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Cambridge
Scholars
Publishing

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This book first published 2018

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-5275-0573-1
ISBN (13): 978-1-5275-0573-5

“They’ve a temper, some of them – particularly verbs, they’re the proudest – adjectives you can do anything with – but not verbs. However, *I* can manage the whole lot!”
(Lewis Carroll, *Through the Looking-Glass*)

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ACKNOWLEDGMENTS

Behind these pages there are many people that I have met and worked with during the last ten years and to whom I am deeply grateful. There are three people in particular to whom I feel indebted: Luigi Rizzi, Manolo Carreiras and Nicola Molinaro. Luigi was the first one to introduce me to the realms of linguistics and to the intricacies of agreement. It was a real pleasure and honour to work with him when I was in Siena, and it still is a pleasure now that I am not there anymore. I truly consider myself lucky for this. Manolo opened the doors of his lab in Tenerife to me in 2009. There I met Nicola and after 8 years, the three of us are still talking about agreement (and many other things), in a less exotic but surely exciting environment (the BCBL in the Basque Country). Without them, almost all the work described here would not have been possible. Another person who significantly contributed to all this is Ileana Quiñones, whose skills, hard work and patience pushed this work on agreement farther than initially expected. My gratitude goes also to my BCBL colleagues and friends, especially to Sendy, whose presence, input and help enrich any conversation, be it agreement-related or not!

I also wish to thank Alessandro Laudanna, for guiding me in my first steps into psycholinguistics, and Francesco Vespignani, the first person to show me an event-related potentials (ERP) waveform. My thanks go also to former and current CISCL members, Cristiano, Giuliano, Vincenzo and especially Irene and Ida, whose presence and friendship made room 322 in the San Niccolò building a very pleasant place to work in.

Finally, I am extremely lucky to have several “anchors” in my life: Jose, my family, Claudia, Iuri, Emma, Laura, Francesca, Hada, Ercole and Ernesto. Their support has mattered and will always matter more than anything else.

INTRODUCTION

AGREEMENT

Agreement is a widespread and varied phenomenon. Its pervasiveness in some languages contrasts with its near absence in others, posing a challenge for the linguists and psycholinguists who attempt to explain the mechanics of its representation and processing. This work explores the intricacies involved in agreement computation, with the aim of unveiling theoretical and psycho-/neuro-linguistic aspects of this crucial syntactic relation. The empirical focus will be on subject-verb (s-v henceforth) agreement and on the features engaged in this dependency: person and number. The analysis will be carried out by making reference to the Minimalist Program (Chomsky 1995; 2001; 2005) and Cartography (Belletti 2008; Cinque 1999; Cinque and Rizzi 2008; Rizzi 1997, 2004; Shlonsky 2010, *inter alia*) recently developed within mainstream generative grammar. Despite the apparently inherent tension that seems to set Minimalism and Cartography in opposition, the combination of these two lines of research may be extremely fruitful: while the former focuses on the generative devices involved in the derivation of syntactic structures, the latter focuses on the "atoms" of the generated structures (Cinque and Rizzi 2008). The two lines of research can therefore be pursued in parallel, and this work represents an attempt at doing so.

Agreement manifests itself when grammatical information appears on a word that is not the source of that information. Early derivational grammars defined agreement as a relation holding between two elements – a controller and a target – that share specific features, with the controller (also called trigger) being the element from which grammatical information originates, and the target the element that inherits the information. S-v agreement is an instantiation of the controller-target relation. What characterises this dependency is the systematic covariance (Steele 1978) existing between the feature sets of the former and latter members of the relation: the subject can vary between singular and plural number and among 1st, 2nd and 3rd person, with the form of the verb that changes accordingly, so that an identity of features is realised. Covariance

is an essential notion: it is not sufficient that two elements happen to share properties; the sharing must also be systematic.

An important aspect of agreement concerns the way this dependency is morphologically expressed on the verb. In Italian, as in many other richly-inflected languages, person and number values are expressed by an affix that attaches to the verb stem. Crucially, the same morpheme marks both person and number information. In the Italian sentence in (1), the agreement morpheme *–e* represents both the 3rd person and the singular number value of the subject 'il gatto'.

(1) Il gatto corre
The $cat_{3.sg}$ $runs_{3.sg}$
'The cat runs'

This leads us to the main research question raised in this work: does the parser distinguish between person and number during agreement processing, or are these features undifferentiated and accessed as a bundle? This question reflects the theoretical divide existing between the single-cluster analysis of agreement elaborated within standard minimalist analyses (Chomsky 1995 and subsequent work) and the distinct-cluster analysis of agreement features put forth within the cartographic framework (Shlonsky 1989, 2000, 2009, 2010; Sigurdsson 2004; Sigurdsson and Holmberg 2008, *inter alia*), which will be thoroughly illustrated in Chapter 1. Similarly, within recent psycholinguistic research, an unequivocal answer has not been given yet. In light of this, the studies presented in Chapter 3 represent an attempt to clarify whether a dissociation between person and number can be maintained, both in processing and syntactic structure terms. The behavioural and neuro-imaging experiments will provide convergent results to the effect that a functional dissociation between the two features can be maintained. Fundamental to this dissociation is the role of *interpretive anchors*, i.e. structural positions where morphosyntactic values are linked – or anchored – and that drive the interpretation of person and number. The *Feature Interpretation Procedure* in Chapter 1 will provide the parser the flexibility necessary to deal with the different information carried by features.

A related issue addressed in this monograph concerns a more fine-grained aspect of subject-verb agreement, namely the distinction between $1^{st}/2^{nd}$ and 3^{rd} person pronouns. Morphological and configurational splits among pronouns have been highlighted in a variety of languages and have been attributed to the different featural specifications of pronouns. A long-standing tradition (Benveniste 1966; Forcheimer 1953; Jakobson 1971) distinguishes 1^{st} and 2^{nd} person from 3^{rd} person pronouns on the basis of

the capacity that the former, but not the latter pronouns, have to pick up and identify a specific speech participant (speaker and addressee). This intrinsic difference in terms of discourse-(un-)relatedness is thought to affect the featural makeup of pronouns. As real persons in the speech act, 1st and 2nd person are specified for the person feature, while 3rd person pronouns, which represent entities being talked about without any active role in the speech act, are specified for the number feature (Anagnostopoulou 2003; Benveniste 1966; Harley and Ritter 2002; Kayne 2000, *inter alia*). Identity with (or inclusion of) a speech participant is thus the criterion used to discern the two classes of pronouns, and the discourse-relatedness of a pronoun is therefore determined solely on this basis. Alternative and less radical feature representations have been developed (Bianchi 2006; Sigurdsson 2004) that do not relate the discourse-relatedness of a pronominal form solely on the basis of the presence of an underlying speech participant. It is true that 1st and 2nd person differ from 3rd person in their reference to a speech role, but there are also similarities between the three forms that have not been captured by former analyses, namely the fact that 3rd person refers to a contextually salient entity, which determines a certain degree of discourse-relatedness (Bianchi 2006). The ERP experiment presented in Chapter 4 will show that the parser is able to differentiate between 1st/2nd and 3rd person agreement and between the different degrees of discourse-relatedness that the two classes of pronouns have.

The idea of a controller-target dependency highlights a fundamental aspect of agreement, namely its asymmetrical character. Seeing agreement as an asymmetrical relation implies not only that this phenomenon is a matter of "displaced" grammatical information (Corbett 2006) copied from the controller to the target, but also that the two elements involved in the relation do not play the same role. There are two interrelated ways in which the asymmetry between controller and target manifests itself. First, the controller (the subject) has no choice of feature value, while the target (the verb) does. The target can have different morphological forms available to match the person and number features of the noun: in (1), the verb *corre*, a 3rd person singular, is one of them, which is chosen on the basis of the person and number values of the subject-controller. The controller, on the other hand, does not have the same availability of morphological forms: a lexical DP comes only as a 3rd person, and the only variance that it is allowed is between singular and plural. In this view, it is the verb that agrees with the subject, and not conversely. Second, the contribution to semantic interpretation is related to the controller rather than to the target: if we shift from a singular to a plural subject in (1), the

verb varies accordingly, but it is not the plural number marking on the verb that will affect the interpretation. Rather, interpretation will rely on the subject argument.

In sum, two assumptions seem rather straightforward and unequivocal about agreement: i) the fact that it is based on a systematic covariance of features, which surfaces with feature identity between controller and target; ii) the unidirectionality of the feature valuing process, which is supposed to operate from subject to verb and not vice versa.

Nevertheless, across languages, agreement patterns are found in which a featural mismatch between subject and verb is allowed. Unagreement in Spanish is one such phenomenon, in which the presence of a person mismatch between subject and verb nonetheless produces a well-formed sentence, as in (2). What ensures the grammaticality of these sentences is the superimposition of verbal 1st person plural interpretation onto the 3rd person plural value of the subject.

(2) Los lingüistas escribimos un artículo muy interesante
The linguists$_{3.pl}$ wrote$_{1.pl.}$ an article very interesting
'We linguists wrote a very interesting article.

The relevance of unagreement resides in the opportunity that it offers to test the degree of permeability of agreement processing to semantic-discourse factors and the directionality of the mechanisms. This issue will be profusely addressed in Chapter 5, where instances of unagreement and standard agreement in Spanish will be compared.

The theoretical analysis of these constructions will be integrated with data from behavioural, electrophysiological and neuroanatomical investigations that will shed light on the time course, the mechanisms and the neuro-biological bases of agreement processing. By adopting features as units of analysis, this work will decompose agreement into its basic building blocks and algorithms, providing the first framework to understand its dynamics and neuro-biological bases in morphologically rich languages.

LIST OF ABBREVIATIONS

Acc	Accusative case
ACC	Anterior cingulate cortex
AG	Angular gyrus
Cl	Clitic
CP	Complementiser Phrase
Dat	Dative case
Dir	Direct (Voice)
DO	direct object
DP	Determiner Phrase
EPP	Extended projection principle
Fem	feminine gender
FIP	Feature Interpretation Procedure
Incl	inclusive
Inv	Inverse (Voice)
IO	Indirect object
IP	Inflectional Phrase
LC	Logophoric Centre
LD	Left dislocation
LIFG	Left Inferior Frontal Gyrus
LF	Logical Form
Masc	masculine gender
MTG	Middle temporal gyrus
NID	Northern Italian Dialect
Nom	Nominative Case
PCC	Person Case Constraint
Pl	plural number
PF	Phonological Form
s-v	subject-verb agreement
sg	singular number
STG/STS	Superior Temporal Gyrus/Sulcus
TP	Tense Phrase
VP	Verb Phrase

CHAPTER ONE

THE LINGUISTICS OF AGREEMENT

In this chapter, agreement will be presented from the perspective of the Minimalist Program (Chomsky 1995 and subsequent work) and of Cartography (Cinque and Rizzi 2008, Shlonsky 2010, *inter alia*), the assumptions of which will lay the foundations of the theoretical and experimental study of s-v agreement that will be carried out throughout this book. The focus will be on the central role that basic building blocks of agreement relations – i.e. features – play at the structural and interpretive level.

Features in the Minimalist Program

The centrality attributed to features in the derivation of agreement relations has been assumed only lately. Early derivational grammars tended to provide a general account for the phenomenon of agreement, as the concern was mainly on the extent to which agreement processes could be assimilated to general syntactic mechanisms, while the substance of what did the agreeing, i.e. phi-features, was largely ignored. In *Syntactic Structures* (Chomsky 1957), agreement was treated as a context-sensitive transformation that followed specific rewrite rules by means of which structural changes were applied. Such rules primarily belonged to the part of grammar that specifies how the pronunciation of syntactic structures is affected, as in (1).

(1) Number transformation – obligatory
Structural analysis: X-C-Y
Structural change: C → { *S* in the Context of NP_{sing} ___ ; *Ø* in other contexts ; *Past* in other contexts }
(from Chomsky 1957, 112)

Number inflection in non-past sentences is rewritten as *-s* when preceded by a singular NP, and as zero elsewhere. The structural change

transformation is in essence a rewrite rule. To surface with the appropriate form, /s/, /z/ or /iz/, the -s morpheme undergoes morphophonological rules.

In *Aspects of the Theory of Syntax* (Chomsky 1965), the approach had become both featural and syntactic. Agreement was described as a phenomenon whose mechanics basically relied on the asymmetry between a controller and a target. Such an asymmetry was captured by means of a process in which the phi-features on the controller were literally copied or moved to the target. In other words, person, number and gender originated in the noun but were eventually expressed somewhere else in the sentence, for example in a verb or in a demonstrative. Phi-features, the substance of agreement, were thus conceived as atomic elements that were manipulated by syntax.

In earlier instantiations of the Government and Binding Theory (Chomsky 1981), a fully-fledged theory of phi-features was still missing, but configurations such as specifier-head agreement were outlined that accounted for the licensing of these features and the realisation of agreement. In other words, s-v agreement was explained by making reference to a specifier-head relation in which the two elements share a specific set of agreement features.

More recently, in the attempt to reduce derivational complexity, superfluous structural configurations and relations among elements have been eliminated and substituted by a feature-checking mechanism. By introducing the so-called Checking Theory, the Minimalist Program (Chomsky 1995) aimed at simplifying the earlier Case Theory by eliminating case assignment under government and treating Accusative Case, like Nominative Case, as assigned under specifier-head agreement.

The minimalist analysis of s-v agreement is essentially based on the interpretive asymmetry existing between agreement features on the subject and those on the verb. More precisely, the mechanisms operating in the realisation of s-v agreement hinge on the opposition between interpretable and non-interpretable features, respectively located on the subject noun and on the verb. This dualism rests on the assumption that, while phi-features on the subject provide Logical Form (LF) with fundamental cues to interpret this dependency (e.g. the plural value of the number feature indicates the cardinality of individuals, a 3rd person value distinguishes an entity being talked about from a speaker or an addressee, and so on), the features on the verb are mere copies of those on the subject, i.e. morphological expressions of a formal relation, and hence redundant values that do not add any relevant information.

Technically, interpretable features enter the derivation endowed with specific person and number values, while uninterpretable ones need to receive a value from the former by means of a formal relation – checking – that permits the licensing of morphosyntactic features in the course of the derivation. For such a relation to be properly established, a local relationship must hold between subject and verb: movement (of the subject DP to SpecTP) is motivated by the need to check off the verb's uninterpretable features in a specifier-head configuration, which is the only admissible checking relation. For Full Interpretation to be possible, a verb's uninterpretable feature must be eliminated after checking, as redundancy is not admitted in an optimal design.

Chomsky (1995) makes a very clear point about the conditions under which features can be checked: features cannot be checked under feature mismatch, as this circumstance would lead to cancelling of the derivation. Here a conflict seems to arise between this theoretical standpoint and certain agreement configurations that allow feature mismatches. In other terms, if a configuration with mismatching features is not a legitimate syntactic object, how can we motivate the presence of "grammatical mismatches" such as the ones in (2) and (3) below in Spanish?

(2) Los lingüistas escribimos un artículo muy interesante
The linguists$_{3.pl}$ wrote$_{1.pl}$ an article very interesting
'We linguists wrote a very interesting article'

(3) Los lingüistas escribís un artículo muy interesante
The linguists$_{3.pl}$ wrote$_{2.pl}$ an article very interesting
'You linguists wrote a very interesting article'

The analysis of these agreement patterns will be dealt with in Chapter 5.

An aspect of the minimalist approach to s-v agreement relevant to the analysis that will be developed here concerns the structural site in which uninterpretable features are located within sentence structure. Chomsky's (1995) assumption is that person and number features form a cluster hosted under the same syntactic head, normally identified with the T node, which is responsible for the expression of tense, as shown in Figure 1-1. It is in T that all uninterpretable phi-features are clustered, without any structural distinction among them. A straightforward consequence of this implementation is that the checking operation accesses the whole feature bundle in a unique computational step, and not in a series of distinct operations, one for each feature to be checked and valued.

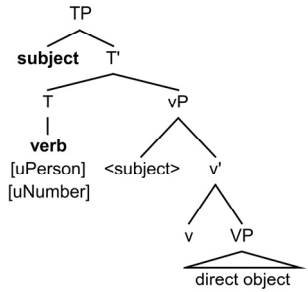

Figure 1-1. Uninterpretable person and number (uPerson, uNumber) form a cluster under the T head. SpecTP is occupied by the subject, whose interpretable features enter in a checking relation with those on the verb.

In subsequent proposals (Chomsky 2000, 2001, 2005), Chomsky refines the concept of feature checking and introduces the operation Agree. Agree permits feature valuation at a distance, through a c-commanding relation holding between a higher head whose uninterpretable features must be checked (the probe, i.e. the verb), and the element whose interpretable features (the goal, i.e. the subject noun) are checked against. Agree then supersedes the original motivation for movement (feature checking) and replaces it with a system of formal licensing. Uninterpretable features serve to implement operations and as such they render the goal active, i.e. able to implement an operation, which in this case is the deletion of the probe. The phi-set contained in the probe seeks a goal, i.e. matching features, with which it can establish agreement. Locating the goal, the probe erases under Matching: the erasure of uninterpretable features on the goal is the operation called Agree (Chomsky, 2000, 122). Checking therefore reduces to deletion of the uninterpretable features under matching. Importantly, deletion is taken to be a "one fell swoop" operation dealing with the phi-set as a unit. Its features cannot selectively erase: either all delete, or none (Chomsky 2000, 124).

Both Checking theory and Agree imply an asymmetrical and unidirectional relation holding between the probe and the goal, due to their different interpretability status: person and number values are copied from the subject to the verb, which amounts to saying that it is the verb that agrees with the subject, and not the converse (Chomsky 2000, 124).

Importantly, Chomsky (1995 and subsequent work) stresses the narrowly syntactic nature that s-v agreement mechanisms have. Both the earlier Checking and the later Agree operations introduced to account for the identity of feature values that surfaces with agreement do not span

outside the boundaries of Narrow Syntax. It is within the limits of this component that checking and uninterpretable feature deletion take place, since the syntactic object handed over to the covert component, i.e. Logical Form (LF), will have to be deprived of any uninterpretable element to ensure that the derivation will converge.

Fine-grained decomposition of agreement projections: Cartography

Besides the minimalist single-cluster approach to s-v agreement, distinct-cluster analyses of this phenomenon can be also found, which stress the structural differentiation of the features involved in s-v agreement. They provide a detailed mapping – i.e. a cartography – of the projections involved in the realisation of this dependency that best captures the cross-linguistic variance of s-v agreement richness.

The cartographic approach to sentence structure has its roots in Pollock's (1989) *Split Infl Hypothesis*, according to which two distinct functional projections can be identified in the inflectional area of the sentence (Inflectional Phrase, IP): one for the realisation of s-v agreement, i.e. AgrSP, and one for tense marking, i.e. TP, with this functional projection being in a higher position than AgrSP. The core assumption behind this structural differentiation was that rich agreement potentially correlates with height of verb movement: for instance, Romance finite verbs, which show rich agreement, move higher than both English finite verbs and Romance participles, which agree less fully.

A slightly different description of the inflectional area and its functional projections was put forth by Belletti (1990), who proposed that AgrSP is higher in the structure than TP, on the basis of the order in which inflectional affixes appear within verbs in Italian (and other languages), as shown in (4):

(4) Parl- av- a
Root- Tense affix-Agr.affix
'He talked'

In (4), the tense affix -*av*- appears closer to the verb root (*parl*-) than the agreement affix (-*a*). According to the Mirror Principle (Baker 1985), the tense affix, being closer to the root, occupies the lowest position in the syntactic tree, while the agreement affix occupies the highest one, resulting in a configuration like (5):

(5) $[_{AgrSP}$ Agr $[_{TP}$ T $[_{VP}$ V]]]

Following Pollock's (1989) and Belletti's (1990) seminal work, AgrSP has been progressively decomposed to provide a detailed mapping of the inflectional area, in which separate functional projections that host distinct morphosyntactic features have been identified (Linn and Rosen 2003; Poletto 2000; Shlonsky 1989; 2000; 2009; Sigurdsson 2004; 2009 Sigurdsson & Holmberg 2008, *inter alia*). In other words, AgrSP has been decomposed into different projections that are responsible for person, number and gender agreement singularly. The grammar can then access phi-features separately, and person, number and gender agreement on the verb would result from the establishment of distinct Agree relations, as the verb moves up in the structure. Data from Hebrew, Arabic, Icelandic and Italian show that by separating the bundle of features involved in s-v agreement and analysing each of them as separate projections, it is possible to explain the syntactic phenomenon of agreement in a way that best captures the fact that not all languages show the same richness of agreement. Let us see how.

In his analysis of Hebrew and Arabic agreement patterns, Shlonsky (1989) argues that instead of an Agr node *per se* that includes a bundle of features, a more articulated structure with separate agreement features can be postulated, as in Figure 1-2. The three features of gender, number and person are separately represented in three different projections: GenderP, NumberP and PersonP, with PersonP occupying the highest position in the tree.

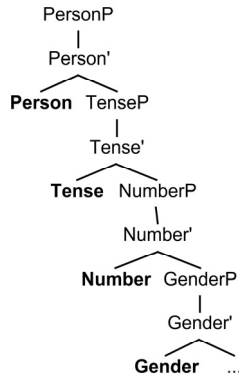

Figure 1-2. Decomposition of the Agr node into separate Person, Number, Tense and Gender projections in Hebrew (Shlonsky 1989).

In Hebrew and Arabic, verbs need to associate with features one by one, in successive steps. A verb can adjoin to NumberP if it has previously adjoined to GenderP and, similarly, it can manifest person agreement only if it manifests number and gender agreement. Shlonsky reports data showing that agreement can be defective, as in Arabic V-initial clauses and in Benoni verbs in Hebrew. Arabic V-initial verbs agree with the subject only in gender, because the verb has failed to go further up in the tree and adjoin to NumberP and PersonP. Full agreement in Arabic occurs only when the subject is preverbal. In Hebrew, Benoni[1] verbs are [-finite] and, as such, they cannot trigger verb raising: V raises to Gender, then to Number, but the non-finiteness of Tense blocks verb raising to PersonP. The result is that verb and subject agree only in number and gender. Table 1-1 shows Hebrew and Arabic agreement patterns.

Table 1-1. Hebrew and Arabic agreement patterns

Agreement patterns in Hebrew	
Future and Past forms: Inflected for gender, number and person	Ata ti – šmor ʾal ha-xacilim You $_{2.m.sg}$ guard on the eggplant You will guard on the eggplants
Benoni forms: V agrees with the subject in gender and number	Ata šomer ʾal ha-xacilim You guard$_{m.sg}$ on the eggplant You guard/are guarding on the eggplants
Agreement patterns in Arabic	
V is clause-initial: Agreement with the subject only in gender	ʾakal – a l- ʾawlaad l-ta ʕaam Ate$_{m}$ the boy$_{m.pl}$ the food The boys ate the food
Preverbal subject: Full agreement (person, number and gender)	Qult – u ʾinna l- ʾawlaad ʾakal –ul ta ʕaam Said-$_{1.sg}$ that the boy$_{m.pl}$ ate-$_{3.m.pl}$ the food I said that the boys ate the food

These observations on s-v agreement led to the assumption that agreement features are dependent one upon the other: gender can be represented without number and person (as in V-initial clauses in Arabic), and gender and number can be represented without person. There is no verb that is marked for number and not for gender, and no verb that is

marked for person and not for number. This implies the hierarchy represented in (6) (Shlonsky 1989)[2]:

(6) **Implicational Hierarchy of Agreement Features**:
   a) If a verb is inflected for number, then it is also inflected for gender;
   b) If a verb is inflected for person, then it is also inflected for number.

According to Shlonsky, the implicational hierarchy above captures the peculiarities of s-v agreement in Hebrew and Arabic, but it can easily be extended to Slavic and Romance languages, as shown in (7) below for French (from Shlonsky 1989), where the past participle *repeintes* agrees in gender and number with *tables*.

(7) Je sais combien de tables ils ont repeintes
I know how many tables$_{f.pl}$ they have re-painted$_{f.pl}$

Contrary to what is assumed by standard minimalist assumptions, within a system of functional projections such as the one postulated by Shlonsky (1989), access to the morphosyntactic features involved in s-v agreement cannot be performed by means of a unique operation. Instead, more operations are necessary, namely one for each morphosyntactic feature that is projected in the structure and that needs to be morphologically realised. This assumption also underlies a recent analysis of Icelandic s-v agreement by Sigurdsson (2004), who proposes that complex functional heads like Infl and v need to be decomposed into different functional categories, with each of them representing a feature, as in (8):

(8) Infl: Pers$_s$, Numb$_s$, M(ood)$_s$, T (ense)$_s$
v: Pers$_o$, Numb$_o$, Asp(ect)$_o$, v
[$_{CP}$… [$_{IP}$ Pers$_s$, Numb$_s$, M, T , Pers$_o$, Numb$_o$, Asp*o* [vP ….v…..]]]

Besides the Inflectional layer of the sentence, another area is important for s-v agreement, namely the Complementiser Phrase (CP) area, where Sigurdsson (2004, 13) locates the so-called logophoric Agent and logophoric Patient (λ_a and λ_p) corresponding to the speaker and the hearer of the speech event, i.e. 1st and 2nd person, as shown in (9):

(9) [$_{CP}$ Force..λ_A λ_P..Top..S_T..S_L[$_{IP}$..Pers$_S$..Num$_S$..M..T..[$_{vP}$…]]]

The relationship between logophoric participants and agreement in the CP area of the sentence will be addressed more in depth later in this chapter, as this will turn out to be of fundamental importance for the analysis of s-v agreement that will be outlined here.

Support for the person-number distinction put forth by Sigurdsson comes from the analysis of subject clitics (SCLs) in Northern Italian dialects (NIDs) carried out by Poletto (2000). In her thorough analysis of the distribution of SCLs, Poletto (2000) identifies two agreement domains, corresponding to two different structural layers of the sentence: the area preceding the negation (NegP) and the area following it, which respectively correspond to the CP and the IP layers of clausal structure, as outlined in Rizzi (1997). These two domains are further divided into sub-domains, on the basis of the type of clitic involved: invariable (inv SCL), deictic (deic SCL), person (hearerP SCL; speakerP SCL) and number clitic (NumbP SCL), as the configuration in (10) illustrates:

(10) $[_{LDP}$ invSCL$_i$ $[_{CP}$ deicSCL $[_{FP}$ t$_i$ $[_{IP}[_{NegP}[_{NumbP}$ SCL $[_{hearerP}$ SCL $[_{SpeakerP}$ InflV $[_{TP}]]]]]]$

Apart from invariable SCLs, which do not vary for any of the six persons of the paradigm, all the other SCLs encode some subject features, without the same feature being repeated twice. Importantly, the subject features realised in the pre-negative field are different from those in the post-negative field. On the one side, deictic clitics encode a [± deictic] feature that distinguishes speech participants from non-speech participants. It should not be surprising that these types of clitics are syntactically represented in the CP area of the sentence, exactly where Sigurdsson (2004) encodes speech act-related features. On the other side, number and person SCLs express person, number and gender features: they are merged in the IP area of the sentence, where the morphosyntactic realisation of agreement is dealt with. Interestingly, person information is split into two positions: hearerP SCL and speaker InflV. Neither of these expresses the distinction between singular and plural number: hearerP SCLs express the [±hearer] distinction but do not distinguish between singular and plural, nor does the speakerP SCL. An important fact concerns 1st person singular and plural, which are not realised by unambiguous clitics, but are either expressed by the same deictic clitic that also expresses 2nd person singular and plural, or by a SCL that agglutinates to the verb, which has moved to SpeakerP, as shown in (10). This split strongly suggests that the morphological concept of person does not correspond to any single functional projection where all six persons (or even more in certain languages) are mapped: the syntactic component seems to take into

account more basic distinctions, such as the deictic distinction between participants and non-participants in discourse. This will turn out to be important when addressing the issue of the Person Asymmetry Hypothesis in Chapter 4. A last remark concerns gender information, which is parasitically represented in the NumberP SCLs, as postulated also in Di Domenico (1997) and Ritter's (1993) analysis of grammatical gender (see Chapter 4 for further details).

In a more recent proposal, on the basis of Icelandic dative-nominative (DAT-NOM) constructions, Sigurdsson and Holmberg (2008) analyse Person (Pn) and Number (Nr) as distinct probing phenomena, as illustrated in (11):

(11) $[_{CP\ ...}$Top…Fin $[_{TP}$ …**Pn**…**Nr**…T…v…DAT…NOM]

Nr and Pn probing are activated by T-raising. T cannot probe for DP number/person unless it has joined the Number (Nr) and Person (Pn) projections separately. Also, Nr and Pn probing must take place immediately after T-raising to Nr and T/Nr raising to Pn, as exemplified in (12) and in (13):

(12) þad þótti/þóttu einum malfrædingi þessi rök sterk
Expl thought$_{3.sg/3.pl}$ one linguist$_{dat}$ these argument$_{nom}$ strong

(13) Expl Pn Nr T $[_{vP}$ DAT V $[_{TP}$ NOM….
Expl Pn **DAT** Nr T $[_{vP}$ DAT V $[_{TP}$ NOM…
Expl Pn DAT **T/Nr** T $[_{vP}$ DAT V $[_{TP}$ NOM….
Expl **T/Nr/Pn** DAT T/Nr T $[_{vP}$ DAT V $[_{TP}$ NOM….

The roll-up type of T-movement exemplified in (13) yields the order of tense, number and person markers in Icelandic morphology shown in (14):

(14) lærdum = learn-PAST-PL-1P
We learned

The order of affixes in (13) recalls the one in (4) and Baker's Mirror Principle (Baker 1985): the tense affix is closer to the verb root than the Agr one, suggesting the lower position in the syntactic tree of the former with respect to the latter. Similarly, person may be seen as occupying a higher position than number.

The structural distinction between the Person and the Number projections that has just been outlined can be strictly connected to the different interpretive properties associated with the two features, which

may have an important role in the operations involved in their licensing and interpretation. Let us now discuss person and number interpretive properties.

Features, anchors and interpretation

It is known that the information conveyed by number and person is intrinsically different. While the former feature expresses the mere numerosity of the subject argument, the latter refers to the subject's role with respect to the participants in the speech act, i.e. speaker and addressee. As Jakobson (1971) observes, "Person characterises the participants of the narrated event with reference to the participants of the speech event." A deictic component is therefore present in person information that may crucially shape the way this feature is licensed and interpreted. Recent theoretical analyses have indeed emphasised the fact that this feature can be interpreted only in relation to speech act participants (Bianchi 2003, 2006; Sigurdsson 2004; Schlenker 2004). For instance, a 1st person value expresses identity with (or inclusion of) the speaker, while a 2nd person value expresses identity with (or inclusion of) the addressee. Third person indicates exclusion of both speaker and addressee and refers to the entity that is being talked about.[3] In this view, speaker and addressee are individuals participating in the speech event, which recalls the Kaplanian representation of context as an index made of several coordinates that directly refer to the actual world of utterance, namely its time, location and participants (Kaplan 1989).

The link existing between person specifications and the speech act has been explicitly implemented in recent cartographic analyses of agreement and agreement features that posit a syntactic encoding of speech act and participants in the left periphery of the sentence. Bianchi (2003, 2006) draws a parallel between person agreement and tense marking and identifies the anchoring point for both features in the so-called Logophoric Centre (LC), which constitutes the centre of deixis and hence corresponds to the speech event, with its spatial, temporal and participant coordinates. In structural terms, Bianchi's LC resides in Fin (following Rizzi's 1997 approach), the head encoding information concerning the finite or non-finite nature of a clause. It is the LC that licenses fully-fledged person agreement and absolute tense, by establishing a link – or anchoring – between the IP layer of the sentence (where "morphosyntactic" person is expressed) and the left periphery of the sentence.

In a similar fashion, such a link has been captured by Sigurdsson (2004) in terms of a *matching relation* among features. What characterises

person with respect to number is the matching established between clause-internal positions – the IP system – and the participants in the speech act expressed in the CP system, as in (10), here repeated as (15):

(15) $[_{CP}$Force..λ_A..λ_P..Top..S_T..$S_L[_{IP}$..$Pers_S$..Num_S..M..T..$[_v$…]]]

More precisely, Sigurdsson (2004, 27) subdivides clause structure into three layers, each of them encoding specific features: the lexical layer in the vP shell, with event features; the inflectional layer in the IP area, with grammatical features; and the speech event layer within the CP area, with speech act features (speech participant, speech time and speech location features). For instance, a matching relation ties lexical to grammatical features, and grammatical features to speech act ones. This way, an Agent can be linked to a 1st person pronoun or 1st person verbal morphology, and consequently to a speaker role (a *Logophoric Agent*, to say it with Sigurdsson), as shown in (16). This would lead to proper interpretation of person.

(16) Θ = +Person = + λ_A - λ_P 1st person by computation
Θ = +Person = - λ_A + λ_P 2nd person by computation
Θ = +Person = - λ_A - λ_P 3rd person by computation

To sum up, for person to be interpreted, matching must necessarily involve speech participants features in the left periphery of the sentence. No such IP-left periphery connection is necessary for number, whose interpretation is independent of the speech role played by the subject argument.

A fundamental difference in interpretive requirements therefore lies at the heart of the distinction between person and number. To clarify this point, the notion of "*interpretive anchor*" will be introduced and used throughout. Let us better define this concept.

A tight connection – anchoring – exists between structure and interpretation: to receive a proper interpretation, each morphosyntactic feature entering a derivation activates its "anchor", a specific feature in the semantic representation of the sentence. The term *sigma* value will be used throughout to refer to the semantic-discourse value of a feature, i.e. its anchor, as opposed to the *phi* value, which refers to the morphosyntactic realisation of a feature (Table 1-2, see D'Alessandro 2004 for a similar approach).

Table 1-2. Phi and sigma values associated with person and number features

Person		
Phi	**Sigma**	
[+1, -2]	[+SPEAKER, -ADDRESSEE]	*1st person*
[-1, +2]	[-SPEAKER, +ADDRESSEE]	*2nd person*
[-1, -2]	[-SPEAKER, -ADDRESSEE]	*3rd person*
Number		
Phi	**Sigma**	
[+sg, -pl]	[+ONE, -GROUP/MANY]	*singular*
[-sg, +pl]	[-ONE, +GROUP/MANY]	*plural*

The link to the anchor will be activated every time the morphosyntactic feature is involved in operations entailing its licensing and interpretation, as happens when Agree is performed. In the case of number, its interpretive anchor will be represented by the number specification on the subject argument, thus involving no link outside of the specifier-head configuration within which subject-verb agreement occurs. In essence, this amounts to saying that number is interpretable on the subject, in accordance with standard minimalist assumptions . A different interpretive anchor is instead identified for person. In this case, interpretation is made possible by the link activated between clause-internal positions (the specifier and head positions of IP) and the speech act representation, where speech participant features are encoded. In other words, person's interpretive anchor resides in the speech act representation. The idea of a link established between the morphosyntactic specification of the person feature in the inflectional area of the sentence and its anchor is not to be taken as an instance of Multiple Agree, as has been postulated to account for phenomena like the Person Case Constraint (Anagnostopoulou 2003, see Chapter 4). Anchoring is here intended as a link established between different structural positions.

In light of this, the interpretability status of nominal and verbal person needs to be re-examined: if neither the former nor the latter represent person's interpretive anchor, they may be seen as two autonomous values, whose interpretation requires separate anchoring to the speech act representation. This obviously marks a fundamental point of departure from standard minimalist analyses of agreement and agreement features, which indicate the subject argument as the locus of person interpretation. The mechanism driving person and number interpretation can be stated as in (17):

(17) FEATURE INTERPRETATION PROCEDURE (FIP)
Features are structurally differentiated and interpreted in relation to their anchor:
a) Person's anchor resides in the speech act representation;
b) Number's anchor resides in the number specification of the nominal argument.

By introducing the notion of "interpretive anchor", an approach to person and number agreement has been sketched that seems to accurately account for the intrinsic differences underlying the two features. In the following chapters, it will be shown that the presence of distinct interpretive anchors for person and number can explain behavioural and neuro-physiological correlates of agreement processing.

Summary

Linguistic analyses differ in the formal details with which agreement mechanisms are described. Early derivational grammars defined agreement as an asymmetric relation between a controller and a target, with the controller (also called trigger) being the element from which grammatical information originates, and the target the element that inherits the information. Such controller-target asymmetry is central to feature-copying models of agreement, like the one developed within the Minimalist Program (Chomsky, 1995, 2000, 2001, 2005). In essence, minimalist agreement hinges on three basic assumptions:

(i) *Feature syncretism*: features are expressed as a feature bundle on a single position in the syntactic tree (Tense, or T), and are uniformly dealt with by the syntactic operation of Agree (see Figure 1-1);
(ii) *Asymmetry*: agreement proceeds asymmetrically from the controller to the target. For instance, in s-v agreement, the person and number features expressed on the subject DP are copied onto the verb by the formal operation Agree. Features are valued and interpretable on the nominal argument, hence they are visible to the interpretive system, while they are uninterpretable on the verb, as mere formal copies of the nominal specifications. Agree connects the two positions, and checks and values the features on the verb.
(iii) *A narrowly syntactic operation*: Agree operates within the domain of Narrow Syntax, as uninterpretable features need to be

> erased from the derivation before these are transferred to the interpretive system.

Following the "*one morphosyntactic property – one feature – one head"* (Cinque and Rizzi 2008) principle, Cartography proposes a distinct-cluster analysis of agreement in which minimalist generative devices such as Agree operate on individual features, rather than on bundles.

Inspired by Cartography, an approach to s-v agreement computation has been proposed that, while relying on computational devices like the Agree operation, departs significantly from standard minimalist assumptions, in that it posits a distinct-cluster representation of agreement features. The presence of different interpretive requirements for person and number is the key point on which the FIP hinges. In the next chapters, the FIP will be tested in two languages – Spanish and Italian – and in different agreement contexts with the goal of assessing its validity in predicting processing correlates.

CHAPTER TWO

SENTENCE AND AGREEMENT COMPREHENSION

Language can be studied from many different perspectives. Chapter 1 has given an example of how linguists attempt to uncover the structure and the computations supporting abstract linguistic knowledge. Understanding how this knowledge is used in real-time comprehension and production, and what the behavioural and neuro-physiological correlates are, belongs to the domain of psycho- and neuro-linguistics. The goal of this chapter is to provide the reader with fundamental tools to test theoretically relevant questions by using some of the experimental paradigms available nowadays for the study of language comprehension. A brief introduction to the experimental techniques that underlie the empirical data presented in the next chapters is provided, spanning from behavioural (online judgements, self-paced reading and eye-tracking) to sophisticated neuro-imaging paradigms such as electro-encephalography (EEG) and functional magnetic resonance imaging (fMRI). Because of the relevance of eye-tracking, EEG and fMRI paradigms for the understanding of the time course and mechanisms supporting agreement processing, a review of previous agreement-related studies employing these techniques will be offered. This will be followed by a review of mainstream neurocognitive models of sentence processing.

The online study of sentence comprehension

The study of language processing can count on the availability of a growing number of sophisticated experimental techniques that have helped us obtain fundamental insights into the mechanisms (*how)*, the spatial (*where)* and temporal dimension (*when)* of sentence and agreement comprehension. As will be clear from the following description (and the empirical studies presented in the next chapters), there is no single perfect technique for the study of language comprehension. Rather, it is from