Polar question meaning in Slavic

Visual world eye-tracking evidence

Mariia Razguliaeva[1] Maria Onoeva[2] Kateřina Hrdinková
Radek Šimík[2] Roland Meyer[1]

[1]Humboldt-Universität zu Berlin, [2]Charles University

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Question and issues

Overarching research question

What can online processing tell us about the semantics of polar questions?

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Issues to consider:

- Predictions of different theoretical approaches

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What can online processing tell us about the semantics of polar questions?

Issues to consider:

- Predictions of different theoretical approaches
- Different strategies of encoding polar questions
- Cross-linguistic differences
- Role of question bias (epistemic vs. evidential)

Theoretical background

Set of alternatives: Hamblin/Karttunen question semantics

- Questions lack truth conditions
- They don't denote a proposition, but rather a **set of propositions**

Hamblin 1973

(1) $[\![\text{Is it raining?}]\!] = [\![\text{Is it not raining?}]\!] =$
$\{\lambda w[\textsc{raining}(w)], \lambda w[\neg\textsc{raining}(w)]\}$ $\{p, \overline{p}\}$

(2) $[\![\text{Who is tired?}]\!] = \{\lambda w[\textsc{tired}(w)(x) : \textsc{human}(x)\} =$
$\{\textsc{tired}(w)(\textsc{Ann}), \textsc{tired}(w)(\textsc{Ben}), \textsc{tired}(w)(\textsc{Cynthia}), \dots\}$

- Hamblin (1973), Karttunen (1977): set of **possible**/**true** answers
- PQs denote a set with **two alternatives**
- Still a dominant baseline theory

Romero & Han 2004; Krifka 2015; Roelofsen 2019; a.o.

Theoretical background

Singleton set / Monopolar approaches

- Polar questions denote a **singleton** set of propositions containing the uttered alternative

  Roberts 1996, 2012; Abels 2007; Biezma & Rawlins 2012; Krifka 2015

- The polar alternative either supplied by context or general semantic principles

(3) (a) $\neq$ (b)

a. $[\![\text{Is it raining?/It is raining?}]\!] = \{\lambda w[\textsc{raining}(w)]\}$

b. $[\![\text{Is it not raining?/It's not raining?}]\!] = \{\lambda w[\neg\textsc{raining}(w)]\}$

Theoretical background

Singleton set approaches – arguments

- No alternatives-triggering element such as wh or disjunction in PQs; but cf. Q-particles in Slavic lgs, which often have the form of a disjunction (*li*/*czy*) Šimík *to appear*
- Cf. alternative questions Biezma & Rawlins 2012

(4) Is it raining or not?

- Singleton semantics of PQs is necessitated by their incompatibility with surprise-predicates Abels 2007

(5) a. I am surprised at which team won the finals.
b. *I am surprised at whether Greece won the finals.

- PQs, as opposed to alternative questions, are typically biased to the uttered alternative (though not necessarily only so).
Büring & Gunlogson 2000; Sudo 2013

Theoretical background

Bias in polar questions

Most PQs impose conditions on use; they are **biased** towards one or both of the alternatives.

(6) A comes in dry light clothes and with sunglasses. B asks:

a. #Is it raining? (cf. Is it sunny?)
b. Is it not raining?
c. Isn't it raining?

(7) A comes in wet and with a dripping umbrella. B asks:

a. Is it raining? (cf. #Is it sunny?)
b. #Is it not raining?
c. #Isn't it raining?

(8) A on vacation on Mallorca, talking over phone with B. B asks:

a. #Is it raining? (cf. Is it sunny?)
b. #Is it not raining?
c. #Isn't it raining?

Theoretical background

Bias in polar questions

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(9) A comes in dry light clothes and with sunglasses. B asks:

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b. Is it not raining?
c. Isn't it raining?

(9a) positive (evidential) bias

(9b) negative evidential bias (+ positive epistemic bias)

(9c) positive epistemic bias (+ negative evidential bias)

Büring & Gunlogson 2000; Romero & Han 2004; Repp 2013; Sudo 2013
AnderBois 2019; **?**; Goodhue 2022

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Situation in Slavic

Main markers of PQ vs. declarative: intonation, verb-first (V1), particles

Czech

- V1 with final rising tune (10a) – neutral
- V2 with final rising tune (10b) – akin to English declarative question (Gunlogson 2002: evidential bias for p, typically epistemic bias for $\bar{p}$)

(10) a. Umyla Dita včera holínky↑? V1
cleaned Dita yesterday rubber.boots
'Did Dita clean the rubber boots yesterday?'

b. Dita umyla včera holínky↑? SVO
Dita cleaned yesterday rubber.boots
'Dita cleaned the rubber boots yesterday?'

Situation in Slavic

Russian

- V1+*li* (11a) – neutral, no bias
- declarative word order with specific pitch accent (LH* L%) on finite verb (11b) – neutral, no bias

(11) a. Počistila li Katja utrom sapogi? V1
cleaned LI Katja morning boots
'Did Katja clean the boots in the morning?'

b. Katja POČISTILA utrom sapogi? SVO
Katja cleaned morning boots
'Did Katja clean the boots in the morning?'

V1 without *li*, XP+*li*

Negation (Slavic)

- propositional negation always proclitic to V

Czech

neg-V1: tendency for epistemic bias towards p; tendency towards outer reading

neg-V2: evidential bias towards $\bar{p}$; inner reading preferred

Staňková 2023; Šimík to appear; a.o.

Russian

neg-V1: neutral or epistemic bias towards p; outer reading (but rare exceptions)

neg-V2: not necessarily biased; ambiguous between inner and outer reading

Brown & Franks 1995; Meyer 2004; a.o.

Particles

Russian *li*

- neutral, sometimes deemed incompatible with bias
- morphologically related to disjunction *ili*
- **hypothesis:** Hamblin-set generator (bipolar semantics)

Russian *razve*

- mismatch between evidential and epistemic bias

Repp & Geist *to appear*, Korotkova 2023, Geist & Repp 2023

Czech *snad*

- similar to *razve*, but not limited to polar questions
- also ambiguous in complex ways

Q-particles: Pol *czy*, Ukr *či*, South-Slavic *(da)li* ...
many modal particles: Cz *copak*, Pol *właśnie, czyżby* ...

Experiment

Online processing of polar questions; so far underexplored

Tian et al. 2021

- English and French PQs
- Overall tendency to look at p (in affirmative Qs, high neg Qs)
- No evidence of a tendency to look at $\overline{p}$ (not even in low neg Qs)

Our experiment

- Conceptual replication and elaboration of Tian et al.'s 2016; 2021 design
- Russian and Czech
- Comparison of questions vs. assertions in a single setup
- Comparison of interrogative (VSO) vs. declarative (SVO)
- Exploratory investigation of selected particles

Research questions and working hypotheses

- **Two alternatives hypothesis:** Do PQs trigger balanced looks to p and $\overline{p}$? Comparison: Assertions.
- **Singleton hypothesis:** Do PQs trigger looks to the uttered alternative? Comparison: Asssertions.
- **Strategy hypothesis:** Does the particle strategy (Russian V1+*li*) map to Hamblin-style semantics (cf. Biezma & Rawlins 2012) and hence trigger more balanced looks? Comparison: Czech word order strategy (akin to English)?
- **Bias hypothesis:** Is question bias evident in the processing? Epistemic or evidential?

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  - yes, in affirmative questions
- **Bias hypothesis:** Is question bias evident in the processing? Epistemic or evidential?
  - evidence for positive epistemic bias
  - in line with the results of Tian et al. 2021

Experimental setup and participants

eye-tracking visual-world paradigm

- listen to mini-conversations while looking at the pictures
  - no context
  - reliability check: pick the most suitable picture
- 80 stimuli pseudo-randomized, a break in the middle
- 99 participants (paid)
  - LABELS CUNI Prague: 48 Czech speakers
  - Zentrallabor HU Berlin: 51 Russian speakers
- instructed and calibrated by the administrators
- `https://osf.io/fjq72/`

Design and stimuli

- variables manipulated within-items in one set up
- yes/no answers manipulated between-items

EXPERIMENT	VARIABLES	ITEMS
E1 PQs	1) verb position: V1 × V2 2) polarity: aff × neg	32
E2 assertions	polarity: aff × neg	16
E3 particles in PQs Ru *razve*, Cz *snad*	polarity: aff × neg	16
E4a Cz particles in assertions	1) polarity: aff × neg 2) particles: *snad* × *asi*	16
E4b Ru force distinction	1) force: quest × contr. focus 2) manip × non-manip	16
total		80

Schematic stimulus and interest periods

1. 1000 ms picture preview
2. Speaker A: PQs or assertion ($\approx$ 1800-2100 ms)
3. 1000 ms gap
4. Speaker B: yes/no reply ($\approx$ 1200-1400 ms)
5. picture selection

Schematic stimulus and interest periods

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R1	R2	R3	R4	R5	R6	R7
$>$ Verb $\pm$ Neg $>$ Subj	$>$ Subj $>$ Verb $\pm$ Neg	Adv	Obj	Gap	I think	$>$ yes $>$ no

- subject: male and female first names
- verb: transitive
- adverbial: temporal or locative (more time for processing)
- object: corresponds to the entity on the pictures
- particles: Ru *li*, *razve*; Cz *snad*, *asi*

Design and stimuli

- random position of two distractors, p picture, $\overline{p}$ picture

Design and stimuli

(12) Czech

A: Umyla Dita včera
washed Dita yesterday
holínky?
boots
'Did Dita wash the boots yesterday?'

- random position of two distractors, p picture, $\overline{p}$ picture

Design and stimuli

(12) Czech

A: Umyla Dita včera
washed Dita yesterday
holínky?
boots
'Did Dita wash the boots yesterday?'

B: Já myslím, že ano.
I think that yes
'I think she did.'

- random position of two distractors, p picture, $\overline{p}$ picture

Design and stimuli

(12) Czech

A: Umyla Dita včera
washed Dita yesterday
holínky?
boots
'Did Dita wash the boots yesterday?'

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I think that yes
'I think she did.'

- random position of two distractors, p picture, $\overline{p}$ picture

Experiment 1: PQs

- 2 × 2 design
  1. verb position: V1 × V2
  2. polarity: affirmative × negative

(13) Czech

a. {**Umyla** / **Neumyla**} Dita včera holínky? V1
washed not-washed Dita yesterday boots

b. Dita {**umyla** / **neumyla**} včera holínky? V2
Dita washed not-washed yesterday boots
'Did Dita (not) wash the boots yesterday?'

(14) Russian

a. {**Počistila** / **Ne počistila**} li Katja utrom sapogi? V1
cleaned not cleaned LI Katja morning boots

b. Katja {**počistila** / **ne počistila**} utrom sapogi? V2
Katja cleaned not cleaned morning boots
'Did Katja (not) clean the boots in the morning?'

Experiment 2: assertions

- polarity: affirmative × negative

(15) a. Stela {**zavřela** / **nezavřela**} na chodbě okno. (Cz)
Stela closed not-closed on hall window
'Stela closed/didn't close the window in the hall.'

b. Anja {**zakryla** / **ne zakryla**} na kuxne okno. (Ru)
Anja closed not closed on kitchen window
'Anja closed/didn't close the window in the kitchen.'

- structurally as V2 condition in Experiment 1
- it allows comparing questions and assertions

Data preprocessing and analysis

- Each stimulus was split into interest regions (individual constituents and the gap)
- Manual annotation of interest region boundaries
- Only information on looks to p and $\overline{p}$ images was included into the analysis
- Linear mixed models with lmerTest package (Kuznetsova et al. 2017) in R were fitted to each interest region
- Items and participants were included as random factors
- Binary predictors: verb position, polarity, force, presence or absence of a particle

Force: results
V2 questions vs. assertions

Results: V2 questions vs. assertions in Czech

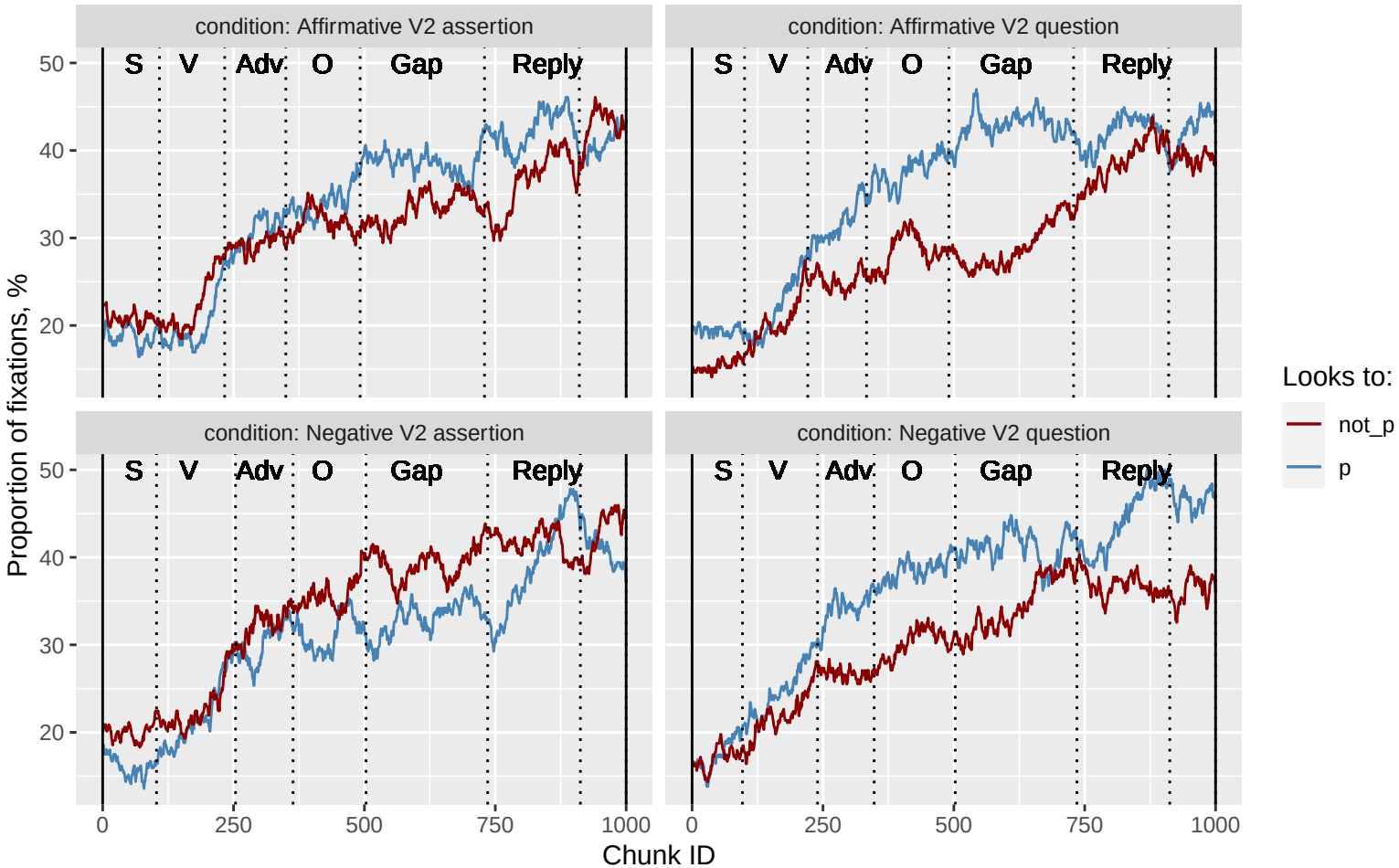
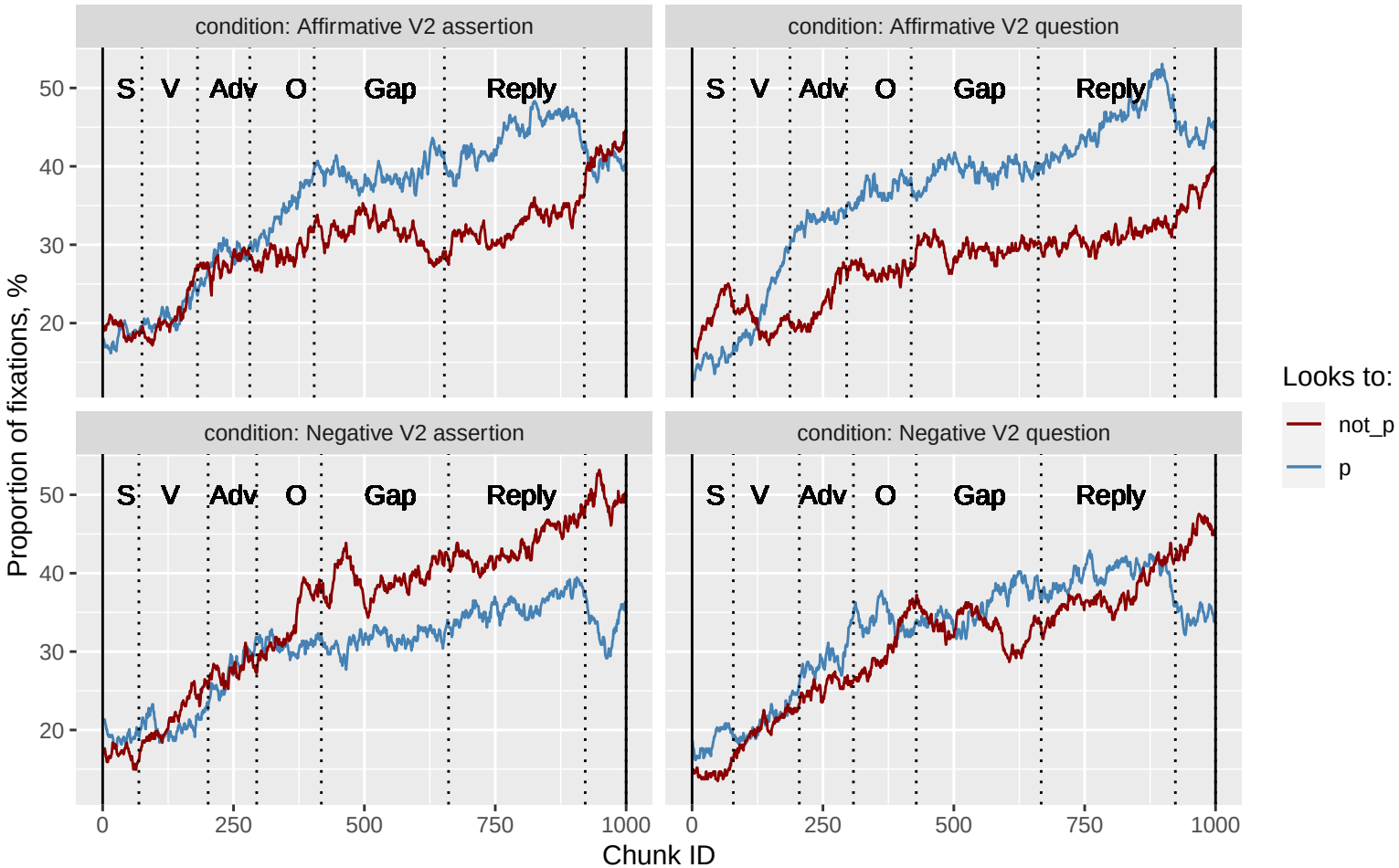


Figure: Progression of proportions of looks to p and $\overline{p}$, normalized for sound duration across conditions (IP boundaries also normalized)

Results: V2 questions vs. assertions in Russian



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Dependent variable: log ratio of fixation proportions

- DV $= 0$ means equal proportions of looks to p and $\overline{p}$
- DV > 0 means more looks to p than to $\overline{p}$
- DV < 0 means more looks to $\overline{p}$ than to p
- The higher the value, the more time is spent looking to p
- The lower the value, the more time is spent looking to $\overline{p}$
- To define if the DV is significantly different from 0 (i.e., there is a significant difference between looks to p and to $\overline{p}$), we looked at the intercepts of linear regression models (without random effects) fitted to each separate condition and interest period (Ito & Knoeferle 2022)

Results: V2 questions vs. assertions

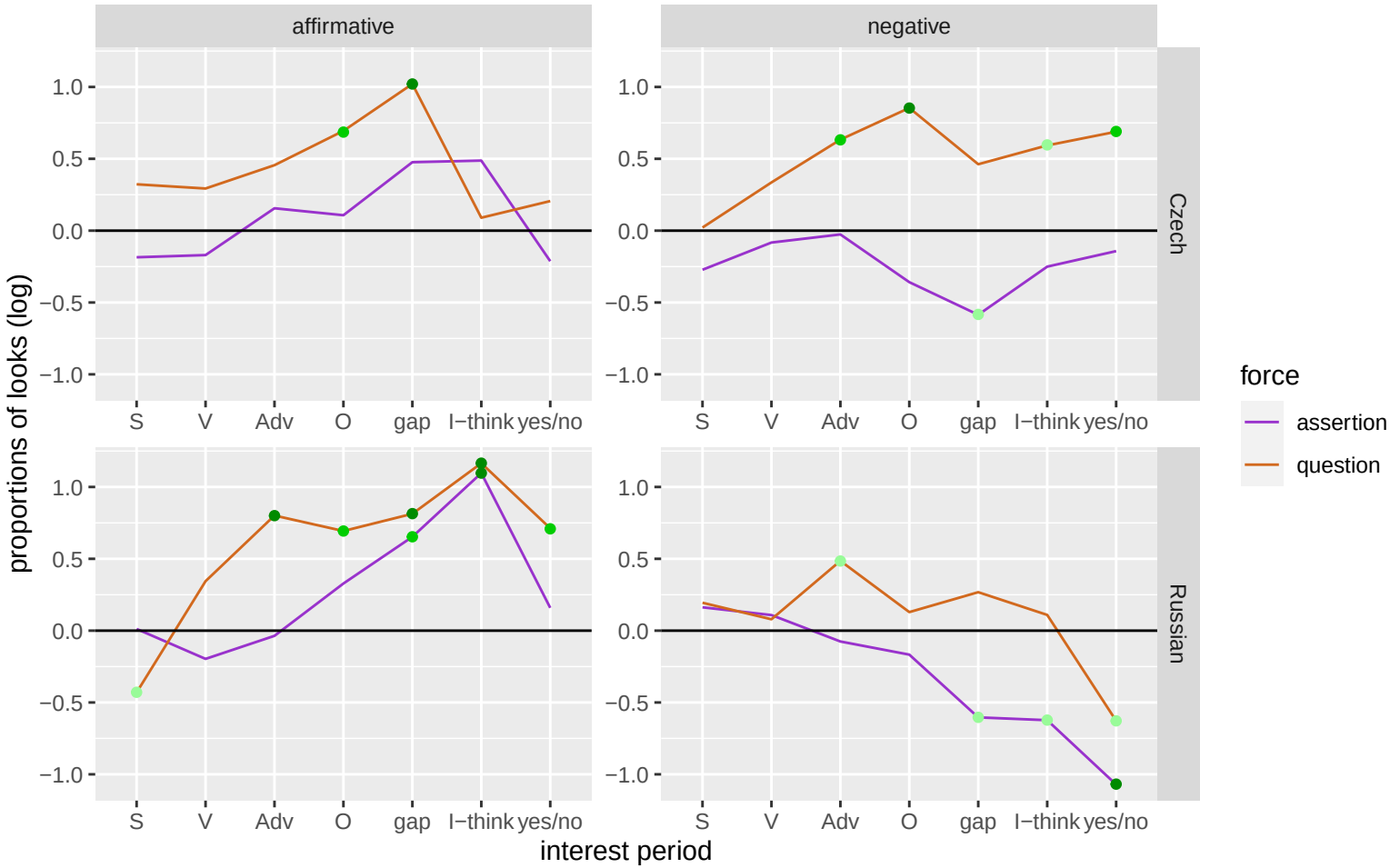

Figure: Average progression of log ratio of fixation proportion $p/\overline{p}$: DV $= 0$ means equal looks to p and $\overline{p}$, DV > 0 more looks to p, DV < 0 more looks to $\overline{p}$. Green points indicate significant difference from 0.

Results: V2 questions vs. assertions

- **Questions** show a tendency towards the positive proposition (analogous to Tian et al. (2021) for English and French): main effect of force in Czech Object ($t = 2.6, p = 0.013$, random intercepts only) and Gap ($t = 2.3, p = 0.027$)
  - Russian negative V2 is a special case: no clear preference for rather p or $\overline{p}$

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- **Assertions** favor looks to the picture corresponding to their polarity: main effect of polarity in assertions: in Russian Gap ($t = 3.381, p = 0.004$) and Czech Gap ($t = 2.941, p = 0.003$, random intercepts only)

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- In affirmative V2 questions, earlier peaks in Russian (Adverbial) than in Czech (Gap)

Interim summary: V2 questions vs. assertions

- Affirmative PQs : **strong preference for looks to p**: may suggest evidence against set-of-alternatives approach and for singleton-based approach
- Negative PQs: **no preference for looks to $\overline{\mathbf{p}}$**: unclear
- Language-specific intonational cues: intonation peak on Verb in Russian vs. final rise in Czech corresponds to earlier vs. later increase of looks to *p*. This holds for affirmative V2 questions.

Verb position: results
V1 vs. V2 questions

Results: V1 vs. V2 questions in Czech

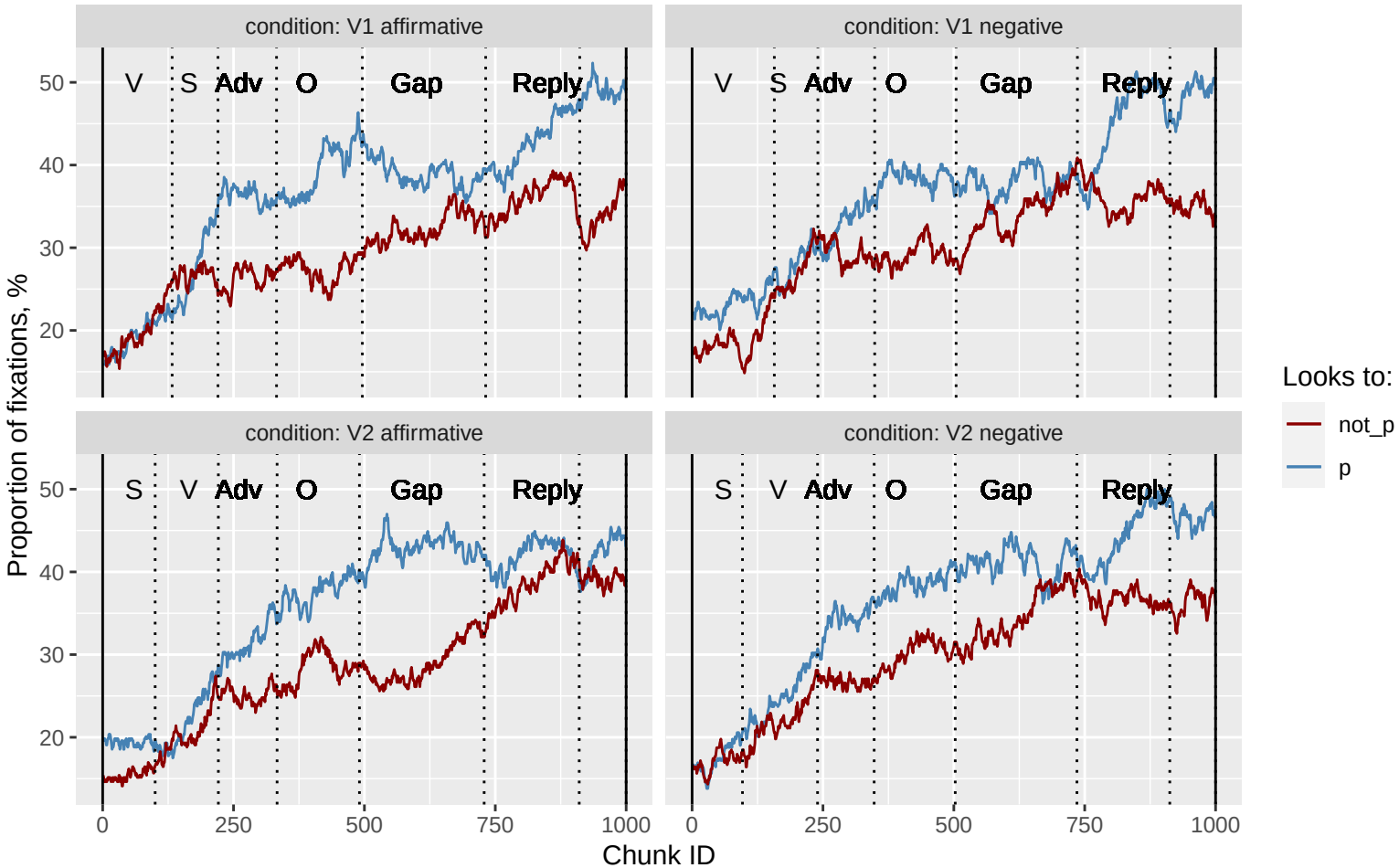
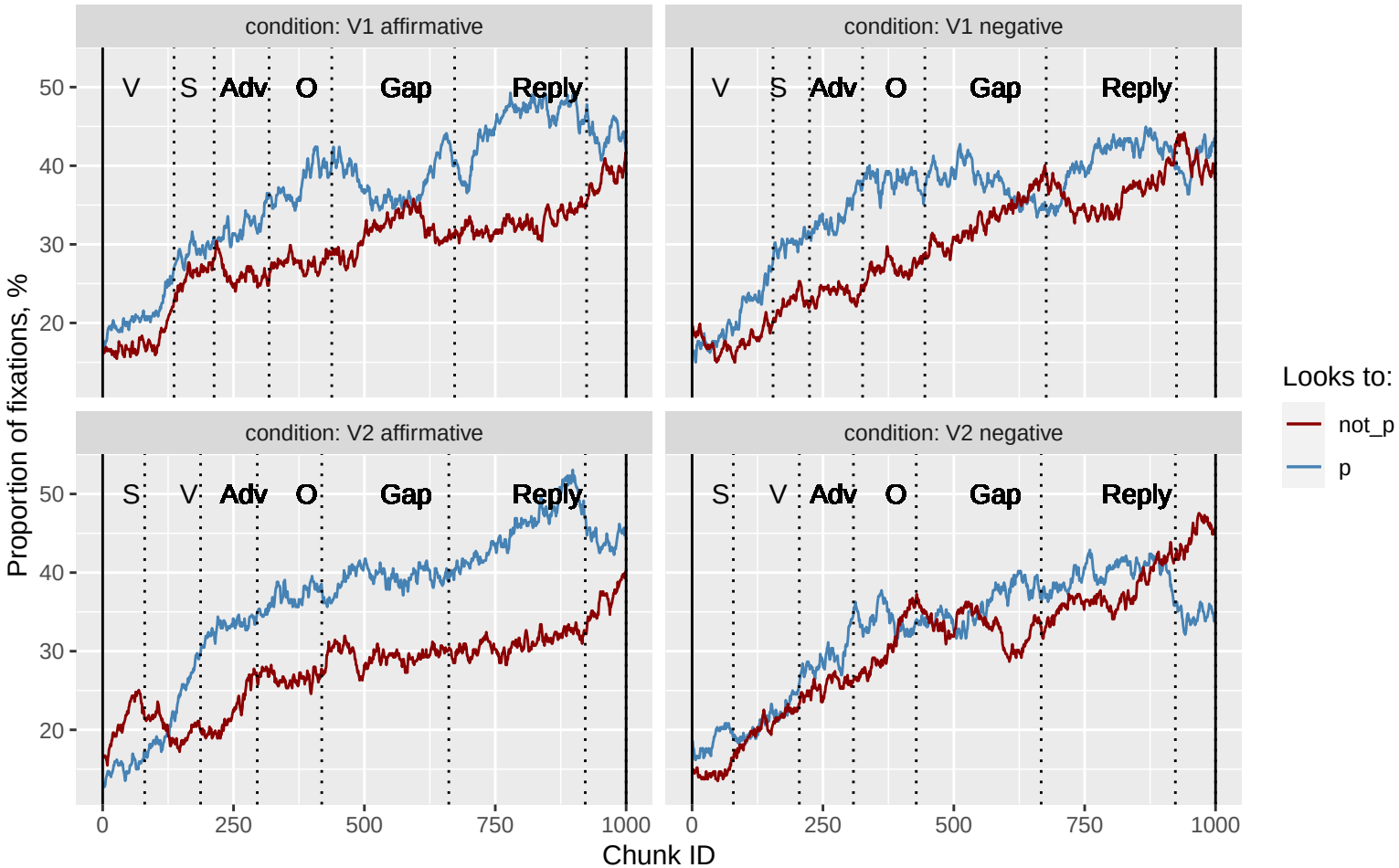


Figure: Progression of proportions of looks to p and $\overline{p}$, normalized for sound duration across conditions (IP boundaries also normalized)

Results: V1 vs. V2 questions in Russian



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Results: V1 vs. V2 questions

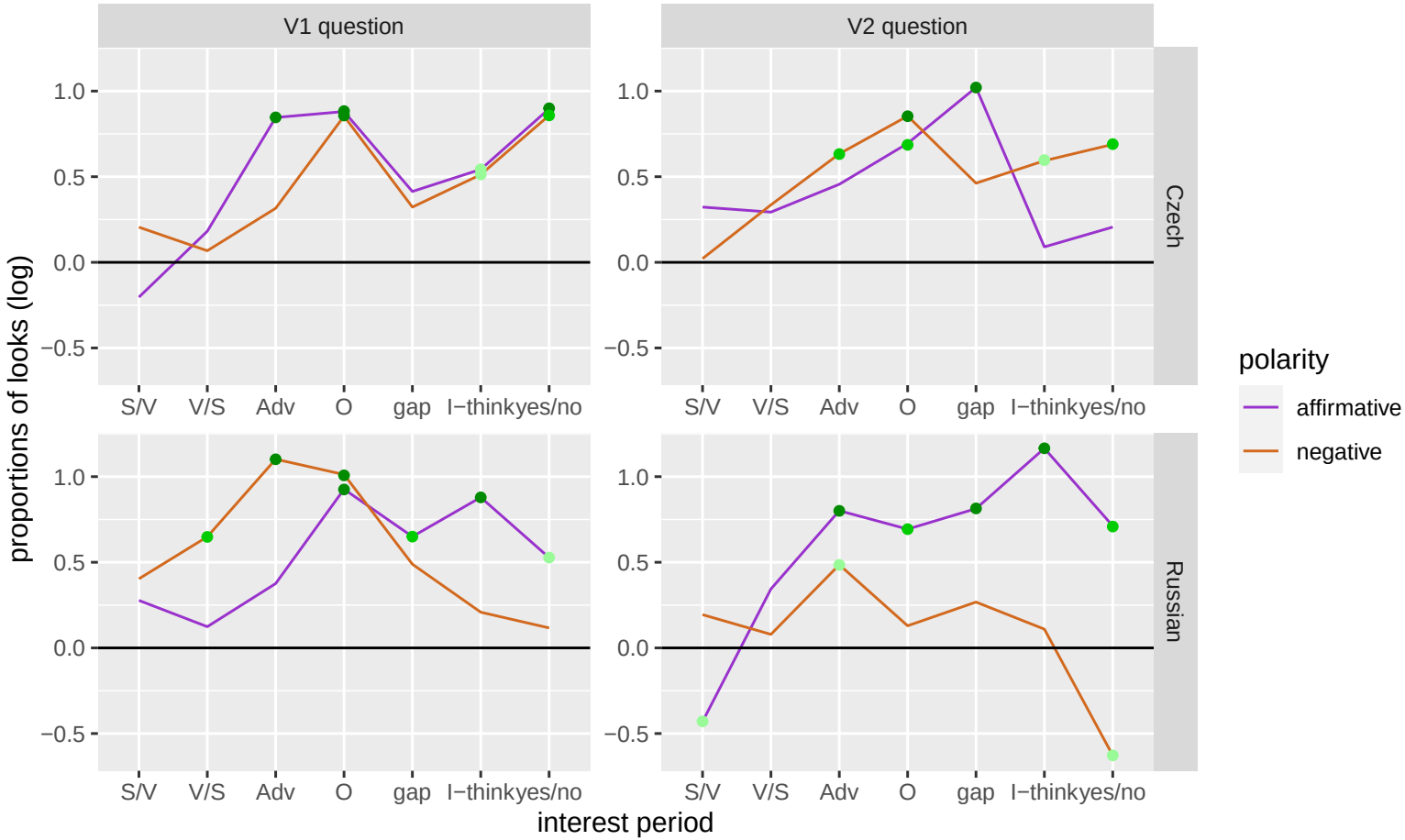

Figure: Average progression of log ratio of fixation proportion $p/\overline{p}$: DV $= 0$ means equal looks to p and $\overline{p}$, DV > 0 more looks to p, DV < 0 more looks to $\overline{p}$. Green points indicate significant difference from 0.

Results: V1 vs. V2 questions

Czech

- No significant effects of verb position and negation
- Affirmative V1 questions reach the peak earlier then affirmative V2 questions

Russian

- Simple effect of verb position in Object ($t = 2.22, p = 0.031$): stronger tendency to *p* in V1 questions
- In affirmative *li*-questions in Russian, the preference of the *p* image becomes significant later (in the Object region) than in affirmative V1 questions in Czech (Adverbial region), affirmative V2 questions in Russian (Adverbial region), and negative V1 questions in Russian (Subject region)
- Interaction of verb position and polarity in Adverbial ($t = -2.26, p = 0.024$): Negation in V1 questions triggers more fixations on *p* image. No such effect in V2 questions

Interim summary: V1 vs. V2 questions

- V1 acts as a strong cue of question in Czech, leading to an earlier peak of looks to p
- V1+*li* in Russian affirmative questions in early regions (before Object) is in line with set-of-alternatives semantics (no significant difference between looks to p and $\overline{p}$)
- No such observations for negative V1 or positive V2 in Russian
- Interaction of verb position and negation in Russian might be due to different epistemic biases in V1 vs. V2 questions
- Negative V2 questions in Russian show no clear preference for rather p or $\overline{p}$: similarly to English low negation questions (Tian et al. 2021)

General discussion

- Prediction of balanced looks to p and $\overline{p}$ (Hamblin 1973) **not borne out** (except for Russian negative V2).
- Prediction of looks to mentioned alternative (singleton set analyses) also **not borne out**.
- Prediction that Russian affirmative *li* questions will elicit more balanced looks than other comparable conditions **borne out**.
- Looks to p dominate across the board (aff and neg Qs, different Q strategies), which is consistent with looks to the **epistemically biased alternative**.
- Prediction of looks to biased alternatives **borne out**.

General discussion

- Why would epistemic bias dominate over evidential bias? Not clear esp. in declarative questions, esp. in Czech. Possibly: epistemic – conventionally associated with PQs; evidential – more context-dependent.
- The "seesaw" pattern evident in Ru *razve*-questions (esp. affirmative) and in Cz *snad*-assertions could be attributed to the processing of the conflicting biases. Supported by the inverse pattern for aff vs. neg, esp. in Czech assertions.

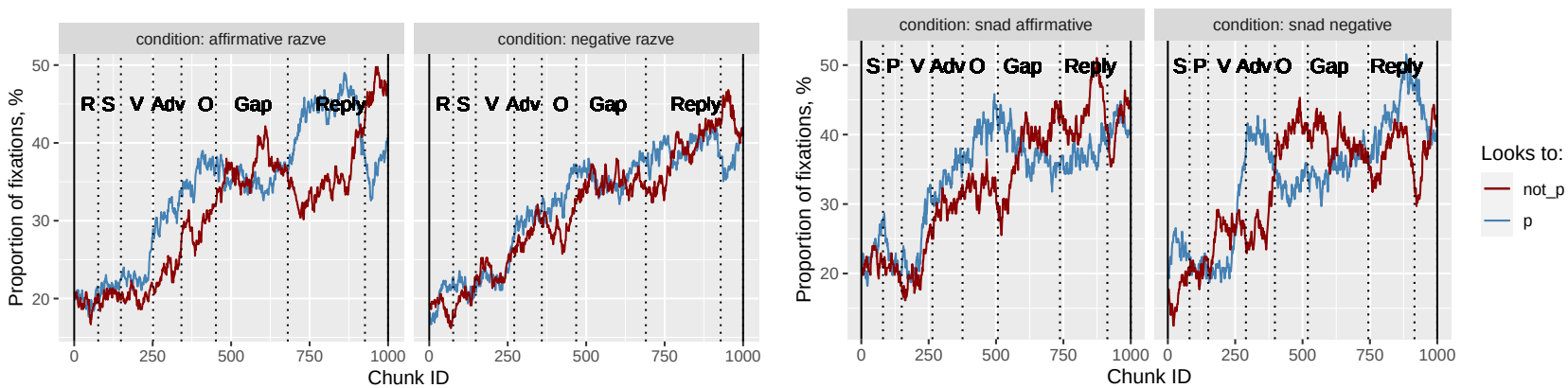

Figure: Proportions of looks to p and $\overline{p}$ in Ru *razve*-questions (left) and in Cz *snad*-assertions (right)

Cross-linguistic picture

- Despite the complex patterns in the results, the dominating looks to p across different conditions is a replication of Tian et al.'s 2021 work on French and English.
- `https://link.springer.com/article/10.1007/s10936-021-09814-y`
- So there seems to be something deeper here we want to understand.

Thank you!

https://www.slawistik.hu-berlin.de/de/member/meyerrol/queslav
https://www.radeksimik.eu/minilab.html
https://mariaonoeva.github.io/

Appendix 1: Experiment design for particles

- polarity: affirmative × negative

E3 particles Cz *snad*, Ru *razve* in PQs

(16) a. {**Vysála** / **Nevysála**} snad Lenka dneska koberec?
vacuumed not-vacuumed SNAD Lenka today carpet
'Did Lenka (not) vacuum the carpet today?'

b. Razve Goša {**napolnil** / **ne napolnil**} včera bassejn?
RAZVE Goša filled not filled yesterday pool
'Did Goša (not) fill the pool yesterday?'

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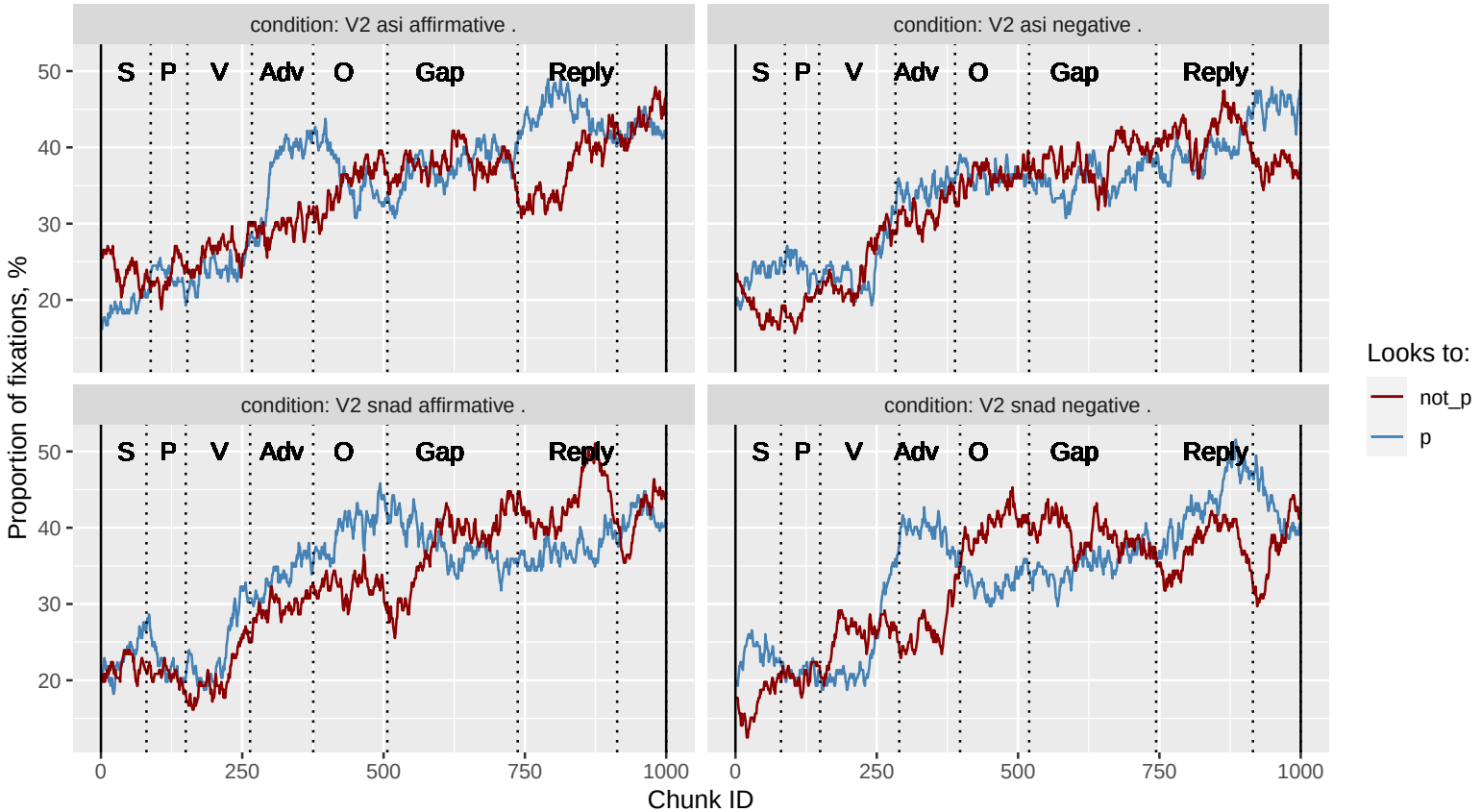
E4a Cz particle *snad* in assertions

(17) Franta snad {**nakrmil** / **nenakrmil**} večer kocoura.
Franta SNAD fed not-fed evening cat
'Franta prehaps fed/didn't feed the cat in the evening.'

Appendix 1: Assertions with *snad* and *asi* in Czech



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Appendix 1: V1-questions with *snad* in Czech

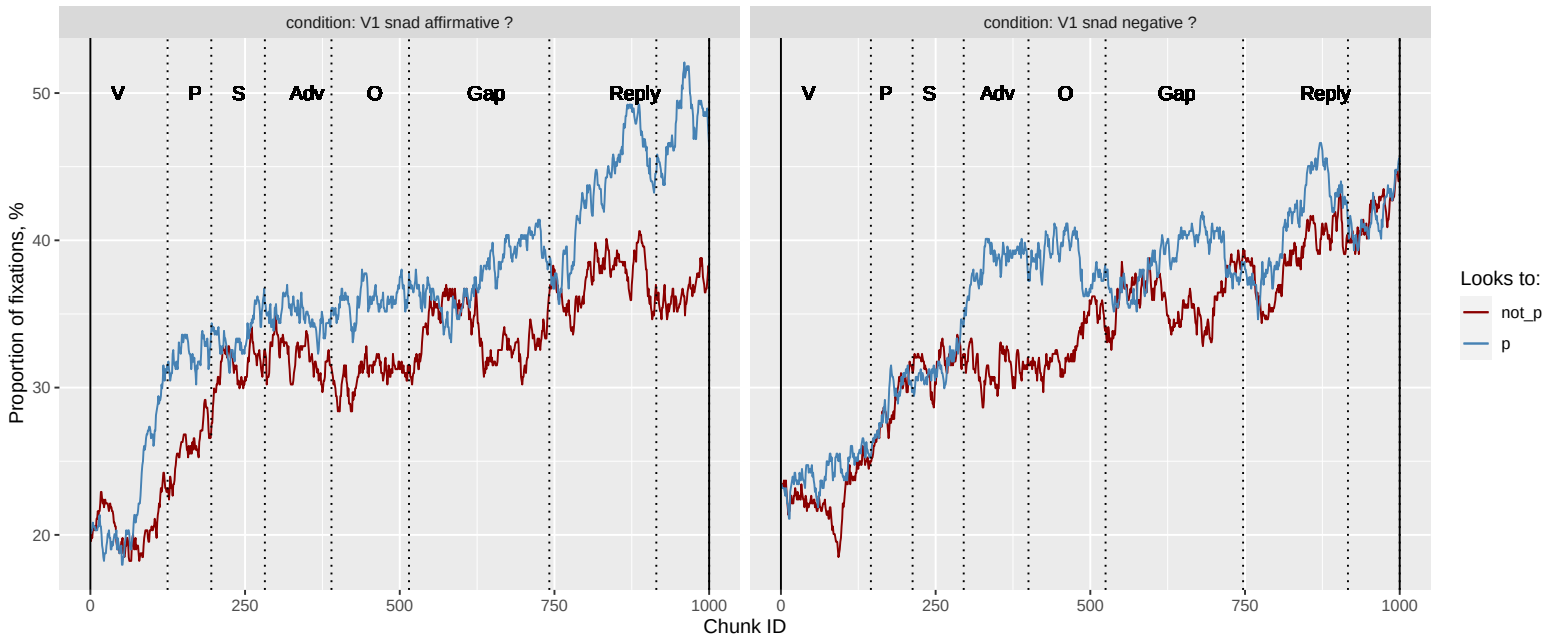

Figure: Progression of proportions of looks to p and $\overline{p}$, normalized for sound duration across conditions (IP boundaries also normalized)

Appendix 1: Assertions and V1-questions with *snad* in Czech

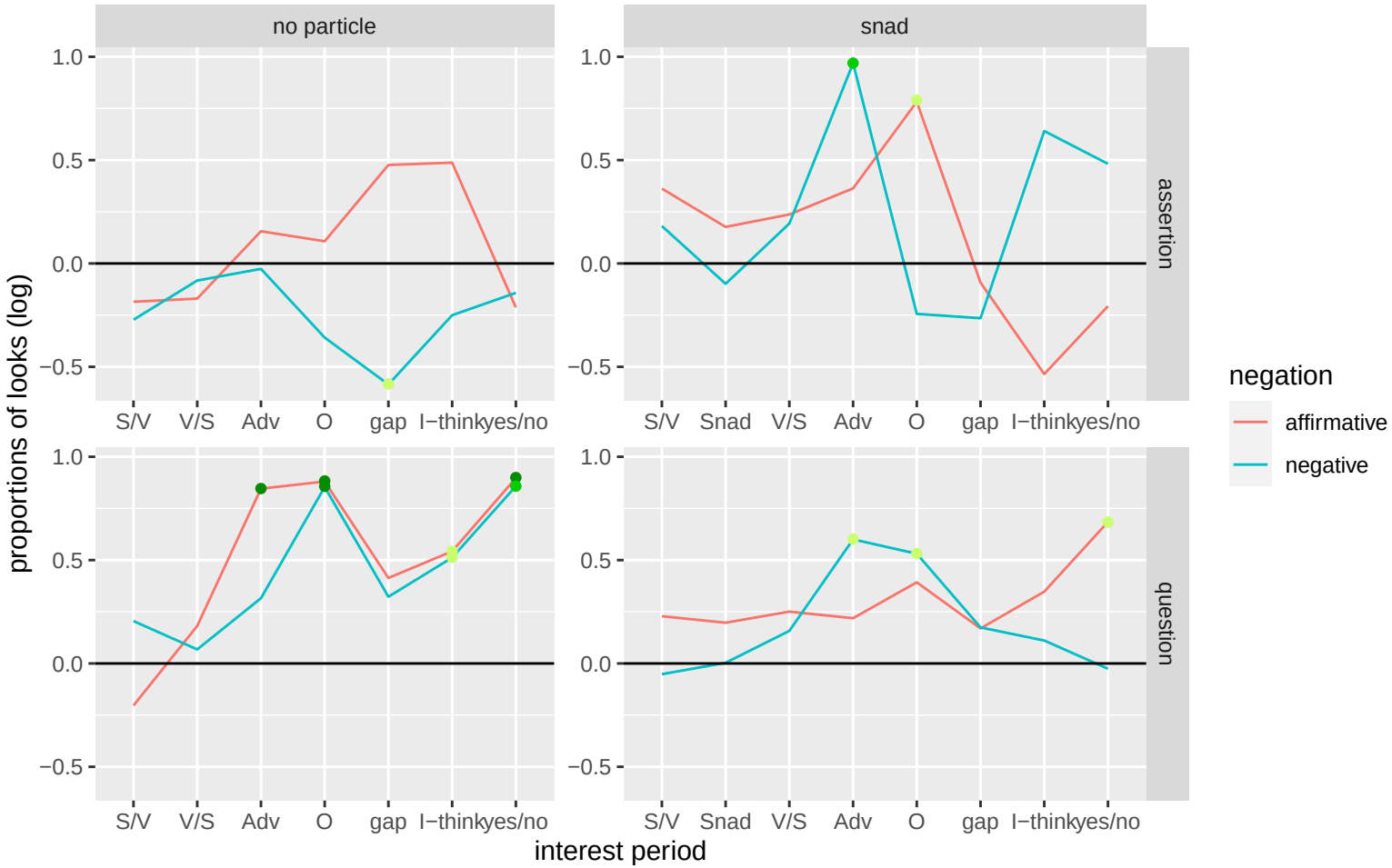

Figure: Average progression of log ratio of fixation proportion $p/\overline{p}$: DV $= 0$ means equal looks to p and $\overline{p}$, DV > 0 more looks to p, DV < 0 more looks to $\overline{p}$

Appendix 1: Assertions and V1-questions with *snad* in Czech

- *Snad* in questions: no significant effects
- *Snad* in assertions:
  - Assertions with *snad* show higher peaks than those without particle
  - Interaction of particle and negation in "I-think" ($t = 3.051, p = 0.002$), random intercepts only

Appendix 1: *razve*-Questions in Russian

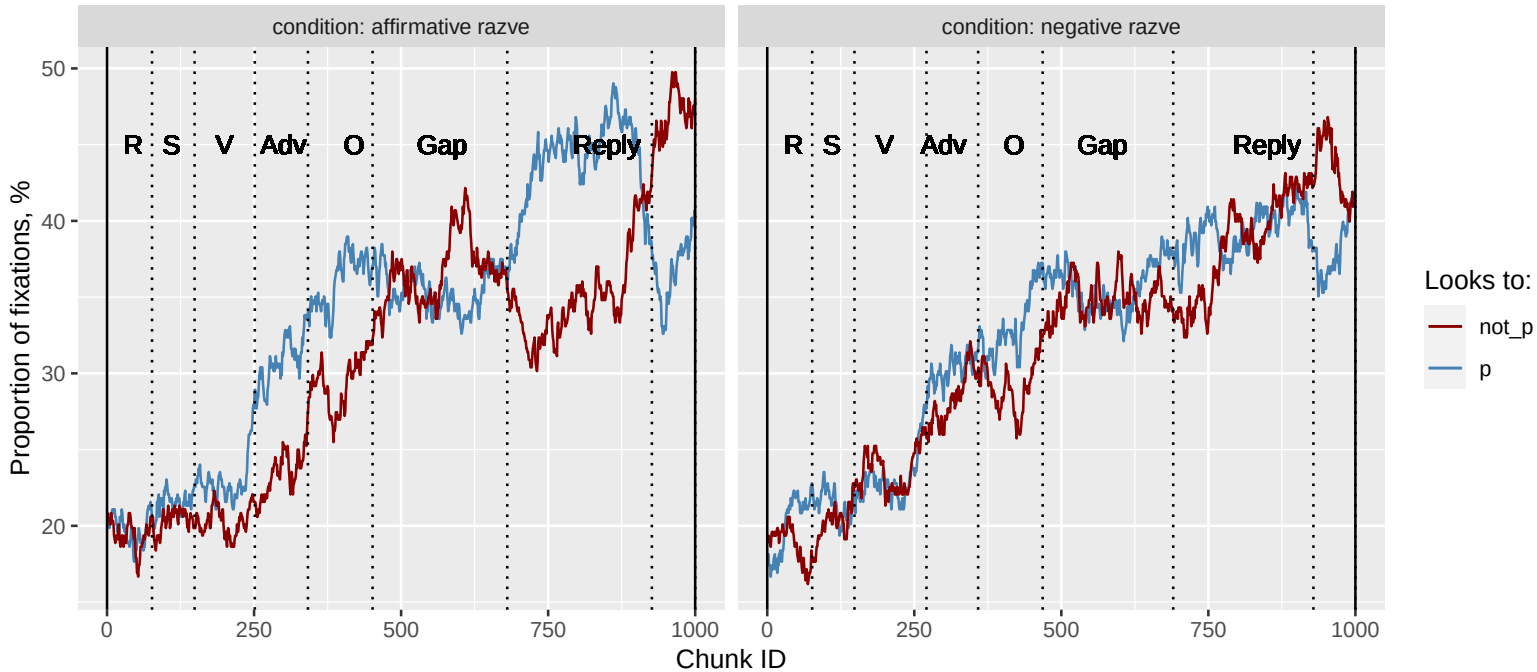

Figure: Progression of proportions of looks to p and $\overline{p}$, normalized for sound duration across conditions (IP boundaries also normalized)

Appendix 1: *razve*-Questions in Russian

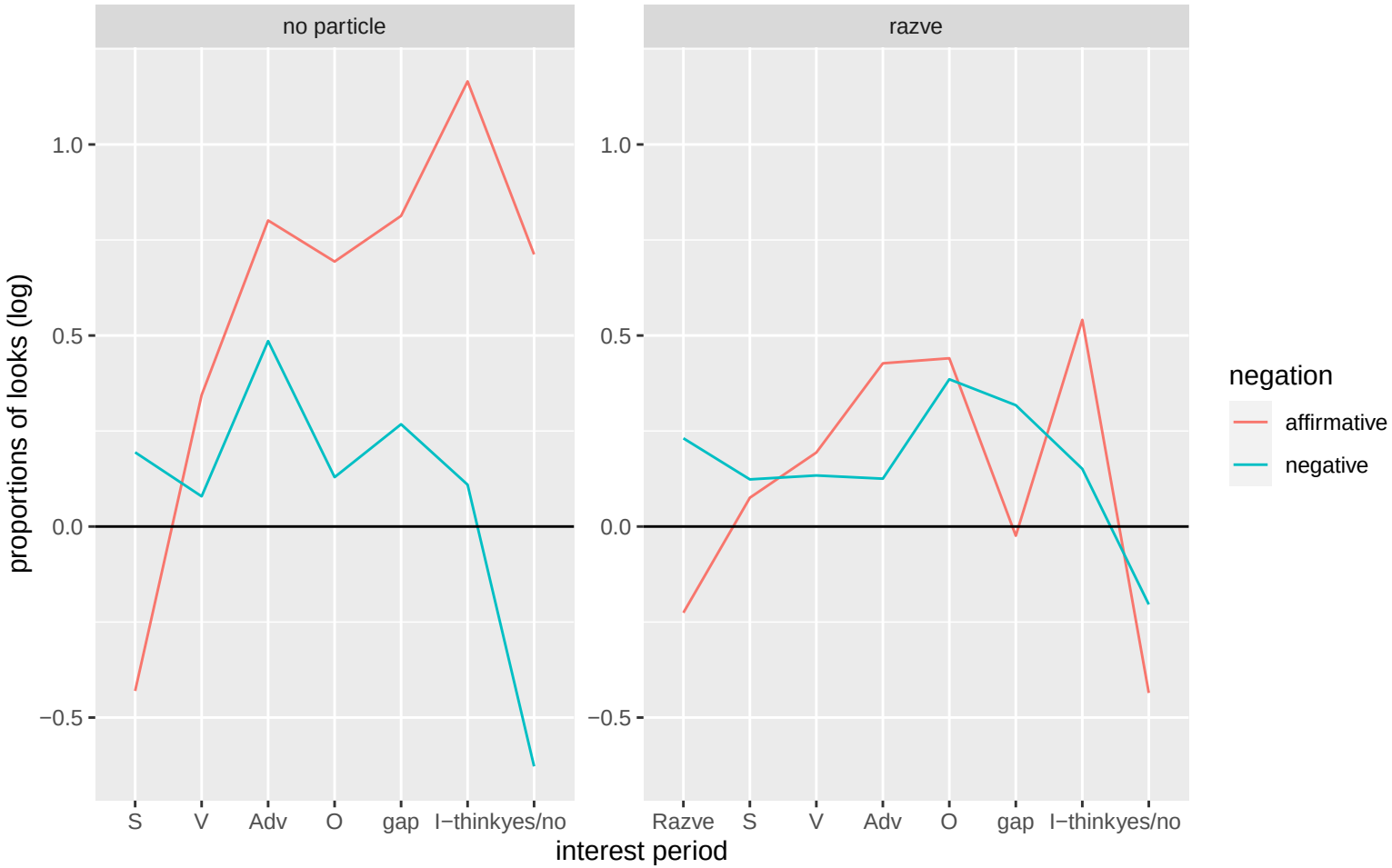

Figure: Average progression of log ratio of fixation proportion $p/\overline{p}$: DV $= 0$ means equal looks to p and $\overline{p}$, DV > 0 more looks to p, DV < 0 more looks to $\overline{p}$

Appendix 1: *razve*-Questions in Russian

- Affirmative questions with *razve* show more balanced looks than affirmative V2-questions without a particle: main effect of particle on the Gap ($t = -2.116, p = 0.039$)
- plausible explanation: hearer must integrate the conflict between epistemic vs. evidential bias in questions with *razve*

Appendix 2: Outlook

Data analysis

The speech pace of the Russian speaker might have been faster than the Czech one; analyze not wrt region, but wrt absolute time from a given onset (verb)

Methodological consequences

- All stimuli were set up as dialogues. Assertions possibly interpreted as prompts to be reacted on by the conversation partner ('I think that yes/no.'). On this background, polar questions might have been interpreted for their "extra" semantic contribution, i.e., bias. Yet, in Tian et al. 2021 no clear difference between experiments with or without dialogue setup.
- More work needed to try to isolate epistemic vs. evidential bias: e.g. more power in the experiments with particles.
- If epistemic is more inherent to PQs and evidential more context-dependent, we might need more contextual support to trigger clearer processing of evidential bias.

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