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Achievements vs. *Accomplishments* : A Computational Treatment of Atomicity, Incrementality, and Perhaps of Event Structure

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Abstract

Achievements and *accomplishments* are argued in this paper to differ w.r.t. *atomicity* (rather than punctuality), a notion strongly but not exclusively related to *incrementality*, i.e., to event-object mapping functions ; the latter will be shown to be unsufficient to account for certain cases of non-atomicity. A computational treatment of incrementality and atomicity will be presented, and a number of related empirical problems considered, notably lexical polysemy in verb – argument relationships. Finally, the approach will be shown to be extendable to the notion of telicity, opening the way to a broader treatment of event structure.

1. Introduction

The punctuality of *achievements* vs. non-punctuality of *accomplishments* has been the object of many theoretical contests ever since those event types were introduced in Vendler's seminal 1957 paper. I will demonstrate here that punctuality breaks up into two, distinct notions, namely *non-durativity* and *atomicity*, before arguing for a compositional semantic account of the latter. I will show that (non-)atomicity interacts closely but not exclusively with the notion of *incrementality*, as formulated in Dowty (1991), and that this property of verbs should be lexically encoded. I will finally discuss some means for an NLP system to represent and calculate atomicity and incrementality, before proposing a formal treatment for a number of cases of lexical polysemy having an impact on them.

1. *Achievements* vs. *accomplishments* - from punctuality to atomicity

Vendler (1957) claimed that *achievements* and *accomplishments* are respectively *punctual* and *durative*. He noted that *at <time expression>* adverbials combine with *achievements* but not *accomplishments*, whereas *finish* combines with *accomplishments* but not *achievements* :

(1a)	*At what time did you reach the top? At noon sharp.*	(achievement)
(1b)	*At what moment did you spot the plane? At 10:53 A.M.*	(achievement)
(2a)	*Yannig *finished leaving.*	(achievement)
(2b)	*Yannig finished drawing the circle.*	(accomplishment)

Dowty (1986) and Moens and Steedman (1988) questioned the coherence of the class of *achievements*, underlining the fact that not all of them are non-durative. As indicated above, Vendler identifies punctual events through the conjunction of the (positive) *at* and (negative) *finish* test. But they sometimes yield conflicting results :

(3a) *Karpov bet Kasparov at 10.00 P.M.*
(3b) **The Allies beat Germany at 10.00 P.M.*
(3c) **Karpov finished beating Kasparov/the Allies finished beating Germany*.

According to the *at* test, (3b) does not qualify as an *achievement* because it is *durative*, whereas (3a) passes this very test and is therefore *non-durative*. Contrariwise, the *finish* test in (3c) yields identical results for both events. The latter test is therefore unrelated to (non-)durativity, unlike the *at* test, which refuses durative events. It also follows from this fact that telic events such as (3b) fall outside Vendler's classification, since they fail both the *finish* test (unlike *accomplishments*) AND the *at* test (unlike *achievements*). If we assume that events such as (3b) are to be classified as *achievements*, non-durativity should not be considered a necessary property of this type of event. The salient common point between (3a) and (3b) is that both events lack *proper subparts*, i.e., are *atomic*. *Atomicity* should thus be regarded as the defining property of *achievements*. It can be tested with *finish*[i].

2. Why atomicity is also a semantic category

Verkuyl (1993), Jackendoff (1996) and many others argue that atomicity is primarily a matter of pragmatic constraints. The following examples illustrate one such pragmatic constraint on atomicity, i.e., the *relative size* of arguments of verbs of consumption :

(4a) ??*John finished eating the blackcurrant berry.*
(4b) *The bird finished eating the blackcurrant berry.*

Blackcurrant berries are so small with respect to a human 'eater' that *eat* denotes an atomic event in (4a), while the same does not hold true of birds (cf. (4b)). Yet I will demonstrate here that atomicity should receive a semantic (and aspectual) dimension. Consider (5) and (6)[ii] :

(5a) ??*The soldier finished crossing the border.*
(5b) *The soldiers finished crossing the border.*

(6a) ??*John finished slamming the door open.*
(6b) *John finished slamming the doors open.*

The plural NPs *the soldiers* and *the doors* possess subparts, along which the crossing and slamming events in (5b) and (6b) are measured, making those events non-atomic (there are several distinct subevents of one door being slammed, and of one soldier crossing the border) ; compare with the atomic (5a) and (6a), where those very NPs are singular. The singular / plural variation being a semantic one, atomicity is a semantic category[iii]. Moreover, atomic events are not compatible with the *progressive perfect*, whereas non-atomic ones freely combine with it, a fact which also militates for a semantic view of atomicity (cf. (7)).

(7a) **The soldier has been crossing the border.* (OK if iterative, i.e., not atomic)
(7b) *The soldiers have been crossing the border.*

3. Towards a semantic account of (non-) atomicity and incrementality

The above data suggests that atomicity is related to the notion of *incrementality*, which Dowty (1991) first formulated. To my knowledge, this notion (which was originally coined to

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[i] I will not discuss other possible tests here for want of space. But note that 'duration' phrases in French (*Ca fait <duration> que P* or *P depuis <duration>*), which combines with a non-atomic event OR a durative atomic event, and *stop*/*arrêter*, which combine with a non-atomic event, can be used as complementary tests.
[ii] Similar examples were proposed by Declerck (1979), but they were only discussed in terms of durativity.
[iii] See Caudal (1998a) for more evidence of the semantic dimension of atomicity, in relation to collective nouns.

study telicity) has never been discussed in relation to atomicity, although this is an obvious thing to do, since both focus on (sub)event structure. I will undertake to bridge this gap here.

3. 1. Incrementality and delimiting arguments

Dowty defines *incrementality* as a property of verbs whose development can be mapped onto the internal structure of one of their arguments (which he calls an *incremental theme*) :

(8) *John drank his glass of beer.*

In (8), the drinking event is measured along the subparts of the reference of *his glass of beer*, its *incremental theme* ; it is mapped onto them through a structure preserving function, i.e., an *event-object homomorphism* - cf. Dowty (1991) and Krifka (1992). Incrementality raises an interesting problem w.r.t. to atomicity, since Dowty (1991) rejects ostensibly the possibility to treat as incremental themes the patient arguments of so-called *achievements* verbs, arguing that incremental themes should be able to undergo a gradual change-of-state[iv]. Unfortunately, Dowty does not consider examples such as (6b), which exhibit an incremental behaviour although they include this very kind of patient argument. I will therefore reject Dowty's objection, and regard (6b) as incremental.

It also follows from the above definition that incrementality entails non-atomicity : it implies that an event's development possesses proper subparts, and therefore that it is non-atomic. But does non-atomicity entail incrementality, conversely ? I.e., are those two notions equivalent ? If not, how is their relationship to be explained ? In order to answer those questions, I will make use of a feature-based notation in the following sections : [+/-ATM] will express atomicity/non-atomicity, and [+/-INC] incrementality/non-incrementality.

3. 2. Non-atomicity with incrementality

Let us call *delimiting arguments* the arguments of a verb measuring-out the development of an associated event (e.g., the internal arguments of *drink* or *slam open*). This notion is substantially broader than that of incremental theme, since it includes e.g., patient arguments of so-called punctual verbs, which Dowty refused to regard as incremental themes. For the sake of simplicity, I will restrict the argumentation below to internal delimiting arguments :

(9a) *Yannig finished eating his pancake.*
(9b) *Yannig finished eating his pancakes.*

(10a) **Yannig finished picking up his book.*
(10b) *Yannig finished picking up his books.*

(9) shows that *eat* can be [-ATM],[+INC] both with a definite singular and plural delimiting argument, whereas (10) shows that *pick up* can be [-ATM],[+INC] only with a definite plural delimiting argument. The development of *eating his pancake* is measured in (9a) along the quantity of pancake remaining to eat, whereas that of *picking up his books* in (10b) is measured along the successive individual books being collected. I will extend the notion of incrementality to this latter kind of event-object mapping.

Under this view, incremental readings involve delimiting arguments in general, rather than mere incremental themes. However, I will oppose two types of incrementality, thus introducing a distinction between Dowty's incrementality and the extension I proposed. I will

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[iv] Cf. Dowty (1991:568) : *Many traditional Themes…are not Incremental Themes. Many achievement verbs entail a definite change of state in one of their arguments…but never in distinguishable separate…subevents.*

call *m-incrementality (*for *quantity of* ***m****atter-****incrementality***) the type of incrementality exhibited by (9a) and *i-incrementality* (for ***i****ndividual-****incrementality***) that exhibited by (10b). At least two classes of verbs can be distinguished in this respect : verbs like *eat* are capable of m-incrementality, i.e., with individual-referring delimiting arguments (they have incremental themes *à la Dowty*), whereas verbs like *pick up* are only capable of i-incrementality, i.e., with collection-referring delimiting arguments (they lack incremental themes *à la Dowty*). Of course, non-atomicity can follow from either i-incrementality or m-incrementality.

Path-movement verbs illustrate another type of incremental non-atomic events :

(11) *Mary walked the Appalachian trail.* (Tenny (1994))

The development of (11) is mapped onto the explicit path argument *the Appalachian trail* in (11). It is therefore [-ATM],[+INC]. White (1994) proposed a generalized path-based incremental theme role to account for the semantic behaviour of both patient and path delimiting arguments, fairly akin to the present one, since it crucially relies on a similar individual / quantity of matter distinction. One could conclude at this point that the present account of incrementality is sufficient to predict (non-)atomicity, and that indeed non-atomicity and incrementality are equivalent notions. If that is right, then all types of non-atomic events should be incremental. However, I will show in 3.3 that it is not the case.

3. 3. Non-atomicity without incrementality

As a matter of act, some non-atomic events lack a delimiting argument. The type of non-atomicity involved cannot therefore be related to ‘standard’ incrementality :

(12) *John finished digesting his pudding.*
(13) *John finished cooking the chicken.*
(14) *John finished registering his son at the university.*

Contrary to (9a/b) and (10b) , neither (12) nor (13) nor (14) are (necessarily) measured along the subparts of their patient argument. *His pudding, the chicken* and *his son* do not behave like delimiting arguments, and those non-atomic events are non-incremental ([-ATM],[-INC]). Some other theoretical device is required to account for such data.

I will claim that *digest* and *cook* receive a *scalar* result state, i.e., one that varies through time : John’s chicken becomes (as a whole) closer to being (finally) cooked as time passes in (13), and John’s pudding gradually turns (as a whole, and not bit by bit ; it is therefore a non-incremental event) into nutriments inside his stomach in (12) (see Caudal (1998b) for further details). I will refer to such gradual, non-incremental events as *scalar events*[v]. *Register* in (14) behaves differently, as it does not involve a scalar result state. Its development rather seems to consist in a series of pragmatically determined registration stages, rather than semantically determined subevents. I will refer to this kind of data as *gradual scenario* events[vi].

I will now turn to the treatment of incremental non-atomic events (section 4), before proposing one for non-incremental non-atomic events (section 5).

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[v] It should be noted that scalar events are a productive, non-closed class, since they include *resultative constructions* (e.g., *pound the metal flat* ; see Levin and Rappaport 1995). It is therefore important for any NLP system or theory to deal with them in a satisfying manner.

[vi] Note that contrary to scalar events and incremental events, ‘gradual scenario’ events do not combine with the *progressive perfect*, cf. **John has been registering his son at the university*, nor with *stop*. Those facts suggest that they should not be regarded as ‘true’ non-atomic events, and that their development has very specific properties. See also the *arrêter* and *depuis* tests in French, which refuse ‘gradual scenario’ events, cf. **Jean arrêta d’inscrire son fils à la fac* and ??*Jean inscrit son fils à la fac depuis deux jours.*

4. A formal and computational treatment of incremental non-atomic events

I will now put forth a formal and computational treatment of incremental non-atomic events, relying on model-theoretic logics and on the *Generative Lexicon* framework (GL ; see Pustejovsky 1995). I will first discuss a few theoretical notions related to the *internal structure* of objects and events, in order to formalize m- and i-incrementality. I will leave aside the treatment of path-movement verbs, referring the interested reader to White (1994).

4. 1. Internal structure of objects and events : Link's **part-of** *operators*

Following Link (1983), I will oppose *individuals* (i.e., the denotata of nouns referring to individual entities) and *collections* (i.e., the denotata of definite plural NPs, collectives, etc. ; see Caudal 1998a). Let A be the domain of entities (events or objects), structured as a semi-lattice. Let *individual_part_of* be a partial order relation on individual entities (henceforth *i-part* or $\leq_i$), connecting an individual to the collection it belongs to. Let $\sqcup_i$ be the join operation on individuals and collections, *y* a collection and *x* an individual, such that *x* is an *i-part* of *y*. The definition of the meronymic operator $\leq_i$ was formulated by Link as follows :

(15) $\forall x,y\ [x \leq_i y \rightarrow x \sqcup_i y = y]$

Following again G. Link, I will define similarly a partial order relation on non-individual parts, *m-part* (or $\leq_m$), which connects an individual and its non-individual parts (e.g., a slab of stone to a rock). All those operators will apply both to events and objects in the model (events being reified). As a consequence, collection-referring NPs as well as i-incremental events possess *i-parts*, whereas individual-referring NPs and m-incremental events have *m-parts*. Let us turn now to the lexical component of our atomicity/incrementality construal procedure.

4. 2. Encoding incrementality within the **Generative Lexicon** *framework*

I will argue that incrementality depends both on *lexical information* and *structural composition*. Whether events will receive (or not) an incremental reading is determined *in fine* at the structural level, depending on the interaction of a verb with the internal structure of its delimiting arguments. I will propose here to encode lexically m-incrementality / i-incrementality, although any potentially incremental verb can receive an i-incremental reading (but recall that not all verbs can be read incrementally). In the spirit of Krifka's *object-event mapping functions* (see Krifka 1992), I will assume an *i-inc* aspectual role function relating the *i-parts* of an argument to the development of an event (causing it to become *i-incremental* with an appropriate delimiting argument), and a *m-inc* aspectual role function relating the *m-parts* of an argument to the development of an event (causing it to become *m-incremental* with an appropriate delimiting argument). The following event/object mapping predicate MAP-I can be derived from Krifka's MAP-O/E (mapping to objects/events) predicates (see Krifka 1992:39) by replacing his standard partial order operator with $\leq_i$:

(16) MAP-I : $\forall R[\text{MAP-I}(R) \leftrightarrow \text{MAP-E}_i\ (R) \wedge \text{MAP-O}_i\ (R)]$
$\forall R[\text{MAP-E}_i\ (R) \leftrightarrow \forall e,x,x'\ [R(x,e) \wedge x' \leq_i x \rightarrow \exists e'\ [e' \leq_i e \wedge R(x',e')]]]$
$\forall R[\text{MAP-O}_i\ (R) \leftrightarrow \forall e,e',x\ [R(x,e) \wedge e' \leq_i e \rightarrow \exists x'\ [x' \leq_i x \wedge R(x',e')]]]$

Let the model stipulate that MAP-I can only be applied to the *i-inc* aspectual-role. A similar formulation can be given for a MAP-M predicate applying only to the m-incremental aspectual role *m-inc* (replace $\leq_i$ with $\leq_m$ in (16)). Thus, by combining Link's *part-of* operators with Krifka's event-object mapping functions, atomicity construal functions can be proposed. Finally, GL will provide us with the proper computational lexical machinery in which to insert those functions. I will encode the necessary aspectual role functions in the EVENTSTR feature and AGENTIVE qualia role, as the following entries for *pick up* and *eat* show :

(17)

```
pick-up
EVENTSTR = [ E1 = [1] e1:pick_act(e1,x,y),
                       i-inc(y,e1)
             E2 = e2:RStage(e2,y) ]
ARGSTR =   [ ARG1 = x:ind
             ARG2 = y:ind ]
QUALIA =   [ AGENTIVE = [1] ]
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(18)

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eat
EVENTSTR = [ E1 = [1] e1:eat_act(e1,x,y),
                       m-inc(y,e1)
             E2 = e2:RStage(e2,y) ]
ARGSTR =   [ ARG1 = x:ind
             ARG2 = y:ind ]
QUALIA =   [ AGENTIVE = [1] ]
```

Note that the **RStage** predicates above refer to result states (RS). The aspectual role functions *i*/*m-inc(x,e)* relate the internal structures of an argument *x* and a (sub)event *e* to one another. They will determine whether *e* will be atomic or non-atomic : if *x* possesses proper subparts, then *i*/*m-inc(x,e)* implies that *e* will also receive subparts, and will therefore be non-atomic. The whole point remains that incrementality is *lexically licensed* but *structurally construed*.

5. Atomicity, incrementality and aspectual polysemy within GL

I will study in this section cases of lexical polysemy interfering with the incrementality functions defined above. I will assume the reader to be familiar with qualia structure and related formal operations (e.g., type coercion and co-composition ; cf. Pustejovsky 1995).

5.1. Lexical polysemy and the internal structure of delimiting arguments

Many implicitly relational nouns exhibit in context a polysemous internal structure. Individual-referring nouns can thus also refer to collections, as in the following French data :

(19a) *Yannig a fini de ranger sa chambre.*
Yannig finished tidying up his room.
(19b) **Yannig a fini de ranger son livre.*[vii]
Yannig finished putting away his book.

Ranger receives an incremental reading in (19a), and a non-incremental one in (19b). In fact, it should be lexically encoded as capable of i-incrementality. Since a room is not a movable entity, a type mismatch arises between *ranger* and the FORMAL role of *chambre*. However, *chambre* receives a *collective* interpretation in (19a) by coercion (i.e., it refers to the movable objects a room contains, the coercion operation using a ‘type-pumping’ device to extract the **movable_obj** type from the CONST of *chambre* ; cf. Pustejovsky and Bouillon 1995). See Caudal (1998a) for a treatment within GL of the related polysemy of *collective* nouns (e.g., *orchestra* and *forest*), which can refer to either individuals or collections.

5.2. Quasi ‘light’ verbs, co-composition and variations in incrementality

It is also necessary to account for a number of cases of variation in the type of incrementality involved, originating in the interaction between verbs and their arguments. Many of them could be treated in terms of *co-compostion*[viii] within GL :

[vii] According to my own judgement, and contrary to what an anonymous reviewer suggested, (19b) remains odd even in the context of a large library. And anyway, if it were not, it would be a ‘gradual scenario’ event, not a truly non-atomic one, cf. : ??*Yannig range son livre depuis dix minutes.* and **Yannig arrêta de ranger son livre.*

[viii] Co-composition refers to cases of lexical polysemy in which a lexical item receives a ‘new’ sense (i.e., one not lexicalized) through the contribution of another lexical item with which it combines. See Pustejovsky (1995).

(20a) **Le moteur acheva de produire un bruit étrange.*
The engine finished emitting a strange noise.

(20b) *Yannig acheva de produire son premier article.*
Yannig finished writing his first paper.

The French verb *produire* yields an i-incremental reading in (20a), vs. a m-incremental reading in (20b). Arguably, *produire* means ‘to cause to come into existence’, and therefore makes use of the content of the AGENTIVE qualia role (i.e., the qualia role indicating how a type is brought into existence) of its internal argument to determine the corresponding ‘creation’ event. The AGENTIVE roles of *bruit* and *article* can be represented as follows :

(21)

```
bruit
ARGSTR = ARG1 = x:sound
QUALIA = AGENTIVE = noise_act(e,y,x),
                    i-inc(e,x)
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(22)

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article
ARGSTR = ARG1 = x:info
QUALIA= AGENTIVE = write_act(e,y,x),
                   m-inc(e,x)
```

As a result of the co-composition operation, the AGENTIVE of *produire* unifies with that of *bruit* and *article*. It receives therefore different event structures and incrementality functions : in the case of *article* in (22), it contains an m-incremental event, and in the case of *bruit* in (21), an i-incremental event. *Produire* can be regarded as a quasi ‘light’, functionally dependent verb, since it has an underspecified AGENTIVE qualia role, so that its event structure and incrementality functions are also underspecified. The necessary information is contributed co-compositionally by the AGENTIVE of one of its arguments.

Similar variations on incrementality can also be triggered by some contextual specification of qualia role information. Consider the following data involving the quasi ‘light’ verb *use* :

(23a) **Yanning finishing using his gun (to kill a bird).*
(23b) *Yannig finished using the tomato (to prepare a dish* / **to throw it).*

Use reconstructs a purpose clause (cf. Whelpton 1999) and inherits its event structure and incrementality functions from the content of the TELIC of its internal argument. The type **`gun`** possessing an i-incremental event in its TELIC (**`shoot_at(e,y:human_ind,z,x:gun)`**), (23a) turns out i-incremental. On the contrary, since natural kinds often lack definite TELIC roles, the incrementality of (23b) is contextually infered (see Asher and Pustejovsky 1999).

5. 3. Dynamicity, external arguments and disabled incrementality functions

Some other examples of coercion involving non-light verbs illustrate how incrementality functions can be contextually ‘disabled’, cf. (24) :

(24a) *Yannig presented his passport in two minutes* / *for two minutes.*
(24b) *The bay presented a magnificent sight for a century* / ??*in a century.*(OK if inchoative)

I assume that the AGENTIVE of (potentially) telic verbs unify with that of their external argument, since the former contains the causing subevent, and the latter the associated ‘causer’ entity. With a dynamic external argument as in (24a), *present* can read like an i-incremental transition. Contrariwise, it only reads like a state with a non-dynamic external argument (cf. *bay*), as in (24b), its incrementality function and causing event being ‘disabled’.

6. Non-incremental non-atomic events and sorted RSs / Result Stages

It has been shown above that incrementality falls short of explaining the non-atomicity of (12) and (13). I will now introduce *sorted* RSs to account for such data, leaving aside ‘gradual scenario' events (cf. (14)) as a pragmatic phenomenon ; this move will be justified by the generality of the RS-based approach, even w.r.t. other aspectual notions such as telicity.

6.1. Introducing Result Stages and sorted RSs

I argued in 3.3 that scalar events are non-incremental because their affected arguments (cf. *the chicken* in (13)) undergo a 'holistic' change-of-state (CoS), contrary to incremental events, whose affected arguments undergo a 'meronymic' CoS (cf. *his pancake(s)* in (9)). In other words, incremental CoSs affect subparts (i-parts or m-parts) of arguments, whereas scalar CoSs affect entire arguments. (13) thus is telic and non-atomic because the (whole) chicken goes through successive states of 'cookedness' before reaching a final state ; this succession of states constitutes a *scalar RS*, which is not predicable of the subparts of an argument, contrary to the RSs of incremental events. Encoding a richer information about RSs in the lexicon, as proposed in Caudal (1998b), appears necessary in the light of such facts[ix].

Moreover, Caudal (1998b) argues that telicity should be represented by assigning two opposed RSs to telic events (a *primary* RS associated to the event's development; cf. *John's been drinking his beer*, and a *secondary* RS associated to the event's completion, cf. *John's drunk his beer*), versus only one RS (a *primary* RS, too) for atelic events. The existence of an opposition between two RSs explains why a CoS occurs with telic events. Following Caudal (1998b), I will therefore attribute unary *Result Stages* (RStages) to atelic events, and binary RStages to telic events. RStages will thus consist in one or two RSs.

6.2. Telicity and the RStage-based approach to event structure

Incrementality, as noted above, was introduced in connection to telicity ; I will now turn to the latter notion, to check whether the approach formulated above could be applied to it. Krifka (1992) formulated a detailed formal treatment of the (a)telicity of non-atomic events using event-object mapping functions. Consider the following contrast :

(25) *John ran for two hours* / **in two hours.*
(26) *John ran a mile in two hours* / *for two hours.*

(25) lacks an incremental argument, and is therefore atelic, whereas the introduction of such an incremental argument in (26) with an m-incrementality function allows for a telic reading.

Yet it can be demonstrated that telicity, like (non-)atomicity, cannot be accounted for on the basis of incrementality alone. Let us turn again to scalar events vs. non-scalar ones :

(27) *John cooked this chicken in* / *for two hours.*
(28) *John drank a glass of beer in* / **for two hours.*

Incrementality cannot explain the telicity of *cook* in (27), since *this chicken* does not behave like an incremental theme ; telicity combined with non-atomicity does not necessarily entail incrementality. Moreover, incrementality cannot explain either why *cook* also receives an atelic reading - (27) is optionally telic, whereas (28) is obligatorily telic. It seems that scalar verbs are often optionally telic (cf. *(re)heat*, *wash*, *polish* etc.), whereas incremental

[ix] An anonymous reviewer suggested that a 'state' incrementality could be attributed to *cook*, claiming that it would make a theory of RStages superfluous. This proposal is not new ; Jackendoff (1996 :332-335) and Ramchand (1997) assigned some kind of (stative) 'property scale' to scalar events. But this leaves the difference between scalar and incremental events w.r.t. affectedness/CoS unexplained : why do the former affect a whole individual in a scalar way, and the latter bits of an individual in a non-scalar way ? We cannot answer this question without a theory of CoSs and RStages and of their role in event construal. The 'state' incrementality / 'property scale' approach misses this point, so that it is little more than an *ad hoc* solution.

verbs such as *drink* are not (if their incremental theme is syntactically realized ; compare *eat*-intransitive with *eat*-transitive).

Contrariwise, the RStage-based approach to event structure can explain the optional telicity of *cook*. If we take into account the fact that scalar verbs possess a scalar primary RS, it appears that they receive a telic reading iff the corresponding 'final degree' (e.g., the state of (well-) cookedness for *cook*) is reached, and receive an atelic one if it is not reached. Scalar verbs such as *cook* and *wash* behave as if one could iterate an action indefinitely without reaching a stable, final RS : one can cook a chicken several times and yet not cook it completely, or cook it beyond the point of well-cookedness (in which case it is 'too' cooked).

6.3. Incrementality and RStages

I have argued above that a unified account of (non-)incremental non-atomic events requires a theory of RStages. Different types of RStages should thus be lexically attributed to incremental verbs and to scalar verbs (cf. the **`RStage`** feature in (17) / (18) ; note that it should share its content with the FORMAL role, since the latter shared its content with 'result' subevents in Pustejovsky 1995). Let us assume a many-sorted logic (cf. White 1994) incorporating *sort axioms*. I argue below that the RStages of e.g., m-incremental verbs should be m-incremental, a fact mirrored in the corresponding sort axioms (cf. (29)-iii). Contrariwise, I claim that scalar verbs should be endowed with non-incremental, scalar RStages.

(29) Sort axioms for unary vs. binary Rstages / binary m-incremental_RStages :

i) $\forall$e,x [Defined (Binary_RStage(e,x)) $\leftrightarrow$ $\exists e_1$, e_2 [Primary_RS(e_1,x) $\wedge$ Secondary_RS(e_2,x) $\wedge$ $e = e_1 \cup e_2 \wedge e_1$ @ $e_2 \wedge$ Delimited$^+$ (e)]]
ii) $\forall$e,x [Defined (Unary_RStage(e,x)) $\leftrightarrow$ [Primary_RS(e,x) $\wedge$ Delimited$^-$ (e)]]
iii) $\forall$e,x [Defined (Binary-m-inc_RStage(e,x)) $\leftrightarrow$ [Binary_RStage(e,x) $\wedge$ m-inc(x,e)]]

I am making use above of an 'abut' operator on events noted @, and of sorts expressing (non-) delimitedness, noted Delimited$^{+/-}$. (29) describes sort axioms for unary, binary and m-incremental binary RStages. It attributes a m-inc function to the latter type of RStages in axiom iii). Note that binary RStages are viewed here as transition functions, developping along some odometer, rather than proper 'stative' subevents. I also assume that some structure preserving mapping function *Res(e',e)* relates an event's development *e'* to its RStage *e*, so that the event-object homomorphism carries over from *e* to *e'*, and *m-inc(x,e')* is true as well. *Scalar RStages* will involve a more general theory of scalar sortal domains I cannot describe here for want of space, but see Pustejovsky (1999) for a related proposal. The basic idea is that scalar sortal domains include a *scaling* function ranging over a scalar semi-lattice structure representing the succession of 'sub-result states' involved.

7. Conclusion

It has been demonstrated in this paper that the so-called punctuality of events should be reduced to the notion of atomicity. It has been shown that (non-)atomicity is at least partly a compositional semantic category, rather than a purely pragmatic one, and that it is directly related to incrementality in many cases, though not in all cases. Formal means to calculate (non-)atomicity within an NLP system have been discussed (see White (1994) for a computational implementation of related interest, in a similar spirit). The machinery exposed above can be used to predict whether an event should be considered as an *accomplishment* (i.e., a non-atomic event, possessing internal subevents) or an *achievement* (i.e., an atomic event, lacking any internal subevent). In order to construe incremental non-atomic events, I proposed to encode m-incrementality vs. i-incrementality in the lexicon, before discussing the problems raised by the polysemous internal structure of certain nouns, or the variations exhibited by certain verbs w.r.t. incrementality functions. Finally, a tentative RStage-based account of non-incremental non-atomic events has been put forth. I showed that this approach can also be successfully applied to all types of non-atomic events, and could also be applied to telicity. In short, the RStage approach to event structure provides us with a unified treatment[x] of (non-)atomicity, incrementality and telicity – a result which standard incrementality-based approaches cannot achieve for reasons exposed above.

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[x] Note that even path-argument verbs can be analysed in terms of RStages if *changes of location* undergone by arguments are treated as some kind of CoSs, and therefore involve an incremental RStage.