

Word order constraints on event-internal modifiers

Tibor Kiss, Jutta Pieper, Alicia Katharina Börner
Linguistic Data Science Lab
Ruhr-University Bochum
{tibor.kiss, jutta.pieper, alicia.boerner}@rub.de

Abstract There is a long-standing debate whether adverbials assume base positions in German clause structure. A major division can be drawn between analyses proposing base positions dependent on class membership, and analyses allowing free generation of adverbials unless adverbials from different classes modify the same event. Based on two experimental studies on *event-internal modifiers* we present an analysis which rejects base positions, as well as free generation of adverbials in isolation.

The results indicate that event-internal modifiers occupy several positions in German clause structure. Adverbials are base generated but constrained by a structural condition together with linear precedence rules based on a ranking of thematic roles, animacy, and the category of the phrase. Event-internal adverbials combine with a verbal projection (identifying the respective event variables) but require the identification of an additional individual variable with its reference phrase. Affirmative interpretations differ from privative ones, in that only the former introduce thematic roles. Hence, linearization constraints based on thematic hierarchies will only apply to affirmative modifiers, while the other constraints apply to affirmative and privative event-internal modifiers, yielding different serializations for affirmative and privative event-internal modifiers.

Keywords: German; adverbial modification; event-internal adverbials; syntax-semantics Interface; experimental syntax

1 Introduction: the syntactic position(s) of event-internal modifiers

The comparatively free arrangement of arguments in German clause structure does not mean that every serialization is possible. Consequently, various analyses of the order of arguments in German clause structure have been proposed (for an overview, see Abels 2015; Frey 2015).

The serialization of modifiers, however, was not a subject of research. Instead, the conjecture that “*adverbial phrases can be interspersed freely among the arguments of the verb*” (Uszkoreit 1987: 145) was taken for granted (see also Zwart (1993), and Neeleman & Reinhart (1998), among others). This view has been challenged in the past 25 years. Frey & Pittner (1998), Frey (2003; 2015), Ernst (1998), Haider (2000; 2010), Maienborn (1995; 2001; 2003), and Maienborn et al. (2016) apply word order constraints to adverbial modifiers as well.

Frey & Pittner (1998) argue that base positions for adverbials depend on membership in specific adverbial classes (such as process-related adverbials, event-internal adverbials, and event-related adverbials).¹ This view is not shared by all analyses of modification in German: Ernst (1998), Haider (2000), and Maienborn et al. (2016) propose relative constraints, and the first two proposals do not assume base positions for adverbials. Relative constraints govern the realization of adverbials of one class given that adverbials of another class are present in the same clause structure. If a single adverbial is realized, the proposals assume that it can be merged and linearized freely. It is a common property of all proposals that serialization constraints are not expressed as such. Instead, structural conditions lead to configurations which are mapped to linear orders. The present analysis will follow the lead of Haider (2000) and Maienborn et al. (2016) in making semantic constraints responsible for structural conditions but extend it to include genuine word order constraints as well. It will differ from these proposals in three respects: First, we will be dealing with modifiers in isolation. Secondly, we will analyze event-internal modifiers, which have as yet only been approached in Frey & Pittner (1998), where structural conditions are postulated but not explained.² Thirdly, neither the relevant semantic condition, nor the assumed linear precedence constraints must be defined specifically for the class of event-internal adverbials. The semantic constraint follows from a type mismatch and a general requirement that unbound dependencies must be resolved, and the linear precedence constraints are well-established in existing proposals dealing with word order constraints for arguments.

Event-internal modifiers are related to an argument in the same minimal clause. Adapting Frey & Pittner’s (1998: 511) terminology, we call this argument the *reference phrase* of the adverbial (*Bezugselement*). The necessity of an adverbial to relate to such a reference phrase will informally be called the *orientation* of the adverbial. Event-internal adverbials can hence be subject- or object-oriented. The following examples help to illustrate the predictions of the proposals for comitatives and instrumentals.

- (1) a. Da hat Claudia **zusammen mit einem Kollegen** was getestet.
 there has Claudia together with a colleague what.ACC tested
 b. Da hat Claudia was **zusammen mit einem Kollegen** getestet.
 ‘Claudia tested something in tandem with a colleague.’

¹ The German term for event-internal adverbials used by Frey & Pittner (1998: 505) is *ereignisintern*. The German term for event-related adverbials used by Frey & Pittner (1998: 512) is *ereignisbezogen*.

² Maienborn’s (2001, 2003) discussion of event-internal adverbials is restricted to locative modifiers in isolation and thus not fully representative of this class.

- (2) a. Da hat Herbert **ganz ohne einen Kollegen** was überprüft.
 there has Herbert entirely without a colleague what.ACC sifted
 b. Da hat Herbert was **ganz ohne einen Kollegen** überprüft.
 ‘Herbert sifted something without a colleague.’
- (3) a. Da hat Hans **mittels eines Graphikeditors** was erstellt.
 there has Hans by.means.of a graphic.editor what.ACC created
 b. Da hat Hans was **mittels eines Graphikeditors** erstellt.
 ‘Hans created something using a graphic editor.’
- (4) a. Da hat Ramona **ganz ohne ein Hilfsmittel** was angeschlossen.
 there has Ramona entirely without a means what.ACC connected
 b. Da hat Ramona was **ganz ohne ein Hilfsmittel** angeschlossen.
 ‘Ramona connected something without using a means.’

The examples in (1) and (2) show *comitatives* with affirmative and privative readings headed by the prepositions *mit* (‘with’) and *ohne* (‘without’), respectively. The examples in (3) and (4) show affirmative and privative *instrumentals*, headed by the prepositions *mittels* (‘by means of’) and *ohne* (‘without’). The a) and b) examples differ with respect to the relative positions of the adverbial phrases and objects. The latter are realized as *wh*-indefinites (*was*, ‘something’), which are assumed to be scrambling-invariant in their existential interpretation (cf. Haider 2010).³

The sentences contain just one adverbial phrase. Hence, proposals assuming relative constraints are silent about the position of the adverbials in (1) to (4).

Frey & Pittner (1998: 511) propose that base positions of event-internal modifiers can be derived from the requirement that they be minimally c-commanded by their reference phrases. They thus predict all a)-examples in (1) to (4) to be grammatical, and all b)-examples to be ungrammatical. The presumed ungrammaticality of the b)-examples is derived from a violation of the minimal c-command constraint: The object intervenes between the subject – the reference phrase of both adverbial types – and the adverbial PP. And since the object is assumed to be scrambling-invariant, its position cannot be derived from scrambling understood as re-merger to the left (see Frey & Pittner 1998:525). The alternative would be to derive the b)-examples by scrambling as lowering but lowering violates Frey & Pittner’s (and almost everybody else’s) analysis of scrambling as raising.

The present study suggests that neither analysis is correct. Event-internal modifiers cannot be realized freely (if in isolation), and they do not occupy a unique base position.

Since individual judgements in uncontrolled environments can be subtle, we have decided to carry out experimental studies to corroborate the analysis. The results indicate that structures of the type (1a) are preferred over structures of the type (1b), while there is almost no preference for the

³ Haider (2010) represents the predominant view of scrambling-invariance of existential *wh*-indefinites, which also follow in the present analysis. It should be pointed out though that this view is not completely without contenders. Lechner (1998: 279) assumes that *wh*-indefinites leave the VP to be realized within AgrOP, but also points out that the mechanism is controversial when dealing with remnant topicalization. Struckmeier (2014: 225ff.) takes up Lechner’s assumption but makes clear that a potential movement of the *wh*-indefinite is semantically triggered to escape the scope of negation, which is not an issue in the structures discussed here. Doubts on Lechner’s analysis can also be raised if the convincing arguments are considered that Haider (2010) provides against the stipulation of functional projections between V⁰ and C⁰ in German clause structure.

types (2a) vs. (2b). Contrasting this pattern, structures of the type (3b) and (4b) are preferred over structures of the type (3a) and (4a), as summarized in table 1.

Table 1: Order preference dependent on adverbials

Example	Adverbial	Preferred order	Preference
(1)	COM affirmative	PP > OBJ	(1a)
(2)	COM privative	OBJ > PP	(2a)/(2b)
(3)	INSTR affirmative	OBJ > PP	(3b)
(4)	INSTR privative	OBJ > PP	(4b)

The present analysis derives the preferences from the interaction of a structural condition with constraints on the ordering of phrases based on the position of the thematic role borne by the phrases on a thematic hierarchy, the animacy of the phrase, and its category. In making use of a structural constraint, the present analysis shares a conceptual core with Frey & Pittner's (1998) and Haider's (2000) analysis: Neither proposal assumes linearization constraints *per se*, but instead employs configurational constraints, from which linearization conditions can be derived. We assume that event-internal modifiers are specific insofar as they syntactically and semantically combine with verbal projections (combining the respective event variables) but require the *identification* of an individual variable with its reference phrase. Adjoining to verbal projections, event-internal modifiers do not have direct access to the arguments of the verb, so the identification must proceed indirectly and requires c-command, as the free variable is projected upwards from the adverbial and can only be identified by phrases c-commanding it. Asymmetric c-command constrains serialization options for the adverbials, as it allows a mapping to linear orders. What is more, comitatives do not introduce genuine thematic relations, but instead take over the thematic relation of the phrase which identifies the individual variable. This accounts for the observation (see Baker 1997: 108) that comitatives introduce secondary agents or themes (depending on their orientation – they can relate to the subject or the object). Instrumentals of course introduce *instruments* (their relational nature has been discussed in Jackendoff 1987: 401). Comitatives and instrumentals combine with an event variable (yielding event identification, see section 4.2.1). As a consequence, the thematic roles introduced by comitatives and instrumentals are integrated into the thematic structure of the modified verbal projection. Being integrated, the phrases occupy linear positions according to the ranking of their roles.

We will assume, however, that only affirmative adverbials introduce thematic roles. Hence, linearization constraints based on thematic hierarchies will only apply to affirmative modifiers, while the other constraints will be applied to affirmative and privative event-internal modifiers.

The structural condition requires that the event-internal modifiers in (1) to (4) must occupy a position that is asymmetrically c-commanded by their respective reference phrases. Since the subject – being the reference phrase in (1) to (4) – c-commands the PP whether it is realized before or after the object, two orders are possible in general. The order (1a) is preferred over (1b) because the argument of the comitative takes over the agent role from its reference phrase and is specified as [animate]. Bearing an agent role, the comitative is ranked higher than the inanimate object (with a theme role). We will justify that no thematic role is introduced by the modifier in privative interpretations. While (2b) is mildly preferred over (2a), both orders are almost on a par, which follows from one constraint being violated in each order: either a constraint placing NPs before PPs, or a constraint placing phrases with the specification [animate] before phrases with the opposite specification. As for (3) and (4), the position of instruments on the thematic hierarchy

is the subject of debate, see Dik (1978: 70), Croft (1991: 173), and Levin & Rappaport Hovav (2009)). Our findings suggest that *themes* are found in a more prominent position than *instruments*, thus accounting for the strong preference of the order OBJ > PP for instrumental adverbials.⁴ In case of affirmative interpretations, the order conforms to the thematic hierarchy as well as to the linear precedence constraint placing NPs before PPs. In case of privative interpretations, the latter is the only applicable constraint in addition to the identification requirement.

It is a consequence of the present analysis that no class-specific constraints are required to determine word order variation among event-internal modifiers. We assume that the identification with a reference phrase is an instance of binding a syntactic (and semantic) dependency, a process which is well-known to be governed by structural relations such as c-command. The application of a thematic ranking, animacy, and the syntactic category to determine serializations is also uncontroversial in German grammar (see Müller 1999, among others).⁵ Finally, the relevance of a mapping between asymmetric c-command (a hierarchical relation) and serialization has also been discussed *in extenso* in Generative Grammar, starting with Kayne (1994).

Taken together, we will argue that event-internal modifiers may occupy several positions in German clause structure, which are not related by movement, but instead should be analyzed in terms of base generation constrained by linear precedence rules, which equally apply to arguments and adjuncts.

The remaining paper is structured as follows:

Section 2 will discuss the analysis of event-internal modifiers in Frey & Pittner (1998). We will concentrate on this proposal because other works – Maienborn (1995; 2001; 2003), Haider (2000), and Maienborn et al. (2016) – either do not recognize the class of event-internal modifiers or draw different distinctions to separate possible event-internal modifiers from process-related and event-related modifiers.

Section 3 will present the results of two experimental studies on the position of comitatives and instrumentals in German clause structure, presenting both the empirical distributions, and the corresponding statistical models, with a focus on categorical features. The full models will be shown in the supplementary data (see section Data availability below).

Section 4 will present our analysis, based on the criticism levelled in section 2, and the empirical evidence provided in section 3.

Section 5 will discuss whether the gradient nature of the empirical evidence should be solely accounted for in terms of acceptability or whether it has repercussions for the concept grammaticality as well.

2 Serializations of event-internal modifiers in Frey & Pittner (1998)

Frey & Pittner (1998: 524f.) propose that different classes of adverbials occupy base positions that are determined by the class membership of the modifiers, which ultimately relates to their

⁴ Alternative orders are not entirely excluded, which speaks in favor of graded grammaticality, an issue that we will take up in section 5.

⁵ Unfortunately, the exact positions of the pertinent thematic roles on such a hierarchy are highly controversial, as we will take up later.

semantics.⁶ If adverbials show up in a position that is not determined by its class membership, the position must be the result of scrambling, which is assumed to be adjunction to the verbal projection and hence can only apply upward and to the left (Frey & Pittner 1998: 525).

Frey & Pittner do not provide specific assumptions about German clause structure, but their reference to the analysis by Haider (1993), which is refined and extended in Haider (2000; 2010), suggests that they assume that the German core clause is a verbal projection, to which arguments and adjuncts are added in binary fashion, with the verb in final position. This verbal projection is the complement of a functional head, usually called C^0 , which either contains a complementizer or a raised finite verb as its head. We basically follow the analysis of Haider (2010), but will extend it with semantic representations, as well as information on serialization.

It is a remarkable aspect of the analysis by Frey & Pittner (1998) that the class of event-internal modifiers is not defined. Frey & Pittner (1998: 505) apply test criteria for base positions to a list of adverbials comprising instrumentals, comitatives, locatives, and mental attitude adverbials.⁷ They continue to assume (Frey & Pittner 1998: 511) that event-internal adverbials can be characterized through an imposition of the argument structure of the verb they modify including the requirement that they relate to, or are oriented towards, a reference phrase.

Frey & Pittner (1998: 511) further propose that locative event-internal adverbials provide a predication over the highest-ranking argument of the verb. This characterization is at odds with the definition of event-internal adverbials in Maienborn (1995; 2001; 2003). Regarding internal locatives, it is also at odds with the empirical facts, and it can be claimed that the locative adverbials discussed in Frey & Pittner (1998) do not belong to the class of event-internal modifiers at all. The following characterization of event-internal modifiers is taken from Maienborn (1995; 2001; 2003):

“Event-internal modifiers are [...] related to the verb’s eventuality argument, [but do] not express [an adverbial modification] for the whole [...] event, but only for one of its parts [...] internal modifiers are linked up to a referent that is related to the verb’s eventuality argument” (Maienborn 2001: 191, 198) “[They] elaborate [the event’s] internal structure [...]” (Maienborn 1995: 238) “So-called event-external modifiers relate to the full eventuality, whereas event-internal modifiers relate to some integral part of it.” (Maienborn 2003: 475)

⁶ “Wie ergibt sich [...] die Grundposition [...] eines Adverbials? Jedes Adverbial besitzt eine inhärente Semantik, die es einer bestimmten Klasse von Adverbialen zuordnet. [...] Aufgrund der semantischen Klassenzugehörigkeit kann dem Adverbial eine Grundposition zugeordnet werden.“ [How can the base position of an adverbial be determined? Every adverbial shows an inherent semantics, which determines the membership of the adverbial in a specific adverbial class. The adverbial will thus be assigned a base position, which is determined by its semantic class membership.] (Frey & Pittner 1998: 525)

⁷ Individual characterizations of comitatives and mental attitude adverbials are provided in Frey & Pittner (1998: 506, 508), while instrumentals and ‘internal’ locatives are not defined but rather taken for granted. Frey & Pittner (1998: 506): “Komitative weisen die Besonderheit auf, daß sie ein Bezugselement haben, mit dem die im Komitativ enthaltene NP [...] auch koordiniert werden könnte.“ [Comitatives are special insofar as they require an antecedent with which the NP contained in the comitative could be coordinated.] Frey & Pittner (1998: 508): “Bei den ‚Adverbien der Subjekthaltung‘ handelt es sich um eine Charakterisierung der Einstellung des [...] Subjektsreferenten zum Ereignis [...]“ [Mental attitude modifiers provide an indication of the attitude of the subject’s referent towards the eventuality.]

Concerning the examples of presumed internal locatives provided by Frey & Pittner (1998), we first notice that it is quite dubious that the examples provided show predications over the highest-ranking argument:

- (5) a. Otto hat in Peters Garten dieses Buch gelesen.
 Otto has in Peter's garden this book read.
 'Otto read this book in Peter's garden.'
 b. Otto hat in der Kantine den Koch beleidigt.
 Otto has in the cantina the cook insulted
 'Otto insulted the cook in the cantina.'

In (5), the locatives provide much more plausibly a predication over the whole event, which can accordingly be localized *in Peter's garden* (5a) or *in the cantina* (5b). Hence, the modifiers in (5) can be claimed to belong to the class of *event-related* modifiers (Frey & Pittner 1998: 512–516).⁸ Further evidence for an assignment to the class of event-related modifiers come from German verbs with *ambient* subjects such as *knarren* ('to creak'), *lichten* ('to clear'), or *rumoren* ('to rumble'). The subject of these verbs is non-thematic, and hence a predication over the highest-ranking argument is impossible. Yet, they can be combined with modifiers of the type used in the analysis of Frey & Pittner (1998):

- (6) a. Es knarrte in Peters Garten.
 it creaked in Peter's garden
 'Something creaked in Peter's garden.'
 b. Es lichtet sich in der Kurve.
 it clears REFL in the bend
 'In the bend, it clears.'
 c. Es rumorte in der Kantine.
 it rumbled in the cantina
 'It rumbled in the cantina.'

If examples like (5) are compared to uncontroversial event-internal locatives, further contrasts can be observed (see also Maienborn 1995: 237f.; Maienborn 2001: 201; Maienborn 2003: 481).

- (7) a. Maria zog Paul im Zimmer an den Haaren.
 Maria pulled Paul in.the room at the hair
 'Maria pulled Paul's hair in the room.'
 b. Paul hat in der Wohnung in Stiefeln geduscht.
 Paul has in the apartment in boots showered
 'Paul took a shower in the apartment wearing boots.'

First note that the examples in (7) contains event-internal (*an den Haaren*, 'by the hair'; *in Stiefeln*, 'wearing boots') and event-related locative modifiers (*im Zimmer*, 'in the room', *in der Wohnung*, 'in the apartment'). Maienborn (2003: 483) points out that two different *wh*-interrogatives must be

⁸ Formally, event-related modifiers can be characterized as functions from events to truth values and are semantically combined with verbal projections through Event Identification (Kratzer 1996), which will be discussed below.

used in a question for event-internal and event-related modifiers. While a question towards an event-related modifier uses the locative interrogative *wo* ('where'), it is necessary to use a complex locative interrogative, such as *worin* ('wherein') or *woran* ('on what') for event-internal locatives, as is illustrated for (7b) in (8).⁹

- (8) a. **Wo* hat Paul in der Wohnung geduscht? In Stiefeln.
 where has Paul in the apartment showered in boots
 b. *Worin* hat Paul in der Wohnung geduscht? In Stiefeln.
 wherein has Paul in the apartment showered in boots
 'What did Paul shower in in the apartment? In boots.'
 c. **Worin* hat Paul in Stiefeln geduscht? In der Wohnung.
 wherein has Paul in boots showered in the apartment
 d. *Wo* hat Paul in Stiefeln geduscht? In der Wohnung.
 where has Paul in boots showered in the apartment
 'Where did Paul shower wearing boots? In the apartment.'

If this criterion is applied to the examples from Frey & Pittner (1998), the use of *wo* ('where') is mandatory, while the complex locative interrogatives cannot be used.

- (9) a. *Wo* hat Otto den Koch beleidigt? In der Kantine.
 where has Otto the cook insulted in the cantina
 'Where did Otto insult the cook? In the cantina.'
 b. **Worin* hat Otto den Koch beleidigt? In der Kantine.
 wherein has Otto the cook insulted in the cantina

Finally, it appears that Frey & Pittner (1998) assume that internal locatives always provide a predication over the highest-ranking argument, while Maienborn (1995; 2001; 2003) shows that event-internal locatives may take the subject as well as an object as a reference phrase, as e.g. illustrated in (10):

- (10) a. Eine Unternehmerin hat ein Rezept auf einer Visitenkarte notiert.
 a entrepreneur has a recipe on a business.card noted.down
 'An entrepreneur noted down a recipe on a business card.'
 b. Ein Spaziergänger hat ein Buch auf einem Mauersprung liegen lassen.
 a rambler has a book on a projection.on.a.wall left
 'A rambler left a book on a projection on a wall.'

In sum, we can argue that the analysis of event-internal locatives in Frey & Pittner (1998) suffers from using locatives which cannot be classified as event-internal modifiers.¹⁰ The reason behind this equivocation might be that the class of event-internal modifiers is not properly defined in Frey

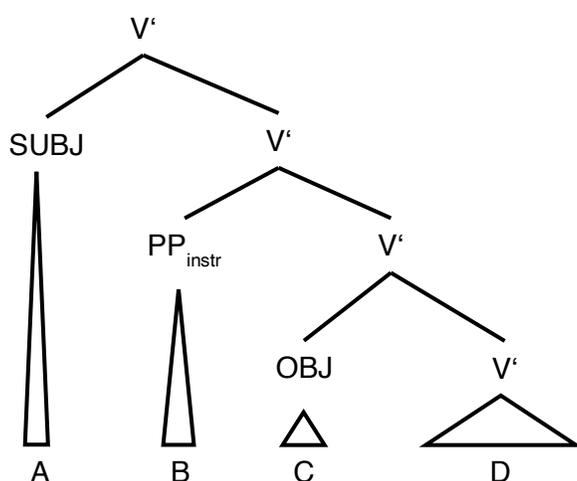
⁹ As Maienborn (2003: 483) points out, the external arguments of complex interrogatives are sortally restricted to belong to the class of objects. Hence, they cannot be used to ask for *events*.

¹⁰ Locatives are not the only adverbials the class membership of which is disputable in Frey's and Pittner's analysis. While Frey & Pittner (1998) assume that temporals belong to the event-related (event-external in Maienborn's terminology) modifiers, Frey (2003) proposes that they belong to the event-internal modifiers.

& Pittner (1998). As the nature of event-internal locatives is far from settled, we have decided to focus on comitatives and instrumentals in the present analysis.

But the empirical evidence adduced in Frey & Pittner (1998) to suggest a minimal c-command relationship between event-internal modifiers and their reference phrases is problematic as well. They assume that instrumental modifiers occupy a position that immediately follows the position of the subject, because the subject must minimally c-command the instrumental.^{11,12} This is schematically depicted in (11): the PP is minimally c-commanded by the subject, and c-commands the object in turn. The c-command relationships can be mapped to linear precedence: if a subject A minimally c-commands B, it follows that $A > B$. The same considerations apply to $B > C$, and hence $A > B > C$, if a subject minimally c-commands a PP, and the PP c-commands the object.

(11) Schematic structure of instrumentals in German clause structure



If the structure in (11) is assumed and the position of the object is taken to be fixed, the positions of the instrumentals in (3b) and (4b) – $A > C > B$ – can only be the result of – illicit – lowering. Frey & Pittner (1998) argue that examples showing the serializations in (3b) and (4b) must be ungrammatical.

They justify their assumptions by looking into scope determination and focus projections. Frey (1993) has argued that if two quantifiers Q_1 and Q_2 show a scope ambiguity in a configuration [... Q_1 ... [... Q_2 ...]], then this configuration must be the result of scrambling, so that the structure contains a trace of the higher quantifier Q_1 : [... Q_1 ... [... Q_2 ... [... t_1 ...]]]. Since Q_1 c-commands Q_2 , and Q_2 c-commands the trace of Q_1 , it follows that the configuration gives rise to scope

¹¹ Frey & Pittner (1998: 506ff.) provide the following exception to the minimal c-command requirement: If α and β are modifiers belonging to the same class, then neither α nor β count as blocking c-commanders. Hence the subject γ minimally c-commands β in the configuration [$S \gamma$ [$VP \alpha$ [$VP \beta$...]]] although α intervenes, if both α and β are event-internal modifiers (as e.g. comitatives or instrumentals).

¹² Frey & Pittner (1998) agree with basically all analyses of instrumental modifiers that instrumentals are subject-oriented (which of course can be demoted in case of passive and other operations). See Jackendoff (1987), Croft (1991), and Baker (1997), among others.

ambiguity. Let us take this argument for granted.¹³ Frey & Pittner (1998: 505f.) present the following examples of isolated verb-final subordinate clauses and claim that (12a) is ambiguous, while (12b) is not.

- (12) a. weil Otto heute mit mindestens einem Schraubenzieher fast jedes Fenster
 because Otto today with at.least one screwdriver almost every window
 öffnen konnte ($\exists\forall$ only)
 open.INF could
 'because Otto managed to open almost every window with at least one screwdriver'
- b. weil Otto heute mindestens ein Fenster mit fast jedem Schraubenzieher
 because Otto today at.least one window with almost every screwdriver
 öffnen konnte ($\exists\forall$ and $\forall\exists$)
 open.INF could
 'because Otto managed to open at least one window with almost every screwdriver'

Before discussing the interpretations of the examples in (12), it seems reasonable to make use of main clauses instead, since scope interpretations are subtle (Frey & Pittner 1998: 492; Haider 2010: 183), and it seems best not to confound them with structures that do not normally appear in isolation. Furthermore, one crucial piece of evidence is missing from (12), as will become clear in the discussion of the examples in (13).

- (13) a. Er hatte mit fast jedem Schraubenzieher mindestens eine Wohnungstür geöffnet.
 he had with almost every screwdriver at.least one apartment.door opened
 'He opened at least one apartment door with almost every screwdriver.'
- b. Er hatte mindestens eine Wohnungstür mit fast jedem Schraubenzieher geöffnet.
- c. Er hatte fast jede Wohnungstür mit mindestens einem Schraubenzieher geöffnet.
 he had almost every apartment.door with at.least one screwdriver opened
 'He opened almost every apartment door with at least one screwdriver.'

Example (13a) differs from example (12a) in that the higher quantifier (embedded in the instrumental) is a universal quantifier. In (13a), the universal quantifier takes scope over the existentially quantified object, while the reverse is not given ($\forall\exists$, $*\exists\forall$). This conclusion is compliant with assuming that linear order in (13a) reflects the syntactic configuration, so that the instrumental PP asymmetrically c-commands the object. Now consider (13b). In contrast to (13a), this example allows both readings. But this cannot be taken as evidence for scrambling. In (13b) the wide scope quantifier is an existential quantifier. The stronger reading – with the existential quantifier taking scope over the universal quantifier – entails the weaker reading in which the universal quantifier receives scope over the existential quantifier, because $\exists\forall$ entails $\forall\exists$ but not vice versa. Consequently, a scope distinction between (12a) and (12b) must also be doubted: if I used at least one screwdriver to open almost every window then almost every window was opened by at least one screwdriver. While admitting that (12a) shows two readings, we do not see a necessity to derive them from different syntactic structures.

Finally, consider (13c), which is missing in Frey & Pittner's argumentation. If (13c) was ambiguous, it would provide evidence for Frey & Pittner's argumentation, but (13c) is not. There is only the

¹³ This is by no means necessary: Kiss (2001) shows that scope ambiguities can be derived without assuming traces of quantifier raising.

weak reading present ($\forall\exists$), which again is compliant with base generating both phrases in their positions. We can thus summarize that the ambiguity of (12b) follows from logical reasoning, and not from syntactic operations, and hence that the examples in (12) do not provide evidence for a specific syntactic configuration.

Next consider focus projection. Haider (2010: 182ff.) argues that focus projection provides evidence for scrambling among arguments. According to his assumptions, a scrambled example like (15b) does not allow maximal focus projection, which means – among other things – that (15b) cannot be an answer to (14).

- (14) Was ist geschehen?
 what is happened
 ‘What has happened?’
- (15) a. Soeben hat jemand einem Verletzten einen ARZT besorgt.
 just.this.minute has someone a.DAT casualty.DAT a.ACC doctor.ACC got
 b. Soeben hat jemand einen Arzt einem VerLETZTEN besorgt.
 ‘Just this minute, someone send for a doctor to help a casualty.’

Haider (2010: 183) assumes that stress must fall on the lowest phrase position in the clause to allow for maximal focus and that this position is occupied by a trace in (15b), which cannot bear stress. The presence of a trace yielding minimal focus only, accordingly, is evidence for scrambling. Frey & Pittner (1998: 505) make use of an analogous argument to provide evidence for a base position of instrumentals above the object. Again, the examples presented are problematic insofar as isolated causal subordinate clauses are presented. Furthermore, the determination of maximal focus, or lack thereof, requires questions and answers, because different foci can be identified by comparing whether a sentence with a given stress pattern can be the answer to a set of questions. In the present case, it suffices to find out whether the sentence in question can be the answer to the question *Was ist geschehen?* (‘What has happened?’), because only then, we can assume maximal focus. Consider the examples in (16).

- (16) a. Was ist geschehen?
 what is happened
 ‘What has happened?’
 b. Otto hat heute mit einem Schraubenzieher eine WOHNUNGSTÜR geöffnet.
 Otto has today with a screwdriver a apartment.door opened
 c. Otto hat heute eine Wohnungstür mit einem SCHRAUBenzieher geöffnet.
 ‘Otto opened an apartment door with a screwdriver today.’

Both (16b) and (16c) are natural answers to (16a), hence show maximal focus. Following Haider this means that stress falls on the lowest phrase in the structure. According to Frey & Pittner (1998), (16c) shows narrow focus only. In fact, maximal focus cannot be derived from their analysis: Scrambling of the instrumental to the right is prohibited as lowering. Hence, Frey & Pittner must assume scrambling of the object, leaving behind a trace, which would then be the lowest phrase, but cannot bear stress. Hence, only a narrow scope emerges, and (16c) should accordingly be an inappropriate answer to (16a), counter to facts. Thus, focus does not provide evidence for a base position of instrumentals above the object. To the contrary, the examples suggest that instrumentals may show up to the left and to the right of an object, thus providing evidence against a minimal c-command constraint on the realization of event-internal modifiers.

Given that the empirical evidence provided by Frey & Pittner (1998) for specific base positions of event-internal modifiers is inconclusive, the following section will present further empirical evidence drawn from controlled experimental studies.

3 Experimental Studies

Test environments to determine order preferences are complex, and the resulting judgements are subtle and often far from stable. Experimental studies suggest themselves to address these problems. Test items are controlled and systematically varied, based on a small set of factors, which are hidden from linguistically naïve participants. Confirmation bias – i.e. the tendency to judge data in favor of one’s own predictions – can equally be avoided by using a sufficient number of participants and lexically diverse items hidden among filler items.

We report two Two Alternative Forced Choice studies (2AFC).¹⁴ A 2AFC aims at detecting differences between conditions by direct comparison. Hence, a choice based on minimal pairs of examples forms the dependent variable. In the present case, participants must choose between two serializations, which are visible as such. The items presented, however, systematically vary hidden properties, which we consider relevant for the selection. Consider the first experimental study (EXP 1) as an illustration: Here, the items are drawn from two adverbial types (subject-oriented comitatives (COM(S)) and instrumentals (INSTR)), and from affirmative and privative interpretations of both types, while objects are kept constant as inanimate *wh*-indefinites with existential interpretation. Choices are drawn from minimal pairs of type (17).

- (17) a. Choice 1: PP{{COM(S), INSTR} × {affirmative, privative}} > *wh*-indefinite
 b. Choice 2: *wh*-indefinite > PP{{COM(S), INSTR} × {affirmative, privative}}

The cross product (adverbial types × interpretations) establishes four conditions. Different proportions of choices for these conditions are predicted by different hypotheses. Since both adverbial types take the subject as the reference phrase, the design illustrated in (17) can be used to formulate a null hypothesis – which conforms to the hypothesis proposed by Frey & Pittner (1998). According to this null hypothesis, the proportions of the four choices should be (almost) identical (see section 4 for further discussion).

The 2AFC format has several advantages. It allows the inclusion of properties which may lead to confounding effects in isolation, but not so if the alternatives are provided together. *Wh*-indefinites with existential interpretations provide the least complex (and least problematic) test environment proposed by Frey & Pittner (1998), but the status of *wh*-indefinites as elements of oral communication may lead to problematic effects in a written presentation.¹⁵ The format as 2AFC

¹⁴ The studies were implemented using JATOS (Lange et al. 2015) for server-side tasks, and jsPsych (de Leeuw 2015) for questionnaire design and implementation. Participants were recruited online via prolific (<https://prolific.co/>). Uncooperative behavior of participants, common to crowdsourcing, was addressed by using control items, attention items, and by an analysis of the response times.

¹⁵ Schütze and Sprouse (2013: 36f.) further suggest that participants should be directed towards oral modality in an experiment with written data via carefully worded instructions. We followed this advice.

reduces such effects because the potentially problematic property is kept constant across the items presented.

As we have already pointed out in section 1, we assume that *wh*-indefinites in existential interpretation are scrambling-invariant. But this assumption presupposes that the existential reading of the *wh*-indefinite is forced, which again implies that the test items are prepared accordingly. We have thus extended the examples by addenda blocking a specific reading of the *wh*-indefinite. Given the addenda, a specific reading leads to a contradiction.

In the following sections, we will discuss the design and results of the experimental studies. Since comitatives must be discerned based on their reference phrases, we will use the following abbreviations from now on: comitative_{subj} for comitatives with subjects as reference phrases, i.e. subject-oriented comitatives, and comitative_{obj} for corresponding object-oriented comitatives.

3.1 Experimental Study 1 on the position of event-internal modifiers

In the first experimental study (EXP 1), we have compared comitatives_{subj} and instrumentals, which are both subject-oriented. As a second factor, we have compared the interpretation of the adverbial, which can either be affirmative or privative, as is illustrated for instrumentals headed by *über* and *ohne* in (18).¹⁶

- (18) a. Max hat erzählt, dass ein Pfleger über eine Pipette was
 Max has told that a care.assistant by.means.of a pipet what.ACC
 verabreicht hat. Was es war, weiß ich aber nicht.
 administered has what it was know I but not
 ‘Max said that a care assistant administered something using a pipet. But I don’t know what it was.’
- b. Eva hat erzählt, dass eine Hausfrau ganz ohne ein Spülmittel was gereinigt
 Eva has told that a housewife entirely without a detergent what.ACC cleaned
 hat. Was es war, weiß ich aber nicht.
 has what it was know I but not
 ‘Eva said that a housewife cleaned something without using any detergent. But I don’t know what it was.’

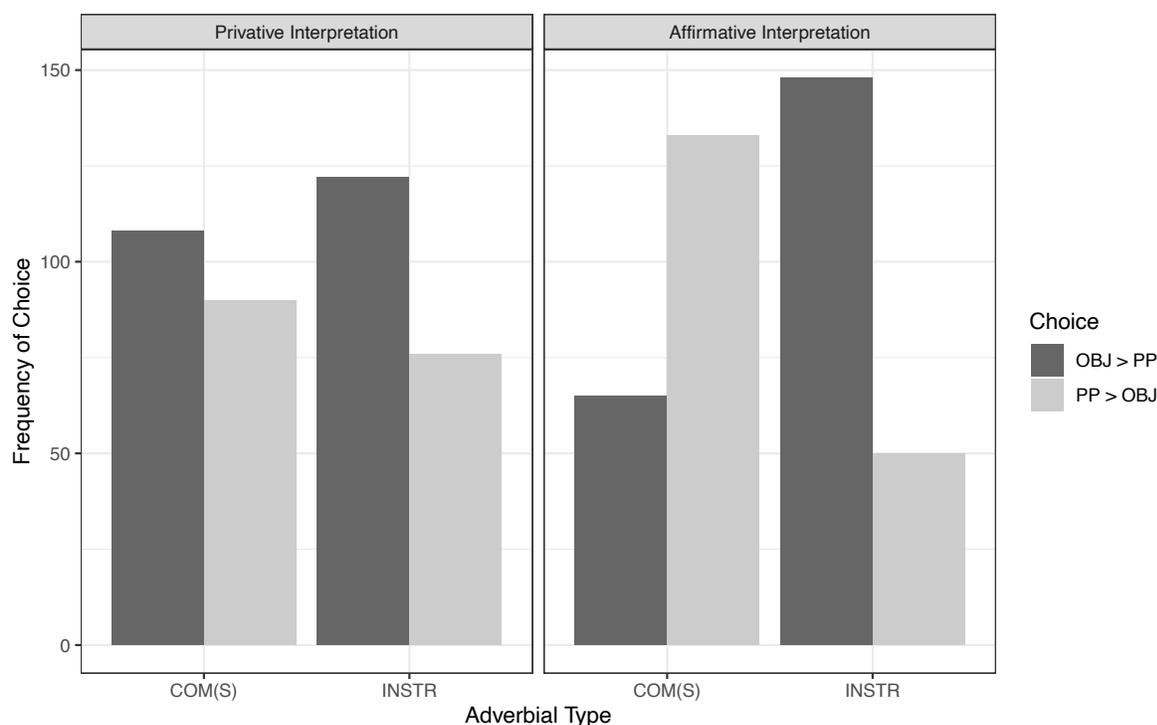
EXP 1 makes thus use of a 2 × 2 design, where the adverbial types and the interpretations are varied. Frey & Pittner (1998) assume that event-internal modifiers must be minimally c-

¹⁶ The preposition *ohne* (‘without’) used for privative readings of comitatives and instrumentals, as well as the preposition *mit* (‘with’) for affirmative readings of comitatives_{subj} had to be combined with P-modifiers (*ganz* (‘entirely’), *zusammen* (‘together’)) in the experimental items to block confounding attachment ambiguities. We cannot exclude that these additional elements may influence judgments. However, we considered it more important to avoid attachment ambiguities, which we encountered in pilot studies with naïve participants: An insertion of a P-modifier makes an interpretation of the PP as a postnominal modifier unlikely. An unmodified P (see (i)) allows an interpretation as a postnominal modifier – which is blocked in (18a).

(i) dass NP[eine Hausfrau PP[ohne ein Spülmittel]] was gereinigt hat.
 ‘that a housewife, who doesn’t own any detergent at all, cleaned something (possibly without using any means at all).’

commanded by the reference phrases. It follows that event-internal modifiers with structurally identical reference phrases show the same linearization preferences. For the subject-oriented modifiers, this should be PP > OBJ. Data from 33 participants entered the analysis, who rated 24 minimal pairs each. The empirical distribution of choices in EXP 1 given in figure 1, however, shows that the preferred pattern is OBJ > PP. What is more, we notice that the linearization preferences for comitatives and instrumentals differ from another. This result raises doubts on the validity of the uniform minimal c-command condition imposed by Frey & Pittner (1998).

Figure 1: Empirical Distribution of EXP 1



The distribution of choices suggests an interaction between the two effects *adverbial type* and *interpretation*.¹⁷ Notice that adverbials with privative interpretations show similar distributions in both serializations, and prefer OBJ > PP. The picture for affirmative interpretations differs strongly: Comitatives_{subj} prefer the serialization PP > OBJ, while affirmative instrumentals show a distribution akin to privative adverbials, with a preference for OBJ > PP. The data have been fed into a *Binomial Generalized Linear Mixed Model* (GLMM; see also the section on Data availability below) to determine whether the sample generalizes to predictions for the population. The predictions for the four conditions are shown in table 2.

¹⁷ In an interaction, each level of a given factor (as e.g. *instrumental* or *comitative*) provides individual predictions in combination of each level of another factor (*privative* or *affirmative*).

Table 2: Model predictions for EXP 1

Effect	Estimate	Std. Error	z value	P(> z)	
INSTR/affirmative	-1.26	0.25	-5.02	< 0.0001	***
COM(S)/affirmative	2.06	0.28	7.24	< 0.0001	***
INSTR/privative	0.63	0.33	1.92	0.0543	.
COM(S)/privative	-1.65	0.36	-4.54	< 0.0001	***

A GLMM provides negative or positive values for the two alternative outcomes (positive: PP > OBJ, negative: OBJ > PP). Predictions are provided as *logarithmic odds*, which can be transformed into probabilities using the *inverse logit* function. The estimate for affirmative instrumentals is negative and highly significant, predicting that affirmative instrumentals prefer OBJ > PP. Affirmative comitatives_{subj} clearly differ from affirmative instrumentals in preferring the serialization PP > OBJ. The effect size of switching from affirmative instrumentals to comitatives_{subj} is large: PP > OBJ becomes 7.85 times more likely for affirmative comitatives_{subj} in comparison to affirmative instrumentals.¹⁸ Switching from affirmative to privative instrumentals has a positive effect, but this effect borders on the level of significance ($p > 0.05$) and might be an artifact. It still must be included, because the corresponding effect for privative comitatives_{subj} is highly significant: The effect for affirmative comitatives_{subj} is undone for privative comitatives_{subj}, which accordingly show the same preference as instrumentals. EXP 1 has shown that event-internal modifiers with structurally identical reference phrases do not behave uniformly, and that the interpretation of the event-internal modifier plays a role in determining its serialization as well.

3.2 Experimental Study 2 on the position of event-internal modifiers

In the second experimental study (EXP 2), we have compared affirmative comitatives and affirmative instrumentals and their serialization with respect to the object. Two hidden factors are varied in the experimental presentation: All comitatives employed here take the object as a reference phrase, and all instrumentals the subject. In addition, we have varied the realization of the object, which can either be a *wh*-indefinite, or a full-fledged indefinite NP, as is illustrated in (19) and (20) for instrumentals.

- (19) a. Eva hat erzählt, dass ein Mediziner was mittels einer Spritze injiziert hat.
 Eva has told that a physician what.ACC by.means.of a syringe injected has
 Was es war, weiß ich aber nicht.
 what it was know I but not
- b. Eva hat erzählt, dass ein Mediziner mittels einer Spritze was injiziert hat. Was es war, weiß ich aber nicht.
 ‘Eva said that a physician injected something using a syringe. But I don’t know what it was.’
- (20) a. Eva hat erzählt, dass ein Mediziner eine Substanz mittels einer Spritze injiziert hat.
 Eva has told that a physician a substance by.means.of a syringe injected
 hat. Was für eine es war, weiß ich aber nicht.

¹⁸ Effect sizes can be obtained by raising Euler’s number (≈ 2.71) to the predicted logarithmic odds. In the present case, $e^{2.06} \approx 7.85$.

- has what for one it was know I but not
- b. Eva hat erzählt, dass ein Mediziner mittels einer Spritze eine Substanz injiziert hat. Was für eine es war, weiß ich aber nicht.
 ‘Eva said that a physician injected a substance using a syringe. But I don’t know which one it was.’

There are two reasons to vary the form of the object: First, consider a serialization of the form OBJ > PP. If the object is not invariant, an analysis relying on scrambling as re-merger to the left might propose that the serialization may result from base generation, but also from scrambling the object, as is illustrated in (21).

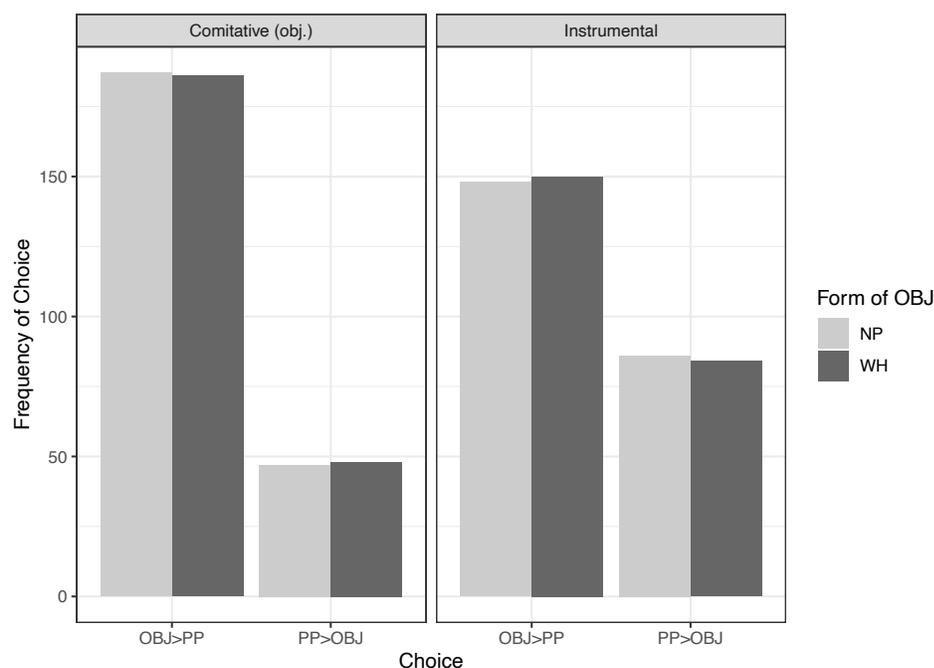
- (21) a. [_V OBJ [_V PP ...]]
- b. [_V OBJ_i [_V PP [_V OBJ_i ...]]]

If scrambling-invariant and scrambling-variant objects prefer the same serialization, e.g. OBJ > PP, the analysis in (21b) cannot be applied to the scrambling-invariant cases.

Secondly, we wanted to compare *wh*-indefinites with full-fledged NPs to determine whether the origin of the former in oral communication affects the choices. In such a case, we would expect a higher fluctuation in choices for *wh*-indefinites than for full-fledged NPs.

Frey & Pittner (1998) assume that comitatives_{obj} should appear behind the object, because the object must minimally c-command the PP. They further assume that instrumentals invariably must appear before the object (and after the subject), because again, the PP must be minimally c-commanded by its reference phrase. Comitatives_{obj} can also be used as a touchstone for analyses which assume relative constraints only, such as Haider (2000) and Maienborn et al. (2016). If a comitative_{obj} appears as only modifier in a clause, its position is free according to these analyses.

We agree with Frey & Pittner regarding the position of comitatives_{obj}, and hence dispute their positional freedom implied by Haider (2000) and Maienborn et al. (2016). But for instrumentals we expect to see a preference for OBJ > PP instead of PP > OBJ, as Frey & Pittner would predict. Data from 39 participants entered the analysis, who rated 24 minimal pairs each. The empirical distribution of choices in EXP 2 shown in figure 2 corroborates this view.

Figure 2: Empirical Distribution of EXP 2

We notice that most choices place the object before the PP for comitatives_{obj}, while the choices for instrumentals show a larger proportion of PP > OBJ. The distribution of instrumentals again stands in clear contrast to the analysis of Frey & Pittner (1998).

Concerning the form of the object, we notice that the serialization patterns are nearly constant across the forms of the object. A *Binomial Generalized Linear Mixed Model* (GLMM) for EXP 2 corroborates this view, see table 3. Again, we will only discuss the categorical factors (adverbial type, and form of object), but see the section on Data availability below for the full model.

Table 3: Model predictions for EXP 2

Effect	Estimate	Std. Error	z value	P(> z)	
Instrumental	-0.65	0.24	-2.69	< 0.01	**
Comitative _{obj}	-1.01	0.29	-3.48	< 0.001	***
wh-Indefinite	-0.06	0.16	-0.35	0.73	

Switching between different realizations of the object does not yield a significant estimate. The high p-value ($p > 0.80$) indicates that the form of the object does not play a role for the prediction. We can thus severely doubt that the serialization OBJ > PP, which is relevant for instrumentals, should be analyzed as scrambling of the object. The pattern is preferred irrespective of the form of the object. In addition, the origin of *wh*-indefinites in oral communication did not affect the choices.

As for the choice of the adverbial type, we should recall that the predictions for the parameters are provided as *logarithmic odds*, which when fed into the *inverse logit* function will provide probabilities of realization. As a binary model, it provides probabilities for the realization OBJ > PP vs. PP > OBJ, as well as for the change in probabilities if we change the adverbial type.

For instrumentals (with a subject as reference phrase), the model predicts a probability of 0.65 for the serialization OBJ > PP. The predicted value is highly significant ($p < 0.01$). The effect of switching from instrumentals to comitatives_{obj} can be measured in the change of probability and by looking at the effect size. In terms of probability, the model predicts a higher value of 0.84 for the serialization OBJ > PP. In terms of effect size, changing to comitatives_{obj} makes the realization OBJ > PP more than 2.7 times more likely than for instrumentals.

We thus predict that OBJ > PP is the preferred order for both comitatives_{obj} and instrumentals, irrespective of their differing orientations. We have also noticed that OBJ > PP is the preferred order irrespective of the form of the object, which accordingly holds for scrambling-invariant *wh*-indefinites. The distributions and their models do not only contradict Frey & Pittner's analysis, but also proposals which attribute positional freedom to adverbials in the absence of other adverbials, such as Haider (2000) and Maienborn et al. (2016).

Both experiments have shown that instrumentals prefer a position below – and to the right of – the object, which is not compatible with the assumption that the base position of instrumentals is found in adjacency to the subject. The only way to derive the latter conclusion would be to allow for scrambling to the right.

The experiments have further shown that the relation to the reference phrase plays a role: although a small number of choices for comitatives_{obj} placed the PP before the object, we conclude that event-internal modifiers must follow their reference phrases (see section 5.). Event-internal modifiers with subjects as reference phrases allow greater freedom than modifiers with objects as reference phrases, but in sum, event-internal modifiers prefer a position to the right of the object – except for affirmative comitatives_{subj}.

4 The Analysis

4.1 General Assumptions

We follow the basic assumptions on German clause structure laid out in Haider (2010). German clauses consist of a right-branching binary verbal projection. A saturated verbal projection (S) forms the complement of a CP, which hosts complementizers or finite verbs, thus yielding verb final, verb initial, and verb second clauses. As Haider (2010) has shown, there is no syntactic evidence for further functional projections between V and C. Syntactic arguments and adjuncts can be combined freely with the verbal projection. Each combination, however, must be licensed by categorical or thematic selection (in the case of non-thematic and thematic syntactic arguments), or by conditions on modification. The most important condition on modification is Event Identification (Kratzer 1996: 122), which takes two sets of conditions for events, and identifies the respective event variables.

It is characteristic of event-internal modifiers that they introduce an event *and* an individual variable for binding. The event variable is necessary to tie the event constrained by the modifier to the event constrained by the modified phrase – a verbal projection. At the same time, the specific semantics of event-internal modifiers requires that a participant within the event be modified, for which a further variable is provided. The parallel binding of both variables is not possible, and general constraints on type-driven translation (Gazdar et al. 1985; Kratzer 1996) prohibit that the individual variable is bound if the modifier is combined with a verbal projection. We will thus

assume that it becomes necessary to store the individual variable for identification. Putting it into storage has the immediate effect that a type-mismatch is removed and that event-internal modifiers can be combined with a verbal projection. But an element in storage creates a syntactic dependency because it is an unbound variable without interpretation. The binding of the variable can only be achieved by identifying it with an *index* introduced by a syntactic element higher up in the tree. Therefore, the binder of the variable has to c-command the event-internal modifier to identify the variable. Since German clause structure consists of a binary right-branching verbal projection, c-command relationships can be mapped to linear precedence. We thus assume that this specific property of event-internal modifiers does not give rise to linearization constraints directly. Instead, the identification requirements can only be fulfilled within a c-command domain, which can be mapped to a linear order given general conditions on German clause structure.

This has immediate consequences for object-oriented modifiers: the modifier must follow the object because only then the object can identify the unbound variable of the modifier. For subject-oriented modifiers, more possibilities become available: the modifier could be realized before or after the object, being c-commanded by the subject in both positions. We have, however, observed that instrumentals prefer a position to the right of the object, while privative subject-oriented comitatives prefer a position before the object.

Various authors have characterized comitatives and instrumentals as being relational, up to the point of assuming that neither comitatives nor instruments are primitive thematic roles (Jackendoff 1987: 401; Baker 1997: 108). Comitatives do not only identify their individual variable with the reference phrase, but also copy the thematic role borne by the reference phrase. Baker (1997: 108) postulates that “comitative[s] [are] usually either [...] second agent[s] or [...] second theme[s]”. Building on this idea, we will assume that affirmative comitatives take over the thematic role borne by their reference phrase. If the reference phrase is a subject, the role taken over will a role prototypically borne by subjects, *agent* in particular. A phrase bearing an *agent* role is subject to ordering constraints placing it before phrases bearing other roles, *theme* in particular. While, there is controversy in the literature on the position of instruments on a thematic hierarchy, the empirical evidence suggests that *instruments* are less prominent than *themes*.

Finally, we have seen that privative modifiers prefer a position to the right of the object. We will account for this observation by assuming that privative interpretations do not introduce thematic roles for their internal arguments, and hence that their ordering is subject to other general constraints. In the present case, we follow the assumption that a placement of PPs to the right of NPs is preferred in German clause structure, which interacts with a constraint placing phrases denoting animate entities in front of phrases denoting inanimate ones (see Müller 1999).

4.2 Identifying individual variables in event-internal modification

4.2.1 The identification requirement

Consider the following schematic analysis of Event Identification proposed in Kratzer (1996: 122) in (22a) with its illustration in (22b).

(22) Event Identification

- a. $f_{\langle e, \langle s, t \rangle \rangle} + g_{\langle s, t \rangle} \Rightarrow h_{\langle e, \langle s, t \rangle \rangle}$
- b. $\lambda x \lambda e R(e, x) + \lambda e P(e) \Rightarrow \lambda x \lambda e [R(e, x) \wedge P(e)]$

If an event-internal PP combines with a verbal projection, the semantic types do not follow the pattern in (22), since both are of type $\langle e, \langle s, t \rangle \rangle$, hence creating a type mismatch. The individual variable of the PP thus stands in the way of combining the event variables of the PP and V'. To resolve this problem, we will assume that the individual variable introduced by the PP will be turned into storage. It becomes a syntactically dependent element, which must be bound by identification with a more prominent syntactic element in the same clause. Let us illustrate this for the bracketed part of (23).

(23) Da hat_i [Ramona mit einem Berater was unterzeichnet t_i].
 there has Ramona with a counsellor what.ACC signed

We assume the semantics provided in (24) for the comitative *mit einem Berater* ('with a counsellor'), where the comitative relation is expressed through the ternary predicate *comitative*(f, z, x), the restriction on the internal argument through *counsellor*(x), and the non-determined thematic role through $\theta(f, x)$, where θ is a variable over possible roles.¹⁹ How this role is determined will be discussed below.

(24) $\lambda z \lambda f \exists x [\text{comitative}(f, z, x) \wedge \text{counsellor}(x) \wedge \theta(f, x)]$

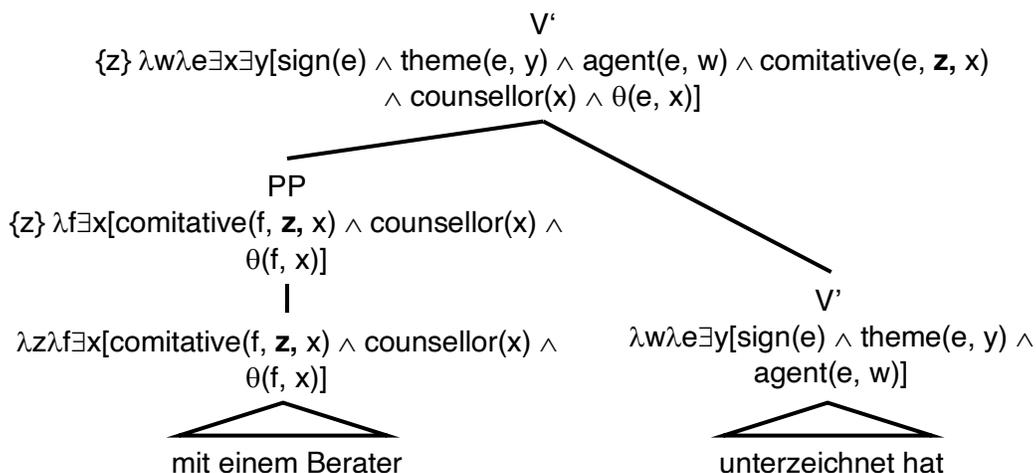
The verbal projection *was unterzeichnet hat* ('signed something') can be represented as follows (we will ignore the auxiliary, as it does not show an influence on the analysis):

(25) $\lambda w \lambda e \exists y [\text{sign}(e) \wedge \text{theme}(e, y) \wedge \text{agent}(e, w)]$

The two types in (24) and (25) cannot be combined directly through Event Identification. Hence, we will assume that the individual variable introduced by the PP (represented as λz) will be stored (represented in prefixed curly brackets, i.e. $\{z\}$ in (26)), and the type of the modifier will be changed accordingly, thus allowing Event Identification to take place (where e and f are identified). Being in storage, z is a syntactically dependent element, which is projected from the position where it is issued, until it is identified with an individual variable provided by another element which is combined with the projection bearing the stored index. It must hence move upwards until it is bound, and potential binders can only be found in syntactically more prominent positions. The introduction of an element in storage and its eventual binding by identification amounts to assuming that the phrase that binds the element in storage must c-command the phrase that introduced the element in storage. The combination of the phrases in (24) and (25) is shown in (26) – where we make the type coercion explicit by assuming that the PP with a storage contains the same PP with an empty storage.

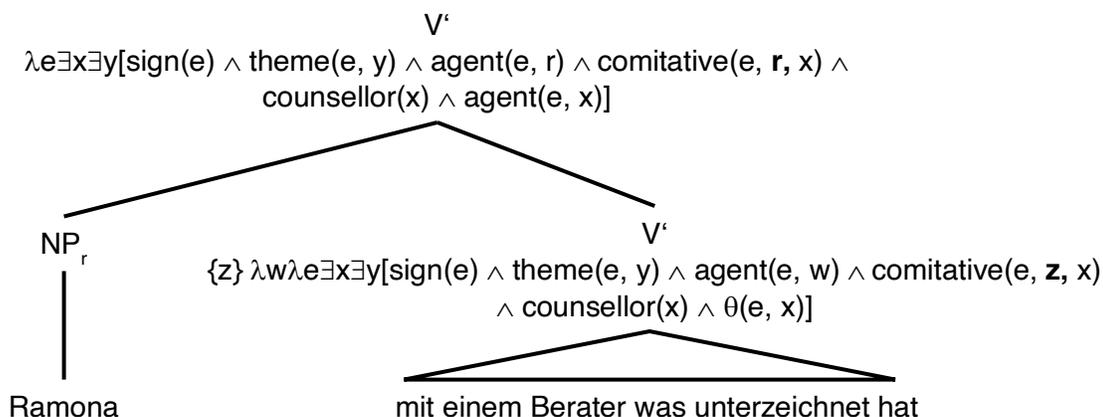
¹⁹ We follow Stolz et al. (2006: 86, 140) in assuming that comitative relations require two entities to be “co-present in the same space (including metaphorical readings of space)”, from which contemporaneity also follows. The specific comitative relation can be one of interaction of the entities, of a subjection under an interaction or another relation, depending on the role that the elements bear with which the free variable of the argument of the comitative are identified.

(26) mit einem Berater was unterzeichnet hat



If the subject is combined with the verbal projection, as illustrated in (27), the individual variable of the subject (**r**) is affected in two ways: It is identified with the open individual variable **w** of the verbal projection, and it identifies the element in storage $\{z\}$ carried by the verbal projection. If such an element is bound, it will be eliminated from the storage – hence, $r = w = z$. And since **w** is the variable bound by the thematic role *agent* in the verbal projection, the role is identified with the variable role stemming from the event-internal modifier (θ).²⁰

(27) Ramona mit einem Berater was unterzeichnet hat

$$\{ \} \lambda e \exists x \exists y [\text{sign}(e) \wedge \text{theme}(e, y) \wedge \text{agent}(e, r) \wedge \text{comitative}(e, r, x) \wedge \text{counsellor}(x) \wedge \text{agent}(e, x)]$$


The semantics of (27) indicates that there is a set of signing events, in which something is the theme, *Ramona* is an agent, a counsellor is an agent, and there is a comitative relation of interaction between the two in the event. We do not have to stipulate that the comitative introduces

²⁰ The assumption that thematic roles for arguments introduced by comitatives and instrumentals are integrated into the thematic structure of the modified event is implicitly already present in Baker's (1997) analysis, when he assumes that comitatives introduce secondary agents and themes.

a secondary *agent* (as Baker 1997: 108 does) but instead assume that comitatives generally take over the thematic role of their reference phrase. Consequently, comitatives are not restricted to being secondary *agents* or secondary *themes*, and in fact, as will become clear below in our analysis of privative modifiers, may not even take over a thematic role.

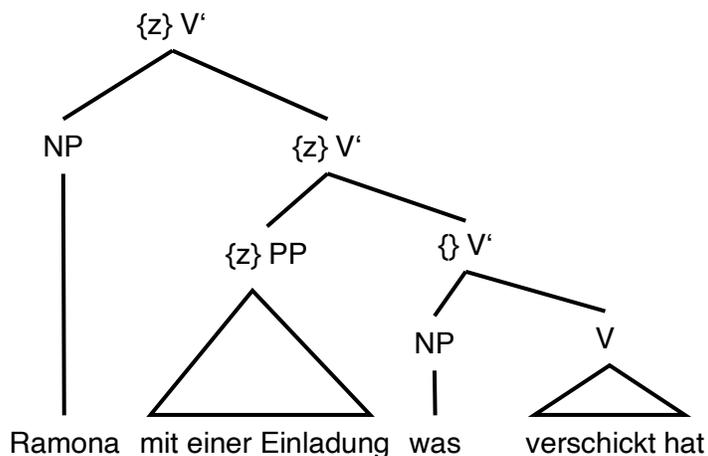
Binding an element in storage does not yield any indication of a linear order *per se*. The linear order follows from the mapping of the syntactic configuration: if α asymmetrically c-commands β , then α precedes β , if the structure in which c-command obtains is right-branching.

We have discussed comitatives that take the subject as a reference phrase. But comitatives can take the object as a reference phrase as well (this also holds for internal locatives, as has been discussed in Maienborn (1995; 2001; 2003)). Generally, comitatives can be ambiguous in this respect, but in the examples discussed so far, we have eliminated the ambiguity by employing arguments and adjuncts which strongly discourage unwanted readings.

- (28) a. Ich habe gehört, dass Ramona was mit einer Einladung verschickt hat.
 I have heard that Ramona what.ACC with a invitation sent.out has
 b. Ich habe gehört, dass Ramona mit einer Einladung was verschickt hat.
 'I've heard that Ramona sent out something along with an invitation.'

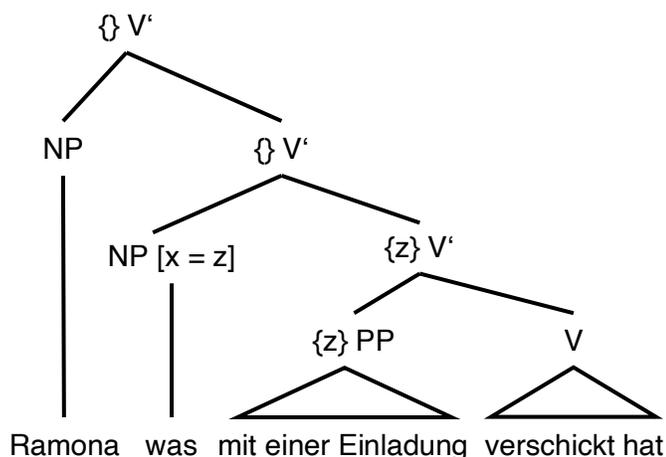
An interpretation as agent is precluded for the comitatives in (28), for the simple reason that inanimate *invitations* cannot act as agents. Hence, the only plausible reading remains the one in which *something in addition to an invitation* has been sent out by Ramona. Following the experimental evidence provided in section 3, we assume that the order (28a) is strongly preferred over the one in (28b). Consider the derivation of (28b) in (29).

(29)



An identification with the subject, and subsequent interpretation as a secondary agent is not possible here, as was already pointed out. But the object cannot serve as a reference phrase for the PP, since the PP is outside the c-command domain of the object (or, in other words: since the element in storage introduced by the PP projects upwards, but the object is found downwards). Comitatives_{obj} are thus predicted to appear below – and hence: to the right – of the object. This condition is satisfied in (30).

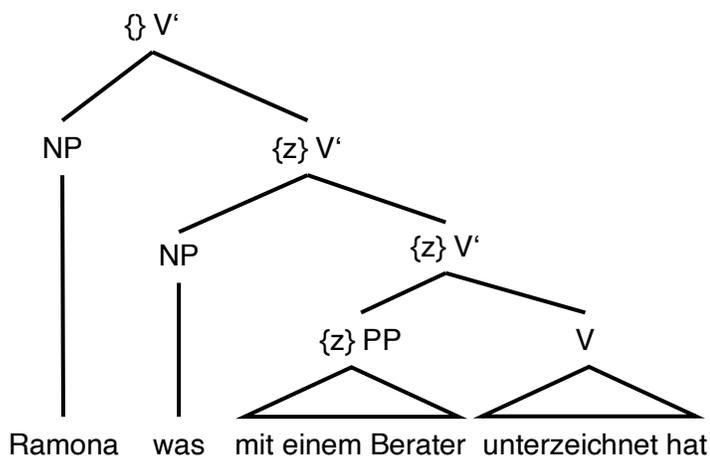
(30)



4.2.2 Interaction with linearization constraints

So far, we have only employed the requirement that the unbound variable of event-internal modifiers needs to be bound, and that this binding applies upwards. While this condition precludes the realization of an object-oriented modifier to the left of the object, as illustrated in (29), it does not block the realization of subject-oriented modifiers to the left *and* right of an object. So, why does (27) show the preferred order of event-internal modifier and object, in contrast to the order in (31)?

(31) Ich glaube, dass Ramona was mit einem Berater unterzeichnet hat.
 I believe that Ramona what.ACC with a counsellor signed has
 'I believe that Ramona signed something in tandem with a counsellor.'

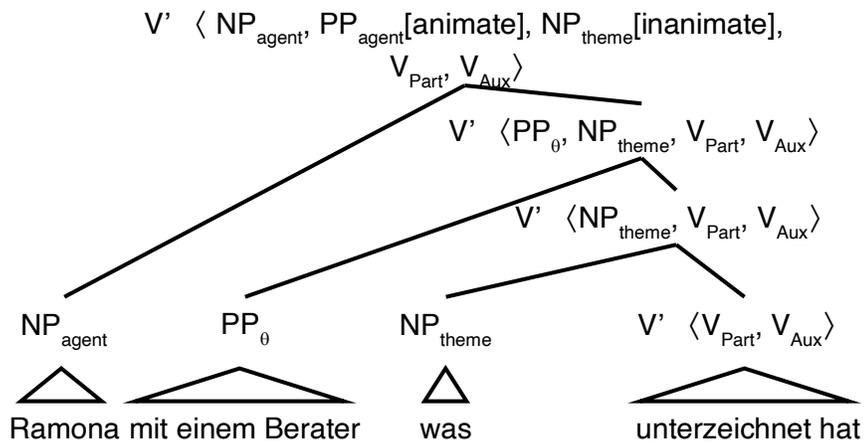


We consider the violation of two established linearization constraints relevant here: First, phrases bearing more prominent thematic roles are realized to the left of phrases bearing less prominent thematic roles. And secondly, phrases referring to animate entities are realized to the left of phrases referring to inanimate entities (Müller 1999). The results of the identification process provide an *agent role* for the event-internal modifier *mit einem Berater*. This role is more prominent

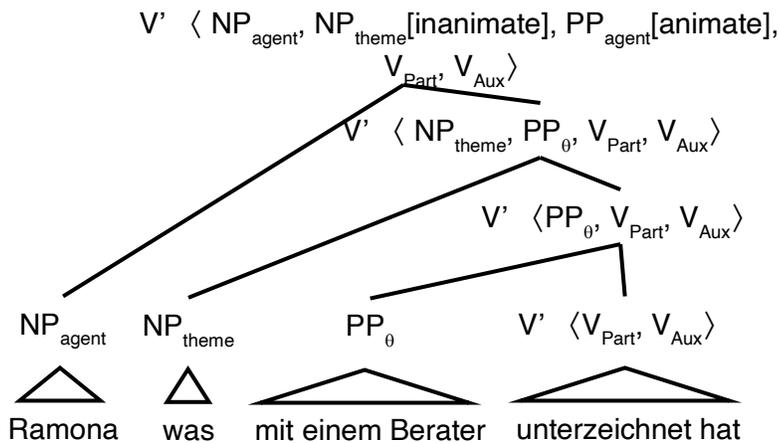
than the *theme role* borne by the object, and of course, the object denotes something inanimate. Both constraints are met by (27) but violated in (31) – and there is a third constraint violated in (27) (the categorical constraint NP > PP), but met by (31), to which we will return below.

How are linearization constraints applied in the absence of scrambling? Various solutions come to mind, and since all of them are equivalent, we will assume that any phrase will contain a representation (as a list) which indicates the order of their daughters. The elements contained in the list of a daughter will be inserted *as elements* in the corresponding list of the mother within the projection of a head (which holds for the V projections in German clause structure). For (27) and (31), a schematic representation is provided in (32a, b). We have only added full specifications (thematic role, category, animacy) to those elements the order of which is under debate.

(32) a. Ramona mit einem Berater was unterzeichnet hat



b. Ramona was mit einem Berater unterzeichnet hat



4.2.3 Instrumentals

We can assume that the identification requirement applies equally well to instrumentals, with the difference being that instrumentals do not take over a role from the reference phrase, but instead introduce an *instrument* role. The identification requirement for the free variable allows an instrumental PP to appear to the left or to the right of the object, because it is c-commanded in both positions by the subject (which will identify the free variable).

For comitatives_{S_{subj}}, we have argued that both positions satisfy the identification requirement, but that the linearization constraint *agent* > *theme* imposes the realization of the comitative to the left of the object. A serialization to the right of the object, however, is the preferred one for instrumentals, as can be witnessed from both experimental studies.

Most researchers assume that *instruments* are more prominent than *themes* (Fillmore 1968; Grimshaw 1990; Croft 1991; Levin & Rappaport Hovav 2009, among others). At first glance, an ordering of the instrumental phrase *before* the object seems to be a natural outcome. But this outcome is not corroborated by the facts, and it also neglects an interaction with other linearization constraints, in particular the constraint requiring NPs to appear to the left of PPs (NP > PP). Given the evidence from the experimental studies, we argue with Dik (1978: 70) that instruments should be ranked below themes on the thematic hierarchy.

Consider the examples in (3) as an illustration, repeated here under (33).

- (33) a. Da hat Hans **mittels eines Graphikeditors** was erstellt.
 there has Hans by.means.of a graphic.editor what.ACC created
 b. Da hat Hans was **mittels eines Graphikeditors** erstellt.
 ‘Hans created something using a graphic editor.’

The linear order in (33b) is strongly preferred, which is not surprising as it does not only meet the requirement that instruments are realized below themes, but also that NPs precede PPs. Animacy does not apply in the case of (33), as both the instrument and the theme were inanimate.

As an intermediate summary, we can state that object-oriented comitatives must appear below (and hence to the right of) the object. It is also already clear that subject-oriented event-internal modifiers do not show a unique linearization pattern, as was proposed by Frey & Pittner (1998). Subject-oriented comitatives and instrumentals could occupy positions above or below the object if the identification requirement stemming from their individual variable would be the only concern. Yet, instrumental PPs prefer a position below the object. This serialization is compliant with the order NP > PP and follows a ranking of instruments below themes. It is not compliant with a base position above the object: scrambling to the left, i.e. scrambling into a lower position, would be the only possibility to account for this serialization, given a base position above the object. It would also require accounting for the observation that this apparent scrambling is almost obligatory. Subject-oriented comitatives prefer a position above the object. This position is again in line with the assumption that the thematic hierarchy influences the serialization of arguments *and* thematically integrated adjuncts. Since the presence of a thematic role shows a major influence on the serialization, it appears sound to assume that the serialization of subject-oriented comitatives and instrumentals would follow different leads in the absence of such thematic roles – a point to which we come in section 4.3.

4.3 Linearization preferences of privative interpretations

It is a remarkable result of the experimental studies that serializations for privative event-internal modifiers are judged differently from patterns for affirmative ones. We have already illustrated this with the examples in (1) and (2), which are repeated here under (34) and (35).

- (34) a. Da hat Claudia **zusammen mit einem Kollegen** was getestet.
 there has Claudia together with a colleague what.ACC tested
 b. Da hat Claudia was **zusammen mit einem Kollegen** getestet.
 'Claudia tested something in tandem with a colleague.'
- (35) a. Da hat Herbert **ganz ohne einen Kollegen** was überprüft.
 there das Herbert entirely without a colleague what.ACC checked
 b. Da hat Herbert was **ganz ohne einen Kollegen** überprüft.
 'Herbert checked something without a colleague.'

While affirmative comitatives_{subj} strongly prefer the position before the object (34a), privative comitatives_{subj} only slightly prefer a position after the object (35b). In fact, the predicted probability of a privative subject-oriented comitative to appear below the object is only slightly higher than the probability to appear above the object (0.56:0.44). The general tendency for instrumentals, however, remains the same: they prefer a position below the object in affirmative and privative interpretations.

We will assume that these observations emerge because privative event-internal modifiers do not introduce additional thematic roles (i.e. neither an abstract role to be filled by another role in the case of comitatives, nor an *instrument* role in the case of instrumentals), which can be derived from their semantics.

- (36) a. Monika hatte mit einem Kollegen was getestet.
 Monika had with a colleague what.ACC tested
 'Monika tested something in tandem with a colleague.'
 b. Monika hatte ohne einen Kollegen was getestet.
 Monika had without a colleague what.ACC tested
 'Monika tested something without a colleague.'

The comitative_{subj} in (36a) asserts that there is at least one colleague. Such an assertion is best represented by existential quantification, as already employed in the analysis in section 4.2.1. That an existential assertion is provided by the comitative_{subj} in (36a) can also be seen by the contradictory continuation of (36a) in (37).

- (37) (Monika hatte mit einem Kollegen was getestet.) #Es gibt aber keinen Kollegen.
 Monika had with a colleague what.ACC tested there is but no colleague
 'Monika tested something in tandem with a colleague. But there is no colleague.'

The existential assertion is further justified by a continuation using a pronoun, as is illustrated in (38):

- (38) (Monika hatte mit einem Kollegen was getestet.) Er hatte sie darum gebeten.
 Monika had with a colleague what.ACC tested he had her for.it requested
 ‘Monika tested something in tandem with a colleague. He asked for it.’

The situation is different with (36b): there is no assertion that there are *no* colleagues. Hence, a representation in which an existential quantifier is embedded under negation, such as $\neg\exists x[\text{colleague}(x) \wedge \text{comitative}(f, z, x)]$, is clearly inadequate. But (36b) also does not presuppose that there are no colleagues. Consequently, (36b) can be continued as in (39).

- (39) (Monika hatte ohne einen Kollegen was getestet.) Sie hatte keinen gefunden.
 Monika had without a colleague what.ACC tested she had none found
 ‘Monika tested something without a colleague. She hadn’t found any.’

We also notice that (36b) does not assert that an individual exists which happens not to have interacted. If this were the case, a representation like $\exists x[\text{colleague}(x) \wedge \neg\text{comitative}(f, z, x)]$ could be assumed. But then, continuations like (40) could not be excluded:

- (40) (Monika hatte ohne einen Kollegen was getestet.) #Er hatte sie darum gebeten.
 Monika had without a colleague what.ACC tested he had her for.it requested
 ‘Monika tested something without a colleague. He asked for it.’

We can thus conclude that privative comitatives neither assert nor presuppose that the restriction of their complement – *Kollege* (‘colleague’) in (36b) – denotes the empty set. Also, it is not the case that an existential quantifier receives scope over the negation introduced by *ohne*.

These observations are best captured by assuming that privative event-internal modifiers with superficially existentially quantified arguments in fact introduce a universal quantification – an assumption that is reminiscent to analyses proposed by Heim (1982) and Kamp et al. (2011). We thus assume the representation for (36b) provided in (41).²¹

- (41) ohne einen Kollegen: $\lambda z\lambda e\forall x[\text{colleague}(x) \Rightarrow \neg\text{comitative}(e, z, x)]$

Privative comitatives do not differ from other event-internal modifiers in introducing free individual *and* event variables. A combination of a privative comitative requires the mechanism introduced in section 4.2.1 to avoid a type mismatch. Hence, the variable *z* will have to be put into storage. Privative comitatives, however, differ from affirmative comitatives in introducing a universal quantification, which scopes over the *negated* comitative predicate. Assuming a universal quantification, the lack of an existential presupposition as well as the lack of a negation of an existential presupposition is captured. Example (41) can be paraphrased as follows: it holds that

²¹ Of course, this analysis raises the question how the superficial existential quantifier can be turned into a universal quantifier. In *Discourse Representation Theory* (Kamp et al. 2011), the quantificational force of the indefinite is determined by a universal quantifier (or implication) which embeds the indefinite. Let us thus assume that the basic semantic representation of *ohne* can be defined as follows: $\lambda P\lambda x\lambda e\forall x[P(x) \rightarrow \neg R(x, e, \dots)]$, where *R* represents the semantic relation introduced by the adverbial. A superficial existentially quantified NP thus only provides the restriction *P*, which is then bound by the universal quantifier.

the members of the set of colleagues are not members of the set of individuals interacting with an individual z in an event e . This interpretation accounts for the felicitous continuation in (39) and the infelicitous continuation in (40). Negating the predicate *comitative* in (41) is sufficient. The introduction of a further thematic role in the scope of the negation is not only superfluous, it also leads to invalid inferences, as will be discussed below. Consequently, the representation in (41) does not contain a thematic role $\theta(e, x)$ to be identified.²²

Let us consider the effect for the analysis at hand. Affirmative comitatives_{subj} and instrumentals differ in the roles that the phrases may bear: Affirmative comitatives_{subj} take over prototypical subject roles. Affirmative instrumentals provide the role *instrument*. These roles are found in different positions on the thematic hierarchy. We have also noticed that phrases with *animate* referents prefer a position before phrases with *inanimate* referents. If *agent* > *theme* does not apply to privative interpretations, because no *agent* role is introduced, two linear precedence constraints remain, one of which is always violated: the order OBJ > COM(S) meets NP > PP, but violates animacy, while the order COM(S) > OBJ meets the latter but violates the former. As either of the constraints must be violated, it does not come as a surprise that both orders are possible, with a slight preference for NP > PP.

Privative instrumentals show a different serialization pattern than privative comitatives. It can be summarized best by stating that the preferred order for instrumental PPs is below the object, irrespective of the interpretation. The consequences of not introducing an *instrument* role here can be illustrated with (42).

- (42) Ramona hat was ohne ein Hilfsmittel angeschlossen.
 Ramona has what.ACC without a means connected
 ‘Ramona connected something without using a means.’
 $\lambda e \exists y [\text{connect}(e) \wedge \text{agent}(e, r) \wedge \text{theme}(e, y) \wedge \forall x [\text{means}(x) \Rightarrow \neg \text{using}(e, r, x)]]$

The example says that *means*, whether they exist or not, have not been used in connecting something. We can see in the representation in (43) that the additional introduction of a thematic role – *instrument*(e, x) – yields unwarranted inferences if it were located inside the scope of the negation (and non-sensical ones if it were represented outside of the scope of negation).

- (43) $\lambda e \exists y [\text{connect}(e) \wedge \text{agent}(e, r) \wedge \text{theme}(e, y) \wedge \forall x [\text{means}(x) \Rightarrow \neg [\text{using}(e, r, x) \wedge \text{instrument}(e, x)]]]$

If the coordination [*using*(e, r, x) \wedge *instrument*(e, x)] is negated, as in (43), then it becomes true if either x has not been used and is an instrument or x is not an instrument and has been used. Clearly, we do not want the second conjunct to follow from (43). We thus see further evidence from *instrumentals* not to introduce thematic roles in privative interpretation. In this case, the position of privative instrumentals with respect to the object is completely determined by the categorial constraint, which requires NPs to be realized before PPs.

²² There is a further argument against introducing thematic roles in privative interpretation that comes from (Kratzer 1996): the introduction of thematic roles is not tied to specific predicates if Neo-Davidsonian semantics is assumed. Kratzer (1996: 131) shows that *agents* are not only severed from verbal predicates, but explicitly excluded from being arguments of a verb. Of course, one could argue that there is another element that introduces *agents* in Kratzer’s analysis. But Kratzer (1996: 126–132) further argues that certain syntactic projections come without such an *agent* at all.

The analysis is summarized in table 4.

Table 4: Overview of fulfilled constraints in the conditions

Order	Variable Id.	ag > th > instr	animacy	NP > PP
COM(O) > OBJ (aff./priv.)	*			*
OBJ > COM(O) (aff./priv.)	✓			✓
COM(S) > OBJ (affirmative)	✓	✓	✓	*
OBJ > COM(S) (affirmative)	✓	*	*	✓
COM(S) > OBJ (privative)	✓		✓	*
OBJ > COM(S) (privative)	✓		*	✓
INSTR > OBJ (affirmative)	✓	*		*
OBJ > INSTR (affirmative)	✓	✓		✓
INSTR > OBJ (privative)	✓			*
OBJ > INSTR (privative)	✓			✓

5 Grammaticality and acceptability

The empirical evidence on which the present analysis is based has been gathered by methods that clearly differ from the ones employed in Frey & Pittner (1998). The question emerges whether the observed differences in acceptability also reflect differences in grammaticality. While the gradient nature of acceptability is uncontroversial (Schütze & Sprouse 2013: 46f.), grammaticality is considered to provide binary distinctions – which as such cannot be derived from the data collected in the experiments presented here. The question hence emerges whether the gradient judgments reported in EXP 1 and EXP 2 (i.e. the varyingly strong preferences) can be viewed as evidence for a gradient nature of grammaticality. It is a topic of ongoing research whether grammaticality should be viewed as binary or gradient, with the categorical model being the prevalent model since Chomsky & Miller (1963). But the gradient conception of grammaticality has gained prominence recently, as can be witnessed in Francis (2022). In a gradient model, grammaticality is analyzed as a continuous property, the gradience of which is modeled by a qualitative component, such as Optimality Theory (Keller 2000), probabilistic approaches (Bresnan 2007), or decathlon models (Featherston 2005).

Before we can provide an answer to the question whether the differences in acceptability reflect differences in grammaticality, we should summarize how acceptability can affect grammaticality. It is generally acknowledged that acceptability can have a degradative or ameliorating effect on grammaticality. In the first case, a grammatical sentence may turn out to be unacceptable, in the second case, an ungrammatical sentence may be considered acceptable.

Let us first consider degradative effects.

The sentences in the minimal pairs consisted of two simple and comparatively short hypotactic structures, and the overall length of the questionnaires was chosen not to influence performance and processing. We can thus exclude cognitive processing factors as e.g. memory burden or limited processing capacities (Francis 2022: 13ff.).

Acceptability has been shown to be susceptible to semantic and pragmatic effects. Both semantic implausibility and pragmatic infelicity are known to lead to reduced acceptability for well-formed

sentences (Juzek & Häussler 2019; Francis 2022:11f.). The examples in EXP 1 and EXP 2 have been carefully designed to be free from semantic implausibilities, ambiguities, and pragmatic infelicities. While the oral nature of *wh*-indefinites used in a written format could be considered a potential factor, the results of EXP 2 have shown that judgments have not been affected by the presence or absence of a *wh*-indefinite. A confounding influence of *wh*-indefinites is thus very unlikely.

Francis (2022: 10, 63–66) discusses prosodic factors influencing acceptability, with ill-formed prosodic structures resulting in reduced acceptability of otherwise well-formed items. But prosodic factors can be excluded in EXP 1 and EXP 2, as all sentences were designed to provide new contexts. In addition, it is well-known that participants apply default prosody in written surveys when no cues are given (Kitagawa & Fodor 2006).

Schütze & Sprouse (2013: 46f.) have pointed out that scale-based judgment tasks may yield gradient responses for the simple reason that participants are asked to provide values on a scale and thus try to oblige to the experimental set-up. But the Forced Choice format used in EXP 1 and EXP 2 did not ask for gradient responses. Hence, we can exclude methodological issues as well. Semantics, pragmatics, and prosody may not only yield degradative effects, but also ameliorating ones, as is discussed in Francis (2022:71). Semantic and pragmatic plausibility may ‘by-pass’ syntactic ill-formedness and yield acceptability despite ungrammaticality. Similar concerns hold for prosodic manipulations. But the set-up of EXP1 and EXP2 as Two Alternative Forced Choice studies make ameliorating effects through plausibility and prosodic manipulation extremely unlikely. Participants in the experiments were presented with minimal pairs that only differed in the serialization of objects and modifiers. So the same consideration holds for ameliorating effects of semantic or pragmatic plausibility that were already wielded against degradative effects above. Let us further consider the consequences of the experimental results for analyses, which assume that we see differences in acceptability, but possibly not in grammaticality.

Both the present analysis and Frey & Pittner (1998) assume that object-oriented comitatives must appear below, and hence to the right, of an object. Yet, the empirical evidence as well as the models derived from EXP2 do not indicate a binary separation. Instead, we observe that a small likelihood for serializations of the form COM(O) > OBJ. Obviously, we want to assume that the serialization is ungrammatical (it does not only violate the identification requirement (section 4.2.1) for the individual variable, but also the linear precedence constraint NP > PP). Hence, a difference between grammaticality and acceptability implies an ameliorating effect that yields the choice of the illicit serialization at least for some speakers. But given that the choice was made from a minimal pair differing in the serialization only, no such ameliorative effect – such as semantic or pragmatic plausibility – can be identified.

Similarly, the observed serialization patterns for privative subject-oriented comitatives cannot easily be accounted for in terms of a tension between acceptability and grammaticality. The present analysis differs from Frey & Pittner (1998) in distinguishing affirmative and privative readings. Frey & Pittner (1998) predict for both readings that subject-oriented comitatives should appear in front of (hence higher than) the object. But this serialization is chosen less often than the reverse order, with both orders almost being on a par (44:56 in favor of OBJ > COM(S)). We have accounted for this by showing that the identification requirement is met by both serializations, and that one linear precedence constraint is violated by either. If we assumed the analysis of Frey & Pittner (1998), the almost equal selection of the serializations could only be accounted for by assuming a continuous degradative effect on the serialization COM(S) > OBJ. Given that each example consisted of a minimal pair of both serializations, such an effect is not easily construed. This would be even worse if we considered serializations of instrumentals. Here, the serialization

predicted by Frey & Pittner (1998) – INSTR > OBJ – is chosen almost as rarely as the (purportedly ungrammatical) serialization COM(O) > OBJ.

If these considerations are taken together, it seems more plausible to assume that the gradient nature of acceptability reflects the gradient nature of grammaticality. We will thus conclude that the distribution of the data presented here, as well as the statistical models, provide evidence for a gradient nature of acceptability – the exact nature of which requires future investigations. We also see that research on word order in German (mostly on the order of arguments) is ambiguous at best when it comes to the distinction between acceptability and grammaticality. Typically, a whole range of diacritics is used to judge examples, as can be witnessed in Uszkoreit (1987), Choi (1996), Müller (1999), and of course in Frey & Pittner (1998). These finely gradated diacritics can of course be interpreted as indicators of graded acceptability. But the question is whether this is the intention of the papers, which in most cases do not deal with acceptability but with grammaticality. So, the use of diacritics may be taken as an indication of gradient levels of grammaticality instead of a binary distinction.

In sum, the experimental set-up has been shown not to include confounding effects (the data are fully disclosed as is discussed in the section on Data Availability) affecting judgments in either way. In the absence of confounding factors, we take acceptability to reflect grammaticality. If the former is gradient, the latter by necessity is as well. A close inspection of the research literature further reveals that graded introspective judgments are standardly employed, and that it remains unclear whether this should be taken as an indication of graded acceptability or graded grammaticality.²³

Competing interests

The authors have no competing interests to declare.

Acknowledgements

The authors would like to thank Markus Egg, Bart Geurts, Hubert Haider, Joachim Jacobs, Claudia Maienborn, and Gereon Müller for comments and suggestions, and Sarah Broll and Amelie Robrecht for their assistance. We would like to thank three anonymous reviewers for their comments and suggestions on an earlier version of this paper submitted to *Glossa: A journal of general linguistics*. The work reported herein was partially supported by the Deutsche Forschungsgemeinschaft under grant no. 332805149 (PI: Tibor Kiss).

Abbreviations

ACC accusative
 DAT dative
 INF infinitive
 REFL reflexive

Data availability

The data and models discussed in the present paper can be found in <https://github.com/Linguistic-Data-Science-Lab/Kiss-et-al-22-word-order-constraints>

²³ Choi (1996) and Müller (1999) employ the following set of diacritics: *, ?*, ??, ?, and (?). Frey & Pittner (1998) only omit ?*. A nice example for diacritics indicating acceptability *and* grammaticality is found in Uszkoreit (1987), where * is used for unacceptable and ungrammatical examples (p. 55 vs. p. 122, respectively), and ?? is assumed to stand for “not ... as ungrammatical as”.

References

- Abels, Klaus. 2015. Word order. In Kiss, Tibor & Alexiadou, Artemis (eds.), *Syntax – Theory and analysis: An international handbook*, vol. 2. (Handbooks of Linguistics and Communication Sciences 42.1), 1400–1448. Berlin/New York: Mouton de Gruyter. <https://doi.org/10.1515/9783110363708-017>
- Baker, Mark C. 1997. Thematic roles and syntactic structure. In Haegeman, Liliane (ed.), *Elements of grammar: Handbook of generative syntax*, 73–137. Dordrecht: Kluwer. https://doi.org/10.1007/978-94-011-5420-8_2
- Bresnan, Joan W. 2007. Is syntactic knowledge probabilistic? Experiments with the English dative alternation. In Featherston, Sam & Sternefeld, Wolfgang (eds.), *Roots: Linguistics in search of its evidential base*. Berlin: Mouton der Gruyter. 75–96.
- Choi, Hye-Won. 1996. Optimizing structure in context: Scrambling and information structure. Doctoral dissertation, Stanford University.
- Chomsky, Noam & Miller, George A. 1963. Introduction to the formal analysis of natural languages. In Luce, R. D. Bush, R. R. & Galanter, E. (Eds.), *Handbook of mathematical psychology 2*. New York: Wiley, 269–321.
- Croft, William. 1991. *Syntactic categories and grammatical relations*. Chicago, IL: The University of Chicago Press.
- de Leeuw, Joshua R. 2015. jsPsych: A JavaScript library for creating behavioral experiments in a web browser. *Behavior Research Methods* 47. 1–12. <https://doi.org/10.3758/s13428-014-0458-y>
- Dik, Simon C. 1978. *Functional grammar*. Amsterdam: North-Holland.
- Ernst, Thomas. 1998. The scopal basis of adverb licensing. In Tamanji, Pius N. & Kusumoto, Kiyomi (eds.), *Proceedings of the 28th Meeting of the North East Linguistic Society*, 127–142. Amherst, MA: GLSA University of Massachusetts.
- Featherston, Sam. 2005. The Decathlon Model of empirical syntax. In Kepser, Stephan & Reis, Marga, (eds.), *Studies in generative grammar: Linguistic evidence: Empirical, theoretical and computational perspectives*. Berlin: Mouton de Gruyter, 187–208.
- Fillmore, Charles J. 1968. The case for case. In Bach, Emmon & Harms, Robert T. (eds.), *Universals in linguistic theory*, 1–88. New York: Holt, Rinehart, and Winston.
- Francis, Elaine J. 2022. *Gradient acceptability and linguistic theory*. Oxford University Press.
- Frey, Werner. 1993. *Syntaktische Bedingungen für die semantische Interpretation: Über Bindung, implizite Argumente und Skopus* [Syntactic conditions for semantic interpretation: About binding, implicit arguments and scope] (Studia Grammatica XXXV). Berlin: Akademie Verlag.
- Frey, Werner. 2003. Syntactic conditions on adjunct classes. In Lang, Ewald & Maienborn, Claudia & Fabricius-Hansen, Cathrine (eds.), *Modifying adjuncts* (Interface Explorations 4), 163–209. Berlin: Mouton de Gruyter. <https://doi.org/10.1515/9783110894646.163>
- Frey, Werner. 2015. Word order. In Kiss, Tibor & Alexiadou, Artemis (eds.), *Syntax – Theory and analysis: An international handbook*, vol. 1. (Handbooks of Linguistics and Communication

Sciences 42.1), 514–562. Berlin/New York: Mouton de Gruyter.
<https://doi.org/10.1515/9783110377408>

- Frey, Werner & Pittner, Karin. 1998. Zur Positionierung der Adverbiale im deutschen Mittelfeld [On the positioning of adverbials in the German middle field]. *Linguistische Berichte* 176. 489–534.
- Gazdar, Gerald, Klein, Ewan, Pullum, Geoffrey K. & Sag, Ivan A. 1985. *Generalized Phrase Structure Grammar*. Cambridge, Massachusetts: Harvard University Press.
- Grimshaw, Jane. 1990. *Argument structure*. Cambridge, MA: MIT Press.
- Haider, Hubert. 1993. Deutsche Syntax – Generativ [German syntax – generative]. Tübingen: Narr
- Haider, Hubert. 2000. Adverb placement: Convergence of structure and licensing. *Theoretical Linguistics* 26. 95–134. <https://doi.org/10.1515/thli.2000.26.1-2.95>
- Haider, Hubert. 2010. *The syntax of German*. Cambridge: Cambridge University Press.
<https://doi.org/10.1017/CBO9780511845314>
- Heim, Irene 1982. The semantics of definite and indefinite noun phrases. Doctoral dissertation, University of Massachusetts, Amherst, MA.
- Jackendoff, Ray. 1987. The status of thematic relations in linguistic theory. *Linguistic Inquiry* 18. 369–411.
- Juzek, Tom & Häussler, Jana. 2019. Semantic Influences on syntactic acceptability Ratings. In: Gattnar, Anja, Hörnig, Robin, Störzer, Melanie & Featherston, Sam (eds.), *Proceedings of Linguistic Evidence 2018. Experimental data drives linguistic theory*. Universität Tübingen. <http://dx.doi.org/10.15496/publikation-32605>
- Kamp, Hans, J. van Genabith & Reyle, Uwe. 2011. Discourse Representation Theory. In Gabbay, D. (ed.), *Handbook of Philosophical Logic*, vol. 15, 125–394. Berlin: Springer.
- Kayne, Richard. 1994. *The antisymmetry of syntax*. Cambridge, London: MIT Press.
- Keller, Frank. 2000. Gradience in grammar: Experimental and computational aspects of degrees of grammaticality. Doctoral dissertation, University of Edinburgh.
- Kiss, Tibor. 2001. Configurational and relational scope determination in German. In Meurers, Walt Detmar & Kiss, Tibor (eds.), *Constraint-based approaches to Germanic syntax*, 141–176. Stanford: CSLI Publications.
- Kitagawa, Yoshihisa & Fodor, Janet D. 2006. Prosodic influence on syntactic judgements. In Fanselow, Gisbert, Fery, Caroline, Schlesewsky, Matthias & Vogel, Ralf (eds.), *Gradience in grammar: Generative perspectives*, 336–358. Oxford: Oxford: University Press.
- Kratzer, Angelika. 1996. Severing the external argument from its verb. In Rooryck, Johan & Zaring, Laurie (eds.) *Phrase structure and the lexicon*, 109–137. Dordrecht: Kluwer.
- Lange, Kristian & Kühn, Simone & Filevich, Elisa. 2015. „Just another tool for online studies“ (JATOS): An easy solution for setup and management of web servers supporting online studies. *PLOS ONE* 10(7). <https://doi.org/10.1371/journal.pone.0130834>
- Lechner, Winfried. 1998. Two kinds of reconstruction. *Studia Linguistica* 52(3). 276–310.

- Levin, Beth & Rappaport Hovav, Malka. 2009. *Argument realization*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9780511610479>
- Maienborn, Claudia. 1995. Towards a compositional semantics for locative modifiers. In Simons, Mandy & Galloway, Teresa (eds.), *Proceedings from Semantics and Linguistic Theory (SALT) V*, 237–254. Ithaca N.Y.: Cornell University Linguistic Publications.
- Maienborn, Claudia. 2001. On the position and interpretation of locative modifiers. *Natural Language Semantics* 9. 191–240. <https://doi.org/10.1023/A:1012405607146>
- Maienborn, Claudia. 2003. Event-internal modifiers: Semantic underspecification and conceptual interpretation. In: Lang, Ewald & Maienborn, Claudia & Fabricius-Hansen, Cathrine (eds.), *Modifying adjuncts* (Interface Explorations 4), 475–509. Berlin: Walter de Gruyter. <https://doi.org/10.1515/9783110894646.475>
- Maienborn, Claudia & Gese, Helga & Stolterfoht, Britta. 2016. Adverbial modifiers in adjectival passives. *Journal of Semantics* 33(2). 299–358. <https://doi.org/10.1093/jos/ffv004>
- Müller, Gereon. 1999. Optimality, markedness, and word order in German. *Linguistics* 37. 777–818. <https://doi.org/10.1515/ling.37.5.777>
- Neeleman, Ad & Reinhart, Tanya. 1998. Scrambling and the PF interface. In Butt, Miriam & Geuder, Wilhelm (eds.), *The projection of arguments: Lexical and compositional factors*, 309–353. Stanford: CSLI.
- Schütze, Carson T. & Sprouse, Jon. 2013. Judgment data. In Podesva, Robert J. & Sharma, Devyani (eds.), *Research methods in linguistics*, 27–50. Cambridge: Cambridge University Press.
- Stolz, Thomas, Stroh, Cornelia & Urdze, Aina (2006) On Comitatives and related categories. A typological study with special focus on the Languages of Europe. Berlin/New York: Mouton de Gruyter.
- Struckmeier, Volker. 2014. *Scrambling ohne Informationsstruktur?: Prosodische, semantische und syntaktische Faktoren der deutschen Wortstellung*. [Scrambling without information structure?_ Prosodic, semantic, and syntactic factors of German word order] (Studia Grammatica 77). Berlin: Akademie Verlag. <https://doi.org/10.1524/9783110347715>
- Uszkoreit, Hans. 1987. *Word order and constituent structure in German*. CSLI Lecture Notes, Vol. 8. Stanford: CSLI Publications.
- Zwart, Jan-Wouter. 1993. *Dutch syntax. A minimalist approach*. Groningen: Groningen University dissertation.