Incremental Processing of Quantificational Restriction: Evidence from Cross-Modal Probe Recognition

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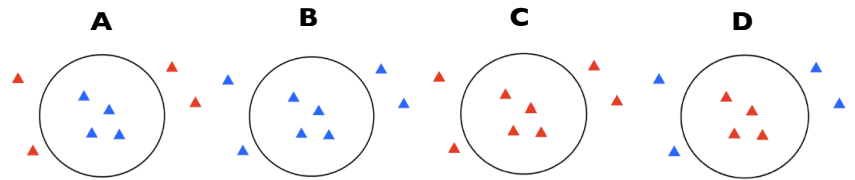
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Background

- Concept of **incrementality** in sentence processing: generally acknowledged with respect to syntactic processing

- Does **compositional semantic interpretation** proceed in a comparable fashion?
  - → Mixed results in previous studies, e.g. from the domain of quantifier processing: (see Wjinen & Kaan, 2006; Bott & Schlotterbeck, 2013).

  (1) Sind alle Dreiecke **blau**, die im Kreis sind?
  Are all triangles blue, that are in the circle?

  - → A local truth evaluation is principally possible on the colour adjective.
  - → A following restriction can lead to a required shift in truth values (e.g. in contexts as in A).

Materials

A **B** **C** **D**

(2) Sind alle Dreiecke **blau**, die im Kreis sind?
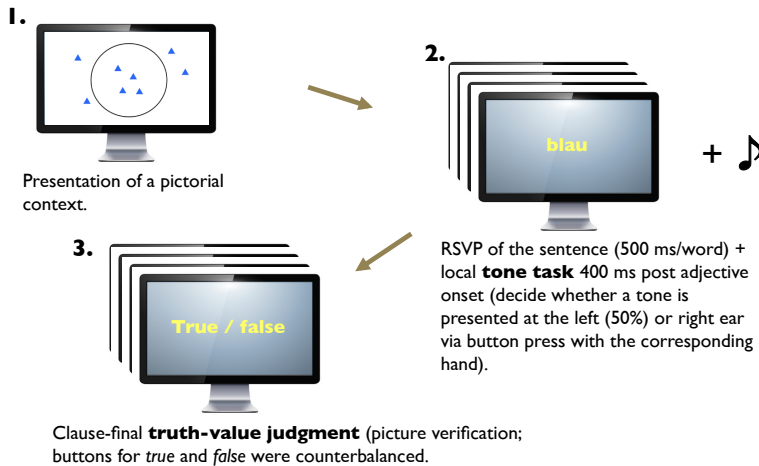Are all triangles blue, that are in the circle?

(3) Sind alle Dreiecke **blau**, die außerhalb des Kreises sind?
Are all triangles blue, that are out-of the circle?

	Local	Global	Shift?
A	false	true	yes
B	true	true	no
C	false	false	no
D	false	false	no

	Local	Global	Shift
A	false	false	no
B	true	true	no
C	false	false	no
D	false	true	yes

. 64 picture-sentence pairs + 64 filler items

The Paradigm: Dual Task

1. Presentation of a pictorial context.

2. RSVP of the sentence (500 ms/word) + local **tone task** 400 ms post adjective onset (decide whether a tone is presented at the left (50%) or right ear via button press with the corresponding hand).

3. Clause-final **truth-value judgment** (picture verification; buttons for *true* and *false* were counterbalanced.

Response preparation (facilitation effect) when the tone evaluation and the truth evaluation trigger the same motor response.

Hypotheses

H1: **Incrementality**: Faster reaction times for the tone evaluation in all contexts when the answer button for the tone task corresponds to the button for the locally assigned meaning.

H2: **Delayed truth evaluation**: no mid-sentence facilitation for the tone task, but clause-final decisions correspond to global judgments.

H3: **Avoiding the risk of reanalysis**: local facilitation for B and C, as the final semantic value is already available on the adjective. No such facilitation for A and D, as potentially following material can induce meaning shifts.

Analyses and Results (n = 64)

Tone task ♪♪

Factors: **Context** (A-D) and **Congruency** (congruent vs. incongruent answer button for local judgments and the tone task).

	A +	A -	B +	B -	C +	C -	D +	D -
RT (ms)	365.8	368.9	350.9	352.8	360.1	375.3	366.9	369.4
Correct (%)	96.1	96.6	97.2	95.8	97.2	95.2	96.7	96.1

RTs: Context: (F(3,189) p <.001 (B vs. other context all p's <.001); all other contexts comparisons p > .9); Identity: F(1,63) = 5,17; p < .05). No interaction (p > .2)

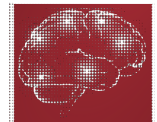**% Correct**: marginally significant effect of Context: p <.07

Truth value judgment ??

Factors: **Complexity** (simple (B and D) vs. complex (A and D) and **Truth Value** (sentence-finally: true vs. false).

	True simple	True complex	False simple	False complex
RT (ms)	303.5	328.9	293.5	339.1
Correct (%)	92.1	86.0	92.9	83.3

RTs: Complexity: (F(1,63)=30.3; p <.001); Truth Value x Complexity (F(1,63)=4.4; p<.05); false: F(1,63)=26.7; p<.001; true: F(1,63)=13.2; p=.001)

% Correct: Complexity: (F(1,63)=64.0; p <.001); Truth Value Complexity (F(1,63)=8.6; p<.01); false: F(1,63)=57.1; p<.001; true: F(1,63)=35.4; p=.001)

. The present results are the basis for future studies using the *Lateralized Readiness Potential* (LRP)

Summary

- Evidence for **H1:** shorter RTs when the answer button for the tone evaluation corresponded to the locally assigned truth value: **incremental mid-sentence response preparation.**

- Additional facilitation effect for Context B. This effect cannot be straightforwardly explained by any of the above-mentioned hypotheses.

- Contrary to the predictions of H3: no interaction between Context and Identity was found.

- Overall good performance (90%), but no indication of costs for required shifts in truth values.

Result in a nutshell: The semantic evaluation of questions involving quantificational restriction proceeds rapidly and **in an incremental manner**.