The Mereological Approach to Aspectual Composition

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1. Aspectual Classes and Aspectual Composition: The Roots

1.1 Aspectual Classes

Aristoteles (Metaphysic Θ 6, 1048b, 18-35), classification of actions into those that have limits (move towards a goal) and those that don't and hence are completed as soon as they begin (*kineisis* 'movements' vs. *energeia* 'actualities')

> E.g., at the same time we are seeing and have seen, are understanding and have understood […] while it is not true that at the same time we are learning and have learned, or are being cured and have been cured.

Vendler (1957), partly based on Ryle (1949): Aspectual classes of Activities, Accomplishments, Achievements, States. Development of linguistic tests. Accomplishment and Activities go on in time, Achievements and States don't. Acc's und Act's differ in homogeneity:

> It appears, then, that running and its kind go on in time in a homogeneous way; any part of the process is of the same nature as the whole. Not so with running a mile or writing a letter; they also go on in time but, but they proceed toward a terminus which is logically necessary to their being what they are. (p. 101)

Kenny (1963): Performance verbs (Acc's and Ach's), Activitiy verbs (Act's) and Static Verbs. Performance verbs always lead to a goal:

> Any performance is describable in the form 'bringing it about that p'

1.2 Formal Mereological and Decompositional Approaches

First formal mereological approaches:

Bennett & Partee (1972), "subinterval property" of expressions like *run* in interval semantics. If *run* is true at time interval t, then it is also true for every part t′ of t. Cf. also Taylor (1977).

First formal decompositional approaches:

Dowty (1972), Dowty (1979): Decomposition of Acc's into an action and a stative predicate. E.g., *draw the circle*: Act in such a way that *the circle is drawn* is true. Combination with interval semantics: *x draw- the circle* is true at the minimal interval t such that *the circle is drawn* is false at the beginning of t, and true at the end. Explanation of tests for acc's vs. act's in this framework, e.g. *in an hour / for an hour* and *almost*.

1.3 Aspectual Composition

Observation: The aspectual class can depend on the nature of the arguments.

Garey (1957), aspect in French, telic vs. atelic predicates.

> If there is a direct object, and if this object designates something that has a structure with a temporal ending to it – a game of chess or of tennis, a Beethoven sonata – the expression verb-plus-object is telic. In the contrary case, if the complement of the verb is atelic – *aux échecs* 'chess', *du violon* 'the violin', *du Beethoven* 'some Beethoven' – or if there is no object (…), the expression is atelic.

Verkuyl (1972): This also holds for non-temporal object NPs. General rule scheme, for direct objects; feature determination [±Specified Quantity] => [±Durative]:

(1) $[_V$ Verb $[_{NP}$ Specified quantity]]: Non-durative
$[_V$ Verb $[_{NP}$ Unspecified quantity]]: Durative

This holds for movement verbs, perform verbs, take verbs and "add to" verbs:

(2) a. *walk (*from the train station to the university) for an hour*
b. *play for an hour (Cello concertos / *a cello concerto) for an hour*
c. *drink (whiskey / *a bottle of whiskey) for an hour*
d. *knit (mittens / *a pair of mittens) for an hour*

Relation between specified quantity distinctions and durative distinctions:

> (…) the semantic information 'UNSPECIFIED QUANTITY OF X' or 'SPECIFIED QUANTITY OF X' pertains directly or indirectly to the Time axis. That ist, the quantities of X involved are expressible in terms of linearly ordered sets of temporal entities. (Verkuyl 1972: p.111)

Can this relationship be expressed explicitly? Many authors have observed similarities between nominal distinctions and verbal distinctions (e.g., Leisi (1953), , Taylor 1977, Bach (1981, (1986), Langacker (1987).

Platzack (1979): Aspectual composition by feature projection of transcategorial feature [± DIVID]:

(3) a. *peel a carrot*: [*a carrot*][–DIVID] → [*peel a carrot*][–DIVID]
b. *peel carrots*: [*carrots*] [+DIVID] → [*peel carrots*][+DIVID]

Problem: Feature projection rules like the ones by Verkuyl and Platzack rules are clearly semantically motivated, but this insight remains at a pre-theoretical level.

This also holds for other feature-based descriptions such as Tenny (1987, (1992) and Jackendoff (1996). Tenny works with the intuitive notion of **measuring out**: In cases like *peel a carrot*, the object NP *a carrot*, which comes with a measure, measures out the event expressed by the verb.

2. The Mereological Approach to the Semantics of NPs

2.1 Sum individuals

Sets or sum individuals as reference objects for conjunction, plural NPs and mass nouns Hausser (1974), Bennett (1975), Link (1983). General sum formation results in a join semi-lattice. One possible implementation:

(4) P = U, , ≤, <, is a *part structure* iff
a. U is a set of entities;
b. , the *sum operation*, is a function from U × U to U
that is idempotent, commutative, and associative, that is:
x x = x and x y = y x and x (y z) = (x y) z]
c. ≤, the *part relation*, defined as: [x ≤ y ↔ x y = y]
d. $<_p$, the *proper part relation*, defined as: [x < y ↔ x $≤_p$ y x ≠ y]
e. , the *overlap* relation, defined as: [x y ↔ z U[z ≤ x z ≤]]
f. Remainder principle: [x $<_p$ y → !z[¬[z x] x z = y]]

Sum individuals were used to model non-boolean conjunction and plural NPs.

(5) a. John and Bill own a boat together.
b. Two men owned a boat together.

2.2 *Cumulative and quantized predicates and measure functions*

"Cumulative" predicates: Quine (1960); "quantized" predicates: Krifka (1989)

(6) A predicate P is **cumulative** iff
(i) x,y[P(x) P(y) → P(x y)]
(ii) x,y[P(x) P(y) ¬ x = y]]

(7) A predicate P is **quantized** iff x,y[P(x) P(y) → ¬ y < x]]

That is, a predicate P is cumulative iff, whenever it applies to x and y, it also applies to the sum of x and y. Also, it should apply to at least two distinct elements.

(8) a. Cumulative nominal predicates: *tea, apples*
b. Quantized nominal predicates: *two liters of tea, two apples*.

From cumulative to quantized predicates by extensive measure functions Krifka (1989):

(9) a. *sixty cups / liters of tea*
b. **sixty degree Celsius of tea*

(10) m is an **extensive measure function** for a part structure P iff:
a. m is **additive**: If ¬ x y, then m(x y) = m(x) + m(y)
b. m has the property of **comensurablity** (a.k.a. Archimedian property):
If m(x) > 0, and y < x, then m(y) > 0.

2.2.1 Example of a quantized predicate:

(11) ⟦*two liters of tea*⟧ = λx[x TEA LITER(x) = 2]
where LITER is an extensive measure function.

This predicate is provably quantized.

Natural languages allow for distinct ways to make use of measure functions:

(12) Measure constructions
⟦*two liters of tea*⟧ = ⟦*two liters*⟧(⟦*tea*⟧)
= λPλx[P(x) LITER(x)=2] (λx[TEA(x)])

(13) Classifier constructions (Chinese): Based on a noun-specific measure function, NATURAL_UNIT, that are specified external to the noun.
⟦*san ge pinguo*⟧ = ⟦*san ge*⟧(⟦*pinguo*⟧) 'three apples'
= λPλx[P(x) NATURAL_UNIT(P)(x)=3](λx[APPLE(x)])
= λx[APPLE(x) NATURAL_UNIT(APPLE)=3]

(14) Count noun constructions: Based on noun-specific measure function incorporated into the noun.
⟦*drei Äpfel*⟧ = ⟦*Äpfel*⟧(⟦*drei*⟧)
= λnλx[APPLE(x) NATURAL_UNIT(APPLE)=n](3)

The selection of singular/plural forms is by syntactic agreement and semantically inconsequential. Cf. general plural agreement with decimal fractions (a) and lack of number agreement in Turkish (b).

(15) a. *one point zero inhabitants / *inhabitant (per square kilometer)*
b. *üç kiz / *kizlar* 'three girl / girls'

Bare plurals (e.g., *Mary ate apples*) lead to an existential quantification over the number argument of a count noun. We can prove that ⟦*apples*⟧ is cumulative.

(16) ⟦*apples*⟧ = λx n[⟦*apple(s)*⟧(x) = n]

Quantization as a reconstruction of Verkuyl's notion of [+SPECIFIED QUANTITY].

2.3 *Objects and Matter*

Objects and masses that make up an object may have distinct properties (Parsons 1970, ter Meulen 1980):

(17) *This ring is new, but the gold that makes up this ring is old.*

Link (1983): Two distinct sorts of entities (masses, individuals), with a mapping relation from objects to the masses that make up the objects.

3. Aspectual Composition: Bach, Verkuyl, Naumann

The insights of feature-based theories of aspectual composition such as Verkuyl (1972), refined analyses of mass nouns and count nouns such as Link (1983), and event semantics as proposed in Davidson (1967), have resulted in fairly precise theories of aspectual composition. A number of options have been pursued.

3.1 Bach (1981, 1986)

Bach distinguishes between two sorts of eventualities: **events** and **processes**. Events have the property of antisubdivisibility (= quantization) and lack additivity (= cumulativity); processes have just the opposite property.

Bach sees the event : process distinction as similar to the object : mass distinction in the nominal domain. An event is made out of processes just like an object is made out of masses.

This could make it possible to treat the influence of object NPs on aspectual class, as in *eat a carrot* (object → event) and *eat pudding* (mass → process).

However, it would be difficult to carry out this argument for *eat carrots* (process) and *eat a pound of pudding* (event), as *carrots* presumably are objects, and *a pound of pudding* presumably is a mass. Also, is there a sortal difference between an eventualty described as *run* and the same eventuality described as *run a mile*?

3.2 Verkuyl (1993, 1999)

Verkuyl (1993), also Verkuyl (1999) attempts to make insights on aspectual composition more explicit, within Generalized Quantifier theory.

[± Specified Quantity] as a property of quantifiers (roughly, whether the intersection ⟦*N*⟧ ∩ ⟦*V*⟧ is delimited by a quantity statement ("bounded"), or whether it is left 'arbitrary' (unbounded). Problem: This is a distinction of how semantic objects are described, not of semantic objects per se.

Aspectual composition by the notion of a **path** (cf. Gruber (1965)). Paths are modelled by functions that map objects to their space-time coordinates, or rather, by increasing intervals. Paths can be in space, but also outline the way in which objects are subjected in events.

(18) *Judith walks* (from s1 to s4
⟦walk⟧(j, { t1,s1 , t2,s2 , t3,s3 , t4,s4 })

(19) *Judith ate three sandwiches* (namely s1, s2, s3, in this order)
⟦*eat*⟧(j,{ t1,{s1} , t2,{s2} , t3,{s3} })

Aspectual composition: If the object NP is bounded (as in *three sandwiches*, the temporal development is bounded; if the object NP is unbounded (as in *sandwiches*), the temporal development is unbounded (for verbs with the ADD TO-property). Problem: It is not clear what exactly "bounded" means.

Another problem: Verkuyl assumes a discrete structure of times (see above, t1, t2 etc.). This is not plausible in many cases, e.g. *Water flowed from the lake to the sea.*

3.3 Naumann (1995)

Naumann (1995) proposes a theory of aspectual composition in a "dynamic logic", essentially in automata-theoretic terms.

4. Aspectual Composition: Krifka (1989, 1992, 1998)

4.1 Basic Idea

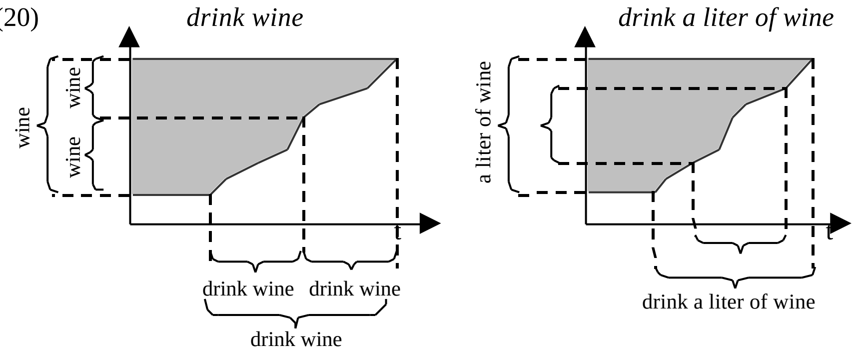
- [– SPECIFIED QUANTITY] predicates like *tea*, *apples* are **cumulative**. If x falls under *apples*, and y falls under *apples*, then the sum of x and y, denoted x y, falls under *apples* again.
- [+ SPECIFIED QUANTITY] predicates like *three cups of tea*, *three apples* are not cumulative but **quantized**: If x falls under *three apples*, then no proper part of x falls under *three apples*.
- Atelic predicates like *run* are cumulative if seen as event predicates. If e is an event of running and e′ is an event of running, then e e′ is an event of running.
- Telic predicates like *recover* are quantized. If e is an event of recovering, then no proper part of e is an event of recovering.
- Incremental predicates express a certain relation between the parts of an object subject to an event and the parts of an event.

In contrast to Verkuyl (1993), no discrete structures assumed.

In contrast to Bach (1986), no ontological distinction "events" / "processes".

4.2 Transfer of Reference Properties

4.2.1 Incremental relation, illustrated by space-time diagrams

(20)


The "gradual" or "incremental" relation (Dowty 1991) of events to objects is crucial for transfer of reference properties; does not obtain for *buy wine / buy a liter of wine*.

4.2.2 Representation format for sentences

Incrementality can be captured in a number of ways. Krifka (1998) assumes the following kind of representation, exemplified by the derivation of *Mary ate apples*:

(21) a.	*ate*:	λx,y,e[EAT(x, y, e)]
b.	*apples*	λSλx,e y[APPLES(y) S(x, y, e)]
c.	*eat apples*:	λSλx,e y[APPLES(y) S(x, y, e)](λx,y,e[EAT(x, y, e)])
		= λx,e y[APPLES(y) EAT(x, y, e)]
d.	*Mary*	λRλe[R(M, e)]
e.	*Mary eat apples*:	λRλe[R(M, e)](λx,e y[APPLES(y) EAT(x, y, e)])
		= λe y[APPLES(y) EAT(M, y, e)]
f.	PAST	λP e[e ≤ NOW P(e)]
f.	*Mary ate apples*:	λP e[e ≤ NOW P(e)](λe y[APPLES(y) EAT(M, y, e)]
		= e y[e ≤ NOW APPLES(y) EAT(M, y, e)]

Here, APPLES is short for λx n[APPLE(x)=n]. We concentrate here on line (c) and the differences between cases like the following:

(22) a.	*eat apples*	λx,e y[APPLES(y) EAT(x, y, e)]
b.	*eat three apples*	λx,e y[APPLE(y) = 3 EAT(x, y, e)]

Transfer of reference properties obtains under certain conditions for the event predicates. These conditions can be given in terms of the relation between the event argument and one additional argument, where the other arguments are open parameters. We will call such relations **thematic roles** (θ).

(23) a. Thematic role of object of *eat*: λyλe[EAT(x, y, e)]
b. Thematic role of subject of *eat*: λxλe[EAT(x, y, e)]

4.2.3 Some relevant properties of event predicates

(24) θ is **cumulative** iff θ(x, e) θ(x′, e′) → θ(x x′, e e′)
(general condition for participants of events)

(25) θ is **unique for objects** iff θ(x, e) θ(x′, e) → x = x′
(general condition for participants of events – possible counterexample: *touch*)

(26) θ is **unique for events** iff θ(x, e) θ(x, e′) → e = e′
(o.k.: *eat, write*; not o.k.: *read, see, push, ride…*)

(27) θ shows **mapping to subobjects** iff θ(x, e) e < e′ → x′[x′<x θ(x′, e′)]
(o.k.: *eat, write*; not o.k.: *read, see, push, ride*)

(28) θ shows **mapping to subevents** iff θ(x, e) x′ < x → e′[e′ < e θ(x′, e′)]
(o.k.: *eat, write, read*; not o.k.: *see, push, ride*)

Definition of strictly incremental object relations:

(29) θ is **strictly incremental** iff θ has the properties (24) – (28),
and there are x, x′, e, e′ such that x′ < x, e′ < e, θ(x, e), θ(x′, e′).

4.2.4 Cumulativity and quantization of event predicates

Proof of cumulativity of *eat apples*:

We have to show: P = λe x[⟦*apples*⟧(x) EAT(x, e)] is cumulative. Assume that ⟦*apples*⟧ and EAT are cumulative, and assume that P(e′), P(e″). That is, that we have x′, x″ such that ⟦*apples*⟧(x′) EAT(x′, e′) and ⟦*apples*⟧(x″) EAT(x″, e″). As ⟦*apples*⟧ is cumulative, we have ⟦*apples*⟧(x′ x″), and as EAT is cumulative, we have EAT(x′ x″, e′ e″). But then there is a x such that ⟦*apples*⟧(x) EAT(x, e′ e″), namely x = x′ x″. Hence we have P(e′ e″), that is, P is cumulative.

Proof of quantization of *eat three apples*:

Assume that ⟦*three apples*⟧ is quantized and that EAT is strictly incremental. Assume to the contrary that P = λe x[⟦*three apples*⟧(x) EAT(x, e)] is not quantized, that is, that there are e′, e″ with P(e′), P(e″) and e′ < e″. This means that there are x′, x″ with ⟦*three apples*⟧(x′) EAT(x′, e′) and ⟦*three apples*⟧(x″) EAT(x″, e″). Due to mapping to subobjects we have that there is a y with y < x″ and EAT(y, e′). Due to uniqueness of objects we have that y = x′, that is, we have x′ < x″. But this is incompatible with ⟦*three apples*⟧(x′), ⟦*three apples*⟧(x″), and the assumption that ⟦*three apples*⟧ is quantized.

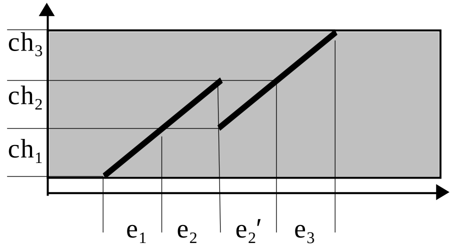
4.2.5 Atomicity of event predicates

Problem: Uniqueness of objects and mapping to subobjects applies to verbs like *eat* and *write*, but not to *read*, even though these verbs seem to behave similarly:

(30) a. *Mary read articles for an hour / *in an hour.*
b. *Mary read three articles *for an hour / in an hour.*

Problem: We can read with "backups". E.g., if e_1 is a reading of chapter 1, ch_1, e_2 is a reading of ch_2, e_2' is a reading of ch_2, and e_3 is a reading of ch_3, then e_1 e_2 e_2' e_3 is a reading of the book b = ch_1 ch_2 ch_3, but e_1 e_2 e_3 is also a reading of b.

(31)



Solution: Analyze READ as the union of strictly incremental readings:

(32) a. R(a, e_1 e_2 e_3), R′(a, e_1 e_2' e_3),
where R, R′…. are strictly incremental;
b. READ = the closure under sum formation of R R′ …,
for example, READ(a, e_1 e_2 e_2' e_3),
as READ(a, e_1 e_2 e_3), READ(a, e_1 e_2' e_3),
and e_1 e_2 e_2' e_3 = [e_1 e_2 e_3] [e_1 e_2' e_3]

(33) A relation θ is **incremental** iff there is a set of strictly incremental relations S,
and θ is S closed under sum formation,
i.e. θ S and θ is cumulative.

Incrementality does not guarantee quantization, but it guarantees atomicity:

Assume ⟦*read three articles*⟧(e) that is, there is an x with READ(x, e) ⟦*three articles*⟧(x). As READ is incremental, there are strictly incremental relations R_1, … R_n READ and events e_1,…e_n with R_1(x, e_1), … R_n(x, e_n) and e = e_1 … e_n. Any such e_i, 1 ≤ i ≤ n, is an atom of ⟦*read three articles*⟧, that is, there is no e′, e′ < e_i, such that ⟦*read three articles*⟧(e′) as the corresponding R_i is quantized.

In (31), e_1 e_2 e_3 and e_1 e_2' e_3 are two atomic readings of the book b.

4.2.6 The basic Vendler tests

(34) a. *Mary read the book / three chapters / *books in three days.*
b. *Mary read books / *the book / *three chapters for three days.*

Interval adverbials like *in three days* specify a minimal time interval for which the verbal predicate is true (cf. Krifka 1989). In order for there to be a minimal time interval, the verbal predicate must be atomic.

Measure adverbials like *for three days* express that for all relevant parts of an interval with the length of three days, the verbal predicate is true (cf. Dowty 1979). This is possible for *read books*, but not for *read the book / three chapters*, if the times are smaller than atomic readings.

5. The Topological Approach to Movement Predicates

If we want to deal with movement predicates we have to assume more general topological structures (cf. Krifka 1998).

5.1 Types of movement predicates

Movement in physical space, delimited by a measure function or by source and goal

(35) a. *Mary walked three miles (in an hour)*
b. *Mary walked from A to B (in an hour)*

Movement in quality space

(36) a. *Mary heated the water from 30º to 70º (in an hour*).
b. *Mary heated the water by 40 degrees (in an hour*).

Movement in quality space with explicit or implicit resultant state

(37) a. *Mary whipped the cream stiff (in an hour)*
b. *Mary baked the cake (in an hour).*

5.2 Topological Structures

Topological structures assume a basic relation of **connectedness** between two entities (regions). Mereological structures can be defined from topological structures, i.e. topological structures are richer than mereological structures (cf. Clarke (1981)).

P = U, @ is a *connectedness structure* iff
a. U is a set of entities;
b. @, the *connectedness relation*, is a relation in U
that is reflexive and symmetric, i.e. x @ x and x @ y → y @ x
c. @ satisfies the following axiom: z[x @ z ↔ y @ z] ↔ x = y

We can define the mereological part relation and adjacency (external connectedness):

(38) a. x is a *part* of y, x ≤ y, iff z[z @ x → z @ y]
b. x and y *overlap*, x y, iff z[z ≤ x z ≤ y]
b. x and y are *adjacent*, x ∞ y, iff x @ y ¬[x y]

With the part relation we can define the sum operation, and part structures, as usual.

We can define convex elements (regions) as follows:

(39) x is a *convex element*, x C, iff y,z[y z = x → y @ z]

5.3 Paths

Paths are convex, linear elements in connectedness structures.

(40) x is a *path* iff x C
and y,z C[y ≤ x z ≤ x ¬[y @ z] → !u C[u ≤ x y ∞ u z ∞ u]]

That is, two disjoint, non-connected parts of a path are always connected by exactly one subpath. This excludes circular and branching paths.

5.4 Movement Predicates

5.4.1 Simple movement predicates

Movement predicates relate the parts of a path to the parts of an event.

(41) a. ⟦*hike the Vernal Falls Path*⟧ = λe[HIKE(VFP, e)]
b. ⟦*hike*⟧ = λe x[HIKE(x, e)]

Simple movement predicates are incremental relations between objects and parts of a path. Hence, they lead to quantized predicates.

In addition, movements satisfy a relation between temporal adjacency of events and spatial adjacency of parts of the path:

Simple movements relate temporal adjacency and spatial adjacency

(42) θ has the **adjacency property** iff
θ(x, e) e′, e″ ≤ e x′, x″ ≤ x θ(x′, e′) θ(x″, e″) → [e′ ∞ e″ ↔ x′ ∞ x″]

5.4.2 General Movement Predicates

General movements include movements with stops, circular movements or movements with backups. Not any two movements form a general movement; to qualify, the second movement must begin where the first movement has ended.

One can show: Event predicates based on general movement relations are atomic.

6. Linguistic Applications

6.1 Progressive in Finnish and German by Case

Use of partitive as an progressive marker in Finnish (cf. e.g. Heinämäki (1983), Kiparsky (1998):

(43) a. *Lapsi söi kalan kun Maija tuli silään.*
child ate fish.ACC when Maija came in
'The child ate a/the fish when Maija came in'

b. *Lapsi söi kalaa kun Maija tuli silään.*
child ate fish.PART when Maija came in
'The child was eating a/the fish when Maija came in'

Use of prepositional objects in German (Krifka 1989):

(44) a. *Das Kind aß einen Fisch als Maija hereinkam.*
the child ate a fish when Maija came in
'The child ate a fish when Maija came in'

b. *Das Kind aß an einem Fisch als Maija hereinkam.*
the child ate at a fish when Maija came in
'The child was eating a fish when Maija came in'

Sketch of explanation (cf. Krifka 1989, 1992):

The partitive case or the *an*-PP changes a nominal predicate so that it can refer to parts of the entities in its original extension (cf. (45.a)). By the transfer of reference properties with incremental objects, this translates to a reference to parts of the event predicate, that is, to progressive meaning (cf. b).

(45) a. ⟦*kalan*⟧ = FISH, ⟦*kalaa*⟧ = λx y[FISH(y) x ≤ y]

b. ⟦*söi kalan*⟧ = λe y[FISH(y) EAT(y, e)]
⟦*söi kalaa*⟧ = λe x,y[FISH(y) x ≤ y EAT(x, e)]
≈ λe e′[⟦*söi kalan*⟧(e′) e ≤ e′]

In Finnish this was grammaticalized to a general way of marking progressives. In German, this marking is restricted to verbs with incremental object relations.

(46) a. *Das Kind schrieb an einem Brief als Maija hereinkam.*
'The child was writing a letter when Maija came in.'
b. **Das Kind sah an einem Bild als Maija hereinkam.*
'The child was looking at a picture when Maija hereinkam'

6.2 Definiteness in Slavic and Chinese by Aspect

Perfectivity and definiteness in Slavic, cf. Wierzbicka (1968), Filip (1997), Wierzbicka 1968 (Czech)

(47) a. *Ota pil víno.*
Ota drank.IMPERF wine 'Ota was drinking wine/the wine'
b. *Ota vypil víno.*
Ota drank.PERF wine 'Ota drank *wine/the wine'

Resultative and definiteness in Chinese (Haihua Pan, pers. comm.)

(48) a. *Mali kan-le shu, jiu zou le.*
Mary read-ASP book, then leave PRT
'Mary read a book/books/the book(s), and then left.'

b. *Mali kan-wan-le shu, jiu zou le.*
Mary read-finish-ASP book, then leave PRT
'Mary read *a book/*books/the book(s), and then left.'

Sketch of explanation (cf. Krifka 1989, 1992):

(49) ⟦*vypil vino*⟧ = ⟦*vy*⟧(⟦*pil vino*⟧)

Perfective aspect in Slavic and resultative marking in Chinese presuppose that the verbal predicate is quantized / atomic, otherwise it does not make sense to talk of a "complete" event of a certain type. We get a quantized / atomic interpretation for verbs like 'drink', 'read' if the object NP is quantized or atomic. With Slavic mass nouns and Chinese nouns, this is the case under the definite interpretation, but not under the indefinite interpretation.

(50) a. ⟦*vino*⟧: (i) WINE – indefinite interpretation
(ii) ιx WINE(x) – definite interpretation

But verbal prefixes in Slavic do not uniformely, or exclusively, express telicity; cf. Filip (to appear).

7. Some Problems and Solutions

7.1 'Some' and 'more than n'

The NPs *some apples* and *more than three apples* are cumulative when analyzed as nominal predicates:

(51) ⟦*some apples*⟧(x), ⟦*some apples*⟧(y) → ⟦*some apples*⟧(x y)

But they lead to quantized / atomic predicates, cf. Mittwoch (1982), White (1994), Zucchi & White (2001):

(52) *Mary ate some apples / more than three apples in an hour / *for an hour.*

Solution: NPs with overt quantifiers have wide scope. Possible implementation:

(53) a. Mary ate some apples in an hour
b. LF: [*some apples*]$_1$ [*Mary* [[*ate* t_1] *in an hour*]]
c. *eat* t_1 λx,e[EAT(x, x_1, e)]
d. *in an hour*: λR,x,e t[R(x,e) H(t)=1 τ(e)≤t]
(+ pragmatic requirement: R(x,e) atomic for e)
e. [*eat* t_1] *in an hour*: λx,e t[EAT(x, x_1, e) H(t)=1 τ(e)≤t]
f. *Mary* [[*eat* t_1] *in an hour*]: λe t[EAT(MARY, x_1, e) H(t)=1 τ(e)≤t]
g. *Mary* [[*ate* t_1] *in an hour*] e t[e<N EAT(MARY,x_1,e) H(t)=1 τ(e)≤t]
h. *some apples*$_1$ λp x_1[APPLES(x_1) p]
i. *some apples*$_1$ [*Mary* [[*ate* t_1] *in an hour*]
x_1[APPLES(x_1) e t[e<N EAT(MARY,x_1,e) H(t)=1 τ(e)≤t]

The pragmatic requirement is satisfied if *some apples* has wide scope.

Wide-scope interpretation of NPs like *apples* is not possible; this can be captured in a number of ways (e.g., narrow scope by lexical force, cf. Carlson (1977), van Geenhoven (1998), de Hoop (1995).

7.2 Source of Incrementality

Proposal: Incrementality is due to lexical meanings. This explains why:

(54) a. *Mary ate a cake in three minutes / *for three minutes.*
b. *Mary saw a cloud *in three minutes / for three minutes.*

Problem: (55) is possible if the clouds are seen in succession (cf. Krifka 1989).

(55) *Mary saw seventeen clouds in three minutes.*

Explanation: *in three minutes* requires atomic event predicate. This is possible in models in which the clouds are seen in succession. Hence incrementality of thematic relation can be stipulated by the context, and need not be part of lexical meaning. This is the case in particular if the expression of the NP indicates that the reference object has parts (*seventeen clouds* vs. *a cloud*).

7.3 Incrementality and Objecthood / Functional Projection

Tenny : Event is measured out by direct object.

Dowty (1991): Incremental Object as a proto-patient relation.

Ramchand (1993), Borer (1998): Measuring-out is located in a functional projection related to direct objects.

Problems of these views: Measuring-out can be triggered by other constituents as well (cf. already Verkuyl 1972 for subjects and indirect objects; Jackendoff 1996).

(56) a. *The long train crossed the border in fifteen minutes.*
b. *John entered the icy-cold water in 30 seconds.*

Perhaps this is restricted to movement verbs in which the subject referent has a double role: It is the agent of the movement, and it is the moved object? Not so:

(57) *Fifty customers complained about the product in two days.*

Hence it is unlikely that incrementality is related to direct objecthood.

Is it related to a functional projection? Perhaps this may explain why there is only one measuring-out phrase per predication (Tenny 1994: Single delimiting constraint).

(58) a. *Mary read letters for three hours* (*in two days*).
b. *Mary read three letters *for an hour.*

But this can also be explained by semantic divisivity constrained of *for*-adverbials.

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