Scalar Implicature

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Examples

Scalar implicatures (SIs) are inferences like (1)–(3)

(1) `The linguist went to Italy or France.`

➠ The linguist didn't go to both It and Fr

(2) `Some of the syntacticians are sad.`

➠ Not all the syntacticians are sad

"Or" doesn't entail "not both"

> (1) The linguist went to Italy or France.
>
> ➠ The linguist didn't go to both It and Fr

This inference is not part of the lexical meaning of "or"

1. Adding "not both" is not redundant

> (2) The linguist went to Italy or France but not both.

"Or" doesn't entail "not both"

(1) The linguist went to Italy or France.

➠ The linguist didn't go to both It and Fr

This inference is not part of the lexical meaning of "or"

2. The inference disappears in certain grammatical contexts

(2) a. The linguist didn't go to Italy or France.

b. No linguist went to Italy or France.

"Or" doesn't entail "not both"

> (1) The linguist went to Italy or France.
>
> ➠ The linguist didn't go to both It and Fr

This inference is not part of the lexical meaning of "or"

3. The inference interacts with certain operators in an unexpected way

> (2) The linguist has to go to Italy or France.

- Obligation: Go to only one of It and Fr!
- Obligation: Go to at least one of It and Fr (and the other one is optional)!

"Some" doesn't entail "not all"

(1) Some of the syntacticians are sad.

➠ Not all of the syntacticians are sad

This inference is not part of the lexical meaning of "some"

(2) Some but not all of the syntacticians are sad.

(3) a. Unless some of my friends come, I won't go.

b. The teacher denied that some of her students cheated.

(4) You need to take some of the intro courses.

"ほとんど" doesn't entail "すべて"

> (1) ほとんどの学生が学生寮に住んでいる。
>
> ➠ Not all students live in dorms

This inference is not part of the lexical meaning of "ほとんど"

> (2) すべてではないが、ほとんどの学生が学生寮に住んでいる。

> (3) a. 現在では、ほとんどの学生が学生寮に住んでいるなんていうことは、もうない。
>
> b. 東京のどの私大でも、ほとんどの学生が学生寮に住んでいるということはない。

> (4) ほとんどの必修科目でAを取る必要がある。

Research questions

Expressions that give rise to SIs are called **scalar expressions** (alt: **scalars**)

If SIs are not part of the lexically encoded meanings of scalar expressions, where do they come from?

- **Pragmaticists**: SIs are pragmatic inferences
- **Grammaticalists**: SIs are due to a phonologically silent operator (Exh/$\mathcal{O}$)

Terminological note

- Griceans claim that SIs are a type of pragmatic inferences called **implicatures** that involve **scales**, e.g. ⟨or, and⟩, ⟨some, (most,) all⟩, ⟨possible, certain⟩
- Some neo-Griceans (e.g., Geurts 2010) use the term **quantity implicature**
    - The Gricean derivation of a SI refers to the **Maxim of Quantity**
    - Quantitiy implicatures are a broader concept, subsuming those cases not involving 'lexical scales', e.g., *ad hoc* implicatures
- For grammaticalists (e.g., Chierchia, Fox & Spector 2012), SIs are technically not 'implicatures', but they still nevertheless use the term 'scalar implicature'

Roadmap

1 Gricean approach

Pragmatic inferences

Not all meaning is encoded in linguisitc expressions

```
(1)  Q: Do you speak Korean or Japanese?
     A: My sister speaks Korean.
```

One naturally concludes from (1A) that the speaker does not speak Korean.

But this inference is arguably not part of the meaning of the linguistic expressions used

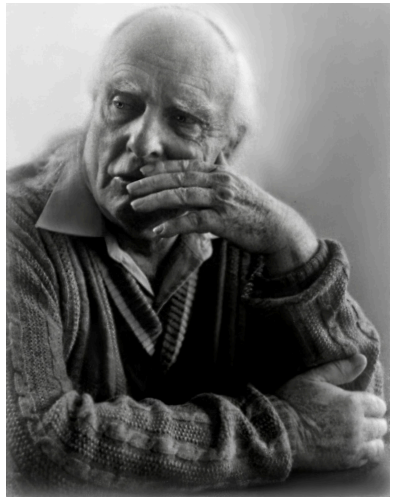
```
(2)  Q: Does anyone in your family speak an Asian language?
     A: My sister speaks Korean.
```

We often conclude more than what is said.

Gricean implicature

Paul Grice pioneered the study of pragmatic inferences

- **Idea**: With the assumption that the speaker is **cooperative**, one may draw extra inferences based on their (linguistic or non-linguistic) behaviour
- Grice called such pragmatic inferences **implicatures**



Cooperativity

It's reasonable to assume that conversational agents are generally **cooperative**

Implicatures arise in non-linguistic communication as well

```
(1)  A: Do you have a lightning cable?
     B: (Shows her Android phone)
     ➠ B doesn't have an iPhone and doesn't have a lightning cable
```

```
(2) At the university cafeteria, there is a bowl of spicy sauce
with a large spoon in it.
➠ The sauce is not so spicy
```

Gricean Maxims

What does it mean to be a cooperative conversational agent?

Grice's (tentative) answer = To follow the four Griceran maxims:

- **Maxim of Quantity**: Be informative
- **Maxim of Quality**: Only say what you believe to be true
- **Maxim of Relation**: Don't say irrelevant things
- **Maxim of Manner**: Make your utterance orderly

A cooperative agent's behavior that seems to flout a maxim must have a reason, e.g.

```
(1) The woman I'm living with will give you a ride.
```

Maxim of Quantity

In the Gricean approach to SIs, the Maxim of Quantity plays a crucial role

The Maxim of Quantity is about **informativity**

- Sub-maxim 1: Don't be underinformative
- Sub-maxim 2: Don't be overinformative

```
(1)  A:  What are you reading?
     B1: A novel.
     B2: Animal Farm.
     B3: p. 46 of Animal Farm.
```

Gricean derivation of SI: *Or*

1. Utterance: "I speak Korean or Japanese"
2. Why didn't the speaker say "I speak Korean **and** Japanese"?, which would have been more informative?
    - "I speak K and J" asymmetrically entails "I speak K or J"
    - Therefore the Maxim of Quantity favours this alternative
3. It must be because asserting the alternative would have been uncooperative
    - The Maxims of Relation and Manner would have been respected
    - It must have violated the Maxim of Quality
    - Therefore, the speaker doesn't believe the alterantive to be true

Gricean derivation of SI: *Some*

1. Utterance: "Some of the cats are asleep"
2. Why didn't the speaker say "**All** of the cats are asleep"?
    - That would have been more informative
    - Therefore the Maxim of Quantity favours this alternative
3. It must be because asserting the alternative would have been uncooperative
    - The Maxims of Relation and Manner would have been respected
    - It must have flouted the Maxim of Quality
    - Therefore, the speaker doesn't believe the alterantive to be true

Summary

(Neo-)Griceans claim that SIs are **implicatures**, a type of pragmatic inference generated via reasoning based on cooperativity

Recipe for SI:

1. Identify a more informative (stronger) **alternative** (e.g., "and" for "or", "all" for "some")
2. Gricean reasoning about Quantity and Quality leads to the negation of the alternative

According to this theory, an SI arises via counterfactual reasoning about a hypothetical utterance of a more informative alternative

Exercise: More SIs

(1) `It's possible that it'll rain tomorrrow.`

➠ It's not certain that it'll rain tomorrow

(2) `Not all the cats are asleep.`

➠ Some cats are asleep.

(3) `The linguist wanted to go to Paris.`

➠ The linguist didn't go to Paris

(4) `A: Do you speak foreign languages?`
`B: I speak Dutch and Russian.`

➠ B doesn't speak any other foreign language.

Controversial cases

(1) `The professor has two PhD students.`

➠ The professor does not have three or more PhD students

(2) `This jacket has pockets.`

➠ The jacket has more than one pocket.

(3) `John can take Syntax or Phonology.`

➠ John can choose between Syntax and Phonology.

Experimental research on SIs

Since the early 2000s, SIs have been investigated experimentally, as well as theoretically (see Chemla & Singh 2014a,b, Noveck 2018 for overviews)

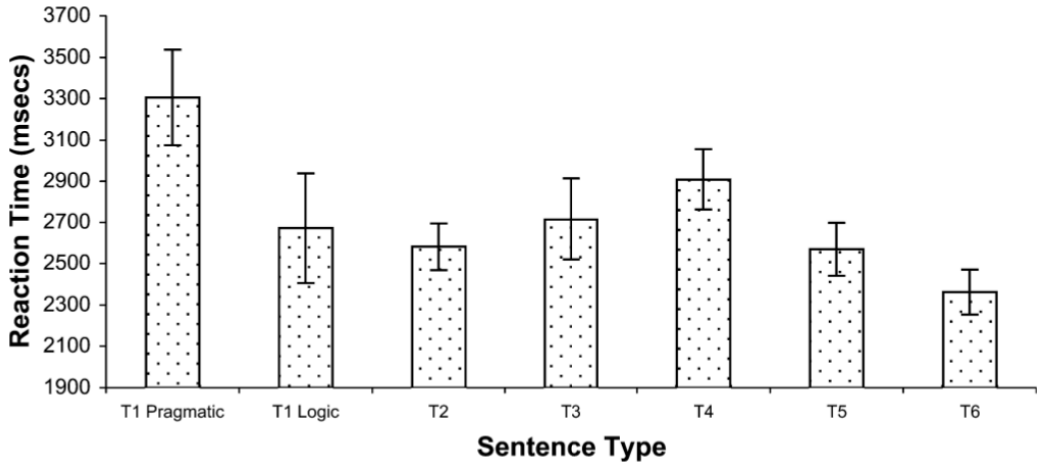
Some relevant findings

- Interpretations with SIs often require extra cognitive resources/processing time (Bott & Noveck 2004, De Neys & Schaeken 2007, a.o.)
- Children often fail to draw SIs (Noveck 2001, Papafragou & Musolino 2003, a.o.)

Bott & Noveck 2004: Experiment 3

Sentence	Example	Mean proportion True
T1	Some elephants are mammals	0.407 (.120)
T2	Some mammals are elephants	0.887 (.018)
T3	Some elephants are insects	0.073 (.012)
T4	All elephants are mammals	0.871 (.021)
T5	All mammals are elephants	0.031 (.006)
T6	All elephants are insects	0.083 (.017)

Note. Scores are based on $N = 32$ participants where each participant was required to evaluate 9 instances of each type of sentence. Outlier responses are not included. Variance is shown in parentheses.



Bott & Noveck 2004: Experiment 4

Short = 900 ms; Long = 3000 ms

Table 3
Summary of results for Experiment 4

Sentence	Example	Short lag	Long lag	Response difference
T1	Some elephants are mammals	.72 (.053)	.56 (.095)	−.16
T2	Some mammals are elephants	.79 (.021)	.79 (.038)	.00
T3	Some elephants are insects	.12 (.012)	.09 (.007)	+.03
T4	All elephants are mammals	.75 (.027)	.82 (.024)	+.07
T5	All mammals are elephants	.25 (.061)	.16 (.022)	+.09
T6	All elephants are insects	.19 (.017)	.12 (.011)	+.07

Note. Scores are based on $N = 45$ participants where each participant was required to evaluate 9 instances of each type of sentence. Outlier responses are not included. The Short lag and Long lag columns contain the proportion of True responses for each condition. Variance is shown in parenthesis. The final column refers to the increase in consistency of responses with added response time. For control sentences this equates to the increase in proportion correct with more time, while for the T1 sentences the figure is the Long condition True response minus the Short condition True response.

De Neys & Schaeken 2007: Dual-task experiment

Memory task sandwitching sentence verification (à la Bott & Noveck 2004):

- Memorise dots ➤ Sentence verification ➤ Reproduce dots
- Load (≈difficulty) manipulated within-subjects

Results (N = 56)

- Load: 73.2% false
- Control: 78.9% false
- No effect on fillers

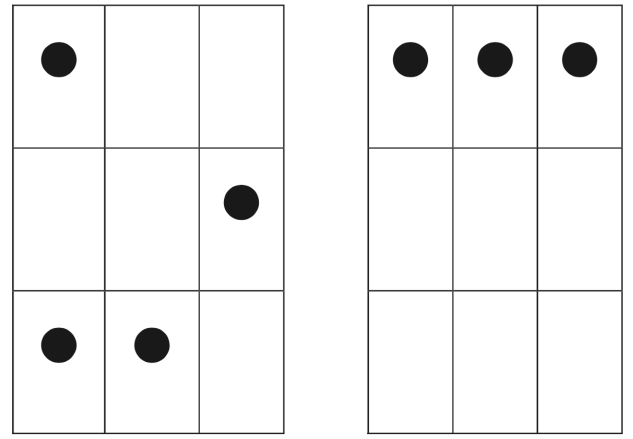


Figure 1. Examples of the dot patterns in the load (a) and control trials (b).

2 Some research topics

2.1 Primary vs. sencodary implicature

Gricean recipe: Upon hearing ϕ (e.g., "The linguist went to Italy **or** France"), Hearer reasons uttering the stronger alternative ψ (e.g. "The linguistic went to Italy **and** France) should have violated the Maxim of Quality

- The Maxim of Quality says: Only utter things you believe to be true, i.e. you have enough evidence for
- So the derived inference is: Speaker does not have enough evidence for the truth of ψ (**primary implicature**) (possibly Speaker has evidence for its falsity, or possibly Speaker doesn't know if it's true or false)

But the preceived SI is typically stronger than this: Speaker has evidence for the falsity of ψ (**secondary implicature**)

Epistemic Step

1. **Primary implicature**: $\neg B_s(\psi)$
2. **Secondary implicature**: $B_s(\neg\psi)$

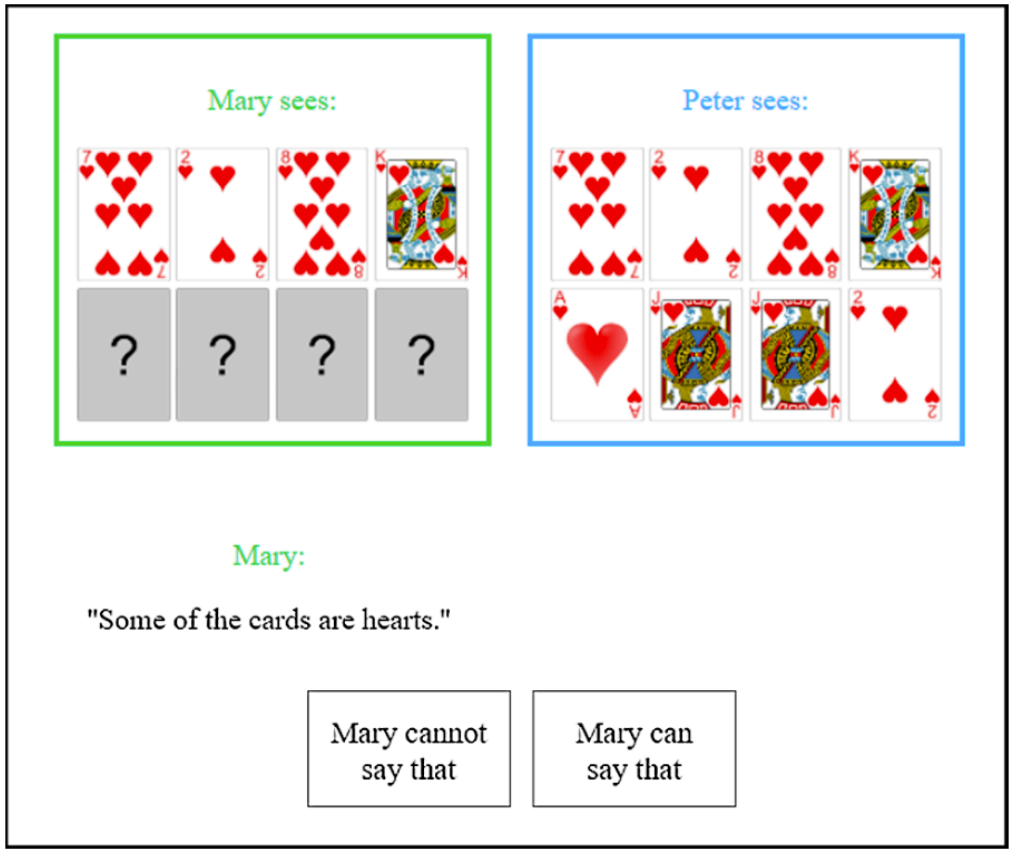
Neo-Griceans (Sauerland 2004, Spector 2006, etc.) assume that a primary implicature gets strengthened to a secondary implicature via an auxiliary assumption, **Opinionatedness** (alt. Experthood, Competence)

3. **Opinionatedness**: $B_s(\psi) \vee B_s(\neg\psi)$

1. + 3. $\Rightarrow$ 2.

But some experimental evidence that secondary SIs are drawn even if Opinionatedness does not hold (i.e., the speaker is known to be uncertain)

Dieuleveut, Chemla & Spector 2014: Experiment 2

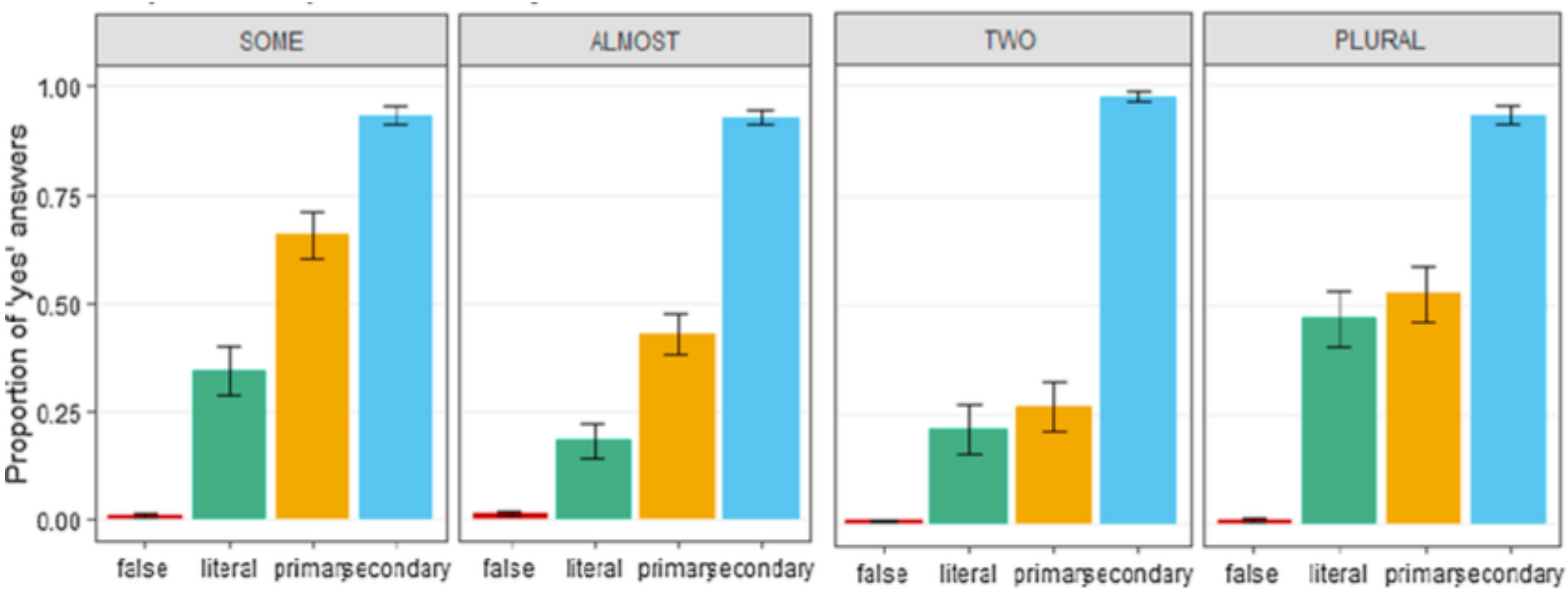


Conditions

- False: All visible, no hearts
- Literal: All visible, all hearts
- Primary: Only some visible, all visible cards are hearts (as in pic)
- Seconday: Only some visible, only some visible cards are hearts

Scalars: *some*, *almost*, *two*, PLURAL

Dieuleveut, Chemla & Spector 2014: Results



2.2 The Symmetry Problem

Classical Gricean theories are naive about alternatives

```
(1) Some of the cats are asleep.
```

The crucial alternative is formed with "all", but one could think of another alternative formed with "some but not all" or "only some"

```
(2)  a. All of the cats are asleep.
     b. Some but not all of the cats are asleep.
```

These alternatives are called **symmetric alternatives**

Symmetric alternatives cannot be both negated consistently, while maintaining the truth of the prejacent

Structural complexity

One might think that the symmetry between "all" and "some but not all" can be broken by the difference in **structural complexity** (see Katzir 2007)

> Alternatives are formed by deleting a constituent or replacing a constituent by a lexical item or contextually salient expression

But not all symmetry problems can be explained by structural complexity (Romoli 2013, Trinh & Haida 2015, Breheny et al. 2018)

```
(1) Not all of the cats are asleep.
    a. None of the cats are asleep.
    b. Some of the cats are asleep.
```

2.3 Embedded SIs

Gricean derivations of SIs only apply at the utterance level

But SIs seem to be able to take scope under logical operators (Chierchia 2004, Chierchia, Fox & Spector 2012, etc.)

> (1) a. There are students that flunked some of the intro courses.
> b. If you order a starter or a dessert with your meal, you'll pay £12. If you order both, you'll pay £15.
> c. The student is under the impression that she is required to take syntax or semantics.

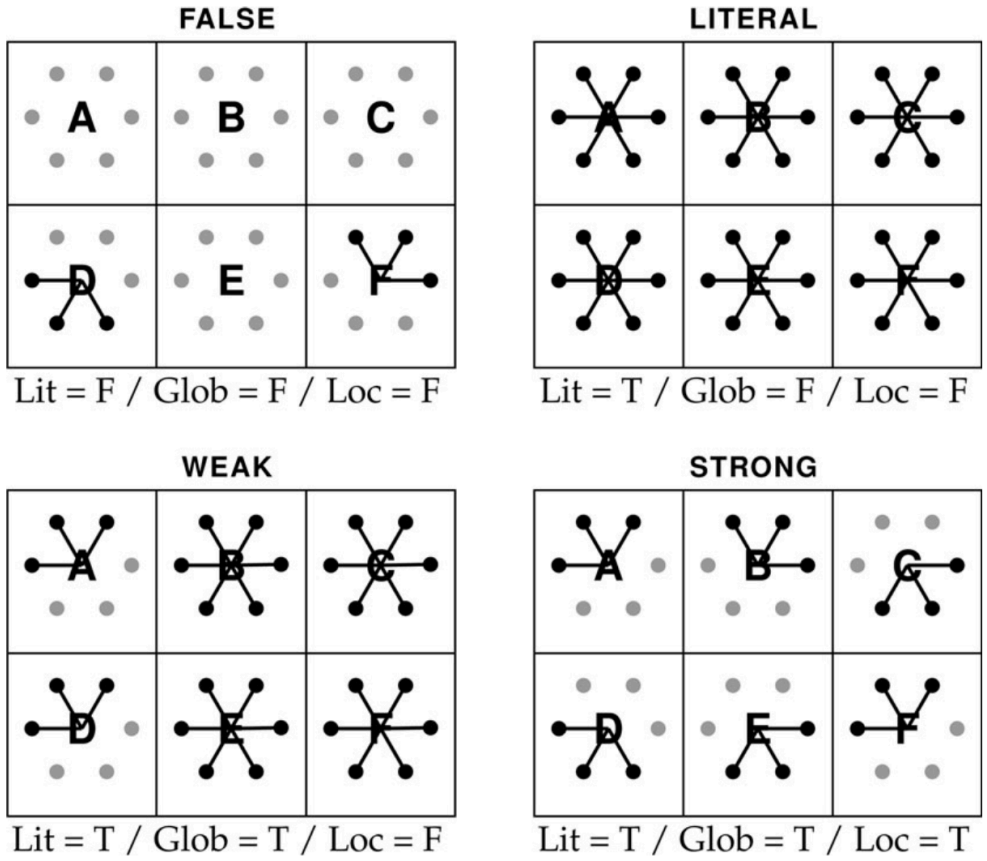
Experimental research on embedded SIs

- Geurts & Pouscoulous 2009 failed to observe evidence for embedded SIs
- Chemla & Spector 2011 found some evidence
- Debate: Geurts & Van Tiel 2013, Cummins 2014, Van Tiel 2014, Potts, Lassiter, Levy & Frank 2014, Franke, Schlotterbeck & Augurzky 2017, Van Tiel, Noveck & Kissine 2018

Difficulties

- By assumption SIs don't arise under negative operators (e.g., negation, "no"), positive or 'non-monotonic' operators must be used
- With a positive operator (e.g., "every"), the local SI reading would asymmetrically entail the global SI reading, so we can't have direct evidence for it

Chemla & Spector 2011: Items



"Every letter is connected with some of its circles" (in French)

- Literal reading (true in L, W, S):
  $\forall x(Lx \rightarrow \exists y(\bullet y \wedge Cxy))$
- Global reading (true in W, S):
  $(\forall x(Lx \rightarrow \exists y(\bullet y \wedge Cxy)) \wedge \neg\forall x(Lx \rightarrow \forall z(\bullet z \rightarrow Cxz))$
- Local reading (true in S):
  $\forall x(Lx \rightarrow (\exists y(\bullet y \wedge Cxy) \wedge \neg\forall z(\bullet y \rightarrow Cxz)))$

Chemla & Spector 2011: Results

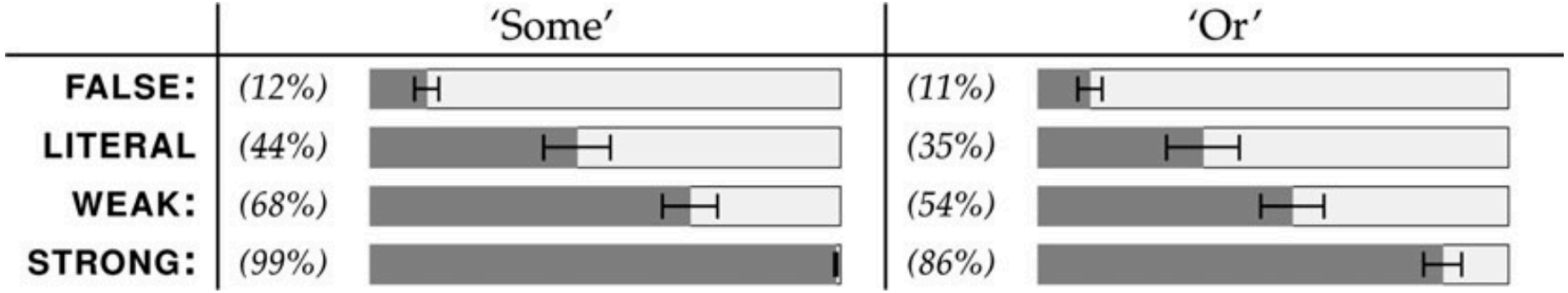


Figure 5 Main results: mean position of the cursor in the target conditions of experiment 1 (see section 4.2.1 or Figure 4 for an illustration). Error bars represent standard errors to the mean.

Chemla & Spector 2011 claim the difference between Weak and Strong as suggesting that there is a local SI reaidng ('the more readings are true, the truer the sentence sounds')

Non-monotonic contexts

```
(1)  a. Exactly 4 students flunked some of the intro courses.
     b. An even number of students flunked some of the intro
        courses.
```

- E.g., the global reading is true and the local reading false, when 3 students flunked some but not all, 1 flunked all
- Note that these sentences might lack the global reading altogether

NB: The global and local readings amount to the same thing for 'exactly one'

```
(2) Exactly one student flunked some of the intro courses.
```

3 Grammatical Approach

Exh

The grammatical approach to SI was developed mainly to deal with embedded SIs

SIs are triggered by a phonologically null operator **Exh** (alt: $\mathcal{O}$) (Groenendijk & Stokhof 1984, Chierchia 2004, Van Rooij & Schulz 2004, Chierchia, Fox & Spector 2012)

$$[\![\mathbf{Exh}\ \varphi]\!](w) = 1 \Leftrightarrow [\![\varphi]\!](w) = 1 \wedge \forall \psi \in \mathsf{Alt}(\varphi)[\mathsf{Cond}(\psi, \varphi) \rightarrow [\![\psi]\!](w) = 0]$$

- φ is called the **prejacent**
- $\mathsf{Alt}(\varphi)$ is the set of (relevant) alternatives to φ
- $\mathsf{Cond}(\psi, \varphi)$ is some condition on ψ given φ; some options:
  - ψ is stronger than φ (i.e. ψ entails ϕ but ϕ doesn't entail ψ)
  - ψ is non-weaker than φ (i.e., φ doesn't entail ψ)
  - ψ is 'innocently excludable' given φ

Example

"Every linguist met some of the philosophers"

- **Exh**(Every linguist met some of the philosophers)
  - Every linguist met at least one of the philosophers; and
  - ¬(Every linguist met all of the philosophers)
- Every linguist λx **Exh**(x met some of the philosophers)
  Every linguist is such that
  - they met at least one of the philosophers
  - ¬(they met all of the philosophers)

Disjunctive alternatives

```
(1) Alex took Syntax or Semantics
    Conjunctive-alt: Alex took Syntax and Semantics
    Disjunct-alt-1: Alex took Syntax
    Disjunct-alt-2: Alex took Semantics
```

The disjunct-alts are used to derive ignorance inferences (= primary implicatures)

They also sometimes give rise to SIs

```
(2) Alex needs to take Syntax or Semantics
    Conjunctive-alt: Alex needs to take Syntax and Semantics
    Disjunct-alt-1: Alex needs to take Syntax
    Disjunct-alt-2: Alex needs to take Semantics
```

Too many stronger alternatives

The disjunctive-alts are stronger (and hence non-weaker) than the prejacent, but negating both of them independently will contradict the prejacent

```
(1) Alex took Syntax or Semantics
    Conjunctive-alt: Alex took Syntax and Semantics
    Disjunct-alt-1: Alex took Syntax
    Disjunct-alt-2: Alex took Semantics
```

Innocently excludable alternatives

Fox 2007 puts forward **innocent exclusion**: Negate as many alternatives as possible, while maintaining consistency with the prejacent

$$\mathsf{IE}(\varphi) := \bigcap \max \mathsf{Excl}_\varphi$$

- $\mathsf{Excl}_\varphi := \{S \subseteq \mathsf{Alt}(\varphi) | \exists w[\overline{S}(w) = [\![\varphi]\!](w) = 1]\}$
- $\overline{S}(w) = 1 :\Leftrightarrow \forall \psi \in S[[\![\psi]\!](w) = 0]$
- $\max X = \{x \in X | \neg \exists y \in X[x \subset y]\}$

E.g. $\mathsf{IE}(\text{A or B}) = \{\text{A and B}\}$;

$\mathsf{IE}(\text{need A or B}) = \{\text{need A and B}, \quad \text{need A}, \quad \text{need B}\}$

Remarks

- When Exh appears under an opeartor, the SI takes scope below the operator
- Exh is, by assumption, anti-licensed under negation. There might be other distributional constraints (Fox & Spector 2018)
- Exh is similar to *only*, but not Strawson-DE so does not license weak NPIs
- The grammatical approach is compatible with Gricean Pragmatics, including certain pragmatic inferences (e.g., ignorance implicatures as primary implicatures)
- The burden of proof is on the grammaticalist
    - Embedded SIs (Chierchia 2004, Chierchia, Fox & Spector 2012)
    - Obligatory SIs (Chierchia 2004, 2013, etc.)
    - Multiple SIs (Franke & Bergen 2020)

Summary

- In most theories of SI, generation of a scalar implicature involves:
    i. Reference to an **alternative**
    ii. Negate the alternative
- Theories mostly differ with respect to the negation mechanism
    - Gricean approach: Reasoning about Quantity and Quality
    - Grammatical approach: Exh
- Every theory needs a recipe for determining alternatives

Next time?

Experimental topics

A) Implicature priming

B) Scalar diversity

C) "Ya" in Japanese

Theoretical topics

D) Free choice as SI (or not)

E) SIs and presuppositions

F) SIs and anaphora

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