Presupposition satisfaction preserves discourse constituency

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Two observations & two questions

1. Dependencies are often constrained by locality in sentence processing.
   - → Are discourse-level dependencies also constrained by locality?
Two observations & two questions

1. Dependencies are often constrained by locality in sentence processing.
   - → Are discourse-level dependencies also constrained by locality?

2. Discourse is structured.
   - Beyond subsentential syntax, semantics
   - Different discourse structure yields different outcomes in e.g. anaphora resolution (Grosz & Sidner 1986; Webber & Joshi 1998; Polanyi 1999; Kehler 2000; Wolf & Gibson 2005, 2006; among many others)
   - → Behavioral measure sensitive to discourse structure and constituency?
Andy also bought [some nectarines]_{F}

- Propositional content $\psi = \text{Andy bought some nectarines}$
- Assume $A = \{\text{Andy bought some nectarines,}
\text{Andy bought some bagels,}
\text{Andy bought some tangerines,}
\text{Andy bought some apples,}
\text{Andy bought some lilacs,}
\text{Andy bought some lightbulbs, ... }\}$

- Presupposition $= \exists \alpha \in A. \alpha \text{ is true } \& \alpha \neq \psi$
  (Andy bought something other than nectarines)
Using focus interpretation to study discourse structure

**Beth bought [some bagels]_F**

**Andy also bought [some nectarines]_F**

- Propositional content \( \psi = \text{Andy bought some nectarines} \)
- Assume \( A = \{ \text{Andy bought some nectarines}, \) 
  \( \text{Andy bought some bagels}, \)
  \( \text{Andy bought some tangerines}, \)
  \( \text{Andy bought some apples}, \)
  \( \text{Andy bought some lilacs}, \)
  \( \text{Andy bought some lightbulbs}, ... \} \)
- Presupposition = \( \exists \alpha \in A. \alpha \text{ is true } \& \alpha \neq \psi \)
  \( (\text{Andy bought something other than nectarines}) \)

Unbounded set of possible meanings → Very small set of possible meanings in a particular discourse context
Beth bought [some bagels]_F
Andy also bought [some nectarines]_F

- Propositional content $\psi = \text{Andy bought some nectarines}$
- Assume $A = \{\text{Andy bought some nectarines,}
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  (Andy bought something other than nectarines)

q1: Are discourse dependencies constrained by locality?
q2: Is the relevant notion of locality linear or hierarchically structured?
Roadmap

1. Experiment 1 (questionnaire): Locality in presupposition satisfaction
2. Experiment 2 (questionnaire): Linear v. structured locality
3. Experiment 3 (eye-tracking): Tracking presupposition satisfaction in real time
4. Conclusions & remaining questions
1. The roommates often go to the farmer’s market on Saturday mornings.
2. Beth always buys some bread.
3. Andy usually buys some carrots and some celery.
4. His doctor says he needs to eat more vegetables.
5. Today Andy treated himself to some croissants.
6. He also bought some nectarines.

Q: Andy got:
local interpretation

1. The roommates often go to the farmer’s market on Saturday mornings.
2. Beth always buys some bread.
3. Andy usually buys some carrots and some celery.
4. His doctor says he needs to eat more vegetables.
5. Today Andy treated himself to some croissants.
6. He also bought some nectarines.

Q: Andy got:
nectarines, croissants
Is presupposition satisfaction constrained by locality?

**global interpretation**

1. The roommates often go to the farmer’s market on Saturday mornings.
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3. Andy usually buys some carrots and some celery.
4. His doctor says he needs to eat more vegetables.
5. Today Andy treated himself to some croissants.
6. He also bought some nectarines.

**Q:** Andy got:

nectarines, croissants, carrots, celery, bread
Experiment 1

- 10 items, N=20
- 2 pseudo-randomized lists
- Participants read discourses on a computer screen. Each 6-sentence discourse was followed by a sentence fragment (e.g. ‘Andy got:’).
- Participants completed the fragment by choosing 1 of 4 continuations:

1. The roommates often go to the farmer’s market on Saturday mornings.
2. Beth always buys some bread.
3. Andy usually buys some carrots and some celery.
4. His doctor says he needs to eat more vegetables.
5. Today Andy treated himself to some croissants.
6. He also bought some nectarines.

**local**

*Andy got ... nectarines and croissants.*
10 items, N=20

2 pseudo-randomized lists

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local

Andy got ... nectarines, croissants, carrots, celery and bread.
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Experiment 1 predictions

- If presupposition dependencies are subject to a locality constraint, **local** interpretation should be preferred.

- If locality effects are graded (stronger bias as dependency length decreases), the intermediate interpretation should be preferred to the global one.

- False interpretation should be rejected.
Experiment 1 results

Local interpretation > Intermediate > Global > False
Experiment 1 results

✓ Local interpretation preferred, suggesting presupposition satisfaction is constrained by (some kind of) locality.

✓ Increasing dependency length corresponds to increasing dispreference: Locality effects appear to be graded.

✓ False interpretations rejected.
The roommates often go to the farmer’s market on Saturday mornings.
Beth always buys some bread.
Andy usually buys some celery.
His doctor told him he needs to eat more vegetables.
Today Andy treated himself to some croissants.
He also bought some nectarines.
Interpretation 2: Locality relativized to structured discourse representation

Which roommate buys what at the farmer’s market?

Beth?
Beth always buys some bread.

Andy?
Andy usually buys some carrots and some celery.

Why?
His doctor told him he needed to eat more vegetables.

What about today?
Today he treated himself to a croissant.
He also bought some nectarines.
Interpretation 2: Locality relativized to structured discourse representation

![Diagram showing a tree structure with nodes labeled as Sub-Q and Ans, illustrating the relativization of locality within a discourse representation.](Image)
Interpretation 2: Locality relativized to structured discourse representation

Which roommate buys what at the farmer’s market?

Beth?

Beth always buys some bread.

Andy?

Andy usually buys some carrots and some celery.

Why?

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Why?

His doctor told him he needed to eat more vegetables.

What about today?

Today he treated himself to a croissant.

He also bought some nectarines.
Interpretation 2: Locality relativized to structured discourse representation

global

Which roommate buys what at the farmer’s market?

Beth?

Beth always buys some bread.

Andy?

Andy usually buys some carrots and some celery.

Why?

His doctor told him he needed to eat more vegetables.

What about today?

Today he treated himself to a croissant.

He also bought some nectarines.
Roadmap

1. Experiment 1 (questionnaire): Locality in presupposition satisfaction
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4. Conclusions & remaining questions
Disentangling linear distance and structured locality

**Experiment 1**

- **Q**
  - **Sub-Q**
    - **Ans**
    - **Sub-Q**
      - **Ans**
      - **Sub-Q**
        - **Ans**
        - **Ans**
      - **Ans**

**Experiment 2**

- **Q**
  - **Sub-Q**
    - **Ans**
    - **Sub-Q**
      - **Ans**
      - **Sub-Q**
        - **Ans**
      - **Ans**
    - **Sub-Q**
      - **Ans**
Disentangling linear distance and structured locality

Which roommate bought what at the farmer’s market?

- Beth?
  - Beth bought some bread.
- Frank?
  - Frank bought some carrots.
- Andy?
  - Andy also bought some nectarines.

When his girlfriend is there, she always gets some croissants.
The roommates went to the farmer’s market this morning.

Beth bought some bread.

Frank bought some celery.

When his girlfriend is there she always gets some croissants.

Andy also bought some nectarines.

Andy bought . . . nectarines and croissants.
intermediate (w.r.t. mention)

1. The roommates went to the farmer’s market this morning.
2. Beth bought some bread.
3. Frank bought some celery.
4. When his girlfriend is there she always gets some croissants.
5. Andy also bought some nectarines.

Andy bought ... nectarines, croissants, carrots and celery.
The roommates went to the farmer’s market this morning.
2 Beth bought some bread.
3 Frank bought some celery.
4 When his girlfriend is there she always gets some croissants.
5 Andy also bought some nectarines.

Andy bought … nectarines, carrots and celery.
The roommates went to the farmer’s market this morning.

Beth bought some bread.

Frank bought some celery.

When his girlfriend is there she always gets some croissants.

Andy also bought some nectarines.

Andy bought … nectarines, carrots, celery and bread.
Based on Experiment 1, expect **local bias** for presupposition dependencies.

→ Strict linear locality preferred even when incompatible with the situation model?

Is there evidence for **structured locality**, when no longer aligned with linear distance?
Local interpretation in terms of *linear distance* is still (always?) available
Presupposition satisfaction respects discourse constituency—bias for interpreting presupposition relative to *local discourse unit*. 
✓ **Linear locality** bias $\rightarrow$ Preferred even when incompatible with situation model!

✓ Preference for locality w.r.t. *hierarchical structure*. (Can’t be due to minimizing linear distance.)

- Do these locality biases influence **online discourse processing** and presupposition resolution?

- Do linearly and structurally local interpretations **compete** in online interpretation?
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1. The roommates went to the farmer’s market this morning.
2. Beth got some bread.
3. Frank got some carrots and some apples.
4. Andy also got some nectarines.

→ Click on what Andy got.
1. The roommates went to the farmer’s market this morning.
2. Beth got some bread.
3. Frank got some carrots and some apples.
4. Andy also got some nectarines.

Which roommate bought what at the farmer’s market?

- Beth?
  - Beth bought some bread.
- Frank?
  - Frank bought some carrots and some apples.
- Andy?
  - Andy also bought some nectarines.
The roommates went to the farmer’s market this morning.
Beth got some bread.
Frank got some carrots and some apples.
Andy also got some nectarines.
The roommates went to the farmer’s market this morning.

Beth got some bread.

Frank got some carrots and some apples.

Andy also got some nectarines.

linearly local

→ minimizes linear distance

→ partial answer to question
The roommates went to the farmer’s market this morning.

Beth got some bread.

Frank got some carrots and some apples.

Andy also got some nectarines.

structurally local

→ local discourse tier

→ respects discourse constituency
1. The roommates went to the farmer’s market this morning.
2. Beth got some bread.
3. Frank got some carrots and some apples.
4. Andy also got some nectarines.

**linear local only:**

(a) carrots, apples
(b) apples
(c) nectarines
(d) nectarines, carrots, apples
The roommates went to the farmer’s market this morning.
Beth got some bread.
Frank got some carrots and some apples.
Andy also got some nectarines.

structured local only:
(a) carrots, apples
(b) apples
(c) nectarines
(d) nectarines, carrots, apples, bread
The roommates went to the farmer’s market this morning.

Beth got some bread.

Frank got some carrots and some apples.

Andy also got some nectarines.

**linear and structured:**

(a) carrots, apples  
(b) apples  
(c) nectarines, carrots, apples  
(d) nectarines, carrots, apples, bread
Experiment 3 questions

- Do linearly and structurally local interpretations **compete in online interpretation**?

- Experiment 3 pits linear locality against **discourse constituency**.
  - Do comprehenders minimize linear dependency length at the expense of preserving discourse constituency?
  - Or violate strict linear locality in favor of an interpretation that corresponds to a discourse constituent?
Experiment 3 results

target:other + target ratio

- Linear:Linear+Other
- Structured:Structured+Other

The graph shows the target:other + target ratio for Linear and Structured conditions, with Linear showing a lower ratio compared to Structured.
Experiment 3 results

**linear local only display**: 200 ms before-200 ms after target word onset

![Average fixation count chart](chart)

- Light yellow: False (Mentioned subset)
- Beige: False (Mentioned set)
- Green: Presupp failure
- Red: Linear local
Experiment 3 results

**linear local only:** 400-800 ms after target word onset

→ Linear local no better than presupposition violating interpretation.
Experiment 3 results

**structured local only**: 200 ms before-200 ms after target word onset

→ Early convergence on structured local interpretation.
Experiment 3 results

**structured local only display**: 400-800 ms after target word onset

→ Early convergence on structured local interpretation.
linear and structured: 200 ms before-200 ms after target word onset

→ Linear and structured local interpretations compete in early window.
Experiment 3 results

**linear and structured**: 400-800 ms after target word onset

→ Late convergence on structured interpretation.
Experiment 3 results

**target:other + target ratio**: early and late windows

![Bar chart showing target:other + target ratio for early and late windows.](chart)

- **Early (-200-200ms)**
  - Linear:Linear+Other: [Value]
  - Structured:Structured+Other: [Value]

- **Late (400-800ms)**
  - Linear:Linear+Other: [Value]
  - Structured:Structured+Other: [Value]

Local superset interpretation no better than novel referent.
✓ *Linearly and structurally local interpretations compete* in online interpretation.

✓ Comprehenders appear to sacrifice minimizing strict linear locality in order to *preserve discourse-level constituency*.

✓ Presupposition triggers do give rise to *expectations about likely discourse continuations*—even when these expectations are about abstract focus alternatives.
Evidence for locality w.r.t. linear distance and hierarchically-organized discourse structure.

In online discourse processing, bias in favor of discourse constituency-preserving interpretations is stronger than bias toward minimizing dependency length.

More generally: presupposition triggers like also give rise to expectations about likely focus alternatives/comparison sets.
Open questions & future directions

- A lot of open issues about the nature of discourse structure
  - hierarchical structure?
  - discourse/rhetorical relations?
  - what types of dependencies are allowed?

- How is discourse organized?
  - QUD/topic structure?
  - different organizations by discourse type?
  - narrative v. dialogue/conversation?
Experimental Semantics/Pragmatics group at Rochester Tanenhaus lab
RAs: Justin Gumina & Seth Rosenblatt

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Experimental materials
The kids go to the candy store with their moms every year to buy Halloween candy.

Andy’s mom always gets **Tootsie Rolls**.

Peter’s mom usually gets **Jolly Ranchers**.

Peter’s favorite flavor is sour apple.

This year she bought some **peanut MnMs**.

She also got some **regular MnMs**.

**Q:** *This year, Peter’s mom bought:*

**A1:** peanut MnMs, regular MnMs

**A2:** Jolly Ranchers, peanut MnMs, regular MnMs

**A3:** Tootsie Rolls, Jolly Ranchers, peanut MnMs, regular MnMs

**A4:** Tootsie Rolls, Jolly Ranchers, peanut MnMs
The employees at the coffeeshop get to take home any leftover baked goods. Ian always claims the danishes. Jon often takes home a piece of carrot cake. His daughter loves carrot cake. When Alison is out sick, he takes home the pound cake. He also takes the leftover dough.

Q: When Alison is not there, Jon takes home:

A1: pound cake, leftover dough
A2: carrot cake, pound cake, leftover dough
A3: danishes, carrot cake, pound cake, leftover dough
A4: danishes, carrot cake, pound cake
Marcy and her roomates go to the local 24-hour drugstore a lot.

Ali buys lottery tickets there every week.

Marcy often buys batteries there.

She goes through batteries quickly.

Sometimes she goes there to get shampoo.

She also gets laundry detergent.

Q: Marcey sometimes goes to the drugstore to buy:

A1: shampoo, laundry detergent
A2: batteries, shampoo, laundry detergent
A3: lottery tickets, batteries, shampoo, laundry detergent
A4: lottery tickets, batteries, shampoo
1. The staff members bring in breakfast food to share whenever there’s an early morning meeting.

2. Ryan always brings fresh fruit.

3. Brigit often brings bagels and muffins.

4. She lives next door to the best bakery in town.

5. Sometimes she brings coffee.

6. She also brings tea for the non-coffee-drinkers.

Q: Sometimes when there's an early mornign meeting, Brigit brings:

A1: coffee, tea
A2: bagels, muffins, coffee, tea
A3: fruit, bagels, muffins, coffee, tea
A4: fruit, bagels, muffins, coffee
The kids are at the candy store with their moms to buy Halloween candy.

Paula’s mom bought some Junior Mints and some Jawbreakers.

Andy’s mom bought some peanut MnMs and some candycanes.

He’s always begging her to get Pixy Stix.

Peter’s mom also bought some Hershey Kisses.

Q: This year, Peter’s mom bought:

A1: Hershey Kisses, Pixy Stix
A2: Hershey Kisses, peanut MnMs, candycanes
A3: Hershey Kisses, peanut MnMs, candycanes, Junior Mints, Jawbreakers
A4: peanut MnMs, candycanes, Junior Mints, Jawbreakers
1. The employees at the coffeeshop took home some of the leftover baked goods.
2. Ian took some cookies and some carrot cake.
3. John picked out some bagels and a danish.
4. His daughter loves their blueberry muffins.
5. Beth also took some scones.

Q: Beth took home:

A1: blueberry muffins, scones
A2: bagels, a danish, scones
A3: cookies, carrot cake, bagels, a danish, scones
A4: cookies, carrot cake, bagels, a danish
1. Marcey and her roommates went to the drugstore to pick up some things.

2. Marcey bought some shampoo and some laundry detergent.

3. Sean bought some lightbulbs and some bandaids.

4. He always forgets to buy batteries.

5. Jess also bought some toothpaste.

Q: At the drugstore, Jess bought:

A1: batteries, toothpaste
A2: lightbulbs, bandaids, toothpaste
A3: shampoo, laundry detergent, lightbulbs, bandaids, toothpaste
A4: shampoo, laundry detergent, lightbulbs, bandaids
The staff members brought a bunch of breakfast food for their early morning meeting.

Ryan brought some bagels and some muffins.

Alex brought some coffee and some donuts.

He never remembers to bring decaf.

Brigit also brought some orange juice.

Q: Brigit brought the following to the morning meeting:

A1: decaf coffee, orange juice
A2: coffee, donuts, orange juice
A3: bagels, muffins, coffee, donuts, orange juice
A4: bagels, muffins, coffee, donuts
The kids are comparing their Halloween candy after going trick-or-treating.

Andy has **some Junior Mints**.

Beth has **some Hershey Kisses and some MnMs**.

*Also-Novel:* Chris also has **some Twizzlers**./

*NoParticle-Novel:* Chris has **some Twizzlers**./

*NoParticle-Mention:* Chris has **some MnMs**.

**mentioned:** Hershey Kisses, MnMs

**subset:** MnMs

**local superset:** Hershey Kisses, MnMs, Twizzlers

**global superset:** Hershey Kisses, MnMs, Junior Mints, Twizzlers

**all novel:** Twizzlers, gumballs, Lemonheads, Jawbreakers
1. The employees at the coffeeshop took home some of the leftover baked goods.

2. Ian took some cookies.

3. Sarah took some muffins and some brownies.

4. Also-Novel: John also took some bagels./
   NoParticle-Novel: John took some bagels./
   NoParticle-Mention: John took some brownies.

mentioned: muffins, brownies
subset: brownies
local superset: muffins, brownies, bagels
global superset: muffins, brownies, cookies, bagels
all novel: bagels, cake, pie, scones
1. The staff members brought a bunch of breakfast food for their early morning meeting.

2. Ryan brought some bagels.

3. Brigit brought some coffee and some donuts.

4. Also-Novel: Lou also brought some orange juice./
   NoParticle-Novel: Lou brought some orange juice./
   NoParticle-Mention: Lou brought some coffee.

mentioned: coffee, donuts
subset: coffee
local superset: coffee, donuts, orange juice
global superset: coffee, donuts, orange juice, bagels
all novel: orange juice, muffins, croissants, tea
Ellen and some of her friends work on commission in a jewelry store at the mall.

Last week, Ellen sold a pearl necklace.

Lisa sold a bracelet and a diamond ring.

**Also-**Novel: Suzanne also sold a watch./
**NoParticle-**Novel: Suzanne sold a watch./
**NoParticle-**Mention: Suzanne sold a bracelet.

**mentioned:** bracelet, diamond ring
**subset:** bracelet
**local superset:** bracelet, diamond ring, watch
**global superset:** bracelet, diamond ring, watch, pearls
**all novel:** watch, earrings, brooch, barrette