The Perfective Paradox: Or How to Eat Your Cake and Have it Too
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1 Introduction

Consider sentence 1 in Hindi and sentence 2 in Japanese. These sentences are self-contradictory in English but perfectly normal in Hindi and Japanese respectively. As I will explain below, the natural readings of these and similar sentences are difficult to account for on the basis of most extant theories of aspect. I call this phenomenon the *perfective paradox*.

1. maĩne aaj apnaa kek khaayaa aur baakii kal khaũũgaa
   I-ERG today mine cake eat-PERF and remaining tomorrow eat-FUT
   I ate my cake today and I will eat the remaining tomorrow

2. wakashita keredo wakanakatta
   boil-PERF though boil-NEG
   I boiled the water, but it did not boil

Traditionally, the perfective aspect is considered quite uncontroversial–a sentence in the perfective is also simply taken to describe an event which has reached an end.[1] The interaction with Vendler's (1967) classification of situation types is seen to be straightforward. For example, the two component theory proposed by Smith can accommodate various interpretations of the perfective (Smith 1990). It has been pointed out that in many languages the perfective can be used for at least the non-stative situation types, namely achievements, activities and accomplishments (Smith 1990) Sometimes it can be used with states as well, as is the case in English. For achievements, the perfective is more natural than the imperfective and signifies the corresponding change of state. For activities, the perfective describes their cessation at any arbitrary point—that is how activities end. For accomplishments, the picture is taken to be equally unremarkable: the perfective simply emphasizes the natural ending of the situation. Unfortunately, this picture, though compelling, is not quite correct. Specifically, in several languages, notably Hindi and Japanese, the perfective form may be used with verbs that usually denote an accomplishment to mean that the described situation has reached an endpoint, but *not* the natural one that would signify the accomplishment.

Intuitively, however, this data is hardly surprising. Accomplishments have features of both achievements and activities: they call for extended action and also have a natural endpoint. Clearly, the action done as part of an accomplishment may either be taken all the way or stopped at any point. In a language like English the use of a simple verb (SV) by default indicates that the natural endpoint is reached, but an additional description is required to state that the action was stopped arbitrarily.

These additional descriptions may, for example, be in the form of determiners (e.g. 'some of the cake'). By contrast, some other languages have distinct forms to emphasize the natural and arbitrary endpoints respectively. In Hindi, simple verbs are used for arbitrary endpoints, and compound verbs for natural endpoints (see Singh 1990). For example, the ungrammaticality of the subordinate clause in sentence 3 indicates that the natural endpoint of the event has been reached. In Japanese, the verb constellation includes the verb for 'to finish' to imply completion.

3. * maĩne kek khaa liya, jo bacaa hai wo raam khaayegaa
   I-ERG cake eat take-PERF what remain is that Ram eat-FUT
   I ate the cake and Ram will eat the rest

In this paper, I discuss the perfective paradox in the context of Hindi. The perfective in Hindi is intimately connected with the phenomenon of ***compound verbs***, which I will now describe briefly.

> Compound Verbs (or CVs for short) are constellations of verbs of the form [Verb1 + Verb2]. Verb1 is called the main verb and carries the semantic weight of the CV. Verb2 is called the explicator verb and loses its independent meaning to a large extent. Two paradigm examples are
>
> 4. dekh-aa
>   see-PERF (a simple verb)
> 5. dekh li-ya
>   see take-PERF (a compound verb)

In a theory of aspect like the one of Smith, it is possible to give the following sort of analysis (Smith 1990). One could say that the compound verb constellations can be used only to refer to the natural endpoints of event types. This would mean completion for accomplishments and change of state for achievements. For any arbitrary endpoints only the simple verb can be used—therefore activities never occur with a compound verb constellation. The analysis seems to work quite well. However, there is *one* shortcoming. Such a framework does not allow us to distinguish between sentences 6 and 7 below, since both of them are accomplishments. There is a clear meaning distinction in sentence 6 between the simple verb form and the compound verb form. The perfective compound verb in sentence 6 implies that both the cakes were eaten entirely; the simple verb form has no such implications. In sentence 7, however, there is no distinction—neither presuppositional or implicational—between the simple and compound verb forms: both imply that the entire mass of one and a half cakes was eaten.

6. laRke-ne do kek khaaye / khaa liye
   boy-ERG two cake eat-PERF / eat take-PERF
   The boy ate two cakes (partly) / entirely

7. laRke-ne deRh kek khaayaa / khaa liya
   boy-ERG one and a half cake eat-PERF / eat take-PERF
   The boy ate one and a half cakes entirely

I submit that any solution to the perfective paradox must also take care of data such as the above. In this paper, I discuss a more subtle approach to the semantics of events that provides just the right concepts to take care of this paradox. The approach is based on a lattice-theoretic account of event and object structure as developed recently by Manfred Krifka (In Press) The resulting approach is not only general but elegant as well.

2 The Theory

In this theory, both events and objects are treated as elements in two lattice structures. Many interesting properties of thematic relations between events and objects then correlate with mathematical properties of the two different lattice structures. The semantics of cumulative and quantized reference is given in terms of a semantic operation for joining two individuals to form a new individual. Cumulative and quantized predicates do not correspond exactly to mass nouns and count nouns. For example, both 'beer' and 'apples' are mass nouns since beer combined with more beer is still beer, and adding more apples to apples yields apples. On the other hand, 'a glass of beer' and 'five apples' are quantized. Suppose there are two entities to which the predicate 'a glass of beer' applies. This predicate then cannot apply to their collection. The case of 'five apples' is similar. These concepts have been expressed formally below.

It turns out from these theories that typically a quantized argument yields a telic verbal predicate and a cumulative argument yields an atelic verbal predicate. However, most interestingly for us, in Hindi we can get an *atelic* interpretation for quantized arguments as we saw in sentence 1. This is not quite an atelic reading, but rather what I call a *partitive telic:* I return to this point in §3.5 below.

The lattice-theoretic analysis of events assumes *events* and *objects* to be two non-overlapping sorts of entities characterized by predicates E and O respectively. The extensions of O and E have the structure of a join semi-lattice without a bottom element. Let $\sqcup$ be the operation of join; $\sqsubseteq$ be the relation of part; $\sqsubset$ be the relation of proper part; and $\circ$ be the relation of overlap. The following properties of object and event predicates are important for this paper.

1. *Cumulativity* is the property of atelic events.
   $\forall P[\mathsf{CUM}(P) \leftrightarrow \forall x, y[P(x) \wedge P(y) \rightarrow P(x \sqcup y)]]$
2. *Quantization* is the property of telic events.
   $\forall P[\mathsf{QUA}(P) \leftrightarrow \forall x, y[P(x) \wedge P(y) \rightarrow y \not\sqsubset x]]$

Thematic relations can be modeled as homomorphisms from objects to events that preserve the lattice structure. The following properties of thematic relations are used later in this paper (see Krifka (In Press) for details).

1. *Summativity* provides the connection between thematic relations and the join operation. For example, two events of eating an apple yield an event of eating two apples.

$\forall R[\mathsf{SUM}(R) \leftrightarrow \forall e, e', x, x'[R(e, x) \wedge R(e', x') \rightarrow R(e \sqcup e', x \sqcup x')]]$

2. ***Uniqueness of objects*** relates every event to a object; e.g., the eating of an apple is related via the patient role to a specific apple.

   $\forall R[\mathsf{UNI\text{-}O}(R) \leftrightarrow \forall e, x, x'[R(e, x) \wedge R(e, x') \rightarrow x = x']]$

3. ***Uniqueness of events*** relates every object to a single event; e.g.; for a particular apple there can be only one event of eating it.

   $\forall R[\mathsf{UNI\text{-}E}(R) \leftrightarrow \forall e, e', x[R(e, x) \wedge R(e', x) \rightarrow e = e']]$

4. ***Mapping to objects*** maps, for example, every part of eating an apple to a part of an apple.

   $\forall R[\mathsf{MAP\text{-}O}(R) \leftrightarrow \forall e, e', x[R(e, x) \wedge e' \sqsubseteq e \rightarrow \exists x'[x' \sqsubseteq x \wedge R(e', x')]]]$

5. ***Mapping to events*** goes the other way: it maps, for example, every part of an apple to a part of the event of eating it.

   $\forall R[\mathsf{MAP\text{-}E}(R) \leftrightarrow \forall e, x, x'[R(e, x) \wedge x' \sqsubseteq x \rightarrow \exists e'[e' \sqsubseteq e \wedge R(e', x')]]]$

6. Using these primitive notions we can define another useful relation, namely ***graduality.*** The ***graduality*** of a thematic relation means that the object is subjected to the event in a gradual manner. For example, ***writing a letter*** or ***eating an apple*** affect their objects gradually.

   $\forall R[\mathsf{GRAD}(R) \leftrightarrow \mathsf{UNI\text{-}O}(R) \wedge \mathsf{MAP\text{-}O}(R) \wedge \mathsf{MAP\text{-}E}(R)]$

3 Perfectivity and Quantization

A change in the reference type of nominals can affect the temporal constitution of the entire construction. In German, progressivity may be marked by a partitive case marking on the patient (Krifka (In Press)). The lattice-theoretic approach provides an explanation of this phenomenon since it allows a change in reference type of the nominal predicate to affect the temporal constitution of the entire construction. E.g., in German a "partitive-patient" relation yields a progressive reading as in ***an einem Fisch essen.*** On the other hand, there are also cases (like Slavic languages) where a verbal predicate operator affects the meaning of the nominal predicate; e.g., perfectivity in Czech is compatible only with a quantized object. In sentence 8 below the perfective is acceptable only with the quantized reading of the patient.

8. ota vypil vino
   Ota drink-PERF wine / the wine
   Ota drank *wine / the wine

Like Slavic languages, Hindi does not have any articles to mark definite or indefinite NPs. This gives rise to two kinds of ambiguity. For one, bare NPs may be interpreted as indefinites or definites; e.g., ***vaain*** can mean 'wine' or 'the wine'. Secondly, count nouns have two further kinds of ambiguity; e.g., apple in Hindi can

not only mean 'an apple', 'the apple', but also 'some mass of apple' or 'any part of an apple'. This ambiguity is one of the causes of the perfective paradox. Let us return to sentence 1 above where the object *kek* is definite. The fact that it is grammatical is a result of the interpretation of 'cake' as 'a part of the cake'.

3.1 Classification of Thematic Roles

In Figure 1 below, properties of thematic relations, as described in §2, have been used to classify the predicates. This figure presents the results of considering four classes of predicates in Hindi in both their simple and compound verb forms.

Example	SUM	GRAD	UNI-E	CV-SV distinction
write a letter	X	X	X	X
read a letter	X	X	—	X
see a cat	X	—	—	—
win a race	X	—	X	—

Figure 1: Classification of Thematic Roles

The first category is of predicates that have the properties of summativity, graduality and uniqueness with respect to events, e.g., *write a letter.*

9. usne ciThii likhii par puurii nahii̅ kii
   he-ERG letter write-PERF but complete NEG do-PERF
   He wrote a letter but did not complete it

10. usne ek ciThii likhii par puurii nahii̅ kii
    he-ERG one letter write-PERF but complete NEG do-PERF
    He wrote one letter but did not complete it

11. usne ciThii likh lii (* par puurii nahii̅ kii)
    he-ERG letter write take-PERF (but complete NEG do-PERF)
    He wrote a letter (* but did not complete it)

12. usne ek ciThii likh lii (* par puurii nahii̅ kii)
    he-ERG one letter write take-PERF (but complete NEG do-PERF)
    He wrote one letter (* but did not complete it)

Members of the second class of event predicates mentioned in Figure 1 have the properties of summativity and graduality, but lack the property of uniqueness with respect to events (e.g., *read a letter*).

13. usne ciThii paRhii par puurii nahii̅ kii
    he-ERG letter read-PERF but complete NEG do-PERF
    He read a letter but did not complete it

14. usne ciThii paRh lii (* par puurii nahiĩ kii)
    he-ERG letter read take-PERF (but complete NEG do-PERF)
    He read a letter (* but did not complete it)

In both these cases, the thematic relation is *gradual.* It appears that the uniqueness of events does not have any effect on whether the reading is partitive or completive. Sentences 10 and 12 use the quantizer *ek*, but they behave just like sentences 9 and 11 respectively which do not have a quantizer. Therefore, it is clear that in cases where the thematic relation is gradual, the SV-CV distinction is not related to quantization. Both for bare NPs and quantized NPs, a CV is used when completion has to be specified; a simple verb is used when a partitive reading is intended.

The next class is different with respect to the graduality of the thematic relation. Sentences 15 and 16 are examples of predicates with the property of summativity, but lacking the properties of graduality and uniqueness with respect to events.

15. usne billii dekhii
    he-ERG cat see-PERF
    He saw a cat

16. usne billii dekh lii
    he-ERG cat see take-PERF
    He saw the cat

These sentences show that the distinction between the CV and the SV forms in this class of event predicates is related to the distinction between definites and indefinites. The CV forces a definite reading of the bare Noun Phrase. The analysis of CVs so far is that when the event in question is *not gradual* as in sentences 15 and 16, then the CVs mark the nominals as being definite.

The other class of predicates I would like to discuss lacks graduality but has the properties of summativity and uniqueness of events. Consider sentence 17 below.

17. usne res jiitii / jiit lii
    he-ERG race win-PERF / win take-PERF
    He won the race

In this sentence there is no aspectual distinction between the forms with a CV or an SV. The use of the CV contributes to pragmatic factors like speaker empathy but that is not of importance here. Therefore we may conclude that predicates that lack graduality do not have any aspectual distinction corresponding to the part-complete relation of gradual patients.

The previous case of sentences with gradual thematic relations is more interesting, so I return to it now.

3.2 Mass Nouns

Consider the following examples that have mass head nouns.

18. usne biar pii
    he-ERG beer drink-PERF
    He drank beer (cumulative reading)

19. usne do gilaas biar pii/ pii lii
    he-ERG two glasses beer drink-PERF / drink take-PERF
    He drank two glasses of beer (quantized reading)

20. usne biar pii lii
    he-ERG beer drink take-PERF
    He drank the beer (some salient amount)

These examples show that Hindi marks explicitly quantized cumulative nominals in a special way. We saw in sentences 9 and 10 that quantization of count nouns was not a crucial factor in the part-complete distinction—both explicitly quantized and non-quantized count nouns interacted similarly with CVs. But, if the cumulative noun is not quantized then the SV is used, while if it is quantized there is no distinction between the SV and CV form—both would imply a completive reading. Sentence 20 shows that even when the patient is not explicitly quantized the CV form transfers the property of quantization to the nominal. Therefore the interpretation of sentence 20 is that of his having drunk some salient quantity of beer.

3.2.1 Count Nouns Behaving as Mass Nouns

It is possible to have an NP with a count head noun behave as a mass noun. For example,

21. usne deRh seb khaaye (* par puure nahĩĩ khaaye)
    he-ERG one-and-a-half apples eat-PERF (but entire NEG eat-PERF)
    He ate one-and-a-half apples (* but did not eat all of them)

22. usne deRh seb khaa liye (* par puure nahĩĩ khaaye)
    he-ERG one-and-a-half apples eat take-PERF (but entire NEG eat-PERF)
    He ate one-and-a-half apples (* but did not eat all of them)

Here there is no aspectual distinction between the SV-CV versions. Even though the head noun is a count noun, by giving it a "non-discrete" determiner, we make it behave like a measure of a mass noun. I.e., one-and-a-half apples is on par with one gallon of wine, and no proper part of the eating of one-and-a-half apples is an eating of one-and-a-half apples. And consequently the CV-SV distinction does not apply to such constructions.

3.3 Count Nouns

However, in the case of explicitly quantized count nouns as in sentence 23 below, the preferred verb form is the CV as in 24. What is interesting about these examples is that sentence 24 has the interpretation that the agent has eaten all the five apples entirely. The interpretation of sentence 23 could be that the agent ate a part of each of the five apples. This is diagramed in Figure 2.

23. usne paanc seb khaaye
    he-ERG five apples eat-PERF
    He ate five apples (not entirely)

24. usne paanc seb khaa liye
    he-ERG five apples eat take-PERF
    He ate five apples (entirely)

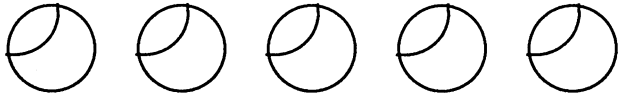

Figure 2: Partitive Reading for Plurals

This shows that when the head noun is a count noun, the default form of the verb that is required is a CV form. The interpretation of this corresponds to that of the English perfective. The SV form can be felicitously used only for a partitive reading (defined formally in §3.4 below).

3.4 Partitive Telicity

A useful property for the definition of *partitive telicity* is that of ATOM. This applies to an element and a predicate and says that the element is an atom of the predicate; i.e., the predicate applies to the given element but to no part of it. ATOM applies to count nouns but not to mass nouns. It can be defined formally as

- $\forall x, P[\mathsf{ATOM}(x, P) \leftrightarrow P(x) \wedge \neg\exists y[y \sqsubset x \wedge P(y)]$

Using this we can define a new relation, *is an atomic part of* ($\sqsubseteq_A$) as the part relation ($\sqsubseteq$) restricted to atoms. Let δ denote the nominal predicate of a given sentence, and let α denote the verbal predicate. Also let θ denote the thematic relation. Now we can formally define the constraints on thematic relations that are captured by SVs and CVs, respectively. As already described, SVs allow readings in which their arguments are not entirely consumed, while CVs require that their arguments be involved as a whole. Thus the thematic relation for CVs is the standard one, while that for SVs is more complex:

- $\theta_{pt}(e, x) \leftrightarrow \forall y[y \sqsubseteq_A x \rightarrow \exists e', z[z \sqsubseteq y \wedge e' \sqsubseteq e \wedge \theta(e', z)]]$

The sentence predicate in each case would be as follows.

SV: $\lambda e \exists x[\alpha(e) \wedge \theta_{pt}(e,x) \wedge \delta(x)]$

CV: $\lambda e \exists x[\alpha(e) \wedge \theta(e,x) \wedge \delta(x)]$

E.g., let α be 'eat', δ be 'five apples', θ be the usual patient relation, and θ_{pt} be the patient relation under the partitive telic reading. Then the SV sentence predicate applies to an event in which parts of each of five apples are eaten, while the CV version applies only to those in which five apples are eaten entirely—this corresponds to the English perfective. θ_{pt} is defined in terms of the atomic parts of the given object- note that count nouns but not mass nouns have atomic parts.

3.5 Partitive versus Progressive

It might seem from the discussion above that the partitive reading for objects (as given in sentences with SVs) coincides with the progressive reading of the corresponding events, as was the case in German. However, this is not the case here. The definition of the progressive is given in terms of an operator PROG (Krifka (In Press)). This says that PROG(α) is true of event e' iff it is a part of an α-event, e.

- $\mathsf{PROG} = \lambda P \lambda e' \exists e[P(e) \wedge e' \sqsubseteq e]$

Consider, once again sentence 23 about the eating of five apples. This sentence is true only if parts of each of the five apples are eaten. The corresponding progressive, on the other hand, would be true if any part of any apple was being eaten. In general, the progressive is true of all subevents of the eating event (e.g., when only one apple has been bitten into); the partitive telic is *not* true of just any such subevent, but only of those subevents in which parts of all five apples are eaten.

The partitive reading seems atelic (as I mentioned in §2) but is not quite that. This is because the eating of five apples in sentence 23 has a natural final endpoint, namely that of biting into the fifth apple. It must be noted, however, that this endpoint is not unique, as it would be in ordinary telic events: as long as there are some parts of the five apples left, one can continue to eat them. Thus it has features of both telic and atelic events. As remarked in §2, I term this reading the *partitive telic* reading.

4 Conclusions

We can conclude from this discussion that the requirements for the perfective form of the SV do not correspond to those for that of the CV, which behaves like the perfective in English. Unlike the CV perfective, the SV perfective, which I have dubbed the *partitive telic*, does not require that its object participate entirely. And unlike the progressive, it suggests completion.

It seems to me that the perfective paradox is the result of the lack of articles and the ambiguity that arises due to the various interpretations of bare NPs. However, the complexity of the verbal forms makes it possible to disambiguate between

different interpretations to a large extent. The perfective marker and CVs provide interesting insights into the relation between nominal reference and aspectual marking.

Endnotes

* I am deeply indebted to Manfred Krifka for comments and discussions.

1. I should clarify that the verb form in sentence 1 is indeed the perfective. It is well-known that the progressive and the habitual are the only imperfective forms available in Hindi (e.g., see Dahl 1985). Consider sentence 25 with the perfective form of the verb and sentence 26 with the progressive form.

25. laRkaa baag mẽ calaa (* aur ab tak cal rahaa hai)
boy park in walk-PERF (and now till walk PROG is)
The boy walked in the park (*and is still walking)

26. laRkaa baag mẽ cal rahaa thaa (aur ab tak cal rahaa hai)
boy park in walk PROG (and now till walk PROG is)
The boy was walking in the park (and is still walking)

Since the coordinate clause in sentence 25 is unacceptable, while that in sentence 26 is acceptable, it is clear that the action in sentence 25 is completed, whereas the action in sentence 26 is not.

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