Activities, Accomplishments and Causation

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Abstract

The *Aktionsart* system is a crucial component of the syntax-semantics interface of Role and Reference Grammar (RRG). The purpose of this paper is two-fold: (i) to review the development of RRG's *Aktionsart* system since its adaptation from Dowty (1979/1991) by Foley & Van Valin (1984) and to relate the various revisions introduced over the years to issues already mentioned in Dowty (1979/1991); (ii) to point out some issues in the latest formulation of the *Aktionsart* system in Van Valin (2018) and to sketch how to overcome them by a more expressive decomposition system.

Keywords

Aktionsart, semantic decomposition, event semantics, telicity, causation

1. Introduction

The *Aktionsart* system and its representation by means of logical structures is one of the cornerstones of the syntax-semantics interface of Role and Reference Grammar (RRG). The logical structures are a core component of the semantic representation of a sentence, and the positions of the arguments in these structures play a crucial role for the realization of the arguments in the syntax as determined by the linking system. The system of *Aktionsart* classes, as well as the system of logical structures in general, has evolved considerably over the years since the publication of Foley & Van Valin (1984), which was largely based on Dowty's (1979/1991) adaptation of ideas from Generative Semantics.

The present paper has a two-fold objective: First, we will take a look at the issues of Dowty's proposal, many of which have been pointed out by Dowty himself, and show how they have been addressed by the various modifications of the decomposition system of RRG. This includes, among other things, the

Table 1: The early *Aktionsart* system of RRG

Aktionsart class	Logical structure
State	$P(x)$ or $P(x, y)$
Activity	DO$(x, [P(x)])$ or DO$(x, [P(x, y)])$ (agentive) $P(x)$ or $P(x, y)$ (non-agentive)
Achievement	BECOME $P(x)$ or BECOME $P(x, y)$
Accomplishment	ϕ CAUSE ψ, with ϕ typically an activity structure and ψ typically an achievement structure

independence of causation from telicity as a consequence of introducing active accomplishments, and the more recent decomposition of (simple) accomplishments into a process and a result component. The second objective of the paper is to address issues of the current decomposition system and to suggest possible ways of how to overcome them. In particular, it will prove useful to clarify the denotational meaning of the logical structures, that is, to spell out the reference to states and events more explicitly. To this end, a decompositional system will be proposed which builds crucially on attributes and which is closely related to frame-based representations.

2. The early *Aktionsart* system and Dowty's heritage

2.1. The early *Aktionsart* system

The original version of the RRG *Aktionsart* system proposed in Foley & Van Valin (1984) uses the four classes *state*, *activity*, *achievement*, and *accomplishment*, much in line with Dowty's adaptation of Vendler's (1957) classification.[1] Table 1 reviews the original system as summarized in Van Valin (1990: 224, 1993: 36). It is characteristic of the early system that accomplishments are consistently analyzed as causative, i.e., as having the logical structure ϕ CAUSE ψ, in accordance with Dowty's aspect calculus (cf. Dowty 1979/1991: 91/124f). Achievements, on the other hand, are assumed to have the general form BECOME ϕ.

Note that the distinction between agentive and non-agentive activity shown in Table 1 is not strictly part of the calculus introduced in Chapter 2 of Dowty's

[1] The following brief review of the development of RRG's *Aktionsart* system draws considerably on Van Valin (2018).

book but is adapted from a revised classification sketched in a later chapter of that book (cf. Dowty 1979/1991: 184). The operator DO is in fact discussed rather controversially by Dowty with respect to its intended use for expressing agentivity, controllability and/or intentionality (cf. Section 2.2 below), and, for similar reasons, the use of DO has been strongly restricted in later versions of the RRG system (cf. Section 2.3). The early system represents unintentional/uncontrolled activities like falling by one-place predicates such as **fall′**, and it also introduces a generalized activity predicate **do′** which is unmarked for agency (Foley & Van Valin 1984: 53).

A remark on notation: The boldface+prime markup for primitive predicates like **fall′** was introduced in Foley & Van Valin (1984) and has been henceforth in use in the RRG literature. The notation was taken from Dowty (1979/1991), who uses boldface for words and employs the prime ′ to indicate the translation from natural language into a logical language. So, for Dowty, **fall** is an English word while **fall′** is a predicate. Since the boldface type does not serve any markup purposes in the standard presentation of RRG, we can simply declare **fall** to be the predicate that (roughly) represents the meaning of the English verb *fall*. For reasons of notational parsimony we will therefore write predicates in boldface without an additional prime in the rest of this paper.

2.2. A short (de)tour through Dowty 1979

It is worthwhile to recall the general motivation behind Dowty's 1979/1991 book. His primary goal was to combine theories of word meaning with Montague's formalized compositional framework of the syntax-semantics interface. The chosen approach to word meaning was inspired by the decomposition analyses (in terms of DO, CAUSE, BECOME, etc.) proposed in the Generative Semantics literature, which he regarded as "the most highly structured version of decomposition analysis" available (Dowty 1979/1991: vi). The respective analyses go back to his dissertation, which was completed in 1972 when Generative Semantics was still flourishing. It was thus already in this thesis where he developed the formal *Aktionsart* classifications and the representations that served as the basis of the semantic structures of the early RRG system shown in Table 1.

While having included the decomposition analyses of his dissertation in the 1979 book, Dowty did not hold back with pointing out the many issues he meanwhile saw in this approach, and with sketching alternative solutions. He also proposed a second approach, *interval semantics*, for modeling the se-

mantics of aspect (which was first published in Dowty 1977). Nevertheless, as Dowty (1979/1991: xix) emphasizes in the new preface to the second printing, the decompositional approach and the interval semantics account are not incompatible but can be fruitfully combined with each other, at least in principle, since they contribute to complementary domains: The decomposition approach is concerned with developing linguistically and cognitively motivated formalized representations for expressing aspectual and *Aktionsart* distinctions. Interval semantics, on the other hand, is concerned with the interpretation of such structures in the temporal domain, i.e., with respect to intervals, subintervals, lower and upper bounds of intervals, etc. That is, interval semantics is not to be seen as an alternative to decompositional semantics but as an attempt to spell out how the decompositional primitives are to be interpreted with respect to the time course or "dynamic contour" of the denoted events.

Among the operators DO, CAUSE and BECOME, only BECOME with its underlying change-of-state interpretation turns out as being useful in this respect. Roughly speaking, BECOME ϕ is true at an interval I if ϕ is not true at (an interval containing) the initial bound of I and ϕ is true at (an interval containing) the final bound of I. It is far less obvious how to evaluate CAUSE within an interval semantics (see the discussion in Dowty 1979/1991: 191, footnote 17). And the notion of intentionality that is supposed to go along with DO is even more remote in this respect. In fact, Dowty (1979/1991: 121) casts serious doubts on the viability of taking DO as an indicator of intentionality and/or controllability and, moreover, finds it "doubtful that DO can really distinguish all activities from statives, after all" (Dowty 1979/1991: 119). Hence, while a decompositional analysis on the one hand and an interpretation of *Aktionsart* and aspect in the temporal dimension on the other hand are compatible with, and most probably even dependent on each other, it is questionable that the triad DO, CAUSE, BECOME is appropriate for this purpose. Moreover, the interval-based semantics calls for further refinements as well, as will be discussed in what follows.

In the new preface, Dowty (1979/1991: xxii) notes that the formal interpretation of BECOME in his interval semantics has the defect that "when an event of change takes place over an interval of time, the change in some sense does not »take place« until the end of the interval." For example, the incremental change which goes along with an event as expressed by *paint the house red* is not captured by his treatment of BECOME. Dowty points to the work of Krifka and others who model the incremental character of such events in terms of an object-to-event homomorphism, and he more generally espouses the idea of developing his interval-based account into an event-based account

since the latter "is conceptually simpler, easier to formalize, and has substantive advantages" (Dowty 1979/1991: xxii).

2.3. Minor revisions of RRG's original *Aktionsart* system

The original adaptation of Dowty's system remained basically unchanged in Van Valin (1990, 1993) except for the following three minor qualifications: (i) The operator DO was restricted to the indication of agency as part of the *lexical* meaning of a verb as it is the case for *murder* in contrast to *kill*; see Van Valin & Wilkins (1996: 307ff) for arguments for restricting DO to lexicalized verbal agency. As mentioned in Section 2.2, there are also qualms about the correct interpretation of DO in Dowty (1979/1991). In particular, he notes that DO behaves like an *implicative verb* in the sense of Karttunen (1971) in that it does not affect the truth conditions of the embedded expression. Dowty (1979/1991: 118) concludes that the "contribution to meaning that DO makes is entirely in its conventional implicature." RRG's abandonment of DO as a general indicator of agency had the consequence that the argument of the generalized activity predicate **do** (cf. Section 2.1) may now be an agent or a pure effector, depending on the context.

(ii) The need for a distinction between punctual and durative achievements is briefly acknowledged (Van Valin 1993: 154, footnote 19). Not all achievements are punctual as attested by verbs such as *cool* and *dry*, which can be used in the progressive and even with durational adverbials. Dowty (1979/1991: 88ff) speaks of *degree achievements* in such cases but evades a thorough formal representation of them in his decomposition system. Likewise, BECOME was kept in Van Valin (1993) both for punctual and durative achievements.

(iii) The argument order in predicates of type **be-LOC** is reversed. While in Foley & Van Valin (1984), in line with Dowty (1979/1991: 210ff), **be-at**(x, y) means that x is (located) at y, the converse interpretation convention was established in Van Valin (1990): x is the location where y is located. This modification was obviously motivated by the desire of having a parallel representation of locative and possession predicates, which allows one to characterize the first argument of these predicates as "locative", or, to put it differently, to have uniform argument positions available for the default macro-role assignment principles. From this perspective, the switch of arguments in the **be-LOC** predicates is mainly theory-driven. On the other hand, alienable possession is in many languages expressed by a locative construction (Foley & Van Valin 1984: 48; see also Stassen 2009: 48ff).

Table 2: Simple *Aktionsart* classes (textbook version)

Aktionsart class	Logical structure
State	$P(x)$ or $P(x, y)$
Activity	**do**$(x, [P(x)])$ or **do**$(x, [P(x, y)])$
Semelfactive	SEML ϕ
Achievement	INGR ϕ with ϕ a state or activity structure
Accomplishment	BECOME ϕ

3. The textbook version and recent developments

What we call the "textbook version" of the *Aktionsart* classes and their logical structures is the version presented in Van Valin (2005, 2010). The textbook version coincides basically with the representation system introduced in Van Valin & LaPolla (1997), except for the semelfactive operator SEML, which has been added later, and a number of minor modifications to be mentioned below. The *Aktionsart* classes of the textbook version are summarized in Tables 2 and 3.

3.1. Simple *Aktionsart* classes

The *Aktionsart* classes listed in Table 2 are called *simple* since the corresponding logical structures are either primitive predicates representing states, or primitive predicates enclosed by **do**$(x, [\dots])$ representing activities, or expressions that result from applying one of the unary operators SEML, INGR or BECOME to a state or activity structure. (Due to lack of space, we put aside a discussion of the SEML operator.) The operator INGR (indicating *ingression*) has been introduced to make explicit the distinction between punctual and non-punctual change-of-state verbs (cf. Section 2.3). INGR is used for punctual verbs such as *shatter* and *explode* while BECOME is reserved for non-punctual, incremental verbs such as *melt* and *dry*. The members of the latter class are now referred to as *accomplishments*, in line with the original terminology of Vendler (1957), and in contrast to Dowty's restriction of this term to causative structures (cf. Section 2.1).

The representation of activities follows basically Van Valin & Wilkins (1996), who show that agency is best understood as being derived from a number of interacting morphosyntactic, semantic and pragmatic factors, and that

Table 3: Complex *Aktionsart* classes (textbook version)

Aktionsart class	Logical structure
Active accomplishment	**do**$(x, [P(x, y)])$ & INGR $Q(y)$ or **do**$(x, [P(x)])$ & INGR $Q(y, x)$
Causative	ϕ CAUSE ψ, with ϕ, ψ logical structures of any type

it is hence inadequate to anchor agency solely to a primitive operator DO in the semantic representation of the verb. The operator DO is therefore restricted to the representation of *lexicalized* agency (cf. Section 2.3) while the predicate **do** is assumed to be underspecified with respect to agency. However, instead of using **do** as a simple one-place predicate for activities, on a par with more specific activity predicates such as **walk**, Van Valin & Wilkins (1996) keep the decomposition structure of activities introduced by Ross (1972) and employed by Dowty (1979/1991), with DO now replaced by **do**. That is, an activity verb such as *walk* is represented by **do**$(x, [\textbf{walk}(x)])$ and not just simply by **walk**(x). This leads to the general semantic structure **do**$(x, [P(x)])$ (or **do**$(x, [P(x, y)])$) shown in Table 2, with the special case of **do**$(x, \varnothing)$ for unspecified activities. This way of representing activities apparently comes in handy for determining the first argument of an activity predicate (i.e., the effector) by the linking system since it can be directly read off from the logical structure. The semantic contribution of **do**, however, seems to be void, except for the case of **do**$(x, \varnothing)$. We will return to this issue in Section 4.1 below.

3.2. Active vs. causative accomplishments

The most prominent change in the *Aktionsart* system of Van Valin & LaPolla (1997) is the introduction of *active accomplishments* as a separate class. The vast majority of this class consists of accomplishment uses of activity verbs. The examples in (1) provide a paradigmatic set of such uses in English.

(1) a. Adam ate an apple. (consumption)
b. Mary drew a circle. (creation)
c. Kim walked to the store. (motion to goal)

According to the original decomposition system of Table 1, all of these accomplishment constructions are to be analyzed as causative (cf., e.g., Van Valin

1990: 224, Van Valin 1993: 38). For example, the sentences (1a) and (1c) would be assigned the logical structures (2a) and (2b), respectively.

(2) a. [**eat**(Adam, apple)] CAUSE [BECOME **consumed**(apple)]
b. [**walk**(Kim)] CAUSE [BECOME **be-at**(store, Kim)]

Van Valin & LaPolla (1997: 100f) point out that a causative analysis of the accomplishments in (1) is untenable for at least two reasons: (i) It is difficult if not impossible to come up with a valid *causative paraphrase* for these constructions. (ii) Languages with *causative morphology* do not mark accomplishment constructions of this type as causative. As a consequence, Van Valin & LaPolla (1997: 111) propose the revised representations in (3), in which the CAUSE operator is replaced by the connective '&', which has the meaning 'and then'.

(3) a. **do**(x, [**eat**(x, y)]) & BECOME **consumed**(y)
b. **do**(x, [**walk**(x)]) & BECOME **be-at**(y, x)

Accomplishment uses of activity verbs are thus conceived as denoting event sequences consisting of an activity immediately followed by an accomplishment. This analysis, however, has the undesirable implication that the accomplishment, which is a non-punctual change of state, does not start before the activity has ended. Therefore, the representations in (3) underwent a further revision in Van Valin (2005), where 'BECOME' is replaced by the punctual change of state operator 'INGR' in order to capture the fact that the resulting state sets in immediately with the activity's end. This has lead to the two logical structures for active accomplishments shown in Table 3.

As noted in Van Valin (2005: 33/66), there are also a few lexicalized active accomplishments in English. The verb *devour* is one such example, which denotes an active accomplishment of consumption. Another candidate is the verb *repair* (cf. Rothstein 2012: 72). It is probably no accident that both, *devour* and *repair* originate from *prefixed* Anglo-French and eventually Latin verbs.

An important consequence of distinguishing active from causative accomplishments is that accomplishments are not bound to causation anymore, as they were in the original *Aktionsart* system. In the revised system, causation is basically orthogonal to the Vendlerian classification. In Table 3, this is reflected by fact that CAUSE can combine logical structures of any type.

3.3. Decomposing simple accomplishments

Van Valin (2005: 44) proposes a further decomposition of the BECOME operator in accomplishment structures. This step is motivated *inter alia* by data from Mparntwe Arrernte (Central Australia) which mark the difference between atelic and telic interpretations of deadjectival verbs overtly in the morphosyntax. Corresponding deadjectival verbs in English are *cool*, *darken*, and *dry*, which allow an atelic and a telic interpretation (*cool for an hour* vs. *cool in an hour*) without overt marking. Having this distinction appropriately represented in the semantics is of course not only relevant for languages which encode it overtly, such as Mparntwe Arrernte, but is equally important for languages like English. The class of verbs in question has been dubbed "degree achievements" in Dowty (1979/1991: 88) and has since then drawn considerable interest (e.g. Hay et al. 1999, Kearns 2007, Kennedy & Levin 2008)

(Simple) accomplishments (of states) consist by definition of a non-punctual, extended component and the final establishment of the resulting state. The solution proposed in Van Valin (2005: 44) is to make this event structure explicit by decomposing BECOME into a progression and an ingression component, that is, into the process (PROC) that leads to the result state and the final setting in of that state; in symbols, BECOME = PROC & INGR. For example, the semantic representation BECOME **cool**(x) of the (telic reading of the intransitive) English verb *cool* would be decomposed as in (4), with **cool** representing the meaning of the adjective *cool*.

(4) BECOME **cool**(x) = PROC **cool**(x) & INGR **cool**(x)

The representation in (4) calls for a further elaboration in at least two respects. The first question is how exactly the expression PROC **cool**(x), and more generally PROC $P(x)$ is to be interpreted. As to this question, there is already a tentative proposal in Dowty (1979/1991: 90) whose basic idea is that a degree predicate P such as **cool** is inherently *vague* and can be true at each time t during the process as expressed by the atelic *cool for an hour* if only P be resolved appropriately at each t. The assumption is that at each time, the undergoer has changed from $\neg P$ to P, with varying resolutions of the vague predicate P. As a consequence, BECOME $P(x)$ can be assumed to be true at all times within the interval denoted by *an hour*. From this perspective, it seems more adequate to apply the operator PROC not to **cool**(x) but to BECOME **cool**(x), understood properly. We will return to this point below in Section 3.4 when we discuss more recent proposals for the representation of active accomplishments, and later in Section 4.2.

A second problematic issue of the proposed decomposition in (4) is the connective '&', which stands for 'and then' and thus expresses temporal succession. Taken literally, the logical structure in (4) says that the punctual change of turning cool (expressed by INGR **cool**) occurs *after* the process of cooling (expressed by PROC **cool**) has ended. This is clearly not an appropriate description since the object in question *is* cool *at the very moment* the cooling process comes to an end. In Section 4.2, we will propose an alternative representation that avoids this "and-then anomaly".

3.4. Decomposing active accomplishments

As explained in Section 3.2, the textbook version of active accomplishment structures (cf. Table 3) does not make use of the BECOME operator anymore since the earlier proposal of Van Valin & LaPolla (1997), which had the form **do**(...) & BECOME ..., was replaced by **do**(...) & INGR .... The reason is that it would be wrong to represent the non-punctual change of state as starting only after the activity has ended. However, as observed by Van Valin (2018), replacing '& BECOME' by '& INGR' in the representation of active accomplishments fails to take into account the incremental change of state (incremental consumption or creation, incremental motion to goal) that co-occurs with the activity. Van Valin (2018) therefore suggests reintroducing BECOME, but this time, the non-punctual, incremental component of the accomplishment is conflated with the activity. In the logical structure, this is realized by decomposing BECOME into PROC & INGR, as sketched in the previous section, and by conjoining the PROC component with the activity:

(5) [**do**(...) ∧ PROC ...] & INGR ...

In this representation, the incremental change component of the accomplishment component is now temporally aligned with the activity component.

A not-so-obvious issue of the PROC & INGR decomposition is the choice of the predicates involved. As discussed in Section 3.3 in the context of degree achievements, a first question concerns the type of predicates the operator PROC applies to. Does PROC take a stative or a dynamic predicate? The first option would allow the straightforward decomposition of BECOME *P* into PROC *P* & INGR *P*, with *P* a stative predicate. The predicate to which PROC is applied is identical to the one under BECOME and INGR in this case, but at the price of putting the burden of expressing the incremental change onto the operator PROC. The second option is to regard PROC as an operator that takes an incremental change description and turns it into the description of a

process that consists of ongoing incremental changes of this type.

In Van Valin (2018), the following tentative decompositions are proposed for the accomplishment components of the active accomplishment examples in (1):

(6) a. [**do**$(x, [$**eat**$(x, y)])$ $\wedge$ PROC **consume**(y)] & INGR **consumed**(y)
b. [**do**$(x, [$**draw**$(x, y)])$ $\wedge$ PROC **create**(y)] & INGR **exist**(y)
c. [**do**$(x, [$**walk**$(x)])$ $\wedge$ PROC **cover.path.distance**$(x, (z))$]
& INGR **be-at**(y, x)

In these decompositions, the operator PROC is apparently applied to dynamic predicates and not to stative ones. We have **consume** instead of **consumed** in (6a), **create** instead of **exist** in (6b), and **cover.path.distance** instead of **be-at** in (6c). It is not fully transparent in each of these examples how the predicates under PROC and INGR are related to each other. In fact, it is not so clear what the predicates **consume** and **create** are supposed to mean in (6a) and (6b), respectively, since their only argument is the undergoer *y*, i.e., the entity being consumed or drawn. It seems that the predicates **being.consumed** and **being.created** would come closer to the intended meaning. The case of (6c) is slightly more intricate. As indicated by the predicate **cover.path.distance**, the incremental change concerns the position of the mover *x* on a path leading to the goal *y*.[2] That is, if **be-at** is to be part of the predicate under PROC then the location variable needs to be bound to varying locations that are getting successively closer to the goal (on the path taken).

Suppose the predicate under PROC should express the type of the ongoing incremental change. Then a systematic decomposition of BECOME into a PROC and an INGR component would require that the dynamic predicate under PROC is systematically related to the stative predicate under INGR. Moreover, the operator PROC should have basically the same effect in active accomplishment decompositions as it has in simple accomplishment structures. We will return to these issues in Sections 4.2 and 4.3.

3.5. Interim summary

If we look back at the development of the RRG *Aktionsart* system since its original adaptation of Dowty (1979/1991), an interesting observation can be made. Recall that Dowty (1979/1991) was not satisfied with the decomposi-

[2] Note that the variable *z* in (6c) is intended to refer to the *distance* covered, not to the path traversed.

tion by DO, CAUSE, and BECOME as a basis of aspectual distinctions. He noted that the DO of agency is neither relevant for aspectual issues nor did he see how to give it a precise interpretation. The evaluation of CAUSE in the temporal dimension is also problematic. Only the change-of-state operator BECOME turned out to be useful for aspectual classification but was noted to lack the ability to express incremental changes.

In a sense, the successive modifications of the RRG system have addressed all of these issues in one way or another. To do largely away with DO was already proposed in Van Valin (1990, 1993). Moreover, the introduction of active accomplishments has released CAUSE from being responsible for defining accomplishments. In fact, causativity is now seen as a largely independent parameter when it comes to Vendlerian classes (cf. Van Valin 2005: 39). As to the deficiencies of BECOME with respect to capturing ongoing incremental changes, the suggested decomposition into PROC & INGR as well as the corresponding proposal for active accomplishments in Van Valin (2018) aim at coping with this problem as well.

In spite of these improvements, there are still a number of issues in the current representation system, as already mentioned in passing. We will address some of them in Section 4 and sketch possible modifications of the present system. The following section takes up again the important distinction between active and causative accomplishments.

3.6. Some intricacies of distinguishing active and causative accomplishments

Despite the two tests mentioned in Section 3.2, (i) existence of a causative paraphrase and (ii) morphological marking of causation in languages that provide such means, it is not always easy to distinguishing causative from active accomplishments. For instance, verbs of transportation like *carry* in motion to goal constructions such as (7) are potential candidates for active accomplishments even if the relevant logical structure, which has three arguments, is not covered by the two templates in Table 3.

(7) John carried the chair into the room.

As to criterion (ii), languages with causative morphology seem not to mark correlates of sentences like (7) as causative. In Georgian, for example, the concept of carrying someone or something somewhere is expressed by verbs of having (which vary with respect to the animacy of the object) plus a preverb of direction (Aronson 1990: 341f). Using verbs of having, taking or holding

combined with directed motion expressions is a widespread pattern for encoding transportation scenarios across languages (Wälchli, 2009). Causative morphology does not play a role here, in general. Possible exceptions are cases where the directed motion verb is transitive, in which case the verb is often analyzed as causative. In Japanese, for instance, the 'carry' verbs *hakobu* ('carry, convey'), *motsu* ('have, hold, carry') and *katsugu* ('carry on shoulders') can combine with transitive verbs of directed motion such as *ireru* ('cause to go in/take in') and *dasu* ('cause to go out/take out') in lexical verb-verb compounds.[3] The use of such lexical compounds for expressing transport to goal scenarios is illustrated in (8a) for the compound verb *hakobiireru* ('carry (and take) in(side)').[4]

(8) a. *Kagu o shinkyo ni hakobi-ire-ta.* Japanese
furniture ACC new home DIR carry-take.in-PAST
'They carried the furniture into their new home.'

b. $\mathbf{do}(x, [\mathbf{carry}(x, y)]) \wedge [[\mathbf{do}(x, \varnothing)]$ CAUSE $[$BECOME $\mathbf{be\text{-}in}(z, y)]]$

Since the most obvious logical structure for *ireru* is $[\mathbf{do}(x, \varnothing)]$ CAUSE $[$BECOME $\mathbf{be\text{-}in}(z, y)]$, and since the carrying and the taking inside encoded by the compound *hakobiireru* occur simultaneously, the logical structure of the compound can be assumed to have the form (8b). In view of this structure, *hakobiireru* is probably best seen as a causative accomplishment verb (*ireru*, 'take in') with a lexically incorporated manner component (*hakobu*, 'carry').

The example in (8) does of course not provide evidence for a causative accomplishment analysis (9a) of the English construction in (7), nor does it preclude an active accomplishment analysis (9b) of that construction.

(9) a. $[\mathbf{do}(x, [\mathbf{carry}(x, y)])]$ CAUSE $[$BECOME $\mathbf{be\text{-}in}(z, y)]$

b. $\mathbf{do}(x, [\mathbf{carry}(x, y)])$ & INGR $\mathbf{be\text{-}in}(z, y)$

The Japanese 'carry' verbs listed above can also combine with a number of intransitive directed motion verbs, in which case the moving entity is identified with the actor of the carrying (Matsumoto 1996: 206ff). Note that the resulting logical structure under an active accomplishment analysis differs from the one in (9b) in that not y but x is the theme of the location predicate.

We can conclude that while there is no morphosyntactic evidence for a

[3] The intransitive counterparts of *ireru* and *dasu* are *iru* ('go into/enter') and *deru* ('come out/exit'), respectively.

[4] The example and its translation are taken from the *Compound Verb Lexicon* hosted by the National Institute of Japanese Language and Linguistics at vvlexicon.ninjal.ac.jp.

causative accomplishment analysis of transport-to-goal constructions like (7), languages may differ with respect to which meaning components are realized overtly in the morphosyntax. It is part of the meaning of 'carry' verbs, and hence inherent in the predicate **carry**, that an actor *x* continuously and directly exerts force on an entity *y* with the effect that *y* is kept above the ground and (more or less) close to *x*. These conditions entail, or at least implicate, that if *x* is changing its location then *y* is moving along with *x* (putting aside the question of whether **carry** already entails the translocation of *x*). It thus basically makes no difference, with respect to what can be inferred about the final location of *y*, whether the (motion-to-)goal phrase adjoined to a 'carry' verb takes *x* or *y* as its argument. Making these meaning aspects of **carry** explicit, however, would require more expressive representations than the current logical structures of RRG (cf. Section 4 below and, e.g., Krifka 2004, Beavers 2011: 38)

The causative paraphrase criterion (i) gives mixed results when applied to a sentence like (7). On the one hand, *John caused the chair to become to be in room* seems an acceptable paraphrase in sense of Van Valin (2005: 38). But it does not support the causative accomplishment analysis in (9b), which says that John's carrying the chair caused it to become to be in the room. It is not just John's carrying the chair, it's John's carrying the chair into the room that caused the chair to become to be there. The 'caused' is to be understood here as indicating a *causal explanation* rather than as referring to a causal relation between events (cf. Davidson 1967: 703, Vendler 1962). In fact, the chair's becoming to be in the room is an *entailment* of John's carrying it there.

Caused motion to goal constructions introduce further intricacies, and it is instructive to see how different authors vary in their judgement with respect to the active/causative accomplishment distinction. Consider the following example taken from Rappaport Hovav & Levin (2001).

(10) We pulled the crate out of the water.

According to Rappaport Hovav & Levin (2001: 783), verbs like *pull* "describe the exertion of a force on a physical object, but do not lexically entail that the force displaces the object. However, when the force does cause a displacement, as in [(10)], then it must be exerted until the result location is attained. Thus, the exertion of force and the displacement occur in tandem." Moreover, they note that (10) "is not so well paraphrased by 'Our pulling the crate caused it to become out of the water'." This line of reasoning, which is similar to the one employed in the above analysis of *carry*, suggests an active accomplishment analysis for (10). Goldberg & Jackendoff (2004: 558), on the other hand, disagree with Rappaport Hovav & Levin about the status of the causative para-

phrase. For them, "is is unclear why [(10)] is considered non-causal" since "it is naturally paraphrased by 'we caused the crate to move out of the water by pulling,' […]." This causative paraphrase, however, is subject to the same objections as the one discussed for *carry*. While the phrase 'by pulling' correctly mentions one of causal factors involved, namely the exertion of force, it does not sufficiently describe the cause for the crate to become to be out of the water. The appropriate description would be 'by pulling at the crate until it was out of the water', which is a causal explanation or, rather, an elaboration.

The domain of caused motion descriptions contains further tricky aspects relevant to the distinction between active and causative accomplishments. For instance, verbs like *push* in motion to goal constructions are ambiguous with respect to whether they mean a continuous exertion of force on the moving object or a punctual push which causes the motion. The first case suggests an active accomplishment analysis along the lines of the *pull* example discussed above, the second case clearly calls for a causative accomplishment structure. A more thorough analysis of this issue is beyond the scope of the present paper, however.

Let us finally have another look at verbs of consumption in accomplishment constructions such as (1a). Consider the following paraphrase for (1a): *Adam's eating an apple caused the apple to become consumed.* This is surely not the most natural and elegant way to express the scenario in question, but on what grounds can it be qualified as inadequate or wrong? The crucial question is whether the relation between the eating activity and the becoming consumed of the affected object or stuff can be characterized as one between cause and effect. Reflecting on the use of the verb *eat* will most probably lead us to the conclusion that it is inherent in what we conceive as eating scenarios that the object eaten (at) gets (successively) consumed. By using the verb *eat*, we do not spell out any of the (possibly causal) chains of events involved (such as separating pieces of food from some bigger chunk by means of the teeth, a knife, a fork, a spoon, etc., putting it into the mouth, and swallowing it, maybe after chewing it). It is thus part of every eating event that the food eaten gets consumed; put differently, that food is becoming consumed when being eaten is a simple entailment, and this entailment holds already for the activity interpretation of *eat*. The accomplishment interpretation of the construction in (1a) then comes about through the implicature that the apple is consumed *completely*.

4. Possible modifications of the *Aktionsart* representations

4.1. Activities revisited

In the current version of RRG, activities are represented as primitive predicates enclosed by **do**$(x, [\dots])$ (cf. Section 3.1). Examples are **do**$(x, [$**walk**$(x)])$ and **do**$(x, [$**carry**$(x, y)])$. The purpose of this **do** envelope is not fully clear, however. If the embedded predicate denotes an activity then adding **do** appears to be redundant from a semantic point of view. We could treat **do**$(x, [\dots])$ simply as a fairly clumsy diacritic which marks off activity predicates and which in addition highlights the actor argument. As mentioned in Section 3.1, having this information readily available in this way might be useful for the formulation of the linking principles. But there are other ways of representing and accessing the relevant information. Instead of referring to the first argument of **do**$(x, [\dots])$, the linking algorithm can simply refer to the first argument of the activity predicate itself. Moreover, in order to single out activity predicates, we may, for instance, assume that such predicates entail a general activity predicate **do**. That is, the lexicon contains conditionals like **walk**$(x) \rightarrow$ **do**(x). In the following sections, we will therefore write **walk**(x) instead of **do**$(x, [$**walk**$(x)])$.

There is a limited number of activity verbs for which the **do** envelope is not redundant since the embedded predicate is stative. The only cases mentioned in Van Valin (2005) are verbs of directed perception such as *listen* and *look at*, *watch* which are analyzed as activity versions of stative perception predicates and are represented as **do**$(x, [$**hear**$(x, y)])$ and **do**$(x, [$**see**$(x, y)])$, respectively. These examples are already discussed in Dowty (1979/1991: 113f) as one of the few cases for which there is a difference between the activity structure and the embedded (stative) predicate. Another of Dowty's examples is the difference between stative and agentive readings of certain adjectives and nouns in predicative constructions. Consider, for instance, the contrast between *John is polite/a hero* and *John is being polite/a hero*. It seems reasonable to argue that the 'is being' construction and likewise the verbs of directed perception encode *agentivity* and are thus candidates for the use of DO. If this is true then **do** is redundant here as well.

4.2. Accomplishments revisited

The decomposition of BECOME into PROC & INGR introduced in Sections 3.3 and 3.4 leaves open the following questions: (i) Which kinds of pred-

icates does PROC apply to? (ii) How is the predicate under PROC related to the one under BECOME (and INGR) in the decomposition? (iii) How can we resolve the "and-then anomaly" that comes with '&'? Let us begin with the last question. Since the final or result state sets in at the very moment the process ends, it seems appropriate to replace '& INGR $P(x)$' by something like 'and finally $P(x)$' or, more formally, '$\wedge$ FINAL $P(x)$', where '$\wedge$' is ordinary conjunction. The term FINAL $P(x)$ is to be taken as true of an event just in case $P(x)$ holds at the end of the event. The underlying idea is that every bounded event has an attribute FIN(AL) whose value is the *final stage* of the respective event.[5] An event e satisfies FIN $P(x)$ if the FIN value s of e satisfies $P(x)$, i.e., if s is a stage of x's being P.[6] Note that FIN $P(x)$ does not exclude *per se* the possibility that $P(x)$ already holds at earlier stages of the event. One way to cope with this point is to derive $\neg P(x)$ for all non-final stages from an appropriately defined representation of the process component.[7] In fact, the version proposed below would allow such an inference. Another option is to represent the accomplishment interpretation of degree achievement verbs simply as INIT $\neg P(x) \wedge$ FIN $P(x)$, which is basically Dowty's explication of BECOME $P(x)$, where INIT(IAL) is an attribute whose value is the initial stage of a bounded event. The representation of the process component would be regarded as irrelevant in this case, for one could argue that the expression *the soup cooled in ten minutes* is true if the soup was not cool at a contextually given moment and it was cool ten minutes later.

As to question (i), the decomposition of BECOME in the active accomplishment representations (6) of Section 3.4, as well as Dowty's sketch of the representation of degree achievements mentioned in Section 3.3, has lead us to the conclusion that the operator PROC applies to dynamic predicates, i.e., to predicates which denote an incremental change. When applied to such a predicate, PROC returns an expression which denotes processes consisting of ongoing incremental changes of the type denoted by that predicate. Question (ii) asks how the dynamic predicate under PROC is defined in terms of the stative predicate that underlies degree achievements such as *cool*. The dynamic predicate needs to express the incremental change towards becoming cool in

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[5] Stages are here conceived as *instantaneous parts* or "snap-shots"; cf. Sider (2001).

[6] Here and in the following, expressions such as F ϕ are to be read as predicates of the form $\lambda x \exists y(\mathrm{F}(x,y) \wedge \phi(y))$, where F is denotes a *functional* relation and ϕ is a one-place predicate. (Alternatively, we could write $\lambda x \exists y(\mathrm{F}(x) = y \wedge \phi(y))$ or more succinctly $\lambda x\, \phi(\mathrm{F}(x))$ if we put aside the complication that F is not a total but only a partial function, in general.)

[7] See also Pustejovsky (1991, 2000).

this case. According to Dowty's tentative proposal mentioned in Section 3.3, the vague predicate **cool** is resolved differently at each time during the cooling process in such a way that BECOME **cool**(x) holds throughout the process. This idea has been taken up by Abusch (1986), who assumes that predicates such as **cool** depend on a contextual parameter and that the *Aktionsart* interpretation of the corresponding degree achievement verb varies according to whether this parameter is determined by the context of utterance or is existentially bound. This leads to BECOME $(\mathbf{cool}(c_{utt}))(x)$ in the first case and to a predicate of the form $\lambda e \exists c(\text{BECOME } (\mathbf{cool}(c))(x)(e))$ in the second case.[8] Following Dowty and Abusch, the latter predicate can be taken as equivalent to $\lambda e \exists c((\text{INIT } \neg(\mathbf{cool}(c))(x) \wedge \text{FIN } (\mathbf{cool}(c))(x))(e))$. Since the parameter c can be chosen appropriately for every event, the predicate is true of every subevent of an event in which x is cooling continuously.[9] By comparison, if the parameter is fixed by the context of utterance then the change-of-state predicate corresponds to an accomplishment reading of the degree achievement verb.

Analyzing the process interpretation of (deadjectival) degree achievement verbs in terms of a variable, context-dependent resolution of the underlying gradable adjective is not very convincing, however. The final stage of the incremental change is obviously better described *comparatively* with respect the initial stage of the change; the change is one from *less cool* to *more cool* rather than from *not cool* to *cool* with *cool* resolved appropriately.[10] Put simply, the incremental change is an increase of the coolness of the undergoer. Specifying the increase presupposes a *scale*, i.e. an *ordered* set of *degrees*. Since an increase of coolness amounts to a decrease of temperature, and since *cool* is commonly analyzed as a dimensional adjective with negative polarity, with temperature as the dimension of measurement, the scale associated with *cool* consists of degrees of temperature with an inverted ordering (i.e., higher degrees of temperature are lower with respect to the scale ordering) (cf. e.g. Bierwisch 1989, Kennedy & McNally 2005). Suppose **temp-stg**(x, d) denotes stages of x's having temperature d. Then changes of state in which x is becoming cooler can be characterized by the predicate in (11).

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[8] The presentation follows basically Kennedy & Levin's (2008: 158) brief exposition of Abusch's approach in an event semantics framework.

[9] Note that it would be wrong to conclude that if the predicate under discussion is true of an event e then it is true of all subevents of e, for an intermediate rise of the temperature is not excluded.

[10] Kennedy & Levin (2008: 171) come to a similar conclusion (but take a different route in their formalization).

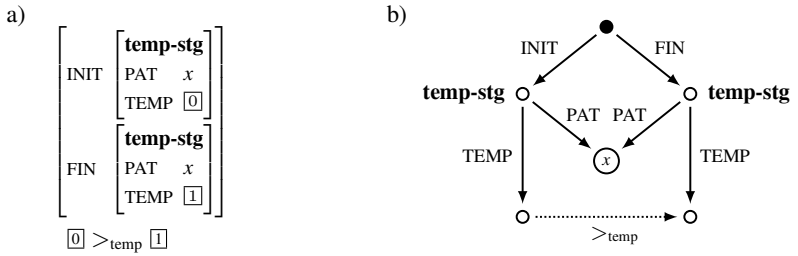

Figure 1: Attribute-value matrix (a) and (minimal) frame model (b) for (12)

(11) $\lambda e \exists d_0 \exists d_1 ((\text{INIT } \textbf{temp-stg}(x, d_0) \wedge \text{FIN } \textbf{temp-stg}(x, d_1))(e) \wedge d_0 >_{\text{temp}} d_1)$

The representation in (12) below is essentially equivalent to the one in (11) but employs more systematically the idea of a representation based on attributes. To this end, **temp-stg** is considered as a stage predicate to which the arguments x and d are bound by the functional relations TH(EME) and PAT(IENT), respectively.[11]

(12) $\text{INIT } (\textbf{temp-stg} \wedge \text{PAT} \doteq x) \wedge \text{FIN } (\textbf{temp-stg} \wedge \text{PAT} \doteq x) \wedge \text{INIT TEMP} >_{\text{temp}} \text{FIN TEMP}$

A semantic decomposition based on attributes (i.e. functional relations) naturally leads to *frame-based* representations.[12] Figure 1b) depicts the frame structure defined by the attribute-value description in (12). The shaded node at the top represents the referential node of the frame; the attribute-value matrix on the left of the figure is a notational variant of the expression in (12).

We started off with the question of how the dynamic predicate under PROC is related to the stative predicate that underlies *cool*. Given that the representations in (11) and (12) are candidates for the predicate under PROC, what is their relation to the respective stative predicate? A primitive stative predicate such as **cool** is obviously not helpful in this respect. What is needed

[11] In addition to the notation introduced in Footnote 6, the following conventions are used here: $\text{F} \doteq y$ stands for $\lambda x\, \text{F}(x, y)$, F G is short for $\lambda x \lambda y \exists z (\text{F}(x, z) \wedge \text{G}(z, y))$, and F **r** G expands into $\lambda x \exists y \exists z (\text{F}(x, y) \wedge \text{G}(x, z) \wedge \mathbf{r}(y, z))$, where F and G are functional relations and **r** is an arbitrary binary relation.

[12] Cf. Osswald & Van Valin (2014) for a general outline of decompositional frame semantics and Kallmeyer & Osswald (2013) for an introduction to the formal framework.

is a lexical semantic representation of dimensional adjectives, as proposed in Bierwisch (1989), Kennedy & McNally (2005), and others, which takes into account the dimension of measurement as well as the scale structure of possible degrees and their ordering. With these semantic ingredients available, the simple positive use of *cool* in expressions such as *the soup is cool* can be roughly characterized by the stage predicate in (13), where $\text{stnd}_{\text{coolness}}$ is a (contextually specified) standard of comparison associated with the coolness scale.[13]

(13) **temp-stg** $\wedge$ PAT $\doteq x \wedge \text{stnd}_{\text{coolness}} >_{\text{temp}}$ TEMP

A full-fledged frame-semantic representation of *cool* would provide attributes for accessing the underlying stage type as well as the coolness scale and its components, including the degree ordering and the standard of comparison. These components are then employed in different ways at the interface to morphology and syntax for deriving the representations in (12) and (13), among others. While spelling this out in detail is beyond the scope of the present paper, it should be clear from the foregoing discussion that a decomposition of BECOME $P(x)$ requires a proper decomposition of $P(x)$, irrespective of the chosen semantic formalism.

We conclude this section with a brief sketch of how to cope with the operator PROC in a semantic framework that is primarily based on attributes. Recall that if ϕ is a change-of-state predicate such as (12) then e satisfies PROC ϕ if e consists of ongoing changes of type ϕ. A straightforward solution is to characterize e by an attribute PROG(RESSION-TYPE) whose value is the *type* of change that goes on in the course of e.[14] In the example discussed above, the respective type T would be an abstract representation of the frame in Figure 1. An additional axiom would ensure that if e satisfies PROG $\doteq T$ then any segment of e is an instance of T.[15]

4.3. The structure of active accomplishments

The different versions of active accomplishment structures discussed in Section 3 all suffer the "and-then anomaly". This is also true of the latest proposal

[13] As to the last conjunct in (13), expressions of the form $c\,\mathbf{r}\,\text{G}$ are to be interpreted as $\lambda x \exists y(\text{G}(x, y) \wedge \mathbf{r}(c, y))$, where c is a variable or constant, G is a functional relation and $\mathbf{r}$ is an arbitrary binary relation.

[14] Galton (2012) seems to advocate a similar view of the nature of processes and activities.

[15] Cf. Balogh & Osswald (2020) for a more elaborate explanation of this approach.

(cf. Section 3.4), which conflates the process component of the accomplishment with the activity component. The logical structures in (6) express that the activity (or process) ends *and then* a punctual change of state occurs. For example, (6b) means that the drawing activity and the simultaneously ongoing creation come to an end *and then* the resulting object comes into existence. Likewise, in the motion-to-goal case (6c), the given analysis says that the motion activity stops *and then* a punctual change of state from not being at the goal to being at the goal occurs. This is obviously not what's happening. Rather, the drawn figure exists at the very moment the drawing activity stops. Likewise, the mover is at the goal at the very moment the motion stops; reaching the goal co-occurs with coming to a final halt – it is not something which happens afterwards.[16] It thus seems advisable to avoid the temporal connective '&' when combining process or activity expressions with accomplishment or achievement expressions in active accomplishment structures.

Instead of starting with ϕ & BECOME ψ as proposed in Van Valin & LaPolla (1997), we may simply start with $\phi \wedge$ BECOME ψ. This representation does not have the above-mentioned temporal succession problem of Van Valin & LaPolla's original proposal, which lead to ϕ & INGR ψ in Van Valin (2005) and eventually to the reintroduction of BECOME as PROC & INGR in Van Valin (2018). Applied to the motion-to-goal case (1c), we get $\mathbf{walk}(x) \wedge$ BECOME $\mathbf{be\text{-}at}(y,x)$, which describes walking activities of x that are simultaneously describable as events of x's coming to be at y. For a decomposition of BECOME, we can follow the strategy of Section 4.2 and use the predicate FIN $\mathbf{be\text{-}at}(y,x)$ to describe events that have final stages at which $\mathbf{be\text{-}at}(y,x)$ holds. The revised version of (6c) then looks as follows, where the expression under PROC remains to be explicated.

(14) $\mathbf{walk}(x) \wedge$ PROC ... $\wedge$ FIN $\mathbf{be\text{-}at}(y,x)$

Recall that BECOME $\mathbf{be\text{-}at}(y,x)$ is intended to capture the meaning of the English preposition *to* in motion-to-goal constructions like *walk to the store* (1c). It is commonly taken as part of the meaning of *to* in such a context that the undergoer x moves continuously towards the goal until the target area is reached. In other words, x traverses a path that leads to the goal (keeping aside the possibility of teleportation). The incremental change component should capture something like 'move (forward) along a path that leads to y'. Thus a possible candidate of the predicate under PROC could

[16] In fact, the motion does not even have to stop at the goal but can continue. But it definitely does not stop before reaching the goal.

be **move.along.path.to**(x, y). Since the incremental steps of a given motion event are all bound to one and the same path, it seems more appropriate to explicitly introduce the path as a constant p on a par with x and y, as in **move.along.to**(x, p, y), or, more simply, **move.along**(x, p), with the additional constraint that the path p ends at y. The incremental change expressed by **move.along**(x, p) is that x (continuously) changes its location on p in the direction of p. In particular, this requires that the path p is directed, that is, its points are linearly ordered. An event (segment) e of type **move.along**(x, p) then satisfies INIT **be-at**(u, x) $\wedge$ FIN **be-at**(v, x), where u and v are points on the path p and u precedes v with respect to the direction of p, in symbols, $u <_p v$. That is, x is located at u at the initial stage of e, and at v at the final stage of e. We arrive at the following representation, which shows the same pattern as (12).

(15) INIT (**be-at** $\wedge$ THEME $\doteq x$) $\wedge$ FIN (**be-at** $\wedge$ THEME $\doteq x$)
$\wedge$ INIT LOC $<_p$ FIN LOC

In contrast to cases like (12), the scalar structure that underlies (15) is not lexicalized but compositionally derived. This is a general property of the active accomplishment constructions in (1) since the activity verb does not *per se* provide a scale. The scalar structures are either path scales, as in the motion-to-goal constructions above, or "extent" or "volume" scales in the creation/consumption constructions, in which case the scale is defined in terms of the incremental theme object (Rappaport Hovav 2008, Kennedy 2012). In all of these cases, the scalar structure is dependent on the event denoted by the activity component of the construction.

4.4. Causative structures

We conclude this section by showing how causative structures fit into the picture developed so far. Dowty (1979/1991) treats causal expressions such as (16a) as statements (like all other formulas of his aspect calculus). If we interpret (16a) as a statement which expresses the causal relatedness of two events then a logical explication of (16a) could look like (16b), where the variables e_1 and e_2 refer to events and $\phi(e_1)$ and $\psi(e_2)$ are sentences and thus fully tensed clauses.

(16) a. ϕ CAUSE ψ
b. $\exists e_1 \exists e_2(\textbf{cause}(e_1, e_2) \wedge \phi(e_1) \wedge \psi(e_2))$

From an RRG point of view, it seems more reasonable to read (16a) as an event description, which is typically associated with a nuclear syntactic structure (at least in the case of direct causation) and thus not yet specified with respect to time and space. This means that the causal expression denotes *complex events* of type *causation*, which have two event components, namely the *cause* component and the *effect* component. A formalization of this analysis is given in (17a), where CAUS(E) and EFF(E)CT are the two attributes of **causation** events whose values are the cause and the effect component, respectively.

(17) a. $\lambda e \exists e_1 \exists e_2 (\textbf{causation}(e) \wedge \text{CAUS}(e, e_1) \wedge \text{EFFCT}(e, e_2) \wedge \phi(e_1) \wedge \psi(e_2))$

b. **causation** $\wedge$ CAUS ϕ $\wedge$ EFFCT ψ

Note that in (17), CAUS is *not* meant to denote the relation between cause and effect but rather the functional relation between complex events of type causation and their cause components. By applying the notational conventions introduced in the previous sections, we can replace the expression in (17a) by the compact version in (17b). The latter expression can be shortened further to CAUS ϕ $\wedge$ EFFCT ψ if we assume that having the attributes CAUS and EFFCT implies being of type **causation**, in symbols: CAUS $\top$ $\wedge$ EFFCT $\top$ $\Rrightarrow$ **causation**, where $\top$ is the *universal* predicate, which is true of everything.[17] It is also possible to state general constraints on the temporal relation between cause and effect. Let $<_\circ$ be the relation that holds between two events (or states) if the first starts earlier than the second. Then we have **causation** $\Rrightarrow$ CAUS $<_\circ$ EFFCT.

In (18), the revised representation is applied to a causative resultative construction. The corresponding standard RRG representation is shown in (18c) for comparison. The complex causation scenario described in (18a) has as its CAUS component a **kick** activity of Kim at the door, and as its EFFCT component a change-of-state of the door becoming **shut**.

(18) a. Kim kicked the door shut.

b. CAUS (**kick** $\wedge$ EFFCTR $\doteq x$ $\wedge$ PAT $\doteq y$) $\wedge$ EFFCT FIN (**shut** $\wedge$ PAT $\doteq y$)

c. [**do**$(x,$ **kick**$(x, y))$] CAUSE [BECOME **shut**(y)]

As mentioned before, an attribute-based analysis of event predicates suggests a "Neo-Davidsonian" representation of the relation between an event and its

[17] $\phi \Rrightarrow \psi$ is short for $\forall x(\phi(x) \rightarrow \psi(x))$, where ϕ and ψ are one-place predicates. Note that F $\top$ is equivalent to $\lambda x \exists y\, \text{F}(x, y)$ by definition of $\top$.

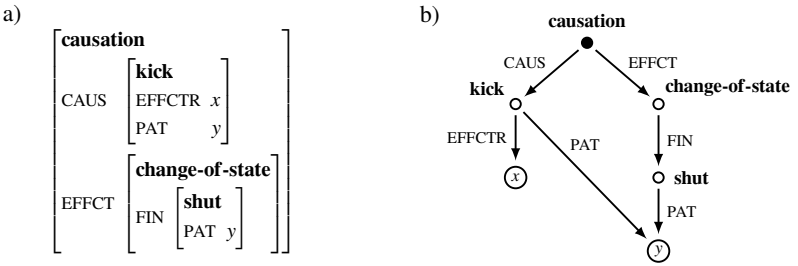

Figure 2: Attribute-value matrix (a) and frame model (b) for (18b)

participants in terms of (functional) thematic relations. Hence, (18b) uses **kick** $\wedge$ EFFCTR $\doteq x \wedge$ PAT $\doteq y$ instead of **kick**(x, y), with the thematic relations EFF(E)CT(O)R and PAT(IENT). Figure 2a) shows a (slightly enriched) presentation of (18b) as an attribute-value matrix; Figure 2b) depicts the corresponding frame model.

Since the logical structures of RRG play a crucial role in the linking system, a few words might be in order about how the proposed representations can be integrated into that system. Recall that it is the position of the arguments in the logical structures that determines the macrorole assignment and thereby, together with other factors, the realization of the arguments in the morphosyntax. With respect to primitive predicates, the representations proposed above differ insofar as they rely on thematic relations instead of the linear ordering of the arguments. However, these two notions are basically equivalent (cf. Van Valin 2005: 55). The depth of embedding of an argument in the representations, on the other hand, which is equally important for the macrorole assignment, is preserved in the attribute-based representations.

5. Conclusion

In the first part of the paper, we have seen that many of the revisions of the RRG *Aktionsart* system go back to deficiencies of Dowty's original Generative Semantics-inspired decomposition system, most of which have been pointed out by Dowty himself, in one way or another. These deficiencies comprise, among others, problems of coming up with a proper denotational interpretation of the operators, as in the case of DO, and issues related to developing a sufficiently fine-grained representation of the temporal course of an event.

The current version of the *Aktionsart* system has resolved a good part of these deficiencies but is still not without flaws. We have discussed the "and-

then anomaly" and the problems of characterizing the process components of simple and active accomplishments. One of our insights was that the decomposition of accomplishments into a process and a result component calls for a decompositional analysis of the underlying predicate. We sketched a system of frame-based representations which allows such a decomposition, has a clear denotational interpretation, and preserves the structural properties of the logical structures. Among the many issues to be spelled out in more detail is the frame-based description of the compositional scale constitution for active accomplishments mentioned at the close of Section 4.3. Another such issue is the proper integration of causal factors in the transitive motion cases discussed in Section 3.6.

It remains to point out that the attribute-based approach sketched in Section 4 is of course not the only way of turning the *Aktionsart* system and its recent extensions into a formal representation language. Formalization as such, however, is indispensable if a precise semantic interpretation is intended to be achieved. Dowty (1979/1991) was meticulous in specifying the formal makeup (i.e., the syntax) and the model-theoretic interpretation of his representation language (dubbed by him the 'translation language', following Montague). When the decompositional elements of Dowty's system were taken over by Foley & Van Valin (1984), formal rigor did not play a similar prominent role, nor did it in the subsequent modifications and extensions of the RRG *Aktionsart* system. The main concern of Foley & Van Valin and later work on RRG was rather to show how semantic structures can contribute to explaining, among others, how verbal arguments and interclausal semantic relations are grammatically encoded across languages.

Acknowledgements

The research presented in this article was supported by the Collaborative Research Centre 991 "The Structure of Representations in Language, Cognition, and Science" funded by the German Research Foundation (DFG) and the project TreeGraSP funded by the European Research Council (ERC). I would like to thank Robert D. Van Valin, Jr. for valuable comments on earlier drafts of this article.

References

Abusch, Dorit. 1986. Verbs of change, causation and time. Technical Report 86-50, CSLI, Stanford, CA.

Aronson, Howard I. 1990. *Georgian: A Reading Grammar. Corrected Edition*. Slavica Publishers, Inc., Columbus, Ohio.

Balogh, Kata & Rainer Osswald. 2020. A frame-based analysis of verbal particles in Hungarian. In Sebastian Löbner, Thomas Gamerschlag, Tobias Kalenscher, Markus Schrenk & Henk Zeevat, eds., *Concepts, Frames and Cascades in Semantics, Cognition and Ontology*. Springer, Dordrecht.

Beavers, John. 2011. An aspectual analysis of ditransitive verbs of caused possession in English. *Journal of Semantics*, 28:1–54.

Bierwisch, Manfred. 1989. The semantics of gradation. In Manfred Bierwisch & Ewald Lang, eds., *Dimensional Adjectives. Grammatical Structure and Conceptual Interpretation*, 71–261. Springer, Berlin.

Davidson, Donald. 1967. Causal relations. *Journal of Philosophy*, 64(21): 691–703.

Dowty, David. 1977. Toward a semantic analysis of verb aspect and the English imperfective 'progressive'. *Linguistics and Philosophy*, 1:45–77.

Dowty, David. 1979/1991. *Word Meaning and Montague Grammar*. D. Reidel, Dordrecht.

Foley, William A. & Robert D. Van Valin, Jr. 1984. *Functional Syntax and Universal Grammar*. Number 38 in Cambridge Sudies in Linguistics. Cambridge University Press, Cambridge.

Galton, Antony P. 2012. The ontology of states, processes, and events. In Mitsuhiro Okada & Barry Smith, eds., *Proceedings of the Fifth Interdisciplinary Ontology Conference*, 35–45, Tokyo, Keio University.

Goldberg, Adele E. & Ray Jackendoff. 2004. The English resultative as a family of constructions. *Language*, 80:532–568.

Hay, Jennifer, Christopher Kennedy & Beth Levin. 1999. Scalar structure underlies telicity in "degree achievements". In T. Matthews & D. Strolovitch, eds., *Proceedings of SALT IX*, 127–144, Ithaca, NY, CLC Publications.

Kallmeyer, Laura & Rainer Osswald. 2013. Syntax-driven semantic frame composition in Lexicalized Tree Adjoining Grammars. *Journal of Language Modelling*, 1(2):267–330.

Karttunen, Lauri. 1971. The logic of English predicate complement constructions. Distributed by the Indiana University Linguistics Club.

Kearns, Kate. 2007. Telic senses of deadjectival verbs. *Lingua*, 117:26–66.

Kennedy, Christopher. 2012. The composition of incremental change. In Violeta Demonte & Louise McNally, eds., *Telicity, Change, and State. A Cross-Categorial View of Event Structure*, Oxford Studies in Theoretical Linguistics, 103–121. Oxford University Press, Oxford.

Kennedy, Christopher & Beth Levin. 2008. Measure of change: The adjectival

core of degree achievements. In Louise McNally & Christopher Kennedy, eds., *Adjectives and Adverbs. Syntax, Semantics, and Discourse*, 156–182. Oxford University Press, Oxford.

Kennedy, Christopher & Louise McNally. 2005. Scale structure, degree modification and the semantics of gradable predicates. *Language*, 81:345–381.

Krifka, Manfred. 2004. Semantic and pragmatic conditions for the Dative Alternation. *Korean Journal of English Language and Linguistics*, 4:1–32.

Matsumoto, Yo. 1996. *Complex Predicates in Japanese*. CSLI Publications, Stanford, CA.

Osswald, Rainer & Robert D. Van Valin, Jr. 2014. FrameNet, frame structure, and the syntax-semantics interface. In Thomas Gamerschlag, Doris Gerland, Rainer Osswald & Wiebke Petersen, eds., *Frames and Concept Types*, 125–156. Springer, Dordrecht.

Pustejovsky, James. 1991. The syntax of event structure. *Cognition*, 41:47–81.

Pustejovsky, James. 2000. Events and the semantics of opposition. In Carol Tenny & James Pustejovsky, eds., *Events as Grammatical Objects*, 445–482. CSLI Publications, Stanford, CA.

Rappaport Hovav, Malka. 2008. Lexicalized meaning and the internal temporal structure of events. In Susan Rothstein, ed., *Theoretical and Crosslinguistic Approaches to the Semantics of Aspect*, 13–42. John Benjamins, Amsterdam.

Rappaport Hovav, Malka & Beth Levin. 2001. An event structure account of English resultatives. *Language*, 77(4):766–797.

Ross, John Robert. 1972. Act. In Donald Davidson & Gilbert Harman, eds., *Semantics of Natural Language*, 70–126. D. Reidel, Dordrecht.

Rothstein, Susan. 2012. Another look at accomplishments and incrementality. In Violeta Demonte & Louise McNally, eds., *Telicity, Change, and State. A Cross-Categorial View of Event Structure*, Oxford Studies in Theoretical Linguistics, 60–102. Oxford University Press, Oxford.

Sider, Theordore. 2001. *Four-Dimensionalism. An Ontology of Persistence and Time*. Clarendon Press, Oxford.

Stassen, Leon. 2009. *Predicative Possession*. Oxford University Press, Oxford.

Van Valin, Robert D., Jr. 1990. Semantic parameters of split intransitivity. *Language*, 66(2):221–260.

Van Valin, Robert D., Jr. 1993. A synopsis of Role and Referece Grammar. In Robert Van Valin, ed., *Advances in Role and Reference Grammar*, 1–164. John Benjamins, Philadelphia.

Van Valin, Robert D., Jr. 2005. *Exploring the Syntax-Semantics Interface*. Cambridge University Press, Cambridge.

Van Valin, Robert D., Jr. 2010. Role and Reference Grammar as a framework for linguistic analysis. In Bernd Heine & Heiko Narrog, eds., *The Oxford Handbook of Linguistic Analysis*, 703–738. Oxford University Press, Oxford.

Van Valin, Robert D., Jr. 2018. Some issues regarding (active) accomplishments. In Rolf Kailuweit, Eva Staudinger & Lisann Künkel, eds., *Applying and Expanding Role and Reference Grammar*, (NIHIN Studies), 355–378. Albert-Ludwigs-Universität, Universitätsbibliothek, Freiburg.

Van Valin, Robert D., Jr. & Randy J. LaPolla. 1997. *Syntax*. Cambridge University Press, Cambridge.

Van Valin, Robert D., Jr. & David P. Wilkins. 1996. The case for 'Effector': Case roles, agents, and agency revisited. In Masayoshi Shibatani & Sandra A. Thompson, eds., *Grammatical Constructions*, 289–322. Clarendon Press, Oxford.

Vendler, Zeno. 1957. Verbs and times. *The Philosophical Review*, 66(2): 143–160.

Vendler, Zeno. 1962. Effects, results and consequences. In R. J. Butler, ed., *Analytic Philosophy*, 1–14. Barnes and Noble, New York.

Wälchli, Bernhard. 2009. Motion events in parallel texts. A study in primary-data typology. Universität Bern. Habilitationsschrift.