Exhaustivity in embedded questions

An experimental comparison of four predicates of embedding

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Overview

- Semantics of embedded questions
- Experiment

Embedded questions

Question semantics

(1) Does Erica have a pet?

(2) Who danced at the party?

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(1) Does Erica have a pet?

(2) Who danced at the party?

> *To understand a sentence is to understand its truth conditions* (Wittgenstein)

- Problem: it is not possible to define truth conditions for questions

Embedded questions

- **Solution:** Embedding questions in a declarative sentence (Hamblin 1973, Karttunen 1977, Groenendijk & Stokhof 1984,…)

(3) Frank knows whether Erica has a pet.

- Reality: Erica has a pet
- Frank believes: Erica has a pet

Embedded questions

- **Solution:** Embedding questions in a declarative sentence (Hamblin 1973, Karttunen 1977, Groenendijk & Stokhof 1984,…)

(3) Frank knows whether Erica has a pet. ☺

- Reality: Erica has a pet
- Frank believes: Erica has a pet

Embedded questions

- **Solution:** Embedding questions in a declarative sentence (Hamblin 1973, Karttunen 1977, Groenendijk & Stokhof 1984,…)

(4) Erica knows who danced at the party.

- Reality: Mary and Alex danced at the party
- Erica believes: Mary and Alex danced at the party

Embedded questions

- **Solution:** Embedding questions in a declarative sentence (Hamblin 1973, Karttunen 1977, Groenendijk & Stokhof 1984,…)

(4) Erica knows who danced at the party. ☺

- Reality: Mary and Alex danced at the party
- Erica believes: Mary and Alex danced at the party

Karttunen 1977

- Building on work by Hamblin (1973)
- The set of propositions that together form a true and complete answer to the question

(5) Who danced?

{Mary danced, Alex danced}

- Say that Mary danced and Alex danced but Bob did not dance
- Meaning of (6): Erica knows the true answers to (5)

(6) Erica knows who danced.

- Weakly exhaustive reading: Erica may have no beliefs or even false beliefs about people who did not dance

Groenendijk & Stokhof 1984

- Criticism of Karttunen (1977): no complete knowledge

Erica knows who danced	Erica knows who danced
Alex danced	Paul didn't dance
Erica knows that Alex danced	Erica knows that Paul didn't dance

- Questions are partitions of the logical space. In a model with only the individuals Paul and Alex:

[[Who danced?]] = {Alex danced, Paul danced, Alex and Paul danced, nobody danced}

- Strongly exhaustive reading: if you know who danced, you know all true and false answers to the question *Who danced?*

Heim 1994

- Reading depends on embedding verb:
  - *know*: strongly exhaustive readings
  - *surprise*: weakly exhaustive readings

(7) Peter knows who danced at the party

⇒ Peter knows who didn't dance at the party

(8) Erica is surprised at who danced at the party

⇏ Erica is surprised at who didn't dance at the party

Spector 2005, Klinedinst & Rothschild 2011

- Third reading: intermediate exhaustive reading
- This reading is the weakly exhaustive reading with the additional assumption that the speaker has no false beliefs
- Under this reading, (9) is true in the scenario below

(9) Will knows who ran.

- Reality: El, Mike, and Max ran. Dustin and Lucas did not
- Will believes that El, Mike, and Max ran and does not have any false beliefs about whether Dustin or Lucas ran

Embedded questions: summary

Reading	*Characteristic*	*(9) Will knows who ran.* *Reality: El, Mike, and Max ran. Dustin and Lucas did not*
Weakly exhaustive reading	True answers	Will knows that El, Mike, and Max ran, and may falsely believe that Dustin or Lucas ran
Intermediate exhaustive reading	True answers + no false beliefs	Will knows that El, Mike, and Max ran and does not have any beliefs about whether Dustin or Lucas ran
Strongly exhaustive reading	True and false answers	Will knows that El, Mike, and Max ran and that Dustin and Lucas did not run

Predictions from previous experimental work

Know

(9) Will knows who ran

- Cremers & Chemla (2016): > 90% acceptance for SE reading and IE reading; 20% acceptance for WE reading
- Our previous experiments: nearly 100% acceptance for SE reading, 50-60% acceptance for IE reading and marginal acceptance for WE reading

Predictions from previous experimental work

Correctly predict

(10) Will correctly predicted who ran

- IE readings available (Spector, 2006)
- Klinedinst & Rothschild (2011) and Cremers & Chemla (2016): evidence for IE reading, not for WE reading

Predictions from previous experimental work

Agree

(11) Will and Joyce agree about who ran

- Chemla & George (2016): evidence for IE and SE readings

Predictions from previous experimental work

Surprise

(12) Will is surprised at who ran

- Cremers & Chemla (2017): evidence for SE reading and WE reading
- Distributive reading: Will is surprised by every individual true answer, i.e. everyone who ran surprised him
- Non-distributive reading: Will is surprised by person or people who ran, but not necessarily by every individual runner

Readings and hypotheses

wissen	
SE	☺
IE	☺/☹
WE	☹

korrekt vorhersagen	
SE	☺
IE	☺
WE	☹

sich einig sein	
SE	☺
IE	☺
WE	☹

überrascht sein	
SE	☹
WEdis	☺
WEnondis	☺

Experiment

Goals

- Gather independent evidence for availability of the different readings
- Test different verbs with the same method
- Prevent use of satisficing strategy (Krosnick 1991, 1999)
- Maximize rational behavior in participants
- Get insights into the reasoning process

Method

Lab-Experiment with performance-based compensation + Interview

- Evidence for effort increasing potential of money (e.g. Camerer & Hogarth 1999)
- Target sentence is object of a bet
- Participants have to decide whether bets are won or not

Method

Scenario:

- TV-Show *The Glass House*
- 5 contestants on the show → fixed domain
- The presenters, Tim and Tiffany talk about events on the show and about the participants
- viewers place bets

Method

2 roles – bias control

role 1: person who is sent by a friend → submit bets

- 5€ starter cash
- 10 cents fee for cashing in bets
- 30 cents reward for won bets (netto reward 20 cents)

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role 1: person who is sent by a friend → submit bets

- 5€ starter cash
- 10 cents fee for cashing in bets
- 30 cents reward for won bets (netto reward 20 cents)

role 2: worker in a betting office → pay reward

- 15€ starter cash
- pay 20 cents for won bets
- 10 cent fine for rejection of won bets

Method

Design:

- Verbs: *know*, *correctly predict*, *be surprised*, *to agree*
- 3 (knowledge state: SE, IE, WE/SE, WEdis, WEnondis) x
- 2 (negation: +/-) x
- 2 (role: submit bet, pay reward)
- 24 test items and 26 fillers/controls
- 24 participants
- coins as starter cash

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no_neg
Tim knows who of the participants petted a snake on the show.

neg
Tim doesn‘t know who of the participants petted a snake on the show

Method

Sample betting slip – *know*, IE, -neg

Lina wettet:

Tiffany weiß, wer von den Teilnehmerinnen und Teilnehmern Einzelkind ist.

Tiffany: „Oh ja, Stichwort Einzelkinder: Ich habe mitbekommen, dass Carlo, Mara und Freddy Einzelkinder sind. Ich finde, das merkt man denen auch irgendwie an. Was Alessa und Sophie betrifft, bin ich mir unsicher. Ich habe nicht mitbekommen, ob die beiden Einzelkinder sind oder nicht.“

Lina bets:

Tiffany knows who of the participants is an only child.

Tiffany: „Oh yes, only children: I noticed that Carlo, Mara and Freddy are only children. I think you can tell by their behavior. Concerning Alessa and Sophie, I am unsure. I did not learn whether the two of them are only children or not.“

Method

Sample betting slip – *know*, IE, -neg

Personen	**Only child**
Alessa	nein
Carlo	ja
Freddy	ja
Mara	ja
Sophie	nein

Method

Sample betting slip – *correctly predict*, IE, +neg

Lina wettet:

Tiffany hat nicht korrekt vorhergesagt, wer von den Teilnehmerinnen und Teilnehmern in der Sendung einen Wutanfall bekommen würde.

Dialog aus der ersten Sendung, in der die fünf Teilnehmerinnen und Teilnehmer neu in das gläserne Haus eingezogen sind.

Tim: „Tiffany, wie ist deine Prognose? Wer von den Teilnehmerinnen und Teilnehmern wird in der Sendung einen Wutanfall bekommen?“

Tiffany: „Also, Freddy, Carlo und Mara scheinen ein wenig cholerisch. Die drei werden in der Sendung einen Wutanfall bekommen und vielleicht werden auch noch andere einen Wutanfall bekommen.“

Lina bets:

Tiffany did not predict correctly who of the participants would throw a tantrum on the show.

Dialog from the first show, in which the participants newly moved to the Glass House.

Tim: „Tiffany, what is your prognosis? Who of the participants will throw a tantrum on the show?“

Tiffany: „Well, Freddy, Carlo and Mara seem a bit choleric. Those three will throw a tantrum on the show and maybe others will also throw a tantrum on the show.“

Method

Sample betting slip – *correctly predict*, IE, +neg

Personen	**Threw tantrum**
Alessa	nein
Carlo	ja
Freddy	ja
Mara	ja
Sophie	nein

Method

Sample betting slip – be surprised, SE, -neg

Lina wettet:

Tiffany war überrascht, wer von den Teilnehmerinnen und Teilnehmern in der Sendung Wasserpfeife geraucht hat.

Tiffany: „Tim, weißt du noch die Sendung, in der Freddy und Alessa Wasserpfeife geraucht haben und die anderen drei extra das Haus verlassen haben, um ein Statement gegen das Rauchen zu setzen? Ich hatte erwartet, dass auch Carlo und Sophie in der Sendung Wasserpfeife rauchen würden. Ich hatte den Eindruck, die beiden wären nicht besonders gesundheitsbewusst.“

Lina bets:

Tiffany was surprised who of the participants smoked shisha on the show.

Tiffany: „Tim, do you remember the episode, in which Freddy and Alessa smoked shisha and other three ostentatiously left the house to put down a marker against smoking? I expected that Carlo and Sophie would also smoke shisha on the show. I had the impression that the two of them were not particularly health-conscious.“

Method

Sample betting slip – be surprised, SE, -neg

Personen	**Wasserpfeife geraucht**
Alessa	ja
Carlo	nein
Freddy	ja
Mara	nein
Sophie	nein

Method

Sample betting slip – *agree*, WE, -neg

Lina wettet:

Tiffany und Tim sind sich einig, wer von den Teilnehmerinnen und Teilnehmern eine anstrengende Persönlichkeit hat.

Tiffany: „Was ich unbedingt noch loswerden will: Ich finde ja, dass alle bis auf Carlo echt anstrengende Persönlichkeiten haben.“

Tim: „Findest du? Ich denke zwar auch, dass Alessa, Sophie und Mara sehr anstrengende Persönlichkeiten haben, neben Carlo hat aber meiner Meinung nach Freddy auch keine anstrengende Persönlichkeit. Die beiden wirken recht unkompliziert.“

Tiffany: „Aha. Nee, ich finde Freddy hat auch eine anstrengende Persönlichkeit.“

Lina bets:

Tiffany and Tim agree on who of the participants has a demanding personality.

Tiffany: „What I wanted to say: I think that everyone apart from Carlo has a really demanding personality.“

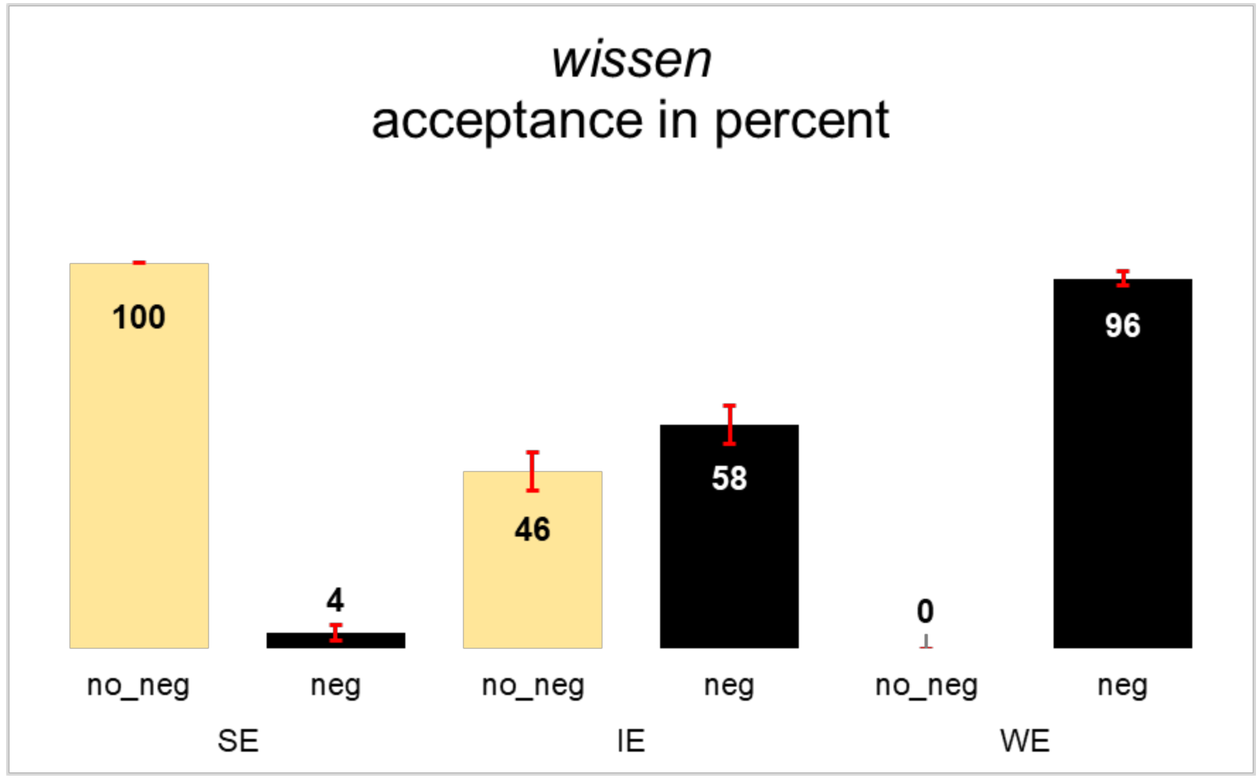
Tim: „Do you think so? I also think that Alessa, Sophie and Mara have very demanding personalites, but in my opinion, beside Carlo, Freddy also doesn‘t have a demanding personality. The two of them seem quite down-to-earth.

Tiffany: „I see. No, I think Freddy has a demanding personality, too,“

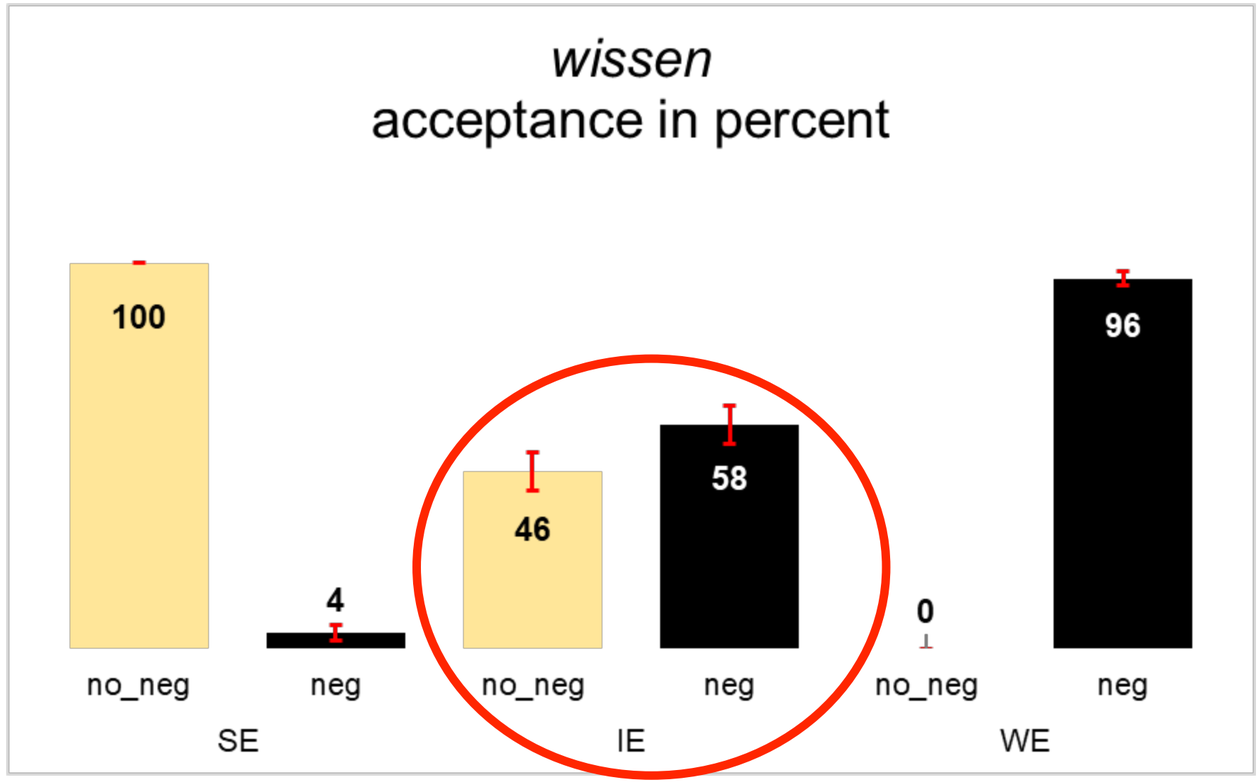
Results

- 24 participants (16 female, 6 male, 2 not specified)
- no exclusions
- no biases to accept/reject bet due to role

Results: *wissen* (*know*)



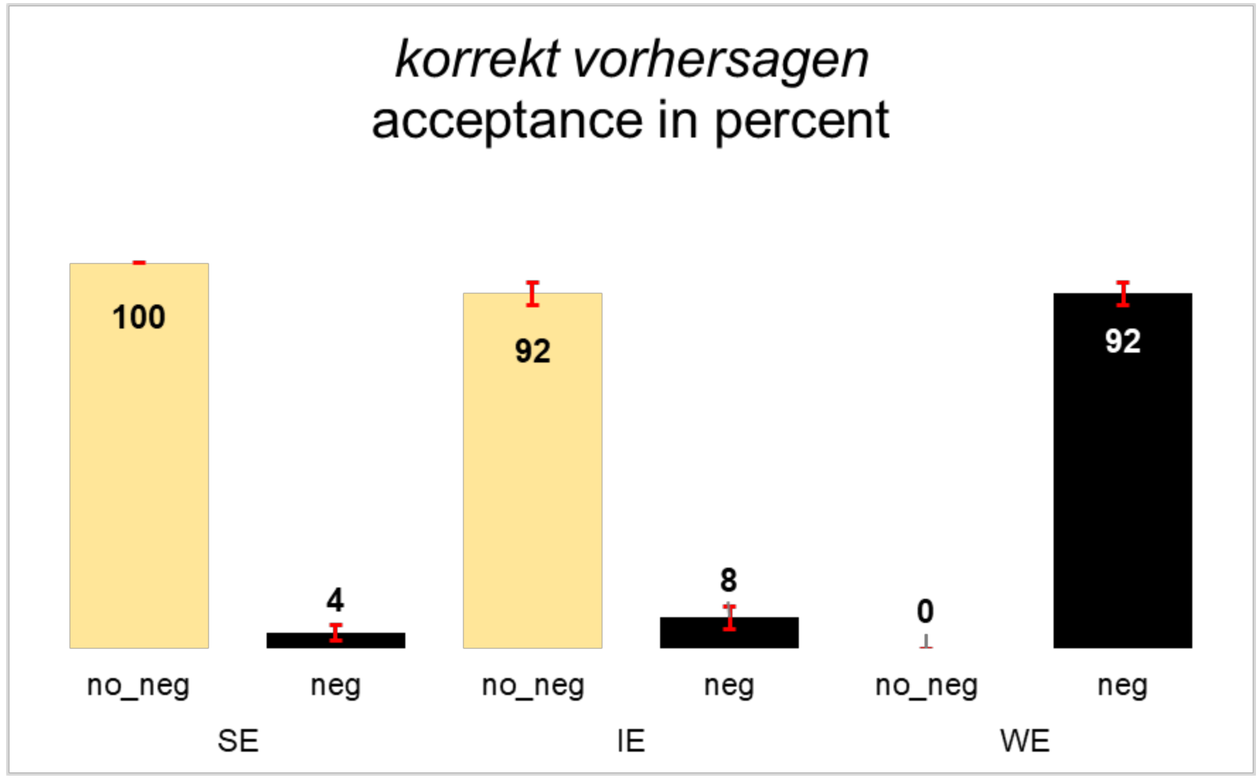
Results: *wissen* (*know*)



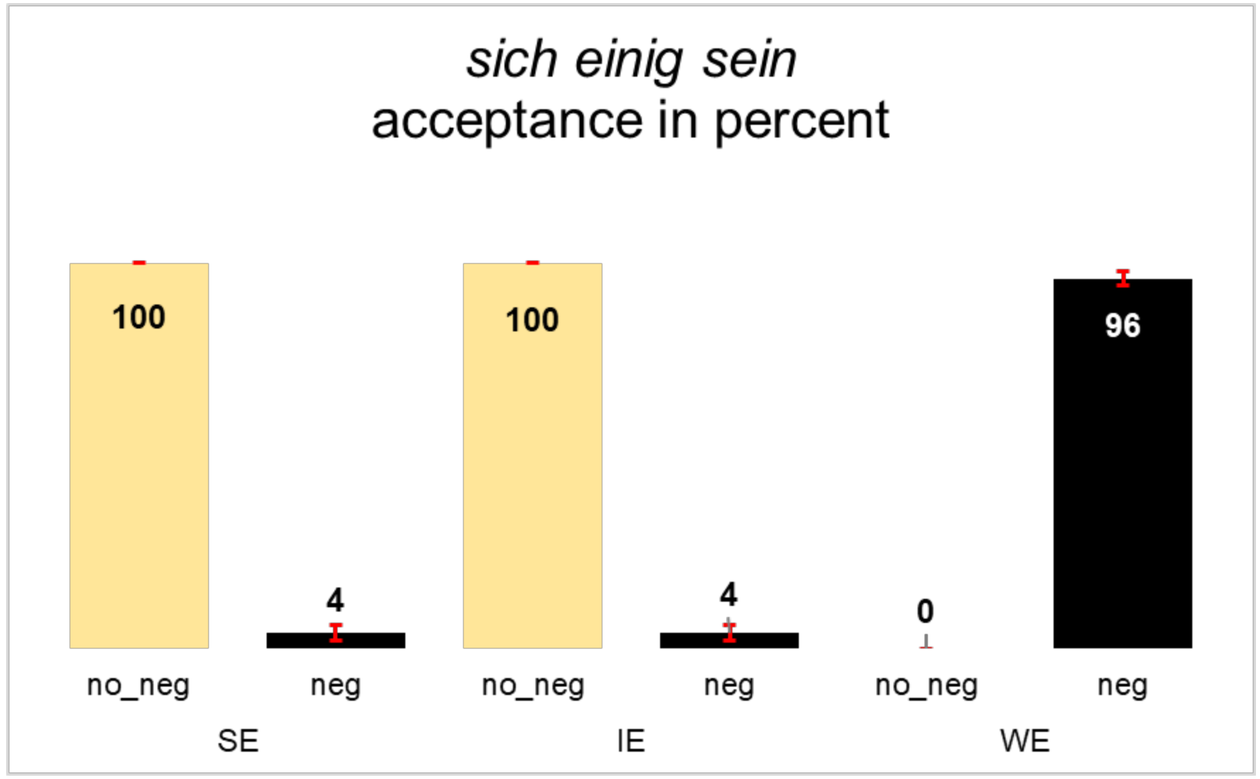
Comments on IE

- Almost half of the people were not sure about their decision
- Yes: „correct guess“
- No: „He/She doesn‘t know, because s/he is uncertain about some people.“

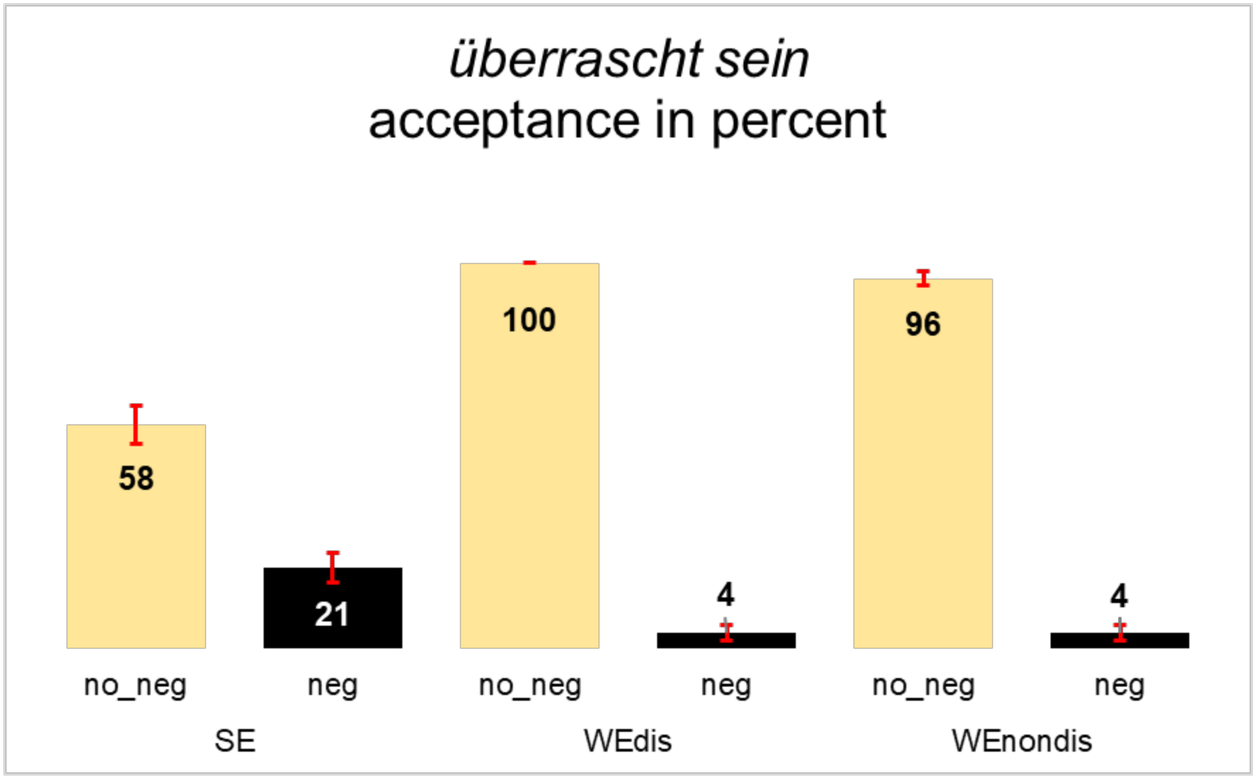
Results: *korrekt vorhersagen* (*correctly predict*)



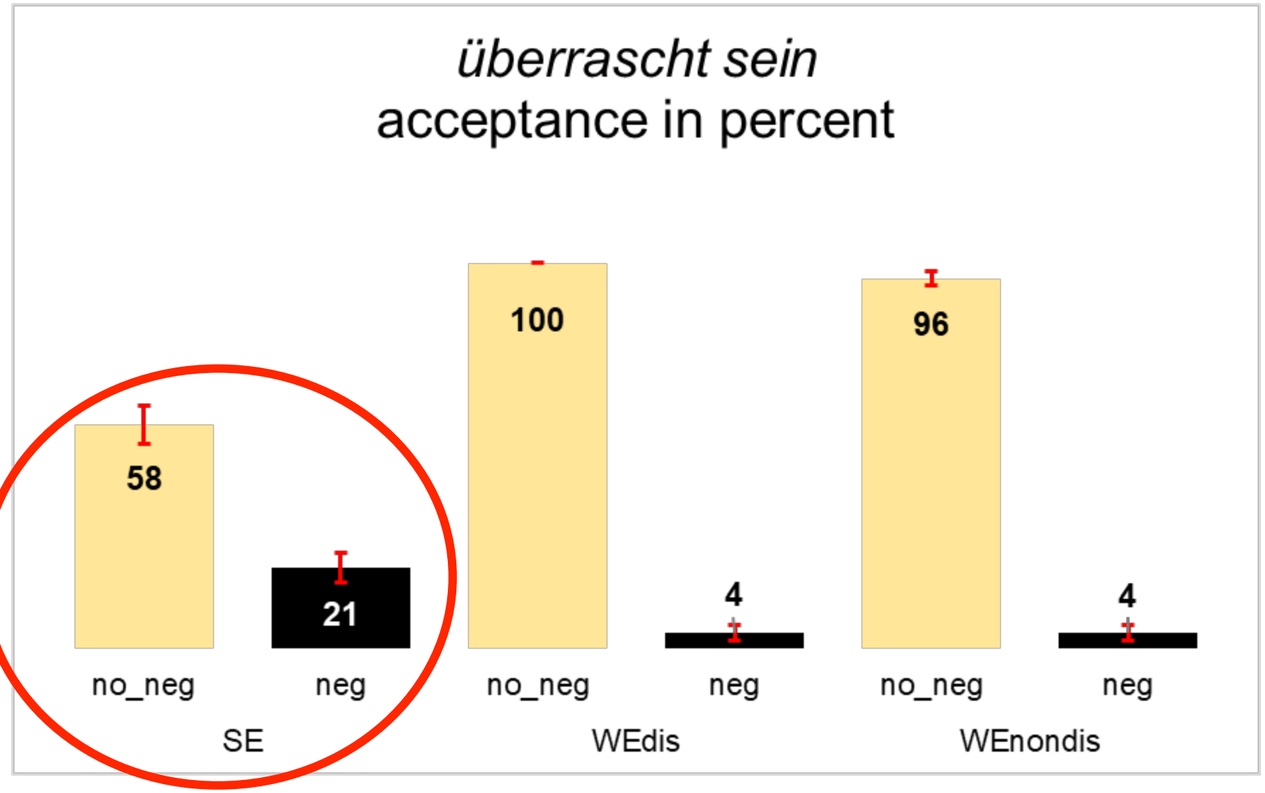
Results: *sich einig sein* (*agree*)



Results: *überrascht sein* (*surprise*)



Results: *überrascht sein* (*surprise*)



Comments on SE

- Few people were sure about their decision
- „Won because of surprise“

Hypotheses and results compared

wissen	
SE	☺ ☺
IE	☺/☹ ☺/☹
WE	☹ ☹

korrekt vorhersagen	
SE	☺ ☺
IE	☺ ☺
WE	☹ ☹

sich einig sein	
SE	☺ ☺
IE	☺ ☺
WE	☹ ☹

überrascht sein	
SE	☹ ☺/☹
WEdis	☺ ☺
WEnondis	☺ ☺

Conclusions

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***wissen* (*know*), *korrekt vorhersagen* (*correctly predict*), *sich einig sein* (*agree*)**

- Replication of previous results
- Lower acceptance in IE condition for *know*
- IE readings for *know* are available but do not constitute the optimal interpretation

Conclusions

***überrascht sein* (*surprise*)**

- Replication of previous experimental results
- evidence for non-distributivity
- *surprise* might differ from the other verbs in a drastic way
- It might select for facts or situations (Ginzburg & Sag 2000, Abenina-Adar 2019)
- ‘surprise’ may be a psychological state caused by complex situations and their overall constitution (viz. Theiler [2014] on surprise being directed *at the overall size and constitution of the answe*r)

Thank you!