The Path of Presupposition Projection in Processing: The Case of Conditionals

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Theoretical & Experimental Work on Presuppositions

Exciting times for presuppositions (PSP)!

- Flurry of new theoretical approaches in recent years
- Emerging body of experimental work, asking questions such as
  - Measuring impact on felicity in more precise terms
  - Extent and variation of contextual constraints imposed by PSP triggers
  - Effect of presuppositions on interpretation choices in light of ambiguities
  - Nature of presuppositions in conditionals and under quantification
  - Time course of PSP interpretation online
  - PSP interpretation options under negation and their time-course

(Chemla and Schlenker 2009, Chemla 2009, Inhoff 1985, Schwarz 2007, Tiemann et al. 2011, Jayez & van Tiel 2011, Amaral et al. 2011, Smith & Hall 2011, Romoli et al 2011, Chemla & Bott 2012 among others)

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Project here:

Time course and processing effects relating to presupposition projection

(Schwarz and Tiemann 2012)

Presupposition Projection

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Assertion: Tina went ice-skating today.
PSP: Tina went ice-skating before.

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Tina went ice-skating again today.

Assertion: Tina went ice-skating today.
PSP: Tina went ice-skating before.

It is not the case that Tina went ice-skating again today.

Assertion: Tina didn't go ice-skating today.
PSP: Tina went ice skating before.

PSP Projection in online processing

- Descriptively:
  mismatch between syntactic location and level of interpretation

- Depending on underlying mechanisms, this could be
  - a challenge that causes effort in processing
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Schwarz and Tiemann 2012:
Evidence for processing costs of projection based on eye tracking reading results

Previous work: Schwarz & Tiemann 2012

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Target

(1) *Dieses Wochenende war Tina {(a)* **nicht wieder** */ (b)* **wieder**
This weekend, was Tina {(a) not again / (b) again
nicht} *Schlittschuhlaufen, weil das Wetter so schlecht war.*
not} ice skating because the weather so bad was

Material

C1: *Tina* **went ice** *skating for the first time last week with Karl. The weather was beautiful, and they* **had a great time**.

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(2) **nicht wieder** (not > again)

Tina had been ice-skating before
AND NOT [she went ice-skating this weekend]

(**Felicitous with C1**)

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AND NOT [she went ice-skating this weekend]

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(3) **wieder nicht** (again > not)

There's a previous time when Tina did not go ice-skating
AND this weekend, she did NOT go ice-skating

(**Felicitous with C2**)

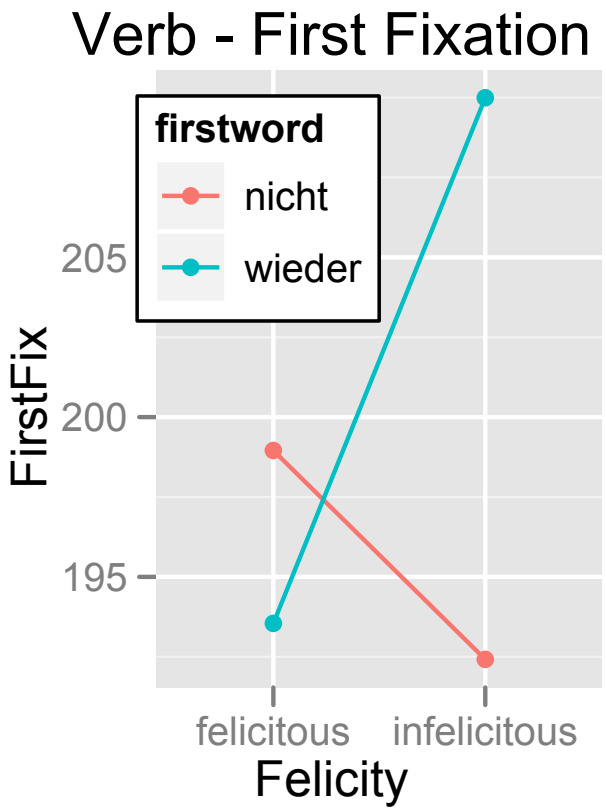
Previous Work - *not again* vs. *again not*

Main Questions

- Is the detection of infelicity reflected in processing, and if so when?
- Does embedding (requiring projection) modulate such effects?

Previous Work - *not again* vs. *again not*

Results for: First Fixation, Go-Past Time and Total Time **on the Verb** (here: *Schlittschuhlaufen*)



- sig. interaction
- (main effect of firstword)
- simple effect of felicity for **wieder nicht**
- simple effect of firstword for **Infelicitous**

Previous Work - *not again* vs. *again not*

Immediate Computation of Presuppositional Content

wieder nicht presupposition is computed & evaluated immediately

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  (in fact, opposite effect for total time on verb)
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- Follow-up rating study: roughly equivalent levels of perceived infelicity for both orderings

Implementations of Mechanisms for PSP projection

Our Interpretation:

PSP Projection delayed

Fits most naturally with accounts that assume
complex process for deriving global presuppositions
(e.g., Sandt and Geurts 1991 and Sandt 1992's DRT analysis)

$\rightarrow$ Chain of manipulations on Discourse Representations

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  - Discourse Representation Theory (DRT)
  - Dynamic Semantics

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→ Chain of manipulations on Discourse Representations

- Comparison of two classical theories:
  - Discourse Representation Theory (DRT)
  - Dynamic Semantics
- What processing predictions, if any, might these alternatives make for PSP projection?

Discourse Representation Theory

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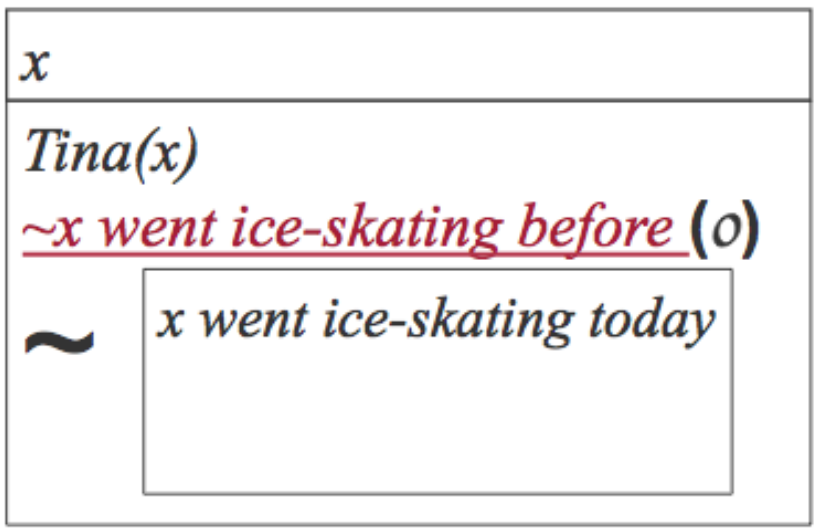
Tina AGAIN NOT went ice-skating today.



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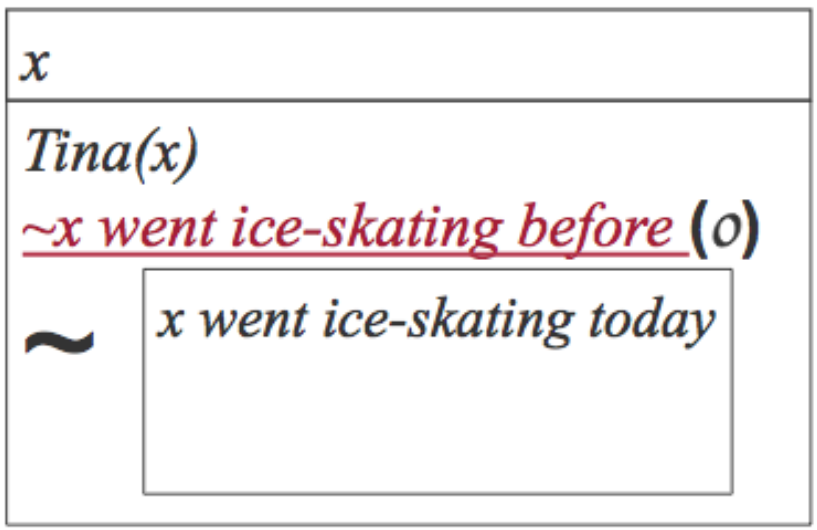

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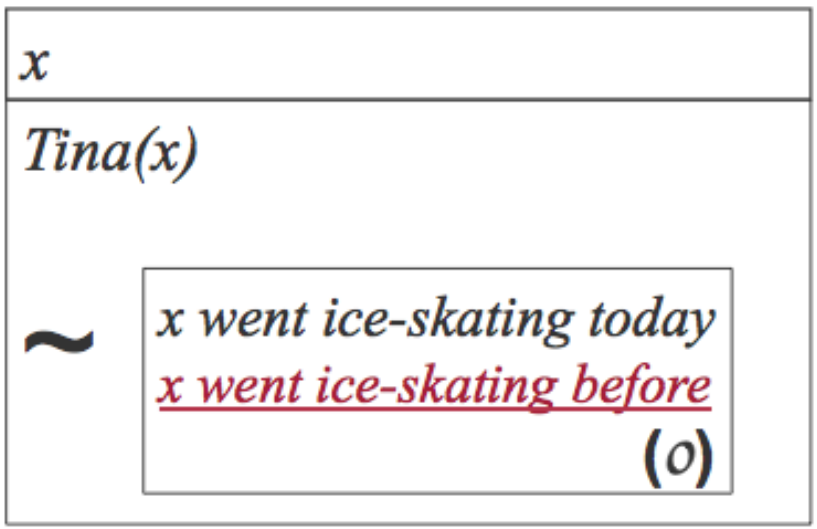

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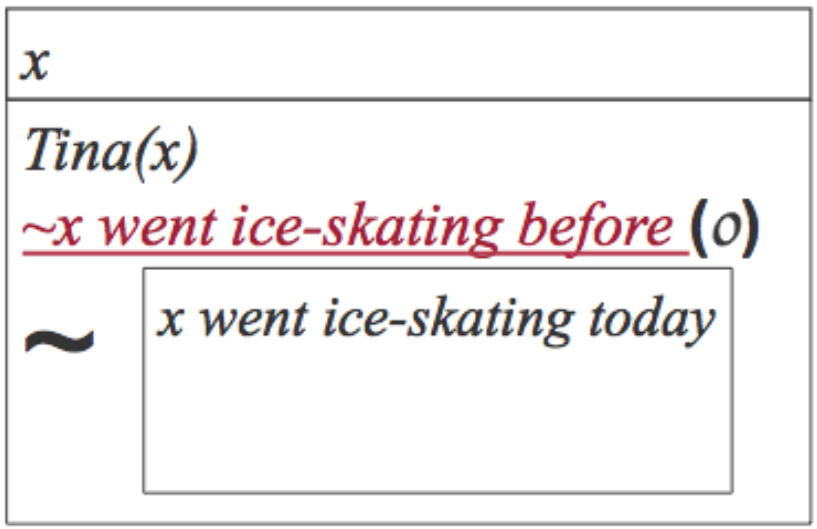

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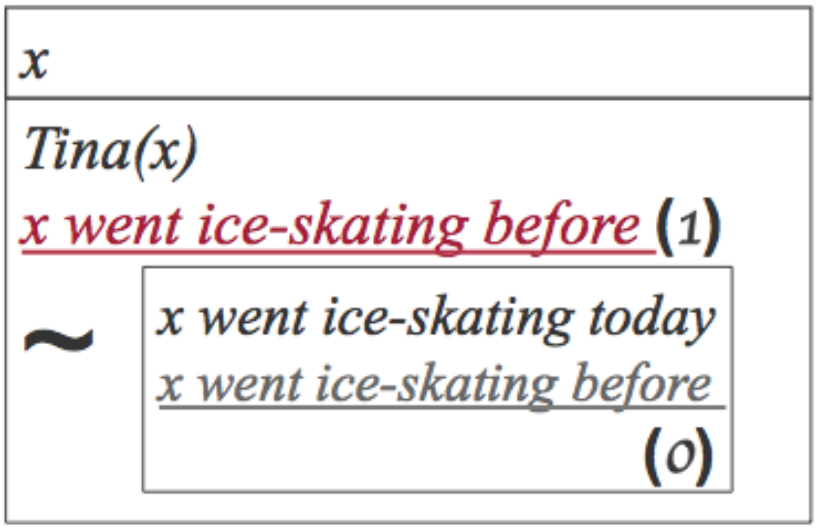

→ Projection involves an additional step in manipulating the Discourse Representation, which could incur processing effort

Dynamic Semantics

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$$r = \text{Tina went ice-skating}$$
$$PSP_r = \text{Tina had been ice-skating before}$$

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Tina AGAIN NOT went ice-skating Tina NOT AGAIN went ice-skating

r = Tina went ice-skating
PSP_r = Tina had been ice-skating before

$$c' = c + \neg r$$

defined iff

$$c + \neg PSP_r = c \qquad c + PSP_r = c$$

Relating the accounts to the processing results

DRT

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More elaborate test of the Hypothesis that Projection takes time:
Broader range of projection path lengths in conditionals

Experiment: If ... { not again / again not}

Design Ingredients

- **Additional layer of embedding**

  ($\rightarrow$ PSP in consequent of Conditional)

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- **Additional layer of embedding**
  ($\rightarrow$ PSP in consequent of Conditional)
- **not again** / **again not** manipulation
- Presupposition always resolvable ($\rightarrow$ no infelicitous conditions)
- Additional variation: location of support for PSP:
  - **globally** in a preceding sentence, or
  - **locally** in the **antecedent** of the *if*-clause

Material

Context

Tina	*war*	*letzte*	*Woche*	{*(I)* ∅ / *(II)*	**nicht**}	*Schlittschuhlaufen.*	*Wenn*	*sie*
Tina	was	last	week		**not**	ice-skating.	If	she
gestern	{*(I)*	**nicht**	/ *(II)* ∅}	*Schlittschuhlaufen*	*war,*	*dann...*		
yesterday		not		ice-skating	was,	then...		

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Context

Tina war letzte Woche {*(I)* ∅ / *(II)* **nicht**} *Schlittschuhlaufen. Wenn sie*
Tina was last week **not** ice-skating. If she
gestern {*(I)* **nicht** / *(II)* ∅} *Schlittschuhlaufen war, dann...*
yesterday not ice-skating was, then...

Target

...geht sie heute bestimmt {*(***NW***)* **nicht wieder** / *(***WN***)* **wieder nicht**}
...goes she today not again again not
Schlittschuhlaufen, auch wenn das Wetter so schön ist.
ice-skating, even if the weather so beautiful is.

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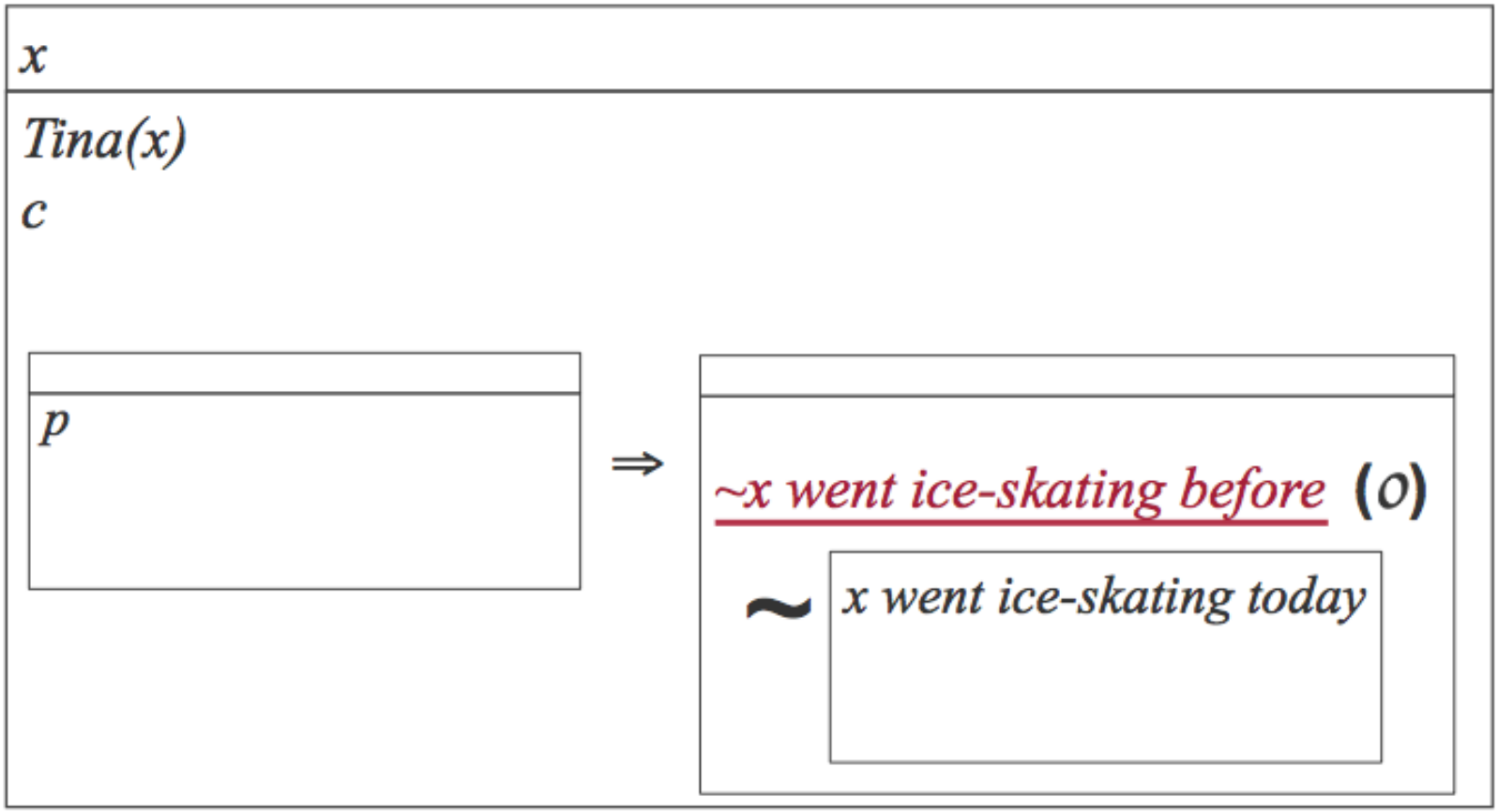
Schlittschuhlaufen, auch wenn das Wetter so schön ist.
ice-skating, even if the weather so beautiful is.

= 4 conditions:

	Local	Global
Context I	**a**: WN	**b**: NW
Context II	**d**: NW	**c**: WN

DRT Predictions: I-WN (local)

p: Tina didn't go ice-skating yesterday



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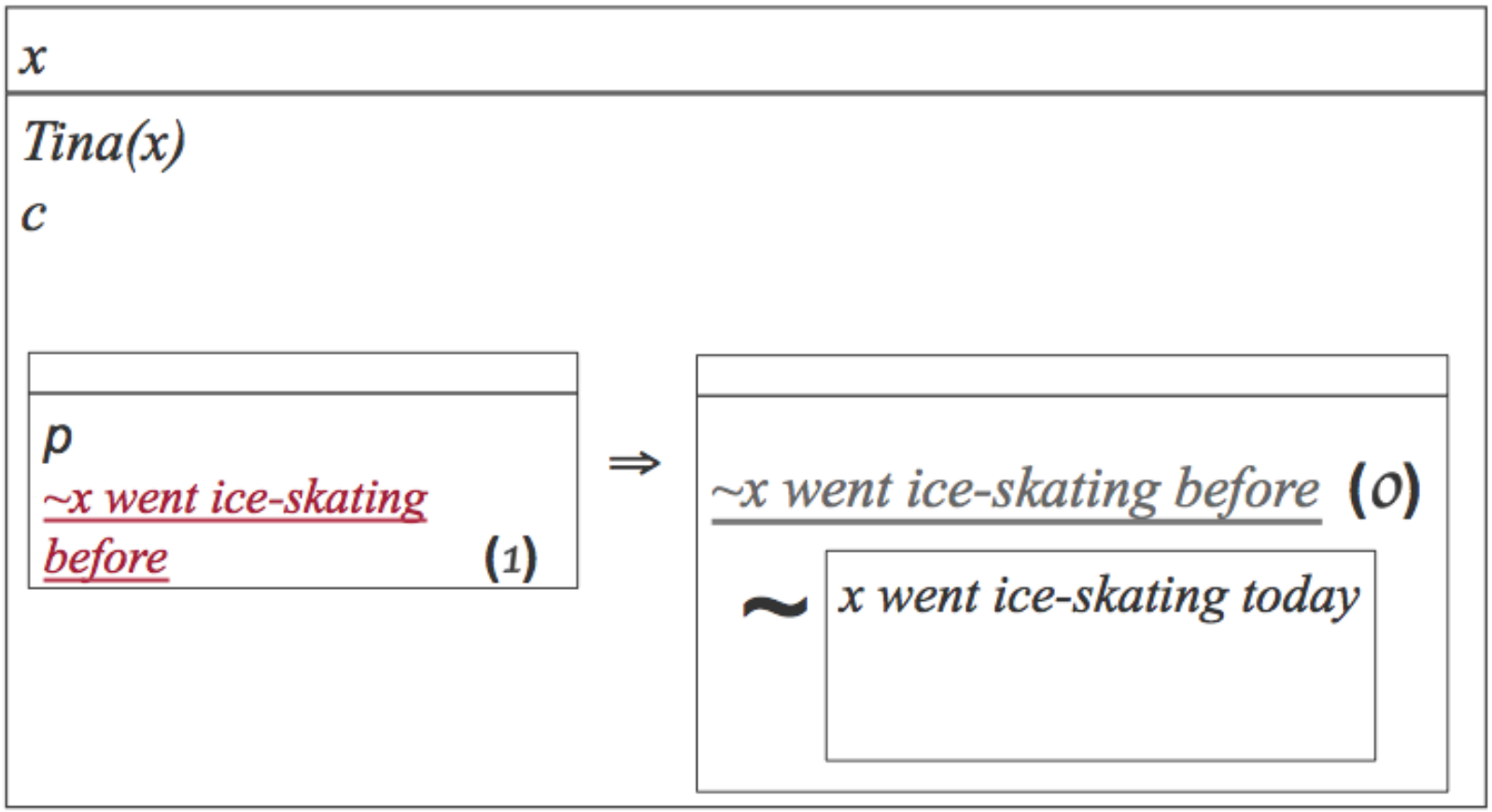
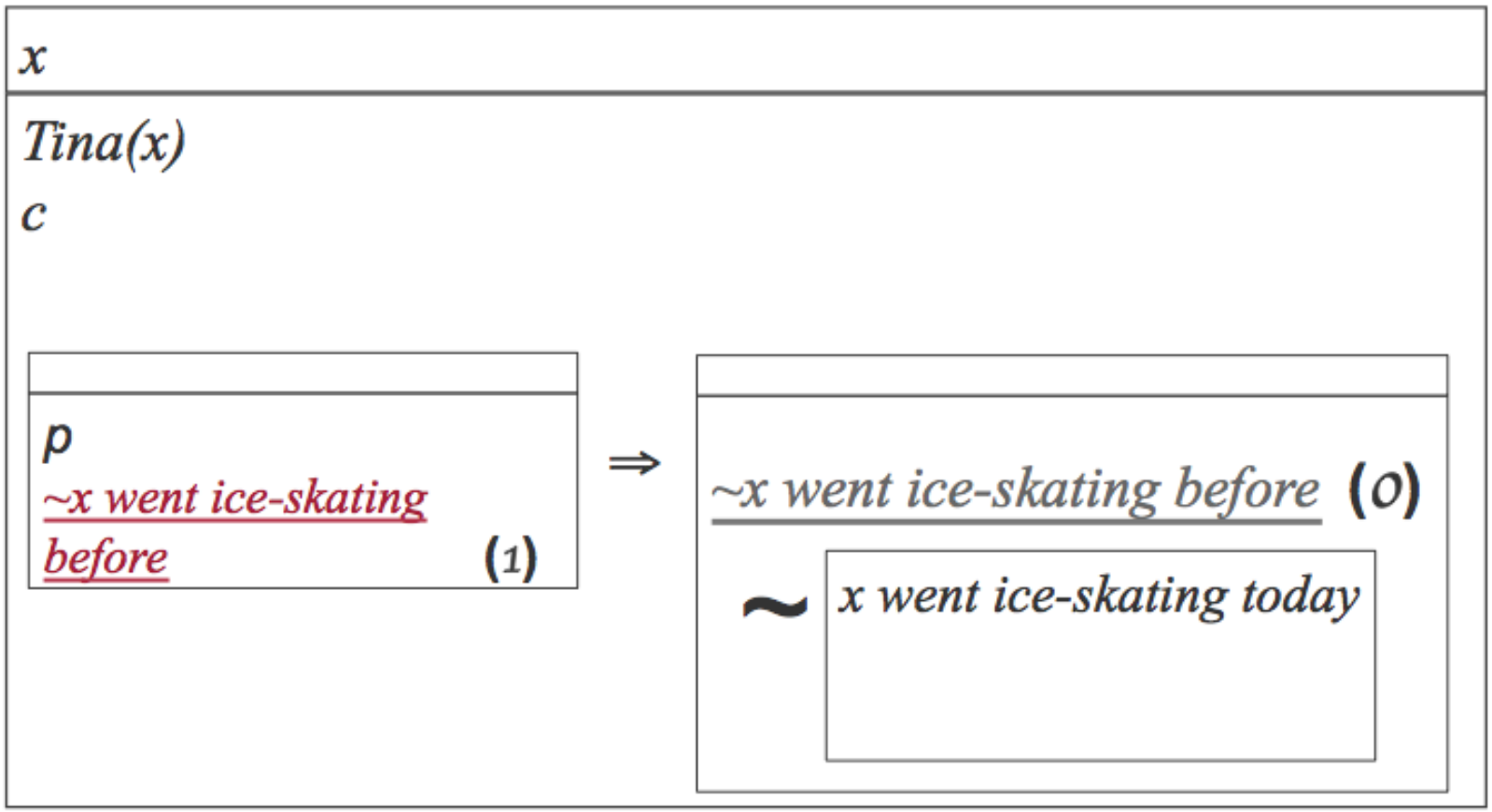


Path length = 1

DRT Predictions: II-WN (global)

c: Tina didn't go ice-skating last week



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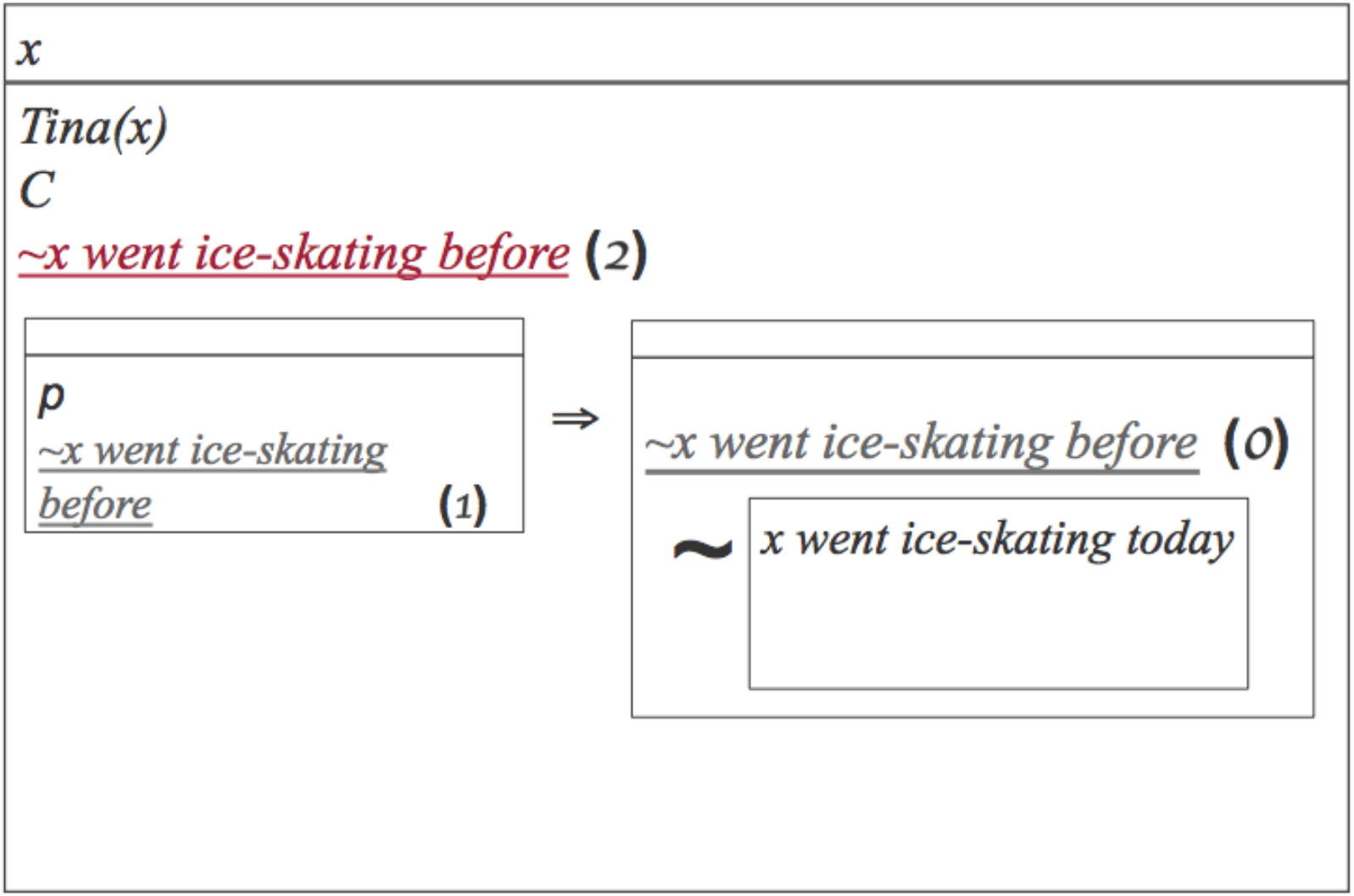
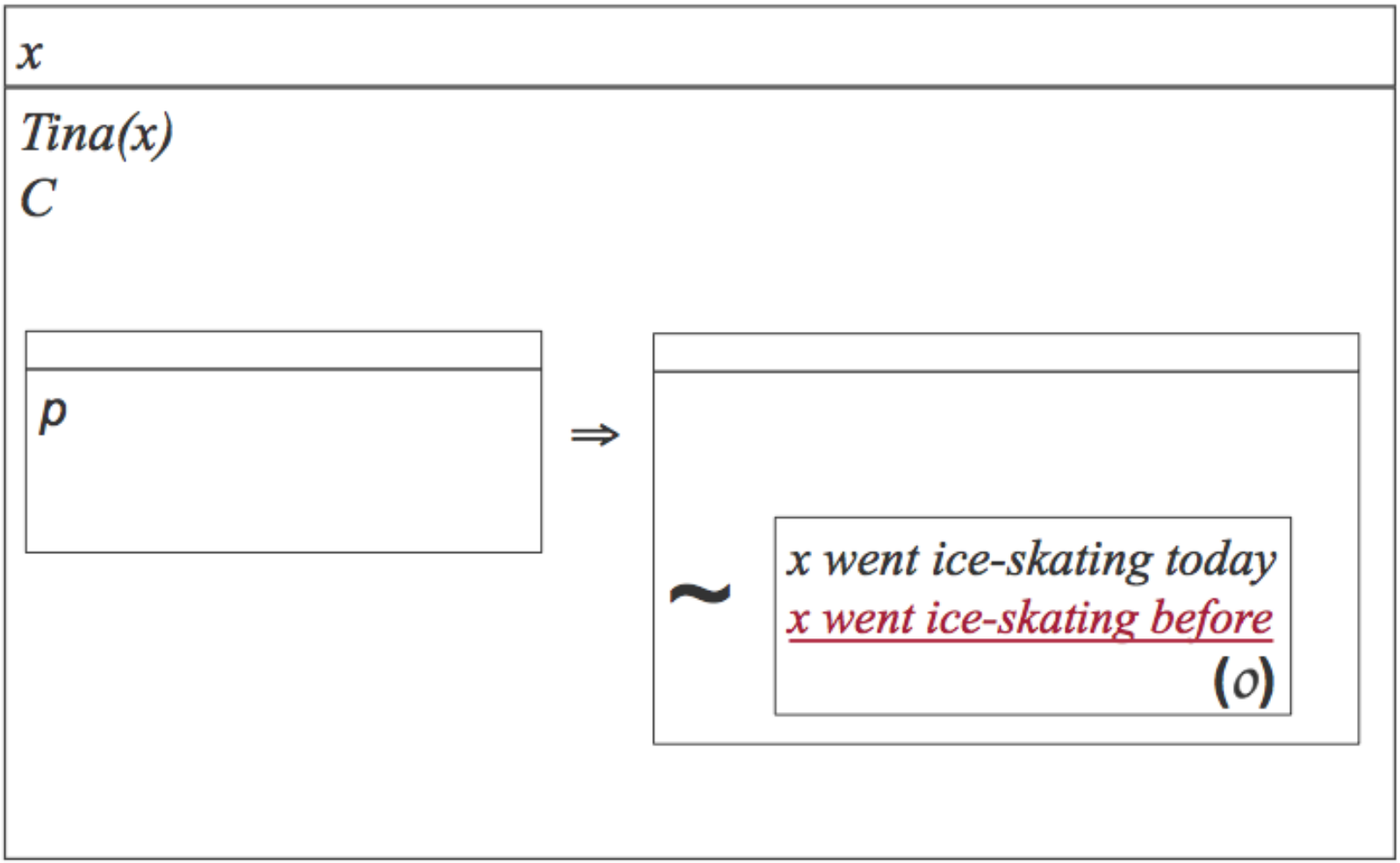


Path length = 2

DRT Predictions: I-NW (global)

c: Tina went ice-skating last week



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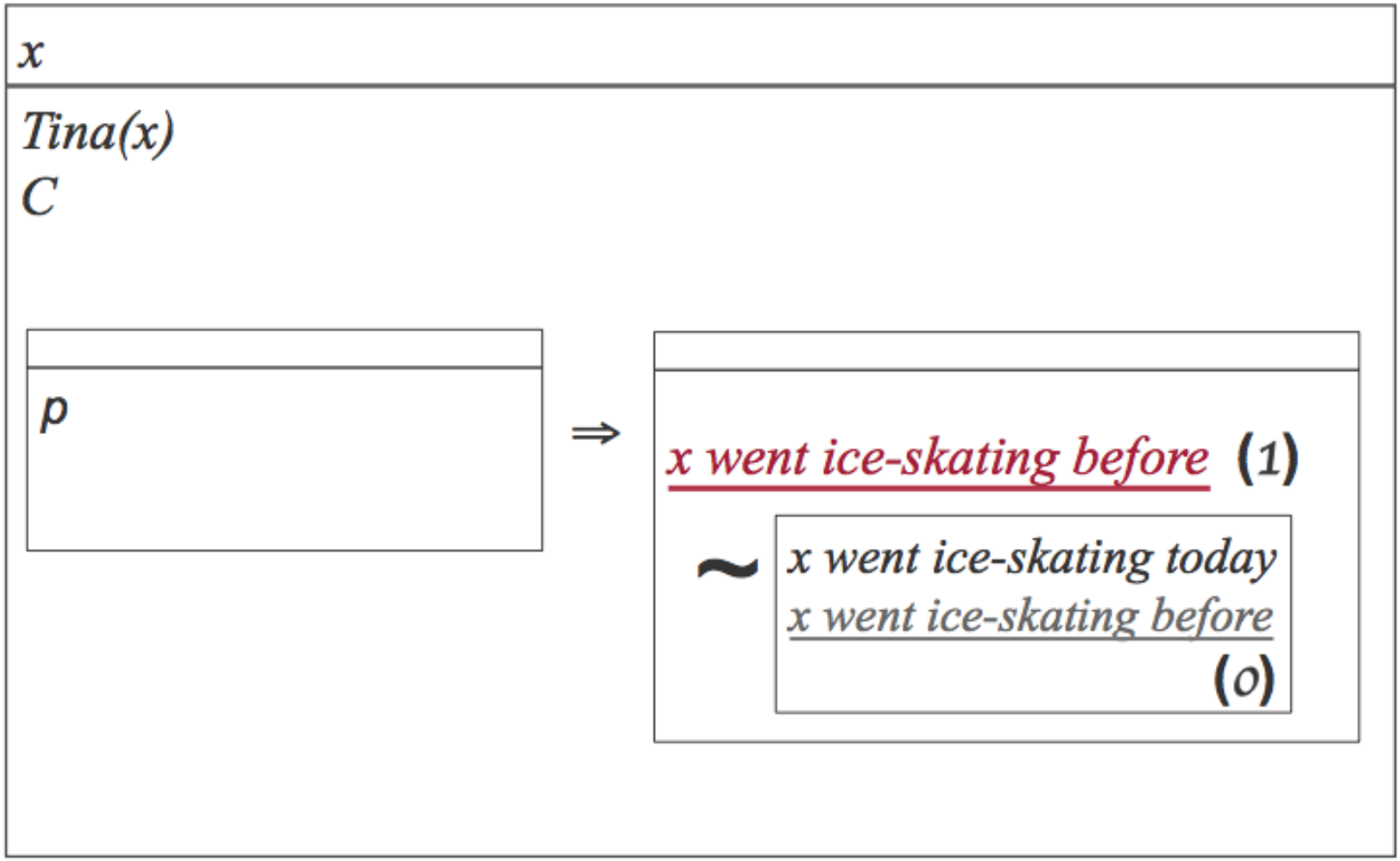

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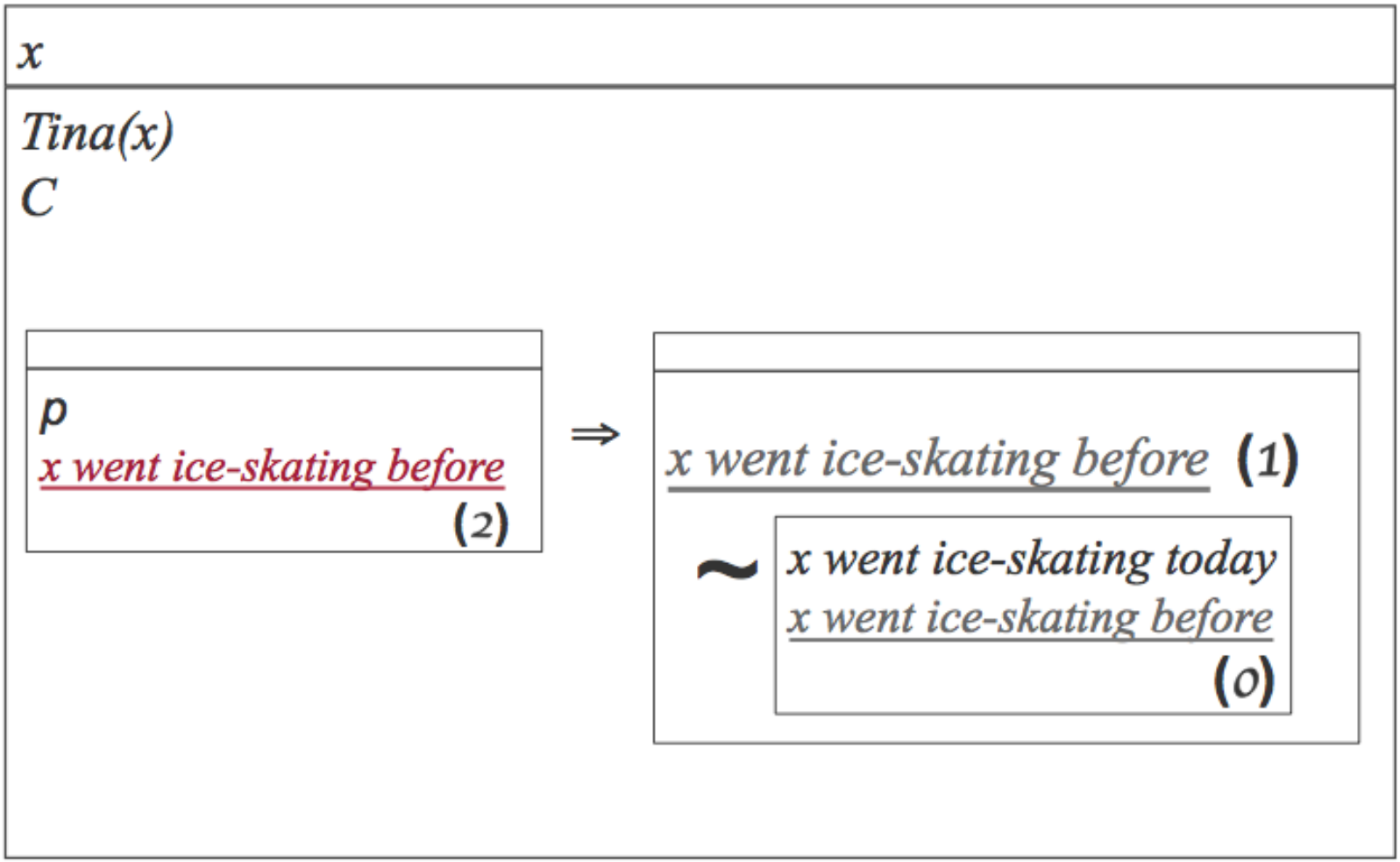

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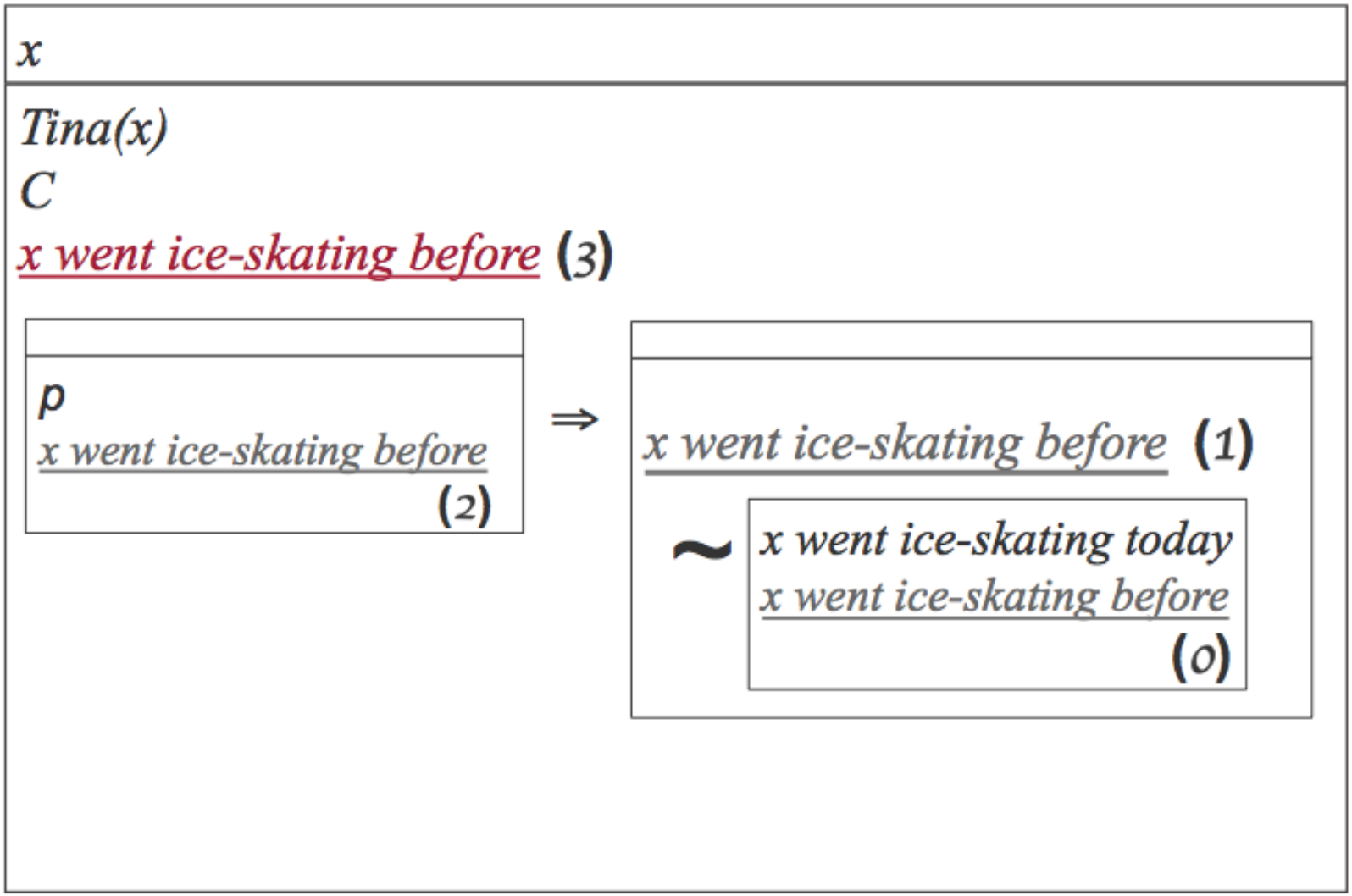
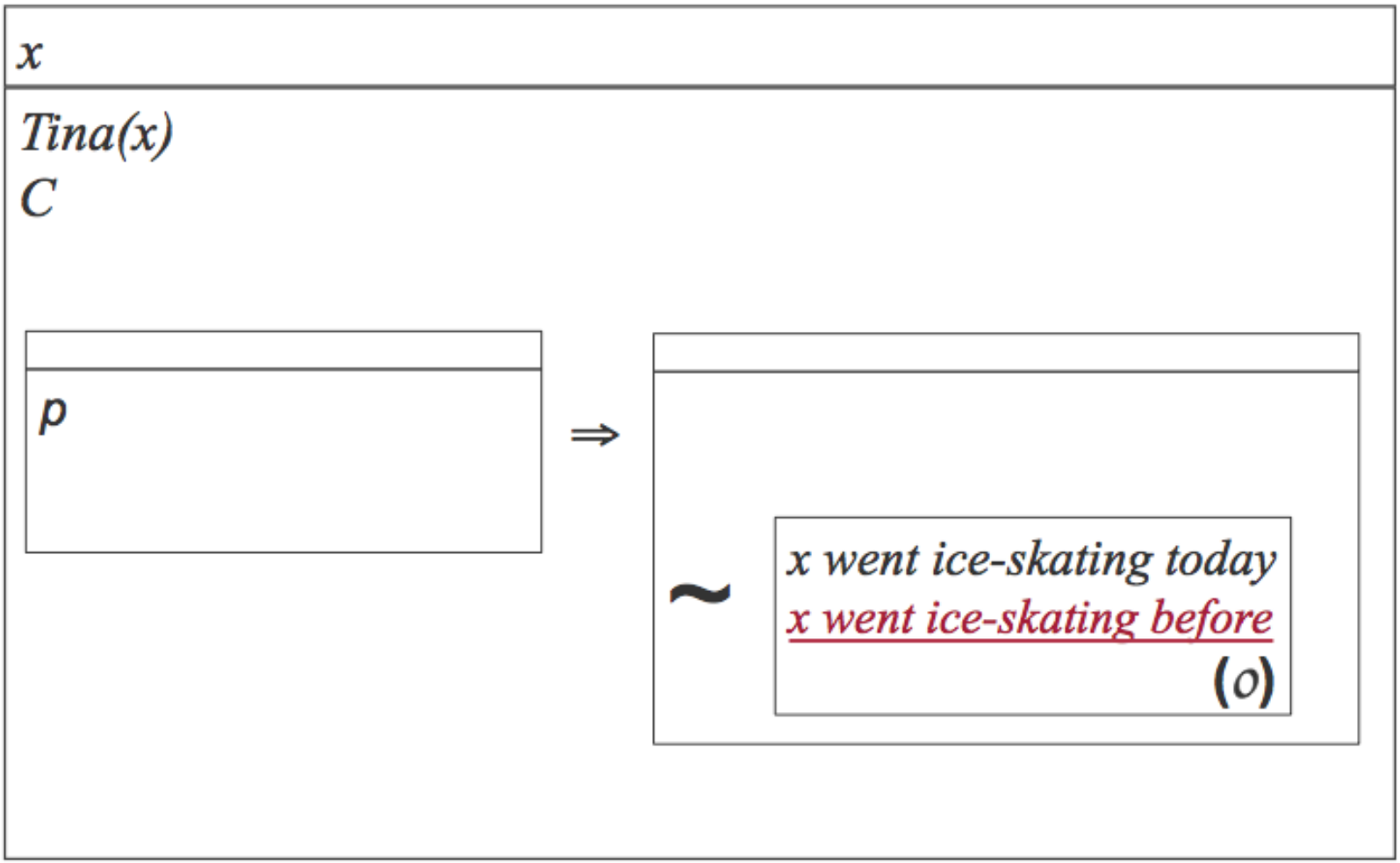


Path length = 3

DRT Predictions: II-NW (local)

p: Tina went ice-skating last week



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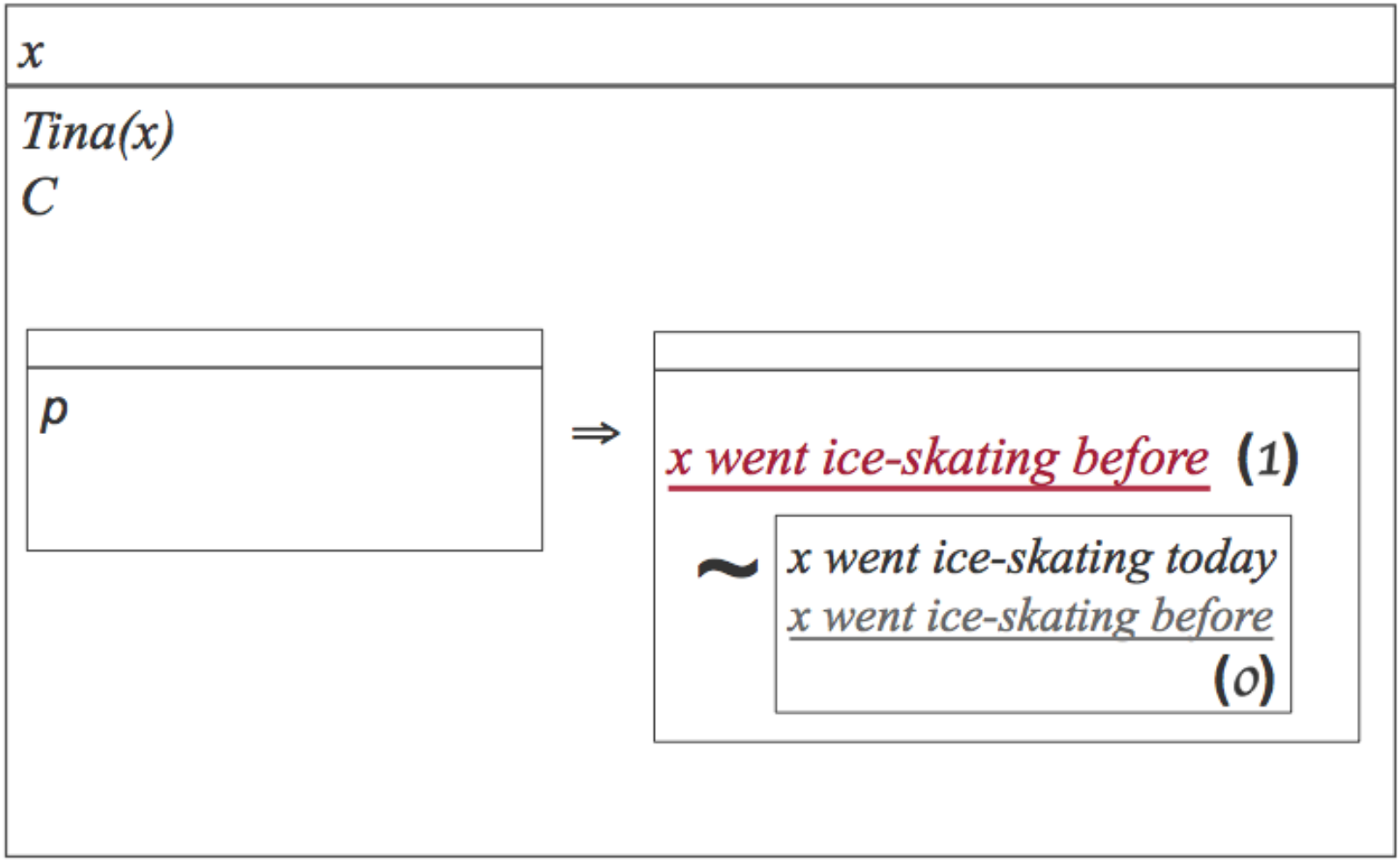

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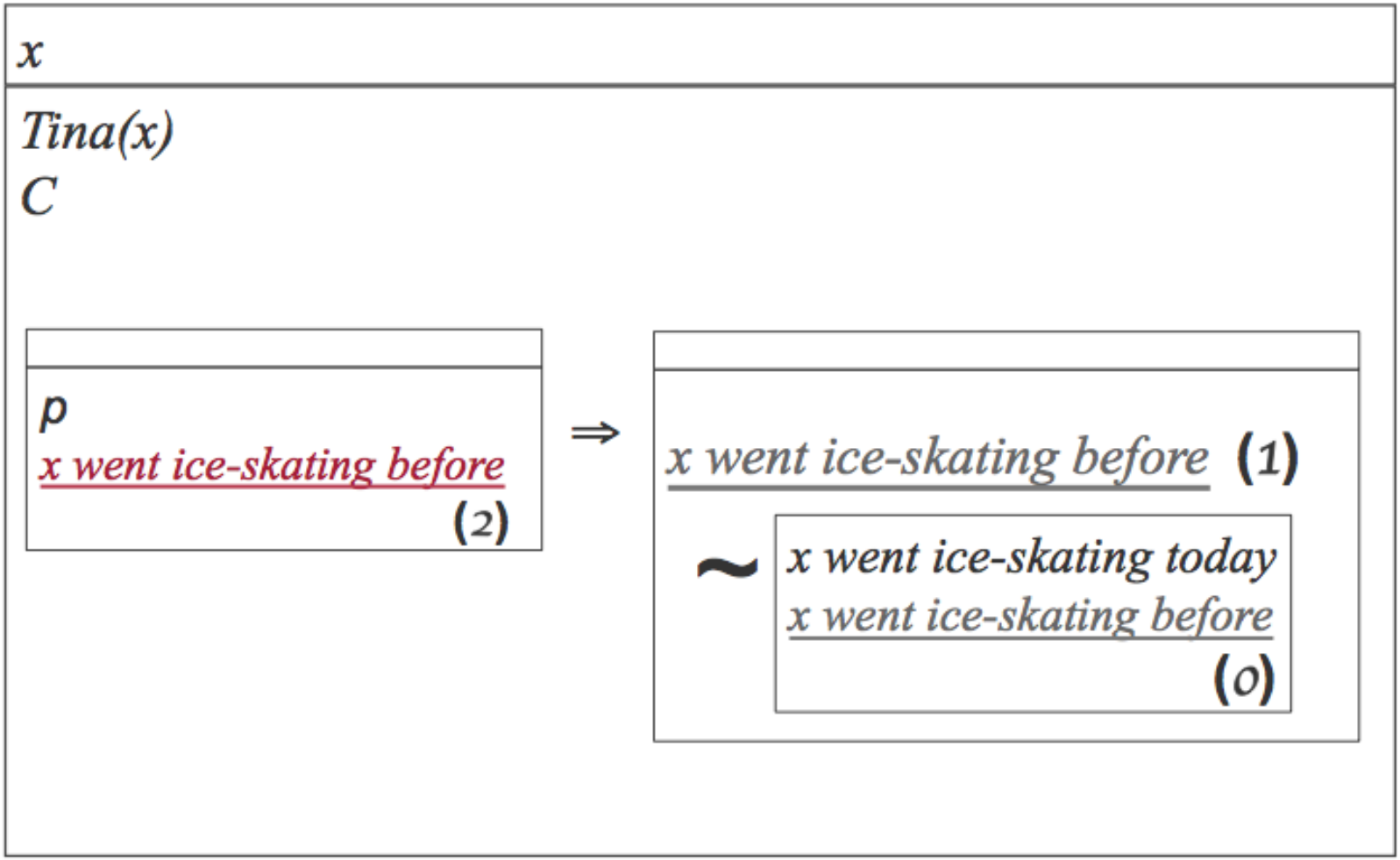
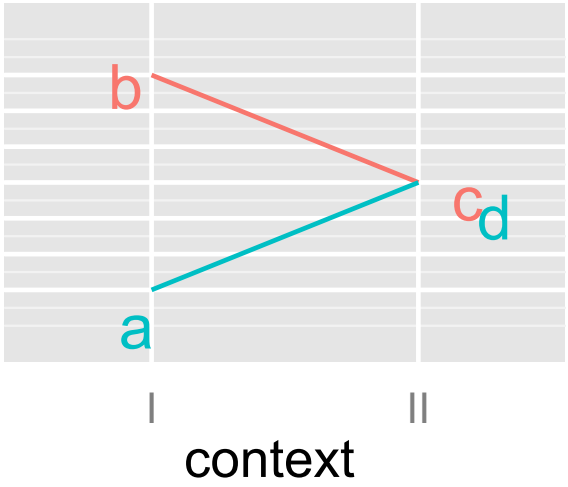


Path length = 2

Predictions of a DRT analysis - Summary



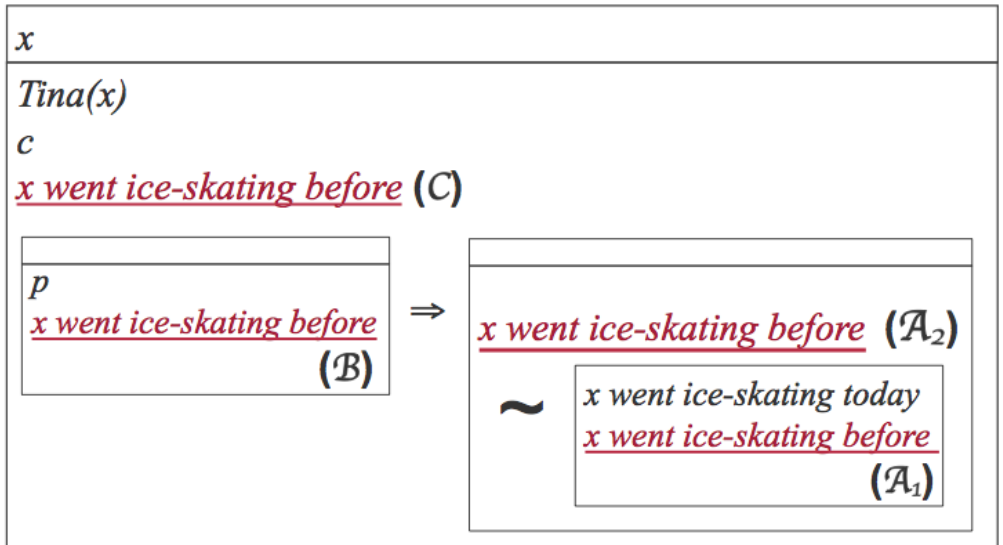
location

~~a~~ global

~~a~~ local

	LOCAL		GLOBAL
I	**a** = 1 (**A_2-B**)	<	**b** = 3 (**A_1-C**)
	∧		∨
II	**d** = 2 (**A_1-B**)	=	**c** = 2 (**A_2-C**)

→ Context * Location interaction (+ main effect of Location)



Dynamic Semantics

Context change potentials and PSP definedness conditions in conditionals:

CCP of an *if*-clause

$c+ \text{If } p, q = c - ((c + p) - ((c + p) + q))$
[defined iff $(c + p) + PSP_q = (c + p)$]

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$\rightarrow$ No way to determine location of support for PSP!

Therefore: No processing prediction based on semantics alone w.r.t. relative processing effort

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(independent from dynamic account)

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	LOCAL		GLOBAL
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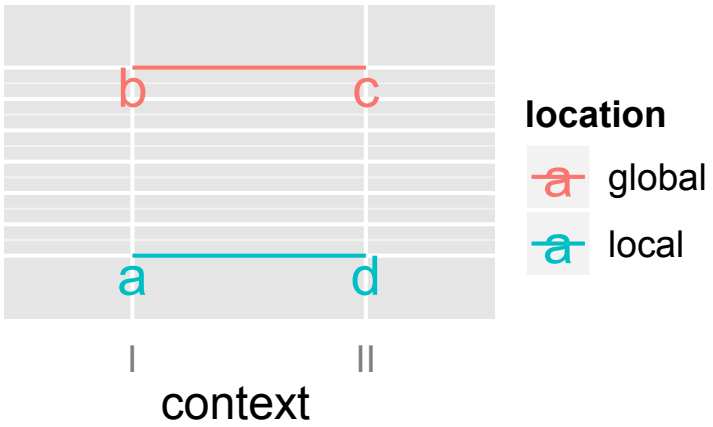
	=		=
II	**d** = 1	<	**c** = 2



→ main effect of Location

Potential predictions of a dynamic semantics analysis

One way of squeezing a potentail prediction out of the dynamic account:

Added complexity for negated PSP

- $PSP_q = \neg r$: $c + \neg r = c?$ $\approx$ $c - (c + r) = c?$
- $PSP_q = r$: $c + r = c?$

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- $PSP_q = r$: $c + r = c?$

Negated PSP in materials

r = Tina had been ice-skating before

WN: $PSP_q = \neg r$ **NW**: $PSP_q = r$

Predictions of a dynamic semantics analysis

Additionally, negation in antecedent might play further role:

Assume:

q: Tina was ice-skating yesterday.

r: Tina had been ice-skating before.

Context I:

WN: $(c' + \neg q) + \neg PSP_r = c' + \neg q$

NW: $(c' + \neg q) + PSPr = c' + \neg q$

Context II

WN: $(c' + q) + \neg PSP_r = c' + q$

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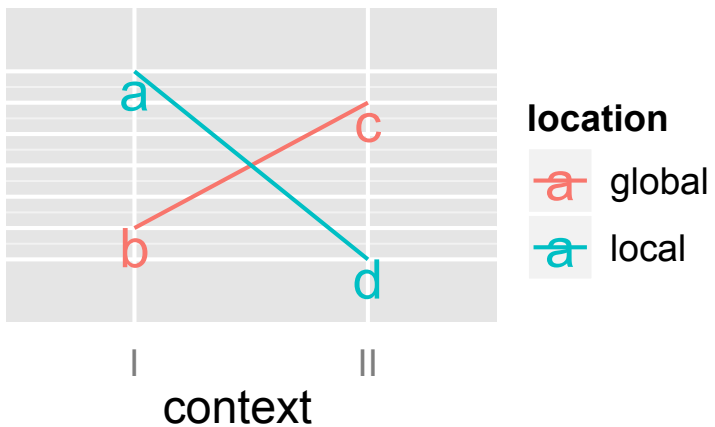
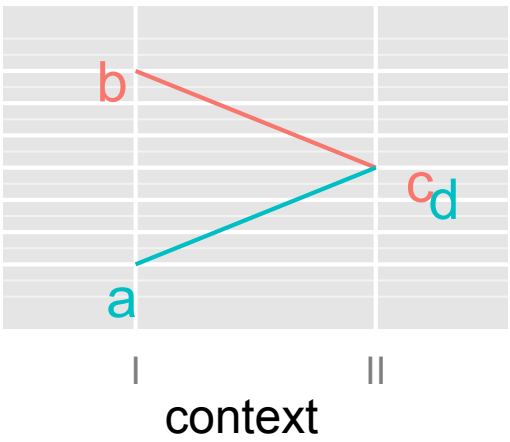
	LOCAL		GLOBAL
I	**a** = 4 (NegPSP)	>	**b** = 2 (PosPSP)
	∨		∧
II	**d** = 1 (PosPSP)	<	**c** = 3 (NegPSP)



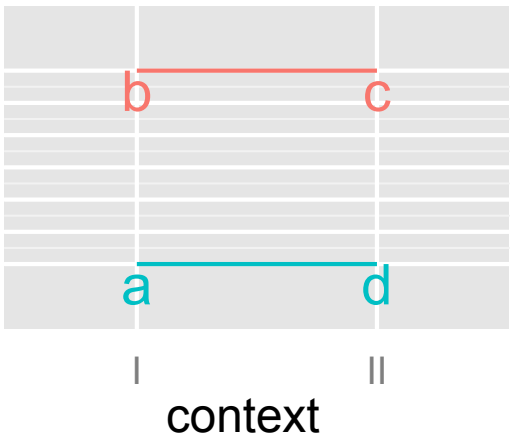
→ Context * Location interaction (BUT different from DRT: a>b, d<c)

Prediction Summary

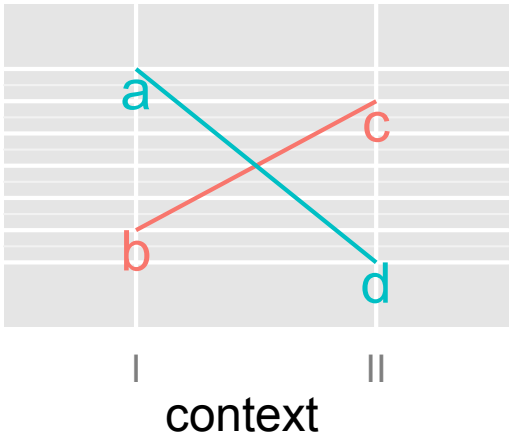
DRT



Processing

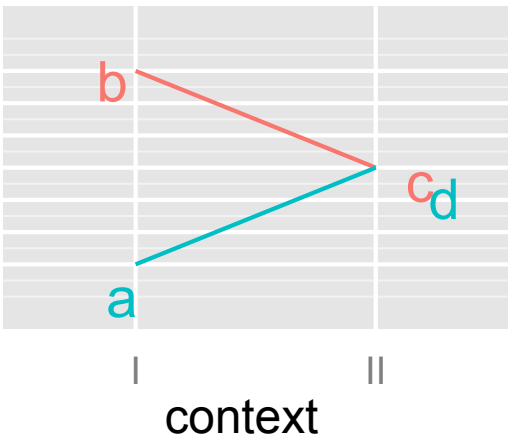


Dynamic (Negation)

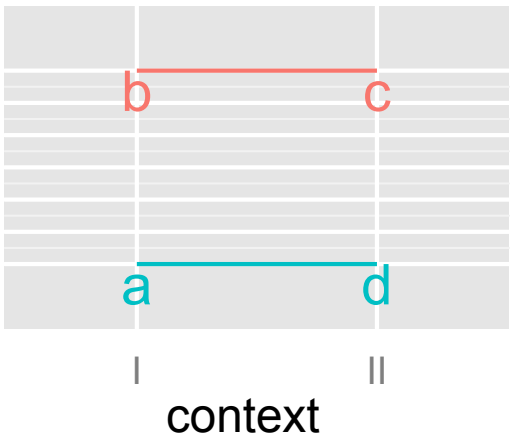


Prediction Summary

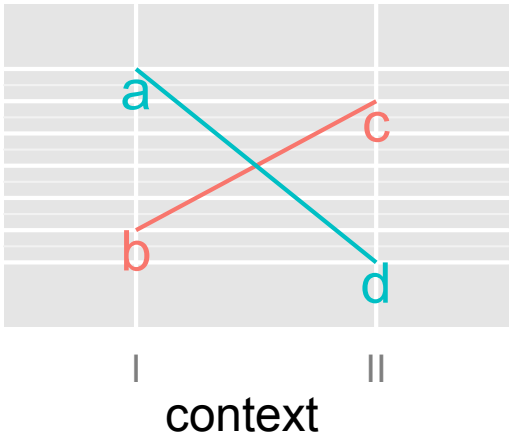
DRT



Processing



Dynamic (Negation)



And the winner is. . .

Results - Reading times on verb

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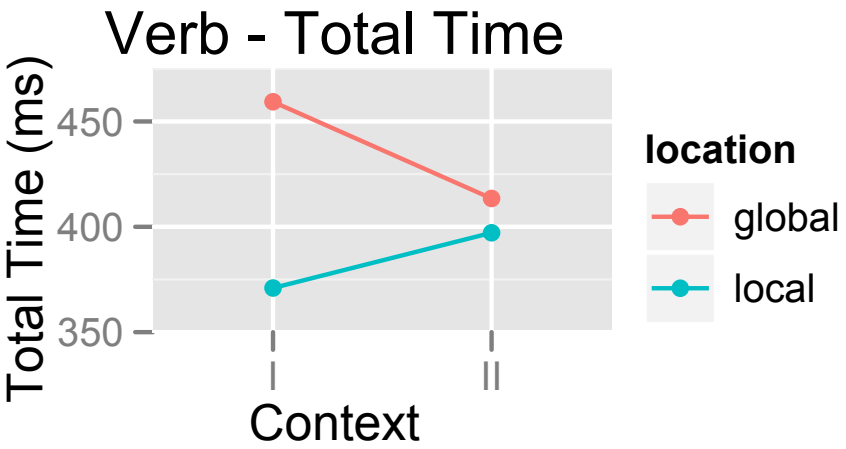

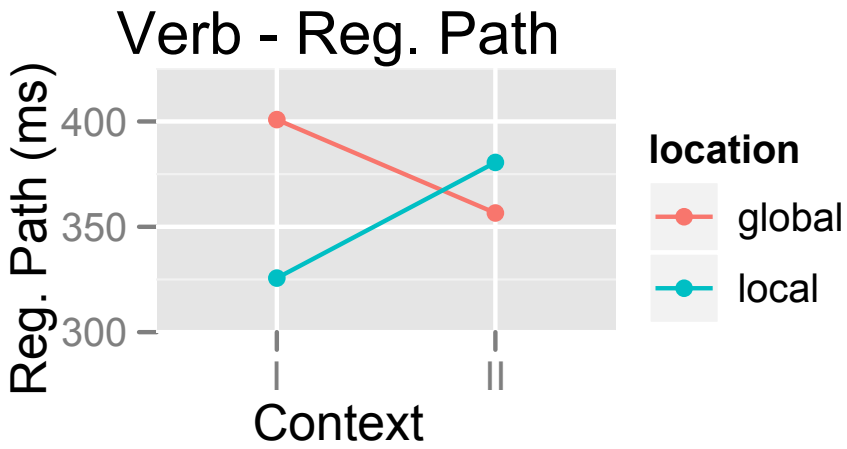

Sum of all fixations on verb

Sum of all fixations from first looking at verb to first moving on to the right

Parallel Results for Rereading time and for **wieder nicht** region

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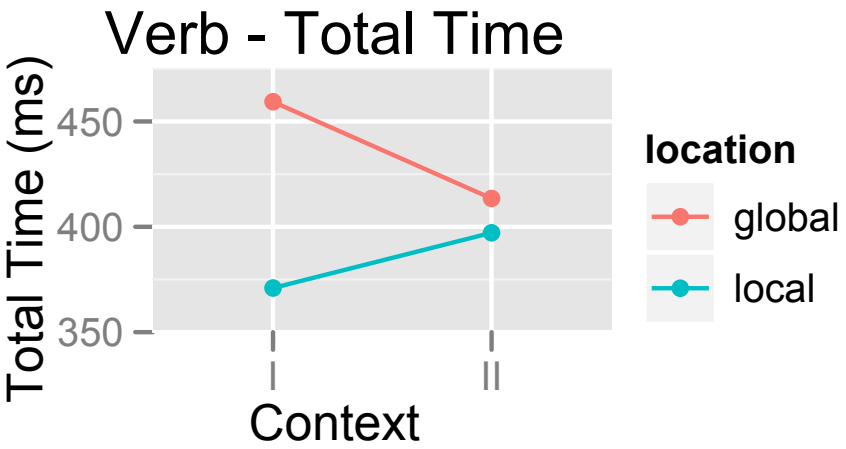

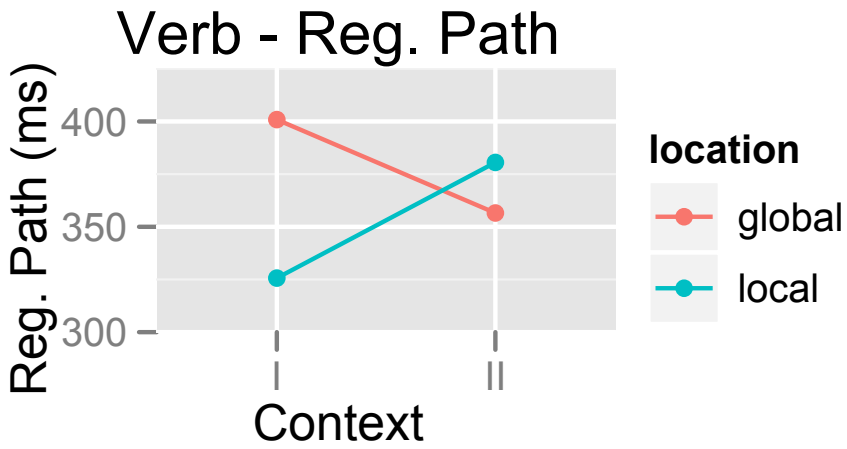

Sum of all fixations on verb

Sum of all fixations from first looking at verb to first moving on to the right

Parallel Results for Rereading time and for **wieder nicht** region

- Sig. interaction
- Main effect of Location (and Context)

- Simple effects:
  - $a < b$, but not $d < c$
  - $a < d$ (Reg Path)

Further Analyses

- Main effect of Firstword (NW $>$ WN) in Firstword $\times$ Location analysis, predicted only by DRT
  (not shown here)

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- Analysis based on **DRT Projection Path Length**
  - equally good as Context $\times$ Location interaction analysis
  - much better than analysis based on Location alone
    (corresponds to processing hypothesis)

Conclusion

- Strong support for representational complexity of PSP projection at the processing level
- DRT Projection Path length is a surprisingly good predictor of processing effort as reflected in reading times
- Potential anaphora processing effects based on clause-distance apparently absent

Open Issues & Further Questions

- Relation to Global $<$ Local finding by Chemla & Bott 2012?
- Do non-anaphoric triggers behave the same way?
- Do pronouns behave the same way?
- Can any other PSP theories capture this data?
- Are there other independent processing interpretations?

References I

Altmann, Gerry and Mark Steedman (1988). "Interaction with Context during Sentence Processing". In: *Cognition* 30, pp. 191–238.

Chemla, Emmanuel (2009). "Presuppositions of quantified sentences: experimental data". In: *Natural Language Semantics* 17, pp. 299–334.

Chemla, Emmanuel and Lewis Bott (to appear). "Processing presuppositions: dynamic semantics vs pragmatic enrichment". In: *Language and Cognitive Processes*.

Chemla, Emmanuel and Phillipe Schlenker (2009). *Incremental vs. Symmetric Accounts of Presupposition Projection: An Experimental Approach*.

Inhoff, Albrecht Werner (1985). "The Effect of Factivity on Lexical Retrieval and Postlexical Process During Eye Fixations in Reading". In: *Journal of Psycholinguistic Research* 14, pp. 45–57.

Sandt, R. van der (1992). "Presupposition Projection as Anaphora". In: *Journal of Semantics* 9.333-377.

References II

Sandt, R. van der and B. Geurts (1991). "Presupposition, Anaphora, and Lexical Content". In: *Text Understanding in LILOG*, pp. 259–296.
Schwarz, Florian (2007). "Processing Presupposed Content". In: *Journal of Semantics* 24, pp. 373–416.
Schwarz, Florian and Sonja Tiemann (2012). "Presupposition Processing - The Case of German *wieder*." In: *Post-Proceedings of the Amsterdam Colloquium 2011*.
Tiemann, Sonja et al. (2011). "Psycholinguistic Evidence for Presuppositions: On-line and Off-line Data". In: *Sinn & Bedeutung 15 Proceedings of the 2010 Annual Conference of the Gesellschaft für Semantik*. Ed. by I. Reich, E. Horch, and D. Pauly, pp. 581–597.
Wetzel, Frederick and Dennis Molfese (1992). "The Processing of Presuppositional information Contained in Sentences: Electrophysiological Correlates". In: *Brain and Language* 42, pp. 286–307.