
Negative polarity illusions and the representation of context

Hanna Muller

Presenting work done in collaboration with Iria
de Dios Flores, Celeste Joly, Colin Phillips, &
Philip Resnik

How is grammatical knowledge used online?

Uniformly good performance is less informative than selective errors

Sometimes sentence comprehension goes poorly

Sometimes sentence comprehension goes poorly

* The key to the cabinets are rusty.

Bock and Miller 1991, Clifton, Frazier, & Deevy
1999, Pearlmutter et al. 1999, Häussler & Bader
2009, Wagers et al. 2009, a.o. 4

Sometimes sentence comprehension goes poorly

* The key to the cabinets are rusty.

#What's the name of the holiday when kids dress up and go door to door giving out candy?

Erickson & Mattson 1981, Bredart & Modolo
1988, Van Oostendorp & De Mul 1990, Reder &
Cleeremans 1990, Reder & Kusbit 1991, Barton &
Sanford 1993

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#What's the name of the holiday when kids dress up and go door to door giving out candy?

* More people have been to Russia than I have.

* No head injury is too trivial to ignore.

* The bill that no senators voted for will ever become law.

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#What's the name of the holiday when kids dress up and go door to door giving out candy?

* More people have been to Russia than I have.

* No head injury is too trivial to ignore.

* **The bill that no senators voted for will ever become law.**

Illusion patterns

The key to the cabinets are rusty.

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Illusion patterns

The key to the cabinets **are** rusty.

The bill that no senators voted for will **ever** become law.

Illusion patterns

The *key* to the cabinets **are** rusty.

The bill that no senators voted for *will* **ever** become law.

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The *key* [to the cabinets] **are** rusty.

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Illusion patterns


The *key* [to the cabinets] **are** rusty.



The bill [that no senators voted for] *will* **ever** become law.



Kathi [didn't think any janitor liked performing his custodial duties,] but **he** had to clean up messes left after prom anyway.



Illusion patterns

*The bill [that no senators voted for] will **ever** become law.*

Outline

1. Basic illusion phenomenon
2. NPI licensing as memory retrieval
3. Intrusive contexts or intrusive licensors? (Experiments 1 & 2)
4. Which property of the context interferes? (Experiments 3 & 4)
5. An alternative generalization & its failures (Experiment 5)
6. Are NPI illusions just quantifier illusions? (Experiments 6 & 7)
7. Bonus: how does local context matter for other illusions?

Basic Phenomenon

NPI = Negative Polarity Item, e.g. *ever, any, lift a finger, give a damn, in years*

NPIs' defining characteristic is their **limited distribution**:

- (1) We **haven't** left the house *in months*.
- (2) * We have left the house *in months*.

Basic Phenomenon

NPIs must occur in the scope of the licenser

(3) I **don't** think the students that read the paper have thought about it *in years*.

(4) * I think the students that **didn't** read the paper have thought about it *in years*.

Basic Phenomenon

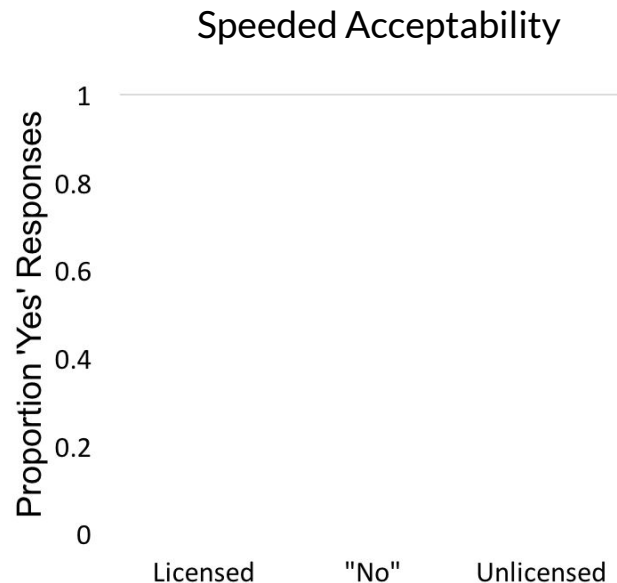
NPIs must occur in the scope of the licenser

(3) I **don't** think the students [that read the paper] have thought about it *in years*.

(4) * I think the students [that **didn't** read the paper] have thought about it *in years*.

Basic Phenomenon

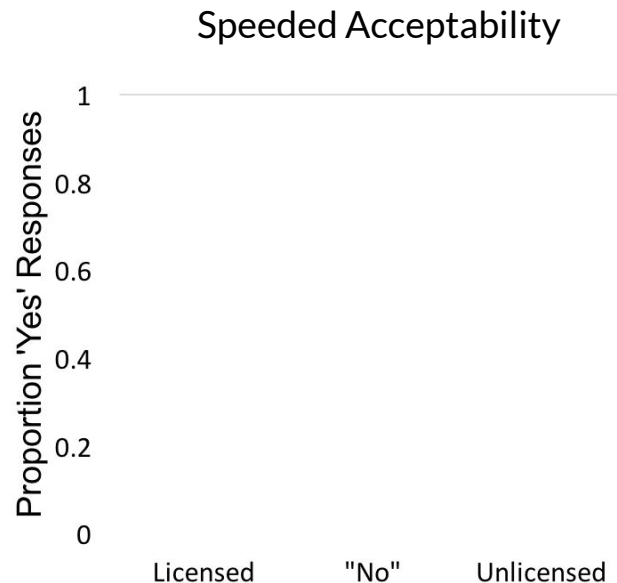
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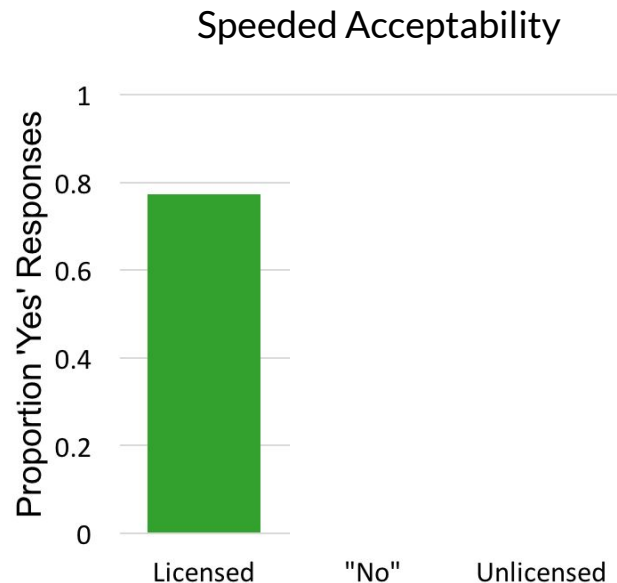
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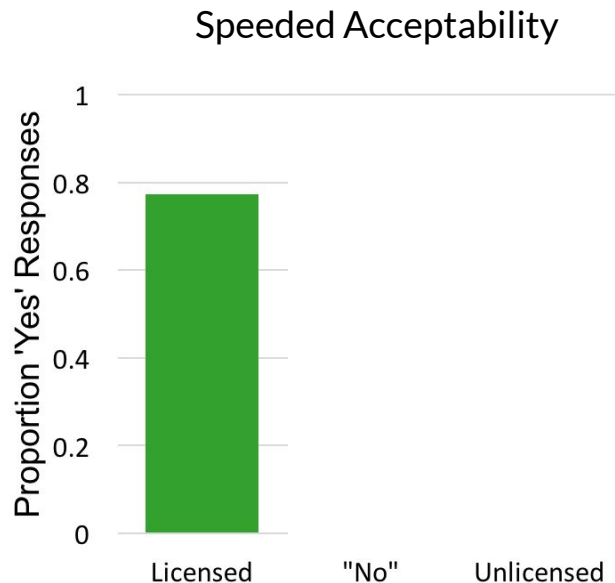


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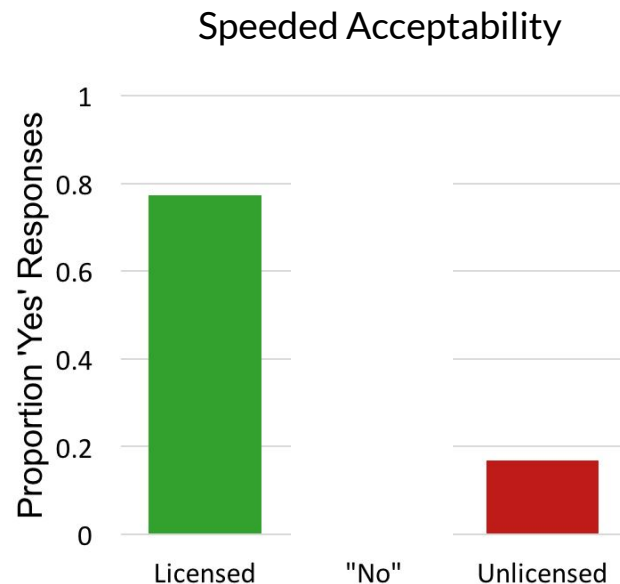


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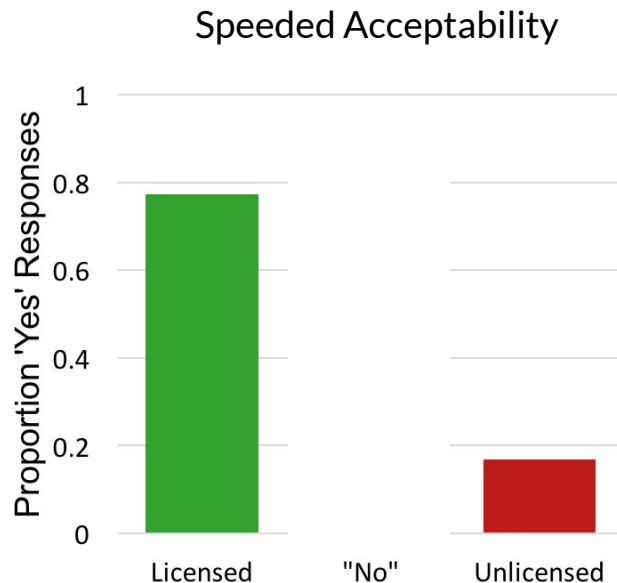
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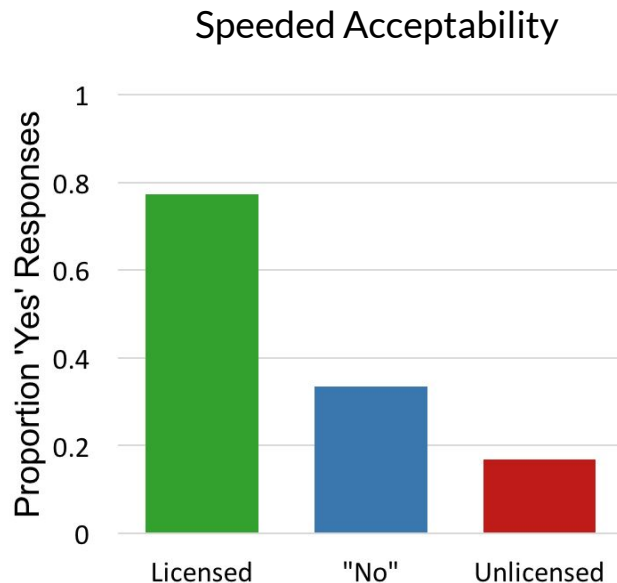
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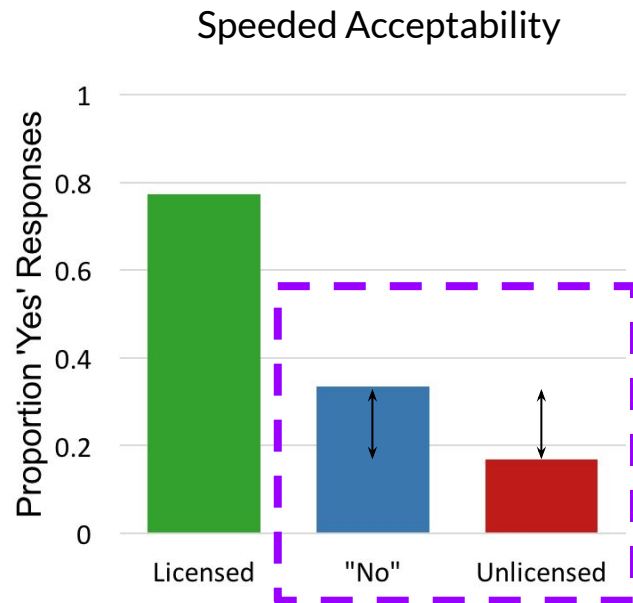
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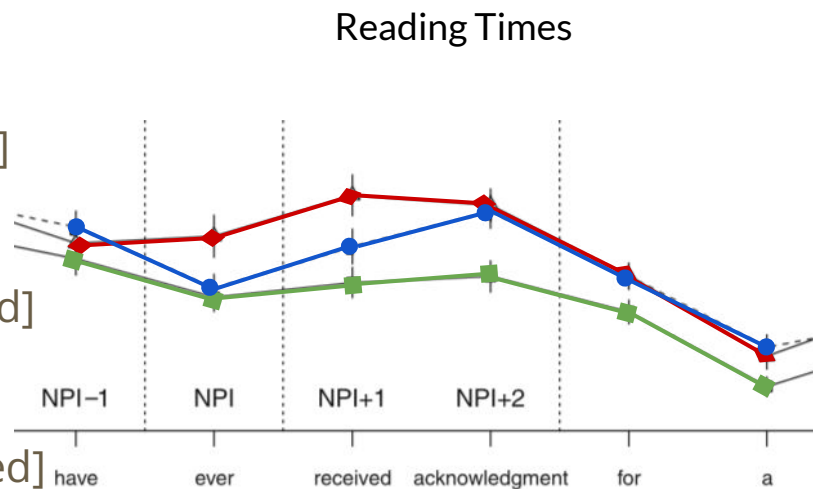
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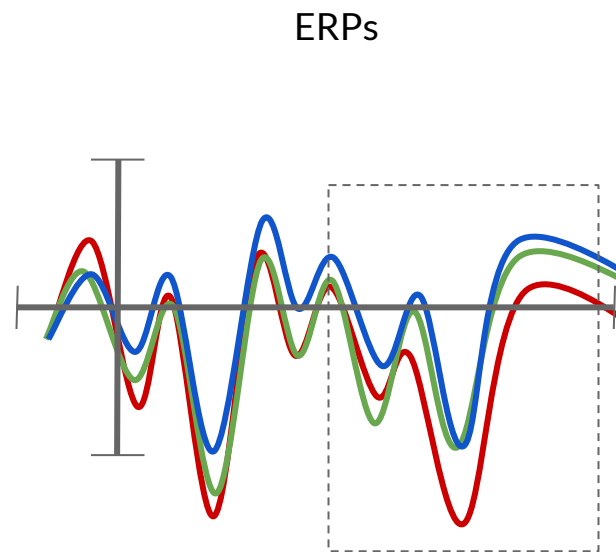
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Memory retrieval

Memory retrieval

No

Memory retrieval

No



+negation
+quantifier
...

Memory retrieval

No authors

Memory retrieval

No authors



+noun
+plural
...

Memory retrieval

No authors



+negation
+noun phrase
+subject

...

Memory retrieval

No authors that

Memory retrieval

No authors that the

Memory retrieval

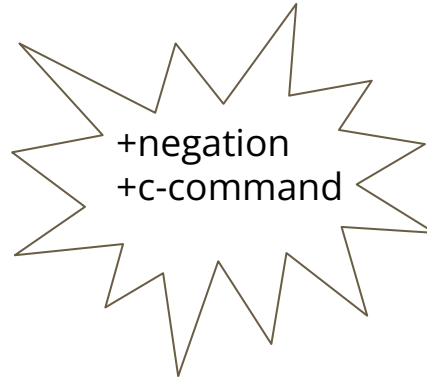
No authors that the critics

Memory retrieval

No authors that the critics recommended have *ever*

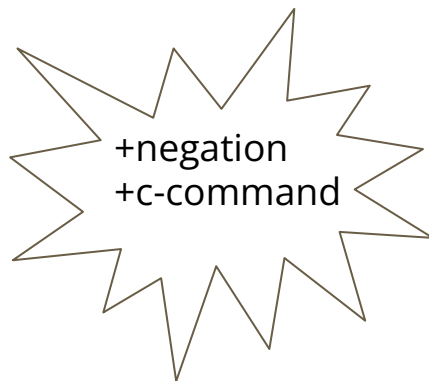
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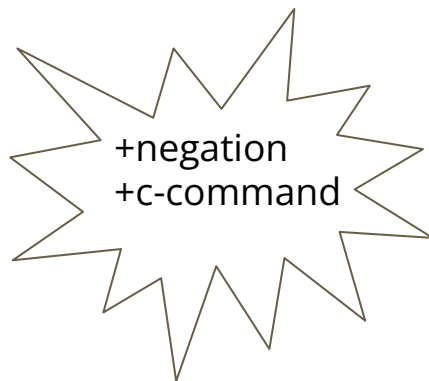
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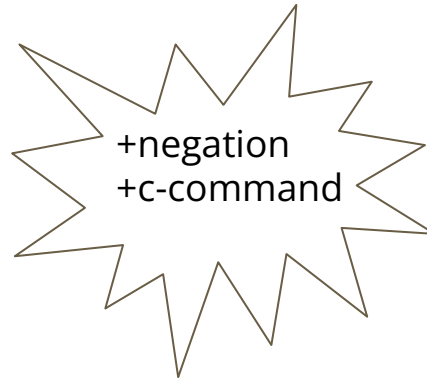
Memory retrieval

The authors that **no** critics recommended have *ever*



Memory retrieval

The authors that no critics recommended have *ever*



Memory retrieval

No authors that the critics recommended have *ever* written a best-selling novel.

Is this how negation is processed?

Is this how NPIs are licensed?

Is that how negation is processed?

Is that how negation is processed?

Two stage view of negation interpretation

A robin is not a bird.

Stage 1: represent "A robin is a bird"

Stage 2: reverse truth conditions

Is that how negation is processed?

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Incremental view of negation interpretation

The top row doesn't contain the pineapple.

As soon as you hear "the top row doesn't contain",
you look to the bottom row



Is that how negation is processed?

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Pragmatics of negation

This is not a hotel.

Appropriate in a context where you might have thought the building was a hotel.

If you didn't already know the question "Is this a hotel?" is under discussion, now you do

Is that how NPIs are licensed?

I haven't ever been to Paris.

Is that how NPIs are licensed?

I haven't **ever** been to Paris.



Is that how NPIs are licensed?

I haven't been to Paris.

↑
ever

Is that how NPIs are licensed?

- Some proposals for licensing by negative lexical items, usually supplemented by a secondary licensing mechanism (Linebarger 1987, Giannakidou 2006, a.o.)
- Licensing by downward entailing contexts (Ladusaw 1979, a.o.) or similar
- Downward entailing contexts make the NPI-containing sentence the strong endpoint of a scale, instead of the weak endpoint of a scale (Fauconnier 1975, a.o.)

Is that how NPIs are licensed?

strong

I haven't ever been to Paris.

I haven't been to Paris in the last five years.

I haven't been to Paris today.

weak

Is that how NPIs are licensed?

weak



I have *ever been to Paris.

I have been to Paris in the last five years.

I have been to Paris today.

strong

Intrusive licensors or intrusive contexts?

The authors [that **no** critics recommended] have *ever* written a best-selling novel.

Intrusive licensors or intrusive contexts?

The authors [that **no** critics recommended] have *ever* written a best-selling novel.

Intrusive licensors or intrusive contexts?

The authors [**that no critics recommended**] have *ever* written a best-selling novel.

Specificity of the illusion

- Prior work shows that the illusion can be “turned off”
- We want to identify precisely the conditions where illusions arise

The distance effect

*The journalists [that **no** editors recommended for the assignment] *ever* thought that the readers would understand the complicated situation. **(illusion)**

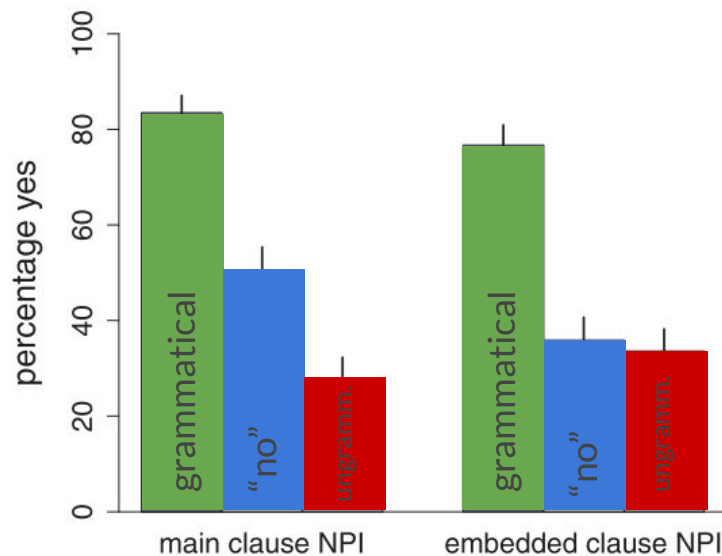
*The journalists [that **no** editors recommended for the assignment] thought that the readers would *ever* understand the complicated situation. **(no illusion)**

The distance effect

(17) **No** journalists [that the editors recommended for the assignment] (*ever*) thought that the readers would (*ever*) understand the complicated situation.

(18) *The journalists [that **no** editors recommended for the assignment] (*ever*) thought that the readers would (*ever*) understand the complicated situation.

(19) *The journalists [that the editors recommended for the assignment] (*ever*) thought that the readers would (*ever*) understand the complicated situation.



Which distance?



(A) *The journalists [that **no** editors recommended for the assignment] (*ever*) thought that the readers would (*ever*) understand the complicated situation.

Which distance?

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The distance effect - Exp 1

(20) *The journalists [that **no** editors recommended **for the assignment**] (*ever*) thought that the readers would understand the complicated situation.

(21) *The journalists [that **no** editors recommended] (*ever*) thought that the readers would understand the complicated situation.

The distance effect - Exp 1

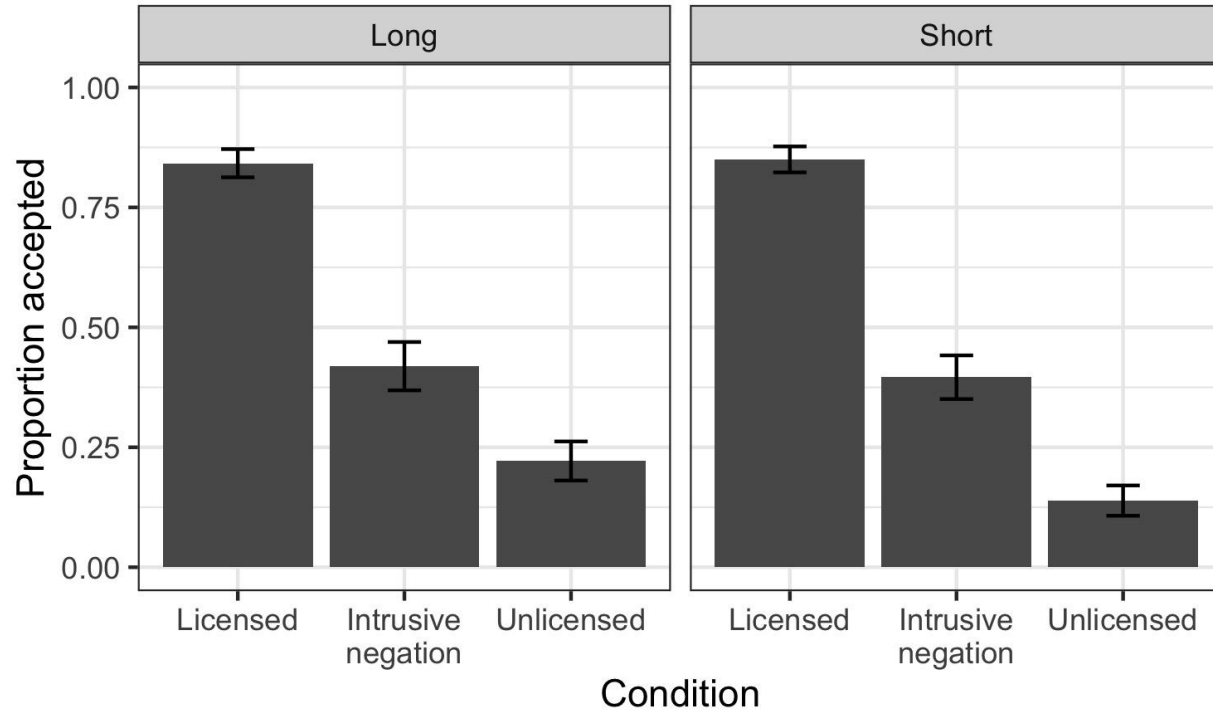


(20) *The journalists [that **no** editors recommended **for the assignment**] (*ever*) thought that the readers would understand the complicated situation.



(21) *The journalists [that **no** editors recommended] (*ever*) thought that the readers would understand the complicated situation.

The distance effect - Exp 1



The distance effect - Exp 2

(a-c) No/The surgeons [that no/the patients trusted] have *ever* prescribed new experimental medications.

The distance effect - Exp 2

(a-c) No/The surgeons [that no/the patients trusted] have *ever* prescribed new experimental medications.

(g-i) No/The surgeons [that no/the patients have trusted] have **healed** *any* injuries with experimental medications.

The distance effect - Exp 2

(a-c) No/The surgeons [that no/the patients trusted] have *ever* prescribed new experimental medications.

(d-f) No/The surgeons [that no/the patients trusted **to heal their injuries**] have *ever* prescribed new experimental medications.

(g-i) No/The surgeons [that no/the patients have trusted] have **healed** *any* injuries with experimental medications.

The distance effect - Exp 2

(a-c) No/The surgeons [that no/the patients trusted] have *ever* prescribed new experimental medications.

(d-f) No/The surgeons [that no/the patients trusted **to heal their injuries**] have *ever* prescribed new experimental medications.

(g-i) No/The surgeons [that no/the patients have trusted] have **healed** *any* injuries with experimental medications.

The distance effect - Exp 2

short

(a-c) No/The surgeons [that no/the patients trusted] have *ever* prescribed new experimental medications.

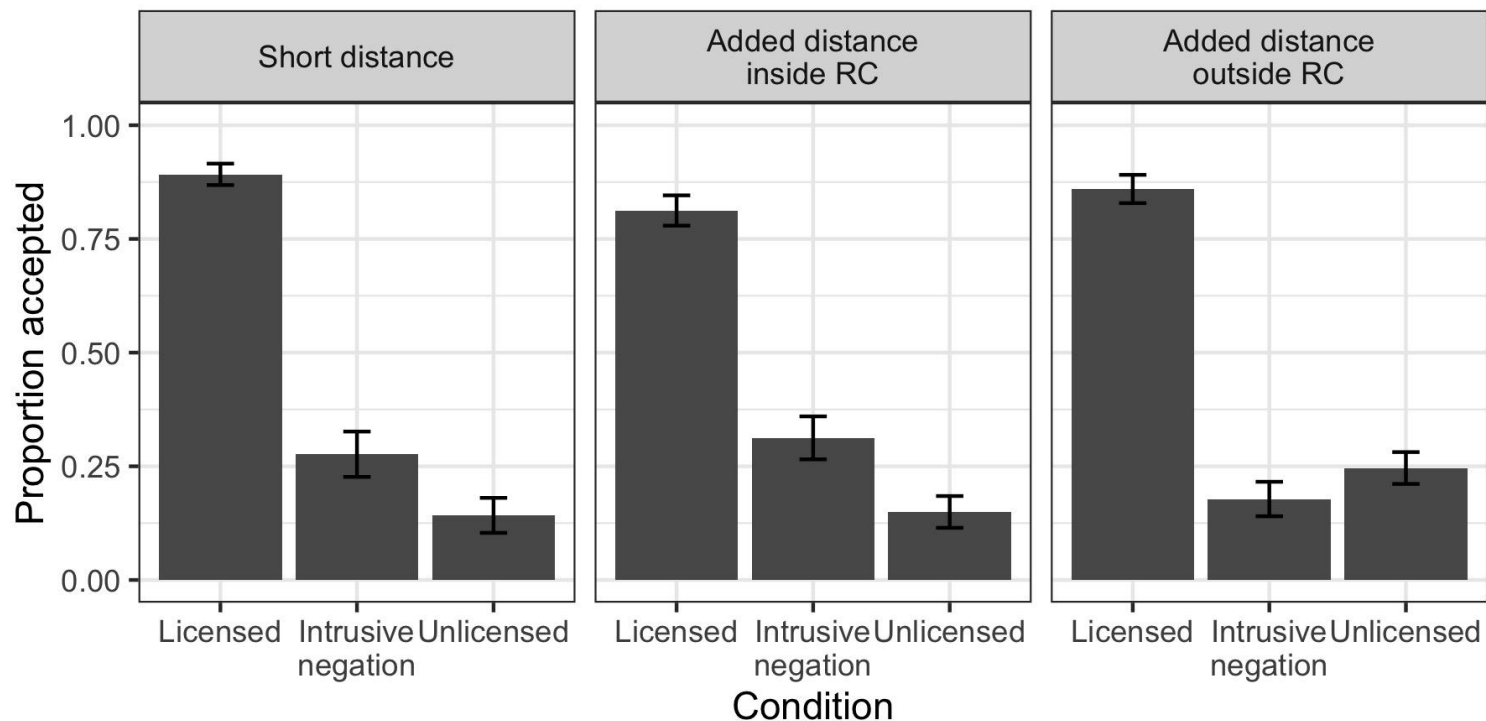
long

(d-f) No/The surgeons [that no/the patients trusted **to heal their injuries**] have *ever* prescribed new experimental medications.

long

(g-i) No/The surgeons [that no/the patients have trusted] have **healed** *any* injuries with experimental medications.

The distance effect - Exp 2



The distance effect

- Short distances from the *licensing environment* to the NPI are critical for illusions to occur
- NPI illusions are insensitive to the distance between the intrusive licensor and the NPI

Outline

- ~~1. Basic illusion phenomenon~~
- ~~2. NPI licensing as memory retrieval~~
- ~~3. Intrusive contexts or intrusive licensors? (Experiments 1 & 2)~~
4. Which property of the context interferes? (Experiments 3 & 4)
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6. Are NPI illusions just quantifier illusions? (Experiments 6 & 7)
7. Bonus: how does local context matter for other illusions?

Intrusive contexts

The authors [**that no critics recommended**] have *ever* written a best-selling novel.

NPIs are strong endpoints of negative scales

weak



I haven't been to Paris today.

I haven't been to Paris in the last five years.

I haven't ever been to Paris.

strong

Negative quantifiers

weak



Some people have been to Paris.

Few people have been to Paris.

No one has been to Paris.

strong

Processing negation

- Negative quantifiers may be utilized when speakers intend to position the current proposition at a low endpoint of scalar alternatives

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Processing negation

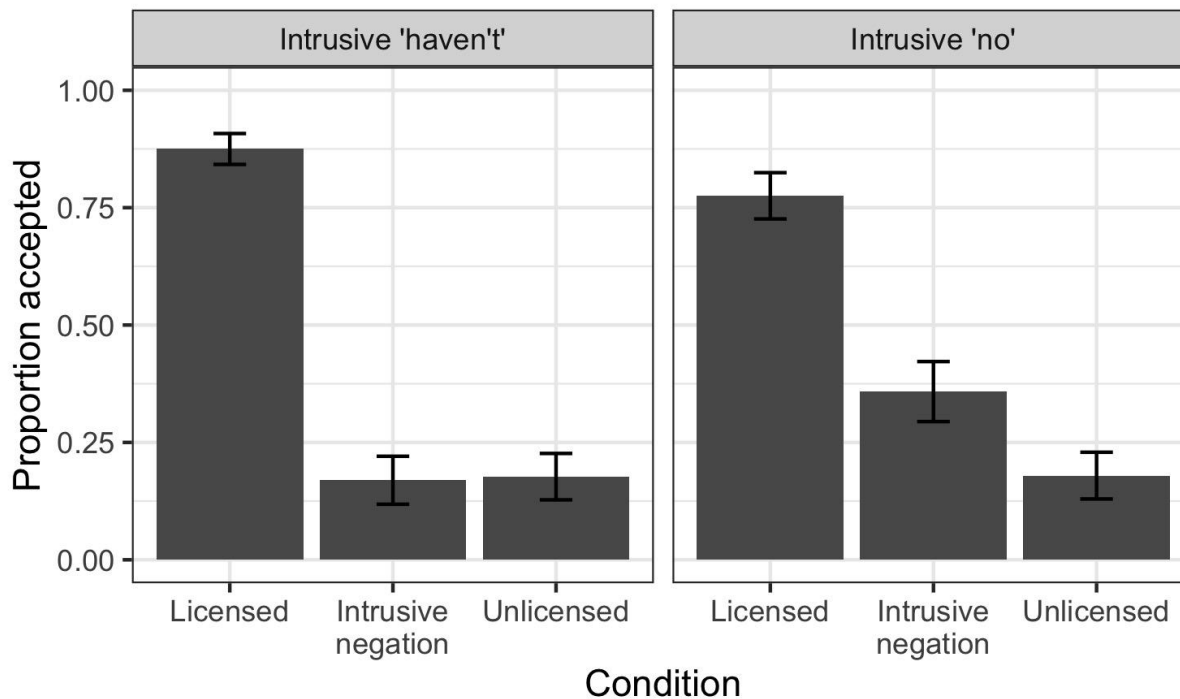
- Negative quantifiers may be utilized when speakers intend to position the current proposition at a low endpoint of scalar alternatives
- Comprehenders can infer scalar alternatives upon hearing a negative quantifier
- Simple sentential negation is also *compatible* with scalar alternatives, but may not, on its own, evoke them
- If the work of positioning the clause meaning with respect to scalar alternatives is done *prior to* the NPI, NPI processing may be facilitated

The licensor effect

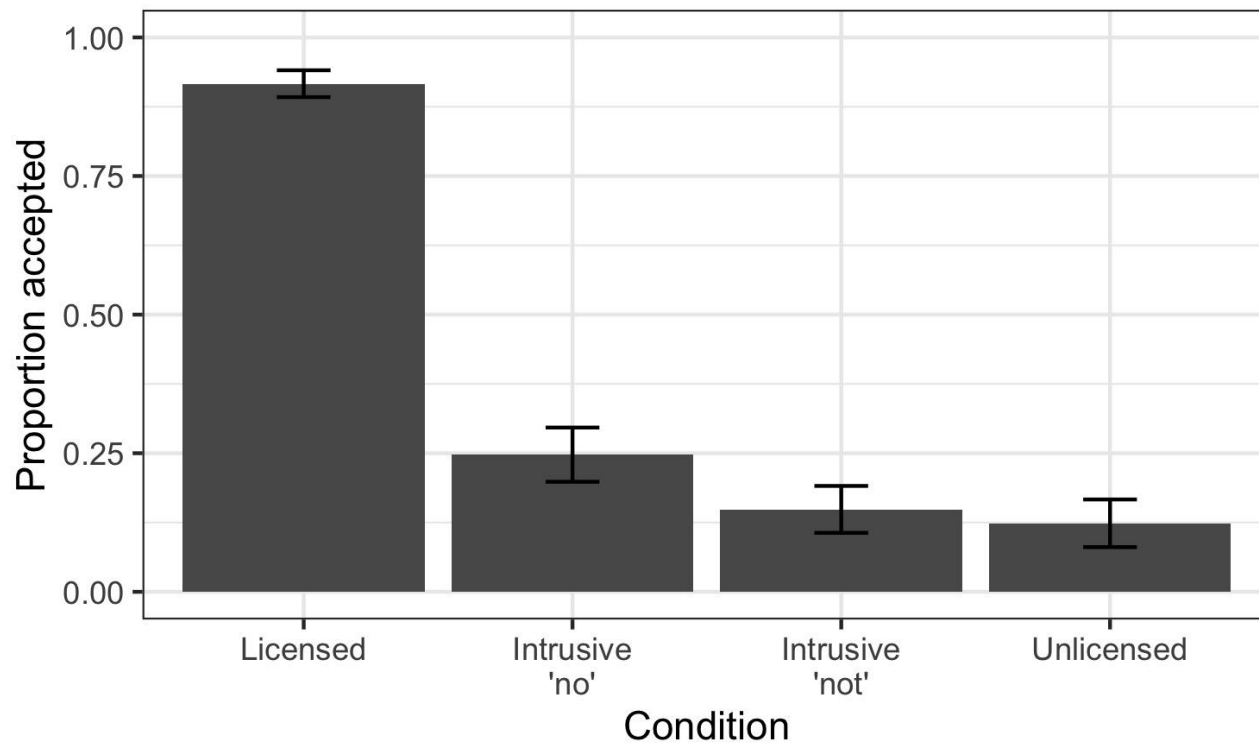
The authors [that **no** critics have recommended for the award] have ever received acknowledgement for a best-selling novel.

The authors [that the critics **haven't** recommended for the award] have ever received acknowledgement for a best-selling novel.

The licenser effect - Exp 3



The licenser effect - Exp 4



Outline

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Structural distance

The journalists [that **no** editors recommended for the assignment] *ever* thought that the readers would understand the complicated situation.

Structural distance

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Structural distance

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Structural distance

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The authors [that the critics **haven't** recommended for the award] have *ever* received acknowledgement for a best-selling novel.

The critics [that **haven't** recommended the authors for the award] have *ever* ...

Structural distance

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The critics [that **haven't** recommended the authors for the award] have *ever* ...

The critics [that have recommended **no** authors for the award] have *ever* ...

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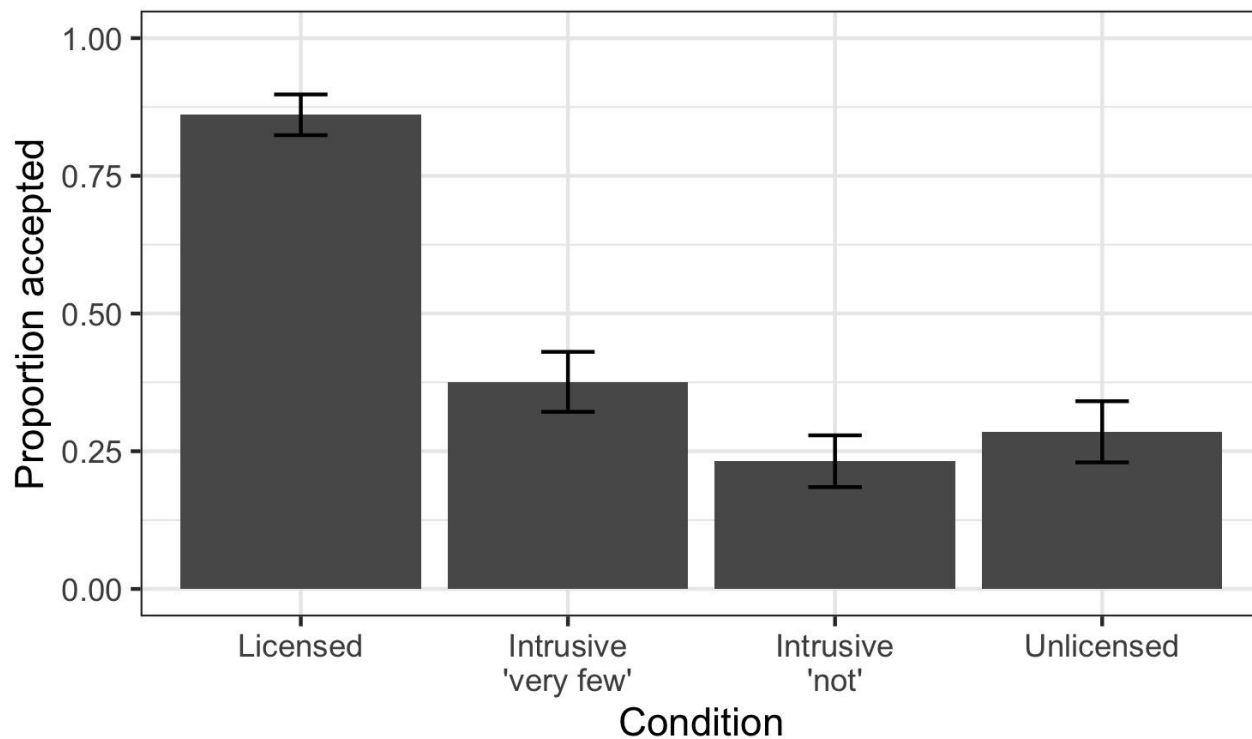
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The authors [that the critics **haven't** recommended for the award] have *ever* received acknowledgement for a best-selling novel.

The critics [that **haven't** recommended the authors for the award] have *ever* ...

The critics [that have recommended **very few** authors for the award] have *ever* ...

Structural distance - Exp 5



Quantifier scope

Someone from every city despises it.

Quantifier scope

The journalists [that **no** editors recommended] *ever* thought that the readers would understand the complicated situation.

No editors [the journalists [that x recommended] *ever* thought that the readers would understand the complicated situation]

NOT [there are some editors, x, s.t. [the journalists that x recommended *ever* thought that the readers would understand the complicated situation]]

Quantifier scope

- Illusion sentences are interpreted as if they are globally negative
- All fallibility is located in quantifier processing - NPI processing is accurate

Probing interpretations - Exp 6

The authors that no critics recommended have ever received acknowledgment for a best-selling novel.

Was that sentence acceptable? Yes / No

Did the authors receive acknowledgment? Yes / No / I don't know

Probing interpretations - Exp 6

The authors that no critics recommended have **ever** received acknowledgment for a best-selling novel.

Was that sentence acceptable? Yes / No

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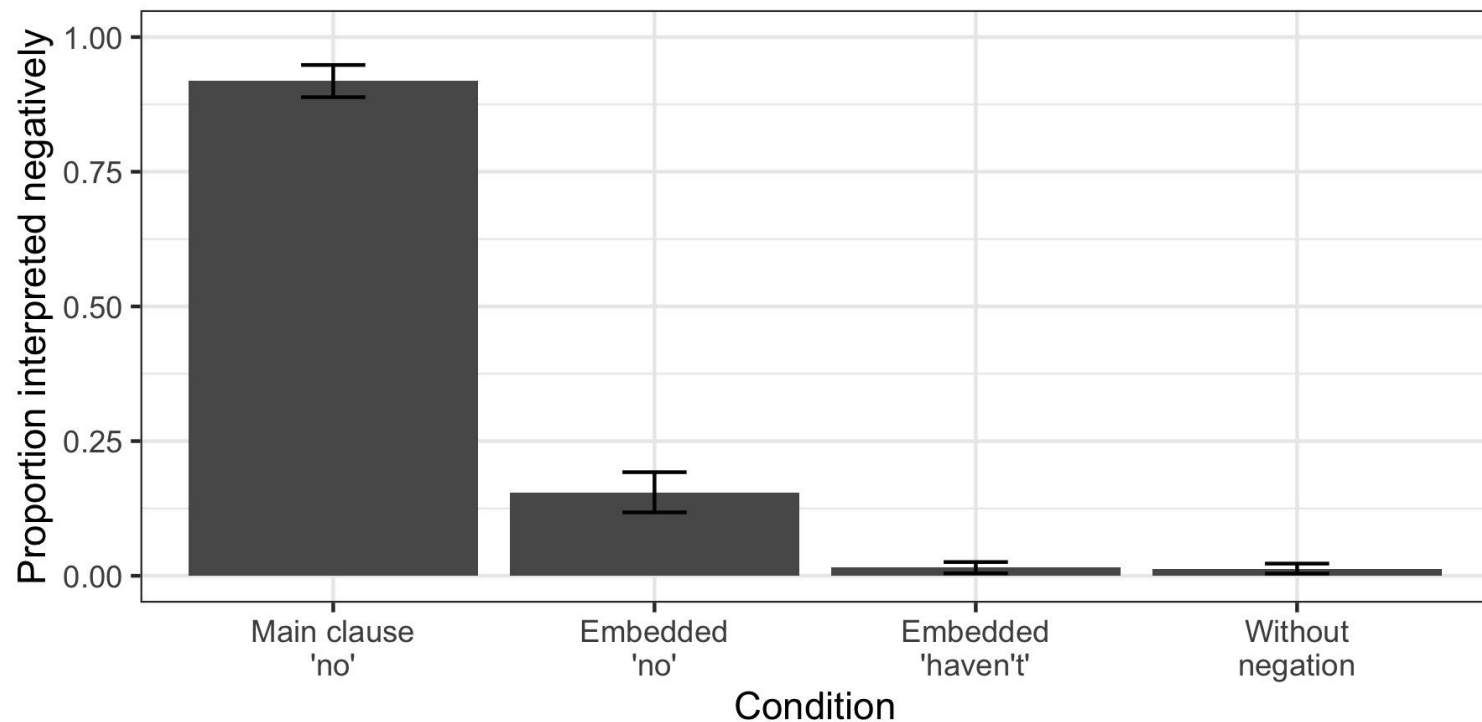
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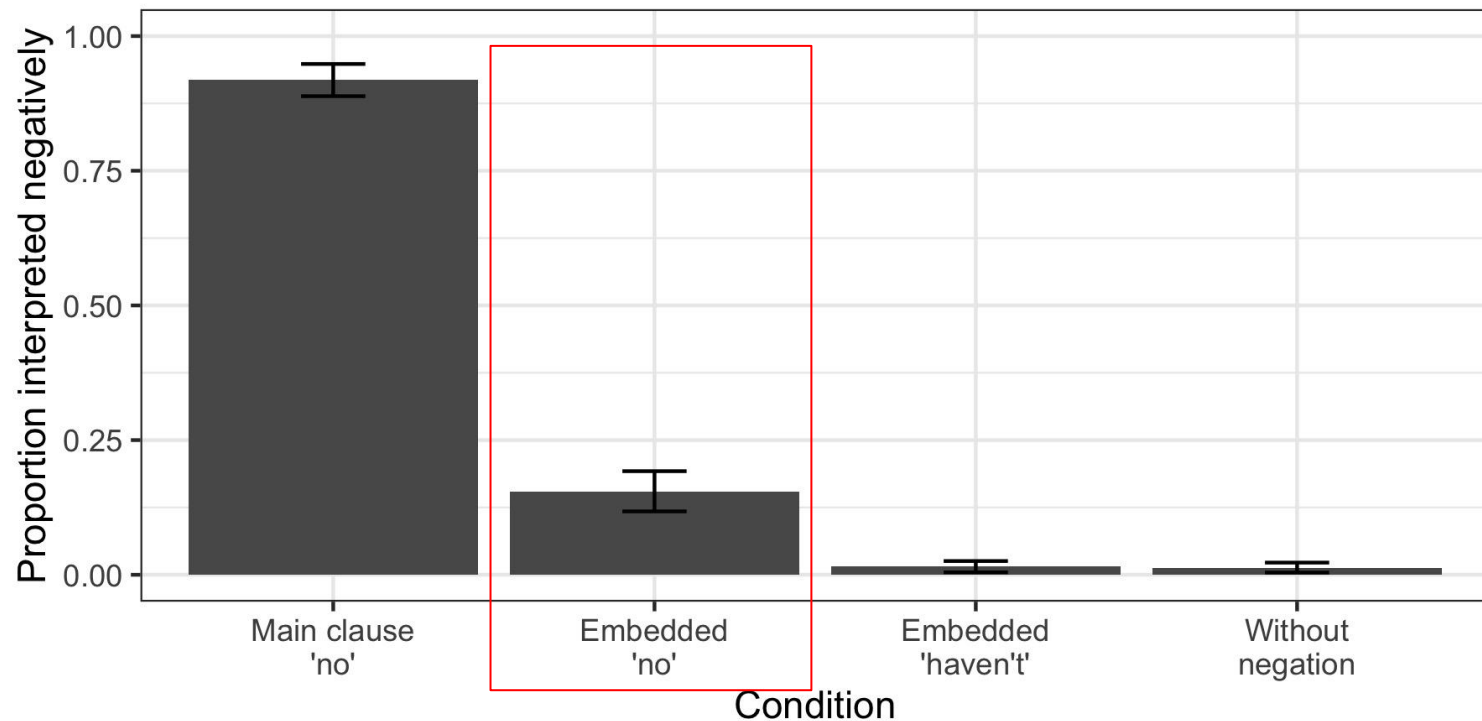
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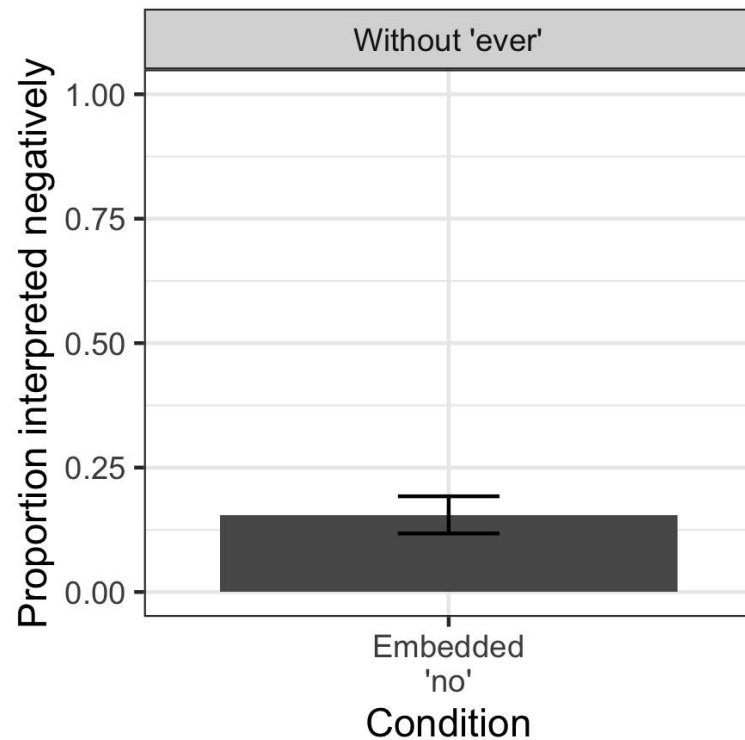
Quantifier scope - Exp 6



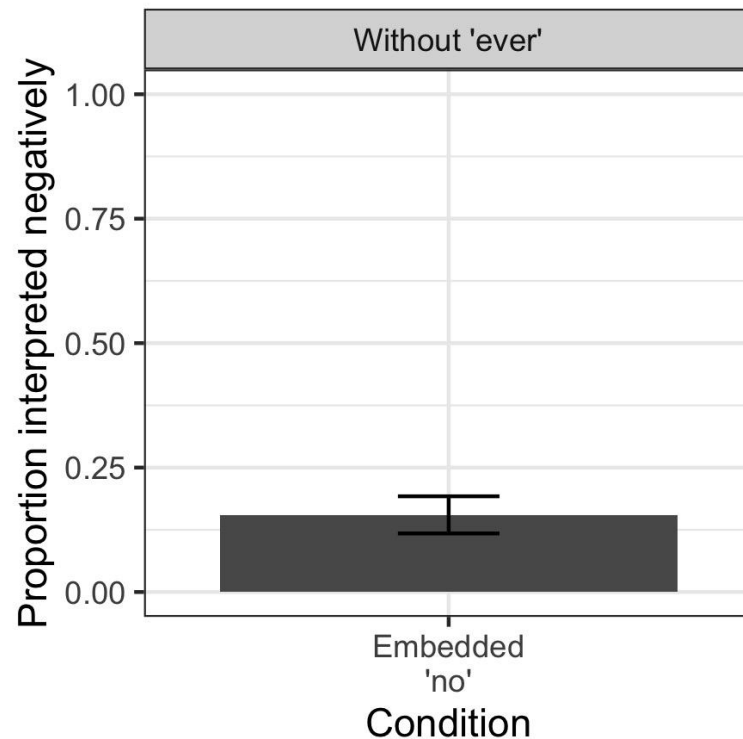
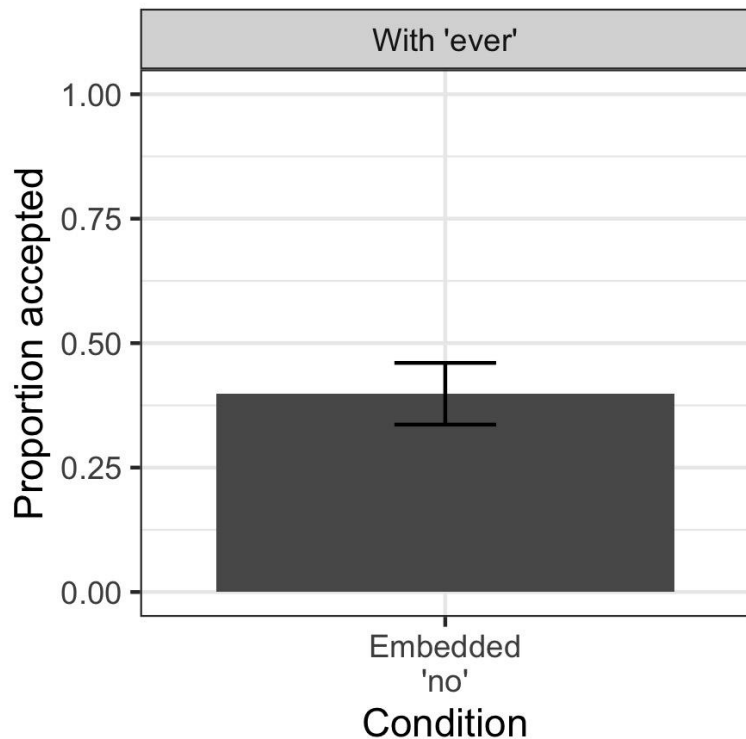
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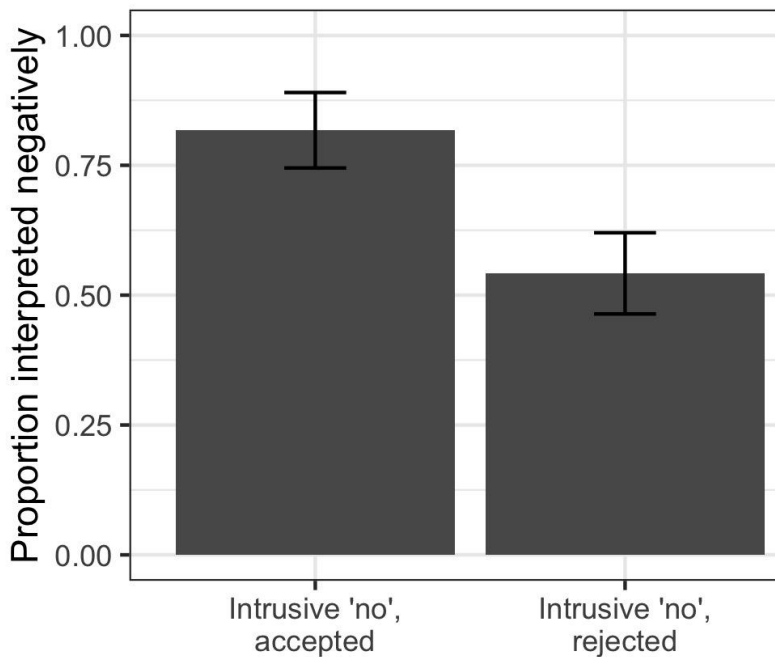
Quantifier scope - Exp 6



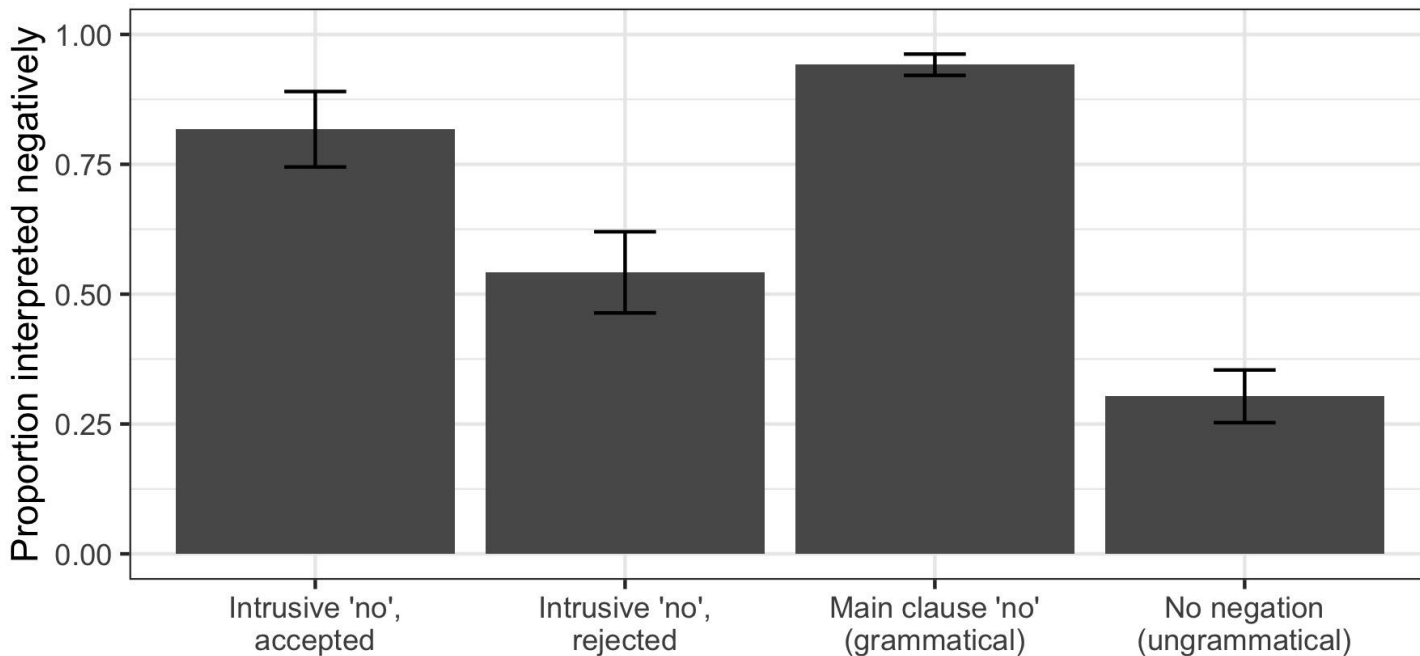
Quantifier scope - Exp 6

- If the cause of the illusion is globally negative interpretations driven by weird quantifier scope, we should find that the trials you accept are all the trials you understood as negative and the trials you reject are all the trials you understood as positive

Quantifier scope - Exp 6



Quantifier scope - Exp 6



Quantifier scope

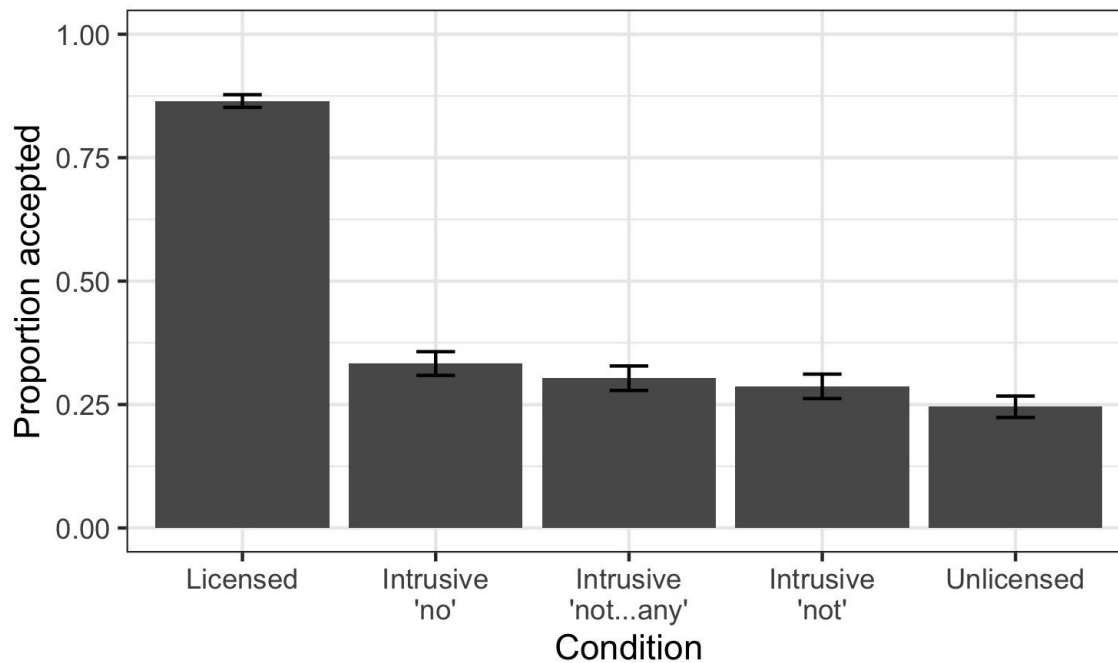
- Does not predict the observed patterns of interpretation
- Are quantifiers critical to illusions? Or only the scalar meanings they suggest?

The critics that have recommended **no** authors of alternative genres have ever objected to mainstream literary trends.

The critics that **haven't** recommended the authors of alternative genres have ever objected to mainstream literary trends.

The critics that **haven't** recommended **any** authors of alternative genres have ever objected to mainstream literary trends.

Quantifier scope - Exp 7



NPI illusions

- ❖ Added distance outside the RC can “turn off” the illusion, but added distance inside the RC has no impact
 - Online NPI licensing operates on representations that are maintained throughout the licensing context, not purely retrieval of prior encoded information
- ❖ Negative quantifiers cause illusions, but other forms of negation don't
 - The context-level property that NPI illusions are sensitive is *not* just being a licenser
- ❖ Interpretations are inconsistent with quantifier scope hypothesis

Moses illusions

Report errors if you see them, otherwise answer

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How many animals of each kind did Moses bring on the ark?

Report errors if you see them, otherwise answer

How many animals of each kind did Moses bring on the ark?

What is the name of the raised bumps on paper which enables deaf people to read?

Report errors if you see them, otherwise answer

How many animals of each kind did Moses bring on the ark?

What is the name of the raised bumps on paper which enables deaf people to read?

What is the name of the holiday during which children dress up and walk from door to door to give candy?

Report errors if you see them, otherwise answer

How many animals of each kind did **Moses** bring on the ark?

What is the name of the raised bumps on paper which enables **deaf** people to read?

What is the name of the holiday during which children dress up and walk from door to door to **give** candy?

Report errors if you see them, otherwise answer

What kind of fruit fell out of the tree after which Einstein discovered the laws of gravity?

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What kind of fruit fell out of the tree after which Einstein discovered the laws of gravity?

How did painter Vincent van Gogh lose his eye during his life?

Report errors if you see them, otherwise answer

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In baseball, where does a player run after hitting the ball with a racket?

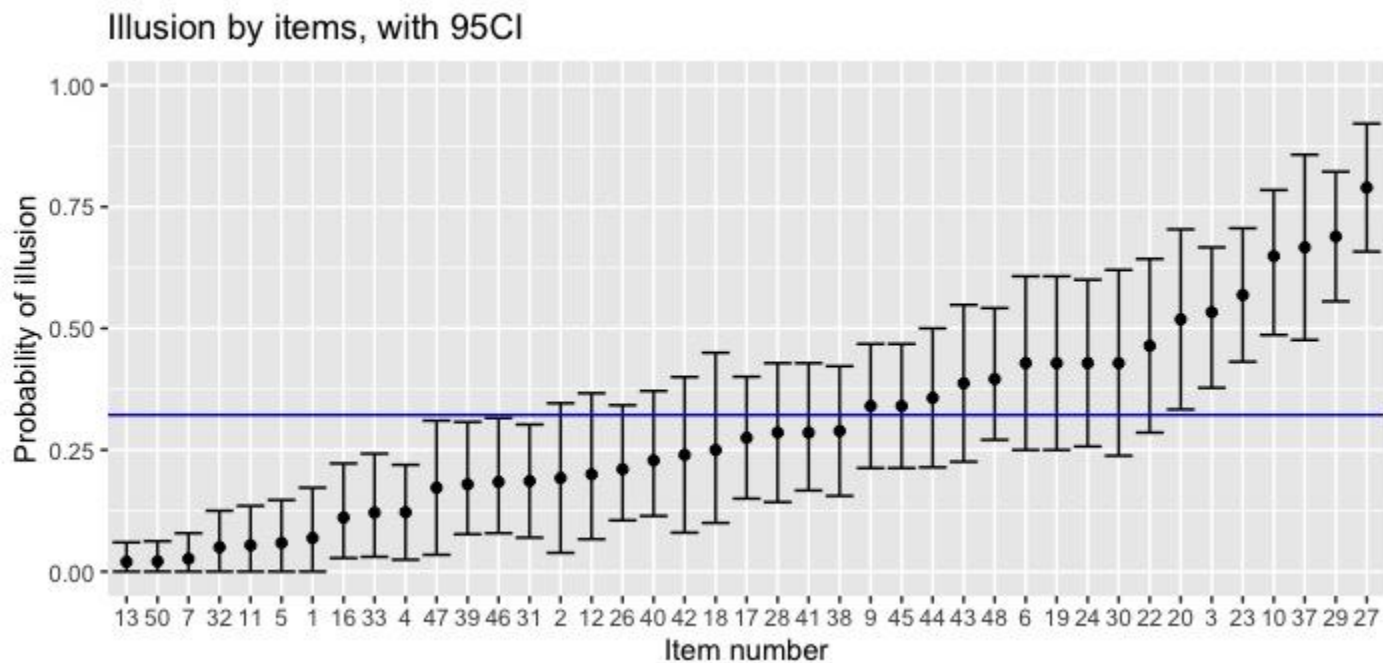
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Variability across stimuli



Incrementally understanding a Moses sentence

Which

Incrementally understanding a Moses sentence

Which British monarch

Incrementally understanding a Moses sentence

Which British monarch formally opened

Incrementally understanding a Moses sentence

Which British monarch formally opened the Olympic

Incrementally understanding a Moses sentence

Which British monarch formally opened the Olympic

Incrementally understanding a Moses sentence

Which British monarch formally opened the Olympic



Incrementally understanding a Moses sentence

Which British monarch formally opened the Olympic winter games



Incrementally understanding a Moses sentence

Which British monarch formally opened the Olympic winter games in London



Incrementally understanding a Moses sentence

Which British monarch formally opened the Olympic winter games in London in 2012?



Incrementally understanding a Moses sentence

Which British monarch formally opened the Olympic winter games in London in 2012?



Thank you!

Lab check-in group for useful discussion: Phoebe Gaston, Chia-Hsuan Liao, Masato Nakamura, Rosa Lee, Cassidy Wyatt

Audiences at CUNY 2017, CUNY 2019, CUNY 2020, PIPP workshop

Funding sources: NRT, MURI, Flagship Fellowship



And to you!

I think people just interpret “ever” as “never”

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(5) **No** authors [that the critics recommended] have *ever* written a best-selling novel.

(6) *The authors [that **no** critics recommended] have *ever* written a best-selling novel.

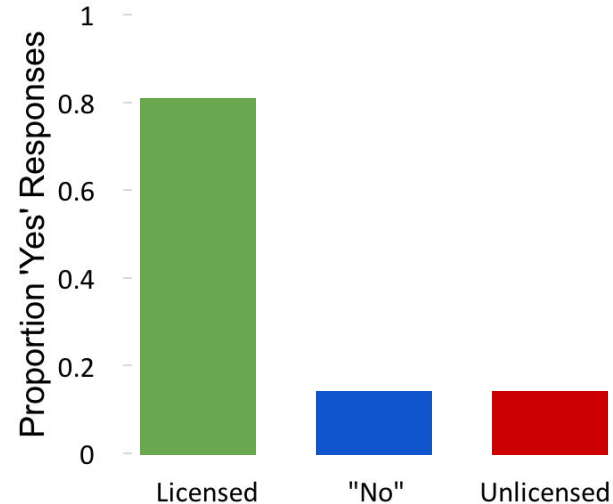
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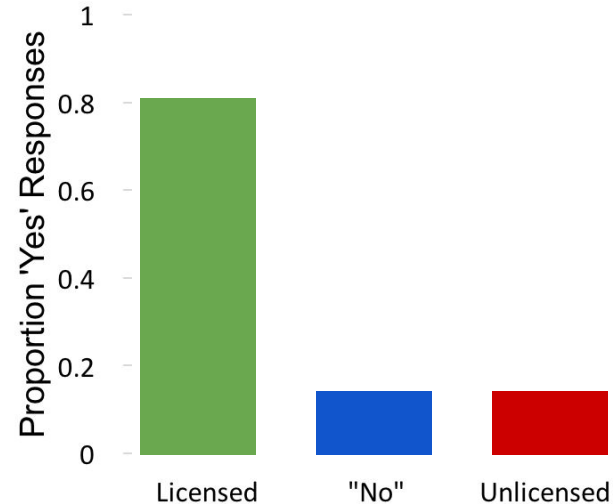


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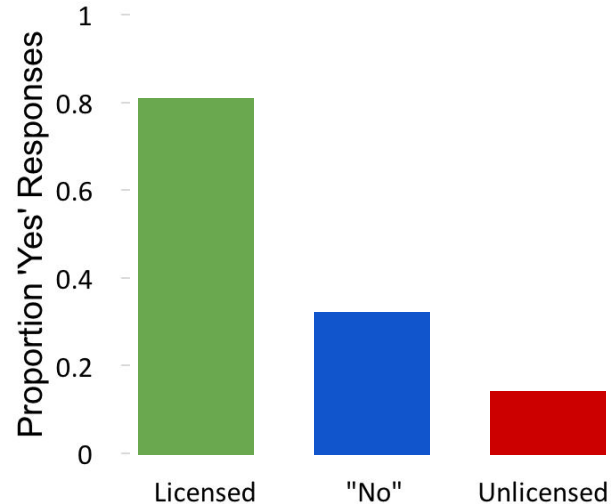


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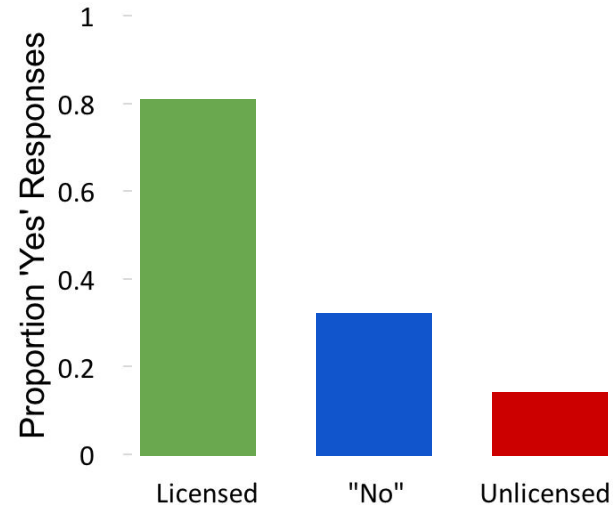


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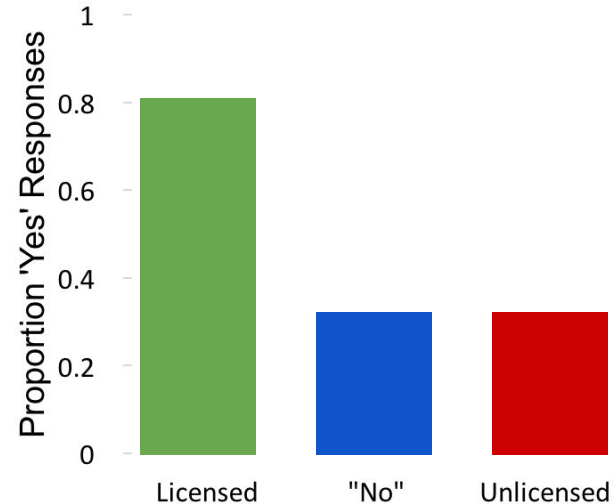


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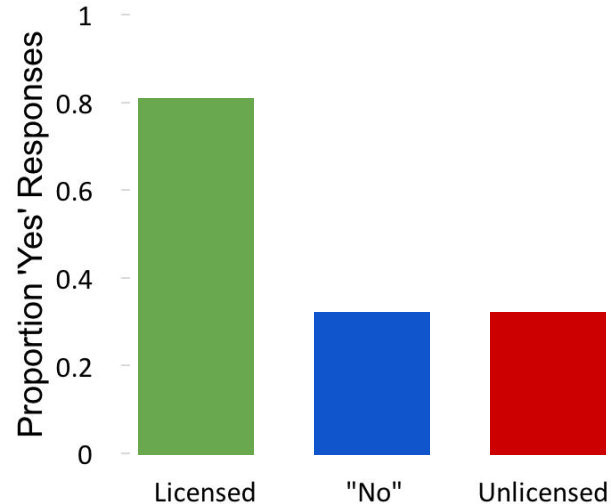


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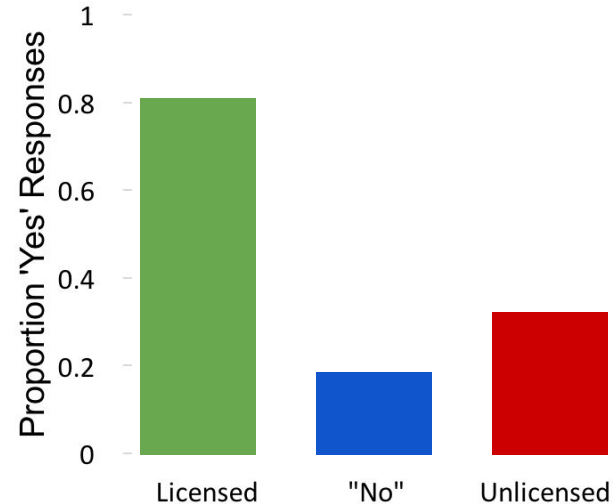


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I think people just get a locally coherent string

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The authors [that no critics recommended for the award] have ever received acknowledgement for a best-selling novel.

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I think people just get a locally coherent string

The authors that no critics recommended for the award have ever received acknowledgement for a best-selling novel.

The horse raced past the barn fell.

I think people just get a locally coherent string

The authors that *no critics have recommended for the award have ever received acknowledgement for a best-selling novel.

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The authors that no critics recommended have ever received acknowledgement for a best-selling novel.

I think people just get a locally coherent string

Ein Mann, der keinen Bart hatte, war jemals glücklich

a man who no beard had was ever happy

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