Towards a psycholinguistic model of bracketing paradoxes

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German nominal compounds modified by an adjective (AN_1N_2) typically have a canonical reading (1) in which the adjectives modifies the second noun of the compound. However, in some constructions, referred to as a *bracketing paradox* [6], the adjective can equally or even preferentially modify the first noun (2). Such constructions appear to have different syntactic and semantic bracketing, seemingly violating compositionality principles [2]. From a grammatical standpoint, the adjective should apply to the second noun or to the compound as a whole (3), but—crucially—not to the first noun [3]. How are bracketing paradoxes licensed, whether odd (4) or unremarkable (5a)? Context, world knowledge, pragmatic factors, and the semantic compatibility between the adjective and nouns are potential contributors to interpretation preferences. Language economy and how lexicalized the compound is may play a role [1, 5]. This multitude of possible factors calls for a broad empirical basis; empirical data on this phenomenon is virtually non-existent [4]. Our studies lay the foundations for a comprehensive model of bracketing paradoxes.

Experiment 1 investigated the role of semantic compatibility between the adjective and the individual nouns in the AN_1N_2 construction. 36 participants evaluated 204 items in 1 of 3 conditions, as in (5), by assigning 1–5 scores on the dimensions of naturalness, comprehensibility, and stylistic form. The ratings across scales were highly correlated ($r \geq 0.95$). We used their mean, scaled to the interval $[0, 1]$ for analysis. Most items received good ratings for AN_1, AN_2, or both (Fig. 1A), due to our attempt to exclude phrases where the adjective was a poor match for both nouns; these are unlikely to be produced. Thus, AN_1 and AN_2 ratings were correlated ($r = -0.5$). A Bayesian Beta regression modeled the AN_1N_2 ratings as a function of AN_1 and AN_2 ratings and their interaction (Fig. 1A–C). As expected, high AN_2 ratings were predictive of high AN_1N_2 ratings ($\beta = 6.3$, 95%-CrI $[4.7, 8.2]$, Fig. 1B). AN_1 ratings had a smaller positive effect on AN_1N_2 ratings ($\beta = 3.3$, 95%-CrI $[1.7, 5.2]$). Crucially, there was an $AN_1 \times AN_2$ interaction ($\beta = -4$, CrI $[-6.2, -2.0]$, Fig. 1C): When AN_2 ratings were low, AN_1 ratings had a large positive effect. When AN_2 ratings were high, higher AN_1 ratings *reduced* the AN_1N_2 ratings, suggesting a perceived conflict.

Experiment 2 investigated which noun in a compound is modified by the adjective. This is not necessarily determined by the ratings obtained in Exp. 1. 20 participants indicated for 235 AN_1N_2-phrases (5a) whether the adjective modifies N_1, N_2, or whether they were unsure. They overwhelmingly selected one of the nouns, with $< 3\%$ "unsure" answers (Fig. 1D), which we excluded from the analysis. 30% of compounds exhibited a flexible attachment preference (6–14 votes for either N_1 or N_2). A Bayesian logistic regression modeled the choice of attachment site (N_2 or not) as a function of the corresponding AN_1 and AN_2 ratings from Exp. 1 and their interaction. There were two main effects ($\beta_{N1} = 1.3$, 95%-CrI $[-2.5, -0.2]$; $\beta_{N2} = 8.0$, 95%-CrI $[6.5, 9.6]$) and an interaction ($\beta = -5.6$, 95%-CrI $[-7.6, -3.7]$, Fig. 1E–F). High AN_2 ratings and low AN_1 led to more N_2 attachment. When AN_2 ratings were low, high AN_1 had a stronger effect on N_2 attachment. When AN_2 ratings were high, AN_1 had a lesser influence on N_2 attachment.

Conclusions: Against grammatical and strictly compositional constraints, the first noun plays an important role in the interpretation of an adjective-nominal compound phrase (in spite of the second noun's dominance over the adjective and compound). This result aligns with the role of semantic and pragmatic factors, which may favor an otherwise unavailable attachment site. When both nouns are good matches for the adjective, acceptability is slightly reduced suggesting a conflict or competition between possible modifees. Both nouns have a positive effect on a compound's acceptability, but their effects are not additive. In the absence of a suitable head noun candidate, the first noun becomes a modification target for the adjective. This work suggests that the inter-

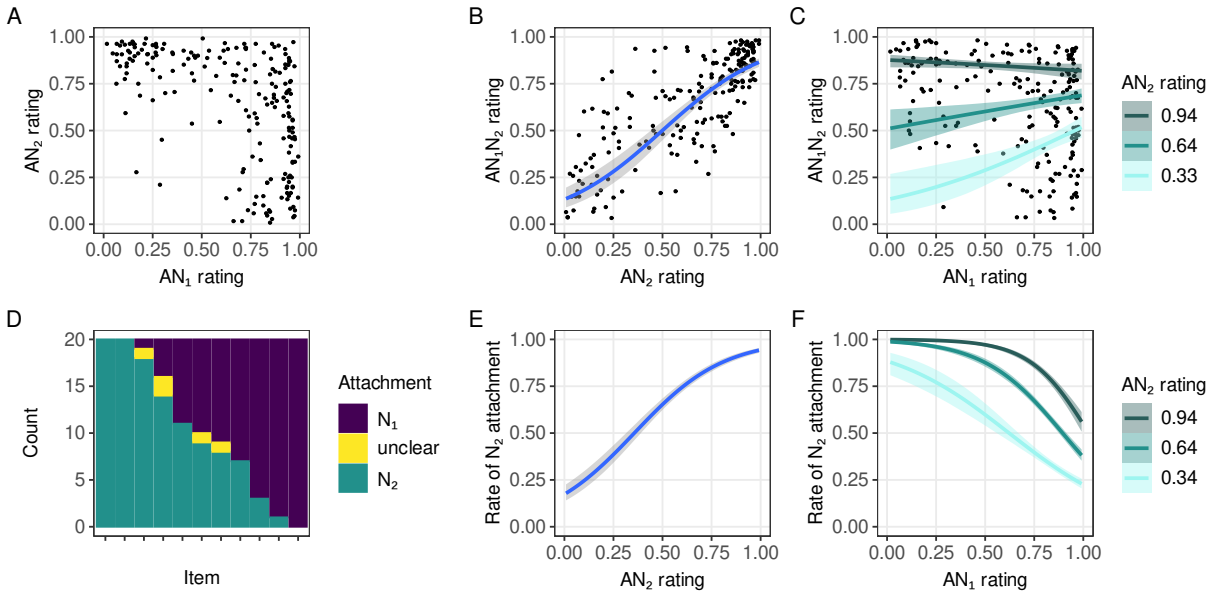

Figure 1: **A:** Exp. 1. Relationship between AN_2 and AN_1. **B:** Exp. 1. Relationship between AN_1N_2 and AN_2. **C:** Exp. 1. Relationship between AN_1N_2 and AN_1. Lines correspond to AN_2 groups. **D:** Exp. 2. Representative selection of items in Exp. 2 ordered by number of N_1/N_2/unsure answers. **E:** Exp. 2. Relationship between AN_1 rating and N_2 adjective attachment. **F:** Exp. 2. Relationship between attachment preference and AN_1 rating. Lines correspond to AN_2 groups.

pretation of bracketing paradoxes is not a clear-cut choice between the nouns, and there is much disagreement on interpretation between readers. Open questions: How do a speaker and listener agree on an interpretation? What makes bracketing paradoxes natural (5a) and unnatural (4)?

(1) [Französischer[Sprachlehrer]] *French* language.*teacher* — canonical reading

(2) [[Französischer Sprach]lehrer] *French language*.teacher — bracketing paradox

(3) Verrückter Chemieprofessor (Crazy chemistry.professor) — ✖ Chemie ✔ Professor

(4) ?Vierstöckiger Hausbesitzer (Four.story house.owner) — ✔ Haus ✖ Besitzer

(5) a. Psychologische Beratungsstelle (Psychological counseling.center) — AN_1N_2

b. Psychologische Beratung (Psychological counseling) — AN_1

c. Psychologische Stelle (Psychological center) — AN_2

[1] Boris Abramov. “Nochmals zur ‘reitenden Artilleriekaserne’.” In: *Beiträge zur Phraseologie – Wortbildung – Lexikologie*. Ed. by Rudolf Grosse et al. Frankfurt a. M.: Lang, 1992, pp. 133–139.

[2] Rolf Bergmann. “Verregnete Feriengefahr und Deutsche Sprachwissenschaft. Zum Verhältnis von Substantivkompositum und Adjektivattribut.” In: *Sprachwissenschaft* 5.3 (1980), pp. 234–265.

[3] Armin Burkhardt. “Gut erhaltene Knochenfunde beim Urmenschen. Zu einigen typischen Attributfehlern in der deutschen Gegenwartssprache.” In: *Sprachreport* 15.2 (1999), pp. 2–10.

[4] Corina Dima et al. “A Corpus-Based Model of Semantic Plausibility for German Bracketing Paradoxes.” In: *CDH*. 2017, pp. 64–70.

[5] Claudia Maienborn. “Wider die Klammerparadoxie: Kombinatorische Illusionen beim Adjektivbezug auf NN-Komposita.” In: *Zeitschrift für Sprachwissenschaft* 39.2 (2020), pp. 149–200.

[6] Julia Winkler. “Kleine Geschichte der ‘schiefen Attribute’.” In: *ZAS Papers in Linguistics* 58 (2015), pp. 124–139.