhaus et al., 1989) is that information of any type can be used to influence the course of decision making. Models of this kind have only given very limited attention to the problems of modifier attachment and (as far as we are aware) no attention at all to crosslinguistic variations in attachment preferences.

However, there is one version of the model that has specifically addressed the problem of resolving modifier attachment ambiguities. According to this account (MacDonald et al., 1994, pp. 697–698), the attachment of a modifier to NP1 or NP2 within a complex head is determined predominantly by the lexical properties of the nouns occupying two competing slots. Thus if the noun 'actress' attracts a modifier more than the noun 'servant' it will "win" the competition for the attachment and the ambiguity will be resolved in favor of the link with 'actress.' Presumably, on this account an overall preference for NP1 (if NP2) attachment is that the nouns occupying the positions in question have a stronger lexical bias in favor of appearing alongside a modifier. Any variation from one language to another could potentially be explained in terms of the lexical properties of the individual nouns used in the experimental studies. Even where there was close translation (e.g., the Spanish actrice for the English 'actress'), there could never be any guarantee that the modifier-attracting properties of the corresponding nouns remained equivalent in the different languages. And so crosslinguistic differences could be explained away in terms of variations in lexical biases.

Undoubtedly, less head-driven or lexically driven versions of the Constraint satisfaction model could be formulated to offer alternative ways of accounting for the data. However, at the time of writing we are unable to locate any specific models of this kind.

4.4. Construal Theory

In contrast with the theories outlined above, the two final accounts assign no role at all to adjustments that might be made over time as the parser is exposed to language. Construal Theory is a refinement of the highly influential garden-path theory developed by Frazier and her colleagues (e.g., Frazier, 1979, 1987; Frazier and Rayner, 1982). It distinguishes between primary and nonprimary attachments—roughly verb-argument-based and nonargument-based, respectively (though the formal definition is more technical than this—see Frazier and Clifton, 1996, p. 41). Attachments of the kind involved in linking an RC to its head are classified as being nonprimary.

It is beyond the scope of this chapter to provide a full description of the theory. However it is maintained that nonprimary relations (including RC-attachment) are subject to a range of influences including discourse, semantic, and syntactic factors. Of these, one of the strongest is a discourse principle referred to as Relativized Relevance. This states that the parser should "preferentially construe a
phrase as being relevant to the main assertion of the current sentence” (Frazier, 1990, p. 321).

With sentences like (3), it is argued (Frazier and Clifton, 1996, pp. 71–83) that this and related discourse principles introduce a pressure in all languages to attach the RC to NP1 as opposed to NP2 (for other versions of the argument, see De Vincenzi and Job, 1993, 1995; and Gilboy et al., 1996). This provides an explanation of the NP1 bias found in most languages. To account for the nonstandard pattern in English, Frazier and Clifton posit a role for a rather different kind of mechanism—one based indirectly on the existence of different genitive forms in English (Frazier and Clifton, 1996, p. 74 and p. 92; see also Frazier, 1990, p. 324, for earlier discussion). The starting point of the argument is that although the Spanish language has just one grammatical device for expressing a complex genitive NP (i.e., the Norman genitive—el criado de la actriz), English has two: the Norman form (‘the servant of the actress’) and the Saxon form (‘the actress’s servant’). The next point to note is that RCs following the Saxon genitive are not subject to the attachment ambiguity that occurs in sentences using the Norman form. Consider sentence (5)—the Saxon version of our earlier example.

(5) Someone shot the actress’s servant who was on the balcony.

In this case the relative clause can only modify the noun ‘servant.’ Frazier and Clifton go on to argue that readers take account of the alternative grammatical forms that the writer might have used. Assuming that writers try to follow the Gricean maxim of clarity, they argue that they would always display the unambiguous Saxon form whenever they wanted to express statements in which the RC modifies ‘servant.’ The Norman form would therefore be left for situations in which it was not so vital to convey the fact that clause was attached to ‘servant,’ and the use of this ambiguous form would therefore be taken to imply that the RC was intended to be interpreted as modifying the alternative NP (‘the actress’). Playing by the rules of a Gricean contract, the reader would therefore interpret Norman sentences like (3) as signalling that the relative clause should be interpreted as being attached to ‘actress’ (i.e., to NP2). Frazier and Clifton (1996) assumed that this tendency is strong enough to outweigh the competing pressure for high attachment (originating from the effects of relativized Relevance), and this is therefore the essence of their explanation of the NP2 attachment preference in English. From here, just one further step in the argument is needed to explain crosslinguistic differences. In Spanish, the absence of an alternative to the Norman genitive means that there is no basis for this kind of ‘Gricean NP2 preference’ to swamp or reverse the prevailing discourse preference for NP1 attachment. The outcome, according to this argument (henceforth dubbed the ‘Gricean argument’ or the “Gricean hypothesis”), is that NP1 attachment should dominate in Spanish (as the empirical evidence confirms), whereas NP2 attachment should prevail in English (provided that the Gricean effect is stronger than the discourse influence).

4.5. A Referential Account

The final account to be considered here is based on a recent suggestion put forward by Konieczny and Hemforth (1996; Hemforth et al., in press; this volume). These authors speculate that relative clause attachment may be handled by a set of procedures that are different from those used to establish the attachment sites for other kinds of modifiers (such as prepositional phrases). Their conjecture is that these procedures draw in part on some of the processes that are used to resolve ambiguities of anaphoric reference, and they present a case for assuming that it is these operations that are particularly prone to NP1 attachment biases. Like the Gibson et al. model, this account sees attachment choice as determined by the competition between two tendencies—one favoring NP1 attachment and the other favoring NP2 attachment. To account for the fact that attachment biases in English appear to differ from those in other languages, Hemforth and her colleagues draw attention to the fact that relative pronouns are frequently omitted in English relative clauses, whereas deletion of this kind is much rarer in the other head-first languages in which modifier attachment has been investigated. They hypothesize that the optional usage of relative pronouns reduces the salience of these entities in sentence processing, and that this in turn reduces the chance that head searching is taken over by anaphoric rather than nonanaphoric machinery. The consequence is that in English the process of finding a host for an RC is less likely to be taken over by NP1-favoring anaphoric procedures than it is in any other language. Since the account is based on the readiness with which relative pronouns can be eliminated we will dub this the “RelPro-drop model.”

4.6. Recap

According to these different proposals, the attachment of RCs to competing sites (NP1, NP2, etc.) is either determined by reference to a system that records the relative preponderance of comparable attachments in the different languages under consideration (Tuning) or somehow computes the “average distance” between heads and their arguments and uses this figure to adjust the setting of the PredProx parameter (PredProx/Recency). According to another class of exposure-based models (Constraint-Based lexicalist models), the biases are determined solely by the lexical properties of the head nouns. In contrast with these accounts, there are proposals that crosslinguistic variations in RC-attachment are produced (rather indirectly) by subtle differences in the detailed grammatical devices available in different languages. Specifically, Construal theory proposes that the NP2
preference in English can be traced back ultimately to the fact that this language has a Saxon as well as a Norman genitive form for expressing possessive relationships. Stressing a rather different grammatical difference, Hemforth and her colleagues base their case on the legitimacy of dropping the relative pronoun from English RCs, and they use this particular phenomenon to explain crosslinguistic differences. The rest of the chapter will examine which of these accounts is currently most viable. We will start with a general assessment of each of the proposals before moving on to a more detailed considerations of recent evidence from Dutch.

5. A PRELIMINARY EVALUATION OF THESE PROPOSALS

5.1. Tuning

The Tuning hypothesis maintains that statistical factors are the sole determinants of initial RC attachment (and, indeed, the only consideration in the initial stages of any other form of ambiguity resolution). In support of this there is some evidence that NP1 attachment prevails in languages where this bias is evident in extensive corpora of the language, and that the reverse occurs where NP2 attachment dominates in corpus samples. Specifically, NP1 attachment prevails both in psycholinguistic preference studies and in corpora in Spanish (Cueto et al., 1996), and in French (Baltazar and Kister, 1995; Mitchell et al., 1995; Zagar et al., 1997), while NP2 attachment predominates in English corpora and experiments (Corley, 1996; Cueto et al., 1996). However, Gibson and his colleagues have recently presented evidence that suggests that Tuning on its own may not be able to account for all RC-attachment effects (Gibson and Schütze, 1996; Gibson, Schütze and Salomon, 1996). Detailed corpus analyses of the preferences found in three-site RC-attachment ambiguities like example (4) indicate that the middle is systematically preferred to NP1 (and detailed analyses argue strongly that these biases survive whatever grain of analysis is used). However, both off-line (Gibson et al., 1996) and on-line studies (Gibson and Schütze, 1996) show that readers prefer to attach modifiers to NP1 rather than to the middle site. The indications are that they make this choice despite the fact that they are likely to have experienced a predominance of the reverse pattern in the past, which suggests at the very least that "pure" Tuning needs to be supplemented by the acknowledgment that there are at least some nonstatistical influences in determining the initial attachments of RCs to their heads.

5.2. PredProx/Recency

According to the Gibson et al. (1996) model, modifier attachment is guided by just two parameters: Predicate-Proximity and Recency. The features of Recency are assumed to be fixed across languages, leaving Predicate Proximity variation to account for any crosslinguistic variation in attachment preferences. In the current version of the model, the relative weight assigned to Predicate Proximity is assumed to be adjusted from language to language using a mechanism similar to linguistic tuning. The strength of the parameter is assumed to be high where the average distance between a verb and its arguments is high, and low in languages where these two entities typically occur in close succession. In the absence of corpus data, Gibson et al. (1996, p. 49) simply assume that English falls toward the low end of the scale, whereas the NP1-attaching languages presumably lie at the opposite extreme. Unfortunately, in its current form the model makes no commitment to a specific definition of verb/argument distance. This is an important shortcoming, especially considering that the "position" of an argument is uncertain in a free-order language. Nor is there any suggestion concerning the formula that relates "distance" to parameter weight. As a result, there is no way of using the framework to predict the preference order for attachment sites in any new language. To this extent the model falls short of being a fully predictive account of attachment phenomena.

On a more positive note, however, it is fair to say that the model has been quite effective in predicting three-site attachments in English and Spanish (Gibson et al., 1995, 1997; Gibson and Schütze, 1996; Gibson, Schütze, and Salomon, 1996).

5.3. Constraint Satisfaction Lexicalist Models

In its simplest form (e.g., MacDonald et al., 1994, pp. 697–698), attachment biases are attributed to the particular lexical items that appear in the two alternative slots. Thus a constraint-satisfaction system for resolving the ambiguity might settle for NP2 attachment simply because the word "actress" has stronger "modifier-attracting properties" than those associated with its competitor. If this were a complete account of the biases either within a language or across languages, a simple prediction would be confirmed. Namely, the attachment biases would be reversed if the nouns in the two slots were exchanged. However, it turns out that the preference pattern remains the same when the noun in slot NP1 is moved to NP2 and vice versa (Corley, 1996; see also Mitchell et al., 1993, p. 479). The model also predicts that there should be no bias at all in studies that are carefully counterbalanced so that each individual noun appears equally often in the two competing slots. In such circumstances, the more clause-attracting noun will draw the RC to the NP1 position just as often as it does to the NP2 position, leaving no residual imbalance. It turns out, however, that carefully counterbalanced studies of this kind do still show the biases that are characteristic of the languages in question (e.g., Corley, 1996; Gibson et al., 1997; Hemforth et al., in press). In short, the head-driven version of the lexicalist model does not seem to provide a satisfactory account of the data.
5.4. Construal Theory

This theory faces problems in accounting for the bilingual data presented by Fernandez (1995). The fact that Spanish–English bilinguals systematically resolved English RC-attachment ambiguities in a different way from English monolinguals indicates emphatically that the answer to the questions of RC attachment cannot lie exclusively in any linguistic analysis of the sentences themselves. The preferences vary as a function of the linguistic background of the people reading the sentences—a clear indication that RC-attachment preferences are influenced by experience. Furthermore, evidence is accumulating that the presence of an unambiguous Saxon genitive form in a language does not necessarily result in a NP2 attachment preference in that language. On the basis of the Gricean argument, we hypothesized that Afrikaans should show an NP2-attachment preference comparable with that in English (on the grounds that it has an unambiguous Saxon genitive form that is widely used in both written and spoken text). However, an off-line study using sentences translated directly from the Cueto/Mitchell questionnaire produced a 52% NP1-attachment preference (Swanepeol, personal communication, 1995). Further problems for Construal account will be set out shortly when we consider the implications of several recent studies carried out in Dutch.

5.5. The RelPro Drop Account

Like Construal this account has some difficulty in explaining the findings reported by Fernandez (1995). If attachment were determined only by the salience of Relative Pronouns in the language under consideration, then Spanish–English bilinguals should not handle English any differently than English monolinguals. The evidence that they do suggests that readers' patterns of behavior are determined in part by their exposure to different languages in the past and not only by the characteristics of the language they are dealing with at the time of testing. The Hemforth–Konieczny account clearly needs to be elaborated to account for findings of this kind.

6. FURTHER EVIDENCE FROM DUTCH

Studies in any new language raise the possibility of uncovering evidence that may bear upon both exposure-based and grammar-based accounts of crosslinguistic differences. Comparisons of on-line and corpus biases can be used to check whether the two kinds of data are compatible with Tuning and other exposure-based accounts. Equally, grammar-based accounts can be put through their paces by providing new opportunities to examine the detailed effects of grammatical variation (e.g., the existence of competing genitive forms and RelPro deletion).

We have previously reported several studies in which we have examined RC-attachment biases in Dutch (Brysbaert and Mitchell, 1993; 1996a,b; Mitchell, Cueto, Corley, and Brysbaert, 1995). As already indicated, these studies show a consistent bias in favor of NP1 attachment. This has been shown by using a direct translation of the original Cueto/Mitchell Spanish–English questionnaire (Brysbaert and Mitchell, 1996a, Experiments I and II) and also in several eye-tracking and self-paced reading experiments that feature a disambiguation region forcing attachment to one of the two competing sites (Brysbaert and Mitchell, 1996a; Experiments II and III). The type of material used in the on-line studies is illustrated in 5(a,b).

(5) a. De gangsters schoten op de zoon van de actrice die op het balkon zat met zijn arm in het gips.
   "The terrorists shot the son of the actress who was on the balcony with his arm in a cast."

b. De gangsters schoten op de zoon van de actrice die op het balkon zat met haar arm in het gips.
   "The terrorists shot the son of the actress who was on the balcony with her arm in a cast."

The underlined continuation in (5a) forces NP1 attachment (to zoon—'son') while the corresponding portion of (5b) resolves the ambiguity in favor of NP2 attachment. The results of the studies consistently revealed that sentences containing regions forcing NP2 attachment took longer to read than those resolved in favor of NP1 attachment. We took this as evidence that the clause was attached to NP1 by the time people read the second part of the RC.

Since the publication of this work (in Brysbaert and Mitchell, 1996a) we have conducted a new series of studies to test the various theoretical positions outlined above. First, we showed that the NP1 attachment preference is undiminished when the disambiguating material turns up just a word or two after the beginning of the RC, undermining accounts that maintain that the RC is initially linked to NP2 before eventually being attached to NP1 (cf. De Vincenzi and Job, 1995, as outlined above).

Second, to test Tuning and other exposure-based hypotheses, we conducted corpus searches to ascertain whether our experimental NP1 attachment bias also shows up in normal language usage (Brysbaert and Mitchell, 1996b). We extracted a random sample of 675 sentences including the substructure NP-VAN-NP-RC from corpora based on four different Dutch newspapers and magazines (Knack, Trends, Style, and Volkskrant). Attachment to NP1 (or NP2) were rated by two independent Dutch-speaking judges. Of the 697 yields a clear attachment to one of the two sites, with a strong and consistent preference for NP2 attachment (see Table 1).
TABLE 1 
Frequencies of Clear Attachments to NP1 and NP2 in Corpus Samples of NP1-\emph{van-NP2}-RC Structures Sampled from Four Dutch Newspapers

<table>
<thead>
<tr>
<th></th>
<th>Knock</th>
<th>Trends</th>
<th>Style</th>
<th>Volkskrant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP1</td>
<td>60</td>
<td>30</td>
<td>36</td>
<td>18</td>
<td>144</td>
</tr>
<tr>
<td>NP2</td>
<td>168</td>
<td>44</td>
<td>81</td>
<td>32</td>
<td>325</td>
</tr>
</tbody>
</table>

Needless to say, this finding was completely unexpected on the basis of the Tuning hypothesis. This is the first study in which two-site corpus biases have failed to coincide with on-line patterns of preferences. (Recall that the discrepancies reported earlier by Gibson, Schütze, and colleagues were based on threesite NPs)

One possible way of refining the Tuning hypothesis and reconciling it with these data would be to show that there are grains of analysis for which an NP1 preference prevails in the face of the more general bias in favor of NP2 attachment. If such subclassess could be identified within the general populations of NP-\emph{van-NP2}-RC structures, then it might be argued that the Tuning device was capable of keeping a using records based on the classification features identified in this analysis (cf. Mitchell et al., 1995). Unfortunately, up to now we have not been successful in our efforts, despite the fact that we have examined an extensive range of sub classifications, generating separate tabulations, among several others, for (a) Relative pronoun—\emph{die or dat}; (b) head type—human versus nonhuman; (c) corpus type—spoken versus written. In every case, we have been unable to find any sub classification that systematically produces a bias in favor of NP1 attachment. This is clearly problematic for the Tuning hypothesis. It is not easy to explain an NP1 attachment bias if samples of the language consistently show that NP2 attachments dominate in normal usage.

Given our failure to define a class of substructures in which NP1 attachment dominates, a possible concern is that the materials we used in our on-line studies may have somehow been unrepresentative of the sentences that occur in “normal” texts. On this argument, the apparent discrepancy between parsing and corpus biases might be due not to the fact that exposure-based models are misguided, but to the fact that there were qualitative differences between the materials used in the experimental studies and those that turned up in the corpora. To test this possibility we are currently running an on-line study using materials sampled randomly from our corpora. If the parsing biases with these materials switch over to showing an NP2 preference, this will indicate that the materials used in our Dutch studies to date must have been subject to uncontrolled or extraneous variation. If the corpus materials continue to show an NP1 preference, then it will become difficult to sustain the argument that attachment is determined exclusively by exposure to language.

Evidence from Dutch has also thrown some light on grammar-based accounts of attachment preference. We deal first with the RelPro drop account because the argument here is relatively straightforward. The Dutch language does not allow the relative pronoun to be omitted in normal circumstances, and so, according to the Hemforth/Konieczny account, Dutch attachment preferences should pattern with those of Spanish, French, and other languages where reduction is prohibited. As indicated above, this is consistent with the on-line evidence available to date, and to that extent the Dutch data are compatible with this account. As a cautionary note, however, it is perhaps worth noting that, according to the current evidence, the salience boost for discourse processes in Dutch (relative to English) only shows up in on-line parsing biases (where the NP1 attachment preference prevails). Our corpus evidence suggests that the putative influence does not extend as far as causing newspaper authors to conform to the same biases in their written composition.

When it comes to Construal theory, the findings are much less encouraging. The Grecean argument predicts that NP2 attachment should prevail in any language that shares with English the basic characteristics of Norman and Saxon genitive forms outlined above. Brysbaert and Mitchell (1996a) argued that Dutch falls into this category. The Dutch language has three genitive forms: (a) the Norman form (e.g., \emph{de hoed van vader} (‘the hat of father’)); (b) the Saxon form (e.g., \emph{vaders hoed} (‘father’s hat’)); and (c) a possessive pronoun form (e.g., \emph{vader zijn hoed} (‘father his hat’)). RCs following complex NPs of the first type are ambiguous in their attachment (as with English, Spanish, and most other languages). In the other two cases such an RC can only be attached to the second site (\emph{hoed}). In other words, like English, Dutch has in addition to the ambiguous form under examination alternatives that force attachment to the site occupied by NP1 in the Norman form. It follows, therefore, that the Grecean hypothesis must predict an NP2 attachment preference in Dutch (in an argument that essentially parallels that for English). As already indicated, however, Dutch shows an NP1 attachment even with sentences that are exact translations of English materials showing the opposite bias (see Brysbaert and Mitchell, 1996a, for details).

This implies that the mere presence of an unambiguous Saxon form in a language is not sufficient to cause the hypothesized Grecean influences to outweigh the competing discourse effects. The implication is that theories that draw on Grecean accounts of this kind need to be elaborated yet again before they can account for the existing data. Possible moves (suggested by Clifton, personal communication, 1996), are to argue that the Grecean shift to NP2 attachment is triggered not by the mere \emph{existence} of unambiguous Saxon forms in the language, but either by the acceptability of these forms in the language in general or, alternatively,
remains to be reconciled with the simplest exposure-based accounts (which explain
the differences in terms of the prevalence of the different attachments in corpora).
More complex explanations of this kind, such as PredProx/Recency theory could
not be addressed because the theory is not formulated with enough precision
to derive predictions about the parameter weights, and therefore attachment biases in
new languages.

8. OVERALL CONCLUSIONS

The work on languages other than English has made it abundantly clear that
any viable theory of syntactic analysis has to postulate something over and above
a proximity or recency principle to account for RC-attachment findings in most
languages. To this extent it is clear that crosslinguistic work in this field has been
gainful in demonstrating the shortcomings of parsing theories that prevailed
a decade or so ago. If research had confined itself to investigations of English it is
possible that none of these problems would have come to light.

The findings from languages other than English have prompted researchers
to make a variety of interesting proposals that might replace or supplement the
locality-recency principles, creating the pressure that replaces NP2 with NP1
attachment. At present, it is not clear which, if any, of these proposals provides the
best basis for an account of the ways in which attachment decisions are made
in different languages. The detailed explanations of crosslinguistic difference have
proved in every case to be either incomplete or incorrect. In almost every case,
the existing accounts would be improved if more precision or detail were added
to the theories. Tuning accounts need to be more explicit about the grain of record-
keeping they rely upon. The PredProx/Recency account needs to offer an explicit
specification of its parameter-setting procedures before it can be applied to new
languages. Constraint-based theories need to shift away from the current emphasis
on constraints imposed by heads or attachment sites, and explore the potential of
nonlexicalist, structure-based systems. The Gricean account within Construal
theory needs to be reformulated so that it does not indiscriminately predict NP2
attachment for any language that has a non-Norman genitive form, but at the
same time doesn't make the wrong predictions about attachment biases in individual
sentences in a language like Dutch. The RelPro Drop needs to be more
explicit about exactly what it is that determines the relative influence of its two
competing mechanisms for linking RCs to their heads.

In addition to all of these theoretical developments, it would obviously be helpful
to have a great deal more empirical data about the attachment preferences in
languages that haven't been examined so far. It begins to look as if most languages
will show an NP1 attachment bias, but there might also be other NP2 languages like English waiting to be discovered and tested. For example, there is some informal evidence that Swedish and other Scandinavian languages may fall into this category. If further examples could be found, this would help us to place tighter limits on the range of explanations for attachment phenomena. Thus, the answers to many of the questions raised in this chapter may lie waiting to be discovered in the processing patterns that characterize the 5990 languages that have yet to be subjected to close experimental scrutiny.

ACKNOWLEDGMENTS

We are grateful to Stefan Grondeilers for assistance and collaboration on the corpus studies and to Chuck Clifton and Barbara Hemforth for their stimulating comments at various stages of this work.

REFERENCES


