

# A Corpus-based Perspective on ‘Split Stimuli’ in German

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**Abstract** Experiencer-object verbs are psychological predicates that realise their stimulus argument as their subject in the canonical transitive pattern. In some sentences though, a part of the semantic stimulus is expressed by a phrase external to the subject, often a PP. Such cases have been referred to as ‘split stimuli’ in the literature. We present an explorative corpus-based investigation of split stimuli in German and show that they are quite frequent, that the number of prepositions licensing such readings is surprisingly large, that the PPs involved in them are adjuncts (they are optional and there may be more than one of them), and that verbs differ largely with respect to the number of split stimulus examples with different prepositions. A further semantic annotation study of the subjects of the sentences and the internal arguments of the prepositions suggests that it is unnecessary to postulate the existence of specific ‘split stimulus’ readings of the prepositions, but that the ‘split’ effect arises from an interplay of the semantics of the verbs and well-known interpretations of the prepositions.

**Keyword** split stimuli, experiencer-object verb, psych verb, prepositions, corpus, German

## Introduction

Experiencer-object (EO) verbs are a subclass of so-called ‘psych verbs’, verbs indicating the psychological state of an experiencer. Being a semantically defined class, these verbs have been noted for distinguishable syntactic behaviour in many languages (see Landau 2010 for a crosslinguistic overview of such peculiarities and an influential analysis), although this view is not without its challenges (Grafmiller, 2013; Żychliński, 2016). This paper will concern itself only with German psych verbs that realise their experiencer argument as the (accusative or dative) object and that have a subject that refers to the semantic stimulus of the psychological state, i.e. the *preoccupare*- and the *piacere*-class in Belletti and Rizzi’s (1988) famous three-fold subclassification. (1a)<sup>1</sup> is an example of a sentence containing an EO verb with an accusative object (*bezaubern* ‘to charm’), (1b) an example of a sentence with a dative-object EO verb (*behagen* ‘to please’).

(1) a. Die Aura der Stararchitekten bezaubert neuerdings die  
 the aura the.GEN<sup>2</sup> star.architects.GEN charms recently the  
 Welt.  
 world  
 ‘The aura of star architects recently charms the whole world.’

b. Ihr behagen schwierige Strecken wie in Altenmark.  
 her.DAT please difficult.NOM courses.NOM like in Altenmark  
 ‘She is comfortable with difficult courses like the one in Altenmark.’

In both cases, the stimulus argument is realised as the subject. Besides this characteristic, EO verbs are known to license a phenomenon that is referred to as ‘split stimulus’ in the literature (Engelberg, 2015; Hirsch, 2018; Temme, 2018). There, the semantic stimulus appears to be ‘split up’ syntactically between the subject and another element, usually a prepositional phrase as in both examples in (2)<sup>3</sup>. We will use this catchy term as well, but our investigation will show that it should not be taken too literally.

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<sup>1</sup> If not stated otherwise, all examples cited in this paper stem from GerEO (Poppek et al. 2022).

<sup>2</sup> We generally follow Leipzig glossing rules with the addition of PTV for the verbal particle.

<sup>3</sup> A note on glossing (and translating) prepositions: Since they are often highly polysemous, there are many possible translations in most cases. Usually, one chooses a translation that covers a similar range of meanings. Since we mostly deal with very specific meanings here, we do not always choose the most usual translation, but the translation that fits the meaning at hand here best. So, we e.g. gloss *an* as ‘about’ (as in *What I like about Anne is that...*), not ‘at’.

- (2) a. [...] Mit « Life on a String » hat [...] Chen Kaige vor zweieinhalb  
 with Life on a String has Chen Kaige ago two.and.a.half  
 Jahren das Publikum beeindruckt.  
 years the audience impressed  
 ‘Two and a half years ago, Chen Kaige impressed the audience with “Life on  
 a String”’
- b. Nicht nur nervt das Programm durch Inkompatibilitäten und  
 not only annoys the program through incompatibilities and  
 Systemabstürze [...] system.crashes  
 ‘The program not only annoys through incompatibilities and system  
 crashes [...]’

In the literature, the phenomenon has been discussed in the context of different phenomena: alternations (e.g., Levin, 1993; van Oosten, 1984), causation (e.g., Bott & Solstad, 2021; Rapp, 2001), and psych verbs in general (e.g., Hirsch, 2018; Klimek & Rozwadowska, 2004; Temme, 2018). To our knowledge, the only work explicitly providing a corpus-based perspective on split stimuli is (Engelberg, 2015). However, with GerEO (Poppek et al., 2022) we have access to a much more exhaustive database than this previous work which will lead us to a different view.

A subclass of split stimuli is discussed in work on English argument structure alternations (Levin, 1993; van Oosten, 1984), namely the ones with a PP headed by *with* whose internal argument expresses an attribute or activity of the subject referent (van Oosten additionally demands that the PP contain a possessive that is co-referential with the subject as in *The kitten amused me with her antics* (1984, p. 182)). Both authors compare such sentences to corresponding sentences in which the attribute or activity and the possessive phrase are realised in the same NP (*The kitten’s antics amused me* (ibid.)). Van Oosten elaborates on differences between these variants, highlighting agentivity (which she takes to be gradable) and topichood.

In research on causativity, some split stimuli are discussed from a different perspective. It is a common feature of the analyses of Rapp (2001) and Bott and Solstad (2021) that they take (a subclass of) EO verbs to be semantically causative, where the subject need not express the whole cause. Rapp demands only that the syntactic stimulus argument has some relation to an unspecified causing primary eventuality (‘Primärvorgang’), Bott and Solstad take stimuli to be semantically propositional. They treat *durch* ‘through’ as having a causative reading, so that in an example with an individual as the subject, the PP fills the semantic gap. According to Rapp, the internal argument of a PP headed by *mit* ‘with’ or *durch* ‘through’ in such cases indicates the primary eventuality left unspecified by the subject (p. 256). Rapp explicitly excludes cases in which the PP names a property of the subject (p. 280).

In the literature on psych verbs, Klimek and Rozwadowska (2004) propose an analysis for a similar construction in Polish in which an NP marked instrumental is used instead of a PP. According to them, the subject of EO verbs starts of as an

internal argument of the verb. It is taken to be a PossessorPhrase with a possessor as its specifier and an attribute as its complement. When the possessor is moved to subject position, the attribute may stay *in situ* and receive instrumental case (alternatively, the whole phrase may move). Because a causer interpretation evolves only after raising, the part that remains VP-internal is interpreted as an object of emotion. Against this, Żychliński (2016 chapter 3.4) argues that the relevant phrases are adjuncts. Hirsch (2018, pp. 165–168), however, takes up the empirical claim about the interpretation of the second part and states that in German split stimulus PPs with *mit* ‘with’ and *durch* ‘through’ indicate the subject matter (a subtype of object of emotion, cf. (Pesetsky, 1995)) of the psychological state of the experiencer. This leads him to the claim that verbs whose subject argument already must indicate the subject matter should not co-occur with split stimulus PPs. Here, alleged facts about split stimuli are used to investigate the selectional restrictions certain verbs impose on their arguments, and ultimately to argue for a subclassification of EO verbs. In a similar way, Temme (2018, pp. 130–132) argues that stimuli that denote facts may not split. As both claims are negative in nature, they lend themselves to corpus investigations and in fact they turn out to be incorrect.

The only work known to us to deal with the topic in German from a corpus-based perspective is Engelberg (2015). Based on verb profiles for 11 verbs and a pattern search on a larger corpus, he shows that verbs differ largely in how often they co-occur with specific stimulus-indicating prepositions. Regarding the differences between the prepositions, he sees a tendency towards eventive states of affairs with *mit* ‘with’ and *durch* ‘through’ (the former, but not the latter often leading to agentive interpretations with animate subjects), and states that *an* ‘about’ and *bei* ‘about’ introduce a topic-comment structure: The topic is introduced in the PP, of which the subject names a property.

Since previous research except for Engelberg’s was not primarily focused on the phenomenon, a limited perspective is not surprising, where only a small set of prepositions is considered (almost always *mit* ‘with’ and *durch* ‘through’, Temme’s (2018) work is an exception) and sometimes illustrated with a tightly delimited set of examples. We will approach the phenomenon in an explorative way based on corpus data, trying to cave out some general distributional characteristics of the different prepositions and verbs as well as semantic differences between the prepositions. Based on this, we will emphasize the insight from the literature on causation cited above: A ‘split stimulus’ reading arises when the PP fills a semantic gap the verb meaning provides.

## Database for Distributional Analysis

The basis of our corpus study is GerEO, a large publicly available resource on the syntactic distribution of German EO verbs and several of their semantic and syntactic properties (see Masloch et al., 2021; Poppek et al., 2022). This data has been

enhanced with additional annotations on the semantic nature of the internal and external arguments of the prepositions.<sup>4</sup>

GerEO contains a total of over 10,000 annotated examples for 64 German EO verbs (up to 200 per verb), annotated by three native speakers of German for syntactic pattern, semantic type of the stimulus, stimulus PP (if present) and further factors. Of the 64 verbs, 16 select a dative, 48 an accusative object. Since the presence of a stimulus PP was already included in the basic GerEO annotations, we extracted the relevant subset for this corpus study from the existing database.

Since our investigation is restricted to PPs that function as a part of a split stimulus, we limited the database for the present study to syntactic patterns where the PP occurs in addition to an overt stimulus subject. The main patterns in GerEO that qualify for this are the prototypical transitive construction of an EO verb with an overt experiencer object (as in the above example (2a)) and an intransitive variant that many of the candidate verbs in the database license (as in (2b)). The latter can be described as an ‘object drop’ variant where the experiencer argument is not overtly realised but receives an arbitrary interpretation.

The subset of GerEO containing only sentences in one of these patterns for which a stimulus PP was annotated contains a total of 780 examples. This data set will now be used to investigate some general distributional properties of split stimuli, mainly the general distribution of different PPs with respect to the verb, before we take a closer look at the different prepositions in the following sections.

## The Big Picture

Figure 1 depicts the counts for each preposition in a reading that could be taken to indicate a part of the stimulus of the two syntactic patterns.

It already leads us to several observations. First and foremost, we see that split stimuli are by no means rare. In contrast to Engelberg’s (2015) claim that only a small number of EO verbs accounts for most split stimulus constructions, we found that the vast majority of all investigated verbs displays occurrences of stimulus PPs. Yet, the quantitative distribution of prepositions differs per verb and some verbs do not co-occur with an additional stimulus PP at all, with no apparent disproportion towards accusative or dative object EO verbs. We also found a limited number of examples where more than one stimulus PP is realised such as (3).

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<sup>4</sup> The original GerEO data by Poppek et al. (2022) is available via [https://github.com/Linguistic-Data-Science-Lab/German\\_EO\\_verbs](https://github.com/Linguistic-Data-Science-Lab/German_EO_verbs). The semantic annotations as well as the annotation guidelines and the script used to generate the figures in this document are available via [https://osf.io/57xnh/?view\\_only=a47f49b647084d7abc680c345a73b5ef](https://osf.io/57xnh/?view_only=a47f49b647084d7abc680c345a73b5ef).

- (3) [...] seine Leistung, mit der er besonders durch die ganz engen  
 his performance with which he especially through the very tight  
 Wendungen zwischen den ersten Hindernissen verblüffte.  
 turns between the first obstacles baffled  
 ‘[...] his performance, with which he amazed [everyone] especially by the  
 very tight turns he took between the first obstacles’

There is more than one stimulus PP in about 3.5 % of the examples. In some cases, even the same preposition is used twice. In combination with the obvious optionality of these PPs, it is a strong reason to analyse them as adjuncts, which implies that split stimuli are not split in a strictly syntactic sense.

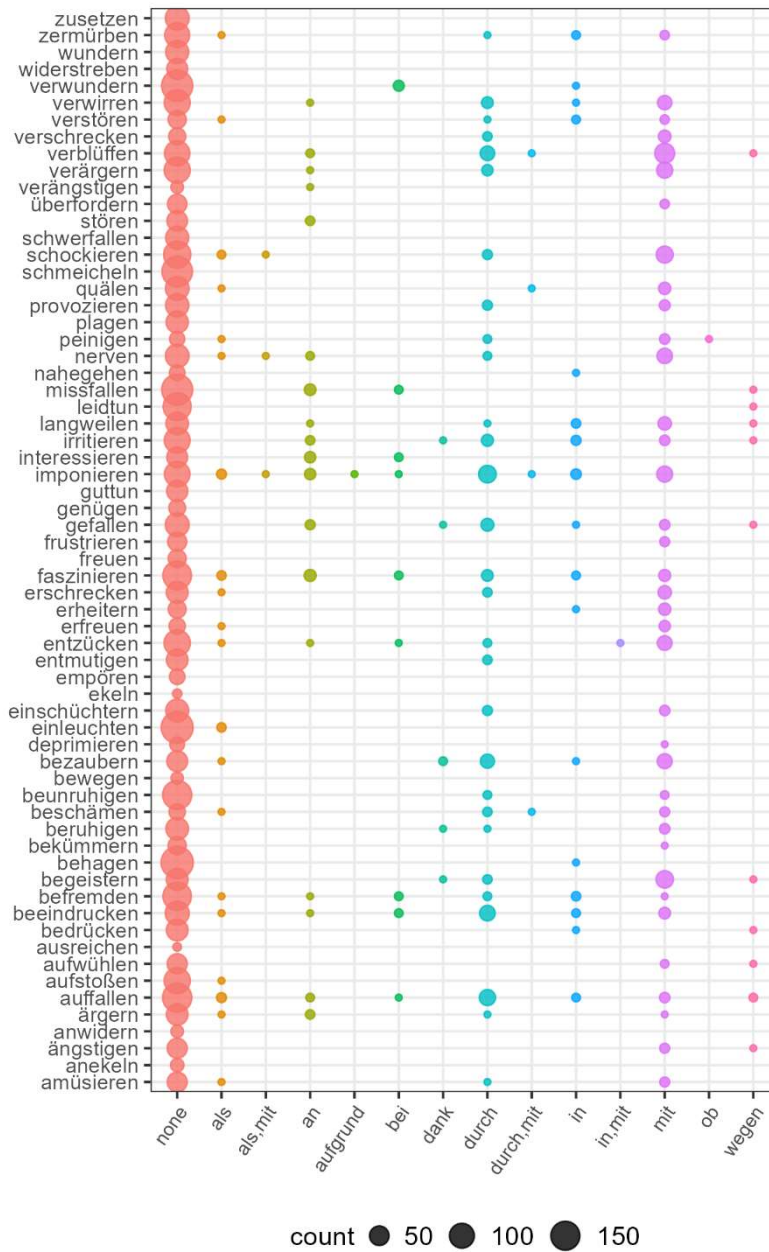
We see that *mit* ‘with’ and *durch* ‘through’ are by far the most frequent prepositions used to express a part of a stimulus in our dataset and that the other prepositions also differ in frequency.

Besides this distributional information, the corpus data further identified several prepositions that were not previously discussed in the context of split stimuli in the literature, including prepositions with a prominent causal reading, viz. *aufgrund* ‘based on’, *dank* ‘thanks to’, *ob* ‘due to’, and *wegen* ‘because of’, as in (4) and (5).

- (4) Lange Schlechtwetterperioden bedrücken ihn der  
 long spells.of.bad.weather depress him the.GEN  
 Frequenzausfälle wegen.  
 frequency.breakdowns due.to  
 ‘Long spells of bad weather depress him because of the frequency  
 breakdowns’
- (5) Dank ihrer Kleinwüchsigkeit und ungewohnten Blütenformen  
 Thanks.to their.3SG small.size and unusual flower.shapes  
 bezaubern sie den Gartenliebhaber.  
 charm they.3SG the garden.lover.  
 ‘Thanks to their small growing size and unusual flower shapes, they charm the  
 garden lover’.

Other prepositions that are used to express part of a stimulus are: *als* ‘as’, *an* ‘about’, *bei* ‘about’ and *in* ‘in’.

**Fig 1 Examples with Stimulus PPs (transitive or intransitive pattern in GerEO) <sup>5</sup>**



## Semantic Annotation

To investigate the semantic conditions that license split stimuli (or rather the use of the respective prepositions), we enriched the data with annotations on the semantics of the subject and the internal argument of the preposition. These annotations are used to detect regular patterns between subject and internal argument of the preposition.

For the annotation, we used the rather coarse-grained semantic categories from the Cislex project (Langer, 2009) with some modifications, namely the addition of the additional categories *abstract\_obj*, *anim\_proxy*, *event(action)* and *ambiguous*. Table 1 provides an overview of the categories used, for a more detailed description, see Langer (2009, p. 79 sqq.); the German terms in brackets are the ones Langer uses.

In general, we agree with Langer’s statement that ‘abstract object’ does not constitute a particularly useful category since it lumps together things that are better kept apart (cf. e.g. Husić, 2020), but in the absence of a more appropriate classification, we consider it more informative than clustering all non-event non-concrete nouns in one category as *misc*. *Anim\_proxy* is a term adapted from GerEO (see Masloch et al., 2021, p. 14 sq.). We use it because institutions etc. seem to behave like animate beings with respect to the semantic selection criteria imposed by EO verbs. *Event(action)* is used because we expect that the internal argument of certain prepositions (e.g., *mit* ‘with’) often denotes an action performed by the subject (Engelberg, 2015; van Oosten, 1984), and we thus want to be able to distinguish actions from generic events. Sometimes there is a notable shift in meaning enforced by the sentence context (including the P) for the P’s internal argument, thus we annotated the meaning of the internal argument in the sentence context as a separate feature. ‘Meaning of the internal argument in the sentence context’ is to be taken as a purely descriptive characterisation here. An example is (6):

- (6) Sie bezaubert mit Noten von getrockneten Früchten [...]  
 3SG.F enchants with notes of dried fruits  
 ‘It enchants with notes of dried fruits’

Here, the subject obviously refers to an individual or a substance (probably a drink) and the PP expresses in this context that it has the *property* of having those notes.

In addition, we annotated two features of the determiner of the PP’s internal argument: Is it missing although it would otherwise be expected? Is it a possessive coreferential with the subject? The latter is a defining feature of van Oosten’s (1984, p. 186) Psychological-Property-Factoring Sentences. We noticed at the

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<sup>5</sup> A detailed numerical table for every verb (including glosses) can be found in the appendix.



very beginning of the annotation that the former happens quite often. It will play a decisive role in our analysis of *als* ‘as’ in the section *Individual Prepositions*.

We thus annotated the following features:

1. The semantic class of the subject.
2. The semantic class of the head noun of the internal argument of the PP
3. The semantic class of the internal argument of the PP in context.
4. Special features of the determiner of the PP’s internal argument (unexpectedly missing / possessive coreferential with subject)

If the noun was ambiguous and could plausibly be assigned to more than one of the categories, we annotated the readings salient in context. In contrast, the category *ambiguous* was only used if no specific label could be assigned at all – this was sometimes the case when the NP was a pronoun. If the internal argument of the PP was a coordination, annotations were performed for all conjuncts separately.

The annotation was carried out by two native speakers with linguistic background knowledge and prior involvement in the project. After annotation by one annotator, annotations went through an adjudication stage where both annotators agreed on a final verdict in case of disagreement regarding the classification.

**Table 1.** Annotated Semantic Categories

Category	Comment
Organism (Lebewesen)	Only used if neither human nor animal or plant are applicable
Human (Mensch)	
Animal (Tiere)	
Plant (Pflanzen)	
Anim_proxy	Entity is not strictly speaking animate, but it is a (complex social) entity that is rooted in sentient beings and in certain (relevant) respects acts like an animate being. Typical examples include institutions, organisations etc.
Concrete_obj (Konkreta)	Concrete objects
Abstract_obj	Non-concrete objects that do not fit into one of the other categories
Material (Stoffbezeichnung)	Prototypical mass nouns with substance/material reading
Event (Ereignisse)	Non-agentive event

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Event(action)	All actions
State (Zustand)	
Property (Eigenschaft)	
Temporal (Zeitbezeichnung)	
Form (Form)	shapes
Locative (Lokativa)	Since the test Langer proposes is not very useful, we use the following one: A noun can be considered locative if the NP it is heading may be the subject of <i>liegen</i> 'to lie' in its reading 'be situated'.
Misc (Diversa)	Does not fit in any of the other categories.
Ambiguous	Cannot be assigned a category within the context given.

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## Individual Prepositions

We will now discuss the results of the semantic annotations for individual prepositions.

### *Als 'as'*

To our knowledge, occurrences of *als* 'as' as parts of a split stimulus have not been mentioned in prior research. Figure 2 depicts the semantic annotations for the subject of the sentence (right bar), the internal argument of the preposition (left bar) and its interpretation (middle bar) in all examples containing *als* 'as' that feature only one stimulus PP and no coordination within the internal argument.<sup>6</sup>

It shows us that its internal argument usually refers to a human being or an abstract object, but that it receives a property interpretation in most cases, while the subject may belong to many different semantic categories, but normally is also a human being.

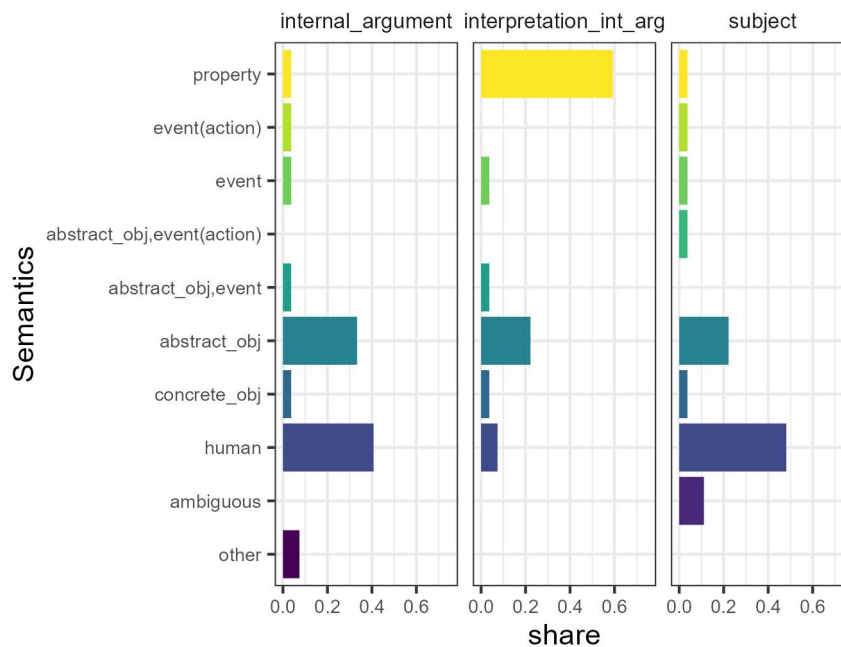
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<sup>6</sup> The same restrictions apply to all similar figures in the following. They are only applied to keep the graphs readable. The number of excluded examples is negligible.

A striking feature of the examples with *als* is that (with one exception) the internal argument of the preposition does not feature a determiner – even if it is headed by a singular count noun as in (7).

- (7) Der Rentner war dem Verkaufspersonal bereits früher als mutmasslicher Ladendieb aufgefallen.  
 the pensioner was the.DAT sales.staff.DAT already earlier as suspected shoplifter noticed  
 ‘The pensioner had already come to the attention of the sales staff as a suspected shoplifter.’

**Fig 2. Semantic classes of both parts of the ‘split stimulus’ with *als***



If we treat *als* as a prepositional copula (cf. e.g., de Swart et al., 2007), this comes as no surprise: The internal argument of the preposition without the determiner is a predicate (type *et*) and thus not in need of a determiner. In the example that contains a determiner we find an identificational use of the preposition.

The reason why *property* is not annotated in every case is that, retrospectively seen, we annotated *property* if on the more prominent reading of the sentence the PP’s predication is the stimulus of the experiencer’s emotion, and what would usually be the class of the head noun of the internal argument if another reading was more prominent. The former reading is, however, possible. In (8), for example, the PP rather names the aspect under which the consideration makes sense.

- (8) Die Rücksichtnahme auf ihre drei Kinder [...] leuchtet als Grund für  
 the consideration for her three children be.evident as reason for  
 die [...] Absage [...] ein  
 the cancellation PTV  
 ‘Consideration for her three children makes sense as a reason for the  
 cancellation.’

(9) is ambiguous between a split stimulus reading and an episodic reading that can be paraphrased as ‘who delighted the masses during the time in which he was a brilliant dribbler’.

- (9) [...] der als genialer Dribbelkünstler die Massen entzückte.  
 who as ingenious dribbling.artist the masses delighted  
 ‘who delighted the masses as a brilliant dribbler.’

We will take this as evidence that the split stimulus reading is not a specific reading of the preposition but arises pragmatically because the EO verb leaves sufficient semantic room: The predicate applied to the subject referent forms a proposition that is a legitimate semantic stimulus<sup>7</sup> of the psychological state indicated<sup>8</sup> by the verb. If the PP does not make other pragmatic sense, it may thus well be identified with it (technically, this may happen via some mechanism along the lines in (Bott & Solstad, 2021, p. 379 sq.)).<sup>9</sup>

A curious case with *als* ‘as’ is (10), where the individual of which something is predicated is already a proposition itself.

- (10) Dass die Bewegung der Himmelskörper exakt zu messen und zu  
 that the movement the.GEN celestial.bodies.GEN exactly to measure and to  
 berechnen sein soll, erschreckt ihn als Beweis der Leblosigkeit  
 compute be shall startles him as proof the.GEN lifelessness.GEN  
 des Weltraums [...]

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<sup>7</sup> We will not go into the details here, but probably different kinds of stimuli have to be distinguished (cf. Pesetsky, 1995).

<sup>8</sup> We do not say ‘denoted’ because it is well conceivable that a verb does not denote the state itself but e.g. only its onset (as claimed for a class of Spanish reflexive marked experiencer-subject verbs by Marín and McNally (2011)).

<sup>9</sup> In its essence, this is very similar to the analysis from (Bott & Solstad, 2021). However, we do not want to claim that the stimulus argument of EO verbs always is underlyingly propositional (for the analysis to work, it is already enough to assume that it *may* be propositional with some of the verbs). We also want to further downplay the role of causation (as also emphasised by Bott & Solstad): The stimulus need not cause the psychological state with all verbs and the stimulus PP need not be causal (as in the case of *als* here).

the.GEN space.GEN

‘The fact that the movement of celestial bodies is to be measured and calculated exactly startles him as proof of the lifelessness of space’

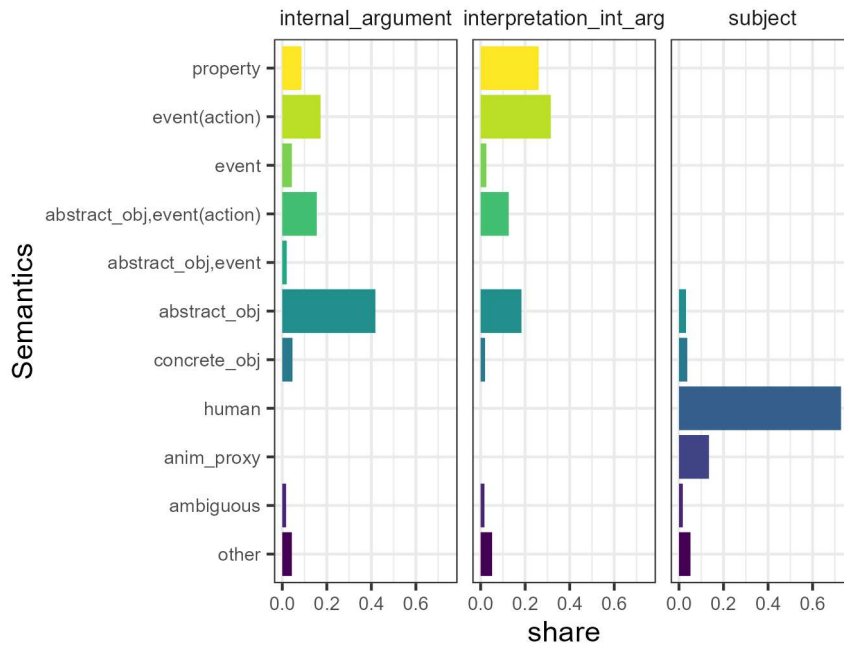
### **Mit ‘with’**

The semantic classes annotated for *mit* ‘with’ are depicted in Figure 3. It is remarkable that the subject always refers to an individual entity here, which in some cases may be abstract. In our dataset, it is mostly a human being, but it may also be some other kind of object or even an event or action.

The internal argument of the PP usually names a property of that individual, an action it performs, or an event related to it. Even if the noun does not typically have a property reading, it often is interpreted as such in these PPs. The many abstract objects here are most often related to utterances or (parts of) pieces of art as in (11). As such, they can be argued to invoke a certain action of the individual (although some examples also allow an instrumental reading of the PP).

- (11) Mit dem Slogan [...] entzückte er [...] seine Anhänger [...]  
 with the slogan delighted he his followers  
 ‘He delighted his followers with the slogan’

If the subject is not animate (or *anim\_proxy*), the PP will almost always be interpreted as naming a property (as in (12)).

**Fig 3. Semantic classes with *mit***

- (12) Der [...] Reihenvierzylinder imponiert mit bulliger Leistungsabgabe.  
 the inline.four.cylinder impresses with beefy power.output  
 ‘The inline-four engine impresses with its beefy output.’

As with *als* ‘as’, we need not postulate the existence of a specific split stimulus reading, but we can relate the examples to established readings of *mit*, as listed in Kiss et al.’s (2020) handbook of German preposition senses, namely a medial reading (covering many actions, reading 2c in (Kiss et al., 2020)), a modal reading specifying a process (which despite its name fits many property interpretations, 2e), a concomitant reading (also covers many property examples, 2f), the causal reading (3a), and an involvement reading (6c).

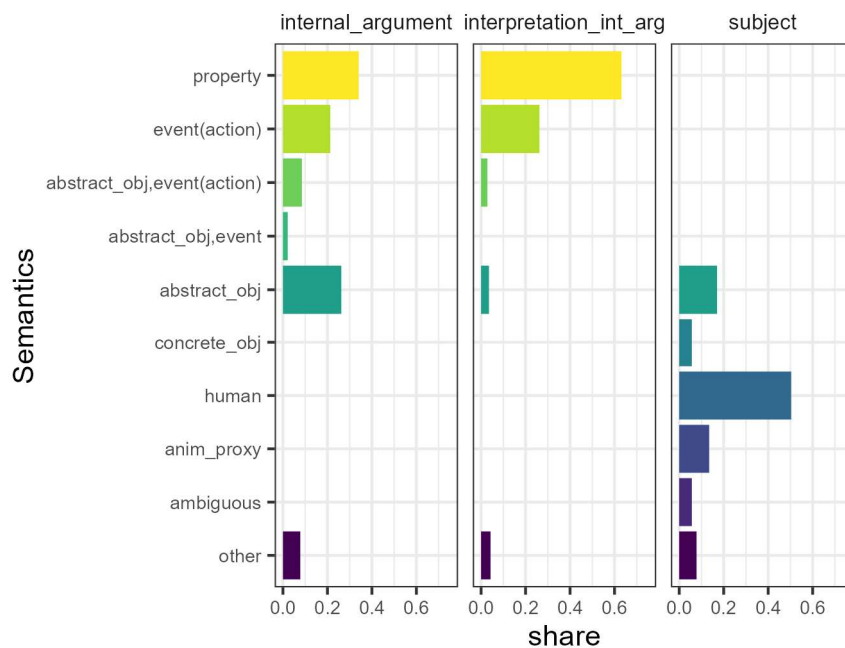
Of course, in contrast to *als*, *mit* does not introduce a predication; but often its external argument is the subject of the sentence, or its internal argument introduces an eventuality and the subject is identified with a participant in it (cf. also Rapp, 2001). The semantic relation thus established may then be identified as the stimulus pragmatically.

### *Durch* ‘through’

As can be seen in Figure 4, *durch* ‘through’ behaves similarly to *mit* ‘with’ with respect to the features we annotated. This is not surprising since it shares the relevant readings (namely medial, modal, and causal) and has been analysed to particularly contribute additional information in the causal relation expressed by the predicate (Solstad, 2007). Quantitatively, the subject has a milder tendency towards human and a stronger towards abstract and concrete objects. The PP readings lean more clearly towards properties (as in (13), although it is also used with actions (as in (14)).

- (13) Der Spanier beeindruckte auf einer Strecke [...] durch Eleganz  
 the Spaniard impressed on a track through elegance  
 und Leichtigkeit [...] and lightness  
 ‘The Spaniard impressed on a track through elegance and lightness’

**Fig 4. Semantic classes with *durch***



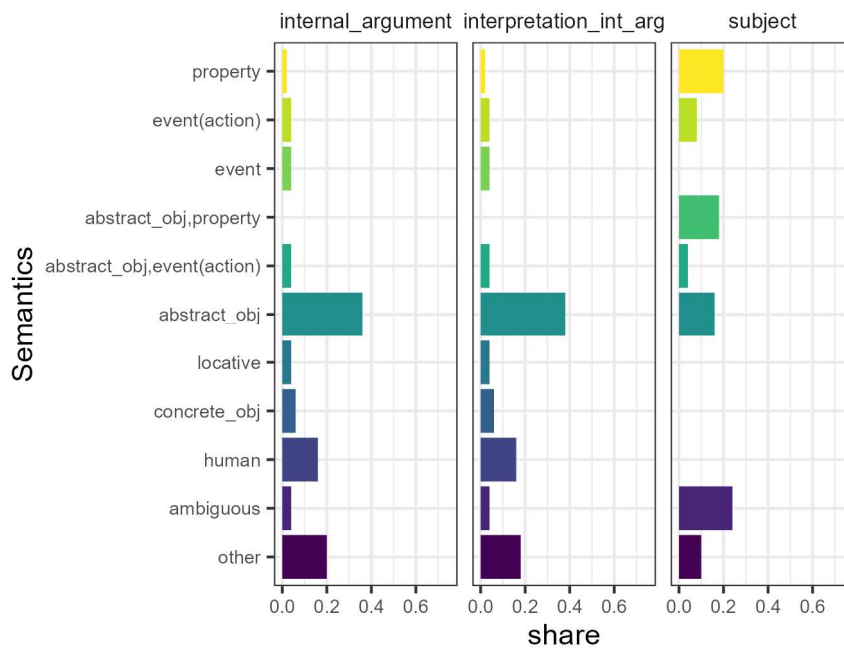
- (14) Deutsche Fernsehanstalten hätten durch falsche Berichterstattung  
 German television.stations have.SBJV through false reporting

die Touristen eingeschüchtert.  
 the tourists intimidated  
 ‘German television stations had intimidated the tourists through false reporting.’

### **An ‘about’**

Figure 5 illustrates that *an* ‘about’ is much more liberal with respect to its internal argument than the other prepositions we looked at. In contrast, subject choice is more restricted. The element in the PP names an individual and the subject the aspect of that individual that leads to the psychological state of the experiencer. This will usually be a property, but it can also be an action or a specific part. Descriptively, we often find a reversed version of the pattern we find with the other prepositions with *an*: in many cases, the subject is interpreted as a property only in context, as in (15).

**Fig 5. Semantic classes with *an***



(15) An Berlusconi imponiert ihnen der Machertyp, an Fini die  
 about Berlusconi impresses them the maker.type about Fini the



Zurückhaltung.

restraint

‘What impresses them about Berlusconi is his “can-do-attitude”, about Fini, it is his restraint.’

The high number of ambiguous subjects is rooted in examples like (16):

- (16) [...] aber es bleibt dabei unklar, was ihn an dem Stück wirklich interessiert.  
 but it remains at.this unclear what him about the play really interests  
 interests  
 ‘But what really interests him about the play remains unclear.’

Actually, in nearly half of all examples with *an*, the subject is *was* ‘what’, sometimes also as an interrogative. The number of ambiguous subjects is lower because we resolved anaphoric dependencies during annotation, which was possible because in many of the examples a construction like *what V-s experiencer an X, is Z* is used.

We can relate this use of *an* to the reading ‘point of reference’ in Kiss et al. (2020, p. 25). Engelberg (2015, p. 475) notes that in examples with *an*, the stimulus is split up in a topic and a comment part. These are pragmatic notions, of course. We will assume that points of reference occur as topics naturally.

## Other Prepositions

We refrain making claims about the remaining prepositions due to the limited range of data in the current database. As noted above, some of them are clearly clausal (*dank, wegen, aufgrund, ob*).

*Bei* ‘about’ seems to behave like *an* ‘about’ (see also Engelberg, 2015, p. 475). An interesting case is *in* ‘in’: While there are examples that are obviously related to spatial readings (or rather: that display spatial readings and can nevertheless be interpreted as forming a part of the stimulus) like (17), we also find examples in which the subject is an individual and the internal argument of the preposition names a property of it – often it even has a determiner which is coreferential with the subject, as in (18). These are hard to relate to an established reading of *in* and resemble many of the examples with *an* and *durch* closely.

- (17) [...] bezaubern im Zugerland die nuancierten Farbtöne.  
 enchant in.the Zug.country the nuanced hues  
 ‘the nuanced hues in the area around Zug are enchanting’

- (18) Crewdson c-prints verstören in ihrer detail-genauen Künstlichkeit.  
 Crewdson.GEN c-prints disturb in their detail-exact artificiality  
 ‘Crewdson's c-prints are disturbing in their minutely detailed artificiality.’

## Reviewing ‘Split Stimuli’

Investigating the behaviour of individual prepositions, we have observed that their readings in ‘split stimuli’ examples can be related to independently established and well-known readings of the prepositions involved. We have also seen that split stimuli PPs are adjuncts. To explain what happens in split stimuli examples, we followed Bott and Solstad (2021) in assuming that the effect arises from an interaction of the semantics of the verb and the meaning of the PP. The semantic stimulus of the psychological state of the experiencer may (for Bott and Solstad: *must*) be propositional, but it need not be syntactically clausal. Other elements in the clause can then be interpreted to provide the ‘missing’ information in accordance with the semantic space left by the verb. As shown by the fact that there can be more than one stimulus PP, this can be more than one element.

We remain agnostic about the precise nature of the stimuli with EO verbs because we consider this particular area beyond the scope of the study and still under-researched, despite some important contributions (e.g. Pesetsky, 1995; Reinhart, 2003). In the literature, split stimuli have sometimes been used to argue for certain selectional restrictions that the verbs impose on their stimuli. In general, this is an insightful idea, but, from the perspective of our data, previous premises about split stimuli in research in that direction appear incorrect.

Hirsch (2018, p. 168 sqq.), for example, argues for a subclassification of accusative-object EO verbs. One subclass is considered aspectually stative and has a subject that refers to the subject matter of the emotion (instead of a mere causer). He assumes that verbs of this class (among them *wundern* ‘to wonder’ and *freuen* ‘to please’, which actually do not occur with split stimuli in our data, cf. Figure 1) are incompatible with split stimulus PPs with *mit* and *durch* because these indicate a subject matter, which is already indicated by the subject. However, while this seems plausible for (11) and (12), it is not the case with (19). The owner’s fear need not be directed towards the lightning start, the perpetrator, or the perpetrator doing a lightning start, it is enough that the perpetrator doing the lightning start caused it.

- (19) [...] wo der Täter [...] sich in einen fremden Wagen setzte,  
 where the perpetrator REFL in a someone.else’s car sat.down  
 der gerade aufgetankt wurde - mit einem Blitzstart ängstigte er  
 that just fuelled was with a lightning.start frightened he  
 nicht nur den Besitzer, sondern riss auch den Zapfschlauch aus dem  
 not only the owner but ripped also the petrol.hose out.of the  
 Einfüllstutzen.

filler.neck

‘[...] where the perpetrator [...] sat down in someone else's car that was being refuelled - with a lightning start he not only frightened the owner, but also ripped the petrol hose out of the filler neck.’

Temme (2018) states that factive stimuli may not split due to their different embedding relation while our data revealed that factive stimuli may in fact split, although it happens only rarely:

- (20) Was mich am Lötischberg [...] ärgert, ist, dass man sich der  
 what me about.the Lötischberg annoys is that one REFL the.GEN  
 Gefahr des noch grösser werdenden Röstigrabens bedient,  
 danger.GEN the.GEN even bigger becoming Röstigraben.GEN employs  
 um uns den Lötischberg schmackhaft zu machen [...]  
 in.order.to us.DAT the.ACC Lötischberg.ACC tasty to make  
 ‘What annoys me about the Lötischberg (tunnel) is that they are using the danger of an ever-growing Röstigraben to make the Lötischberg palatable to us.’

Temme's hypothesis might be based on her interpretation of split cases mostly as property-bearer relations while our data has shown the semantic variations on this matter are considerably greater and allow for several semantic relations between the elements.

Research on alternations in English has investigated the properties of some exemplars of English ‘split stimuli’ and contrasted them to examples in which both parts form the subject of the sentence together (Levin, 1993; van Oosten, 1984). While the information-structural and pragmatic factors discussed in this kind of research certainly play a role, we would like to emphasise the grammatical independence of the variants (without implying that they would deny it). Sometimes, a ‘split’ may be necessary for purely grammatical reasons: E.g. the German indefinite pronoun *man* ‘one’ does not have a genitive form, so it could not form a subject together with its ‘split’ counterpart. A non-split variant of (21a) thus does not exist.<sup>10</sup>

- (21) a. Da fällt man mit fremdländischem Esswerkzeug natürlich auf.  
 There strikes one with foreign eating.utensils naturally PRT  
 ‘Of course, you stand out with foreign eating utensils.’  
 b. \*Da fällt mans/eines fremdländische Esswerkzeug natürlich auf.

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<sup>10</sup> This example is rather special in that the preposition's internal argument refers to a concrete object. The most natural interpretation is ‘as someone who has/uses foreign eating utensils’, but this issue is orthogonal to one at hand.

## Conclusion and Further Perspectives

Our distributional study illustrated that the phenomenon of the semantic stimulus dispersing over several constituents is not a rare one in German and that taking this supposed ‘split’ to be syntactic is not feasible. Rather, the relevant PPs are adjuncts.

We showed that various prepositions display different semantic restrictions on their internal argument and subject and we suggested that the ‘split stimulus’ effect arises from the interplay of a semantic gap left open by the verb and regular readings of the prepositions, following similar considerations by Bott and Solstad (2021).

Nevertheless, our analysis leaves open questions for further work. The first question is concerned with the precise semantics of the prepositions involved, a problem we only hinted at. This particularly applies to the exact readings involved in ‘split stimulus’ examples, but also to the precise semantic differences between prepositions occurring in similar configurations (*mit, durch; an, bei*).

Another aspect beyond the scope of this article is the question of differences between the verbs. It is an interesting idea to use (distributional) data on the availability of (certain kinds) of split stimuli to investigate the selectional restrictions the verbs impose on their subjects (Hirsch, 2018; Temme, 2018), but to get meaningful results in this direction, corpus data has to be augmented with (experimental) acceptability judgment data, which may establish negative evidence.

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[to be filled in final version]

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## Appendix

**Table 2.** Overall Distribution

	none	als	als,mit	an	aufgrund	bei	dank	durch	durch,mit	in	in,mit	mit	ob	wegen
<i>amüsieren</i> 'amuse'	53	1	0	0	0	0	0	1	0	0	0	4	0	0
<i>anekeln</i> 'sicken'	14	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>ängstigen</i> 'frighten'	54	0	0	0	0	0	0	0	0	0	0	4	0	1
<i>anwidern</i> 'disgust'	11	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>ärgern</i> 'anger'	67	1	0	3	0	0	0	1	0	0	0	1	0	0
<i>auffallen</i> 'strike'	154	4	0	2	0	1	0	27	0	2	0	5	0	2
<i>aufstoßen</i> 'strike (neg.)'	114	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>aufwühlen</i> 'stir up'	54	0	0	0	0	0	0	0	0	0	0	2	0	1
<i>ausreichen</i> 'suffice'	2	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>bedrücken</i> 'distress'	68	0	0	0	0	0	0	0	0	1	0	0	0	1
<i>beeindrucken</i> 'impress'	91	1	0	1	0	2	0	24	0	2	0	8	0	0
<i>befremden</i> 'alienate'	143	1	0	1	0	2	0	2	0	3	0	1	0	0
<i>begeistern</i> 'thrill, enthuse'	69	0	0	0	0	0	1	3	0	0	0	35	0	1
<i>behagen</i> 'please'	197	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>bekümmern</i> 'concern'	40	0	0	0	0	0	0	0	0	0	0	1	0	0
<i>beruhigen</i> 'calm'	76	0	0	0	0	0	1	1	0	0	0	5	0	0
<i>beschämen</i> 'shame'	28	1	0	0	0	0	0	3	1	0	0	4	0	0



