### Finnish & English implicatives generate inferences over their complements (Karttunen 1971):

1. a. Hän onnistui-kuitenkaan kokeilla-ampua ampua karhu-n.
   - He didn't manage to shoot the bear.

2. b. He didn't manage to fly.

### Causal dependence

#### Baglini & Francez's (2015) insight:

The relationship between an implicative’s presuppositions and its complement is one of causal dependence.

#### Their proposal: manage(X)

- a. presupposes a causally necessary but insufficient catalyst C for X
- b. asserts that C actually caused X in context

### Causal necessity and sufficiency are defined via causal entailment (Schulz 2011):

- a dynamics D represents causal relationships between propositions P; a function F determines the value of a variable from its causal ancestors
- a situation is an assignment of propositions to the values (0, 1, undetermined)
- an operator T_P calculates immediate causal consequences of a situation s

A set of literals \( \Sigma \): causally entails \( \phi \) in \( D \) if \( \phi = 1 \) is a consequence of iterative applications of \( T_P \) to the situation \( \Sigma = 1 \).

- \( C \) is causally necessary \( X \) if \( C \equiv D \neg X \)
- \( C \) is causally sufficient \( X \) if \( C \equiv D X \)

### Some complications

Presupposing a causally necessary but insufficient factor \( C \) gets us inferences (i)-(iii) for \( I = manage \):

- (i) \( X \) doesn’t presuppose \( C \), so \( I(X) \) presupposes \( C = 1 \) and we can’t conclude \( I(X) \) asserts \( C = X \), so \( X = 1 \) asserts \( C = \neg X \), so \( X = 0 \).

**BUT:** if \( C \) is sufficient for \( X \), and \( I(X) \), \( X \) must have an independent causal ancestor \( Y \) (or set) that suffices in context. \( Y \) must be false in assertions of \( I(X) \).

- this works with manage’s variable presuppositions: effort, difficulty, unlikeliness (cf Coleman 1975)
- it doesn’t work for attribute-specific Finnish examples (3-6) which presuppose a crucial attribute that apparently determines \( X \).
- additionally, entailments (i) and (ii) must hold: we cannot account for the weaker inference pattern of one-way implicatives (7-8), but Finnish data prompt a unified account

### Proposal

#### Causal dependence underlies implicativity: (i)

\( I(X) \) backgrounds causal dependence of complement \( X \) on a prerequisite \( Y \) lexically presupposed by \( I \).

An utterance \( I(X) \) with dynamics \( D \):

- i. presupposes the existence of an unreversed causal prerequisite \( Y \) for \( X \) that suffices in context.
- Y is necessary for X: \( Y \equiv X \)
- ii. asserts that \( Y \) holds in context \( (Y = 1) \)
- \( I(X) \) asserts \( Y = 0 \)
- iii. Two-way implicatives \( I \) additionally presuppose \( Y \)'s sufficiency for \( X \):
- \( Y \equiv D X \) in context

### Supporting evidence

When a non-\( Y \) prerequisite is left open, two-way \( I_2 \) (cf 4) are infelicitous:

- A hunter had lost track of whether he had fired all of his bullets. He put his gun down to get some food, planning to check after eating. While both hands were in his pack, he saw a bear coming towards him. #Hän ehtii ampua karhun.

There is no such problem for one-way \( I_1 \) (cf 7):

- (9) Hän jaksoa nouta, mutta päätti-i sitä vastaan. ... but decid-i he.PART against-ILL
  - ‘He had strength to rise, but chose not to.’

### Data from Finnish: Two-way (\( I_2 \)) and one-way (\( I_1 \)) implicatives

#### Two-way \( I_2 \)

<table>
<thead>
<tr>
<th>Presupp</th>
<th>( I(X) )</th>
<th>Ent/Impl</th>
</tr>
</thead>
<tbody>
<tr>
<td>ehtii have.time</td>
<td>X needs time</td>
<td>Hän ehtii-i ampua-karhu-n. ( \rightarrow ) He shot the bear.</td>
</tr>
<tr>
<td>he.NOM have.time-PST shoot-INF bear-GEN/ACC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hieno have.heart</td>
<td>X needs resolve</td>
<td>Hän hieno-i tappa-a kisa-n. ( \rightarrow ) He killed the cat.</td>
</tr>
<tr>
<td>he.NOM have.heart-PST kill-INF cat-GEN/ACC &quot;He had the heart to kill the cat.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>jaksaa have.strength</td>
<td>X needs strength</td>
<td>Hän jaksaa-i noust-a. ( \rightarrow ) He rose.</td>
</tr>
<tr>
<td>he.NOM have.strength-PST rise-INF &quot;He had strength to rise.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hieno have.heart</td>
<td>X needs</td>
<td>Hän hieno-i tappa-a kisa-n. ( \rightarrow ) He didn’t kill the cat.</td>
</tr>
<tr>
<td>he.NOM have.heart-PST kill-INF cat-GEN/ACC &quot;He had the heart to kill the cat.”</td>
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</tbody>
</table>

### Consequences of the proposal:

**If implicative \( I \) lexically presupposes prerequisite \( Y \)...**

#### We get the desired inferences:

(i) \( X \) alone does not invoke \( Y \), so \( X \neq I(X) \)

(ii) \( I(X) \) sets \( Y = 1 \):
- if \( I = I_1 \), we get nothing more
- if \( I = I_2 \), we have \( Y \equiv D X \), so \( X = 1 \) and \( I(X) \equiv X \)

(iii) \( -I(X) \) sets \( Y = 0 \):
- for any \( I \), \( \neg Y \equiv \neg X \) gives \( X = 0 \) and \( \neg I(X) \equiv \neg X \)

**We predict implicatures on \( I_1 \):**

- \( I_1(X) \) presupposes \( Y \) as a prerequisite for \( X \)
- reasoning about speaker choice may implicate \( Y \) is the only prerequisite, yielding sufficiency in context
- the circumscriptive reasoning recalls conditional perfection (Geis & Zwicky 1971).

**We can account for polarity-reversing implicatives \( I \):**

(i) He neglected to fix the tap. \( \rightarrow \) He did not fix the tap.

(ii) He didn’t neglect to fix the tap. \( \rightarrow \) He did fix the tap.

Either (a) or (b), along with (c):
- (a) \( I \) holds \( Y \) is necessary for \( X \)
- (b) \( I \) holds \( \neg Y \) is necessary for \( X \)
- (c) two-way \( I \) adds sufficiency

**Outlook & Questions**

- how do the differences between one- and two-way implicatives arise?
- some \( I_1 \) show variable implicative- or factive-type implicatures; does this relate to “factive” variability (e.g. be lucky to X; Karttunen 2014)?
- implicative inferences resemble the actuality entailments of ability modals (Bhatt 1999; Haquard 2009); can the latter also be accounted for by causal dependence?