The Processing of Scalar Implicatures

Day 3 - 30/7/2009

Eytan Zweig

EGG 2009, Poznań

- Yesterday we saw that data from children suggests that:
  - Children understand informativity scales.
  - They do not usually process implicatures.
- This has been taken by most experimenters to support an account in which implicatures are costly.
- However, note that it is not directly contradictory to the default account.
- It may be that what the children lack is the default calculation, and therefore the informativity scales are insufficient

- Today we will see accounts that address the default view directly and compare it with a context-based view.

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Brain and Language

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Characterizing the time course of an implicature: An evoked potentials study

Ira A. Noveck* and Andres Posada

Institut des Sciences Cognitives, 67 blvd. Pinel, 69675 Bron Cedex, France

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Noveck & Posada (2003)

- Three sentence types:
  - Patently true “Some people have brothers.”
  - Patently false “Some kangaroos have airplanes.”
  - Underinformative: “Some televisions have screens.”
- (Note: study was conducted in French)
- Words were presented on screen one at a time
- At the end of the sentence, subjects had to judge whether it was true or false.
- Reaction times and ERPs were measured for the last word in the sentence.

Noveck & Posada (2003)

- Of the 19 subjects, 7 responded to all the underinformative sentences as “true”, and 12 as “false”.

Table 1
Reaction times to the presented items as a function of response type to the Underinformative statement

Type of response to the Underinformative statement	Patently True statement	Patently False statement	Underinformative
Those who respond logically to the Underinformative statement ($n = 7$)	647	633	655
Those who respond pragmatically to the Underinformative statement ($n = 12$)	1064	856	1203
Total	911	774	1014

Note. Those who respond logically to the Underinformative items (e.g., *Some elephants have trunks*) choose true and those who respond pragmatically choose false (see text for explanation).

Noveck & Posada (2003)

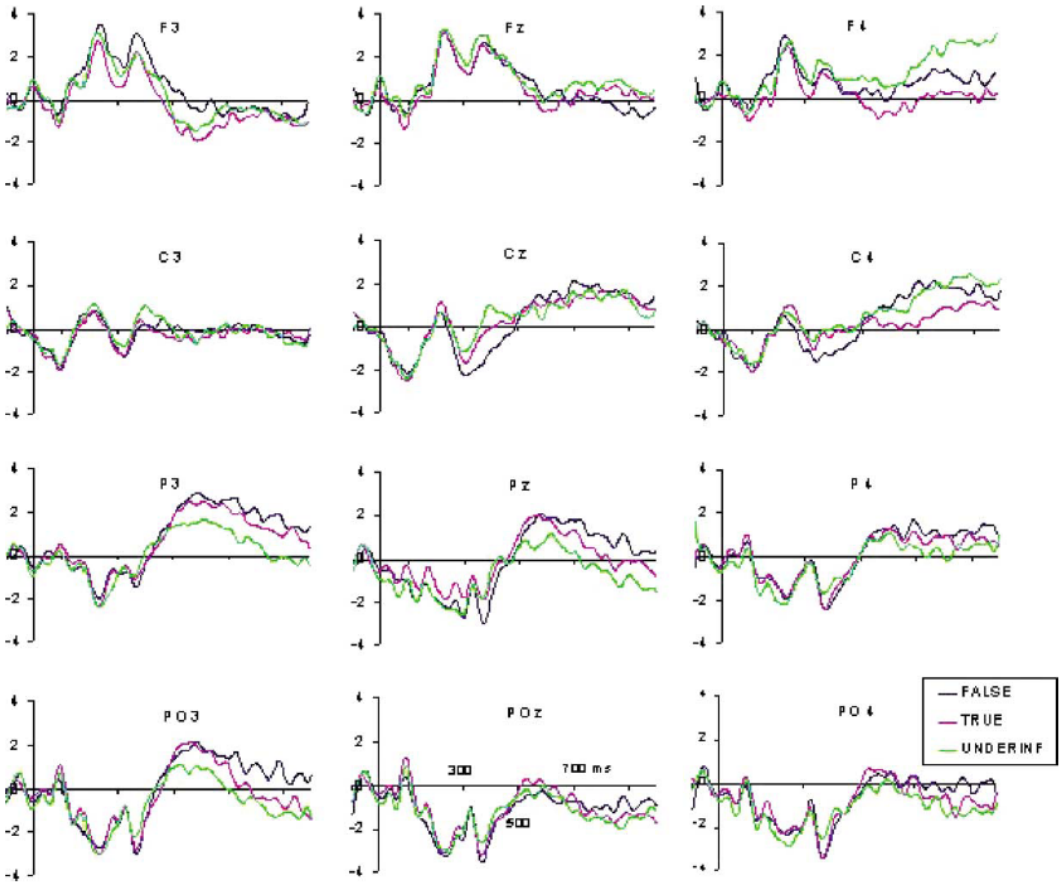


Fig. 1. The grand average ERP's in the three conditions—Patently False, Patently True, and Underinformative.

Noveck & Posada (2003)

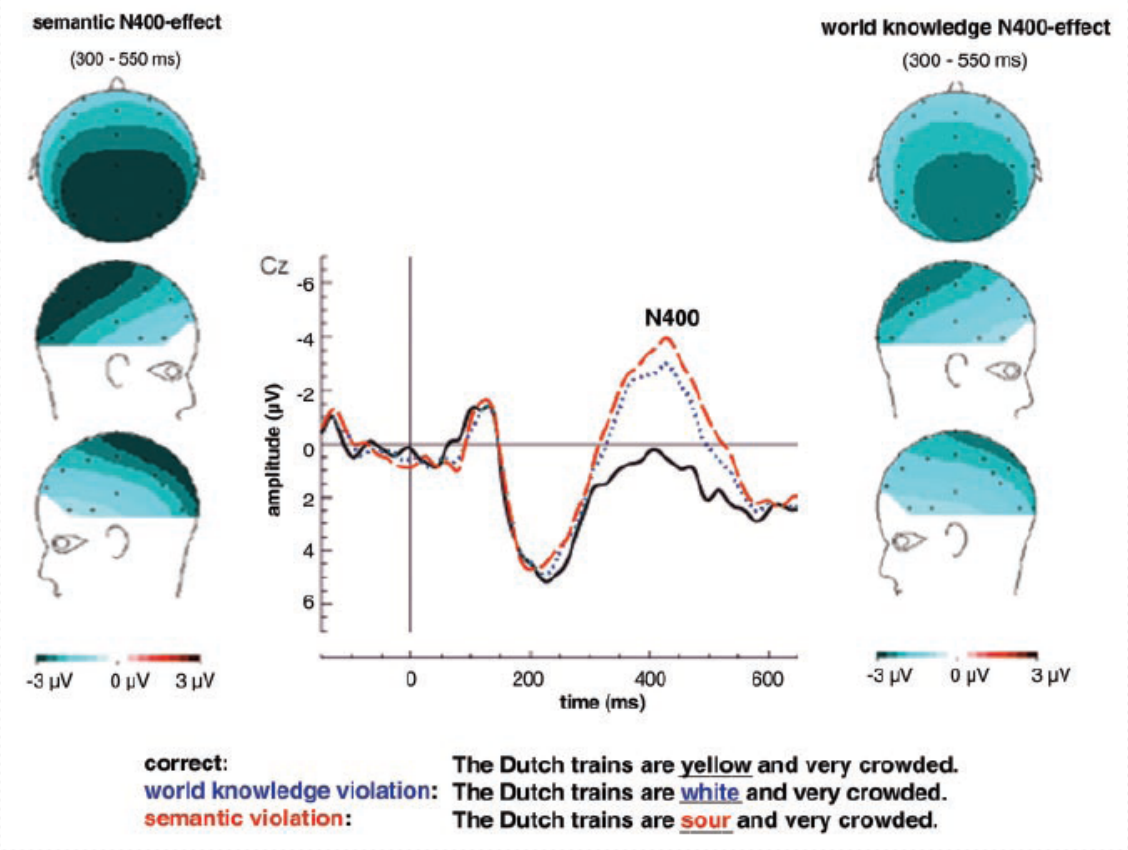
- All conditions had similar waveforms, but there were differences in N400s.
- Patently false items and patently true items did not differ from each other, but both showed larger N400s than underinformative items.
- There was no difference between the pragmatic and logical responders as far as the underinformative items.
- But, pragmatic responders get more extreme N400s for pragmatically false items.

Noveck & Posada (2003)

- “The increased negativity among the Patently True and Patently False items indicate that these items prompt significantly more semantic integration than the Underinformative items; the waveforms from the Underinformative items indicate that they required little semantic integration overall”.
- They note that in all the underinformative sentences, the final word is an “essential feature” of the subject.

Noveck & Posada (2003)

- Note: Hagoort et al. (2004):



Noveck & Posada (2003)

- Their conclusions:
  - N400 reflects the extra cost at processing an unexpected word.
  - Implicatures are calculated later, not part of initial semantic integration.
- This argues against the default view, as that would predict implicatures are calculated during sentence composition.

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Some utterances are underinformative: The onset and time course of scalar inferences☆

Lewis Bott* and Ira A. Noveck

Institut des Sciences Cognitives, Centre National de la Recherche Scientifique, Lyon, France

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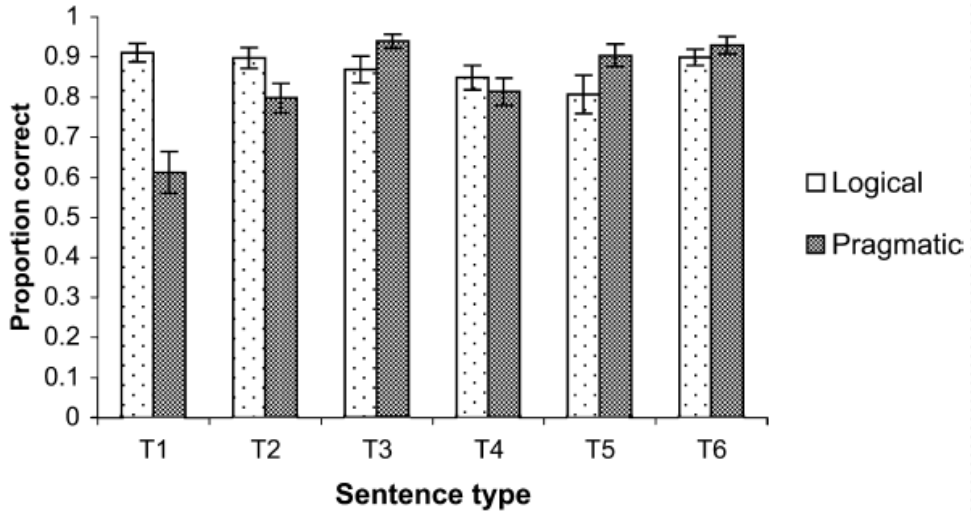
Bott & Noveck (2004)

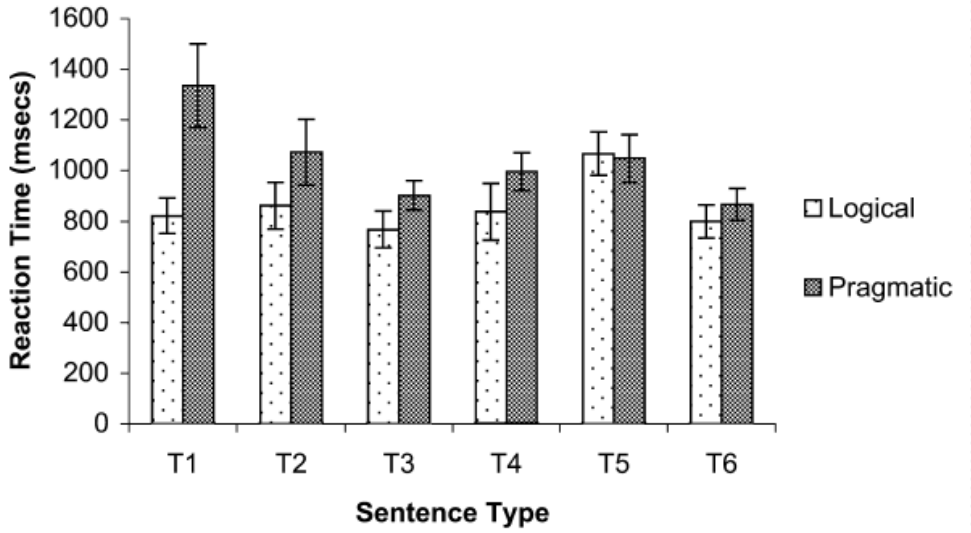
- Experiment 1: subjects (n=22) were asked to give true/false judgements for six types of sentences (in French); the critical condition being underinformative sentences:
  - Some elephants are mammals.
- They were **explicitly** instructed to interpret *some* as either "some but not all" or "some and possibly all".
- After each trial, subjects were given feedback (correct/incorrect)

Bott & Noveck (2004)

Table 1
Examples of the sentence types used in Experiments 1–4

Reference	Example sentence	Appropriate response
T1	Some elephants are mammals	?
T2	Some mammals are elephants	T
T3	Some elephants are insects	F
T4	All elephants are mammals	T
T5	All mammals are elephants	F
T6	All elephants are insects	F





Bott & Noveck (2004)

- Experiment 1 conclusions:
- Logical inferences the same as control sentences.
- Pragmatic inferences harder than logical inferences.
- Suppressing implicatures is easy.
- None of the above is consistent with the default view.

Bott & Noveck (2004)

- Experiment 1 may suffer from a response bias; it may simply be easier to say “true”.
- The second experiment ties to solve this by altering the task; instead of judging whether the sentence is true, the task is to judge someone else’s judgement:
  1. Mary says the following sentence is true/false.
  2. Some elephants are mammals.
- The speakers were asked to judge whether Mary is correct.
- N=29

Bott & Noveck (2004)

Table 1
Examples of the sentence types used in Experiments 1–4

Reference	Example sentence	Appropriate response
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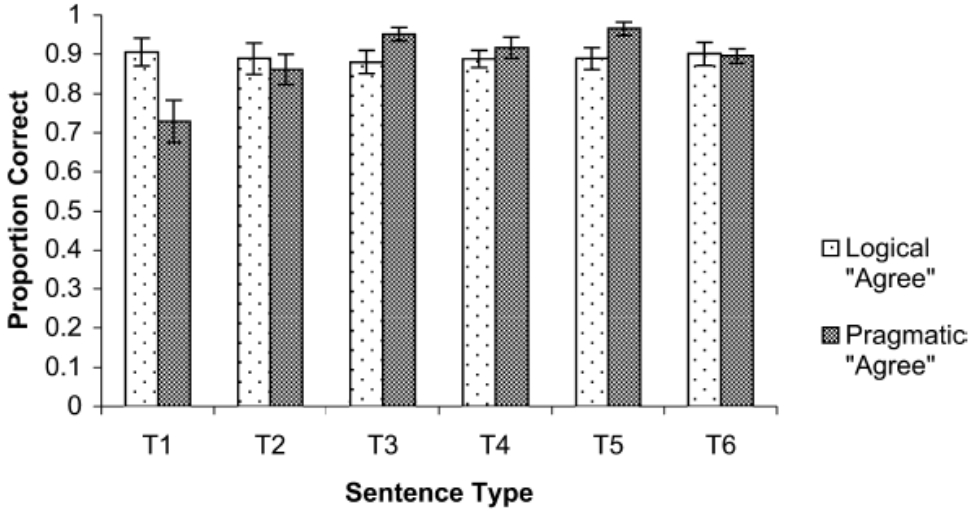
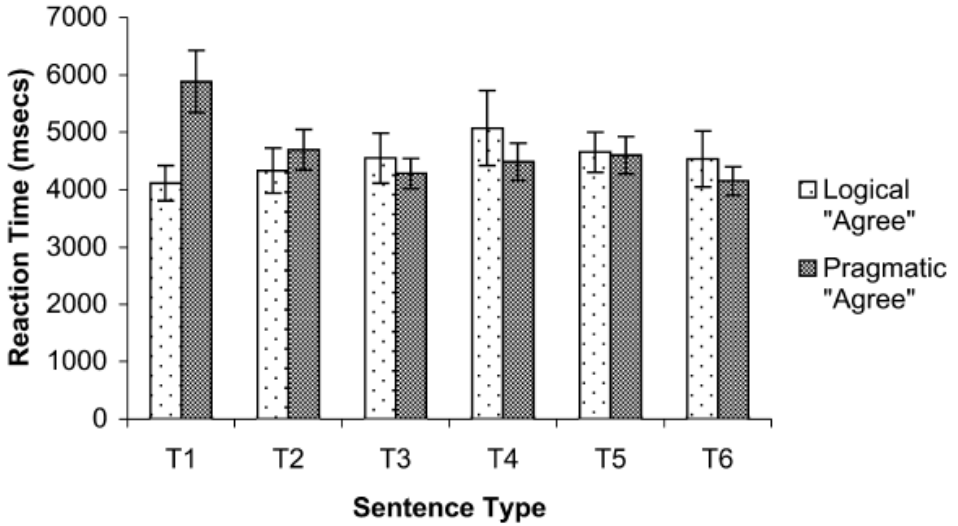




Bott & Noveck (2004)

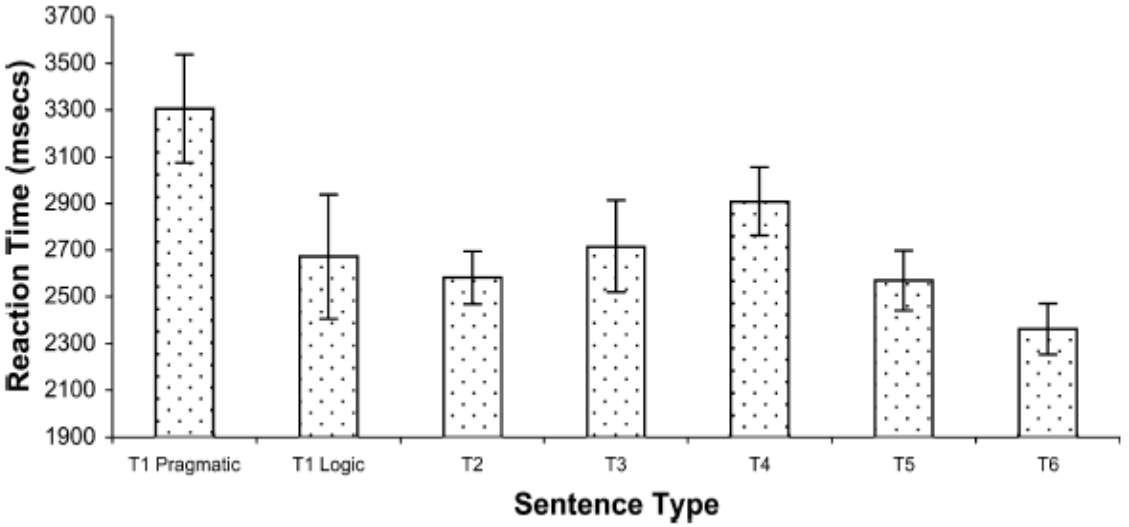
- Both experiments are problematic because of the explicit instructions. It could be that the strategy employed in this task is not identical to the one for naturalistic conditions.
- Experiment 3 replicates experiment 1 without the instructions.
- N=32

Bott & Noveck (2004)

Table 2
Proportion responding "True" to each of the Sentence Types in 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)

- While all three experiments provide evidence against the default meaning view, they do not provide evidence for the relevance theory view directly.
- The relevance theory view argues that implicatures are "cognitive effects determined by the situation".
- Experiment 4 aims to address this by "varying the cognitive resources available to participants".
- In some conditions, the subjects had to answer quickly (short lag), and in others, they had more time to think.

Bott & Noveck (2004)

- In some conditions, the subjects had to answer quickly (short lag), and in others, they had more time to think.
- Long lag was equivalent to the time in experiments 1-3 (up to 3 seconds).
- Short lag was 900 ms.
- 45 subjects overall, of which 20 got long lag and 25 short lag.

Bott & Noveck (2004)

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.

Bott & Noveck (2004)

- Short lag increases the chance of a "logical" response.
- Conclusion: implicatures are affected by cognitive resources.

- But, how does this actually tell the relevance theory views apart from non-default Neo-Gricean views?
- Also, remember Papafragou & Tantalou (2004) – *ad hoc* implicature easier than quantifier implicatures.

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When People Are More Logical Under Cognitive Load

Dual Task Impact on Scalar Implicature

Wim De Neys and Walter Schaeken

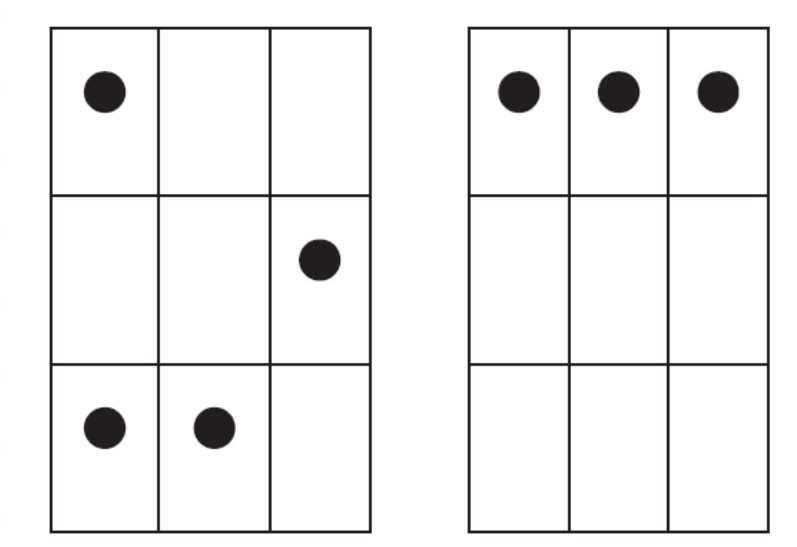
University of Leuven, Belgium

De Neys & Schaeken (2007)

- Similar to Bott & Noveck experiment 4, this experiment tries to test implicature calculation under reduced cognitive load.
- Like Noveck and his co-authors, De Neys & Schaeken consider Levinson to be the representative of the Neo-Griceans.

De Neys & Schaeken (2007)

- In this experiment, subjects judged sentences while concurrently trying to remember a visual dot pattern.
- The complexity of the dot pattern was varied.



De Neys & Schaeken (2007)

Experiment 2 results:

	Hard	Easy
Underinformative Correct (pragmatic) responses	73.2%	78.9%
Filler correct responses	93.6%	93.0%

De Neys & Schaeken (2007)

- Conclusion: memorizing dots make implicature calculation harder.
- Thus, implicature calculation is effortful, not default.

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Are generalised scalar implicatures generated by default? An on-line investigation into the role of context in generating pragmatic inferences

Richard Breheny[a,*], Napoleon Katsos[b], John Williams[b,1]

[a]*Department of Linguistics, University College London, London WC1E 6BT, UK*
[b]*RCEAL, University of Cambridge, Cambridge, UK*

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Breheny, Katsos & Williams (2006)

- Three studies that attempt to compare the default vs. context-driven views of implicature processing.
- First experiment replicates an earlier experiment by Bezuidenhout and Cutting (2002), using better controlled items.
- Bezuidenhout and Cutting used numeral implicatures which we have already seen are problematic. They also treated possessive phrases as implicature triggers, which is not a usual move.
- Breheny, Katsos & Williams replicated the experiment using *or*.

Breheny, Katsos & Williams (2006)

- The experiment was a self-paced reading experiment.
- There were two contexts – upper bound, which supported the exclusive reading, and lower bound, which support the inclusive reading.

Table 1
The English translation of an item from Experiment 1

Upper-bound context
John was taking a university course/and working at the same time./For the exams/he had to study/from short and comprehensive sources./Depending on the course,/he decided to read/the class notes or the summary./
Lower-bound context
John heard that/the textbook for Geophysics/was very advanced./Nobody understood it properly./He heard that/if he wanted to pass the course/he should read/the class notes or the summary./

Note: The critical phrase is in italics, but was presented in the standard font in the experiment.

Breheny, Katsos & Williams (2006)

Experiment 2 results:

	RT
Upper bound (exclusive)	1291
Lower bound (inclusive)	1204

Breheny, Katsos & Williams (2006)

- The data shows that contexts that support inclusive readings are read faster.
- This is consistent with a view where implicatures are not default, but rather arise only in contexts that require them.

Breheny, Katsos & Williams (2006)

- The second experiment tests neutral contexts (one where there is no information as to whether the implicature is relevant).

12a. Meriki apo tus simvulus ihan sinadisi me to diefthidi.
Some-nom pl. of the consultants-acc. had-3rd pl. past meeting-acc. with the director-acc.
I ipolipi den kataferan na parevrethoun.
The rest-nom pl. neg managed-3rd pl. attend-3rd pl. past. subj
(Some of the consultants had a meeting with the director. The rest did not manage to attend.)

b. O diefthidis ihe sinadisi me merikus apo tus simvulus.
The director-nom. had-3rd pl. meeting-acc. with some-acc pl. of the consultants-acc.
I ipolipi den kataferan na parevrethoun.
The rest-nom pl. neg managed-3rd pl. attend-3rd pl. past. subj
(The director had a meeting with some of the consultants. The rest did not manage to attend.)

Breheny, Katsos & Williams (2006)

- They argue that sentence-final positions are less important informationally that sentence-initial positions, and thus those contexts are less likely to give rise to implicatures.
- They predict that in the second sentence, “the rest” will be easier to read if the implicature in the first sentence was calculated.
- They used controls with “only some”, in which the “not all” reading must be generated.

Breheny, Katsos & Williams (2006)

Table 3
Mean reading time on the target segment 'the rest' or 'the other(s)' in Experiment 2

	Reading time (milliseconds)	Standard deviation
Sentence initial-'some'	613	125
Sentence initial-'only some'	611	110
Sentence final-'some'	628	138
Sentence final-'only some'	586	112

Breheny, Katsos & Williams (2006)

- Overall, both experiments (and the third I have not discussed) support a context-driven view.
- The authors point out that being context-driven does not necessarily mean accepting the relevance-theory approach.
- Rather, they propose an “interactive” default view which accords roles to both structural and contextal factors in implicature calculation.