

## The weak, the strong and the likelihood: experiments on Slavic scalar particles

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**Intro:** Scalar particles (SP) like English *even*, German *sogar* among many others associate with focused elements, they are often building material of Negative Polarity Items (NPIs) as a strong English NPI *even one*. Their distribution and behavior can be explained from their pragmatic scalar and additive presuppositions. But despite their impressive research history (Karttunen&Peters 1977, Rooth 1985, Schwarz 2005, ...) many unresolved issues remain: i) are SP like English *even one* (scopal theories like Karttunen&Peters 1977) or two homophonous items (ambiguity theories like Rooth 1985)? ii) what is the exact nature of SP’s presuppositions? Our contribution to SP debate is the following: using essentially Krifka’s (1995) idea (formulated for strong NPIs) which delimits distribution of strong NPIs/SP to contexts where they are less likely than all the relevant focused alternatives we are able to: i) interpret results of 2 experiments on Czech and Slovene SP and strong NPIs; ii) explain domain restriction effects observed before (von Stechow 1994) and to confirm the quantification over alternatives as a universal (not existential) presupposition; iii) to show that ambiguity approaches to *even* (Rooth 1985) cannot work (at least in case of Czech/Slovene NPIs and SP).

**Experiments:** we ran two experiments, first consisting of two parts on Czech, second (replicated design of part 1 from the Czech experiment) on Slovene. Both experiments were truth value judgment tasks, 48<sub>cz</sub> and 57<sub>sl</sub> speakers successfully passed the fillers. Experiments were run online on IBEX farm and statistically interpreted in R using mixed model probit regression.

**Part 1:** conditions (for both languages): TOP, MID, LOW varied for *i/ani* (with *i/ani* we label both Czech lexemes and Slovene *celo/niti* too). Error-bar graph<sub>cz</sub> is in the Figure 1, example<sub>cz</sub> item in (1). The statistical model confirms that: *i* combines with strong elements and *ani* with weak elements, *i* with weak elements was perceived as ungrammatical, *ani* with strong elements too. Both strong *i* and weak *ani* are statistically not distinguishable from each other ( $z_{cz} = -0.780/z_{sl} = -1.071$ ,  $p_{cz} = 0.435122/p_{sl} = 0.284034$ ) and much better than strong *ani* (diff:  $z_{cz} = -9.645/z_{sl} = -4.298$ ,  $p_{cz} = 2e-16/p_{sl} = 1.73e-05$ ) and much better than weak *i* ( $z_{cz} = -7.306/z_{sl} = -3.869$ ,  $p_{cz} = 2.75e-13/p_{sl} = 0.000109$ ). Patterns found in both languages converge.

**Part 2:** was only tested on Czech speakers, conditions were: ANT, NR, NEG, ANI-NEG-TOP, ANT-I-BOT, the first three varied for *i/ani*. The error-bar graph is in Figure 2, an example item in (2). Statistical model confirms that: *i* associates with strong elements and *ani* with weak elements. The least acceptable were conditions ANT-ANI and NEG-I, all others fared better (reference level condition: ANT-ANI). The best was *i* with strong elements in the antecedent ( $z = 13.137$ ,  $p = 2e-16$ ). Considerably better than reference level were also *ani* with weak elements in negated sentences ( $z = 13.022$ ,  $p = 2e-16$ ) and *i* with weak elements in antecedent ( $z = 9.924$ ,  $p = 2e-16$ ) and much better were also NR-ANI ( $z = 7.359$ ,  $p = 1.85e-13$ ) and NR-I ( $z = 6.461$ ,  $p = 1.04e-10$ ) and more acceptable was also *ani* with strong elements in negated sentences ( $z = 4.667$ ,  $p = 3.06e-06$ ). The second worst was NEG-I, indistinguishable from the reference level condition ( $z = 1.794$ ,  $p = 0.0728$ ).

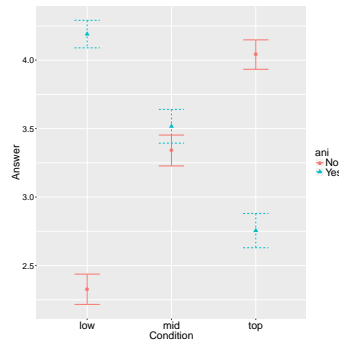


Figure 1: Part-1

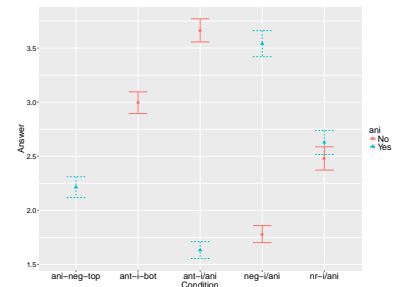


Figure 2: Part-2

- (1) Brown rice can preserve essential vitamins but it has to be stored in the fridge, packed in hermetical dose and you have to consume it up to three days after cooking.
- a. Rýže v ledniče (vydrží **i** tři dny)/(nevydrží **ani** tři dny). (TOP)  
'The rice in the fridge (lasts even three days)/(doesn't last neg-even three days).'
  - b. Rýže v ledniče (vydrží **i** dva dny)/(nevydrží **ani** dva dny). (MID)  
'The rice in the fridge (lasts even two days)/(doesn't last neg-even two days).'
  - c. Rýže v ledniče (vydrží **i** jeden den)/(nevydrží **ani** jeden den). (LOW)  
'The rice in the fridge (lasts even one day)/(doesn't last neg-even one day).'
- (2) Mother would be happy if her son would work for the police. The lowest rank is a sergeant, the highest is a general and somewhere in the middle is a colonel.
- a. Syn se nakonec nestal (**ani** rotným)/(**ani** generálem). (NEG-ANI/ANI-NEG-TOP)  
'Son at the end didn't become neg-even (sergeant)/(general).'
  - b. Jestli se syn stane **ani** rotným, bude matka ráda. (ANT-ANI)  
'If her son becomes neg-even sergeant, his mother would be happy.'
  - c. Otec nechce, aby se syn stal (**ani** rotným)/(**i** generálem). (NR-ANI/NR-I)  
'Father doesn't want his son to become (neg-even sergeant)/(even general).'
  - d. Syn nakonec vystudoval biochemii a nestal se **i** generálem. (NEG-I)  
'Son at the end studied biochemistry and didn't become even general.'
  - e. Jestli se syn stane (**i** generálem)/(**i** rotným), matka bude . . . . (ANT-I/ANT-I-BOT)  
'If son will become (even general)/(even sergeant), his mother will be happy.'

**Theoretical interpretation:** both *i* and *ani* bear strong unlikelihood presupposition (formalized after Crnič 2011 as obligatory association with covert  $\llbracket even \rrbracket^{g,c}(C, p, w)$  is defined only if  $\exists q \in C [p \triangleleft_c q]$ ), on top of that *ani* is a super strong NPI (restricted to A(nti)-M(orphic) environments:  $\llbracket AM \rrbracket = O(\neg X) = \neg O(X)$  after Zwarts 1998). We formalize this as features on the lexemes: *i* . . . [EVEN], *ani* . . . [EVEN,AM] and both lexemes compete for insertion via the Maximize Presupposition (MP) mechanism of Heim (1991). Next, we follow the scopal treatment of *even*.

**Explanation of the data pattern:** *i* prefers narrow scope of covert *even* w.r.t. DE operators (if present): [DE[EVEN . . . *i* . . . ]], *ani* prefers wide scope of covert *even* w.r.t. DE operators [EVEN [DE . . . *ani* . . . ]]. That explains the basic patterns in both experiments: the requirement of *i* for strong elements and *ani* for weak elements (conditions TOP-I, LOW-ANI, ANT-I and NEG-ANI + unacceptability of LOW-I and TOP-ANI): implication as well as negation (being DE) reverse the direction of likelihood/entailment. For the middle of the scale in-between acceptability of MID conditions we propose a solution in terms of domain restriction (e.g. alternatives for *i* in (1) are {1 day, 2 days} and for *ani* {2 days, 3 days}). This solution is more in the correspondence to the experimental data than another logical possibility of weakening  $\forall$  from  $\llbracket even \rrbracket$  to  $\exists$  as it would predict the same (unobserved) acceptability rating of MID conditions as TOP-I and LOW-ANI. Next, as conditions ANT-I-BOT and ANI-NEG-TOP relative acceptability shows, the items can associate even with EVEN scoping reversely to the default pattern: [DE [EVEN . . . *ani* . . . ]] and [EVEN [DE . . . *i* . . . ]] which is a strong argument against NPI-*even*-theories like Rooth (1985) which cannot explain such a pattern. NR condition NR-ANI shows most clearly the super strong nature of *ani*: NR predicates are exactly the  $\neg O(X) = O(\neg X)$  type of predicates. We hypothesize that both NR conditions lowered acceptability is due to the NR semantic entailment 'transferring' negation (see Gajewski 2005) which is to some extent costly. Finally, the unacceptability of *i* in negated sentences is caused by its competition with more specific *ani* [EVEN, AM] which due to MP should be inserted. And ungrammaticality of *ani* in DE (ANT-I) is a simple result of feature clash: implications are not AM.

**SELECTED REFERENCES:** Crnič, L. 2011. "Getting even." *Ph.D. thesis, MIT* • Crnič, L. 2014. "Against a dogma on npi licensing." In *The art and craft of semantics: A festschrift for Irene Heim 1*, 117–145 • Heim, I. 1984. "A note on negative polarity and downward entailment." In *Proceedings of NELS* Vol. 14, 98–107 • Heim, I. 1991. "Articles and definiteness." In *Semantics: An international handbook of contemporary research*, 487–535. • Karttunen, F. & S. Peters. 1977. "Even questions." In *Proceedings of NELS* 2, 115–134 • Krifka, M. 1995. "The semantics and pragmatics of polarity items." In *Linguistic analysis* 25 (3–4), 209–257 • Rooth, M. 1985. "Association with focus" • Schwarz, B. 2005. "Scalar additive particles in negative contexts." In *NLS* 13(2), 125–168 • Zwarts, F. 1998. "Three types of polarity." In *Plurality and quantification*, 177–238.