1. Introduction

Grammatical relations, such as subject, direct object and indirect object, have been used as descriptive terms for centuries, the distinction between subject and predicate having been taken over from Ancient Greek and Roman philosophy and grammar. Alternative names are grammatical functions (e.g. Bresnan 2001), syntactic functions (e.g. Chomsky 1981) or syntactic relations. Common to all approaches to grammatical relations is that they have been considered to be relationships between two elements of a clause, so that subject is only a short term for the subject of the predicate or the subject of the clause. Traditionally, grammatical relations are primarily used for major constituents of the clause and only marginally for parts of major constituents (e.g. attribute of a noun). For this reason, this article will focus on grammatical relations at the major clausal level. The main issues connected to grammatical relations can be formulated as follows: (i) Are grammatical relations basic or derived notions? If they are derived notions, which are the basic underlying concepts? (ii) Are grammatical relations universal, language-specific or construction-specific notions? (iii) What are the major theoretical approaches to grammatical relations? The basic notions that are employed in the definition or identification of grammatical relations in various approaches will be the leading thread for the organization of this article. The next section is devoted to morphosyntactic notions associated with grammatical relations such as case marking and agreement. Structural approaches to grammatical relations will be the topic of section 3. The next two sections will present semantic factors that determine the choice of grammatical relations. Section 4 presents an overview of the basic issues concerning the relationship between grammatical relations and semantic roles such as agent and patient. Besides semantic roles, there are other semantic factors that may determine the choice of grammatical relations. These factors include, among others, referential properties related to topicality, animacy, person differences, definiteness or specificity. They are the topic of section 5. Section 6 focuses on language processing; section 7 offers a final discussion.

2. Grammatical relations, case marking, and agreement

In traditional grammars oriented on Ancient Greek and Latin, grammatical relations are associated with case marking (cf. Blake 2001: 18-19; Butt 2006: 13-15). The subject is identified with the nominative, the direct object with the accusative, and the indirect object with the dative or another oblique case. The impact of this tradition is still manifest, for example, in the most recent edition of a standard descriptive grammar of German, Duden (2005), as shown in (1):

(1) Grammatical relations defined by cases for German (Duden 2005: 817-818)
   a. Nominalphrase im Nominativ & Aktant = Subjekt
      [noun phrase in the nominative & participant = subject]
   b. Nominalphrase im Akkusativ & Aktant = Akkusativobjekt
      [noun phrase in the accusative & participant = accusative object]
   c. Nominalphrase im Dativ & Aktant = Dativobjekt
      [noun phrase in the dative & participant = dative object]
   d. Nominalphrase im Genitiv & Aktant = Genitivobjekt
      [noun phrase in the genitive & participant = genitive object]
The notion of participant is defined as in many other approaches in terms of semantic roles: a participant bears a semantic role selected by the predicate (Duden 2005: 790). In other approaches and in this article, the notion of argument is used instead of participant. In the case-based view, there are as many distinct grammatical relations as there are cases for verbal arguments, as shown in (1).

How adequate is the case-based view of grammatical relations? Let us start the discussion on the construction- and language-specific level. The case-based view explains verb agreement in German and many other languages, at least for the core patterns. Descriptive grammars (cf. Duden 2005: 819 for German), functional typology (cf. Moravcsik 1988) and Generative Grammar (cf. Chomsky 1981, 1995) converge in the view that the nominative argument is the privileged trigger of verb agreement. Moreover, verb agreement is restricted to the nominative argument in many accusative languages, for example, among the European languages in German, Latin, Russian, within the Indic group in Sinhalese, within the Altaic group in Tatar and Turkish. This is shown for German in (2):

(2) Case-based verb agreement in German
\[
\text{Die Kind-er seh-en dich.}
\]
\[
\text{NOM.PL child-NOM.PL see-3PL you.ACC.SG}
\]
‘The children see you.’

The case expressions discussed so far are associated with nominal dependents and establish dependent-marking (cf. Nichols 1986). If functionally equivalent expressions are attached to the verbal head, they are classified as head-marking. Head-marking is illustrated by the Abkhaz example in (3):

(3) Head-marking in Abkhaz (North-West Caucasian, Hewitt 1979: 51)
\[
a-xac’a a-ph’os l-yo’za a-s’q’ò ò-lò+z-lò-y-tyt’
\]
\[
\text{the-man the-woman her-friend the-book it-her+for-to her-he-gave}
\]
‘The man gave the book to the woman for her friend.’

The example (3) shows prefixes attached to the verbal head in the absence of case expressions on the dependent noun. They distinguish agent (the person giving), recipient (the person receiving), benefactive (for whose benefit), and patient (the thing given). The patient is zero-marked.

Ergative languages are notoriously difficult to capture in terms of case marking. In the ergative construction, which is shown in (4) below, the patient of a multvalenced predicate (P) is coded by the same case as the subject of a monovalenced predicate (S) and differently from the agent of a multivalenced predicate (A). The case of S and P is called absolutive (or nominative), the case of A is called ergative.

(4) Case-based agreement and ergative case marking in Avar (Charachidzé 1981: 144)
\[
a. \text{yas y-oré’ana.}
\]
\[
\text{girl.ABS,CL2 CL2-woke-up}
\]
‘A/the girl woke up.’
\[
b. \text{y-osana yas di-cca.}
\]
\[
\text{CL2-took girl.ABS,CL2 I-ERG}
\]
‘I took a/the girl.’

The English translations of (4a, b) show the accusative pattern: S and A are coded alike by the nominative, while P appears in the accusative (or objective). So cases code different semantic roles (A vs. P) in the two types of constructions. Despite this role-semantic difference, case-
based rules in ergative and accusative languages are similar. This similarity holds under the plausible assumption that the nominative and the absolutive are morphosyntactically equivalent cases, despite their different role-semantic functions (cf. for this view, among others, Sasse 1978; Dixon 1994; Primus 1999). Closest to the nominative constraint on agreement mentioned so far are ergative languages in which verb agreement is restricted to the absolutive argument. In many North-East Caucasian languages, the verbal head agrees in nominal class, i.e. gender and number, with the absolutive argument to the exclusion of other case arguments (cf. for other ergative languages, Primus 1999, Chap. 6). This type of agreement is illustrated by the Avar examples in (4a, b) above. A description of verb agreement in Avar in terms of cas zéro (i.e. nominative or absolutive) is offered by Charachidzé (1981: 145), who adequately classifies the zero-marked argument as le prime actant and the ergative argument as le second actant for agreement.

So far, the case-based approach to grammatical relations turned out to be quite successful. However, the above-mentioned nominative-absolutive constraint on agreement fails to account for some construction-specific agreement patterns. (5a) shows a construction with two nominatives in German consisting of a demonstrative pronoun in subject position and a predicative nominal. The verb fails to agree with the demonstrative pronoun das, which is in the privileged subject position, and agrees instead with the predicative nominal Blumen. (5b) shows a there-construction in English. In this construction, the dummy element there, which is in preverbal subject position, fails to agree. The verb agrees instead with the postverbal nominative argument.

(5) Construction-specific problems with case-based agreement in German and English

a. Das sind Blumen.
   this.NOM.SG be.3PL flower-NOM.PL
   ‘These are flowers.’

b. There are cows in next door’s garden.

Agreement with a predicative nominal, as in (5a), is also found in other languages (e.g. Czech, cf. Corbett 2006: 63). However, the pattern is language-specific, as shown by the English translation of (5a), where the verb agrees with the demonstrative these in subject position (cf. also Engl. It is me with its German equivalent Das bin (be-1SG) ich). In the constructions illustrated in (5a, b), agreement is triggered by a nominative argument in a non-canonical position for subjects. But there is also agreement failure when nominative arguments appear in a non-canonical position (cf. Barlow 1992; Samek-Lodovici 2003). Cross-linguistically, case-based agreement is even less stable, since there are languages in which case plays no role in verb agreement, as discussed for Warlpiri later on.

A challenge to case-based approaches to grammatical relations and to case theories in general is Icelandic. Icelandic has various case patterns for verbal arguments. Transitive constructions with nominative subjects and accusative objects work exactly like their counterparts in other accusative European languages including English. In contrast to English, however, Icelandic also has what has become known as quirky case subjects, that is, subjects which are marked with a case other than nominative. An impressive amount of studies have demonstrated that the argument in preverbal position in Icelandic behaves like a subject irrespective of its case. Cf. the examples in (6):

(6) Quirky case subjects in Icelandic (Barðdal and Eythórsson 2003: 754, 760)

a. Mér er kalt.
   me.DAT is cold.
   ‘I am freezing.’

b. Mér hefur aldrei líkað Guðmundur.
me.DAT has never liked Guðmundur.NOM
'I have never liked Guðmundur.'
c. Honum var hjálpað.
him.DAT was helped.
'He was helped.'

These dative subjects have most of the properties of nominative subjects in Icelandic, except for verb agreement, which is restricted to the nominative. Thus, for instance, quirky case subjects may be the empty subject (PRO) of infinitival clauses and control an obligatory reflexive pronoun, i.e. block coreference with a personal pronoun. This is shown in (7a, b):

(7) Subject behaviour of non-nominative arguments in Icelandic (Thráinsson 1979: 469-471)

a. Ég vonaðist til að PRO verda hjálpað.
   I.NOM hoped COMP PRO.DAT was helped.
   'I hoped to be helped.'
b. Honum er kalt heima hjá sér / *honum.
   him.DAT is cold home at REFL.DAT / PRON.DAT
   'He is freezing at his home.'

Correspondingly, nominative objects in Icelandic, as in (6b), have all object properties except for verb agreement. Since nominative objects are able to trigger verb agreement, this property qualifies them as morphosyntactic subjects (cf. Thráinsson 1979: 466 for some idiolectal variation).

Cross-linguistically, non-canonical case marking of subjects and objects is a widely distributed pattern (cf., among others, Verma and Mohanan 1991; Aikhenvald et al. 2001; Bhaskararao and Subbarao 2003). This pattern is often found for the experiencer and stimulus argument of verbs denoting a mental state (psych-verbs), which are recurrently discussed in this article. Languages differ as to what subject properties non-nominative experiencers accumulate, but a structural subject position in terms of basic order is one of the cross-linguistically most stable subject properties, while subject-verb agreement is less likely to be controlled by non-nominative experiencers (but there is agreement with oblique experiencers in Dargwa (North-East Caucasian), for instance, cf. Corbett 2006: 59).

Let us sum up this section. The case-based view of grammatical relations originated in Ancient Greek and Roman grammatical tradition and is still prominent in descriptive grammars of European languages. Case-based relations explain some of the phenomena that are associated with grammatical relations. This was shown for verb agreement in greater detail. However, even European languages, which are in the focus of case-based approaches, cannot be captured exhaustively as there are constructions which challenge a purely case-based treatment. For this reason, recent functional and formal approaches shifted the focus of their investigations to other types of relations. The next section will introduce structural relations as explananda for grammatical relations.

3. Grammatical relations, phrase structure, and lexical argument structure

Whereas it seems natural to associate grammatical relations with cases in languages such as Ancient Greek, Latin, Russian, or German, which have a relatively rich case system, this is less obvious for languages like English, French and Norwegian, which have almost completely lost their case inflection. Unsurprisingly, alternative structural approaches to
grammatical relations have been devised especially for languages like these. (8) shows a simple phrase structure analysis of a transitive clause in English:

(8) \[ S \{ Felix [VP [V slapped] Rosa]] \]

Subject is identified with the noun phrase that is immediately dominated by the sentence node. Object is the noun phrase that is internal to the VP. In the example (8), Felix is in subject position and Rosa in object position.

Crucially, the subject is in structural c-command of the object. This relation is usually defined as follows: from two structural positions \( x \) and \( y \) that do not dominate each other, position \( x \) c-commands position \( y \) if and only if \( y \) is included in all maximal projections (i.e. phrases) that dominate \( x \). Since Rosa is included in the only phrase dominating Felix, namely \( S \), Felix c-commands Rosa. C-command is assumed to be asymmetrical for grammatical relations: the object Rosa does not c-command the subject Felix, since VP is a phrase that dominates Rosa but not Felix. Ultimately, differences in the behaviour of different grammatical relations are explained by phrase-structural asymmetries in terms of c-command in this kind of approach. Thus, for example, the Icelandic reflexivization pattern shown in (7c) above can be explained by the fact that the structural position of a quirky subject asymmetrically c-commands VP-internal constituents; c-command within a local domain is the crucial condition on anaphor binding in phrase-structural approaches (cf. Chomsky 1981; Reinhart 1983).

The phrase-structural approach to grammatical relations has been proposed with some variations in generative grammar since Chomsky (1965). Later, particularly in the Minimalist Program (cf. Chomsky 1995; Adger 2003), lexical heads such as V have been supplemented with functional heads such as little \( v \) and Tense (T, formerly Inflection I or Agreement Agr).

(9) illustrates the phrase-structural positions of subject and object in the Minimalist Program for a sentence such as Cassandra has foretold disaster.

(9) Subject and object in the Minimalist Program (Adger 2003: 205)

\[ TP \]
\[ \quad \text{subject} \]
\[ T' \]
\[ \quad T \]
\[ \quad \quad \text{vP} \]
\[ \quad \quad \quad <\text{subject}> \]
\[ \quad \quad \quad \quad v' \]
\[ \quad \quad \quad \quad \quad v \]
\[ \quad \quad \quad \quad \quad \quad \text{VP} \]
\[ \quad \quad \quad \quad \quad \quad \quad \text{verb} \]
\[ \quad \quad \quad \quad \quad \quad \quad \text{object} \]

In the Minimalist Program, there are only two abstract syntactic operations, merge and move, move being a special instance of merge. Different syntactic levels such as D- and S-structure are eliminated in favour of a stepwise derivation. The relevant steps in the derivation of Cassandra has foretold disaster are as follows. Cassandra is the agent of the verb foretold. As such, it is merged in the specifier of little \( v \) and linearly follows the auxiliary has in T at this stage of the derivation. Disaster is the direct object and, accordingly, it is merged in the specifier of the lexical V-head. Merged or basic positions (formerly D-structure positions) are determined by semantic roles in this kind of approach. Principles like those in (10) map
semantic roles (theta roles in the terminology of generative grammar) onto basic syntactic positions (cf. Baker 1997: 120):

(10)  
   a. An agent is the specifier of the higher VP [little vP in later approaches]  
   b. A theme is the specifier of the lower VP.

*Cassandra* appears linearly in front of the auxiliary *has* in the specifier of TP, which is the surface subject position. This indicates that the subject moves to the specifier of TP and leaves a copy in the basic subject position, i.e. the specifier of vP (cf. the bracketed subject in (9)). Crucially, the Minimalist Program introduces two subject positions in different functional phrases, as shown in (9). These two positions are motivated by quantifier floating (*the dragons have all eaten the pigs*) and by the expletive *there*-construction illustrated in (5b) above. The subject function is split up yet in another respect. Its surface realization is associated with two different types of features: EPP and nominative case. Their contribution is stated in (11), cf. Adger (2003: 222):

(11)  
   a. Finite T bears [nom] and little v bears [acc].  
   b. Finite T bears [uN*], the EPP-feature, which causes something to merge into the specifier of TP (either an expletive or a nominal phrase).

The EPP-feature is reminiscent of the earlier Extended Projection Principle, which requires that every sentence has a (possibly non-overt) subject. Motivations for dissociating the nominative-feature from the EPP-feature are nominative arguments in little vP, as in the *there*-construction in (5b) above, and in VP, as in the psych-verb construction in (6b) above. In these constructions, nominative-feature checking and agreement by Tense occur non-locally, namely outside TP within VP. So the nominative feature is not the sole motivation for an argument noun phrase or an expletive to occur in the specifier of TP, i.e. the surface subject position, as in earlier generative approaches. A subject in the specifier of TP can also be motivated by the EPP-feature, in which event it may not be case-marked or agreeing as a canonical subject (cf. Adger 2003, Chap. 6).

In sum, a clear tendency in the treatment of grammatical relations emerges in mainstream generative grammar: the clausal subject notion is decomposed in two phrase-structural relations and two subject features. The basic structural positions of verbal arguments are determined by semantic roles. Surface positions of arguments or expletives are associated with the EPP and are dissociated, in principle, from case and agreement. With respect to semantic roles and cases, the mainstream model presented in (9)-(11) is non-hierarchical: cases and semantic roles are not arranged on independent hierarchies. Rather, asymmetries in terms of semantic roles or cases are derived from phrase-structural asymmetries, as stated in (10) and (11). The decomposition of the subject notion helps to improve the analysis of non-canonical subjects and objects (cf. Ura 2000; Adger 2003, Chap. 6; Mohr 2005; Bobaljik and Wurmbrand 2009 for complications and remaining problems).

One of the remaining problems of the mainstream generative approach is of greater typological relevance and will be mentioned here. Despite its enhanced flexibility, the treatment of grammatical relations in the Minimalist Program fails to dissociate nominative (or absolutive) case from agreement. However, there are languages in which verb agreement is based on argument structure and not on phrase structure or case marking. This type of agreement is found in a number of ergative languages (cf. Primus 1999, Chap. 6), including Warlpiri (Pama-Nyungan, Australian), which is illustrated here in (12):

(12) Verb-agreement based on argument structure in Warlpiri (Hale 1983: 18)  
    a. ngaju ka-rna wangka-mi
Warlpiri is a flexible constituent order language with no palpable phrase-structural asymmetries between grammatical relations. Therefore, Hale formulates the agreement rule on the basis of the following lexical structure of arguments (Hale 1983: 23):

(13) \[X_{\text{agent}} [Y_{\text{patient}} V]\]

One type of agreement marker, -\(rna\) in the examples in (12), is controlled by the highest argument position in argument structure. The other type of agreement marker, -\(ngku\) in the examples in (12), is selected by the lower argument position. For this lexical structural hierarchization, Hale adduces reflexivization facts so that his analysis of verb agreement in terms of lexical argument structure is well supported. The only remaining problem is that the semantic roles mentioned in (13) do not apply to the non-agentive verb ‘see’ in (12c) or to many other non-agentive verbs that pattern like those illustrated in (12). As we will see in section 4 of this article, this is a problem of defining semantic roles and not an argument against Hale’s analysis of this kind of agreement in terms of lexical argument structure.

Returning to verb agreement in the Minimalist Program, the most advanced line of research in terms of phrase-structural relations, the explanation gap under discussion can be stated as follows. Since subject-verb agreement is associated with nominative case via Tense, this approach fails to capture an agreement pattern dissociated from case and conditioned by the position of an argument in the argument structure of the verb, which is in its turn determined by its semantic role.

Other syntactic theories are more flexible in this respect. A dissociation of case, phrase-structural and argument-structural relations and typological motivation for these distinctions are found in Lexical Functional Grammar (cf. Mohanan 1994; Bresnan 2001; Butt 2006, Chap. 5.7) and in the functional typological approach of Bickel (2006). In Lexical Functional Grammar (LFG), there are four types of information that are associated with grammatical relations. They are organized on three structural levels: feature structure for cases and for grammatical relations taken as primitive notions, argument structure for semantic roles, and constituent structure for linear order and phrase-structural relations. The different types of information can be accessed in parallel and independently from each other.

Another non-derivational framework that accommodates parallel access to different types of information is Optimality Theory (OT). OT is compatible with several non-derivational theories, including LFG (cf. Bresnan 2000 for a LFG-based optimality-theoretical approach). In this article, Woolford’s OT-treatment of quirky case subjects in Icelandic will be illustrated in greater detail (cf. Woolford 2001, 2003). Her approach is devised as a supplement to Chomsky’s case theory in so far as basic phrase-structural conditions on cases and the distinction between structural and lexical cases are taken over. The principles for structural cases are formulated in (11a) above. Lexical cases are tied directly to semantic roles and are specified in the lexical entry of the verbal head. OT is primarily concerned with constraint interaction. Typological variation is exclusively explained in terms of different constraint rankings. Woolford (2001) introduces three case markedness constraints, which are ordered in an invariant ranking, as shown in (14):

\[\begin{align*}
\text{C1:} & \quad \text{raising} \\
\text{C2:} & \quad \text{subject} \\
\text{C3:} & \quad \text{passive}
\end{align*}\]
(14)  *DATIVE >> *ACCUSATIVE >> *NOMINATIVE

This invariant ranking establishes the following markedness hierarchy of cases:

(15)  nominative > accusative > dative

Without the intervention of competing constraints, the markedness constraints universally block dative cases first and, finally, cases altogether. The competitor that is relevant to our discussion is the faithfulness constraint in (16):

(16)  FAITHLEX: A lexically specified inherent Case feature must be realized.

The variation between Icelandic and English is explained by constraint re-ranking as in (17).

(17)  Icelandic: FAITHLEX >> *DATIVE  
     English: *DATIVE >> FAITHLEX

OT is a competition model. The acceptability of a pattern is not exclusively determined by its own properties but rather by the question whether it satisfies the relevant higher ranked constraints better than other candidates with the same input specifications. The evaluation of competing candidates is represented in a tableau. In an OT-tableau, the input is given in the first cell, the candidates are enumerated in the first column and the constraints are aligned in the subsequent columns as specified by the ranking of the language under discussion. (18)-(19) show the evaluation of an input with two argument noun phrases (NP) and the lexical specification of the dative case on the first NP, the subject.

(18)  Lexically case-marked (quirky) subjects in Icelandic (Woolford 2001)

<table>
<thead>
<tr>
<th>V[+dat sub] NP NP</th>
<th>FAITHLEX</th>
<th>*DATIVE</th>
<th>*ACCUSATIVE</th>
<th>*NOMINATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. NP-dat NP-nom</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. NP-dat NP-acc</td>
<td></td>
<td>*</td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>c. NP-nom NP-acc</td>
<td>!</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Due to its high rank in Icelandic, the faithfulness constraint on lexical cases selects candidates with quirky case subjects. Additionally, the winning candidate, marked by a pointing finger, has a nominative object. The nominative is determined by the markedness constraint against accusatives, which is violated by candidates with an accusative object.

In English, dative subjects are eliminated from the competition due to the high rank of the markedness constraint against datives, as shown in (19). The winning candidate (19c) has canonical case marking.

(19)  Lexically case-marked subjects in English (Woolford 2001)

<table>
<thead>
<tr>
<th>V[+dat sub] NP NP</th>
<th>*DATIVE</th>
<th>FAITHLEX</th>
<th>*ACCUSATIVE</th>
<th>*NOMINATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. NP-dat NP-nom</td>
<td>* !</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. NP-dat NP-acc</td>
<td>* !</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. NP-nom NP-acc</td>
<td>* !</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To conclude, the main departure of OT from mainstream generative grammar is that case theory is supplemented with case constraints that are ranked according to a markedness hierarchy of cases. This hierarchy holds irrespective of phrase-structural considerations. OT shares with LFG the property of a non-derivational model that is able to access various types of information in parallel. In addition, OT is particularly well suited to explain typological variation and competing forces that shape grammars. Our examples showed the tension between faithfulness to the input, which optimizes functional expressiveness, and formal economy, which bans marked forms. There is a growing community of linguists working within this framework on topics related to grammatical relations (cf., among others, Legendre et al. 1993 on relational alignment typology; Bresnan et al. 2001 and Sells 2001 on voice; Aissen 2003; de Swart 2007 on differential case marking; Wunderlich 2003 on case and agreement in Icelandic; Primus 2004 on linking semantic roles to cases and psych-verbs; de Hoop 2009 on case theory).

Let us sum up this section. We started our discussion with mainstream generative grammar, the prominent representative of a phrase-structure driven view on grammar in general and on grammatical relations in particular. One conspicuous recent development within the Minimalist Program is the decomposition of grammatical relations. Thus, the clausal subject is associated with two phrase-structure positions, specifier of Tense and of little $v$. In addition, its surface realization is determined by two features, the EPP and nominative case. This step contributes to a more adequate treatment of non-canonical subjects and objects. Nevertheless, mainstream generative grammar does not consider lexical argument structure, semantic roles in particular, and cases as independent types of information. They are only put to work in order to explain phrase-structural configurations. By contrast, two productive prominent lines of research, Lexical Functional Grammar and Optimality Theory, accommodate various types of information, which apply in parallel independently from each other. This was illustrated in greater detail by an optimality-theoretical treatment of non-canonical case marking of subjects and objects in Icelandic. As a consequence of these recent developments, grammatical relations such as subject or object play a less prominent role than in older approaches. They are short terms for other types of information, as in the Minimalist Program or in OT-based generative grammar. In Lexical Functional Grammar, they are still used as primitive notions, but their role has decreased as a consequence of a shift in focus towards other types of information.

4. Grammatical relations and semantic roles

The next two sections will present semantic factors that determine the choice of grammatical relations. This section presents an overview of the basic issues concerning the relationship (linking) between grammatical relations and semantic roles such as agent and patient. Besides semantic roles, there are other semantic factors that may determine the choice of grammatical relations. These factors include, among others, referential properties related to topicality, animacy, definiteness or specificity, but also to negation, tense and aspect (cf. Hopper and Thompson 1980; Kulikov et al. 2006; Næss 2007). Reference-related properties will be presented in the next section.

Approaches dealing with the relationship between grammatical relations and semantic roles incorporate principles that guarantee a transparent mapping, but they may differ with respect to how strictly they adhere to transparency. The strict principles in (20)-(21) characterize the framework of mainstream generative grammar.

(20) The Theta-Criterion: Each argument bears one and only one theta role, and each theta
role is assigned to one and only one argument (Chomsky 1981: 36).

In the Minimalist Program (cf. Chomsky 1995, Chap. 4), the Theta-Criterion is derived from principles of feature checking. Another influential principle is (21):

(21) The Uniformity of Theta-Assignment Hypothesis (UTAH): Identical thematic relationships between items are represented by identical deep structural relationships between those items (Baker 1997: 75).

Similar principles are the Universal Alignment Hypothesis of Relational Grammar (Perlmutter and Postal 1984) and the Function-Argument-Biuniqueness Condition of Lexical Functional Grammar (cf. Butt 2006, Chap. 5.7). Arguments against such strict one-to-one mapping assumptions are discussed in Jackendoff (1990), Dowty (1991) and Culicover and Jackendoff (2005) and will be touched upon in the context of Dowty’s proto-role approach later in this section.

Principles mapping grammatical relations onto semantic roles presuppose more specific assumptions about semantic roles. There are several views on semantic roles and different terminologies: deep cases (Fillmore 1968), thematic relations (Jackendoff 1990), theta roles (Chomsky 1981, 1995; Baker 1997), proto-roles (Dowty 1991), macroroles and microroles (Van Valin and LaPolla 1997; Farrell 2005, Chap. 4), among others. The different approaches can be split up basically in three lines of research. In the role-list view, semantic roles are unanalyzable entities that are listed in the lexical representation of a predicate. The other two views are decompositional. In one kind of decompositional approach, a few generalized roles are defined in terms of basic notions such as causation, motion, or sentience. In another kind of decompositional approach, roles are defined in terms of structural positions in the lexical structure of verbs. The two decompositional views can be combined (cf. Van Valin and LaPolla 1997; Primus 1999). This section will deal with role-list approaches and with Dowty’s proto-role framework (cf. Primus 2009 for a discussion of the lexical structural view and a comparison of the different approaches).

Many influential approaches employ a list of informally defined semantic roles and a linking mechanism that is grounded on an implicitly or explicitly assumed role hierarchy. Fillmore’s Case Grammar (1968) and Dik’s Functional Grammar (1978, 1997) are pioneering works in this line of research. Role lists are also used in mainstream generative grammar (cf. Baker 1997). Baker’s use of theta roles and his mapping principles for agent and theme were illustrated in (10) above. Within functional grammars, Dik’s approach is representative. Dik assumes that subjects can be linked to any semantic role, in principle. However, subject and object selection is not entirely random. In nominative languages, it is restricted by the following hierarchy of semantic roles (cf. Dik 1978: 76):

(22) agent > patient > recipient > benefactive > others

If the subject can be assigned to some semantic role on this hierarchy, then it can be linked to any higher role on this hierarchy. Correspondingly for objects, except that objects cannot be assigned to agents. This hierarchy generalization also explains the fact that the agent is linked to the subject and the patient to the object in the basic accusative construction. As mentioned above, the ergative construction, which characterizes ergative languages, has a different linking pattern. It can be explained if the first two positions on the hierarchy in (22) are reversed so that the patient outranks the agent. The ergative construction was illustrated by Avar examples in (4) above. In this type of linking, the patient of a multivalenced predicate is coded by the same case as the subject of a monovalenced predicate and differently from the agent of a multivalenced predicate.
The linking difference between accusative and ergative constructions constitutes a major parameter within relational (alignment) typology (cf. article ## in this handbook). This difference, which shows up in various ways in the grammar of the respective language types, makes a universal application of the subject and object notion questionable. This difficulty is a consequence of the mainstream European grammatical tradition that ties subject to agentivty and object to patienthood. Functional typological approaches use a relational terminology that is neutral with respect to role linking. Following Dixon (1979, 1994), many approaches use the notion of pivot in order to capture generalizations that are formulated in terms of subject in traditional approaches (cf. Keenan’s list (1976) of subject properties). Similarly, Role-and-Reference-Grammar eliminates the subject concept in favour of the notion of privileged syntactic argument (cf. Van Valin and LaPolla 1997; Farrell 2005, Chap. 4).

Let us take a closer look at Dixon’s pivot concept. Dixon and followers use S for the argument function of intransitive predicates and, in addition, A for the agentive and P for the patient-like argument of a multivalenced predicate, as already mentioned above in the context of the Avar examples in (4). On this basis, this influential line of research defines an ergative pivot as \{S, P\} and an accusative pivot as \{S, A\}. Accusative and ergative verb agreement, illustrated in (2) and (4) above by examples from German and Avar, can be analyzed in these terms as follows. In German, verb agreement works on the basis of a \{S, A\}-pivot. Avar has a verb agreement rule with a \{S, P\}-pivot.

These examples suffice to illustrate the advantage and the weakness of this kind of approach to grammatical relations. The advantage of the pivot notion or of similar concepts is that the pivot is delinked from semantic roles, at least superficially. However, semantic roles enter the definition of pivot types, thereby shifting the focus of this line of research towards semantic roles as basic explanatory notions. The problematic side is that the pivot notion obscures the explanation of purely formal, morphosyntactic rules such as verb agreement in German and Avar. As mentioned in section 2 above, case-based rules in ergative and accusative languages are similar. This similarity holds under the plausible assumption that the nominative and the absolutive are morphosyntactically equivalent cases, despite their different role-semantic functions (cf. for this view, among others, Sasse 1978; Dixon 1994; Primus 1999). In both types of languages, nominative and absolutive are the least marked cases. This explains why verb agreement takes nominative or absolutive arguments as privileged targets. This explanation is not tied to the assumption of one universal markedness hierarchy of cases. Even if each language would have its own case system and its own case hierarchy, case-based agreement will target the argument with the least marked case (whichever it is) as the privileged option. The unpredictable part is that agreement is case-based, since there are languages like Warlpiri, in which agreement is based on argument structure (cf. (12) above). The predictable part is that if agreement is case-driven, the argument with the least marked case of the language will be its privileged target. Let us return to Dixon’s pivot notion. Recall that in Dixon’s terms, German verb agreement works on the basis of a \{S, A\}-pivot, while Avar has a verb agreement rule with a \{S, P\}-pivot. The problem is that the parallelism between German and Avar and the exact nature of the trigger (the case function) are obscured in this type of analysis.

Let us return to semantic roles. So far, I have discussed role-list approaches. Role lists are a convenient tool for preliminary role analyses and linking hypotheses. However, this kind of approach has several weaknesses. Its first weakness is that the number of individual roles exceeds by far the number of core syntactic functions, so that one-to-one mapping principles cannot be taken literally. Consider, for example, the concepts of A and P in Dixon’s definition of pivot types. Within a role-list approach, A covers only agents and P only patients. Experiencer and stimulus, as illustrated in the examples (2), (6b) and (12c) above, are different roles. Obviously, this is not the way A and P are intended to work. Instead, A and P
are implicitly taken to refer to two sets of roles that fall under some unspecified generalized notion of agentivity and patienthood. The same kind of criticism applies to Baker’s mapping principles in (10) above, which use agent and theme to the exclusion of other roles such as experiencer and stimulus. In order to map a high number of individual roles to a small number of core grammatical relations, role-list approaches are forced to claim that many alternative roles belong together in some way that is left unexplained.

The second problem is that role lists are unstructured sets, so that additional stipulations in form of role hierarchies are needed. However, these additional stipulations do not offer a substantive explanation for the attested role asymmetries. As a result, role hierarchies and roles used in mapping principles of role-list approaches come in an unduly high number of variants (cf. Levin and Rappaport Hovav 2005: 154-183).

Decompositional approaches to semantic roles fare better. In this section, I will discuss Dowty’s (1991) work as a representative of a non-structural decompositional approach. Related influential approaches are Role-and-Reference Grammar (cf. Van Valin and LaPolla 1997; Farrell 2005, Chap. 4) and the transitivity concept of Hopper and Thompson (1980). Dowty defines two superordinate proto-roles by a small set of semantic primitive properties. The agent proto-role is characterized by volition, sentience, causation, autonomous movement and independent existence on the part of an argument with respect to its verbal head lexeme. See (23):

\[(23) \quad \text{Agent proto-role (Dowty 1991: 571)}
\]
\[a. \quad \text{x does a volitional act: John refrains from smoking.}
\[b. \quad \text{x is sentient of or perceives another participant: John knows / sees / fears Mary.}
\[c. \quad \text{x causes an event or change of state in another participant: His loneliness causes his unhappiness.}
\[d. \quad \text{x is moving autonomously: Water filled the boat.}
\[e. \quad \text{x exists independently of the event named by the predicate: John needs a car.}
\]

Although most verbs select more than one proto-agent property for their subject argument (e.g. murder, nominate, or give), each of these properties may occur in isolation, as shown by the subject argument in the examples in (23). The patient proto-role is defined and illustrated by the object argument of the examples in (24):

\[(24) \quad \text{Patient proto-role (Dowty 1991: 572)}
\]
\[a. \quad \text{x undergoes a change of state: John moved the rock.}
\[b. \quad \text{x is an incremental theme: John filled the glass with water (also stationary relative to other participants).}
\[c. \quad \text{x is causally affected by another participant: Smoking causes cancer.}
\[d. \quad \text{x is stationary relative to another participant: The bullet entered the target.}
\[e. \quad \text{x does not exist independently of the event, or not at all: John needs a car / seeks a unicorn.}
\]

Incremental theme is an event-related role for a participant whose degree of affectedness parallels the degree of completeness of the event. Incremental affectedness does not imply a physical change of state, cf. read a book and memorize a poem. Conversely, not every change of state or location is incremental, cf. push a cart.

The list of properties in (23) and (24) is preliminary for Dowty: properties can be deleted or added without changing the logic of his approach. Candidates for deletion are stationary (cf. Primus 1999: 42-43) and incremental theme (cf. Levin and Rappaport Hovav 2005: 106-110). Role properties that are neglected by Dowty include the target of sentience or emotion (cf. Pesetsky 1995), possessor (proto-agent) and possessed object (proto-patient) following,
among others, Jackendoff (1990).

The specific roles of role-list approaches can be defined in terms of proto-role properties: agents by volition and possibly more proto-agent properties; instruments and causers by causation without volition; experiencers by sentience without other proto-agent properties. Thus, Dowty’s generalized-role approach allows for a high number of specific roles to be subsumed under a small set of general roles. This reduces the inventory of superordinate role concepts dramatically without a neglect of finer distinctions.

The selection of grammatical relations is assumed to be sensitive to the higher or lower number of consistent role properties accumulated by an argument. Dowty’s argument selection principle is given in (25):

(25) Argument Selection Principle (Dowty 1991: 576): The argument for which the predicate entails the greatest number of proto-agent properties will be lexicalized as the subject of the predicate; the argument having the greatest number of proto-patient entailments will be lexicalized as the direct object.

This principle is meant to capture lexical default mappings for arguments with a high number of consistent properties such as selected by the verbs *break* and *hit*. Underspecified roles that accumulate a low number of consistent proto-role properties or none at all may have a variable realization. Psych-verbs, like those illustrated in (2), (6a,b) and (12c) above, show a considerable mapping variation within one language and cross-linguistically: they may have canonical case marking, as in the German accusative construction in (2) and the Warlpiri ergative construction in (12c), or may select non-canonical subject and object marking, as in the Icelandic examples in (6a,b). Note that there are also German psych-verbs with non-canonical marking of subject and object and Icelandic psych-verbs with canonical marking. According to Dowty (1991: 579), a psych-verb entails that the experiencer has some perception or sentience of the stimulus (proto-agent property of sentience or perception) and that the stimulus causes some emotional reaction or cognitive judgement in the experiencer (proto-agent property of causation). So each argument has a weak but equal claim to subjecthood. Psych-verbs and symmetrical predicates, such as *x rhymes with y* and *x resembles y*, which subcategorize for two arguments with properties that belong to the same proto-role, call into question mapping principles such as the Uniformity of Theta-Assignment (UTAH) mentioned in (21) above. UTAH is also problematic for the accusative-ergative distinction, since agents and themes are coded differently in these types of constructions.

For ergative constructions, Dowty assumes a reversal of proto-roles: subjects are associated with proto-patients and objects with proto-agents. However, Dowty is aware of the problem of using *subject* and *object* for the analysis of ergative languages. This problem can be omitted if one combines the basic assumptions of the approaches of Dowty and Dixon. Dixon’s concepts of A and P, which are widely used in functional typology in order to define pivot-types, would be of greater typological use if they would denote proto-roles. In the combined view, the accusative construction is based on a \{S, proto-agent\}-pivot, while the ergative construction takes a \{S, proto-patient\}-pivot. These are canonical (i.e. default) mappings. Departures from a canonical mapping only occur if arguments are distinguished by a low number of consistent role-properties or not at all.

In sum, semantic roles are a major determinant of grammatical relations and of the major typological distinction between accusative and ergative constructions. There are various approaches to semantic roles. In this section, role-list approaches were compared to Dowty’s generalized-role (proto-role) approach. Dowty’s approach allows for a high number of specific roles to be subsumed under two general roles without additional stipulations. This reduction is necessary in order to explain the mismatch between a multitude of individual roles and the small number of syntactic argument slots. In addition, generalized-role
approaches such as Dowty’s are better suited to define Dixon’ pivot notion or similar notions than role-list approaches. Dowty’s approach is also able to explain non-canonical case marking with psych-verbs. In the next section, we will turn to parameters of variation due to referential semantic properties.

5. Grammatical relations and reference-related properties

The reference-related view of subject and predicate can be traced back to Plato’s distinction between ónoma and rhêma. In this conception, the subject is that part of a logical statement which names an entity the statement is about. The predicate is that part of the statement that states something about the subject. The German terms Satzgegenstand, lit. ‘sentence entity’, for subject and Satzaussage, lit. ‘sentence statement’, for predicate are anchored in this tradition. Similar definitions for subject and predicate are found in many school grammars of individual languages. More recent approaches interpret this distinction between subject and predicate within discourse semantics as topic (or theme) and predication (or comment). A discourse-functional view on grammatical relations characterizes a variety of functional approaches to grammar (e.g. Sasse 1978; Givón 1984; Kuno 1987; Lambrecht 1995; Dik 1997; Halliday and Matthiessen 2004). In generative grammar, this view is defended for discourse-configurational languages (cf. Kiss 1995). The correlation between subject and topic can be illustrated by the English example in (26).

(26)  What about Felix?
   a. Felix goes out with Rosa.
   b. Rosa goes out with Felix.

In English (cf. Reinhart 1981: 62), there is a strong preference in discourse to interpret the grammatical subject of the sentence as its topic. Thus, (26a) is a more appropriate than (26b) as an answer to the question What about Felix? What about x is a test question for topics. Despite this preference, the phrase-structural preverbal position associated with subjecthood in English is not restricted to topics. Recall the there-construction in (5b) above, in which the expletive there is in surface subject position but cannot be interpreted as a topic. Topics have to be referential: they have to refer to something in a real or possible world. Hence, expletives and negated quantifier phrases such as nobody cannot be topics.

The situation is different in discourse-configurational languages such as Rumanian, Hungarian, and Finnish (cf. Kiss 1995). In such languages, the structurally highest argument position has to be interpreted in terms of topic rather than subject. In word order typology, Rumanian, for example, has to be classified as TVX (with T for topic, V for predicate, X for any other constituent) instead of SVO (with S for subject and O for object). The problem for a theory of grammatical relations is that in Rumanian, Hungarian and Finnish, topics do not share other subject properties, especially not obligatory nominative marking, which is responsible for most of the other subject properties in these languages. This means that, in these languages, nominative case marking competes with topicality in sharing subject properties.

Subject and object asymmetries are associated with several other referential properties in many languages. Subjects of transitive clauses are predominantly animate, for instance, up to 69% in Norwegian (Øvrelid 2004) and up to 93% in spoken Swedish (Dahl 2000). Correspondingly, objects refer predominantly to inanimate entities (89% in Dahl’s corpus and 90% in Øvrelid’s sample). Furthermore, in transitive clauses, definite subjects are preferred over indefinite subjects, while the reverse association holds for objects (cf. Kaan 1998 for
Dutch; Øvrelid 2004 for Norwegian). As to person, 1. or 2. person is preferably coded as a subject and 3. person as an object (cf. Sells 2001; Bresnan et al. 2001).

Soft constraints, i.e. tendencies or preferences, in one language may be inviolable hard constraints in another language (Bresnan et al. 2001). This view is supported by typological findings. There are a variety of grammaticalized phenomena that are determined by reference-related properties. Three types of phenomena have been extensively discussed in the literature: voice-alternations including direct and inverse marking, differential subject or object marking and morphological split ergativity.

In voice alternations, for example in Plains Cree (Algonquian) and Lummi (Northern Straits, Salishan), direct marking is used if the proto-agent is higher on the person hierarchy 1 > 2 > 3 or more topical than the proto-patient. Otherwise, a different indirect (or inverse) marking is used (cf. Givón 1994, Bresnan et al. 2001). This corresponds to the tendency found in the more familiar European languages to use passives if the proto-patient is more topical than the proto-agent (cf. Sells 2001; Bresnan et al. 2001). In Tagalog and other Austronesian languages, nearly all noun phrases compete for the principal grammatical relation and the choice among them rests on referential properties. Cf. the Tagalog examples in (27):

(27) Reference-related pivot in Tagalog (Austronesian; Kroeger 1993: 13)

a. *b-um-ili* ang *lalake* ng *isda* sa *tindahan*.
   PERF.AV-buy NOM man GEN fish DAT store
   ‘The man bought fish at the/a store.’

b. *b-in-ili-Ø* ng *lalake* ang *isda* sa *tindahan*.
   PERF-buy-OV GEN man NOM fish DAT store
   ‘The/a man bought the fish at the/a store.’

c. *b-in-ihl-an* ng *lalake* ng *isda* ang *tindahan*.
   PERF-buy-DV GEN man GEN fish NOM store
   ‘The/a man bought fish at the store.’

Each verbal clause in Tagalog must contain one and only one major constituent marked by the proclitic *ang*. This principal grammatical relation is variously identified in the literature as ‘topic’, ‘focus’, ‘pivot’, ‘subject’, or ‘nominative’ (Kroeger 1993). The other constituents are marked by the proclitics *ng* (‘genitive’) or *sa* (‘dative-locative’), depending on their semantic role. The constituent marked by *ang* is the pivot in a number of constructions, such as conjunction reduction, relative constructions and quantifier floating. A characteristic of Tagalog and other Austronesian languages is that the semantic role of the pivot (‘nominative’) is reflected in a verbal affix which is analysed by Kroeger (1993) as a voice marker. In the active voice of Tagalog (AV in the glosses in (27a)), the agentive role is marked by *ang*. In the objective voice (OV in (27b)), the patient-like role is marked by *ang*, while in the dative-locative voice (DV in (27c)), the recipient or location takes this marker. So the choice of the voice marker is jointly determined by case marking (*ang*) and semantic roles, since it varies due to the semantic role of the *ang*-marked phrase. The choice of the *ang*-proclitic is determined by two factors as well: referential properties and patient preference. The *ang*-marked noun phrase must be referential and normally definite; if a patient-like role is definite it must be marked by *ang* (cf. Kroeger 1993: 14 in conformity to other studies on Tagalog).

Referential properties also determine what is now commonly called differential object marking (Bossong 1985; Aissen 2003; de Swart 2007). In some languages, certain direct objects are marked by an object marker, while other objects remain unmarked. This pattern of variation is controlled by the referential property of the object noun phrase such as animacy, definiteness or specificity, or a combination of these factors. This pattern of variation is found, for instance, in Romance, Iranian and Indic languages. Cf. the Hindi examples in (28):
Differential object marking in Hindi (Mohanan 1994: 80)

a. *Ila-ne bacce-ko / bacca ut\textsuperscript{*}aayaa.
   Ila-ERG child-OBJ / child lift.PF.M.SG
   ‘Ila lifted the child.’ or ‘Ila lifted a child.’

b. *Ila-ne haar-ko / haar ut\textsuperscript{*}aayaa.
   Ila-ERG necklace-OBJ / necklace lift.PF.M.SG
   ‘Ila lifted the / a necklace.’

The differential object marker, the postposition \textit{ko}, must be used with human noun-phrase referents, which can be interpreted as definite or indefinite, as shown in (28a). If an inanimate participant is marked, it is interpreted as definite, if it is unmarked, it is indefinite, as shown in (28b). So differential case marking in Hindi is jointly determined by referential properties such as animacy and definiteness and by the semantic role and case of the argument (nominative proto-patient). Note that not every nominative argument takes the reference-related marker \textit{ko} in Hindi. The target of differential \textit{ko}-marking is only a nominative proto-patient argument. Reference-related alternations also occur on the subject in some languages, yielding a pattern of variation that is commonly called \textit{differential subject marking} (cf. Aissen 2003; de Hoop and de Swart 2008).

Morphological split ergativity is another type of variation that is determined by referential properties in some languages (cf. Silverstein 1976; Dixon 1994, Chap. 4). For example, in many Australian ergative languages, pronouns, 1. and 2. person in particular, pattern accusatively while other types of noun phrases show ergative marking.

To conclude, reference-related variation in the realization of grammatical relations is a serious problem for any attempt at defining subject, object or pivot in one-dimensional terms because this type of variation induces a relational split. A relational split crops up whenever properties that are associated with one particular grammatical relation, for instance subject or pivot, are distributed over different noun phrases in a clause. In this section, I have shown how reference-related phenomena generate such split behaviour. Recall discourse-configurational languages such as Rumanian, Hungarian and Finnish. In these languages, subject is split between the topic function and the nominative function. Tagalog poses another type of problem. It occurs whenever a phenomenon related to a certain grammatical relation is multi-dimensional. Recall that the choice of the \textit{ang}-marker is determined by referential properties and can be attached to any semantic role in the clause, as widely acknowledged in the literature. However, semantic roles are also relevant, since proto-patients have to be marked by \textit{ang} if they are definite. Voice in Tagalog is also a multi-factor phenomenon. The choice of the voice marker is jointly determined by case marking (\textit{ang}) and semantic roles, since the voice marker varies due to the semantic role of the \textit{ang}-marked phrase. Differential case marking in Hindi is also multi-dimensional. It is jointly determined by the semantic role and case of the argument (nominative proto-patient) and by its referential properties such as animacy and definiteness.

6. Grammatical relations in language processing

The last decades witnessed a boom in neuroscientific research. Advanced neuroscientific methods offered new perspectives on issues related to the question of how language is processed online in the brain. In parallel, an increasing number of theoretical approaches pursue a processing-driven view on grammar (cf. Hawkins 1994, 2004; Bresnan et al. 2001; Culicover and Jackendoff 2005). As a consequence, there is a rapidly growing body of research devoted to language processing. This section offers a survey of important results gained within the field of grammatical relations.
An early influential study on the processing of grammatical relations is Frazier (1987). Her experiments on Dutch revealed that an initial argument that is ambiguous with respect to its grammatical relation is incrementally interpreted as the subject of the clause. This processing strategy, which has become known as the subject (first) preference in psycho- and neurolinguistics, was documented for a variety of languages with various experimental methods in the subsequent years (cf., among others, de Vincenzi 1991 for Italian; Schriefers et al. 1995 for German; Ishizuka 2005 for Japanese; Demiral et al. 2008 for Turkish; Bornkessel-Schlesewsky and Schlesewsky 2009: 170-173 for an overview). Let us discuss this preference starting with the Turkish example in (29):

(29) Subject-first preference in Turkish (Bornkessel-Schlesewsky and Schlesewsky 2009: 171 following Demiral et al. 2008)

a. Dün pilot gördüm.
   yesterday pilot see.1SG.PAST
   ‘Yesterday I saw (a) pilot.

b. Dün pilot uyudu.
   yesterday pilot sleep.3SG.PAST
   ‘Yesterday (the) pilot slept.’

The basic order of Turkish is subject-object-verb (SOV). In addition, a pronominal subject, particularly a first person subject, as in (29a), is usually dropped (pro-drop). Hence, an initial noun phrase in Turkish may have an unmarked object reading, which is not available in non-pro-drop languages such as Dutch and German. In (29), the temporary subject-object ambiguity is resolved by the agreement marker of the verb. In the study of Demiral and colleagues, critical test items, such as (29a), are contrasted with a corresponding control item that has an unambiguously marked object. The pattern of event-related brain potentials (ERPs) elicited by Demiral and colleagues at the disambiguating verb position indicates that speakers initially pursue a subject analysis.

There are also preferences related to modifiers and objects. There is a well-documented argument-over-modifier preference: a prepositional phrase that is ambiguous between an argument reading and a modifier interpretation is preferably parsed as an argument (cf. Bornkessel-Schlesewsky and Schlesewsky 2009: 102-103, 174-175). Studies on the interpretation of an ambiguous noun phrase as a direct or indirect object are more sparse and the findings inconclusive (cf. Bornkessel-Schlesewsky and Schlesewsky 2009: 175-180).

The experiments with verb-final structures, for instance, in Turkish, Japanese, German, and Dutch, reveal a general trait of the human language processing system (cf. Crocker 1994; Bornkessel-Schlesewsky and Schlesewsky 2009: 89-94). To fulfill the demands of effective real time communication, processing must be accomplished very rapidly and in an incremental fashion. This means that decisions must be made even in the absence of complete and certain information without waiting until the end of a construction in order to begin interpreting it. To accomplish incremental interpretation in this sense, the human processor must assign structure and meaning to the input as quickly as possible. In addition, the human processor must generate predictions. For our topic this means that a verb-dependent element is interpreted with respect to its grammatical relation, i.e. structural relation or case, and its semantic role, as soon as it is encountered even in the absence of complete and certain information without waiting until the verbal head is parsed. When two verbal dependents are encountered, they are interpreted relative to each other by using any cue that may help to identify their grammatical and semantic role. The predicted interpretations are guided by general principles such as subject-first, argument-over-modifier, subject-animate, and object-inanimate. When the interpretation of an ambiguous element turns out to be wrong, a conflict arises at the point where disambiguation towards the dispreferred reading occurs. In the
Turkish example (29a) above, this happens with the first-parse subject interpretation of pilot when verb agreement, which enforces an object reading, is processed. The need to switch from one reading to another leads to an additional processing effort that can be identified experimentally.

In sum, the neurolinguistic experiments support the accessibility hierarchy of grammatical relations proposed by Keenan and Comrie (1977). Cf. (30):

(30) The accessibility hierarchy of grammatical relations
subject > direct object > indirect object > other oblique arguments or modifiers

The above-mentioned neurolinguistic findings regarding the interpretation of ambiguous phrases can be summarized on the basis of this hierarchy as follows. A subject interpretation is more accessible than an object interpretation, and an argument interpretation is more accessible than an analysis as a modifier. The results for direct and indirect objects are less conclusive. This fits in well with typological work on the variant behaviour of indirect objects (cf. Faltz 1978; Dryer 1986; Primus 1998).

In the linguistic literature, the hierarchy of grammatical relations was used for the behaviour of grammatical relations, i.e. for rules, such as verb agreement, relativization and passive. The main results can be subsumed under the schema in (31):

(31) Hierarchy-based rule schema
a. If in a language a rule applies to a grammatical relation B, then for every grammatical relation A that outranks B on the relational hierarchy, this rule also applies to A.
b. There is at least one language where a rule applies to a grammatical relation C and for every D that is outranked by C on the relational hierarchy, this rule does not apply to D.

Let us apply the above schema to the function of the relative pronoun in relative clauses. The schema prohibits relative pronouns (or gaps corresponding to such pronouns) that are exclusively confined to direct objects. If a language has relative pronouns in the direct-object function, it must also have relative pronouns in the subject function. Additionally, rules that skip positions are blocked. For instance, no language is supposed to have relative subject pronouns and relative indirect-object pronouns to the exclusion of relative pronouns in direct-object function. The last clause of the schema, (31b), states that each grammatical relation on the hierarchy is cross-linguistically relevant.

There is an overwhelming number of psycho- and neurolinguistic studies for various languages showing that object relatives such as in (32b) lead to an increased processing cost in comparison to subject relatives such as in (32a) (cf. Bornkessel-Schlesewsky and Schlesewsky 2009: 188-198).

(32) Subject vs. direct-object relativization strategy in English
a. The managers that praised the designer examined the sketches.
b. The managers that the designer praised examined the sketches.

To conclude, the processing of grammatical relations and of relation-based constructions seems to fit in well with theoretical and typological generalizations and their explanation in terms of a hierarchy of grammatical relations. However, under closer inspection, the situation turns out to be more intricate. The complexity arises due to intervening factors that lead to a split interpretation in terms of grammatical relations. This parallels the situation discussed for grammar in the previous sections. Without going into technical details of neurolinguistic
methodology and theory, it suffices to mention the most important intervening factors. Sentence processing is guided by several types of information. In addition to phrase-structure and case, interpretation in terms of semantic roles plays an important role (cf. Bornkessel 2002; Bornkessel-Schlesewsky and Schlesewsky 2009: 134-143). Furthermore, a number of studies indicate that the processing of verbal arguments also depends on referential properties of the noun phrases such as animacy, topicality and definiteness (cf. Kaan 1998; Mak et al. 2006 with respect to relative clauses). Finally, neurolinguistic studies suggest that the types of information are not associated as assumed in the theoretical literature. In German, for instance, there is a dissociation between allegedly ‘structural’ case functions and phrase-structure relations (cf. Frisch and Schlesewsky 2001). In sum, the different factors that have been found to interfere with grammatical relations in grammar are also attested in language processing.

7. Final discussion

This article has shown that the relational interpretation of major sentence constituents is an important factor in grammar and language processing. A whole range of phenomena including verb agreement, relativization, reflexivization, basic word order, and voice cannot be captured appropriately without reference to the relational network between the verbal head and its dependents (head-dependent relations). Furthermore, there is a growing body of evidence indicating that hierarchical relations between the co-dependents of a head (co-argument asymmetries) are accessed in a way that is independent from the verbal head (cf. Primus 1998, 1999; Bornkessel-Schlesewsky and Schlesewsky 2009). Major typological parameters such as the ergative-accusative distinction also rest on relational interpretation. A challenge to all kinds of linguistic approaches is the question of the exact nature of these relationships. In this article, the discussion centred around the question whether grammatical relations such as subject, object, and pivot are appropriate tools to capture the relational network between major sentence constituents and its role in grammar and processing. The answer seems to be negative. This article has uncovered two serious types of problems tied to subject, object, pivot and similar notions. These are relational splits (cf. for this term Ura 2000) and multi-factor relational phenomena.

A relational split occurs when behaviour or coding properties that tend to cluster for a particular grammatical relation, the subject for instance (cf. Keenan 1976), are distributed over different types of noun phrases. This leads to a situation in which each type of noun phrase accumulates some but not all subject properties that are relevant in a particular language. Recall the English there-construction in section 2 above, which is repeated here for convenience: There are cows in next door’s garden. In this construction, there is subject in terms of surface structural position, but not with respect to case and agreement. Correspondingly, cows is subject in terms of case and agreement but not with respect to surface structural position. Thus, three subject properties related to case, agreement, and surface structure are split between there and cows in this type of construction. In constructions with a quirky case subject, such as in the Icelandic examples discussed in section 2 above, subject properties are split between the nominative argument, which, if present, determines verb agreement, and the highest structural argument position, which determines the function of infinitival PRO and triggers obligatory reflexivization, i.e. blocks coreference with a personal pronoun. A relational split was also mentioned for discourse-configurational languages such as Rumanian, Hungarian and Finnish. In these languages, the highest structural argument position is restricted to topics while case marking is tied to semantic roles and determines a number of phenomena such as verb agreement. So subject is split between the topic function and the nominative function in these languages.
Multi-factor relational phenomena are also a serious problem for subject, object and similar notions. Let us recall the determinants of case marking. In languages such as English, there are structural cases that are determined by surface phrase-structural relations, as amply discussed in the generative literature. But a structural case can also be checked in the basic position of an argument noun phrase, which is determined by the semantic role of the argument. This happens, for example, in the there-construction mentioned above with the structural nominative of the noun phrase cows. In Tagalog and other Austronesian languages, one case marker (ang in Tagalog) is determined primarily, but not exclusively by referential properties such as topicality and definiteness. The other factor is a proto-patient preference, as mentioned in section 5 above. Voice in Tagalog is also a multi-factor phenomenon. The choice of the voice marker is jointly determined by case marking (ang) and semantic roles, since the marker varies due to the semantic role of the ang-marked phrase. Differential case marking in Hindi, which was illustrated in section 5 above, is determined by the semantic role and case of the argument (nominative proto-patient) as well as by its referential properties such as animacy and definiteness.

Behavioural properties of subjects and objects are also determined by more than one factor in many languages. Verb agreement, for example, is a multi-factor rule in some languages. As shown by German and Avar examples in section 2 above, agreement is often triggered by the unmarked (primary or privileged) case function of the language in question (nominative or absolutive). In other languages, agreement is determined by the position of the argument in the lexical argument structure of the verb. This was shown for Warlpiri in section 3 above. Hindi has attracted attention in the typological literature due to a multi-factor agreement rule that is jointly determined by the nominative case function and by argument structure (cf. Mohanan 1994: 102-106; Bickel and Yaadava 2000; Corbett 2006: 195). In Hindi, there is a tense-aspect-driven alternation between the ergative and accusative construction. In the ergative construction, the proto-patient is in the nominative, in the accusative construction, the nominative is assigned to the proto-agent. The ergative construction was illustrated in (28) above. According to Mohanan, among others, agreement in Hindi is triggered by the highest argument in the argument structure of the verb that is also in the nominative. When there is no nominative argument, a default agreement marker is selected (masculine singular). Bickel and Yaadava (2000) go one step further in their claim that a combination of morphological and argument-structural notions is a general characteristic of the over-all syntax of many if not all Indo-Aryan languages. The above survey has focused on multi-factor phenomena within one language. However, from a cross-linguistic perspective, virtually all phenomena are multi-dimensional, turning any attempt towards a universal definition of grammatical relations into a fruitless enterprise. What is case driven in one language, for instance, is motivated by structural relations in another. This was shown for case-based verb agreement in German and Avar and structure-driven verb agreement in Warlpiri.

Due to space limitation, the previous sections have selected a small range of data from the overwhelming array of critical data discussed in the pertinent literature (cf. among others, Bhat 1991; Palmer 1994; Primus 1999; Farrell 2005; Bickel (in press)). Some of the critical data presented in this article were selected from well-studied European languages, in order to show that notions such as subject and object fail to account even for the languages these notions were primarily devised for.

The dilemma engendered by notions such as subject and pivot can be illustrated by Icelandic quirky case subjects. As suggested by this terminology, this type of argument is classified as a subject. This explains a number of facts including the structural position of this type of argument, infinitival PRO and reflexivization facts. However, verb agreement, which is triggered solely by nominative arguments in Icelandic, is left unexplained. The dilemma is that verb agreement in Icelandic could have been explained if a different, case-based subject
notion would have been used instead of a structural one. The typological notions of pivot or privileged syntactic argument generate the same type of dilemma. If we apply the pivot notion to the arguments in Icelandic that are classified as subjects in alternative approaches, we cannot capture verb agreement. Conversely, if we classify the agreeing arguments as pivots in Icelandic, we fail to capture the other facts. The dilemma of any definition of subject or pivot can now be stated in general terms for the notion of subject as follows. The dilemma for other grammatical relations applies correspondingly. If we define (or identify) subject in terms of X, we capture some generalizations but miss others, which we might have captured if we had defined subject in terms of Y. But if we define subject in terms of Y, then we miss the generalizations we could have captured in terms of X. The dilemma cannot be solved, of course, by adding more correlates to the list of possible subject properties. On the contrary, the more types of correlates we find to be relevant, the clearer the dilemma becomes.

Let us summarize the solutions to this dilemma that are proposed in the recent literature. They come in two flavours: decompositional and construction-based approaches. Here again, we focus on the subject for ease of exposition. In decompositional approaches, the subject notion is eliminated and replaced by different types of relational information. This trend characterizes, for example, the Minimalist Program (MP), Optimality Theory (OT), and Lexical Functional Grammar (LFG), as discussed in section 3 above. MP is a derivational, serial model that is focused on phrase-structural relations to the detriment of other types of relations. By contrast, LFG and OT are better equipped for relational splits and multi-factor-phenomena since both theories are non-derivational and are able to access different types of relations in parallel. In recent variants of LFG, subject and object are still primitive notions, as in earlier LFG approaches, but their role has decreased in favour of other types of relational information. Another appeal of non-derivational approaches is the fact that the different types of information can be arranged on their own hierarchy, as illustrated by the case markedness hierarchy in OT in section 3 above. By this step, such approaches are able, in principle, to capture the type of function (or property) that ties different subject correlates together: a function that qualifies for a subject is the first member of a hierarchy of functions of the same kind. The notion of nominative argument, for instance, captures a case relation between a head and a dependent. However, when subject properties are at issue, what counts is the fact that nominative is the first member on the case hierarchy of the respective language. This carries over to other types of relational information including structural and role-semantic hierarchization. To conclude, subject, object and pivot have to be replaced by more specific relations between a head and a dependent and, in addition, by hierarchy relations between co-dependents (cf. Primus 1998, 1999; Bornkessel-Schlesewsky and Schlesewsky 2009).

This hierarchy-based view of subject is adequately captured by the typological terms pivot or privileged syntactic argument. However, within functional typology, these notions are one-dimensional. Recall that Dixon’s pivot types are based exclusively on semantic roles, as discussed in section 4 above. This leads to a neglect of other types of relational information in this line of research. Functional typological approaches favour a construction-based solution to the problems engendered by grammatical relations. In face of the problem that criteria for a particular grammatical relation do not converge on the same type of argument, construction-based approaches reconceptualize the notion of subject, object or pivot as the syntactic relation that an argument bears to a specific construction (or rule) rather than to the clause in which the argument is realized (cf. Croft 2001; Christofaro 2008; Bickel, in press). The variation between verb agreement in German and Avar can be analyzed in terms of the construction-based pivot notion as follows (cf. also section 4 above). In German, the pivot (or subject) for verb agreement is \{S, A\}. In Avar, the pivot for verb agreement is \{S, P\}. The problem with the construction-based pivot notion is that the parallelism between German and Avar, which can be captured in terms of the highest (alternatively primary or privileged) case function, and the exact nature of the trigger (case) are obscured in this type of analysis. More
importantly, the construction-based approach to grammatical relations cannot cope with relational splits and multi-factor relational phenomena. Let us demonstrate this on quirky case subjects in Icelandic. Infinitival PRO has a \{S, A\}-pivot. The pivot of verb agreement must be \{S, A\} as well, since Icelandic has no ergative pivot of the type \{S, P\}. The competing relational dimensions of Icelandic, the privileged structural relation for infinitival PRO vs. the privileged case relation for verb agreement, cannot be captured by a construction-based pivot (or subject) notion. In sum, the construction-based pivot notion predicts variation where there is none, for instance, in verb agreement in German and Avar, and fails to account for variation where it occurs, for instance, among the rules (or constructions) in Icelandic.

This shows that the solution to the problem imposed by grammatical relations cannot be solved by a construction-based approach \textit{per se}. A more appropriate solution is a decompositional approach to the notion of pivot, subject or privileged syntactic argument and a hierarchization of different types of information. This carries over to the other relational notions such as direct and indirect object. A construction-based approach is needed on independent grounds and is pursued not only in functional typological approaches. Many recent theories of grammar incorporate construction-based variation to a smaller or larger extent. Thus, among others, Culicover and Jackendoff (2005) advocate for a decidedly construction-based approach within generative grammar. In the Minimalist Program, a mainstream generative approach which, taken superficially, seems to be far away from constructionism, cross-linguistic variation is exclusively explained by lexical variation (cf. Adger 2003).

References


de Hoop, Helen and Peter de Swart (eds.) 2008 *Differential Subject Marking.* Dordrecht: Springer Netherlands.


25


Hewitt, George B. 1979 *Abkhaz.* Amsterdam: North Holland.


Kulikov, Leonid, Andrej Malchukov and Peter de Swart (eds.) 2006 *Case, Valency and Transitivity.* Amsterdam: Benjamins.


Næss, Åshild 2007 *Prototypical Transitivity.* Amsterdam: John Benjamins.


Schriefers, Herbert, Angela D. Friederici and Katja Kühn 1995 *The processing of locally ambiguous relative clauses in German.* *Journal of Memory and Language* 34: 499-520.


