

A PROBABILISTIC ACCOUNT OF
VERB PHRASE ELLIPSIS
INTERPRETATION IN CONTEXT
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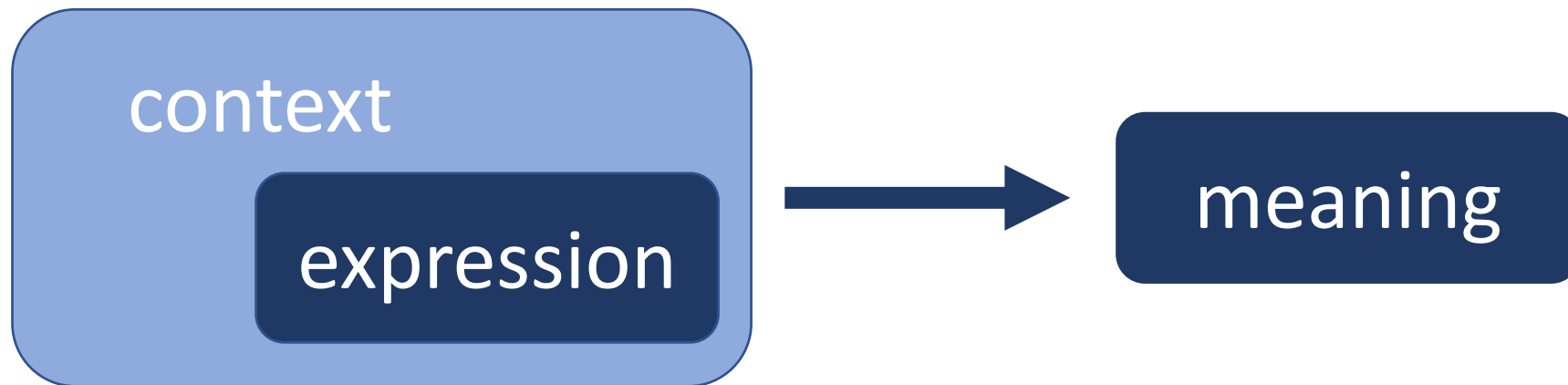
FORM-MEANING MAPPING

Linguistic expressions encode literal meanings:



FORM-MEANING MAPPING

Utterances used in context can have augmented meanings:



A: *Don't* !



Verb phrase ellipsis: Expression is inherently incomplete!

A: *Don't* !



Verb phrase ellipsis: Expression is inherently incomplete!

Today: How do we interpret verb phrase ellipsis?

More broadly: How do we recruit linguistic and contextual information to interpret context-sensitive expressions?

B: *I'm going to move this candle.*

A: *Don't ___!*

Observation 1:

A prior linguistic antecedent is sufficient for interpretation.

Identity of form:

(Sag 1976, Hankamer & Sag 1976, Rooth 1992, Fiengo & May 1994, i.a.)

Identity of meaning:

(Dalrymple et al. 1991, Hardt 1993, Ginzburg & Sag 2000, Merchant 2001, i.a.)

Identity w.r.t. augmented antecedent:

(Fox 1999, Arregui et al. 2006, van Craenenbroeck 2013, Thoms 2015, i.a.)

B: *I'm going to move this candle.*

A: *Don't move this candle!*

Observation 1:

A prior linguistic antecedent is sufficient for interpretation.



A: Don't ___!

Observation 2:

An informative context is sufficient for interpretation.

Interpretation w.r.t. context:

(Hankamer & Sag 1976, Schachter 1977, Webber 1978, Hardt 1992, Kehler 1993, Merchant 2004, Miller & Pullum 2013, Poppels & Kehler 2018, i.a.)



A: *Don't touch the flame!*

Observation 2:

An informative context is sufficient for interpretation.



B: *I'm going to move this candle!*

A: *Don't ___!*

Don't move the candle?

Don't touch the flame?

How is VPE interpreted in complex discourse contexts?

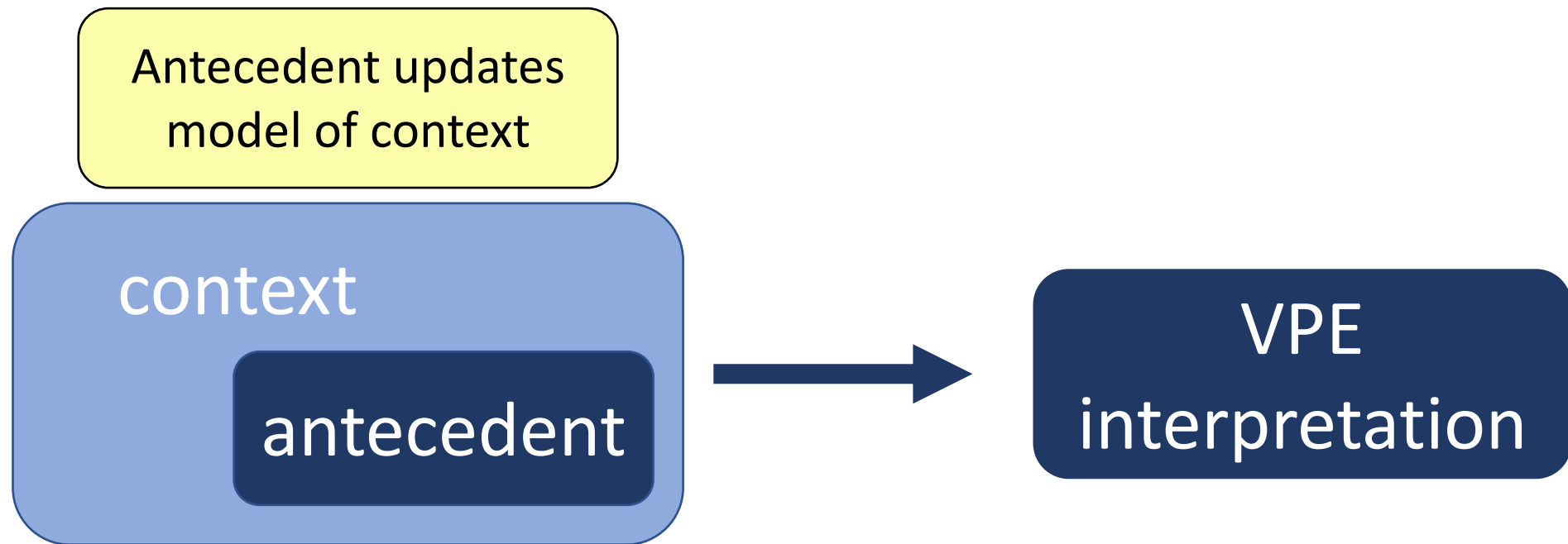
- 1) General discourse resolution
- 2) Interpretation via linguistic antecedent
- 3) A combination of both strategies

More broadly, the missing material in VPE makes it a good case study for probing the mapping between **linguistic form**, mental representations of **discourse contexts**, and **meaning**.

General Discourse strategy:

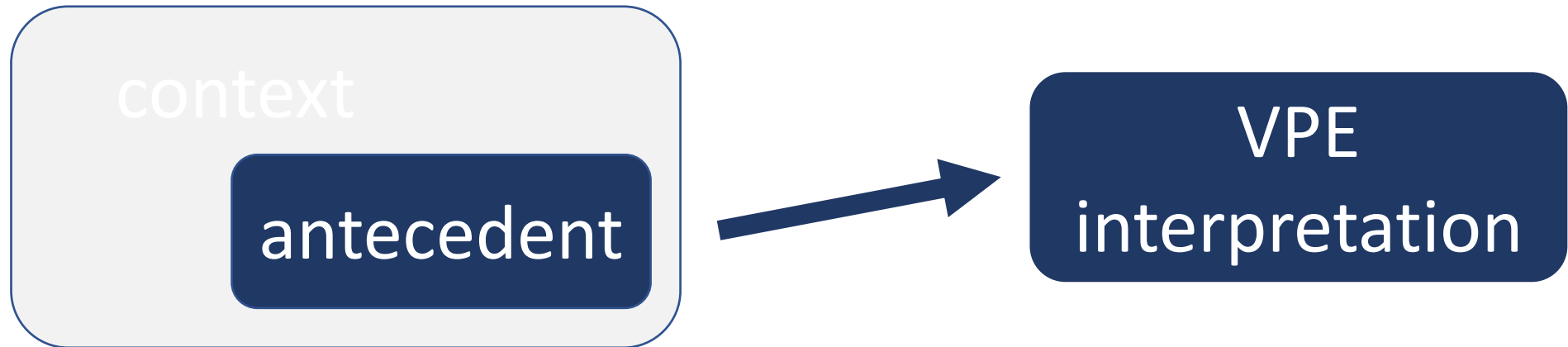
(cf. Miller & Pullum 2013)

Interpret VPE by retrieving the most salient proposition from the discourse context.



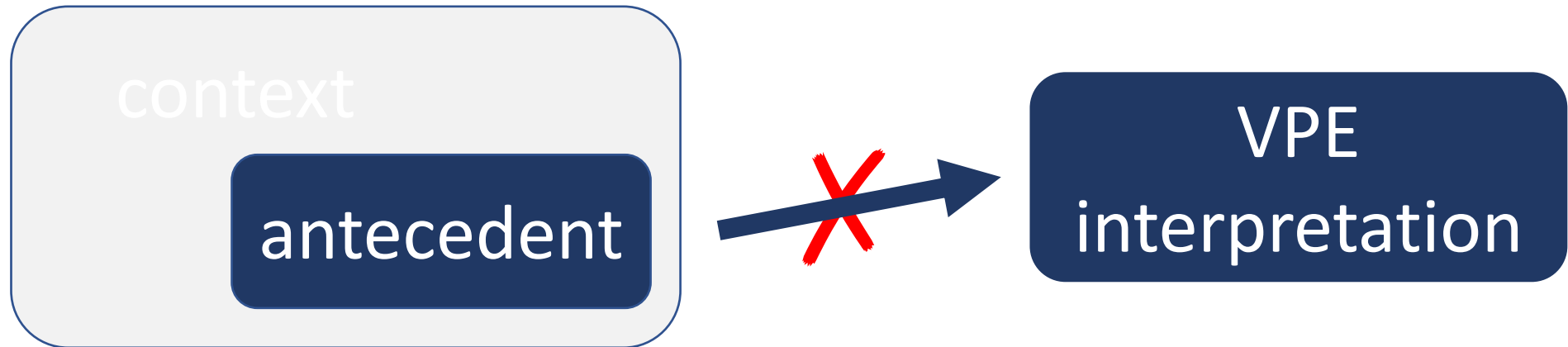
Linguistic Antecedence strategy:

Preferentially use linguistic antecedent to fill in missing content at ellipsis site.



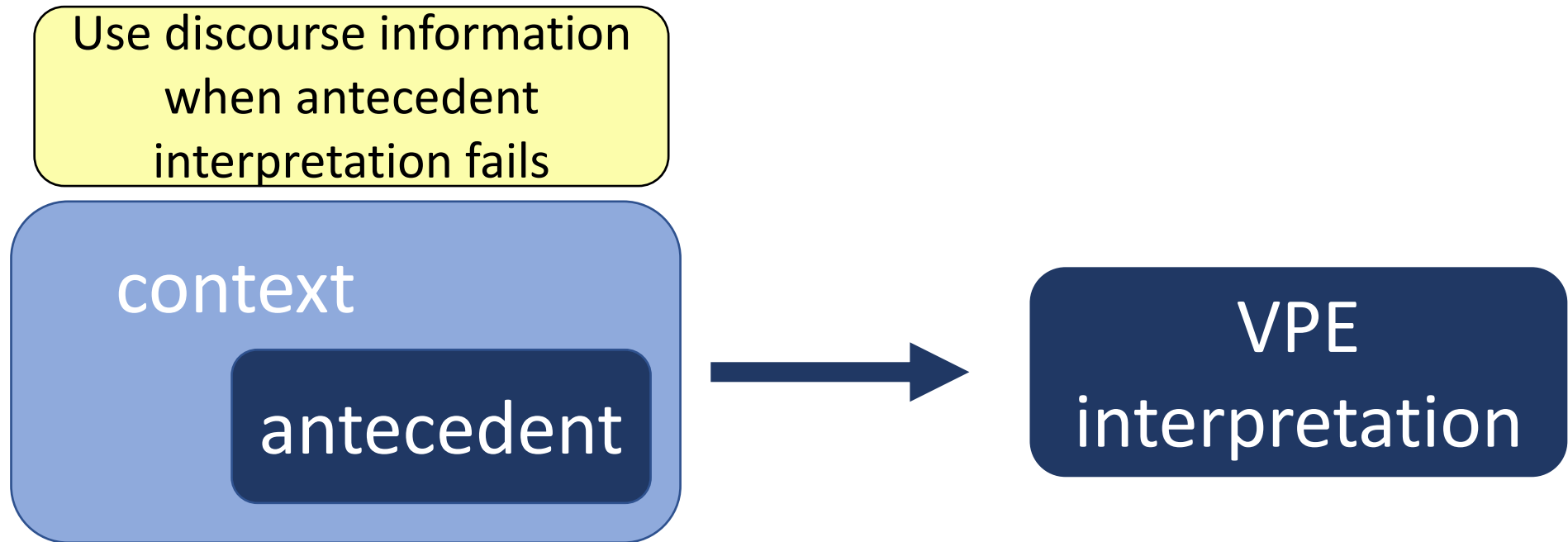
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Linguistic Antecedence strategy:

Preferentially use linguistic antecedent to fill in missing content at ellipsis site.



CURRENT STUDY

Experiments 1 & 2: Assessing VPE interpretation in context

Neither the **General Discourse** nor the **Linguistic Antecedence** strategy sufficiently predicts VPE interpretation

Modeling:

The best model of VPE interpretation proportionally combines **both strategies**

The **linguistic antecedent** influences interpretation beyond its contribution to discourse status.

EXPERIMENTAL PARADIGM



Son: I want to buy candy bars!

Father: We can't.

6 critical scenarios

9 conditions per scenario

EXPERIMENTAL PARADIGM



comic strip context
(3-way manipulation)

Son: I want to buy candy bars!

Father: We can't.



Context 1

low support



Context 2

middle support



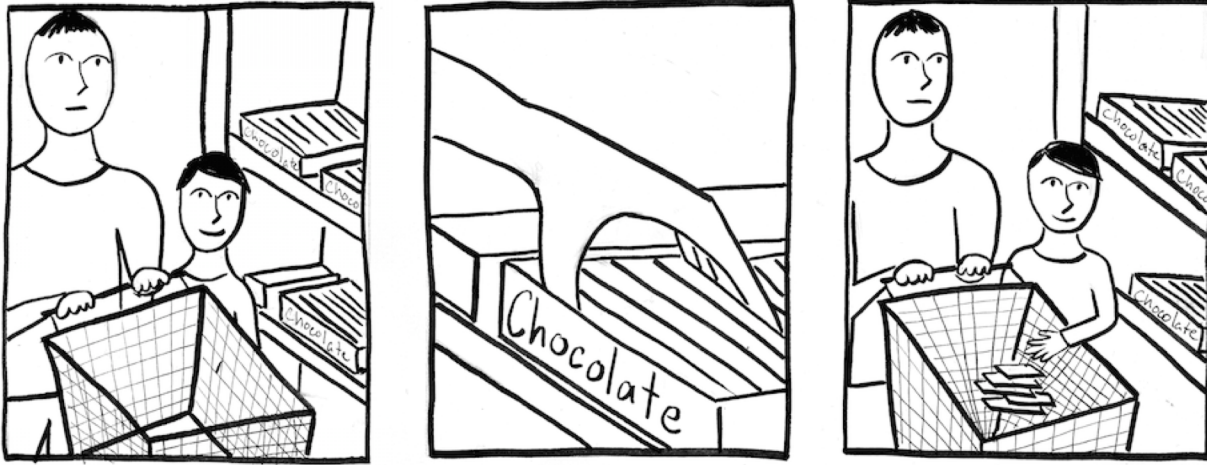
Context 3

high support



increasing
contextual
support for
number
information

EXPERIMENTAL PARADIGM



Son: I want to buy candy bars!

Father: We can't.

linguistic antecedent
(3-way manipulation)

[no utterance]

Antecedentless

Son: I want to buy
candy bars!

**No-numeral
antecedent**

Son: I want to buy
five candy bars!

**Numeral
antecedent**



increasing
formal
support for
number
information

EXPERIMENTAL PARADIGM



Son: I want to buy candy bars!

Father: We can't.

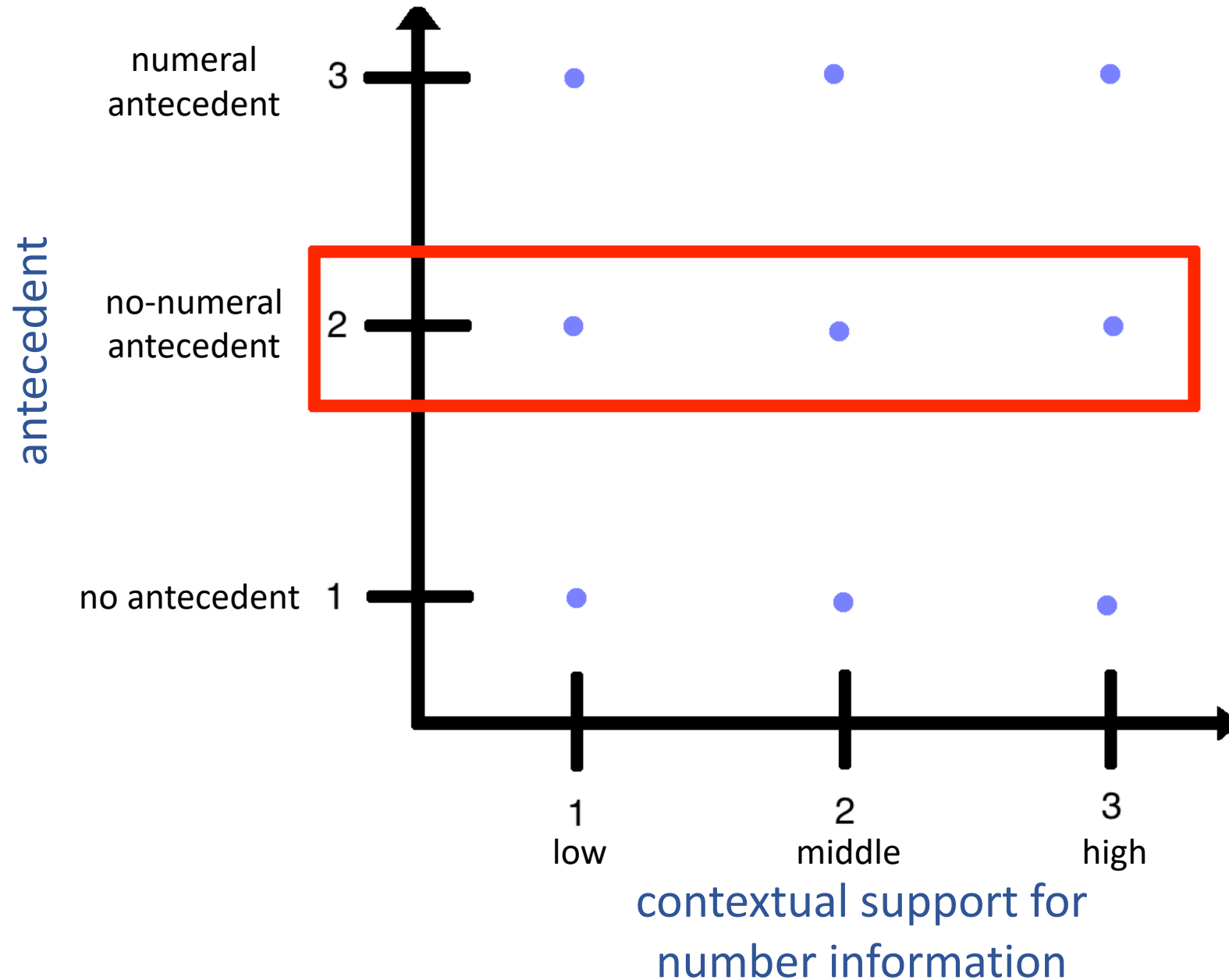
VPE reply

Given the manipulations in

contextual support for number information

formal support for number information

Is the **VPE site** interpreted as **containing number information**?



Son:
I want to buy
candy bars!

Full data
available in
question
period

Linguistic Antecedence strategy

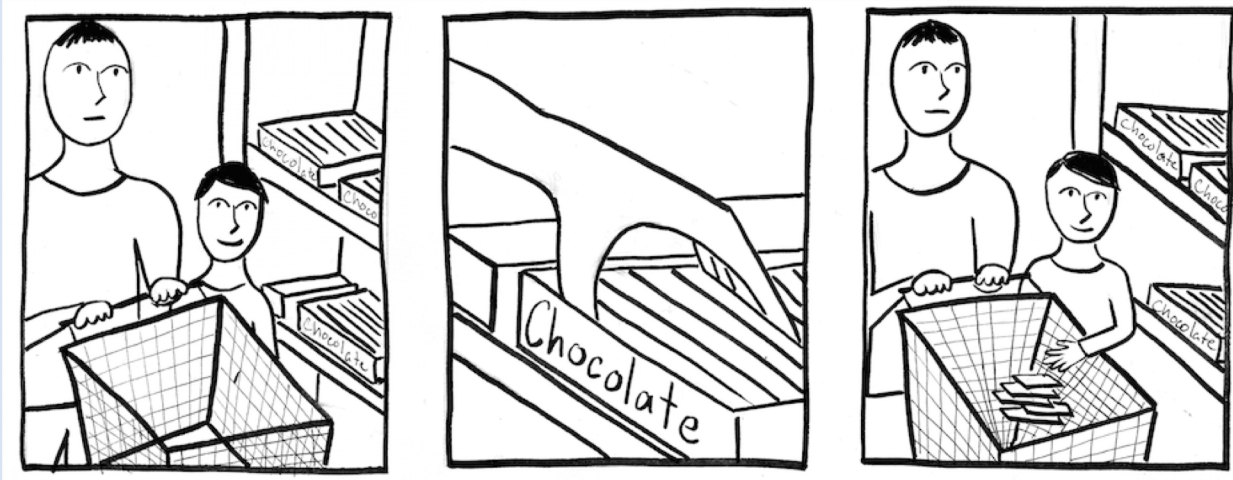


Son: I want to buy candy bars! antecedent

Father: We can't buy candy bars. VPE

Use
linguistic
antecedent
content

General Discourse strategy



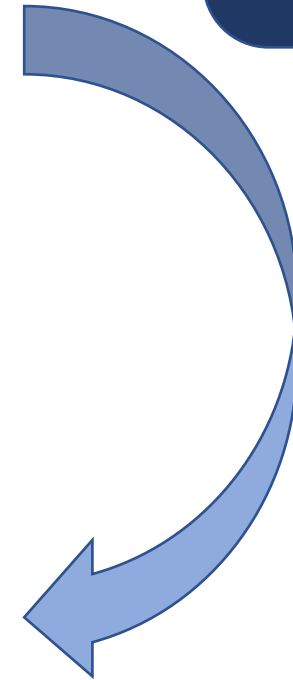
context

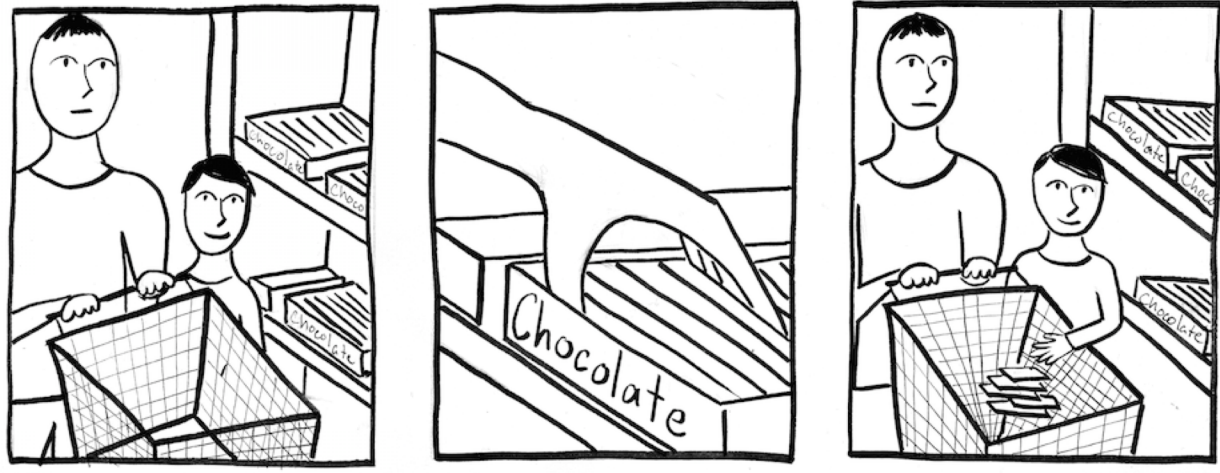
Son: I want to buy candy bars! antecedent

Father: We can't.

VPE

Use most salient proposition





Son: I want to buy candy bars!

Father: We can't.

First, we'll assess the most salient proposition intended by the son.

EXPERIMENT 1: MOST SALIENT PROPOSITION



Context 1

or

Context 2

or

Context 3

Son: I want to buy candy bars!

Which of the following do you think is most likely?

Which of the following do you think is most likely?


A:

The son wants to buy candy bars, but doesn't care how many.

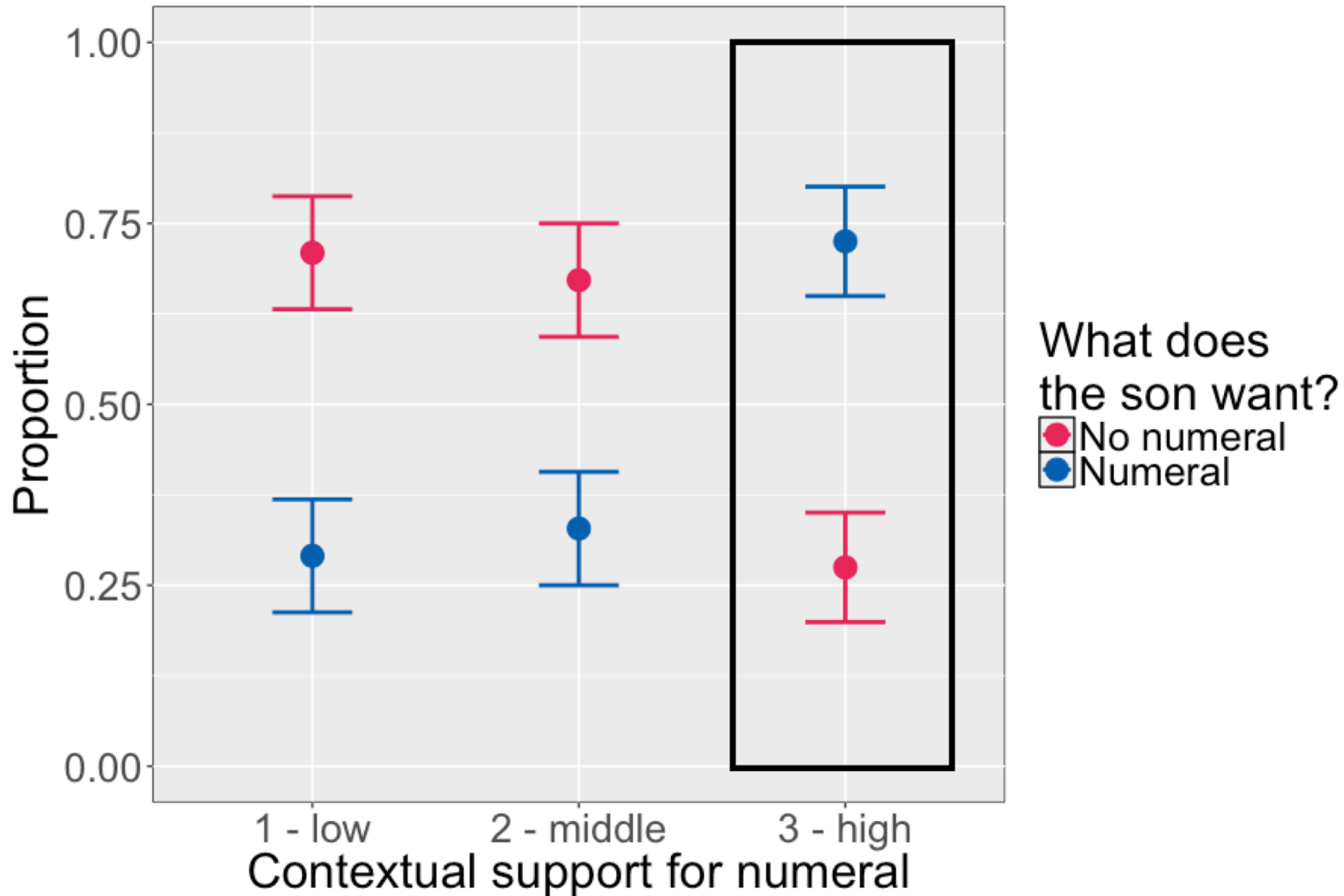
> 0 
no numeral

B:

The son wants to buy a specific number of candy bars.

$= n$ 
numeral

Son: I want to buy candy bars!



Contextual support for number information significantly changes ratings of proposition intended by son

EXPERIMENT 2: VPE INTERPRETATION



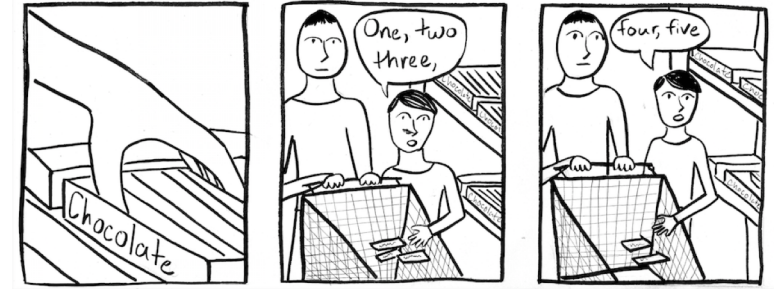
Context 1

or



Context 2

or



Context 3

Son: I want to buy candy bars!

Father: We can't.

Do you think it is more likely that **the father** meant:

Do you think it is more likely that **the father** meant:

A:

We can't buy any candy bars.



= 0



no numeral

B:

We can't buy five candy bars, but maybe we could buy fewer.



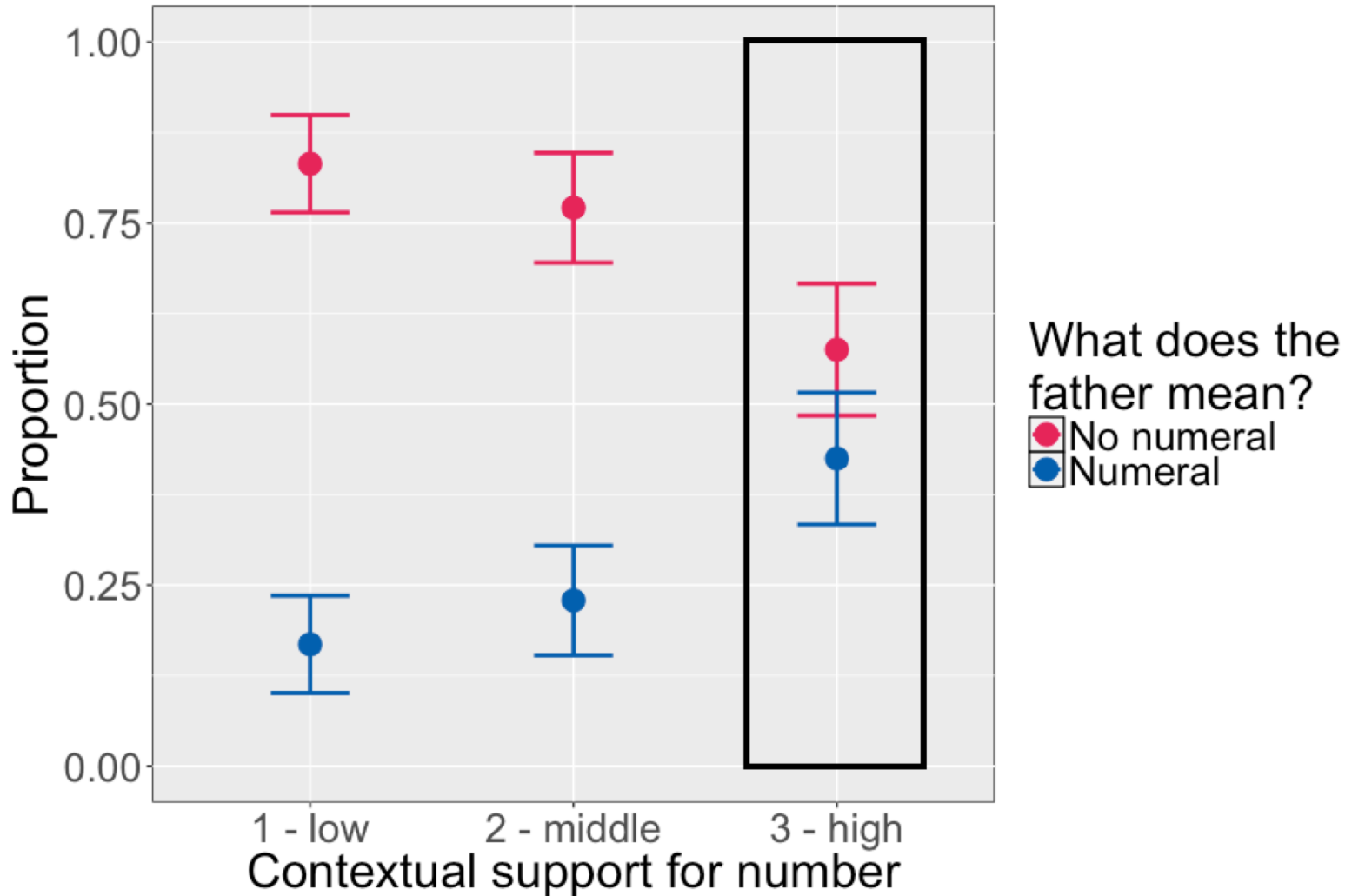
< n



numeral

Son: I want to buy candy bars!

Father: We can't (buy candy bars).

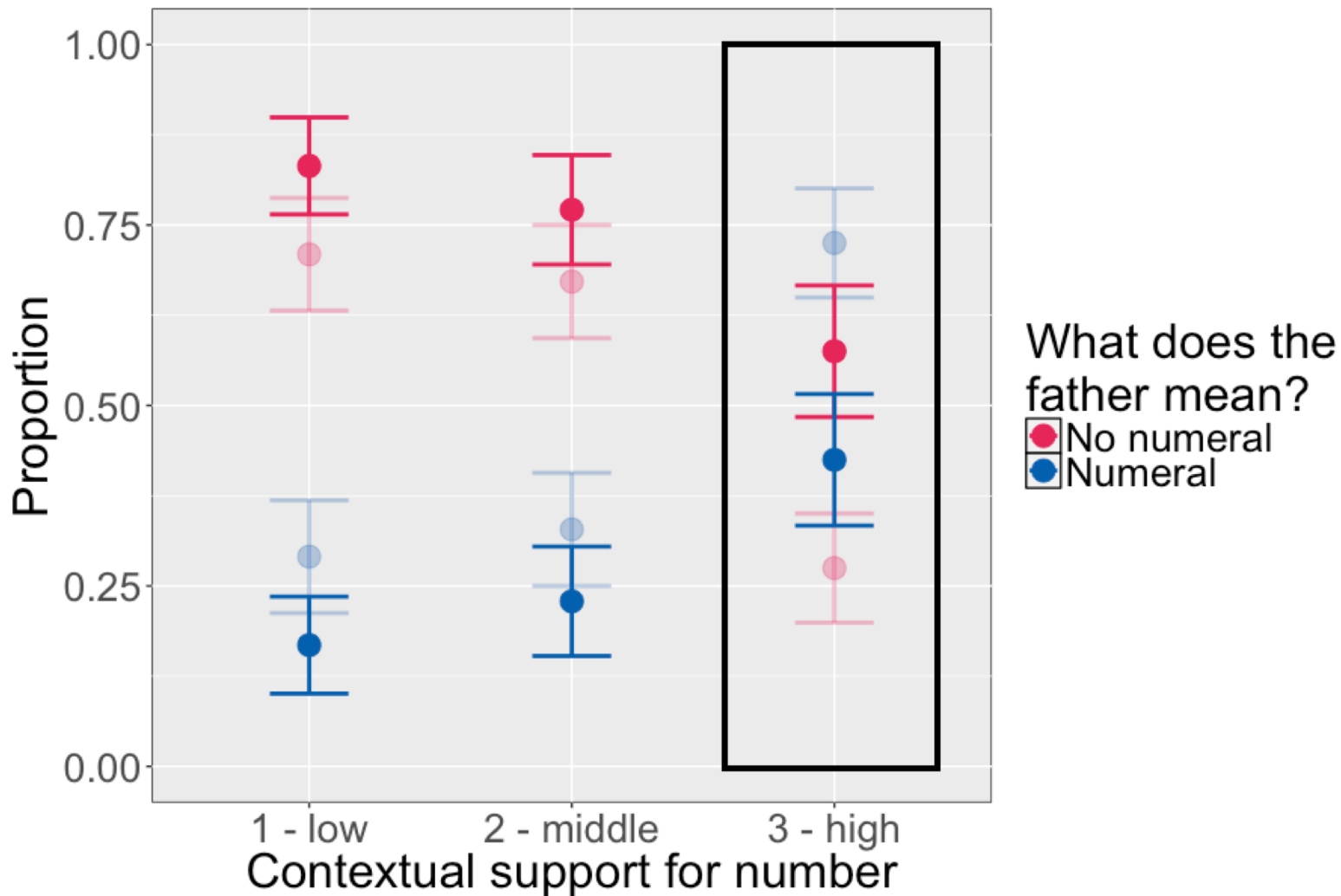


Strict Linguistic Antecedence strategy predicts categorical preference for **no numeral** interpretation (red).

This prediction fails.

salient discourse proposition

Father: We can't.



General Discourse strategy predicts interpretation will closely track salient proposition in discourse.

This prediction also fails.

Neither interpretive strategy on its own can adequately predict the observed data.

The observed interpretations are intermediate between the predictions of the two models.

This points to an interpretive mechanism combining **both strategies**.

To explicitly model this interaction, we constructed **three models** of interpretation.

General Discourse model:

Interpretation with respect to discourse status

Linguistic Antecedence model:

Interpretation with respect to linguistic antecedent

Hybrid model:

Proportionally combines the two interpretive strategies

$$P(\text{Interpretation}) \propto \llbracket \text{utterance} \rrbracket \cdot \text{Prior}$$

↑
estimated
in Expt 2

↑
1 or 0

↑
estimated
in Expt 1

(Franke 2009, Jäger 2011, Frank & Goodman 2012, Goodman & Stuhlmüller 2013, Bergen & Goodman 2015, Lassiter & Goodman 2017)

General Discourse model

$$P(\text{Interpretation}) \propto \llbracket \text{VPE} \rrbracket_{\text{discourse}} \cdot \text{Prior} + \text{Noise}$$



always 1

Formally:
$$P(m|u, c) = (1 - \epsilon) \cdot P(m|c) + \epsilon \frac{1}{|M|}$$

Linguistic Antecedence model

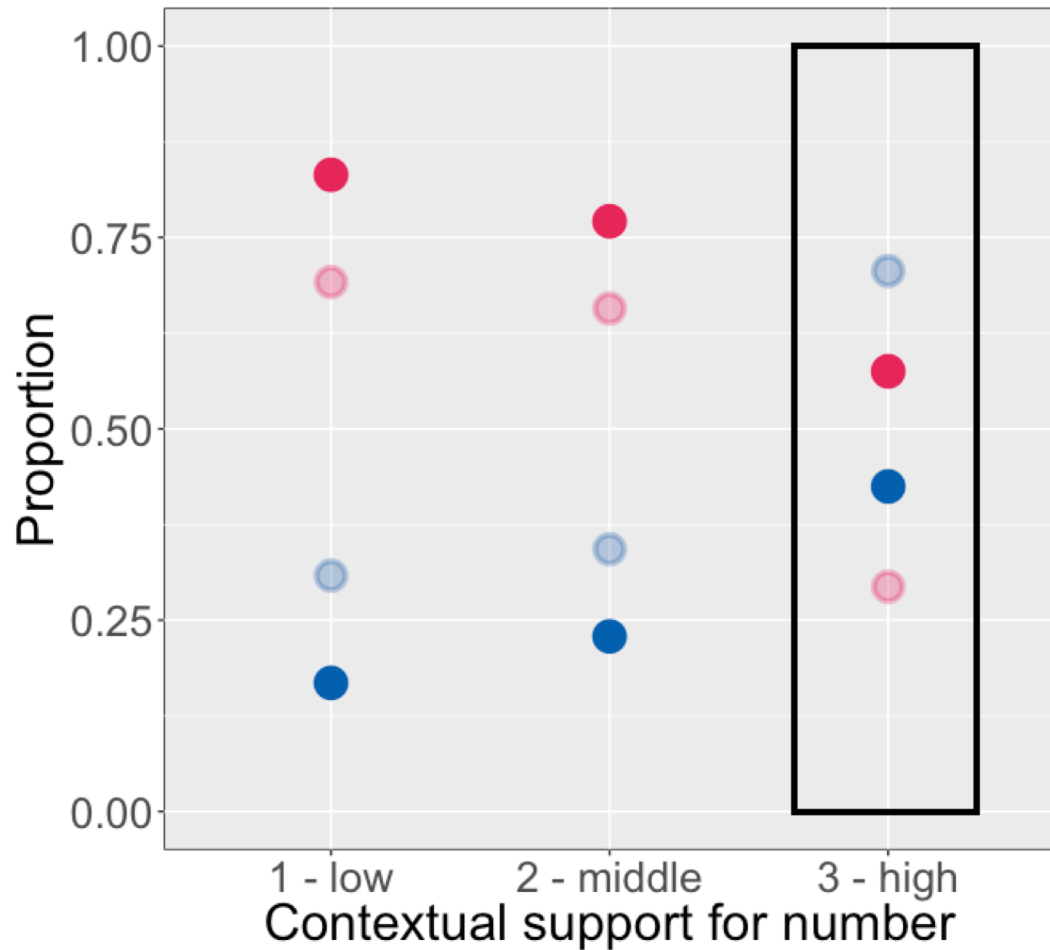
$$P(\text{Interpretation}) \propto \llbracket \text{VPE} \rrbracket_{\text{linguistic}} \cdot \text{Prior} + \text{Noise}$$



1 or 0 depending on
linguistic antecedent

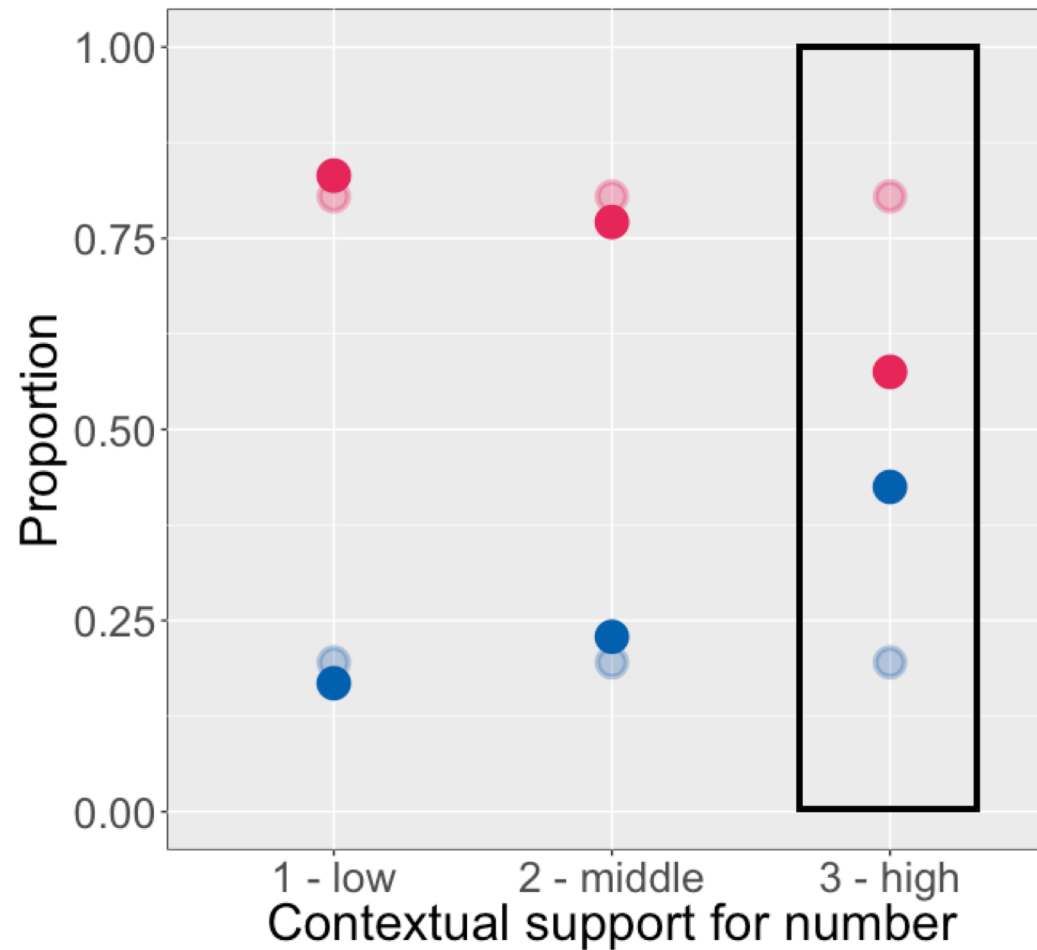
Formally:
$$P(m|u, c) = (1 - \epsilon) \frac{\llbracket u \rrbracket_{\text{linguistic}}^{m,c} \cdot P(m|c)}{\sum_{m' \in M} \llbracket u \rrbracket_{\text{linguistic}}^{m',c} \cdot P(m'|c)} + \epsilon \frac{1}{|M|}$$

General Discourse model



Overestimates role of broad discourse status

Linguistic Antecedence model



What does the father mean?
● No numeral
● Numeral

Underestimates role of broad discourse status

Hybrid model

$$P(\text{Interpretation}) \propto \beta \cdot \text{Linguistic} + (1 - \beta) \cdot \text{Discourse} + \text{Noise}$$



same as
Linguistic
Antecedence
model



same as
General
Discourse
model

Formally:

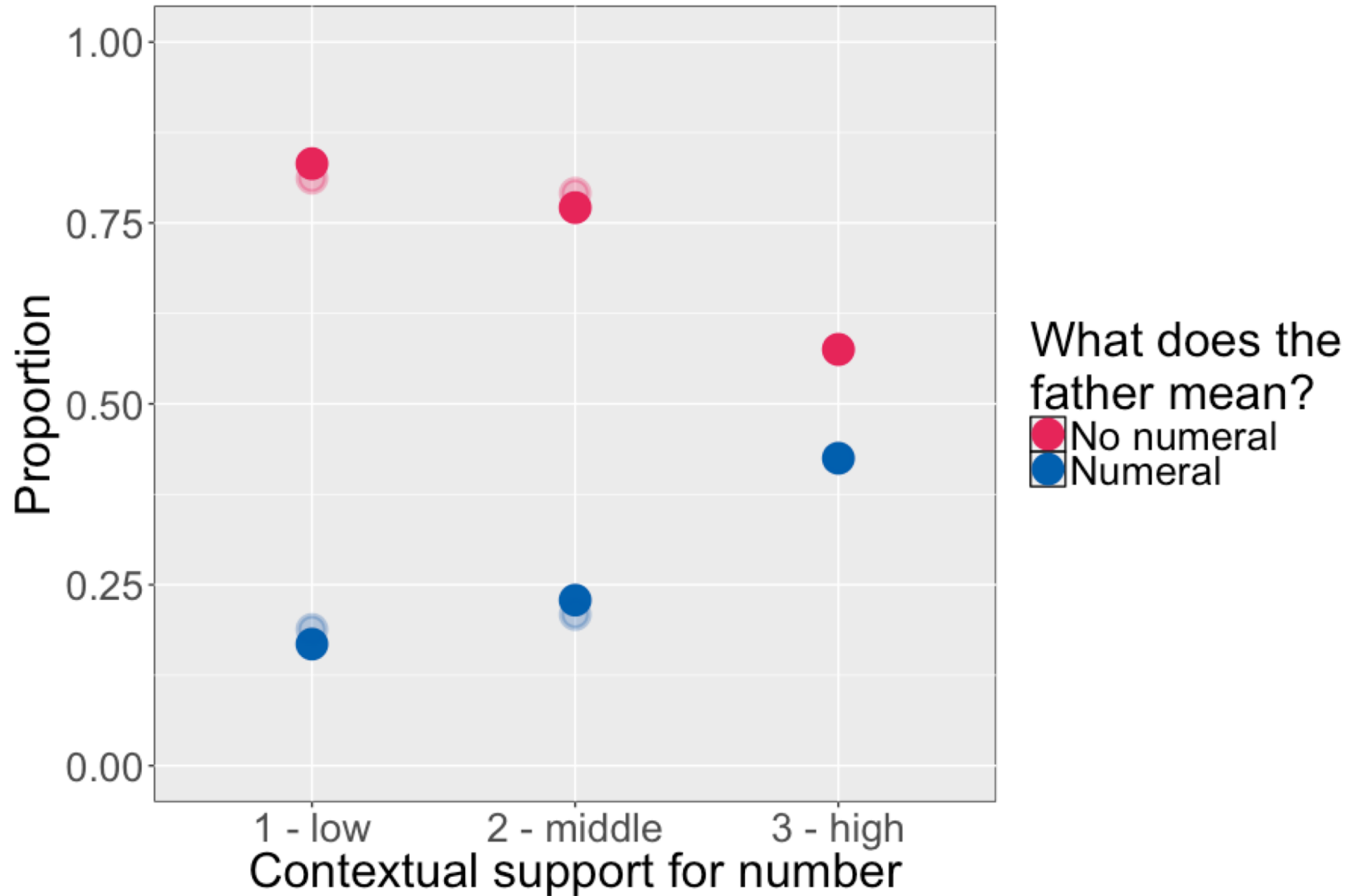
$$P(m|u, c) = (1 - \epsilon) \left(\beta \cdot \frac{[[u]]_{\text{linguistic}}^{m,c} \cdot P(m|c)}{\sum_{m' \in M} [[u]]_{\text{linguistic}}^{m',c} \cdot P(m'|c)} + (1 - \beta) \cdot P(m|c) \right) + \epsilon \cdot \frac{1}{|M|}$$

Hybrid model

Maximum
Likelihood
Estimate:

$$\beta = .420$$

Based on all
data
(9 conditions)



CONCLUSION

Both **experimental** and **modeling** evidence show that VPE interpretation is sensitive to both the **linguistic antecedent's form** and the interpretations' broader **discourse status**.

Interpretation is constrained by **linguistic antecedents** beyond their contribution to **discourse status**.

The **mechanism** by which the two information sources are combined is unspecified and worthy of study.

THANKS TO...



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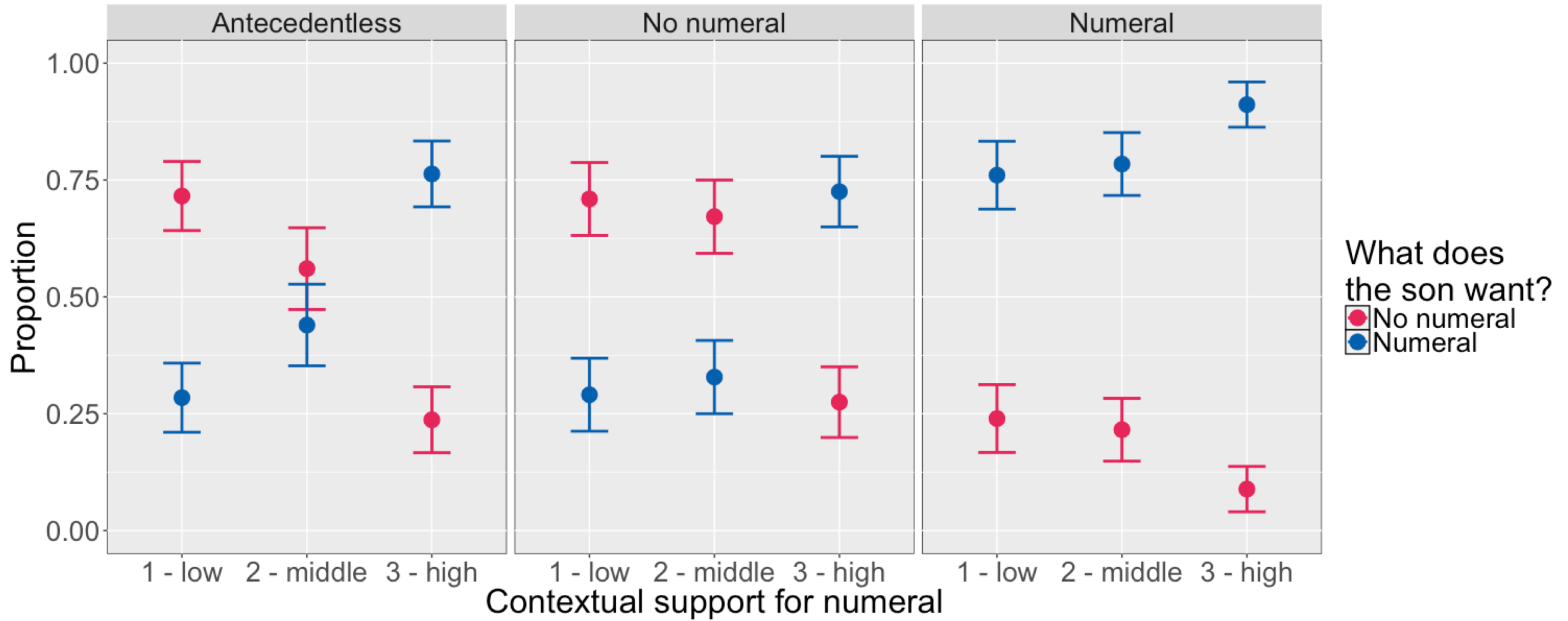
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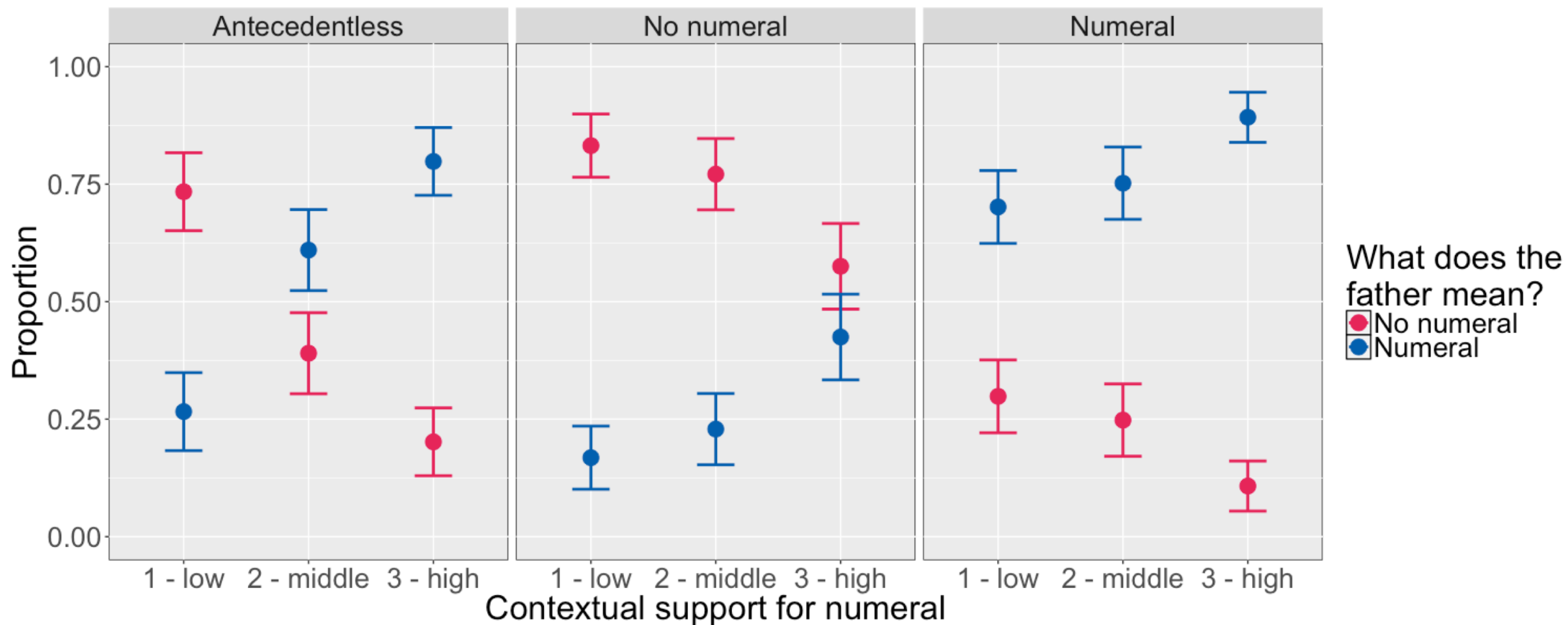
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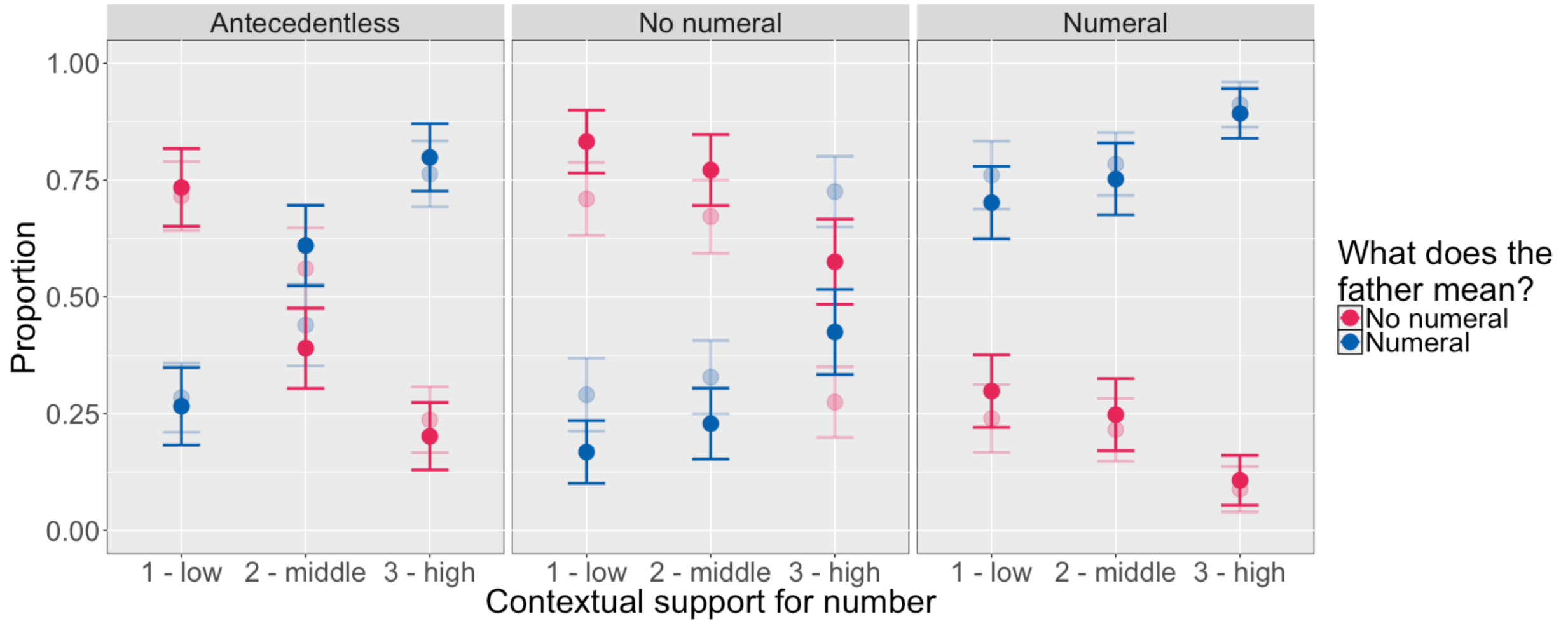
Experiment 1 (prior) results – 9 conditions



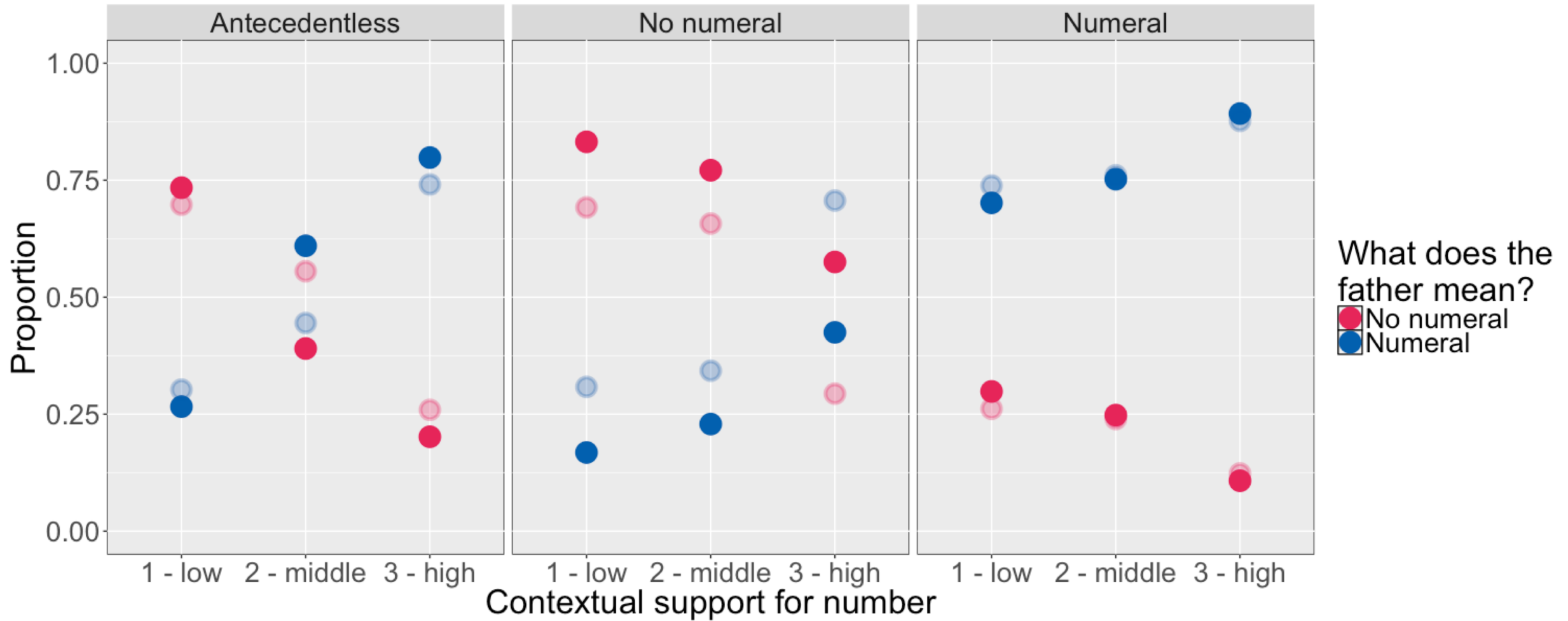
Experiment 2 (VPE interpretation) results – 9 conditions



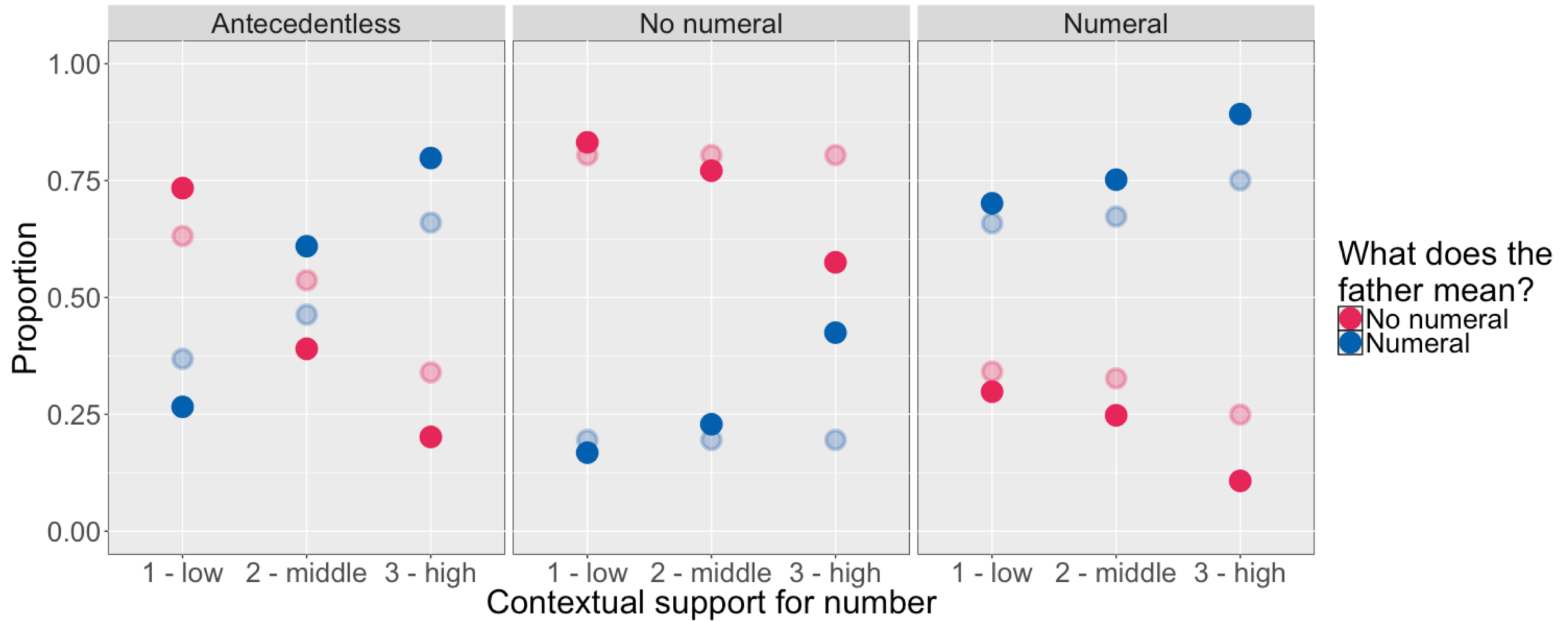
Expt 1 vs. Expt 2 – 9 conditions



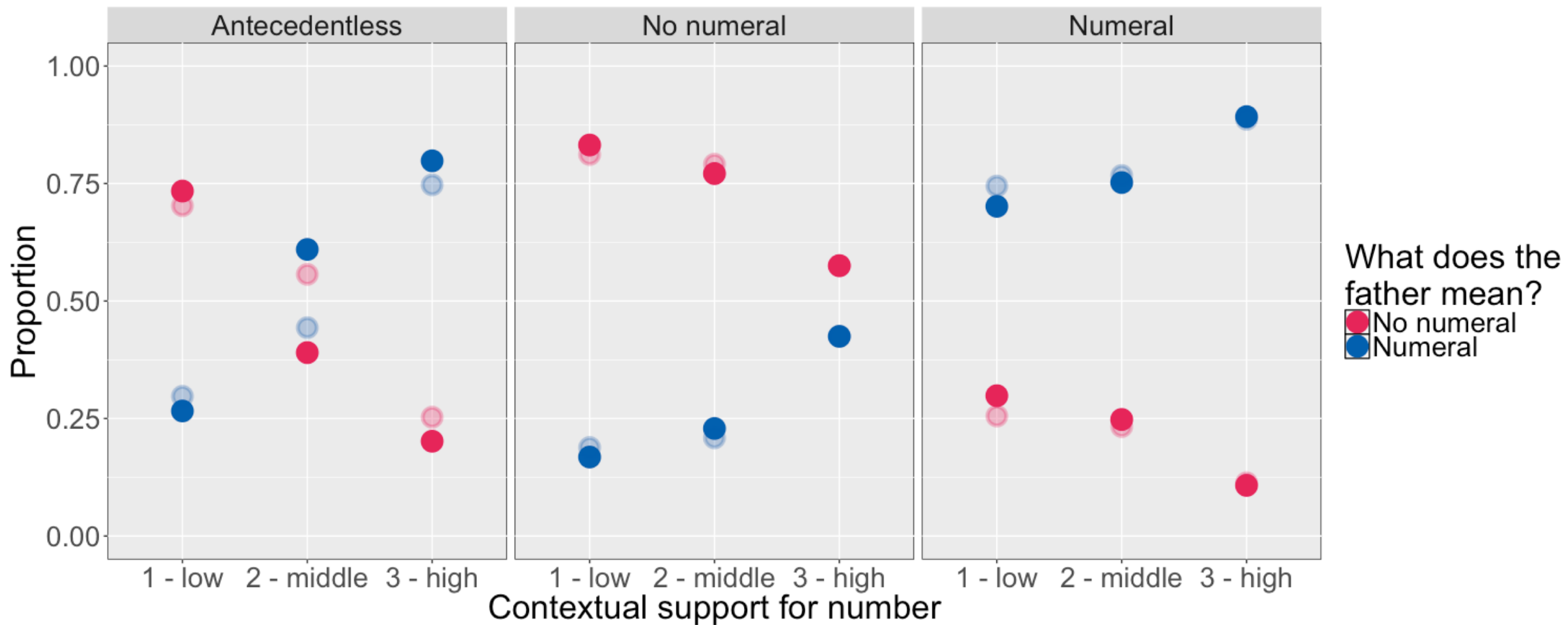
General Discourse model – 9 conditions



Linguistic Antecedence model – 9 conditions



Hybrid model – 9 conditions



[[VPE]]_{linguistic}?

I want to buy candy bars.

We can't.

[[VPE]]_{linguistic}?

I want to buy candy bars.

We can't.

[[VPE]]_{linguistic}?

I want to buy candy bars.

We can't buy candy bars.

0



no numeral

✓ [[VPE]] = 1

3



numeral

✗ [[VPE]] = 0