Word order constraints on event-internal modifiers

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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 may occupy several positions in German clause structure. They are base generated but constrained by a structural condition together with linear precedence rules. 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. Linear precedence rules apply to all event-internal adverbial types in both affirmative and privative interpretation, except for one linearization constraint based on thematic roles which only applies to affirmative comitatives. The interaction of the identification requirement with the linear precedence constraints accounts for the diverging patterns of serializations observed with event-internal modifiers.

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

The comparatively free arrangement of arguments in German clause structure does not imply that arguments can be realized in any order. German is not a free word order language, and 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, has been disregarded for quite some time. It was taken for granted that *"adverbial phrases can be interspersed freely among the arguments of the verb"* (Uszkoreit 1987: 145, 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 uncontroversial: 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 minimal clause. If a single adverbial is realized, the proposals assume that it can be merged and linearized freely. It is a remarkable property of all proposals that serialization constraints are not expressed as such. Instead, structural conditions lead to configurations which are mapped to linear orders. Expressed linearization conditions are hence descriptive devices originating from configurational constraints.

While the present analysis shares with Haider (2000) and Maienborn et al. (2016) that structural conditions emerge from semantic properties of the modifiers, it differs from these, and most other previous proposals in various respects.

First and foremost, we do not assume that linear order can be derived completely from structural conditions. On the contrary, we propose that regulative linear precedence rules restrict possible phrase structures. Heads and phrases may thus merge in various ways, but the resulting phrases must obey linear precedence constraints, and phrases not obeying these constraints will be considered ill-formed.

Secondly, we will focus on modifiers in isolation and propose that they must obey linearization constraints as well. Thirdly, 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]

The present analysis of event-internal modifiers combines a semantic constraint with linear precedence constraints, neither of which must be defined specifically for the class of event-internal adverbials. The linear precedence constraints are well-established in existing proposals dealing with the word order of arguments. The semantic constraint takes care of individual variables that cannot be resolved during the combination of the modifier with the modified phrase. They must be resolved by projecting and binding the variable.

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

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[1]   Frey & Pittner (1998: 505, 512) use the German terms *ereignisintern* for event-internal, and *ereignisbezogen* event-related adverbials, respectively.

[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.

(Bezugselement). Using the term *orientation* of the adverbial we informally characterize the necessity to relate the adverbial to a reference phrase. 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 Ramona **zusammen mit einem Berater**   was   unterzeichnet.
            there has Ramona together   with a   counsellor what.ACC signed
      b. Da hat Ramona was **zusammen mit einem Berater** unterzeichnet.
            'Ramona signed something together with a counsellor.'

(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 meanings 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).

Base positions of event-internal modifiers must be minimally c-commanded by their reference phrases according to Frey & Pittner (1998: 511). They thus predict all a.-examples in (1) to (4) to be grammatical, and all b.-examples to be ungrammatical. The object intervenes between the subject – the reference phrase of both adverbial types – and the adverbial PP in all b.-examples. Hence the minimal c-command constraint is violated, and the examples should be ungrammatical. But the object in the b.-examples is assumed to be scrambling-invariant, so that its position cannot be derived from scrambling understood as re-merger to the left (see Frey & Pittner 1998: 525). Since the PPs are not in their presumed base position in the b.-examples, and the position of the object cannot be derived by scrambling, the only remaining alternative would be to derive the b.-

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[3] Haider (2010) represents the predominant view of scrambling-invariance of existential *wh*-indefinites. 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 V^0 and C^0 in German clause structure.

examples by scrambling as lowering but lowering violates Frey & Pittner's (and almost everybody else's) analysis of scrambling as raising.

Evidence from experimental studies, however, shows that structures of the type (3b) and (4b) are preferred over structures of the type (3a) and (4a) (see section 3.). The general pattern is shown in Table 1: structures of the type (1a) are preferred over structures of the type (1b), while there is almost no preference for the types (2a) vs. (2b). This distribution clearly contradicts Frey & Pittner's predictions but is also at odds with relative constraints (as we will deal with solitary occurrences of event-internal modifiers here).

Table 1: Order preference dependent on adverbials

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

The present study suggests that neither an analysis based on relative constraints (and multiple occurrences of adverbials), nor one based on fixed base positions of single adverbials is correct. Event-internal modifiers cannot be realized freely (even if in isolation), and they do not occupy a unique base position.

We assume that event-internal modifiers combine with verbal projections (thus identifying 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 this identification must proceed indirectly. As the free variable is projected upwards from the adverbial, it can only be identified by phrases c-commanding it. The event-internal modifiers in (1) to (4) must thus 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.

As for comitatives, we will argue that they take over the thematic relation of the phrase which identifies the individual variable. This assumption does not only account for the observation (see Baker 1997: 108) that comitatives introduce secondary agents or themes, but also for their order preference: if the internal argument of the comitative is identified with an *agentive* thematic role, it does not only assume the most prominent role, but in addition will most likely also be identified as referring to an *animate* entity. Analyses of the order of arguments in German have long proposed two linear precedence rules, i.e. [agent] < [¬agent] (Uszkoreit 1987; Jacobs 1988; Frey 2015), and [animate] > [¬animate] (Müller 1999). The application of both rules requires a position of the comitative to the left of the object, hence (1a). In making use of a linear precedence rules affecting *agentive* arguments, we do not make claims about the structure of a thematic hierarchy, and also, we do not claim that roles in general have repercussions in word order. So neither a linear precedence rule affecting thematic roles*,* nor the rule governing animacy applies to *instrumentals.* Their position can be derived from a categorical constraint which requires PPs to follow NPs (Gazdar et al. 1985; Müller 1999), hence (3b) and (4b).

Finally, regarding (2a) vs. (2b), there is no preferred order. We will justify the claim that only affirmative comitatives introduce additional thematic roles. Hence, two competing linear precedence

rules remain: a constraint placing NPs before PPs, and a constraint placing phrases with the specification [animate] before phrases with the opposite specification. Linearization constraints applicable to instrumentals will not differ between affirmative and privative meanings, but two of the three linearization constraints applicable to affirmative comitatives will also apply to privative ones. And because the two constraints cannot be satisfied at the same time, the non-preference in ordering privative comitatives is predicted.

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 respective influence of agentive roles, animacy, and the syntactic category on the determination of serializations is also uncontroversial in German grammar (see Uszkoreit 1987; Müller 1999; Frey 2015; among others). 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, restricted by the identification requirement and by linear precedence rules, which equally apply to arguments and adjuncts.

The remaining paper is structured as follows:

Section 2 will discuss problematic aspects in the treatment of *instrumentals* 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 are available 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. It will also deal with the tension between the binary concept of grammaticality, and the gradient evidence provided in the experimental studies. Section 5 will summarize the results.

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

Frey & Pittner (1998: 524f.) propose that adverbials occupy base positions that are determined by the class membership of the modifiers, which ultimately relates to their semantics.[4] If adverbials

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[4] "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)

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). It is a remarkable aspect of the analysis by Frey & Pittner (1998) that the class of event-internal modifiers is not defined. We will employ the following informal characterization of event-internal modifiers 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)[5]

Frey & Pittner (1998: 511) characterize event-internal modifiers by their orientation towards a reference phrase (Maienborn's *referent that is related to the verb's eventuality argument* in the above quotation). Orientation can only be met according to Frey & Pittner if a minimal c-command relationship pertains between the reference phrase and the event-internal modifier. As event-internal modifiers, they list instrumentals, comitatives, locatives, and mental attitude adverbials.[6] 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. 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.[7,8] This is schematically depicted in (5): the PP is minimally c-commanded by the subject, and c-commands the object in turn (as will be made clear in section 4, we share with Haider (2010) the assumption that German shows a binary right-branching clause structure). 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.

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[5] The term "event-external" used in Maienborn (2001; 2003) relates to the term "event-related" in Frey & Pittner (1998).

[6] 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.]

[7] 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 γ [VP α [VP β …]]] although α intervenes, if both α and β are event-internal modifiers (as e.g. comitatives or instrumentals).

[8] 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.

(5) Schematic structure of instrumentals in German clause structure
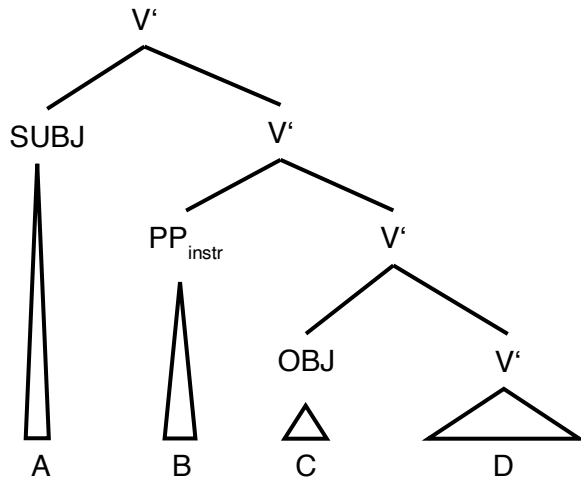
If the structure in (5) is assumed and the position of the object is taken to be fixed (because it is realized as an existential *wh*-indefinite), the positions of the instrumentals in (3b) and (4b) – A > C > B – can only be the result of – illicit – lowering. Frey & Pittner (1998) argue that examples showing the serializations in (3b) and (4b) must be ungrammatical.

They justify their assumptions by looking into scope determination and focus projections.

Frey's (1993) Scope Principle, which is assumed in Frey & Pittner (1998), accounts for scope ambiguities by assuming that a quantifier Q_2 may take scope over a quantifier Q_1 if Q_2 either c-commands Q_1 or the trace of Q_1. Hence, a scope ambiguity emerging from [… Q_2 … [… Q_1 …]] must be the result of scrambling: in [… Q_2 … [… Q_1 … [… t_2 …]]] one reading emerges from Q_2 c-commanding Q_1, and the other from Q_1 c-commanding the trace of Q_2. Let us take this argument for granted.[9] Frey & Pittner (1998: 505f.) present the following examples of isolated verb-final sub-ordinate clauses and claim that (6b) is ambiguous, while (6a) is not.

(6) 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'

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. Hence, it seems reasonable to make use of main clauses instead. Example (6b) shows an existential quantifier to

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[9] This is by no means necessary: Kiss (2001) has shown that scope ambiguities can be derived without assuming traces of quantifier raising. Recently, Fanselow et al. (2022) have provided experimental evidence that inverse scope can be found in German sentences showing no indication of scrambling.

the left of a universal quantifier, with an option of inverse scope that is assumed to provide evidence for an analysis where the object has been scrambled over the instrumental PP. Example (7b) is a main clause corresponding to (6b), and showing the same configuration of the quantifiers. Furthermore, we have added (7a), which is identical to (7b), except that the order of the quantifiers used has been swapped so that the object is now realized as an existential quantifier, while the PP is realized as a universal quantifier.

(7) a. Otto hatte fast   jedes Fenster mit mindestens einem Schraubenzieher geöffnet.
         Otto had almost every window with at.least   one   screwdriver   opened
         'Otto opened almost every window with at least one screwdriver.'
     b. Otto hatte mindestens ein Fenster mit fast   jedem Schraubenzieher geöffnet.
         Otto had   at.least   one window with almost every   screwdriver   opened
         'Otto opened at least one window with almost every screwdriver.'

If (7b) is ambiguous, as proposed for (6b) by Frey & Pittner (1998), then (7a) should be ambiguous as well, since (7a) and (7b) show the same syntactic structure. Moreover, the supposed ambiguity of (7a) cannot be derived from logical inference since the strong reading ($\exists\forall$) cannot be derived from the weak reading ($\forall\exists$).[10] But (7a) is not ambiguous: the universal quantifier unambiguously takes scope over the existential one. This reading, however, is compliant with base generating both phrases in their positions.[11]
Next consider focus projection. Haider (2010: 182ff.) assumes that an example containing a scrambled argument like (9b) does not allow maximal focus projection, which means – among other things – that (9b) cannot be an answer to (8).

(8)   Was ist geschehen?
      what is happened
      'What has happened?'
(9) 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.'

According to Haider (2010: 183), stress must fall on the lowest phrase position in the clause to allow for maximal focus. This position is occupied by a trace in (9b), which cannot bear stress. The presence of a trace yielding minimal focus only is hence taken as 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

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[10] Logically, the weak reading of (6b), i.e. $\forall\exists$, can be derived from the strong reading since the former follows from the latter, but this would be pragmatically odd in a language like German that allows both orders: if the weak reading is taken to be true, the sentence should receive a structure which indicates that the strong reading is at least not known to be true, i.e. $\forall\exists$.

[11] A possible base generation of a quantified instrumental modifier to the left of the object does not contradict the analysis proposed in section 4, as will be discussed in section 4.5.

the question *Was ist geschehen?* ('What has happened?'), because only then, we can assume maximal focus. Consider the examples in (10).

(10) a. Was ist geschehen?
          what is happened
          'What has happened?'
      b. Otto hat mit einem Schraubenzieher eine WOHnungstür geöffnet.
          Otto has with a   screwdriver   a   apartment.door opened
      c. Otto hat eine Wohnungstür mit einem SCHRAUbenzieher geöffnet.
          'Otto opened an apartment door with a screwdriver.'

Both (10b) and (10c) are plausible answers to (10a), hence show maximal focus. Following Haider this means that stress falls on the lowest phrase in the structure. According to Frey & Pittner (1998), (10c) 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 (10c) should accordingly be an inappropriate answer to (10a), 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.

The empirical evidence provided by Frey & Pittner (1998) for specific base positions of event-internal modifiers is inconclusive, neither quantification nor focus projection suggest that a base position of *instrumentals* ought to be proposed to the left of the object. The following section will adduce further evidence from controlled experimental studies.

3   Experimental Studies

Test environments to determine order preferences are complex, and the resulting judgments are subtle and often far from stable, calling for controlled experimental studies instead. Here, test items are controlled and systematically varied, based on a small set of factors, which are hidden from linguistically naïve participants. In this section, we report two *Two Alternative Forced Choice studies* (2AFC).[12] A 2AFC aims at detecting differences between conditions by direct comparison. Hence, a choice based on minimal pairs forms the dependent variable, which in the present case leads to picking one serialization from two alternatives. The minimal pairs presented systematically vary hidden properties, which are considered relevant for the selection. In fact, the pairs provided in examples (1) to (4) illustrate the choices from the first experimental study (EXP 1): the items are drawn from two adverbial types (subject-oriented comitatives and instrumentals), and from affirmative and privative senses of both types, yielding a 2×2 factorial design. In examples (1) and (2), the adverbial type – comitative – is kept constant, and the sense is varied, and the

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[12] 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 (see Pieper et al. 2023).

same consideration applies to examples (3) and (4). The resulting cross product can thus be represented in a 2 × 2 table, as illustrated in table 2, where the choice (a) corresponds to PP > OBJ, and (b) to OBJ > PP (the order shown in table 2 reflects the design of EXP 1):

Table 2: 2 × 2 factorial design in EXP 1

		Adverbial Type	
		instrumental	comitative
Sense	affirmative	(2a) vs. (2b)	(1a) vs. (1b)
	privative	(4a) vs. (4b)	(3a) vs. (3b)

Different hypotheses can be made explicit by establishing proportions of choices, i.e. choices of (a) or (b) items, respectively for the four different cells. Consider the hypothesis proposed by Frey & Pittner (1998). According to this hypothesis, there should be a strong preference for picking serializations of type (a) in the first cell for affirmative comitatives, and the resulting proportion should be identical (modulo chance) to the proportions picked for the other cells. Thus, neither changes of adverbial type nor of the sense should affect the choices made.[13] Of course, the distribution of data illustrated in table 1 suggests an alternative hypothesis, to which we will come below.

The 2AFC format allows the inclusion of properties which may lead to confounding effects in isolation, but not so if the alternatives are provided together. Existential *wh*-indefinites provide the least complex test environment proposed by Frey & Pittner (1998), but the status of *wh*-indefinites as elements of oral communication may result in problematic effects in a written presentation.[14] The format as 2AFC reduces such effects because the potentially problematic property is kept constant cross 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 must be 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, which is illustrated with test items from EXP 1 in (11).[15]

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[13] Recall that it follows from the minimal c-command requirement by Frey & Pittner (1998) that event-internal modifiers with structurally identical reference phrases should show the same linearization pattern, viz. PP > OBJ for subject-oriented event-internal modifiers. Different senses of the individual types are ignored in Frey & Pittner (1998).

[14] 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.

[15] The preposition *ohne* ('without'), showing the privative meaning of comitatives and instrumentals, and the preposition *mit* ('with') showing the affirmative meaning 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) in comparison to (12b)) allows an interpretation as a postnominal modifier. Such a reading is blocked in (12a) because it would require a different case of the prepositional object.
(i)   Eva hat erzählt, dass NP[eine Hausfrau PP[ohne ein Spülmittel]] was gereinigt hat.
         'Eva has told that a housewife, who doesn't own any detergent at all, cleaned something.'

(11) 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.'

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

As was already illustrated in table 2, we have compared comitatives$_{subj}$ and instrumentals in EXP 1, both of which are subject-oriented, using prepositions showing affirmative and privative senses. Data from 33 participants entered the analysis, who rated 24 minimal pairs each. The empirical distribution of choices in EXP 1 is given in figure 1.

Figure 1: Empirical Distribution of EXP 1
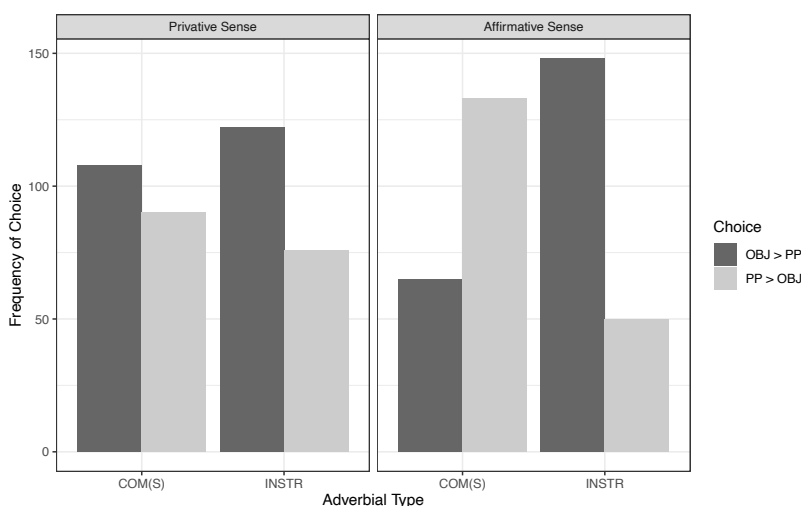
The overall preferred choice for the serialization in figure 1 is OBJ > PP, with a higher proportion for privative senses, and for affirmative instrumentals. Only affirmative comitatives$_{subj}$ show a preference for the serialization PP > OBJ. It follows of course that the linearization preference for instrumentals and comitatives, as well as the linearization preferences for affirmative and privative

senses within the adverbial types differ from one another. Further, the empirical distribution of choices suggests an interaction between the two effects *adverbial type* and *preposition sense*.[16] To model the data, we have used a Binomial Generalized Linear Mixed Model (GLMM, Bates et al. 2015) with *adverbial type* and *preposition sense* as treatment-coded fixed effects, where *instrumental* is taken as reference value for *adverbial type,* and *affirmative* as reference value for *preposition sense.* The inclusion of an interaction between *adverbial type* and *preposition* sense provides individual predictions for all four combinations. We have chosen a random structure for the model that again takes the interaction between the two effects into account to determine random slopes for participants. In addition, we have included a random intercept for the items since items do not vary across conditions (and the influence of the items can be neglected in the model). The model predictions are shown in table 3, the complete analysis is available as part of the supplementary material.

Table 3: Modelled probabilities for PP > OBJ in EXP 1

Effect	Probability	Std. Error	lower conf. limit	upper conf. limit
Instrumental affirmative	0.221	0.043	0.148	0.317
Comitative$_{subj}$ affirmative	0.690	0.044	0.596	0.770
Instrumental privative	0.347	0.065	0.233	0.482
Comitative$_{subj}$ privative	0.445	0.064	0.325	0.571

As is indicated in table 3, the model predicts affirmative instrumentals to show a strong preference for the serialization OBJ > PP ($\beta = -1.26$, $p < 0.0001$). We observe a strong effect for comitative$_{subj}$ with affirmative senses, raising the probability for the serialization PP > OBJ significantly ($\beta = 2.06$, $p < 0.0001$). Privative instrumentals also show an effect towards the serialization PP > OBJ, which however is not significant ($\beta = 0.63$, $p < 0.1$). Finally, we notice a significant effect for privative comitatives$_{subj}$ ($\beta = -1.65$, $p < 0.0001$), so that the probability for the serialization PP > OBJ is reduced again. The model predictions thus confirm what has been observed for the sample: subject-oriented event-internal modifiers neither behave uniformly across types, nor across senses. Both influence the serialization preferences of the adverbial. Affirmative comitatives$_{subj}$ are predicted to show the pattern PP > OBJ, while privative comitatives$_{subj}$ and instrumentals irrespective of their sense are predicted to show the pattern OBJ > PP.

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

In the second experimental study (EXP 2), we have compared affirmative adverbials with different reference phrases and their serialization with respect to the object. The basic design of the experiment is the same as in EXP 1: we provide a full factorial design for two factors with two levels each. As the first factor *(adverbial type)* we compare *object-oriented* comitatives and *subject-oriented* instrumentals. As the second factor, we have varied the *form of the object*, which can either be a *wh*-indefinite, or a full-fledged indefinite NP, as is illustrated in (12) and (13) for instrumentals.

---

[16] In an interaction, each level of a given factor (as *comitative* or *instrumental* in the present case) provides individual predictions in combination of each level of another factor (*affirmative* or *privative*).

(12) 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.'

(13) a. Eva hat erzählt, dass ein Mediziner eine Substanz mittels   einer Spritze injiziert
          Eva has told   that   a   physician a   substance by.means.of a   syringe injected
          hat. Was für eine es war, weiß ich aber nicht.
          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.'

The reason to vary the form of the object is to adduce evidence against a possible explanation of
serialization pattern OBJ > PP. If the object is not invariant, an analysis relying on scrambling as
re-merger to the left might propose that – as an alternative to being base generated – the seriali-
zation may result from scrambling the object, as is illustrated in (15).

(14) a. [$_{v'}$ OBJ [$_{v'}$ PP …]]   b.   [$_{v'}$ OBJ$_i$ [$_{v'}$ PP [$_{v'}$ OBJ$_i$ …]]]

The analysis in (14), however, cannot be applied to account for the position of scrambling-invariant
objects to the left of an event-internal adverbial. If the form of the object does not show a suffi-
ciently strong effect, then an analysis that relies on scrambling – as in (14b) – cannot be main-
tained. Frey & Pittner (1998) assume that comitatives$_{obj}$ should appear behind the object, because
the object must minimally c-command the PP. For the same reason, they assume that instrumen-
tals invariably must appear before the object (and after the subject). Hence, they would predict
that the serialization patterns for comitatives$_{obj}$ and instrumentals diverge, with the former being
realized after the object, and the latter in front of them. Comitatives$_{obj}$ in the test items in EXP 2
can also be used as a touchstone for analyses which assume relative constraints only, such as
Haider (2000) and Maienborn et al. (2016), since they appear as solitary modifiers in a smallest
clause. The present analysis agrees with Frey & Pittner (1998) regarding the position of comita-
tives$_{obj}$, and hence disputes the positional freedom implied by Haider (2000) and Maienborn et al.
(2016). As for the position of instrumentals, both experimental studies tell a different story.
Data from 31 participants entered the analysis, who rated 24 minimal pairs each. The empirical
distribution of choices in EXP 2 is given in figure 2.

Figure 2: Empirical Distribution of EXP 2
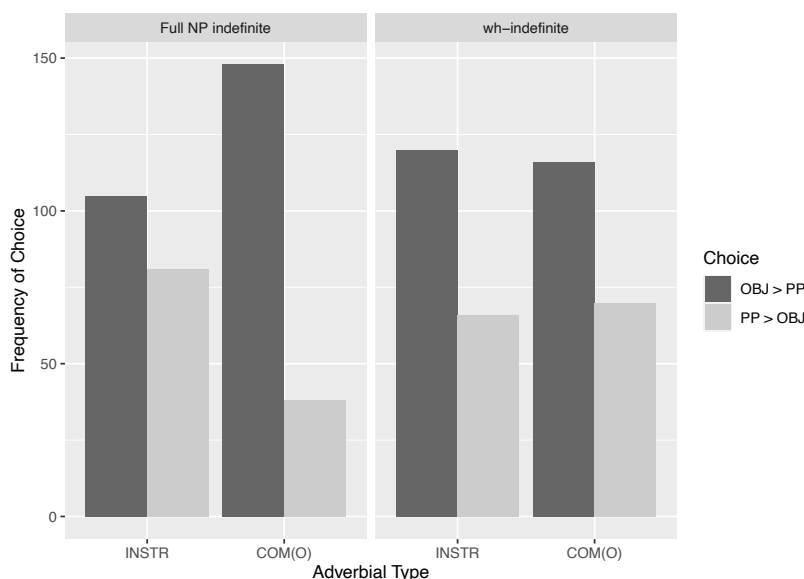
There is a general preference for the pattern OBJ > PP across the adverbial types and the forms of the object (with a nearly identical distribution in the case of *wh*-indefinites). To model the data, we have again used a Binomial Generalized Linear Mixed Model (GLMM, Bates et al. 2015) with *adverbial type* and *form of object* as treatment-coded fixed effects, where *comitative$_{obj}$* is taken as reference value for *adverbial type,* and *full indefinite NP* as reference value for *form of object.* The inclusion of an interaction between *adverbial type* and *form of object* provides individual predictions for all four combinations. We have chosen a random structure for the model that again takes the interaction between the two effects into account to determine random slopes for participants. In addition, the model contains a random intercept for the items (which do not vary and only show a negligible influence). The model predictions are shown in table 4, the complete analysis is available as part of the supplementary material.

Table 4: Model predictions for PP > OBJ in EXP2

Effect	Probability	Std. Error	lower conf. limit	upper conf. limit
Comitative$_{obj}$ NP	0.140	0.049	0.068	0.266
Instrumental NP	0.423	0.078	0.281	0.579
Comitative$_{obj}$ wh	0.314	0.097	0.159	0.525
Instrumental wh	0.321	0.071	0.200	0.472

The model predicts a very low probability (0.14) for the serialization PP > OBJ for comitatives$_{obj}$ and full indefinite NPs ($\beta = -1.81$, p < 0.0001). While we observe an effect if comitatives$_{obj}$ are substituted by instrumentals ($\beta = 1.50$, p < 0.01), the effect is not strong enough you yield a reversal of serialization preferences, so the OBJ > PP is also predicted to be preferred for instrumentals and full indefinite NPs. The most remarkable effect can be observed if we look into instrumentals and objects realized as *wh*-indefinites: the predicted probability for the pattern PP > OBJ *drops* if the object is realized as a *wh*-indefinite ($\beta = -1.46$, p < 0.05). The model also predicts that *wh*-indefinites yield an effect in favor of the serialization PP > OBJ for comitatives$_{obj}$ ($\beta = 1.03$, p <

0.05), which corresponds to the data, but is surprising nevertheless (see the discussion in section 4.5). The model predictions thus confirm what has been observed for the sample: there is a general preference across adverbial types and forms of the object for the serialization OBJ > PP. What is more, there is an even stronger tendency for this pattern if the object is realized as a scrambling-invariant *wh*-indefinite, which raises serious doubts on the analysis (14b).

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 distributions and their models do not only contradict Frey & Pittner's minimal c-command analysis, but also proposals which attribute positional freedom to adverbials in the absence of adverbials of other classes, such as Haider (2000) and Maienborn et al. (2016). 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 4.5). 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

Basic assumptions on German clause structure are laid out in Haider (2010). German clauses consist of a right-branching binary verbal projection. A saturated verbal projection (S) forms the complement of C, which hosts complementizers or finite verbs, thus yielding verb final, verb initial, and verb second clauses. Following the evidence adduced by Haider (2010: 58–67) against functional projections between V and C, we do not assume additional functional projections between V and C. We depart from Haider's assumptions in allowing arguments and adjuncts to combine with the verbal projection in any order. The combination must be licensed by categorial or thematic selection, or by conditions on modification, to which we return immediately. The order of combinations within the projection of a head is subject to linear precedence constraints. A linear precedence constraint of the form A > B requires that the daughter A found within the projection of a head must be realized to the left of daughter B within the projection of the same head, while the basic structure of the projection of the head is retained. For German verbal projections, and their binary branching structure, it follows that the combination in (15a) is licit, while the one in (15b) is blocked because it violates A > B, as will be further discussed in section 4.3.

(15)   a.

b.

```
            V'
           /  \
          B    V'
              /  \
             A    V
```
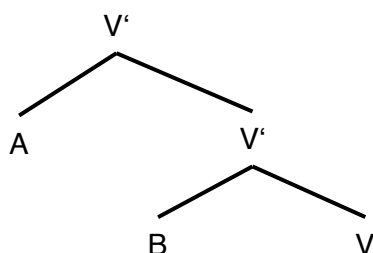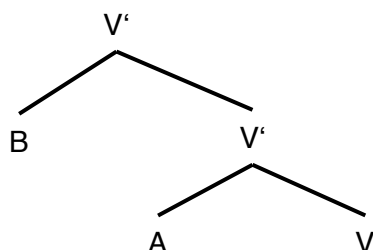
Modifiers introduce event variables, which must be identified with the event variable introduced by the modified phrase. Kratzer (1996: 122) introduces the rule of *Event Identification,* which we take as a starting point of our analysis. It is characteristic of event-internal modifiers, however, that they introduce an event *and* an individual variable. The event variable ties 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. Binding of both variables in parallel is not possible, and general constraints on type-driven translation (Gazdar et al. 1985; Kratzer 1996) prohibit that the individual variable is bound as a side effect of the combination of the modifier with a verbal projection. Thus, it becomes necessary to suspend the identification of the individual variable. This suspension emends the type-mismatch and ensures the combination of the event-internal modifiers with the verbal projection. But the suspension of the variable creates a syntactic dependency because suspended variables lack 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, asymmetric 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.

Immediate consequences follow for object-oriented modifiers: the modifier must follow the object. The modifier must be c-commanded by the object to identify its suspended variable, and c-command can only be obtained if the modifier is realized to the right of the object. 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 affirmative subject-oriented comitatives prefer a position before the object, and privative subject-oriented comitatives are neutral.

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 individual variable of the reference phrase but will also require that the role relating the individual variable of the reference phrase to the event will be the role borne by the internal argument of the event-internal modifier. Baker (1997: 108) postulates that "comitative[s] [are] usually either […] second agent[s] or […] second theme[s]". The present analysis does not have to specifically stipulate that comitatives can bear 'secondary' roles. Instead, we will introduce a meaning postulate which will apply to affirmative comitatives to the effect that whatever the role of the reference phrase will be, it will also be the role of the internal argument of the event-internal modifier. In case

of subject-orientation, the role taken over will of course be a role borne by subjects, such as *agent*. A well-established linear precedence constraint requires that *agentive* phrases are placed before *non-agentive* phrases (Uszkoreit 1987; Jacobs 1988; Frey 2015; see section 4.3). This is not to say that the observed contrasts in linearization will always be handled by mapping a thematic hierarchy to linear precedence rules.

Given its formulation, the meaning postulate identifying roles will only apply to affirmative comitatives (see sections 4.2 and 4.3), and we will not assume that *instrumentals* – be they affirmative or privative – introduce a thematic role of *instrument* in the first place (see section 4.4). The differences between affirmative comitatives and instrumentals will be accounted for by the application of two independently required linear precedence rules, one placing PPs to the right of NPs (Gazdar et al. 1985; Müller 1999) and the other placing phrases denoting animate entities in front of phrases denoting inanimate ones (Müller 1999), as will be discussed in section 4.3 and 4.4.

4.2   Identifying individual variables in event-internal modification

Consider the following definition of Event Identification proposed in Kratzer (1996: 122) in (16a) with its illustration in (16b).

(16)   Event Identification
       a. $f_{<e, <s, t>>} + g_{<s, t>} \Rightarrow h_{<e, <s, t>>}$
       b. $\lambda x \lambda e R(e, x) + \lambda e P(e) \Rightarrow \lambda x \lambda e[R(e, x) \wedge P(e)]$

In the case of event-internal PPs, both the PP and the modified phrase are of type $<e, <s, t>>$, hence creating a type mismatch. To resolve this type mismatch, we assume that the individual variable introduced by the PP must be suspended. 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 (17).

(17)   Da   hat$_i$ [Ramona mit einem Berater   was   unterzeichnet t$_i$].
       there has Ramona with a   counsellor what.ACC signed

The semantics of the comitative *mit einem Berater* ('with a counsellor') is provided in (19), where the comitative relation is expressed through the ternary predicate *comitative(f, z, x),* and the restriction on the internal argument through *counsellor(x).*[17] The internal argument of the comitative *x* is not related to the event *f* through a thematic role in (19), but will eventually receive the very role borne by the external argument *z* in the main event. How this role is determined will be discussed below.

(18) $\lambda z \lambda f \exists x[comitative(f, z, x) \wedge counsellor(x)]$

---

[17] 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.

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

(19) $\lambda x'\lambda e\exists y[\text{sign}(e) \wedge \text{theme}(e, y) \wedge \text{agent}(e, x')]$

Being of the same type, (18) and (19) cannot be combined directly through Event Identification. To meet Event Identification (where e and f are identified), it becomes necessary to get rid of the individual variable, which will be suspended, represented by prefixed curly brackets, i.e. $\{z\}$, in (20). Being suspended, z becomes 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 suspended 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 suspended elements and their eventual binding by identification amounts to assuming that the phrase binding a suspended element must c-command the phrase that introduced it. The combination of the phrases in (18) and (19) is shown in (20) – the type coercion is made explicit by embedding the PP without the suspension in the PP with a suspended variable.[18]
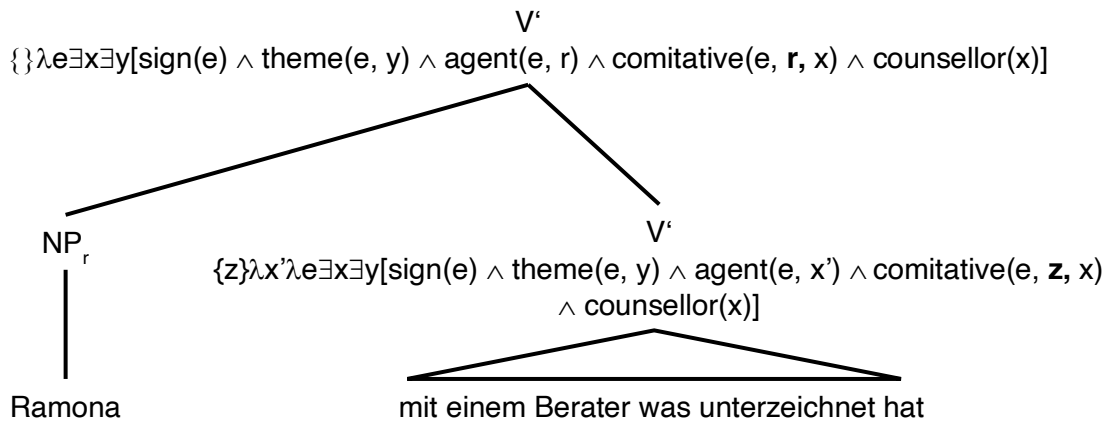
(20) mit einem Berater was unterzeichnet hat
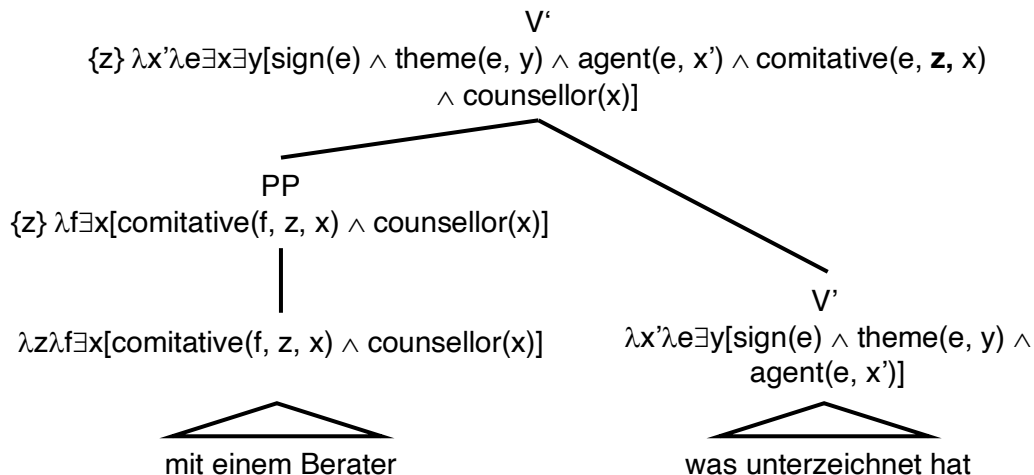
If the subject is combined with the verbal projection, as illustrated in (21), the individual variable of the subject **(r)** is affected in two ways: First, it is identified with the open individual variable **x'** of the verbal projection, and it identifies the suspended element *{z}* projected by the verbal projection. If such an element is bound, it will be no longer be suspended – hence, **r = x' = z.**

---

[18] *Suspension* may be defined as a lexical operation which turns prepositions with event-internal senses (and hence: with two external arguments) into prepositions that only show a single (event-type) external argument, so that the preposition already comes out from the lexicon with a suspended individual variable. The coercion shown in (20) merely serves illustrative purposes.

(21) Ramona mit einem Berater was unterzeichnet hat

V'

{}λe∃x∃y[sign(e) ∧ theme(e, y) ∧ agent(e, r) ∧ comitative(e, **r,** x) ∧ counsellor(x)]

NP$_r$

Ramona

V'

{z}λx'λe∃x∃y[sign(e) ∧ theme(e, y) ∧ agent(e, x') ∧ comitative(e, **z,** x)
∧ counsellor(x)]

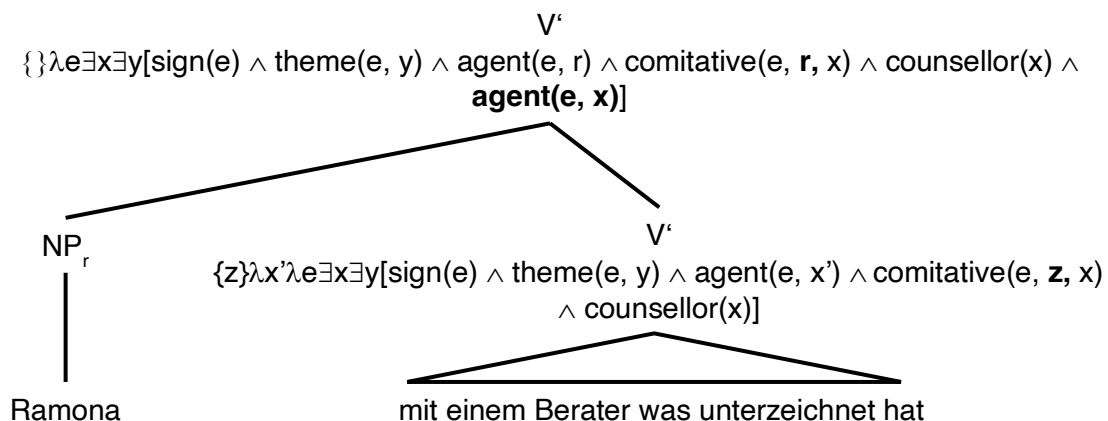mit einem Berater was unterzeichnet hat

Secondly, we will assume that comitatives are constrained by the following meaning postulate provided in (22), where θ must be instantiated by a specific thematic role.

(22) Comitative Meaning Postulate
      ∀θ∀e∀x∀y[[comitative(e, x, y) ∧ θ(e, x)] → θ(e, y)]

The meaning postulate (22) states that the role that relates the variable of the external argument of the *comitative* relation to the modified event is the same role that relates the *internal* argument of the *comitative* relation to that event. In the present case, this variable has been identified as **r** in (21). And so, a second thematic role is introduced in the event structure, which relates the internal argument of the *comitative* – **x** – to the main event *e* using the very same role that relates **r** to *e,* i.e. *agent.*

(23)

V'

{}λe∃x∃y[sign(e) ∧ theme(e, y) ∧ agent(e, r) ∧ comitative(e, **r,** x) ∧ counsellor(x) ∧
agent(e, x)]

NP$_r$

Ramona

V'

{z}λx'λe∃x∃y[sign(e) ∧ theme(e, y) ∧ agent(e, x') ∧ comitative(e, **z,** x)
∧ counsellor(x)]

mit einem Berater was unterzeichnet hat

The semantics of (23) indicates that there is a set of signing events, in which *Ramona* is an agent, a counsellor is an agent, and there is a comitative relation between the two in the event. We do not have to stipulate that the comitative introduces a secondary *agent* (as Baker 1997: 108 does): which role a comitative takes, depends on the role borne by the phrase, which identifies the suspended individual variable. 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 provide a 'secondary' role.[19]

If a suspended element is bound, the linear relationship between the binder and the origin of the suspended variable follows from the required asymmetric c-command between the two: in a right-branching structure, α precedes β if α asymmetrically c-commands β.

Comitatives can take the object as a reference phrase as well (which also holds for *internal loca-tives,* as has been discussed in Maienborn (1995; 2001; 2003)). In principle, comitatives can be ambiguous in this respect, but compositional semantics often resolves the ambiguity.

(24) 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.
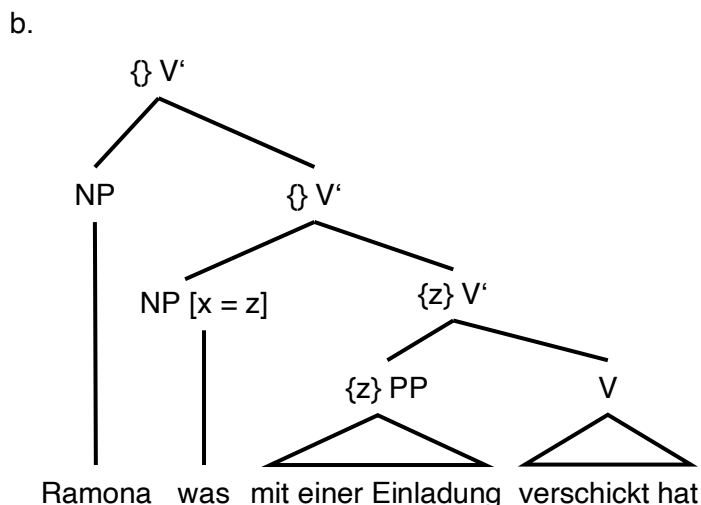   'I've heard that Ramona sent out something along with an invitation.'

An interpretation as agent is precluded for the comitatives in (24), for the simple reason that inan-imate *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. As (25a) shows, the order (24b) is in violation of the identification requirement.[20]

(25)   a.

Ramona mit einer Einladung was   verschickt hat

---
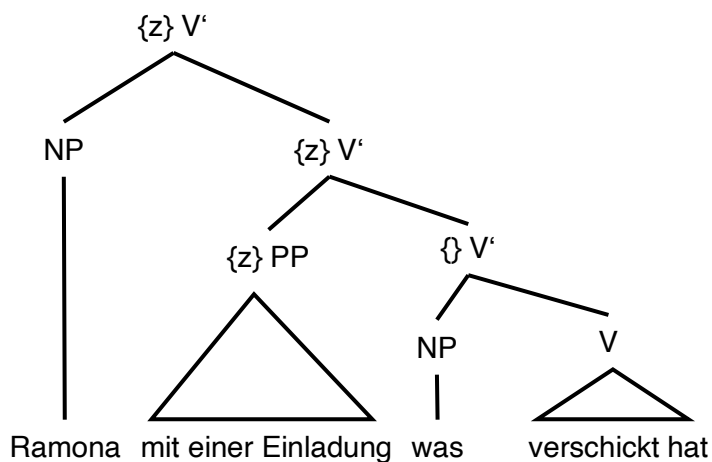
[19] It should also be clear that the identification of roles is independent of the inventory of roles assumed.

[20] The reader will have noticed a discrepancy between the analysis in (25) and the experimental evidence provided in section 3.2: While we assume here that the derivation is ungrammatical, the experimental evidence has only indicated that there is a very strong tendency to block the realization of a comitative$_{obj}$ in front of the object. This discrepancy will be taken up in section 4.5.

b.

```
            {} V'
           /    \
         NP      {} V'
          |     /    \
      NP [x = z]      {z} V'
          |          /     \
          |      {z} PP      V
          |       /  \      /  \
    Ramona  was  mit einer Einladung  verschickt hat
```

An identification with the subject, and subsequent interpretation as a secondary agent is not possible in (25a), 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 (25b).

And since *was* 'something' is the theme in (23), the internal argument of the comitative *einer Einladung* 'an invitation' will become a theme as well, following the meaning postulate provided above.

4.3 On the differing serialization preferences of subject-oriented comitatives and instrumentals

We assume that an unbound individual variable introduced by event-internal modifiers is responsible for the modifiers being realized to the right of their reference phrases, because the unbound variable must be bound by a syntactically more prominent element. The relationship between syntactic configuration and linear precedence will be further elaborated in this section to account for the differing preferences of subject-oriented affirmative comitatives and instrumentals. We have illustrated in (1a, b) and (17), and in (3a, b), repeated here under (26), that affirmative comitatives$_{subj}$ prefer a position to the left of the object, while affirmative instrumentals prefer a position to its right – an observation that has also been corroborated by the experimental studies reported in section 3.

(26) 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.'

This difference can be accounted for by integrating linear precedence rules (LP rules), which we conceive as regulative constraints on admissible phrase structures, so that the syntactic merger yields well-formed structures only if phrases realized within the domain of a head meet (at least a subset of) the LP rules as well.

The LP rules considered responsible for the different serializations are well-established as such but have hitherto not been applied to account for the position of modifiers. First, we follow the analyses by Uszkoreit (1987), Jacobs (1988), and Frey (2015), which assume that the distinction between agentive and non-agentive thematic roles is reflected in German word order. We do not take this distinction to reflect a mapping between a thematic hierarchy and linear order. In fact, we are agnostic regarding specific positions of thematic roles on such a hierarchy (see Levin & Rappaport Hovav (2009) for a recent skeptical view on the definition of a thematic hierarchy), but assume that the role *agent* can be distinguished from all other thematic roles.

(27)   [agent] > [¬agent]

Secondly, we will follow Müller (1999) in assuming an animacy constraint, as proposed in (28).

(28)   [animate] > [¬animate]

Hence, phrases denoting animate referents should be realized to the left of phrases denoting inanimate referents.
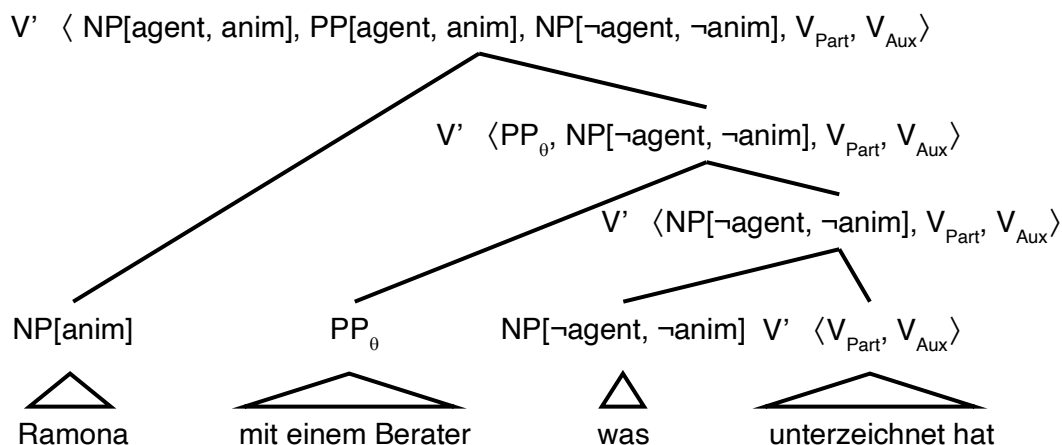Thirdly, we will follow Gazdar et al. (1985) and Müller (1999) in assuming a constraint placing NPs in front of (adverbial) PPs.
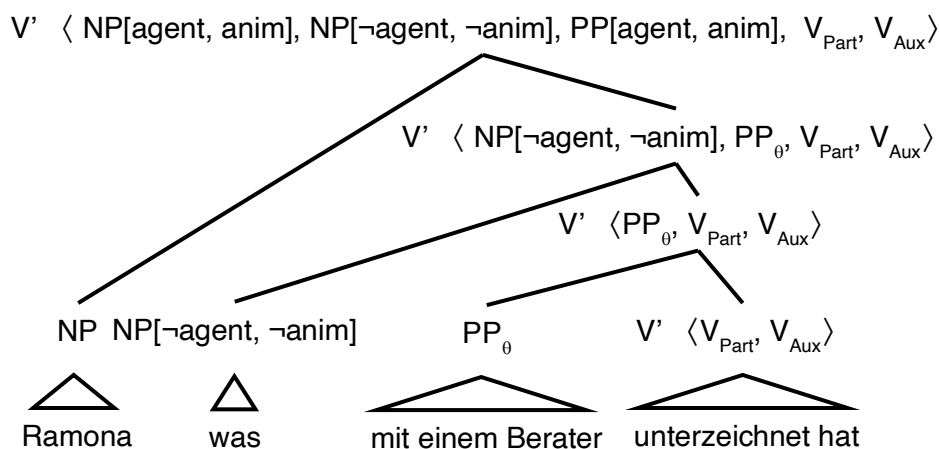
(29)   NP > PP

How are linearization constraints defined in the absence of a movement analysis of scrambling? Previous analyses of German word order in terms of LP constraints suffered from the assumption that LP rules must be applied to local trees (which had immediate impact on phrase structure, see Uszkoreit (1987) as an illustration). We will thus assume that LP constraints apply within the projection of a syntactic head. Hence, phrases contain an ordered (list) representation of their daughters, and LP rules apply to this list. Ideally, all LP rules should be satisfied by the projection of the head. We will, however, see that this cannot always be attained. In such a case, the structure will be chosen that satisfies the largest number of applicable LP rules (see sections 4.4 and 4.5). It follows that more than one structure can be well-formed because all applicable LP rules are satisfied, which implies that we do not have to assume a specific base order for a given structure. Under the well-established assumption of a binary branching German clause structure, ensuing orders on this list are required to be mapped to syntactic prominence.
The application of this idea to subject-oriented affirmative comitatives is illustrated in (30), which extends (22).

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

V'   ⟨ NP[agent, anim], PP[agent, anim], NP[¬agent, ¬anim], V_{Part}, V_{Aux}⟩

      V'   ⟨PP_θ, NP[¬agent, ¬anim], V_{Part}, V_{Aux}⟩

           V'   ⟨NP[¬agent, ¬anim], V_{Part}, V_{Aux}⟩

NP[anim] PP_θ NP[¬agent, ¬anim] V'   ⟨V_{Part}, V_{Aux}⟩

Ramona   mit einem Berater   was   unterzeichnet hat

b. Ramona was mit einem Berater unterzeichnet hat

V'   ⟨ NP[agent, anim], NP[¬agent, ¬anim], PP[agent, anim], V_{Part}, V_{Aux}⟩

      V'   ⟨ NP[¬agent, ¬anim], PP_θ, V_{Part}, V_{Aux}⟩

           V'   ⟨PP_θ, V_{Part}, V_{Aux}⟩

NP NP[¬agent, ¬anim] PP_θ V'   ⟨V_{Part}, V_{Aux}⟩

Ramona   was   mit einem Berater   unterzeichnet hat

The analysis predicts that (30a) should be preferred over (30b), although the suspended variable of the comitative can be identified in both structures.

The specifications for the subject and the comitative in (30) share the features [anim] and [agent], while the indefinite object is specified as [¬anim] and [¬agent].

If we apply all three LP rules to (30), then the first two are satisfied in (30a), while the third one (NP > PP) is violated. In comparison, the first two are violated in (30b), while NP > PP is satisfied. Since (30b) satisfies less constraints than (30a), and there is no comparable structure that satisfies more constraints than (30a), it follows that (30a) is a grammatical structure, and (30b) is not (see also the discussion in section 4.5).

The identification requirement applies equally well to instrumentals, but there is no reason to assume that instrumentals are governed by a meaning postulate identifying thematic roles (in fact, there is no reason to assume an *instrument* role in this analysis of instrumental modifiers, see section 4.4). The identification requirement for the suspended 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). But, as with comitatives, the identification requirement does not suffice to provide an explanation why instrumentals strongly prefer a position to the right of the object, as illustrated in (26). This explanation is provided by the (non-)application of the LP rules in (27) to (29). The order of the indefinite inanimate object and the instrumental PP is not determined by the LP rule (27), because neither bears the role *agent*. And both phrases are inanimate, so that the rule (28) does not discriminate either. The only remaining rule in this setting is (29), which requires the PP to appear after the NP object, which applies to (26b), but not to (26a). It thus follows from the analysis that (26b) is well-formed, but (26a) is not.[21]

4.4 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, as illustrated in (1) and (2). While affirmative comitatives$_{subj}$ strongly prefer the position before the object, privative comitatives$_{subj}$ only slightly prefer a position after the object – a minor preference that may be up to chance, given the range of the 95 % confidence interval. The general tendency for instrumentals, however, remains the same: they prefer a position below the object in affirmative and privative interpretations.

Let us illustrate how these contrasts can be derived if we assume for the moment that privative comitatives do not introduce a 'secondary' thematic role. Since an LP rule dealing with serializations depending on thematic roles does not apply, a privative subject-oriented comitative preceding an (inanimate) object (cf. (31) below) meets the LP rule (28), because a phrase denoting an animate entity is realized in front of a phrase denoting an inanimate one, but it violates the LP rule (29) at the same time, because a PP precedes an NP. If the object precedes the comitatives, rule (29) is obeyed, but rule (28) is violated. There is hence no structure which does not violate one or the other rule, and this condition accounts for the optionality of both serializations. Now consider instrumentals. In the case of the experimental test items, all objects were inanimate, but the complements of instrumentals are prototypically inanimate as well. Hence, it is not only LP rule (27), but also LP rule (28), which does not apply, leaving it to the application of LP rule (29). This rule requires NPs to be serialized to the left of PPs, which accounts for the strong preference of (26b) over (26a).[22]

This line of reasoning of course presumes that we can argue against thematic roles being issued by privative comitatives. Consider the interpretation of the privative comitative in (31).

(31) Monika hatte ohne   einen Kollegen was   getestet.
      Monika had   without a   colleague what.ACC tested
      'Monika tested something without a colleague.'

There is no assertion in (31) that there are *no* colleagues, but only an assertion that there are no colleagues that stand in a comitative relation to *Monika* in *e.* In addition, (31) does not presuppose that there are no colleagues and can thus be continued as in (32).

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[21] The discrepancy between the analyses of (26) and (30) and the findings of section 3 will be taken up in section 4.5.

[22] And if the inanimate object would be substituted by an animate one, the preference for the order OBJ > Instrumental would of course gain even more strength as both (28) and (29) would be violated by the order Instrumental > OBJ.

(32) (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 can thus conclude that privative comitatives neither assert nor presuppose that the restriction of their complement – *Kollege* ('colleague') in (31b) – denotes the empty set. Logically, this can be captured by considering that the appropriate representation of the meaning of (31) – $\neg\exists x$[colleague(x) $\wedge$ comitative(e, m, x)] – is logically equivalent to a universal quantification with negated restriction. We thus assume the representation for the privative comitative in (31) provided in (33).

(33) ohne einen Kollegen: $\lambda z\lambda e\forall x$[colleague(x) $\Rightarrow$ ¬comitative(e, z, x)]

If privative comitatives introduce a universal quantification, which scopes over the *negated* comitative predicate, the lack of an existential presupposition as well as the lack of a negation of an existential presupposition is captured. And since the *comitative* relation is negated, the introduction of a further thematic role is not licensed by the meaning postulate (22), because the comitative relation is in the scope of negation. Without the introduction of an additional agent role, LP rule (27) cannot apply, and we are left with an application of LP rules (28) and (29), one of which is violated in either serialization, thus accounting for the optionality observed in (2a, b).

The analysis is summarized in table 4.

Table 4: Overview of fulfilled constraints in the conditions

Order	Variable Id.	[agent] > [¬agent]	animacy	NP > PP
Comitative$_{obj}$ > OBJ (aff./priv.)	*			*
OBJ > Comitative$_{obj}$ (aff./priv.)	✓			✓
Comitative$_{subj}$ > OBJ (affirmative)	✓	✓	✓	*
OBJ > Comitative$_{subj}$ (affirmative)	✓	*	*	✓
Comitative$_{subj}$ > OBJ (privative)	✓		✓	*
OBJ > Comitative$_{subj}$ (privative)	✓		*	✓
Instrumental> OBJ (affirmative)	✓			*
OBJ > Instrumental (affirmative)	✓			✓
Instrumental > OBJ (privative)	✓			*
OBJ > Instrumental (privative)	✓			✓

4.5   On the discrepancy between judgments and grammar rules

There is a noticeable discrepancy between the probabilities for different serializations based on the acceptability judgments in the experimental studies and an analysis, which makes use of a binary distinction between grammatical and ungrammatical examples. While the gradient nature of acceptability is uncontroversial (Schütze & Sprouse 2013: 46f.), grammaticality is considered to provide binary distinctions. A possible resolution would be to show that the gradient judgments reported in EXP1 and EXP2 are reflections of a gradient nature of grammaticality itself. 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).

Although it would clearly be preferable to eliminate discrepancies between grammatical rules and acceptability judgments, we can only hint at some conclusions drawn from these discrepancies in the present paper, focusing on the distribution of comitatives$_{obj}$ (the same considerations apply to the analysis of comitatives$_{subj}$ and instrumentals), which have been illustrated in (23), repeated here under (34).

(34)   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.'

The present analysis and Frey & Pittner (1998) do not differ in the predicted position(s) of comitatives$_{obj}$, the difference is that the present analysis provides a principled account, based on the semantics of event-internal modifiers and the necessity to identify a suspended individual variable. In case of comitatives$_{obj}$, this condition can only be satisfied if the comitative is realized to the right of the object, because this is the only position which allows an identification of the suspended variable by the object. What is more, a serialization of the form comitative$_{obj}$ > object – as in (34b) – does not only violate the identification requirement, but also the LP rule (29), which requires NPs to appear to the left of PPs. Yet, the model based on EXP 2 assigns a probability of around 20 % for the realization comitative$_{obj}$ > object. 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 the experimental studies did not ask for gradient responses. Given that (34b) violates two grammatical constraints, it is hard to justify that (34b) is a gradient grammatical structure.

A possible explanation for choosing (34b) despite the violations of the identification requirement and an LP rule could be that speakers ignore them, as long as they can make sense out of an (otherwise potentially grammatical) string. Language is a means to convey information, and speakers ignoring grammatical constraints could take examples to be *natural* – which is what we have asked for in the experimental studies to avoid confusion around the term *acceptable* – as long as the relevant information can be derived from the examples. In this case, example (34b) can receive a pragmatic interpretation using semantic hints, which combines the illicit combination with an appropriate interpretation (but ignores compositional semantics).

Let us assume that speakers choosing (34b) are tentatively aware that the comitative cannot be related to the subject for the simple reason that *invitations* are *inanimate,* and hence cannot become co-agents. To make sense of (34b), only one option remains, viz. to relate the comitative to the object despite its position.

Finally, one can view the predictions for the serializations (cf. the experimental results in sections 3.1 and 3.2) from the perspective of the competition between possible constraint sets in Table 4: Both the orders object > instrumental (in both senses of the instrumental) and object > comitative$_{obj}$

have received comparatively high predictions (around 80 %). It holds for both cases that all relevant constraints are satisfied. Now consider the predictions for comitative$_{subj}$ > object in affirmative and privative interpretations: it holds for both cases that there cannot be a serialization of arguments and adjuncts that meets *all* constraints. Affirmative comitatives must be realized before the object due to the application of the LP rule [agent] > [¬agent] (27) and of the LP rule [animate] > [¬animate] (28), but at the same time violate the LP rule NP > PP (29). The reverse order would, however, violate LP rules (27) and (28). We see this tension to be responsible for the comparatively lower prediction for the serialization comitative$_{subj}$ > object of 69 % (see table 3). Finally, both serializations of privative comitatives with respect to the object will satisfy one constraint at the expense of another one. It should thus not be surprising that the serializations are truly optional. This leads us to the question how much the present analysis has in common with *Optimality Theory* (OT, Legendre et al. 1998; Müller 2015), the latter being the most prominent approach to consider violable constraints. Müller (2015: 875) characterizes optimality-theoretic approaches as imposing the following properties of constraints:

(35) a. Constraints are universal.
      b. Constraints are violable.
      c. Constraints are ranked.
      d. The well-formedness of a linguistic expression cannot solely be determined based on internal properties of the expression.

It is obvious that the present analysis assumes partial constraint violation (35b) and is compliant with competition (35d), as is witnessed in table 4. Privative comitatives$_{subj}$ allow two different serializations where each serialization violates a constraint because there is no structure in which both constraints can be satisfied in parallel. One could argue that their optionality emerges because of a tie in competition. The linear precedence constraints, however, are not ranked, and the analysis also does not assume a non-trivial ranking between the identification requirement and the LP rules. What is more, we have not argued that all constraints are violable. To the contrary, the nature of the identification requirement makes it clear that it must not be violated (despite speaker's choosing examples in which it is). The linear precedence constraints presented here are not ranked either. While we would not assume a non-trivial ranking between the identification requirement and the linear precedence constraints, one could argue for a ranking within the linear precedence constraints.

In section 2, we have discussed that neither focus nor scope provides evidence for a specific base position of *instrumentals,* counter the assumptions made in Frey & Pittner (1998). Let us again consider a verb-second version of Frey & Pittner's example (6a) showing wide scope of an instrumental, as well as a variation of example (10c) showing narrow focus of an instrumental.

(36) a. Otto hatte mit fast   jedem Schraubenzieher mindestens ein Fenster geöffnet.
         Otto had   with almost every   screwdriver   at.least   one window opened
         'Otto had used almost every screwdriver to open at least one window.'
      b. Otto hat mit einem Schraubenzieher eine WOHnungstür   geöffnet.
         Otto has with a   screwdriver   a   apartment.door opened
         'Today, Otto used a screwdriver to open an APARTMENT door.'

The examples in (36) are grammatical, but of course, both violate LP rule (29) and hence should receive an analysis akin to the one for the examples in (26).[23] It should be clear, though, that the examples employed so far (which originated in the test items in EXP 1 and EXP 2) contained event-internal modifiers the objects of which were indefinite NPs, and if objects were *wh*-indefinites, they cannot bear stress. So, neither scope nor focus was at issue in the examples discussed. It is well-known that scope and focus have an effect on word order, and the grammaticality of the examples in (36) shows that LP rules referring to scope and focus outrank the LP rules discussed so far. Example (36a) shows a wide scope interpretation, example (36b) shows a narrow focus interpretation of the event-internal modifier, where stress is indicated through small caps. Frey (2015: 522) discusses the following two LP rules covering scope and focus (see also Jacobs 1988 for the latter):

(37) a. non-focal > focal
      b. scope bearer > scope taker

Clearly, the rules in (37) would outrank the LP rules proposed so far. So, the LP rules meet three of the four criteria for an optionality-theoretic interpretation of the constraints employed (cf. (35)). It is an empirical issue to show that the LP rules are in fact universal and allow different rankings. For an analysis of scope and order in English, we might thus rank (27) higher than (37b), yielding the greater scope potential of English in comparison to German.

There is, however, no necessity to endorse OT because the present analysis assumes *constraint violation* and *competition.* Regarding these properties, Samek-Lodovici (2006: 94) states that „[w]hether UG constraints conflict or not is an empirical issue. If they do, and they do appear to do so, a formally precise theory of their interaction becomes necessary for a proper understanding of grammar …". This does not imply that OT must be chosen. And, OT will not help resolving the issues concerning the concept of grammaticality, as discussed above. Müller (2015: 876) states that *"optimality equals grammaticality",* but we have seen that structures that come out as optimal, such as (30a), receive lower choice proportions in the experimental studies than other structures such as (23a) or (26b), which are optimal as well.

5.   Conclusion

The present analysis of event-internal modifiers in German clause structure derives their position from their semantics, which requires the identification of a suspended variable, and hence an asymmetric c-command relation, and independent linear precedence rules, which refer to the distinction between agentive and non-agentive thematic roles, animacy, and the categorial distinction between NPs and PPs.

It is a crucial aspect of the present proposal that we do not have to rely on specific properties of the class of event-internal modifiers (apart from the requirement to identify their suspended variable, which ultimately derives from the semantics of the modifiers). The linear precedence rules employed here have been proposed independently to deal with the serialization of arguments or

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[23] Recast in terms of *Optimality Theory,* one would not assume an identical analysis because examples of type (36) that would share the same lexical material with (26) were not in the same *Candidate Set* as examples of type (26), since the inclusion of scope and focus leads to differences in interpretation (see Legendre et al. (1998: 258) for different characterizations of *Candidate Sets* in OT).

the serialization of arguments and adjuncts in Uszkoreit (1987), Jacobs (1988), and Frey (2015), among others.

The analysis makes the same predictions for the position of object-oriented comitatives as Frey & Pittner (1998) but derives the predictions from the aforementioned constraints. Empirical evidence makes it clear that a minimal c-command constraint, as proposed by Frey & Pittner (1998) for subject-oriented comitatives and instrumentals, is not warranted. The observed contrasts between these two event-internal adverbials again follow from the proposed analysis.

Proposals employing relative constraints – such as Ernst (1998) and Haider (2000; 2010) – argue for positional freedom in the absence of adverbials of the same class. The empirical evidence gathered in the experimental studies shows that this conclusion is not correct, and that constraints govern the serialization of event-internal modifiers in isolation.

Finally, the analysis of affirmative comitatives can be seen as a touchstone for analyses considering a possible substitution of thematic relations from word order constraints in favour of *case* or *grammatical functions.* Neither an approach based on case, nor an approach based on grammatical functions could account for the fact that affirmative comitatives preferably occupy a position before the object. It is only through the identification of thematic roles that we can provide an explanation why a prepositional modifier may precede a nominal object, which is further corroborated by the different pattern for privative comitatives.

Abbreviations
ACC = accusative, DAT = dative, INF = infinitive

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-23-word-order-constraints

Competing interests
The authors have no competing interests to declare.

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