Chapter 14
On Krifka's "Nominal Reference, Temporal Constitution and Quantification in Event Semantics"

Hana Filip

Abstract Krifka, in his paper "Nominal reference, temporal constitution and quantification in event semantics", provides the first formal mereological (algebraic) analysis of the relation between nominal reference and temporal constitution (also based on his 1986 PhD thesis). The focus is on two manifestations of this relation in the grammar of natural languages. First, as many observed, there are direct structural analogies between the following two sets of distinction: namely, mass/count and atelic/telic. They are clearly reflected in their parallel cooccurrence patterns with quantifiers, numerical and measure expressions. Second, nominal reference and temporal constitution interact and mutually constraint each other in the derivation of meaning of complex verbal predicates. One key example is *aspectual composition(ality)* e.g., *eat soup* (atelic) versus *eat two apples* (telic). In order to provide an adequate analysis of the relevant data Krifka's principal innovation is to assume a single join semi-lattice structure, undetermined with respect to atomicity, relative to which he defines two higher-order, cross-categorial predicates for reference types of natural language predicates: namely, quantized and cumulative. Specifically in the case of aspectual composition, the interactions and mutual constraints between the structure of objects and eventualities stem from the systematic mappings (homomorphisms) whose source is the lexical semantics of verbs. Such mappings are also independently motivated by other phenomena exhibiting systematic interactions objects and eventualities.

Keywords Mereology · Grammatical aspect · lexical aspect · Nominal reference · Aspectual composition · Measure function · Event semantics

H. Filip (✉)
Department of Linguistics, Heinrich-Heine-University, Düsseldorf, Germany

L. McNally, Z. G. Szabó (eds.), *A Reader's Guide to Classic Papers in Formal Semantics*, Studies in Linguistics and Philosophy 100,
https://doi.org/10.1007/978-3-030-85308-2_14

An Overview

Main Issues and Challenges

The term 'temporal constitution'[1] subsumes the telic/atelic distinction (Garey, 1957). Intuitively, a verbal expression (a lexical V, a complex verbal predicate or a sentence) is telic if its denotation includes a terminal point (e.g., *recover (from an illness), solve the puzzle, walk a mile, enter the room*), and atelic if it does not (e.g., *walk, rain, stand*). Given that Krifka (1989, p. 75) aligns the telic/atelic distinction with Vendler's (1957) accomplishment/activity distinction, it is plausible to view *temporal constitution* as implicitly corresponding to *aspectual class* (Dowty, 1979, building on Johnson, 1977) or *situation aspect* (Smith, 1991/1997), which are commonly taken to concern the classification of verbal predicates based on the internal temporal structure, or 'temporal contours' (Rappaport Hovav, 2008, and references therein), of their denotata.

The relation between nominal reference and temporal constitution is manifested in two ways in the grammar of natural languages, according to Krifka (1989). First, there are parallels based on the intuition that singular count nouns (or NPs) (*(a) cat*) and telic predicates have discrete countable entities, or atoms (Bach, 1986), in their denotation, while prototypical mass nouns (or NPs) (*beer, air, mud*) and atelic predicates do not (they take their meaning from the non-atomic domain, Bach, 1986).[2] One of Krifka's key contributions is to define this parallelism in formal (mereological) terms. Observations regarding this parallelism have a long tradition across virtually all schools of thought in linguistics and philosophy (Krifka, 1989 cites Leisi, 1953; Taylor, 1977; Bach, 1986, for instance). In general terms, and assuming that telic predicates denote (sets of) EVENTS and atelic ones PROCESSES (Bach, 1981; Parsons, 1990, and references therein), we have the following structural analogy: EVENT: PROCESS = OBJECT: STUFF (Bach, 1986)

[1] The term 'temporal constitution'is a translation of the German 'Zeitkonstitution', coined by François (Francois, 1985).

[2] The use "count nouns (or NPs)" and "mass nouns (or NPs)" here reflects the fact that there is no general agreement concerning the level of linguistic description on which these categories are grammatically relevant. Starting with Verkuyl (1971, 1972) at least, there have been debates whether the telic/atelic distinction, and subsequently also the mass/count distinction (Pelletier & Schubert, 2002), are distinctions that are relevant at the level of lexical items at all, and whether they should instead be viewed as distinctions at the level of phrasal constructions, as constructional properties of NPs, VPs and sentences.

(see Rothstein's commentary on Bach, 1986, this volume).[3] (States are set aside, given their 'atemporal', or non-temporal, character, see e.g., Bach, 1981, 1986).

Nominal and verbal predicates also exhibit parallels in their co-occurrence patterns with quantifiers, numerical and measure expressions:

(1) a. There was a lot of beer in the barrel. ≈ The baby slept a lot today.
b. There were three books on the table. ≈ He knocked three times on the door.

This led to proposals that verbal predicates, just like nominal predicates, have the grammatical feature 'count' or 'mass' (see e.g., Allen, 1966; Leech, 1969; Verkuyl, 1971,1972; Gabbay & Moravcsik, 1973; Bolinger, 1975; Mourelatos, 1978/81), although there is no general agreement on whether these are lexical or constructional/phrasal features (See fn.2.)

Krifka (1989) gives new impetus to this research tradition by arguing that the basic distinction between singular count nouns (denoting sets of singular OBJECTS) and mass nouns (denoting STUFF) in the nominal domain is insufficient to account for all the relevant semantic and distributional analogies with the verbal domain. Among others, telic predicates parallel not only singular count predicates (*(an/one/the) cat*), but also counting constructions (*three cats*) and measuring constructions (*a glass of beer, three pounds of apples*), while atelic predicates are similar not only to mass predicates (*beer*) but also to bare plurals (*cats*). The basic structural analogy EVENT: PROCESS = OBJECT: STUFF is insufficient to account for such parallels, along with its grounding in the basic atomic/non-atomic distinction that is presupposed by the lattice theory of Link (1983, 1987) (see also Champollion and Brasoveanu, this volume). It is one of Krifka's main theses that such parallels are best analyzed in terms of two new lattice-theoretic properties of quantization and cumulativity (see below), which leads him to revisions and extensions of Link's and Bach's theories.

Second, the relation between nominal reference and temporal constitution (telicity) is manifested in their interactions and mutual constraints, a phenomenon widely-known as *aspectual composition(ality)* (coined by Verkuyl, 1971,1972).[4]

[3] For Krifka (1989, 1998), these two sets of distinctions are taken to be semantic properties of nominal and verbal predicates, rather than being inherent in entities in the domain, in the external world. There are debates and numerous misunderstandings concerning the status of these categories. The key question is whether these are ontological categories (Bach, 1986; Parsons, 1990, i.a.) or whether these are categories that are properties of verbal and nominal predicates (Krifka, 1986, 1989; Filip Filip, 1993a, b; Partee, 1999, i.a.) (See Filip, 2011, 2012 for summaries of these debates.)

[4] There is a long-standing tradition of observations related to aspectual composition(ality), which can be traced to the nineteenth century philology (e.g., Streitberg, 1891). Some notable precursors are Poutsma (1926) and Jacobsohn (1933) (cited by Verkuyl, 1971, 1972, also 2005 and elsewhere, who credits them as the major sources of inspiration for his theory of aspectual compositionality), Garey (1957) (inspiration for Filip, 1985 and Krifka, 1986) and Leech (1969, p.137) who speaks of 'semantic concord' between nominal arguments and complex verbal predicates.

Krifka's examples are given below, along with his judgments marked as '*' (see (2a,b) in Krifka, 1989):

(2) a. Mary drank beer (for 10 min)/(*in 10 min). ATELIC
b. Mary drank a glass of beer (*for 10 min)/(in 10 min). TELIC

The compatibility with durative adverbials (e.g. *for 10 min*) and time-span adverbials (e.g. *in 10 min*) provides the fundamental diagnostic test for the telic/atelic distinction. The domain of application of durative adverbials is restricted to atelic predicates, while that of time-span adverbials to telic ones.[5] For Krifka, the key observation tied to the above pair of sentences is that the telicity difference between them must stem from the difference in the referential type of their direct object NPs, given that there is no other difference between them: so, the VP *drink beer* is atelic due to its mass direct object *beer*, while the VP *drink a glass of beer* is telic due to the singular measure pseudo-partitive NP *a glass of beer*.

What any theory of aspectual composition must explain is not only when the referential type of an argument NP influences the telicity of a complex verbal predicate, as in (2a,b), but also when it does not, as the minimal pair of sentences below illustrates:

(3) a. Mary swirled beer in her glass (for 10 min)/(? in 10 min). ATELIC
b. Mary swirled a glass of beer (for 10 min)/(? in 10 min). ATELIC

(3a,b) are both atelic, despite the difference in the referential type of their direct object NPs, *beer* and *a glass of beer*. Given that (2) and (3) only differ in their main lexical verbs, *drink* versus *swirl*, Krifka (1989) argues that the source of telicity in (2) lies in the lexical semantics of *drink* and the way it composes with its direct object argument, which systematically leads to a telic or an atelic interpretation of a complex verbal predicate. This phenomenon is referred to as aspectual composition(ality). Notice that *drink* and *swirl* are both episodic (dynamic) and their direct object is an 'affected object', or a Patient/Theme argument, put in traditional terms. Therefore, such semantic notions will not do, as Krifka also argues, to motivate why direct objects of *drink*, but not of *swirl*, participate in aspectual composition. Instead, to this goal, he defines a novel notion of a thematic

[5] The interpretations that are relevant for this test concern the temporal extent of singular eventualities denoted by predicates in the scope of these temporal modifiers. The interpretations that are irrelevant are iterative and generic interpretations. Moreover, for time-span modifiers, we need disregard the shifted inchoative interpretation of atelic predicates under which the time-span modifier denotes the measure of time until the onset of denoted eventualities from 'now' or some other reference point (see also Vendler, 1957, p. 147) (e.g., *The children ran in an hour* understood as meaning they started running after an hour from some understood reference point), and for durative modifiers, the irrelevant interpretations regard the duration of the result state that follows the set terminal point in the denotation of telic verbal expressions (e.g., *John put the wine into the fridge for half an hour*).

role in terms of incremental relations between the parts of an object subjected to an eventuality and the parts of that eventuality (see further below for details).

By arguing that the source of aspectual composition lies in the lexical semantics of verbs, Krifka (1986, 1989 and elsewhere) improves on the previous analyses of this phenomenon, which were feature-based and relied on rules projecting features from nominal arguments of verbs to VPs and sentences, but left what is their fundamentally semantic grounding at a pre-theoretical level (see also the same criticism of Dowty, 1979, p. 76). As Krifka (2001) observes, this holds for Verkuyl's (1972) first pioneering analysis in the spirit of Generative Semantics which uses the feature [± SPECIFIED QUANTITY], for Platzack's (1979) proposal couched in the Extended Standard Theory (Chomsky, 1970, 1975) and based on the feature [± DIVID], but also for later proposals, such as Tenny's (1987, 1992) within the Government and Binding Theory (Chomsky, 1981).

Theoretical Prerequisites: Lattices and Measure Functions

Krifka's (1989) lattice-theoretic (or mereological) event semantics builds on Link (1983, 1987) who was the first to use the algebraic device of a complete join semi-lattice (without bottom element) for the semantic analysis of mass and plural terms. Another key source of inspiration is Bach's (1981) recasting of the aspectual classes (STATE, PROCESS, EVENT) in mereological terms, and Bach's (1986) extension of Link's (1983) lattice-theoretic analysis of mass and plural nouns to the verbal domain. Both Link and Bach assume a model with two separate, but related, domains, structured by complete join semi-lattices: one atomic and the other non-atomic. Atomic semi-lattices consist of minimal, discrete elements, or atoms. Non-atomic semi-lattices are 'not known to be atomic' (Link, 1983) or 'not-necessarily-atomic' (Partee, 1999). On Bach's view, EVENT (telic) predicates and count nouns take their denotation from the ATOMIC semi-lattice domain, while PROCESS (atelic) predicates and mass nouns from the NON-ATOMIC one.

The binary split between the atomic and non-atomic conception of the world, as many noticed, raises inconsistencies and problems in the semantic analyses of nominal and verbal predicates. For instance, take a measure (pseudo-partitive) construction like *a pound of pudding*. As Krifka (2001) observes, it is singular count, and so on Link's and Bach's theory, its denotation would have to be atomic, but what it denotes is some pudding-stuff (to the amount of one pound), which corresponds to a non-atomic denotation. This problem carries over to the meaning of complex predicates derived by means of aspectual composition. It is unclear how, on the original proposals of Link and Bach, we can compositionally derive an EVENT (telic) interpretation of *eat a pound of pudding*, if *a pound of pudding* were to take its denotation from a non-atomic (mass) lattice. To take another example, *eat apples* is PROCESS-denoting (atelic), and hence takes its denotation from a non-atomic lattice, but *apples* denotes atoms (OBJECTS), and hence takes its denotation from an atomic lattice (ibid.).

Such observations, among others, lead Krifka (1986, 1989, p. 81, 2001 and elsewhere) to assume a single join semi-lattice structure, undetermined with respect to atomicity.[6] While atomic semi-lattices have smallest discrete elements (atoms), non-atomic ones may not, they are "not necessarily atomic" (Partee, 1999, p. 94). Moreover, Krifka assumes three domains, each having the structure of a non-atomic semi-lattice: namely, objects, eventualities[7] and times. If, for instance, a predicate *O* is used to denote objects[8] (whereby the domain of entities of the sort O includes discrete things like apples, animate beings like people, and also stuff like water), as opposed to eventualities *E* and times *T*, its denotation will be structured by a semi-lattice that is defined by means of a two-place *join* operation $\cup_O$, and the two-place relations *part* $\subseteq_O$, *proper part* $\subset_O$ and *overlap* $\circ_O$, all of which are indexed by *O*.

Based on such algebraic structures, Krifka defines higher-order, cross-categorial predicates and relations over first order predicates that allow him to analyze the meanings of natural language predicates. Of key importance are two predicates for reference types: namely, cumulative and quantized. Some examples are given below:

(4)

cumulative predicates	quantized predicates
nominal: *beer, cats*	nominal: *a cat, two cats, three glasses of beer*
verbal (atelic): *rain, walk*	verbal (telic): *recover, build a house*

The notion of cumulative reference is due to Van Orman Quine (1960). For predicates of objects, Krifka's mereological definition is given below (see Krifka, 1989, D12; also 1998, (3)), where *P* is a variable of the type of first order predicates applying to entities of the sort *O* (object). (The formulas given below, and also other formulas in this paper, are taken from different published papers by Krifka, and also from some of his handouts. Given that they span 20 years or so, there are occasional slight variations in the treatment of specific logical components.)

(5) $\text{CUM}_O(P) \leftrightarrow \forall x,y\,[P(x) \wedge P(y) \rightarrow P(x \cup_O y)] \wedge \exists x,y\,[P(x) \wedge P(y) \wedge \neg x = y]$
Example: If *beer* applies to *x* and *y*, then it also applies to *x* and *y* taken together.

[6] This, among others, obviates the minimal part problem posed by the putative divisive reference of mass nouns and process-denoting (atelic) predicates (Taylor, 1977; Bach, 1981, i.a.), and also unintuitive results such that there is a sharp sortal difference between what *walk* (atelic, non-atomic domain) and *walk a mile* (telic, atomic domain) describe, even though it arguably is the same eventuality in the world under two different descriptions (Krifka, 2001).

[7] In compliance with later developments in event semantics, here the term 'eventuality' (coined by Bach, 1981) is used instead of 'event', given that 'event' is now restricted to mean an entity in the denotation of telic (accomplishment, and also achievement, according to some at least) predicates, and given that by 'events' Krifka (1989) intends to cover the domain from which both telic and atelic predicates draw their denotation.

[8] Krifka (1989) uses *S*, rather than *O*, for the relevant predicate variable.

Cumulative predicates of eventualities (*rain, walk, sleep*) can be defined in an analogous way, where *P* is a variable of the type of first order predicates applying to entities of the sort *E* (eventualities):

(6) $CUM_E(P) \leftrightarrow \forall e,e' [P(e) \wedge P(e') \rightarrow P(e \cup_E e')] \wedge \exists e, e' [P(e) \wedge P(e') \wedge \neg e = e']$
Example: If an eventuality *e* constitutes (some) activity that satisfies the predicate *walk*, and *e'* does, as well, then the sum of *e* and *e'* constitute (some) activity that also satisfies the predicate *walk*.

All quantized predicates are derived from cumulative ones by means of EXTENSIVE MEASURE FUNCTIONS. The property of QUANTIZED reference is defined for predicates of objects (Krifka, 1989, D14, 1998, (4)) and for predicates of eventualities below:

(7) $QUANT_O(P) \leftrightarrow \forall x,y[P(x) \wedge P(y) \rightarrow \neg y \subset_O x]$
Example: If *a cat* applies to each of the two (different) entities *x* and *y* separately, then one cannot be a proper part of the other. A predicate *P* is quantized if and only if whenever it holds of *x*, it does not hold of any of its proper parts.

(8) $QUANT_E(P) \leftrightarrow \forall e, e' [P(e) \wedge P(e') \rightarrow \neg e' \subset_E e]$
Example: If an eventuality *e* falls under the predicate of *recover* and *e'* as well, then *e'* cannot be a proper part of *e*.

The intuition behind the definitions of quantized predicates, both nominal and verbal, is that they determine what is 'one' discrete and indivisible entity in their denotation, which is modeled by an extensive measure function in their logical structure. The notion of an extensive measure function grounds the analysis of counting and measure constructions as well as classifier constructions in classifier languages like Chinese.

Extensive measure functions are lexicalized by relational nouns that refer to standard measures, such as *pound, hour* or *liter*, and they are also derived from sortal nouns that denote container nouns, such as *cup, basket, bag, bottle*, and may denote either standard(ized) measures like *cup*, or non-standard measures like *bottle* (the notion of a 'non-standard measure' is here used approximately in the sense of Cartwright, 1975; Lønning, 1987). An extensive measure function is a function (possibly partial) from individuals to numbers which preserve certain structures in the object domain (Krifka, 1989, p. 78, following Suppes & Zinnes, 1963). Its defining property is additivity[9,10] For instance, adding 2 pounds of apples to 3 pounds of apples yields 5 pounds of apples which weigh more in pounds than the quantity of any of the proper parts of the total quantity of 5 pound of apples.

[9] For a formal definition of an extensive measure function see Champollion and Krifka, 2016, §13.21.

[10] Schwarzschild (2002, 2006) relies on a closely related property of monotonocity in his analyses of closely related phenomena.

Nouns that denote standard or non-standard extensive measure functions are used to form a measure (or pseudo-partitive) construction, as illustrated in the following example:

(9) $[\![\textit{three meters of snow}]\!] = \lambda x\,[\text{SNOW}(x) \wedge \text{METER}(x) = 3]$

A measure (pseudo-partitive) construction consists of a MEASURE PHRASE (*three meters (of)*) which is an operator on the denotation of a CUMULATIVE predicate that denotes what is measured, either some stuff (*snow*) or plural entities (such as *books*, as in *three meters of books*).[11,12] According to Krifka, measure phrases apply to "predicates that are not quantized yet" (Krifka, 1998, p. 202) and yield quantized predicates. Empirical support comes from examples like the following one:

(10) ? fifty pounds of three meters of snow

Here, the measure phrase *fifty pounds (of)* is applied to the predicate denoted by the measure (pseudo-partitive) construction *three meters of snow* which leads to an ungrammatical result, which would not be expected if *three meters of snow* were not quantized. Krifka (1989, 1998, and elsewhere) uses such ungrammatical examples in support of his argument that generally measure (pseudo-partitive) constructions denote quantized predicates.

However, there are uses of measure (pseudo-partitive) constructions which are not quantized: e.g., *Two glasses of wine equals one glazed doughnut* (comparative construction) or *As much as 2 feet of snow is expected/ possible /forecast over the next 3 days*. Were *2 feet of snow* here quantized, then it would have to govern a plural verb agreement, as in *More than two feet of snow were measured on Christmas Day*, for instance, and be compatible with the quantifier *many,* as in *There are still as many as five feet of snow at higher elevations* (see Rothstein, 2011; Landman, 2016; Filip & Sutton, 2017 for a discussion of the quantized property of the measure (pseudo-partitive) construction).

The notion of an extensive measure function also grounds the meaning of count nouns. Although mass and count nouns are interpreted with respect to the same non-atomic domain, they are typally different, because the meanings of count nouns are derived by means of a noun-specific measure function incorporated in the lexical structure of count nouns, namely, the 'natural unit' NU function. Consequently,

[11] Measure phrases, such as *five meters*, are of type [N/N] and analyzed by means of the NUMBER (n) expressed by the numerical word (*five*) and a measure function (μ), expressed by some measure word (*meter*). Syntactically speaking, numericals (*five*) belong to a basic category NM (numerical number), and consequently measure words (*meter*) have the category [N/N, NM] (see (4), Krifka (1989, p.83).

[12] Krifka (1989) analyzes extensive measure phrases (such as *five ounces(of)*) as 'quantizing modifiers' that derive quantized predicates from non-quantized ones, namely, denoted by mass terms (*beer, gold*) and plural terms (*apples*): $\forall P \forall \mathcal{P}[\text{QMODO}(P,\mathcal{P}) \leftrightarrow \neg\text{QUA}(P) \wedge \text{QUA}(\mathcal{P}(P))]$ (Krifka, 1989, D28, p.82). In later works, he specifies the input of measure phrases in terms of the property of cumulative reference.

count nouns denote two-place relations between entities *x* and numbers *n* (Krifka, 1989, p. 85), as illustrated by a simplified lexical entry for *cat*:

(11) $[\![cat]\!] = \lambda x\ [\text{CAT}(x) \wedge \text{NU}(\text{CAT})(x) = 1]$

NU operates on entities in the non-atomic domain, or more precisely on the intension of the mass noun (Krifka, 1989, pp. 84–85). It is NU that makes singular count nouns semantically quantized by capturing what is intuitively 'one' discrete and indivisible object in their denotation, or their QUANTITATIVE criterion of application (Krifka, 1989, p. 84). In contrast, mass nouns like *water* are cumulative, because they lexically specify only a QUANTITATIVE criterion of application (ibid.), which makes them one-place predicates:

(12) $[\![water]\!] = \lambda x[\text{WATER}(x)]$

One of Krifka's main innovations is to use measure functions to capture a variety of quantization phenomena in natural languages, including the similarities between COUNT nominal expressions and TELIC verbal expressions. Both denote QUANTIZED predicates, which means that they have only indivisible discrete entities of the appropriate sort in their denotation, and just what they are is determined by the requisite measure function in their logical structure. Such discrete entities need not be the absolutely smallest elements (atoms), unlike in Bach (1986) and Link (1983, 1987). They may be specified relative to either one unit of measurement (as in *a/one/the cat* or *eat an apple*) or multiples thereof (as in *two cats* or *eat two apples*).

Krifka's analysis of quantization/cumulativity phenomena in the verbal domain rests on two fundamental assumptions about the nature of eventualities. Inspired by Davidson (1967, 1969), Krifka takes eventualities to be entities in their own right, apart from objects (*O*) and times (*T*). Second, unlike entities of the sort of objects, i.e., things like apples or stuff like water, eventualities per se are assumed to be measurable via their run times or via various measurable dimensions of objects which bear a relation to eventualities (where 'object' is widely construed as subsuming concrete objects like apples, but also paths or property scales).[13] Krifka's original proposal is that measure functions (or relations) on eventualities are *derived* from measure functions on times or objects. This idea capitalizes on the overarching hypothesis that there are systematic parallels between their domains, each structured by an algebraic join semi-lattice.

Take, for instance, *Kim walked for an hour*. As many semanticists agree, durative adverbials like *for an hour* are adverbial counterparts to adnominal measure

[13] This is reminiscent of Strawson's (1959) view that the possibilities for identifying eventualities without reference to objects are limited, because eventualities fail to provide "a single, comprehensive and continuously usable framework" of reference of the kind provided by physical objects (Strawson, 1959, p. 46ff.).

phrases like *a pound (of)* (Vlach, 1981; Bach, 1981, i.a.).[14] Durative adverbials and adnominal measure phrases are quantizing modifiers. When applied to non-quantized predicates they derive quantized predicates, and they cannot be applied to quantized predicates: *?a pound of a watermelon, ?solve the puzzle for an hour*. While a measure phrase like *a pound (of)* can directly apply to non-quantized predicates of objects, as in *a pound of cherries,* a durative adverbial like *for an hour* cannot directly apply to non-quantized predicates of eventualities, because its constituent temporal measure function HOUR applies to time-intervals, not to eventualities. However, a measure function on times like HOUR can indirectly measure eventualities by measuring their 'run times', or temporal traces, which are mapped from eventualities by the temporal trace function τ (see Appendix for a definition). τ is a homomorphism (a structure-preserving mapping) relative to the join operations for eventualities $\cup_E$ and times $\cup_T$ (Krifka, 1989, p. 97, (D40); Link, 1987), and it is used to analyze temporal adverbials like *for an hour,* as in *walk for an hour*:

(13) $[\![\textit{walk for an hour}]\!] = \lambda x,e[\text{WALK}(e) \wedge \text{AGENT}(e,x) \wedge \text{HOUR}(\tau(e)) = 1]$

Measure functions can be 'transferred' from one domain to another with ease (Krifka, 1990, p. 519), which affords the derivation of quantized verbal predicates that may be delimited not just based on their run times, but also relative to a variety of dimensions along which properties of objects can be measured. For instance, extensive measure functions on distances in space like MILE can yield derived measure functions on eventualities based on a path trace function π (a homomorphism) and used to analyze locative adverbials like *(for) two miles*, as in *walk (for) two miles* (see Appendix for details). This idea can also be extended to the analysis of locative and directional adverbials like *in/to/towards the station* in the derivation of the meanings of quantized (telic) and cumulative (atelic) complex verbal predicates: cp. *walk to the station* (telic) versus *walk towards the station* (atelic).

Temporal Constitution of Complex Verbal Predicates: Aspectual Composition

Another 'transfer' mechanism, which also relies on the notion of a homomorphism, mediates the transfer of reference properties, quantized and cumulative, between nominal arguments and the temporal constitution of verbal predicates. It is in a nutshell, Krifka's view of the phenomenon known as aspectual composition(ality)

[14] "An hour full of running is naturally assumed to be without gaps, like a bathtub full of water. A year full of winning (iterative) has got to have gaps, like a street full of policemen" (Vlach, 1981, p. 282, fn. 17).

(see also above). Krifka's examples (along with his judgments marked as '*'), which were introduced at the outset of the paper, are here repeated for convenience:

(14) a. Mary drank beer (for 10 min)/(*in 10 min). ATELIC
b. Mary drank a glass of beer (*for 10 min)/(in 10 min). TELIC

Intuitively, drinking of some quantity of beer is such that every proper part of that beer corresponds to a proper part of the eventuality of drinking of that beer, and vice versa. A change of state that the beer undergoes proceeds in distinguishable separate stages, each tracking a successive stage of the relevant drinking eventuality. It is Krifka's key claim that it is precisely verbs like *drink* which entail this type of 'synchronized' object-eventuality change that induce aspectual composition.[15]

The argument with respect to which this entailment holds (*beer* and *a glass of beer* in the examples above) is an Incremental Theme argument. As a historical aside, Krifka's (1986, 1989, 1992) original term is 'Gradual Patient'. The term 'Incremental Theme' was coined by Dowty (1988, 1991), and subsequently adopted by Krifka (e.g., Krifka, 1998). Dowty (ibid.) integrates the Incremental Theme relation (Krifka's Gradual Patient relation), along with its lattice-theoretic underpinnings, into his theory of thematic Proto-Roles and argument selection, where it is treated as one of the properties of the Patient Proto-Role.[16]

Formally speaking, a verb like *drink* entails a homomorphism between the part structure (semi-lattice structure) associated with an Incremental Theme argument and the part structure (semi-lattice structure) associated with the eventuality argument. The homomorphism is defined in terms of five two-place relations for thematic roles (see Appendix). They define incremental relations between the eventuality argument and one other semantic argument, which is paradigmatically instantiated by an Incremental Theme argument.

Assuming, as Krifka does, that the source of aspectual composition lies in incremental relations like *drink*, and assuming the cross-categorial quantization/cumulativity reference properties (defined in (5)–(8)), aspectual composition directly follows the standard semantic composition of a sentence: namely, the way in which verbs normally combine with their arguments by applying compositional semantic rules to independently motivated syntactic structures (Krifka, 1989, p. 91ff.):

[15] As Krifka (1998, and elsewhere) also observes, similar notions and relations mediating between participants and eventualities were proposed by others: e.g., [+ADD-TO] V property (Verkuyl, 1972, 1993), 'measuring out' tied to the internal direct object DP (Tenny, 1987, 1994), 'structure-preserving binding relations' (Jackendoff, 1996).

[16] Dowty's (1987, 1989, 1991) treatment of Incremental Theme as one of the lexical determinants of argument selection is not entirely uncontroversial. For instance, Jackendoff (1996), Rappaport Hovav and Levin (2002, 2005, pp. 284–285) argue that Incremental Theme is not a factor in argument selection, while agreeing that the intuition behind it, which concerns structure-preserving mappings between eventualities and some suitable objects, plays an important role in a variety of aspectual phenomena.

(15) $\phi = \lambda e \exists x\, [\alpha(e) \wedge \delta(x) \wedge \Theta(e, x)]$ Krifka (1989, p. 93, (12))
If Θ is an Incremental Theme relation, then (i) when δ (nominal predicate) is cumulative, ϕ is cumulative (atelic, activity); (ii) when δ (nominal predicate) is quantized, ϕ is quantized (telic, accomplishment), provided ϕ is a singular predication, i.e., the existential closure over the event argumentv e is not a plural quantification. Example:

a. $[\![\textit{eat two apples}]\!] = \lambda x,e \exists y[2\text{APPLES}(y) \wedge \text{EAT}(x,y,e)]$[17] QUANTIZED

b. $[\![\textit{eat soup}]\!] = \lambda x,e \exists y[\text{SOUP}(x) \wedge \text{EAT}(x,y,e)]$[18] CUMULATIVE

This also correctly predicts that the predicate *push two carts* is cumulative, even if its Theme argument *two carts* is quantized, because *push* is a non-incremental relation (for the term a 'non-incremental relation' see e.g., Krifka, 1998):

(16) a. $[\![\textit{ push two carts}]\!] = \lambda e.\exists x\, [\text{PUSH}(e) \wedge \text{CARTS}(x) = 2 \wedge \text{THEME}(e,x)\ ]$ CUMULATIVE

b. $[\![\textit{ push carts}]\!] = \lambda e.\exists x.\exists n\, [\text{PUSH}(e) \wedge \text{CARTS}(x) = n \wedge \text{THEME}(e,x)\ ]$ CUMULATIVE

A striking feature of Krifka's mereological approach to aspectual classes is that it relies on non-temporal cross-categorial mereological properties, in departure from Vendler (1957) and others, who following Vendler, focus on defining their 'temporal contours' in terms of properties of time intervals and instants (Levin & Rappaport Hovav, 2005, and references therein).

There are two important (and often misunderstood) corollaries of Krifka's mereological approach to aspectual composition:

- Incrementality does not guarantee quantization (telicity).
- Neither incrementality nor quantization (telicity) are exclusively linked to the (internal) direct object argument.

Let us examine them in turn. Incrementality and quantization (telicity) are independent of each other. There are quantized (telic) predicates that are non-incremental. For example, *make a dot* (Krifka, 1998) is quantized by virtue of having atomic events in its denotation, but it is non-incremental, because its denotation has no proper temporal parts, and a dot itself has no spatial proper parts. There are also complex incremental predicates that are cumulative, because their Incremental Theme argument is cumulative: e.g., *eat soup, burn fall leaves, polish silverware (?in an hour/for an hour).* Being a direct object argument is neither a sufficient nor a necessary condition for it to function as an Incremental Theme and/or to serve as the single most important ingredient for determining the quantization (telicity)

[17] The simplified logical representation of the complex predicate *eat two apples* is taken from Krifka (1998, example (53b)).

[18] The simplified logical representation of the complex predicate *eat soup* follows the style of (15a), which in turn is taken from Krifka (1998, example (53b)).

of complex verbal predicates. It is not sufficient, because many verbs that take a direct object argument are non-incremental (*push a cart, see a photograph*). It is not necessary, because, for instance, the Incremental Theme can also be realized as the subject argument of transitive verbs like *cross, penetrate, permeate, pass, skirt* (Verkuyl, 1972; Declerck, 1979; Filip, 1990; Dowty, 1991; Jackendoff, 1996; Levin & Rappaport Hovav, 2005):

(17) a. John entered the icy water (very slowly). Dowty (1991)
b. At the turtle race, the winning turtle crossed the finish line in 42 seconds.

It is also worth mentioning that such data provide a compelling argument against syntactic theories of aspect that assume that *only* the (internal) direct object argument participates in defining the telicity of complex verbal predicates (e.g., Verkuyl, 1972/73; 1993; Tenny, 1987, 1994; Kratzer, 2004; Borer, 2005, and references therein). This argument is spelled out in Dowty (1991, p. 571, fn. 15).

The object-eventuality homomorphism motivates a variety of interactions between nominal arguments and verbal predicates in English, as we have just seen. In English, aspectual composition turns on the referential properties of the Incremental Theme DP, where the main operators are quantifier and measure phrases with which it may be formed. In different languages, such interactions are subject to additional constraints stemming from the realization of the Incremental Theme argument, and in languages with grammatical aspect also from the semantics of aspectual forms by which verbal predicates are expressed. For instance, in German, the Incremental Theme can be syntactically realized either as an accusative-marked direct object or as a 'partitive' ('conative') *an*-PP. The latter has an effect on a complex verbal predicate that is taken to be close to the progressive aspect in English: e.g., *'Das Kind aß an einem Fisch* 'The child was eating a fish' versus *Das Kind aß einen Fisch* 'The child ate a fish' (see also Filip, 1989, 1993a, b; 1999; Kratzer, 2004). Krifka (1989) also mentions Finnish, where the accusative/partitive case alternation on certain Theme arguments, not just Incremental Themes, results in an effect comparable to the perfective/imperfective aspect (see also Filip, 1993a, b, 1999; Kiparsky, 1998).

Given that the object-eventuality homomorphism 'works in both directions' (Krifka, 1992, p. 49), we also have a converse case where a verbal predicate operator has effects on the interpretation of the Incremental Theme argument. Some of the clearest examples come from languages that have a well-developed grammatical category of aspect and that lack a (fully developed) system of (in)definite articles. Krifka (1989) mentions Chinese and Slavic languages. Regarding Slavic languages, Krifka's theory (see Krifka, 1986, 1992) sheds a new light on the often cited, but ill-understood, 'definiteness' effect of perfective verbs on their arguments. Building on Wierzbicka (1967) for Polish and Filip (1985) for Czech, the object-eventuality homomorphism makes the correct generalization that the 'definiteness' effect will be restricted to bare mass and plural Incremental Theme arguments of perfective verbs, while singular count ones are exempt from it, as illustrated by the following examples:

(18) a. Petr snědl[PFV] kaši / olivy.
Peter ate porridge.SG.ACC / olives.PL.ACC
'Peter ate (up) (all) the porridge/(all) the olives.'

b. Petr snědl[PFV] hrušku.
Peter ate pear.SG.ACC
'Peter ate (up) a pear/the pear.'

Krifka's analysis relies on the common (though not entirely uncontroversial) assumption that nouns in languages lacking articles are lexically ambiguous between a definite and an indefinite interpretation. Specifically, in Slavic languages, as Krifka also assumes, mass nouns (*wine*) and plural nouns (*pears*) are quantized on the definite reading and cumulative on the indefinite reading; singular count nouns (*pear*) are quantized in both interpretations. Perfective verbs, which Krifka takes to be uniformly quantized, enforce the quantized interpretation of their Incremental Theme, which for mass or bare plural nouns must also be definite.

The advantage of Krifka's analysis of Slavic data like those above is that it improves on analyses that assume a uniform 'definiteness' effect of perfective verbs on all and only arguments that fill the (internal) direct object slot (e.g., Borer, 2005; Schoorlemmer, 1995; Verkuyl, 1993, 1999, and references therein). Such accounts massively overgeneralize. For instance, they wrongly predict that the direct object in (18b) is required to have a definite interpretation only. Instead, Krifka's analysis is more nuanced, as the 'definiteness' effect related to perfectivity depends on the thematic role, countability properties and grammatical number of arguments of perfective verbs.

Critical Comments

The notion of quantization has borne the main brunt of criticism. To illustrate the nature of contentious issues, four central problematic areas will be addressed below.

Quantization and the Grammatical Count Property

In the nominal domain, quantization, as defined in (7), is not a necessary condition for a noun to be grammatically count, contrary to Krifka's (1989) proposal. Krifka (1989, p. 87, due to Partee, p.c.) himself draws attention to this problem, and gives two examples of count nouns that fail to be quantized, namely *twig* and *sequence*. Other examples like *twig*, a sortal count noun, are *wall, fence, hedge, bush, stick, ribbon, bouquet*, among many others. (*A) sequence (of)* exemplifies a relational count noun that fails to be quantized, and among other examples are *portion, quantity, piece, distance*, for instance, some of which can also be taken as denoting a

non-standard measure (a 'non-standard measure' roughly in the sense of Cartwright, 1975; Lønning, 1987). (The distinction between sortal and relational nouns is not always easy to draw, but the above examples, however, should suffice to illustrate the intuition behind it.) We can best show what it means for a noun to be count, and yet fail to denote a quantized predicate with *sequence*, as in *a sequence of numbers* (also discussed in Zucchi & White, 1996). For instance, take a sequence of numbers like *1, 2, 3, 4*. It has proper parts, such as *1, 2, 3* or *2, 3, 4*. The predicate *a sequence (of numbers)* felicitously applies both to the main sequence *1, 2, 3, 4* and also to *1, 2, 3* or *2, 3, 4*, which are its proper parts. But this means that the predicate *a sequence (of numbers)* fails to be quantized, according to (7).

Various solutions to this problem converge on the idea that the meaning of such singular count nouns is partially specified by context. That is, what we view as one entity in their denotation, for the purposes of grammatical counting operations, depends on context, and can be rather arbitrary. However, once the context is fixed, such nouns denote a quantized set (see Champollion & Krifka, 2016; Chierchia, 2010; Rothstein, 2010). Such observations also lead to the conclusion that no context-independent notion, be it quantization as defined in (7) which relies on the extensive measure function NU, or an atom in a Boolean algebra (see Link, 1983, 1987; Bach, 1986, i.a.), will do to analyze the meaning of singular count nouns as a whole class (see e.g., Zucchi & White, 1996, 2001; Rothstein, 2010; Filip & Sutton, 2017, i.a.). Instead, the notion that is needed to ground the count property of nouns is a notion that allows for what counts as 'one' in their denotation to be fixed relative to a particular context.

Non-quantized Incremental Themes in Quantized Predications

The context-dependency of count nouns like *twig* and *sequence* also carries over to aspectual composition. Despite failing quantization as defined in (7), they still pattern with prototypical count nouns like *cat* or *letter*, which satisfy quantization (7), in so far as they enforce quantized (telic) predicates:

(19) a. Sally wrote [NON-QUANT a sequence of numbers] in 10 seconds/ ?for 10 seconds.
b. Sally wrote [QUANT a letter to her friend] in 10 seconds/ ?for 10 seconds.

A similar quantization problem also arises with DPs that fail to be quantized, according to (7), due to their determiners, rather than due to the lexical properties of their head nouns.[19] Salient examples include DPs with vague determiner quantifiers like *many, a lot, (a) few*, *some* and *most,* and cardinal numericals combined with approximative modifiers like *at least/at most*. Nonetheless, such non-quantized DPs

[19] Related observations were also made by L. Carlson (1981), Mittwoch (1988), Dahl (1991) and Moltmann (1991).

still enforce a quantized (telic) interpretation on complex verbal predicates, when they function as Incremental Themes:

(20) Sally ate [NON-QUANT at least three apples] in an hour / ?for an hour.

In order to solve this puzzle, Krifka (1998, p. 221) proposes that quantificational indefinite DPs (*subject to existential closure*), such as *at least three apples*, have a wide-scope reading with respect to time-span adverbials like *in an hour*, because only this satisfies the application conditions of such adverbials. The LF structure of the above sentence then approximately amounts to: [at least three apples]$_1$ [Sally [[ate x_1] in an hour]]. However, this wide-scope solution predicts odd or anomalous readings for many sentences with quantificational indefinites. For instance, *Every guest ate some muffins* would mean that every guest ate the same muffins (Zucchi & White, 1996, p. 241ff.).

Quantized Incremental Themes in Cumulative Predications

There are also Incremental Themes that are quantized in compliance with (7), and which, however, contrary to Krifka's aspectual composition (15), do not force a quantized (telic) interpretation on complex verbal predicates, but rather also allow for them to have a non-quantized (atelic) interpretation in an appropriate context (see also Kratzer, 2004; Partee, 1999):

(21) a. Bill ate the apple bit by bit for 10 min (and still didn't finish it). Jackendoff (1996)
b. She ate the sandwich in 5 min/ for 5 min. Hay et al. (1999)
c. We both ate the soup for a couple of minutes while the rest of the dishes cooled down.

(22) a. He read a book in/for an hour. Fillmore (1971) (in Dowty, 1979, p. 61)
b. Bill washed the car
(i) . . . (clean) in an hour.
(ii) . . . for an hour, but only got its hood clean.
. . . for an hour, but none of its parts got completely clean.

Given that an indisputably quantized Incremental Theme argument does not necessarily force a quantized interpretation on a verbal predicate, as the above examples show, obligatory quantization (telicity) by aspectual composition (15) is a more limited phenomenon than commonly assumed (Filip, 2004, i.a.).

Notice also that examples like those in (21a-c) clearly invalidate a common claim about the link between the definiteness of a direct object DP (or an internal direct object DP) and telicity of verbal predicates (e.g., Borer, 2005, and

references therein).[20] Definite argument DPs, even if they are uncontroversially quantized, according to (7), such as *the apple*, are not sufficient to enforce a telic interpretation on a complex verbal predicate (Filip, 1996, 2004; Jackendoff, 1996). Worth mentioning is also that the definite article is best not viewed as a quantifier or an expression of quantity (*pace* Borer, 2005, i.a.), because it "asserts neither universality nor distributivity nor any particular cardinality" (see Partee, 1995, p. 581).

Perfective Semantics Reduced to Quantization

For languages that have a grammatical perfective/imperfective aspect, it is commonly assumed that all perfective verbs are uniformly telic, and so uniformly quantized (in the sense of (8)), according to Krifka (1986, 1989, 1992). However, what is less known is that a typical feature of such languages is a sizeable class of verb forms (verbs or constructions) that are perfective, according to the relevant language-specific distributional and semantic tests, and yet fail quantization (8), due to the meaning of the lexical material making them up.

In Slavic languages, as Filip (1992, 2000, 2005a, b) argues, the main 'culprits' are prefixes which are used to form perfective verbs from (im)perfective ones. Given that prefixation is the most common process by which perfective verbs are derived, perfectives which fail quantization are also common. A case in point are prefixes that have meanings/uses resembling those of measure phrases or vague quantifiers in the nominal domain, such as *a small/large quantity (of), many, much, a lot (of), (a) little (of)* (ibid.; also Kiparsky, 1998). For instance, the attenuative (glossed as 'ATN') use of the prefix *po-* (illustrated in the Czech example in (23) below) contributes the meaning of a relatively low degree on some measurement scale (which would be most likely related to time in (23)) and relative to some contextually provided standard.

(23) po.povídat$^{\text{PERF}}$ si
ATN.chat REFL
'to chat for a (short) while'

While nominal measure (pseudo-partitive) constructions like *a small quantity of wine* are non-quantized due to their vague measure phrases (here *a small quantity (of)*), perfective verbs like *popovídat si* 'to chat for a (short) while' are non-quantized due to prefixes which contribute the meanings of vague quantity or measurement to them. The perfective verb *popovídat si* 'to chat for a (short) while' fails to be quantized, as defined in (8), given that an eventuality of chatting for a while has proper parts that also qualify as chatting for a while. But this means that

[20] Borer (2005) argues that a telic interpretation must be licensed by a quantity DP, with a definite DP being one subtype, including definite mass nouns and definite plurals.

such Slavic perfective verbs are problematic for a uniform semantic characterization of perfective verbs in terms of quantization, as defined in (8).

Moreover, Slavic perfective verbs that are formed with prefixes that denote some vague measure tend to enforce a non-specific indefinite and non-quantized interpretation of their mass and bare plural Incremental Themes (Filip, 1997, 2005a, b), which is unexpected on any account of Slavic aspectual composition:

(24) Na.vařili jsme hodně jídla na sváteční večeři.
CUM.cooked AUX.1PL a.lot.of food.SG.GEN for holiday dinner
'We cooked up a lot of food for the holiday dinner.'

Impact and Most Important Subsequent Developments

Krifka's (1986, 2007, and elsewhere) proposal to base the analysis of predicates in natural languages on a single non-atomic domain, as opposed to Link's (1983, 1987) original two-domain approach, has been steadily gaining more proponents, especially in the last 10 years or so (Chierchia, 2010; Landman, 2016; Filip & Sutton, 2017, i.a.).

Many discussions have also concerned the meaning of the formally marked plural form, whether *Ns* in English, for instance, means *one or more N*, as Krifka (1986 and elsewhere) suggests (Sauerland, 2003; Sauerland et al., 2005; Chierchia, 2010; Yatsushiro et al., 2017, i.a.) or *two or more Ns,* as Link (1983) orginally proposed (Chierchia, 1998, and references therein); another possibility is to treat it as ambiguous between *one or more N* and *two or more Ns* (Farkas & de Swart, 2010).

Krifka's (1989) observations and formal representations of classifier constructions like *five head of cattle* and their similarities to classifier contructions in classifier languages like Chinese energized debates concerning formal analyses of nominal constructions in classifier languages. Krifka (1995) argued that classifiers combine with numericals first, and then the result combines with nouns (see also Bale & Coon, 2014 on Chol (Mayan) and Sudo, 2017 on Japanese), which is in contrast to a more common view that classifiers combine with nouns to yield countable predicates which then combine with numericals and quantifiers (Chierchia, 1998, 2010, 2015, and references therein).

Many recent algebraic (mereological) theories of the mass/count distinction agree on the key role of context, in contrast to Krifka's (1989 and elsewhere) algebraic (mereological) theory which relies on context-independent notions of cumulativity and quantization. For instance, Rothstein (2010, 2017) treats all count noun denotations in a uniform way of type $<e \times k,t>$, i.e., functions from an individual and a counting context, in which that individual counts as one, to truth values. Chierchia (2010, 2015) argues that count concepts have 'stable atoms' in their denotation, i.e., minimal entities that are the same ones in every context, while mass concepts are vague in so far as they can be construed as atomic or not, depending on context.

Broadening the empirical scope beyond prototypical mass nouns (*water*) and count nouns (*cat*) led to further challenges for a uniform analysis of nominal count predicates in terms of quantization (7). Chierchia (1998, 2010) and Landman (2011, 2016) focus on object mass nouns like *furniture, kitchenware, silverware* (also known as fake mass nouns), which are grammatically mass, but their denotations consist of discrete objects, rather than undifferentiated stuff. This is problematic for Van Orman Quine's (1960) view that count nouns divide their reference, while mass nouns do not, adopted in Link (1983). Landman (2011, 2016) argues that all mass nouns denote overlapping sets, which leads to overspecification (Landman, 2011, p. 17) with respect to how many entities we can distinguish as counting as 'one' simultaneously in the same context, and prevents (grammatical) counting (cp. *#three kitchenware(s)* versus *three cups*). Given this individuation overspecification, it is unsurprising that noun concepts of collective artefacts like FURNITURE exhibit a variation in their encoding as mass or count in a particular language and cross-linguistically (Sutton & Filip, 2016, 2021).

Granular aggregates like rice or sand and collective aggregates like insects or small fruit conceptually exclude overlaps among what we view as the smallest entities in their denotation, and yet allow either mass or count encoding (Sutton & Filip, 2016, 2021). Based mainly on English, Welsh, Turkana (Nilo-Saharan), Maltese (Afroasiatic), and Dagaare (Niger-Congo), Grimm (2012) introduces the notion of *cluster* (of externally connected individuals) which allows him to differentiate a mereological sum counting as a clustered entity (e.g., *rice, sand*) from a mereological sum viewed as one individual entity. Predicates of discrete individuals like *cat* or *grain of rice* involve the notion of a *maximally strongly self connected* (MSSC) individual, i.e., an entity for which every part internally overlaps with the whole.

Turning to temporal constitution, Krifka (1998) develops a comprehensive framework of "telicity by precedence and adjacency", in order to provide an explicit formal analysis of telic predicates built with locative and directional adverbials like *(for) two miles* and *in/to/towards the station* (see Section "Theoretical prerequisites: lattices and measure functions"). Krifka (1998) models both temporal and path traces as one-dimensional directed PATH structures. In the Figure/Path constellations with directed motion predicates, the PATH is implied by the measure construction (*500 miles*) or by the Source- and/or Goal-PP, as we see below:

(25) a. Sam drove 500 miles/(from Boston) to New York.
b. We flew over the lake in an hour/over water for hours. Talmy (1985)

The requisite incremental relations hold between the parts of some eventuality and the spatially adjacent segments of a PATH structure. A quantized PATH yields a quantized (telic) verbal predicate, while a cumulative PATH, a cumulative (atelic) predicate. Among others, directed motion predicates like *walk to the post office* are problematic for this straightforward correlation, because they fail to be quantized (8), and yet are telic. This forces Krifka to abandon a uniform analysis of all telic predicates in terms of quantization, and to define telicity, a weaker notion than quantization as follows: "An event description *R* is telic if and only if it applies

to events *e* such that all parts of *e* that fall under R are initial and final parts of *e*" (Krifka, 1998, p. 207).

The analysis of predicates describing motions in a physical space provides a basis for the modeling of changes in other domains.[21] This also allows us to analyze changes of various qualitative properties of objects, including those denoted by Themes of so-called 'degree-achievement' verbs (in the sense of Dowty, 1979) or scalar verbs (Hay et al., 1999; Rappaport Hovav, 2008, and references therein), as the examples below illustrate:

(26) a. The temperature rose in/for 6 days.
b. We cooled the metal (from 90 °C) to 20 °C.
c. The room darkened (in 10 min/?for 10 min).

Krifka's unified treatment of various kinds of changes presupposes that both Goal PPs and Result XPs are represented as endpoints on a generalized PATH. The notion of result, completion or culmination, which many consider a key semantic property of telic (accomplishment) predicates (see e.g., Tenny & Pustejovsky, 2000), also in the spirit of Vendler (1957), has no separate place in this theory. This means that differences between Goal-based and Result-based telicity (Levin & Rappaport Hovav, 2005; Rappaport Hovav, 2008) cannot be accounted for.

Krifka's (1998) development of a comprehensive framework of "telicity by precedence and adjacency" coincided with the emergence of a SCALAR turn in the theory of telicity (see e.g., Hay et al., 1999, also Filip, 1993a, 1997, 1999). The first purely scalar analysis is Hay et al. (1999) who focus on the variable telicity of so-called 'degree achievements' (Dowty, 1979), which are lexically associated with a scale, as in (26a-c) above. Kennedy and Levin (2008) provide a detailed analysis of this phenomenon, also building on the insights of Kennedy and McNally (2005) on gradable adjectives.

Beavers (2013) extends Krifka's (1998) "telicity by precedence and adjacency" to include a class of ternary FIGURE/PATH theta-relations that allow for double, interdependent Incremental Themes that are implicated in the derivation of (a)telic interpretations of predications that involve complex Figure/Path constellations. For a predication of this type to be telic, the FIGURE must have quantized reference and the PATH must be bounded. We may illustrate this with examples taken from Filip (1993a, b, 1999):

(27) a. The earthquake shook a book off the shelf in/#for a few seconds. Filip (1993a, b, 1999)
b. The earthquake shook books off the shelf for/#in a few seconds.

Krifka's (1986, 1989, 1992) classic mereological approach to aspectual composition, as outlined above (see Section "Temporal constitution of complex verbal

[21] This idea is inspired by the Localist Theory (Gruber, 1965), which inspired the framework of Conceptual Semantics of Jackendoff (1991, 1996).

predicates: Aspectual composition") is characterized in Krifka (1998) as a static theory of telicity or "telicity by sums and parts", and extended by means of a dynamic theory of "telicity by precedence and adjacency", which is closely related to scalar theories of telicity. In effect, this amounts to two types of telicity, albeit both of which crucially rely on incremental relations.

This led to various attempts at combining Krifka's classic mereological approach to aspectual composition (aka Krifka-Dowty framework) with scalar (or alternately path or degree) semantics (Filip & Rothstein, 2005; Filip, 1997, 2008, 2017; Piñón, 2008; Beavers, 2008; Rappaport Hovav, 2008; Kennedy, 2012, i.a.). One of the challenges for such an integration is that the class of incremental verbs and that of scalar verbs (including degree achievements) cannot be (straightforwardly) reduced one to the other, because incremental verbs are not lexically associated with a scale, while scalar verbs do not take an Incremental Theme.

One attempt at such an integration is Filip (Filip, 1993a, b, 1999) who extends Krifka's classic mereological approach to aspectual composition with the notion of a generalized scale in order to account for a variety of telicity phenomena that are not of compositional nature. The requisite incremental relations (or structure-preserving mappings) are treated as having their source in the lexical semantics of verbs, as in the original proposals of Krifka (1986, 1989, 1992) and Dowty (1991), but in addition can also be a property of grammatical constructions. Among others, the latter allows for the analysis of (a)telic interpretations of verbal predicates which depend on the lexical material of a sentence interacting with context and general world knowledge (about how various states of affairs take place). For instance, in the following sentences the 'degrees' on the relevant scale are ordered steps of script-like scenarios. The requisite incremental relations then generally obtain between the parts of some eventuality and the 'degrees' (or segments) of the scale, which allow us to track its progress.

(28) a. The doctor examined the patient (in an hour). — Filip (1993a, b, 1999)

b. John was becoming an architect but was interrupted. — Dowty (1991)

In this connection with such examples, we may also observe that the varied sources of incremental relations (or structure-preserving mappings), which motivate telic and atelic interpretations of complex verbal predicates, also led to questioning their status with respect to the grammar of natural languages. Rather than having their source in the lexical semantics of verbs, as Krifka (1986, 1989, 1992) and Dowty (1991) originally proposed, they are taken to be an emergent property of the lexical structure of verbs interacting with pragmatics (Jackendoff, 1996), a property of the [telic] inflectional head above VP (Kratzer, 2004), and even not part of the grammar of natural languages at all and instead entirely determined by world knowledge and pragmatic factors (Borer, 2005).

Another approach that attempts at combining Krifka's classic mereological approach to aspectual composition with scalar semantics is proposed by Filip and Rothstein (2005) and Filip (2008, 2017). Their main goal is to solve the

quantization puzzle posed by predicates like *write a sequence of numbers* or *eat at least three apples* (Section "Non-quantized incremental themes in quantized predications" above). On their account, such predicates denote sets of maximal events with respect to an induced SCALE, and relative to context. The scale is induced by the Incremental Theme argument, provided it contains some scale-inducing expression, such as a numerical expression, quantifier (and so giving rise to scalar implicatures), or a count noun denoting an object with an inherent internal structure (whose parts can be ordered relative to a scale). The requisite incremental relations hold between the parts of some eventuality and the segments of the relevant scale. This maximization approach to quantization (telicity) is also extended to apparently non-quantized perfective verbs in Slavic languages, as exemplified by (23) and (24) above. Here, the requisite scale is induced by verbal prefixes, as they carry a quantitative, measurement or change of state meaning. Crucially, verbal prefixes in Slavic languages do not contribute telicity (quantization) to the meaning of perfective verbs, contrary to what is commonly assumed, but rather they introduce an ordering criterion on eventuality stages, or alternately they directly introduce a scale,[22] which is a prerequisite for the application of a context-relativized maximization operator that derives the quantized (telic) interpretation of perfective verbs in which they occur.

The idea of maximization that grounds the quantized (telic) interpretation of verbal predicates in Filip's and Rothstein's work is inspired by the notion of a *Maximal Participant* introduced by Zucchi and White (1996, 2001). They propose that indefinite DPs like *a sequence of numbers* denote *Maximal Participants* in sentences like *John wrote a sequence of numbers* in order to solve the quantization puzzle that such indefinite DPs raise (Section "Non-quantized incremental themes in quantized predications" above). That is, while *a sequence of numbers* on its own fails to be quantized, in *John wrote a sequence of numbers* it denotes the maximal (participant) sequence written by John at some contextually determined reference time, which then motivates the telic (quantized) interpretation of the whole sentence. However, this amounts to having the maximization built into an indefinite DP, which leads to wrong interpretations for non-quantized (atelic) sentences (Rothstein, 2004, p. 153). For instance, it wrongly predicts that *The emperor has ruled fewer than 5 countries for the last 10 years* requires that the same maximal set of fewer than 5 countries be ruled by the emperor at all times in the last 10 years. Therefore, to avoid such wrong predictions, Filip and Rothstein (2005) and Filip (2008, 2017) treat the requisite maximization operator as a property of VPs (as in English) or perfective verbs (as in Slavic languages).

An important, though less noticed, refinement of Krifka's theory concerns the introduction of a Strictly Incremental Theme (Krifka, 1998). Its single most important characteristics is the UNIQUENESS OF EVENTS relation, which an Incremental Theme lacks (see Appendix for more details). It holds between the

[22] Kagan (2013) applies this idea to a full-fledged scalar approach to the semantics of Russian prefixes.

eventuality argument and one other argument of verbs that entail a permanent and non-reversible change for that argument, which means that for a given entity token denoted by that argument there can be at most one (unique) eventuality related to it. A good example is *eat an apple*: you can eat one and the same apple at most once. Other examples are: *drink, build, burn, destroy, compose, write.* In contrast, incremental relations like *read* do not entail UNIQUENESS OF EVENTS. For instance, you can reread the same book or the same passages from a given book more than once. The class of *read*-type verbs is very large, some examples are: *examine*, *analyze*, *barbecue*, *roast*, *iron*, *bathe*, *massage*, *wash*, *comb*, *brush*, *fry*, *polish*, *explain*, *confuse*, *pollute*, *control*, *cover*, *insulate*, *test*, *decorate*, *describe*, *drain*, *mop, survey, check* ... (Kratzer, 2004, p. 396, (10)).[23] The distinction between an Incremental Theme and a Strictly Incremental Theme is, among others, relevant for specifying the conditions under which a verbal predicate will have an obligatory quantized (telic) interpretation consistently in any context (Section "Quantized incremental themes in cumulative predications" above), although Krifka (1998) does not exploit it to this purpose. The conditions are sensitive to two main parameters, as Filip (2008) suggests: A verbal predicate will have a quantized (telic) interpretation consistently in all its occurrences if its Strictly Incremental Theme argument contains some expression of quantification, cardinality or measure, as we see below:

(29) Mary ate all the sandwiches/three sandwiches
  (i) ... ? for an hour/in one hour.
  (ii) ... ?? but only finished two.

In contrast to (29), and as we have seen in examples in (21a-c), mere definiteness of the Strictly Incremental Theme argument does not enforce the quantization (telicity) of complex verbal predicates. Moreover, Incremental Theme arguments (which are not Strictly Incremental Theme arguments) may not enforce the quantization (telicity) of complex verbal predicates, even if they contain some expression of quantification, cardinality or measure: e.g., *Kim baked three pizzas for 20 min/ in 20 min*.

The impact of Krifka's (1989) paper "Nominal Reference, Temporal Constitution and Quantification in Event Semantics" goes well beyond the above observations. They represent merely a selection of some of the themes that have been recurrent in the theory on aspect since its publication. They have to suffice to illustrate the richness of this paper, and its indelible impact on how semanticists and philosophers conceive of the parallels between nominal and verbal domains.

[23] The line between incremental and non-incremental verbs is not always easy to draw, given that nearly all episodic verbs may be interpreted as incremental in a suitable context, cp. 'latent incremental theme verbs' (Rappaport Hovav & Levin, 2005).

Appendix

(1) Temporal trace function τ: $E \rightarrow T$ Krifka (1989), p. 97 (D 40)
$\forall e \forall e' [\tau(e \cup_E e') = \tau(e) \cup_T \tau(e')]$
The run time of the sum of two events *e* and *e'* is the sum of the run time of *e* and the run time of *e'*.

(2) Locative trace function: π: $E \rightarrow L$ Lasersohn (1995), Krifka (1998)
$\forall e \forall e' [\pi(e \cup_E e') = \pi(e) \cup_L \pi(e')]$
The path trace of the sum of two events *e* and *e'* is the sum of the path trace of *e* and the path trace of *e'*.[24]
Example: $[\![$*walk two miles*$]\!] = \lambda x,e[\text{WALK}(x,e) \wedge \text{AGENT}(e,x) \wedge \text{MILE}(\pi(e)) = 2]$
A set of sums of walking eventualities, each to the amount of two miles

(3) A DERIVED MEASURE FUNCTION μ'. Intuitively, it describes the transfer of a measure function from one domain to another, on the assumption that there is a homomorphism *h* from one domain to the other, i.e., a function that preserves some structural relation defined on its domain in a similar relation defined on the range (Krifka, 1989, p.80). For example, a measure function μ for times like HOUR, WEEK or YEAR can be used as a derived measure function μ' on temporal traces of eventualities:

(a) $\forall e[\mu'(e) = \mu(\tau(e))]$ Krifka (1989), p. 97 (D41)
where $\tau(e) = t$, the temporal trace of *e*
(b) HOUR'(e) = HOUR(τ(e))
(c) $[\![$*sing for an hour*$]\!] = \lambda x,e[\text{SING}(e) \wedge \text{AGENT}(e,x) \wedge \text{HOUR}'(e) = 1]$

[24] As Krifka (1998, Section 4.4) observes, this does not work in cases of backtracking, walking in curves or circles. In order to treat such a case, we can construct a measure function for motion eventualities from a measure function for distances which makes use of the mapping of motion eventualities to distances. This measure function can be standardized by linear moving events (for them, we have only to measure the distance between the start and the end), and it can be generalized by claiming additivity for any moving eventualities (that is, if *e* is a moving event of 6 kilometers and e' is a moving event of 4 kilometers, and *e* and e' do not overlap, then $e \; U_E \; e'$ is a moving event of 10 kilometers, even if the start and the end of $e \; U_E \; e'$ is less than 10 km apart).

(4) Two-place predicates that capture the structure-preserving 'transfer' properties of thematic relations that mediate between objects and eventualities (Krifka, 1998, D 29-D 33, p. 92, and 2001)

• *Summativity (cumulativity)*

$\forall R[\text{SUM}(R) \leftrightarrow \forall e,e',x,x' [R(e,x) \wedge R(e',x') \rightarrow R(e \cup_E e', x \cup_O x')]]$

A general condition for the relation between thematic relations and the join operations. For example, two events of drinking a glass of wine yield an event of drinking two glasses of wine (Krifka, 1989, D29, p.92).

• *Uniqueness for Objects*

$\forall R[\text{UNI-O}(R) \leftrightarrow \forall e,x,x'[R(e,x) \wedge R(e,x') \rightarrow x = x']]$

There can be no two distinct objects which bear the thematic relation R to the same event (Krifka, 1989, D30).

• *Uniqueness for Eventualities*

$\forall R[\text{UNI-E}(R) \leftrightarrow \forall e,e',x[R(e,x) \wedge R(e',x) \rightarrow e = e']]$

There can be no two distinct events which bear *R* to the same object, that is, an event is related to a specific object. E.g., a drinking of a glass of wine is rela -ted only to this glass of wine as a theme/patient and to nothing else (Krifka, 1989, D31).

(o.k.: *eat, write*; not o.k.: *read, see, push, ride*)

• *Mapping to Subobjects*

$\forall R[\text{MAP-O}(R) \leftrightarrow \forall e,e',x [R(e,x) \wedge e' \subset_E e \rightarrow \exists x'[x' \subset_O x \wedge R(e',x')]]$[25]

If an event bears R to an object, any subpart of the event bears R to some subpart of the object. E.g. every proper subpart of an event e of drinking a glass of wine corresponds to a proper subpart of the glass of wine (Krifka, 1989, D32).

(o.k.: *eat, write*; not o.k.: *read, see, push, ride*)

• *Mapping to Subeventualities*

$\forall R[\text{MAP-E}(R) \leftrightarrow \forall e,x,x'[R(e,x) \wedge x' \subset_O x \rightarrow \exists e'[e' \subset_E e \wedge R(e',x')]]$.[26]

If an event bears R to an object, any subpart of the object bears R to some subpart of the event (Krifka, 1989, D32).

(o.k.: *eat, write, read*; not o.k.*: see, push, ride*)

[25] Following Krifka (1998, 2001), the *Mapping to Subobjects* is defined in terms of ' $\subset'$, instead of ' $\subseteq'$ used in Krifka (1989).

[26] Following Krifka (1998, 2001), the *Mapping to Subevents* is defined in terms of ' $\subset'$, instead of ' $\subseteq'$ used in Krifka (1989).

(5) Classification of thematic relations (Krifka, 1989, p. 96 (14), 1998, 2001)

Example	SUM	UNI-O	MAP-E	MAP-O	UNI-E	
eat an apple, write a letter	+	+	+	+	+	Strictly Incremental Theme
read a book	+	+	+	−	−	Incremental Theme
push a cart, see a movie	+	+	−	−	−	Theme/Stimulus

(6) a. Strictly Incremental Theme: $\forall R[\text{SINC}(R) \leftrightarrow \text{UNI-O}(R) \wedge \text{MAP-O}(R) \wedge \text{MAP-E}(R) \wedge \text{UNI-E}(R)]$

b. Incremental Theme: $\forall R[\text{INC}(R) \leftrightarrow \text{UNI-O}(R) \wedge \text{MAP-O}(R) \wedge \text{MAP-E}(R)]$

(7) Maximal Participant:
$\forall x[\text{MAX}(P, x) \leftrightarrow P(x) \wedge \neg\exists y[P(y) \wedge x < y]]$ Zucchi and White (1996, 2001)
An individual is a maximal P iff it is P and it is not a proper part of another P.

(8) $[\![\textit{write a sequence}]\!] = \lambda y \lambda e \exists x[\text{WRITE'}(e) \wedge \text{AG}(y, e) \wedge \text{PAT}(x, e) \wedge \text{MAX}(\lambda z \exists e'[\text{WRITE'}(e') \wedge \text{AG}(y, e') \wedge \text{PAT}(z, e') \wedge \text{SEQUENCE'}(z) \wedge \tau(e') \leq tR], x)]$
Zucchi and White (2001), p. 261)

Bibliography

Allen, R. L. (1966). *The verb system of present-day American English*. Mouton.

Bach, E. (1981). On time, tense and aspect: An essay in English metaphysics. In R. Pragmatics (Ed.), *Peter Cole* (pp. 63–81). Academic Press.

Bach, E. (1986). The algebra of events. *Linguistics and Philosophy, 9*, 5–16.

Bach, E., Jelinek, E., Kratzer, A., & Partee, B. (Eds.). (1995). *Quantification in natural languages. Studies in linguistics and philosophy, 54*. Kluwer Academic Publishers Group.

Bale, A., & Coon, J. (2014). Classifiers are for numerals, not for nouns: Consequences for the mass/count distinction. *Linguistic Inquiry, 45*(4), 695–707.

Beavers, J. (2008). Scalar complexity and the structure of events. In J. Dölling, T. Heyde-Zybatow, & M. Schäfer (Eds.), *Event structures in linguistic form and interpretation* (pp. 245–268). Mouton de Gruyter.

Beavers, J. (2013). Aspectual classes and scales of change. *Linguistics, 54*(special issue), 681–706.

Bolinger, D. (1975). *Aspects of language*. Harcourt and Brace.

Borer, H. (2005). *Structuring sense, Volume I: In name only* (Vol. 1) and *Volume II: The normal course of events* (Vol. 2). Oxford University Press.

Carlson, L. (1981). Aspect and quantification in tense and aspect. In P. Tedeschi & A. Zaenen (Eds.), *Syntax and semantics, 14* (pp. 31–64). Ann Arbor.

Cartwright, H. (1975). Amounts and measures of amount. *Noûs, 9*, 143–164.

Champollion, L., & Krifka, M. (2016). Mereology. In M. Aloni (Ed.), *The Cambridge handbook of semantics* (pp. 513–541). Cambridge University Press.

Chierchia, G. (1998). Plurality of mass nouns and the notion of "semantic parameter". In S. Rothstein (Ed.), *Events and grammar* (Studies in linguistics and philosophy) (Vol. 7, pp. 53–103). Kluwer.

Chierchia, G. (2010). Mass nouns, vagueness and semantic variation. *Synthese, 174*, 99–149.

Chierchia, G. (2015). How universal is the mass/count distinction? Three grammars of counting. In A. Li, A. Simpson, & W.-T. D. Tsai (Eds.), *Chinese syntax in a cross-linguistic perspective* (pp. 147–175). Oxford University Press.

Chomsky, N. (1970). Remarks on nominalization. In R. A. Jacobs & P. S. Rosenbaum (Eds.), *Readings in English transformational grammar* (pp. 184–221). Ginn.

Chomsky, N. (1975). *Reflections on language*. Random House.

Chomsky, N. (1981). *Lectures on government and binding*. Foris Publications.

Dahl, Ö. (1991). Review: Manfred Krifka, Nominalreferenz und Zeitkonstitution: Zur Semantik von Massentermen, Pluraltermen und Aspektklassen. *Language, 67*, 813–816.

Davidson, D. (1967). The logical form of action sentences. In N. Rescher (Ed.), *The logic of decision and action* (pp. 81–95). Pittsburgh University Press.

Davidson, D. (1969). The individuation of events. In *Essays in honor of Carl G. Hempel* (pp. 216–234). Springer.

Declerck, R. (1979). Aspect and the bounded/unbounded (telic/atelic) distinction. *Linguistics and Philosophy, 17*, 761–794.

Dowty, D. R. (1979). *Word meaning and Montague grammar*. Reidel.

Dowty, D. R. (1988). "Thematic Proto-Roles, Subject Selection, and Lexical Semantic Defaults", ms. (Paper presented at the 1987 LSA Colloquium. San Francisco).

Dowty, D. R. (1989). On the semantic content of the notion 'thematic role'. In B. H. Partee, G. Chierchia, & R. Turner (Eds.), *Properties, types, and meanings, vol. II* (pp. 69–130). Kluwer.

Dowty, D. R. (1991). Thematic proto-roles and argument selection. *Language, 67*, 547–619.

Farkas, D. F., & de Swart, H. (2010). *The semantics of incorporation*. CSLI Publications.

Filip, H. (1985). *Der Verbalaspekt und die Aktionsarten dargelegt am Beispiel des Tschechischen*. Master's thesis, Universität München.

Filip, H. (1989). Aspectual properties of the AN-construction in German. In W. Abraham & T. Janssen (Eds.), *Tempus - Aspekt - Modus. Die lexikalischen und grammatischen Formen in den germanischen Sprachen ('Tense - Aspect - Mood. Lexical and Grammatical Forms in the Germanic Languages')* (pp. 259–292). Linguistische Arbeiten, Band 237). Max Niemeyer Verlag.

Filip, H. (1990). Thematic roles and aspect. In B. Birch, K. Hunt, & V. Samiian (Eds.), *Proceedings of the Western conference on linguistics (WECOL) 20* (pp. 88–99). California State University.

Filip, H. (1992). Aspect and interpretation of nominal arguments. In C. P. Canakis, G. P. Chan, & J. M. Denton (Eds.), *Proceedings of the Chicago linguistic society (CLS) 28* (pp. 139–158). The University of Chicago.

Filip, H. (1993a). *Aspect, situation types and noun phrase semantics*. Ph.D. thesis, University of California at Berkeley.

Filip, H. (1993b). Verbal aspect and object case marking: A comparison between Czech and Finnish. In J. A. Nevis & V. Samiian (Eds.), *Proceedings of the Western conference on linguistics (WECOL) 22* (pp. 43–59). California State University.

Filip, H. (1996). Quantification, aspect and lexicon. In G.-J. M. Kruijff, G. Morrill, & D. Oehrle (Eds.), *Proceedings of the ESSLLI'96 conference on formal grammar* (pp. 43–56). Charles University.

Filip, H. (1997). Integrating telicity, aspect and NP semantics: The role of thematic structure. In J. Toman (Ed.), *Formal approaches to Slavic linguistics (FASL) III. The College Park meeting 1994* (pp. 61–96). Ann Arbor Michigan Slavic Publications.

Filip, H. (1999). *Aspect, eventuality types and noun phrase semantics*. Routledge. A revised version of *Aspect, situation types and noun phrase semantics*. Ph.D. thesis, University of California at Berkeley (1993).

Filip, H. (2000). The quantization puzzle. In J. Pustejovsky & C. L. Tenny (Eds.), *Events as grammatical objects, from the combined perspectives of lexical semantics, logical semantics and syntax* (pp. 39–95). CSLI Publications.

Filip, H. (2004). The telicity parameter revisited. In *Proceedings of SALT XIV* (pp. 92–109). Cornell University/CLC Publications.

Filip, H. (2005a). On accumulating and having it all: Perfectivity, prefixes and bare arguments. In H. Verkuyl, H. de Swart, & A. van Hout (Eds.), *Perspectives on aspect. Studies in theoretical psycholinguistics* (Vol. 32, pp. 125–148). Springer.

Filip, H. (2005b). In G. N. Carlson & F. J. Pelletier (Eds.), *Reference and quantification: The Partee effect. Festschrift for Barbara hall Partee* (pp. 229–288). CSLI.

Filip, H. (2008). Events and Maximalization: The case of telicity and Perfectivity. In S. Rothstein (Ed.), *Theoretical and Crosslinguistic approaches to the semantics of aspect* (pp. 217–256). John Benjamins.

Filip, H. (2011). Aspectual class and Aktionsart. In C. Maienborn, K. von Heusinger, & P. Portner (Eds.), *Semantics: An international handbook of natural language meaning* (pp. 1186–1217). Mouton de Gruyter.

Filip, H. (2012). Lexical Aspect. In R. I. Binnick (Ed.), *The Oxford handbook of tense and aspect* (pp. 721–751). Oxford University Press.

Filip, H. (2017). The semantics of perfectivity. In P. M. Bertinetto (Ed.), *Special issue of the Italian journal of linguistics*. Symposium Press.

Filip, H., & Rothstein, S. (2005). Telicity as a semantic parameter. In J. Lavine, S. Franks, H. Filip, & M. Tasseva-Kurktchieva (Eds.), *Formal approaches to Slavic linguistics (FASL) XIV. The Princeton University meeting* (pp. 139–156). University of Michigan Slavic Publications.

Filip, H., & Sutton, P. R. (2017). *Singular count NPs in measure constructions.* Paper presented at the semantics and linguistic theory 27, University of Maryland.

Fillmore, Ch. J. (1971). Lectures on Deixis, (Lectures delivered to the 1971 Santa Cruz Linguistics Institute; distributed by the Indiana University Linguistics Club, Bloomington.)

Francois, J. (1985). Aktionsart, Aspekt und Zeitkonstitution. In C. Schwarze & D. Wunderlich (Eds.), *Handbuch der Lexikologie* (pp. 229–249). Kronberg.

Gabbay, D. M., & Moravcsik, J. M. E. (1973). Sameness and individuation. *Journal of Philosophy, 70*, 513–526.

Garey, H. B. (1957). Verbal aspects in French. *Language, 33*, 91–110.

Grimm, S. (2012). *Number and individuation.* Ph.D. thesis, Stanford University. Stanford, CA.

Gruber, J. S. (1965). *Studies in lexical relations.* Ph.D. thesis, Massachusetts Institute of Technology.

Hay, J., Kennedy, C., & Levin, B. (1999). Scalar Structure Underlies Telicity in "Degree achievements". In *Proceedings of SALT IX* (pp. 127–144). Cornell University/CLC Publications.

Jackendoff, R. (1991). Parts and boundaries. *Cognition, 41*(1), 9–45.

Jackendoff, R. (1996). The proper treatment of measuring out, telicity, and perhaps even quantification in English. *Natural Language and Linguistic Theory, 14*(2), 305–354.

Jacobsohn, H. (1933). Aspektfragen. *Indogermanische Forschungen, 51*, 292–318.

Johnson, M. (1977). *The syntax and semantics of Kikuyu tense and aspect.* Ph.D. thesis, Ohio State University.

Kagan, O. (2013). Scalarity in the domain of verbal prefixes. *Natural Language and Linguistic Theory, 31*, 483–516.

Kennedy, C. (2012). The composition of incremental change. In V. Delmonte & L. McNally (Eds.), *Telicity, change, state: A cross-categorical view of event structure* (pp. 103–121). Oxford University Press.

Kennedy, C., & Levin, B. (2008). Measure of change: The adjectival core of degree achievements. In L. McNally & C. Kennedy (Eds.), *Adjectives and adverbs: Syntax, semantics, discourse* (pp. 156–182). Oxford University Press.

Kennedy, C., & McNally, L. (2005). Scale structure and the semantic typology of gradable predicates. *Language, 81*, 345–381.

Kiparsky, P. (1998). Partitive case and aspect. In M. Butt & W. Geuder (Eds.), *Projecting from the lexicon* (pp. 265–307). CSLI.

Kratzer, A. (2004). Telicity and the meaning of objective case. In J. Guéron & J. Lecarme (Eds.), *The syntax of time* (pp. 398–424). The MIT Press.

Krifka, M. (1986). *Nominalreferenz und Zeitkonstitution. Zur Semantik von Massentermen, Individualtermen, Aspektklassen*. Ph.D. thesis, Universität München, Germany.

Krifka, M. (1989). Nominal reference, temporal constitution and quantification in event semantics. In R. Bartsch, J. van Benthem, & P. van Emde Boas (Eds.), *Semantics and contextual expressions* (pp. 75–115). Foris.

Krifka, M. (1990). Four thousand ships passed through the lock: Object-induced measure functions on events. *Linguistics and Philosophy, 13*, 487–520.

Krifka, M. (1992). Thematic relations as links between nominal reference and temporal constitution. In I. A. Sag & A. Szabolcsi (Eds.), *Lexical matters* (pp. 29–53). CSLI.

Krifka, M. (1995). Common nouns: A contrastive analysis of Chinese and English. In G. N. Carlson & F. J. Pelletier (Eds.), *The generic book* (pp. 398–411). Chicago University Press.

Krifka, M. (1998). The origins of telicity. In S. Rothstein (Ed.), *Events and grammar* (pp. 197–235). Kluwer.

Krifka, M. (2001). *The mereological approach to aspectual composition*. Paper presented at the Conference "Perspectives on Aspect", University of Utrecht, The Netherlands.

Krifka, M. (2007). *Masses and countables: Cognitive and* linguistic factors. Paper presented at the CASTL Workshop "The Syntax and Semantics of Measurement", Tromsø, Norway.

Krifka, M., Pelletier, F. J., Carlson, G. N., Ter Meulen, A., Chierchia, G., & Link, G. (1995). Genericity: An introduction. In G. N. Carlson & F. J. Pelletier (Eds.), *The generic book* (pp. 1–124). University of Chicago Press.

Landman, F. (2011). Count nouns – Mass nouns – Neat nouns – Mess nouns. In M. Glanzberg, B. H. Partee, & J. Šķilters (Eds.), *Formal semantics and Pragmatics: Discourse,Context and models. The Baltic international yearbook of cognition, logic and communication 6*. New Prairie Press.

Landman, F. (2016). Iceberg semantics for count nouns and mass nouns: The evidence from portions. *The Baltic International Yearbook of Cognition Logic and Communication, 11*, 1–48.

Lasersohn, P. (1995). *Plurality, conjunction and events*. Kluwer Academic Publishers.

Leech, G. N. (1969). *The new English grammar: A descriptive introduction*. M.I.T. Press.

Leisi, E. (1953). *Der Wortinhalt. Seine Struktur im Deutschen und Englischen*. Quelle und Mayer.

Levin, B., & Rappaport Hovav, M. (2005). *Argument realization*. Cambridge University Press.

Link, G. (1983). The logical analysis of plurals and mass terms: A lattice-theoretical approach. In R. Bäuerle, C. Schwarze, & A. von Stechow (Eds.), *Meaning, use, and interpretation of language* (pp. 302–323). De Gruyter.

Link, G. (1987). Algebraic semantics of event structures. In J. A. G. Groenendijk, M. Stokhof, & A. von Stechow (Eds.), *Proceedings of the sixth Amsterdam colloquium* (pp. 243–272). ILLC.

Lønning, J. T. (1987). Mass terms and quantification. *Linguistics and Philosophy, 10*, 1–52.

Mittwoch, A. (1988). Aspects of English aspect: On the interaction of perfect, progressive, and durational phrases. *Linguistics and Philosophy, 11*, 203–254.

Moltmann, F. (1991). Measure adverbials. *Linguistics and Philosophy, 14*(6), 629–660.

Mourelatos, A. P. D. (1978/1981). Events, processes and states. *Linguistics and Philosophy, 2*, 415–434. Reprinted 1981 in Tedeschi, P., & Zaenen, A. (Eds.), *Syntax and semantics 1914: Tense and aspect* (pp. 1191–1212). Academic Press.

Parsons, T. (1990). *Events in the semantics of English: A study in subatomic semantics*. The MIT Press.

Partee, B. H. (1995). "Quantificational Structures and Compositionality." Bach, E. et al. (1995). 541–601.

Partee, B. H. (1999). Nominal and temporal semantic structure: Aspect and quantification. In E. Hajičová, T. Hoskovec, O. Leška, & P. Sgall (Eds.), *Prague Linguistic Circle Papers* (Vol. 3, pp. 91–108).

Pelletier, J. F., & Schubert, L. K. (2002). Mass expressions. In D. Gabbay & F. Guenthner (Eds.), *Handbook of philosophical logic, 10* (pp. 1–87). Kluwer Academic Publishers.

Piñón, C. (2008). Aspectual composition with degrees. In L. McNally & C. Kennedy (Eds.), *Adjectives and adverbs in semantics and discourse* (pp. 183–219). Oxford University Press.

Platzack, C. (1979). *The semantic interpretation of aspect and Aktionsarten: A study of internal time reference in Swedish*. Foris Publications.

Poutsma, H. P. (1926). *A grammar of late modern English, part II*. Nordhoff.

Rappaport Hovav, M. (2008). Lexicalized meaning and the internal temporal structure of events. In S. Rothstein (Ed.), *Theoretical and crosslinguistic approaches to the semantics of aspect* (pp. 13–42). John Benjamins.

Rappaport Hovav, M., & Levin, B. (2002). Change of state verbs: Implications for theories of argument projection. *Proceedings of the 28th Annual Meeting of the Berkeley Linguistics Society, 28*, 269–280.

Rothstein, S. (2004). *Structuring events: A study in the semantics of lexical aspect*. Wiley-Blackwell.

Rothstein, S. (2010). Counting and the mass/count distinction. *Journal of Semantics, 27*(3), 343–397.

Rothstein, S. (2011). Counting, measuring and the semantics of classifiers. *The Baltic International Yearbook of Cognition, Logic and Communication, 6*, 1–41.

Rothstein, S. (2017). *Semantics for counting and measuring*. Cambridge University Press.

Sauerland, U. (2003). A new semantics for number. In R. B. Young & Y. Zhou (Eds.), *Proceedings of SALT XIII* (pp. 258–275). Cornell University/CLC Publications.

Sauerland, U., Anderssen, J., & Yatsushiro, K. (2005). The plural is semantically unmarked. In S. Kepser & M. Reis (Eds.), *Linguistic evidence. Empirical, theoretical and computational perspectives* (pp. 413–434). De Gruyter Mouton.

Schoorlemmer, M. (1995). *Participial passive and aspect in Russian*. Utrecht University. OTS dissertation series.

Schwarzschild, R. (2002). The grammar of measurement. In B. Jackson (Ed.), *Proceedings of SALT XII* (pp. 225–245). Cornell University/CLC Publications.

Schwarzschild, R. (2006). The role of dimensions in the syntax of noun phrases. *Syntax, 9*(1), 67–110.

Smith, C. S. (1991/1997). *The parameter of aspect*. Kluwer. Reprinted in Carlota S. Smith (Ed.) (1997). *The parameter of aspect* (2nd Ed., pp. 227–261). Springer.

Strawson, P. F. (1959). *Individuals. An essay in descriptive metaphysics*. Methuen.

Streitberg, W. (1891). Perfective und imperfective Actionsart im Germanischen. *Beiträge zur Geschichte der deutschen Sprache und Literatur, 15*, 7–177.

Sudo, Y. (2017). Countable nouns in japanese. *Proceedings of WAFL, 11*, 1–11.

Suppes, P., & Zinnes, J. L. (1963). Basic measurement theory. In D. R. Luce & e.a. (Eds.), *Handbook of mathematical psychology* (Vol. 1, pp. 2–76). Wiley.

Sutton, P. R., & Filip, H. (2016). Mass/count variation: A Mereological, two-dimensional semantics. In S. Rothstein & J. Šķilters (Eds.), *Baltic international yearbook of cognition, logic, and communication 11*. New Prarie Press.

Sutton, P. R., & Filip, H. (2021). The count/mass distinction for granular nouns. In H. Filip (Ed.), *Countability in the nominal and verbal domain*. Cambridge University Press.

Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical forms. In T. Shopen (Ed.), *Language typology and syntactic description: Grammatical categories and the lexicon* (Vol. 3, pp. 57–149). Cambridge University Press.

Taylor, B. (1977). Tense and continuity. *Linguistics and Philosophy, 1*, 199–220.

Tenny, C. (1987). *Grammaticalizing aspect and affectedness.* Ph.D. thesis, MIT Press.

Tenny, C. (1992). The aspectual Interface hypothesis. In I. Sag & A. Szabolsci (Eds.), *Lexical matters* (pp. 1–27). Center for the Study of Language and Information.

Tenny, C. (1994). *Aspectual roles and the syntax-semantics interface*. Kluwer.

Tenny, C., & Pustejovsky, J. (2000). A history of events in linguistic theory. In C. L. Tenny & J. Pustejovsky (Eds.), *Events as grammatical objects, from the combined perspectives of lexical semantics, logical semantics and syntax* (pp. 3–37). CSLI Publications.

Van Orman Quine, W. (1960). *Word and object*. MIT Press.

Vendler, Z. (1957). Verbs and times. *Philosophical Review, 56*, 143–160.

Verkuyl, H. J. (1971). *On the compositional nature of the aspects*. Ph.D. thesis, University of Utrecht.

Verkuyl, H. J. (1972). *On the compositional nature of the aspects*. Reidel.

Verkuyl, H. J. (1993). *A theory of aspectuality. The interaction between temporal and Atemporal structure*. Cambridge University Press.

Verkuyl, H. J. (1999). *Aspectual issues. Structuring time and quantity* (CSLI Lecture Notes) (Vol. 98). CSLI Publications.

Verkuyl, H. J. (2005). Aspectual composition: surveying the ingredients. In H. J. Verkuyl & H. de Swart (Eds.), *Perspectives on aspect. Studies in theoretical psycholinguistics* (pp. 19–39). Springer.

Vlach, F. (1981). The semantics of the progressive. In P. J. Tedeschi & A. Zaenan (Eds.), *Syntax and semantics 14: Tense and aspect* (pp. 271–291). Academic Press.

Wierzbicka, A. (1967). On the semantics of verbal aspect in polish. In *To honor Roman Jakobson. Volume 3* (pp. 2231–2249). Mouton.

Yatsushiro, K., Sauerland, U., & Alexiadou, A. (2017). The unmarkedness of plural: Crosslinguistic data. In M. LaMendola & J. Scott (Eds.), *BUCLD 41: Proceedings of the 41st annual Boston University conference on language development* (pp. 753–765). Cascadilla.

Zucchi, A., & White, M. (1996). Twigs, sequences, and the temporal constitution of predicates. In *Semantics and linguistic theory (SALT) VI* (pp. 329–346). CLC Publications.

Zucchi, A., & White, M. (2001). Twigs, sequences, and the temporal constitution of predicates. *Linguistics and Philosophy, 24*, 223–270.