(Non)culmination by abduction

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Non-culminating accomplishments with $PFV_H$

(1) Hindi data from Singh (1991)

a. maïne aaj apnaa kek khaayaa
   I.ERG today mine cake eat.$PFV_H$
   ‘I ate my cake today’

b. aur baakii kal khaũũgaa
   and remaining tomorrow eat.$FUT$
   ‘and will eat the remaining part tomorrow.’
Non-culminating accomplishments with PFV_H and IPF_R

(1) Hindi data from Singh (1991)

a. maïne aaj apnaa kek khaayaa
   I.ERG today mine cake eat.PFV_H
   ‘I ate my cake today’

b. aur baakii kal khaūūgaa
   and remaining tomorrow eat.FUT
   ‘and will eat the remaining part tomorrow.’

(2) Russian data from Padučeva (1996)

a. Ty čital ‘Kapitanskuju dočky’?
   ‘You read.PST.IPFR Captain’s daughter
   ‘Have you read The Captain’s Daughter?’

b. Da, xotja ne do konca.
   Yes even.though not until end
   ‘Yes, though not until the end.’
Two key questions

1. Where are the truth-conditions for $\text{PFV}_H$ and $\text{IPF}_R$ such that these operators:
   - don’t trigger a culmination entailment
   - are consistent with perfective and imperfective operators in other languages (including operators which trigger a culmination entailment)
Two key questions

1. Where are the truth-conditions for PFV<sub>H</sub> and IPF<sub>R</sub> such that these operators:
   ▶ don’t trigger a culmination entailment
   ▶ are consistent with perfective and imperfective operators in other languages (including operators which trigger a culmination entailment)

2. How does the culmination implicature come about? That is, how exactly are PFV<sub>H</sub> and IPF<sub>R</sub> involved in the computation of the implicature?
Roadmap

- Overview of previous attempts to explain how the culmination implicature comes about.
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- Propose an abduction framework that explains how the culmination implicature comes about with PFV$_H$ and IPF$_R$. 
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- Overview of previous attempts to explain how the culmination implicature comes about.
- Propose an abduction framework that explains how the culmination implicature comes about with PFV$_H$ and IPF$_R$.
- Provide a hypothesis for how the proposed analysis could be extended to account for data such as (3):

  (3)  
  a. They offered me a position at their bank, but I turned it down.  
  b. Living in a large city offered Rebecca a number of advantages, #but she refused them. (Piñón 2014)
Adopts a Dowty (1979)-style analysis of perfective forms in two Salish languages.

Proposes that the “implicature of culmination arises [with perfective forms] because in all inertia worlds, the event culminates. In the absence of other information, the hearer assumes that the ‘normal’ course of events (culmination) takes place.”

A culmination implicature is absent in the case of the English progressive—which has the same inertia-worlds analysis—due to the presence “of a contrasting perfective form which entails culmination.”
How to extend to PFV\textsubscript{H} and IPF\textsubscript{R}?

Bar-El et al.'s (2005) line of reasoning would come up against a problem in the case of PFV\textsubscript{H} and IPF\textsubscript{R}, both of which have a contrasting perfective form that entails completion.

(4) a. maïne aaj apnaa kek khaa li-yaa
   I.ERG today mine cake eat take-PFV
   "I ate my cake today"

   b. #aur baakii kal khaûûgaa
      and remaining tomorrow eat.FUT
      "and I will eat the remaining part tomorrow."

(5) a. Ty pročital ‘Kapitanskuju dočky’?
   You PFV.read.PST Captain’s daughter
   ‘Have you read The Captain’s Daughter?’

   b. #Da, xotja ne do konca.
      Yes even.though not until end
      ‘Yes, though not until the end.’
Simple forms in Tamil start out with a culmination entailment, which is weakened as a result of the pronounced availability of an alternative form asserting event realization.

English has a number of devices signaling lack of event realization, so there is no comparable reduction of the culmination entailment in simple forms.
Pederson’s analysis is in opposition to many other analyses of non-culminating construals (e.g., Smith 1991; Koenig and Muansuwan 2000; Bar-El et al. 2005; Altshuler 2014), since it assumes for them a semantics that excludes a non-culminating interpretation.
How to extend to PFV_H and IPF_R?

- We cannot use it to explain the case of IPF_R, which is an imperfective form and does not exclude non-culmination (indeed, most regard non-culmination a primary interpretation of IPF_R; see Glovinskaja 1982, 2001, Padučeva 1995, 1996, Grønn 2003 and references therein for discussion.)
With respect to PFV$_H$, Arunachalam and Kothari (2010, p. 18) argue that “[b]ecause full completion (telic) interpretations entail partial completion interpretations, the full completion interpretation is stronger, and therefore speakers may prefer it”.
What semantics should we assume for the different aspectual operators in different languages, and how does this semantics interact with the suggested pragmatic principle?
A culmination implicature is most pronounced in the case of IPF$_R$ exactly when the use of the corresponding PFV$_R$ is excluded for some reason.

Develops a bidirectional OT analysis in which the two aspects in Russian “compete” based on various factors.
Unresolved question

- Fails to explain the fact that the exclusion of PFV_R is not necessary for the culmination inference from IPF_R (Grønn 2008, p. 132–3; see also Altshuler 2014 for discussion.).
Interim summary

In agreement:

▶ The defeasible culmination inference has, at its roots, a pragmatic explanation
▶ Competing forms play a role in the availability and strength of this inference

What we need:

▶ A framework that can incorporate all the insights from previous research on the defeasible culmination inference in a great variety of languages.
We propose to exploit abduction, i.e., the inference to the best explanation, which is (contrary to deductive reasoning) defeasible.
Abduction

We propose to exploit *abduction*, i.e., the inference to the best explanation, which is (contrary to deductive reasoning) defeasible.

- Abductive reasoning, suggested first by Charles Sanders Peirce, has come to be widely employed in AI (cf., e.g., Hobbs et al. 1993; for an overview, see, e.g., Josephson and Josephson 1996 or McIlraith 1998), and it is also abundantly used in everyday reasoning (cf. Douven, 2011).
Abduction

We propose to exploit *abduction*, i.e., the inference to the best explanation, which is (contrary to deductive reasoning) defeasible.

- Abductive reasoning, suggested first by Charles Sanders Peirce, has come to be widely employed in AI (cf., e.g., Hobbs et al. 1993; for an overview, see, e.g., Josephson and Josephson 1996 or McIlraith 1998), and it is also abundantly used in everyday reasoning (cf. Douven, 2011).

Role of conditionals in abductive reasoning

- Suppose that we observe that the street is wet and that we know that if it has been raining, then the street would be wet.
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- We then infer (abduce!) that it has been raining, as it is a good explanation of our observation that the street is wet.
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- if we observe $q$, and our theory tells us that $p \rightarrow q$, then we abduce $p$, because together with the theory, this entails what we observe, and is definitely at least among the simplest explanations.
Suppose that we observe that the street is wet and that we know that if it has been raining, then the street would be wet. We then infer (abduce!) that it has been raining, as it is a good explanation of our observation that the street is wet. Abductive inferences often involve inference to the antecedent of a conditional on observing the consequent:

- if we observe \( q \), and our theory tells us that \( p \rightarrow q \), then we abduce \( p \), because together with the theory, this entails what we observe, and is definitely at least among the simplest explanations.

Since an inference to the antecedent from the consequent is not deductively valid, this type of inference is defeasible.
Constraints on abduction

- Abduction involves:
  - O: something that is observed and is to be explained,
  - T: a theory which is the conjunction of the set of non-defeasible rules of reasoning, and
  - E: the explanation abduced on the basis of O and T.
- T and E together entail O, but neither T, nor E do so alone.
Criteria for best explanation

Reasons to regard explanation $E_1$ as better than $E_2$ generally include the following (in order of importance; see McIlraith 1998 and Hobbs 2004):

- $E_1$ is *simpler*, which in our case means ontologically more parsimonious.
- $E_1$ is *logically stronger* or at least *more specific/presumptive*.
- $E_1$ explains more observed facts.
- $E_1$ is more probable.
Working through an example

1. Observation: street_wet
Working through an example

1. **Observation:** street\_wet
2. **Theory:**
   2.1 rain \rightarrow street\_wet
   2.2 watercart \rightarrow street\_wet
Working through an example

1. Observation: street_wet
2. Theory:
   2.1 rain → street_wet
   2.2 watercart → street_wet
3. Explanation:
   3.1 rain
   3.2 watercart
Working through an example

1. **Observation**: street_wet

2. **Theory**:
   2.1 rain $\rightarrow$ street_wet
   2.2 watercart $\rightarrow$ street_wet

3. **Explanation**:
   3.1 rain
   3.2 watercart

- Both rain and watercart are suitable explanations for street_wet, since both entail it together with the theory.
- In absence of any further criteria, there is no way to decide between rain and watercart as the best explanation.
- We infer: rain $\lor$ watercart.
Further criteria

- Neither rain, nor watercart appears simpler than the other, and neither one is stronger than the other.
- However, if the street is in an area where it tends to rain several times a week, while a watercart only comes by once every month, then rain is much more probable than watercart, and is thus a better explanation in this respect.
Explaining the culmination inference of non-culminating forms via abduction

**First step:** There is a core semantic analysis encoding the asserted content, which provides us with the observation on hearing an assertion. So our observation on hearing an assertion of $p$ is its logical form.
Perfective versus imperfective

$PF_{H}$ is distinguished from $IP_{R}$ via a requirement for \textit{maximal} events with respect to an event predicate $P$, building on work by Filip (1999), Koenig and Muansuwan (2000), Bohnemeyer and Swift (2004) and Altshuler (2014).

- viz. the difference between \textit{maximal} and \textit{culminated events} with respect to $P$.

- Perfective operators in the world’s languages encode maximality; lack of maximality, but partiality for the imperfective operators (Filip (2008), Altshuler (2014)).
Imperfective forms

We build on Filip 1999 and endorse a distinction between imperfective forms which describe *parts* and those that describe *proper parts* of (possible) events belonging to the relevant predicate.

- PROG is true of proper parts of (possible) events, while IPF_R is true of (not necessarily proper) parts.
- As such, the IPF_R, but not PROG, is compatible with both culminating and non-culminating construals.
Explaining the culmination inference of non-culminating forms via abduction

1. First step: There is a core semantic analysis encoding the asserted content, which provides us with the observation on hearing an assertion. So our observation on hearing an assertion of $p$ is its logical form.

2. Second step: General principles of mereology and mereological principles relating to predicates, which provides us with the theory of our abductive framework.
   - These are in a conditional form, and some of them will include the relevant observation as its consequent.
On deck...

Overview of abbreviations used to describe the theory of our abductive framework
Abbreviations (Part 1): Actualist and possibilist quantifiers over events (see, e.g. Prior and Fine 1977)

(6) \( \exists_@ e(P(e)) \) stands for “there is an actual \( P \)-event” and is true at the world of evaluation \( w_0 \) just in case there is an event in \( w_0 \) which belongs to the denotation of \( P \) at \( w_0 \).

(7) \( \forall_@ e(P(e)) \) stands for “all actual events are \( P \)-events” and is true at the world of evaluation \( w_0 \) just in case all events in \( w_0 \) belong to the denotation of \( P \) at \( w_0 \).
Abbreviations (Part 1): Actualist and possibilist quantifiers over events (see, e.g. Prior and Fine 1977)

(8) $\exists \Diamond e(P(e))$ stands for “there is a possible $P$-event” and is true at the world of evaluation $w_0$ just in case there is an event in some possible world $w$ which belongs to the denotation of $P$ at $w$.

(9) $\forall \Diamond e(P(e))$ stands for “all possible events are $P$-events” and is true at the world of evaluation $w_0$ just in case $\neg \exists \Diamond e(\neg P(e))$ is true at $w_0$, that is, just in case at all possible worlds $w$, all events belong to the denotation of $P$ at $w$. 
Abbreviations (Part 2): Non-defeasible mereological principles

(10) $\text{Max}(P)(e)$ stands for “$e$ is a maximal actual part of a possible $P$-event”. That is, $\text{Max}(P)(e)$ iff

$$\exists \diamond e'[e \sqsubseteq e' \land P(e')] \land \neg \exists @ e''[e \sqsubseteq e'' \land \exists \diamond e'(e'' \sqsubseteq e' \land P(e'))].$$

(11) $\text{PrPart}(P)(e)$ stands for “$e$ is an actual proper part of a possible $P$-event”. That is, $\text{PrPart}(P)(e)$ iff

$$\exists \diamond e'(e \sqsubset e' \land P(e')).$$

(12) $\text{Part}(P)(e)$ stands for “$e$ is an actual (not necessarily proper) part of a possible $P$-event”. That is, $\text{Part}(P)(e)$ iff

$$\exists \diamond e'(e \sqsubseteq e' \land P(e')).$$
On deck…

Theory of our abductive framework
Partial events

(13) $\exists_@e(\PrPart(P)(e)) \rightarrow \exists_@e(\Part(P)(e))$

- The part-of relation is a superset of the proper part-of relation.
- Hence, if the antecedent of (13) is true, then so is the consequent.
Culminated events and partial events

(14) \( \exists_@e(P(e)) \rightarrow \exists_@e(\text{Part}(P)(e)) \)

- The part-of relation is reflexive: all events that have culminated are parts of themselves.
- Hence, if the antecedent of (14) is true, then so is the consequent.
Partial events and maximal events

\[(15) \quad \exists \@e (\text{PrPart}(P)(e)) \rightarrow \exists \@e (\text{Max}(P)(e)) \]

- The set of events are ordered by the part-of relation and form a join semi-lattice (Krifka 1992).
- If we take the join of all the actual proper parts of a possible P-event, that join will be the maximal part of that possible P-event.
- Hence, if the antecedent in (13) is true, then so is the consequent.
Culminated events and maximal events

\[ \exists @e(P(e)) \rightarrow \exists @e(\text{Max}(P)(e)) \]

- (16) holds for a telic predicate \( P \), because all events that have culminated are necessarily maximal parts, as an event cannot develop (as a \( P \)-event) beyond its culmination.
- (16) holds for an atelic predicate \( P \) because the join of a set of \( P \)-events in a given situation is the maximal event (and part) in that situation (Filip 2008).
- in the case of telic predicates \( P \), the ordered event parts are not of the same kind; in the case of atelic predicates \( P \), they are (down to some granularity).
More on telicic predicates

These principles encode the idea that accomplishments, but not achievements, describe temporally extended events, i.e., have proper parts (Vendler 1957, Dowty 1979 and Krifka 1989, 1992)

Accomplishment($P$) $\rightarrow$ $\forall_{e} (P(e) \rightarrow \exists_{e'} (e' \sqsubset e))$  (1a)

Achievement($P$) $\rightarrow$ $\forall_{e} (P(e) \rightarrow \neg \exists_{e'} (e' \sqsubset e))$  (1b)
On deck…

Abducing the culmination inference with $PFV_H$
Abduction and the culmination inference with PFV\textsubscript{H}

Assume an assertion of a sentence with a predicate $P$ in the PFV\textsubscript{H}

1. Observation:
   \[ \exists @e (\text{Max}(P)(e)) \]  \hspace{1cm} (O\textsubscript{H})

2. Theory:
   \[ \exists @e (P(e)) \rightarrow \exists @e (\text{Max}(P)(e)) \]  \hspace{1cm} (T\textsubscript{H})

3. Explanation:
   \[ \exists @e (P(e)) \]  \hspace{1cm} (E\textsubscript{H})

- $(O\textsubscript{H})$ asserts the occurrence of a maximal part of a possible $P$-event.
- $(T\textsubscript{H})$ encodes the non-defeasible inference from a complete (realized) event to a maximal part (viz. (16))
- Based on our theory, the occurrence of a complete event is a possible explanation of the observation.
Remaining task

- Abduction is the inference to the *best explanation*, which means that it does not preclude the existence of alternative explanations.
  - Recall that this is exactly what guarantees the non-monotonicity of this reasoning process.
In order to derive the culmination inference for PFV$_H$, we must therefore show why the existence of a complete $P$ event is the best explanation for the existence of a maximal part of a possible $P$-event.

- Recall that simplicity, strength and coverage are often used as criteria in selecting best explanations.
Alternative explanation

1. Observation:
\[ \exists_{\@} e \left( \text{Max}(P)(e) \right) \quad (O_H) \]

2. Theory:
\[ \exists_{\@} e \left( \text{PrPart}(P)(e) \right) \rightarrow \exists_{\@} e \left( \text{Max}(P)(e) \right) \quad (T_{H\Box}) \]

3. Explanation:
\[ \exists_{\@} e \left( \text{PrPart}(P)(e) \right) \quad (E_{H\Box}) \]

- While the rule in \((T_{H\Box})\) can be applied for accomplishments, it is \textit{vacuously} true (and hence of no explanatory value) in the case of achievements, which have no proper parts (viz. \((1b))\).

- Thus, \((E_{H\Box})\) cannot be abduced in the case of achievements, so it has a worse coverage than \((E_H)\).
On deck…

Abducting the culmination inference with $\text{IPF}_R$
Abduction and the culmination inference with IPF$_R$

Assume an assertion of a sentence with a predicate $P$ in the IPF$_R$

1. Observation:
   \[
   \exists_{@e} (Part(P)(e)) \quad (O_R)
   \]

2. Theory:
   \[
   \exists_{@e} (P(e)) \rightarrow \exists_{@e} (Part(P)(e)) \quad (T_R)
   \]
   \[
   \exists_{@e} (PrPart(P)(e)) \rightarrow \exists_{@e} (Part(P)(e)) \quad (T_R<)
   \]

3. Explanation:
   \[
   \exists_{@e} (P(e)) \quad (E_R)
   \]
   \[
   \exists_{@e} (PrPart(P)(e)) \quad (E_R<)\]
Abduction and the culmination inference with IPFₚᵢₙₚᵢₜ

1. Observation:

   \( \exists \varrho e ( \text{Part}(P)(e)) \)  \hspace{1cm} (O_R)

2. Theory:

   \( \exists \varrho e (P(e)) \rightarrow \exists \varrho e (\text{Part}(P)(e)) \)  \hspace{1cm} (T_R)

   \( \exists \varrho e (\text{PrPart}(P)(e)) \rightarrow \exists \varrho e (\text{Part}(P)(e)) \)  \hspace{1cm} (T_R \sqsubset)

3. Explanation:

   \( \exists \varrho e (P(e)) \)  \hspace{1cm} (E_R)

   \( \exists \varrho e (\text{PrPart}(P)(e)) \)  \hspace{1cm} (E_R \sqsubset)

Analogous to PFVₚᵢₜ, there are reasons to favor \((E_R)\) to \((E_R \sqsubset)\):

- it is conceptually simpler
- it has better coverage
- it is more specific
How do we abduce the processual reading with IPF? 

(17) Včera ja čital “Vojnu i Mir”. 
‘yesterday I read.PST.IPF “War and Peace”’

‘Yesterday I was reading “War and Peace”.’
Grønn’s (2003) insight, building on Gasparov 1990

“if the interval of the assertion time is ‘small’ compared to what would constitute the normal length of the temporal trace of the event, we get a processual reading” (Grønn 2003, p. 171)
Applying Grønn’s (2003) insight to our framework

Observation

(18)  \( \exists_{@e} (\text{Part}(W&P)(e) \land |\tau(e)| \leq 1 \text{ day}) \)

Theory:

(19)  \( \exists_{@e} (W&P(e)) \rightarrow \exists_{@e} (\text{Part}(W&P)(e)) \)

(20)  \( \exists_{@e} (\text{PrPart}(W&P)(e)) \rightarrow \exists_{@e} (\text{Part}(W&P)(e)) \)

(21)  \( \forall e \forall e' (e \sqsubseteq e' \rightarrow |\tau(e)| \leq |\tau(e')|) \)

(22)  \( \forall_{@e} \exists_{@e'} (e' \sqsubseteq e \land |\tau(e')| \leq 1 \text{ day}) \)

(23)  \( \forall e (W&P(e) \rightarrow |\tau(e)| > 1 \text{ day}) \)
Choosing the best explanation

Potential Explanations

(24) $\exists e (W&P(e) \land |\tau(e)| > 1 \text{ day})$

(25) $\exists e (W&P(e) \land |\tau(e)| \leq 1 \text{ day})$

(26) $\exists e (\text{PrPart}(W&P)(e) \land |\tau(e)| > 1 \text{ day})$

(27) $\exists e (\text{PrPart}(W&P)(e) \land |\tau(e)| \leq 1 \text{ day})$

- (25) must be rejected, because it contradicts the theory (in particular, the rule in (23)).

- (24), (26) and (27) are acceptable explanations, because the observation can be derived from them.
Choosing the best explanation

Potential Explanations

(24) \( \exists @e (W&P(e) \land |\tau(e)| > 1 \text{ day}) \)
(26) \( \exists @e (\text{PrPart}(W&P)(e) \land |\tau(e)| > 1 \text{ day}) \)
(27) \( \exists @e (\text{PrPart}(W&P)(e) \land |\tau(e)| \leq 1 \text{ day}) \)

- In the case of (24) and (26) we would infer that the actual event in the explanation and the observed event are not the same events (because no event can be both shorter and longer than 1 day), so these explanations would force us to assume more events than (27).
- While (24) and (26) are more specific than (27), given ontological parsimony as a more important factor in deciding among explanations than specificity, (27) is the best explanation.
On deck...

Agent control and defeasible causatives in English
Piñón’s (2014) defeasible causatives data

(28) a. They **offered** me a position at their bank, but I turned it down. [Agent]
b. Living in a large city **offered** Rebecca a number of advantages, #but she refused them. [Causer]

- Defeasible causatives display a different kind of non-culmination reading than PFV$_H$ and IPF$_R$: they allow for the total lack of a partial change of the relevant kind, i.e. zero change of state (zero CoS) readings.

- Demirdache and Martin (2015) argue that in most languages, zero CoS readings, as opposed to partial CoS readings, tend to require an agentive external argument.
(28)  a. They **offered** me a position at their bank, but I turned it down. [Agent]

b. Living in a large city **offered** Rebecca a number of advantages, #but she refused them. [Causer]

➤ (28-b) seems to be odd due to a lack of a conversational partner to make the refusal to.
Alleviating the unacceptability

(29) Living in a large city offered you a number of advantages, you just didn’t take them. [Causer]
Possible application of abduction

- It seems that the ease of cancellation of an inference in the case of defeasible causatives in English is:
  1. graded
  2. is dependent on a number of lexical, syntactic and other, contextual, factors. (Time and expertise prevent me from considering more examples here).

- Given that both 1 and 2 have been observed in the case of partial CoS readings in languages that allow for such construals, it at least suggests the possibility that the defeasible CoS inference of defeasible causatives is also amenable to a similar abductive inference process as the culmination inference from PFV$_H$ and IPF$_R$. 
What’s the observation?

- In order to construct such an inference, a suitable semantic analysis of defeasible causatives is needed which supplies the observation about which we can reason.

- While the semantic analysis of defeasible causatives is still a matter of discussion (cf. Koenig and Davis 2001; Martin 2015; Martin and Schäfer 2016), the recent proposal by Martin (2015) appears a promising proposal to use to this end.
Outline of an abductive inference for defeasible causatives

1. **Observation**: there is a process of type $P$ (e.g., a teacher talking about a topic).
2. **Theory**: If there is an event of type $Q$ (e.g., learners learning about the topic via being taught), then there is a process of type $P$ (i.e., $P$ is a necessary condition for $Q$).
3. **Explanation**: there is an event of type $Q$. 
Outline of an abductive inference for defeasible causatives

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2. **Theory**: If there is an event of type $Q$ (e.g., learners learning about the topic via being taught), then there is a process of type $P$ (i.e., $P$ is a necessary condition for $Q$).

3. **Explanation**: there is an event of type $Q$.

- Because agentive processes in the case of defeasible causatives are very much *indicative* of the corresponding CoS (based on Martin 2015), there cannot be many other $Q$’s that have $P$ as their necessary conditions

- The opposite holds for causer processes: e.g., there being a book including text on some topic (a $P$-event) is an important necessary component of not just explaining that topic to its readers, but of many other events: e.g., it also features in the reading and in the writing of that text.
If assume, following Martin (2015) that causatives with a cause rather than an agent must semantically include the caused change as their component, we explain why they are typically bad when we try to defeat the CoS (despite there being many possible Q features). They appear to be good only if the process is indicative of the change itself.

In the case of agentive causatives, the CoS is inferred via abduction. Since there are not many Q features, this inference is quite salient. So much so, that its defeasibility has been somewhat unexplored.
Conclusion

- Introduction of how abduction can be used to derive culmination inferences with non-culminating accomplishments.
- Application of the abduction framework to PFV\(_H\) and IPF\(_R\).
- Hypothesis about how to apply the abduction framework to defeasible causatives in English, which allow from zero CoS readings not found with PFV\(_H\) and IPF\(_R\).
- Let’s continue hypothesizing, testing and theorizing about other aspectual forms and construals using the abductive framework.
- Seek collaboration.


