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ABSTRACT

Two competing hypotheses about speech processing were examined in two experiments. The hypotheses were that: (1) people rely on the configurational properties of sentences in relative clause (RC) processing; and (2) people rely on the grammatical roles of the noun phrases involved in relativization in RC processing. The first experiment used a comprehension task to test native speakers of Spanish, a VO language, learning Basque, an OV language. The results provide strong support for the idea that the configurational properties of sentences play a crucial role in language processing, as opposed to the idea that it is the grammatical relations holding between elements of a sentence that affect the relative difficulty of processing . The second experiment tested native speakers of English, a VO language, learning Spanish, another VO language. This experiment, while failing to provide support for either hypothesis, raised an interesting theoretical issue: that when parameters have to be reset in the second language learning, acquisition is hindered considerably. (MSE)

PROCESSING RELATIVE CLAUSES IN BASQUE AND SPANISH*

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Abstract

Two different conceptions about speech processing were examined in two experiments. Experiment 1 used a comprehension task to test native speakers of a VO language (Spanish) learning an OV language (Basque). The results provided strong support for the idea that the configurational properties of sentences play a crucial role in language processing (in particular for the *Interruption Hypothesis*, Slobin, 1971), as opposed to the idea that it is the grammatical relations holding between elements of a sentence that affect the relative difficulty of processing (as claimed by the *Accessibility Hierarchy Hypothesis*, Keenan & Comrie, 1977). Experiment 2 tested native speakers of a VO language (English) learning another VO language (Spanish). Experiment 2, while failing to provide support for either of the hypotheses raised a very interesting theoretical issue: the idea that when parameters have to be reset in L2 learning acquisition is hindered to a considerable extent.

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1. Introduction

The aim of this paper is to determine what factors have an influence on Relative Clause (RC) processing. Two different conceptions about speech processing will be explored (following Hakuta, 1981): one based on the idea that speech is processed according to the *configurational properties* of sentences, and the other based on the idea that speech is processed according to the underlying *grammatical relations* within a sentence. We assume that these ideas about language processing apply universally, irrespective of the choice of parameters of specific languages according to the options that universal grammar makes available (Chomsky 1980, 1981).

Second language learning has often provided adequate grounds for testing hypotheses about speech processing. We are interested here in the relative difficulty of processing a very specific syntactic structure, namely, Relative Clauses (RCs) by native speakers of Spanish (VO language) learning Basque (OV language) and native speakers of English (VO language) learning Spanish. A restrictive relative clause is a noun modifier and forms a syntactic unit with the noun it modifies. Its position to the right or to the left of the head noun within an NP will depend on how a particular language instantiates the *head parameter*. OV languages are normally leftward expanding - heads occur to the right in their phrasal categories and follow their modifiers so that the linear sequence is built from right to left. Conversely, VO languages are normally rightward expanding - heads occur to the left in their phrasal categories and are followed by their modifiers so that the linear sequence is built from left to right.[1] The position of the RC is thus inherently tied to the syntactic organisation of the language.

[1] Languages are not always consistent in their branching direction. In Basque, genitives, adjectives and RCs behave quite differently within a N",with genitives and RCs to the left of the head noun and adjectives to its right. Eguzkitza (1987: 13-17) argues that genitives and adjectives hang from different levels in the component structure of N" (i), which makes him reach the conclusion that Basque is uniformly head-last as to the projection of N. However, in our opinion, this uniformity becomes obscure when one considers RCs. RCs seem to behave like genitives as to their position to the left or the right of the head noun, but at the same time, they are adjoined

In Basque (1b) the RC precedes its head, and there are no relative pronouns (RPs).[2] Instead, we find an invariable relative marker (RM) whose shape is *-(e)n*.[3] The head noun is the object of the RC and is missing from it. Basque RCs do not involve movement. What we find is a phonologically empty NP that is coindexed with the head noun (Eguzkitza, 1987: 15), so there is no overt marker of the syntactic function of the relativised NP in the RC. The difference between the structure of a RC in English and Spanish, on the one hand, and Basque, on the other, is made explicit in (2).

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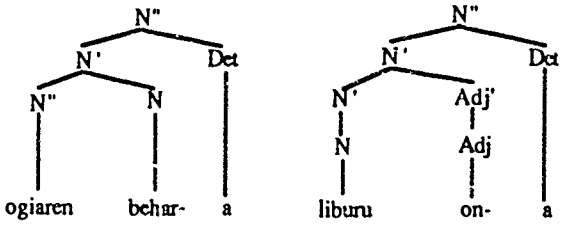
to N', as adjectives are. The behaviour of RCs does thus reveal an inconsistency in the language.

(i) a. ogiaren beharra
bread-det/sg-gen need-det/sg-abs
'the need for bread'

b. liburu ona
book good-det/sg-abs
'the good book'



2 We are aware of the status of English *that* and Spanish *que* as relative markers. However we are using the the general term 'relative pronoun' with reference to any wh-phrase that introduces a RC in Spanish and English, as opposed to what we find in languages with a consistently invariable relative marker, like Basque.

3 In the past the form of the RM and that of the past tense morpheme merge so that there is no distinction between the relativised and the non-relativised form of the V. A string like (i) can be interpreted as *the book that the father bought* and *the father bought the book*, Basque being a typical 'scrambling' language superficially, in which almost every possibility of word order is open (Eguzkitza, 1987: 130).

(i) Aitak erosi zuen liburua
father-det/sg-erg to-buy did-it(O)/he(S) book-det/sg-abs

(1) a. He leído [el libro [que han comprado]]
have-I read the book that have-they bought

b. [[Erosi duten] liburua] irakurri
to-buy have-it(O),they(S) that book-det/abs/sg to-read

dut
have-it(O)/I(S)

'I have read the book that they have bought'

(2)a. SPANISH/ENGLISH [comp [.... +WH ....]]

b. BASQUE [[.... [e] ....] comp]

no movement

It is worth noting that all major categories show morphological case-marking in Basque (there are at least fifteen cases according to Azkárate et al, 1981: 45). As Eguzkitza (1987: 6) has pointed out Basque relies on 'word shape' as an indicator of grammatical relations, allowing a great variety of possible word orders in s-structure. The head noun of a RC takes the case-ending that corresponds to its function in the main clause so that there is no overt indication of its grammatical role in the RC. The fact that grammatical relations between Subject (S), Direct Object (DO) and Indirect Object (IO) are explicit in the shape of the auxiliary verb helps to minimize the effect of the inflectional loss in the RC. However, S, DO and IO are not the only positions that can be relativised in Basque. Speakers of the main dialect relativise other positions as well, such as directional, ablative, locative and instrumental (De Rijk, 1972: 119), which lose their inflectional markers making RC processing a potentially difficult task in Basque.

2. Strategies for RC processing

Listeners, when hearing a string of words, try to segment this continuum into constituents in order to recover the grammatical relations underlying the different components of a sentence. In parsing a string listeners use certain strategies which are normally based on specific properties of the s-structure of their language and which typically involve word order and the identification of function words and/or inflectional markers. RCs present two main problems for the successful completion of this task (Antinucci et al, 1979):

1. Listeners must identify the elements that belong to the main clause and separate them from the sequence of items that constitute the RC.
2. Listeners must recover the function of the missing NP in the RC.

Language-specific strategies are in turn affected by what seem to be universal operating principles concerning the processing of complex structures in general and RCs in particular. These are language-independent mental operations which are part of the language user's cognitive system and are used in speech processing, where they interact closely with the speaker-hearer's knowledge of the grammatical system of a particular language. There are conflicting opinions in the literature about what (universal) strategies have an effect on the processing of RCs. However, this variety of theories and experimental work can be reduced to a conflict between two conceptions of speech processing (following Hakuta, 1981): theories based on the idea that s-structure *configurational properties* of specific languages are the most important factor affecting RC processing and theories in which processing is intimately related to the *grammatical relations* of the linguistic components of a RC, in particular the NPs involved in relativisation.

Theories based on configurational properties of sentences (mainly, Bever, 1970; Slobin, 1971) are concerned with the way the presence of a RC affects word order and the linear sequence of the elements in a sentence containing a RC. In a pioneering work on language processing,

Bever (1970) claimed that, in VO languages, any first NV(N) sequence is assumed by listeners to correspond to a main clause unless the V is clearly marked as subordinate. This strategy was based on the idea that speech is processed sequentially as it is heard. It follows from this assumption that discontinuous constituents, whose elements are not expressed sequentially in surface structure word order, are likely to create difficulties in processing. This is the central idea underlying what we will call the *Interruption Hypothesis* (Slobin, 1971).

Standard English shows a relatively fixed SVO order. It therefore seems reasonable to think that listeners will exploit word order strategies to the maximum in order to parse English input. In Spanish, where word order is more flexible, the relation between S and V is made explicit in the verb ending. As for Basque, it shows a dominant SOV order, although practically all permutations of major categories are possible in declarative sentences provided that the position immediately preceding the main V is filled. This is the focus position or *galdegaia* (*galde* 'ask', *gaia* 'subject' - the subject one asks about).[4] Table 1 shows how the presence of a RC in S and O position can alter the linear sequence of the dominant order in Spanish and English, on the one hand, and Basque, on the other. According to the Interruption Hypothesis, centre-embedded RCs, which 'interrupt' the main clause by positioning themselves immediately after S in English and Spanish (SS, SO) and after O in Basque (OS, OO), are more difficult to process than right-/left-embedded RCs owing to constraints on short-term memory (Slobin, 1971: 42).[5]

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[4] For a full description of the *galdegaia* position see Eguzkitza (1987: 87-121).

[5] According to Kuno (1974) languages will use devices to minimize the effect of those structures that create processing difficulty, such as centre-embedding RCs. Examples of such devices are the choice between prenominal and postnominal RCs and clause-initial and clause-final markers. By looking at Table 1, we can see that postnominal positioning of RCs in Basque would create centre-embedding with both subject and object RCs.

TABLE 1

Sentence type	SPANISH/ENGLISH	BASQUE
SS	N(S)[RP V N(O)] V N(O)	[N(O) V RM] N(S) N(O) V
SO	N(S)[RP N(S) V] V N(O)	[N(S) V RM] N(S) N(O) V
OS	N(S) V N(O)[RP V N(O)]	N(S) [N(O) V RM] N(O) V
OO	N(S) V N(O)[RP N(S) V]	N(S) [N(S) V RM] N(O) V

As for Bever's NV(N) strategy, we can see that in Spanish and English the SVO sequence of the main clause remains unaltered in sentences of the type OS and OO, where O is the head noun of the RC, so we would expect listeners to interpret the initial SVO sequence correctly as a main clause. When the head noun is S the presence of an obligatory relative pronoun (RP) in Spanish stops any main clause interpretation of the initial sequences of SS and SO. In Standard English, where the relative pronoun is optional in SO and OO, the presence of an initial NNV sequence in SO structures blocks any incorrect segmentation of the sentence.

In Basque the first N(N)V sequence in the four sentence types is an initial candidate as a main clause until the relative marker (RM) is heard, since neither S nor O need be lexically present. One could argue, however, that in practice, S and O are only likely to be deleted when they are *given information*, and from a semantic/pragmatic perspective, speakers use RCs when they want to provide the listener with some crucial information concerning a particular object or set of objects, the head noun, which is precisely the element missing in the RC. It is thus unlikely that listeners are expecting a sentence with a missing S or O in such contexts, so that sentences of the type SS and SO should not constitute a problem from a semantic/pragmatic point of view. Since in OO sentences the presence of two NPs carrying ergative markers stops any main clause interpretation the only sentence type that is likely to create confusion is OS.[6] By the time the perceiver hears the suffix of

[6] Even in the case of OO the homophony between the ergative and the plural marker /-k/ could lead to confusion in Basque, until the form of the

the relative marker: *-en* (which in the past merges with the past tense morpheme: *-en*) in (3b) s/he has already heard an N(S) an N(O) and a V with the ending for the present habitual *-tzen*. The listener is now expecting a main verb auxiliary to complete the sentence. The presence of the relative marker tells the listener to look ahead for the coming NP *erizaina* 'the nurse' and to work out its function within the RC while s/he is listening for the end of the sentence.[7]

(3) a. Pazienteak medikua gorrotatzen
patient doctor hate

duen
does-det/erg/sg-det/abs/sg pres.habitual-he(S)/he(O)-RM

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auxiliary V is heard (). Thus, the presence of /-it-/ in *zituen* indicates that the O of the transitive V is plural. The absence of /-it-/ in (ii) blocks any main clause interpretation of the first NNV sequence.

(i) Gizonak neskak ikusi zituen.
man-det/sg-erg girl-det/pl-abs to-see did-them(O)-he(O)
'The man saw the girls'

(ii) Gizonak [neskak ikusi zuen] mutila
-det/sg-erg did-he(O)-she(S) boy-det/sg-abs

jo zuen
to-hit did-he(O)-he(S)

'The man hit the boy that the girl saw'

[7] Nothing has been said about intonation. According to Clancy *et al* (1986) the role of intonation appears to be significant only when sentences cannot be processed in a simple left-to-right fashion. Their results in an experiment on RC processing by Korean children suggest that there is no significant difference in the understanding of sentences pronounced with clear or monotone intonation.

erizaina maite du
nurse-det/abs/sg to-love does-he(S)/he(O)

'The patient loves the nurse who hates the doctor'

b. Pazienteak medikua gorrotatzen du.
'The patient hates the doctor'

In English and Spanish sentences containing RCs both word order and the presence of relative pronouns clearly mark the V as subordinate, thus making the segmentation of speech a relatively easy task. As for Basque, we have already said that the initial sequences in sentences containing subject and object RCs are potential problems for correct parsing. Therefore, it is only in an OV language like Basque that we will consider the effect of Bever's initial sequence strategy on the processing of RCs. We must then 'rename' it the *NNV Strategy*.

Hypotheses concerning the rearrangement of the linear sequence of linguistic units have received different names in the literature (Sheldon, 1974, 1976; Prideaux, 1982). What we will call with Sheldon the *Word Order Hypothesis* claims that when word order is preserved in the RC the sentence is easier to process. Thus, English and Spanish SS and OS, in which the relativised NP is the S of the RC (subject focus), are predicted to be easier to process than sentences with object focus (SO, OO), since the canonical order is preserved in the RC with the RP occupying the position of the missing S. However, it is difficult to determine what this strategy predicts for Basque where both N(S)V and N(O)V are possible candidates for canonical order.[8]

[8] Prideaux (1982: 26) in his analysis of Japanese RCs argues that N(O)V structures are more 'canonical' than N(S)V structures in SOV languages like Japanese, since the S is normally given information, and thus, it is more likely to be omitted. This renders N(O)V as the structure preserving the canonical word order. In Basque the existence of the *galdegaia* principle - the focus position - makes it difficult to reach a conclusion about whether SV or OV preserve the canonical word order.

The predictions made by the Word Order Hypothesis match the predictions of what we will call the *Accessibility Hierarchy Hypothesis* (Keenan & Comrie, 1977), which belongs to the second set of hypotheses mentioned above - those concerned with the grammatical relations between NPs in a sentence with a RC. The *accessibility hierarchy* in (4) is claimed to be a universal expression of the relative accessibility to relativisation of NP positions (Keenan & Comrie, 1977: 66) - the lower the position in the hierarchy, the harder it is to process the sentence. Consequently, sentences containing RCs with subject focus (SS, OS) ought to be easier to process than those with object focus (SO, OO) in ALL languages.

(4) SU > DO > IO > OBL > GEN > O COMP

English is classified as a language that allows relativisation in all positions in the hierarchy, and Spanish as a language that allows relativisation in all positions but O COMP (Keenan & Comrie, 1977: 74) (for criticism of this classification of Spanish, see Alcoba, 1985: 102). Basque allows relativisation in only S, DO, and IO positions according to Keenan & Comrie (1977: 72). They also suggest that relativisation in any other position in the hierarchy would create processing difficulties, but not in these three positions since the relation between S(erg), DO(abs) and IO(dat) is explicit in the form of the auxiliary V. However, sentence (5) is an example of ambiguity where the head noun can be interpreted as the IO of the RC (a) or the S of the RC (b). Difficulties are even greater when other positions are relativised (we refer the reader back to the introduction for a description of Basque RCs).

(5) liburua emman di-o-n gizona
book-det/sg-abs to-give have-it-to-him that man-det/sg-abs

nire aita da
my father-det/sg-abs is

a. 'The man that he has given the book to is my father'
b. 'The man that has given him the book is my father'

The relevant factor underlying the idea of language processing in the Accessibility Hierarchy is that perceptual difficulty follows from the grammatical role of the relativised NP in the RC. Processing a sentence with a relativised O is a more difficult task than processing a sentence with a relativised S. Another idea connected with the grammatical role of NPs is presented in Sheldon's (1974) *Parallel Function Hypothesis*. She claims that sentences in which the relativised NP and the head noun have the same grammatical role in their respective clauses (SS, OO) are easier to process than sentences in which the role of the relativised NP in the RC and that of the head noun in the main clause are different (SO, OS). Table 2 provides a summary of the predictions made by the different hypotheses.

TABLE 2

	SOV LANGUAGES				SVO LANGUAGES			
	SS	SO	OS	OO	SS	SO	OS	OO
IH	+	+	-	-	-	-	+	+
WOH	(+)	(-)	(+)	(-)	+	-	+	-
NNV S			-					
AH	+	-	+	-	+	-	+	-
PFH	+	-	-	+	+	-	-	+

(**IH**: Interruption Hypothesis; **WOH**: Word Order Hypothesis; **NNV S**: NNV strategy; **AH**: Accessibility Hierarchy Hypothesis; **PFH**: Parallel Function Hypothesis; + : easy to process; - : difficult to process)

This theoretical controversy is as yet incompletely resolved by the empirical work supporting the different hypotheses. Slobin's (1971) *Interruption Hypothesis* and the idea that centre-embedding causes problems in RC comprehension (Kuno, 1974) have received strong support from experiments involving L2 learners and children (Hakuta,1981; Clancy *et al*, 1986). These experiments provide strong evidence for the effect of the Interruption Hypothesis on RC comprehension in languages with a dominant SOV order. However, the results obtained for SVO languages, like English, have proved 'disappointingly inconsis-

tent (Clancy *et al*, 1986: 252). There is also a large number of experiments providing evidence for the *Accessibility Hierarchy Hypothesis* for both SOV and SVO languages (Sheldon, 1974; Prideaux, 1982 ; De Villiers *et al*, 1979; Cook, 1975). As for the *Parallel Function Hypothesis* the only evidence we have found is in Sheldon (1974).

3. The Experiments

The following experiments were designed to test the comprehension of subject and object RCs in an attempt to determine the relative difficulty of processing different types of RCs. Experiment 1 tested the comprehension of Basque subject and object RCs by native speakers of Spanish learning Basque. The results obtained provided strong evidence to support the *Interruption Hypothesis*. Experiment 2 was an attempt to extend these results to SVO languages such as English and Spanish. The results obtained failed to support any of the hypotheses tested. This was explained in terms of the interaction between L2 acquisition and theories of universal grammar.

Two competing hypotheses were tested:

HYPOTHESIS 1: people rely on the *configurational properties* of sentences in RC processing - it is the location of the RC that accounts for the relative complexity of processing. In a comprehension test we would expect more errors in sentences with centre-embedded RCs than in those with right-/left-embedded RCs (see Table 3).

HYPOTHESIS 2: people rely on the *grammatical roles* of the NPs involved in relativisation in RC processing. It is the factor of which NP is relativised that accounts for the relative complexity of processing. In a comprehension test we would expect more errors in sentences with relativised N(O) than in those with relativised N(S) (see Table 3).

These hypotheses are the result of the combination of two variables, following Sheldon (1976):

1. The effect of the location of the RC in the sentence: that is whether the RC is right-/left-embedded or centre-embedded.
2. The factor of which NP is relativised: that is, whether the relativised NP is the S or the O of the RC.

Variable 1 has an effect on the configurational properties of the main sentence: the linear order of constituents in s-structure. Of the three hypotheses mentioned in relation to this - Interruption Hypothesis, Word Order Hypothesis and NNV Strategy - (see Table 2). we decided to test only one, the *Interruption Hypothesis* (IH), for simplicity. The Interruption Hypothesis predicts that centre-embedded RCs are more difficult to process than right-/left-embedded RCs. Variable 2 concerns the grammatical roles of the NPs involved in relativisation. Both the Accessibility Hierarchy Hypothesis and the Parallel Function Hypothesis relate to this (see Table 2). We tested only the *Accessibility Hierarchy Hypothesis* (AH), which predicts that sentences in which the relativised NP is the O of the RC are more difficult to process than those in which the relativised NP is the S of the RC, all other things being equal. By combining these two variables we have four types of sentence, examples of which in the languages involved are shown in Table 4.

BASQUE	SPANISH	ENGLISH
gizon-a-k	*el hombre*	
man-det/sg-erg	det/sg-masc man	'the man'
mutil-a	*a-l chico*	
boy-det/sg-abs	to-det/sg-masc boy	'the boy'
neska	*a la chica*	
girl-det/sg-abs	to det/sg-fem girl	'the girl'
neska-k	*la chica*	
girl-det/sg-erg	det/sg-fem girl	'the girl'
jo zuen	*golpeó*	
to-hit did-3rd.p(O) 3rd.p(S)	did hit-3rd.p(S)	'hit'
ikusi zuen	*vio*	
to-see did-3rd.p(O)	did see-3rd.p(S)	'saw'
-en (in *zuen*)	*que*	'that'

TABLE 3
Predictions for the processing of RCs

	BASQUE				SPANISH/ENGLISH			
	SS	SO	OS	OO	SS	SO	OS	OO
IH	easy	easy	hard	hard	hard	hard	easy	easy
AH	easy	hard	easy	hard	easy	hard	easy	hard

TABLE 4
Sentence types

SS: MATRIX NP = SUBJECT RELATIVISED NP = SUBJECT

Neska ikusi zuen gizonak mutila jo zuen.
El hombre *que vio a la chica* golpeó al chico.
The man *that saw the girl* hit the boy.

SO: MATRIX NP = SUBJECT RELATIVISED NP = OBJECT

Neskak ikusi zuen gizonak mutila jo zuen.
El hombre *al que la chica vio* golpeó al chico.
The man *(that) the girl saw* hit the boy.

OS: MATRIX NP = OBJECT RELATIVISED NP = SUBJECT

Gizonak *neska ikusi zuen* mutila jo zuen.
El hombre golpeó al chico *que vio a la chica.*
The man hit the boy *that saw the girl.*

OO: MATRIX NP = OBJECT RELATIVISED NP = OBJECT

Gizonak *neskak ikusi zuen* mutila jo zuen.
El hombre golpeó al chico *al que la chica vio.*
The man hit the boy *(that) the girl saw.*

3.1 Experiment 1

Subjects:

42 Spanish-speaking adults learning Basque. Their average age was 25. They were attending intensive courses in Basque - 4 hours a day - at two different *euskaltegi* (Basque language schools subsidised by the Basque Government). They were at a very advanced level in their learning of the language; some were doing their 7th or 8th three-month course (out of 8) and others were doing a special course in preparation for the official certificate of proficiency in Basque, called *E.G.A.*, issued by the Basque Government. Ss were told they were doing a psycholinguistic experiment and the aim of the experiment was explained to them in general terms.

Materials and Procedure:

Ss were given four sheets of paper with the possible answers for a comprehension test and a separate answer sheet where they had to indicate (by writing a single letter *a*, *b* or *c*) which they thought was correct as well as the degree of confidence in their choice on a 5-point scale. The experiment was done in two different *euskaltegi* in four sessions in total. Ss were divided into two groups in each *euskaltegi* and listened to 20 sentences in Basque, which had been pseudo-randomised and which were presented in a different order to each group. There were 5 sets of sentences each consisting of the 4 types of sentence in Table 4. Sentences were read to the subjects in one of the *euskaltegi* and were played on a tape in the other.

On the sheets given to the subjects there were three paraphrases in Spanish for each of the sentences they had just heard in Basque. The paraphrases consisted of conjoined sentences constructed according to the following pattern, which was, of course, presented in several different orders for the different sentences: a) none of the conjoined sentences corresponded to the meaning of either the RC or the main clause in the Basque sentence, b) only one of the conjoined sentences corresponded to the meaning of either the RC or the main clause in the Basque sentence

and c) both conjoined sentences corresponded to the meaning expressed in the Basque sentence (6) (see Table 3 - key to translation).

(6) Neska ikusi zuen gizonak mutila jo zuen
'The man that saw the girl hit the boy'

a. La chica vio al hombre y el chico golpeó al hombre.
'The girl saw the man and the boy hit the man'

b. El hombre vio a la chica y el chico golpeó al hombre.
'The man saw the girl and the boy hit the man'

c. El hombre vio a la chica y el hombre golpeó al chico.
'The man saw the girl and the man hit the boy'

Two different procedures were used:

Method A - Ss listened to the 20 sentences once, with a minute's interval between each of them. During that time (perhaps unnecessarily long) they had to decide whether the correct answer was a, b, or c and rate their confidence in their choice.

Method B was exactly like Method A with the difference that sentences were heard twice – the second time being 15 seconds after the first time, but still with a minute's interval between successive different sentences.

Instructions were given in Basque, illustrated with an example to make sure Ss understood what they were expected to do.The experiment was conducted in a classroom situation by the teachers of the four groups that took part in it. It was left to the teacher of each group to decide which method to use as well as whether to read the sentences or have them on tape. 23 Ss were tested under Method A and 19 under Method B.

Results and Discussion:

Table 5 shows the mean number of correct responses to the 20 Basque sentences. For each subject there were five possible correct answers for each sentence type. Performance increased slightly for Method B when each sentence was heard twice. To test the *Accessibility Hierarchy Hypothesis* (AH) we compared the scores obtained for sentences of the type SS with the scores for SO, and OS with OO using a paired t-test (two-tailed). Conversely, to test the *Interruption Hypothesis* (IH), we compared SS with OS, and SO with OO (see Table 6).

TABLE 5
Mean number of correct responses for the four sentence types

	SS	SO	OS	OO
METHOD A	3.2	3.3	1.6	2.5
METHOD B	3.3	4.0	2.2	2.5

TABLE 6
Analysis of mean substractions using a paired t-test

		AH		IH	
		SS-SO	OS-OO	SS-OS	SO-OO
METHOD A	MEAN	-0.17	-0.87	1.56	0.87
	P VALUE	0.56	0.01	0.00	0.02
METHOD B	MEAN	-0.33	-0.31	1.10	1.42
	P VALUE	0.09	0.37	0.01	0.00

Our experiment failed to provide support for the *Accessibility Hierarchy Hypothesis*. Performance on SS is lower than performance on SO (though not to a significant extent) and also contrary to what the Accessibility Hierarchy Hypothesis predicts there were more correct responses for OO than for OS, the difference being highly significant for Method A. On the other hand, SS scores are significantly higher than OS scores and SO are significantly higher than OO, providing strong

evidence for the predictions made by the *Interruption Hypothesis*, which claims that centre-embedded RCs create difficulty in processing.

The confidence scores (Tables 7 and 8) tend to confirm the hypothesis that centre-embedded RCs create perceptual confusion. The order of the mean confidence rates matches the scores obtained in the comprehension task. We used a non-parametric test (Wilcoxon test) to compare the paired confidence scores of all Ss in Experiment 1 for the four sentence types. The analysis provided further support for the Interruption Hypothesis - the mean difference between the pairs SS and OS and SO and OO being statistically significant. As for the Accessibility Hierarchy Hypothesis, SS-SO fails even to approach significance and although OS-OO does reach significance, as with the results for the comprehension task, the difference lies in the opposite direction from the predictions made by the Accessibility Hierarchy.

TABLE 7
Mean confidence rates

SS	SO	OS	OO
3.3	3.4	2.7	3.0

TABLE 8
Analysis of confidence rates using Wilcoxon test

	SS-SO	OS-OO	SS-OS	SO-OO
P VALUE	0.5	0.02	0	0

General discussion:

The results for the comprehension task and the confidence scores in Experiment 1 provide strong support for the Interruption Hypothesis. When the linear order of constituents is 'interrupted' in surface structure, comprehensibility is lower owing to the load on short-term memory. It is also worth noting that OS was the sentence type that had the lowest mean in both the comprehension test and the confidence scores, which is in accordance with the predictions made by the NNV strategy (see Table 2).[9] Thus, the results in Experiment 1 suggest that it is the con-

[9] It seems that despite intonational clues subjects still interpreted the first part of sentences like (i) as constituting a main clause:

figurational properties of sentences that account for the difficulty of RC processing in Basque. The experiment failed to support the predictions of the Accessibility Hierarchy Hypothesis. In this section we will examine what we consider to be some basic problems underlying this hypothesis: in particular, the lack of theoretical and empirical evidence supporting the psychological validity of the hypothesis and the basic confusion between processing mechanisms and grammatical description.

The *Accessibility Hierarchy Hypothesis* (Keenan & Comrie, 1977) was formulated following a cross-linguistic study of what positions languages can and cannot relativise. There seems to be a general agreement about the descriptive power of the Accessibility Hierarchy Hypothesis across languages (but for criticism see Alcoba, 1985; Manaster-Romer, 1979). It is also predictive in the sense that it claims that if a language can relativise IOs, then it can also relativise DOs and SUs (for criticism see Cinque, 1981). Keenan & Comrie (1977) classify languages according to the positions they can relativise and so, English is classified as a language that can relativise all positions in the hierarchy, Spanish can relativise all positions but O COMP, and Basque can only relativise SU, DO and IO. Our objection is: does this inevitably entail that WITHIN A GIVEN LANGUAGE the positions that can be relativised should be ordered hierarchically, and if so, what does it mean to say that SUs are 'more accessible' to relativisation and so on?

It could be argued that evidence for the existence of the hierarchy within a language can be found in the fact that there are normally more RCs with subject focus than RCs with object focus, an idea present in Keenan (1975: 140). However, this could be explained in terms of discourse constraints. From a discourse point of view a RC makes a statement about a head noun, which can be regarded as the 'theme' of the RC. As it is normally Ss that are 'themes' in sentences, we would ex-

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(i) Gizonak neska ikusi zuen (mutila jo zuen)
man-det/sg-erg girl-det/sg-abs to see did-he(O)-she(S)

'The man saw the girl'

pect to find more relativised NPs in S position in the RC than in any position other than S. The hierarchy could then be justified on discourse grounds, but not on the grammatical properties of RCs.[10] The existence of what we could call a 'discourse hierarchy' could explain the results obtained by Prideaux (1982) and Sheldon (1976) in support of the Accessibility Hierarchy Hypothesis. Both these experiments were based on the *intuitions* of native speakers about the relative complexity of subject and object RCs in their own language. Interestingly, some native speakers of Basque we asked agreed that sentences with object focus were more difficult to understand than sentences with subject focus, which suggests that native speakers' intuitions may well be based on discourse considerations, rather than structural factors.

Even if we accept the existence of the hierarchy on theoretical grounds, its psychological validity remains debatable. There are different interpretations in the literature about what it means to say that Ss are 'more accessible' to relativisation than Os from a psycholinguistic point of view (Gass, 1977: 339; Clancy *et al*, 1986: 229). Our own interpretation of the predictions made by this hypothesis has been that RCs with object focus should be more difficult to understand than RCs with subject focus. However, this is a dangerous statement since it reveals a basic confusion between processing strategies and grammatical description. Also, the Accessibility Hierarchy Hypothesis explains processing difficulty by concentrating on the grammatical role of the relativised NP in the RC, but ignores the role the head noun plays in the main clause. It ignores the fact that RCs are embedded in main clauses and cannot be understood without them. In fact, any hypothesis stated in purely grammatical terms is challenged by the results in Experiment 1, since there are no grounds for attributing any real explanatory power to the *Parallel Function Hypothesis* either: performance on SS and SO was

[10] In fact Keenan & Comrie (1977: 94) admit that heads of RCs share a logical property with subjects of sentences. Also, Krock and Hindley (1982, cited in Clancy, 1986: 229) make the observation that even in languages that allow relativisation in all positions Ss are more often relativised than Os and so on. This does not seem to depend on any grammatical property of the sentence, but rather on thematic constraints.

very similar and the difference between OS and OO can be explained more consistently in terms of the NNV strategy.

The conclusion to be drawn from these observations is that unless the Accessibility Hierarchy Hypothesis and the Parallel Function Hypothesis are re-stated in such a way that they take into account the role played by the configurational properties of specific languages in RC processing there are strong objections against attributing to them a significant part in RC processing. In this regard it is interesting that the predictions made by the Accessibility Hierarchy Hypothesis coincide with the predictions made by the *Word Order Hypothesis* (see Table 2) and experimental results that have often been mentioned as providing support for the Accessibility Hierarchy Hypothesis (Cook, 1975) could in fact be better explained in terms of the Word Order Hypothesis. Cook himself admits that the reason why sentences with object focus create difficulty is that they disrupt the canonical word order of English (Cook, 1975: 204)

The two hypotheses that receive support from the results in Experiment 1 concentrate on s-structure properties mainly, but they also take into account the grammatical description of a sentence containing a RC. In languages that show a rigid word order, such as English, the grammatical function of the head noun in the main clause affects configurational properties in a crucial way, as the position of the RC in the sentence will be determined by the grammatical role of the head noun. In languages like Basque, in which almost every permutation of elements is possible, any approach to language processing that concentrates on s-structure provides an insight into the grammatical description of the language, since, as Eguzkitza points out (1986: 143), 'in Basque there is no apparent change from the deep structure relations to the surface structure cases'.

In summary, the results obtained for Experiment 1 suggest that, at least for an SOV language like Basque, non-native speakers process RCs attending primarily to s-structure properties of sentences containing RC. The observations derived from the analysis suggest the adequacy of an integrated approach to language processing. In this sense,

an account of how RCs are processed in Basque should concentrate on both the universal properties of grammatical description, and configurational properties specific to Basque.

3.2 Experiment 2

Subjects:

19 first and second year students at the University of Leeds (England) reading Spanish as a main subject of their degree. Their command of Spanish was thought to be equivalent to the command of Basque of Ss in Experiment 1. They were all volunteers and were tested in four sessions outside lecture hours. The aim of the experiment was explained to them in general terms.

Materials and Procedure:

The material matched that of Experiment 1. The Basque sentences were translated into Spanish and the questionnaire into English. It is worth noting that in Spanish the preposition *a* before a personal N(O) indicates the accusative case in a sentence in which there are no other NPs in the VP. Although this provides a very important s-structure clue, we decided to use this structure instead of the alternative construction without the preposition, also possible in Spanish, as we considered that the construction with the preposition was more 'natural'. The procedure was exactly the same as for Experiment 1. We used Method A and the sentences were on tape.

(7) El espía abrazó a la chica a la que el detective hirió.
the spy embraced-he to the girl to the that the detective hurt

'The spy embraced the girl (that) the detective hurt.

a. The spy embraced the girl and the detective hurt the girl.
b. The spy embraced the girl and the girl hurt the detective.
c. The spy embraced the detective and the girl hurt the detective.

Results and Discussion:

The slight difference between the mean scores for the four sentence types (Table 9) can be attributed to chance alone. The high scores suggest that the task proved too easy for the Ss, an idea that the confidence scores (Tables 10 and 11) seem to confirm. As in Experiment 1 we compared the difference between the mean confidence scores for the four sentence types using a non-parametric test (Table 12). Ss were more confident about their choices in sentences with subject focus, than in those with object focus as the *Accessibility Hierarchy Hypothesis* predicts. At the same time, no evidence was found that Ss felt more insecure about their choices in sentences with centre-embedded RCs. On the contrary, the difference between SS and OS, on the one hand, and SO and OO, on the other, lies in the opposite direction from what the Interruption Hypothesis predicts.

TABLE 9

Mean number of correct responses

SS	SO	OS	OO
4.6	4.6	4.7	4.5

TABLE 10

Mean confidence rates for the four sentence types

SS	SO	OS	OO
4.3	3.7	4.5	4.1

TABLE 11

Analysis of mean confidence rates in Experiments 1 and 2 by means of Mann-Whitney test

	SS1-SS2	SO1-SO2	OS1-OS2	OO1-OO2
P VALUE	0.00	0.01	0.00	0.00

TABLE 12

Analysis of mean confidence rates in Experiment 2 by means of Wilcoxon test

	SS-SO	OS-OO	SS-OS	SO-OO
P VALUE	0.00	0.00	0.05	0.00

It is difficult to reach a conclusion from these results, since confidence scores are influenced by factors which might not depend upon the incorrect or correct comprehension of a sentence. The reason why we included the confidence task in the experiments was to make sure Ss answered all questions in the comprehension test, even if they did not know the answer. In Experiment 1, the confidence scores provided further support for the results obtained in the comprehension task. In Experiment 2, where the comprehension task proved inadequate, we are left with only the evidence of the confidence scores in support of the Accessibility Hierarchy Hypothesis. In our opinion, no conclusion can be reached until an appropiate comprehension task is designed that can provide results capable of distinguishing between the hypotheses.

Comparison of the comprehension task scores in Experiments 1 and 2 raises an interesting theoretical issue in relation to theories of L2 acquisition and the concepts of parametric variation and markedness in Universal Grammar. In particular, it has been suggested that when L1 and L2 do not match in branching direction (Spanish and Basque, for example) acquisition of L2 will be hindered as the parameters will need to be reset for L2 (White, 1987; Phinney, 1987). Gass (1977) tested language transfer in those areas in which languages of the world differ in their relativisation strategies and found evidence that Universal Grammar plays a leading role in assigning a relative order of difficulty in RC processing. The same conclusion was reached by Flynn (1984) about the acquisition of anaphora in L2 learners of Spanish, Japanese and English.

The higher scores obtained in the comprehension task in Experiment 2 compared to Experiment 1 can then be explained in the light of these theories. English and Spanish are languages with a basically consistent right-branching direction, as opposed to Basque that shows a dominant left-branching direction. When the parameters for branching direction match, acquisition of certain syntactic structures, like RCs, is easier than when there is a mismatch in branching direction. Thus, Ss in Experiment 1 found the task much more difficult than Ss in Experiment 2.

4. Conclusion

Processing RCs presents several perceptual difficulties. After examining different language-specific and language-universal principles affecting RC processing (mainly, Bever, 1970; Slobin, 1971; Sheldon, 1974, 1976; Keenan & Comrie, 1977) we have argued that all these contradictory hypotheses result from the contention between two different ideas about language processing in general and RC processing in particular (following Hakuta, 1981): one based on configurational properties of sentences and the other on the grammatical relations of elements in a sentence. Our own experimental results provided strong support for the idea that it is surface structure properties of sentences that affect processing difficulty. In particular, the *Interruption Hypothesis* (Slobin, 1971) received strong support in Experiment 1 against the *Accessibility Hierarchy Hypothesis* (Keenan & Comrie, 1977), which explains perceptual difficulty on grammatical grounds. It was also suggested that only an integrated approach to language processing could account for the relative difficulty of processing RCs in Basque. The comparison between the results obtained in Experiment 1 and those obtained for the processing of Spanish RCs by English Ss (Experiment 2) raised the issue of the interaction between theories of L2 acquisition and Universal Grammar, particularly the concept of branching direction as an instance of parametric variation. However, we could not draw any conclusion about the relative difficulty of RC processing in an VO language, like Spanish. This question is still open for further research.

APPENDIX: SENTENCES USED IN THE EXPERIMENTS

EXPERIMENT 1

GROUP A

1. Gizona neska ikusi zuen mutila jo zuen.
2. Manifestariak zapaldu zuen poliziak ikasiea atxilotu zuen.
3. Medikua gorrotatzen zuen pazienteak erizaina maite zuen.
4. Espiak detektibea zauritu zuen neska besarkatu zuen.

5. Arbitroa bultzatu zuen jokalariak aurkako taldekoa jo zuen.
6. Pazienteak medikuak gorrotatzen zuen erizaina maitè zuen.
7. Neska ikusi zuen gizonak mutila jo zuen.
8. Detektibeak zauritu zuen espiak neska besarkatu zuen.
9. Manifestaria zapaldu zuen poliziak ikaslea atxilotu zuen.
10. Jokalariak arbitroa bultzatu zuen aurkako taldekoa jo zuen.
11. Poliziak manifestariak zapaldu zuen ikaslea atxilotu zuen.
12. Detektibea zauritu zuen espiak neska besarkatu zuen.
13. Arbitroak bultzatu zuen jokalariak aurkako taldekoa jo zuen.
14. Gizonak neska ikusi zuen mutila jo zuen.
15. Medikuak gorrotatzen zuen pazienteak erizaina maite zuen.
16. Poliziak manifestaria zapaldu zuen ikaslea atxilotu zuen.
17. Pazienteak medikua gorrotatzen zuen erizaina maite zuen.
18. Espiak detektibeak zauritu zuen neska maite zuen.
19. Neskak ikusi zuen gizonak mutila jo zuen.
20. Jokalariak arbitroak bultzatu zuen aurkako taldekoa jo zuen.

COMPREHENSION TEST: GROUP A

1. a. El hombre golpeó a la chica y la chica vio al chico.
   b. El hombre golpeó a la chica y el chico vio a la chica.
   c. El hombre golpeó al chico y el chico vio a la chica.
2. a. El manifestante pisó al policía y el policía arrestó al manifestante.
   b. El manifestante pisó al estudiante y el policía arrestó al manifestante.
   c. El estudiante pisó al policía y el policía arrestó al manifestante.
3. a. La enfermera odiaba al médico y el paciente amaba a la enfermera.
   b. El médico odiaba al paciente y la enfermera amaba al paciente.
   c. El paciente odiaba al médico y el paciente amaba a la enfermera.
4. a. El espía abrazó a la chica y el detective hirió a la chica.
   b. La chica abrazó al espía y el detective hirió a la chica.
   c. El espía abrazó a la chica y la chica hirió al detective.
5. a. El jugador empujó al árbitro y el jugador pegó al contrario.
   b. El contrario empujó al árbitro y el jugador pegó al contrario.
   c. El jugador empujó al árbitro y el contrario pegó al jugador.
6. a. El paciente odiaba al medico y el paciente amaba a la enfermera.

b. El médico odiaba a la enfermera y el paciente amaba a la enfermera.
c. El médico odiaba al paciente y la enfermera amaba al paciente.

7. a. La chica vio al hombre y el chico golpeó al hombre.
b. El hombre vio a la chica y el chico golpeó al hombre.
c. El hombre vio a la chica y el hombre golpeó al chico.

8. a. El detective hirió al espía y la chica azó al espía.
b. El detective hirió al espía y el espía a azó a la chica.
c. El detective hirió a la chica y el espía abrazó a la chica.

9. a. El estudiante pisó al manifestante y el policía arrestó al manifestante.
b. El estudiante pisó al manifestante y el policía arrestó al estudiante.
c. El policía pisó al manifestante y el policía arrestó al estudiante.

10. a. El jugador pegó al contrario y el árbitro empujó al contrario.
b. El jugador pegó al contrario y el contrario empujó al árbitro.
c. El jugador pegó al árbitro y el jugador empujó al contrario.

11. a. El policía arrestó al manifestante y el estudiante pisó al manifestante.
b. El policía arrestó al estudiante y el estudiante pisó al manifestante.
c. El policía arrestó al estudiante y el manifestante pisó al estudiante.

12. a. El detective hirió a la chica y el espía abrazó a la chica.
b. El espía hirió al detective y el espía abrazó a la chica.
c. El espía hirió al detective y el detective abrazó a la chica.

13. a. El árbitro empujó al contrario y el jugador pegó al contrario.
b. El árbitro empujó al jugador y el jugador pegó al contrario.
c. El árbitro empujó al contrario y el contrario pegó al jugador.

14. a. El hombre golpeó a la chica y el chico vio al hombre.
b. El hombre golpeó al chico y el chico vio a la chica.
c. El hombre golpeó al chico y la chica vio a la chica.

15. a. El paciente odiaba al médico y el paciente amaba a la enfermera.
b. El médico odiaba al paciente y el paciente amaba a la enfermera.
c. El médico odiaba al paciente y el médico amaba a la enfermera.

16. a. El policía arrestó al estudiante y el estudiante pisó al manifestante.

b. El policía arrestó al estudiante y el policía pisó al manifestante.
c. El policía arrestó al manifestante y el policía pisó al estudiante.

17. a. La enfermera amaba al paciente y el paciente odiaba al médico.
b. El paciente amaba a la enfermera y la enfermera odiaba al médico.
c. El paciente amaba a la enfermera y el médico odiaba a la enfermera.

18. a. El espía abrazó a la chica y el detective hirió a la chica.
b. El espía abrazó a la chica y la chica hirió al detective.
c. El espía abrazó al detective y la chica hirió al detective.

19. a. La chica vio al chico y el chico golpeó al hombre.
b. El hombre vio a la chica y la chica golpeó al chico.
c. La chica vio al hombre y el hombre golpeó al chico.

20. a. El jugador pegó al árbitro y el árbitro empujó al contrario.
b. El jugador pegó al contrario y el árbitro empujó al contrario.
c. El jugador pegó al árbitro y el jugador empujó al contrario.

EXPERIMENT 2

GROUP A

1. El hombre golpeó al chico que vio a la chica.
2. El policía al que el manifestante pisó arrestó al estudiante.
3. El paciente que odiaba al médico amaba a la enfermera.
4. El espía abrazó a la chica que hirió al detective.
5. El jugador que empujó al árbitro golpeó al contrario.
6. El paciente amaba a la enfermera a la que el médico odiaba.
7. El hombre que vio a la chica golpeó al chico.
8. El espía al que hirió el detective abrazó a la chica.
9. El policía que pisó al manifestante arrestó al estudiante.
10. El jugador golpeó al contrario que empujó al árbitro.
11. El policía arrestó al estudiante al que el manifestante pisó.
12. El espía que hirió al detective abrazó a la chica.
13. El jugador al que el árbitro empujó golpeó al contrario.
14. El hombre golpeó al chico al que la chica vio.
15. El paciente al que el médico odiaba amaba a la enfermera.
16. El policía arrestó al estudiante que pisó al manifestante.
17. El paciente amaba a la enfermera que odiaba al médico.

18. El espía abrazó a la chica a la que el detective hirió.
19. El hombre al que la chica vio golpeó al chico.
20. El jugador golpeó al contrario al que el árbitro empujó.

COMPREHENSION TEST: GROUP A

1. a. The man hit the girl and the girl saw the boy.
   b. The man hit the girl and the boy saw the girl.
   c. The man hit the boy and the boy saw the girl.
2. a. The demonstrator stepped on the policeman and the policeman arrested the student.
   b. The demonstrator stepped on the student and the policeman arrested the student.
   c. The student stepped on the policeman and the policeman arrested the demonstrator.
3. a. The nurse hated the doctor and the patient loved the nurse.
   b. The doctor hated the patient and the nurse loved the patient.
   c. The patient hated the doctor and the patient loved the nurse.
4. a. The spy embraced the girl and the detective hurt the girl.
   b. The girl embraced the spy and the detective hurt the girl.
   c. The spy embraced the girl and the girl hurt the detective.
5. a. The football player pushed the referee and the football player hit the opponent.
   b. The opponent pushed the referee and the football player hit the opponent.
   c. The football player pushed the referee and the opponent hit the football player.
6. a. The patient hated the doctor and the patient loved the nurse.
   b. The doctor hated the nurse and the patient loved the nurse.
   c. The doctor hated the patient and the nurse loved the patient.
7. a. The girl saw the man and the boy hit the man.
   b. The man saw the girl and the boy hit the man.
   c. The man saw the girl and the man hit the boy.
8. a. The detective hurt the spy and the girl embraced the spy.
   b. The detective hurt the spy and the spy embraced the girl.
   c. The detective hurt the girl and the spy embraced the girl.

9. a. The student stepped on the demonstrator and the policeman arrested the demonstrator.
   b. The student stepped on the demonstrator and the policeman arrested the student.
   c. The policeman stepped on the demonstrator and the policeman arrested the student.
10. a. The football player hit the opponent and the referee pushed the opponent.
   b. The football player hit the opponent and the opponent pushed the referee.
   c. The football player hit the referee and the football player pushed the opponent.
11. a. The policeman arrested the demonstrator and the student stepped on the demonstrator.
   b. The policeman arrested the student and the student stepped on the demonstrator.
   c. The policeman arrested the student and the demonstrator stepped on the student.
12. a. The detective hurt the girl and the spy embraced the girl.
   b. The spy hurt the detective and the spy embraced the girl.
   c. The spy hurt the detective and the detective embraced the girl.
13. a. The referee pushed the opponent and the football player hit the opponent.
   b. The referee pushed the football player and the football player hit the opponent.
   c. The referee pushed the opponent and the opponent hit the football player.
14. a. The man hit the girl and the boy saw the man.
   b. The man hit the boy and the boy saw the girl.
   c. The man hit the boy and the girl saw the boy.
15. a. The patient hated the doctor and the patient loved the nurse.
   b. The doctor hated the patient and the patient loved the nurse.
   c. The doctor hated the patient and the doctor loved the nurse.
16. a. The policeman arrested the student and the student stepped on the demonstrator.
   b. The policeman arrested the student and the policeman stepped on the demonstrator.

c. The policeman arrested the demonstrator and the policeman stepped on the student.

17. a. The nurse loved the patient and the patient hated the doctor.
    b. The patient loved the nurse and the nurse hated the doctor.
    c. The patient loved the nurse and the doctor hated the nurse.
18. a. The spy embraced the girl and the detective hurt the girl.
    b. The spy embraced the girl and the girl hurt the detective.
    c. The spy embraced the detective and the girl hurt the detective.
19. a. The girl saw the boy and the boy hit the man.
    b. The man saw the girl and the girl hit the boy.
    c. The girl saw the man and the man hit the boy.
20. a. The football player hit the referee and the referee pushed the opponent.
    b. The football player hit the opponent and the referee pushed the opponent.
    c. The football player hit the referee and the football player pushed the opponent.

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