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On the "Imperfective paradox" and related problems

1. Introduction

In English, as in most languages, a sentence can appear in various tense and aspect forms, such as

(1) John was sleeping.
(2) John slept.
(3) John has slept.
(4) John had slept.
(5) John will sleep.

On some level, the meaning of these sentences, when uttered on some occasion, is the same; very roughly speaking, they have the same lexical content. On some other level, it is not the same. Their truth values are different, although not completely different: There may well be entailment relations between them. For example, we would say that in a situation where (1) is true, (2) cannot be false. Similarly, if someone claimed (4), then he is also committed to (3). On the other hand, there is no such relation from (2) to (5), or from (5) to (1).
Entailment relations of this kind depend on the various aspect and tense markers involved. But they also depend on the particular lexical meaning of the words, notably the verb.[i] For example, whilst we would say that someone who was sleeping also slept, this does not hold for a verb such as to leave. From

(6a) John was leaving.

it does not follow:

(6b) John left.

It may well be that eventually he managed to leave, and this may even be the most natural course of events; but it is also possible that he changed his mind and stayed.
In other words, the existence of a particular entailment relations not only depends on tense and aspect but also on the particular "temporal character" of the verb, its "Aktionsart", or whatever the terms are. In fact, such entailment relations have been used as an important criterion in the analysis of verb types from Aristotle to most recent classifications.
I think all attempts in this direction are on shaky ground, and in this paper, I will try to show this for three such entailment relations which have played, and still play, a major role in the rich literature on temporality. These are the following ones (apart from the labels, the presentation essentially follows Dowty (1979), p. 55-60 and 133-134, whose exposition is particularly clear; x is some subject, V some verb or verb phrase):

A. Aristotle's entailment

x is Ving entails x has Ved

Aristotle's entailment discriminates between "atelic" and "telic" verbs (Garey's (1957) terminology) or between "activities" and "accomplishments" (Vendler 1967; in what follows, I shall often use Vendlers terms, because the are probably best-known). Compare again:
(7a) John is sleeping.

(7b) John has slept.

(8a) John is leaving.
(8b) John has left.

(7a) entails (7b), but (8a) does not entail (8b).

B. The Subinterval entailment

x Ved for y time entails x Ved for any subinterval of y

This entailment, so the assumption goes, discriminates between states and activities, on the one hand, and accomplishments and achievements, on the other.[ii] Thus, if on some occasion, John slept for seven hours, then he slept for any subinterval of those seven hours. But if he left London, and it took him two hours to do so, then he did not leave London at any subinterval of those two hours.

C. The Imperfective paradox entailment

x was Ving entails x Ved

Note that here, the "event"[iii] referred to by V is in both cases in the past, whereas Aristotle's entailment goes from an on-going "event" to some "event" in the past (albeit perhaps with a special relation to the present, as expressed by the present perfect).
Like in the preceding cases, activities and accomplishments exhibit a different behaviour. If, on some occasion, John was sleeping, then we can truthfully say that the slept. But if he was leaving the kitchen, then we can't necessarily say that he left it. The non-entailment becomes particularly clear for verb phrases with an "effected object", such as to build a house. Clearly, if John was building a house, this does not entail that he ever built it.

Before turning to these entailments in more detail, a word about the notion of entailment is in order. The general idea is clear: a entails b, if b can't be wrong when a is true. There are several problems, though, two of which I will mention. First, should we consider a and b to be sentences, or utterances, or still something else? This is surely a difficult question, but no one which need to bother us here. In what follows, I shall always assume that the a and b are sentences uttered on some particular occasion by the same speaker.
Second, the interpretation of such an utterance not only depends on what is explicitly said but also on a number of contextual factors. These must be kept constant. For example, it does not make much sense to speak of a possible entailment between He was sleeping and He slept unless we assume that he refers to the same person. Unfortunately enough, the situation is not always so straightfgorward. Contextual factors are often implicit. Under the assumption that water freezes below zero degrees, is it then correct to say that

(9a) The temperature was below zero.

entails

(9b) The water was freezing.

We would surely say "yes", and we would not like to accept an argument such as "Yeah, but I meant the temperature outdoor, and the water on the hot stove". Similarly, no reasonable person would be inclined to accept that

(10a) It is winter.

entails

(10b) It is summer.

although this is clearly correct under the common notions of summer and winter, if different hemispheres are meant in both utterances. We may call this the problem of "hidden parameters", and any discussion on whether there is an entailment or not makes only sense if these "hidden parameters" are made explicit, or tacitly kept constant. Nothing forbids us, of course, to define the notion of "entailment" such that it includes inferences "across" hidden parameters, such that the entailment from (10a) to (10b) is valid. But I see no point in such a definition.
There may be other hidden parameters than place. Consider, for example:

(11a) John died.

We would not want to say that (11a) entails

(11b) John did not die.

although if there is a time at which John died, there must be a time at which he is alive, and a time at which he is dead (this, I think, is part of the meaning of "to die"). Hence, there is also a time (actually, many times) in the past for which (11b) is true.[iv]

There are still other "hidden parameters", but the point should be clear. My main argument in what follows is that A - B are fallacious in that they most often ignore hidden parameters.

2. Aristotle's entailment

Aristotle distinguished two types of verbs, verbs of **kinesis** and verbs of **energeia** (see Potts 1965, Taylor 1965). The first group, exemplified by to watch, to think is not goal-oriented, the second group, exemplified by to learn (something), to become healthy, is goal-oriented. And he says about them (Metaphysics 1048b):

> Thus, you are watching and thereby have watched already, you are thinking and thereby have thought already; by contrast, you are learning (something) and have not learned (it) already, and you are becoming healthy and have not yet become healthy. At the same time, we are living well and have lived well, we are happy and have been happy. Otherwise, the process should have ended at some time, like the process of becoming meagre. But it has not come to an end at the present moment: we are living, and have lived.

Numerous authors drew on this distinction, either directly or indirectly. Well-known is Garey's distinction between "atelic" and "telic" verbs, the former being those "which do not have to wait for a goal for their realization, but are realized as soon as they begin". (Garey 1957, p. 106). Even better known is Vendler's distinction between four "time schemata" which are more or less well reflected in four verb types. Two of them, state verbs and achievement verbs, do normally not assume the progressive, hence the entailment as stated above does not directly apply to them. But the logic behind the distinction among those is quite the same. State expressions are "atelic", achievement expressions are "telic". Thus, from He is in London, it follows He has been in London. This is the case with which I will begin here.
If you are in London, then you have been in London; that is true. But the time of your being in London, and the time of your having been in London are not the same. The latter is a

proper subinterval of the former. This becomes immediately clear, if the time intervals are made explicit by some time adverbial, for example by all week or for three days. If you are in London all week, you haven't been in London all week. And if you are in London for three days, then this does not entail that you have been in London for three days. In fact, if it is true that you are (right now) in London for three days, then this even excludes that (on this occasion) you have been there for three days.
The same argument can be made for activities in progressive aspect. Thus, if John is sleeping for two hours, this does not entail that he has slept for two hours (although it is true that he has slept for some indeterminate subinterval of those true hours).
In both cases, then, Aristotle's entailment is only correct if an implicit parameter, the duration of the "event" denoted, here your being in London or John's sleeping, is not kept constant. Note that the "event" always has such a duration, no matter whether it is lexically specified by some adverbial or not. The addition of an adverbial such as for two hours or all week makes this duration explicit, it does not change the nature of the "event" in question. Sleeping always lasts for a certain time, and so does being in London, although it may not be explicitly said how long.

3. The Subinterval entailment

Although the idea that some verb types have the "subinterval property" is much older, Bennett and Partee (1972, p.14) were the first to couch it in this form:

> SUBINTERVAL verb phrases have the property that if they are the main verb phrase of a sentence which is true at some interval of time I, then the sentence is true at any subinterval of I including every moment of time in I.

By now, the subinterval property is generally considered to be the major criterion to distinguish between state/activity-like verbs and accomplishment/achievement-like verbs.
There two problems with this notion, a minor one and a serious one. The less serious problem is that one would like to be able to ignore "minor interruptions". Consider, for example

(12) John slept for more than ten hours.

Then, we would not like to say that this is wrong because he woke up for a moment and went to the bathroom. So, there are "irrelevant" interuptions which, under a "literal" interpretation of the Subinterval entailment, would violate it. I think exceptions of this type can be booked under the global fuzziness of natural language, just as we would not say that He left at four is wrong, because he left a minute past four.
The second problem is much more serious. Whenever you sleep, you sleep somewhere - in the guestroom, on the floor, next to the elevator, wherever. This place need not be specified, but it can, and there is little reason to assume that the nature of the activity is changed by rendering its place explicit. Consider now:
(13) For three months, John slept on the floor.

In this case, we would not be inclined to assume that John slept during each subinterval of those three months. John could be a normal adult, and then we would assume that, if (13) is true, that there were some 90 intervals of about eight hours each, during which he slept (on the floor!), and some different 90 intervals of about 16 hours, during which he did not sleep. John could also be a two-weeks-old baby, with a somewhat different distribution of pertinent subintervals. And John could also be a hibernating bear, in which case we would indeed assume that this sleep is not interrupted by a (relevant) subinterval, during which he did not sleep.

Nothing forbids us to call the first two possibilities "iterative" or "frequentative", and the last one "semelfactive". Then, we could save the Subinterval entailment by saying that it only applies under a semelfactive reading. But "semelfactive" means in this case only that his sleeping is not interrupted. Then, the Subinterval entailment boils down to "x Ved for y time entails x Ved at any time during y, unless there is some interruption in his Ving". Which is true.
The crucial hidden parameter in this case is "frequency" of the "event". We are inclined to assume that there is regularly an implicit "semel" (i.e., one time); but as examples like (13) show - and it is not difficult to find others -, this is only a special case. If sleep is the main verb phrase of a sentence true at some interval of time I, then it depends on how long I is, on the one hand, and on world knowledge, on the other, whether we assume this sentence to be true at an any subinterval of I. The subinterval property, as defined here, is not part of the lexical content of sleep.

4. The Imperfective paradox entailment

Although other authors had noticed the problem before, Dowty (1979, p. 133/4) was the first to recognise its importance for the analysis of English aspect, notably English progressive. If, upon some occasion, John was building a house, then this does not entail that he built a house. But if John was pushing a cart, then this entails that he pushed a cart.
I think the point is well-taken for accomplishments (and achievement verbs to the extent to which they tolerate the progressive). The point is less well-taken, in fact wrong, for activity verbs, and the reason is, that the time for which the relevant claim is correctly made is not kept constant. this becomes clear, if the relevant time is explicitly marked. Suppose a witness is asked at court:

(13) What did John do yesterday between ten and eleven?

Then, the time for which the witness has to give testimony is precisely fixed: It is yesterday between ten and eleven. An appropriate answer might be:

(14) He was sleeping.

This answer is truthful if John slept all night. But would it have been an appropriate answer to say He slept? Surely not.
The same point is even more suggestive if the relevant time, for which he is claimed to sleep, is very short, as in (15) - given in answer to the question How is the baby?

(15) I just looked into his room. He was sleeping.

Then, (15) does not entail at all that he slept **at the time at which the speaker looked into the room.**
Summing up, there is no Imperfective paradox entailment for accomplisments. But there is no such entailments for activities, either - if the relevant parameters are kept constant. The crucial parameter in this case is the time for which the claim is made. If this time is say 10 o'clock, then it may well be that x was Ving at ten o'clock without that x Ved at ten o'clock. So, the Imperfective paradox entailment is much the same as the inference from John was dead to John was alive: If there was a time at which John was dead, there was also a time at which John was alive - albeit not the same time.

5. Inherent temporal features of the lexical content

Do these observations mean that there are no temporal differences between various verb types, such as state verbs, activity verbs, etc, or whatever the classification may be ? Surely not. It should be clear, howewer, that these differences concern the lexical content of the various expressions, not the "events" they refer to. By lexical content, I mean that part of the meaning of some (simple or compund expression) which stems from the lexicon. In that sense, it contrasts with contextual information, on the one hand, and reference, on the other. The lexical content of a verb such as sleep or of a compound expression such as John sleep does not occupy a place in time. It is neither long nor short, nor before or after the time of speaking. The "event" to which such a lexical content contributes to refer in an utterance, does occupy some interval on the time axis. Therefore, it inevitably has a number of properties which are typical of time spans. Their exact nature depends on the kind of time structure which one assumes to underly natural language. This is a matter of dispute, but let us assume that time spans

- have a position relative to other time spans, notably the time utterance

- have boundaries and, as a consequence, a duration (i.e., a multiple or fraction of some regular event)

- can be counted.

Thus, if the utterance John slept is true, then the event of his sleeping has a position on the time axis (in this case, it is before the time of utterance), and it has a duration, although nothing is said about this duration. In fact, the utterance John slept need not necessarily refer to just one such event; as example like For two days, Napoleon slept very well or utterance (13) above illustrate, the exact number is left to the world knowledge of the listener.
None of those properties of the event(s) belongs to the lexical content John sleep. This particular lexical content by itself does not tell us anything about the position of the event on the time line, nor about its duration, nor about its frequency. But this information can be added, if there is need. Usually, this is done by appropriate adverbs. Thus, the speaker could specify a position by adding yesterday at lunchtime, a duration by for two hours, and a frequency by twice. In all of these cases, the lexical specification can be definite or indefinite. I shall say, that a lexical content which includes a (lexical) specification of a definite position is "p-definite"; similarly for definite duration (d-definite) and definite frequency (q-definite). For example, the lexical content John sleep twice is q-definite, and John sleep or John sleep sometimes is not. Note that the addition of such an adverb does not change the nature of the "event". It only makes properties of the "event" explicit which are left implicit otherwise.
It seems that simple verbs (or adjectives + copula) are never p-definite, d-definite or q-definite in this sense. It is this fact which leads to the "hidden parameters" discussed above: If neither duration, nor position, nor frequency are lexically fixed, then a it easily escapes our attention that they are different in both utterances. Consider again Aristotle's entailment in which duration is the relevant "hidden parameter". In

(16a) John is sleeping.
(16b) John has slept.

the duration of John's sleeping is in both cases not d-definite. But in both cases, the event - if the utterance is true - has a fixed duration, and this duration must be different. In the Subinterval entailment, the crucial parameter is frequency. An expression such as John slept on the floor is not q-definite; but the entailment is only correct if only one "sleeping on the floor" is meant. And the Imperfective paradox entailment works for activity verbs only if the position of the relevant time span is shifted - which is possible, since it is not fixed by the lexical content of the utterance.

This does not mean, howewer, that the lexical content of verbs does not contain any information about the intervals to which they can be linked (or more precisely, about the intervals of the "event(s)" to which they can refer). In particular, they can require that any such interval includes two opposing sub-intervals. Such is the case for a verb like die which requires a first sub-interval in which the argument, say John, is alive, and a second sub-interval, in which this very argument has the opposing property of being dead. Nothing is said about whether this transition is smooth or abrupt: It is only required that there are these two sub-interval in this order. Verbs (and lexical contents in general) of this type might be called "two-state verbs" (or "two-state contents"). Note that neither the two sub-states are d-definite nor the entire lexical content. The verb die does not say anything about how long the being alive should be, nor, about how long the being dead should be, and it is meaningless to specify the entire duration of someones beind alive and being dead. Therefore, one can't say - to use a familiar example - John opened the window for two hours, unless only one of the states (the state of the window's being open) is meant.

The fact that "two-state verbs" involve two mutually exclusive states, such as being not open and being open, or being alive and being dead, has another important consequence. If there is an interval which includes the transition from one state to the opposing one, i.e., if it is true at some interval that say John opened the window, then this interval must of necessity be "interrupted": It must contain a subinterval at which the window is not open, and a subinterval at which it is closed. Hence, the interval must be of necessity "interrupted". This is not so for John slept for three days, which does not, by its lexical content, include two distinct subintervals. Hence, the interval at which it is true, **can** be interrupted, but it need not. Note, further, that, if John was opening the window is true at some interval T, then T is "homogeneous: It only includes the first of the two states, i.e., that state at which John is somehow active in getting the window open, but not the state at which it is open. Hence, John was opening the window normally - although not necessarily - has the subinterval property. If John was opening the window at some interval T, he also did so at any subinterval of T (with the qualifications mentioned above).

There are also lexical contents which require that they either apply to an argument forever or not at all. This is the case for "atemporal properties", such as a door's being from steel, in contrast to a door's being open. If we call the former "0-state" and the latter "one-state", we get a simple classification of verbs (and adjectives) according to the inherent temporal properties of their lexical content. When combined with other expressions, these lexical contents can be enriched in various ways, such as to specify the duration, the position, the frequency of the intervals of the events, which they can refer to in an utterance. We shall not follow this up here (cf. Klein 1991); the general point should be clear, howewer.

References

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Notes

[i]. Throughout this paper, I do not systematically distinguish between verbs, copula constructions and verb phrases. This is not to mean that these (and other) distinctions are negligable in general for the description of aspect, tense and inherent temporal features, quite to the opposite. But they are not relevant to our present concern. Therefore, I will mostly speak of "verbs".

[ii]. Since states and achievements normally do not tolerate the progressive, Aristotle's entailment (as well as the following one) cannot, or often not, used for discriminative purposes, although the distinction is in a way quite parallel.

[iii]. The term "event" is used here in a very global sense, such as to comprise events proper, processes, states, etc.

[iv]. This is not correct if the the negation in (11b) has wide scope. Examples such as Yesterday morning, he was hit by a car and seriously hurt. But he did not die. He died, howewer, seven hours later from a heart attack show that the negation in sentences such as He did not die need not have wide scope. Note, incidentally, that a definite analysis of the simple past avoids the false entailment for the simple reason that it automatically keeps the "hidden time parameter" constant.