

Projective variability of (semi)factive verbs in family of sentence contexts: A rating study*

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Abstract

Investigating the influence of the embedding context on the projectivity of factive and semifactive predicates, this study has two main goals. On the one hand, we investigate empirically whether factive and semifactive verbs exhibit different degrees of projectivity depending on the Family of Sentences context in which they are embedded (as claimed by Karttunen [9]). Furthermore, we also investigate the relationship between projectivity and at-issueness for these contexts, thereby offering new experimental evidence regarding the Gradient Projection Principle (as formulated by Tonhauser et al. 2018 [23]). The results from our web-based rating study in German show two things: First, our study provides new empirical evidence that the Gradient Projection Principle does indeed generalize to the other Family of Sentences contexts. Second, our results do not support [9]’s theoretical claim as to the influence of the embedding context on projectivity for these verbs. Still, the data provide new empirical support for the observation that the individual verbs do differ with regard to their projectivity, beyond their partition along the lines of (semi)factivity.

1 Projective Variability among (semi)factive verbs

Among the semantic dimensions along which presuppositions may be distinguished, projection, that is, the ability to survive in an entailment-cancelling environment, is undoubtedly among their most prominent characteristics. However, despite being used as a means to identify presuppositions (e.g. [4], [2]), existing theoretical and experimental research has shown that presuppositions do not project equally stably in these environments (e.g. [23], [7], [26]). This projective variability can be attributed to various factors, such as prosody and information structure (e.g. [22], [8], [19]), personal beliefs (e.g. [13], [6]) or the particular environment in which a presupposition is embedded. The impact of the latter on the projective behaviour of factive verbs was already observed by Karttunen [9], as discussed for his original examples (1):

- (1) a. John didn’t {regret / realize / discover} that he had not told the truth.
b. Did you {regret / realize / discover} that you had not told the truth?
c. If I {regret / realize / discover} later that I have not told the truth, I will confess it to everyone.
d. It is possible that I will {regret / realize / discover} later that I have not told the truth.

According to [9], while each verb is projective when embedded under negation (1a), that is, each verb triggers the presupposition that the agent of the complement has not told the truth, this is no longer the case in the other environments in (1b) - (1d). In particular, *realize* and *discover* are claimed to differ from *regret* as they allow for both factive and non-factive-interpretations. The

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presupposition of the former can, but must not, project when embedded in polar questions, in the antecedents of conditionals, or in modal constructions. This observed projective variability was Karttunen’s impetus to differentiate between factive and semifactive verbs. Thus, [9], as many others following him (e.g. [1], [7]), posited the thesis that factive verbs do not form a homogeneous class. What is notable about his account, however, is that the projective variability among factive verbs is taken to be a function of Family of Sentence ([4]; henceforth FoS) context, which distinguishes his approach from other categorizations of factive verbs. Existing empirical work ([23], [7] or [26]) was able to identify projective variability between factive verbs, but did not examine to what extent the FoS environment has an impact. The present study therefore investigates whether the variability in projection between factives and semifactives depending on the FoS environment can be empirically confirmed, as theoretically hypothesized by [9].

To examine the projective behaviour of factive and semifactive verbs relative to FoS context, we employed the experimental paradigm used by [23], who studied the projectivity and at-issueness of various presupposition triggers in polar questions, and extended it to the other three FoS contexts. This naturally leads to another objective for our study: The investigation of the relationship between projectivity and at-issueness, that is, the extent to which content is considered to be up for debate (e.g. [15], [21]). For instance, [23], among others (e.g. [26], [12]), were able to provide strong empirical evidence that at-issueness is a promising explanation for the variability in projection between presupposition triggers. This was formulated by [23] in their *Gradient Projection Principle*, stating that a presupposition projects more strongly the less at-issue it is. However, in which way the Gradient Projection Principle may also interact with the FoS context has, to our knowledge, not been considered. Our study therefore set out to replicate earlier findings on the close relationship between the degrees of (non-)at-issueness and projectivity in polar questions and, furthermore, to explore to what extent these can be transferred to the other three FoS contexts as discussed for the examples in (1).

2 Empirical Investigation

2.1 Methods

In this experiment ($N = 105$; participants recruited via Prolific), the potential projective variability as hypothesized by [9] was investigated for six different factive or semifactive verbs in German. The three factive verbs *wissen* ‘know’, *bereuen* ‘regret’ and *enthüllen* ‘reveal’ were chosen as they have been found to show particularly strong projective behaviour in other (theoretical and empirical) studies (e.g. [11], [23], [7]). The three semifactive verbs *bemerken* ‘notice’, *entdecken* ‘discover’ and *herausfinden* ‘find out’/ ‘learn’ were chosen primarily for the reason that they – or, rather, their English equivalents – were explicitly classified as semifactive by [9].

To elicit **projectivity**, we employed the *certain that* test of [23], which measures projectivity by assessing speaker-commitment and which has proven to be a robust method, e.g. by [22], [8], [20], [13] or [7]: Participants were asked to imagine overhearing utterances as part of brief dialogues at a kitchen party. In the utterances the expressions associated with projective content were embedded in an FoS environment such as a question: “Did Marius reveal that Kim defrauded the tax office?”. Participants’ task was to indicate by means of a slider from “no” (0) to “yes” (100) whether they would judge the speaker to be certain about this particular content: “Is the speaker certain that Kim defrauded the tax office?”. Projection should evoke a positive answer.

Based on [9]’s observations for (1), we extended the design in [23] by including three more FoS

Figure 1: Sample experimental trial of the *certain that* test for the trigger *enthüllen* ‘reveal’ in a modal context from the internet questionnaire with the respective translation given in (2).

contexts in addition to questions: embedding under negation, in the antecedents of conditionals, and in modal constructions with *vielleicht* ‘maybe’. Accordingly four different experimental conditions were realized in the *certain that* test, as exemplified for the factive *enthüllen* ‘reveal’:

(2) Projectivity Ratings

- a. **question:** The speaker asks: “Did Marius reveal that Kim defrauded the tax office?”
- b. **negation:** The speaker says: “Marius did not reveal that Kim defrauded the tax office.”
- c. **antecedence of conditional:** The speaker says: “If Marius revealed that Kim defrauded the tax office, then he will not trust her with any documents.”
- d. **modal:** The speaker says: “Maybe Marius revealed that Kim defrauded the tax office.”

Question: Is the speaker certain that Kim defrauded the tax office?

An example trial for the modal FoS context is shown in Figure 1.

In order to elicit the **at-issueness** of the same verbs, we adopted the *Are you sure?* method from [23]’s Experiment 2, measuring the extent to which a presupposition is up for debate by asking the participants to judge (again, using a slider ranging from “no” to “yes”) whether the presupposition addresses a preceding “Are you sure?” question. Here, at-issueness should evoke a negative answer. Departing from the design of [23], the at-issueness of the triggers was only investigated in simple assertions, that is, in one experimental condition, as exemplified in (3) for the semifactive verb *herausfinden* ‘find out’/‘learn’, as we did not see how to apply the *Are you sure?* method in the scope of entailment-canceling operators, that is, in FoS contexts.

(3) At-Issueness Rating

- a. The speaker says: “Pia found out that David has British ancestors.”
- b. Her interlocutor asks: “Are you sure?”
- c. The speaker says: “Yes, I am sure that David has British ancestors.”

Question: Did the speaker answer her interlocutor’s question?

For each of the six factive and semifactive verbs, 15 different lexical contexts/situations were constructed, each of which occurred in the five different conditions of the experiment (as shown in (2) and (3)). The resulting items were distributed over five experimental lists according to a Latin Square design (90 trials in each list). In addition to the factive and semifactive verbs, our experiment included another presupposition trigger type, the so-called *Occasion verbs* (cf. [3, 18]) as filler items (15 items, each in the five conditions). Additionally, each list included 30

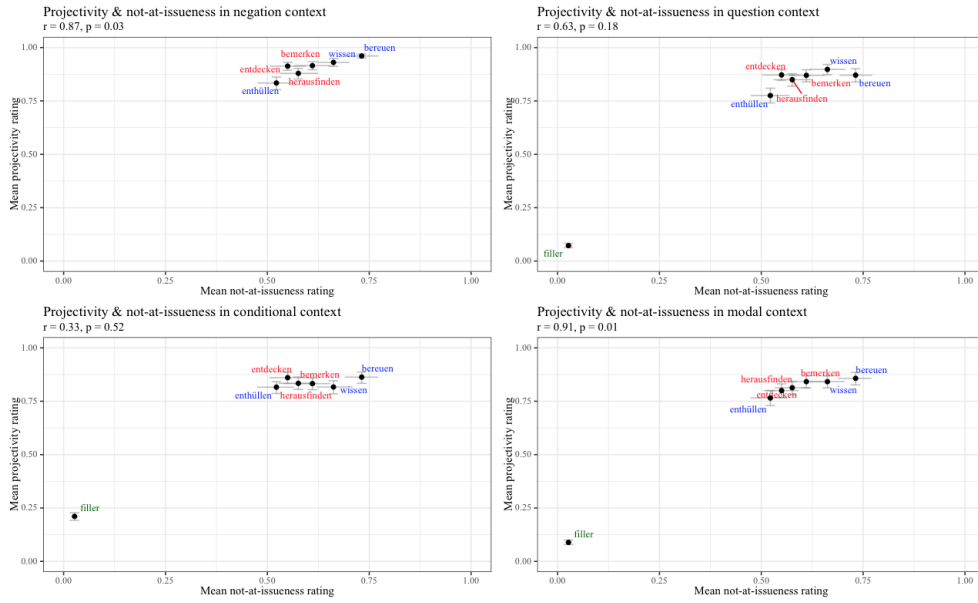


Figure 2: Projectivity/(non)-at-issuance ratings per FoS context and correlation coefficients between not-at-issuance and projectivity ratings (95% confidence intervals estimated via bootstrapping); factive verbs in blue, semifactives in red, distractor items in green.

distractor items querying about clearly non-projective content (in all FoS contexts except for negation) as well as at-issuance to check whether participants were focusing on the task.

2.2 Results and Discussion

We will first discuss whether the Gradient Projection Principle generalizes to the other FoS contexts. The plots in Figure 2 show the mean projectivity and not-at-issuance ratings of the individual triggers in each of the four FoS environments. The observed positive correlations between non-at-issuance and projectivity suggest an effect of at-issuance for each of the FoS contexts: higher non-at-issuance ratings resulted in higher projectivity ratings, as predicted by the Gradient Projection Principle. Put differently, there seems to be a clear relationship between (non)-at-issuance and projectivity across FoS contexts. This observation was corroborated by linear mixed-effects analyses, finding a significant main effect of at-issuance on projectivity in each of the FoS contexts (question: $\chi^2(1) = 4.09, p < 0.05$; negation: $\chi^2(1) = 5.56, p < 0.02$; antecedent of conditionals: $\chi^2(1) = 11.67, p < 0.001$; modal construction: $\chi^2(1) = 7.26, p < 0.01$). Further, when aggregated over the four FoS contexts, linear mixed-effects analyses found a significant main effect of at-issuance on projectivity ($\chi^2(1) = 9.04, p = 0.003$), but no significant interactions between at-issuance and FoS context ($\chi^2(3) = 7.17, p = 0.07$). Hence, these results not only support [23]’s findings on the Gradient Projection Principle in polar questions, but also provide new empirical evidence that this principle does generalize to the other FoS environments.

Next, we will consider the empirical applicability of [9]’s observation regarding the differences in projective variability between factive and semifactive verbs. As can be seen from Figure 3, the data did not show projective variability between the two verb classes depending on the

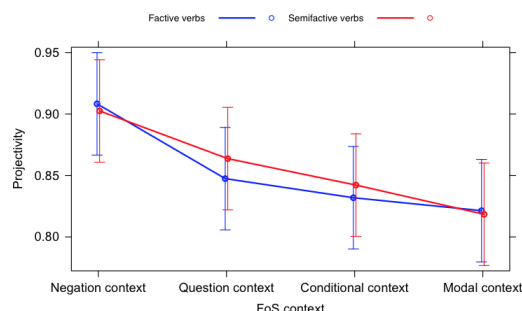


Figure 3: Relationship between FoS context and trigger type on projectivity.

FoS environment. Rather, the two trigger types showed a similar projective behaviour in each of the FoS contexts (recognizable by their lines running parallel across the contexts). What is more, if we take another look at Figure 2, it can be seen that the individual verbs cluster very similarly in all FoS contexts. This observed lack of variability across contexts was confirmed by a linear mixed-effects regression model analyzing the fixed effects of at-issueness and FoS environment, revealing no significant interaction effects ($\chi^2(3) = 3.27, p = 0.35$). Moreover, across FoS contexts, both factive and semifactive verbs were rated to be rather highly projective and, more importantly, did not differ noticeably in their projectivity ($\bar{x}_{factive} = 0.85$, $\bar{x}_{semifactive} = 0.86$), hence turning out to be more uniform than assumed. This was also supported by linear mixed-effects analyses, revealing no significant main effect of trigger type on projectivity ($\chi^2(1) = 0.03, p = 0.85$).

The findings of our study can thus be taken to speak against a substantially different modulation of projective variability depending on the FoS context for factive and semifactive verbs. However, we did find projective variability between FoS contexts, as can be seen, for example, by the descending lines in Figure 3. This observation found support by a linear mixed-effects regression model, revealing a significant main effect of FoS context on projectivity ($\chi^2(3) = 158.45, p < 0.0001$). Furthermore, our findings provide evidence for variability in the projective behaviour of the individual verbs, as follow-up analyses found a significant main effect of the individual verbs on projectivity ($\chi^2(5) = 50.56, p < 0.0001$). In particular, the verb *enthüllen* ‘reveal’ differed significantly from the other factive verbs in that it was always the least projective trigger across all the FoS environments, that is, even less projective than the semifactive verbs (as can also be seen in Figure 2).

3 General Discussion

The main findings of our study can be summarized as follows. First, [9]’s theoretical observation regarding the projective variability between factive and semifactive verbs depending on FoS context could not be confirmed empirically. Second, we found projective variability across FoS contexts as well as across individual verbs, when detached from their classification along the lines of (semi)factivity. Finally, and most importantly, our study is – to our knowledge – the first to show that [23]’s Gradient Projection Principle was found to be transferable to the other FoS contexts.

Our results support the findings in previous research. With regard to projective variability for different FoS contexts, for instance, [16, 17] also found conditionals and negation to differ

with regard to the strength of their projectivity. It should, however, be added that their projectivity ratings do not entirely coincide with ours. One desideratum for future research is therefore to consider possible reasons for the different projectivity ratings across FoS contexts. Furthermore, while the (semi)factive verbs in the MegaVeridicality dataset ([24, 25]) would indeed be in line with [9]’s observation, our conclusion that [9]’s differentiation into factive and semifactive verbs cannot be empirically proven, finds support in the results of [26], [23] and [7] for the (semi)factive verbs included in their investigations as well as for the (semi)factive verbs in the VerbVeridicality ([14]) and CommitmentBank datasets ([5]). However, these studies found, as we did, projective variability between individual verbs. Of particular interest is the fact that [23] and [7] also found the verb corresponding most closely to *enthüllen*, *reveal*, to exhibit a weaker projective behaviour in comparison to the semifactive verbs that were studied there, even though the individual verbs were not categorically distinguishable from each other in terms of their projectivity. This supports observations that there are other factors besides FoS context that may also have an influence on projectivity (see, for instance, [5] for discussion). The following considerations seem to be of relevance. For instance, the findings of [13] or [6] have shown that the prior beliefs of listeners can have an impact on the extent to which a presupposition projects. In these studies, contents that were presented with facts higher in probability also received higher projectivity ratings. Consequently, it may be that the party context in which all the items were embedded (cf. Section 2.1) was judged to be less plausible for the verb *enthüllen* compared to the other verbs, since the revelation of a fact implies that this very fact was not (publicly) known beforehand. This in turn might lead to higher uncertainty ratings and thus lower projectivity. This assumption is reminiscent of another factor that may also contribute to the salience of the verb *enthüllen*, which is the notion of factive verbs as (un)informative presuppositions (e.g. [19]). In this context, the complement of the verb *enthüllen* could be comprehended as higher in informativity than, for instance, the one for *know*, thereby being more at-issue and hence less projective than the other, not (so) informative presuppositions.

Finally, it may be considered whether the differences in projectivity could be due to differences in argument structure, a factor not commonly associated with projectivity. Thus, in our experiment, *enthüllen* ‘reveal’ was the only three-place verb including an argument position for the addressee/recipient, as in “x reveals to y that z”. As our items were always of the type “x reveals/knows/regrets that z” (see (2)), *reveal* would always occur without the addressee of the revelation being specified. In this case, however, it does not seem too far-fetched that the speaker in our experimental items could be implicitly included among the addressees of the revelation. For instance, one might imagine “Marius revealed that Kim defrauded the tax office”, being interpreted as “Marius revealed to us that Kim defrauded the tax office”. If this were to be the case, however, it may well that filtering is enforced, as there would otherwise be a risk of incoherence, compare *#Kim defrauded the tax office, and Marius revealed to us that Kim defrauded the tax office*. Should these speculation lead in the right direction, we would expect different explicitly mentioned addressees to be associated with projective variability across all FoS contexts as illustrated in (4):

- (4) a. Marius revealed to us that Kim defrauded the tax office.
 b. Marius revealed to them that Kim defrauded the tax office.

There are certainly a number of additional factors or issues which may influence the projective variability of factive and semifactive verbs. In any case, joining the effort to clean up the mess so “joyfully” left behind by Karttunen and colleagues ([10]: p. 728) proves time and again to be an intriguing and entertaining endeavour.

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