

Gyarmathy, Z., & Altshuler, D. (2020). (Non) culmination by abduction. *Linguistics*, 58(5), 1373-1411.

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In Gyarmathy & Altshuler (2020), the authors propose a new approach to the problem of culmination inference, which is called abduction, or abductive reasoning. Abductive reasoning involves inference to the antecedent of a conditional sentence on observing the consequent, which means that: if we observe O, and our theory T tells us that $E \rightarrow O$, then we abduce E, because together with the theory, this entails what we observe (Gyarmathy & Altshuler 2020: 9). Abductive reasoning is an inference that goes backwards, from the consequence to the possible factor: there can be various factors that can all cause the consequence to occur, and the possibility of each factor to be considered the cause of the situation depends on contextual and world knowledge. For example, there are two people in the room, John and Mary, and there is a stolen necklace in this room, then, through abductive reasoning, the inference process will be as shown below:

E_1 : Mary stole the necklace.

E_2 : John stole the necklace.

T: Someone stole the necklace, whether E_1 or $E_2 \rightarrow O$.

O: There is a stolen necklace in the room.

In this case, if no other contextual knowledge is considered, the possibility of inferring E_1 and E_2 is the same, but, if there is contextual knowledge given as

C: John has a criminal record.

then, the possibility of E_2 goes up, E_2 becoming the most presumptive explanation. Through abductive reasoning, E_2 , which is “John stole the necklace”, can be implied from the

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observation O, which is “there is a stolen necklace in the room”.

For the abductive reasoning to be applicable for explaining culmination implicature, the authors use two specific types of predicates, namely, the simple perfective in Hindi (PFV_H) and the imperfective in Russian (IPF_R). In PFV_H, there is a phenomenon that allows the description of perfective accomplishments to be compatible with the event not having culminated. The Hindi example in (1) from Singh (1991) illustrates this phenomenon: the perfective *khaayaa* (‘eat’) is used to describe an eating event that has culminated. However, the perfective description is compatible with the eating event not having culminated, as the follow-up in parenthesis shows.

- (1) *maĩne aaj apnaa kek khaayaa (aur baakii Kal khaĩũgaa)*
 I.ERG today mine cake eat.PFV and remaining tomorrow eat.FUT
 ‘I ate my cake today (and I will eat the remaining part tomorrow).’

(Gyarmathy & Altshuler 2020: 2)

The perfective predicate could fail to entail culmination in PFV_H, even by itself, without the following parenthetical sequence, but, at the same time, it remains an accomplishment². In addition, the authors argue that IPF_R carries a defeasible inference of culmination. The Russian example in (2) from Grønn (2008) shows that IPF_R can describe both culminated event and non-culminated events:

- (2) *Kto čital “Vojnu i Mir”?*
 who read.PST.IPF “War and Peace”
 ‘Who has read “War and Peace”?’

(Gyarmathy & Altshuler 2020: 2)

The event in (2) is compatible with a non-culminated reading event, which means that the question at hand turns out to be a question about a proper part of the accomplishment, “Who was engaged in reading *War and Peace*?”.

To explain the culmination implicature of PFV_H and IPF_R, the authors embrace the

² In this case, the perfective *khaayaa* (eat) is used to describe a culminated eating event. The authors state that, in a normal context, it “tends” to express a culminated event, but also can have a non-culminating reading, which means that the possibility of a culminated reading is higher.

theory, following Koenig & Muansuwan (2000), that divides perfective predicates into two categories: culminated events and maximal events. Culminated events are those under the category that an event e has culminated with respect to event predicate P iff $P(e)$ holds, which means that event e indeed happens in the actual world. A maximal event is $\text{Max}(P)(e)$, an event e is maximal (in the inertia world in the sense of Dowty (1979), or in a possible world in Landman (1992)) with respect to event predicate P iff:

- for some possible e' of which e is a part, $P(e')$ holds.
- there is no event e'' in the world of evaluation such that:
- e is a proper part of e''
- there is some possible e' of which e'' is a part, such that $P(e')$ holds.

Illustrated as $\text{Max}(P)(e)$ iff:

$$\exists \diamond e' [e \sqsubseteq e' \wedge P(e')] \wedge \neg \exists @ e'' [e \sqsubset e'' \wedge \exists \diamond e' (e'' \sqsupseteq e' \wedge P(e'))]$$

(Gyarmathy & Altshuler 2020: 13)

Where \diamond means in the inertia world, and $@$ means it actually exists in the real world. So, in example (1), the event e “I ate my cake today” would be a part of the event e' in the inertia world, so that e' is a complete event of “ate my cake”, and there is not an event e'' existing in the actual world, so that e'' is in the denotation of “ate my cake” and is a part of the inertia world e' ; also at the same time e (I ate my cake today) is a proper part of e'' . This means that event e is the largest or maximal event that satisfies the event description, i.e., in the denotation of “ate my cake”, there is no e'' larger than e that satisfies the event description.

This proposal contrasts with culminated events (or telic events), as conceived by Krifka (1998), which are associated with “telicity as the property of an event predicate X that applies to events e such that all parts of e that fall under X are initial and final parts of e .” (Krifka 1998: 9). If e is telic, then the only e' in the denotation of the event description and is a part of e is e itself. But if e is a maximal event, there is no exclusion of an event e'' in the denotation of the event description and is a proper part of e .

For Gyarmathy & Altshuler (2020), the idea of the maximal event states that perfective predicates which allow for non-culminating construals like PFV_H describe maximal

events, whereas perfective predicates that do not allow such construals describe culminated events.

With the Hindi simple perfective out of the way, the authors continue to discuss the imperfective in Russian. Following Filip (1999), the authors use a theory that divides the imperfective also into two categories: one is the imperfective form that describes a part of an event, the other is the imperfective form that describes a proper part of an event. The relation of proper part is a strict partial ordering, meaning that if e is a proper part of an event predicate P , then e cannot be in the denotation of P , as illustrated below:

$$\text{PRPART}(P)(e) \text{ iff } \exists_{\diamond} e'(e \sqsubset e' \wedge P(e'))$$

e is an event in the actual world, and e' is the event in the inertia world, which is the denotation of P . Then, e is a proper part of P if and only if there is an event e' of which e is a proper part. For example, predicates like the English progressive describe a proper part, as shown in (3):

- (3) Max is crossing a street.

The progressive e “is crossing a street” is a proper part of the event predicate P “crossed the street” because there is a possible e' in the inertia world in which the event “cross the street” is complete, hence e' is the denotation of P “crossed the street”.

The relation of part is a non-strict relation of part-or-equal, which means that events in the part relation can overlap, as illustrated below:

$$\text{PART}(P)(e) \text{ iff } \exists_{\diamond} e'(e \sqsubseteq e' \wedge P(e'))$$

e is a part of P if e is overlapping with e' or e can be a proper part of e' , which means that the imperfective which describes a part relation can be describing the completion of the possible event e' . The authors argue that predicates like IPF_R describe a part relation in (2), therefore they can have both a culminated reading and a non-culminated reading. The event “read war and peace” in (2) is a part of the event description P “(completely) read *War and Peace*” and e' corresponds to the “(completely) read *War and Peace*” event; therefore, when e is overlapping with e' , the event in (2) gets a culmination reading in which the event is complete, and when e is a proper part of e' , the event gets a non-culmination reading.

For the authors, perfective predicates have two possible consequences: one is to describe culminated events which have culmination readings, the other is to describe maximal events which have non-culmination readings. When it comes to imperfective predicates, imperfectives describing part of an event have culmination readings and non-culmination readings, imperfectives describing a proper part of an event can only have non-culmination readings. Based on this, to use abductive reasoning, the authors proposed four theories T, which are as follows:

$$(T1) \quad \exists_{@e} (P (e)) \rightarrow \exists_{@e} (PART (P) (e))$$

If there is a culminated event e in the actual world, then e could describe a part relation with the event predicate P , according to the IPF_R example (2).

$$(T2) \quad \exists_{@e} (P (e)) \rightarrow \exists_{@e} (MAX (P) (e))$$

If there is a culminated event e in the actual world, then e could be a maximal event in the denotation of P , according to the PFV_H example (1).

$$(T3) \quad \exists_{@e} (PRPART (P) (e)) \rightarrow \exists_{@e} (PART (P) (e))$$

If there is an event e in the actual world which describes a proper part relation with the event predicate P , then event e can describe a part relation with the event predicate P , according to the logic in $PART (P) (e)$ and $PRPART (P) (e)$.

$$(T4) \quad \exists_{@e} (PRPART (P) (e)) \rightarrow \exists_{@e} (MAX (P) (e))$$

If there is an event e in the actual world which describes a proper part relation with the event predicate P , then e could be a maximal event in the denotation of P , according to the logic in $PART (P) (e)$, $PRPART (P) (e)$ and $Max(P)(e)$.

Applying the abductive reasoning to the PFV_H , the authors observe that the PFV_H is related to maximal events, so O is fixed. However, there are two theories, T2 and T4, and two explanations, E2 and E4, as illustrated below (H stands for Hindi):

$$O_H: \exists_{@e} (MAX(P)(e))$$

$$T2: \exists_{@e} (P (e)) \rightarrow \exists_{@e} (MAX (P) (e))$$

T4: $\exists_{@}e$ (PRPART (P) (e)) \rightarrow $\exists_{@}e$ (MAX (P) (e))

E2: $\exists_{@}e$ (P (e))

E4: $\exists_{@}e$ (PRPART (P) (e))

(Gyarmathy & Altshuler 2020: 16)

The criteria for selecting the right explanation (which is E2, according to the authors) is that E2 has the best coverage and is more specific, because, when the event predicate is an accomplishment, unlike achievements, it does have proper parts, so theory T4 cannot be applied to both accomplishments and achievements, making the selected theory have more coverage. They also consider that when the event does have proper parts, E2 entails E4 (according to T1 and T3), while the reverse does not hold, making E2 more specific. Thus, E2 is the best explanation, so accomplishments (in terms of PFV_H) imply culmination events by themselves but are cancelable, and achievements entail culmination events and are not cancelable because they do not have proper parts. However, the process of selection of the best explanation in abductive reasoning, admitted by the authors, can be influenced by contextual knowledge, world knowledge and meta-level information, so the criteria for the selection of the best explanation needs to be studied in the future.

When it comes to the application of abductive reasoning to the IPF_R, the authors argue that, since the observation of the event is not the same as in PFV_H, another set of theories is used. The observation for the imperfective is a part relation, and there are two theories, T1 and T3, and two explanations, E1 and E3, as illustrated below (R stands for Russian):

O_R: $\exists_{@}e$ (PART (P) (e))

T1: $\exists_{@}e$ (P (e)) \rightarrow $\exists_{@}e$ (PART (P) (e))

T3: $\exists_{@}e$ (PRPART (P) (e)) \rightarrow $\exists_{@}e$ (MAX (P) (e))

E1: $\exists_{@}e$ (P (e))

E3: $\exists_{@}e$ (PRPART (P) (e))

(Gyarmathy & Altshuler 2020: 19)

The authors argue that, similarly to the case of PFV_H, E1 is the best option for O_R, due to its broader coverage and greater specificity. For the process of selecting the best

explanation, the authors use the term “minimal contexts”, which means that the observed events are only events themselves without any additional context. The reason for this is that additional context can change the selection process, as shown in (4):

- (4) *Včera ja čítal “Vojnu i Mir”.*
 yesterday I read.PST.IPF “War and Peace”
 ‘Yesterday I was reading “War and Peace”.’

This time, the IPF_R event is the same as in (2) but with a temporal modifier “yesterday”. Now, the additional context is given, and the selection process will change to favor the explanation E3, because the assertion time of the event is smaller than what one considers the normal length of the event. So, the temporal modifier changes the observation O_R to a different kind, as shown below,

$$O_4: \exists_{@} e (\text{PART}(P)(e) \wedge \tau(e) \leq 1 \text{ day})$$

where $\tau(e) \leq 1 \text{ day}$ means that the time trace for the event e takes less than one day, as the temporal modifier is “yesterday”. From this observation, the potential theory and explanation differ from the one for (2). From this point of view, the external factor for the abduction reasoning is important for selecting the best explanation. When considering IPF_R, the authors argue that there is an external factor which is the possibility of a Russian perfect assertion.

“Taking into account facts of conversation, the best explanation for hearing/uttering a Russian sentence with IPFR will include the fact that the corresponding PFVR would have been more misleading in conveying the relevant facts of the world.”

(Gyarmathy & Altshuler 2020: 24)

Consider, for example, (5):

- (5)
 a. *Ja otkry-l okno.*
 I PFV.open-PST window
 ‘I (have) opened the window.’

- b. *Ja otkr-yva-l okno.*
 I open-IPF-PST window
 ‘I (have) opened the window.’

Note that (5a) is a Russian perfect predicate (PFV_R) and (5b) is an IPF_R one. The authors argue that the perfect predicate in (5a) has a resultative perfect interpretation, by so having the additional inference that the window is open at the speech time. When the speaker wants to express that the window has been opened (P), while it is currently closed, the predicate in (5a) cannot be used because of the result perfect interpretation, hence contradicting the observation. Then, the speaker is given no choice but to select the IPF_R in (5b), even though IPF_R is neutral between a culmination reading and a non-culmination reading. Furthermore, the authors argue that because the PFV_R is rejected in this context, the IPF_R will not get the non-culmination reading which PFV_R does not have, so the event will have a culmination implicature. Also, when the PFV_R is not rejected (contrarily to the window case), because interpretation is restricted by the PFV_R to not having the same interpretation, the IPF_R will have a non-culmination implicature.

The authors state that the English progressive, although similar to the imperfect in Russian, does not have the same semantics, for the English progressive describes a proper part of the event predicate. Since the observation is not O_R, which is a part relation, the proper part relation cannot be a consequence of the culminated event P, as shown below:

$$\#T_E: \exists_{@}e(P(e)) \rightarrow \exists_{@}e(\text{PRPART}(P)(e))$$

This theory is false: the rule here does not work with achievements, because achievements are culminated events, but they do not have a proper part, making this theory T_E unacceptable. Hence, the observation of a proper part relation cannot go backwards to infer a culminated event, and so, no culmination inference can be expected in English progressives.

From a pragmatic perspective, the culmination inference in Gyarmathy and Altshuler (2020), as the authors argue, has mixed behaviors. Specifically, there is a distinction between implicature and presupposition. According to Gyarmathy (2015), presupposition is cancelable in unembedded contexts, so the process event which right-boundary achievements infer is a presupposition, since it can be canceled when the achievement predicate is not embedded under any operators, as in, for example, the “moving toward the station” event inferred by the

achievement “arrive at the station”. Nonetheless, the authors argue that culmination inferences do not behave like presuppositions, as shown in example (6):

- (6) Možet byt’ Ivan čital poslednie stročki pis’ma.
 May be Ivan read.IPF.PST last lines letter
 ‘Ivan may have read the last lines of the letter.’

The culmination inference (IPF_R) in (6) does not project in the same way as presuppositions: no actual culminating reading is implied. Also, it appears that the culmination inference survives in embedded contexts like implicatures, so in this case, (6) behaves more like a conversational implicature than a presupposition.

However, when running a test for conversational implicature, culmination inferences present mixed results, as shown in (7):

- (7)
- a. Ja čital poslednie stročki pis’ma. Čital ix do
 konca.
 I read.IPF.PST last lines letter read.IPF.PST them until
 end.
 ‘I read the last lines of the letter. I read them fully.’
- b. Ty čital ‘Vojnu i mir’? #Čital do konca?
 you read.IPF.PST ‘War and peace’ read.IPF.PST until end
 ‘Have you read ‘War and peace’? #Have you read it completely?’

The reinforcement test can check if the inference is a conversational implicature; unlike entailments or presuppositions, conversational implicatures can be reinforced by adding a reinforced discourse. In (7a), the IPF_R shows no difficulty in adding the reinforced discourse, but in (7b), this is not possible. So, the authors argue that culmination inferences are neither presuppositions nor conversational implicatures but of some different kind of implied content.

From the explanation of culmination inference, the authors also show that abductive reasoning can be applied to distinguish defeasible causatives from non-defeasible ones.

According to Martin & Schäfer (2012), defeasible causatives are conceived as follows:

“With agentive subjects, these verbs are used to denote an act performed with the intention of triggering a certain result, but this result does not have to occur for the sentence to be true. With causer subjects, the same verbs entail the occurrence of the result.”

(Martin & Schäfer 2012: 248)

The difference between an agentive subject and a causer subject can be shown in a French example such as (8):

(8)

- a. *Pierre lui enseignera le russe. Mais évidemment, il ne l'apprendra pas.*
‘Pierre will teach him Russian. But obviously, he will not learn it...’
- b. *Ce voyage lui enseignera le russe, # mais, évidemment, il ne l'apprendra pas.*’
‘This trip will teach him Russian. #But obviously, he will not learn it...’

(Martin & Schäfer 2012: 248)

The authors argue that defeasible causatives with a causer subject are not impossible but much harder to achieve than with an agent subject. As shown in (9), the unacceptability of (8b) is due to lexical, syntactic, and contextual factors, just like the theory of abductive reasoning.

- (9) Living in a large city offered you a number of advantages, you just didn’t take them.
[Causer]

(Gyarmathy & Altshuler 2020: 32)

The reason defeasible causativity with agentive subjects is easier to achieve is that agentive subjects are highly indicative of the associated change as its result (Martin 2015). This leads to a single explanation E for the observation O_a , and E_a will be inferred by abductive reasoning and is cancelable. However, with causer subjects, which are not indicative of the associated change as its result, there could be many explanations E_c to a single O_c . For example, in (8b) there can be various sources of Russian in the trip to learn

from, and in all of those sources, none of them appears to be better as an explanation for the observed process than the others. Consequently, the explanation cannot be easily inferred, thus it is not cancelable.

For the abduction theory to work, it is a prerequisite that the endpoint (culmination) inclusion of accomplishments (at least in Hindi and Russian) be an inference rather than an entailment. This view differs from the traditional aspectual classification, in which culmination entailments are typically taken to be a diagnostic criterion for defining accomplishments, but in the end they raise questions about the nature of (non-)culminating accomplishment inferences, which are likely not a conversational implicature. They explain the occurrence of the phenomenon based on a semantic distinction between telicity and maximality.

The application of abductive reasoning to culmination inferences has some benefits, namely, abductive reasoning is a general and convenient tool for analyzing defeasible rules and competing forms. Moreover, it is computationally viable, providing some parameters and regulations for machine learning.

However, regarding the theory of culmination inference, it may be considered too specific, as the authors only use two specific predicate types in two languages. Additionally, when the authors compare PFV_R and IPF_R, they argue that IPF_R cannot get a non-culmination inference because the rejected PFV_R does not have this reading, but according to recent research, this argument can be called into question. Specifically, in Kasher & Hacoen (2023), it is shown that the majority of Russian native speakers accept the non-culmination reading of PFV_R, in particular, Russian native speakers accept both non-culmination readings from IPF_R and PFV_R, as shown in (10):

(10)

- a. *Malčik narišoval zvezdu, no odnovo lučika ne xvataet.*
 boy draw.PFV.PST star-acc but one ray not sufficient.
 ‘The boy drew a/the star, but one point is missing.’
- b. *Malčik rišoval zvezdu.*
 boy draw.IPF.PST star.
 ‘The boy was drawing a/the star.’

The two readings in example (10) are both highly acceptable to almost the same

degree for Russian native speakers, and this shows that PFV_R could also have a non-culmination inference. Such observations could lead to more nuanced research into the external factors of IPF_R for selecting the best explanation in the abductive reasoning theory.

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