

A memory-based account of robust negative polarity illusion effects

There have been many studies of negative polarity illusions in psycholinguistics (Muller & Phillips, 2020; Parker & Phillips, 2016; Vasishth et al., 2008; Xiang et al., 2009, a.o.). An illusion arises when a negative polarity item (NPI) licenser (e.g., *no*) for an upcoming NPI (e.g., *ever*) fails to license it and when comprehenders fail to recognize this error (1). However, this illusion effect is only observed when specific linguistic or experimental requirements are met, such as with the NPI *ever* not *any* (Parker & Phillips, 2016), with the licenser *no* but not *not*, *n't*, or *never* (Orth et al., 2021), and during speeded judgment tasks or self-paced reading but not during simple acceptability tasks (Parker & Phillips, 2016). Here, we present a novel construction in (2) that triggers a robust illusion effect even during untimed acceptability tasks – when the NPI licenser and the matrix subject determiner are both vague quantifiers, like *few* and *many* (Exp.1-6). We propose a memory-based account for the illusion source: we show that the relevant syntactic position of the two vague quantifiers is easier to be confused about and harder to recall than the canonical *no/the* pair in (1) (Exp.7). This suggests that comprehenders of (2) could have a lossy memory representation of the preceding context before the NPI, leading to a higher probability of failure in licenser retrieval. Our account falls into an information-theoretic lossy-context surprisal account for language processing (e.g., Futrell et al., 2020; Hahn et al., 2022).

Exp.1–6 show that the combination of two vague quantifiers (*few/many* in Exp.1, *few/most* in Exp.6) elicits a robust illusion effect. In Exp.1, 36 critical items varied by a 2x3 between-subjects manipulation (Tab.1): (i) whether the sentence featured the *few/many* pair or the *no/the* pair (as the baseline) in the matrix and the embedded positions, (ii) whether the relative position of the two words created a Grammatical Licenser condition (e.g., *few...[that many...]...ever...*), an Irrelevant Licenser condition (e.g., *many...[that few...]...ever...*), or a No Licenser condition (e.g., *many...[that many...]...ever...*). In Fig.1 (Exp.1), the Irrelevant Licenser condition with *few/many* was rated higher than its No Licenser condition ($\beta=-0.39$, HPD=[-0.63, -0.14], reference=Irrelevant Licenser), indicating an illusion effect. But no such illusion appeared in the *no/the* baseline ($\beta=0.19$, HPD=[-0.02, 0.41], reference=Irrelevant Licenser). Exp.2-6 iterated over the constructions tested against the baseline *no/the* pair (*no/many* in Exp.2, *no/all* in Exp.3, *few/all* in Exp.4, *few/the* in Exp.5, *few/most* in Exp.6, Tab.2) with the same experimental design as Exp.1. An illusion effect was only found in the *few/most* construction where its Irrelevant Licenser condition (*most...[that few...]*) was rated higher than the *no/the* Irrelevant Licenser condition (*the...[that no...]*) ($\beta=-0.46$, HPD=[-0.68, -0.22], reference=*few/most*, Fig.1 Exp.6). This reveals a robust illusion phenomenon that no research has found in untimed experiments, which was only triggered by a vague quantifier in the matrix subject and the vague quantifier and NPI licenser *few* in the embedded clause.

Exp.7 adopted a memorize-recall task to see whether participants hold a lossy memory of the vague quantifier construction in sentence processing. Participants were exposed to sentences like *Few students with many awards have gone to top PhD programs in the world*, performed a math calculation problem, and judged whether a newly appeared sentence was identical to the exposure sentence. The manipulation was 2x2x2 crossing the determiner/quantifier construction in the exposure sentence (*few/many* vs. *no/the*), whether the negative licenser came first in the construction ([+NEG]...[-NEG] vs. [-NEG]...[+NEG], e.g., *few...many* vs. *many...few*), and whether the two words experienced a position exchange in the recall phase (e.g., *few...many* in the recall sentence when the exposure is *many...few*). Fig.2 shows an interaction effect: participants were less likely to correctly recognize a position switch for the vague quantifiers than the *no/the* condition ($\beta=1.27$, SE=0.45, CrI=[0.40, 2.16]), suggesting participants hold a lossier memory of *few/many*.

Our research leads to a memory-based account for the NPI illusion effect. Participants seem to hold a lossier memory of *few* and *many* before encountering *ever*, which confuses the NPI licenser retrieval process and causes a strong illusion. We speculate that it is (i) the vagueness property of *few* and *many* (or *most*) – the quantity of the modified entities can only be inferred from the context not the semantics of the quantifiers, requiring more cognitive resources during language processing – and (ii) two vague quantifiers appearing in the same sentence that lead to such a lossy memory.

(1) **The** authors [that **no** critics recommended] have **ever** received acknowledgment for a best-selling novel.

(2) **Many** authors [that **few** critics recommended] have **ever** received acknowledgment for a best-selling novel.

	few...many	no...the
Grammatical licensor	Few authors [that many ...]...ever...	No authors [that the ...]...ever...
Irrelevant licensor	Many authors [that few ...]...ever...	The authors [that no ...]...ever...
No licensor	Many authors [that many ...]...ever...	The authors [that the ...]...ever...

Table 1: Conditions for Exp.1 (within-construction manipulation following Parker & Phillips (2016))

Constructions	Example trial for the irrelevant licensor condition
Control: no...the	The authors [that no critics recommended] have ever received acknowledgment for a best-selling novel.
Exp1: few...many	Many authors [that few critics recommended] have ever received acknowledgment for a best-selling novel.
Exp2: no...many	Many authors [that no critics recommended] have ever ...
Exp3: no...all	All authors [that no critics recommended] have ever ...
Exp4: few...all	All authors [that few critics recommended] have ever ...
Exp5: few...the	The authors [that few critics recommended] have ever ...
Exp6: few...most	Most authors [that few critics recommended] have ever ...

Table 2: Example trial for the Irrelevant Licensor condition in Exp.1-6

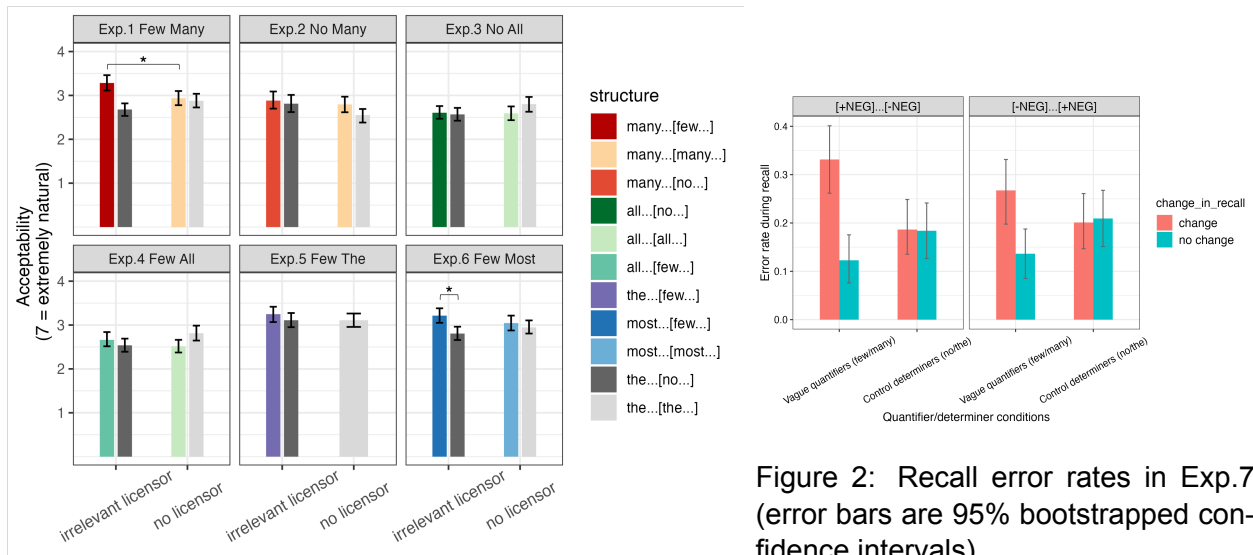


Figure 2: Recall error rates in Exp.7 (error bars are 95% bootstrapped confidence intervals)

Figure 1: Acceptability ratings in Exp.1-6 (the highly acceptable Grammatical Licensor condition was not revealed due to space limits; error bars are 95% bootstrapped confidence intervals; * means the Bayesian confidence intervals for an effect do not cross zero)