

Towards a psycholinguistic model of bracketing paradoxes

German nominal compounds modified by an adjective typically have a canonical reading (1) in which the adjectives modifies the second noun of the compound. However, in some constructions, the adjective can equally or even preferentially modify the first noun (2). The latter construction is referred to as a *bracketing paradox* (Winkler 2015). These constructions appear to have different syntactic and semantic bracketing, seemingly violating compositionality principles (Bergmann 1980; Frege 1892). 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 (Bergmann 1980). How, then, are bracketing paradoxes licensed, whether odd (4) or unremarkable (5a)? Context, world knowledge, and pragmatic factors are potential contributors to interpretation preferences, along with morphosyntactic agreement, and the semantic compatibility between the adjective and nouns. Language economy and how lexicalized the compound is likely also play a role (Maienborn 2020). This multitude of possible factors calls for a broad empirical basis to enable further progress; empirical data on this phenomenon is, however, virtually non-existent. Our study begins to close this gap and lays the foundations for a comprehensive model of bracketing paradoxes.

- | | | |
|-----|---|--------------------------------|
| (1) | [Französischer[Sprachlehrer]] <i>French language.teacher</i> | canonical reading |
| (2) | [[Französischer Sprach]lehrer] <i>French language.teacher</i> | 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 ₁ N ₂ |
| | b. Psychologische Beratung (Psychological counseling) | AN ₁ |
| | c. Psychologische Stelle (Psychological center) | AN ₂ |

Experiment 1 investigated the role of semantic compatibility between the adjective and the individual nouns in the adjective-nominal-compound construction. 36 participants were asked to evaluate 204 AN₁N₂ in one of 3 conditions, as in (5). They assigned 1–5 scores on the dimensions of naturalness, comprehensibility, and stylistic form. The ratings across scales were highly correlated ($r \geq 0.95$). We, therefore, used the mean of these ratings which was scaled to the interval [0, 1] for analysis. All but three items received good ratings for either AN₁ or AN₂ or for both (Fig. 1A). This is due to our attempt to exclude constructions where the adjective was a poor match for both nouns, as these are unlikely to be produced. As a result, AN₁ and AN₂ ratings were negatively correlated ($r = -0.5$). A Bayesian Beta regression modeled the averaged and scaled ratings of the AN₁N₂ constructions as a function of the corresponding AN₁ and AN₂ ratings along with their interaction (Fig. 1A–C). As expected, high AN₂ ratings were predictive of high AN₁N₂ ratings ($\beta = 6.3$, 95%-CrI [4.7, 8.2], Fig. 1B). However, AN₁ ratings, too, had a positive, albeit smaller effect on AN₁N₂ ratings ($\beta = 3.3$, 95%-CrI [1.7, 5.2]). Crucially, there was an interaction of the AN₁ and AN₂ ratings ($\beta = -4$, CrI [-6.2, -2.0], Fig. 1C): When AN₂ ratings were low, AN₁ ratings had a substantial positive effect. When AN₂ ratings were high, higher AN₁ ratings slightly *reduced* the AN₁N₂ ratings, suggesting a perceived conflict.

Experiment 2 investigated which noun in a compound is modified by the adjective, as this is not necessarily determined by the ratings obtained in Exp. 1. 20 participants indicated for 235 AN₁N₂-phrases (5a) whether the adjective modifies N₁, or N₂, or whether they were unsure. Participants overwhelmingly selected one of the nouns, with only < 3% “unsure” answers (Fig. 1D). Therefore, we excluded “unsure” answers from the analysis. 30% of compounds exhibited a flexible attachment preference, with 6 to 14 votes for either N₁ or N₂. A Bayesian logistic regression modeled the choice of attachment site (N₂ or not) as a function of the corresponding AN₁ and AN₂ ratings from Exp. 1 and their interaction. There were two main effects ($\beta_{N_1} = 1.3$, 95%-CrI [-2.5, -0.2]; $\beta_{N_2} = 8.0$, 95%-CrI [6.5, 9.6]) as well as an interaction ($\beta = -5.6$, 95%-CrI [-7.6, -3.7], Fig. 1E–F).

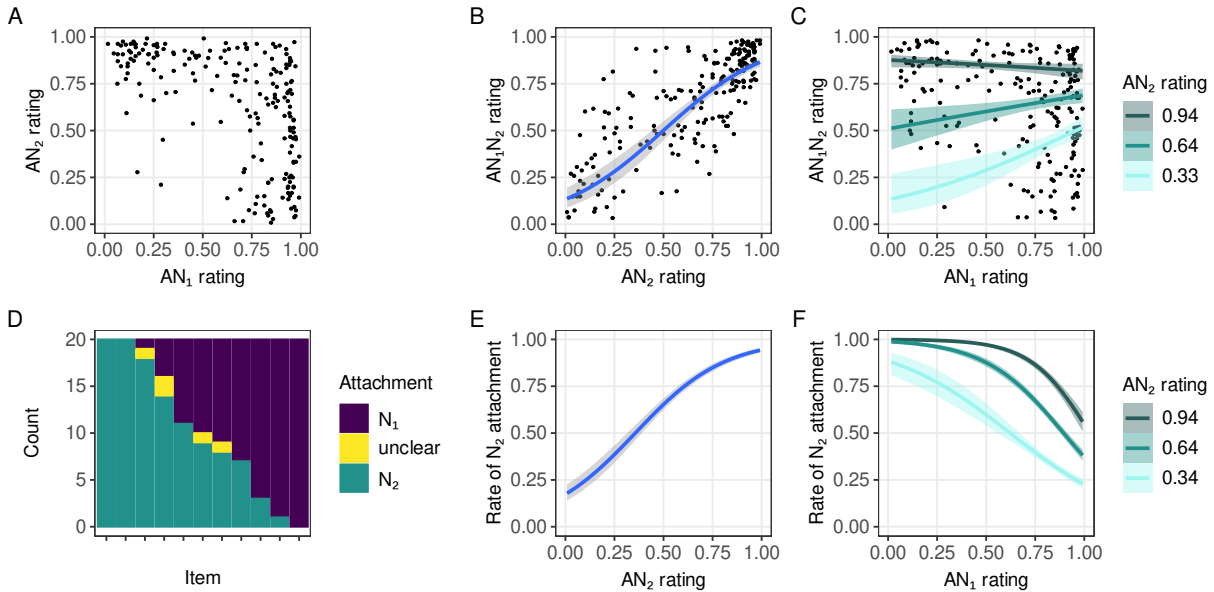


Figure 1: **A:** Exp. 1. Relationship between AN_2 and AN_1 . **B:** Exp. 1. Relationship between AN_1N_2 and AN_2 . **C:** Exp. 1. Relationship between AN_1N_2 and AN_1 . Lines correspond to AN_2 groups. **D:** Exp. 2. Representative selection of items in Exp. 2 ordered by number of N_1/N_2 /unsure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

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: Contrary to grammatical and strictly compositional constraints on their relationship, the first noun plays an important role in the acceptability of a nominal compound modified by an adjective. This is in spite of the second noun’s dominance over the adjective and compound. This result aligns with the role of semantic and pragmatic factors on such constructions, which may favor an otherwise grammatically unavailable attachment site. When both nouns are good matches for the adjective, acceptability is slightly reduced suggesting a perceived conflict or competition between possible attachment sites. Thus, even though both nouns have a positive effect on a compound’s acceptability, their effects are not additive. In the absence of a suitable head noun candidate, the first noun becomes an attractive modification target for the adjective. This work suggests that the interpretation of bracketing paradoxes is not a clear-cut choice between the nouns, and there is much uncertainty and disagreement on interpretation between readers. Open questions include how do a speaker and listener agree on an interpretation and what distinguishes natural (5a) and unnatural (4) sounding bracketing paradoxes.

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

Frege, Gottlob (1892). “Über Sinn und Bedeutung.” In: *Zeitschrift für Philosophie und philosophische Kritik* NF 100, pp. 25–50.

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

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