**Deriving the Change-of-State Constraint**Joseph Potashnik. Please do not distribute without permission**.**

**Abstract** The change-of-state (COS) constraint on the distribution of the causative-unaccusative alternation was not accorded explicit truth conditions. This paper gathers empirical evidence from heterogenous sets of transitives and intransitives, establishing its effect. By defining states to be vectors of measurements, and change-of-states to be scalar changes, the interaction of a scalar structure with a standard counterfactual model of causation is shown to yield the COS constraint. The constraint is an integral part of preservation properties (of events and arguments’ states) of the causative-unaccusative alternation.

**Keywords** Causative ・ Unaccusative ・ Scalarity ・States ・ Change-of-State ・Causation

# 1 Introduction

*1.1 States and the COS constraint*

The notion of states and of changes of states (henceforth: COS) is relied upon extensively in linguistic literature. COS verbs such as *open*, *break*, or *melt* figure prominently in a large subclass of unaccusatives. Yet, the semantics of COS are elusive and are often employed intuitively. Scalar theories of argument structure have been proven useful in exploring these notions. These theories, which treat COS as a scalar change, are successful in explaining compositional variable behavior of Degree Achievements (Hay, Kennedy & Levin 1999, Kennedy & McNally 2005, Kennedy & Levin 2008), as well as incremental theme verbs (Kennedy 2012, following Krifka 1989). Scalarity is also used to separate Manner verbs from Result verbs (Rappaport Hovav & Levin 2010). The semantics of COS were shown to be preserved upon generalization from the standard temporal axis to spatial and functional ones (Deo, Francez & Koontz Garboden 2013).

The main concern of the paper is to provide a semantic analysis of states and of changes-of-states. In a nutshell, a state is defined to be a vector of measurements of an object along contextually relevant scales. A COS occurs if there are two unequal measurements along a given scale. I argue that an ordering relation is neither mathematically nor empirically motivated, and a weak type of scales exist on a par with nominal scales in a standard Levels of Measurement typology (Stevens 1946, Alper 1987, Luce 1997). Abstracting away from scale types allows unordered changes to be scalar.

I go on to derive the different behavior of scalar and nonscalar verbs with respect to a traditional model of causation. Because only scalar verbs have well-defined states, only causatives of scalar verbs show the COS constraint (see (2) below). Fillmore (1970) first showed that surface contact verbs such as *hit* (that do not imply COS) do not show the causative-unaccusative alternation, contrasting with verbs such as *break* (as in (1)).

(1) a. The boy broke the window / The window broke.   
b. The boy hit the window / \*The window hit.

(2) **The COS constraint**

No COS 🡪 No causative-unaccusative alternation.

The presence vs. the absence of a COS interpretation in the internal argument is the minimal difference between (1a-b); yet why should the COS interpretation be tied to the availability of the alternation in the first place has not yet received a satisfactory answer in linguistic literature. For example, Jaeggli (1986) proposed the following:

(3) Affectedness Constraint (Jaeggli (1986))  
If a complement of x is unaffected, it is impossible to eliminate the external role.

Originally, (3) was formulated to capture the set of verbs disallowing NP-preposing in passive nominals. It is often also associated with the study of middles (Roberts 1987, Fellbaum & Zribi-Hertz 1989, Fagan 1992, Hoekstra & Roberts 1993). According to Jaeggli, a relation between an affected complement and its predicate is ‘well defined’, by virtue of being independent of the relation holding between the predicate and its external argument. Such a ‘well-defined’ relation is absent when unaffected objects are involved. Unfortunately, it is not formally clear what 'well-defined relation' means.

Section 2 looks in depth at the scope of the empirical distribution of the causative-unaccusative alternation. The study reveals that the COS constraint is indeed a necessary condition; the alternation vanishes in the presence of a non-COS reading. The fact that unaccusatives (but not unergatives) show the COS constraint further strengthens the hypothesis that the former (but not the latter) are scalar. Section 3 develops a scalar theory that accords the notions of states, and changes-of-states, a truth-conditional. The COS constraint is shown to result from the interaction of causation and scalarity.

Section 4 addresses the evidence previously taken to support the claims that unaccusative manner of motion verbs (e.g., *roll*) are nonscalar and show the evidence to be inconclusive. I also show that *roll*-verbs pattern with Degree Achievements with respect to their combination with degree constructions and their temporal/extent ambiguity. Once the requirement for an ordering relation in scales is relaxed in favor of value differences, the behavior of *roll*-verbs is consistent with a scalar analysis. This is a welcome result since such verbs are unaccusatives, generally taken to be scalar.

A few words should be said regarding the scope of this paper. It is couched in semantic terms and does not touch upon the question whether the locus of the alternation is syntactic or lexical. It is agnostic to directionality and does not select between casuativization approaches (Pesetsky 1995, Harley 2008, Ramchand 2008, to name a few), decausativization approaches (Levin & Rappaport Hovav 1995, Reinhart 2002, Härtl 2003, Horvath & Siloni 2011, among others), reflexivization (Chierchia 2004, Koontz-Garboden 2009) or non-directional accounts (Borer 2005, Alexiadou et al 2006, Pylkkänen 2008 (common-stem), Harley 2012). This paper also asserts that the COS constraint is a necessary condition, but most likely not a sufficient one. Other necessary conditions such as the External Argument Restriction and Direct Causation seem relevant (see discussion in section 2). Lastly, the definitions of COS and states of objects are limited to quantified objects, i.e., count-nouns.

*1.2 COS Diagnostics*

*1.2.1 Successive object modifications test*

Before formulating a definition of states of objects, it is fruitful to look at some tests detecting the presence of COS in order to better understand speakers’ intuitions. COS, when embedded in a causative sentence, was traditionally formulated as entailing a result state ψ, which obtains for participant x as a result of predicate φ being true (Dowty 1979). Hence, if φ, but not ψ is a contradiction, COS has occurred (for instance, by employing past participles, e.g. #*John cleaned the house but it is not cleaned*). Beavers (2011) proposes a general test which abstracts away from concrete ψs: if the continuation “but nothing is different about x” is a contradiction, then a COS in some property of x took place. For instance (examples taken from Beavers 2011):

(4) a. John just painted the bedroom, #but nothing is different about it.  
b. John just carved the wood into a toy, #but nothing is different about it.

What is it about the word “different” used here that licenses COS? Beavers (2011) answers that "Intuitively, something is different about x only picks out properties that can be observed by looking at x itself". “Different” in this context means that two observable states of the object are unequal. As such, it suffices to speak of different states (or different observations) of the object, not necessarily of result states. Atelic COS verbs that do not entail result states (e.g. *widen*, *cool*) also support the claim that the end state is not the semantic determinant involved in the test. Note that only inequality, but not ordering, plays a role in Beavers’ test.

I wish to add two of my own tests to the family of φ, but not ψ COS entailment tests. Keeping in mind that COS may minimally be achieved by requiring two different states, let us assume that an object is in a certain original state at a given time t1. The object transitioned later to a different state at t2. Therefore, as of time t2, another hypothetical change of the object from the original state to the newer state is contradictory, because the object is no longer in its original state. To flesh it out, consider a context where John wishes to perform a certain action on an object. To his annoyance, Mary has preceded him and performed the same action (expressed by the same verb) on the same object. Although Mary just did it, John is determined to carry out his plan nonetheless. Now, if the object has a certain state with respect to this verb which has changed, John's actions would lead to a contradiction. By contrast, if the object has no state with respect to the verb, or a state which has not changed, John's actions are licit. Consider the following examples:

(5) Non COS verbs

a. John crossed the road (too) right after Mary had done it / right after it had been crossed.  
b. John touched Ed's cheek (too) right after Mary had done it.  
c. The French army surrounded the city right after the British one had done it.  
d. John supported the old woman right after Mary had done it.  
e. The German army attacked the country right after the Russian one had done it.

(6) COS verbs

a. #John broke the window right after Mary had done it / right after it had been broken.  
b. #John emptied the pool (too) right after Mary had done it.  
c. #John killed the woman (too) right after Mary had done it.  
d. #John opened the door (too) right after Mary had done it.[[1]](#footnote-1)  
e. #John froze the water (too) right after Mary had done it.

The test above reinforces the intuition that verbs such as *cross*, *touch*, *surround*, *support* and *attack* do not involve COS of their direct object. As shown in section 3, the pattern that such verbs do not show unaccusative alternates is predicted by the COS constraint (see (2)). By contrast, traditional COS verbs are infelicitous in the test’s environment.

The successive object modification test has a shortcoming: it fails to detect states of atelic predications because, given that the object has states, the initial state of the second modification may be the end state of the first modification (e.g., *John heated the soup right after Mary did it).* The next test is suited for detecting states in atelic cases.

*1.2.2 Simultaneous object modifications test*

Similarly to the previous test, let us assume an object is in a certain state at time t1. Two independent, simultaneous actions denoted by a given verb are performed on this object; each is directed at transitioning the object to some new state independently of the other action. If the result is contradictory, the object has two distinguishable states at the same time and the presence of states is detected by the test. Consider a context where John and Mary are competitors given a task to perform a certain action on the same object, starting simultaneously. Some time later, Mary has managed to fully accomplish the task by herself, while John was not as successful. Now, if the result is contradictory, Mary (but not John) reached the desired state, hence the test detects the presence of states. Alternatively, if the object has no state with respect to the verb, or has a state which has not changed, competitive simultaneous actions are licit. Note that the task is contextually constructed as telic since Mary accomplishes it in a given amount of time. Consider the examples below which utilize a progressive aspect:

(7) Non COS verbs

a. They began crossing the road simultaneously; John was still crossing it when Mary finished.  
b. They began isolating the virus; John was still isolating it when Mary finished.  
c. The armies began surrounding the city; John’s army was still surrounding it..  
d. They began striking the target; John was still striking it when…

(8) COS verbs

a. #They began opening the door simultaneously; John was still opening it when Mary finished.  
b. #They began freezing the water; John was still freezing it when Mary finished.  
c. #They began heating the soup; John was still heating it when Mary finished.[[2]](#footnote-2)  
d. # They began moving/rolling the stone; John was still moving/rolling it when Mary finished.

Verbs such as *cross*, *isolate*, *surround* and *strike* are felicitous in the test's environment. As such, the test reinforces the intuition that these verbs do not involve COS. By contrast, traditional COS verbs such as *open*, *heat* and *freeze* verbs are infelicitous in the test’s environment. Manner of motion verbs such as *roll* or *move* (see (8d)) pattern here with COS verbs. I argue that locations can serve as a basis for states, and that change of location verbs are COS verbs. In other words, the correspondence between property scales and path scales can be extended to unordered degrees. The scalar typology (based on Stevens 1946, Alper 1987, Luce 1997) is introduced in section 2; empirical evidence supporting a scalar analysis of unaccusative *roll*-verbs is discussed in section 4.

The simultaneous object modification test requires the predicate to be compatible with the progressive; a requirement which canonically suits atelic predicates but also many achievements (Rothstein 2004).

Recapitulating, the two new tests introduced above enrich the inventory of linguistic tests employed to assess speakers’ intuitions regarding COS and its entailments. As their predecessors, they rely on distinctness but not on ordering.

**2 The COS constraint: data**

*2.1 Setting aside independent constraints*

In order to get a sense of the generalization involved, this section collects evidence from four kinds of independent sets: (i) non-alternating transitives, (ii) non-alternating unaccusatives, (iii) transitives showing both COS and non-COS readings, but whose unaccusative alternates show only a COS reading, and (iv) unaccusatives showing both COS and non-COS readings, but whose transitive alternates show only a COS reading. The intuition shared by all these sets is that, when the alternation is blocked, the internal argument does not undergo COS or is “unaffected”. This much is true for both transitives and unaccusatives, and furthermore remains true when either set shows the alternation only under a COS reading. Therefore, Jaeggli’s observation (see (3)) is a private case of a larger phenomenon.

The alternation manifests other constraints too. The most known one relates to the nature of the external argument: the subject position may be occupied by agents, natural forces or instruments, which all are conceivable causes (Levin & Rappaport Hovav 1995, Van Valin & Wilkins 1996, Reinhart 2002, Ramchand 2008, among many others).

(9) a. Walter / the heat / the candle melted the ice.   
b. The ice melted.

Transitive verbs whose external argument is exclusively agentive do not exhibit the alternation. The External Argument Restriction (EAR) is demonstrated in (10) below.

(10) a. John / \*the straw /\* his thirst drank the lemonade.  
b.\*The lemonade drank.

The full picture is more complex, depending on fine-grained semantics. For instance, the external argument of *bloom* verbs admits natural forces but not agents or instruments.

(11) a. The fruit trees blossomed. (Wright 2002, cited in RH&L 2012)  
b.\*The farmer/\*the new fertilizer blossomed the fruit trees.  
c. Early summer heat blossomed fruit trees across the valley.

Subtle subject-object dependencies also affect the availability of the alternation, which vanishes for certain choices of objects (Spalek 2014, examples in (12) are from Rappaport Hovav 2014, RH&L 2012).

(12) a. I emptied the trash can. e. The waiter cleared the table.  
b.\*The trash can emptied. f.\*The table cleared.  
c. I emptied the tub. g. The wind cleared the sky.  
d. The tub emptied. h. The sky cleared.

Hence, in addition to an across-the-board COS interpretation, further constraints such as the EAR and subject-object dependencies are at work, beyond the scope of this paper. That is, a COS interpretation is a necessary (but not sufficient) condition for the alternation. Direct Causation (Wolff 2003) is likely to be a necessary condition too. This paper does not attempt to derive the Direct Causation Restriction, External Argument Restriction or subject-object dependencies. The reader is referred to Rappaport Hovav & Levin 2012 and to Rappaport Hovav 2014 for a thorough discussion.

*2.2 Non-alternating transitives*

Consider a large class of verbs of positioning with respect to stationary objects, consisting of smaller subclasses (in (13) below, *hit*-verbs date back to Fillmore 1970). Here, strictly agentive verbs are excluded in order to control for the EAR. English examples are provided in (14); the same pattern emerges in Hebrew and French but omitted here and in all subsequent examples due to reasons of space.

(13) **Stationary object verbs:**

verbs of crossing*: cross, traverse, reach, enter, …*   
verbs of surface contact: *touch, hit, support, strike, carry…*verbs of attack and defend: *attack, defend, protect, risk…*   
others: *encircle, frame, surround, isolate…*

(14) a. The cavalry / the waters / the walls / the catapults surrounded the city.   
b.\*The city surrounded.   
c. John / the disease attacked David.   
d.\*David attacked. (intended meaning: he became attacked)  
e. John / the storm / the arrow struck the bird.  
f.\*The bird struck. (intended meaning: it became struck)  
g. The cavalry / the weather conditions / the walls protected/risked the city. h.\*The city protected/risked.  
i. John / the hurricane / the ship crossed the ocean.  
j.\*The ocean crossed.

The descriptive generalization of this heterogenous set is that the object is “unaffected” or does not undergo COS. Clearly, the object may be in some contextually relevant state, so it is vital to develop a truth-conditional analysis of what a state is and when COS is entailed. For example, it is possible to imagine a scenario for *the waters surrounded the city* in which the state of the city changed: perhaps it became flooded or inaccessible. Nonetheless, this change is not entailed from the meaning of *surrounded* (unlike *flooded*). Section 3 tackles the relevant representations of predicates and their relations to COS.

Another question relates to whether the subjects of the verbs in (14) correspond to cause roles. In order to capture the thematic underspecification of subjects of causatives, various theories defined linguistic entities which encapsulate realizations of thematic roles; entities such as an underspecified cause role (Levin & Rappaport Hovav 1995, Reinhart 2002), or a "flavor" of voice (*v*cause, see Folli & Harley 2005, among others). It is not clear which other thematic role the external arguments in (14) can be accorded, given that current linguistic theories only allow them to correspond to either agent or cause roles. Section 3 shows that the verbs in (14) and canonical causatives indeed share a large part of causal semantics but differ with respect to a certain temporal property of causation, resulting in different aspectual behavior and different entailments.

*2.3 Non-Alternating unaccusatives*

A mirror-image to non-alternating transitives, non-alternating unaccusatives also exist. They are characterized by a lack of COS. The first class in this set is verbs of existence (see Levin & Rappaport-Hovav 1995:148-151 for unaccusativity diagnostics). The lack of causatives for existence verbs, as shown in (15) below, corroborates that claim that only COS verbs may participate in the alternation.[[3]](#footnote-3)

(15) a. The solution exists.  
b. \*John exists the solution.  
c. John waited (for an hour).  
d. \*Mary / the rain waited John (for an hour).  
e. The archaeological findings survived.  
f. \*Luck survived the archaeological findings.

A second class of unaccusatives which do not denote COS are verbs of measurement. Verbs such as *cost*, *weigh*, *last* and *measure* do not show causative alternates and do not passivize. The examples in (16) below show that measure verbs pattern with existence verbs with respect to the (un)availability of the causative.

(16) a. The present cost ten dollars.[[4]](#footnote-4)b.\*John / \*the expenses / \*the wrapping cost the present ten dollars.   
c. The box weighed five kilograms.   
d.\*John / \*the mass / \*the machine weighed the box five kilograms.   
e. The movie lasted two hours.   
f.\*John / \*the screening / \*the TV lasted the movie two hours.

A third class of non-alternating unaccusatives is the one of spatial configuration verbs (in a “simple location” sense). Verbs such as *sit*, *stand* and *lie* have a range of meanings associated with them. Languages diverge with respect to the morphological realizations of those different meanings. What is relevant here is the meaning of “simple position”, in which the unaccusative is predicated of inanimates and describes their location (e.g. *the statue stood in the corner*, see Hoekstra & Mulder 1990, L&RH 1995). Under that interpretation, verbs of spatial configuration pattern with verbs of existence and verbs of measurement: they do not have COS interpretation and lack causative alternates. What makes the class unique is the availability of agentive causatives which pattern neither morphologically nor thematically with canonical causatives (for a full discussion, see Levin & Rappaport-Hovav 1995:128-130). These agentive causatives have obligatory COS interpretation, corresponding to a distinct second meaning of spatial configuration verbs (i.e., COS, as in *the child stood (up)*).

(17) a. The statue stood in the corner.   
b. John / \*gravity / \*the lever stood the statue in the corner.   
c. The books sat on the table.   
d. John / \*gravity / \*the box (\*sat)/set the books on the table.   
e. The dress lay on the bed.   
f. John / \*gravity / \*the hanger (\*lay)/laid the dress on the bed.

Concluding, non-alternating unaccusatives (existence verbs, measure verbs and spatial configuration verbs) reinforce the hypothesis that a lack of COS blocks the alternation.

*2.4 Fill-verbs*

A third phenomenon providing relevant evidence is the situation where both alternates exist, but only under certain entailments. Verbs such as *fill*, *cover* or *obstruct*, in their transitive use, show two readings: an eventive reading, where the direct object undergoes COS, and a stative reading, where it does not. The intransitive counterpart of these verbs allows only a COS interpretation, thus lacking the stative reading. The examples in (18) provide additional indication that the COS constraint is valid. Otherwise, the unavailability of the intransitive stative reading is unexpected. Note that both transitive readings are causatives: the water caused the pool to fill (eventive) or to be full (stative).

(18) a. The water filled the pool. (eventive / stative)  
b. The pool filled (with water). (eventive / \*stative)  
c. *ha-šeleg kisa et ha-arec*. (Hebrew)  
 the-snow covered acc the-earth  
 ‘The snow covered the earth.’ (eventive / stative)  
d. *ha-arec hitkasta be-seleg*.  
 the-earth covered (intransitive) in-snow  
 ‘The earth covered with snow.’ (eventive / \*stative)

*2.5 Bloom verbs*

Another empirical reinforcement is provided by the intransitive mirror image of *fill* verbs, namely, verbs which show two intransitive uses. There is only a single transitive use: the one corresponding to a COS interpretation in the direct object (a closely related behavior is shown for verbs of spatial configuration, see section 2.3).

Verbs such as *bloom*, *blossom*, *rot*, *erode* and *decay* have been labeled as verbs of internal COS. A subset of internal COS verbs, such as *bloom*, *sprout*, *flower* or *grow* also has a mode-of-being sense which describes a certain state of existence (Levin 1993:250-251). The causative (where it exists) corresponds only to the COS reading (see also McKoon & Macfarland 2000, Wright 2002, Rappaport Hovav 2014).

(19) a. The cactus blossomed (for two days). (eventive / stative)  
b. Bright sun blossomed the cactus. (eventive / \*stative)  
c. The corn grew in the fields. (eventive / stative)  
d. The hot sun grew the corn in the fields (eventive /\* stative)

In each of the intransitive sentences in (19), the subject may be interpreted as being a certain state for the duration of the event, an interpretation which is blocked in the transitive alternate.

Recapitulating, this section revisits the causative-unaccusative alternation distribution with an empirical study of independent, heterogenous sets of verbs that share the common denominator of blocking the alternation when COS interpretation is absent. The results strengthen the hypothesis that the COS constraint is a necessary condition for the alternation. The representations of these examples will be again reviewed in light of a model-theoretic derivation of the COS constraint, developed in the following section.

**3 What is COS?**

*3.1 Intrinsicality*

The first step toward formally defining states of objects is the intuition that the state is fully determined by the object itself: a function of what has been labeled as the object’s intrinsic properties. In what follows, I present a theory of intrinsicality by Langton & Lewis (1998), upon which I proceed to define states.

Most approaches agree that, with respect to the domain of individuals, an unaccusative is predicated of its subject alone. This is the main difference between unaccusatives and passives, as seen below:

(20) a. \*The window broke by John.  
b. The window was broken by John.

The example in (20b) is taken to support the claim that the passive existentially closes a distinct external argument, which remains a part of the verb's representation. (20a), on the other hand, does not include a distinct external argument. The "by itself" diagnostic also differentiates between unaccusatives and passives:

(21) a. The window broke by itself.  
 b.\*The window was broken by itself.

The incompatibility of the passive with "by-itself" modification ((21b)) shows it to include a distinct argument in its semantic representation, since “by itself” denies a cause role that is not identical to the antecedent of “itself”. By contrast, the unaccusative is compatible with "by-itself" modification ((21a)), and thus does not have a-priori to include an additional distinct argument in its semantic representation. Whether there actually is another argument in the representation is a matter of debate (see Chierchia 2004, Alexiadou et al 2006, Pylkkänen 2008, Koontz-Garboden 2009, Horvath & Siloni 2013, and Beavers & Koontz-Garboden 2013 for competing approaches).

As such, the subject of an unaccusative has a property not evaluated relatively to other individuals: an intrinsic property (following Kim 1982, Lewis 1986, Langton & Lewis 1998). From a philosophy of the mind viewpoint, Langton & Lewis argue that that intrinsic properties are *independent of accompaniment*, as defined below:

(22) A property P is independent of accompaniment iff:

1. Possibly, there exists a lonely P.
2. Possibly, there exists a lonely non-P.
3. Possibly, there exists an accompanied (i.e. not lonely) P.
4. Possibly, there exists an accompanied non-P.

L&L say that an object is “accompanied” iff it coexists “with some contingent object wholly distinct from itself”. A “lonely” or “unaccompanied” object is one that is not accompanied. Being a cube or being 10 cms long are examples of intrinsic properties. Being a brother, thinking of Paris, being next to John are examples of extrinsic ones.

L&L’s account builds on basic, non-disjunctive intrinsic properties. *Intrinsic duplication* is a relation that holds between two objects iff they share all their basic intrinsic properties, and an intrinsic property is one that can never differ between intrinsic duplicates (whether actual or possible in a Lewisian theory of possible worlds). Intrinsic properties are therefore duplication preserving. The crucial question of what constitutes a non-disjunctive property is discussed at the end of this section.

(23) Langton & Lewis: Duplication Preserving

1. a basic intrinsic property is non-disjunctive and independent of accompaniment.
2. x at world *u* is a duplicate of y at world *v* iff, for any basic intrinsic property P, x has P at *u* iff y has P at *v*.
3. F is intrinsic iff, for any x and y, and for any possible worlds *u* and *v* such that x at *u* is a duplicate of y at *v*, x has F at *u* iff y has F at *v*.

Let us extend the definition of intrinsicality from properties to (verbal) predicates.

(24) Intrinsic predicates

A predicate P with an argument x is intrinsic iff there is a relation R (a part of the lexical meaning of P) between the event e and an intrinsic property of x.

More formally, P is intrinsic if:  
*to P* : ∃δ∃Rλe λx [(P(e) ∧ proto-role(e, x)) ⇔ R(e, δ)] (presupposition: δ(x))

For example, the sentence *the soup cooled* means that there is an event that entails a certain relation, R, which is a part of the meaning of *cool*, between the event and an intrinsic property of the soup, called temperature. The converse is also true: if the same relation between an event and the temperature of the soup holds, it entails the predicate *cool*. The presupposition is that *the soup* has temperature, preserved in questions, in the antecedent of conditionals and under negation.

Intrinsic predicates cannot entail extrinsic properties. Assume that δ is extrinsic λxλyδ(x,y) = λxλyδ(y)(x) and rewrite δ’ = λyδ(y), thus λxλyδ(x,y) = λxδ’(x) and δ’ is an intrinsic property of x. The presupposition now becomes that the individual x has the intrinsic property δ’, which is a function of an accompanying y, in contradiction to the definition of intrinsicality.

The distinction between intrinsic and extrinsic properties is driven by perception of relations, not by mathematical necessity. If any property could have been perceived to be intrinsic or to have an intrinsic equivalent, then for every transitive verb one would find an intransitive alternate with the corresponding intrinsic property, contrary to fact. The hypothetical intransitives of *cross*, *read*, *carry* or *surround* require their subjects to be independent of accompaniment, which is impossible in the way we perceive the world.

At this stage, a circular reasoning problem arises. Although the unavailability of an intransitive alternate is predicted for extrinsic predicates, the underlying presuppositions have not been addressed. It is possible that we were led to believe that *carry* is extrinsic because \**the plank carried* happens to be absent in English, but nothing a-priori excludes its intrinsicality. The question reverts to the ability to discern the basic building blocks of intrinsic properties. Langton & Lewis reply that those are “natural” or “fundamental” properties, rather than ones that merely satisfy linguistic predicates. They argue that the correct results are achieved by any construal of naturalness on which properties are built (e.g., “common-sense” or “standard physics”), although there are reasons to doubt their argument (see Marshall & Parsons 2001, Sider 2001).

How is it possible to tease apart “natural” properties from the corresponding intransitive predicates in the context of a linguistic task? Given that the set of unaccusatives is not entirely stable across languages, can one infer if there are marked or unmarked lexically encoded intrinsic properties, or is all variation a historic accident? Unfortunately, it is impossible to do justice to these questions in the scope of this paper. I continue to rely on intrinsicality having acknowledged the risk of circular reasoning, pending further experiments or studies.

*3.2 Scalar predicates*

Suppose that the relation between the event and the intrinsic property, R(e, δ), is not an arbitrary but a special function ƒ into a range of distinct values determined by δ, S(δ), then, given ƒ has a certain structural property, the occurrence of *e* entails a structure of values in S(δ) and vice versa: a structure of values in S(δ) entails *e*. In what follows, it is shown that when predicates include the special function ƒ, the arising linguistic patterns and entailments differ from predicates which do not include it.

A measure function ƒ is a function from concrete entities to abstract entities such that the empirical relations holding in the concrete entities, are preserved in arithmetical relations holding in the abstract entities (i.e., a homomorphism. For the closely related topic of the Event-Argument model of telicity, see Tenny 1994, Krifka 1989, Landman 2000, Rothstein 2004, Wechsler 2005, among many others). In current context, the relations holding in the event structure are preserved in the relations holding in a structure of S(δ), a finite or infinite set of abstract values for having the property δ. We say an intrinsic predicate P is scalar iff there is an S(δ) and if ƒ is a measure function into S(δ). Rewriting (24) yields:

(25) Scalar Predicates: P is scalar iff  
*to P* : ∃ƒλe λx [(P(e) ∧ proto-role(e, x)) ⇔ ƒ(e)]

Scales is a topic much researched in statistics, psychology, and linguistics (Hay, Kennedy & Levin 1999, Kennedy & McNally 2005, Kennedy & Levin 2008, Levin & Rappaport Hovav 2010, Beavers 2013, and Deo et al 2013, among others). I follow Steven’s (1946) classification of levels of measurements. There are four types of scales: nominal, ordinal, interval and ratio. The nominal scale is a set of distinct elements. The stronger ordinal scale includes an ordering relation between its elements. An interval scale is stronger still and includes meaningful distances between its elements. Ratio scale is the strongest in the typology and includes a “true zero” element on top of distinctness, ordering relation and distances. Scales also vary with respect to their finitness or whether they are close or open ended. Below is a table summarizing the defining features of each type:

(1) Table 1: Types of Scales

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type of property δ | Categorical | | Quantitative | |
| Scale level | Nominal | Ordinal | Interval | Ratio |
| Defining Feature | Distinct Categories | Ordered Categories | Meaningful Distances | Absolute Zero |
| Operations | = , ≠ | ≤ , ≥ | + , - | ×, ÷ |

In linguistic literature, gradable predicates are analyzed as involving at least meaningful distances (i.e., interval scales). Here, the view that all scale types are licensed, and show corresponding predicates, is advocated for the following reasons: (i) Section 1.2 showed that COS diagnostics are sensitive to distinctness alone. A theory that takes these diagnostics to reflect speakers’ intuitions will allow nominal scales. (ii) There is no need to posit a restriction on scale types unless evidence dictates there is one. (iii) there is evidence supporting the existence of predicates with nominal scales. COS verbs such as *crack* or *die* are sometimes taken to encode a two-point scale (L&RH 2010), but unlike gradable predicates, an ordering relation between these two points seems quite arbitrary (e.g., cracked vs. not-cracked or dead vs. not-dead). Also, unaccusative manner of motion verbs, such as *roll*, *move* or *curve* involve unordered set of spatial points in their basic sense. Evidence of their scalar behavior is presented at length in section 4.

I follow Kennedy & McNally (2005), Kennedy & Levin (2008) in using measure functions, and Deo et al (2013) in abstraction over axes. μ is a partial function from objects, worlds, and an ordered axis to values in S. Two such possible μs are (D is the domain of individuals, W of worlds, T of ordered times, L of ordered locations):

(26) Measurement Functions

a. Temporal: μδ : D x W x T → S(δ), or μδ(x,w,t) = s where ∈ S(δ).  
b. Spatial: μδ : D x W x L → S(δ), or μδ(x,w,l) = s, where ∈ S(δ).

Let TIMES(e) be the time points in the span of *e*. Plugging in a temporal μ for ƒ(e) in (25), yields (27):

(27) Scalar Predicates: P is scalar iff (standard temporal interpretation)  
*to P*: ∃δ∃μλeλx[(P(e) ∧proto-role(e, x)) ⇔ ƒ(e) ∈  
 { { μδ(x, w, t) | t∈ TIMES(e)} } ]

In prose, a predicate P is scalar iff for any event falling under P, there is a certain measurement function (henceforth: μ) homomorphic with it. A scalar predicate P taking an argument x therefore selects a subset of μs out of all possible μs measuring x along δ. For example, to *die* denotes a set of events that are homomorphic with a measurement of “dead” and an earlier unequal measurement. In a first order approximation, Kennedy & Levin (2008), and Deo et al (2013) are correct to argue that, given prior knowledge of an ordering relation <1, there is a concise description of the set: all events such that μδ(x, w, tinit) <1 μδ(x, w, tfinal).[[5]](#footnote-5) Hence, (27) can be made compatible with their truth-conditional analysis. Bear in mind that such descriptions oversimplify speakers’ judgments. In the set of events s1 that begin with an object at 50° and end with it at 40° (that is, the infinite set of μs going through these two points), only a very few can be regarded as cooling. For example, events in s1 for which the object spends 99% of the time at 80°, or fluctuates between 80° and 20°, cannot be felicitously described as cooling events, although there is a sufficiently small final interval in which the object is cooler than in an initial one. More accurate truth conditions should include that it is a maximal event of cooling, i.e., contains only subevents of cooling (Filip & Rothstein 2005, Filip 2008), with the tolerated deviations in magnitude, frequency or duration (for minimal activities, pauses and gaps, see Dowty 1979, Krifka 1989, Landman & Rothstein 2010). For present purposes, it suffices that there is a finite lexicalization of such homomorphisms.

Lastly, to state the theoretical discussion in the most general terms possible, allow predicates to be *partially scalar.* A partially scalar predicate P contains both scalar and nonscalar components (termed NS(e) for Non Scalar). Given that the measurements are divorced from the thematic role of the argument, rewrite:

(28) Partially Scalar Predicates: P is partially scalar   
*to P*: ∃δ∃μλeλx[(P(e) ⇔ ƒ(e) ∈{ { μδ(x, w, t( | t∈ TIMES(e)} } ∧ NS(e)) ∧ proto-role(e, x) ]

The motivation for (28) is also empirical. There are sets of closely related verbs that share entailments but differ in the manner those are achieved: *smash* means to *break* violently whereas *shatter* means to *break* into numerous pieces. Manner-of-death verbs such as *drown*, *electrocute* and *asphyxiate* entail *die*, but diverge in their manner: they share their scalar component but differ in their non-scalar one. (28) allows unrestricted range for the possible meanings of verbal predicates. Whether these verbs syntactically show complementary behavior of non-scalar and scalar readings (Mateu & Acedo-Matellan 2011, Levin & Rappaport Hovav 2013, 2019) is a question beyond the current scope.

Recapitulating, a scalar predicate lexicalizes homomorphisms between event and scalar structures; the latter is a function μ of the measurements of the subject along its intrinsic property δ during the event. The power of the scale (e.g., nominal, ordinal) and the properties of the scale (e.g., open, close) vary according to the semantics of δ.

*3.3 States, change of states, and scalar changes*

A state is a vector of measurements of the object, such that the ith element in the vector is a measurement of the object (at time t and world w) along a scale S(δi) that corresponds to some contextually relevant intrinsic property δi. More formally, let Δ be a contextual dimension function which assigns to a property N an n-tuple of intrinsic scalar properties <δ1,δ2, .. ,δn> which are contextually relevant for the objects that fall under N.

**The state function of an object x** (at time t and world w) is a function in a vectorized form that is obtained by associating each δi with a corresponding measurement function μδi D x W x T → S(δi). Note that intrinsic properties often have more than one possible scale (e.g., imperial or metric scales), thus there are multiple μs corresponding to the same property. **The state of an object x** is the vector which results from applying the object x to the state function.

(29) **The state function (temporal case)**

If N is a property, ΔN a contextual dimension function, w a world, t a time, d an object such that d has N in w at t, then the state function is

λx.stateΔN, w, t= (μ1, μ2, … , μn), such that μi : D x W x T → S(δi)

(30) **The state of an object d**

the state of an object d in w at t is the result of applying d to the state function:  
λx.stateΔN, w, t(d)

The state function maps an object d (relative to the dimensions in ΔN) to its state: the vector of the measurements that the scales assign to d in w at t. In other words, the state of an object is a point in n-dimensional space of its relevant measurements. Change of State (COS) straightforwardly follows from (30).

(31) λx.stateΔN, w, t1(d) ≠ λx.stateΔN, w, t2(d) , i.e.,   
<μ1x,w, t1(d), μ2x,w, t1 (d), … , μnx,w, t1 (d)> ≠ <μ1x,w, t2(d), μ2x,w, t2 (d), … , μnx,w, t2(d)>  
∃μi : D x W x T → S(δi) such that μix,w,t1(d) ≠ μix,w,t2(d).

In prose, COS in an object exists if the measurements along some relevant δi are unequal at two different times (COS is evaluated at both times with the same state function). Since the definition of the state function is based on scalar structure, change of state equals scalar change. Although the notion that COS is a case of scalar change is now widespread in linguistic literature, it is not couched in terms of what the entity “state” actually is (but see Gawron 2007 for independent formulation of state functions).

Scalar structures allow us to meaningfully define states and change of states. A state of an object d in world w at time t is a point in n-dimensional space of its contextually relevant measurements: )μ1x,w, t(d), μ2x,w, t(d), … , μnx,w, t(d)(. COS equals scalar change: there are at least two distinct measurements along some contextually relevant intrinsic property of the object at two different times. To be clear, subjects of nonscalar predicates might have contextually relevant states too, but as the predicates do not involve measurement functions, those states are not entailed.[[6]](#footnote-6) The different behavior of scalar and nonscalar predicates is demonstrated in the following sections.

*3.4 Causation as a counterfactual dependence*

The last milestone before addressing the source of the COS constraint in the alternation is the definition of causation. I use the traditional model of causation as a counterfactual dependence between two events (Lewis 1973):

(32) **counterfactual dependence**: e2 counterfactually depends on e1 when both counterfactual conditions hold in a set of worlds:  
a. For every world, if e1 occurs, then e2 occurs: e1→ e2.[[7]](#footnote-7)  
b. For every world, if e1 had not occurred, e2 would not have occurred either: ¬e1→¬e2.

**Causation:** e1 causes e2 in w iff:c. e2 counterfactually depends on e1 in a causally-related set of worlds.  
d. Temporal asymmetry: e1 precedes e2in w, or, the present counterfactually depends on the past in w.[[8]](#footnote-8)

Consider whether an event e2 occurs at the last time point t0 before it is interpreted as a caused event. (i) e2 does not occur at t0; it can straightforwardly be said that e1 brought about, or caused, e2. (ii) e2 occurs at t0 (although it is not caused by e1 then). From (32b) follows that if e1 did not occur, then e2 would not occur. We then say that e1 maintains e2.

Although maintenance and causation are symmetric in the set of counterfactual worlds, maintenance is not a type of causation since it breaks temporal asymmetry in the world in which it occurs. For example, in a world w1 Gal falls forward (e1) and brings about a broken window (e2). In a causally related world w2, Gal does not fall (¬e1), maintaining the window unbroken (¬e2). In maintenance worlds, the maintained and maintaining events are *contemporaneous*: the intact window simultaneously depends on Gal’s balance. In another example, a city’s safety (e2) simultaneously depends on the presence of walls (e1). According to (32d), causes must precede their effects since in a causal relation, an event in the present cannot counterfactually depend on another one in the present or in the future (Neeleman & van de Koot 2012).

A direct consequence of the temporal properties of maintenance is that the argument of e2 is *not* independent of accompaniment (since it must be accompanied by the argument of e1 down to instants or to minimal activities), and thus the contextually relevant properties are extrinsic. By contrast, causation is compatible with intrinsicality of the relevant properties of the argument of e2. In the next sections, it is shown that the causative-unaccusative alternation preserves intrinsic properties of the internal argument.

The conclusion is that causation, evaluated with respect to a given world w, must be interpreted as bringing about an event e2 in w; e2 cannot occur before it is interpreted as caused. Maintenance is a distinct type of counterfactual dependence that differs from causation in its temporal properties and in its obligatory extrinsic interpretation.

With respect to lexical causatives, neo-Davidsonian event semantics are assumed: e2 is taken to be the caused event associated with the object of the transitive and e1 to be the causing event associated with its subject (Dowty 1979, Parsons 1990, Levin & Rappaport-Hovav 1995, Piñón 2001, Chierchia 2004). Whether e1 or e2 are syntactically realized is a question orthogonal to the model and beyond the scope of this paper. I also assume that in the case of lexical causatives the caused argument receives a theme role, unlike periphrastic causatives in which the argument is realized via a separate predicate. A standard analysis of a causative *break* is:

(33) *to* *break*: λxλyλe∃e2∃e1[break(e) ∧ cause(e1, y) ∧ theme(e2, x) ∧ e1 causes e2 ∧   
e = (e1,e2) ]

*3.5 Causation + scalar structure = the COS constraint*

*3.5.1 Entailments of nonscalar lexical causatives*

In his discussion of a counterfactual model of causation, Dowty repeats von Wright’s (1968) observations that upon hearing about an event such as in (34), the speaker must believe that three kinds of facts obtain, as in (35).

(34) John opened the door. (Dowty 1979:99)

(35) a. The door was not open just before John acted.  
b. The door was open just after John acted.  
c. The door would not have become open on that particular occasion if John had not acted and all else had remained the same.

The problem is that the facts in (35a-b) do not obtain across the board for all causatives but depend on the type of the event. They hold true for scalar events, but not for nonscalar ones (the reason of which will become immediately clear). Consider the causatives of *work*, *run*, *eat (*i.e., *feed), worry* and *ring*. The sentences in (37) are not entailed from the sentences in (36). At best, they are conversational implicatures, and hence can be cancelled.

(36) a. Maria worked Carmen hard.  
 b. The coach run the group.   
 c. The parents fed the baby.  
 d. Luigi worried Aliyah.  
 e. Deion rang the bell.

(37) a. Carmen was not working just before Maria acted. (not entailed from 26a).  
 b. The group was not running just before the coach acted.(not entailed from 26b). c. The baby was not eating just before the parents acted. (not entailed from 26c). d. Aliyah was not worried just before Luigi acted. (not entailed from 26d). e. The bell was not ringing just before Deion acted. (not entailed from 26e).

(38) a. Carmen was already working before Maria walked in.  
 b. The group was performing warm up runs before the lesson began.  
 c. The baby was eating happily when the parents entered the kitchen.  
 d. Aliyah was already very worried.  
 e. Daphne rang the bell before Deion.

So, the nonscalar causatives in (36) do not behave on a par with the scalar (35): there is a state of “open” but not of “worried” or of “working”. The same pattern emerges with respect to (35b): nonscalar causatives do not entail that a certain state obtains when the event concludes. What remains to be explained is the connection between scalar structure and the entailments about earlier and later events.

First, consider the case of nonscalar lexical causatives. The caused subevent e2 can be written as in (39). It was shown in section 3.4 above that causation entails that a negation of e2 must hold at t0, the last time point before e2. (40) lists these possible negations among the set of alternatives to (39).[[9]](#footnote-9)

(39) caused-*P*: ∃e2λx[P(e2) ∧theme(e2, x) ∧ other-modifiers(e2) … ]

(40) not caused-P:

a. ∃e2λx[¬P(e2) ∧ proto-role(e2, x)]  
b. ∃e2λx[P(e2) ∧ agent (e2, x)] or  
 ∃e2λx[P(e2) ∧ cause (e2, x)] or  
 ∃e2λx[P(e2) ∧ experiencer (e2, x)] or   
 ∃e2λx[P(e2) ∧ instrument (e2, x)]  
c. ∃e2λx[P(e2) ∧theme(e2, x) ∧ ¬other-modifiers(e2) … ]

There are three options for a predicate obtaining at t0. First, in (40a), e2 does not occur, an option corresponding to the entailment in (35a). Second, in (40b), e2 occurs but the thematic role assigned to the argument is different. The subject is not a theme but can be either an agent (38a-c), an experiencer (38d), or an instrument (38e). Third, the modifiers are different, as seen the following example:

(41) a. Mariaj worked Carmeni hard after shei worked rather lazily.  
 b. The coach run the group faster after they ran absent-mindedly.  
 c. Deion rang the bell to the tune of happy birthday after it rang melancholy.

Moreover, when the cause relation between e1 ande2 is reinterpreted as a modifier of e2, a distinct earlier cause argument gives rise to a different modifier, as in (40c). This is the context of the Successive Object Modification Test in which two events are identical modulo the cause argument (section 1.2.1). The felicitousness of the predicates in the test’s environment (see (42) below) shows that they are nonscalar (do not have states).

(42) a. Maria worked Carmen hard right after Prince did it.  
 b. The coach run the group right after their mothers did it.  
 c. The parents fed the baby right after the nanny did it.  
 d. Luigi worried Aliyah right after Fahreen did it.  
 e. Deion rang the bell right after Daphne did it.

In sum, a caused event falling under a predicate P, can be reconciled with the very same predicate P obtaining prior to the caused event without contradiction. Therefore, the semantic representation leads to the conclusion that the examples in (37) are not entailed, in contrast with Dowty’s observations. To be fair, such predicates were never taken to have states; however there was a stipulation that only predicates such as causative *open* have states but predicates such as causative *work* or *worry* do not. The truth-conditions as to what constitutes a state are explicitly spelled out under a scalar theory.

*3.5.2 Entailments of scalar lexical causatives: the default reading*

The reason that (partially) scalar lexical causatives behave differently from nonscalar ones stems from the additional information that a sequence of measurements of the argument is homomorphic with the event. So, unlike nonscalar predicates, scalarity places severe restrictions on possible earlier and later events.

Let us set aside the question of endurantism vs perdurantism (Lewis 1986). In the former, classical approach, objects endure identically through time, whereas in the latter, objects “persist” through an interval of time by having instantaneous temporal parts in all the instants that comprise the interval. I adhere to using properties, states, and measurements of objects, relative to a time t or to a location l, whereas proponents of perdurantism can easily adjust those to time slices or to spatial parts of objects.

Without loss of generality, let dn ∈ { μ(x, w, tn) } be a possible measurement along the property δ that is lexicalized by the partially scalar predicate P at time tn, the last time point of e2. Let d0 ∈ { μ(x, w, t0) } be a measurement along the same δ at time t0, the timepoint immediately preceding the first time point of e2.

(43) Partially Scalar Predicates: P is partially scalar (repeated from (28))  
*to P*: ∃δ∃μλeλx[(P(e) ⇔ ƒ(e) ∈{ { μδ(x, w, t( | t∈ TIMES(e)} } ∧ NS(e)) ∧ proto-role(e, x) ]

Any event occurring at t0 for which the property δ is contextually relevant falls into one of two equivalence classes: into the event class characterized by d0 ≠dn or into the event class characterized by d0 =dn. Two events that differ in their manner, in their thematic role assignment, or in any other event modifiers but agree on d0 ≠dn fall into the first class. Each class is examined in turn below.

Let e’ be an arbitrary event in the class d0 ≠dn. In itself, it does not guarantee that that e’ and e do not both fall under the same scalar predicate P since there might be several μs that go through d0 and dn. It does however guarantee that the object underwent scalar change along δ (COS).

The meaning of a scalar predicate lexicalizing an *absolute standard* is that the object has reached the standard at the end of the event regardless of context. Hence, all μs included in the predicate exceed or end with that absolute degree, be it minimum standards such as *open* or *bent*, or maximum standards such as *close* or *straight* (see Kennedy & McNally 2005, Kennedy & Levin 2008). Given a corresponding AP for the state, or the measurement, at tn, the first classd0 ≠dn entails ¬AP at t0.

(44) a. John opened the door ⇒ The door was not open just before John acted.  
b. John straightened the rod ⇒ The rod was not straight just before John acted.  
c. John dried the towel ⇒ The towel was not dry just before John acted.

As was shown in section 3.5.1, such entailments do not arise when states are not well-defined with respect to P. Moreover, these entailments do not hold even for scalar causatives that do not lexicalize absolute standards (rather, they are implicatures):

(45) a. John heated the soup !⇒ The soup was not hot just before John acted.  
b. John lengthened the skirt !⇒ The skirt was not long just before John acted.

Providing context to scalar causatives with minimum standards to indicate that the standard has been reached before the beginning of the event cancels the entailment (see 46a-b). Causatives with maximum standards show the opposite behavior (see 46c-d).

(46) a. John opened the door a bit more !⇒ The door was not open before.  
b. John bent the rod a bit more !⇒ The rod was not bent before.  
c. John closed the door a bit more ⇒ The door was not closed before.  
d. John straightened the rod a bit more ⇒ The rod was not straight before.

Partially scalar predicates lexicalizing absolute standards behave on a par. If the scalar components of *break*, *smash* and *shatter* are identical*,* the prediction is that any of these predicates can be used interchangeably, as is borne out (47a-c). The same applies to manner-of-death verbs (47d-f).

(47) a. John broke/smashed/shattered the window ⇒ the window was not broken.  
b. John broke/smashed/shattered the window ⇒ the window was not smashed.   
c. John broke/smashed/shattered the window ⇒ the window was not shattered.  
d. John killed/drowned/ electrocuted the victim ⇒ the victim was not killed.  
e. John killed/drowned/ electrocuted the victim ⇒ the victim was not drowned.[[10]](#footnote-10)  
f. John killed/drowned/ electrocuted the victim ⇒ the victim was not electrocuted.

For predicates that do not have absolute standards (i.e., open-ended scales), if there is no contextually understood final state, the final degree or the final state must be named for the entailment to hold (otherwise, it is impossible to generate the reading that d0 ≠dn).

(48) a. John heated the soup to 50° ⇒ the soup was not in 50°.  
b. John lengthened the skirt to 50 cm ⇒ the skirt’s length was not 50 cm.  
c. John rolled the stone to the courtyard ⇒ the stone was not in the courtyard.

Recapitulating, a closer scrutiny reveals that entailments of lexical causatives vary greatly. The above scalar account provides truth-conditional analysis as to why the entailments of (partially) scalar causatives and nonscalar causatives diverge.

*3.5.3 Entailments of scalar lexical causatives: the restituitive reading*

Considering the second equivalence class of earlier events, let e’ be an arbitrary event in the class d0 =dn. Without loss of generality, choose one μ homomorphic with the caused subevent e2 out of all μs falling under the predicate, and look at measurements of μδ(x, w, t) at time interval [t1,tn]. The case of a constant measurement of the same degree (d0) is addressed in section 3.5.4 below. Alternatively, some d1 differs from d0 (and dn).

(49) The restituitive reading

d0 =dn , ∃t1∃d1, s.t d0 ≠d1 , μ(x, w, t1) = d1 , t1 ∈TIMES(e2)

This reading is felicitous iff the speaker accommodates the event to include a reversal from the final/initial state. This is what has been known as counter-directional change (see Fabricius-Hansen 2001, Horvath & Siloni 2011, Pedersen 2014). Here, only a distinctness requirement is posited as nominal scales are allowed.

(50) John opened the door.

(51) a. The door was not open just before John acted. (default reading), or  
b. The door was open just before acted. John slightly closed the door and opened it (again). (accommodation required)

Both readings (51a-b) entail a scalar change and hence COS. Unlike the default reading, the restituitive reading requires either accommodation or explicit contextual support. As before, the entailment applies to (partially) scalar lexical causatives lexicalizing absolute standards or with contextually understood final state, for the same reason.

*3.5.4 Entailments of maintenance: a non-causative interpretation*

Lastly, let us address the case where d0 ­holds at t0 and throughout e2 (for all events falling under P). In what follows, I argue that such pseudo “causative” is in fact maintenance that holds down to instants or to minimal activities, involving a constant μ.

Recall that in section 3.4, maintenance was argued to be distinct from causation although both share the same counterfactual dependencies (contra a “stative causer” analysis, Kratzer 2000, Pylkkänen 2000) since a maintaining event cannot precede a maintained event, and the relevant property must be extrinsic because it is not independent of accompaniment.

Let us define the stative predicate P’ to denote an event e3 which is homomorphic with the constant μ that measures d0. As such, any continuous interval *c* in which d0 holds, the stative e3 holds too, and it is true down to instants and in any subinterval of *c* (Bennet and Partree 1972, Dowty 1979, Landman 2008).

(52)A minimal stative scalar predicate P’

P’(at t): ∃e3∃δ∃μλx[(P’(e3) ⇔ μδ(x, w, t) = d0) ∧ proto-role(e, x)]

If e3 occurs at an instant t (or a minimum interval), independently from all other instants (since it is homomorphic with μ which depends only on current time point) then from the truth of the conditional e1→ e3, e1, e1 occurs at the same instant t, also independently from all other instants. e3 is *contemporaneously* maintained with e1 in any subinterval. The conclusion is that e3 cannot be considered (*during* P’) as being caused because e1 cannot precede e3. The maintained argument of e3 is necessarily accompanied by the argument of e1. There is a scalar structure is based upon S(δ), but as δ is interpreted as an extrinsic property, the state of the subject is not well-defined (empirical evidence for this claim is discussed in section 3.6 below).

Having established that a stative scalar predicate P’ cannot be interpreted as caused, let us turn our attention to partially scalar ones. In such a case, the causing event changes not an earlier measurement but a nonscalar modifier. That is, a change of manner (compare with such available readings in (40c), (41), (42)).

I cannot do justice to the question why manner adverbials are generally excluded from stative predicates. There is a considerable support in literature regarding the well-known stative adverbials gap (see Katz 2003 for lack of a Davidsonian event variable; Maienborn 2005 and Rothymayr 2009 for Kimian states). To demonstrate the issue, compare the different readings (see (54) below) of an adverbial such as *majestically* in the following eventive and stative sentences:

(53) a. The actor stood up majestically. (COS)  
 b. The actor stood majestically. (agentive maintain posture)  
 c. The castle stood majestically on the cliff. (simple position)

(54) a. The manner of the standing is majestic. (event-oriented, manner adverbial)  
 b. The subject is majestic. (subject-oriented adverbial)

Examples (53a-b), analyzed here as partially scalar predicates, allow the truthfulness of either reading and the falsity of the other. So, (53a-b) can mean that the way the actor rose or the way he maintained his posture was majestic (i.e., an activity), which is consistent with his portrayal of a non-majestic character. By contrast, the stative (53c) must be predicated of the subject: if one chooses to accept that the way the castle stands is majestic (54a), then it is because the castle itself has, or displays, majesty, (54b).

I limit myself to proposing an explanation as to why manner adverbials are exempted from stative scalar predicates. A true manner adverbial informs us about the way the event unfolds (as in (53a)) without committing to a subject-oriented reading (as in (54b)). So, a sentence such as *the door opened violently* means that for each of the infinitely many μs describing an opening of a door, the manner of the event homomorphic with that μ is violent. There is no commitment to particular measurements or properties of the subject as the adverbial is compatible with all of them.

The “impoverished” stative scalar predicates are different since they lexicalize a *single* constant μ that ties the subject to a specific measurement, μδ(x, w, t) = d0. ­It follows that it is impossible to provide a manner adverbial that modifies the event without committing to the fact that such an event (homomorphic with μ) means that the subject has a certain property value. i.e., the adverbial is subject-oriented too. The absence of true manner adverbials from stative scalar predicates is thus motivated.

In sum, stative scalar predicates were shown to be compatible with a transitive alternate that only has a maintenance interpretation; they are barred from showing lexical causatives. Stative partially scalar predicates do not exist because their events are homomorphic with a single constant μ, thus forcing a subject-oriented interpretation. The question why in English there no productive alternation between a stative scalar predicate and a corresponding non-causative transitive is discussed in section 3.6 below.

Recapitulating the entire discussion of causation and scalarity, lexical causatives do not entail COS in the general case, as evidenced by the behavior of causatives of nonscalar predicates such as *work*, *run*, *eat, worry* and *ring* (see (36)-(41)) and of scalar lexical causatives with no absolute standards such as *heat, lengthen* and *roll* (see (48)). The divergent patterns are expected because causation and states of objects are two independent linguistic entities. They may, however, co-appear. In such a case, their semantic interaction yields the COS constraint.

*3.6 Meaning preservation in causation vs. meaning shift in maintenance*

The choice of linguists to define the causative-unaccusative alternation as the set of corresponding pairs is based on the systematic preservation of a certain partial identity. Although the alternates are not truth-conditionally equivalent, there is a relation of entailment between them: the causative entails the corresponding unaccusative. This follows naturally if the unaccusative event and the caused subevent e2 in the lexical causative are identical (e.g. *Mary melted the ice* ⇒ *the ice melted* or *Jonah rolled the stone* ⇒ *the stone rolled*).

These entailments are strongly tied with intrinsic properties of the argument. When a predicate is (partially) scalar with respect to an intrinsic property δ, the set of all μs into S(δ) is well-defined, and the scalar components of two predicates are identical iff their sets of μs are identical. Given that both alternates share the same event(s), it follows from a scalar analysis of unaccusatives that the alternation preserves intrinsicality.

(55) Preservation properties of the causative-unaccusative alternation:

a. The alternation preserves the intrinsic properties of the internal argument.  
b. The subject of the unaccusative and the object of the causative are *intrinsic duplicates*.

(56) Duplicaton Preserving: (Repeated from (23)

a. x at world *u* is a duplicate of y at world *v* iff, for any basic intrinsic property P, x has P at *u* iff y has P at *v*.   
b. F is intrinsic iff, for any x and y, and for any possible worlds *u* and *v* such that x at *u* is a duplicate of y at *v*, x has F at *u* iff y has F at *v*.

The entailments of maintenance are entirely different from causation due to the former’s temporal properties and obligatory extrinsic interpretation. In (57b) below, the safety of the city is intrinsic, whereas in (57a), the city’s safety contemporaneously depends on the subject. Thus, *the city* in (57a-b) are not intrinsic duplicates.

(57) a. The cavalry / the walls protected the city.   
 b. \*The city protected. (intended meaning: the city is safe).

Let us explore (57) in more depth. For the safety to be intrinsic in a sentence such *as the walls protected the city*, *the walls* must be a proper part of an intrinsic duplicate of *the city* in any counterfactual world in which the property holds (see (56)), i.e. a part of itin any safe world, clearly a false statement. Furthermore, if it were true, no information is added to (57a) in comparison with (57b), contrary to fact. *The city* (in 57a) has no state with respect to safety.

Additional evidence is found by looking at the state of the object as the event e2 concludes at time tn with a measurement dn. A second distinct state obtaining later entails that there is a μ going through those two states, and an event homomorphic with this μ occurred. It is possible only given explicit information about such a later event, or if it is included in a presupposed set of the natural course of events (e.g., cooling). This is in fact Dowty’s second entailment, (35b). The reader is welcome to verify that such entailments hold for scalar events, but not for nonscalar ones.

(58) a. John opened the window ⇒ the window is open (after event is concluded).  
b. Mary broke the window ⇒ the window is broken (after event is concluded).  
c. Murat moved the stone ⇒ the stone is in a final location.  
d. Jonah warmed the soup ⇒ the soup is a final degree.

If the hypothesis that maintenance verbs involve an extrinsic property is true, the prediction is that the measurement does not necessarily endure after event is concluded, which is borne out.

(59) a. John protected the city !⇒ the city is safe/protected (after event is concluded).  
 b. John held the log !⇒ the log is the same location (after event is concluded). c. The army surrounded the city !⇒ the city is surrounded (after conclusion).

This discussion establishes a clear-cut distinction between causative-unaccusative pairs and hypothetical maintenance-unaccusative pairs:

(2) Table 2: Causative alternation vs. Maintenance (hypothetical) alternation

|  |  |  |
| --- | --- | --- |
|  | Causation | Maintenance |
| Temporal behavior | e1 precedes e2 | e1 contemporaneous with e2 |
| Preservation of intrinsicality | Yes | No |
| Preservation of events | Yes | No |
| In the presence of a scalar event | COS (non-constant measurement function μ) | constant measurement function μ |

Nothing of what has been said so far precludes the a-priori existence of a productive maintenance alternation. After all, the meaning-shift involved in maintenance is systematic, too: the scalar structure on S(δ) shifts from being along an intrinsic property to being along an extrinsic one. Such an alternation however would be different from the canonical causative-unaccusative alternation in its preservation properties. The investigation of the productivity of maintenance phenomenon cross-linguistically, and in nonscalar verbs, is left for a future research.

*3.7 revisiting evidence from non-alternating verbs*

It is now possible to explain the behavior of non-alternating verbs from all sets visited in section 2 in light of the scalar theory. First, some non-alternating stationary-objects verbs (section 2.2) such as *cross* or *surround* seem to lexicalize extrinsic properties (as they require accompaniment), barring intransitive alternates entirely. This is a subtle point since there is an element of circular reasoning, which I propose to circumvent by considering all possible intrinsic properties. In stationary objects, none of the intrinsic properties of the object are altered and measuring any of them is constant. If stationary-object transitives are analyzed as involving a constant μ (on a par with *protect*, see (57)), the prediction is that they exhibit maintenance characteristics. The reader may verify the verbs in (13) (e.g. *cross, surround, hit, protect, carry*…) indeed have them: the event maintained by the object is contemporaneous with the maintaining event of the subject (which is either an activity or an aspectual stative), and the object is accompanied by the subject down to instants or to minimal activities. Lacking COS, these verbs are predicted not to belong to the causative-unaccusative alternation although they do share counterfactual dependency semantics with causative verbs.

Second, non-alternating unaccusatives (section 2.3) all denote constant μs. Verbs of existence denote a constant spatio-temporal function that relates their subject to a constant scalar coordinate in time and space. Unless the coordinate is recoverable from context or is contextually irrelevant, it must be spelled out since the spatio-temporal scale is open-ended. The same logic applies equally to the “simple position” sense of spatial configuration verbs. The constant μ in verbs of measurement is self-evident.

Third, *fill*-verbs in their stative meaning do not show the alternation (section 2.4). The stative reading of *fill* has a spatial μ: each location within the extent of the object has a constant measurement, that is, each location within the pool is filled to (at least) some contextually implicit standard degree (unlike spatial uses of COS verbs such as *widen* or *narrow*, see Deo et al 2013). The eventive reading, by contrast, ranges not over the set of spatial locations but over the level of the extent of the object itself, i.e., the extent (size) of the object increases over time. Lastly, *bloom*-verbs (section 2.5) also show that a constant μ with respect to the relevant intrinsic property blocks the causative alternate.

In each and every case, a constant μ reading (i.e, a non-COS reading) blocks the alternation. The theory pursued here showed how the interaction of causal semantics and scalar structure yields the COS constraint of the causative-unaccusative alternation. These results do not preclude the possibility of a distinct maintenance alternation, with distinct characteristics (see table (2)), unproductive in English.

***4 In defense of a scalar analysis of roll-verbs***

*4.1 No distinction between property and path scales*

Since spatial coordinates are measurable values, I make no distinction between property scales and path scales, regarding the corresponding predicates as based upon scalar structures. This analysis differs from previous accounts in which *roll*-verbs are taken to not involve COS. Levin & Rappaort Hovav (2010) argue that these verbs describe a change, but unlike inherently directed motion verbs (e.g. *enter*), they lack an ordering relation and therefore do not qualify as scalar changes. The approach adopted here relies on a (standard) typology of incrementally progressive scales (Levels of Measurement, see section 3). There is no theoretical reason to preclude scalar verbs such as *crack* or *die*, for which an ordering relation is arbitrary, from being associated with weaker nominal scales. So far, it is merely a matter of definition what constitutes a scalar change. Nonetheless, the burden of proof, that *roll*-verbs pattern with other COS verbs, rests with me. I address below evidence from resultatives previously taken to support the claims that *roll*-verbs are nonscalar and show it to be inconclusive. I also show that *roll*-verbs pattern with (scalar) degree achievements with respect to their combination with degree constructions and their temporal/extent ambiguity.

*4.2 Resultatives of scalar verbs*

The extensive study of resultatives reveals that if a verb lexicalizes a scale, a secondary resultative predication cannot introduce a different scale (Tenny 1994, Goldberg 1995, Levin & Rappaport Hovav 1995, Tortora 1998, Wechsler 2005, among others).

(60) a. \*We dimmed the room empty. d. \*The vase fell broken.   
b. \*We froze the people out of the room. e. \*Willa arrived breathless.   
c. \*We broke the vases worthless.

If a scalar verb licenses a resultative, the latter can only be interpreted as further specifying a state. In this regard, “resultative” is a misnomer because the secondary predication does not introduce a new result state at all; it only pinpoints, or singles out, a pre-existing final state along a dimension lexicalized by the verb. It is a weak (Washio 1997), or false (Rappoport 1999), resultative. Formally, the state function measures the object along two contextually relevant intrinsic properties δ1, δ2. Since δ1 is encoded by the verb, the measurement along δ2 is fixed according to the final state that includes the measurement along δ1. For example, (61a) means that the final state of the ice-cream is frozen, further specifying it to be solid. (61c) means that the final state is the deictic center, further specifying it to be the airport (see also Tortora 1998).

(61) a. We froze the ice cream solid.  
b. The biologist dimmed the room to the level of starlight.  
c. We arrived at the airport.  
d. The leaves fell to the ground.

Based on evidence such as (60), (61) above, L&RH (2010) correctly argue that it is expected from nonscalar verbs to license a wide range of scale-denoting XPs, unlike scalar verbs which license a more restricted set. L&RH go on to argue that examples such as (62) support the claim that *roll*-verbs are nonscalar, because they permit a range of scale-denoting XPs (examples (62a-d) are taken from L&RH 2010).

(62) a. We rolled the dough **flat / smooth**.  
b. Rinse out all the soap and roll it [=the sampler] **dry** between two towels, squeezing out the water as you go.  
c. Champ rolled the window **closed**.  
d. Mary’s eyelids rolled **shut**.  
e. John rolled the dough **thin**. (Washio 1997:(27) weak resultatives)

The examples above do not necessarily support L&RH’s claim. The question is not whether a larger-than-average range of compatible resultatives for *roll* deems it nonscalar, but whether the secondary predications in (62) are true resultatives, i.e. introducing a new state, and not pinpointing a pre-existing one along a scale lexicalized by the verb. I first show that the role of the primary and secondary predicates can be reversed, which is consistent with a scalar analysis of *roll*-verbs. I then provide additional evidence in which *roll*-verbs pattern with scalar verbs.

A contextually relevant property associated with the predicates *flatten*, *smooth*, *shut*, *close* is that they involve a (usually downwards) change-of-location of certain objects. In examples (62), the adjectives specify a final low(er) location: they pinpoint a pre-existing low location that coincides with the final location resulting from the change-of-location encoded by *roll*. It is possible to reverse which predicate further specifies the other because the intersection is the same. The extension of the corresponding deadjectival verbs with a secondary PP that describes the same change-of-location expressed by *roll* (e.g., *down*) yields the same scalar component modulo the manner.

(63) a. With the 2nd batch, I **flattened** the dough **down** by spoon to leave a little caved center. (<https://thecoconutmama.com/coconut-flour-cookies/>)  
b. he had **flattened** the thick dead grass **down to earth level.**c. we **smoothed** the fabric **down.**d. I **closed** the window **down** and the glass broke.  
e. I **shut** my eyes/the window **down**.  
f. The heavy dew **wet** the grass **down flat**. (cf. 62b “wet” vs. “dry”)

If one accepts that *roll/smooth flat* equals “flatten down by manner of rolling/smoothing”, then one accepts also that the scalar components of both paraphrases are equal. Given an undisputed Single Delimiting Constraint and the predicates reversal in (62)-(63), the conclusion that *roll*-verbs are scalar and license false (weak) resultatives follows, contra L&RH’s argument. The wider range of resultatives arises since these predicates (*flat*, *smooth*, *shut*) admit final locations of some objects in addition to final properties.

The original question then reverts to the tests distinguishing true resultatives modifying nonscalar verbs from false (weak) resultatives modifying scalar ones. It seems that the confusion partly arises from the fact that *flat* functions as weak resultative for *roll* and as a strong resultative for *hammer*. The insensitivity of *hammer* to states is detected by various diagnostics, such as the consecutive and simultaneous object modification tests, Beavers’ test (section 1) and Gawron’s tests (discussed below).

(64) a. John hammered the metal (too) right after Mary had done it.  
b. John hammered the metal but there was nothing different about it.

(65) a. #John hammered the metal **flat** (too) right after Mary had done it.  
b. #John hammered the metal **flat** but there was nothing different about it.

Since (65), unlike (64), shows sensitivity to state detection, it emerges that the secondary predication compositionally introduces a scalar structure which was not lexicalized by *hammer*. By contrast, *roll*-verbs show sensitivity to state detection (see (8d), (48c)).[[11]](#footnote-11)

More empirical evidence in favor of analyzing *roll*-verbs as scalar comes from a discussion found in Gawron (2007) and Kennedy (2012). According to Gawron, incremental theme verbs (as in (66)) do not combine with degree constructions in the same way degree achievements do (as in ((67)). *Roll*-verbs (as in (68)) by contrast, pattern with degree achievements but not with incremental theme (see also LR&H 2010):

(66) a. ??Jones wrote the paper more than Smith did. (Kennedy 2012:(29))  
b. ??Jones didn’t write the paper as much as Smith did.  
c. ??Jones wrote the paper too much.  
d. ??Jones wrote the paper two sections.  
e. Jones wrote the book some more !⇒ the book will be more written.

(67) a. Jones lowered the rope more than Smith did.  
b. Jones didn’t lower the rope as much as Smith did.   
c. Jones lowered the rope too much. (accommodation required)  
d. Jones lowered the rope two meters.   
e. Jones lowered the rope some more ⇒ the rope is lower.

(68) a. Jones rolled the stone more than Smith did.  
b. Jones didn’t roll the stone as much as Smith did.   
c. ?Jones rolled the stone too much.(open scale, no contextually implicit standard)  
d. Jones rolled the stone two meters.  
e. Jones rolled the stone some more ⇒ the stone covered more distance.

The contrast between incremental theme verbs and degree achievements is due to the lack of scalar structure in the former vs. its presence in the latter. Thus, the fact the *roll*-verbs pattern with degree achievements with respect to the same data indicates that they too are compatible with scalar structure. In more detail, since the comparative “more” requires an ordering relation, the acceptance of (68) strengthens a nominal scale into an interval scale: as the event unfolds, each state of the stone measures the distance accumulated, which is equal to the length of the path, for any path. A spatial scale can be easily equipped with an ordering relation by summation of changes of locations. This piece of evidence does not show that *roll*-verbs must be lexically scalar, but it shows that they are, unlike incremental theme verbs, compatible with a scalar structure.

*Roll*-verbs also pattern with degree achievements with respect to their ambiguous extent/temporal readings because they express not only the manner in which a path is traversed but also the path shape itself. Gawron (2007) and Deo et al (2013) show that generalizing the domain of scalar structure in degree achievements to range over any axis (including a spatial one) predicts the availability of readings such as in (69) below. The same ambiguity is present in *roll*-verbs. Compare:

(69) The crack widened from the north tower to the gate. (extent / temporal)

(70) a. The mountains rolled from Canada to New Mexico. (extent)  
 b. The stone rolled from the hilltop to the valley. (temporal)  
 c. The road twisted past soft cliffs. (extent)  
 d. The tip of the coil twisted. (temporal)  
 e. The road swung around the bottom of the hill. (extent)  
 f. The pendulum swung rhythmically. (temporal)

If the extent readings of degree achievements are licensed due to (generalized) scalar structure, then a scalar analysis of *roll*-verbs straightforwardly predicts the same pattern.

(71) Measurement Functions ((26), repeated)

a. Temporal: μδ : D x W x T → S(δ), or μδ(x,w,t) = s where ∈ S(δ).  
b. Spatial: μδ : D x W x L → S(δ), or μδ(x,w,l) = s, where ∈ S(δ).

In the case of (71b), μ is an identity function: the measurement of an argument occupying a location is the location itself.[[12]](#footnote-12) The resultant scalar structure is a set of nominal locations along some path-shape, an ordered axis lexicalized in the verb. Because spatial μ is an identity function, the ordering of its domain and range can be the same. *Roll*-verbs such as *swing*, *twist*, or *wind* are found in path-shape set in Fillmore & Baker (2000).

Recapitulating, in their basic sense, partially scalar *roll*-verbs have at least an unordered change-of-location sense and an entailed ordered one along any path the subject makes (a distance scale) or along a lexicalized path-shape. Under a theory which treats locations as states and which allows scales to vary in power, the classification of *roll*-verbs as COS verbs is consistent with the diagnostics of COS, with their behavior with respect to secondary predication, with their combination with degree construction, with their temporal/extent ambiguity, and with their unaccusativity.

**5 Summary**

The fact that the distribution of alternating and non-alternating verbs is partly governed by the COS constraint was a stipulation. Previous attempts, such as the affectedness constraint (Jaeggli 1986), lacked explicit truth conditions. This paper showed the co-occurrence of causation and scalar structure to yield the COS constraint. Thus, if unaccusatives are scalar, then alternating unaccusatives, but not unergatives, are expected to show it. The paper studies several heterogeneous sets of non-alternating transitives and unaccusatives that that share a common denominator of lacking COS interpretation, strengthening the empirical basis of the COS constraint (section 2). The scalar account pursued here (in the footsteps of Hay, Kennedy & Levin 1999, Kennedy & McNally 2005, Kennedy & Levin 2008, Deo et al 2013) develops a well-defined notion of a state (of an object): the vector of measurements along all contextually relevant properties. Again, unaccusatives, but not unergatives, entail well-defined states. The paper also ties he COS constraint to the preservation properties of the alternation (section 3). From a closer scrutiny of unaccusative manner-of-motion verbs such as *roll*, which were previously taken to be nonscalar, the conclusion emerges that they are consistent with a scalar analysis (section 4). Filling the lacuna of the COS constraint, the semantic properties of states, and of the causative-unaccusative alternation, become clearer.

References

Alexiadou, Artemis, Elena Anagnostopoulou & Florian Schäfer. 2006. The properties of anticausatives crosslinguistically. *Phases of Interpretation*, vol. volume 91, 187–212. (Studies in Generative Grammar). Mouton de Gruyter.

Alper, Theodore. 1987. "A classification of all order-preserving homeomorphism groups of the reals that satisfy finite uniqueness". *Journal of Mathematical Psychology*. 31 (2): 135–154.

Beavers, John. 2011. On affectedness. *Natural Language & Linguistic Theory* 29(2). 335–370.

Beavers, John. 2013. Aspectual classes and scales of change. *Linguistics* 51(4). 681–706.

Beavers, John and Andrew Koontz-Garboden. 2013. Complications in diagnosing lexical meaning: A rejoinder to Horvath and Siloni. *Lingua* 134:210–218

Bennett, Michael and Barbara Partee. 1972. *Towards the logic of tense and aspect in English*. Report for the System Development Corporation. Santa Monica.

Borer, Hagit. 2005. *Structuring Sense. In Name Only. vol I. The Normal  Course of Events. vol II*. Oxford University Press.

Chierchia, Gennaro. 2004. A semantics for unaccusatives and its syntactic consequences. In A Alexiadou (ed.), *The unaccusativity puzzle: Explorations of the syntax-lexicon interface*, 22–59. Oxford: Oxford University Press.

[Deo](http://ling.auf.net/lingbuzz/001883?_s=1AnpSpR5jqCW3_5Y&_k=chUT1k3jDWTrhl9v&1) Ashwini, [Itamar Francez](http://ling.auf.net/lingbuzz/001883?_s=1AnpSpR5jqCW3_5Y&_k=chUT1k3jDWTrhl9v&2) and [Andrew Koontz-Garboden](http://ling.auf.net/lingbuzz/001883?_s=1AnpSpR5jqCW3_5Y&_k=chUT1k3jDWTrhl9v&3). 2013. From change to value difference in degree achievements. *Proceedings of SALT* 23: 97–115.

Dowty, David. 1979. *Word meaning and Montague grammar: the semantics of verbs and times in generative semantics and in Montague’s PTQ*. Dordrech; Boston:Kluwer Academic Publishers.

Fabricius-Hansen, Catherine. 2001. Wi (e) der and again (st). *Audiatur Vox Sapientiae.A Festschrift for Arnim von Stechow* 52. 101–130.

Fagan, Sarah. 1992. *The syntax and semantics of middle constructions: A study with special reference to German*. Cambridge University Press.

Fellbaum, Christiane, and Anne Zribi-Hertz. 1989. "La construction moyenne en français et en anglais: étude de syntaxe et de sémantique comparées." *Recherches linguistiques de Vincennes* 18: 19-57

Filip, Hana and Susan Rothstein. 2005. “Telicity as a Semantic Parameter.” *Formal Approaches to Slavic Linguistics* (FASL) XIV. The Princeton University Meeting, edited by James Lavine, Steven Franks, Hana Filip and Mila Tasseva-Kurktchieva. Ann Arbor, MI: University of Michigan Slavic Publications. Pp.139-156

Filip, Hana. 2008.  [“Events and Maximalization.”](http://user.phil-fak.uni-duesseldorf.de/~filip/Filip.Events.Max.2008.pdf) *Theoretical and Crosslinguistic Approaches to the Semantics of Aspect*, edited by Susan Rothstein. Amsterdam: John Benjamins. Pp.217-256.

Fillmore, Charles. 1970. The grammar of hitting and breaking. In R. A. Jacobs, & P. A. Rosenbaum (Eds.), *Readings in English transformational grammar* 120-133. Waltham, MA: Ginn.

Fillmore, Charles and Colin Baker. 2000. FrameNet web site. <https://framenet.icsi.berkeley.edu/fndrupal/>

Folli, Raffaella and Heidi Harley. 2005. Consuming results in Italian and English: Flavors of v. In *Aspectual inquiries*. Eds. Roumyana Slabakova and Paula Kempchinsky. 95–120. Dordrecht: Kluwer.

Frisch, Mathias. 2007. Causation, Counterfactuals and Entropy, In Huw Price & Richard Corry *(eds.), Causation, Physics, and the Constitution of Reality: Russell's Republic Revisited.* Oxford University Press

Gawron, Jean Mark. 2007. *Paths and the Language of Change*, unpublished ms., San Diego State University, San Diego, CA.

Gazdar, Gerald. 1979. *Pragmatics: Implicature, presupposition, and logical form*. Academic Press New York.

Goldberg, Adele. 1995. *Constructions: A construction grammar approach to argument structure*. University of Chicago Press.

Harley, Heidi. 2008. On the causative construction. In Shigeru Miyagawa & Mamoru Saitō (eds.), *The Oxford handbook of Japanese linguistics*. Oxford University Press, USA.

Harley, Heidi. 2012. Lexical decomposition in modern generative grammar. *Handbook of Compositionality*. Oxford: OUP, 328–350.

Härtl, Holden. 2003. Conceptual and grammatical characteristics of argument alternations: The case of decausative verbs. *Linguistics* 41(5). Walter de Gruyter. 883–916.

Hay, Jennifer, Christopher Kennedy & Beth Levin. 1999. Scalar structure underlies telicity in degree achievements. *Proceedings of SALT*, vol. 9, 127–144.

Hoekstra, Teun and Rene Mulder. 1990. Unergatives as copular verbs: Locational and existential predication. *The Linguistic Review* 7 (1). 1–79.

Hoekstra, Teum & Ian Roberts. 1993. Middle constructions in Dutch and English. *Knowledge and language* 2. 183–220.

Horn, Laurence. 1972. *On the semantic properties of logical operators in English*: UCLA dissertation.

Horvath, Julia & Tal Siloni. 2011. Causatives across components. *Natural Language & Linguistic Theory*. 1–48.

Horvath, Julia & Tal Siloni. 2013. Anticausatives have no Cause (r): A rejoinder to. *Lingua* 131. Elsevier. 217–230.

Jaeggli, Osvaldo. 1986. Passive. *Linguistic Inquiry* 17(4). 587–622.

Katz, Graham. 2003. Event arguments, adverb selection, and the Stative Adverb Gap. In *Modifying Adjuncts*: Ewald Lang, Claudia Maienborn & Catherine Fabricius-Hansen (eds.), Berlin: Mouton de Gruyter. pp. 455-474

Kennedy, C. and L. McNally. 2005. “Scale Structure and the Semantic Typology of Gradable Predicates”. *Language* 81.2.

Kennedy, C. and B. Levin. 2008. “Telicity Corresponds to Degree of Change”, in McNally, L. and C. Kennedy (eds.), *Adjectives and Adverbs: Syntax, Semantics and Discourse*. Oxford: Oxford University Press

Kennedy, C. 2012. “The Composition of Incremental Change”, in Demonte, V. and L. McNally (eds), *Telicity, Change, State: A Cross-categorical View of Event Structure*. Oxford: Oxford University Press.

Kim, Jaegwon. 1982. Psychophysical supervenience. *Philosophical Studies* 41(1). 51–70.

Koontz-Garboden, Andrew. 2009. Anticausativization. *Natural Language & Linguistic Theory* 27(1). pp. 77–138

Kratzer, Angelika. 2000. Building statives. In L. Conathan (Ed.), *Proceedings of the 26th Annual Meeting of the Berkeley Linguistics Society*, (pp. 385-399). Berkeley.

Krifka, Manfred. 1989. Nominal reference, temporal constitution and quantification in event semantics. In *Semantics and contextual expression*, ed. Renate Bartsch, Johann van Benthem, and Peter van Emde Boas, 75–115. Stanford, CA: CSLI Publications.

Kutach, Dougles. 2013. *Causation and its Basis in Fundamental Physics*, Oxford: Oxford University Press.

Landman, Fred. 2000. *Events and Plurality*, Kluwer: Dordrecht.

Landman F. & S. Rothstein (2010). Incremental homogeneity and the semantics of aspectual for phrases. In M. Rappaport Hovav, I. Sichel and E. Doron (eds.) *Syntax, Lexical Semantics and Event Structure*, Oxford University Press.

Lewis, David. 1973. *Counterfactuals*. Cambridge, Mass. : Harvard University Press.

Lewis, David. 1986. *On the plurality of worlds*. Oxford: B. Blackwell.

Lewis, David & Rae Langton. 1998. Defining “intrinsic.” *Philosophy and Phenomenological Research* 58(2). 333–345.

Levin, Beth & Malka Rappaport-Hovav. 1995. *Unaccusativity: at the syntax-lexical semantics interface*. (Linguistic Inquiry Monographs ; 26). Cambridge, Mass: MIT Press.

Levin, Beth & Malka Rappaport Hovav. 2010. Lexicalized Scales and Verbs of Scalar Change. *46th Annual Meeting of the Chicago Linguistics Society*.

Levin, Beth. and Malka Rappaport Hovav. 2013. `Lexicalized Meaning and Manner/Result Complementarity, in B. Arsenijević, B. Gehrke, and R. Marín, eds., *Subatomic Semantics of Event Predicates*, Springer, Dordrecht, 49-70.

Levin, Beth. and Malka Rappaport Hovav. 2019. [Lexicalization Patterns](https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199685318.001.0001/oxfordhb-9780199685318-e-18), in R. Truswell, ed., *Oxford Handbook of Event Structure*, Oxford University Press, Oxford, UK, 395-425.

Luce, Robert. 1997. "Quantification and symmetry: commentary on Michell 'Quantitative science and the definition of measurement in psychology'". *British Journal of Psychology*. 88 (3): 395–398

Maienborn, Claudia 2005. On the limits of the Davidsonian approach: The case of copula sentences. *Theoretical Linguistics* 31, 275–316.

Marshall, Dan and Josh Parsons, 2001, “Langton and Lewis on ‘*Intrinsic*’”, *Philosophy and Phenomenological Research*, 63: 347–51.

Mateu, Jaume and Vıctor Acedo-Matellan, 2011. “The Manner/Result Complementarity ´ Revisited: A Syntactic Approach”, Research Report GGT-11-02, Grup de Gramatica Teorica, Department de Filologia Catalana, Universitat Autonoma de Barcelona, Barcelona.

McKoon, Gail and Talke Macfarland. 2000. Externally and interally caused change of state verbs. *Language* 76, 833--858.

Neeleman, Ad & Hans van de Koot. 2012. The Linguistic Expression of Causation. In Martin Evarert (ed.), *The Theta System: argument structure at the interface*. Oxford University Press.

Parsons, Terence. 1990. *Events in the semantics of English: a study in subatomic semantics*. (Current Studies in Linguistics Series). Cambridge, Mass: MIT Press.

Pedersen, Walter. 2014. A Scalar Analysis of Again-Ambiguities. *Journal of Semantics*. Oxford University Press.

Pesetsky, David. 1995. *Zero syntax: experiencers and cascades*. (Current Studies in Linguistics ; 27). Cambridge, Mass: MIT Press.

Piñón, Christopher. 2001. Modelling the causative-inchoative alternation. *Linguistische Arbeitsberichte* 76. 273–293.

Price, Huw and Brad Weslake, 2009. The Time-Asymmetry of Causation, in Helen Beebee, Chris Hitchcock, and Peter Menzies (eds.). *The Oxford Handbook of Causation*, Oxford: Oxford University Press, 414–43.

Pylkkänen, Liina. 2000. On Stativity and Causation. In C. Tenny, & J. Pustejovsky (Eds.), Events as *Grammatical Objects. The Converging Perspectives of Lexical Semantics and Syntax* (pp. 417-445). Stanford: CSLI Publications.

Pylkkänen, Liina. 2008. *Introducing arguments*. (Linguistic Inquiry Monographs ; 49). Cambridge, Mass: MIT Press.

Ramchand, Gillian. 2008. *Verb meaning and the lexicon: a first-phase syntax*. (Cambridge Studies in Linguistics ; 116). Cambridge, UK: Cambridge University Press.

Rappaport Hovav, Malka, and Beth Levin. 2010. Reflections on manner/result complementarity. In *Syntax, lexical semantics, and event structure*, ed. Edit Doron, Malka Rappaport Hovav, and Ivy Sichel, 21–38. Oxford: Oxford University Press.

Rappaport Hovav, Malka, and Beth Levin. 2012. Lexicon uniformity and the causative alternation. In: Martin Everaert, Marijana Marelj and Tal Siloni (Eds.), *The Theta System: Argument Structure at the Interface*. Oxford University Press, Oxford, UK, pp. 150--176.

Rappaport Hovav, Malka. 2014. lexical content and context: the causative alternation in english revisited. *Lingua* 141: 8-29.

Rapoport, Tova. 1999 Structure, Aspect, and the Predicate, *Language* 75, 653-677.

Reinhart, Tanya. 2002. The Theta System: an overview. *Theoretical Linguistics 28*(3). De Gruyter. 229–290

Rizzi, Luigi. 1990. *Relativized minimality.* The MIT Press.

Roberts, Ian. 1987. *The Representation of Implicit and Dethematized Subjects*. Dordrecht: Foris.

Rothmayr, Antonia 2009. *The Structure of Stative Verbs*. Amsterdam: Benjamins.

Rothstein, Susan, 2004. *Structuring Events: A Study in the Semantics of Lexical Aspect*. Blackwell: Oxford.

Sider, Theodore, 2001. “Maximality and Intrinsic Properties”, *Philosophy and Phenomenological Research*, 63: 357–64.

Spalek, Alexandra. 2014. *Verb Meaning and Combinatory Semantics: A Corpus-Based Study of Spanish Change of State Verbs*. Doctoral dissertation. universitat pompeu fabra

Stevens, Stanley. 1946. On the theory of scales of measurement. *Science, 103,* 677–680.

Tenny, Carol. 1994. *Aspectual roles and the syntax-semantics interface*. *Vol. 52.* Dordrecht: Kluwer.

Tortora, Christina. 1998. Verbs of Inherently Directed Motion Are Compatible with Resultative Phrases. *Linguistic Inquiry* 29(2): 338-345.

van Valin, Robert and David Wilkins. 1996. The case for’effector': Case roles, agents, and agency revisited. In Masayoshi Shibatani (ed.), *Grammatical constructions: Their form and meaning*, 289–322. Oxford: Oxford University Press.

Washio, Ryuichi. 1997. Resultatives, compositionality and language variation. *Journal of East Asian Linguistics* 6, 1-49

Wechsler, Stephen. 2005. Resultatives under the ‘event-argument homomorphism’ model of telicity, In Nomi Erteschik-Shir and Tova Rapaport, (eds.), *The Syntax of Aspect*. Oxford University Press, Oxford.

Wolff, Phillip. 2003. Direct causation in the linguistic coding and individuation of causal events. *Cognition* 88, 1--48.

von Wright, Georg. 1968. An essay in deontic logic and the general theory of action: with a bibliography of deontic and imperative logic. *Acta Philosophica Fennica* (2l)*,* Amsterdam, North-Holland.

Wright, Sandra. 2002. *Transitivity and change of state verbs*. BLS 28, 339--350.

1. If one accommodates (6d), a counter-directional change interpretation arises, which reverts the object to its original state under the condition that the change is reversible (Fabricius-Hansen 2001, Horvath & Siloni 2011). See section 3.5.3 for restitutive readings. [↑](#footnote-ref-1)
2. One needs to be explicit regarding the nature of the task. In (8c), Mary finished heating the soup to a certain temperature, so it cannot be that John lagged at heating the soup to the same temperature. In (8d), Mary had to move or roll the stone a certain distance, so it cannot be that John lagged behind. It means that the state is well-defined with respect to the dimension underlying the task (e.g., temperature, distance). [↑](#footnote-ref-2)
3. Some existence verbs include a spatio-temporal argument (e.g. *live*). I motivate its presence in section 3.7. [↑](#footnote-ref-3)
4. Measure phrases (MP) are not referential and cannot be used with quantifiers or with pronouns: *the present costs (\*every/\*any) ten dollars/(\*it)*. MP cannot be extracted from wh-islands (Rizzi 1990). [↑](#footnote-ref-4)
5. The ordering of points or subintervals (initial, final) is made according to the order relation of the axis itself, <2, (e.g., temporal), divorced from the ordering of the scale. See Deo et al (2013) for details. [↑](#footnote-ref-5)
6. Scalar structures can be inserted compositionally. Crucially, these scales are not lexically assigned at the level of the verbal predicate. See discussion of weak and strong resultatives in section 4. [↑](#footnote-ref-6)
7. e1→ e2 is a counterfactual statement and means: "if e1 were true, e2 would be true". It is written in such a form in order to distinguish it from other kinds of conditional statements. [↑](#footnote-ref-7)
8. Lewis has no built-in time asymmetry, which he derives independently. An alternative is the entropy-driven “past hypothesis” (See Frisch 2007, Price and Weslake 2009, Kutach 2013 for discussion). [↑](#footnote-ref-8)
9. Unlike scalar implicatures (Horn 1972, Gazdar 1979), the alternatives need not be ordered with respect to the information conveyed in the causative utterance. [↑](#footnote-ref-9)
10. The assumption involved in (47e,f) is that drowning or electrocution results in death (at t0 / at tn). [↑](#footnote-ref-10)
11. Beavers’ test “#but there was nothing different about it” applies only to property scales. It cannot be applied to either inherently directed motion verbs that are widely analyzed as scalar, or to *roll*-verbs. [↑](#footnote-ref-11)
12. Equivalently, the argument can be viewed as a function from spatial intervals/points to spatial parts. [↑](#footnote-ref-12)