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On affectedness

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Abstract Affectedness—usually construed as a persistent change in or impingement of an event participant—has been implicated in argument realization, lexical aspect, transitivity, and various syntactic operations. However, it is rarely given a precise, independently-motivated definition. Rather, it is often defined intuitively or diacritically, or reduced to the properties it is meant to explain, especially lexical aspect. I propose a semantic analysis of affectedness as a relationship between a theme participant that undergoes a change and a scale participant that measures the change (following Beavers 2008a, 2009 and Kennedy and Levin 2008). I justify this analysis by re-examining the empirical diagnostics for affectedness, and argue that affectedness is not reducible to lexical aspect, but is tightly correlated with it in a way that motivates an analysis involving two interdependent participants. This model also provides a precise way of defining the pervasive notion of degrees of affectedness, as a hierarchy of monotonically weakening truth conditions about the result state of the theme on the scale. This hierarchy further captures important subset relations among predicates regarding affectedness diagnostics, and ultimately brings together many of the above phenomena under a single, unified approach.

Keywords Affectedness · Lexical semantics · Syntax · Aspect · Telicity

1 Introduction

The notion of affectedness—usually construed as a persistent change in or impingement of an event participant—is frequently evoked in work on lexical semantics and syntax, so much so that it is nearly impossible to reference all of the relevant

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work. However, there are several phenomena for which affectedness has been especially key. Affectedness has long been central to work on argument realization, especially in determining direct objecthood (Fillmore 1968, 1970, 1977; Anderson 1971, 1977; Jackendoff 1990; Dowty 1991; Beavers 2006, 2010, *inter alia*). Furthermore, affectedness has been linked to lexical aspect, especially as a determinant of telicity (Tenny 1992, 1994; Jackendoff 1996; Krifka 1998; Beavers 2006, 2008a, 2009; *inter alia*). Affectedness has also been evoked in constraints on syntactic operations, including DP-passives and middles (Anderson 1979; Fiengo 1980; Jaeggli 1986; Condoravdi 1989, *inter alia*) and causativization (Alsina 1992; Ackerman and Moore 1999, 2001b; *inter alia*). Finally, affectedness is widely assumed to figure into whether or not a verb is transitive, both within and across languages (Hopper and Thompson 1980; Tsunoda 1981, 1985; Blume 1998; Testelec 1998; Næss 2003; *inter alia*).

Yet despite widespread appeal to the notion, affectedness rarely receives a precise, independently motivated analysis. Rather, it is usually defined intuitively (e.g. as the property of having undergone some change; see e.g. Fillmore 1970: 125), or through representational schema that lack predictive force. For example, change-of-state and change-of-location are sometimes assumed to be distinct, both conceptually and linguistically (e.g. they license different result state modifiers; Jackendoff 1990: 94). Therefore they are often modeled via separate thematic roles (patient vs. theme) or separate event types (GO vs. BECOME). Yet they figure into object realization and aspect in nearly identical ways (Tenny 1994). For this reason they are sometimes modeled in terms of the same semantic primitives (a general theme role or BECOME event; Rappaport Hovav and Levin 1998: 108–109). Still further theories adopt a multistratal view of lexical meaning that allows for criss-crossing generalizations to capture the similarities and differences (e.g. the "action" vs. "thematic" tiers of Jackendoff 1990). All are equally valid intuitions, but a question less often addressed is whether we can find independent criteria by which we can predict what effects languages will treat the same and how they will be similar.

Affectedness is also well known to be a matter of degree. Intuitively, in (1) the patient *the apple* is increasingly less affected from (1a) to (1d).

(1) a. John ate the apple up. (Apple is completely gone)
b. John cut the apple. (Apple cut, not necessarily to a particular degree)
c. John kicked the apple. (Apple impinged, not necessarily affected)
d. John touched the apple. (Apple manipulated, not necessarily impinged)

Degrees of affectedness have been especially important in work on transitivity (Hopper and Thompson 1980, *inter alia*), where higher degrees of affectedness correspond to higher transitivity. However, high and low affectedness are hard to define precisely, and are usually left to intuition. For example, Hopper and Thompson (1980: 252–253) claim that "[t]he degree to which an action is transferred to a patient is a function of how completely that patient is AFFECTED" (emphasis theirs), although they never define degree of transfer.

Finally, rarely is affectedness defined in a way that brings all of the above phenomena together under a single rubric. This is largely because affectedness is often

appealed to in discussion of other phenomena, but is rarely an object of study itself. The primary strand of literature that has tied multiple affectedness-based phenomena together is work on lexical aspect, following Tenny (1992, 1994) in particular. In this literature, affectedness is done away with as a primitive, and is instead reduced to a set of aspectual properties, especially telicity (determining the endpoint of the event) and measuring out (measuring the time course of the event). But there is a conceptual difference between affectedness and aspect, and it is a complex empirical question whether they can be distinguished linguistically, though I believe they can.

My goal is to address affectedness head on and propose a new way to put its use in linguistic theorizing on more explicit and precisely articulated empirical and theoretical grounds, with the following four objectives:

1. To reassess the empirical diagnostics that isolate an independent notion of affectedness, and clarify how it does and does not correlate with lexical aspect;
2. To synthesize recent proposals about aspect and change into a single, unified model;
3. To use this model to give a precise definition of degrees of affectedness;
4. To sketch how this model captures the empirical diagnostics of affectedness and aspectual correlations in a consistent way.

In Sect. 2 I review several semantic diagnostics for affectedness, and show that while the diagnostics do not all pick out the same arguments of the same predicates—suggesting that different things that have been called affectedness in prior literature may not be the same thing—the diagnostics do roughly group predicates into a subset hierarchy, where those that pass n tests are a strict subset of those that pass $n-1$ tests. This suggests that a unified analysis of different notions of affectedness is indeed possible. In Sect. 3 I compare these diagnostics with the standard aspectual diagnostics thought to be associated with affectedness, and show that they only partly coincide. While affected arguments figure into telicity, they are not the only ones that do, and conversely affected arguments do not consistently figure into measuring out, though others do. I argue that this shows us that affectedness is not a property of just one entity, but requires a relation between multiple entities.

In Sect. 4 I outline a notion of change by which we can analyze all of these disparate facts, where change is an inherently *relational* concept involving both a theme participant that undergoes the change and a scale participant defining the progress of the change over time (following Hay et al. 1999; Wechsler 2001, 2005; Beavers 2002, 2006, 2008a, 2009; Kennedy and Levin 2008; Rappaport Hovav 2008). Furthermore, the constraints imposed on each participant are relativized to the other, such that we need a thematic relation that relates both participants back to the event simultaneously (contra a standard Parsons 1990-style thematic relation). I show that explicitly positing an additional entity—the scale—into the equation has two advantages for understanding change. First, it gives us a principled way to capture the indirect relation of change and aspect in Sect. 3: some aspectual properties correlate with the scale, some with the theme, and some with both. Second, it allows us to abstract away from real world changes in a principled way. Different real world changes are distinguished by the *type* of the scale (e.g. scales of cleanliness, color, dirtiness, volume, position, etc.), but can be compared to one another in terms of the

structure of the scale, regardless of type (e.g. subpart structure and specificity of the endpoints).

In Sect. 5 I return to the question of what affectedness is and define four degrees of affectedness based how specific a predicate is about where theme ends up on the scale, ranging from highly specific down to unspecified that a scale even exists. These four degrees form an implicational hierarchy of monotonically weakening truth conditions, where an entity affected to degree m is affected to all degrees less than m. I show how this hierarchy captures the subset property of the affectedness diagnostics discussed in Sect. 2, thus bringing together many different notions of affectedness and their relation to lexical aspect into a single model. I discuss the role of a semantic theory of affectedness in a larger theory of lexical semantics in Sect. 6.

2 Empirical diagnostics for affectedness

I first review various empirical diagnostics for affectedness, some proposed in previous literature and some developed here. Not surprisingly, given that affectedness itself is not a well-defined notion, the diagnostics do not all pick out the same arguments of the same predicates. Likewise, some diagnostics show variable behavior within certain predicate classes. Still others emerge not as a single diagnostic but a family of parallel diagnostics, each appropriate for a different class of predicates but sharing aspects in common. However, I show that there is order to these discrepancies. Variable behavior of some diagnostics within predicate classes I argue is due to a small set of orthogonal factors. Once these factors are controlled for, the diagnostics group predicates into a subset hierarchy, where those that have arguments that pass n tests are a strict subset of those that have arguments that pass $n-1$, thus linking the apparently disparate diagnostics together. This is an important fact I ultimately explain in terms of a theory of degrees of affectedness based on structural properties of scales. Conversely, families of parallel diagnostics can be defined in terms of the same structural properties holding for different real world types of scales.

Before beginning, it is useful to limit the empirical scope of the study, so as to make the discussion manageable. As mentioned above, affectedness usually has to do with persistent change (or impingement, which I later subsume under a model of change), where change is standardly understood as a condition ψ obtaining that did not obtain before. Often this is analyzed by a linguistically primitive BECOME event type, where [BECOME ψ] entails that for some time interval I ψ does not hold at the initial point in I but starting at the final point in I ψ does hold (Dowty 1979: 140–144, updating von Wright 1963). However, "change" is quite a general notion; as Dowty has it, ψ could be anything, even an activity or process (e.g. [BECOME *It is raining*] is a well-formed formula). Affectedness is usually conceived of as the more specific notion that ψ is a new state that obtains and maintains for some entity x due to the event, in particular what Kratzer (2000) calls a "target state" (after Parsons 1990: 235). I focus on this notion here.

I assume that change can only be encoded in dynamic predicates. But which dynamic predicates indicate changes, and which changes do languages treat as the

"same"? It is not my goal to be exhaustive, but the physical properties in (2) have all been considered types of affectedness for some entity *x*.[1]

(2) a. *x* changes in some observable property. (*clean/paint/delouse/fix/break* **x**)
b. *x* transforms into something else. (*turn/carve/change/transform* **x** *into y*)
c. *x* moves to and stays at some location. (*move/push/angle/roll* **x** *into y*)
d. *x* is physically impinged. (*hit/kick/punch/rub/slap/wipe/scrub/sweep* **x**)
e. *x* goes out of existence. (*delete/eat/consume/reduce/devour* **x**)
f. *x* comes into existence. (*build/design/construct/create/fashion* **x**)

We can reduce the six categories in (2) to four categories (building on Tenny 1994: 15–18; see also Tenny 1992; Jackendoff 1996; Krifka 1998, Rappaport Hovav and Levin 2005; Rappaport Hovav 2008). First are "change-of-state" predicates that entail changes in a property of a participant as in (2a,b). Second are "directed motion" predicates that entail change in location as in (2c) (which I call "motion" predicates for short). Third are "surface contact" and "impact" predicates in (2d) that entail contact but no change (a point I return to below) (Fillmore 1970; Rappaport Hovav and Levin 2005). Fourth are "creation/consumption" predicates as in (2e,f). Predicates of coming-into-existence are also said to have EFFECTED rather than AFFECTED objects (Quirk and Greenbaum 1973: 171–175; Lakoff 1976: 52; Hopper 1985: 68; see also Jespersen 1933: 109 on "Objects of Result"). These classes are just rough guidelines for ease of discussion. There are many subtypes among each, all with their own unique properties (see e.g. Levin 1993 and Baker and Ruppenhofer 2002).

The properties in (2) are not unrelated; they are all prototypical properties of direct objects (Fillmore 1970, 1977; Anderson 1971, 1977; Tsunoda 1981; Dowty 1991; Beavers 2006, 2010, *inter alia*). Likewise, almost all are conditioning factors on middle and DP-passive formation (Condoravdi 1989: 23–24). Thus we have a *syntactic* reason to group them together. But do we also have a *semantic* reason? I review and re-evaluate some of the evidence for this below, and argue that we do.

What happened to X is Y Perhaps the only proposed, direct test for affectedness is Cruse's (1973: 13) *What happened to X is Y* (see also Lakoff 1976: 47–48; Jackendoff 1990: 125–130; Rappaport Hovav and Levin 2001: 786–787).[2] Intuitively, the object of (3a) is affected and passes *What happened to X is Y*, as in (3b). But for (4a), the object is intuitively unaffected and likewise does not pass the test, as in (4b).

[1] Affectedness may also include change-in-possession, such as coming-to-possess (*give* **x** *y*), ceasing-to-possess (*take* **x** *from y*), or being the theme in a possession change (*y* in the last two examples). Since possession presents its own issues (e.g. systematic polysemy; Green 1974; Tham 2005), I set it aside here, though see Beavers (2011). I also set aside non-physical change, such as change in mental state (e.g. *become angry*) or non-physical condition/status (e.g. *become president*), though I suspect an analysis similar to the one I develop here can be extended to at least some of these.

[2] Jackendoff also gives *What Z did to X is Y*, which presupposes an agent *Z*. Since I am not interested in agentivity I focus on *What happened to X is Y*, though the two are usually interchangeable.

(3) a. The Romans destroyed the barbarian city.
b. What happened to the barbarian city is that the Romans destroyed it.

(4) a. They followed the star (out of Bethlehem).
b. #What happened to the star is they followed it (out of Bethlehem).

However, (4b) is acceptable if a special context is established, e.g. a supernatural context where the star is there to lead people out of Bethlehem and vanishes once its mission is accomplished. However, this requires a very rich context and is not entailed by *follow the star* per se, conforming to what Jackendoff (1990: 294; fn. 7) calls a "discourse patient". To keep things manageable, I focus only on change that is entailed by the predicate regardless of context (Jackendoff's "grammatical patient").[3]

Applying the test to the objects in (2), we see they nearly all pattern alike. In particular, (2a–e) are all amenable to *What happened to X is Y* as in (5a–e) respectively, suggesting that (2a–e) are not just syntactically but also semantically related.

(5) a. What happened to the bedroom is John cleaned/painted it.
b. What happened to the wood is John turned/carved it into a toy.
c. What happened to the vase is John moved/pushed it into the house.
d. What happened to the car is John hit/wiped it.
e. What happened to the cake is that John destroyed/ate it.

However, *What happened to X is Y* shows variable behavior with two of the types in (2). First, this test is sometimes odd for effected objects (see also Quirk and Greenbaum 1973: 174 and Hopper 1985: 72 for similar data on *What Z did to X is Y*):

(6) #What happened to the shed is John built/constructed it.

Prima facie this suggests that effected objects do not share whatever property the other participants in (2) have that makes them acceptable in this test. However, interestingly, in some contexts effected objects are acceptable with *What happened to X is Y*, including building model airplanes or things that are being recreated:[4]

(7) a. What happened to the model airplane is John built it.
b. What happened to the shed is John rebuilt/reconstructed it.

Why would these contexts be relevant? One thing that unifies them is that the object has independent existence prior to the event, since model airplanes exist as kits before assembly and things that are recreated existed before. This is a property that all of the other predicates in (2) share in common as well, and thus may be an additional property of *What happened to X is Y* that should be taken into account. Furthermore, if

[3]There is another, colloquial use of *What happened to X* as in *What happened to Mary?* which means *Where did Mary go?* (as pointed out to me by Steve Wechsler). This may be related, but I set it aside here.

[4]Indeed, in Google searches for *build* in the middle voice (a construction which supposedly only applies to verbs with affected objects; see Sect. 3) most of the examples I found involved model airplane kits. However, not everyone accepts (7) to the same degree; I find them both unexceptional, one native speaker has told me they sound a bit "cute", and one anonymous reviewer finds (7b) acceptable but not (7a).

What happened to X is Y is taken to be an affectedness diagnostic, then prior existence must therefore also be a factor relevant for affectedness—perhaps something cannot be "affected" if it did not exist prior to the event. However, since my main focus is change that comes about over time, I set this aside as orthogonal. What is most crucial here is that the class of creation predicates is not wholly precluded by this test.

Second, while theme objects of transitive motion verbs pass the test (see (5c)), theme subjects of intransitive motion vary in acceptability, and are unacceptable in contexts where agentivity is also entailed, as with agentive modifiers:

(8) What happened to John is that he (#deliberately) rolled down to the bottom of the hill.

Like prior existence, I assume that this is a further independent factor on the acceptability of *What happened to X is Y*, though again not one pertinent to change. What is again crucial is that motion predicates are not ruled out a priori. Thus this test picks out all of (2) broadly speaking.

Entailment Since change is defined as a target state ψ obtaining for participant x as a result of predicate ϕ being true, another affectedness test is entailment: is ϕ*, but not* ψ a contradiction? To ask this, we need to know what ψ is. As a first pass we could look at past participles based on ϕ, following Tenny (1994: 22–24). Applying this to (2) gives (9), where only (9d) sounds even remotely felicitous, although the interpretation must be that *is hit* means 'is damaged' and *is wiped* means 'is clean'.[5]

(9) a. John just cleaned/painted the bedroom, #but it is not cleaned/painted.
b. John just turned/carved the wood into a toy, #but it is not turned/carved into a toy.
c. John just moved the pot into the room, #but it is not moved into the room.
d. John just hit/wiped the car, ?but it is not hit/wiped.
e. John just destroyed/ate the cake, #but it is not destroyed/eaten.
f. John just built/constructed the house, #but it is not built/constructed.

A reviewer suggests, however, that some of (9) may be independently ill-formed because the relevant participles do not form good copular predicates, giving ?-judgments for *The pot is moved into the room* and *The wood is carved into a toy*. There may be speaker variation (I find these acceptable), but as the reviewer notes present perfect predication with durational modifiers gets at the same point (see also Kratzer 2000):

(10) a. The bedroom has been painted/cleaned for four days now.
b. The wood has been carved/turned into a toy for four days now.
c. The pot has been moved into the room for four days now.

[5] I indicate contradiction by a #-mark on the continuation that forms the test, though properly speaking the entire string is infelicitous. I use *just* to mitigate against the possibility of a change occurring and being subsequently undone. Kratzer (2000) proposes the test *X is still Ved*, which gets at the same idea.

d. #The car has been wiped/hit for four days now. (Except in special context)

e. The cake has been eaten/destroyed for four days now.

f. The house has been built/constructed for four days now.

Thus we could say that everything but impact/contact predicates entail affectedness.

However, with ψ varying based on ϕ, one could argue that this does not show that all of these predicates involve the *same* notion of "affectedness". Ideally, we should identify a single ψ of high generality that obtains by virtue of all of these predicates (akin to *happened/did to*). However, it is unlikely that one single such ψ exists. Nonetheless, I believe we can break (2) up into a handful of subtypes based on different entailments to fit into the *ϕ, but not ψ* frame. For example, *something is different about X* picks out property change and creation/consumption predicates in (2a,b,e,f) but excludes motion and surface contact/impact predicates in (2c,d):

(11) a. John just cleaned/painted the bedroom, #but nothing is different about it.

b. John just turned/carved the wood into a toy, #but nothing is different about it.

c. John just walked/rolled down to the bottom of the hill, but nothing is different about him.

d. John just hit/wiped the car, but nothing is different about it.

e. John just destroyed/ate the cake, #but nothing is different about it.

f. John just built/constructed the house, #but nothing is different about it.

Why do motion and surface contact/impact not satisfy this? Intuitively, *something is different about X* only picks out properties that can be observed by looking at *X* itself. For motion, we might need a different ψ that takes into account *X*'s surroundings, such as *X is somewhere else*, which picks out motion predicates:

(12) John just walked out of the room, #but he is not somewhere else.

The frame is the same as in (11)—*ϕ, but not ψ*—but ψ is different.

Conversely, for surface contact/impact predicates, I am not aware of a target state which must obtain. Intuitively, something can be hit, wiped, etc., and be exactly the same as it was before the event. Thus the entailment test does not group all of (2) together, unlike *What happened to X is Y*. However, there is an interesting relationship between these two diagnostics: controlling for prior existence and agentivity, the entailment diagnostic picks out a *subset* of the arguments that *What happened to X is Y* does. In a related discussion, Rappaport Hovav and Levin (2001: 784–790) suggest that *What happened to X is Y* really picks out "force recipients" that take transmission of force (following Croft 1990, 1991, 1998), a subset of which are additionally entailed to undergo a change, which are in fact those that pass the entailment diagnostic. I return to this below. For now, it is useful to distinguish the subset of force recipients that also pass entailment tests; for convenience I refer to them as "patients".

Resultatives Another affectedness test is secondary resultative predication. Although result XP modifiers are often assumed to only predicate of deep structure objects (see Levin and Rappaport Hovav 1995: 34), Rappaport Hovav and Levin (2001: 786) show that the actual constraint is semantic: the subject of the result XP must be a force recipient (citing also Goldberg 1995: 188).[6] This is why subjects of transitive motion verbs take result XPs, "skipping over" the object, as in (13), since the men and not the star change location (Rappaport Hovav and Levin 2001: 786; (49a)).[7]

(13) The wise men followed the star to Bethlehem.

However, things that are not force recipients do not permit resultatives:

(14) #James saw the barn red. (On resultative reading, for either argument)

This gives us another semantic test, and indeed nearly all of the predicates in (2) (except perhaps creation predicates; see below) allow result XPs for their force recipients as in (15):

(15) a. John painted the bedroom (a fierce red).
b. John carved the wood (into a toy).
c. John pushed the vase (into the room).
d. John pounded the metal (flat).
e. John reduced the water level (to nothing).

Creation predicates are only sometimes acceptable with resultatives, though usually in the same contexts as *What happened to X is Y*:

(16) a. John built the model airplane into a stunning, life-like museum piece.
b. John rebuilt/#built the shed into a sturdier contraption than before.

If the relevant factor is prior existence, it must be a condition on both diagnostics. Thus result XPs mirror *What happened to X is Y* (cf. Rappaport Hovav and Levin 2001, see also Goldberg 1995: 188–189).

However, resultatives vary across languages. Washio (1997) shows that Japanese resultatives are more restricted, primarily occurring with predicates that already entail a result. This is shown in (17), where *someru* 'dye' entails a result and allows a result XP, but not *keru* 'kick':

[6] By "subject of the result XP" I refer to whichever argument—subject or object—for which the target state obtains. There are numerous other constraints governing resultatives, including aspectual constraints, constraints on types of result XPs, etc.; see Wechsler (2001, 2005); Beavers (2002, 2008a) and Boas (2003). Most of these other factors are not relevant here. I am only interested here in the acceptability of a predicate with a result XP modifier as a test for whether that predicate encodes affectedness in the absence of the modifier, all else being equal. Therefore, I focus only on what Wechsler (1997, 2005) refers to as "control" resultatives, where the result XP is predicated of an independently subcategorized for argument of the verb. I set aside "ECM" resultatives, where an otherwise non-subcategorized argument is predicated of and thus the result XP "adds" an argument to the predicate, as in *drink the pub *(dry), drink himself *(silly), wind his way *(down the trail)*, etc.

[7] Rappaport Hovav and Levin do not necessarily classify *the wise men* here as a force recipient. However, following Croft (1998: 48) (who they build on), subjects of self-directed motion involve internal transmission of force, thus falling under this category. This analysis can be extended to unaccusatives (e.g. *the lake froze solid*) by assuming a theory of internal causation or covert external causation as in Levin and Rappaport Hovav (1995: 90–98).

(17) a. *Mary-ga doresu-o pinku-ni some-ta*
Mary-NOM dress-ACC pink-DAT dye-PAST
'Mary dyed the dress pink.'

b. **Kanozyo-wa musuko-o azadarake-ni ket-ta*
she-TOP son-ACC black and blue-DAT kick-PAST
'She kicked her son black and blue.' (Washio 1997: 5–6; (13b), (18b))

Washio (1997: 12–16) also notes that some verbs that do not entail a result but restrict possible target states also permit result XPs, including *nobasu* 'roll out', *migaku* 'polish', *niru* 'boil, simmer', and *haku* 'wipe (in a removal context)', as in (18) for *haku*.

(18) *Kare-wa teeburu-o kirei-ni hui-ta*
he-TOP table-ACC clean-DAT wipe-PAST
'He wiped the table clean.' (Washio 1997: 16; (49))

However, an informant tells me that result readings do arise by implicature for these four verbs (which Washio hints at). If so, the generalization is that the Japanese resultatives diagnostic picks out (implicated) patients, while the English one picks out force recipients, a weaker condition.

Types of result XPs Another, related diagnostic is the relative variability of possible result XPs (although this is a hard notion to quantify; see Boas 2003: 150–158, 216–233 for a related discussion). For example, *shatter* allows only result XPs describing numbers of pieces, while *wipe* allows result XPs describing various physical changes (see also Washio 1997: 7–8; Rappaport Hovav 2008: 22–23):

(19) a. John shattered the vase into a million/thirty-six different pieces.

b. #John shattered the vase slightly/in half/into two pieces/silly/flat/red/up.

(20) a. John wiped his face dry/clean/off/raw/to a healthy glow.

b. #John wiped his face flat/red/up.

This lines up with the patient vs. non-patient force recipient distinction: non-patient force recipients allow more types of result XPs than patients.

However, even among patients there is variability in number of result XPs, correlated with how specific the predicate is about the target state. While *shatter* is quite specific about what result obtains (there must be a lot of pieces) and only allows a small range of result XPs, *cut* is in general fairly open about what result obtains, and also allows a range of result XPs indicating many types of damage or shapes:

(21) a. John cut the bread into a million pieces/an amusing shape/open/up.

b. #John cut the bread clean/flat/red.

However, *cool* is also fairly open about what result must obtain (any decrease in temperature), yet only permits temperature result XPs:

(22) a. John cooled the soup down/to a palatable level/to 250°F.

b. #John cooled the soup red/congealed/into mush.

Unlike the other diagnostics, this does not pick out some predicates and exclude others. Rather, it defines degrees of variability, though I suggest below that this does ultimately line up with the other diagnostics in an interesting way.[8]

Telicity A final semantic domain where nearly all of (2) figure is lexical aspect, especially in determining telicity (Tenny 1992, *inter alia*). However, the connection between affectedness and lexical aspect is complex, and I set it aside until Sects. 3–4. Instead, I note here simply that telicity picks out a subset of each class in (2). Predicates that entail very specific results (e.g. *John shattered the vase*) are naturally telic, but not those that entail non-specific results (e.g. *John cooled the soup*) or entail no result at all, as discussed by Hay et al. (1999). I make the notion of specificity of change more precise in Sect. 5.

Summary In this section I have reviewed several tests for affectedness. The diagnostics do not all isolate the same predicate classes, and some tests vary within predicate classes depending on other, orthogonal factors. I summarize the tests as follows (including telicity, which I discuss in greater detail in the next section):

(23)

Diagnostics	**Dynamic predicate ϕ entails that x is a**			
	patient		**non-patient**	
	specific result (Predicates in (2a–c,e,f))	**non-specific result** (Predicates in (2a–c,e,f))	**force recipient** (Those in (2d))	**Non-force recipient** (Other)
ϕ is telic	✓	×	×	×
Change entailed of x	✓	✓	×	×
x takes result XP	✓	✓	✓/×	×
Happened/did to x	✓	✓	✓	×
ϕ is dynamic	✓	✓	✓	✓/×
Result XP variation	Low	Low/High	High	N/A

One could just say that all of the diagnostics pick out slightly different notions, and we should not expect them to unify. However, despite the fact that the tests do not all line up, they have a crucial property that I do not believe has been discussed before: setting aside a few orthogonal factors as discussed above, the tests group types of dynamic predicates into *subset relations* regarding change, where a subset of dynamic predicates take force recipients, a subset of these entail change, and a subset of these are telic. Likewise, the variability in result modifiers decreases the smaller the subsets get. I take this as evidence that a unified analysis of all these diagnostics—i.e. a single concept of affectedness—is both possible and desirable. I turn next to a discussion of how all of this connects with lexical aspect, and also address the question of what the crucial ingredients are for an analysis of affectedness that captures these facts.

[8] Rappaport Hovav and Levin (1998: 102–103, 2005: 281–282) also note that surface contact and result verbs differ in allowing resultatives with non-subcategorized objects (e.g. *Sandy wiped/*broke the dishes off the table*). This may follow from a more general property that surface contact verbs allow object deletion more readily than result verbs (Rappaport Hovav 2008: 22–26). I return to this briefly in Sect. 5.

3 The (partial) correlation of affectedness to lexical aspect

Tenny (1992, 1994) has argued that affectedness is reducible to a combination of two aspectual properties: delimiting and measuring out the event (see also Cornips and Hulk 1999, Egerland 2000). I examine Tenny's arguments for this and show that while (a subset of) patients do delimit events, so do a second argument of patient-taking predicates, namely a path or scale. Conversely, only paths/scales consistently measure out events, while patients do not (at least not consistently). Given that patienthood is a property of just one argument, measuring out is only consistently a property of the other, and delimitation is a property of both, I ultimately conclude that *both* arguments are necessary components of an analysis of affectedness.

Tenny's argument for an aspectual definition of affectedness, rather than one based on change, is that some operations that have previously been tied to affectedness qua change also pick out other participants, pointing to a broader category. In particular, DP-preposing—which subsumes middle formation and DP-internal passivization—is thought to be restricted to affected arguments (Anderson 1979: 14–15; Fiengo 1980: 37–38; Jaeggli 1986: 607–608). Indeed, passing the entailment diagnostic from Sect. 2 seems to correlate with the ability to undergo DP-preposing, as shown in (24)–(25) for DP-passives and (26)–(27) for middles.

(24) a. The Romans just destroyed the city, #but nothing is different about it.
b. The city's destruction

(25) a. The cops just pursued the criminals, but nothing is different about them.
b. #The criminals' pursuit by the cops

(26) a. John just opened the door, #but nothing is different about it.
b. This door opens easily.

(27) a. Bob just avoided the traffic jam, but nothing is different about it.
b. #Traffic jams avoid easily. (cf. Tenny 1992: 8–9)

However, path objects also undergo preposing, but crucially do not pass the entailment diagnostic (Tenny 1992: 9–10; Jackendoff 1996: 312; fn. 7):

(28) a. The settlers just crossed the desert, but nothing is different about it.
b. The desert crosses easily for settlers with large wagons.

Thus patients and paths share some property in common that determines that they both permit DP-preposing, but that property is not undergoing a change. Tenny instead argues that the relevant category is a combination of two aspectual factors:[9]

> "An affected argument has been generally described as an argument which undergoes some change. Undergoing change is a temporal process. An affected argument can be more adequately described in aspectual terms, as an argument which *measures out* and *delimits* the event described by the verb." "...[t]he

[9]This is part of the Aspectual Interface Hypothesis (Tenny 1992: 2–3, *inter alia*) that the only lexical semantic information visible to syntax is aspect; see Rappaport Hovav and Levin (2005) for a rebuttal.

> term 'measure out' is used here in an informal sense, as a convenient metaphor for uniform and consistent change, such as change along a scale... A delimited event is one that the language encodes as having an endpoint in time." (Tenny 1992: 9, 4–5, emphasis mine)

Thus patients and paths are both "affected" in Tenny's sense. But how can we tell what measures out and delimits the event? To tell if a participant delimits the event, we can see if how it is realized has an effect on telicity (e.g. a definite, specific vs. bare plural/mass DP; Tenny 1994: 24–29; see also Garey 1957; Verkuyl 1972, 1993; Krifka 1989, 1992, 1998; Dowty 1991; Ackerman and Moore 2001a). Telicity in turn is probed for by *in/for* modifiers, where *in an hour* modifiers are more acceptable with telic predicates than *for an hour* modifiers and vice versa for atelic predicates (Dowty 1979: 56–58). (As noted above, only a subset of patient-taking predicates are telic; I return to this below.) For example, in (29) the expression of the patient influences the telicity of the predicate and in (30) the expression of the path does, suggesting that both delimit the event described by the respective verbs.

(29) a. Sandy ate the peach in/?for an hour.
b. Sandy ate peaches for/??in an hour.

(30) a. John crossed the desert in/?for ten days.
b. John crossed deserts for/??in ten days.

Non-patients do not effect telicity, nor do non-paths, as in (31a,b) respectively:

(31) a. John avoided (the) reunion(s) for/??in an hour.
b. John wandered (the) desert(s) for/??in three days.

For measuring out, Tenny (1994: 15–29) offers several diagnostics. One of the clearest is whether *V X halfway* and *V half of X* are synonymous. If so, *X* measures out the event, since progress through half of *X* corresponds to half of the event. For example, (32a) and (32b) are synonymous, suggesting that the patient argument of *eat* measures out the event, and similarly for the path argument of *cross* in (33).

(32) a. Sandy ate half of the peach.
b. Sandy ate a peach halfway.

(33) a. John crossed half of the desert.
b. John crossed the desert halfway.

Non-patients and non-paths do not measure out, as in (34a,b) respectively:

(34) a. John avoided half of the reunion. ↮ #John avoided the reunion halfway.
b. John wandered half of the desert. ↮ #John wandered the desert halfway.

Thus patients and paths appear to share the properties of delimiting and measuring out in common, despite the fact that only patients are also entailed to change.

However, as I now show, these two aspectual diagnostics do not in fact line up so neatly with one another. I start with motion predicates, which describe events in which there is necessarily *both* a patient and a path. Not surprisingly, the relevant diagnostics give conflicting outputs, as noted already by Jackendoff (1996: 310–311), since here only the path, but not the patient, measures out the event:

(35) a. Half the ball rolled down the hill. ↮ The ball rolled down the hill halfway.

b. The ball rolled down half of the hill. ↔ The ball rolled down the hill halfway.

Thus *halfway* and *half of* do not always coincide for patients. This is unexpected if being a patient is subsumed under measuring out. Interestingly, patients and paths do both delimit the event. However, they do so *even in the same predicate* (see Dowty 1979: 63; Jackendoff 1996: 340–341; Filip 1999: 100–101; Rothstein 2004: 99, Beavers 2009). In (36a) a definite, specific patient moving on a delimited path yields telicity. But a bare plural patient as in (36b) yields atelicity, as does a non-delimited path as in (36c).

(36) a. The ball rolled down to the bottom of the hill in/?for an hour.

b. Balls rolled down to the bottom of the hill for/??in an hour.

c. The ball rolled (further) for/??in an hour.

Thus with motion predicates, the relevant diagnostics—delimiting, measuring out, and entailing change—all pick out the same predicate class, but one picks out two arguments, and the others one argument each:

(37)

	Patient	**Path**
Delimits event	✓	✓
Halfway/half of	×	✓
Change entailed	✓	×

This all applies equally well to change-of-state predicates as in (38), where again the patient does not measure out (as noted already by Gawron 2006: 32)

(38) Bill dimmed half of the lights. ↮ Bill dimmed the lights halfway.

However, something *does* measure out the event in this case, although it is not the patient. Rather, as Tenny (1994: 15–16) herself suggests, it is a property of the patient, namely its relative dimness (e.g. from fully bright to completely out). This is shown in (39), where *dim half dim* and *dim halfway* are synonymous.[10]

(39) Bill dimmed the lights half dim ↔ Bill dimmed the lights halfway.

Thus the patient changes but the property measures out (cf. Dowty 1991: 569 on *holistic* vs. *incremental theme*). Furthermore, telicity is again doubly determined. Definite, specific objects and specific results determine telicity, but not bare plural objects and/or vague results (e.g. a comparative result XP; Goldberg and Jackendoff 2004: 542–543)[11]:

[10] Context also plays a role, since *half dim* means different things in different contexts (see Kearns 2007; Kennedy and Levin 2008 on the role of context in the interpretation of deadjectival "degree achievement" verbs). To me, both clauses in (39) have the same reading regardless of what constitutes half dim in context.

[11] The relevant reading for the *for an hour* modifier is that the event lasted five minutes; there is an irrelevant reading that the result state lasted for five minutes before being undone.

(40) a. Bill dimmed the lights half dim in/?for five minutes.

b. Bill dimmed lights half dim for/??in five minutes.

c. Bill dimmed the lights dimmer and dimmer for/??in five minutes.

Thus change-of-state predicates and motion predicates pattern alike vis-à-vis the breakdown in (37).

A predicate class where patients do seem to both measure out and delimit are creation/consumption predicates, where *drink half a pint of ale* and *drink a pint of ale halfway* are synonymous and *drink a pint of ale* is telic while *drink ale* is not. However, there is evidence that even here something other than the patient figures into the aspectual properties of the predicate, as seen by looking at the conative alternation (Levin 1993; van der Leek 1996; Broccias 2003; Beavers 2006, 2009, 2010). Transitive *drink* with a definite, specific object is telic as in (41a), while a bare mass noun object yields atelicity as in (41b). However, keeping a definite, specific DP patient but using the conative *drink at* instead produces an atelic predicate, as in (41c).

(41) a. John drank a pint of ale in/?for an hour.

b. John drank ale for/??in an hour.

c. John drank at a pint of ale (slowly) for/??in an hour.

Why is (41c) atelic? It cannot just be that there is no measuring out here, since the patient is still consumed in increments over the course of the event. Rather, (41c) simply leaves open exactly what the result state is: the ale could be all consumed or only partly consumed by the end of the event. Following Beavers (2006), we can analyze this by separating the quantity of the patient from the quantity consumed in the event. On this analysis, (41c) says exactly how much patient there is but is vague as to how much of the patient is consumed, just as in (36c) the exact goal is left unspecified or in (40c) the exact target state is left unspecified, despite a fully specified quantity for the patient (see also Hay et al. 1999: 141; Rappaport Hovav 2008: 17). So we again have determination of telicity conditioned by two factors: the quantity of the patient as expressed by the predicate and what the predicate says about the ultimate result. The reason the patient of a transitive creation/consumption predicate passes the *halfway/half of* diagnostic is because the relevant result state—complete consumption—has to do with the entire physical extent of the patient, and it is hard in this case to distinguish the quantity of the patient from the measure of how much of it is consumed, although (41) shows we independently need both notions.

In sum, the affectedness diagnostics in Sect. 2 pick out patients (or force recipients), measuring out diagnostics pick out primarily paths or properties, and delimitation diagnostics pick out both patients and paths/properties. Unlike the variable results for the diagnostics in Sect. 2, which organized predicates into a subset hierarchy, these diagnostics pick out the same predicate classes but different participants within those classes. How can we make sense of all of this? I next outline a model of change that relies on these two separate participants, by which we can define all of the relevant affectedness diagnostics discussed in this section and the last under a single rubric.

4 An analysis of measuring out, telicity, and change

4.1 A scalar model of change

I review here a model of change developed in Beavers (2002, 2006, 2008a, 2009), which in turn builds on proposals by Tenny (1992, 1994), Dowty (1991), Jackendoff (1996), Krifka (1998), Hay et al. (1999), Wechsler (2001, 2005), Kennedy and Levin (2008), Ramchand (2008), Rappaport Hovav (2008), and Croft (2009a, 2009b, 2011 (in prep.)). The key insight of this model is that all types of change can be defined as a transition of a theme along a scale that defines the change.[12] Following Kennedy and McNally: (2005: 351–355), a scale is a triple $\langle S, R, \delta \rangle$ where:

(42) a. $\delta =$ some property/dimension (e.g. height, length, temperature, position).

b. $S =$ a set of degrees for having property δ.

c. $R =$ an ordering of members of S (which also determines directionality).

When an entity changes in property δ, it increases from some initial degree $d' \in S$ of having δ to some subsequent degree $d \in S$. Hay et al. (1999: 131–132) notate this via an operator *INCREASE*, defined as follows:

(43) $INCREASE(P(x))(d)(e)$ is true iff x has P to some degree d' at the beginning of e and degree $d' + d$ at the end.

For example, in (44) the scale is $\langle \Re, <, \text{LONG} \rangle$ and the rope transitions from some degree $d' \in \Re$ on the LONG dimension to some degree $d \in \Re$, $d = d' + 5inches$.

(44) Kim lengthened the rope 5 inches. (Hay et al. 1999: 130; (8), 132; (17b))
$\exists e[INCREASE(long(rope))(5\ inches)(e)]$

Crucially, this model requires two entities—a theme and a scale—to define change, exactly the two entities picked out by delimitation and measuring out diagnostics in Sect. 3. In this section I recap and update a version of the scalar model developed in Beavers (2009) (building on Beavers 2002, 2006, 2008a) which captures these facts—especially double determination of telicity—thereby providing further support for a scalar analysis of change. I then use this model in the next section to define (degrees of) affectedness, thereby incorporating the data in Sects. 2 and 3 together.

Following my earlier work, I implement the Hay et al./Kennedy and Levin scalar analysis in the mereological model of motion and property change of Krifka (1998: 222–230), which has the advantage of a built-in way of mapping subevent structure to subpart structure of event participants. This is not a part of the Hay et al./Kennedy and Levin model, though not incompatible with it, but is something Beavers (2009) in particular capitalizes on to analyze double telicity effects. In the Krifka-based scalar model, entities fall into at least three domains:

[12] I use the term "theme" here for entities that undergo or potentially undergo scalar change, in keeping with the metaphor of "motion" along a scale. This will ultimately subsume force recipients above.

(45) a. U_P = the set of objects.
b. U_E = the set of events.
c. U_H = the set of connected, directed paths/scales.

Entities in each domain are mereologically complex, where for any $x, x' \in U_X$:

(46) a. x' may be a subpart of x ($x' <_X x$) or a subpart or equal to x ($x' \leq_X x$).
b. $x \oplus_X x'$ is the sum (or join) of x and x'.
c. x is atomic iff for all $x' \leq_X x$, $x' = x$.

A scale is a mereologically complex argument $s \in U_H$ of the change predicate that represents the dimension of change (cp. δ in (42a)), where:

(47) a. Degrees on s are atomic subparts of s (cp. $s' \in S$ in (42b)).
b. Subscales of s are non-atomic subparts of s (cp. $S' \subset S$ in (42b)).
c. There is a precedence relation $\ll_H$ such that for any non-overlapping $s', s'' <_H s$, either $s' \ll_H s''$ or $s'' \ll_H s'$ (cp. R in (42c)).

Following Krifka, I notate degrees on a scale s by mnemonic names for the state of having that property to that degree. Thus if on Kennedy and McNally's approach being completely clean is having degree 1 on the CLEAN scale, I represent this as having/being at state **clean** $<_H s$ for cleanliness scale s; nothing hinges on this.

A change is a transition of theme x between initial and final states on scale s in event e, indicated by operators *SOURCE* and *GOAL*. Informally $SOURCE(s, b, e)$ says that x is at state b on s at the beginning of g, and $GOAL(s, g, e)$ says x is at state g on s at the end of e. I focus only on goal states here, and assume sources are contextually inferred for any predicate. Thus I define an operator $result'$ as follows, where the subscript c indicates a constant determined by context (constants are boldfaced).

(48) For all dynamic predicates ϕ, themes x, events e, states g, and scales s:
$[[\phi(x, s, e) \wedge result'(x, s, g, e)] \leftrightarrow [\phi(x, s, e) \wedge SOURCE(s, \mathbf{b_c}, e) \wedge GOAL(s, g, e)]]$

This says that for event e described by ϕ, $g <_H s$ is the target state of theme x on scale s iff x transitions to g by the end of e from a contextually determined state $\mathbf{b_c} <_H s$ at the beginning of e (cp. *INCREASE* above).

What differentiates motion, change-of-state, and creation/consumption is not their underlying event structure, but rather the *type* of scale selected by the predicate: a location scale (i.e. a path), a property scale, or an extent scale respectively (Beavers 2008a; Rappaport Hovav 2008). For the motion predicate in (49a), the scale is the ordered set of positions or locations John traverses from some contextually defined initial location to the cafe, i.e. $walk'(\mathbf{john}, s, e)$ says that this is a walking event e of John along a path s, and $result'(\mathbf{john}, s, \mathbf{cafe}, e)$ says that John transitions from some initial point on s to the cafe, which is a subsequent point on s.[13] Analogously, the change-of-state predicate in (49b) describes a wiping event of the table by John

[13]The equivalent in terms on Kennedy and McNally's implementation would be a scale of degrees of proximity to the goal along an ordered series of locations.

along a scale s consisting of degrees of cleanliness, and the table transitions from some initial degree of cleanliness to some subsequent degree **clean** on s. The consumption predicate in (49c) analogously describes an eating event of the apple by John, wherein the apple transitions along a scale of volume from some initial non-0 degree to 0. (I ignore tense here and throughout.)

(49) a. John walked to the cafe. (scale s of *position* of John)
$\exists e \exists s[walk'(\textbf{john}, s, e) \wedge result'(\textbf{john}, s, \textbf{cafe}, e)]$

b. John wiped the table clean. (scale s of *cleanliness* of the table)
$\exists e \exists s[wipe'(\textbf{john}, s, \textbf{table}, e) \wedge result'(\textbf{table}, s, \textbf{clean}, e)]$

c. John ate the apple. (scale s of *volume/existence* of the apple)
$\exists e \exists s[eat'(\textbf{john}, s, \textbf{apple}, e) \wedge result'(\textbf{apple}, s, \textbf{0}, e)]$

Thus, while the scale types vary across predicates in what real world concept they represent—position for *walk to*, cleanliness for *wipe clean*, volume for *eat*—the meanings of the predicates in (49) are otherwise *formally* parallel, i.e. they have parallel semantic decompositions, where the first conjunct represents the process (qua a CAUSE event) and the second the result (qua a BECOME event).

4.2 Scalar change and lexical aspect

To capture the aspectual properties discussed in Sect. 3, however, we need to look in more detail at how transitions actually come about—i.e. what is the process by which x goes from its initial to its final state on s in e? In Krifka's work, aspectual properties, in particular telicity, are modeled as properties of predicates over events that depend on the mereological properties of the events they describe. The mereological properties of events are determined in turn by the mereologically homomorphic θ-relations they stand in to certain privileged event participants, usually called incremental themes (see Krifka 1989, 1992, 1998; Tenny 1992, 1994; Dowty 1991, Jackendoff 1996, *inter alia*). I review relevant aspects of Krifka's model first. I then point out some issues the data in Sect. 3 bring up, and outline a revised analysis.

For simplicity I assume a predicate ϕ is telic iff for any event it describes it does not describe any subpart of that event (see also Krifka 1989: 90).[14] For example, *John built the house* is telic since for any event it describes, no subevent is also a building of the house. Rather, it would be part of building a house, or building part of a house. However, *John slept* is atelic, since any event of John sleeping consists of subevents of John sleeping. To predict the telicity of any given predicate, we must look at its incremental theme, if it has one. For creation/consumption, the patient is the incremental theme on Krifka's approach, and he defines the homomorphism I give informally in (50) between theme x and event e (see Krifka 1998: 213; (51)):

(50) **Strictly Incremental Relation**: every unique part of e corresponds to a unique part of x and vice versa.

[14] Beavers (to appear) gives a more sophisticated definition of telicity based on shared end points of events and subevents (revising Krifka 1998: 207; (37)). For expository purposes I adopt the simpler definition of telicity, though nothing hinges on this here; see also fn. 15.

For predicates that assign this thematic role to their theme arguments, the event progresses in an isomorphic fashion through the theme. For example, in *John drank the wine*, each part of the drinking event corresponds to a unique part of the wine. For any event of drinking a specific amount of wine that can be described by *John drank the wine*, any subevent of that event is a subevent of drinking a smaller unique quantity of wine, and cannot be described by *John drank the wine*, which is thus telic. Conversely, for *John drank wine* a subevent of drinking wine is also an event of drinking wine, and thus the predicate is atelic. The crucial difference is whether or not the theme is expressed by a DP that has quantized reference (no subpart of anything described by the DP can also be described by the DP). In general, quantized reference induces a telic predicate, and non-quantized reference induces an atelic predicate.

For motion and change-of-state predicates, Krifka (1998: 224; (69)) defines a slightly different relation, given in (51) for path or property scale s in event e.

(51) **Strict Movement Relation**: every unique part of e corresponds to a unique part of s and vice versa; temporal adjacency in e corresponds to spatial/scalar adjacency in s.

By (51), the event progresses as the theme moves unidirectionally along the scale, and each part of the event corresponds to a unique part of the scale. If *John walked from his house to the store* describes John crossing a path from the house to the store, any subevent of this is an event of John crossing a part of the path from the house to the store, and thus cannot be described by the same sentence, which is thus telic. For *John walked* the path is undetermined, so any subevent of John walking (somewhere) is an event of John walking (somewhere), and the predicate is atelic. The difference hinges on the explicit boundedness of the path. Like a Strictly Incremental Relation, the Strict Movement Relation is isomorphic in number of subparts. But a Strict Movement Relation also preserves adjacency, where temporally adjacent subparts of the event correspond to spatially adjacent traversal of the path.[15]

Despite the appeal of this approach, Krifka assumes only one incremental theme per predicate. However, the double telicity facts discussed in Sect. 3 are surprising in light of this assumption. How can we incorporate the fact that not one but two entities are relevant for computing telicity? We could naïvely assume that each entity stands in an independent homomorphic relation to the event. However, as Beavers (2009: 94–95) shows, this is untenable. Consider (36) again, repeated here:

(52) The balls rolled down to the bottom of the hill in/?for an hour.

Suppose the event stands in a Strictly Incremental Relation to the theme and a Strict Movement Relation to the path. Now, consider a context for (52) in which I stand on top of the hill and throw two balls down the hill at once. At some point both balls

[15] Krifka (1998: 219; (59)) defines a more general Incremental Relation that embeds a Strictly Incremental Relation but allows two different parts of the event to correspond to the same part of the theme in certain contexts (e.g. *John read the book*). Likewise, Krifka (1998: 225; (71)) also defines a general Movement Relation that embeds a Strict Movement Relation but allows backtracking, loops, and stop-n-go motion. It is for these more complex relations that the more sophisticated definition of telicity discussed in fn. 14 is required. I adopt the stricter Strictly Incremental Relation and Strict Movement Relation here for expository purposes, though Beavers (to appear) recasts this analysis in terms of more general relations.

will move simultaneously. Yet this contradicts the Strictly Incremental Relation: one part of the event corresponds to two parts of the theme. However, there is a crucial caveat. While two parts of the theme move at the same time, they must do so on different parts of the path. If two balls are entirely co-located they are the same ball. Thus the violation of the Strictly Incremental Relation can be mitigated if we make the homomorphism relative to different parts of the path, a point I return to below.[16]

Furthermore, in the same scenario, one ball could move faster and end up at the bottom before the other. In this case at some time t the faster ball is rolling along one point near the end of the path, while at $t + 1$ the slower ball is rolling along a non-adjacent point near the beginning. This violates the Strict Movement Relation, where temporally adjacent motion must happen at spatially adjacent points on the path. However, again, there is an issue of relativity. This problem only arises if we look at different parts of the theme. If we focus on just one (indivisible) part of the theme, it of course never moves along spatially non-adjacent parts of the path at temporally adjacent times. This suggests again that we can mitigate the problem if we take both arguments into account in a mutually constraining way: the Strictly Incremental Relation only holds for particular parts of the path, while the Strict Movement Relation only holds for particular parts of the theme.

To account for this, Beavers (2009: 98; (17)) proposes a Figure/Path Relation, where the innovation is that the θ-relation makes reference to both entities at once. In a Figure/Path Relation, e is decomposed into a series of *motion subevents*, one for each part of x crossing all of s. Thus in (52), the event decomposes into a series of motion subevents, one for each ball moving along the entire scale. This replicates the isomorphism of the Strictly Incremental Relation up to individual motion subevents. However, each motion subevent is itself related to the scale via a Strict Movement Relation, meaning each subevent is further decomposed in terms of the scale. This is defined informally in (53).[17]

(53) **Figure/Path Relation:** Every unique part of x corresponds to a unique part of e. Each such subevent stands in a Strict Movement Relation to s, and the sum of all such subevents constitutes e.

I diagram the decomposition informally as in Fig. 1. Line (a) represents the entire event, which is fully broken down in (b) into subevents by parts of the theme crossing the entire scale. By Strict Movement Relations, each of these subevents is broken down again by parts of the scale as in (c), holding the part of the theme constant. These subevents are rearrangable, holding each part of the scale constant and grouping together each subevent of each part of the theme crossing that part of the scale as in (d). Joining these produces (e), a series of subevents of the entire theme crossing

[16] A reviewer suggests that this problem can be obviated by viewing the theme as atomic, in which case there is no contradiction. However, we still need to account for the fact that *The water flowed down to the bottom of the hill* and *Water flowed down to the bottom of the hill* differ in telicity, and the standard analysis of this kind of effect on the Krifka approach is via a homomorphic relationship (as for *drank* (*the*) *water*). To ignore subparts of the theme would require a new, different analysis for just this one case.

[17] This definition differs from Beavers (2009: 98; (17)), which incorrectly assumes that each motion subevent is non-overlapping with every other motion subevent, disallowing readings where two parts of the theme move at the same time (albeit on different parts of the path). The version here corrects this.

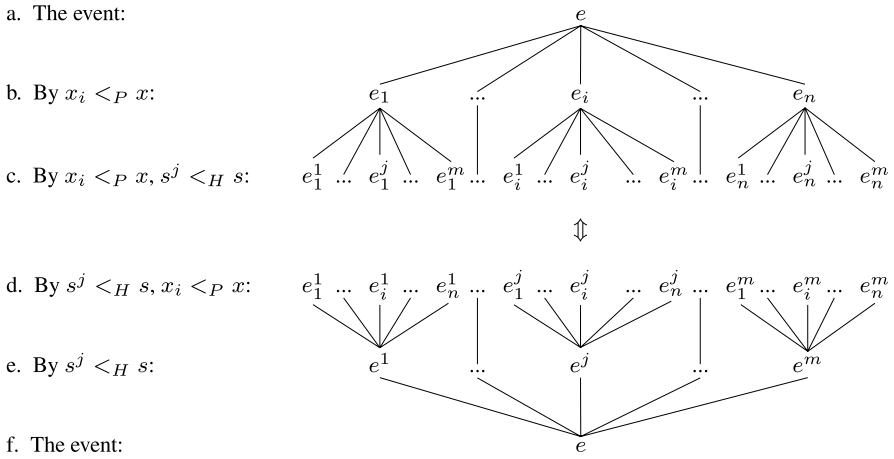

Fig. 1 Breakdown of an event in a Figure/Path Relation

each part of the scale. Joining these produces the entire event again as in (f). (See Beavers (2009: 97–101) for more explicit details of this analysis.)

Thus (53) provides multiple perspectives on the event. For telicity, the two most important are (a) and (f), where the event is broken down by either the path or the theme, predicting double telicity. For example, telicity is guaranteed for (54) (the λ-term represents the meaning prior to existential closure over the event).

(54) The ball rolled down to the bottom of the hill.
$\lambda e \exists s [roll'(\textbf{ball}, s, e) \wedge result'(\textbf{ball}, s, \textbf{bottom}, e)]$

Recall that a predicate ϕ is telic iff for any event that ϕ describes ϕ does not describe any subevent of that event. On the homomorphic approach, these subevents are mapped to subparts of the incremental themes, and telicity hinges on whether subparts of the incremental themes match the constraints imposed by ϕ. Any event e described by (54) is related by the Figure/Path Relation to the theme **ball** and the path s from a contextually determined source to the bottom of the hill. By the Figure/Path Relation, any $e' <_E e$ is therefore mapped to some $x' <_P$ **ball** and/or some $s' <_H s$. But no such x' or s' will satisfy (54), since $x' \neq$ **ball** and s' is not the full path s described by (54). Thus e' is not in (54), which is thus telic.

However, if the quantity of the theme or boundedness of the scale is left open, the predicate is atelic:

(55) a. Balls rolled down to the bottom of the hill.
$\lambda e \exists s \exists x [roll'(x, s, e) \wedge ball'(x) \wedge result'(x, s, \textbf{bottom}, e)]$

b. The ball rolled (further).
$\lambda e \exists s \exists g [roll'(\textbf{ball}, s, e) \wedge result'(\textbf{ball}, s, g, e)]$

For any e described by (55a), for some $e' <_E e$ there is $x' <_P x$ such that $ball'(x)$, meaning e' satisfies (55a), making it atelic. Likewise, for all e described by (55b), for some $e' <_E e$ there is an $s' <_H s$ satisfying this description (since no constraints hold for s other than having *some* goal), making (55b) atelic.

This extends directly to change-of-state and creation/consumption in exactly the same way, since the representations are formally parallel to (54)–(55):

(56) a. Bill dimmed the lights half dim.
$\lambda e \exists s[dim'(\textbf{bill}, s, \textbf{lights}, e) \wedge result'(\textbf{lights}, s, \frac{1}{2}\textbf{dim}, e)]$

b. Bill dimmed lights half dim.
$\lambda e \exists s \exists x[dim'(\textbf{bill}, s, x, e) \wedge light'(x) \wedge result'(x, s, \frac{1}{2}\textbf{dim}, e)]$

c. Bill dimmed the lights (dimmer and dimmer).
$\lambda e \exists s \exists g[dim'(\textbf{bill}, s, \textbf{lights}, e) \wedge result'(\textbf{lights}, s, g, e)]$

(57) a. John drank a pint of ale.
$\lambda e \exists s[drink'(\textbf{john}, s, \textbf{ale}, e) \wedge result'(\textbf{ale}, s, \textbf{0}, e)]$

b. John drank ale.
$\lambda e \exists s \exists x[drink'(\textbf{john}, s, x, e) \wedge ale'(x) \wedge result'(x, s, \textbf{0}, e)]$

c. John drank at a pint of ale.
$\lambda e \exists s \exists g[drink'(\textbf{john}, s, \textbf{ale}, e) \wedge result'(\textbf{ale}, s, g, e)]$

Thus telicity is not about the entire theme being affected, nor is it about traversal of an entire scale. Telicity is instead a property a predicate has when *all of the theme crosses all of the scale*, an inherently relational definition.

Furthermore, something not discussed by Beavers (2009) is that the theme/scale distinction gives us a way to capture the failure of measuring out diagnostics with theme arguments: in *V half of X* half of the theme is predicated of, but in *V X halfway* half of the scale is, i.e. *halfway* is a scalar modifier like *completely* (producing a denotation like (56b)). The reason *halfway* and *half of* line up with patients of creation/consumption predicates as in *drink a pint of ale halfway/drink half a pint of ale* is because the endpoint on the scale represents consuming all of the theme, which is indistinguishable from a direct mapping to the theme itself.

In summary, the scalar analysis I adopt unifies all types of changes under a single analysis and recognizes two entities, a theme and a scale of change, which stand in a mutually constraining relation to each other and the event. This provides a natural way to capture the complex correlation of change and aspect in Sect. 3, providing additional motivation for a scalar model. I now return to the affectedness diagnostics of Sect. 2 and the subset hierarchy they form, and argue that they can be modeled naturally in terms of a theory of (degrees of) affectedness which hinges on this analysis.

5 Modeling affectedness and degrees of affectedness

5.1 Specificity of change

As mentioned in Sect. 1, affectedness is often assumed to be a matter of degree, with a contrast between high vs. low affectedness. However, high and low affectedness are hard to define precisely, since this putatively involves defining what sorts of changes constitute more of an effect than others. As noted above, Hopper and Thompson (1980: 252–253) claim that "[t]he degree to which an action is transferred to a patient is a function of how completely that patient is AFFECTED" (emphasis theirs),

although they never define degree of transfer. Conversely, Næss (2003: 1202) defines higher effects as those that either affect more of the object or are more salient. Næss motivates the latter property by comparing *kill* to *break*, where *kill* entails higher affectedness because it has more dramatic consequences for humans. I have no idea how to codify this, and I am unsure if it has any real linguistic consequences.

The part/whole relation is also complicated, since it is as much a question of amount as of effect. Do *drink beer* vs. *drink the beer* differ in the degree of affectedness or in how much beer is affected to the same degree? Likewise, changes that affect small parts of entities might be greater than those that affect more. If I chip the rim of a glass is it less affected than if I smudge it all up? In principle we should keep quantity distinct from degree of affectedness, and the Figure/Path Relation lets us do this by separating themes and scales. I propose here a principled, linguistically motivated analysis of degrees of affectedness, and ultimately of affectedness. The crucial factor is specificity: the more specific a predicate is about the theme's progress on the scale, the higher the degree of affectedness. Furthermore, we do not need to decide whether killing or breaking results in more of an effect. Rather, we can isolate equivalence classes of real world changes through affectedness tests and aspect, side-stepping the fuzziness issue.

I start with the quantized vs. non-quantized change contrast of Hay et al. (1999: 132–138), illustrated in (58a,b) respectively (see also the indefinite/definite change contrast of Dowty 1979: 168–170). In (58a) the soup become exactly 5°C cooler, so that a specific result is entailed, and the predicate is telic. In (58b) it is known to have become cooler, but not by how much, and the predicate is by default atelic.[18]

(58) a. The soup cooled 5°C in/?for an hour.

b. The soup cooled for/??in an hour.

However, both predicates entail a change in their patient arguments:

(59) The soup cooled 5°C, #but nothing is different about it.

Following Hay et al. (1999: 132), quantized and non-quantized changes both involve a transition of a theme x along a scale s in event e, but differ in how specific the predicate ϕ is about the result. For quantized change ϕ supplies a specific goal state $\mathbf{g}_{\phi}$ on s, while in non-quantized change ϕ only entails that a goal state exists.

But what about objects of surface contact/impact predicates that permit result XPs and pass *What happened to X is Y* but do not necessarily change? As the label "force recipient" conveys, these participants receive force transmission, which creates the appropriate conditions for change to occur, even if it does not. This is a property shared with patients. Rappaport Hovav and Levin (2001: 787–788) codify potential for change as being at the endpoint of a non-branching chain of force transmission, upon which a new force-dynamic link can be added corresponding to change. It is beyond the scope of this paper to formalize an appropriate theory of force-dynamics (for this see Talmy 1976, 1988, 2000, as well as Croft 1990, 1991, 1998). All that

[18] I say "by default" since as Hay et al. (1999: 136–138) note degree achievement predicates such as *cool* can have telic readings in contexts where it is clear that a specific result is obtained, e.g. for (58b) can be telic if it is known that the soup is always cooled to a certain temperature before serving.

is important for now is codifying a notion of potential for change which interfaces with the scalar theory outlined here. For this I tentatively build on the notion of LATENT ASPECTUAL STRUCTURE of Tenny (1992: 20; (42)) and assume that potential for change corresponds to the existence of a scale argument (a prerequisite for a Figure/Path Relation), though a transition is not entailed and the scale is left latent.[19] A non-force recipient has a role without a latent scale.

These definitions are summarized in (60) for predicate ϕ and theme x:

(60) a. x undergoes a **quantized** change iff $\phi \rightarrow \exists e \exists s[result'(x, s, \mathbf{g}_{\phi}, e)]$
(e.g. accomplishments/achievements: *break, shatter, destroy, devour x*)

b. x undergoes a **non-quantized** change iff $\phi \rightarrow \exists e \exists s \exists g[result'(x, s, g, e)]$
(e.g. degree achievements/*cutting*: *widen, cool, lengthen, cut, slice x*)

c. x has **potential** for change iff $\phi \rightarrow \exists e \exists s \exists \theta[\theta(x, s, e)]$
(e.g. surface contact/impact: *wipe, scrub, rub, punch, hit, kick, slap x*)

d. x is **unspecified** for change iff $\phi \rightarrow \exists e \exists \theta'[\theta'(x, e)]$
(e.g. other activities/states: *see, laugh at, smell, follow, ponder, ogle x*)

This classification of participants differs from the one in (2), repeated here:

(61) a. x changes in some observable property. (*clean/paint/delouse/fix/break* **x**)

b. x transforms into something else. (*turn/carve/change/transform* **x** *into y*)

c. x moves to and stays at some location. (*move/push/angle/roll* **x** *into y*)

d. x is physically impinged. (*hit/kick/punch/rub/slap/wipe/scrub/sweep* **x**)

e. x goes out of existence. (*delete/eat/consume/reduce/devour* **x**)

f. x comes into existence. (*build/design/construct/create/fashion* **x**)

The classification in (61) is based on types of changes (motion, creation, consumption, property), and thus on the type of the scale, while (60) is based on scalar structure (where the theme ends up), regardless of the scale type. One of the key advantages of the definitions in (60) is that they are related in terms of monotonically weakening truth conditions, defined by existential generalization. Non-quantized change is an existential generalization over the goal of a quantized change, potential for change is an existential generalization over the θ-relation between the theme, scale, and event, and being unspecified for a change is an existential generalization over the thematic role of the theme, producing the implicational AFFECTEDNESS HIERARCHY in (62).

[19] Rappaport Hovav and Levin (2001, 790) model "latent aspectual structure" as a cancelable implicature of change due to force transmission (e.g. *John wiped the table* implicates being cleaner). However, this does not capture the fact that some impact predicates such as *John hit the table* do not implicate change. As an alternative to the analysis of potential for change I adopt, we could assume potential change is change with a probability less than 1 but greater than 0 of obtaining, or that obtains at some possible world but not necessarily the real one (the analysis proposed in Beavers 2006: 160 and adopted in Beavers 2010). Closer to Rappaport Hovav and Levin's analysis, we could simply posit force transmission as a prerequisite for a Figure/Path Relation, whether entailed or inferred from context. All of these proposals would work just as well in most of the foregoing discussion; I comment on this further below.

(62) **The Affectedness Hierarchy**: for all x, ϕ, e,

$$\underset{(quantized)}{\exists s[result'(x,s,\mathbf{g}_{\phi},e)]} \rightarrow \underset{(non\text{-}quantized)}{\exists s \exists g[result'(x,s,g,e)]} \rightarrow \underset{(potential)}{\exists s \exists \theta[\theta(x,s,e)]} \rightarrow \underset{(unspecified)}{\exists \theta'[\theta'(x,e)]}$$

Because this hierarchy is implicational, if x bears some degree of affectedness n on (62) it bears all degrees to the right of n, i.e. reaching a definite target state entails reaching some target state, which entails that there is a scale argument, which entails being a participant in the event. Since the definitions of different degrees of affectedness encode monotonically weakening truth conditions, their hierarchical arrangement follows directly, independent of any data that lead us to posit these definitions.

This property in turn explains how the affectedness diagnostics in Sect. 2 are related. Recall that affectedness diagnostics classify predicates into subset relations, where predicates that pass n tests are a subset of those that pass $n-1$ tests. I show that this pattern follows the Affectedness Hierarchy as illustrated in (63).

(63)

Diagnostics	**Degree of affectedness of x entailed by ϕ**			
	Quantized	**Non-quantized**	**Potential**	**Unspecified**
ϕ is telic	✓	×	×	×
Change entailed of x	✓	✓	×	×
x takes result XP	✓	✓	✓/×	×
Happened/did to x	✓	✓	✓	×
ϕ is dynamic	✓	✓	✓	✓/×
Result XP variation	Low	Low/High	High	N/A

For each diagnostic, the key factor is that picking out some particular degree of affectedness on the hierarchy automatically involves picking out all stronger degrees of affectedness since these entail the weaker degree, so that if an argument affected to degree n passes some diagnostic an argument passing any higher degree also will.

First, as discussed in Sect. 4, explicit boundaries on a scale guarantee telicity due to the Figure/Path Relation (provided the theme is expressed by a DP with quantized reference). Thus telicity follows from the definition of quantized change in (60a). None of the other degrees of affectedness in (60b–d) meet this condition, thus determining atelicity. Second, quantized and non-quantized change in (60a,b) differ from potential and unspecified change in (60c,d) in that only the former two entail a result. This means predicates entailing (non-)quantized changes should pass entailment diagnostics, e.g. *ϕ, but not ψ* should be a contradiction for appropriate ψ. Stating the relevant truth conditions is simple due to the Affectedness Hierarchy; we need only state the conditions for entailment tests in terms of non-quantized change, as in (64). This automatically subsumes all quantized changes, since quantized change always entails non-quantized change, but excludes potential and unspecified change. The difference between the motion diagnostic in (64a) and the other in (64b) has only to do with scale type, not degree of affectedness.

(64) a. *ϕ, but x is not somewhere else* is infelicitous if ϕ entails that x undergoes a non-quantized change along a physical path.

b. *ϕ, but nothing is different about x* is infelicitous if ϕ entails that x undergoes a non-quantized change along a property/extent scale.

Thus generating an entailment of change at all is conditioned by how specific the predicate is about there being some transition along a scale. But the *specific* entailment generated is conditioned by an orthogonal factor, namely the type of scale. More predicate-specific tests could be defined similarly in terms of more specific types of scales. Sensitivity to these two orthogonal factors—scalar structure regardless of scale and scale type regardless of structure—is predicted on this approach.[20]

Third, *What happened to X is Y* picks out quantized, non-quantized, and potential change as defined in (60a–c), but excludes unspecified change as in (60d). We can again use the Affectedness Hierarchy to pick out the strongest common truth conditions, namely potential for change (ignoring non-agentivity and prior existence):

(65) *What happened to x is* ϕ is felicitous if ϕ entails x has potential for change.

By the Affectedness Hierarchy, this picks out (non-)quantized and potential changes.

Fourth and finally, recall from Sect. 2 that English allows result XP modifiers for force recipients, while Japanese only allows them for (implicated) patients. The difference corresponds to two different cut-offs on the Affectedness Hierarchy. English result XPs target potential for change (see also Goldberg 1995: 188), while Japanese has a stronger condition:

(66) a. An English predicate ϕ permits a result XP iff ϕ entails its theme argument x has potential for change.

b. A Japanese predicate ϕ permits a result XP iff ϕ entails/implicates its theme argument x undergoes a non-quantized change.

Unspecified change predicates do sometimes allow result XP modifiers in English, though usually just in ECM resultative constructions (see fn. 6). However, this is possible only if a scale can be inferred contextually (e.g. *He sneezed the napkin off the table*). As Boas (2003: 260–277) discusses, this involves rich context and a process of analogy (cp. *He blew the napkin off the table with a sneeze*), and is perhaps best thought of as wholesale coercion of the predicate's meaning to encode a degree of affectedness for which result XP modifiers are independently allowed as in (66).

Furthermore, recall that predicates differ in how many types of result XP modifiers they allow. For non-quantized change, *cool* only allows result XP modifiers that describe temperatures, reflecting the specificity it already puts on its result/scales:

(67) a. John cooled the soup to 50/100/250°F/down/to a palatable level.

b. #John cooled the soup red/congealed/into mush.

However, other non-quantized change predicates allow more types of result XPs modifiers, such as *cut*, which allows various result XPs of physical rending:

(68) a. John cut the bread into ten/a million pieces/an amusing shape/slightly/up.

b. #John cut the bread clean/flat/red.

[20] See Kennedy and McNally (2005: 361–367) for more on the relationship of event and scalar structure; see also Wechsler (2001, 2005), Beavers (2002, 2008a) on scalar gradability and event structure.

These differences can be accommodated in terms of weaker or stronger sortal constraints on result or scale arguments. Any predicate that selects a result or scale from domain U_H of scales may restrict that result/scale to some $X \subset U_H$. For two predicates selecting result/scale from $X \subset U_H$ and $Y \subset U_H$ respectively, if $|X| < |Y|$ then the former predicate imposes stronger conditions on possible results/scales.[21] Conversely, quantized change predicates such as *shatter x* by definition impose stronger conditions on their results than non-quantized change predicates, and thus categorically permit less variability in possible result XPs than non-quantized change predicates. However, even quantized change predicates may differ in how many types of result XP modifiers are possible. As Boas (2003: 216–233) notes *kill* allows at best only *dead* as a result XP, while *shatter* may allow either *to* (*X*) *pieces* (for large *X*) or a very narrow set of result locations (*all over the table*), so that two quantized change predicates differ in allowing one or two types of results/scales.

Likewise, if predicates entailing potential change indeed take latent scale arguments as I have proposed, we might expect sortal constraints on possible result XP modifiers here as well. A glance through the verb/result XP pairs collected by Boas (2003: 321–340; Appendix A) from the British National Corpus suggests that these predicates largely take two or three types of result XPs.[22] First, both impact and surface contact verbs take result XP modifiers involving motion (*apart, into the ground, off, open, over the edge, over the top, shut*), either for removal of some element from the surface of the force recipient or, in the case of impact predicates, motion of the force recipient itself. Second, both classes also allow result XPs denoting states of the force recipient that result from removal (*dry, empty, clean*) and thus might be reduced to an extension of the first case.[23] Third, both classes also involve various types of physical change (*flat, to pieces, soft, smooth*) or mental change (*awake, unconscious, silly, stupid, sore, dead, to death, over the edge* (metaphorically)) resulting from physical contact. The physical/mental changes mostly fit the mold of adverse change or "damage" (one exception is *kick awake*, attested once in the sample). Thus there seems to be a limited number of result XP modifier types, though more detailed corpus work is needed to determine if these restrictions hold up. If they do, this provides evidence for positing a latent scale upon which these constraints can be stated (though see below).

In sum, the Affectedness Hierarchy gives us the subset property of affectedness tests without further stipulation, since it defines subset relations through weakening truth conditions which different tests are sensitive to. To my knowledge, this notion

[21] Alternatively, the difference may have to do with total vs. partial ordering. Degrees for *cool* are totally ordered (for any two different degrees one is always cooler than the other), but for *cut* some results of physical rending may not be orderable, e.g. *cut a piece of paper into a dog shape* vs. *cut a piece of paper into a cat shape* may reflect change along two different branches of a partially ordered space of rending.

[22] Attested impact verbs in Boas's sample are *ax, bang, bash, batter, bayonet, beat, bludgeon, bump, bust, chip, club, dab, gun, hack, hammer, kick, knock, pat, paw, peck, pound, pummel, punch, ram, shoot, slam, smack, spear, stab, stamp, stomp, stone, strike, trample, whip*, while attested surface contact verbs are *brush, caress, comb, dust, lick, mold, polish, press, rinse, rub, sand, scour, scrape, scrub, skim, smooth, swab, towel, wash, wipe*, taking a liberal view of what counts in each class.

[23] Washio (1997: 12–16) gives additional arguments that English and Japanese "wipe" verbs restrict possible result XPs due to a "disposition toward removal" (p. 16).

has never figured into work on affectedness, yet is crucial for understanding the diagnostics. Now that we have defined an independent ranking of affectedness types, we can define the traditional notions of "high" and "low" affectedness simply as points on the Affectedness Hierarchy. High affectedness is quantized change, and all other points on the hierarchy are lower degrees. Crucially, this is based on properties of scales independent of scale type, side-stepping the thorny issue of identifying which real world changes constitute high or low affectedness, a welcome result.

The test of this analysis of degrees of affectedness is to compare it to work on transitivity, where degrees of affectedness have figured prominently. Hopper and Thompson (1980) argue that clauses that entail higher degrees of affectedness are more transitive than those showing lower degrees.[24] Tsunoda (1981) and Malchukov (2005) take this further by positing hierarchies of basic verb meanings corresponding to relative degree of transitivity cross-linguistically. Malchukov (p. 81) gives the hierarchy in (69) from most to least transitive based on properties of the object. As indicated, this aligns with the Affectedness Hierarchy, which makes an additional distinction between non-quantized and quantized change[25]:

(69)

effective action	>	**contact**	>	**pursuit**
('break')		('hit')		('wait/search for')
((non-)quantized change)		(potential for change)		(unspecified for change)

The analysis of pursuit-type verbs as being lowest on the Affectedness Hierarchy—no change specified for their objects—conforms to the characterization of Blume (1998), who argues that these are two participant verbs where no proto-patientive entailments (following Dowty 1991) are assigned, but both arguments have some agentive properties.[26] Thus the Affectedness Hierarchy conforms to hierarchies independently motivated by research on transitivity, and in fact provides an independent explanation for such hierarchies based on strength of truth conditions about the effect.

5.2 Alternative proposals

An interesting related proposal is given in Washio (1997: 38–42), who proposes five types of patient roles given in Fig. 2, which he argues form a containment relation: Patient$_1$s are a subset of non-Patients, and for all $1 \geq i \geq 3$ Patient$_{i+1}$s are a subset of Patient$_i$s. Washio argues that English allows result XPs for all Patients, but Japanese only allows them for Patient$_3$s and Patient$_4$s, i.e. a subset of their distribution in

[24] Hopper and Thompson (1980) do not define transitivity grammatically, but it is usually taken to mean nominative/accusative or ergative/absolutive case-frames (Tsunoda 1981; Malchukov 2005).

[25] Malchukov also identifies a fourth, lowest degree of transitivity for motion predicates such as *go*. This may seem counterintuitive since I have defined motion as another type of change, but crucially Malchukov's examples consist entirely of non-causative motion verbs, which have only one core obligatory argument (the theme) and thus are grammatically intransitive for the simple reason of being monadic.

[26] A reviewer asks about non-physical low affectedness of the sort discussed by Cooreman (1994: 59–60) in conjunction with antipassives in Jaceltec, including *insult, help, teach, mimic, look at, request of, solicit/ask, look for/take care of x*, which Cooreman characterizes as having an O argument that is not "physically and/or lastingly affected by the action". Since these predicates do not entail physical change, they would indeed be at the low end of the Affectedness Hierarchy, conforming to Cooreman's classification, though this is not to say they do not form some positively defined class.

"non-Patient	the verb lexically specifies that it is not affected; hence it may not undergo any change of state; e.g., *see her (*stiff)*.
Patient_1	the verb, being intransitive, lexically specifies nothing about [result state]; it may be interpreted as "affected" by virtue of discourse or pragmatics; Jackendoff's [(1990, 294)] discourse patient; e.g., *run (the pavement) thin*.
Patient_2	the verb lexically specifies that it is affected; hence it may undergo some change of state; but the verb does not specify whether or how it changes; e.g., *drag the logs (smooth)*.
Patient_3	the verb lexically specifies that it is affected; hence it may undergo some change of state; the verb does not specify whether it actually changes its state or not; but the verb specifies that, if it does change, then it changes in certain fixed directions (the verb has a disposition toward certain states); e.g., *wipe the table (clean)*.
Patient_4	the verb lexically specifies that it undergoes some specific change of state; hence it is also affected; e.g., *sharpen the pencil (pointy)*."

Fig. 2 Washio's Patients (Washio 1997: 40; (116), (115))

English. Likewise, the increasing specificity of these Patients figures into variation in possible result XP modifiers, just as discussed above (see Washio 1997: 7–14).

However, there are a few problems with Washio's classification. First, there is not in fact a containment relation in Fig. 2, since non-Patients are stipulated to not be affected, Patient_1 is stipulated to be unspecified for an effect, and Patient_2 through Patient_4 are stipulated to be affected, all of which are inconsistent. Second, the Patient_1 vs. Patient_2 distinction hinges on a grammatical property (transitivity), but this has nothing necessarily to do with affectedness (and indeed the examples illustrating the contrast are simply unaccusative vs. causative motion verbs).[27] Third, the Patient_2 vs. Patient_3 contrast is not motivated by anything other than the resultative facts it is meant to explain. The approach outlined here avoids these issues since the Affectedness Hierarchy is (a) based on weakening truth conditions and thus properly defines a containment relation, (b) entirely independently motivated, and (c) wholly semantic, where we expect a theory of affectedness to be based.

Nonetheless, the key insight behind Washio's classification is clear, and it can easily be related to mine. (Non-)quantized change correlates with his Patient_4, making an additional distinction between specific results vs. non-specific results. His Patient_1 through Patient_3 correlates with potential change, divided by how specific a predicate is about possible changes, which I captured above in terms of sortal constraints. Finally, being unspecified for a change correlates with Washio's non-Patient. Thus the classifications are quite compatible, though they differ in details.

Conversely, Rappaport Hovav (2008) argues for a simpler classification between scalar and non-scalar verbs. The former encode scalar change (*cool, widen*), subsuming my (non-)quantized change class, and the latter do not encode scalar change (*ex-*

[27] Washio (1997: 8) assumes without motivation that all intransitive verbs by definition do not encode target states, but never discusses unaccusatives, the classic case of intransitives with patient arguments.

ercise, laugh, see), subsuming my potential and unspecified change class.[28] However, on her classification, surface contact/impact predicates should share no properties in common with scalar change verbs. She argues for this based on the fact that surface contact verbs like *scrub* allow a wide range of result XPs (including results for non-subcategorized objects), object deletion, and *out-* prefixation, none of which apply to scalar verbs like *dim*, suggesting that they do not form a class (cf. Rappaport Hovav 2008: 22–24; (12a,c), (16a,c), (18b,c)); she does not discuss impact predicates):

(70) a. Cinderella scrubbed her knees sore/the table clean.
b. We dimmed the room half dim/*empty.

(71) a. All last night, Cinderella scrubbed.
b. All last night, we dimmed *(the lights in the house).

(72) a. Cinderella outscrubbed her stepsisters.
b. *Our stage-hand outdimmed your stage-hand.

This is explained, Rappaport Hovav suggests, if verbs that lexicalize scales only take result XPs compatible with the lexicalized scale (see also Wechsler 2001, 2005; Beavers 2002, 2008a) and must overtly realize the affected argument. This latter condition in turn rules out object deletion for such verbs, and thereby also *out*-prefixation and non-subcategorized objects, which require deletion of the default object.

Rappaport Hovav's arguments separating scalar result verbs from the rest are not at issue; on my analysis this distinction is also made, and her diagnostics are thus easy to define. The question is whether surface contact/impact verbs also share something in common with result verbs. Here I argue that Rappaport Hovav's analysis is incomplete, since as (63) shows impact/surface contact predicates do pattern with result verbs in taking (control) result XPs, passing *What happened to X is Y*, and showing higher transitivity, facts that motivate Rappaport Hovav and Levin (2001: 784–790) to posit the category "force recipient" in the first place. Thus they must share *some* property—having a force recipient—in common with result predicates by which we can define these diagnostics, something not captured on Rappaport Hovav's analysis.

The only question is one of technical implementation, and here I suggest that while the assumption that potential change predicates have a latent scale superficially contradicts Rappaport Hovav, the intuition is the same: these predicates do *not* entail change, and such a reading can only arise through context, exactly as Rappaport Hovav (p. 19) suggests. But does the scale come from context wholesale or is it is latent in the predicate with only some of its details filled in by context? These two possibilities are largely notational variants, and the only potential empirical difference I can see is whether or not these predicates impose any constraints on possible changes (e.g. possible result XPs), thereby constraining the scale or result to some $X \subset U_H$. As I tentatively suggested above this may be true. However, this could probably be accommodated in some alternative implementation of force recipients

[28] Rappaport Hovav also argues that incremental theme verbs (*eat, drink, read*) do not have scale arguments, but rather the scale is provided by their object (which in the case of *eat* is also affected non-incrementally) (see also Ramchand 2008: 25–33). However, the conative data in Sect. 3 argues against this analysis of *eat/drink*.

as in fn. 19.[29] In any case, the specific implementation does not change the fact that the force recipient category is independently motivated. Crucially, once it is posited, however analyzed, some version of the Affectedness Hierarchy immediately follows: potential and (non-)quantized change predicates share force recipients in common, of which patienthood is a more specific subtype, and undergoing quantized change is a further subtype, defining a subset relation and thereby giving us an implicational hierarchy. Thus the core of the analysis does not change however force recipients are implemented.

5.3 Summary

Degree of affectedness reflects how specific a predicate is about the result, and the Affectedness Hierarchy captures four linguistically relevant levels of specificity, picked out by specific clusters of properties. The relevant properties classify predicates into subset relations, and the Affectedness Hierarchy gives us an independently-motivated way to capture this. Furthermore, since scalar change is the key underlying concept, we also capture the fact that aspectual diagnostics isolate two different participants. Likewise, we correctly predict two axes of variation among changes: type of scale and structure of scale. At this point, we could ask whether we want to actually define the term "affected" as some point on the hierarchy, perhaps as potential change (the most liberal contentful option). However, this is a purely terminological matter, and I leave it open here. What is important is that the hierarchy gives us the relevant categories and relates them together in a principled way.

6 Conclusion

Although affectedness has been implicated in numerous linguistic phenomena, it has rarely been addressed directly. I have reiterated empirically that affectedness is a true linguistic primitive, encompassing changes in state, location, and existence. I have further argued that while affectedness is connected to telicity and measuring out, it is not reducible to these notions, which instead together pick out two separate arguments of a change predicate, namely a theme and a scale. I propose that the underlying θ-relation borne by an affected argument relates these two entities together in a mutually constraining way. Positing a scale into the affectedness relation gives us (a) the ability to separate measuring out and affectedness, as well as different determinants of telicity, (b) two orthogonal axes of variation among changes in terms of scalar type vs. scalar structure, and (c) a precise characterization of degrees of affectedness as how specific a predicate is about the endpoint of the theme's movement on the scale.

[29] Beth Levin (p.c.) suggests that the ease with which surface contact and impact predicates allow result XPs may be because the manners they encode lead naturally to certain types of results, but that this is a matter of real world knowledge rather than lexicalization. However, it is difficult to tell real world knowledge from lexicalization when it affects the grammatical behavior of the verb in question. Any variant of the analysis sketched here captures the mixed behavior of these verbs in a more perspicuous way.

The relevant degrees of affectedness fall into an implicational Affectedness Hierarchy based on monotonically weakening truth conditions, which gives us a way to analyze affectedness tests and other phenomena. For some diagnostics, applying to predicates that entail a certain degree of affectedness means applying to predicates entailing stronger degrees of affectedness, supporting the implicational analysis. Other phenomena are gradient in nature, where the gradation follows the degree of affectedness, again implicating a hierarchy. The fact that no phenomenon picks out a discontinuous range on the hierarchy, or picks out a continuous range that excludes quantized change, is telling. This supports the implicational nature of the hierarchy, and suggests that languages do not contain constraints that rule out certain phenomena from applying to particular higher degrees of affectedness (i.e. there are no constraints of the form "X applies to entities affected to degree *n* but not degrees greater than *n*").

Versions of this model have been applied to empirical domains for which affectedness and its correlates have been implicated, including object/oblique alternations (Beavers 2006, 2010), DP-preposing (Beavers 2008b), and auxiliary selection in split-intransitive languages (Gaylord 2007). However, there may be other degrees of affectedness than the four I posited. The approach of Washio (1997) suggests that quantitative restrictions on possible target states may require positing further degrees. There may also be other types of scales, including scales related to non-physical changes (including mental states). Likewise, there may be change that is non-scalar in nature. Rappaport Hovav (2008) assumes that pure activities such as *play* (*baseball*) do involve some (temporary) change (since something must occur in the middle of the event), though it does not follow any trajectory that can be measured. These are all topics for future investigation.

Returning to the larger issue of affectedness in linguistic theory, we can also ask how this theory fits into a larger theory of lexical semantics. As noted in the introduction, affectedness is usually defined either intuitively or through representational diacritics. Representationally, the most common approach is to posit some primitive component of decompositional verbal structure such as a BECOME event type (Dowty 1979; Foley and Van Valin 1984; Rappaport and Levin 1988; Levin and Rappaport Hovav 1995; Rappaport Hovav and Levin 1998, 1989; Jackendoff 1990; Jackendoff 1996; Van Valin and LaPolla 1997, *inter alia*), or a syntactic head that predicates a target state (Baker 1997; Travis 2000; Folli and Ramchand 2002; Folli and Harley 2004; Ramchand 2008, *inter alia*). On these approaches an argument is simply identified by its position in the decomposition (i.e. being a particular argument of the relevant primitive). Syntactic approaches have been especially prevalent of late, where the head itself has syntactic properties (such as determining c-command relationships between arguments) from which other syntactic properties should follow directly.

However, such approaches run the risk of circularity if the heads themselves are not also identifiable by independent semantic diagnostics; otherwise they are what Koenig and Davis (2006) call "syntactic diacritics". I have suggested that affected arguments have positive, semantic identificational properties. This raises the question of whether the semantic diagnostics discussed here correlate with an independently defined set of syntactic properties, pointing to a one-to-one correspondence with a

syntactic decompositional primitive. If so, this would further justify decompositional approaches. If not, it suggests that there is an independent, linguistically relevant semantic tier of information that makes a different classification of arguments, something that must be reconciled with decompositions.

Furthermore, I have suggested here that many different types of changes—motion, change-of-state, creation/consumption—can be subsumed under a single formal analysis based on shared semantic properties, differentiated only by types of scales. However, some decompositional approaches (e.g. Ramchand 2008) have suggested that these different types of change are associated with different decompositional structures. The degree to which this is motivated, the question remains of how and why different decompositions would yield the same semantic properties. Similarly, the Affectedness Hierarchy is implicated in a range of phenomena. But do different degrees of affectedness correspond to different subevental primitives, variations on the same primitive (e.g. different types of BECOME heads), or a wholly separate component of lexical meaning? This again depends on identifying the syntactic correlates of the relevant subevental primitives. But if degrees of affectedness do correspond to different subevental primitives, we must then ask what it means for primitives to be semantically related to one another in terms of strength of truth conditions. These are all questions for future investigation. My goal here is instead simply to (re)define the empirical and theoretical terms upon which further investigation of affectedness can proceed, by putting the intuitive semantic basis of measurable change at center stage.

Acknowledgements The analysis of affectedness developed here grew out of a model proposed in my dissertation (Beavers 2006) as a convenient tool for analyzing certain classes of object/oblique alternation. This paper represents an attempt to develop an independent motivation for this analysis and examine its ramifications, as well a more sophisticated correlation to lexical aspect, building on Beavers (2009) (see Beavers 2010 for an updated analysis of object/oblique alternations based on it). I would like to thank three anonymous NLLT reviewers for their excellent and extensive comments. I would also like to thank Hans Boas, Bill Croft, Ashwini Deo, Itamar Francez, Chris Kennedy, JP Koenig, Andrew Koontz-Garboden, John Moore, Chris Piñón, Malka Rappaport Hovav, Susan Rothstein, Steve Wechsler, and audiences at the University at Buffalo, State University of New York and Yale University for their comments and feedback. I would also like to thank Makiko Nakayama for her judgments on some Japanese data.

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