Groups and Eventualities: A Theory of Aspectuality

Ivan Alexandrov Derzhanski

Doctor of Philosophy
University of Edinburgh
1995

Abstract

This thesis is devoted to the development of a unified formal treatment of **aspectuality**. The proposed treatment is based on the conception of aspectuality as a generic category, interpreted as the way in which the entities (objects or eventualities) belonging to the denotation of a predicate occupy an area within the universe in which the predicate is defined, as determined by the contour of the area, but irrespective of the nature (spatial or temporal) and the mereological and topological organisation of the domain. Such a conception is supported by the intuitive semantic analogy between the aspectual properties of the denotata of verbal and nominal expressions, which include the stativity and telicity of the former and the countability, quantification, specificity and definiteness of the latter. The analogy is also reflected in the formation of the temporal constitution of the eventuality expressed in the clause as a result of the interaction between the aspectual properties of the nominal constituents of the clause and the lexical semantics and the morphosyntactic properties of the verb.

As a starting point I use the set-theoretic account of plurality developed in Landman 1989, which presents a response to the lattice-theoretic Logic of Plurals and Mass Terms originally formulated in Link 1983. Landman's account relies on a fundamental distinction between two kinds of compound entities, *viz.* **sums**, whose properties are fully determined by the properties of their components, and **groups**, for which that is not so. I propose some modifications of the formalism, aimed at achieving greater generality and inhibiting some cases of overgeneration. I then explore the application of the theory of plurality to the domain of eventualities, focussing upon the formal parallels in the analysis of the referential properties of the classes of entities recognised in the nominal and the verbal domain.

Finally, I address the question of the treatment of **aspectual composition** in a group-based theory of aspectuality. I turn to the theory of properties of thematic relations developed by Krifka 1991 and show how by introducing the notion of a **termset** of arguments, by generalising the property **uniqueness of events** to sets of thematic roles and by including the run time directly into the argument frame of the predicate the power of Krifka's theory can be recreated, and its coverage extended to a wider range of phenomena, within the proposed framework.

Declaration

I declare that this thesis has been composed by myself and that the research reported here has been conducted by myself unless otherwise indicated.

Ivan A Derzhanski

Edinburgh, 15 June 1995

Acknowledgements

I am indebted to my supervisors, Robin Cooper and Elisabet Engdahl, for encouraging me to undertake this research and to pursue it to a successful conclusion. I've always admired their attention to detail as much as the breadth and the depth of their scholarship. Without Robin's scepticism, a lot of chaff would have been left in. Without Elisabet's enthusiasm, I would have winnowed away much of the grain.

I am obliged to my colleagues from the working group on Tense and Aspect, especially Sheila Glasbey and Martin Mellor, for numerous intriguing discussions of matters more or less directly related to my work. Many of my ideas were presented at various stages at meetings of this group, the working group on Meaning and Computation, the workshop on Parametric Variation and the Annual Conference of the Centre for Cognitive Science, as well as the conference 'Events and Grammar' held in November 1993 at Bar Ilan University (Ramat Gan, Israel), and I thank all those who listened to me and commented on what I had to say.

A couple of discussions which took place in early 1992 on the Lojban mailing list (an Internet list devoted to the discussion of Lojban, a constructed language based on predicate logic) made me aware of the existence of some interesting semantic problems and inspired me to explore them in detail. Among those who took part in those discussions, I would mention here the names of John Cowan and And Rosta. `ki'esai`.

I very much appreciated the prompt and sharp judgements and valuable insights of my informants. I thank Chris Eich for sharing his native Welsh with a complete stranger and Scott Horne for treating a long-time friend to his knowledge of Chinese.

I am grateful to Donald Knuth, Leslie Lamport and Serge Rosmorduc for designing and developing TEX & METAFONT, LATEX and Sesh Nesout ( ), respectively, and making scholarly writing as great a pleasure as it could ever be.

And I thank all my friends in Edinburgh, on the Internet and in the realm of conventional mail for their affection, their support and their faith in me.

Contents

Introduction

0.1 Aims and Motives

The present work is devoted to the development of a unified, cross-categorial formal treatment of **aspectuality**, compatible with the major current semantic frameworks. The proposed treatment is based on the conception of aspectuality as a generic category, which has both 'nominal' manifestations (such as countability, number, quantification, specificity and definiteness) and 'verbal' ones (such as stativity, telicity and iterativity). This category is interpreted as the way in which the entities (objects or eventualities) which belong to the denotation of a predicate defined in a given universe occupy an area within that universe, as determined by the contour of the area, but irrespective of the nature of the domain (spatial or temporal) and its mereological and topological organisation (including its finiteness, dimensionality, density, continuity, the existence of a metric etc).

There are two reasons, one of descriptive and one of explanatory nature, for which I believe that such a conception is eminently worthy of exploration.

First, it is supported by the intuitive semantic analogy between the aspectual properties of the denotata of nominal and verbal expressions, which has been pointed out by numerous authors and in many different contexts (*inter alia*, Leech 1936, Weinreich 1963, Allen 1966, Bolinger 1975, Taylor 1977, Bach 1979, Borg 1981, Mourelatos 1981, Mittwoch 1982, Dahl 1984, Bach 1986). A frequently drawn parallel is the one between countability and telicity, both of which, to use a metaphor due to Taylor 1977, characterise the way in which an entity (be it a stuff or substance or an atelic or telic eventuality) occupies a spatial or temporal area by either *filling* it uniformly or *delimiting* it. A similar relation exists between plurals and iteratives, two categories which are grammaticised alike in some languages (Gleason 1969; cf. p. 51). At the level of linguistic description, then, the conception of aspectuality as a generic category deserves attention because of its implications for the development of compact semantic formalisms, in which the perceived analogies are carried over to the formal representation.

Second, it has been suggested (*inter alia*, by Carlson 1981, Krifka 1991, Eberle 1991, Kabakčiev 1992) that the parallelism between nominal and verbal aspectuality can provide an important insight into the nature of **aspectual composition** (the interaction between the aspectual properties of the non-verbal constituents of the clause and the lexical semantics and the morphosyntactic characteristics of the verb towards the formation of the aspectual properties of the eventuality expressed in the clause). The reasoning behind this suggestion is that, if the principal types of nominal and verbal aspectuality be analysed as manifestations of some generic types of reference in the corresponding domains, then aspectual composition becomes effectively a process of transfer of reference properties from the non-verbal constituents to the eventuality. Various strategies for the treatment of aspectual composition which make use of this analogy have been proposed in the literature.

In Krifka 1991 it is demonstrated how both the opposition between unquantified plural/mass

terms and singular count or quantified plural/mass terms and the opposition between atelic and telic predicates can be analysed as manifestations of two generic types of reference, *viz.* **cumulative** and **quantised** (cf. p. 4). In its original form the account leaves some problems open. Consider the following examples:

(0.1) a. *John saw seven zebras in an hour.*
b.* *John saw a zebra in an hour.*

The acceptability of the time-span adverbial *in an hour* in (0.1a) as opposed to (0.1b) argues for the existence of an aspectual difference between the two eventualities. (Paraphrasing one of Vendler 1967's criteria for aspectual classification, accomplishments but not achievements cooccur with time-span adverbials.) In light of the adopted conception of aspectual composition, we should be able to explain this difference by appealing to a parallel difference in the reference types of the objects of the two sentences. However, since both *seven zebras* and *a zebra* are quantised, we are led to conclude that, despite its evident virtues, the bipartition of reference types on its own is not sufficient to capture fully the details of the interaction of nominal and verbal aspectuality, and consequently it needs to be employed jointly with a more elaborate treatment of plurality.

For this purpose I use the set-theoretic account of plurality developed in Landman 1989, which presents a response to the lattice-theoretic Logic of Plurals and Mass Terms (LPM) originally formulated in Link 1983 and aimed at giving more structure to the domain of individuals than, for example, Montague's semantics does. Landman's account relies on a fundamental distinction between two kinds of compound entities, *viz.* **sums**, whose properties are fully determined by the properties of their components, and **groups**, for which that is not so. All expressions in the formal language, terms and predicates alike, are further classified according to the level of grouping on the basis of an associated system of floating **types**, with the possibility of altering the type of an expression by means of a **lifting** operation. In the present theory the same mechanism is applied to the domain of eventualities, and I argue that its use makes it possible to capture some aspectual distinctions which are lost in an account relying on a simple bipartition of reference types.

0.2 Organisation of the Thesis

The exposition is divided into three chapters.

In Chapter 1 I introduce the principal provisions of Landman 1989's theory of plurality. I propose some modifications and extensions of the formalism, aimed at achieving greater generality and inhibiting some cases of overgeneration. I then concentrate on the formal representation of number and countability, the classes of nominal expressions determined by them and the processes of conversion between those classes. I also discuss the implicit and explicit realisation of the individual classes and conversion processes in natural languages.

In Chapter 2 I explore the application of the theory of plurality to the domain of eventualities. Using the postulates of Taylor 1977 and the aspectual network of Moens & Steedman 1988 as my theoretical starting point, I discuss the representation of the individual aspectual classes and the processes of conversion between them which find their realisation in natural languages, with particular emphasis on the formal parallels in the analysis of aspectuality in the nominal and the verbal domain.

Finally, in Chapter 3 I address the question of the treatment of aspectual composition in a theory of aspectuality which employs the framework developed in the first two chapters. I turn to Krifka 1991's theory of properties of thematic relations and show how by introducing the notion of a **termset** of arguments, by generalising the property **uniqueness of events** to sets of thematic roles and by including the run time directly into the argument frame of the predicate the power of Krifka's theory can be recreated and its coverage can be extended to a wider range of aspectual phenomena.

0.3 Some Further Remarks

Throughout the discussion I draw support for the theory from, and test it against the facts of, a variety of genealogically and typologically diverse languages. In doing so I am guided by the assumption that it is an advantage for syncretism and polysemy to be reflected by parallelism in the formalisation (and my sharing of Dowty 1989's belief that 'the general expectation of parallelism in syntactic form and semantic function has, historically, led us to insightful analyses of natural languages far more often than it has led us astray'), as well as my concern for the cross-linguistic relevance of the proposals.

Due to the nature of the research, the exposition abounds in formulæ which represent interpretations of terms, predicates, sentences and derivations between them. In designing the notation for this study I have pursued simultaneously many goals, among which were acknowledging the existing tradition without being constrained by it, achieving compactness without leaving out any relevant details, emphasising some useful analogies without suggesting many false ones and satisfying my own sense of æsthetics, without, I hope, going too sharply against that of the reader.

Some of the ideas presented in Section 1.3, Subsection 2.2.2 and Sections 2.3 and 3.2 were reported in Derzhanski 1993, but have been fundamentally reworked here. The exposition in Subsection 1.2.1 and Section 1.3 is largely derived from Derzhanski 1994.

The information on the genealogical affiliation of each language which accompanies each entry in the Language Index comes from Ruhlen 1987.

Chapter 1

Plurality

In the poem '*Die Vergänglichkeit*' ('Ephemerality') by Johann Peter Hebel (1760–1826) the smooth-tongued grandfather extols the splendour of the town of Basel (Switzerland) in the following terms:

. . . 's sinn Hüüser drin, 's isch menggi Chilche nit
there are [such] houses in it [that] there is many a church not

so groß, un Chilche, 's sinn in menggem Dorf
so big and [so many] churches [that] there are in many a village

nit so viil Hüüser . . .
not so many houses

What is remarkable about this verse is that, despite the syntactic parallelism in the construction employed, which can be represented schematically as '[in Basel] there are houses with property ϕ and churches with property ψ',

(1.1) $$\exists h[\mathrm{houses}(h) \wedge \mathrm{in\_Basel}(h) \wedge \phi(h)] \wedge \exists c[\mathrm{churches}(c) \wedge \mathrm{in\_Basel}(c) \wedge \psi(c)]$$

there is a semantic difference, which is characterised as a difference in the type of reference associated with the predication in the two cases: the property ϕ is possessed by every one of the selected Basel houses, whereas property ψ is not a property of any individual church in Basel. Using the terminology which shall be introduced further in this chapter, the former is an instance of **distributive** and the latter of **collective** predication. An adequate theory of plurality must be able to predict this distinction on the basis of the properties of the predicates ϕ and ψ.

A related, more general task for such a theory is to account for the variation in the applicability of collective predication to singular and plural count terms, collectives and mass terms, as illustrated in examples (1.2–1.3).[1]

(1.2) a. *The water gathers in big pools.*
b. ! *The horse gathers in the field.*
c. *The horses gather in the field.*
d. *The herd of horses gathers in the field.*
e. *The herds of horses gather in the field.*

[1] The acceptability judgements for examples (1.3) presuppose the use of the verb *count* as meaning 'determine the quantity of' rather than 'assign a number to'.

(1.3) a. ! *I counted the water.*

b. ! *I counted the horse.*

c. *I counted the horses.*

d. *I counted the herd of horses.*

e. *I counted the herds of horses.*

Of particular interest here is the possibility for multiple readings in the cases involving plural collectives. For instance, example (1.3e) can refer to the speaker's determining the number of herds, the number of horses in each herd or the total number of horses.

It is the development of such a theory that this chapter is devoted to.

My starting point shall be the set-theoretic account of plurality developed in Landman 1989, which in turn constitutes a response to the lattice-theoretic Logic of Plurals and Mass Terms (LPM), originally formulated in Link 1983. Landman's account involves the development of a formal first-order language of plurality with abstraction over individual variables and a set-theoretic interpretation for it.

I shall discuss the principal provisions of the theory, presenting in parallel the syntax and the semantics of the language of plurality, and shall propose a few modifications and extensions to Landman's account.[2] I shall then concentrate on the formal representation of number, the characteristic properties of count and mass terms and the various processes of conversion between these classes, the implicit or explicit realisation of which is found in natural languages. In the final section of the chapter I shall present some additional illustration of the conversion processes and their formal treatment by examining the number system and the status of count and mass terms in Arabic.

The application of the theory to the domain of eventualities shall be the subject of the subsequent chapters.

1.1 The Logic of Plurality and the World of Battleships

In this section I shall introduce the syntax and semantics of the theory of plurality of Landman 1989 and discuss the fundamental **types of reference**, by which is understood the relation of a predicate to entities structurally connected to elements of its extension. For the sake of observability, the functioning of the theory shall be demonstrated initially by means of an exemplary universe defined in a two-dimensional finite discrete space, although frequent references to the mereologically and topologically more complex 'real world' shall be made throughout this section of the exposition.

Figure 1.1 displays a board on which a player has allocated his fleet for a game of battleships.[3] The fleet consists of 4 boats, 3 tankers, 2 destroyers and 1 cruiser, with the ships of each category taking up respectively 1, 2, 3 and 4 fields.

The universe in this example is built upon the sixty-four fields of the chessboard, which are the **atoms** in the model. Over them there are defined basic predicates reflecting the location of each field in absolute terms and relative to the other fields, as well as its state of being occupied or vacant. The remaining **entities** distinguished in the game (ships and collections of ships)

[2] Although the language of plurality is a first-order language, for the sake of convenience I shall occasionally use formulæ which involve higher orders of quantification, in particular when defining properties of predicates, in the exposition. Such formulæ, which are not part of the semantic representation language in the strict sense, are to be understood in the usual metalogical way.

[3] Similar lessons can be drawn from other board games, such as chess or Go, and cellular automata, such as John Conway's game of Life.

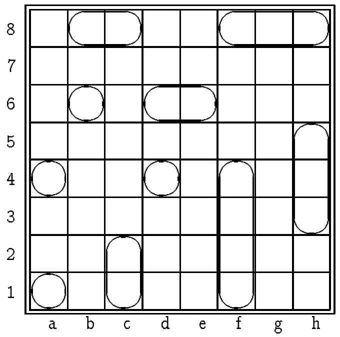

Figure 1.1: The world of battleships.

are essentially structures of fields which satisfy certain characteristic predicates; e.g., $\boxed{\text{c1–2}}$ is a tanker because the two fields c1 and c2 are adjacent and both are occupied, but all of their other neighbours are vacant. (Needless to say, the conditions for tankerhood would be more complex if the rules of the game allowed ships to touch one another.)

The interpretation of a n-place predicate is the set of n-tuples of interpretations of individuals to which it applies, whereby a 1-tuple is taken to be identical to its only element. I use '$[\![\cdot]\!]$' to denote the interpretation function.

(1.4) $$[\![\phi]\!] = \{\langle [\![a_1]\!], \ldots, [\![a_n]\!]\rangle \mid \phi(a_1, \ldots, a_n)\}$$

Thus, if a field is interpreted as the singleton set of its location, e.g., $[\![\underline{\text{a1}}]\!] = \{\text{a1}\}$, the following are examples of denotations of spatial predicates:

(1.5) $$[\![\text{left\_half}]\!] = \{\{\text{a1}\}, \{\text{a2}\}, \ldots \{\text{d7}\}, \{\text{d8}\}\}$$

(1.6) $$[\![\text{adjacent}]\!] = \{\langle\{\text{a1}\},\{\text{a2}\}\rangle, \ldots \langle\{\text{d7}\},\{\text{d8}\}\rangle\}$$

(1.7) $$[\![\text{adjacent\_to\_}\underline{\text{a1}}]\!] = \{\{\text{a2}\}, \{\text{b2}\}, \{\text{b1}\}\}$$

1.1.1 Compound entities

A formal counterpart to nominal conjunction in natural language is provided by the idempotent, commutative and associative operation of **summation**, which relates any two entities a and b to their **sum** $c = a \sqcup b$. In the set-theoretic model summation is represented by set union, which is why it is postulated that individual entities, such as the fields in the extensions of the predicates in examples (1.5–1.7), must be represented as singleton sets.

(1.8) $$[\![a \sqcup b]\!] = [\![a]\!] \cup [\![b]\!]$$

The sum $a \sqcup b$ is a compound entity (a plural individual) of which a is a **part** (as is b). I shall use the notation $a \sqsubseteq c$ (respectively, $b \sqsubseteq c$) for this partial ordering relation.[4]

(1.9) $$\forall a \forall c [a \sqsubseteq c \leftrightarrow a \sqcup c = c]$$

[4] It is interesting to observe that the English conjunction *and* and its counterparts in other languages actually require their conjuncts not to be parts of one another, ruling out such constructions as *cabbages and vegetables*, although a conjunction of this kind is employed in the definition of the part relation in (1.9).

Any entity is trivially a part of itself. A **proper part** is a part not equal to the sum, and we write $a \sqsubset c$ if $a \sqsubseteq c \wedge a \neq c$.

The relation under consideration refers to an individual part of a collection (e.g., two boats out of four) rather than a material part of a thing (the middle two fields of the cruiser or the mast of a real ship). It is modelled by means of the subset relation.

$$[\![a \sqsubseteq c]\!] = [\![a]\!] \subseteq [\![c]\!] \qquad (1.10)$$

In the present theory the properties predicated of a sum are inherited from the properties of its parts. For example, the fields $\underline{a6}$, $\underline{b5}$, $\underline{b7}$ and $\underline{c6}$ are in the left half in the board (because every one of them is) and are adjacent to $\underline{b6}$ (for similar reasons). A predicate such as *be field(s) in the left half of the board* or *be field(s) adjacent to* $\underline{b6}$, which applies to the sum of any two elements of its extension, is said to have **cumulative reference** (Quine 1960).

$$\forall \phi [\textsc{cum}\,\phi \leftrightarrow \forall x \forall y [\phi(x) \wedge \phi(y) \rightarrow \phi(x \sqcup y)]] \qquad (1.11)$$

Closely related is the concept of **distributive reference** (Bunt 1979), also called **subdivisive** (Bach 1986) or **divisive** (Eberle 1991). Distributive reference is had by a predicate which applies to any part of an entity in its extension.[5]

$$\forall \phi [\textsc{div}\,\phi \leftrightarrow \forall x \forall y [\phi(x) \wedge y \sqsubseteq x \rightarrow \phi(y)]] \qquad (1.12)$$

By contrast, a predicate such as *be four fields*, which never applies to a proper part of an element of its extension, is said to have **quantised reference** (Krifka 1991).

$$\forall \phi [\textsc{qua}\,\phi \leftrightarrow \forall x \forall y [\phi(x) \wedge \phi(y) \wedge x \sqsubseteq y \rightarrow x = y]] \qquad (1.13)$$

Quantised reference characterises also the lexically singular predicates corresponding to the different ranks of ships, such as *be a cruiser*, which holds for $\boxed{\text{f1–4}}$, the entity occupying the four fields which constitute the cruiser, but not for any proper part thereof.[6] While the structure of a ship is based on the sum of the fields occupied by it, it is more complex than that: for many purposes the sum of the two destroyers must be distinguished from the flat sum of the six fields which they take up between them.

[5] Or in any case it *generally* applies to its parts. In many circumstances (though by no means always) universality turns out to be too strict a quantifier, and it can be argued that generic implication should be used instead, possibly with the further addition of domain-sensitive restrictions on the choice of parts of c to which the predicate applies. This is as true with respect to eventualities, regarded as predicates over times of evaluation, as it is with respect to any other entities. Cf. Vlach 1981's condition for the truth of a stative sentence for an interval:

> The sentence ϕ is true for the interval I if and only if ϕ is true at a set of subintervals of I which are *more or less scattered* all over I in such a way that there are *no large gaps* between [them; emphasis mine—*I.D.*].

Carlson 1981 carries that observation further by pointing out that it is in fact a characteristic property of *all* that truth is ascertained for each member of some sufficiently fine partition (or perhaps just cover) of the whole, left to be determined by various pragmatic considerations. The point is well taken, although (as he himself admits) his example *All the ground was speckled with leaves* (which means that there were no bare spots big enough to break a pattern of speckles, rather than that there were absolutely no bare spots) has more to do with the lexical meaning of *speckled* than with the partitive character of *all* as a universal quantifier; a better illustration would be *All the ground was covered with leaves.*

I am compelled to leave this detail without further consideration.

[6] It may be objected that since the cruiser, being a single object, has no individual parts, this statement is trivially true. However, in the general context of Krifka's theory it appears more appropriate to think of quantised reference as being defined in terms of material rather than individual parts. The real world provides many examples of quantised predicates which apply to material parts of elements of their extensions. For example, a horse remains a horse if it is deprived of its tail and mane. Similarly, an apple remains an apple after its skin and core have been removed. In an Adyghean folk tale the heroine is given the task to procure a ram *and* a piece of meat from *the same* ram. (As per fn. 4, neither conjunct may be part of the other.) She proves equal to the challenge by having the animal gelded and curing the severed flesh. In the last chapter of *The Return of the King*

Entities with the appropriate features are obtained by means of the operation called **group formation**, which converts the sum c to the **group** of the same components $\uparrow c$. In the set-theoretic model the interpretation of a group is a singleton set, whose only element is the interpretation of the sum. By virtue of this a group can have no proper parts, any more than a singleton set has a proper non-empty subset.

$$[\![\uparrow c]\!] = \{[\![c]\!]\} \qquad (1.14)$$

The converse operation, which Landman 1989 calls **member(ship) specification**, but to which I shall refer simply as **ungrouping**, is also available, so $c = \downarrow x$ if $x = \uparrow c$. This is reflected in the definition of the semantics of the operation, presented in (1.15). The notation $\iota X[P]$ is used for the definite description 'the X such that P'.

$$[\![\downarrow x]\!] = \iota X\,[[\![x]\!] = \{X\}] \qquad (1.15)$$

A group is a formally singular entity which is subject to **collective** predication; it may have properties unrelated to the properties of its components, or derived from theirs in non-trivial ways, in particular, via collective body formation, collective action or collective responsibility.[7] The following examples are drawn from Landman 1993:

(1.16) *The boys touch the ceiling.*
(If they're forming a pyramid, then only one of them does, just as it is a particular part of his body that comes in surface contact with part of the ceiling.)

John R R Tolkien relates how '[o]n [Galadriel's] finger was Nenya, the ring wrought of *mithril*, that bore a single white stone flickering like a frosty star'. Yet the adamant is an integral part of the physical object known by the proper name Nenya, the Ring of Water, to the same extent as the *mithril* base.

It is true that in none of these examples the entity can be divided into two parts of the same kind; but even this is not a necessary condition. The book from which the last example comes, along with two other books (*The Fellowship of the Ring* and *The Two Towers*), constitutes the book *The Lord of the Rings.* As Taylor 1977 observes, tables can be so constructed as to enable a number to slot together so as to form a larger one.

It can be objected that the tablehood of the parts is independent from the tablehood of the whole, and that there necessarily are areas which are not tables, although they fall within the larger table and contain one or more of the smaller ones. The word *book*, too, has more than one meaning; *The Lord of the Rings* is a single book in so far as it is a single literary composition, and its division into three named or six numbered books refers to different kinds of bookhood.

Some increasingly more problematic cases, suggested by Grandy 1979 and Pelletier 1979′, include *lump of gold*, which can be divided physically into two lumps of gold, *quantity of gold* (in the technical sense), which already contains conceptually an infinite number of quantities of gold, and the very expressions *individual*, *thing* and *entity*, as well as *sequence* (Krifka 1993). Outside the spatial domain we find *interval*, *period*, *process* and *event.* The proper treatment of such cases requires the involvement of topological notions.

Carlson 1981 draws attention to the fact that *water* and *some water* have different impact on the aspectuality of the clause, although they clearly refer to exactly the same entities. In his game-theoretic account the construct *some* N authorises the proponent of the sentence to choose an object, say A, such that A *is/are* N, and the game is continued with A substituted for the quantified expression. This amounts to saying that the speaker has a specific referent (type or thing) in mind.

[7] The **partake** operator of Link 1983 serves to distinguish between those individual components of the composite referent of the argument which play an active rôle in the event and those that do not. This operator is introduced to account for the fact that natural language appears to possess special means for indicating whether or not it is the case that every member of a group partakes in an event (compare *the children built the raft* to *all the children built the raft*). It maps every predicate ϕ to ${}^{\mathsf{T}}\phi$, read '**partakes in** ϕ', the extension of which is made up of *some* individual parts of the members of the extension of ϕ, and the following meaning postulate for it is presented:

$$^{\mathsf{T}}\phi(x) \rightarrow \exists y[x \sqsubseteq y \wedge \phi(y)]$$

It is emphasised that 'the operator "${}^{\mathsf{T}}$" can be only partially characterized in view of the essentially pragmatic nature of its intended interpretation'. In fact it appears to be undercharacterised to the point of not being really useful.

(1.17) *The boys carried the piano upstairs.*
(This includes the one walking in front with a flag, as well as those who actually were holding one end of the instrument or the other.)

(1.18) *The marines invaded the island.*
(This is unlikely to refer to two unauthorised marines landing in a rubber boat; but in any case it is the shared responsibility, not the numbers, that makes the use of collective predication possible.)

It is convenient for ships in the battleships game to be regarded as groups of fields.

(1.19) $$[\![\text{boat}]\!] = \{\{\{a1\}\}, \{\{a4\}\}, \{\{b6\}\}, \{\{d4\}\}\}$$

(1.20) $$[\![\text{cruiser}]\!] = \{\{\{f1, f2, f3, f4\}\}\}$$

Groups can be components of sums, which in turn can undergo group formation without restriction on the iteration. As an illustration Landman 1989 uses the example of a fragment of the structure of society as analysed in *Das Kapital* by Karl Marx, where *the farmers* and *the city proletariat*, both of which are groups of individuals, are components of the larger group which is *the working classes*, *the working classes* and *the exploiting classes* further constitute *the state*, and the process can continue, so that *the states of Central Europe and the states of Western Europe who distrust one another* denotes a group of groups of states.

It is nevertheless important to observe that the possibility for unlimited grouping is merely a conceptual one, and that languages only provide a finite set of number distinctions; e.g., in English both *class* and *state* are singular collective nouns, regardless of the fact that a class is a component of a state.[8]

1.1.2 Pluralisation

It was stated that in the present theory the properties of a sum are fully determined by the properties of its parts. Two operations of **pluralisation** of predicates are designed to express this regularity.

Ordinary pluralisation

For a given unary predicate ϕ its corresponding **(ordinary) plural predicate** $^*\phi$ denotes the closure of ϕ under summation; in other words, the plural predicate holds for all entities for which the singular one does, as well as their sums.

(1.21) $$\forall\phi\forall C[^*\phi(\bigsqcup_{c\in C} c) \leftrightarrow C \neq \emptyset \wedge \bigwedge_{c\in C} \phi(c)]$$

[8]The exposition so far makes it sound as though a group is fully identified by its elements, which is not entirely precise. In fact groups with the same elements may have different properties. For example, *be permanently at war with one another* can be predicated of *the working classes and the exploiting classes*, but not of *the state*, although the two are groups with the same elements and therefore should, according to what was said so far, denote the same entity. Consequently the property of being a group and the set of its elements may be only part of the description of an entity. This is an issue which is not of central importance to the present discussion, since we are interested in the possibility of constructing groups, but not in their uniqueness; it is, however, recognised in Landman's theory, where it is acknowledged that different groups may have the same elements and the grouping and the ungrouping operations are accordingly introduced as a one-to-many and a many-to-one function, respectively.

In general it can be argued that unrestricted group formation, such as is postulated here, is both too powerful and too expensive a tool and that its work could be done by discourse-level 'grouping'. See fn. 11 for a brief discussion.

The denotation of $^*\phi$ is therefore the closure of the denotation of ϕ under set union.

(1.22) $$[\![^*\phi]\!] = \{\bigcup C \mid \emptyset \neq C \subseteq [\![\phi]\!]\}$$

For example,

(1.23) $$[\![\text{destroyer}]\!] = \{\{\{f8, g8, h8\}\}, \{\{h3, h4, h5\}\}\}$$

(1.24) $$[\![^*\text{destroyer}]\!] = \{\{\{f8, g8, h8\}\}, \{\{h3, h4, h5\}\}, \{\{f8, g8, h8\}, \{h3, h4, h5\}\}\}$$

Plural predicates have **homogeneous reference** (Bunt 1979), which is to say that they are both cumulative and distributive.

(1.25) $$\forall\phi[\forall x\forall y[^*\phi(x) \wedge {}^*\phi(y) \to {}^*\phi(x \sqcup y)]]$$

(1.26) $$\forall\phi[\forall x\forall y[^*\phi(x) \wedge y \sqsubseteq x \to {}^*\phi(y)]]$$

Rule (1.26), according to which, if a plural predicate holds for an entity, it holds for any part of it, expresses the essence of distributive predication. Link 1983 proposes that all inherently distributive predicates working on plural terms, unlike all other predicates, should enter the formalisations in the form of the corresponding plural predicates; otherwise singular (collective) predication is assumed. This ensures the correct handling of cases such as the ones presented in examples (1.27):

(1.27) a. *The dogs died.* $\quad ^*D(d_1 \sqcup \ldots \sqcup d_n) \Rightarrow {}^*D(d_1) \wedge \ldots \wedge {}^*D(d_n)$
b. *The dog died.* $\quad ^*D(d) \Rightarrow D(d)$

If *died* is consistently represented as the plural predicate $^*D$, it is reduced to the singular predicate D when, as in (1.27b), it is applied to a singular entity. It would be incorrect to apply the singular predicate to a plural entity, which is why in (1.27a) the reduction only takes place after the predicate is distributed over the parts of the sum which constitutes its argument, including the individual dogs (represented here by $d_1, \ldots, d_n$).

Example (1.28), on the other hand, has two readings, depending on whether *carried the piano upstairs* is represented as a singular or a plural predicate.[9] In the latter case it distributes over the three individual piano carriers.

(1.28) *Tom, Dick and Harry carried the piano upstairs.*
a. $C(\uparrow(t \sqcup d \sqcup h))$
b. $^*C(t \sqcup d \sqcup h) \Rightarrow {}^*C(t) \wedge {}^*C(d) \wedge {}^*C(h) \Rightarrow C(t) \wedge C(d) \wedge C(h)$

Characteristically, the distributive reading is excluded in the alternative construction in which a part of the group is expressed as a comitative constituent. The availability of the distributive reading sets (1.28) apart from (1.29).

(1.29) a. *Tom and Dick carried the piano upstairs with Harry.*
b. *Tom carried the piano upstairs with Dick and Harry.*

This indicates that the comitative construction in (1.29) is connected by way of a meaning postulate to (1.28a), but not to (1.28b).

One further distinction between singular and plural predication is that only the former is **thematic** (Landman 1993), i.e., associated with certain semantic properties characteristic of the corresponding argument position. In the case of a sum it is its components, rather than the sum as a whole, that have the relevant thematic properties.

[9]The representation of the argument as a group in (1.28a) and a sum in (1.28b) follows from the representation chosen for the predicate in a way which shall be discussed in Subsection 1.1.4.

Proper pluralisation

The extension of the **proper plural predicate** $^{+}\phi$, present in Link 1983 but not in Landman 1989, contains just the non-trivial sums in the extension of $^{*}\phi$.

$$\forall c \forall \phi [^{+}\phi(c) \leftrightarrow {}^{*}\phi(c) \wedge \neg\phi(c)] \tag{1.30}$$

$$\forall c \forall \phi [^{+}\phi(c) \rightarrow |[\![c]\!]| > 1] \tag{1.31}$$

As pointed out by Ojeda 1993, the plural in natural languages such as English is ambiguous between a **general** reading, semantically indeterminate with respect to number,

(1.32) a. *How many children do you have?*

b. *Are there any questions?*

and a **specific** reading, restricted to numbers greater than one (i.e., to the semantic difference between the domains of the general reading of the plural and the singular). By virtue of excluding the singular, proper plurals are a formal counterpart to the specific reading of the plural; for example, if B stands for *is a boy* and ^{+}B, interpreted as *are boys*, applies to the referent of *Tom, Dick and Harry*, then it applies to any two of Tom, Dick and Harry, but unlike the ordinary plural $^{*}B$ it doesn't apply to any one of them alone. On the other hand, ordinary plurals correspond to the general reading of the plural in English, or to the basic (neutral with respect to number) form of the noun in a wide range of other languages. Since proper plurals are cumulative, but not generally distributive, their reintroduction into the theory means that cumulativity and distributivity are not quite the two sides of the same coin any more, as they are for Landman 1989.

Obviously, if a singular predicate has an empty or singleton extension, the ordinary plural predicate is trivially equivalent to it, and the proper plural predicate has an empty extension.

$$\forall \phi \left[|[\![\phi]\!]| \leq 1 \rightarrow [\![^{*}\phi]\!] = [\![\phi]\!] \wedge [\![^{+}\phi]\!] = \emptyset\right] \tag{1.33}$$

It is understood that any pluralisation of a predicate whose arity is greater than one is associated with a certain argument position.

1.1.3 Typing

In order to ensure that predicates apply to terms with the appropriate structure, all expressions in the language of plurality are rigidly typed: a term x has a **type** (denoted '$\mathrm{typ}\, x$') associated with it, and a predicate imposes certain requirements on the types of its arguments. The type of a term is a non-negative integer corresponding to the level of grouping. The type of a sum is equal to, and the type of a group is greater by one than, the type (or the highest of the types) of its parts.

$$\mathrm{typ} \bigsqcup_i a_i = \max_i \mathrm{typ}\, a_i \tag{1.34}$$

$$\mathrm{typ} \uparrow c = 1 + \mathrm{typ}\, c \tag{1.35}$$

Thus, if fields in the battleships game are entities of type 1, ships are entities of type 2. The predicate *be a fleet* belongs to type 3 if the fleet, which occupies 20 fields altogether, is taken as the group of all 10 ships, or to type 4 if it is thought of as a structure consisting of the groups of boats, tankers and destroyers and the cruiser. In the 'real world' it is reasonable to assume

that individual physical entities belong to type 1. In the example based on *Das Kapital* the group of *the states of Central Europe and the states of Western Europe* is, by virtue of its construction (though not because of any direct linguistic evidence), of a type higher by 4 than the type of *the farmers*.

A verbal or nominal expression of a natural language is normally formalised as a family of predicates, consisting of various pluralisations of a primitive predicate. The type signatures of the members of this family reflect certain properties of the thematic relations, the nominal reference of the arguments and (where applicable) the temporal constitution of the eventuality. The relevant mechanisms will be explored in Section 3.2.

A right superscript notation will be used to indicate the types of both terms and predicates. Thus, x^m will stand for the term x of type m and $\phi^{\dots,m_n}$ for the n-ary predicate ϕ which expects its ith argument to be of type m_i for each $i \leq n$. The values of m_i compose the **type signature** of the predicate ϕ, which is also where pluralisation is indicated, being prefixed to the type of the corresponding argument; e.g., the binary predicate $\phi^{m_1,m_2}(\theta_1,\theta_2)$ is converted to $\phi^{{}^{*}m_1,m_2}$ by ordinary pluralisation relative to its first argument, and to $\phi^{m_1,{}^{+}m_2}$ by proper pluralisation relative to its second argument.

1.1.4 Lifting

The mechanism of **lifting**, introduced by Landman 1989, realises the possibility of the application of a predicate to arguments belonging to types other than the ones indicated in the predicate's type signature. It is derived from a mechanism discussed by Partee & Rooth 1983 in connexion with the problem of treating conjunctions of predicates which call for functional or individual readings of their arguments, as in

(1.36) a. *The temperature is ninety and rising.*

b. *The president is a Republican now, but changes next week.*

In either of these examples the second of the conjoined predicates interprets the subject as denoting a function (a physical magnitude or a civil office) and the first interprets it as denoting the current value of this function (a numeric value or an individual, respectively). The conjunction takes place at the lowest matching types, implying the insertion of corresponding type-converting operations.

In the present theory a parallel mechanism is needed to account for cases of conjunction of predicates which require their shared arguments to be treated as belonging to different types. Consider:

(1.37) *The girls met at breakfast and were wearing their golden earrings.*

a. $(\lambda x[M(x) \wedge {}^{*}W(x)])(g)$

b. $M(g) \wedge {}^{*}W(g)$

Here M (*met at breakfast*) requires *the girls* to be translated as a group, while $^{*}W$ (*were wearing their golden earrings*) requires it to be interpreted as a sum over which the predicate can distribute. Consequently, regardless of the precise choice of g for the initial representation of *the girls*, after the transition from (1.37a) to (1.37b) one of the two predicates will not be directly applicable to g. The mechanism of lifting is aimed at dealing with this problem.

Lifting of predicates

If a predicate is to be applied to a term belonging to a higher type, prior to the application the type of the argument is lowered, or, using Landman's phrasing, the predicate ϕ is **lifted** to $\ell(\phi) = \lambda x[\phi(\text{LOWBR}(x))]$, where $\text{LOWBR}(x)$ converts x to a term of a lower type. This is warranted by the fact that nominal expressions in natural language often describe a structure which is not directly relevant to the interpretation (in other words, what is true for the complex structure is true for the flat sum), a regularity which Schwarzschild 1992 formulates as

(1.38) **The Upward Closure Phenomenon**: If a predicate [...] is true of a group G of first order, it has a homonym that is true of all higher order groups formed using all the members of G.

The nature of the conversion depends on the predicate ϕ, as follows:

(1.39) a. A singular predicate 'flattens' its argument x by converting it to $\uparrow\Downarrow\downarrow x$ (the group of the components of its elements), where the operator '$\Downarrow$' (written as '$\downarrow^2$' in Landman 1989) is defined by the condition $\Downarrow(\alpha \sqcup \beta) = \downarrow\alpha \sqcup \downarrow\beta$.

b. A plural predicate distributes over the parts of the argument, which is to say that it applies to $\downarrow x$.

Here 'singular' and 'plural' are interpreted relative to the argument whose higher type causes the lifting.

Thus it is possible to make the following statements about *the cards of the minor suits and the cards of the major suits*, a group of groups of playing cards $c^3 = \uparrow(\uparrow(\clubsuit \sqcup \diamondsuit) \sqcup \uparrow(\heartsuit \sqcup \spadesuit))$, where $\clubsuit^1$, $\diamondsuit^1$, $\heartsuit^1$ and $\spadesuit^1$ denote the sums of all cards of the corresponding suit:

(1.40) a. *The cards of the minor suits and the cards of the major suits are green.*
$\ell(\ell(^*G^1))(c) \equiv (\lambda x.^*G^1(\Downarrow\downarrow x))(c) \equiv {}^*G^1(\clubsuit \sqcup \diamondsuit \sqcup \heartsuit \sqcup \spadesuit)$

b. *The cards of the minor suits and the cards of the major suits form a deck.*
$\ell(F^2)(c) \equiv (\lambda x.F^2(\uparrow\Downarrow\downarrow x))(c) \equiv F^2\uparrow(\clubsuit \sqcup \diamondsuit \sqcup \heartsuit \sqcup \spadesuit)$

c. *The cards of the minor suits and the cards of the major suits are shuffled.*
$\ell(^*X^2)(c) \equiv (\lambda x.^*X(\downarrow x))(c) \equiv {}^*X^2(\uparrow(\clubsuit \sqcup \diamondsuit) \sqcup \uparrow(\heartsuit \sqcup \spadesuit))$

d. *The cards of the minor suits and the cards of the major suits are separated.*
$S^3(c) \equiv S^3\Big(\uparrow(\uparrow(\clubsuit \sqcup \diamondsuit) \sqcup \uparrow(\heartsuit \sqcup \spadesuit))\Big)$

In the first three cases the argument is converted to the appropriate type and structure by lifting the predicate in a way which follows directly from the type of the predicate. *Be green*, which is defined for single objects, is distributively applied to the sum of all cards (and hence to every individual card). *Form a deck*, which is defined for groups of single objects, is applied to the group of all cards. *Be shuffled*, which is also defined for groups of single objects, is distributively applied to the sum of the two groups of cards. *Be separated*, which is defined for groups of any type, is applied to the group of the two groups of cards.

In the battleships game lifting accounts for the possibility for spatial predicates to be applied to entities of types higher than the type of fields. For example, in

(1.41) *The boat* $\boxed{\text{a4}}$ *is in the left half of the board.*

the predicate L, *be in the left half of the board*, is lifted once:

(1.42) $$L(\boxed{\text{a4}}) \equiv (\ell(L))(\boxed{\text{a4}}) \equiv L(\downarrow\boxed{\text{a4}}) \equiv L(\underline{\text{a4}})$$

This allows the derivation of statements about the parts of singular entities, such as any of the four fields that constitute a cruiser:

(1.43) *The cruiser is in the right half of the board.*

$$^*R(\boxed{\text{f1–4}}) \equiv (\ell(^*R))(\boxed{\text{f1–4}}) \equiv {}^*R(\underline{\text{f1}} \sqcup \underline{\text{f2}} \sqcup \underline{\text{f3}} \sqcup \underline{\text{f4}}) \rightarrow R(\underline{\text{f3}})$$

Groups of ships and their characteristic predicates, such as *be four boats*, belong to type 3. Consequently, in

(1.44) *The four boats are in the left half of the board.*

the predicate $^*L$ is lifted twice (before and after being distributed).

(1.45)
$$\begin{aligned} ^*L(\uparrow(\boxed{\text{a1}} \sqcup \boxed{\text{a4}} \sqcup \boxed{\text{b6}} \sqcup \boxed{\text{d4}})) &\equiv \ell\Big(^*(\ell(L))\Big)(\uparrow(\boxed{\text{a1}} \sqcup \boxed{\text{a4}} \sqcup \boxed{\text{b6}} \sqcup \boxed{\text{d4}})) \\ &\equiv {}^*(\ell(L))\,(\boxed{\text{a1}} \sqcup \boxed{\text{a4}} \sqcup \boxed{\text{b6}} \sqcup \boxed{\text{d4}}) \\ &\equiv \ell(L)(\boxed{\text{a1}}) \wedge \ell(L)(\boxed{\text{a4}}) \wedge \ell(L)(\boxed{\text{b6}}) \wedge \ell(L)(\boxed{\text{d4}}) \\ &\equiv L(\underline{\text{a1}}) \wedge L(\underline{\text{a4}}) \wedge L(\underline{\text{b6}}) \wedge L(\underline{\text{d4}}) \end{aligned}$$

In example (1.37) above the type difference between M and W will lead directly to the conversion of the conjunction $\lambda x[M(x) \wedge {}^*W(x)]$ to $\lambda x[M(x) \wedge (\ell(^*W))(x)]$, where both conjoined predicates are of the same type.

Lifting of terms

If the predicate is defined for a type higher than the type of the argument, Landman allows for the argument, call it x, to be lifted (that is, to have its type raised) by being converted into the singleton group $\uparrow x$. I shall leave out this rule, which I find to be of more harm than help, for reasons which shall be exposed presently.

Consider again examples (1.2–1.3), partly repeated here as (1.46–1.47).

(1.46) a. ! *The horse gathers in the field.*

b. *The horses gather in the field.*

c. *The herd of horses gathers in the field.*

(1.47) a. ! *I counted the horse.*

b. *I counted the horses.*

c. *I counted the herd of horses.*

The sentences in (1.46a) and (1.47a) are unacceptable (except under generic interpretation) rather than simply false in all situations. A natural way to account for this is to assume that *gather in the field* and *count*, being predicates of type 2, require a group, while *the horse* belongs to type 1, and application is impossible in such circumstances. But if the option of lifting arguments exists, we are obliged to lift the object to a singleton group and assign a truth value to the sentence.

On the other hand, if *the horses* already belongs to type 2, as does *the herd of horses*, lifting the argument in the other two sentences in each group of examples is superfluous.

Consider also the following:[10]

(1.48) a. *The cards with blue backs and the cards with green backs are separated.*

b. *The cards up to six and the cards from seven up are separated.*

c. *The cards are separated.*

When interpreted as saying that the blue-backed cards are separated from the green-backed cards, example (1.48a) can be translated as

(1.49)
$$S_1^3\Big(\uparrow(\uparrow(\bigsqcup_{B^1(b)} b) \sqcup \uparrow(\bigsqcup_{G^1(g)} g))\Big)$$

with S standing for *be separated*, B for *be a blue-backed card* and G for *be a green-backed card*. Under this interpretation $S_1^m(z)$ is true if z is a group of type m, where $m \geq 2$, and the components of z (of which in this case there are two, the group of the blue-backed cards and the group of the green-backed cards) are separated from one another.

Example (1.48b), referring to the situation where the cards up to six are separated from the cards from seven up, yields a very similar structure.

(1.50)
$$S_1^3\Big(\uparrow(\uparrow(\bigsqcup_{r(x^1)\preceq 6} x) \sqcup \uparrow(\bigsqcup_{7\preceq r(y^1)} y))\Big)$$

Here $r(z)$ stands for 'the rank of z' and '$\preceq$' for the ordering of ranks within a suit.

In contrast, what (1.48c) is saying may be that all individual cards in the deck(s) are separated from one another, as in (1.51),

(1.51)
$$S_1^2\Big(\uparrow(\bigsqcup_{C^1(x)} x)\Big)$$

or it may have the sense of (1.48a) or (1.48b), if uttered by a player in order to state that the two decks, which have just been used for a game of rummy, are now ready for playing bridge, or that the deck is prepared for a game of belotte. There may also be an explicit indication of the partition in the sentence or elsewhere in the discourse.

(1.52) a. *The cards are separated by the colour of their backs.*

b. *The cards are separated by rank.*

The latter options are accounted for by a representation parallel to the one in (1.51), but with a different predicate translating *be separated*, namely, one defined so that $S_2(c_2)$ is true if the components of the group c_2 form, in some unspecified way, groups which are separated from one another. In other words, $S_2(c_2)$ is true if S_1 applies to some group c_1 of higher type, from which c_2 can be obtained by the flattening operation described in (1.39a).

(1.53)
$$S_2 = \lambda c_2 \exists c_1 [c_2 = \uparrow\Downarrow\downarrow c_1 \wedge S_1(c_1)]$$

Schwarzschild 1992 formulates the connexion between S_2 and S_1 as

[10]The discussion of examples similar to (1.48b) constitutes the key part of Landman 1989's argument for the introduction of groups into the theory of plurality. He observes that if the noun phrase which is the subject of that sentence is represented in the same way as the one in the corresponding position in (1.48a) or (1.48c), as it would be in a theory operating with sums alone (such as the original one of Link 1983), the information about the way in which the cards are separated, which is provided by the internal structure of the term and which sets the interpretations (1.49), (1.50) and (1.51) apart from one another, would be lost. He further shows, by means of similar examples, that the same phenomenon obtains at higher levels of grouping, which argues for the existence of groups of a theoretically infinite number of different types.

(1.54) **The Mereological Generalisation**: If a predicate [...] is true of a group G of any order, it has a homonym that is true of that first order group which is composed of the individuals used to generate G.

and notes that it appears to involve an operation converse to lifting of predicates. Indeed, from (1.53) it follows that $S_1(c) \rightarrow (\ell(S_2))(c)$.

But what does that say about the possibility to apply lifting of terms? Let us observe that in order to interpret (1.48c) in one of the abovementioned ways, or in any other way, the hearer uses information which is not present in the form of the noun phrase chosen by the speaker and which is not going to be recovered by lifting *the cards* to a type 3 group of one element.[11] Therefore there is nothing to be lost by allowing only the lifting of predicates, but not of arguments. I shall postulate instead that the application of a predicate to an argument of a lower type does not yield any truth value, reflecting the semantic ill-formedness of the corresponding sentences.

This decision has one important consequence. Since predicates can always convert their arguments into sums of a lower type for the purpose of distributing over their components, I shall postulate that no referents of noun phrases are ever introduced as sums of two or more elements. Instead, all nominal expressions introduce groups which, if necessary, are ungrouped by lifting the predicate.

1.1.5 Multiple pluralisation

Linguistic evidence suggests that, apart from referring to a single argument position, pluralisation must also be allowed to affect more than one argument position at a time (to affect a **termset**[12], a tuple of argument positions). Consider the examples:

(1.55) a. *The two hens saw two eggs.*

b. *The two hens laid two eggs.*

One of the possible interpretations of (1.55a) is that each of the two hens (call them h_1 and h_2) saw (each of) the two eggs (e_1 and e_2). If the predicate $S^{1,1}(x, y)$ (y *saw* x) is pluralised relative to both the seen and the seer ($S^{*1,*1}$), then it can be distributed over both arguments

[11]The fact that (1.48c) can be interpreted as (1.49) or (1.50), and each of (1.48a) and (1.48b) can have the interpretation intuitively assigned to the other, leads to the question whether it is justified to regard the interpretations (1.49) and (1.50) as directly derived from the corresponding examples and the sentences in (1.48a–1.48b) as ambiguous between a specific reading, in which the partition is the one indicated by the form of the noun phrase, and a general one, in which that is not necessarily the case.

Schwarzschild 1992 argues that there is not sufficient justification for this approach. In his view the listener always starts with the more general (1.53), of which all other interpretations are subcases (and which can be obtained from (1.48a–1.48b) by means of lifting), and then possibly uses the information provided by the construction of the noun phrase, along with information derived from prior discourse and extralinguistic knowledge, to choose the appropriate partition corresponding to c_1 in (1.53). This leads him to abandon the group approach altogether and to return to an ontologically simpler sums approach, in which the form of the noun phrase does not enter the formalisation directly, although the information contributed by it is considered at a subsequent stage, when the partition is reconstructed. He does not elaborate on the formal representation of this information, which seems to require a mechanism not unlike Landman's groups.

It appears to me that there is no harm in accepting the ambiguity described above. The status of the specific interpretation of (1.48a–1.48b) as a representation obtained directly from the sentence rather than a prominent subcase of the general interpretation will then explain why this interpretation is more directly available, unless there is some external evidence against it.

[12]The term **termset** is borrowed from the terminology of Lojban. To the best of my knowledge, it was introduced by John Cowan.

in a straightforward manner. The inference is presented below. (For simplicity's sake, tense is ignored at the present stage, and eventualities are not reified.)

$$(1.56)\quad \begin{aligned} & S^{1,1}(e_1,h_1) \wedge S^{1,1}(e_1,h_2) \wedge S^{1,1}(e_2,h_1) \wedge S^{1,1}(e_2,h_2) \\ \rightarrow\ & S^{*1,*1}(e_1 \sqcup e_2, h_1 \sqcup h_2) \\ \rightarrow\ & S^{*1,1}(e_1 \sqcup e_2, h_1) \wedge S^{*1,1}(e_1 \sqcup e_2, h_2) \end{aligned}$$

On the other hand, considering that a egg can only be laid once, and by a single hen (conditions whose formalisation shall be discussed in Section 3.2), the premises of the inference in (1.56) are invalid for (1.55b), as they also are for (1.55a) if the desired interpretation is the one where each hen saw one of the eggs. The correct interpretation will be obtained if the predicate $L^{1,1}(x,y)$ (y *laid* x) is pluralised relative to the **termset** of the layee and the layer, assuming the form $L^{*\langle 1,1\rangle}$. The inference is presented in (1.57).

$$(1.57)\quad \begin{aligned} L^{1,1}(e_1,h_1) \wedge L^{1,1}(e_2,h_2) \ \rightarrow\ & L^{*\langle 1,1\rangle}(\langle e_1,h_1\rangle \sqcup \langle e_2,h_2\rangle) \\ \rightarrow\ & L^{*\langle 1,1\rangle}(\langle e_1 \sqcup e_2, h_1 \sqcup h_2\rangle) \\ \rightarrow\ & L^{*\langle 1,1\rangle}(e_1 \sqcup e_2, h_1 \sqcup h_2) \end{aligned}$$

This implies that the operation of summation is extended to termsets in the intuitive way: the sum of two termsets is the termset of the sums.

$$(1.58)\quad \langle a_1,\ldots,a_n\rangle \sqcup \langle b_a,\ldots,b_n\rangle = \langle a_1 \sqcup b_1,\ldots,a_n \sqcup b_n\rangle$$

Rule (1.59) is a generalised reformulation of the cumulative rule (1.25). It is assumed that $\langle\theta\rangle \equiv \theta$, that is, a 1-tuple is identical to its unique element.

$$(1.59)\quad \begin{aligned} & \bigwedge_{l} \phi^{\ldots,m_k,{}^*m_{k+1},\ldots,{}^*m_n}(\ldots,x_k,x_{k+1,l},\ldots,x_{n,l}) \\ & \rightarrow \phi^{\ldots,m_k,{}^*\langle m_{k+1},\ldots,m_n\rangle}(\ldots,x_k,\textstyle\bigsqcup_l x_{k+1,l},\ldots,\bigsqcup_l x_{n,l}) \end{aligned}$$

We shall encounter multiple pluralisation again in Section 3.3.

1.2 The 'Real World'

Having made use of the example of the battleships game to illustrate some aspects of plurality, I shall now proceed to considering a number of issues which are particular to the more complex 'real world'. The scare quotes are due to the fact that a number of controversial matters will still have to be glossed over.

1.2.1 Mass terms

There is a syntactic and a semantic side to the parallelism between mass terms and plurals. Syntactically, the analogy materialises, e.g., in the use of the quantifier *all (the)* or the indefinite article ∅ as opposed to *a(n)* in English. In other languages the formal correspondence between mass terms and plurals can go even further. For example, in Lak (Žirkov 1955) plural forms of demonstrative pronouns are used with syntactically singular mass terms, as well as with their plural forms, which presumably refer to kinds or quantities:

(1.60)	Lak	singular	plural
	count term	*mu ḳili* '**that** saddle'	*mij ḳillu* '**those** saddles'
	mass term	*mij šin* '**that** water'	*mij šinnu* '**those** waters'

In Egyptian many abstract nouns are morphologically plural (*nfr.w* 'beauty', *ḫʿ.w* 'appearance; coronation, brightness'; *.w* is the masculine plural suffix), and mass terms are commonly written with the three strokes indicating plural number, even if they are morphologically singular (*ḥmꜣ.t* 'salt', *ỉrp* 'wine', *ḥ(n)ḳ.t* 'beer').[13] Examples from a number of other languages are offered in Ojeda 1993.

On the other hand, mass terms differ from plurals in their inability to cooccur with quantifiers such as *several* and explicit numerals. In addition, in Standard English they differ from count plurals in that they cooccur with *much* and *little* instead of *many* and *few*.[14] Jespersen 1924 reports that certain dialects of south-west England (e.g., the dialect of Dorset) go even further than that, referring to count terms by *he* (oblique *en*) and specifying them by the demonstratives *theäse* and *thik*, while reserving *it*, *this* and *that* for mass terms; thus, *theäse stwone* is a whole shapen rock, whereas *this stwone* is a lot of broken stone. Similarly, in the Danish spoken in Hanherred (Jutland) the distinction between common and neuter gender, which is largely arbitrary in the standard language, is given a regular expression by shifting count terms into the former and mass terms into the latter.

Semantically, the analogy between mass terms and plurals can be reduced to the property cumulative reference, which is shared by the two domains, as illustrated by the following classic examples, which I borrow from Link 1983:

(1.61) a. If the liquid in your glass is water and the liquid in my glass is water, then the liquid in the two glasses is water.

b. If the animals in this camp are horses and the animals in that camp are horses, then the animals in both camps are horses.

The difference is that the mass domain has no intuitive atomicity; there is no minimal amount of water corresponding to the single horse.

It is mass terms that present the most critical problem for extending the analogy of the battleships game to the real world. In that example the part of the board not taken up by ships *is water*, as is any subpart of it. In general an area of the board *is water* if and only if every field a_i of it, taken as an entity (i.e., as a group), *is water*. In this respect *be water* behaves as a plural predicate, and the notation can be made to reflect this.

$$(1.62)\quad \bigwedge_i W(a_i) \rightarrow {}^*W(\textstyle\bigsqcup_i a_i)$$

Here W translates *be a water field*, i.e., *be water* as defined for a single field of the board.

It is straightforward enough to identify the single vacant field of the chessboard as a minimal amount of water, given that it is the minimal entity which possesses the only characteristic property of water in that world. Natural science tells us that the minimal portion of water which has the properties of the substance is the molecule.[15] It is hardly satisfactory to analyse *water* as a semantic pluralisation of *water molecule*, however, since as a mass term *water* has exactly the same properties as terms denoting substances without such a convenient structure, e.g., *milk* (a water emulsion of several substances in a more or less fixed proportion) or *fruit*

[13] The evidence from scribal practice is not, of course, linguistic evidence in the strict sense of the expression, nor can its consistency be relied upon, but it seems relevant because, and to the extent to which, it reflects the scribes' intuitions about their native language.

[14] Ware 1989 brings up a few borderline cases of nouns which cooccur with *many* and *few* while being incompatible with explicit numerals, e.g., *tidings* or *clothes*.

[15] The extent to which the properties of water distribute down to the molecule can be a subject of debate. For example, the molecule is polarised, yet it is normal to think of water (the substance) as being electrically neutral; furthermore, it is not clear how the single molecule relates to the transparency of water or to its density.

cake (a stuff heterogeneous above the level of molecules). Furthermore, since language does not provide access to any 'water atom' (witness the ill-formedness of **three water* and the absence of a 'natural', context-free interpretation of *three waters*), any atomarisation of mass terms will necessarily rely on the recognition of an abstract entity for purely theoretical purposes.

Let us therefore adopt a slightly different approach (one based on mathematics rather than natural science) and begin by considering the organisation of space in the battleships game, as compared to the real world.

On the chessboard the elementary unit of space is the field; a group of such units may make up an area occupied by a ship or by water. In the real world space is a three-dimensional continuum of points. My proposal is to regard those points as being able to contain abstract amounts of matter, which will be referred to as **atoms** (entities of type 0, which have no proper parts and do not directly correspond to any linguistic expression). A group of atoms makes up a **thing** (an entity of type 1), which can be an individual thing or an amount of matter. The characteristic predicates of mass terms apply to sums of atoms, and by virtue of this are formally very close to the formalisations of plurals, which apply to sums of things. The properties shared by mass terms and plurals are expressed as properties of sums of any type, while the properties restricted to mass terms pertain to type 0, and the ones restricted to plurals (such as cooccurrence with explicit numerals) require a sum of type 1 or higher.

This allows us to apply the regularity in (1.62) to the real world, assuming that the summation is done over the infinite set of points enclosed in a given spatial area.

It is my opinion that this strategy serves better to emphasise the analogy between mass terms and plurals, and in Section 3.3 it will become evident that it is also advantageous because it offers an elegant account for the transfer of reference type.[16]

1.2.2 Portions of matter

In board games such as chess and battleships a field is commonly equated with the chessman – or a group of fields with the ship – occupying it; if <u>d1</u> is occupied by the white queen, $\boxed{\text{d1}}$ is used to refer to the white queen; if there is a tanker on <u>d–e6</u>, a tanker is what $\boxed{\text{d–e6}}$ is. This doesn't work any longer, however, as soon as colocal entities are taken into consideration. For example, on the chessboard two rooks of the same colour may form a battery, which has properties separate from theirs; it hasn't existed for as long a time as they have done (which, from the point of view of the game, is most likely since its beginning), and it may cease to exist while the player is still in possession of both rooks.

In the 'real world' cospatial entities are very frequently under consideration. A ring and the gold which constitutes it occupy exactly the same space, but they may have different and even contradictory properties. For one thing, the ring is certainly newer, probably significantly newer, than the gold. Furthermore, if the object is hammered or molten, the ring will be destroyed, whereas the gold won't be.

In order to deal with this problem, Grandy 1979 proposes that objects be analysed as relations between times and quantities of stuff.[17] Suppose a wedding ring is made of the same gold

[16] The uniform account for transfer of reference is the compensation obtained for the increase of theoretic complexity brought about by the introduction of a level of abstract atomic entities. Such entities are not assumed in non-atomic mass theories, including the original theories of Link 1983 and Landman 1989, where only concrete portions of matter are considered. Likewise, for Krifka 1991 cumulativity is a feature which mass terms share with plurals, but it does not make them plurals, even at an abstract level. In my account cumulativity follows directly from the representation of the predicate.

[17] Grandy's representation leaves open the possibility for the same thing to consist of different portions of matter at different times, as is the case with the sword carried by Aragorn (J R R Tolkien, *The Lord of the Rings*), which 'was broken and was made again', presumably using a different amount of iron the second time, but being

which was previously an Ottoman coin. Then the coin C relates an amount of gold g to the period t_C between its minting and its melting, while the ring R relates the same amount of gold g to the later period t_R from its molding onwards. The statements that gold g constitutes thing C and thing R at the corresponding times are expressed as $C(g, t_C)$ and $R(g, t_R)$, respectively. The coinhood of C and the ringhood of R are represented formally as second-level predicates.

(1.63) a. The coin C doesn't exist during t_R. $\neg\exists x[C(x, t_R)]$

b. The gold g is a ring during t_R. $\exists R[\mathcal{R}(R) \wedge R(g, t_R)]$

Note the correspondence between the indefinite determiner *a* in the English sentence in (1.63b) and the existential quantifier in the formal representation.

This makes *gold* a first-order and *ring* a second-order predicate. A difference in order must obtain accordingly between all predicates applying to the corresponding entities.

(1.64) a. The gold g is new. $N(g)$

b. The ring R is new. $\mathcal{N}(R)$

Here N and $\mathcal{N}$ are respectively the first-order and the second-order version of *be new*. In the view of Chellas 1979 this is a disadvantage, since the newness of the gold and the newness of the ring seem to be instances of the same concept. He is right in so far as we can compare the two, but it is not obvious that we can do so legitimately, since in fact the newness of the ring refers to the recency of the forming of its shape (a property which a stuff can't have) and the newness of the gold to the recency of its having been extracted from nature and made fit for use in art or industry. Consequently it is only the newness of the gold, not of the ring, that distributes to all of its parts.

In the present theory the difference in order between the predicates *be gold* and *be a ring* and the associated versions of *be new*, which is postulated in Grandy's account, corresponds to a difference in type. Compare:

(1.65) a. The thing x is gold. ${}^{+}G^{0}(\downarrow x^{1})$

b. The thing x is a ring. $R^{1}(x^{1})$

(1.66) a. The gold g is new. ${}^{+}N^{0}(\downarrow g^{1})$

b. The ring r is new. $N^{1}(r^{1})$

Whether two levels are sufficient depends on one's interpretation of the relation *consists of*. Bach 1986 draws attention to the fact that a stuff may make up another stuff, as water makes up snow (or ice). Furthermore, stuffs may be put together to form an alloy or solution: apart from water, snow also contains air, hydrogen and oxygen atoms make up water, bronze consists of copper and tin.

Since only mass terms are involved in these cases, however, they refer to different relations (i.e., different kinds of constitution), from the point of view of both ontology (since the type

recognised as unequivocally the same sword (thus $S(i_1, t_1) \wedge S(i_2, t_2)$, where $i_1 \neq i_2$, in Grandy's notation). Consider also the Tin Woodman (L Frank Baum, *The Wizard of Oz*), whose entire body was cut off, limb by limb, and made again from tin, somehow preserving the identity of the whole in the process. This may look like a far-fetched example, but in fact it only differs from the constant update of the matter which makes up any living organism in that the latter happens gradually.

Such cases can be subject to ambivalent judgements. The discussion in Burge 1979 of a steel engine whose parts are taken out one by one and replaced by aluminium ones leads to the conclusion that *This engine was once steel, but is now aluminium* is less felicitous if the steel parts have been assembled into the same configuration in the meantime, so that there are two candidates for the designation *this engine*.

of the predicate is not raised) and natural science (since they appeal to different physical or chemical phenomena). In my opinion those relations should be kept separate from one another and from the relation of constitution which connects a mass term to a count term.[18]

1.3 Grinding and Packaging

1.3.1 Grinding

As Pelletier 1979′ observes, masshood is a property which can be acquired by a nominal expression in appropriate context; to use the terminology employed by Bach 1986 and based on Pelletier's 'Universal Grinder' (attributed to David Lewis), a count term can undergo **grinding** into a mass term. For example, although *apple* is normally a count noun, and is used as such in examples (1.67a), in (1.67b) it has the features of a mass noun:

(1.67) a. (I) *There is an apple on the table.*
(II) *There are two apples on the table.*
b. *There is apple in the salad.*

Despite Pelletier 1979″'s statement that 'there can be made a *prima facie* case that nothing is immune from the grinder treatment', it can be shown that the universality of the Universal Grinder is subject to certain limitations. Some examples offered by Ware 1989 include *hole*, *opening* and *mouth*, with which the Grinder would have a hard time, since there is no grindable matter in them. Collective nouns, such as *herd*, *team*, *department* or *parliament*, are also difficult to grind.

(1.68) a. ! *Much flock was slaughtered for the feast.*
b. ! *The conference hall was full of committee.*

But there are many individual physical entities which are no less problematic. The Grinder would grind an apple into apple and a rabbit into rabbit (though in common usage such mass terms often refer to the stuff making up a particular, paragmatically determined part of the countable thing; the core of an apple is not normally considered apple, and rabbit is the flesh or the fur of rabbits, depending on whether one is talking cooking or furriery). But it would grind a chair into sawdust (or wood, or oak, ebony or whatever other kind of wood furniture can be made of), not into chair, and if it is operating properly, it would grind a table into indistinguishable sawdust. It wouldn't grind a ring into ring; it would grind it into copper, silver, gold or whatever else it happens to be made of. We can conclude that the ease with which *apple* is used as a mass term has to do with the fact that the apple is the only natural object consisting of apple, whereas a ring owes its ringhood solely to its shape. This restriction affects all nouns which refer to entities for which configuration is significant.

Still, the productivity of grinding can't be doubted, and it becomes even more pervasive if we consider that a mass term need not denote a physically homogeneous mass. Many a mass term refers to a non-individuated plurality of things. In this sense chairs and tables can be

[18] It must be noted that the types assigned to the various forms and states of existence of matter are not fixed in the theory, and in each particular context they can be chosen so as to accommodate as many levels of grouping as need to be accounted for. It follows that it is possible, if necessary, to assign different types to atoms, molecules and principle phases of matter, thus acknowledging the fact that ice crystals in general, and snowflakes in particular, have more structure than hydrogen dioxide, which in turn has more structure than the hydrogen and oxygen atoms, and consequently translating *be snow* as a plural predicate of a type higher than 0.

'ground' into furniture, which is not the same thing as wood, or shoes and boots into footwear, which again is different from leather.

Let us move on to the formal representation of grinding. For any predicate ϕ Link 1983 introduces its **mass term correspondent** ${}^{m}\phi$, which holds for all portions of matter constituting part of an entity for which ${}^{*}\phi$ holds; e.g., if P is *be an apple*, ${}^{m}P$ is *be apple [matter]*. He also defines corresponding mass term versions of the part relation and the summation operation.

In (1.69) D is the set of individual portions of matter and h is the semilattice homomorphism which grinds every individual into the portion of matter constituting it.

$$\forall p \forall \phi [{}^{m}\phi(p) \leftrightarrow p \in D \wedge p \sqsubseteq \bigsqcup_{\phi(x)} h(x)] \tag{1.69}$$

My strategy will be based on the approach of Subsection 1.2.1. I shall write ${}^{\prime}P$ for *be an apple atom*. (Here 'atom' must not be understood in the sense in which it is used in natural science, as we are talking not just of a minimal, but of a *dimensionless* amount of apple matter, that is, an amount fitting into a point in space—obviously an abstract entity, to which language provides no direct access, just as it provides no access to the 'water atoms' discussed in that subsection.) The **atomisation** operator '′' converts a predicate ϕ into the predicate ${}^{\prime}\phi$, which holds just for the atoms belonging to elements of the extension of ϕ.

$$[\![{}^{\prime}\phi]\!] = \{\, \alpha \mid \alpha \in A \wedge \alpha \in^{*} [\![\phi]\!] \,\} \tag{1.70}$$

(Here A is the set of atoms in the model and $\in^{*}$ the transitive closure of the membership relation.) Accordingly ${}^{+\prime}P$ means *be apple [matter]*.

$$\textsc{grnd}(\phi) = {}^{+\prime}\phi \tag{1.71}$$

Bach 1986 makes the point that no entity to which ϕ applies need actually exist. As noted in his discussion of what he calls the **partitive puzzle**, the principle 'no apples—no apple' (i.e., if there were no apples in nature, none could be ground, and consequently the mass term *apple* could not have the meaning attributed to it here, derived from the one of the count term *apple*), which seems to follow from (1.69), does not hold: a quantity of matter synthesised in a laboratory may qualify for applehood without ever having been part of an apple. This is even more obvious with respect to concrete or abstract artifacts.

(1.72) a. *This is part of a paper on natural language metaphysics.*
b. *We found part of a Roman aqueduct.*

It is crucial, however, that the paper be at least conceived as existing in the future; no amount of text is part of a paper unless there is intention for it to be included into one. Similarly, the aqueduct must have existed at least in the minds of the Roman engineers and construction workers, even though their effort may, as Bach puts it, have been interrupted by an invasion of hordes of barbarians from the north. And although apple need not come from apples, the concept of it does, otherwise it would not be referred to by a ground count term. The refutation of 'no apples—no apple' merely shifts the meaning of *apple* from 'stuff that apples consist of' to 'stuff empirically indistinguishable from the one that apples consist of'.

The grinding of count terms is not normally indicated in the morphology of English. Consequently, the conversion for them follows the diagram in Figure 1.2.

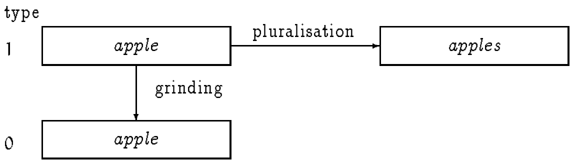

Figure 1.2: Grinding and pluralisation in English.

1.3.2 Packaging

The operation opposite to grinding, i.e., the conversion of mass into count terms, is called **packaging** by Bach 1986, who notes that packaging, unlike grinding, is polyvalent, since there are infinitely many ways to package a certain kind of matter, and among them not infrequently there is more than one which is of linguistic relevance. For example, *a beer* can refer to a sort of beer or to a conventional amount (a standard glass or bottle) of beer. Similarly, *a sugar*, apart from a kind of sugar, can denote a quantity ranging from a cube or sachet to a single molecule, depending on the setting being a tea table or research in organic chemistry, and in the context of shopping it may acquire the additional meaning of a standard (e.g., kilogramme) package of sugar.

In light of the conventions regarding the treatment of mass terms, the primary mass predicate *be* ϕ is to be represented as $^*\phi^0$, and then the outcome of the packaging, *be a [specific] quantity (portion, piece) of* ϕ, is formally represented as in (1.73),

(1.73) $$\textsc{pack}_{\mathcal{Q}}(^*\phi) = \lambda x[^*\phi^0(x) \wedge \mathcal{Q}^1_\phi(x)]$$

where $\mathcal{Q}^1_\phi$ symbolically represents the conditions set on the quantity or the physical integrity (i.e., the spatial continuity) of the entity or on its constituting a subkind of ϕ.

The packaging of mass terms into names of kind and names of standard unit is not normally indicated in the morphology in English, cf. *beer* and *sugar* above, and the same is true for many other languages. None the less, the conversion can be established by syntactic tests, such as pluralisation or the presence of the indefinite article *a* in English. In the Welsh sentences in (1.74) the morphologically singular noun *cwrw* 'beer' can be recognised as a mass or a count term by its cooccurrence with the mass quantifier *peth* or the count quantifier *rhai*, both of which correspond to *some* in English.[19]

(1.74) Welsh

a. *Mae peth cwrw yn well na dim.*
is some (MASS) beer in better than none
'Some beer is better than none.'

b. *Mae rhai chwrw yn well na'i gilydd.*
is some (COUNT) beer in better than others
'Some beers are better than others.'

The usual explicit construction for naming both standard and non-standard quantities of stuff in English is the one represented in (1.75),

[19] The mutation of *cwrw* to *chwrw* after *rhai* is morphonologically determined, and is not related to the change in reference type.

(1.75) μ *of* $^*\phi$: $\textsc{pack}_{\mathcal{Q}_\mu}(^*\phi) = \lambda x[^*\phi^0(x) \wedge \mathcal{Q}^1_{\mu,\phi}(x)]$

a special case of (1.73), where the quantity (and possibly also the shape) $\mathcal{Q}_{\mu,\phi}$ is expressed by the head noun.[20] For example, a *pound of sugar* is sugar and has to weigh 0.454kg; on the other hand, on its physical integrity and shape no conditions are set. A *cube of sugar* is also sugar; the conditions set on its quantity are less strict, but it must be a single physical entity, whose shape, and to a certain extent its size, are determined by its cubehood, though in a stuff-specific manner.

In some languages there is a more or less productive derivational strategy associated with this process. In Russian, for example, the suffixes *-in-a* and *-ink-a* form count nouns denoting individual entities pertaining to a stuff, a homogeneous collection or a pair.

(1.76) Russian

name of class		name of unit (*-in-a*)		name of unit (*-ink-a*)	
žemčug	'pearls'	*žemčužina*	'pearl'		
štany	'trousers'	*štanina*	'trouser-leg'		
lëd	'ice'	*l'dina*	'ice-floe'	*l'dinka*	'piece of ice'
soloma	'straw'	*solomina*	'(a) straw'	*solominka*	'(a) straw'
rosa	'dew'			*rosinka*	'drop of dew'
čaj	'tea'			*čainka*	'tea-leaf'

The second of these suffixes is in fact a composition of the first and the feminine diminutive suffix *-k-*. The presence of *-k-* is obligatory with some stems ('tea-leaf' is never **čaina*), and if it is not, as it is often the case with diminutives, it may or may not alter the kind of thing referred to (a *l'dina* is normally a block of ice floating in the Arctic Ocean, say, while a *l'dinka* can be any odd ice crystal; on the other hand, a *žemčužina* is simply a pearl of small size). Occasionally the diminutive alone serves the same purpose; in those cases it could be said that the size specification is preceded by an implicit packaging operation.

(1.77) Russian

name of class		name of unit	
karamel'	'caramels, toffee'	*karamel'ka*	'caramel, toffee sweet'
morkov'	'carrots'	*morkovka*	'carrot'
bumaga	'paper'	*bumažka*	'strip of paper, document, banknote'
šokolad	'chocolate'	*šokoladka*	'chocolate bar'

All names of unit form plurals, and so do some names of class; the plurals of the former denote a plurality of units and plurals of the latter a plurality of kinds.

(1.78)

Russian	name of class		name of unit	
singular	*trava*	'grass'	*travinka*	'blade of grass'
plural	*travy*	'herbs'	*travinki*	'blades of grass'
singular	*pyl'*	'dust'	*pylinka*	'speck of dust'
plural	——		*pylinki*	'specks of dust'

These examples show that, instead of one, Russian has *two* standard lexical packaging operations, only one of which has an overt realisation in the morphology. The relevant part of the conversion network is presented in Figure 1.3.

[20] A consequence of this view is that in the present theory the predicates *sugar* and *pound of sugar* apply to different entities and belong to different types.

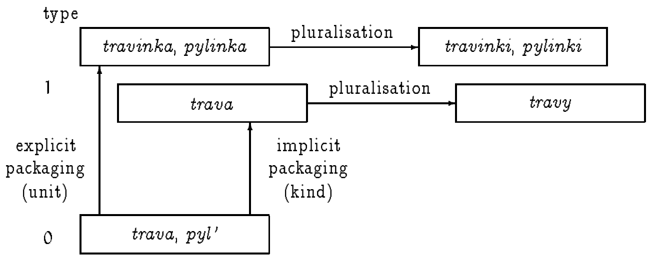

Figure 1.3: Packaging and pluralisation in Russian.

The process of formation of names of unit is even more productive in the Brythonic branch of the Celtic languages, which part ways with the rest of the Indo-European family, including the Goidelic branch of the same group, in their treatment of class nouns denoting things typically found in collections. In Welsh (Jones & Thomas 1977) from such a name of class there can be derived, by means of one of the suffixes *-yn* and *-en*, a name of unit, for which the term **singulative** has been introduced by Zeuss 1871. The only difference between the two singulative suffixes is that the nouns formed with *-yn* are masculine and the ones formed with *-en* are feminine. Semantically the two singulatives are equivalent, and either one or the other is formed from a given class noun, although exceptionally there may be two singulatives with different meaning corresponding to the same class noun, as in the case of *coed* 'wood; trees' (in the bottom row of the table); the semantic difference, however, is idiosyncratic.

(1.79) Welsh

name of class		name of unit (*-yn*)		name of class		name of unit (*-en*)	
adar	'birds'	*aderyn*	'bird'	*sêr*	'stars'	*seren*	'star'
pysgod	'fish (pl.)'	*pysgodyn*	'(a) fish'	*brics*	'bricks'	*bricsen*	'brick'
caws	'cheese'	*cosyn*	'(a) cheese'	*pys*	'peas'	*pysen*	'pea'
grawn	'grain'	*gronyn*	'(a) grain'	*ŷd*	'corn'	*yden*	'grain of corn'
coed	'wood; trees'	*coedyn*	'log, stick'		⟶	*coeden*	'tree'

There are a few mass nouns among the English counterparts in the columns containing the class nouns. In all cases it is the name of class which is used to denote the outcome of grinding: e.g., *pysgod* 'fish (pl.)' also has the meaning 'fish matter'.

The generalisation is captured by translating *pysgod* as $^*\mathrm{F}^0(x)$. It is lifted once when applied to a thing (an entity of type 1) and twice when applied to a group of things (an entity of type 2). The singulative *pysgodyn* '(a) fish' could be interpreted as 'a quantity of fish (property of the stuff) such that it constitutes a natural object (property of the thing)'.

$$\textsc{pack}_{\mathcal{Q}}(^*\mathrm{F}) = \lambda x[^*\mathrm{F}^0(x) \wedge \mathcal{Q}^1_{\mathrm{F}}(x)] \tag{1.80}$$

Note that grinding for count terms is unmarked, as it is in English (Figure 1.2); cf. *afal* 'apple (matter)', pl. *afalau* 'apples'.

Unlike their Russian counterparts, in Welsh names of class are grammatically plural (serving as antecedents for plural anaphora). Compare:

(1.81) Welsh

a. (I) *Lle mae'r* ***afal? — Mae o*** *ar y bwrdd.*
where is the apple is he on the table
'Where is the **apple**?—**It's** on the table.'

(II) *Lle mae'r* ***afalau? — Maen nhw*** *ar y bwrdd.*
where are the apples are they on the table
'Where are the **apples**?—**They're** on the table.'

b. (I) *Lle mae'r* ***adar? — Maen nhw*** *ar y wal.*
where are the birds are they on the wall
'Where are the **birds**?—**They're** on the wall.'

(II) *Lle mae'r* ***aderyn? — Mae o*** *ar y wal.*
where is the bird is he on the wall
'Where is the **bird**?—**It's** on the wall.'

Traditional grammars or Welsh and of other Brythonic languages often consider the singulative and the class noun to be the singular and the plural members of the same nominal paradigm. There are two reasons to consider this less than fully adequate. First, the class noun can be used as a count noun denoting a kind (or sometimes an amount other than the canonical one, which is the domain of the singulative) without any morphological indication. Some class nouns can even be morphologically pluralised, as if they were singular terms: *ydau* 'sorts of barley', *gweiriau* 'sorts/lots of hay' (class form *gwair* 'hay', singulative *gweiryn* 'blade of hay'). Second, the singulative also can often be pluralised, as if it were a primary singular: *cosynnau* 'cheeses', *gronynnau* 'grains', *dalennau* 'leaves (of a book), pages'.

The existence of such forms as *ydau* and *gronynnau* identifies the formation of the Welsh singulative as a derivational process akin to the one operating in Russian. There are two differences, however: first, in Welsh this process is morphologically more regular and significantly more productive; and second, the formation of the plural of the Welsh singulative, while still sometimes possible, is strongly limited by the syntactic (though not morphological) plurality of the class noun. The relevant part of the conversion network is presented in Figure 1.4.

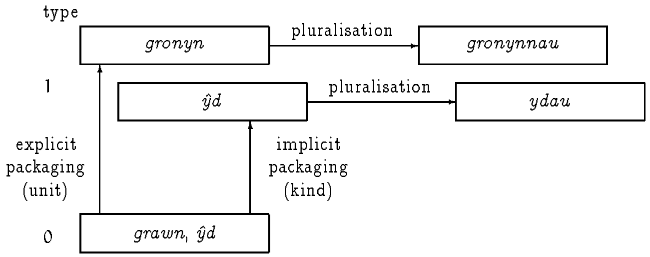

Figure 1.4: Packaging and pluralisation in Welsh.

More complex operations involving packaging can also be found in some languages. For instance, the derivational mechanism illustrated in the Chukchi examples (1.82), where the suffix *-t'ul* forms lexical items denoting a piece of a homogeneous thing (and, by extension, a piece of the edible part of an animal), can be interpreted as a composition of grinding and subsequent packaging (Skorik 1977).

(1.82) $\boxed{\text{Chukchi}}$

$$\textsc{pack}_{\mathcal{Q}}(\textsc{grnd}(\phi)) = \lambda x[{}^{*\prime}\phi^{0}(x) \wedge \mathcal{Q}^{1}_{\phi}(x)]$$

ṅilg-yn	'belt'	*ṅilg-y-t'ul*	'piece of a belt'
uttuut	'wood'	*utt-y-t'ul*	'piece of wood'
tekicg-yn	'meat'	*tekicg-y-t'ul*	'piece of meat'
r'ew	'whale'	*r'ew-y-t'ul*	'piece of whale meat'

The suffix *-stück* in German serves a very similar purpose.

Count terms can also be packaged into **collectives**, which deserve attention for their resistance to grinding (cf. examples (1.68) above) and some other properties correlated with the fact that the type of the corresponding predicates is greater than or equal to 2. In Egyptian collectives, like mass nouns, are written with the three strokes of plurality, regardless of their grammatical number (*mnmn.t* 'herd', pl. *mnmn.wt* 'herds'). In British English many collective nouns can trigger plural agreement and serve as antecedents for plural anaphora. The latter phenomenon is also observed in Welsh (Jones & Thomas 1977):

(1.83) $\boxed{\text{Welsh}}$

— ***Beth mae'r llywodraeth yn mynd i wneud?***
what is the government in go to do

— ***Maen nhw 'n mynd i godi trethi.***
are they in go to raise taxes

'What's the **government** going to do?—**They're** going to raise taxes.'

Neither English nor Welsh have productive processes of collective noun formation, but such derivational techniques are found in other languages, such as Chukchi (Skorik 1977)[21], Eskimo (Menovščikov 1967) and Basque (Saltarelli & Azkarate 1988).

(1.84) $\boxed{\text{Chukchi}}$

singular		collective	
ṅinqej	'boy'	*ṅinqej-y-mk-in*	'small group of boys'
i'g-yn	'wolf'	*i'g-y-mk-in*	'small pack of wolves'
nymnym	'village'	*nym-y-tkun*	'a few scattered villages'
jara-ṅy	'house'	*jara-tkon*	'a few scattered houses'
lele-lgyn	'glove'	*lili-ret*	'pair of gloves'
y'tt'-yn	'dog'	*y'tt'-y-ret*	'harness of dogs'
kejṅ-yn	'brown bear'	*kejṅ-y-giniw*	'many brown bears'
jara-ṅy	'house'	*jara-genew*	'multitude of houses'

(1.85) $\boxed{\text{Eskimo}}$

singular		collective	
ju-k	'man'	*ju-gjak*, *ju-lġun*	'group of men'
qawa-k	'bird'	*qawa-gjak*, *qawa-lġun*	'flock of birds'
tuṅtu	'wild deer'	*tuṅtu-gjak*, *tuṅtu-lġun*	'herd of wild deer'
aṅja-q	'boat'	*aṅja-gjak*, *aṅja-lġun*	'group of boats'

[21] The alternations *-tkun*/*-tkon* and *-giniw*/*-genew* in Chukchi are phonologically predictable.

(1.86) $\boxed{\text{Basque}}$

singular		collective	
ardi	'sheep'	*ar-talde*	'flock of sheep'
gizon	'man'	*giza-talde*	'group of men'
jende	'person'	*jende-tza*	'multitude of people'
diru	'money'	*diru-tza*	'tonne of money, treasure'

The parallel between the two kinds of packaging, the one operating on mass terms and the one operating on plural count terms, is evident from the comparison of (1.73) and the formal representation of collectives in (1.87),

(1.87)
$$\textsc{pack}_{\mathcal{Q}}({}^{*}\phi) = \lambda x[{}^{*}\phi^{1}(x) \wedge \mathcal{Q}^{2}_{\phi}(x)]$$

where $\mathcal{Q}^{2}_{\phi}$ symbolically represents the conditions set on the quantity ('a few', 'a standard number of', 'a full set of', 'many') or the organisational integrity of the entity.

A trivial instance of a collective is a **definite** plural or mass term, referring to the entire quantity of stuff (for a mass term) or all individual entities of the corresponding kind (for a count term) present in the situation. Making use of Link 1983's translation of the English definite determiner

(1.88) *the*: $\lambda Q \lambda P \exists y \big[Q(y) \wedge \forall x[Q(x) \to x \sqsubseteq y] \wedge P(y)\big]$

and defining $\mathcal{Q}_{\phi}$ as $\lambda y \forall x[{}^{*}\phi(x) \to x \sqsubseteq {\downarrow} y]$, a representation for definite terms in the present theory is derived.

(1.89) *the* ${}^{*}\phi$: $\lambda y[y = {\uparrow} \bigsqcup_{{}^{*}\phi(x)} x]$

Another trivial case is that of **specific indefinites**, such as are marked by the quantifiers *some* or *several* in English and which indicate that the speaker knows the quantity to be low, but can not or will not specify it further.

1.3.3 Representative pluralisation

A final operation on count terms which I shall consider in detail in this section is the formation of **representative plurals** (also called **cohort** or **associative plurals**), a category of very broad areal and genetic distribution across languages.[22] Representative plurals share with collectives the property of mapping a count term to a term denoting a group whose elements are united by some relation, but they differ in that the count term only designates *one* of the components of the group, normally one which is singled out as a pivot. As a rule, their formation is restricted to proper names of human or anthropomorphised beings (or phrases used as such), kinship terms or social or professional titles, treated in all cases as definite descriptions, and their denotation is the group consisting of the person named and his relatives and/or permanent or temporary associates.[23] The size of the group may be restricted, yielding subcategories such as **representative dual**.

[22] The data and the formulation of part of the empirical observations in this passage are drawn from Edith Moravcsik's summary of the responses to her query on representative plurals posted on the LINGUIST subscription list on 5 April 1994.

[23] The semantic pattern of this category is shared by the non-singular personal pronouns for the first and second person, which are representative plurals of the corresponding singular pronouns; *we* and *ye* mean respectively 'I and the others' and (at least in most cases) 'thou and the others'. In some languages, for example in Winnebago and Sierra Populuca, a similar relation obtains between the plural and dual first person inclusive pronoun, i.e., 'I+thou and the others' as opposed to 'I+thou' (Forchheimer 1953).

Several different strategies for the realisation of representative pluralisation are found in natural languages, including regular or exceptional non-singular (plural or dual) marking. Some examples of these strategies follow.

(1.90) Kalispel (Vogt 1940) *uł- sınčı̣ḷé*
PL coyote
'the coyotes; the coyote and his people/friend(s)/son(s)'

(1.91) Turkish

a. *kardeş -im -ler* 'my brother and his family'
sibling 1SG.POSS PL

b. *kardeş -ler -im* 'my brothers'
sibling PL 1SG.POSS

(1.92) Japanese

a. *sensei -tachi*
teacher PL
'(the) teachers; the teacher and his colleagues or friends'

b. *watakushi -tachi*
I PL
'we (i.e., I and the others)'

Less frequently a collective noun is appended to the pivot, as in some English-based creoles and pidgins (Australian Aboriginal English *Bill-mob* '[the mob (i.e., the group) consisting of] Bill and his associates'; Hawai'ian Pidgin English *Bill-folk* 'Bill and his folk'), or the subject noun itself does not acquire any overt marking, and the conversion is indicated merely by non-singular agreement carried by the verb.

(1.93) Gurindji *Bill ngu -wula yani.*
AUX 3DL went
'Bill and someone else went.'

Such cases of implicit representative pluralisation are effectively cases of grammaticised synecdoche, lying halfway between the domains of semantics and stylistics.

A formal representation for the most general case of a representative plural formed from the predicate ϕ is offered in (1.94).

(1.94) $$\lambda x[x = \uparrow \bigsqcup_{^*(\lambda i[\phi(i) \vee \exists j[\phi(j) \wedge \psi(j,i)]])(i)} i \wedge \mathcal{Q}_\phi(x)]$$

Here the predicate applied to the individual elements of the sum from which the group x is formed can be informally interpreted as 'ϕ or a ψ of ϕ', with $\psi(j,i)$ standing for a vaguely defined relation such as 'i is a relative/companion of j'; this relation is never overtly expressed in the construction, and its precise interpretation varies depending on the language, the construction chosen (where there is more than one) and the predicate ϕ. The condition $\mathcal{Q}_\phi(x)$ represents any restrictions on the size of the whole group x.

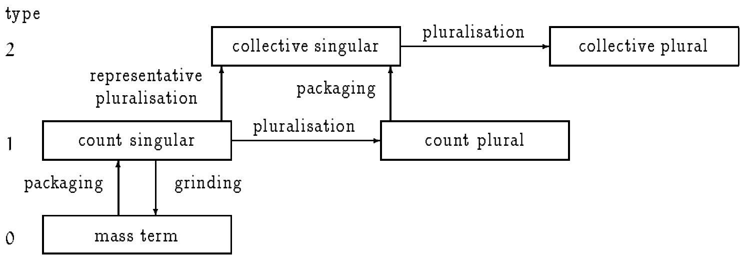

Figure 1.5: Conversion of types of nominal reference.

1.3.4 A transition network

For ease of observation, the conversions discussed in this section are presented in Figure 1.5 in the form of a transition network. The possibility for collectives to be further packaged, yielding terms of types higher than 2, is not reflected in the diagram; when explored, it follows the pattern of the upper two rows. It must be noted that although collectives (other than representative plurals) are semantically formed from plurals, as shown in (1.87) and indicated by the corresponding arrow in the diagram, in the morphology it is usual for them to be formed directly from the nominal stem, not from a form inflected for plural number.

It can be seen that the network constitutes a chain consisting of triangular links of the type displayed in Figure 1.6.

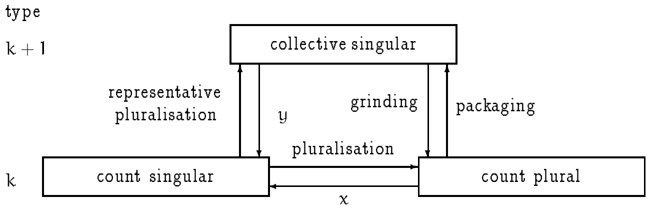

Figure 1.6: The triangular nucleus on which the network in Figure 1.5 is based.

In principle a transition is possible from every node of the nucleus to either of the two others, but a comparison between the diagrams in Figure 1.5 and Figure 1.6 shows that the actually occurring transitions are subject to a number of restrictions. In particular, singular count terms of type 0 are not normally formed, since their denotations would be are the abstract atoms introduced in the present theory. Also, count terms of type 2 and higher are not normally ground, as shown by examples (1.68).

The arrow marked with x corresponds to an operation which could be called **singularisation**. Where it occurs, it affects ordinary plurals rather than proper ones.

(1.95) $$\textsc{sing}(^*\phi) = \lambda x[^*\phi(x) \wedge |[\![x]\!]| = 1]$$

The Basque definite singular, formed from an indefinite general plural (*jende-a* 'the person' from *jende* 'a person; people', cf. the definite (proper) plural *jende-ak* 'the people'), can be regarded as an example of singularisation. On the other hand, the formation of singulatives, as I argued above, is more appropriately treated as a case of packaging.

The arrow marked with ɥ corresponds to selecting the most prominent member of a group, the converse operation to representative pluralisation (another form of synecdoche).

1.4 Number in Arabic

For some additional illustration of the conversion processes and their formal treatment in the present theory we shall now look briefly at the number system and the status of count and mass terms in Arabic.

The nominal morphology of Classical Arabic is characterised by a uniquely sophisticated category of number, in which several different kinds and levels of pluralisation are distinguished. This system is preserved to varying degrees in the Arabic vernaculars of the present day, as well as in Standard Maltese.

1.4.1 Singulatives

One of the most characteristic features of the Arabic number system is the formation of singulatives. The addition of the feminine suffix *-at̂-* to a mass noun (which is nearly always masculine) yields a category which traditional grammar knows under the Latin term ***nomen unitatis vel individualitatis***—a singulative, which denotes a specific subkind or a specific quantity of the stuff:

(1.96)

name of class		name of unit	
ḏahab	'gold'	*ḏahabat̂*	'nugget, lump of gold'
ḫašab	'wood, lumber, timber'	*ḫašabat̂*	'piece of wood, timber; pale, post; plank, board'
laħm	'meat'	*laħmat̂*	'dish of meat'
ǧubn	'cheese'	*ǧubnat̂*	'portion of cheese'

If the primary noun indicates a kind or collection of things (normally corresponding to an English plural), the *nomen unitatis* refers to an individual member of it:

(1.97)

name of class		name of unit	
naħl	'bees'	*naħlat̂*	'bee'
'akam	'hills, mounds'	*'akamat̂*	'hill, mound'
ḫaĭm	'tents, booths'	*ḫaĭmat̂*	'tent, booth'

Not infrequently the primary noun denotes both a collection and a stuff. An example is *daǧāǧ* 'chickens; fowl (as a generic designation); chicken flesh', whose singulative *daǧāǧat̂* is accordingly ambiguous between 'hen, chicken' and 'portion of chicken meat', two subcases of the more general interpretation 'a quantity of chicken (property of the stuff) such that it constitutes a natural object or a conventionally determined amount (property of the thing)'. The treatment proposed for the Welsh noun *pysgod* 'fish', formulated in (1.80), is also applicable to this case,

(1.98) $$\textsc{pack}_{\mathcal{Q}}(^*C) = \lambda x[^*C^0(x) \wedge \mathcal{Q}^1_C(x)]$$

except that here there are two ways in which the predicate can be quantised and hence two possible ways for the condition $\mathcal{Q}^1_C(x)$ to be satisfied.

If the suffix *-at̂-* is added to an action nominal (also referred to by the Arabic term ***maṣdar***) which denotes a process, the result is the so-called ***nomen vicis***, denoting a single event of the relevant kind, as a refreshing exception from Croft 1991's general observation that action nominals tend to lack number inflexions:

(1.99)

name of class		name of unit	
'akl	'eating'	*'aklat̂*	'meal'
ḍarb	'striking'	*ḍarbat̂*	'stroke'

1.4.2 Dual and plural

From a count noun there can be formed a **dual** by adding the dual suffix *-ā(ni)/-aĭ(ni)* to the stem, after the feminine suffix if there is one. From many count nouns there can also be formed a **sound plural** by adding the plural suffix *-ū(na)/-ī(na)* (masculine) or *-āt-* (feminine) to the stem.

The dual denotes two individuals (kinds, quantities); its use is, however, not obligatory unless emphasis must be placed on the number 2. The following examples from Cowell 1964, also quoted by Ojeda 1992, illustrate the distinction between the dual and the plural in those cases in which the number 2 must not be excluded:

(1.100) Syrian Arabic

a. (I) *ᶜando banāt bass*
at him daughters-PL only
'He has only daughters.' (Not necessarily more than two; but no sons.)

(II) *ᶜando băntān bass*
at him daughters-DL only
'He has only *two* daughters.' (No more than two.)

b. (I) *lmanṭo dayye' ᶜand lăktāf*
the coat tight at the shoulders-PL
'The coat is tight in the shoulders.'

(II) *lmanṭo dayye' ᶜand lkătfēn*
the coat tight at the shoulders-DL
'The coat is tight in *both* shoulders.'

These examples show that the dual effectively packages the sum into a group of two components.

(1.101) $$\textsc{dual}(\phi) = \lambda x[^*\phi(\downarrow x) \wedge |[\![\downarrow x]\!]| = 2]$$

The group character of the dual is further confirmed by the fact that it can be used in a representative sense, denoting a conventional pair of which the thing named is the more prominent member (as determined by usage):

(1.102)

'abu	'father'	*'abawā(ni)*	'father and mother'
'aḫu	'brother'	*'aḫawā(ni)*	'brother and sister'
qamar	'moon'	*qamarā(ni)*	'moon and sun'
mašriq	'East'	*mašriqā(ni)*	'East and West'

The plural is unmarked with respect to number in its general meaning, although it has the specific meaning of a number greater than two when contrasted to the singular and the dual (Ojeda 1992).

Accordingly, the dualisation and the sound pluralisation of a *nomen vicis* express double or multiple occurrence of the event.

As for the formal representation of the sound plural, the proper pluralisation of the predicate corresponding to the singulative yields the same representation as in the case of the Russian or Welsh pluralised singulatives.[24]

$$^{+}\textsc{pack}_{\mathcal{Q}}(^{*}\phi) = {}^{+}\lambda x[^{*}\phi^{0}(x) \wedge \mathcal{Q}^{1}(x)] \qquad (1.103)$$

Howell 1900 notes that for many singulatives there is also a corresponding **broken plural** (occasionally more than one), formed by changing the vowel pattern of the word (*ʼikām* 'hills, mounds', *ḫiʼām* 'tents, booths').[25] He doesn't dwell on the semantic difference between the broken plural (where it exists) and the name of class[26], beyond the fact that a plural, such as *riǧāl* 'men' (plural of *raǧul* '(a) man'), has to denote at least three individuals, whereas in the case of a class noun there is no such restriction, and one or two dates are already *tamar* 'dates', apart from being *tamaraẗ* '(a) date' or *tamaratā(ni)* '2 dates'.

With respect to the distinction between broken and sound plurals (for those nouns from which both are formed), Caspari 1896 says:

> As regards their meaning, the plurales fracti [broken plurals.—*I.D.*] differ entirely from the sound plurals; for the latter denote several *distinct* individuals of a genus, the former a number of individuals viewed *collectively*, the idea of individuality being wholly suppressed. [...] The plurales fracti are consequently, strictly speaking, *singulars* with a *collective* signification, and often approach in their nature to *abstract nouns*.

Where a sound plural coexists with one or more broken ones, it tends to be used as a plural of paucity, in view of the collective character of the broken plural and in line with the fact that practical countability decreases as numbers increase. (Cf. Croft 1991's statement to that effect: 'The individuals that make up the whole are more salient in smaller quantities, simply because there are fewer of them and more attention can be focu[ss]ed on each.')

For Maltese Borg 1981 presents two explicit examples of nouns which have both a class form and a broken plural:

(1.104)

class form	*ħajt*	'thread'	*qamħ*	'wheat'
singular (singulative)	*ħajta*	'piece of thread'	*qamħa*	'grain of wheat'
determinate (sound) plural	*ħajtiet*	'pieces of thread'	*qamħiet*	'grains of wheat'
indeterminate (broken) plural	*ħjût*	'lengths of thread'	*qmûħ*	'varieties of wheat'

The glosses show that the broken plural is essentially a plural of the class noun. This is in fact predictable from its derivation, which does not go by the way of the singulative, unlike the

[24]This formula translates the semi-specific meaning of the Arabic plural ('two or more ...'), in which the dual is included, although the singular is not. The specific meaning ('three or more ...') can be captured by including a constraint which excludes the domain of the dual, much as the specific reading of the English plural excludes the domain of the singular.

[25]The formation of broken plurals is one of the most idiosyncratic areas of Arabic morphology. There are 33 patterns of broken plurals, 4 of which are marked as **plurals of paucity**, specifically referring to a number up to ten and obligatorily used with numerals in that range; the rest are **plurals of multitude**, referring by default to a number greater than ten.

[26]The term traditionally used in Arabic grammar for a class noun is **collective**, but I shall eschew it here for fear of confusion with another subclass of nouns denoting compound entities, which are different from class nouns in that they form no singulatives.

derivation of the sound plural. Consequently, the conversion processes follow the diagram in Figure 1.7, strictly parallel to the one proposed for Russian in Figure 1.3 and for Welsh in Figure 1.4.

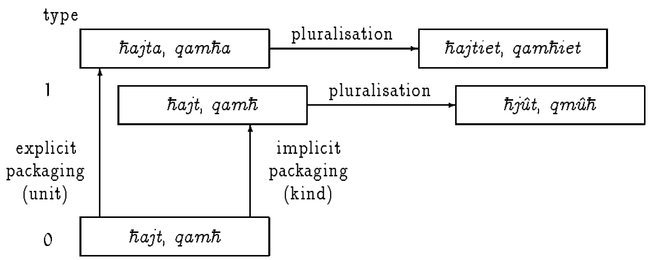

Figure 1.7: Packaging and pluralisation in Maltese.

Some examples brought up by Ojeda 1992 show that the same distribution is found in the modern Arabic vernaculars.

(1.105)

	Cairene Arabic		Syrian Arabic	
class form	*šaǧar*	'trees'	*samak*	'fish'
singular (singulative)	*šaǧaraẗ*	'tree'	*samakaẗ*	'(a) fish'
determinate (sound) plural	*šaǧarāt*	'trees'	*samakāt*	'fish'
indeterminate (broken) plural	*ʼašǧār*	'kinds of trees'	*ʼasmāk*	'kinds of fish'

1.4.3 Dual and plural of the plural

In Classical Arabic from a broken plural it is often possible to form a dual, a sound plural and/or further broken plurals. This amounts to treating (that is, reinterpreting diachronically) the broken plural as a singular noun. The semantic effect is either increasing the minimal number of individuals denoted by the form or extending the meaning of the pluralisation to entities of a higher type (that is, to groups or kinds).

The first option, according to Howell 1900, is in action in the case of the collective *naᶜam* 'camels (or other grazing livestock, e.g., cattle, sheep, goats)', which presumably refers to 3 or more camels.[27] This noun, he reports (referring to works by the Arab grammarians al-Ǧārabardī and Ibn Yaᶜīš), pluralises to *ʼanᶜām* '9 camels or more' ('3 or more *naᶜams*'), which in turn can be pluralised to *ʼanāᶜīm* '27 camels or more' ('3 or more *ʼanᶜāms*'). This interpretation, which is based on a literal understanding of the specific meaning of the plural, seems to be taking numeric ranges more seriously than actual usage is. In any case, no commitment to the range 9 to 26 is apparent in the use of *ʼanᶜām* in '*Sūraẗu l-ʼAnᶜām*' ('Cattle Chapter'), the 6th chapter of the *Qurʼān*. Rather, the word is employed there in the context of a discussion of *different species* of livestock.[28] Here are the relevant verses:

(1.106) *wa- min(a) l-ʼanᶜāmi ħamūlaẗ(an) wa- farša(n)*
and from the cattle-GEN burden-f.ACC and spread-ACC
'And of the cattle [Allah has created] some for burden and some for slaughter.' (6:143)

[27]Traditional grammar calls *naᶜam* a **quasi-plural**, not a genuine plural, because there is no singular corresponding to it, but not a genuine collective either, because no constraints are imposed on the organisation of the group.

[28]I thank Hussein Bushnaq for bringing this fact to my attention.

(1.107) *min(a) ḍ-ḍa'n(i) ṯnaĭn(i) ŭa- min(a) l-ma^{c}z(i) ṯnaĭn(i)*
from the sheep-GEN 2-ACC and from the goats-GEN 2-ACC
qul(u) ḏ-ḏakaraĭn(i) ħarrama 'am(i) l-'unṯaĭaĭn(i)
say-IMP-2SG.M the 2 males-ACC forbid-PRF-3SG.M or the 2 females-ACC
'[O]f the sheep two and of the goats two. Say: Has he forbidden the two males or the two females ...?' (6:144)

This brings us to the second option, which accounts for cases such as

(1.108)	singular	plural	plural of the plural
	ğamal 'he-camel'	*ğimāl* '[herd or kind of] he-camels'	*ğamā'il* 'herds or [different] kinds of he-camels'
	qaŭl 'speech'	*'aqŭāl* '[collection of] speeches'	*'aqāŭīl* 'collections of speeches'
	balad 'village, town, city'	*bilād* 'villages, towns, cities; country; countries (forming a whole)'	*buldān* 'countries'

All this evidence points towards the conclusion that the extension of a broken plural consists of groups of elements of the extension of the singular; in other words, the broken plural is a kind of collective noun, but with no requirements imposed on the size under the general reading and only a lower bound of three under the specific reading.

(1.109)	singular	^{c}*abd*	'slave'	S
	sound plural	^{c}*abdūn*	'slaves'	$\lambda x[{}^{+}S(x)]$
	broken plural	^{c}*abīd*	'slaves'	$\lambda x[{}^{+}S(\downarrow x)]$

Unlike the sound plural, the broken plural raises the type of the predicate.

1.5 Summary

The purpose of this chapter was the development of an account of nominal reference based on the theory of plurality of Landman 1989, a theory which relies on a consistent distinction between sums and groups and on a classification of all expressions into types according to the level of grouping, with the possibility of lowering the type of a term by lifting the predicate whose argument it is.

I argued for a formal representation of mass terms which reflects their similarity to plural count terms. The mass and the count subdomain of the domain of material entities can thus be united into a monolithic system such as the one presented in the diagram in Figure 1.5.

I discussed the classes of count and mass terms, singular and plural terms, singulatives, collectives and representative plurals and the processes of conversion between them and showed how they can be represented by means of the operations defined in the theory, *viz.* group formation, ungrouping, ordinary and proper pluralisation and atomisation. The correspondence between the major categories recognised in natural languages and the formal concepts and tools of the theory is summarised in Table 1.1.

In the subsequent chapters we shall see how the present theory is applied to the domain of eventualities.

singular count or specific plural or mass term	atom or group; singular (quantised) predicate; collective predication
non-specific plural or mass term	sum; plural (cumulative) predicate; distributive predication
• generic interpretation of the plural	• ordinary pluralisation
• specific interpretation of the plural	• proper pluralisation
grinding (conversion to mass term)	atomisation + pluralisation
packaging (conversion to count term; formation of collective term; explicit expression of amount)	conjunction with a predicate of a higher type

Table 1.1: The formal representation of nominal aspectuality.

Chapter 2

Aspectuality

The poem '*Ja vnov' povstrečalsja s Nadeždoj* ...' 'I met Hope again ...' by Bulat Okudžava ends with the following line:

Nas junost' svodila,
us-ACC youth bring together-<u>I-VE</u>/PST-SG.F

da starost' svela.
but old age bring together-<u>P-VE</u>/PST-SG.F

'Youth was bringing us together, but Age brought us together', 'Youth tried (for a long time, maybe repeatedly) to bring us together, but Age succeeded in doing it'.

In the original Russian two different lexical items are used, two verbs which belong to the same **mode of action**[1], but differ in their **aspect**; both refer to the same process of bringing the poet and Hope together, bounded by the state of their being together, but the imperfective *svodit'* (in the first line) does not imply the reaching of the boundary, while the perfective *svesti* (in the second line) does. As a consequence of that, Youth's activity can be predicated of any subinterval of its time, while Age's accomplishment pertains to a definite interval and has an identifiable culmination.

The morphologically realised category of aspect in Russian, as well as the other Balto-Slavic, the Kartvelian and many other languages, is one of the manifestations of a cross-linguistically relevant conceptual semantic category, which I shall refer to as **aspectuality**. The aspectuality of a clause, or of a verbal expression in general, determines the way in which its referent, the **eventuality**[2] expressed by it, occupies an area within the temporal domain.

In this chapter I shall discuss the application of the theory of plurality presented in Chapter 1 to the domain of eventualities.

Following a brief discussion of the organisation of the temporal domain, I shall address the question of the division of eventualities into aspectual classes and the representation of the characteristic properties of the individual classes and of the conversions between them within the proposed framework. The theoretical starting point shall be the set of postulates formulated by Taylor 1977 for the former part of the exposition and the aspectual network of Moens &

[1] This expression is a loan translation of the German term **Aktionsart**, the use of which for the derivationally motivated semantic classifications of verbs recognised in particular in the Slavic languages, a category different from both aspect and aspectual class, though correlated with them to a considerable degree, goes back to Agrell 1908. Some authors subsequently have used the German term for what I call an aspectual class. I shall discuss the category mode of action in Section 2.4.

[2] In my use of this term I follow Bach 1986. The term **event**, which is also commonly used in the literature for this purpose, I reserve for a dynamic eventuality, i.e., an eventuality other than a state.

Steedman 1988 for the latter. My goal will be to give a formal expression, using the tools of the present theory, to the close parallelism between the denotata of verbal and nominal expressions, which has been pointed out and discussed by several authors. In the two final sections of the chapter I shall present some additional illustration of the conversion processes and their formal treatment by examining the aspectual systems of two unrelated languages, Modern Bulgarian and Mandarin Chinese.

2.1 The Structure of Time

Since eventualities exist in time, a word on the assumptions concerning the mereological and the topological structure of the temporal domain is due at this point.

The universe in the temporal domain is built upon a set of **moments** (temporal atoms, points in time).[3] No definite assumptions need be made regarding the cardinality of this set. In board games time is discrete; the eventualities in them are states obtaining in an integer number of successive positions and events happening in an integer number of moves, each of which leads from one position to another. This may or may not be an adequate model of time in the 'real world'. It is certainly possible to think of time as a finite or countably infinite series of units with non-zero duration, although that would necessitate the reformulation of some concepts (such as the notion of an open-fronted interval in fn. 8). Nevertheless, the underlying assumption throughout the present discussion shall be that it is a continuum, or at least a dense set, of infinitely brief moments. For this reason I shall not discuss any worlds in which time is obviously discrete.

Most questions pertaining to temporal precedence belong, strictly speaking, to the domain of tense. For a discussion of aspect it is usually considered sufficient to assume that, unlike space, time possesses an at least partial ordering relation, called a relation of **precedence**, which has the property **backwards linearity**: each moment has a unique past, although not necessarily a unique future.

$$t_1 \preceq t_2 \wedge t_2 \preceq t_3 \quad \rightarrow \quad t_1 \preceq t_3 \tag{2.1}$$

$$t_1 \preceq t_3 \wedge t_2 \preceq t_3 \quad \rightarrow \quad t_1 \prec t_2 \vee t_1 = t_2 \vee t_1 \succ t_2 \tag{2.2}$$

This can accommodate both linear time (where the ordering is also forward linear) and branching time as developed by Dowty 1977.

An **interval** is a continuous group of moments. The condition on its integrity can be formulated either topologically (as integrity would be defined in the spatial domain) or by means of the relation of precedence (if two moments belong to an interval, then so does any moment which precedes one of them and is preceded by the other). In (2.3) c is a sum of moments.

$$\mathrm{interval}(\uparrow c) \leftrightarrow \forall t_1 \forall t_2 \forall t_3 [t_1 \sqcup t_3 \sqsubset c \wedge t_1 \prec t_2 \prec t_3 \rightarrow t_2 \sqsubset c] \tag{2.3}$$

An interval which is a material part of another is called a **subinterval** of the latter.

The predicates defined in the temporal domain operate on times in the broadest sense. The notation $\phi(t)$ shall stand for 'the eventuality ϕ happens at time t' ('t is a time of the eventuality ϕ'), where t is a moment, an interval or a series of moments or intervals. The

[3] I assume time to have an atomic structure for theoretical convenience. This is a convention which is perfectly compatible with a view that moments, like the spatial atoms of Subsection 1.2.1, are abstract entities with no actual existence and all run times are intervals with a measurable, albeit possibly very short duration. For arguments in favour of a non-atomic time theory, where time points are constructed out of time intervals, and an exposition of such a theory cf. Landman 1991.

convention that the referents of nominal expressions are always to be represented as groups, which was argued for in Subsection 1.1.4, shall by extension also apply to the referents of verbal expressions.

2.2 Aspectual Classes

The concept of **aspectual class** is due to the idea that it is possible to derive the aspectual properties of a verbal expression, or an eventuality denoted by one, from its belonging to one of a small number of classes, which are identified by means of semantic or semantically motivated criteria. Despite Verkuyl 1989's observation that aspectual classes can not obviate the need of referring to the criteria themselves, their use, in one form or the other, as a descriptive device is virtually universal practice.

2.2.1 Aspectual classifications

Numerous ways to divide eventualities, and the linguistic expressions denoting them, into classes according to their aspectual characteristics have been proposed in the literature. They differ in several points, namely,

- at what level the classification operates (ontological or linguistic, and in the latter case lexical, phrasal or sentential; some classifications refer to more than one level);
- how many classes are recognised, what names are given to them and what the relations between them are (the architecture of the system);
- what syntactic and/or semantic criteria are employed for assigning a verbal expression to a specific class (the most commonly cited ones being logical entailments and restrictions on cooccurring phase verbs and temporal adverbials, as well as a few based on, or related to, agentivity, *viz.* causative semantics, formation of imperatives and cooccurrence with agentive adverbs of manner such as *carefully*, *deliberately* or *vigorously* or their counterparts in other languages);
- what other aspectual categories are considered (for example, in Holisky 1981 a Georgian verb pertaining to one of the four classes of Vendler 1967 is further characterised as having linear or punctual aspect; Guiraud-Weber 1988's tripartition of Russian verbs is also orthogonal to imperfective or perfective aspect; in contrast, for Moens & Steedman 1988 the aspectual properties of a verbal expression are fully encoded by its class).

Finally, some authors, such as Mourelatos 1981, also consider a number of intermediate levels of classification, which makes possible the concise formulation of generalisations across aspectual classes.

The result of this proliferation of classifications is a certain degree of terminology mismatch (in particular, an overloading of the term **event**), as can be seen from the table in Table 2.1, which presents a comparison of a number of systems. It must be remembered that, due to the differences mentioned above, the correspondence between the individual classes recognised in the different classifications is at best approximate. It is not being claimed, for example, that everyone who uses one of the terms **activity**, **energeia** or **process** means the same thing, although the terms share a column in the table.

In his fundamental work Vendler 1967 offers the English verbal expressions in Table 2.2 to illustrate the four aspectual classes distinguished in his theory. It is noteworthy that he

Mourelatos 1981	mass-quantified			count-quantified		
	situation					
	state		occurrence (action)			
			process	event (performance)		
				development	punctual occurrence	
Guiraud-Weber 1988	adynamic			dynamic with progressive effect	dynamic with immediate effect	
Moens & Steedman 1988	state		process	culminated process	culmination	point
Carlson 1981	stative	dynamic	activity	accomplishment	achievement	momentaneous
Smith 1991	state		activity	accomplishment	achievement	semelfactive
Vendler 1967	state		activity	accomplishment	achievement	
Kenny 1963	state		activity	performance		
Taylor 1977	state		energeia	kinesis		
Verkuyl 1989	state		process	(terminative) event		
Krifka 1991	cumulative reference			quantised reference		

Table 2.1: Some of the existing aspectual classifications.

states	activities	accomplishments	achievements
know	*walk*	*paint a picture*	*recognise*
love	*run*	*run a mile*	*find*
have	*write*	*write a letter*	*lose*
desire	*drive a car*	*draw a circle*	*die*

Table 2.2: The four classes of Vendler 1967.

persistently refers to his enterprise as designing a classification of *verbs*, yet his examples are in fact *verb phrases*, and the presence of the minimal pairs *write* : *write a letter* and *run* : *run a mile* among them certainly indicates that he can not be said to be unaware of the impact of constituents such as the object or a measure adverbial on the aspectuality of the clause; nevertheless, he does not comment on it. It has been observed subsequently (*inter alia*, by Dowty 1979, Vlach 1981 and Verkuyl 1972 and 1989) that other constituents, including the subject, can have a similar impact, and from this it follows that aspectuality should be regarded as a property of the clause as a whole, rather than being restricted to the verb or the verb phrase. The mechanism of **aspectual composition**, by which I mean the interaction between the aspectual properties of the verb and the nominal and adverbial constituents towards the formation of the aspectuality of the clause, shall be explored in detail in Chapter 3.

It seems justified to say that most authors working on aspectuality have made use of Vendler's quadripartition to one extent or the other (or at least have referred to it), but, as I observed above, this does not mean that it has always been interpreted in the same way. Four ways to organise a system of aspectual classes are compared in the summary offered in Verkuyl 1989, who draws attention to the crucial importance of the relations between the classes for their interpretation. I present them in Figure 2.1, using Vendler's terminology everywhere for ease of observation. The architectures can be generalised in a straightforward way for systems with fewer or more than four classes.

The architecture of the system embodies the relations which are assumed to exist between the aspectual classes. For example, in the **cross-classification** in Figure 2.1, which appears to cross-classification

state	activity
achievement	accomplishment

partial ordering

<table>
<tr><td rowspan="3">state</td><td colspan="3"></td></tr>
<tr><td rowspan="2">activity</td><td colspan="2"></td></tr>
<tr><td>accomplishment</td><td>achievement</td></tr>
</table>

strict hierarchy

state
activity
accomplishment
achievement

hinge ordering

state	activity	
	accomplishment	achievement

Figure 2.1: Four architectures for aspectual classifications.

have been Vendler's original intended interpretation of his system, states and achievements (the left column of the table) are counterposed to activities and accomplishments (the right column) on the basis of the ability of the former and the inability of the latter to be evaluated in a single moment, a distinction manifested, *inter alia*, in their respective inability and ability to be overtly progressivised (that is, to form continuous tenses) in English. The examples and the judgements are Vendler's own.

(2.4) a.* *She is loving him.* (state)

b.* *She was recognising him.* (achievement)

(2.5) a. *He was running.* (activity)

b. *He is drawing a circle.* (accomplishment)

By contrast, in the other three architectures this affinity between states and achievements is dismissed as accidental, since they manifest the behaviour they seem to share on different grounds: the meaning of the former is already continuous in a simple tense, which makes overt progressivisation redundant, whilst the meaning of the latter is incompatible with continuity, which rules out progressivisation. Instead of being grouped with achievements, in those architectures states are counterposed to the three other categories, which don't form a natural class in a cross-classification. On the other hand, the distinction between the **atelic** states and activities, which don't pertain to a definite temporal entity, and the **telic** accomplishments and achievements, which do, is lost in a **partial ordering**, another highly popular architecture going back to Kenny 1963 and ultimately to Aristotle. The **hinge ordering**, the general type to which Verkuyl 1989's classification belongs, is aimed at recovering this distinction (the horizontal division) whilst preserving the autonomy of states (the leftmost column). In a **strict hierarchy**, such as the one developed by ter Meulen 1983, each of the four Vendler-classes is defined by adding a semantic condition to the definition of the one immediately above it, so that achievements are effectively assumed to be a kind of accomplishments, which are a kind of activities, which are a kind of states.

In this study I shall assume the classification in Figure 2.2, a hinge ordering of aspectual classs distinguished by a characteristic **eventuality contour**[4] (ignoring the correlation with agentivity, the assumption of which underlies some of Vendler's criteria), and shall combine the terminology chosen by Taylor 1977 with the one of Vendler 1967. Both the term **activity** and the term

[4]A variation of the term **event contour**, which is part of the terminology of Lojban. I believe it was introduced by John Cowan.

<table>
<tr><td colspan="4">eventuality</td></tr>
<tr><td rowspan="3">state</td><td colspan="3">event</td></tr>
<tr><td rowspan="2">energeia
(activity)</td><td colspan="2">kinesis</td></tr>
<tr><td>accomplishment</td><td>achievement</td></tr>
<tr><td colspan="2">atelic</td><td colspan="2">telic</td></tr>
</table>

Figure 2.2: A hinge ordering with two intermediate levels.

energeia will be used; I will treat them as synonyms, using the former in conjunction with the two terms **accomplishment** and **achievement** and the latter in conjunction with the more general term **kinesis**.

The following sentences illustrate the four aspectual classes:

(2.6) *I was tired.* (state)

(2.7) a. *I ran.* (energeia)

b. (I) *I saw the picture.* (kinesis: achievement)

(II) *I hung the picture.* (kinesis: accomplishment)

2.2.2 Aspectual classes and Taylor's postulates

In order to relate the discussion of aspectual classes to the formalism exposed in Chapter 1, I shall now turn to Taylor 1977, who formulates meaning postulates to represent the logical characteristics of each of the three aspectual classes distinguished by him.[5]

States

States, such as the one in (2.6), express the most primitive kind of eventuality—an internally unbounded continuous state of affairs with no temporal substructure. Taylor's postulate for states is based on the intuitive observation that an interval t can count as a time within which a state σ holds only if, and indeed inasmuch as, every moment t' within this interval counts as such a time.[6]

(2.8) $$\mathrm{state}(\sigma) \leftrightarrow \Big(\mathrm{Per}(t) \rightarrow \big(\sigma(t) \leftrightarrow \forall t'[\mathrm{Mom}(t') \wedge t' \sqsubset t \rightarrow \sigma(t')]\big)\Big)$$

Carlson 1981 further distinguishes a **stative** and a **dynamic** class, depending on whether the verbal expressions, which share the ability to cooccur with both momentaneous and duration adverbials, allow the formation of continuous tenses in English. The stative class is illustrated in (2.9), the dynamic one in (2.10).

(2.9) a. *At that point I remembered the rule.*

b. *I remembered the rule for two days.*

c.* *At that point I was remembering the rule.*

(2.10) a. *At seven o'clock the caravan stood in its old place.*

b. *The caravan stood in its old place for days.*

c. *At seven o'clock the caravan was standing in its old place.*

[5]Taylor's postulates are presented here in his own notation, where Mom(t) stands for 't is a moment', Per(t) for 't is a period (i.e., an interval)', $t \sqsubseteq t'$ for 't falls within t′' and $t \sqsubset t'$ for 't falls properly (wholly) within t′'.

[6]See fn. 5, Chapter 1, on the generalisation 'every'.

He proposes to account for this difference by postulating that a stative predicate can only be evaluated in moments, whereas a dynamic one can only be evaluated in either moments or extended intervals. The dynamic class is closely related in his classification to the class of achievements, which can also be evaluated either in what he calls the **climactic moment** (or **climax**) or in an interval which contains the climactic moment.

(2.11) a. *At that point he closed the door.*
b. *At that point he was closing the door.*

The difference is that for dynamics any moment can function as a climax, whereas for achievements the climax is unique.

Carlson 1977 and Bulygina 1983 argue (on the basis of English and Russian linguistic material, respectively) for another, cross-linguistically relevant, division of this class into **individual-level** predicates (**qualities**, **properties**), which are not localised in time, and **stage-level** predicates (**stative phenomena**, **stative episodes**), which are. The latter, but not the former, admit frequency adverbials such as *always* or *often*.[7]

(2.12) a. *He is a drunkard.* individual-level
b. *He is (often) drunk.* stage-level

As regards their contour, however, both qualities and stative phenomena are equally well covered by Taylor's definition.

Energeiai

Energeiai, exemplified in (2.7a), have much in common with states, but they differ from them in two important ways.

The first distinction, which is of central relevance in particular within Discourse Representation Theory (Kamp & Reyle 1993), is made on the basis of the fact that an event (including an energeia) introduces a new discourse referent, while a state under most circumstances merely contributes a new condition involving an existing discourse referent (the reference point). In this context Tommola 1991 discusses the category of 'narrative aspectuality' (as opposed to 'resultative aspectuality') as a means for structuring the discourse.

The second difference, is that energeiai are dynamic, i.e., they express a continuous change of state, but this change either has no natural boundary or in any case is not requred to reach it. This is the difference with which we are concerned here, since it is the one which affects the eventuality contour.

Taylor's postulate for energeiai captures the difference between the ways in which energeiai and states take time. By virtue of its dynamics an energeia can't happen in a moment (it constitutes a *change of state* over time, hence the need of registering the state in more than one moment); it fills an interval, by whose size (which determines the duration of the event) it is characterised.[8]

(2.13) $$\mathrm{energeia}(\epsilon) \leftrightarrow \big(\epsilon(t) \rightarrow \mathrm{Per}(t) \wedge \forall t''[t'' \sqsubset t \wedge \mathrm{Per}(t'') \rightarrow \epsilon(t'')]\big)$$

[7]The quantificational treatment of this class of adverbials shall not be discussed in detail here; some considerations on their properties, in particular on their interaction with expressions of temporal measure, are presented in Moltmann 1991.

[8]One further requirement of Taylor's is that the interval t fall, properly or otherwise, within an open-fronted interval (that is, one which contains within it no earliest moment) which is itself a time of ϵ. This is needed because if the application time of ϵ has an earliest moment t_0, then the frequently cited criterion for energiahood 'if x is ϵing, then x (has) ϵed' will be invalidated for t_0.

Indeed, as Vlach 1981 notes, states are compatible with momentaneous adverbials, whereas energeiai are not, except possibly under an inchoative reading.

(2.14) a. *Max was here at 2:30.*
b. ! *Mary ran at 2:30.*

Thus both states and energeiai are atelic (have no set terminal point), but they differ in their relation to atomic time intervals (i.e., to moments); both are cumulative, but energeiai are of limited distributivity.[9]

The two types of atelic eventualities shall be expressed as plural predicates of type 0 (defined for moments and sums of moments), lifted before being applied to intervals (groups of moments, hence entities of type 1). The distinction between ordinary plural and proper plural predicates provides a straightforward way to express the difference between states and energeiai in the formalisation, as well as to allow for it to be glossed over for those languages, and for those contexts, in which it is not realised.

(2.15) State: $\ell({}^*\sigma^0)(t^1) \equiv {}^*\sigma({\downarrow}t)$ cf. (2.6)

(2.16) Energeia: $\ell({}^+\epsilon^0)(t^1) \equiv {}^+\epsilon({\downarrow}t)$ cf. (2.7a)

Kineseis

Kineseis, illustrated in (2.7b), are closed events, which delimit the time they take, not happening in any of its proper subintervals; otherwise speaking, they are quantised relative to the run time. Taylor's postulate for kineseis reflects this property.

(2.17) $$\mathrm{kinesis}(\kappa) \leftrightarrow \big(\kappa(t) \rightarrow \mathrm{Per}(t) \wedge \forall t'[t' \sqsubset t \rightarrow \neg\kappa(t')]\big)$$

Taylor's view is that 'mere moments do not suffice as times of application' of kineseis, any more than they do for energeiai, as confirmed by the condition 'Per(t)' in the postulate in (2.17). From this it appears that he does not, strictly speaking, consider instantaneous kineseis to be eventualities at all. If this condition is removed, however, the postulate will trivially apply to them as well (that is, they do not happen in any proper subinterval of their application times, since moments have no proper subintervals).

In his original theory Vendler 1967 introduces two separate classes of closed events, which he calls **achievements** and **accomplishments**. The former are punctual phase transitions, whereas the latter are linear processes bringing forth a phase transition, i.e., activities culminating in achievements.

Verkuyl 1989 argues that the distinction between the classes of achievements and accomplishments is not well grounded and should be left out of consideration. He draws attention to the fact that whether an event takes a moment or an interval of time is more of an accidental circumstance than an inherent property which would be relevant to language, and that in any case 'the length of the event in question does not seem to be of importance at all if the event is conceived of as taking time'. This is to say that an event which would normally be classified as

[9]The postulate in (2.13) is actually restricted to **homogeneous** energeiai, that is, such for which it is strictly true that they happen in every subinterval of an application time of theirs: every part of an interval filled by a *falling* event, however brief, is itself filled by falling (that is, by motion driven by gravity). It needs to be qualified further before it can apply to **heterogeneous** energeiai, which contain subprocesses within which they don't apply: an interval filled by a *walking* or a *talking* event contains subintervals whose brevity does not permit the process contained in them to be identified as walking or talking. They are therefore treated as consisting of recurring stages, each of which is essentially a miniature kinesis.

an achievement or an accomplishment can be 'stretched' or 'squeezed' into the other aspectual class under the influence of modern technology or in some other way, and the linguistic criteria will bear witness to the conversion. Consider the examples:

(2.18) a. *John typed the letter 'p' at noon sharp.*

b. ! *John typed that business letter at noon sharp.*

Example (2.18a) is usually thought of as being perfectly acceptable, while (2.18b) is judged odd; but if John's word processor took three minutes to display the letter 'p' on the screen after John pressed the $\boxed{\text{P}}$ key, and on the other hand the hitting of a single key instantly produced a copy of a standard business letter, the judgements may well be reversed. A similar argument could be made for the case of example (0.1b), repeated here in (2.19b),

(2.19) a. *John saw seven zebras in an hour.*

b.* *John saw a zebra in an hour.*

which would be acceptable if JOHN is a pattern recognition system of low efficiency, whose designers and users think of the 'seeing' as happening over the interval between the moment in which JOHN receives its visual input and the moment in which it reaches the conclusion that a zebra is present in it.[10]

In many cases it doesn't take any modern technology to stretch an achievement over an interval by including the prelude (the preparatory stage), or at least a part of it, into the time occupied by the event.

(2.20) a. *I spent all last night realizing how easily I could slip.*

Laura Stevenson, *The Island and the Ring*

b. *The old man was dying.*

c. *The taxi was arriving.*

In the view of Carlson 1981, the extending of an achievement over an interval containing the moment in which it holds need not be restricted to supplying a preparatory stage, and accordingly he distinguishes between initial, internal and final climactic moments, depending on their position within the intervals.

(2.21) a. *The dog attacked me at once.* (initial climax)

b. *At that point the 'plane took off from the ground.* (internal climax)

c. *He lost the tournament when he missed that ball.* (final climax)

Some languages provide morphosyntactic evidence which further supports the view that the two classes of kineseis must be considered jointly, at least for some purposes. As I shall show in Section 2.4, Bulgarian sets achievements and accomplishments (expressed by verbs of the perfective aspect) formally apart from activities and states (expressed by verbs of the imperfective aspect and distinguished from one another by tense). Furthermore, the derivational process known as **secondary imperfectivisation**, which relates, for example, the imperfective verb in (2.22c) to the perfective one in (2.22b), allows for nearly any achievement to be stretched over a time longer than a moment.

[10] It is also acceptable, of course, if John is a veterinary surgeon and for him, in a professional context, to *see* an animal means to perform a medical examination it.

(2.22) Bulgarian

a. *Mljakoto vreše.*
the milk boil-I–VE/IPF-3SG
'The milk was boiling.'

b. *Mljakoto zavrja.*
the milk boil(INCH)-P–VE/AOR-3SG
'The milk began to boil.'

c. *Mljakoto zavirаše.*
the milk boil(INCH)-I–VE/IPF-3SG
'The milk was beginning to boil.'

An essentially identical strategy of combining aspect and tense for the purposes of identifying a verb form as expressing a state, energeia or kinesis is found in Georgian, whose tense system is characterised by the same oppositions as the Bulgarian one. Georgian differs from the Slavic languages in that it has no productive secondary imperfectivisation, but compensates for it by possessing multiple ways of deriving atelic predicates from one another. In particular, the derivation of inchoatives, marked by the suffix *-d-*, goes through a stage at which the verb is imperfective, and although it nearly always proceeds to the acquisition of a perfectivising preverb, such as *a-* in (2.23c), in some cases it does not. This means that the initiation of the corresponding activity is formally treated as a process taking time, which culminates in the actual initiation of the process denoted by the stem.

(2.23) Georgian

a. *Rʒe duğ-da.*
milk-NOM boil-I–VE/IPF-3SG
'The milk was boiling.'

b. *Rʒe duğ-d-ebo-da.*
milk-NOM boil (INCH)-I–VE/IPF-3SG
'The milk was beginning to boil.'

c. *Rʒe aduğ-d-a.*
milk-NOM boil (INCH)-P–VE/AOR-3SG
'The milk began to boil.'

In Mandarin, whose aspect system shall be discussed in Section 2.5, the classes of achievements and accomplishments are also united under the morphologically motivated category of **resultative verbs** (Tai 1984, Cartier 1972).[11]

The appeal to crosslinguistic evidence brings forth the question how anglocentric Verkuyl's argument is, in other words, to what extent it is dependent on the possibility to build continuous tense forms from any English verb. The argument works reasonably well for Bulgarian, with its nearly unfailing secondary imperfectivisation and the option to read almost any imperfective verb as denoting an ongoing process. Its application to languages which fail to provide the necessary

[11] This is in itself a heterogeneous category, composed of **inchoative verbs**, typically cooccurring with the aspect marker *-le* 'become' (*sǐ* 'die', *dǒng* 'understand'), and **resultative verb compounds**, of which the first component indicates a process and the second a state obtaining after the phase transition (*shāsǐ* 'kill' ('kill-die'), *xuéhuì* 'learn' ('study-know')). The latter structure parallels elegantly the analysis of an accomplishment as an activity culminating in an achievement (here represented by the ensuing state). However, it must be noted that this subcategory also includes verbs whose English counterparts Vendler 1967 classifies as achievements (*zhǎodào* 'find' ('seek-reach'), *kànjian* 'see' ('look-meet')).

grammatical means for 'stretching' an instantaneous event over an interval is somewhat less straightforward. One such language is Russian, in which there is a large class of perfectiva tantum (chiefly semelfactives[12], delimitatives or inchoatives, e.g., *morgnut'* 'blink (once)', *xlynut'* 'gush, spout', *poguljat'* 'take a walk', *poletet'* 'fly forth'), as well as a large class of aspectual pairs which are functionally (though not morphologically) defective, in that the imperfective member has only an iterative meaning. Events denoted by clauses headed by such verbs can not be extended over intervals. Some examples of the latter are offered in (2.24–2.25).

(2.24) Russian

a. *On prišël.*
he-NOM come-P–VB/PST-SG.M
'He came.'

b. *On prixodit.*
he-NOM come-I–VB/PRS-3SG
'He comes (habitually).' (*'He's coming.')

(2.25) Russian

a. *Čto slučilos'?*
what-NOM occur-P–VB/PST-SG.N
'What happened?'

b. *Čto slučaetsja?*
what-NOM occur-I–VB/PST-3SG
'What happens (regularly, under such and such circumstances)?'
(*'What is going on?')

Guiraud-Weber 1988 groups the class of morphologically defective and the class of functionally defective verbs together under the category of **verbes dynamiques à effet immédiat** and attributes their failure to imperfectivise to semantic reasons. This argument, for all its intuitive appeal, leaves without an explanation the existence of obviously idiosyncratic restrictions, which can hardly be explained on the basis of the lexical meaning of the verbs. For example, the verb *vljubit'sja* 'fall in love' can be imperfectivised to *vljubljat'sja* 'be in the process of falling in love; fall in love (repeatedly)', while the semantically parallel verb *voznenavidet'* 'come to hate, conceive a hatred for' doesn't undergo secondary imperfectivisation. Similarly, *umeret'* 'die' has an imperfective counterpart, namely *umirat'* 'be in the process of dying; die (repeatedly)', whereas the euphemism *skončat'sja* 'pass away' has none. Compare also the verbs in examples (2.24–2.25) to the closely related (in terms of either derivation, semantics or both) or even synonymous verbs in examples (2.26–2.27), which form regular aspectual pairs and by virtue of this are categorised as **verbes dynamiques à effet progressif**.

(2.26) Russian

a. *On ušël.*
he-NOM go away-P–VB/PST-SG.M
'He went away.'

b. *On uxodit.*
he-NOM go away-I–VB/PRS-3SG
'He goes away.' 'He's going away.'

[12] A class of verbs expressing a single occurrence of a repeatable action. The term is derived from the Latin *semel* 'once'.

(2.27) Russian

a. *Čto proizošlo?*
what-NOM happen-P–VB/PST-SG.N
'What happened?'

b. *Čto proisxodit?*
what-NOM happen-I–VB/PRS-3SG
'What is going on (at the present moment)?'

If the existence of an imperfective counterpart of a perfective verb and the semantic relation between the two is determined by the duration of the event denoted by the latter (instantaneous or continuative), then the perfective verbs in examples (2.24–2.25) and (2.26–2.27) must correspond to predicates evaluated respectively in moments and intervals, possibly differing only in the perspective on what is in reality the same event.

The *-te iru* construction of Japanese provides another example of a phenomenon for which the traditional explanation, which depends on a distinction between continuative and instantaneous events, turns out to be flawed. As Jacobsen 1984 points out, the common assumption that whether this construction has a progressive or a resultative interpretation is determined by the duration of the event, which is what examples (2.28) and many similar ones seem to indicate,

(2.28) Japanese

a. *Kodomo wa asonde iru.*
child TOP play-GER be
'The child is playing.'

b. *Kare wa shinde iru.*
he TOP die-GER be
'He has died/is dead.' (*'He is dying.')

is proven incorrect by a significant number of counterexamples, including pairs of a transitive and an intransitive verb, in which the former typically has a progressive and the latter a resultative meaning:

(2.29) Japanese

a. *To wo akete iru.*
door ACC open (TR)-GER be
'I am/(S)he is/... opening the door.'

b. *To ga aite iru.*
door NOM open (INTR)-GER be
'The door is open.'

In actual fact, as he shows, the verbs for which the *-te iru* construction has a progressive interpretation are the ones expressing change (though not necessarily a momentary change) in the referent of the subject. That is to say that *-te iru* strives to select an interval during which the subject is in some marked state (the progressive state for the agent, who is engaged in the action while it lasts, the consequent state for the patient, of which it is predicated).

Still, while it is true that the expressed event is open to interpretation as being punctual or durative, an implication to this effect is clearly present in each particular case, and indeed I did appeal to the aspectual distinction between achievements and accomplishments to explain the difference in the acceptability of (0.1a) and (0.1b) under normal circumstances.

In my view the solution of the contradiction lies in the recognition that the aspectual properties of kineseis are determined primarily by the fact that the predicates are quantised and to a lesser extent by the type of the run time (0 for an achievement and 1 or higher for an accomplishment). The observed difference with respect to cooccurrence with temporal adverbials amounts to the fact that, unlike moments, temporal structures of type 1 or higher have a non-zero duration, which can be measured and by which the event is characterised.

(2.30) Achievement: $\psi^0(t^0)$ cf. (2.7b-I)

(2.31) Accomplishment: $\psi^1(t^1)$ cf. (2.7b-II)

In order to account for iterativity, application times in general shall be regarded as entities of type 2 (groups of intervals, which in turn constitute groups of moments), and the possibility of iterative interpretation shall be expressed by an additional pluralisation operator on the eventuality predicate.

2.3 Conversion of Aspectual Classes

The relation of the aspectual class of the eventuality expressed by a clause to the lexical properties of the verb is frequently obscured by the possibility of the eventuality being converted to a different class. The conversion may be implicit (triggered by the nominal or adverbial constituents of the clause, by another associated conversion or by the context), or it may be indicated explicitly by derivation or by verbal or nominal inflexion, in a necessarily language-specific manner. In the latter case it may be signalled by the mode of action, aspect and/or tense of the verb or (as in Finnish and Estonian and to a certain extent the Germanic languages) the syntactic marking of the object of the sentence.

The possibility of applying any operation of aspectual class conversion to a predicate may depend on the derivation of that predicate. In this sense I agree with Holisky 1981's statement, made within a discussion of the morphology of aspect in Georgian, that

> the characterization of aspect types must be made with reference to the verbal *root* of Georgian, and not merely to a particular surface verb form. [... E]ach verb root in Georgian must be marked for aspect; each root will be in one of Vendler's four classes.

My approach differs from hers in that I don't share her assumption that all forms traditionally grouped within the paradigm of a single verb must necessarily be considered to belong to the same aspectual class (and consequently to be distinguished where necessary by the value of another, orthogonal aspectual category). For example, I regard the Georgian pair *ċers* '(s)he writes/is writing/will be writing' and *daċers* '(s)he will write' as a state and a kinesis, respectively, rather than a linear and a punctual aspect form of the same accomplishment verb.

2.3.1 Organisation of Moens & Steedman's network

The transition network in Figure 2.3 is introduced by Moens & Steedman 1988 to define the ontology by which the conversion of aspectual types is driven. For ease of reference I use Vendler 1967's terms **activity**, **accomplishment** and **achievement** instead of Moens & Steedman's **process**, **culminated process** and **culmination**.

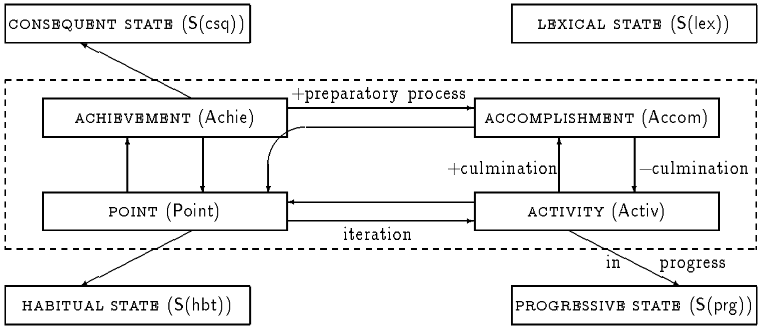

Figure 2.3: The aspectual network of Moens & Steedman 1988.

The underlying interpretation of the individual types of eventualities is based on a generic eventuality structure called a **tripartite nucleus**, shown in Figure 2.4. The relation between the

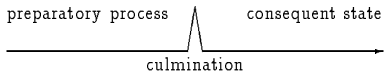

Figure 2.4: The tripartite nucleus.

three components of the nucleus is set in terms of contingency (the culmination is brought about by the preparatory process and in turn brings about the consequent state), and their relative allocation in time (the preparatory process precedes, and the consequent state follows, the culmination) is a side effect of that. The choice of aspectual class in each particular case determines which parts of the nucleus are considered relevant, without necessarily excluding the existence of the others. For example, an accomplishment is composed of a preparatory process and a culmination, while an activity is just the former and an achievement just the latter.

In the diagram in Figure 2.4 the dashed box in the centre sets events (inside) apart from states (outside). The allocation of the four classes of events reflects the underlying architecture, a cross-classification of events, the two criteria in which are the atomicity of the event and

	atomic	extended
+consequence	achievement	accomplishment
−consequence	point	activity

Table 2.3: The cross-classification of events.

the existence of an associated consequent state. In this context an event is considered to be atomic if it has no substructure or its substructure is disregarded, and to be extended otherwise. (See Table 2.3.)

The class of **points**, which corresponds to what is known in Slavic linguistics as the **semelfactive** mode of action, includes events (not necessarily instantaneous ones) which are viewed as indivisible wholes and whose consequences are not an issue in the discourse. A result of the latter condition is that points, unlike achievements, sound odd in the perfect tenses, which select the consequent state of the event:

(2.32) a. # *Harry has hiccoughed.* (point)
b. *Harry has reached the top.* (achievement)

An unlabelled edge in most cases indicates a conversion which amounts to a mere change in the speaker's perspective on the reported event, while a labelled edge indicates the inclusion of a stage (preparatory process, culmination or consequent state) into, or its exclusion from, the eventuality contour.

The dynamic part of the network, that is, the part in the dashed box in the centre of Figure 2.3, which includes events and transitions between them, excluding states and transitions to and from them, is in fact equivalent to the triangular scheme in Figure 2.5, which in turn is parallel to the one in Figure 1.6.

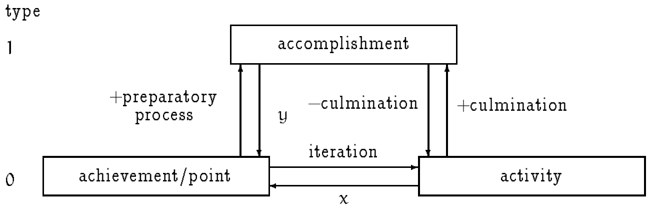

Figure 2.5: The triangular nucleus which underlies the dynamic part of the aspectual network.

As in the case of conversion of types of nominal reference, a transition is possible from every node of the nucleus to either of the two others. The implicit transitions between points and achievements, which don't affect the eventuality contour, are carried out in this diagram within the node shared by the two classes. The arrows marked with x and y correspond to the unlabelled edges leading from the Activ and the Accom node to the Point node.

2.3.2 Aspectual modifiers in English

For English Moens & Steedman recognise five types of overt aspectual modifiers, which are associated with nodes or edges in the network.

Habitual states

The simple present and the simple past tense under habitual interpretation cause a transition of the edge Point → S(hbt).

(2.33) *Fido barks (often).*

The eventuality is converted into a point if it is not one already, so that the entire path may have the form Activ → Point → S(hbt), Accom → Point → S(hbt) or Achie → Point → S(hbt).

(2.34) *He drank wine (often).* Activ → Point → S(hbt)

Closely related is the class of **dispositional states**, which Moens & Steedman do not discuss. Dispositional states are also morphologically unmarked in English,

(2.35) *He drank wine.* (He was not a teetotaller.)

but they differ from the habitual ones, and are similar to the subclass of qualities illustrated in (2.12a), in that they do not admit modifiers such as *often* or *regularly*. Unlike a habit, a disposition does not require even the occasional occurrence of the event; as Bulygina 1983 observes, (2.36) is a plausible interchange between a hostess and her guest.

(2.36) — *Do you eat olives?*
— *I don't know, I've never had any.*

The habitual reading of the question in these circumstances would have compelled the guest to reply in the negative.

Progressive states

The continuous tenses cause transition along the edge Activ → S(prg).

(2.37) *The president is speaking.*

The treatment of the progressive as a kind of state is in line with Vlach 1981's proposal known as 'progressive as a stativiser', based on the observation that progressives and states have the same aspectual properties (if they hold in a given interval, they also hold in any of its subintervals, atomic or not), that many natural languages have progressive constructions which are syntactically parallel to locatives, as illustrated below (the locative adpositions are set in boldface),

(2.38) Gaelic

a. *Tha mi* ***aig*** *an teine.*
be-PRS I at the fire
'I am at the fire.'

b. *Tha mi* ***ag*** *obair.*
be-PRS I at working
'I am working.'

(2.39) Georgian

a. *Ezoši war.*
yard-in be-PRS-1SG
'I am in the yard.'

b. *Çerilis gadaçeraši war.*
letter-GEN copy-P–VE/INF-IN be-PRS-1SG
'I am copying a/the letter.'

(2.40) Turkish

a. *Odun ocaktadır.*
wood fireplace-LOC-3SG
'The wood is in the fireplace.'

b. *Odun ocakta yanmaktadır.*
wood fireplace-LOC-3sg burn-INF-LOC-3SG
'The wood is burning in the fireplace.'

(2.41) Chinese

a. *Wŏmen zài kètáng.*
We (be) at classroom
'We are in the classroom.'

b. *Wŏmen zài shàngkè.*
We (be) at hold class
'We are having a class.'

and that, again in many languages, the distinction between progressive and non-progressive aspect fails to show up for stative verbs (e.g., in Standard English stative verbs generally appear in the simple but not in the continuous tenses – hence the absence of an edge from S(lex) to S(prg), – while at least some varieties of Scottish and Indian English feature the reverse situation; in Japanese stative verbs either always appear in the progressive construction formed with *-te iru* or never do).

The operation of progressivisation can be expressed conveniently by means of the atomisation operator defined in Section 1.3. Given that an energeia is formally represented as ${}^{+}\phi$ (a proper plural predicate), $\phi(t)$ is true for any moment t belonging to an interval within which the event takes place, and the corresponding ordinary plural

(2.42) $$ {}^{*\prime}({}^{+}\phi) = {}^{*}\phi $$

(conversion to a state) holds for all subintervals, atomic or not.

Progressives are closely related to habitual and dispositional states in that they predicate of all moments of a given interval a feature derived from an event by which that interval is characterised; the three differ in the degree to which they require the interval to be covered by occurrences of the event.

Since activities are atelic, as are states, the imperfective paradox – the problem of an event being brought up without its occurrence being asserted – doesn't arise at this stage. However, as Ogihara 1990 observes, this doesn't necessarily mean that it is solved. It is merely shifted to the edge Accom → Activ, where accomplishments are to have their culminations removed. The question is, then, how the activity is identified as the accomplishment's preparatory process. Its discussion in further detail lies outwith the scope of this work.

(2.43)
a. *John was hanging the picture.* Accom → Activ → S(prg)
b. *Harry was reaching the top.* Achie → Accom → Activ → S(prg)
c. *#Harry is hiccoughing.* Point → Achie → Accom → Activ → S(prg)

The operation accompanying the implicit transition of the edge Accom → Activ, which yields a predicate denoting an incomplete action bounded by a real or hypothetical event, could be referred to as **partitivisation**. It is also conveniently expressed by means of the atomisation operator, or more precisely by means of the operation of grinding defined in its terms. If $\psi(p)$ is true for an interval p, then ${}'\psi(t)$ is true for any moment t within p, hence the partitive

(2.44) $$ \textsc{grnd}(\psi) = {}^{+\prime}\psi $$

(conversion to an energeia) holds for all subintervals of p longer than a moment.

In examples (2.43b–2.43c) the achievement is implicitly extended over an interval by having a preparatory process leading to it included into the eventuality contour. This conversion

can be compared to the formation of representative plurals, also discussed in Section 1.3, and represented accordingly as in (2.45),

(2.45) $$ \textsc{repr}(\psi) = \lambda x^{1}\exists t^{0}\exists p^{1}[x = \uparrow(t \sqcup \downarrow p) \land \psi(t) \land ({}^{+}\phi_{\psi(t)})(\downarrow p)] $$

where the activity ${}^{+}\phi_{\psi(t)}$ is the process accompanying the achievement ϕ happening in the moment t. This doesn't, in fact, require that the process be a preparatory one, thus accommodating Carlson 1981's trichotomy of initial, internal and final climactic moments, illustrated in (2.21).

An alternative way for an eventuality to be converted into an activity for the purposes of progressivisation is by way of the iterative edge Point → Activ.

(2.46)
a. *Harry is hiccoughing.* Point → Activ → S(prg)
b. *Roger was running a mile.* Accom → Point → Activ → S(prg)
c. *#Harry was reaching the top.* Achie → Point → Activ → S(prg)

As already noted, iteration amounts to pluralisation.

(2.47) $$ \textsc{iter}(\psi) = {}^{+}\psi $$

In some languages iteratives are also grammaticised as plural entities; cf. the parallel treatment of plural nouns and iteratives in Quileute, where *-ʔ-* with reduplication of the preceding vowel is a pluralisation marker for both nouns and verbs (Gleason 1969), or the optional use of reduplication for marking distributive plurality of the eventuality or of any argument in Straits Salish (Jelinek 1991).

(2.48) Quileute

a. (I) *a-ʔt'šit* 'chief'
(II) *a-ʔa-ʔt'šit* 'chiefs'

b. (I) *é-la·xali* 'I leave him'
(II) *é-ʔe-la·xali* 'I leave him often'

(2.49) Straits Salish

a. (I) *s-leniy* '[she is a] woman'
(II) *s-len-leniy* '[they are] women'

b. (I) *neq-ŋ* 'he dives'
(II) *neq-neq-ŋ* 'he dives repeatedly; they dive [repeatedly]'

Expressions of duration

An expression of duration, such as a *for*-adverbial or an equivalent, causes transition along the edge Activ → Accom.

(2.50)
a. *Mary played the piano for thirty minutes.*
b. *Mary spent thirty minutes playing the piano.*

The transition is caused by the fact that the expression *for thirty minutes* sets for the entire interval a condition which, unlike *play the piano* itself, does not distribute to its subintervals. Thus $^{+}\phi^{0}$ is quantised to the form in (2.51),

$$\text{(2.51)} \qquad \text{PACK}_{\mathcal{Q}_d}(\phi) = \lambda p^1[^{+}\phi^0(\downarrow p) \wedge \mathcal{Q}_d^1(p)]$$

where $\mathcal{Q}_d^1(p)$ stands for the fact that the interval p has the duration d, formulated by reference to a metric or to another extended or recurrent event. If the eventuality is not an activity – and even if it is, as in (2.52a), – it can be converted to a point and then iterated.

(2.52) a. *Mary played the piano for three years.* Activ → Point → Activ → Accom
b. *John arrived late for several days.* Achie → Point → Activ → Accom

The inclusion of a durative adverbial affects the temporal constitution of the predicate: *hang pictures* is cumulative while *hang pictures for three minutes* is quantised. The inclusion of a measure phrase into an unspecific plural of mass term has a parallel effect: *water* is cumulative while *two litres of water* is quantised. This enables Krifka 1993 to group *for three minutes* and *two litres (of)* under the category of **extensive measure functions**.

None the less, an imperfective verb is used in Slavic and Georgian, and a monomorphemic verb (**verbe unitaire** for Cartier 1972) in Mandarin. This is not surprising, considering that perfectivisation in these languages is associated with a change of the mode of action, which is not affected here, since the quantisation is restricted to the duration of the event, without a terminal point being set or reached.

Expression of time span

An expression of time span, such as an *in*-adverbial or an equivalent, causes no transition on its own, but requires an accomplishment,

(2.53) a. *The boys carried the piano upstairs in five minutes.*
b. *It took the boys five minutes to carry the piano upstairs.*

the obtaining of which may cause some other conversion.

(2.54) a. *John reached the top in two hours.* Achie → Accom
b. *I found the keys in ten minutes.* Achie → Accom
c. *I ran in three minutes.*
(I) '3 minutes passed from some earlier time referred to in the discourse to the time of my running.' Activ → Point → Achie → Accom
(II) '3 minutes passed from the beginning of my running (of a specified distance) to its end.' Activ → Accom

The impact of the modifier is to convert ϕ^1 into the likewise quantised form in (2.55),

$$\text{(2.55)} \qquad \lambda p^1[\phi^1(p) \wedge \mathcal{Q}_d^1(p)]$$

where $\mathcal{Q}_d^1(p)$ has the same interpretation as in the case of a durative adverbial.

In fact the classes of *in*- and *for*-adverbials differ in their pragmatic effects. To wit, the time indicated by the former is implicitly allowed to be an underestimate, whereas the one introduced by the latter is more likely to be an overestimate, as shown by the possible continuations of (2.50a) and (2.53a):

(2.56) a. *Mary played the piano for 30 minutes—even for 40 minutes.*
b. *The boys carried the piano upstairs in 5 minutes—actually in 4 minutes.*

This difference, which is due to the contrast in the type of reference (cumulative *vs.* quantised) of the predicate which translates the verbal expression cooccurring with the adverbial, is not reflected by the representation of the adverbials in the formulæ in (2.51) and (2.55).

Consequent states

A perfect tense causes transition along the edge Achie → S(csq), that is, it converts a culmination to an appropriate consequent state (its formation selects the final part of the nucleus referred to by the predicate).

(2.57) a. *Harry has reached the top.* Achie → S(csq)
b. *# The star has twinkled.* Point → Achie → S(csq)
c. *#I have worked in the garden.* Activ → Point → Achie → S(csq)
d. *The mountaineer has climbed Mt Everest.* Accom → Point → Achie → S(csq)

On the subject of the acceptability of these sentences, I quote Moens & Steedman 1988:

> The most obvious of these consequences for [(2.57a)] is that Harry still *be* at the top, although as usual there are other possibilities. Informal evidence that this indeed is the function of the perfect can be obtained by noticing that perfects are infelicitous if the salient consequences are *not* in force.

To support this statement, they observe that uttering

(2.58) *I have spilled my coffee.*

would be infelicitous if the observable result of the event, namely the puddle of spilt coffee on the table or the floor, is no longer present. The outcome of the formation of the perfect is also less than fully felicitous if no recognisable consequences could be associated with the event in the first place, as is the case in (2.57b–2.57c), where a culmination and a consequent state are formally attributed to the event for the purposes of the transition of this arch.

The previous paragraph describes the **resultative** perfect, found in English and in many other languages. Closely related is the **experiential** perfect, which is also of very wide distribution and in some languages coexists with a resultative perfect. For the purposes of the experiential perfect the consequent state is defined as 'the state of a ϕ-eventuality having taken place',

$$\text{(2.59)} \qquad {}^{*}\lambda t \exists t'[\phi(t') \wedge t' \prec t]$$

which trivially holds for all moments later than the time of ϕ, unless some idiosyncratic restrictions are in force. The existence of such a state does not depend on the existence of a 'natural' culmination, and consequently it is not required that ϕ be a telic predicate.

2.3.3 Some further considerations

In the previous subsection some simple aspectual modifiers found in English were discussed. More complex paths are also possible, and are regarded as compositions of the fundamental ones. Here is an example, accompanied by a diagram (in Figure 2.6) showing the conversions and a formal representation, in which P translates *play the Minute Waltz* and $\mathcal{Q}_{2d}$, $\mathcal{Q}_{lt\ 60s}$ and $\mathcal{Q}_{gt\ 1hr}$ translate the three expressions of temporal measure in the order in which they occur in the sentence:

(2.60) *It took me two days to play the Minute Waltz in less than sixty seconds for more than an hour.*

Activ → Accom → Accom → Point → Activ → Accom → Point → Achie → Accom

$$\textsc{repr}\Big(\lambda p' [^{+\prime}(\lambda p[P(p) \wedge \mathcal{Q}_{\mathrm{lt\ 60s}}(p)])\,(p') \wedge \mathcal{Q}_{\mathrm{gt\ 1hr}}(p')]\Big)(p'') \wedge \mathcal{Q}_{\mathrm{2d}}(p'')$$

$$\left[\begin{array}{l} \textit{It took me two days} \\ \textit{to} \left[\begin{array}{l} \left[\begin{array}{l} \left[\begin{array}{l} [\textit{play}]_{\mathsf{Activ}} \\ \textit{the Minute Waltz}\end{array}\right]_{\mathsf{Accom}} \\ \textit{in less than sixty seconds}\end{array}\right]_{\mathsf{Accom}} \\ \textit{for more than an hour}\end{array}\right]_{\substack{\mathsf{Point} \to \mathsf{Activ}\\ \to \mathsf{Accom}}} \end{array}\right]_{\substack{\mathsf{Point}\to\mathsf{Achie}\\ \to\mathsf{Accom}}}$$

Figure 2.6: A very complex aspectual conversion.

It must be noted that transition along some of the edges is only permitted if certain syntactic, semantic or pragmatic conditions (universal or language-dependent) are met. In particular,

(2.61)
a. a move along the edge Point → Activ is only possible if the semantics of the event identifies it as repeatable;
b. a move along the edge Activ → Accom is permitted only if the context allows a culmination point to be associated with the process;
c. a move along the edge Point → Achie requires the availability of associated relevant consequences of the event;
d. a move along the edge Achie → Accom is dependent on the existence of a preparatory process;
e. a move along the edge Accom → Activ in English needs to be licensed by the presence of continuous tense, which means that it must be part of a route to the edge Activ → S(prg).

The last restriction entails that all verbal expressions which Vendler 1967 would classify as accomplishments, but which can cooccur with a *for*-adverbial (*play the sonata*, *read a book*, *climb Ben Nevis*), are really activities, but are coerced along the edge Activ → Accom unless protected by a continuous tense or a *for*-adverbial (since the default interpretation is the terminative one). As in the case in which a durative adverbial is present, the transition of this edge is accompanied by the conversion of the activity $^{+}\phi^{0}$ into (2.62),

(2.62) $$\textsc{pack}_{\mathcal{Q}}(\phi) = \lambda p^{1} [^{+}\phi^{0}(\downarrow p) \wedge \mathcal{Q}^{1}_{\phi}(p)]$$

where $\mathcal{Q}^{1}_{\phi}(p)$ stands for the fact that the natural boundary of the activity is reached in the interval p. As such the verbal expressions under consideration differ from the ones which enter the network already as accomplishments (*build a shed*) and can't normally receive a partitive interpretation.

(2.63) ??*John built a shed for several days.*

In the terminology of Dahl 1984, the T-property (existence of a terminal point) is set to a positive value for both sets of verbal expressions, but the value of the P-property (actual reaching of the terminal point) is initially negative for the former and positive for the latter set. In the absence of any morphosyntactic indications in English, however, it is far from obvious what in the nature of the processes or our knowledge of the world causes this difference.

One should note that the modifier causing a conversion may also influence, in terms of both quantity and quality, the side effects of the conversion. In all examples in (2.64–2.65) a lexical achievement is stretched to an accomplishment, but while the preparatory process added to the reaching of the top in (2.64a), which repeats (2.54a), may include the whole climbing, the one in (2.64b), which repeats (2.43b), includes only its very last stage (Glasbey 1993), and in the case of the finding of the keys the very possibility of stretching the event depends on the modifier, as shown by the comparison of (2.65b) and (2.65a), which repeats (2.54b):

(2.64)
a. *John reached the top in two hours.* — Achie → Accom
b. *John was reaching the top.* — Achie → Accom → Activ → S(prg)

(2.65)
a. *I found the keys in ten minutes.* — Achie → Accom
b.* *I was finding the keys.* — Achie → Accom → Activ → S(prg)

It seems that the stretching of an achievement to an accomplishment in these cases involves the inclusion of a preparatory process which is normally expressed by a different lexical item. Thus, the preparatory process associated with *find* is the activity denoted by *look for* (*search*, *seek*); *reach (the top)* can be stretched over the stage immediately preceding the culmination, but otherwise it is supplemented by *climb*. The result of this is that time-span expression can be applied, but progressivisation fails, as it requires 'looking into' a process which must remain unnamed.

There are some other problems with employing the network as defined for analysing English aspectual phenomena. For example, lexical and habitual states can cooccur with expressions of duration,

(2.66)
a. *For how long did you love her? For three years.*
b. *How long did you believe in the stork? Till I was seven.*

and in many cases so can progressive states,[13] although that appears to depend strongly on their derivation in ways which shall not be explored here.

(2.67)
a. *The milk was boiling for ten minutes.*
b.* *The milk was beginning to boil for ten minutes.*

There is, however, no path from any of the stative nodes to the Activ → Accom edge.

The lack of any connexion between the node S(lex) and the rest of the network also leaves open the problem of the handling of the inchoative reading of lexical states, which is not shared by progressive states. Quoting Ogihara 1990,

> We can say that a lexical stative sometimes appears to move narrative time forward because it allows the possibility that when it is asserted to be true at a certain interval I, it is the maximal interval at which it is true.

[13] Cf. Vendler 1967's remark: 'Accordingly, the question *For how long did he push the cart?* is a significant one [...]. And, of course, the corresponding answer will be *He was pushing it for half an hour*'. It is interesting that he doesn't comment upon the fact that his respondent switches from the past simple to the past continuous tense, though he certainly can't fail to realise it.

This reading can be triggered by connectives such as *when*:

(2.68) a. *I owned the yacht when Uncle Herbert died.*

b. *Macbeth believed in ghosts when he saw Banquo.*

According to the analysis of Moens & Steedman, the *when*-clause allocates the event which is the referent of the main clause somewhere in the preparatory process of its own referent or in its consequent state. If the main clause denotes a lexical state, it should be possible for it to be converted into an event expression.

Another problem is posed by the restrictions on the aspectual class of a stative *until*-clause:

(2.69) a. *'Tis held a great part of incivility for maidens to drink wine until they are married.* Howell, *Letters*

b. *He kept the window open until she was shivering from cold.*

c.* *He was unhappy until she was building him a house.*

Finally, there is no path from the stative nodes to the Achie → S(csq) edge, which leaves open the question how their perfect tenses are to be treated. This includes the perfect continuous tenses of all verbs which have them. The only available path goes to the Activ node, via Accom → Activ if necessary, and from there to S(csq) along the subpath Activ → Point → Achie → S(csq).

2.4 Aspect in Bulgarian

In this section I shall examine the aspect system of Modern Bulgarian, a language in which regular overt expression is given to some of the oppositions and conversion processes realised implicitly in many other languages. As we shall see, the impact of this feature is twofold: overt aspect marking obviates the need of a specific context for certain conversions, while its absence inhibits others, even in contexts which would be sufficient to enable them in English.

2.4.1 An overview of the aspect system

The most pervasive feature of the verb system of Bulgarian, shared with all other Slavic languages, is the division of all verbs into two **aspects**, known as **imperfective** and **perfective**.[14] All but about 50 of the primary verbs, and therefore also of the verb roots, in the language are imperfective.[15] There is also a recently formed class of **biaspectual** verbs, which can be interpreted as belonging to either aspect. The vast majority of them contain the loan suffix *-ira-* (cf. German *-ier-*).

An imperfective verb can be perfectivised by the addition of a preverb (of a choice of 18) or the inchoative/semelfactive/attenuative suffix *-n-*. (Only in a small number of cases the addition

[14] The verbs in the text are cited the second/third person singular aorist indicative (AOR.2/3SG in the glosses), as the morphologically simplest form, rather than the first person singular present indicative form (PRS.1SG), which is traditionally used for this purpose. The aspect, except in the glossed examples, is indicated by a superscript '$^{\rightarrow}$' for imperfective (I–VE) and '$^{\bigcirc}$' for perfective (P–VE).

[15] Among the exceptions are such highly frequent verbs as *vidja*$^{\bigcirc}$ 'see' ('become visually aware of, receive in one's visual field'), *kaza*$^{\bigcirc}$ 'say', *xvørli*$^{\bigcirc}$ 'throw', *dade*$^{\bigcirc}$ 'give' etc., whose perfective aspect is not revealed by the morphology and from which imperfective verbs are derived, e.g., *vižda*$^{\rightarrow}$ 'see' ('be visually aware of, have in one's visual field'). The existence of such exceptions is a feature shared by all Slavic languages, although the choice of stems varies from language to language, cf. Russian primary imperfective *videt'*, derived perfective *uvidet'* 'see'.

of a preverb to an imperfective verb is not correlated with a change of aspect, and there is also a small number of imperfective verbs containing the suffix *-n-*.)

As examples (2.70–2.71) show, from the primitive imperfective verb *pi*$^{\rightarrow}$ 'drink' there can be derived a large number of perfective verbs, each of which expresses a bounded event related to drinking.[16] The object of *pi*$^{\rightarrow}$, call it y, is the ingested liquid, and the same is true for the verbs in (2.71a–2.71b), although it is only for the ones in (2.71a) that the boundary of the event is set by the quantity of y. In (2.71c) the subject is still the drinker, as it is in the reflexives and reciprocals in (2.71e); in (2.71d) it is either the host or the liquid itself.

(2.70) *pi*$^{\rightarrow}$ 'drink y'

(2.71) a. (I) *izpi*$^{\bigcirc}$ 'drink up y'
(II) *dopi*$^{\bigcirc}$ 'drink the rest of y, finish the drinking of y'

b. (I) *napi*$^{\bigcirc}$ 'have the first swallow of y' ('drink on')
(II) *zapi*$^{\bigcirc}$ 'start drinking y'
(III) *propi*$^{\bigcirc}$ 'start drinking y for the first time or after a long pause'
(IV) *prepi*$^{\bigcirc}$ 'drink more (y) than one's fill, overdrink'
(V) *otpi*$^{\bigcirc}$ 'have a swallow/draught of y' ('drink off')
(VI) *pijna*$^{\bigcirc}$ 'drink a little y'

c. (I) *propi*$^{\bigcirc}$ 'squander y on drink, dissipate y, drink y away'
(II) *podpi*$^{\bigcirc}$ 'drink more than y could spare one, sponge on y for drink'
(III) *nadpi*$^{\bigcirc}$ 'drink more than y, outdrink y'
(IV) *dopi si* $^{\bigcirc}$'complete one's drinking, quench one's desire for alcohol'
RBFL-DAT

d. (I) *opi*$^{\bigcirc}$ 'make y drunk, intoxicate y'
(II) *napi*$^{\bigcirc}$ 'make y drunk, liquor y up'

e. (I) *zapi se*$^{\bigcirc}$ 'go on the guzzle'
(II) *propi se*$^{\bigcirc}$ 'take to drink, become a drunkard'
(III) *nadpi se*$^{\bigcirc}$ 'compete in drinking'
(IV) *opi se*$^{\bigcirc}$ 'get drunk, become intoxicated'
(V) *napi se*$^{\bigcirc}$ 'drink one's fill; get drunk'

A preverb can also be added to a perfective verb, affecting the lexical meaning, but not the aspect; the event is still bounded, but the boundary is further specified. While the impact of the first (perfectivising) preverb is often idiosyncratic, the interpretation of any further preverbs is strictly compositional: *po-*, for example, is attenuative, *do-* is completive.

(2.72) a. *poprepi*$^{\bigcirc}$ 'drink somewhat more (y) than one's fill, overdrink slightly'

b. *donapi se*$^{\bigcirc}$ 'get completely drunk, complete one's inebriation'

In theory there is no restriction on the number of preverbs in a single verb.

A perfective verb can be imperfectivised by the suffix *-(v)a-*, frequently accompanied by a change in the final root vowel; the verb *pijna*$^{\bigcirc}$ becomes *pijva*$^{\rightarrow}$ and the ones in *-pi*$^{\bigcirc}$ become

[16] The list only includes verbs whose meaning involves, in one way or the other, the ingestion of liquid, leaving out such verbs as *popi*$^{\bigcirc}$ 'absorb; soak in' or *propi*$^{\bigcirc}$ 'soak through', whose semantic connexion to the primary verb *pi*$^{\rightarrow}$ 'drink' is more remote.

-piva$^{\rightarrow}$. The secondary imperfective verb expresses the process of moving towards the boundary or the recurrence of its reaching.

The process of secondary imperfectivisation is productive and can be undergone by all verbs except those in whose derivation perfectivisation follows upon secondary imperfectivisation, such as *zaogležda*$^{\bigcirc}$ 'begin to look at (from all sides, carefully)' (inchoative derived from *ogležda*$^{\rightarrow}$, the result of the imperfectivisation of *ogleda*$^{\bigcirc}$ 'look at (from all sides, carefully)', derived in turn from the primary imperfective verb *gleda*$^{\rightarrow}$ 'look'). Such verbs are, however, not typical for the language; in addition, they can often be used as biaspectual, thus undergoing implicit tertiary imperfectivisation.

Apart from the genuine biaspectual verbs, there also exists a class of pairs of homonymous verbs which belong to different aspects by virtue of their derivation, such as *zaxvørlja*$^{\rightarrow/\bigcirc}$ or *nastava*$^{\rightarrow/\bigcirc}$, each of which, as shown in Figure 2.7, is the final point of two derivational paths. The vertical arrows indicate derivations which don't affect the aspect.

imperfective	→	perfective	→	imperfective	→	perfective
		xvørli	→	*xvørlja*	→	***zaxvørlja***
		'throw, hurl, cast'				'start to throw'
		↓				
		zaxvørli	→	***zaxvørlja***		
		'throw away, cast aside'				
stoja	→	*stana*	→	*stava*	→	***nastava***
'stand'		'stand up; become'				'stand up (coll.)'
		↓				
		nastana	→	***nastava***		
		'come, begin, fall (for an age or season)'				

Figure 2.7: The derivation of homonymous pairs of verbs of different aspect in Bulgarian.

2.4.2 Aspectual classes and Bulgarian aspect

One of the most frequently cited criteria for distinguishing between verbal expressions denoting the two classes of dynamic eventualities is the FIT-**criterion** (so named by Verkuyl 1989; the name comes from the initials of the three 'keywords' *from*, *in*, *take*). This criterion is based on the ability of the expressions to combine with certain constructions of temporal measure: energeiai (activities) do not take time-span adverbials (*in*-phrases or their equivalents), but they take durative adverbials (*for*-phrases or their equivalents), whereas kineseis (accomplishments) take time-span adverbials but not durative adverbials (the ones which seem to be able to are actually energeiai, according to the argument of Moens & Steedman).

(2.73) a. *I hung pictures for three minutes.*
b.* *I hung pictures in three minutes.*
c.* *It took me three minutes to hang pictures.*

(2.74) a.* *I hung the picture for three minutes.*
b. *I hung the picture in three minutes.*
c. *It took me three minutes to hang the picture.*

In Bulgarian the distribution of expressions of temporal measure is correlated with the aspect of the verb. The correlation finds its most consistent realisation in the two synthetic past tenses, the aorist and the imperfect.[17] Of these the aorist, the principal narrative tense, locates an event in a moment or interval in the past; the imperfect is a scene-setting tense, which states that an ongoing or recurring eventuality is taking place in a moment or interval. The imperfect of a perfective verb may not appear as the head of a main clause.

In a clause headed by a verb in the aorist the imperfective or perfective aspect of the verb determines whether the clause may contain a durative adverbial (in Bulgarian a bare noun phrase, corresponding to a *for*-phrase in English) or a time-span adverbial (a phrase introduced by the preposition *za*, which corresponds to the English *for* in benefactives and in expressions of purpose and of price, but to *in* in expressions of temporal measure;[18] I shall use 'ZA' in the glosses, since using either *for* or *in* would be misleading). A clause headed by a verb in the imperfect tense (the paradigmatic counterpart of the operation of progressivisation) can take neither a durative nor a time-span adverbial.

(2.75) a. (I) *Piex vino.*
drink-I–VB/IPF-1SG wine
'I was drinking wine.'

(II) *Piex vino, kogato Irina vleze.*
drink-I–VB/IPF-1SG wine when enter-P–VB/AOR-3SG
'I was drinking wine when Irene came in.'

(III) *Piex vino, dokato Irina pleteše.*
drink-I–VB/IPF-1SG wine whilst knit-I–VB/IPF-3SG
'I was drinking wine whilst Irene was knitting.'

b. *Pix vino (trideset minuti).*
drink-I–VB/AOR-1SG wine 30 minutes
'I drank wine (for 30 minutes).'

c. *Izpix vinoto (za trideset minuti).*
drink (up)-P–VB/AOR-1SG the wine ZA 30 minutes
'I drank the wine (in 30 minutes).'

Note the obligatory use of the definite article, the existence of whichis a feature which sets Bulgarian apart from the rest of the Slavic branch, on the object in (2.75c), ***vinoto*** '**the** wine'. The existence of a definite article, along with the correlation between aspect and temporal adverbials, allow the aspectual class of each individual occurrence of a biaspectual verb (and consequently also its aspect) to be derived from the context, in essentially the same way as it is done for all verbs in languages such as English (Kabakčiev 1992):

[17] In the future and the future-in-the-past the distinction between the two types of atelic eventualities is neutralised.

[18] A certain semantic parallel can be perceived between the uses of *za* in expressions of price and expressions of time span. Compare:

- *Kupix*$^{\bigcirc}$ *vinoto za trideset liri.* 'I bought the wine *for* 30 pounds.'
('Buying the wine cost me 30 pounds.')
- *Izpix*$^{\bigcirc}$ *vinoto za trideset minuti.* 'I drank the wine *in* 30 minutes.'
('Drinking the wine took me 30 minutes.')

(2.76) a. *Analiziraxme danni tri časa.*
analyse-I–VB/AOR-1SG data 3 hours
'We analysed data for 3 hours.'

b. *Analiziraxme dannite tri časa.*
analyse-I–VB/AOR-1SG the data 3 hours
'We analysed the data for 3 hours.'

c. *Analiziraxme dannite za tri časa.*
analyse-P–VB/AOR-1SG the data ZA 3 hours
'We analysed the data in 3 hours.'

The same distribution of expressions of temporal measure obtains for semantically stative verbs. In the Bulgarian counterparts of the sentences in (2.66) the verbs are in the aorist:

(2.77) a. *Kolko dølgo ja običa? — Tri godini.*
how much long her-ACC love-I–VB/AOR-2/3SG 3 years

b. *Kolko dølgo vjarva v štørkela?*
how much long believe-I–VB/AOR-2/3SG in the stork
— Dokato stanax na sedem godini.
until become-P–VB/AOR-1SG on 7 years

The imperfect can cooccur with a temporal adverbial only if it expresses an ongoing iteration (and then the expression of temporal measure refers to each individual occurrence of the iterated event rather than the entire series) or the durative adverbial measures the duration of the state from its beginning to the moment in the past where it is registered.

(2.78) a. *Piex vino trideset minuti.*
drink-I–VB/IPF-1SG wine 30 minutes
'I used to drink wine for 30 minutes.'

$$^{*\prime}(\lambda p[D^0(\downarrow p) \wedge \mathcal{Q}_{30\,\mathrm{min}}(p)])(t)$$

b. *Izpivax vinoto za trideset minuti.*
drink (up)-I–VB/IPF-1SG the wine ZA 30 minutes
'I used to drink the wine in 30 minutes.'

$$^{*\prime}(\lambda p[D^1(p) \wedge \mathcal{Q}_{30\,\mathrm{min}}(p)])(t)$$

(2.79) a. *Kolko dølgo ja običaše?*
how much long her-acc love-I–VB/IPF-2/3SG
'For how long had you loved her?'

b. *Kolko dølgo vjarvaše v štørkela?*
how much long believe-I–VB/IPF-2/3SG in the stork
'How long had you believed in the stork?'

In light of the acknowledged status of the imperfect, the morphologically more complex tense, as the marked member of the opposition 'aorist : imperfect' in Bulgarian (Tommola 1991), its formation is to be associated with a transition of the edge Activ → S(prg). A conclusion from this is that Bulgarian, strictly speaking, has no lexical states. All atelic predicates start life as energeiai and are progressivised when necessary.

Thus the dichotomy of the two aspects parallels the distinction between energeiai and kineseis (including accomplishments, achievements and points). It follows that the conversions between the various types of kineseis are implicit in Bulgarian, as they also are in English, but a conversion of an energeia into a kinesis (except for one realised by a duration expression) necessarily materialises as perfectivisation, and a conversion of a kinesis into an energeia materialises as imperfectivisation.

The first of these processes, perfectivisation, carries with itself a shift in lexical meaning. It is essentially a change of the mode of action, by which a spatial orientation, a specific intensity, a degree of involvement of the arguments in the event or such circumstantial features as completion or recurrence can be specified, setting conditions which are to be met by the event as a whole (i.e., as a group). The variety of morphological means by which the conversion can be realised reflects the multitude of ways in which a terminal point can be set. The mode of action of each of the derived perfective verbs is associated with a certain (though possibly vaguely determined) quantity of the process (in the terminology of Dahl 1984, the setting of the T-property to a positive value). In general it can be said that the energeia expressed by the imperfective verb, represented as $^{+}\phi$, is thereby packaged to the form in (2.80). The condition symbolised by $\mathcal{Q}$ is contributed by the change of mode of action.

(2.80)
$$\mathrm{PACK}_{\mathcal{Q}}(\phi) = \mathcal{Q}^1_{\phi}$$

The conversion of the verb to the perfective aspect, associated with this condition, signifies the requirement for the terminal point to be actually reached (the simultaneous setting of the P-property to a positive value).

By contrast, in accordance with the fact that a kinesis has a unique culmination, and therefore there is a unique energeia which results from its elimination, Bulgarian morphology provides a single means for expressing the conversion. Imperfectivisation is limited to aspect, which is to say that it is not associated with a change of the mode of action; the terminal point is still set in the same way, but the requirement for its reaching is waived (the P-property is reset to a negative value).

(2.81) a. *Včera toj dostroi edna baraka.*
yesterday he-NOM build-P–VB/AOR-3SG one-SG.F cabin
'Yesterday he completed the building of a cabin (which he or someone else had started earlier).'

b. *Včera toj dostrojava edna baraka.*
yesterday he-NOM build-I–VB/AOR-3SG one-SG.F cabin
'Yesterday he spent some time completing the building of a cabin.' (It doesn't matter whether he actually did complete it.)

The derivational processes are sufficient conditions for conversion; in particular, a transition along the edge Accom → Activ does not require progressivisation or the presence of an expression of duration. The sentence in (2.82b), the Bulgarian counterpart of (2.74a), is well-formed, and it conveys the meaning that the speaker has spent three minutes hanging the picture, without any commitment as to the outcome of the effort:

(2.82) a. *Zakačix kartinata za tri minuti.* $H^1(t^1)$
hang-P–VB/AOR-1SG the picture ZA 3 minutes

b. *Zakàčax kartinata tri minuti.* $^{+\prime}H(\downarrow t^1)$
hang-I–VB/AOR-1SG the picture 3 minutes

On the other hand, the derivational processes are also necessary conditions for transition, and pragmatics alone doesn't have the power to set a culmination point to an event expressed by a clause headed by an imperfective verb. The inclusion of a time-span expression into such a clause yields an ungrammatical sentence:

(2.83)* *Bjagax za njakolko minuti.* cf. (2.54c·II)
run-I–VB/AOR-1SG ZA several minutes

This immediately leads to the question of the fate of the unlabelled edge Activ → Point, since its transition would require perfectivisation with preservation of the mode of action. This edge was mentioned in the context of the following four paths:

Activ → Point → S(hbt); Activ → Point → Achie → S(csq);

Activ → Point → Activ → Accom; Activ → Point → Achie → Accom.

The fourth of these conversions has no counterpart in Bulgarian, where (2.54c·I) can only be translated using a prepositional phrase headed by *sled* 'after', not a *za*-phrase. The counterparts of the others involve no perfectivisation, so they must be considered to be following different routes.

(2.84) a. *Šaro lae (često).* cf. (2.33)
bark-I–VB/PRS-3SG often

b. *Rabotil søm v gradinata.* cf. (2.57c)
work-I–VB/PRF-1SG in the garden

c. *Marija sviri na piano tri godini.* cf. (2.52a)
play-I–VB/AOR-3SG on piano 3 years

Let us first consider example (2.52a/2.84c), the most plausible reading of which is the iterative one. It indicates the recurrence of the event of Mary playing the piano, that is, the existence of a series (a group) of intervals, over each of which an event of that type takes place. The entire event can be adequately represented as a plural temporal entity. Ignoring the duration adverbials, (2.50a) is represented as ${}^{+}\mathrm{P}^{0}(\mathrm{t}^{1})$ and (2.52a) as ${}^{+}\mathrm{P}^{0}(\mathrm{t}^{2})$, considering that the superposition of two pluralisation operators would be redundant. The predicate P, which belongs to type 0, is lifted once in (2.50a) and twice in (2.52a). Indeed, example (2.85), the Bulgarian counterpart of (2.50a), features the same imperfective verb as (2.84c).

(2.85) *Marija sviri na piano trideset minuti.*
play-I–VB/AOR-3SG on piano 30 minutes

On the other hand, if the recurrent event is a kinesis, its conversion to an energeia is reflected in the imperfectivisation of the verb.

(2.86) a. *Zakačix si paltoto na pirona.* Achie
hang-P–VB/AOR-1SG REFL-DAT the coat on the nail
'I hung my coat on the nail.' $\mathrm{H}^{1}(\mathrm{t}^{1})$

b. *Zakàčax si paltoto na pirona tri godini.* Achie → Activ
hang-I–VB/AOR-1SG REFL-DAT the coat on the nail 3 years
'I hung my coat on the nail for three years.' ${}^{+}\mathrm{H}^{1}(\downarrow\mathrm{p}^{2})$

In view of the absence of any syntactic distinction between habituals and progressives (including progressivised iteratives) in Bulgarian, the route Point → Activ → S(prg) can be recognised as a substitute for Point → S(hbt).

Finally, the imperfective aspect of the verb in (2.84b) indicates that a transition of the edge Activ → S(csq) need not include a conversion to a kinesis, and consequently a separate arch for this transition is required. The preservation of the opposition of aspect in the perfect tenses leads to a distinction not made by the English perfect (unless the perfect continuous is taken into account). Of the following two examples (2.87a) means that there is a shed that John has built, while (2.87b) means that John has the experience of having performed, or partaken in, the action of building a shed, although no shed built by him need actually exist.

(2.87) a. *Ivan e postroil baraka.*
build-P–VB/PRF-3SG shed
'John has built a shed.'

b. *Ivan e stroil baraka.*
build-I–VB/PRF-3SG shed
ditto

With all this having been said, the question of the content of the class of points deserves serious consideration. In Bulgarian semelfactive verbs (*migna* 'blink (once)', *izlaja* 'bark (once)') are morphologically complex, being derived by perfectivisation of the corresponding verbs which denote an undetermined quantity of the action (*migam* 'blink', *laja* 'bark'). The associated derivational process could be regarded as a move along a *qualified* edge Activ → Point, but morphologically it is no different from the formation of an inchoative or a terminative verb (Activ → Achie or Activ → Accom). The treatment of semelfactives as achievements is also justified by the fact that the perfect tense is much more readily formed from any verb in Bulgarian than it is in English; in other words, there is always a consequent state (be it the experience of any of the participants of the event, indirect evidence or hearsay).[19] In terms of the network as presented in Moens & Steedman 1988 this could mean that Achie → S(csq) unconditionally invokes Point → Achie. However, the need of the recognition of points as a separate aspectual class in Bulgarian is seriously undermined.

The network thus assumes the form in Figure 2.8. Two dashed boxes set events (the domain of the aorist) and states apart from one another in the diagram; within the class of events another dashed box groups the two classes of kineseis together, and the edges to and from it are shared by both. The edge corresponding to the addition of a preparatory process to an achievement, Achie → Accom, is the only labelled edge whose transition is not reflected in the morphology.

2.5 Aspect in Chinese

In this section I shall look briefly at the aspect system of Mandarin Chinese, a language in which overt aspect marking is syntactically optional in many contexts, but which none the less possesses a highly complex system of aspectual categories, realised by both derivational and inflexional strategies.

[19] Cf. the loss of the aorist and the imperfect as a result of their gradual replacement by the perfect in most other Slavic languages, or the severe restriction of the use of the tense corresponding to the aorist (passé simple, passato remoto) in most spoken forms of French and Italian.

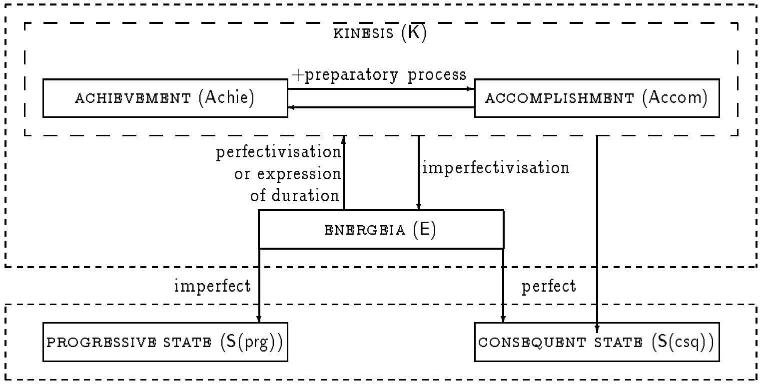

Figure 2.8: The aspectual network for Bulgarian.

2.5.1 Aspectual derivation

According to the structure of the stem, the verbs of Mandarin Chinese can be divided into **primary verbs** (mostly monomorphemic ones) and **resultative verb compounds**, which consist of a primary verb and a **resultative verb complement**. As shown by the examples in Table 2.4, the resultative verb complement can be a subordinate verb or adjective characterising the culmination or the consequent state of the event or an adverb indicating, possibly metaphorically, the direction of the process denoted by the primary verb.

primary verb		resultative complement		resultative compound	
kàn	'look'	*míngbai*	'understand'	*kànmíngbai*	'read and understand'
zǒu	'walk'	*kāi*	'open'	*zǒukāi*	'walk away'
hē	'drink'	*zuì*	'(be) drunk'	*hēzuì*	'get drunk'
è	'(be) hungry'	*sǐ*	'die'	*èsǐ*	'starve to death'
shā	'kill'	*sǐ*	'die'	*shāsǐ*	'kill'
xiě	'write'	*hǎo*	'(be) good'	*xiěhǎo*	'write properly'

Table 2.4: Perfectivisation in Chinese.

A resultative complement can be adequately compared to a perfectivising preverb in languages such as Bulgarian. As Tai 1984 observes,

> Accomplishment verbs in English, when in past or perfect tenses, necessarily imply an attainment of the goal. Their supposed equivalents in Chinese do not contain such an implication as an inherent part of the meaning, even though the implication in question can sometimes emerge from the composite meaning of the whole predicate or the context explicitly or implicitly provided. To ensure the attainment of the goal, Chinese resorts to resultative verb compounds [...].

In my view Tai's accomplishment verbs are lexical activities, which are converted into accomplishments by the formation of a resultative compound.

One difference between the two languages is that while in Bulgarian the perfective verb is generally lexicalised, in Chinese the resultative verb compound is usually created by the speaker on the fly (Cartier 1972), and there is often a choice of several complements with nearly identical meaning; thus, both *hēguāng* and *hēdiào* mean 'drink up (a certain amount of liquid)'.

2.5.2 Aspectual inflexion

Apart from the stem, a verb form in Mandarin Chinese may contain an aspect marker, which can be one of the three suffixes *-le*, *-guo* or *-zhe* and the preverbal stativiser *zài* (*zhèng*, *zhèngzài*), which may cooccur with *-zhe*. An unmarked primary verb may have the semantics of a state, an energeia or a momentary kinesis (point or achievement). Both the semantics of the stem and the aspect marker, if one is present, contribute towards the formation of the aspectuality of the inflected verb form.

Examples (2.88) present the Chinese counterparts of (2.75):

(2.88) a. (I) *Wǒ zài hē jiǔ.*
I be at drink wine
'I was drinking (the) wine.'

(II) *Àilíng jìnlái shí wǒ zhèngzài hē jiǔ.*
enter-come time I just be at drink wine
'I was drinking (the) wine when Irene came in.'

(III) *Àilíng zài biānzhī, wǒ (tóngshí) zài hē jiǔ.*
be at knit I then be at drink wine
'I was drinking (the) wine whilst Irene was knitting.'

b. *Wǒ hēle (sānshí fēn de) jiǔ.*
I drink-AOR 30 minute 's wine
'I drank wine (for 30 minutes).'

c. *Wǒ (zài sānshí fēn nèi) hēdiàole jiǔ.*
I at 30 minute within drink-consume-AOR wine
'I drank the wine (in 30 minutes).'

In examples (2.88a) the auxiliary verb *zài* 'be at', preceded or not by the adverb *zhèng* 'just', identifies the eventuality as a **progressive** state. This marker may cooccur or (usually in a subordinate clause) alternate with the **stative** suffix *-zhe*, which indicates a **resultative** consequent state (specifically a reversible physically observable one) when used on its own.

(2.89) a. *Tā kāile mén.* Activ-*le*
(s)he open-AOR door
'(S)he opened the door.'

b. *Mén kāizhe.* Activ → S(res)
door open-RES
'The door is opened.'

The progressive construction is not formed from lexical achievements and resultative verb compounds.

(2.90)* *Tā zài sǐ.*
(s)he be at die
('(S)he is dying.')

(2.91) a. *Wǒ zài xué zhōngwén.* Activ → S(prg)
I be at study Chinese
'I am studying Chinese.'

b.* *Wǒ zài xuéhuì zhōngwén.*
I be at study-know Chinese
('I am learning Chinese.')

(2.92) a. *Wǒ zài shā ta.* Activ → S(prg)
I be at kill (s)he
'I am killing him/her.'

b.* *Wǒ zài shāsǐ ta.*
I be at kill-die (s)he

There are a few exceptions, presented by Cartier 1972, who notes that the suffix *-zhe* is still incompatible with the verbs in question. Some of her examples follow.

(2.93) *Nǐ zài diū dōngxi ne.* Achie → S(prg)
thou be at lose thing still
'Thou art [in the process of] losing something.'

(2.94) Activ → Accom → S(prg)

a. *Tā zhèngzài yòng shítou nòngsǐ yī tiáo chīhuò.*
(s)he just now be at use stone kill 1 strip caterpillar
'(S)he is killing a caterpillar with a stone.'

b. *Tā zhèngzài pǎoguòlai.*
(s)he just now be at run-come
'(S)he is coming running.'

In (2.88b–2.88c) the **perfective** marker *-le* labels the eventuality as a single event (as opposed to a state) taking place prior to the reference time.[20] My glossing of *-le* as -AOR is based on the fact that this function is shared by the Bulgarian aorist, as we saw in Section 2.4.

The suffix *-le* also serves to indicate the conversion of a lexical state into an energeia, in particular for the purpose of its further conversion to a kinesis by the addition of a durative adverbial, as in (2.95b). Such adverbials may not cooccur with states, including resultative states, as shown by the ungrammaticality of (2.96b); (2.96c) could be paraphrased as '[Since the doors] were closed, several days [passed]'.

(2.95) a. *Tā zhù zài xiāngxia.* S(lex)
(s)he live at village
'(S)he lives in the countryside.'

b. *Wǒ zài nàli zhùle liǎng ge yuè.* S(lex) → Activ → Accom-*le*
I at there live-AOR 2 item month
'I lived there for two months.'

(2.96) a. *Miào mén hái guānzhe.* Activ → S(res)
temple door still close-RBS
'The temple doors are still closed.'

[20] Since Chinese lacks tense, the position of the reference time relative to the utterance time is not overtly expressed.

b.* *Guānzhe jǐ tiān mén.*
close-RBS several day door

c. *Guānle jǐ tiān mén.* Activ-*le*
close-AOR several day door
'[The temple] was closed for a few days.'

There is a fourth marked aspectual category, that of **experiential** (**irresultative**) states—a particular variety of consequent states, characterised by the fact that the eventuality has taken place (has been experienced), but no tangible result state obtains any longer. It is identified by the experiential suffix *-guo*.

(2.97) *Wǒ hēguo jiǔ le.* Activ → S(exp)
I drink-BXP wine already
'I have drunk wine. (I have had the experience of drinking wine.)' cf. (2.88b)

(2.98) a. *Wǒ kànjianle nǎ wèi làotóur.* Activ → Accom-*le*
I look-perceive-AOR that person old man
'I saw that old man.'

b. *Nǎ wèi làotóur nǐ kànjianguo ma?* Activ → Accom → S(exp)
that person old man thou look-perceive-BXP ?
'Hast thou (ever) seen that old man?'

In the absence of any of these overt markers the aspectual class is determined on the basis of the semantics of the stem and the context. Quoting Smith 1991, who uses the term **viewpoint (aspect)** for the semantic correlate of the morphologically marked category in Chinese,

> Viewpoint morphemes are syntactically optional; as a result the neutral viewpoint is in principle always available. The choice of an explicit viewpoint morpheme thus carries a certain emphasis not available in languages in which viewpoint is syntactically obligatory.

Overt aspect marking is incompatible with a narrow class of stative verbs (*cúnzài* 'exist', *zhàn* 'stand') and, for all other verbs, with certain syntactic environments (e.g., subordination). Null marking is also the only available option for events in the future of the reference time and for habitual states.

(2.99) a. *Měige rén huì sǐ(*le).*
every item man can die
'Every man is mortal.'

b. *juéxīn gǎizhèng(*le) zhèxie quēdiǎn cuòwù*
be determined correct these fault error
'be determined to correct these faults and errors'

(2.100) a. *Tā xiěle yì fēng xìn.* Activ-*le*
(s)he write-AOR 1 sheet letter
'(S)he wrote a letter.'

b. *Tā měi tiān xiě yì fēng xìn.* Activ → S(hab)
(s)he every day write 1 sheet letter
'(S)he wrote a letter every day.'

Lexical points can be iterated implicitly; the fact of the conversion does not become evident until it is followed by another conversion particular to energeiai, such as progressivisation.

(2.101) a. *Tā kòule mén.* Point-*le*
(s)he knock-AOR door
'(S)he knocked at the door.'

b. *Tā zài kòu mén.* Point → Activ → S(prg)
(s)he be at knock door
'(S)he was knocking at the door.'

The network for Chinese so obtained looks as in Figure 2.9. In order to avoid overloading the

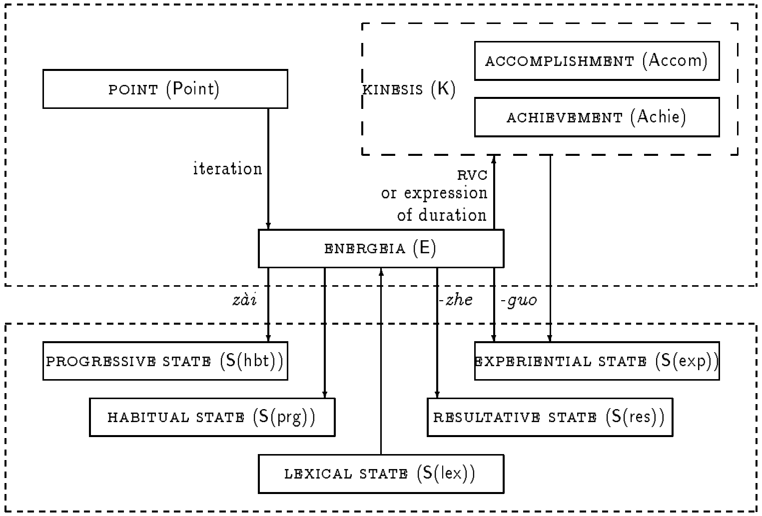

Figure 2.9: The aspectual network for Chinese.

diagram, the edges Achie → S(prg) and Accom → S(prg), which are explored only exceptionally, as in examples (2.93–2.94), have been eliminated.

Two dashed boxes set events (the domain of the optionally used verb suffix *-le*) and states apart from one another; within the class of events another dashed box groups the two classes of kineseis together, and the edges to and from it are shared by both. It is to be noted that those two nodes are not connected; achievements are not stretched over intervals, which accounts for their failure to cooccur with expressions of time span.

(2.102)* *Èsǐ huāle ta sānge yuè.*
hungry-die take-AOR him three item month
('(S)he starved to death in three months.')

The failure of resultative compounds to progressivise indicates that there is no secondary imperfectivisation either; a culmination may not be removed from the eventuality contour, nor can a telic eventuality be iterated.

(2.103)* *Tā měi tiān xiěwán yì fēng xìn.* cf. (2.100b)
(s)he every day write-finish 1 sheet letter

Thus the only conversions within the class of events are the implicit iteration of points and the perfectivisation of energeiai realised as the formation of resultative compounds or accompanying the addition of an expression of duration.

2.5.3 Negation: a durativiser?

It has been stated by several authors that negation should be treated as a kind of stativiser—a modifier which converts an eventuality of any aspectual class into a negative state. This consideration is based on the observation that negative clauses show durative aspectual behaviour, for example with respect to cooccurrence with expressions of duration, even when their affirmative counterparts do not. This implies that (2.104a) and (2.104b) are both well-formed, while (2.104c) is not, because *not wake up* shares the atelicity of *sleep*, parting ways with the telic *wake up*.

(2.104) a. *She slept for fourteen hours.*
b. *She didn't wake up for fourteen hours.*
c.* *She woke up for fourteen hours.*

This approach is formally correct, byt hardly intuitive. The statement actually made by a negative clause is not that there is a $\neg\phi$-eventuality (whatever that might be) obtaining in the relevant interval, but that there isn't any ϕ-eventuality obtaining anywhere within it. A spatial analogy might serve to illustrate the conceptual difference between the two logically equivalent statements. Consider examples (2.105–2.106):

(2.105) a. *The box is full of gold.*
b.* *The box is full of a ring.*

(2.106) a. *There is no gold in the box.*
b. *There is no ring in the box.*

All of these examples attempt to make a statement with respect to the entire volume of the box, and three of them actually succeed in doing so. The reason for the failure of the fourth is that *a ring*, as a singular count term, denotes a substance of fixed size, which can't fill an arbitrary volume, unlike the stuff denoted by *gold*. One can see, however, that there is no such distinction between the absence of a stuff and the absence of a substance. Now, as pointed out by Taylor 1977 (Subsection 2.2.2), atelic eventualities fill time in a way similar to the one in which stuffs fill space, while telic eventualities and substances delimit, instead of filling, temporal or spatial areas of fixed size. Saying that a negated telic eventuality becomes atelic is akin to saying that *no ring* is a mass term and example (2.106b) describes the box as full of a particular stuff, namely 'no_ring', 'ringlessness' or whatever one might choose to call it. One shouldn't have to make such a counterintuitive assertion in order to be able to say that no part of the volume of the box contains a ring. In the same way it should be possible to say that no part of an interval is a time of a ϕ-eventuality, without committing oneself to the view that the whole interval is thereby the time of a $\neg\phi$-eventuality. Negation need not be a durativiser, any more than it is an amassifier.

Note also that negated predicates are formally not durative; they are not cumulative, which durative predicates always are. The inference

(2.107) $$\forall t_1 \forall t_2 [\phi(t_1) \wedge \phi(t_2) \rightarrow \phi(\uparrow(\downarrow t_1 \sqcup \downarrow t_2))]$$

does not hold if ϕ is the negation of a telic eventuality. Indeed, if I hung a picture in a certain interval, *not hang a picture* is something I did in either half of that interval (this is part of what it means for the accomplishment to be quantised), but the same can not be said of the whole. In the same way the predicate *no_apple* holds for each of the two halves of an apple, but not for the entity composed of them, since the whole apple is not a no_apple.

Chinese is a language which presents tangible evidence against the treatment of negation as a durativiser. Consider the examples:

(2.108) a. *Tánle liǎngge xīngqī de qín.*
play-AOR 2 item week 's lute
'(I) played the lute for two weeks.'

b. *Méi tán liǎngge xīngqī de qín, zhǐ tánle sān tiān.*
haven't play 2 item week 's lute only play-AOR 3 day
'(I) didn't play the lute for two weeks, (I) only played for three days.'

c. *Liǎngge xīngqī méi tán qín.*
2 item week haven't play lute
'For two weeks, (I) didn't play the lute.'

In (2.108b) *méi* negates *tán liǎng ge xīngqī de qín* 'play the lute for two weeks'. The sentence has no interpretation which would attribute the duration expression *liǎng ge xīngqī* 'two weeks' to *méi tán qín* 'didn't play the lute', which shows that this latter is not, in fact, an atelic predicate. This doesn't, however, prevent one from saying that no event of *tán qín* 'playing the lute' occurred within a period of *liǎng ge xīngqī* 'two weeks', which is what happens in (2.108c).

The Chinese counterparts of (2.104a–2.104b) show the same characteristic variation in the constituent order: the time adverbial is in postverbal position in the affirmative sentence and in preverbal position in the negative one.

(2.109) a. *Tā shuìle shísìge zhōngtóur.*
(s)he sleep-AOR 14 item hour

b. *Tā shísìge zhōngtóur méi xǐnglái.*
(s)he 14 item hour haven't wake-come

It is of particular interest to observe that the position of the duration expression in (2.108c) and (2.109b) is the same as it occupies in sentences containing a frequency adverbial.

(2.110) a. *Zuótian wǒ dúle sān cì kèwén.*
yesterday I read-AOR 3 time(s) text
'Yesterday I read the text three times.'

b. *Shàng yuè wǒ jiànguo ta sān cì.*
up month I perceive-EXP him/her 3 time(s)
'Last month I saw him/her three times.'

This suggests that, rather than a durativiser, at least in Chinese negation is a kind of frequency specifier, indicating, as it were, 0 occurrences of the negated eventuality.

2.6 Summary

The purpose of this chapter was to explore the application of the theory of plurality to the domain of eventualities.

I examined a number of aspectual oppositions (atelic and telic eventualities, energeiai and kineseis, achievements and accomplishments) in order to support my contention that the concepts, categories and operations defined in the theory are indeed well suited for representing the individual aspectual classes and the processes of conversion between them. The correspondence between the aspectual categories recognised in natural languages and the formal tools of the theory is summarised in Table 2.5.

atelic eventuality	sum; plural (cumulative) predicate
• state	• ordinary plural
• energeia (activity)	• proper plural
telic eventuality	atom or group; singular (quantised) predicate
• instantaneous event (point or achievement)	• predicate of type 0
• accomplishment	• predicate of type 1 or higher
imperfectivisation	
• iteration	pluralisation
• removing a culmination	atomisation + pluralisation
perfectivisation	
• formation of semelfactive	atomisation
• setting a terminal point	conjunction with a predicate of a higher type

Table 2.5: The formal representation of verbal aspectuality.

I endeavoured to show that the intuitive analogy between nominal and verbal aspectual classes (mass terms and energeiai, count terms and kineseis, plurals and iteratives, singulatives and semelfactives etc.) can be given a straightforward formal expression in the framework, as can be seen from a comparison of the diagrams in Figure 1.6 and Figure 2.5. Some of the parallels, such as the one between the formation of representative plurals and the 'stretching' of achievements into accomplishments, are only interesting in so far as they illustrate the extent of the analogy between the two domains. Others, however, are directly relevant for the treatment of aspectual composition, as we shall see from the discussion in the final chapter.

Chapter 3

Aspectual Composition

Consider the following sentences:

(3.1) *John shot a zebra (*for/*in an hour).*

(3.2) a. *John shot zebras.*
b. *John carried a zebra.*

(3.3) a. *John shot seven zebras.*
b. *John brought a zebra.*

The sentences in examples (3.2a) and (3.3a) are headed by the same verb as the one in (3.1), the lexical achievement *shoot*, while the ones in (3.2b) and (3.3b) share with (3.1) the object *a zebra*. The aspectual criteria discussed in Chapter 2 (such as cooccurrence with temporal adverbials), however, identify (3.1) as an achievement, (3.2a–3.2b) as activities and (3.3a–3.3b) as accomplishments, showing that the temporal constitution of the **eventuality** which constitutes the semantic content of a clause is derived from the interaction of the reference properties of all of its constituents, in the process of what Verkuyl 1989 calls **aspectual composition**. This interaction is not a random one; the transitions of the formal representations of the aspectual class of the eventuality between (3.1), (3.2a) and (3.3a) within the diagram in Figure 2.4 replicate the corresponding transitions for the reference type of the object within the analogous diagram in Figure 1.6.

type			$\longrightarrow$	type		
2	$\boxed{\textit{seven zebras}}$			1	$\boxed{\text{(3.3a): accomplishment}}$	
1	$\boxed{\textit{a zebra}}$	$\boxed{\textit{zebras}}$		0	$\boxed{\text{(3.1): achievement}}$	$\boxed{\text{(3.2a): activity}}$

Figure 3.1: Transfer of reference types for the object of *see*.

The relevance of the aspectual properties of a nominal constituent to the aspectuality of the clause is determined by the way in which the entity denoted by it participates in, or is related to, the eventuality expressed by the clause in which it occurs, that is, by the properties of what is commonly referred to as its **thematic role** (**thematic relation**, **semantic relation**).

In this chapter I shall discuss the application of the formal tools presented in Chapters 1 and 2 for the development of an account for aspectual composition which makes use of the parallelism in the representation of reference properties in the two domains.

The status and interpretation of the fundamental concepts of eventuality and thematic role and the relations between them will be in the focus of my attention in the first section of the exposition. The subsequent sections shall be devoted to the use of thematic roles specifically for analysing the composition of aspectual properties.

3.1 Eventualities and Thematic Roles

Within formal semantics there can be said to exist two theories of predicates and arguments, a contrast between which is drawn in Dowty 1989 and in Chierchia & McConnell-Ginet 1990. The two theories differ in the position assumed in them on whether n-place predicates are a basic concept, in terms of which thematic roles are defined, or *vice versa*.

3.1.1 Ordered argument systems

In an **ordered argument system** a verb denotes a relation of fixed arity, following the standard mechanism of formal predicate logic.

(3.4) $$\phi'(x_1, \ldots, x_n)$$

Here ϕ' is the n-place predicate to which the system maps an expression of natural language. For example, the sentence in (3.4a) is assigned the representation in (3.4b).

a. *Jones buttered the toast with a knife in the bathroom at midnight.*
b. $\text{butter}'(t, k, b, m, j)$

The order by which the arguments of the pentadic predicate 'butter′' are identified is chosen arbitrarily when the predicate is defined.

A **specific** (**individual**) **thematic role** θ_i^ϕ of an n-ary predicate ϕ', where $0 < i \leq n$, is the set of all properties which can be entailed from (3.4) regarding the ith argument of ϕ'.

(3.5) $$\theta_i^\phi = \{\alpha \mid \Box[\phi'(\ldots, x_i, \ldots) \to \alpha(x_i)]\}$$

For example, it is possible to define a specific thematic role called 'butteree', consisting of everything that can be concluded about something on the basis of the knowledge that it appears in the first argument position of the predicate 'butter′' encountered in (3.4b), i.e., the knowledge of the fact that someone butters it with something, somewhere and at some time.

(3.6) $$\theta_1^B = \{ \alpha \mid \Box[\exists x_2 \exists x_3 \exists x_4 \exists x_5 [\text{butter}'(x_1, x_2, x_3, x_4, x_5)] \to \alpha(x_1)] \}$$

If the ith position of the predicate ϕ' has been assigned the thematic role θ_i^ϕ, an expression in the ith argument position of ϕ' is referred to as the **bearer** of θ_i^ϕ. In example (3.4a) *the toast* is the bearer of the butteree role.

A **thematic role (type)** is then defined as the intersection of a number of specific thematic roles. In the following formula Σ is a set of ordered pairs of predicates and positions in their argument frames and θ_Σ is a thematic role type based on Σ.

(3.7) $$\theta_\Sigma = \bigcap_{\langle\phi, i\rangle \in \Sigma} \theta_i^\phi$$

The set Σ should be chosen so that θ_Σ contains at least one property other than the trivial $\lambda x \exists \phi \exists i [\langle \phi, i \rangle \in \Sigma \wedge \phi'(\ldots, x, \ldots)]$ with x in the ith position of ϕ'. This means, for example, that a hypothetical thematic role based on the specific roles borne by the subjects of the two verbs *like* and *please*, call them θ_2^L and θ_2^P, would be useless for all practical purposes, because almost nothing could be guaranteed about its bearer apart from the trivial fact that, by virtue of the definition of the role, it either likes something or pleases someone.

There are two further conditions, derived from the way in which thematic roles are employed in linguistic descriptions, which should be met by a system of thematic role types:

(3.8) **Completeness**: Every specific thematic role is accounted for by some thematic role type. (Every argument position of every predicate is assigned a thematic role type.)

(3.9) **Distinctness**: Every argument position of a predicate is distinguished from every other argument position of the same predicate by the thematic role types assigned to the two positions.

The latter of these, incidentally, provides an additional reason for the unfeasibility of the hypothetical role $\theta_{\{\langle L,2\rangle,\langle P,2\rangle\}}$. Since the verbs *like* and *please* are near synonyms, but the subject of each corresponds to the object of the other, the same role could equally well be assigned to the two objects, and consequently it would be of no use for the purpose of distinguishing between the arguments of the predicates.

3.1.2 Event-based systems

In an **event-based system** (also called a **neo-Davidsonian thematic roles system**, as an acknowledgement of the fundamental contribution of Davidson 1967) a verb is a monadic predicate of eventualities, which are given the status of autonomous semantic units, and thematic roles are relations between eventualities and entities.

(3.10) $$\exists e[\phi''(e) \wedge \bigwedge_{i \in I} \theta_i(e, x_i)], \forall i[i \in I \subseteq \{1, \ldots, n\} \rightarrow \theta_i \in \Theta(\phi)]$$

Here ϕ'' is a monadic predicate to which an expression of natural language is mapped in the system, $\theta_i(e, x_i)$ expresses the fact that the entity x_i is related to the eventuality e by the thematic role θ_i and $\Theta(\phi) = \{\theta_1, \ldots, \theta_n\}$ is the set of all thematic roles associated with the predicate ϕ, that is, all thematic roles for which it makes sense to be predicated of an eventuality of the kind denoted by ϕ.

Thus the following are possible representations of (3.4a), the first from Dowty 1989 and the second from Eberle 1991 (both slightly modified):[1]

(3.11) $$\exists e[\text{butter}''(e) \wedge \text{Th}(e, t) \wedge \text{Ag}(e, j) \wedge \left(\begin{array}{|l} \text{with a knife}''(e) \\ \text{in the bathroom}''(e) \\ \text{at midnight}''(e) \end{array}\right)]$$

(3.12) $$\exists e[\text{butter}''(e) \wedge \text{Th}(e, t) \wedge \text{Ag}(e, j) \wedge \text{with}(e, k) \wedge \text{in}(e, b) \wedge \text{at}(e, m)]$$

By using the functional notation $\theta_i(e) = x_i$ instead of the relational $\theta_i(e, x_i)$ in the formalisations a requirement of **uniqueness of the thematic role bearer** is enforced, according to which no two distinct entities may bear the same thematic role in the same eventuality.

(3.13) $$\forall e \forall \theta_i \forall x \forall y \Box[\theta_i(e, x) \wedge \theta_i(e, y) \rightarrow x = y]$$

[1] The following two-letter notations are used for thematic roles in the body of the text and in the formulæ: 'Ag': **agent**, 'Co': **cotheme**, 'Ef': **effector**, 'Go': **goal**, 'Lo': **location**, 'Pt': **patient**, 'So': **source**, 'Th': **theme**. The notation 'Θr', possibly accompanied by a subscript, indicates any thematic role.

The formal representations of a predicate ϕ in the two theories are related by the regularity in (3.14), assuming that the set of thematic roles from which $\theta_1, \ldots, \theta_n$ are chosen covers all argument positions of all predicates of the language. The latter condition, strictly speaking, is not to be taken for granted, since the only way to ensure that a given set meets this condition is to test it empirically against all predicates in the lexicon.

(3.14) $$\phi' = \lambda x_1 \ldots \lambda x_n \exists e[\phi''(e) \wedge \theta_1(e, x_1) \wedge \ldots \wedge \theta_n(e, x_n)]$$

I shall not engage in comparing the adequacy of the two described systems or commit myself to one of them here. For the sake of brevity, I shall use both notations as a shortcut and a full form of one another, leaving out the single and double primes identifying the translation of predicates as pertaining to an ordered arguments or an event-based system.

3.1.3 Run times

The positions in the argument frame of ϕ' in (3.4) and the thematic roles associated with ϕ'' in (3.10) are intended to establish the relations between the eventuality and the denotata of the nominal and adverbial constituents of the clause.

Since eventualities happen in time, their relation to their run times is of particular importance for a discussion of aspectuality. Krifka 1991 introduces a **temporal trace** function τ, which maps the domain of eventualities onto the domain of times.

In order to obtain more direct access to the run time, I will include it into the argument frame of the predicate as an additional argument bearing a special thematic role. This leads to the notations in (3.15a) as an alternative to (3.15b).

(3.15) a. (I) $\phi'(t, x_1, \ldots, x_n)$
(II) $\phi''(e) \wedge \odot(e) = t \wedge \theta_1(e) = x_1 \wedge \cdots \wedge \theta_n(e) = x_n$
b. $(\phi'(x_1, \ldots, x_n))(e) \wedge \tau(e) = t$

In the preceding chapter the notation $\phi(t)$ was used for the statement 'a ϕ-eventuality happens at time t' ('t is the time of a ϕ-eventuality'), without subjecting the predicate ϕ to any further analysis. That notation was therefore equivalent to $\exists e[\phi''(e) \wedge \tau(e) = t]$ in an event-based system. The one in (3.15a) is merely an extension of it, in which the arguments $x_1, \ldots, x_n$ have also been included. I shall henceforth make a point of listing the run time in 0th position in the shortcut notation, a convention I didn't adhere to in (1.59). In the full notation thematic roles are of course accessed by name, not number, and I shall use '$\odot$' (a stylised image of the face of a clock) for the run time.

It appears expedient to rule out the possibility of having distinct eventualities with identical predicates and argument sets, that is, to require the validity of (3.16).

(3.16) $$\forall \phi \forall e \forall e'[e \in \phi \wedge e' \in \phi \wedge \forall \theta \forall x[\theta(e, x) \leftrightarrow \theta(e', x)] \rightarrow e = e']$$

Krifka 1991 does allow for this possibility, but if run times are included in the argument frames of predicates, it is no longer required by actual linguistic evidence. It is ruled out if (3.17), proposed by Gennaro Chierchia and reworded here as in Dowty 1989, is adopted as definition of the concept of eventuality.

(3.17) An **event[uality]** is an $(n+1)$-tuple $\langle \phi, x_1, \ldots, x_n \rangle$, where ϕ is an n-place property and $x_1, \ldots, x_n$ are individuals.

This formulation is intended for an ordered argument system. Within a neo-Davidsonian thematic roles system it can assume the following form:

(3.18) An **eventuality** is a pair $\langle \phi, \{\langle \theta_1, x_1 \rangle, \ldots, \langle \theta_n, x_n \rangle\} \rangle$, where ϕ and $x_1, \ldots, x_n$ have the same meaning as in (3.17) and $\{\theta_1, \ldots, \theta_n\} = \Theta(\phi)$ is the set of all thematic roles of the predicate ϕ.

A consequence from this definition of eventuality is that (3.13), the requirement for uniqueness of the thematic role bearer, is trivially met.

It should be noted that under (3.18) eventualities become syntactic objects, which can be constructed at will, and therefore it is necessary to speak of their **occurrence** rather than their existence in contexts such as (3.10).

3.2 Properties of Thematic Roles

In this section I shall look at the set of properties of thematic relations examined by Krifka 1991, but using directly the run time instead of the eventuality and applying the treatment of plurality outlined so far. The impact of the properties of thematic relations on aspectual composition will be discussed in Section 3.3.

3.2.1 Uniqueness of events and identification sets

The property **uniqueness of events** indicates that there is only one eventuality of the relevant kind related to the entity by the thematic relation θ_i; for example, for a specific glass of wine there can be only one drinking event in which it appears as patient. This property accounts for the distinction between effected and consumed objects (patients), on the one hand, and stimuli or affected objects (themes), on the other.

(3.19) $$\forall \theta_i \big[\textsc{uni-b}\,\theta_i \leftrightarrow \forall e \forall e' \forall x[\theta_i(e,x) \wedge \theta_i(e',x) \rightarrow e = e']\big]$$

Uniqueness of events entails uniqueness of run times, since where there is only one eventuality, there is also a single run time associated with it.

This property is used, *inter alia*, to inhibit undesired iterative readings, guaranteeing the quantised reference of the predicate applied to the eventuality. With some predicates, however, iteration is excluded even though none of the thematic relations has *on its own* the property uniqueness of events. An example is *discover*, a lexical achievement represented as the predicate $D^{0,1,1}(\odot, \mathsf{Th}, \mathsf{Ag})$. Despite (3.21a) and (3.21b) and the ensuing acceptability of (3.20a) and (3.20b), the iterative reading of (3.20c), which would be enforced by the duration adverbial, is inhibited by (3.21c):

(3.20) a. *Tourists discovered that quaint little village all summer.*
b. *I discovered new quaint little villages all summer.*
c. *I discovered that quaint little village (*all summer).*

(3.21) a. $\neg\textsc{uni-b}(\mathsf{Th}_D)$ (a theme may be discovered many times by different agents);
b. $\neg\textsc{uni-b}(\mathsf{Ag}_D)$ (an agent can make many discoveries);
c. a given agent can discover a certain theme at most once.[2]

[2]This presupposes the use of *discover* in the sense of 'become aware of the existence of', 'obtain sight or knowledge of [something] previously unknown for the first time', not any of the metaphoric senses based thereon, which allow for an iterative reading.

Therefore it appears expedient that the uniqueness property be predicated of sets of thematic relations rather than individual roles. I shall use the notation '$\phi \,!\, \Phi$' for 'there can be at most one way to satisfy $\phi(x_0, \ldots, x_n)$, if the values of the roles in the set Φ are fixed', and shall call Φ an **identification set** of the predicate ϕ.

(3.22) $$\phi \,!\, \Phi \rightarrow \left(\begin{array}{l} \phi(x_0, \ldots, x_n) \wedge \phi(x'_0, \ldots, x'_n) \\ \rightarrow \forall i[0 \leq i \leq n \rightarrow x_i = x'_i] \vee \exists i[\theta_i \in \Phi \wedge x_i \neq x'_i] \end{array} \right)$$

Obviously any superset of an identification set of a predicate is also an identification set of its, and since it was assumed that, as per (3.18), eventualities with the same predicate have to differ in the value of at least one thematic role in order to be distinct, the set $\Theta(\phi)$ of all thematic roles which can be had by a predicate ϕ is trivially an identification set.

(3.23) $$\forall \phi[\phi \,!\, \Theta(\phi)]$$

The following rule (3.24) is a generalisation of (1.33) for predicates whose arity is greater than one: a predicate can't be properly pluralised relative to a termset if it has an identification set which doesn't include any of the roles in that termset.

(3.24) $$\begin{array}{l} \exists \Phi[\phi \,!\, \Phi \wedge \{\theta_1, \ldots, \theta_k\} \cap \Phi = \emptyset] \\ \quad \rightarrow \quad \big|[\![^{*\langle m_1, \ldots, m_k \rangle, \ldots}\phi]\!]\big| = \big|[\![\phi]\!]\big| \wedge [\![^{+\langle m_1, \ldots, m_k \rangle, \ldots}\phi]\!] = \emptyset \end{array}$$

3.2.2 Considerations on identification sets

I shall now discuss the properties of several kinds of identification sets and their relation to the properties of thematic relations.

To begin with the simplest case, if a predicate has an *empty* identification set, it obviously has either an empty or a singleton extension. The latter subcase corresponds to the property **singular reference**,

(3.25) $$\forall \phi \Big[\textsc{sng}\,\phi \leftrightarrow \exists x\big[\phi(x) \wedge \forall y[\phi(y) \rightarrow x = y]\big]\Big]$$

which is had, *inter alia*, by predicates translating definite noun phrases (such as *the letter*) and is used for eliminating undesirable iterative readings. This shall be discussed in more detail in Section 3.3.

The case of a *singleton* identification set generalises Krifka's uniqueness of events, contributing the possibility for the single identifying role to be the run time itself. In this case simultaneous eventualities of the corresponding kind are excluded. For example, if $K^{0,1}(\odot, \mathsf{Th})$ is the predicate *king of England*, then $K \,!\, \{\odot\}$ expresses the fact that at any time there is at most one king of England, so that (3.26) has to express a pair of non-overlapping eventualities.

(3.26) *Edward and George were kings of England.* $K^{*0,*1}(t, e \sqcup g)$

Similarly, if $M^{0,0,0,0}(\odot, \mathsf{Th}, \mathsf{So}, \mathsf{Go})$ is the predicate *move Th from So to Go* in chess, then $M \,!\, \{\odot\}$ (only one move is made at a time); if $S^{0,0}(\odot, \mathsf{Lo})$ is *shoot at Lo* in the battleships game, then $S \,!\, \{\odot\}$ (only one shot is made at a time) as well as $S \,!\, \{\mathsf{Lo}\}$ (at most one shot can be performed at every field).

The predicate D for *discover* presents an example of a *doubleton* identification set. We can rewrite the statements in (3.21) as (3.27):

(3.27) a. $\neg D \,!\, \{\mathsf{Ag}\}$;
b. $\neg D \,!\, \{\mathsf{Th}\}$;
c. $D \,!\, \{\mathsf{Ag}, \mathsf{Th}\}$.

Doubleton identification sets involving the time of application as one of the roles indicate the **commitment** (**engagement**) of that role for the run time. For example, $\phi \,!\, \{\odot, \mathrm{Ag}\}$ holds if ϕ is a predicate such as *read* or *drink*, whose agent can be involved in at most one eventuality of the designated type at a time. Also, if $\phi^{0,1,1}(\odot, \mathrm{Co}, \mathrm{Th})$ is the translation of a relational noun or the head of a possessive construction, interpreted as '(be) a ϕ of Co at time $\odot$', then $\phi \,!\, \{\odot, \mathrm{Th}\}$ if a theme can be related to no more than one cotheme and $\phi \,!\, \{\odot, \mathrm{Co}\}$ if no more than one theme can be related to any individual cotheme.

Since eventualities are identified unambiguously by their predicates and argument frames, identification sets containing all thematic roles but one, that is, having the form $\Theta(\phi) \setminus \{\theta\}$, correspond to Krifka's property **uniqueness of objects**, which expresses the fact that an eventuality is related to a specific object; for example, a drinking of a glass of wine is related via the patient role to nothing but this glass of wine.

(3.28) $$\forall\theta_i[\textsc{uni-o}\,\theta_i \leftrightarrow \forall e\forall x\forall x'[\theta_i(e,x) \wedge \theta_i(e,x') \rightarrow x = x']]$$

Regarding this property Krifka notes the following:

> Obviously, it does not hold for the stimulus relation, as e.g. I can see a zebra and, with the same event of seeing, see the mane of the zebra as well. And it does not obtain with affected objects, as e.g. I can touch a shoulder and a person with the same event of touching.

By virtue of (3.13), the requirement for uniqueness of the thematic role bearer, the eventualities shall only be required to be cotemporal, while remaining distinct, and the connexion between the seeing of the mane and the seeing of the zebra, or the touching of the shoulder and the touching of the person, can be established by meaning postulates capitalising respectively on the fact that the mane is a material part of the zebra (as in $\downarrow m \sqsubseteq \downarrow z$) and that the shoulder is a material part of the touchee.

In some cases uniqueness of events may or may not obtain depending on whether the predicate is given a type-oriented or a token-oriented reading. For example, *type the letter* is something which can only be done once to the particular physical copy of the letter, but any number of times to the text. Since the latter reading can be paraphrased as 'type (in the token-oriented sense) a copy of the letter', it can be said that the type-oriented predicate performs a kind of implicit type conversion. In the formula in (3.29) ϕ_0 is the token-oriented version of the predicate ϕ and $\upsilon(z,x)$ stands for 'z is an instance of x'.

(3.29) $$\phi(t,x) \leftrightarrow \exists z[\phi_0(t,z) \wedge \upsilon(x,z)]$$

Thus only the patient role of ϕ_0 has the property uniqueness of events, because different choices of z can make for different ϕ-eventualities which share the same x.

The object–event homomorphism is brought forth by two **mapping** properties. A thematic relation has the property **mapping to objects** if every part of the eventuality corresponds to a part of the object,

(3.30) $$\forall\theta_i\Big[\textsc{map-o}\,\theta_i \leftrightarrow \forall e\forall e'\forall x\big[\theta_i(e,x) \wedge e' \sqsubseteq e \rightarrow \exists x'[x' \sqsubseteq x \wedge \theta_i(e',x')]\big]\Big]$$

and it has the property **mapping to events** if every part of the object corresponds to a part of the eventuality.

(3.31) $$\forall\theta_i\Big[\textsc{map-e}\,\theta_i \leftrightarrow \forall e\forall x\forall x'\big[\theta_i(e,x) \wedge x' \sqsubseteq x \rightarrow \exists e'[e' \sqsubseteq e \wedge \theta_i(e',x')]\big]\Big]$$

Krifka observes that these properties

> seem to be sound assumptions for gradual patient relations. Take as an example the reading of a book; every part of the book corresponds to a part of the reading and vice versa. With other thematic relations, these properties normally do not obtain; for example, there is no correspondence between parts of the person that is reading and the reading event. But note that as we can have sum individuals, it is possible that mapping to events and mapping to objects (as well as uniqueness of objects) apply to other thematic relations in certain circumstances as well. As an example, consider *see seven zebras*. Even if a single experiencer is involved, this predicate can be applied to events with different temporal structure, for example to events where seven zebras are seen simultaneously, or to the sum of seven consecutive events, in each of which a single zebra was seen. Now, in the second case, it does make sense to speak of mapping to events and mapping to objects, as for every part of the complex seeing event (down to the observings of single zebras) there is a part of the sum individual of the zebras which is seen in this event.

In a theory such as the present one, in which a typing mechanism is used to control the structure of the terms to which predicates apply, one can reformulate the quoted paragraph more concisely by saying that the mapping properties can always obtain (though they don't necessarily have to) if the argument is of a type higher than the one expected by the predicate, which is then pluralised with respect to this argument (but not otherwise). This is a direct consequence of the need for the predicate to be lifted and the resulting ungrouping of the argument with the possibility of distribution. Since mapping licensed by the thematic relation has the same effect on the aspectuality of the clause as mapping caused by the compound structure of the argument, it is my opinion that the introduction of types into the theory allows the capture of an important generalisation.

In the example of *see seven zebras* the verb *see* is represented as $S^{0,1,1}(\odot, \mathrm{Th}, \mathrm{Xp})$.[3] The theme *seven zebras*, however, is of type 2 (it ultimately corresponds to a structure such as $\uparrow\bigsqcup_{1\leq i\leq 7} z_i^1$). The predicate may be applied to it by being pluralised relative to it and distributed over its components, as in (3.32). Alternatively, the pluralisation and the subsequent distribution may affect the termset of the run time and the theme, as in (3.33).[4] In either case the distribution is preceded by ungrouping. In the formulæ in (3.32–3.33) x stands for the experiencer, a role with which we are not concerned here.

(3.32) $$S^{0,{}^*1,1}(t, \uparrow\bigsqcup_{1\leq i\leq 7} z_i^1, x) \;\rightarrow\; \bigwedge_{1\leq i\leq 7} S(t^0, z_i, x)$$

(3.33) $$S^{{}^*\langle 0,1\rangle,1}(t, \uparrow\bigsqcup_{1\leq i\leq 7} z_i^1, x) \;\rightarrow\; \exists t_1 \ldots \exists t_7[t^1 = \uparrow\bigsqcup_{1\leq i\leq 7} t_i \wedge \bigwedge_{1\leq i\leq 7} S(t_i^0, z_i, x)]$$

This means that while *see a zebra* is of type 0 relative to the run time (applying to moments), *see seven zebras* is of type 1 (applying to intervals). The same considerations hold for the case of *see a/the zeal of zebras*[5], if the seeing takes place zebra by zebra.

[3] Here it is implied that *see* is interpreted as an achievement, in the sense of 'receive in one's visual field', 'become visually aware of'. When it has the meaning 'have in one's visual field', it is a state and consequently is pluralised relative to the run time, and when it is interpreted as 'examine visually, become acquainted with (the appearance of)', as in *see the town* or *see the patient*, it expects an interval rather than a moment.

[4] Even in (3.33), since $\neg(S \,!\, \{\odot, \mathrm{Xp}\})$ (i.e., seeing events with the same experiencer may be cotemporal), it is possible that $t_i = t_j$ for any i and j, up to $t = t_1 = \ldots = t_7$, which corresponds to the case of the simultaneous seeing of the seven zebras. Thus (3.32) is in fact equivalent to a distinguished subcase of (3.33), but one worthy of attention for its own sake.

[5] According to Sparkes 1985, *zeal* is a collective term for zebras.

In a similar way, while the theme of *see* is of type 1 (a single entity), the theme of *see in an hour* has to be of type 2 (a group), since the type of *an hour* is also higher than the one normally expected by S.

Thus the unacceptability of example (0.1b), repeated here as (3.34), is formally parallel to the unacceptability of examples (1.2b) and (1.3b), repeated here as (3.35–3.36).

(3.34) ! *John saw a zebra in an hour.*

(3.35) ! *The horse gathers in the field.*

(3.36) ! *I counted the horse.*

Krifka also considers some examples in which the two mapping properties apply with certain restrictions. By definition there is no mapping to events unless every part of the object corresponds to a part of the eventuality, but what counts as a part of the object may depend on the predicate, which has the option of selecting specific aspects of it. For example, *eating the apple* affects (and distributes over) its volume, while its *peeling* or *washing* affects its surface. Furthermore, if the apple has been cut in half and what is referred to as *the apple* is the group of the two halves, the cutting will have led to the creation of two new surface areas, which would have to be affected by *washing the apple*, but not by *peeling the apple*.[6]

The predicate thus performs a kind of implicit type conversion; 'ϕ x' is interpreted as 'ϕ_0 the ϕable part of x', where ϕ_0 is a version of ϕ to which mapping to events applies without any reservation. In the general formula in (3.37) $\eta_\phi(\mathrm{Co}, \mathrm{Th})$ stands for 'Th is the ϕable part of Co'. As shown in (3.38), the case for *eat*, the conversion makes distribution over the termset of the run time and the object possible.

$$(3.37) \qquad \phi(t, x) \rightarrow \exists z[\phi_0(t, z) \land \eta_\phi(x, z)]$$

$$(3.38) \qquad E^{1,1}(t, x) \rightarrow \exists z^1[E_0^{+\langle 0,0\rangle}(\downarrow\langle t, z\rangle) \land \eta_E^{1,1}(x, z)]$$

The case with mapping to objects is similar. The process of *building a house* is a gradual one, yet some subevents of the building (e.g., the erection of a scaffold and its subsequent disassembling) do not correspond to any part of the object. This indicates that, strictly speaking, mapping to objects characterises the corresponding role of the principal subevent, the one which actually brings the house into being and of which the entire complex event is a representative plural. Here, too, the conversion makes distribution possible.

$$(3.39) \qquad \phi = \mathrm{REPR}(\phi_0)$$

$$(3.40) \qquad B^{1,1}(t, x) \rightarrow \exists t'^1[\downarrow t' \sqsubseteq \downarrow t \land B_0^{+\langle 0,0\rangle}(\downarrow\langle t', x\rangle)]$$

The two mapping properties, in conjunction with uniqueness of objects, characterise what Krifka calls **gradual** thematic relations—relations which transfer the reference properties of the argument to the eventuality. The requirement of uniqueness of objects appears superfluous if mapping is accounted for by type coordination, which is actually a stronger mechanism than the definitions in (3.30–3.31), since the mapping relations can trivially obtain in cases where intuitively it makes little sense to talk of object–event homomorphism; for example, the achievement *see* has mapping to objects, because the eventuality has no proper parts, and *bring* has mapping to events at any level, because every part of the object corresponds to a part of

[6] The relevant part of the object may also depend on the choice of some of the other arguments. For example, the *eating* of *the apple* with *John* as agent may be completed even if the core (and possibly the skin) still exists, whereas if the agent is *John's donkey*, we would expect the entire apple to be consumed.

the event (though not necessarily a proper part), but in neither case is there any distribution involving the run time. For this reason I will reformulate graduality as a property of all thematic roles whose fillers are of a type higher than the one expected by the predicate.

3.3 Composition of Predicates

This section is devoted to discussing the formal details of the mechanism by which the verbal expression corresponding to the predicate $\alpha^{n,m}(\odot, \Theta\mathrm{r})$ is combined with the nominal expression corresponding to the predicate $\delta^{m'}(\mathrm{Th})$. (I assume that **theme** is the thematic role universally assigned by nominal expressions to their referents.) No requirements are imposed in this section on the syntactic function of the nominal constituent translated by δ in the clause, nor is it implied that the predicate α need be a translation of what would be recognised as a constituent (such as a verb phrase) in any particular syntactic theory.

For the predicates α and δ to be composed means that they must share a thematic role filler; in this case the Θr of α is the theme of δ. The general schema for the composition of the m-place predicate ϕ and the n-place predicate ψ, where the ith argument of ϕ (the bearer of its role θ_i) is the jth argument of ψ (the bearer of its role ϑ_j), is as follows:

$$(3.41) \qquad (\phi^{\theta_i}/_{\vartheta_j}\psi)(x_1, \ldots, x_{i-1}, x_{i+1}, \ldots, x_m, y_1, \ldots, y_{j-1}, y_{j+1}, \ldots, y_n)$$
$$\leftrightarrow \exists z[\phi(x_1, \ldots, x_{i-1}, z, x_{i+1}, \ldots, x_m) \land \psi(y_1, \ldots, y_{j-1}, z, y_{j+1}, \ldots, y_n)]$$

The arities of the two predicates are established, and the arguments involved in the composition identified, on the basis of information provided by the syntax. This means that the syntax must have access to the structure of the argument frames.

The identification sets of the $(m + n - 1)$-place predicate $(\phi^{\theta_i}/_{\vartheta_j}\psi)$, which is the result of the composition, are derived from the identification sets of the two components. If the sets Φ and Ψ identify respectively a ϕ- and a ψ-eventuality, then a $(\phi^{\theta}/_{\vartheta}\psi)$-eventuality is identified by the union of Φ and Ψ, but excluding θ and ϑ, unless they both participate in the identification;

$$(3.42) \qquad \phi \,!\, \Phi \land \psi \,!\, \Psi \land \neg(\theta \in \Phi \land \vartheta \in \Psi) \rightarrow (\phi^{\theta}/_{\vartheta}\psi) \,!\, (\Phi \cup \Psi \setminus \{\theta, \vartheta\})$$

in the latter case there can be multiple $(\phi^{\theta}/_{\vartheta}\psi)$-eventualities which share all xs in $\Phi \setminus \{\theta\}$ and all ys in $\Psi \setminus \{\vartheta\}$, but differ in the choice of the entity z. This is the reason for which uniqueness of events does not obtain for type-oriented predicates even when it does for their token-oriented counterparts: adhering to the notation of (3.29), $\phi = (\phi_0{}^{\mathrm{Pt}}/_{\mathrm{Th}}\upsilon)$, and $\phi \,!\, \{\mathrm{Pt}\}$ does not follow from $\phi_0 \,!\, \{\mathrm{Pt}\}$ and $\upsilon \,!\, \{\mathrm{Th}\}$.

A prerequisite for the composition of $\alpha^{n,m}(\odot, \Theta\mathrm{r})$ and $\delta^{m'}(\mathrm{Th})$ is the compatibility of the types of the two predicates relative to the shared argument. According to the conventions of Subsection 1.1.4, it is required that $m \leq m'$, so that sentences such as (3.35) and (3.36), in which that is not the case, are ruled out directly.

Depending on whether $m = m'$ or $m < m'$, as well as on the presence of pluralisation on $(\alpha^{\Theta\mathrm{r}}/_{\mathrm{Th}}\delta)(\odot)$ and on its effect, several cases are to be distinguished. These will be considered in the rest of this section.

3.3.1 Direct composition

If $m = m'$ (the nominal expression is of the type expected by the predicate), the verbal expression is represented as a singular predicate relative to Θr, since regular pluralisation relative to Θr, on its own or in a termset, would be discharged by distributivity, and proper pluralisation is inapplicable. The composition of $\alpha^{n,m}(\odot, \Theta r)$ and $\delta^{m}(\mathrm{Th})$ yields the form in (3.43),

$$\gamma^{n}(\odot) = (\alpha^{\Theta r}/_{\mathrm{Th}}\delta) = \lambda t\exists x[\delta(x) \wedge \alpha(t,x)] \tag{3.43}$$

and if the composite predicate is singular, the predicate translating the verbal expression is singular relative to the run time as well, and the reading obtained refers to a single event.

$$\gamma^{n}(t) \rightarrow \exists x[\delta^{m}(x) \wedge \alpha^{n,m}(t,x)] \tag{3.44}$$

Under this reading, which is always available, regardless of the identification sets of the predicates α and δ, example (1.3e), repeated here as (3.45), refers to the speaker's determining the number of herds, without being concerned with the individual horses. In the formula below $C^{1,m,1}(\odot, \mathrm{Th}, \mathrm{Ag})$, where $m \geq 2$, translates *count*, while $H^{2}(\mathrm{Th})$ translates *(be) a herd of horses.*

(3.45) *I counted the herds of horses.* $C^{1,3,1}(t, \uparrow\bigsqcup_{H^2(h)} h, i)$

Other examples of direct composition yielding a singular predicate are (3.1) and (3.3b), which are repeated below. accompanied by their translations, where the predicate $S^{0,1,1}(\odot, \mathrm{Pt}, \mathrm{Ag})$ stands for *shoot*, $B^{1,1,1}(\odot, \mathrm{Pt}, \mathrm{Ag})$ for *bring*, $Z^{1}(\mathrm{Th})$ for *(be) a zebra* and j^{1} for *John*.

(3.46) *John shot a zebra.* $\exists z[Z^{1}(z) \wedge S^{0,1,1}(t,z,j)]$

(3.47) *John brought a zebra.* $\exists z[Z^{1}(z) \wedge B^{1,1,1}(t,z,j)]$

The difference in the aspectual classes of the two verbs is reflected in the types of the corresponding predicates relative to the run time.

3.3.2 Lifting composition

If $m < m'$ (the nominal expression is of a type higher than the one expected by the predicate) and the verbal expression is represented as a singular predicate relative to Θr (i.e., it has the form $\alpha^{n,m}$ or $\alpha^{+n,m}$), the lifting of the predicate lowers the type of the argument by flattening it, and it is treated as if it were of type $m'-1$. Under this reading example (3.45) refers to determining the total number of horses in the herds.

$$C^{1,2,1}(t, \uparrow\Downarrow\downarrow(\uparrow \bigsqcup_{H^2(h)} h), i) \tag{3.48}$$

If the verbal expression is represented as a predicate pluralised relative to Θr or to a termset which contains it, the lifting causes the ungrouping of the argument $x = \uparrow\bigsqcup_j x_j$.

If the predicate is singular relative to the run time, a single event reading with parallel application and no mapping is obtained.

$$\gamma^{n}(t) \rightarrow \exists x[\delta(x) \wedge \alpha^{n,+m}(t, \downarrow x)] \tag{3.49}$$

This case is illustrated by (3.32), where all zebras are mapped to a single moment in which the seeing event happens.

The latter reading is unavailable if α ! $[\odot]$, that is, if Θr has the property uniqueness of objects. In that case the only option is for the predicate to be pluralised relative to the termset of Θr and the run time and to distribute over both. The reading obtained is the gradual one,

in which the argument and the run time are mapped componentwise to one another and the reference properties of the argument are inherited by the composite predicate.

$$\gamma^{n+1}(t) \rightarrow \exists x[\delta(x) \wedge \alpha^{+\langle n,m\rangle}(\langle t,x\rangle)] \tag{3.50}$$

Since the predicate is pluralised, and in (3.3a) also lifted, relative to the termset of the run time and the patient, so that the ungrouping and the distribution necessarily affect both, the run time is a sum or a group of moments if the patient is introduced respectively as a sum or a group of zebras.

The gradual reading is always available, regardless of the identification sets of the predicates. It is illustrated by (3.33), as well as by (3.2a) and (3.3a), which are repeated below.

(3.51) *John shot zebras.* $\exists \bar{z}[{}^{+}Z^{1}(\bar{z}) \wedge S^{+\langle 0,1\rangle,1}(\langle t,\bar{z}\rangle, j)]$

(3.52) *John shot seven zebras.* $\exists z\big[({}^{+}Z^{1}(\downarrow z) \wedge 7^{2}(z)) \wedge S^{+\langle 0,1\rangle,1}(\downarrow\langle t,z\rangle, j)\big]$

It also yields the last interpretation of (3.45), which refers to determining the number of horses in each herd separately.[7]

$$C^{+\langle 1,2\rangle,1}(\downarrow\langle t, (\uparrow \bigsqcup_{H^2(h)} h)\rangle, i) \rightarrow t = \uparrow \bigsqcup_{H^2(h)} \iota\tau[C^{1,2,1}(\tau,h,i)] \tag{3.53}$$

The same regularity applies to distribution over the parts (that is, the atoms) of an individual entity or quantity of stuff.

(3.54) *I drank the wine.*

$$D^{+\langle 0,0\rangle,1}(\downarrow\langle t, (\uparrow \bigsqcup_{W^0(\iota)} \iota)\rangle, i) \rightarrow t = \uparrow \bigsqcup_{W^0(\iota)} \iota\tau[D^{0,0,1}(\tau,\iota,i)] \tag{3.55}$$

Here $D^{0,0,1}(\odot, \mathrm{Pt}, \mathrm{Ag})$ translates *drink* and ${}^{+}W^{0}(\mathrm{Th})$ ('be a sum of wine atoms') translates *(be) wine*. The drinking maps 'wine atoms' to moments and thereby also maps the entire amount of wine to an interval containing all drinking moments.[8]

The treatment of mass terms as plurals of a lower type thus provides a general insight into mapping conditioned by pluralisation, which is characteristic for gradual thematic relations.

3.3.3 Plural composition

If the composite predicate is pluralised, the reading obtained is durative or iterative.

$${}^{+}\gamma^{n}(t) \rightarrow {}^{+}\lambda\tau\exists x[\delta(x) \wedge \alpha^{n,m}(\tau,x)](t) \tag{3.56}$$

This formula allows for the value of x to vary. In a distinguished subcase this option is not exploited, and the choice of x is the same for all times, with the effect that the pluralisation applies to the run time position of α alone.

$$\exists x[\delta(x) \wedge \alpha^{+n,m}(t,x)] \tag{3.57}$$

[7] The formula is in fact a simplification of what it should be, as it makes the assumption that there is a unique counting time τ for each herd h, which, strictly speaking, is incorrect, in so far as the event can be iterated. The same is true for the analogous formulæ further in the exposition.

[8] This view implies equality between the cardinalities of the set of atoms within the entity and the set of moments within the interval. This is indeed correct with respect to spatially and temporally discrete worlds, such as the world of battleships; for example, given that a cruiser occupies 4 fields, it takes 4 shots to sink, as does the group of 2 tankers or 4 submarines. In a continuous universe such as the 'real world', where measurements are made in real numbers, all cardinalities of sets of this kind are equal to $\aleph_1$.

The latter reading may be enforced or inhibited by the identification sets of γ, which are determined in accordance with (3.42). If either α has singular reference or δ has singular reference and Θr has the property uniqueness of events, then the empty set is an identification set of γ, which rules out the iteration of the event.

(3.58) $$\alpha \,!\, \emptyset \vee (\delta \,!\, \emptyset \wedge \alpha \,!\, \{\Theta r\}) \rightarrow (\alpha^{\Theta r}/_{Th}\delta) \,!\, \emptyset$$

Since the predicate δ translates a nominal expression, it has singular reference if it is of the form 'identity to a' (where a is any given entity), a type of predicate for which Link 1983 introduces (though without discussion) the notation I_a.

(3.59) $$I_a = \lambda x\,[x = a]$$

(3.60) $$(\alpha^{\Theta r}/_{Th} I_a) = \lambda t[\alpha(t, a)]$$

From (3.42) it follows that the setting of an argument to a given value entails the exclusion of the corresponding thematic role from the identification sets in which it appears. All other identification sets of α are inherited with no alteration by $(\alpha^{\Theta r}/_{Th} I_a)$.

For example, the sentence

(3.61) *An orc slew Balin.* $\lambda t\exists x[O^1(x) \wedge S^{0,1,1}(t, b, x)]$

denotes an event which can not be iterated. The predicate *slay Balin* has singular reference because *(be) Balin* does and the patient role of *slay*, whether regarded specifically as a 'slayee' or more generally as a destroyed patient, has the property uniqueness of events.

(3.62) $$I_b \,!\, \emptyset \wedge S \,!\, \{Pt\} \rightarrow (S^{Pt}/_{Th} I_b) \,!\, \emptyset$$

Since the agent of *slay* does not appear in any identification set, its inclusion, whether it takes place before or after the introduction of the patient, makes no difference; the same result is obtained if the sentence is analysed as applying the predicate *an orc slew* (or the semantically eqivalent *was slain by an orc*) to the argument *Balin* rather than the predicate *slay Balin* to the argument *an orc*. By contrast, the event expressed in the sentence

(3.63) *Gimli slew an orc.* $\lambda t\exists x[O^1(x) \wedge S^{0,1,1}(t, x, g)]$

can be iterated, provided a different orc is slain on each occasion.

Similarly, the single event reading is the only available choice in (3.65a), where δ has singular reference, but is unavailable in (3.65b), where $\alpha \,!\, \{\Theta r\}$, a restriction which reflects the fact no bullet can wound the same victim more than once,

(3.64) $$W \,!\, \{Pt, Ef\} \rightarrow \forall x[(W^{Pt}/_{Th} I_x) \,!\, \{Ef\}]$$

even though neither the patient nor the effector of *wound* have the property uniqueness of events on their own. Example (3.65c), where neither restriction holds, leaves open the question whether the arrow was the same one on both occasions. The predicate $W^{0,1,1}(\odot, Pt, Ef)$ stands for *wound*, $B^1(Th)$ for *(be) a bullet*, a^1 for *this arrow* and m^1 for *Miles*.

(3.65) a. *Miles was wounded by this arrow twice.*

$$^{+}\lambda t[W(t, m, a)](t_1 \sqcup t_2) \rightarrow W(t_1, m, a) \wedge W(t_2, m, a)$$

b. *Miles was wounded by a bullet twice.*

$$^{+}\lambda t\exists x[W(t, m, x) \wedge B(x)](t_1 \sqcup t_2) \rightarrow \exists x_1[W(t_1, m, x_1) \wedge B(x_1)] \wedge \exists x_2[W(t_2, m, x_2) \wedge B(x_2)]$$

c. *Miles was wounded by an arrow twice.*

Direct composition can also yield a plural predicate if α is already pluralised relative to the run time because of the lexical properties of the verb or the impact of another argument. An example is (3.2b), repeated below.

(3.66) *John carried a zebra.* $\exists z[Z^1(z) \wedge C^{+0,1,1}(t, z, j)]$

$C^{+0,1,1}(\odot, Pt, Ag)$ translates *carry*, a predicate pluralised with respect to the run time because the verb it translates is a lexical energeia.

The same considerations apply in the case of lifting composition, where a durative or iterative reading is obtained by pluralisation relative to the run time,

(3.67) $$^{+}\gamma^{n}(t) \rightarrow {}^{+}\lambda\tau\exists x[\delta(x) \wedge \alpha^{n,+m}(\tau, \downarrow x)](t)$$

and in a distinguished subcase the choice of x is the same for all τ, with the effect that the pluralisation applies to the run time position of α alone.

(3.68) $$\lambda t\exists x[\delta(x) \wedge \alpha^{+n,+m}(\downarrow t, \downarrow x)]$$

The reading is unavailable if $\alpha \,!\, \{\odot\}$ or $\alpha \,!\, \{\Theta r\}$.

3.4 Graduality and Degree of Affectedness

In this section I shall explore the mechanism of aspectual composition for gradual thematic roles, that is, roles characterised by the two mapping relations. As the name suggests, the volume of the bearer of such a thematic role is spanned gradually by the process as time progresses, and may be affected either partially or totally in the course of the entire event, depending on conditions which I shall discuss presently.

In the previous section we saw how the formal representations of (3.1), (3.2a) and (3.3a), repeated below, are obtained and how the aspectual properties of the patient are transferred to the eventuality as a result of the fact that the pluralisation and the type conversion affect the termset of that argument and the run time.

(3.69) a. *John shot a zebra.* $\exists z[Z^1(z) \wedge S^{0,1,1}(t, z, j)]$

b. *John shot zebras.* $\exists \bar{z}[^{+}Z^1(\bar{z}) \wedge S^{+\langle 0,1\rangle,1}(\langle t, \bar{z}\rangle, j)]$

c. *John shot seven zebras.* $\exists z\big[(^{+}Z^1(\downarrow z) \wedge 7^2(z)) \wedge S^{+\langle 0,1\rangle,1}(\downarrow\langle t, z\rangle, j)\big]$

We also saw that the same considerations apply to mass terms, so that (3.70a) and (3.70b) are formally parallel to (3.2a) and (3.3a), respectively.

(3.70) a. *I drank wine.* $\exists \bar{w}[^{+}W^0(\bar{w}) \wedge D^{+\langle 0,0\rangle,1}(\langle t, \bar{w}\rangle, i)]$

b. *I drank a litre of wine.* $\exists w\big[(^{+}W^0(\downarrow w) \wedge \mathcal{Q}^1_{1l}(w)) \wedge D^{+\langle 0,0\rangle,1}(\downarrow\langle t, w\rangle, i)\big]$

The formulæ appear to indicate that *wine* and *a litre of wine* are modelled as distinct entities. In reality this is no more than an artifact of the convention according to which the corresponding predicates belong to different types; $\exists w[\ldots(\downarrow w)\ldots]$ expresses the same thing as $\exists \bar{w}[\ldots(\bar{w})\ldots]$, whereby the two are related by $w = \uparrow\bar{w}$.

Sentences (3.70a) and (3.70b) can be visualised by the two space–time diagrams in Figure 3.2. The curve in each diagram represents the drinking process, which maps every amount of wine to the time of its consumption by the speaker.

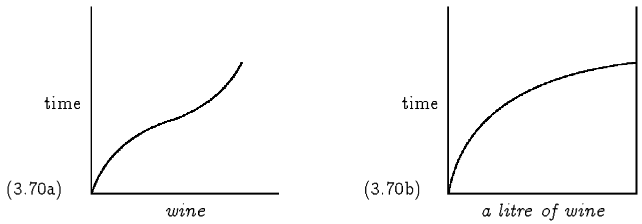

Figure 3.2: Space–time diagrams for wine-drinking.

The predicate which translates the verb, $S^{0,1,1}(\odot, \mathsf{Th}, \mathsf{Ag})$ or $D^{0,0,1}(\odot, \mathsf{Pt}, \mathsf{Ag})$, is pluralised with respect to the termset of the role corresponding to the object and the run time and distributed over the two. (Pluralisation with respect to the object alone is ruled out because in both cases $\{\odot, \mathsf{Ag}\}$ is an identification set, hence the assumption that all zebras are not shot, and all the wine is not drunk, in a single moment.) As a result a seeing or drinking moment is counterposed to each of an unspecified number of zebras or wine atoms, and the run time t is equated to the sum of all of these moments.

The proposed translations of (3.2a) and (3.70a) are in fact equivalent to (3.71) and (3.72), where the singular counterpart of the predicate which translates the object is composed with the predicate which translates the verb, yielding respectively $(S^{\mathsf{Th}}/_{\mathsf{Th}} Z^1)$ and $(D^{\mathsf{Th}}/_{\mathsf{Pt}} W^0)$.

(3.71) $$^{+}(\lambda\tau\exists z[Z^1(z) \wedge S^{0,1,1}(\tau, z, j)])\,(t)$$

(3.72) $$^{+}(\lambda\tau\exists\iota[W^0(\iota) \wedge D^{0,0,1}(\tau, \iota, i)])\,(t)$$

According to the latter formulæ, the run time is a sum of moments in each of which a zebra is seen or a wine atom is drunk.

The eventuality, which in those two sentences is an activity, can be quantised by a duration adverbial, as in (3.73),

(3.73) *I drank wine for half an hour.* $\exists w[{}^{+}W^0(\bar{w}) \wedge \mathcal{Q}^1_{\frac{1}{2}h}(t) \wedge D^{+\langle 0,0\rangle,1}(\langle\downarrow t, \bar{w}\rangle, i)]$

to which the space–time diagram in Figure 3.3 corresponds. The run time has to be a group of moments, because it is the argument of a predicate of type 1, namely $\mathcal{Q}^1_{\frac{1}{2}h}$, which holds of intervals with a fixed duration.

Here, too, the patient can be composed with the verb, yielding $(D^{\mathsf{Th}}/_{\mathsf{Pt}} W^0)(\odot, \mathsf{Ag})$ as a translation of the verb phrase *drink wine*.

(3.74) $$\mathcal{Q}^1_{\frac{1}{2}h}(t) \wedge (D^{\mathsf{Th}}/_{\mathsf{Pt}} W^0)^{+0,1}(\downarrow t, i)$$

In (3.3a) and (3.70b) the sentence attempts to supply to the predicate which translates the verb an argument belonging to a type higher than the one expected. The application is carried out

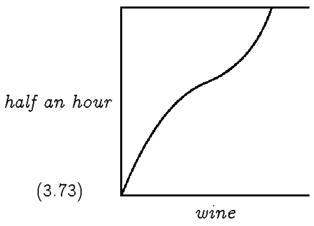

Figure 3.3: A space–time diagram for an eventuality quantised by a duration adverbial.

by having the predicate which translates the verb lifted before being distributed over the termset. As a result the run time t is equated to the interval which is the group of all moments involved. The object is totally affected by the event.

Not all arguments which can be totally affected need be, however, particularly when there is some variation in the choice of the argument which is to act as a measure of telicity by being totally or partially affected.

In their discussion of

(3.75) a. *Bill loaded the hay on the truck.*
b. *Bill loaded the truck with the hay.*

Foley & Van Valin 1984 state that the two sentences have the same underlying logical structure, which is formulated as

(3.76) $$\big[\textsc{do}\big(x, [\mathbf{do}'(x)]\big)\big]\ \textsc{cause}\ \big[\textsc{become}\ \mathbf{be\text{-}at}'(y, z)\big]$$

in their notation. On the basis of this structure the semantic relations (i.e., the thematic roles) borne by the constituents are determined: y (*the hay*) is a **theme** and z (*the truck*) is a **locative**, because they are respectively the first and the second argument of the abstract predicate **be-at**′, and x (*Bill*) is an **agent**, by virtue of being the first argument of the operator DO, whose second argument is a construct which in itself would have made x an **effector**. The syntactic contrast between the two examples is brought about by the different choice of the constituent to which the **undergoer** macrorole (a category mediating between syntax and semantics in Role and Reference Grammar) is assigned. In (3.75a) the undergoer is the theme *the hay*; in (3.75b) it is the locative *the truck*. Both theme and locative are relatively low in the hierarchy of semantic relations and therefore either one is a plausible choice for the undergoer macrorole; on the other hand, to agents, such as *Bill* in this example, it may not be assigned.

With respect to the aspectual behaviour of the nominal constituents of two sentences, one of which in either case is responsible for the telicity of the event, they say the following:

> Notice that [(3.75a)] implies that all the hay was loaded but not that the truck was full, whereas [(3.75b)] implies that the truck was full but not that all of the hay was loaded.

Thus one can visualise (3.75a) by the diagram on the left and (3.75b) by the one on the right in Figure 3.4. The curve represents the loading process, which is further conceived of as being mapped to time; it maps the loaded part of the hay to the filled part of the body of the lorry. (Of course, although each sentence requires only the argument which delimits the process to be totally affected, neither explicitly precludes the other argument from being totally affected as well; in that case the curve would run to the upper right corner of the rectangle.) One should note the similarity between the diagrams for (3.75a) and (3.70b), on one hand, and the ones for (3.75b) and (3.73), on the other.

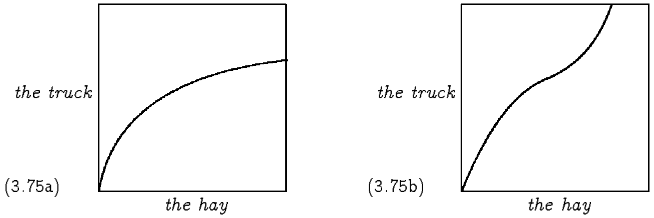

Figure 3.4: A pair of hay–lorry diagrams.

Foley & Van Valin continue:

> This is a clear correlation between the occurrence of an argument as undergoer and a reading of total affectedness. This relates directly to the close link between undergoer and patient, since patients are arguments which suffer a change of state and are therefore thoroughly affected by the action of the verb, and since patients are prototypical undergoers. Affectedness is part of the inherent semantics of undergoer, and arguments other than patients occurring as an undergoer acquire this semantic flavo[u]ring in addition to the meaning of their own semantic relation.

Before we consider the treatment of these sentences in the present theory, let us look at two less complex examples, (3.77a) and (3.77b), which only differ from (3.75a) and (3.75b) in that the quantity of hay is not specified. The two are illustrated by the open-ended diagrams in Figure 3.5.

(3.77) a. *Bill loaded hay on the truck.*
b. *Bill loaded the truck with hay.*

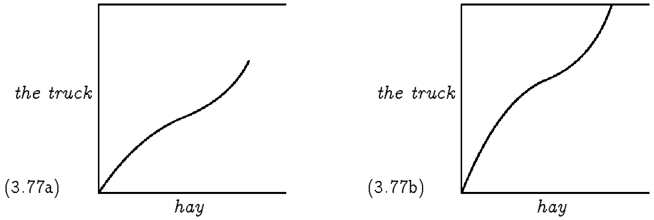

Figure 3.5: Two open-ended hay–lorry diagrams.

Since the theme, an indefinite mass term, is not quantised, the question of its referent being totally affected does not arise. In (3.77a) the location is not totally affected either; the sentence expresses an energeia rather than a kinesis, which means that a proper plural predicate is applied to a sum of moments, as in (3.71) and (3.72). In each of those moments Bill loads an atomic amount ι of hay into an atomic location (a point) κ in the body of the lorry.

The verb *load* is translated as the predicate $L^{0,0,0,1}(\odot, \mathsf{Th}, \mathsf{Lo}, \mathsf{Ag})$; ${}^{+}H^{0}$ stands for *be hay* and l for *the truck* (i.e., 'the lorry'), and $\bar{h}$ and $\bar{l}$ are the total amount of hay and the part of the volume of the lorry which actually take part in the event, in the same way as $\bar{w}$ in (3.70a) was the total amount of wine.

$$
\begin{aligned}
(3.78)\qquad {}^{+}L_{H,l,b}(t) &\leftrightarrow {}^{+}(\lambda\tau\exists\iota\exists\kappa[H(\iota) \wedge {}'I_l(\kappa) \wedge L^{0,0,0,1}(\tau,\iota,\kappa,b)])\,(t)\\
&\leftrightarrow \exists\bar{h}\exists\bar{l}[{}^{+}H(\bar{h}) \wedge {}^{+}I_l(\bar{l}) \wedge L^{+\langle 0,0,0\rangle,1}(\langle t,\bar{h},\bar{l}\rangle, b)]
\end{aligned}
$$

The predicate $L_{H,l,b}$ is the outcome of the composition of L with the singular counterpart of the predicate translating the theme, the location, which is ground to points in accordance with the expected type, and the agent, which does not take part in the distribution, since its type matches the expected one from the outset.

$$
(3.79)\qquad L^{0}_{H,l,b} = (((L^{\mathsf{Th}}/_{\mathsf{Th}}H)^{\mathsf{Lo}}/_{\mathsf{Th}}{}'I_l)^{\mathsf{Ag}}/_{\mathsf{Th}}I_b)
$$

The hay–lorry (that is, space–space) diagram for this example is as similar to the space–time diagram for (3.70a) as the formal representation in (3.78) is to the one in (3.72), and indeed one could think of (3.70a) as describing a process of 'loading' wine-drinking on time, intuitively parallel to loading hay on a lorry.

In (3.77b) the location is totally affected. The predicate is composed with the theme and pluralised with respect to the termset of the run time and the location,

(3.80) *load with hay*: $(L^{\mathsf{Th}}/_{\mathsf{Th}}H)^{+\langle 0,0\rangle,1}(\langle\odot, \mathsf{Lo}\rangle, \mathsf{Ag})$,

$$
(L^{\mathsf{Th}}/_{\mathsf{Th}}H)^{0,0,1}(\tau,\kappa,x) \leftrightarrow \exists\iota[H(\iota) \wedge L(\tau,\iota,\kappa,x)]
$$

whose filler consequently is totally affected in the course of the event. Each location κ in the lorry is mapped to a time τ in which Bill loads an amount ι of hay into κ, and the group of those times is the total run time, just as the group of the locations is the volume of the body of the lorry.

$$
(3.81)\qquad (L^{\mathsf{Th}}/_{\mathsf{Th}}H)^{+\langle 0,0\rangle,1}(\downarrow\langle t,l\rangle, b) \rightarrow t = \uparrow\bigsqcup_{'I_l(\kappa)} \iota\tau\exists\iota[H(\iota) \wedge L^{0,0,0,1}(\tau,\iota,\kappa,b)]
$$

The hay–lorry diagram for this example matches exactly the space–time diagram constructed for example (3.73) (Figure 3.3), and the intuitive parallel between the loading of a lorry with hay and the filling of half an hour with wine-drinking has an analogy in the evident similarity between (3.74) and the left half of (3.81).

Let us now return to (3.75), starting with (3.75b). It differs from (3.77b) in that the atomic entities loaded are not simply *hay* atoms, but atoms of *the hay*, selected by the predicate ${}'I_h$, where $h = \uparrow\bigsqcup_{H(\iota)}\iota$ stands for *the hay*, rather than H. The predicate thus assumes the form in (3.82) for (3.75b).

(3.82) *load with the hay*: $(L^{\mathsf{Th}}/_{\mathsf{Th}}{}'I_h)^{+\langle 0,0\rangle,1}(\langle\odot, \mathsf{Lo}\rangle, \mathsf{Ag})$,

$$
(L^{\mathsf{Th}}/_{\mathsf{Th}}{}'I_h)^{+\langle 0,0\rangle,1}(\downarrow\langle t,l\rangle, b) \rightarrow t = \uparrow\bigsqcup_{'I_l(\kappa)} \iota\tau\exists\iota[{}'I_h(\iota) \wedge L^{0,0,0,1}(\tau,\iota,\kappa,b)]
$$

The same reasoning can be applied to (3.75a), where the predicate assumes the form in (3.83) after being composed with the potential undergoer which does not become an actual one.

(3.83) *load on the truck*: $(\mathsf{L}^{\mathsf{Lo}}/_{\mathsf{Th}}{}'\mathrm{I}_l)^{+\langle 0,0\rangle,1}(\langle\odot,\mathsf{Th}\rangle,\mathsf{Ag})$,

$$(\mathsf{L}^{\mathsf{Lo}}/_{\mathsf{Th}}{}'\mathrm{I}_l)^{+\langle 0,0\rangle,1}(\downarrow\langle t,h\rangle,b) \rightarrow t = \uparrow \bigsqcup_{'\mathrm{I}_h(\iota)} \iota\tau\exists\kappa['\mathrm{I}_l(\kappa) \wedge \mathrm{L}^{0,0,0,1}(\tau,\iota,\kappa,b)]$$

Can we find a pair of sentences which are to (3.75) as (3.70a) and (3.73) are to (3.77), that is, of examples with a quantised 'filler' and a temporal 'container', which only differ in the presence or absence of a duration adverbial? The answer to this question is affirmative. Compare (3.75) to (3.84),

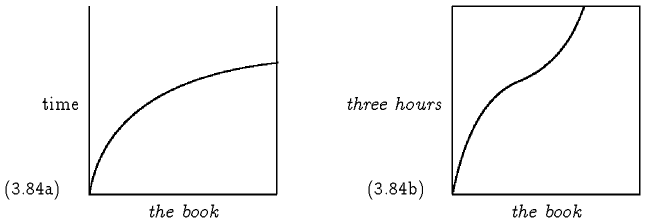

Figure 3.6: Space–time diagrams for reading a book.

(3.84) a. *I read this book.* $\mathrm{R}^{+\langle 0,0\rangle,1}(\downarrow\langle t,b\rangle,i)$

b. *I read this book for three hours.* $\mathcal{Q}^1_{3h}(t) \wedge (\mathrm{R}^{\mathsf{Th}}/_{\mathsf{Th}}{}'\mathrm{I}_b)^{+0,1}(\downarrow t,i)$

where the reading process either 'loads' the book on time or 'loads' three hours with the book, so that the book ends up being totally affected in (3.84a) and partially affected in (3.84b).

It was mentioned in Chapter 2 that *read the book*, along with *play the sonata* and *climb Ben Nevis*, belongs to a class of verbal expressions which behave as either kineseis or energeiai depending on the presence of a duration adverbial. Here we see that in (3.84b) the theme *the book*, like *the hay* in (3.75b), is ground to $^{+\prime}\mathrm{I}_b$ and composed with the translation of *read*, the predicate $\mathrm{R}^{0,0,1}(\odot,\mathsf{Th},\mathsf{Ag})$. This is not possible for the patient of *drink*, which must be included in a termset with the run time and act as the argument which sets the terminal point for the event.

(3.85) a. *I drank the wine.* $\mathrm{D}^{+\langle 0,0\rangle,1}(\downarrow\langle t,w\rangle,i)$; cf. (3.70b)

b.* *I drank the wine for half an hour.*

So the English verb *drink* is correctly translated as $\mathrm{D}^{\langle 0,0\rangle,1}(\langle\odot,\mathsf{Pt}\rangle,\mathsf{Ag})$, and this still rules in (3.70), (3.73) and (3.54) while ruling out (3.85b) as desired, though it is not necessarily the case for the counterparts of *drink* in other languages.

To summarise what was said and demonstrated so far, the quantised argument x whose type is higher than the one expected (and whose thematic role consequently is a gradual one)

(3.86) a. is partially affected if it is ground and directly composed with the predicate which translates the verbal expression, following (3.56), but with $\delta = {}'\mathrm{I}_x$;

b. is totally affected if it is included into a termset with the run time, following (3.50) and with $\delta = \mathrm{I}_x$.

3.5 Graduality and Mode of Action

In the previous section we saw how a quantised argument bearing a gradual thematic role may be prevented from being totally affected by the presence of another argument which can set a terminal point for the event: in (3.75a) *the truck* is not totally affected because *the hay* is, while in (3.75b) the opposite is the case. In many languages (such as Bulgarian, from which the examples in this section are drawn) the phenomenon observed in (3.75) is more pervasive than it is in English, and a quantised argument can be partially affected even though none of the referents of the other non-verbal constituents can act as a measure of telicity.

Let us contrast the English sentences (3.70a) and (3.54) with the Bulgarian sentences in (3.87). Note that examples (3.87a) and (3.87c) replicate examples (2.75b) and (2.75c), and that the definite article in (3.87c–3.87d) is obligatory.

(3.87) a. *Pix* *vino.*
drink-I–VB/AOR-1SG wine
'I drank wine.'

b. *Pix* *vinoto.*
drink-I–VB/AOR-1SG the wine
'I drank (of) the wine.' ('I spent (some) time drinking (some of) the wine.')

c. *Izpix* *vinoto.*
drink (TERM)-P–VB/AOR-1SG the wine
'I drank (up) the wine.'

d. *Izpivax* *vinoto.*
drink (TERM)-I–VB/AOR-1SG the wine
'I drank the wine.' ('I spent (some) time drinking up the wine.')

The sentence in example (3.87a) is headed by the imperfective verb *pi* of the **evolutive** mode of action, which expresses the development of a process without reference to a potential terminal point. It expresses the same energeia as (3.70a) does. It should therefore be translated likewise, as an application of a proper plural predicate, obtained from the composition of the verb with the nominal constituents, to a run time.

$$\mathrm{D}^0_{W,i} = ((\mathrm{D}^{\mathsf{Pt}}/_{\mathsf{Th}}W)^{\mathsf{Ag}}/_{\mathsf{Th}}\mathrm{I}_i) \tag{3.88}$$

$$^{+}\mathrm{D}_{W,i}(t) \leftrightarrow {}^{+}(\lambda\tau\exists\iota[W(\iota) \wedge \mathrm{D}(\tau,\iota,i)])(t) \tag{3.89}$$

Example (3.87b), illustrated by the space–time diagram in Figure 3.7, differs from (3.87a) in that

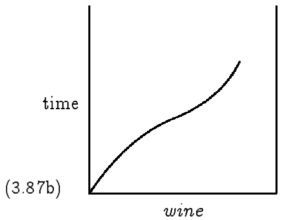

Figure 3.7: A space–time diagram for a potentially bounded event.

the atomic entities consumed are not simply *wine* atoms, but atoms of *the wine*. Unlike the situation in the English example (3.54), here it does not necessarily follow that a drinking moment is stated to exist for every one of them; that would make the eventuality quantised, conflicting with the aspect of the verb.

(3.90) $$\mathrm{D}^{0}_{w,\mathrm{i}} \;=\; ((\mathrm{D}^{\mathsf{Pt}}/_{\mathsf{Th}}{}'\mathrm{I}_{w})^{\mathsf{Ag}}/_{\mathsf{Th}}\mathrm{I}_{\mathrm{i}})$$

(3.91) $${}^{+}\mathrm{D}_{w,\mathrm{i}}(\mathrm{t}) \;\leftrightarrow\; {}^{+}(\lambda\tau\exists\iota[{}'\mathrm{I}_{w}(\iota) \wedge \mathrm{D}(\tau,\iota,\mathrm{i})])\,(\mathrm{t})$$

In example (3.87c) the head of the sentence, the perfective verb *izpi*, belongs to the **terminative**[9] mode of action, which expresses the carrying out of a process to its natural termination, as opposed to any other way of setting a terminal point to it. The sentence expresses an accomplishment derived from the activity in (3.87b) by adding to it the condition that it be carried out to its natural termination. In other words, the interval must be composed of a full set of moments τ for which $\mathrm{D}_{w,\mathrm{i}}(\tau)$ is true. Such a set contains a drinking moment for each wine atom.

(3.92) $${}^{+}\mathrm{D}^{0}_{w,\mathrm{i}}(\downarrow\mathrm{t}) \wedge \mathcal{Q}^{1}_{\mathrm{D}_{w}}(\mathrm{t}),\;\; \mathcal{Q}_{\mathrm{D}_{w}}(\mathrm{t}) \rightarrow \forall\iota[{}'\mathrm{I}_{w}(\iota) \rightarrow \exists\tau[\tau \sqsubseteq \downarrow\mathrm{t} \wedge \mathrm{D}(\tau,\iota,\mathrm{i})]]$$

Since $\mathrm{D}_{w,\mathrm{i}} = \lambda\tau\exists\iota[{}'\mathrm{I}_{w}(\iota) \wedge \mathrm{D}(\tau,\iota,\mathrm{i})]$, this formula is equivalent to (3.55), but the two differ in their derivation.

In example (3.87d) the head of the sentence, the imperfective verb *izpiva*, is obtained from the perfective verb in example (3.87c) by secondary imperfectivisation and also belongs to the terminative mode of action. The eventuality which the sentence expresses is an activity, as in (3.87a), but this activity is derived from the accomplishment in (3.87c) by grinding, so that its run time is stated to be composed of moments belonging to an actual or hypothetical interval in which the accomplishment occurs.

(3.93) $${}^{+\prime}\mathrm{I}_{(\uparrow\bigsqcup_{{}'\mathrm{I}_{w}(\iota)}\iota\tau[\mathrm{D}(\tau,\iota,\mathrm{i})])}(\mathrm{t})$$

The same conversion process is undergone by the English sentence (3.54) under progressivisation. It is compatible with the inclusion of the patient in a termset with the run time, which is obligatory in English, though not in Bulgarian.

The terminative mode of action refers to the natural termination of a process, which may be determined by the spanning of the full extent of a totally affected gradual argument. As such it is to be contrasted with the **attenuative** mode of action,

(3.94) a. *Pijnax vino.*
drink (ATTN)-<u>I-VB</u>/AOR-1SG wine
'I drank some wine.'

b. *Pijnax čaša vino.*
drink (ATTN)-<u>I-VB</u>/AOR-1SG glass wine
'I drank a glass of wine (which is not a large amount).'

which characterises the amount of the process, and the referent of any gradually affected argument, as being small, though it is not required to be specified any further. Unlike all cases considered in Section 3.4, here the amount of the affected entity is set by the verb.

The relation between the attenuative and the terminative mode of action is similar to the one between a specific indefinite and a definite term, as confirmed also by the use of the overt quantifier *some* in the English translation of (3.94a).

[9] The term used by Maslov 1965, from where the terminology in this section is generally drawn, is **general resultative**. I eschew it because of the possible clash with the term **resultative**, which refers to a particular kind of consequent state or one of a variety of corresponding categories existing in many natural languages.

Taken as a couple, these two modes of action are opposed to other couples in which the amount of the process is estimated in other ways. I shall mention two such couples briefly. In examples (3.95–3.96) the process is measured by the time filled by it. The two modes of action which are distinguished here, namely the 'specific indefinite' **delimitative** ('for a while', or for a brief time as explicitly indicated by an adverbial) and the 'definite' **transdurative** ('throughout' the duration of the object, which must be specified except in a few idiosyncratic cases), are essentially temporal counterparts of the attenuative and the terminative mode of action, since they use time rather than matter (or space) as a measure of telicity.

(3.95) *Pospax (polovin čas).*
sleep (DLMT)-<u>P-VB</u>/AOR-1SG half hour
'I slept for a while/for half an hour.'

(3.96) a. *Prespax u tjax.*
sleep (TDUR)-<u>P-VB</u>/AOR-1SG at them-ACC
'I spent the night (i.e., slept through [the night]) in their home.'

b. *Prospax filma.*
sleep (TDUR)-<u>P-VB</u>/AOR-1SG the film
'I slept through the film.'

In (3.97–3.98) the process is presented as being resumed from an intermediate stage rather than initiated. (The implied preceding stage of the process is represented by the dotted curve in the diagrams in Figure 3.8.) The **completive** and the **definitive** mode of action, which are not always distinguished lexically, differ in that the former merely adds a further amount of the process to that stage, whereas the latter carries it to its natural termination, which may be determined by the full spanning of a gradual argument.

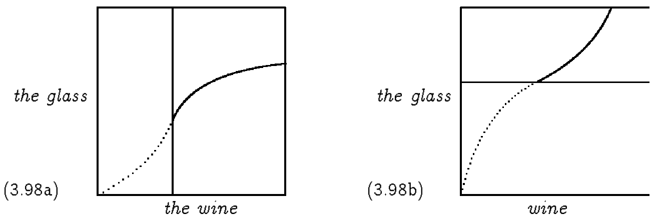

Figure 3.8: The definitive mode of action in wine–glass diagrams.

(3.97) *Doljax (malko) vino (v čašata).*
pour (CMPL)-<u>P-VB</u>/AOR-1SG a little wine in the glass
'I poured some more wine (into the glass).'

(3.98) a. *Do(na)ljax vinoto (v čašata).*
pour (DFNT)-<u>P-VB</u>/AOR-1SG the wine in the glass
'I poured the rest of the wine (into the glass).'

b. *Doljax čašata (s vino).*
pour (DFNT)-<u>P-VB</u>/AOR-1SG the glass with wine
'I filled up the glass (with wine).'

To summarise, this brief survey of some modes of action shows that the degree of affectedness of a gradual argument depends both on its being introduced by a cumulative or a quantised expression and on the mode of action of the verb, as shown in Table 3.1. The elegant general-

mode of action	evolutive	'specific indefinite'	'definite'
cumulative expression	never quantised	quantised by the verb	——
quantised expression	partially affected	totally affected	

Table 3.1: The degree of affectedness of a gradual argument.

isations obtained as a result of the treatment of time as a gradual argument in all cases support the idea of including the run time into the argument frame of the predicate as a bearer of a special thematic role.

3.6 Summary

The purpose of this chapter was to develop an account of the formation of the aspectuality of the clause on the basis of the aspectual properties of the non-verbal constituents and the lexical properties of the verb. I argued that aspectual composition is a process of direct transfer of aspectual properties; in other words, instead of assuming that in examples (3.1), (3.2a) and (3.3a) the aspectual class of the eventuality is affected in some way by the number and the quantification of the object, while remaining an inherently different category (as in the left-hand table in Figure 3.9), I contend that the eventuality has *the same* reference type as the object, modulo a constant offset determined by the definition of the predicate (as in the right-hand table). This is only possible because aspectuality is not one thing in the spatial and

example	class	
	object	eventuality
(3.1)	singular	achievement
(3.2a)	bare plural	activity
(3.3a)	quantified plural	accomplishment

example	type	
	object	eventuality
(3.1)	1	0
(3.2a)	$^+1$	$^+0$
(3.3a)	2	1

Figure 3.9: Two views on aspectual composition.

another in the temporal domain; it is a single category, and the individual 'nominal' and 'verbal' categories, which I examined, are its manifestations.

This view is the basis of the treatment of the run time as one of the arguments of the predicate, represented in its type signature, possibly present in its identification sets and available for inclusion in termsets along with the 'spatial' arguments. Some additional benefits of this treatment, of descriptive nature, were discussed in the course of my survey of Bulgarian modes of action.

The identification sets of a predicate may enforce or inhibit the coordination of the reference types of two or more arguments, brought about by forming a termset of the arguments. Aspectual composition, then, amounts to the coordination of reference where one of the arguments happens to be the run time.

Conclusion

Review of the Thesis

The purpose of this work was the development of a theory of aspectuality as a generic category, based on the theory of plurality of Landman 1989 and the theory of properties of thematic relations of Krifka 1991. Let me state once again, in what I hope is an observable form, the main characteristics and premises of the account presented here.

- Two kinds of compound entities, **sums** and **groups**, are distinguished in both the spatial and the temporal domain, and operations which convert one into the other (**summation**, **group formation** and **ungrouping**) are defined.

- Predicates can be subjected to ordinary or proper **pluralisation** relative to a single argument or a termset of two or more arguments. As a rule, collective predication is brought about by the application of singular (quantised) predicates to groups, while distributive predication is brought about by the application of plural (cumulative) predicates to sums.

- A **type**, corresponding to the level of grouping, is assigned to each term and to each argument position of every predicate. A predicate can be applied directly to an argument of the type for which it is defined. If the argument belongs to a higher type, the predicate is **lifted** relative to the relevant argument position, which results in the lowering of the type of the term.

  An entity of the lowest type in the system is an **atom**, a point in space or time, and the operation of **atomisation** of predicates selects the atomic entities enclosed within members of the extension of a given predicate. Both mass terms and atelic eventualities (states and energeiai) are treated formally as plurals.

The concepts mentioned so far are formal counterparts of a number of nominal and verbal aspectual categories recognised in natural languages. Those categories include classes of expressions or entities (at a linguistic or an ontological level, respectively) as well as explicit or implicit processes of conversion between them. The correspondence between the formal concepts and their manifestations is summarised in Tables 1.1 and 2.5.

- The **run time** is included as a special thematic role in the argument frame of a predicate which translates a verbal expression, and in the signature of the predicate it is assigned a type, which reflects the aspectual class of the expression.

- A predicate is characterised by one or more **identification sets**, which constitute a generalisation of the feature uniqueness of events (Krifka 1991). An identification set consists of thematic roles whose fillers are jointly sufficient to identify the eventuality.

- Finally, **aspectual composition**, which is regarded as a process of coordination of reference, is a direct effect of the need for the types of the arguments, one of which is the run time, to meet the requirements imposed by the type signature and the identification sets of the predicate.

Directions for Future Work

In the interest of compatibility, the present theory does not make any definite assumptions about the general semantic framework in conjunction with which it is used. The implications of its incorporation into the major current semantic frameworks and its interaction with their premises should be addressed in detail in future research.

The ease of such incorporation depends on the modularity of the host framework and on the concepts and tools already provided by it for handling the kind of phenomena for which this theory is designed. For example, the interpretation of plurals adopted in Discourse Representation Theory (DRT) in its classical form (Kamp & Reyle 1993) is based on Link 1983's lattice-theoretic account, whose fundamental premises are shared by Landman 1989's set-theoretic account and hence also lie in the heart of the account presented here. For this reason the application of this theory for the treatment of plural and collective terms in DRT should be relatively straightforward; it would amount to little more than the following:

- assigning a type as well as a number (singular or plural) to each discourse referent;
- reformulating the two operations of DRT which form plural terms, summation ($x \oplus y$) and abstraction ($\Sigma w : K$), in terms of group formation;
- revising the language-sensitive rules governing the choice of singular or plural anaphora, taking into consideration the type as well as the number of the discourse referent.

On the other hand, the use of plurality for the treatment of mass terms and of atelic eventualities has no counterpart in classical DRT, nor does the treatment of aspectual composition proposed here, and their introduction would require a lesser or greater amount of adjustment. Similar considerations apply in the case of any other general semantic framework.

It should be restated here that this theory is concerned with aspectuality as determined by the contour of the areas occupied by the entities which belong to the denotation of a predicate defined in a given spatial or temporal universe, in other words, by the type of nominal or temporal reference of the predicate. This means that the interpretation of some aspectual distinctions is left largely or entirely to the host framework. Among those are, for example, the distinction between states and energeiai, which is less than fully captured by Taylor 1977's postulates, and the distinctions between achievements and points and between progressive, habitual and generic states, for which the postulates do not account at all.

There are many other issues which I did not discuss here, but which I consider eminently worthy of being pursued in subsequent research. Among them I would mention the following:

- The details of the mechanism which govern the conversion of nominal and verbal aspectual classes in each language. Some problems with the employing of the network in Figure 2.3 for analysing English aspectual phenomena were pointed out at the end of Section 2.3. For the most part they involve edges whose transition may or may not be possible depending on the entire derivation. It may be possible to inhibit certain conversions by assigning a weight to every arch and a cost to every path in the transitional networks and setting a limit for the maximal permissible cost of each derivation. A more traditional strategy would involve introducing one or more other aspectual categories in addition to the system of types.

- The interface to syntax. By eschewing this question here I was able to avoid committing myself to any particular syntactic framework, which was expedient in particular in view of the cross-linguistic character of this study. This does not mean that I would dispute the relevance of the details of the conversion of linguistic expressions which bear aspectual meaning into formal representations. Of particular interest here are a number of issues related to determining the scope of aspectually relevant constituents and the order of their inclusion into the formalisations.
- The interaction between aspect and tense. These two categories are inherently different, since tense deals with linear order and aspect with type of reference in the temporal domain. Yet they are by no means orthogonal, since the expression of tense in natural languages tends to be highly correlated with the expression of aspect: aspectual distinctions which are made in some tenses may be neutralised in others (cf. in Bulgarian the opposition 'aorist : imperfect', which has no counterpart in the non-past tenses), and some categories may undergo a change of status (cf. the gradual 'temporalisation' of the perfect in many languages, a process in the course of which an aspectual category expressing the conversion of an event into a consequent state is transformed into a past tense).
- The applicability of the theory for the design of implementable grammars for handling aspectual phenomena in natural language processing and generation.

Finally, I devoted separate sections of this work to plurality in Arabic and to aspectuality in Bulgarian and Chinese, and throughout the rest of the discussion I drew support for the theory from these and a wide variety of other languages. This, I hope, has gone some way towards confirming the cross-linguistic relevance of the theory. However, the choice of languages was to some extent arbitrary, and the selection was not intended to be typologically exhaustive or even representative. In a further study the range of languages surveyed could be extended, with the purpose of obtaining and formulating (in the form of linguistic universals, preferably as considerations on parametric variation) useful generalisations regarding the systems of nominal and verbal aspectuality which exist in natural languages.

Language Index

References

Agrell, Sigurd (1908). *Aspektänderung und Aktionsartbildung beim polnischen Zeitworte.* Lund.

Allen, Robert L (1966). *The Verb System of Present-Day American English.* The Hague: Mouton.

Bach, Emmon (1979). 'Tenses and Aspects as Functions on Verb Phrases'. Unpublished ms.

—— **(1986).** 'The Algebra of Events'. *Linguistics and Philosophy* **9**.1:5–16.

Bäuerle, Rainer, Christoph Schwarze & Arnim von Stechow (1983) (eds.) *Meaning, Use and Interpretation of Language*, Walter de Gruyter: Berlin.

Bolinger, Dwight (1975). *Aspects of Language.* New York: Harcourt & Brace.

Borg, Albert J (1981). *A Study of Aspect in Maltese.* Ann Arbor, Michigan: Karoma.

Bulygina, Tat'jana (1983). 'Klassy predikatov i aspektual'naja xarakteristika vyskazyvanija'. In: *Aspektual'nye i temporal'nye znachenija v slavjanskix jazykax*, Moscow: Nauka.

Bunt, H C (1979). 'Ensembles and Mass Terms'. In: Pelletier 1979, pp. 249–277.

Burge, Tyler (1979). 'Mass Terms, Count Nouns and Change'. In: Pelletier 1979, pp. 199–218.

Carlson, Lauri (1981). 'Aspect and Quantification'. In: Tedeschi & Zaenen 1981, pp. 31–64.

Carlson, Greg (1984). 'A Unified Analysis of the English Bare Plural'. *Linguistics and Philosophy* **1**.6:413–457

Cartier, Alice (1972). *Les verbes résultatifs en chinois moderne.* Paris: C. Klincksieck.

Caspari, Carl Paul (1896). *A Grammar of the Arabic Language*, translated and edited with numerous additions and corrections by William Wright. Cambridge: University Press.

Chellas, Brian F (1979). 'Quantity and Quantification'. In: Pelletier 1979, pp. 227–231.

Chierchia, Gennaro & Sally McConnell-Ginet (1990). *Meaning and Grammar: An Introduction to Semantics.* Cambridge: MIT Press.

Cowell, Mark (1964). *A Reference Grammar of Syrian Arabic.* Washington: Georgetown University Press.

Croft, William (1991). *Syntactic Categories and Grammatical Relations.* Chicago & London: University of Chicago Press.

Dahl, Östen (1984). 'Perfectivity in Slavonic and Other Languages'. In: De Groot, Casper & Hannu Tommola (1984) (eds.), *Aspect Bound: A Voyage into the Realm of Germanic, Slavonic and Finno-Ugrian Aspectology*, Foris: Dordrecht, pp. 3–22.

Davidson, Donald (1967). *Essays on Actions and Events.* Oxford: Clarendon Press.

Derzhanski, Ivan A (1993). 'Groups, Plurality and Events'. Paper presented at the conference 'Events and Grammar', Bar-Ilan University, Israel, 23–25 November 1993.

—— **(1994).** 'On the Atomarisation of Mass Terms'. In: *11th European Conference on Artificial Intelligence, Amsterdam, 8–12 August 1994.* ECAI'94 *Workshop W2: 'Parts and Wholes: Conceptual Part-Whole Relations and Formal Mereology'*, pp. 135–137.

Dowty, David R (1977). 'Toward a Semantic Analysis of Verb Aspect and the English "Imperfective" Progressive'. *Linguistics and Philosophy* **1**.1:45–79.

—— **(1979).** *Word Meaning and Montague Grammar.* Dordrecht: Reidel.

—— **(1989).** 'On the Semantic Content of the Notion of "Thematic Role"'. In: Gennaro Chierchia, Barbara H Partee & Raymond Turner (eds.), *Properties, Types and Meaning*, Kluwer Academic Publishers, V. II, pp. 69–129.

Eberle, Kurt (1991). *Ereignisse: Ihre Logik und Ontologie aus textsemantischer Sicht.* IWBS report, IBM Deutschland GmbH, Stuttgart.

Foley, William A & Robert D Van Valin, Jr (1984). *Functional Syntax and Universal Grammar.* Cambridge: Cambridge University Press.

Forchheimer, Paul (1953). *The Category of Person in Language.* Berlin: De Gruyter.

Glasbey, Sheila R (1993). *Event Structure in Natural Language Discourse.* PhD Thesis, Centre for Cognitive Science, University of Edinburgh.

Gleason, Henry A (1969). *An introduction to descriptive linguistics.* London: Holt, Rinehart & Winston.

Grandy, Richard E (1979). 'Stuff and Things'. In: Pelletier 1979, pp. 219–225.

Guiraud-Weber, Marguerite (1988). 'Sémantisme verbal et aspect en russe'. *X^e congrès international des slavistes, Sofia, 14–22 septembre 1988. Communications de la délégation française.*

Holisky, Dee A (1981). 'Aspectual Theory and Georgian Aspect'. In: Tedeschi & Zaenen 1981, pp. 127–144.

Howell, Mortimer S (1900). *A grammar of the classical Arabic language: tr. and comp. from the works of the most approved native or naturalized authorities.* Allahabad: Printed at the North-Western Provinces and Oudh Government Press.

Jacobsen, Wesley M (1984). 'Lexical Aspect in Japanese'. In: Testen *et al.* 1984, pp. 150–161.

Jelinek, Eloise (1991). 'Quantification in Straits Salish'. Manuscript, LSA Summer Institute.

Jespersen, Otto (1924). *The Philosophy of Grammar.* London: Allen & Unwin.

Jones, Morris & Alan R Thomas (1977). *The Welsh Language: Studies in its Syntax and Semantics.* Cardiff: University of Wales Press.

Kabakčiev, Krasimir (1992). *Glagolno-imenna søčetaemost i aspektualnost.* Sofia: Kliment Oxridski.

Kamp, Hans & Uwe Reyle (1993). *From Discourse to Logic: Introduction to Model-theoretic Semantics of Natural Language, Formal Logic and Discourse Representation Theory.* Kluwer Academic Publishers.

Kenny, Anthony J P (1963). *Action, Emotion and Will.* New York: Humanities Press.

Krifka, Manfred (1991). 'Thematic Relations as Links between Nominal Reference and Temporal Constitution'. In: Ivan Sag & Anna Szabolcsi (eds.), *Lexical Matters*, CSLI Notes 24: Chicago University Press.

—— (1993). 'The Origins of Telicity'. Paper presented at the conference 'Events and Grammar', Bar-Ilan University, Israel, 23–25 November 1993.

Landman, Fred (1989). 'Groups'. *Linguistics and Philosophy* **12**.5:559–605; **12**.6:723–744.

—— (1991). *Structures for Semantics.* Kluwer Academic Publishers.

—— (1993). 'Events and Plurality'. Paper presented at the conference 'Events and Grammar', Bar-Ilan University, Israel, 23–25 November 1993.

Leech, Geoffrey N (1936). *Towards a Semantic Description of English.* Bloomington: Indiana University Press.

Link, Godehard (1983). 'The Logical Analysis of Plurals and Mass Terms: A Lattice-Theoretical Approach'. In: Bäuerle *et al.* 1983, pp. 302–323.

Maslov, Jurij S (1965). 'Sistema osnovnyx ponjatij i terminov slavjanskoj aspektologii'. In: Ju S Maslov & A V Fëdorov (eds.), *Voprosy obščego jazykoznanija*, University of Leningrad, pp. 53–80.

Menovščikov, Georgij A (1967). *Grammatika jazyka aziatskix ėskimosov.* Leningrad: Acad. Sc. of the USSR.

Mittwoch, Anita (1982). 'On the Difference between *Eating* and *Eating Something*: Activities versus Accomplishments'. *Linguistic Inquiry* **13**.1:113–122.

Moens, Marc & Mark J Steedman (1988). 'Temporal Ontology and Temporal Reference'. *Computational Linguistics* **14**.2:15–28.

Moltmann, Friederike (1991). 'Measure Adverbials'. *Linguistics and Philosophy* **14**.6:629–660.

Mourelatos, Alexander P D (1981). 'Events, Processes, and States'. In: Tedeschi & Zaenen 1981, pp. 191–212.

Ogihara, Toshiyuki (1990). 'The Semantics of the Progressive and the Perfect in English'. In: Hans Kamp (ed.), *Tense and Aspect in English*, DYANA Deliverable R2.3.A, pp. 3–38.

Ojeda, Almerindo E (1992). 'The Semantics of Number in Arabic'. In: Chris Barker & David Dowty (eds.), *Working Papers in Linguistics No. 40: Proceedings from the Second Conference on Semantics and Linguistic Theory*, Ohio State University.

—— (1993). *Linguistic Individuals.* CSLI Lecture Notes 31.

Partee, Barbara & Mats Rooth (1983). 'Generalized Conjunction and Type Ambiguity'. In: Bäuerle *et al.* 1983, pp. 361–383.

Pelletier, Francis J (1979) (ed.) *Mass Terms: Some Philosophical Problems.* Reidel: Dordrecht.

—— (1979′). 'Non-Singular Reference'. In: Pelletier 1979, pp. 1–14.

Quine, Willard V O (1960). *Word and Object.* MIT Press: Cambridge.

Ruhlen, Merritt (1987). *A Guide to the World's Languages. Volume 1: Classification.* Stanford University Press.

Saltarelli, Mario & Miren Azkarate (1988) . *Basque.* London: Croom Helm.

Schwarzschild, Roger (1992). 'Types of Plural Individuals'. *Linguistics and Philosophy* **15**.6:641–675.

Skorik, P Ja (1977). *Grammatika čukotskogo jazyka.* Moscow: Acad. Sc. of the USSR.

Smith, Carlota (1991). *The Parameter of Aspect.* Kluwer Academic Publishers.

Sparkes, Ivan G (1985) (ed.) *Dictionary of Collective Nound and Group Terms.* Gale Research Co.: Detroit, Michigan.

Tai, James H-Y (1984). 'Verbs and Times in Chinese: Vendler's Four Categories'. In: Testen *et al.* 1984, pp. 289–296.

Taylor, Barry (1977). 'Tense and Continuity'. *Linguistics and Philosophy* **1**.2:199–220.

Tedeschi, Philip J & Annie E Zaenen (1981) (eds.) *Syntax and Semantics*, V. 14: *Tense and Aspect*, New York: Academic Press.

ter Meulen, Alice (1983). 'The Representation of Time in Natural Language'. In: Alice ter Meulen (ed.), *Studies in Model-theoretic Semantics*, pp. 177–191.

Testen, David, Veena Mishra & Joseph Drogo (1984) (eds.) *The 20th Regional Meeting of the Chicago Linguistic Society: Papers from the Parasession on Lexical Semantics.*

Tommola, Hannu (1991). 'Ob aspektual'nyx kategorijax. (Bolgarskie vidy v zerkale finskogo jazyka—i čerez prizmu russkogo jazyka)'. In: *Bølgarističnі izsledvanija.* III *bølgaro-skandinavski simpozium, 20–26 septemvri 1985*, Sofia: Kliment Oxridski, 1991, pp. 233–249.

Vendler, Zeno (1967). *Linguistics in Philosophy.* Ithaca: Cornell University Press.

Verkuyl, Hans (1972). *On the Compositional Nature of the Aspects.* Dordrecht: Reidel.

—— (1989). 'Aspectual Classes and Aspectual Composition'. *Linguistics and Philosophy* **12**.1:39–94.

Vlach, Frank (1981). 'The Semantics of the Progressive'. In: Tedeschi & Zaenen 1981, pp. 271–292.

Vogt, Hans (1940). *The Kalispel Language: an Outline of the Grammar, with Texts, Translations, and Dictionary.* Oslo: I kommisjon hos Dybwad.

Ware, Robert X (1989). 'Some Bits and Pieces'. In: Pelletier 1979, pp. 15–29.

Weinreich, Uriel (1963). 'On the Semantic Structure of Language'. In: Joseph Greenberg (ed.), *Universals of Language: report of a conference held at Dobbs Ferry, New York, April 13–15, 1961*, Cambridge, Massachusetts: MIT Press.

Zeuss, Kaspar (1871). *Grammatica Celtica: E monumentis vetustis tam hibernicae linguae quam britannicarum dialectorum, cambricae, cornicae, armoricae comparatis gallicae priscae reliquiis.* Berolini: apud Weidmannos. Paris: Maisonneuve.

Žirkov, Lev I (1955). *Lakskij jazyk: fonetika i morfologija.* Moscow: Acad. Sc. of the USSR.