Readings of pronouns across connectives are sensitive to monotony

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L'ÉCOLE DES HAUTES ÉTUDES EN SCIENCES SOCIALES

17/01/2024 - https://tinyurl.com/sub29pronouns

Introduction

(1) Donkey Sentences [Geach, 1964]

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b. No farmer who owns a donkey pats it.

c. Some farmer who owns a donkey pats it.

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(1) Donkey Sentences [Geach, 1964]

a. Every farmer who owns a donkey pats it. (✓∃∀)

b. No farmer who owns a donkey pats it. (✓∃, ?∀)

c. Some farmer who owns a donkey pats it. (✓∃, ?∀)

What if farmers may have multiple donkeys?
[Foppolo, 2008, Denić and Sudo, 2022]

(2) A priori readings

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Kanazawa's generalization [Kanazawa, 1994]

- When a quantifier Q has a different monotony in its restrictor and scope, it favors an universal reading. (*every*)
- When a quantifier Q has the same monotony in its restrictor and scope, it favors a existential reading. (*some, no*)

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- There is always an existential reading.
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This predicts: *every* accepts both $\forall$ and $\exists$, *some* and *no* only have $\exists$.

Research question I

Are readings of anaphora across connectives likewise sensitive to the monotony of the environment?

(3) Cross-connective anaphora

a. There is a circle and it is blue. (cross-conjunction)

b. Either there isn't a circle or it is blue. (cross-disjunction, aka bathroom)

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(4) a. **Universal:** …*every circle is blue.*

b. **Existential:** …*some circle is blue.*

Not much said on readings of cross-disjunction anaphora (although theories make predictions).

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For conjunction, a fundamental property of all dynamic systems for anaphora is that they validate 'Egli's theorem' [Elliott, 2020]:

(5) a. There is a circle and it is blue. $[\exists x, Px] \wedge Qx$

b. There is a circle that is blue. $\exists x, [Px \wedge Qx]$

Under Egli's theorem, the presence of negation in conjunction would not affect the availability of an existential reading.

(6) a. There is a circle and it is not blue.

b. There is a circle that is not blue.

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Research question II

Does Egli's theorem hold?

Results

- As a first approximation, Kanazawa's (modified) generalization extends to cross-connective anaphora …

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- As a first approximation, Kanazawa's (modified) generalization extends to cross-connective anaphora …
- …no theory of cross-disjunction anaphora quite predicts it.
- The presence of negation in the second conjunct affects the reading in cross-conjunction cases …
- …Egli's theorem does not hold in full generality.

Experiments 1&2: readings of conjunction and disjunction

(7) There is a circle and it is blue.

a. **existential:** *...and at least one circle is blue*

b. **universal:** *...and every circle is blue*

c. **uniqueness:** *...and the one circle is blue*

$$\text{uniqueness} \Rightarrow \text{universal} \Rightarrow \text{existential}$$

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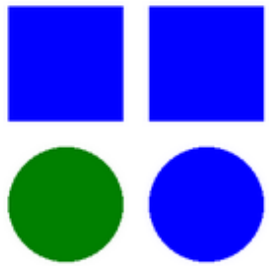
$$\text{uniqueness} \Rightarrow \text{universal} \Rightarrow \text{existential}$$

Q1: which readings are accessed by participants?

Methodology

- TVJ task
- A sentence presented along with a picture
- Picture represents geometrical shapes of various colors
- Rate from *completely false* to *completely true*
- 7-point scale

There is a triangle and it is red



Completely false ○ ○ ○ ○ ○ ○ ○ Completely true

Why not just a true/false answer?

Why not just a true/false answer?

- [Marty et al., 2015] argue that intermediate scale values can be used to detect otherwise invisible ambiguities.
- [Waldon and Degen, 2020] argue that they may be used to detect other types of non-truth (e.g. implicatures, presuppositions)

(8) There is a circle and it is blue.

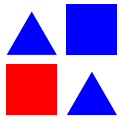
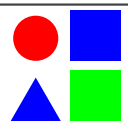
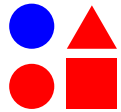
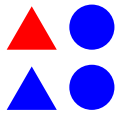
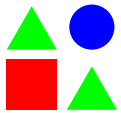
	existential	universal	unique
PRONOUN-FIRST-FALSE 	F	F	F
PRONOUN-SECOND-FALSE 	F	F	F
PRONOUN-EXISTENTIAL 	T	F	F
PRONOUN-UNIVERSAL 	T	T	F
PRONOUN-UNIQUE 	T	T	T

Table: Readings true in each condition

Q2: if a uniqueness reading is observed, is it due to an implicature arising from the indefinite?

(9) There is a person in the classroom.
⇝ *there is exactly one person in the classroom*

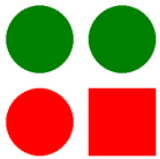
Compare with a no-pronoun baseline:

(10) There is a circle and the triangle is green.

		no uniqueness	uniqueness
NoPro-Both-False	▲	F	F
NoPro-First-False	▲	F	F
NoPro-True-Weak	● ● ▲	T	F
NoPro-True-Strong	●▲	T	T

Table: Readings true in each condition

There is a triangle and the square is red



Completely false ○ ○ ○ ○ ○ ○ ○ Completely true

NoPro-First-False

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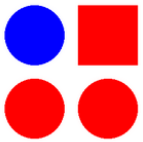

Completely false ○ ○ ○ ○ ○ ○ ○ Completely true

NoPro-Both-False

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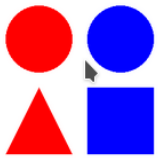


Completely false ○ ○ ○ ○ ○ ○ ○ Completely true

NoPro-True-Weak

There is a square and the circle is blue

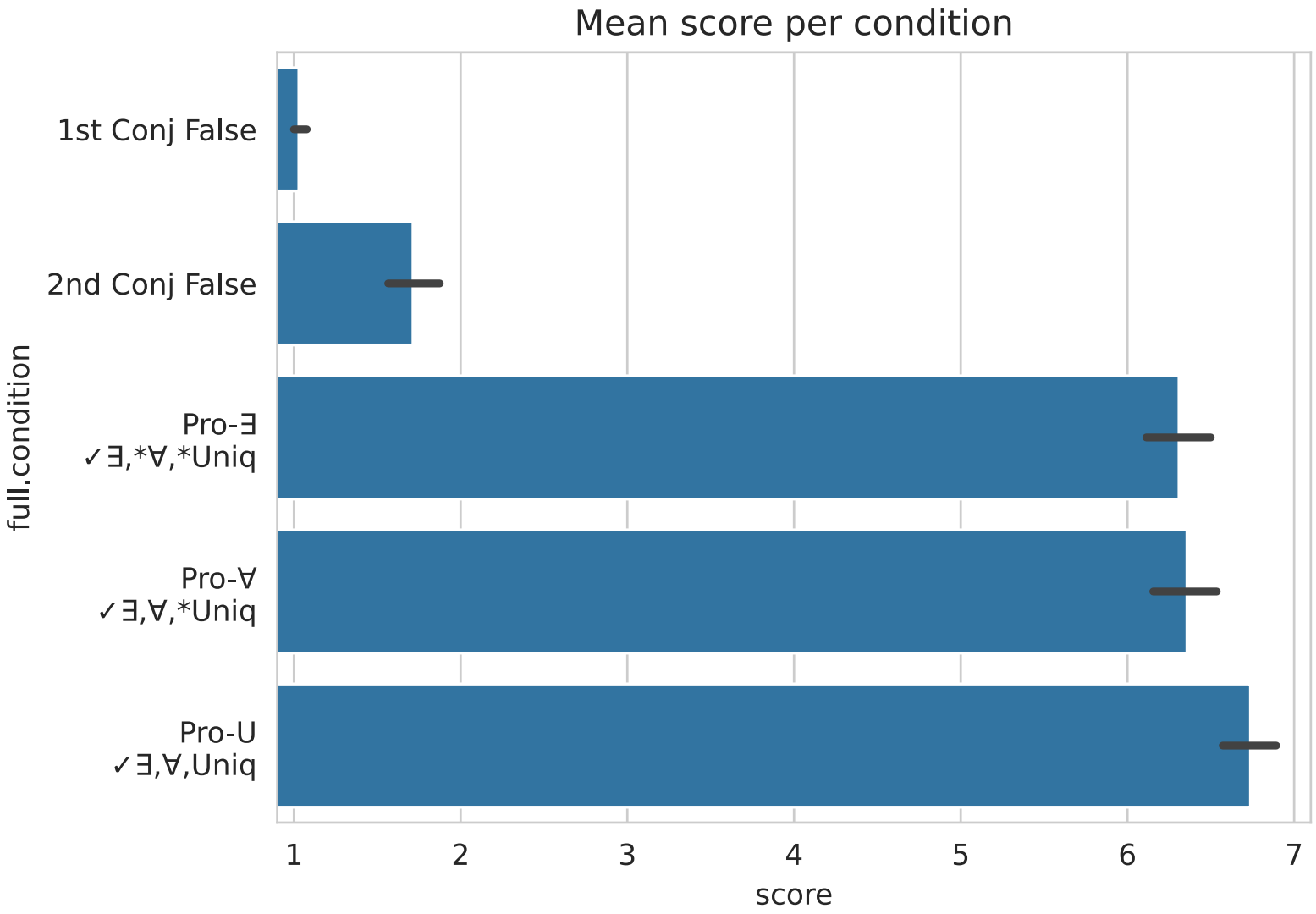
Completely false ○ ○ ○ ○ ○ ○ ○ Completely true

NoPro-True-Strong

- Recruited on the Prolific platform
- 60 participants
- 3 trials per condition $\times$ (5 + 4) conditions = 27 trials
- Excluded participants who, on more than one trial, did not give one of the two lowest ratings to the NoPronoun-Both-False and Pronoun-First-False conditions.
- Excluded participants who always answered with one of the two leftmost scale items for all trials.

$\rightsquigarrow$ 4 participants excluded

Experiment I: Results



Experiment I: Results

- Significant difference between Pro-Second-False and Pro-Exists ($\chi^2(1) = 393.92$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *speakers access an existential reading.*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

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- Difference between Pro-Universal and Pro-Unique is not significant ($\chi^2(1) = 37.29$,p-value $< 3.1e^{-9}$)
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- Difference between Pro-Universal and Pro-Unique is not significant ($\chi^2(1) = 37.29$,p-value $< 3.1e^{-9}$)
  $\rightsquigarrow$ *Evidence for a uniqueness reading in the pronoun condition.*
- The interaction between Pro/NoPro is not significant ($\chi^2(1) = 2.06$, p-value $= 0.302$)
  $\rightsquigarrow$ *No evidence for an interaction with the no-pronoun condition, i.e. no evidence that the uniqueness reading is due to the pronoun as opposed to being an implicature*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

Experiment 2: disjunction

(11) Either there isn't a circle or it is green.

a. **existential:** …*or at least one circle is green*

b. **universal:** …*or every circle is green*

c. **uniqueness:** …*or the one circle is green*

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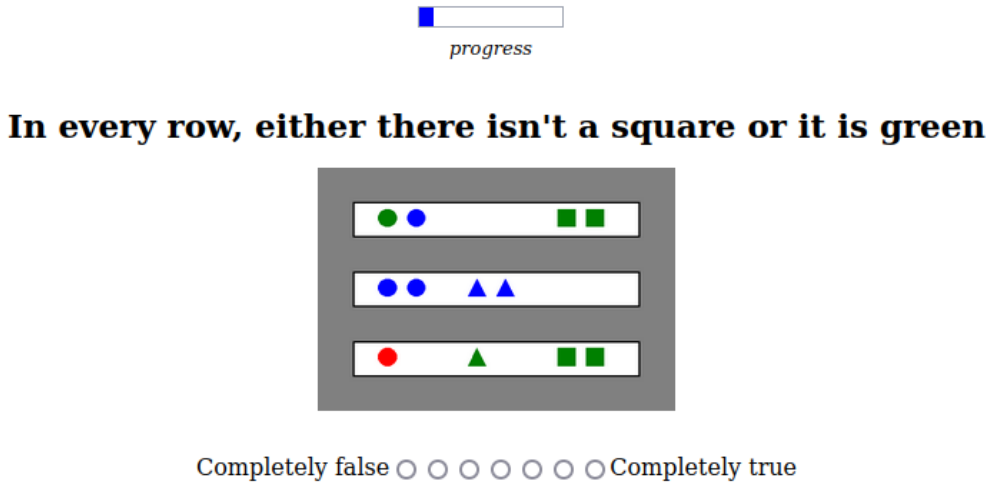
If participants interpret the sentence as providing a description of the picture, they may find it odd that the speaker choose to be so uninformative.

Experiment 2: disjunction



(12) In every row, either there isn't a circle or it is blue.

a. **existential:** *in every row, . . . or at least one circle is blue*

b. **universal:** *in every row, . . . or every circle is blue*

c. **uniqueness:** *in every row, . . . or the one circle is blue*

$$(12c) \Rightarrow (12b) \Rightarrow (12a)$$

Experiment 2: disjunction

It’s a hard task !

Experiment 2: disjunction

(13) In every row, either there isn't a circle or it is blue.

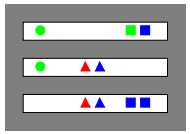
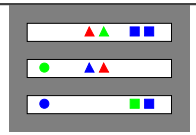
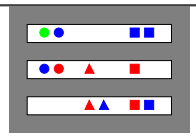
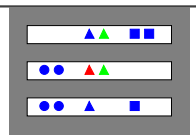
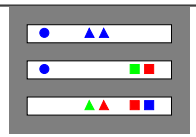
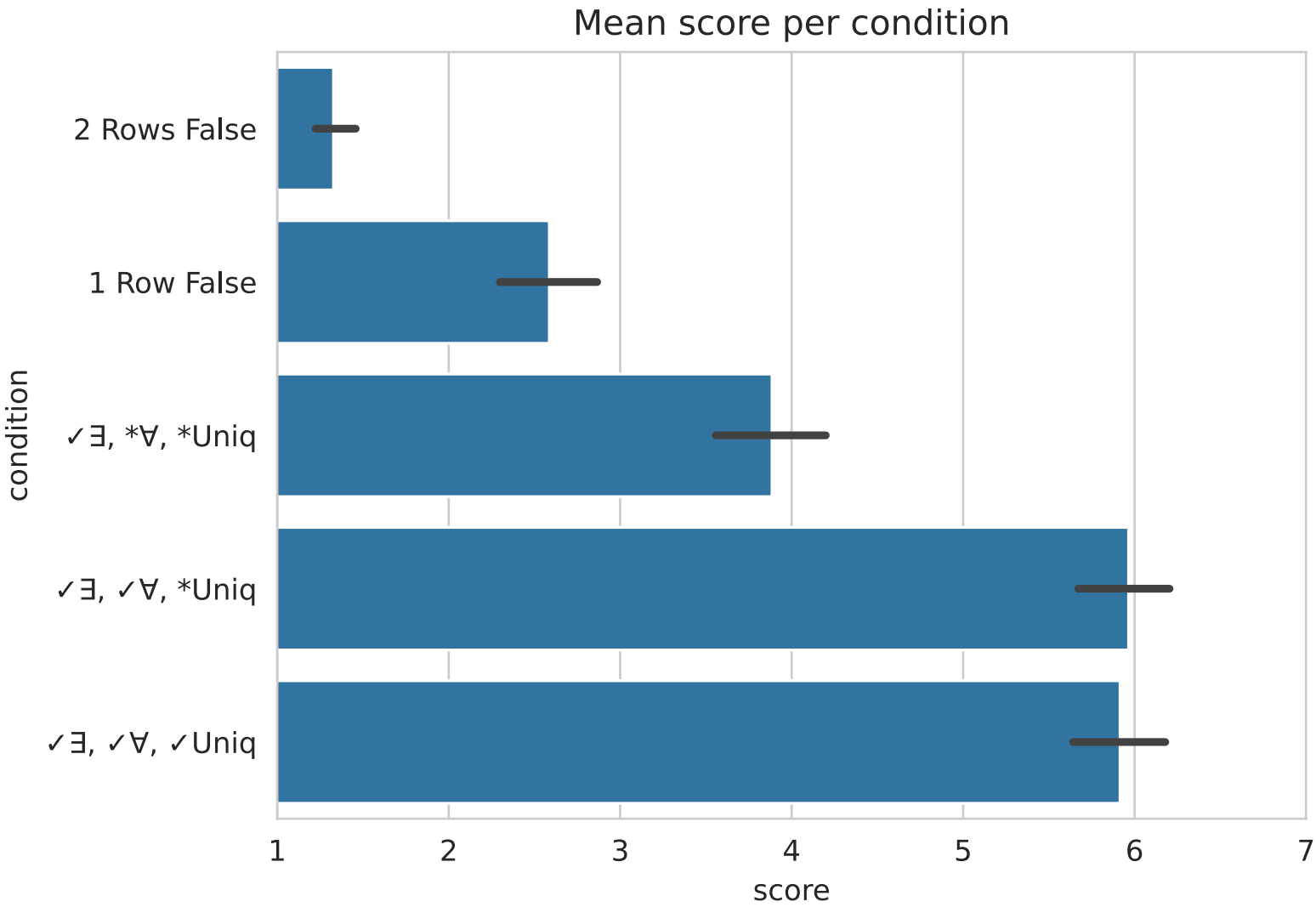
		existential	universal	unique
Disj-F2Rows		F	F	F
Disj-F1Row		F	F	F
Disj-∃		T	F	F
Disj-∀		T	T	F
Disj-U		T	T	T

Table: Readings true in each condition

Experiment 2: disjunction

- Recruited on the Prolific platform
- 80 participants
- 3 trials per condition $\times$ 5 conditions = 15 trials
- Excluded participants who, on two trials, didn't give one of the two lowest scores to the Disj-F2Rows condition.
- Excluded 13 participants.

Experiment 2: results



Experiment 2: results

- Significant difference between Disj-F1Row and Disj-$\exists$
  ($\chi^2(1) = 40.214$, p-value $= 4..55e^{-10}$)
  $\rightsquigarrow$ *the existential reading exists*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

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- Significant difference between Disj-$\exists$ and Disj-$\forall$ ($\chi^2(1) = 99.141$, p-value $= 7.06e^{-23}$)
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  $\rightsquigarrow$ *the existential reading exists*
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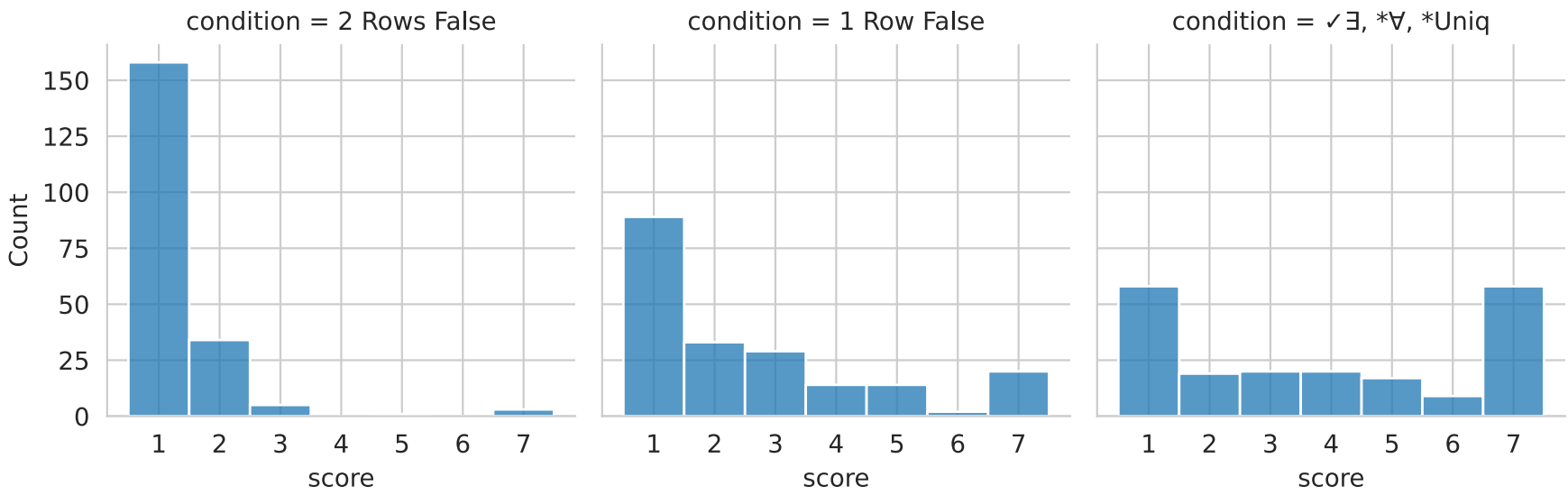
  $\rightsquigarrow$ *the universal reading exists.*
- No significant difference between Disj-$\forall$ and Disj-U
  ($\chi^2(1) = 0.1884$, p-value $= 0.6643$)
  $\rightsquigarrow$ *no evidence for a uniqueness reading*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

Truth-partiality

Counter-hypothesis: there is no existential reading ; the difference between Disj-$\exists$ and Disj-$\forall$ reflects partial-truth responses.

Experiment 2: results



⇝ the distribution of Disj-∃ looks bi-modal

⇝ Disj-F1Row does not

Interim summary

(14) a. [...a circle ...] $\wedge$ [...it ...] (exist., *univ.)

b. $\neg$ [...a circle ...] $\vee$ [...it ...] (exist., univ.)

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In line with:

Kanazawa's generalization (modified)

- There is always an existential reading.
- When the pronoun and its antecedent are in environments of different monotonicity, a universal reading is available.

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Question

Is Kanazawa's generalization predicted?

- Many dynamic theories predict (tendentially) Kanazawa's generalization for donkey sentences …
- …but don't predict cross-disjunction anaphora are possible [Groenendijk and Stokhof, 1991]
- Some dynamic theories only predict universal readings [Krahmer and Muskens, 1995]
- Some dynamic theories only predict existential readings [Hofmann, 2019, Elliott, 2020, Hofmann, 2022]
- Some dynamic theories predict a uniqueness reading [Gotham, 2019]

Experiment 3: the effect of negation on cross-conjunction anaphora

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(15) There is a circle and it is blue.

(16) There is a circle and it is not blue.

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(15) There is a circle and it is blue.
$\rightsquigarrow$ *There is a circle that is blue.*

(16) There is a circle and it is not blue.
$\rightsquigarrow$ *There is a circle that is not blue.*

Experiment 3: the effect of negation on cross-conjunction anaphora

(15) There is a circle and it is blue.
$\rightsquigarrow$ *There is a circle that is blue.*

a. **existential:** *...and at least one circle is blue*

b. ~~**universal:** *...and every circle is blue*~~

(16) There is a circle and it is not blue.
$\rightsquigarrow$ *There is a circle that is not blue.*

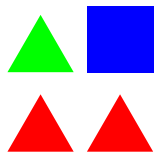
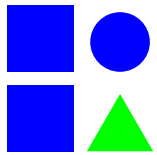
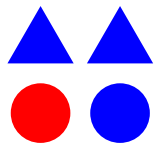
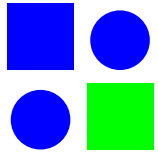
a. **existential:** *...and at least one circle is not blue*

b. ~~**universal:** *...and every circle is not blue*~~

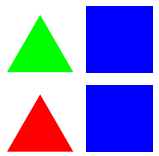
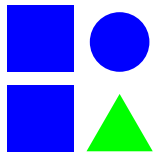
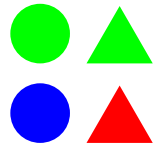
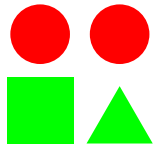
Reading expected by Dynamic Semantics (Egli's theorem)

Experiment 3: the effect of negation on cross-conjunction anaphora

(17) There is a circle and it is blue.

Example	Condition
	Pos-F1st
	Pos-F2nd
	Pos-∃
	Pos-∀

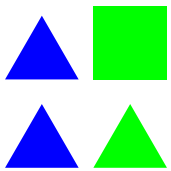
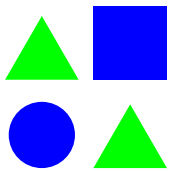
(18) There is a circle and it is not blue.

Example	Condition
	Neg-F1st
	Neg-F2nd
	Neg-∃
	Neg-∀

Experiment 3: the effect of negation on cross-conjunction anaphora

Control sentence:

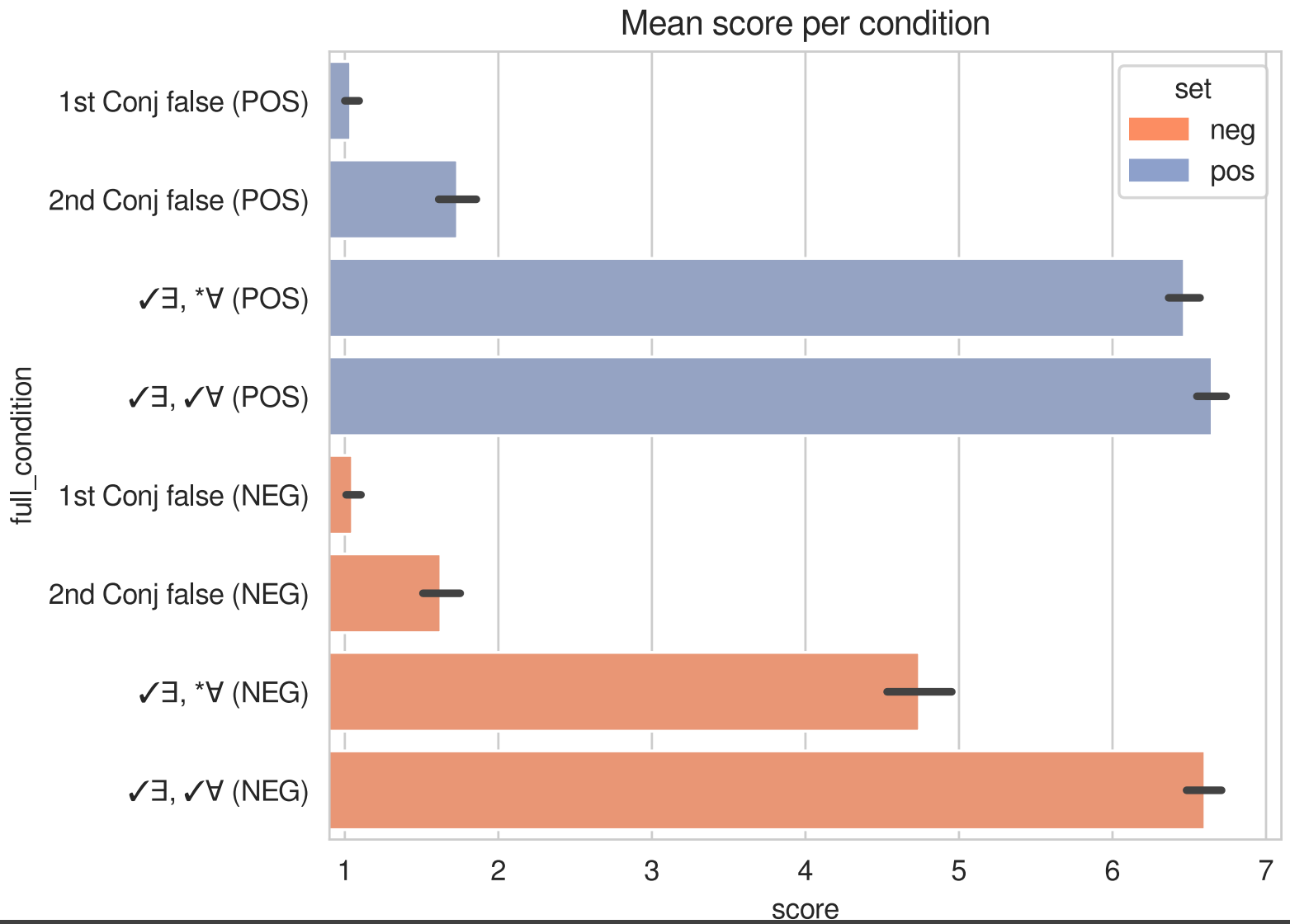
(19) There is a circle and the square is blue.

Example	Condition
	Control-BothConjFalse
	Control-True

Experiment 3: the effect of negation on cross-conjunction anaphora

- Recruited on the Prolific platform
- 120 participants
- 3 trials per condition $\times$ 5 conditions = 15 trials
- No controls
- Excluded participants who, on two trials or more, didn't give one of the two lowest scores to the false condition of the control and the two highest score to the true condition control.
- Excluded 6 participants

Experiment 3: the effect of negation on cross-conjunction anaphora



Experiment 3: the effect of negation on cross-conjunction anaphora

- Significant difference between Pos-F1 and Pos-$\exists$
  ($\chi^2(1) = 798.91$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the existential reading exists in positive sentences*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

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  ($\chi^2(1) = 17.03$, p-value $< 3.67e^{-5}$)
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- Significant difference between Pos-$\exists$ and Pos-$\forall$
  ($\chi^2(1) = 17.03$, p-value $< 3.67e^{-5}$)
  $\rightsquigarrow$ marginal universal reading? different error rates?
- Significant difference between Neg-F1 and Neg-$\exists$
  ($\chi^2(1) = 441.01$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the existential reading exists in negative sentences*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

Experiment 3: the effect of negation on cross-conjunction anaphora

- Significant difference between Pos-F1 and Pos-$\exists$
  ($\chi^2(1) = 798.91$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the existential reading exists in positive sentences*
- Significant difference between Pos-$\exists$ and Pos-$\forall$
  ($\chi^2(1) = 17.03$, p-value $< 3.67e^{-5}$)
  $\rightsquigarrow$ marginal universal reading? different error rates?
- Significant difference between Neg-F1 and Neg-$\exists$
  ($\chi^2(1) = 441.01$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the existential reading exists in negative sentences*
- Significant difference between Neg-$\exists$ and Neg-$\forall$
  ($\chi^2(1) = 301.5$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the universal reading exists in negative sentences*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

Experiment 3: the effect of negation on cross-conjunction anaphora

- Significant difference between Pos-F1 and Pos-$\exists$
  ($\chi^2(1) = 798.91$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the existential reading exists in positive sentences*
- Significant difference between Pos-$\exists$ and Pos-$\forall$
  ($\chi^2(1) = 17.03$, p-value $< 3.67e^{-5}$)
  $\rightsquigarrow$ marginal universal reading? different error rates?
- Significant difference between Neg-F1 and Neg-$\exists$
  ($\chi^2(1) = 441.01$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the existential reading exists in negative sentences*
- Significant difference between Neg-$\exists$ and Neg-$\forall$
  ($\chi^2(1) = 301.5$, p-value $< 2.2e^{-16}$)
  $\rightsquigarrow$ *the universal reading exists in negative sentences*
- Significant interaction Pos/Neg and $\exists/\forall$
  ($\chi^2(1) = 105.37$, p-value $= 2.03e^{-24}$)
  $\rightsquigarrow$ *the universal reading is definitely more easily accessed in negative sentences than in positive sentences*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni corrected)

Experiment 3bis: paraphrase control

Counter-hypothesis: Negation is confusing?

Experiment 3bis: paraphrase control

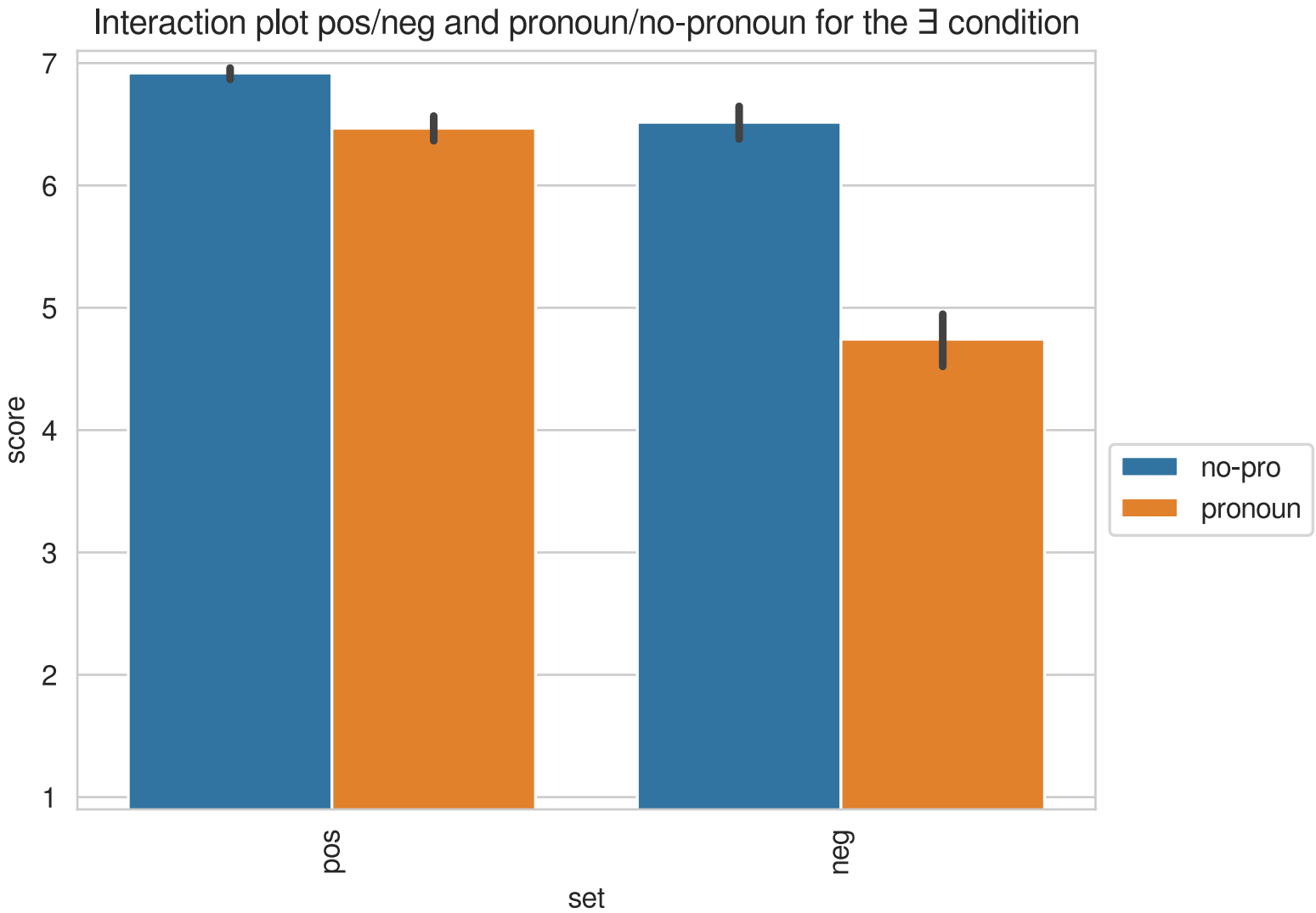
Counter-hypothesis: Negation is confusing?
We test the Egli paraphrases of the sentences using the same protocol and same conditions:

(20) Control sentences

a. There is a circle that is blue.

b. There is a circle that is not blue.

Experiment 3bis: paraphrase control



Experiment 3bis: paraphrase control

- Significant interaction Pro/NoPro and F1/$\exists$
  ($\chi^2(1) = 5$, p-value $= 0.025$)
  $\rightsquigarrow$ *the universal 'construal' is (more easily) accessed with*

(Stats: likelihood ratio test, CLMM, Holm-Bonferroni correction includes comparisons from experiment 3)

Conclusion

Negation reveals a universal reading. This challenges a fundamental property of dynamic systems, Egli's theorem.

Discussion

Question: How do we account for this?

Discussion

Two possibilities

1. the presence of negation creates a new scope environment.
2. the presence of negation affects what is relevant, what discourse we reconstruct.

Two possibilities

1. **the presence of negation creates a new scope environment.**
2. the presence of negation affects what is relevant, what discourse we reconstruct.

The pronoun (when read existentially) is like a quantifier ; it can have scope.

(21) a. There is a circle and not [it$_\exists$ is blue].

b. There is a circle and it$_\exists$ is not blue.

Cf pseudo-scope of anaphora
[Brasoveanu, 2007, Solomon, 2012, Chatain, 2018].

Two possibilities

1. the presence of negation creates a new scope environment.
2. **the presence of negation affects what is relevant, what discourse we reconstruct.**

- The two readings are always possible, disambiguated by context [Elliott, 2023, Chatain, 2024, Spector, 2024].
- Default contexts heavily favor $\exists$ readings in cross-conjunction anaphora.
- Negation may cue more specific contexts where the $\forall$ reading is possible.

Conclusion

Conclusion

- Egli's theorem does not hold in full generality.
- Kanazawa's generalization extends to connectives ; the $\exists/\forall$ ambiguity does not depend on the presence of a quantifier.

Thank you!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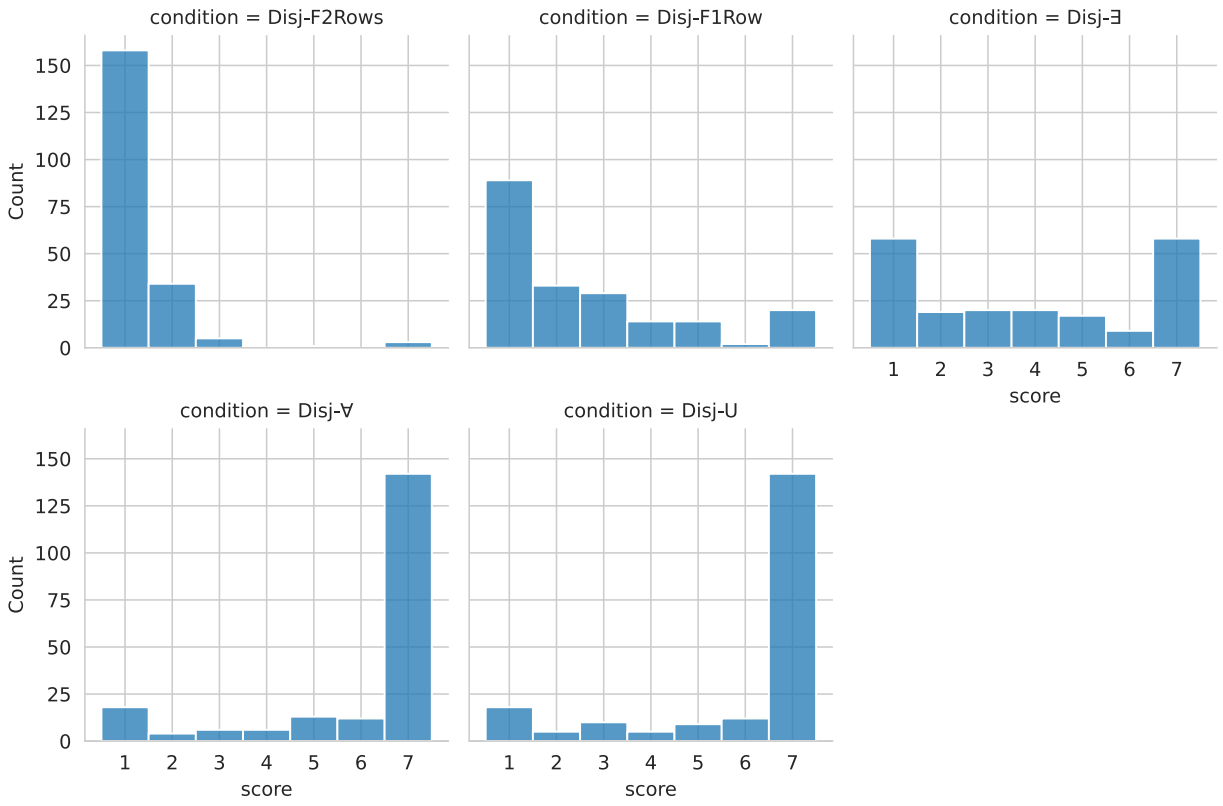
Discussion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condition = Disj-F1Row
condition = Disj-∃
condition = Disj-∀
condition = Disj-U
Count
score
0
25
50
75
100
125
150
1
2
3
4
5
6
7

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