Towards Verb Modification in Frames
A Case Study on German *Schlagen* (to hit)

Anja Goldschmidt[1]([✉]), Thomas Gamerschlag[2], Wiebke Petersen[3],
Ekaterina Gabrovska[2], and Wilhelm Geuder[2]

[1] UiL OTS, Utrecht University, Utrecht, The Netherlands
`A.Goldschmidt@uu.nl`
[2] CRC 991, Heinrich Heine University Düsseldorf, Düsseldorf, Germany
[3] Department of Linguistics and Information Science,
Heinrich Heine University Düsseldorf, Düsseldorf, Germany

Abstract. *Hit*-verbs have three basic meaning components, namely movement, contact and force (e.g. [12], Levin 1993), which interact with the verbs' argument structure in various ways. In this paper, we map out the different grammatical constructions of the German verb *schlagen* (usually, though loosely, translated as 'hit'; also 'beat', 'strike') and their restrictions on agentivity and the force component. Using modification by pure manner adverbs as a tool to test for possible default values of the force component, and agent-oriented adverbs to discover possible interactions with agentivity, we show that German *schlagen* is rather liberal with respect to its force component. Crucially, the force component may not only be modified by standard, force-denoting manner adverbs such as *lightly* and *hard*, but also through agent-oriented adverbs such as *playfully*, via a defeasible inference. We show further that our findings can be profitably modelled in Frame Semantics, a framework which is especially well suited for modelling a fine-grained decomposition of word meaning, including the manner-related components of verbs.

Keywords: Hit-verbs · Modification · Force · Agentivity · Frame semantics

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1   Introduction

In the literature on English verb classes, one class has been especially discussed by syntacticians as well as semanticists: 'verbs of contact by impact'. The name of this class of verbs can be traced back at least to Levin (1993) [12], although already Fillmore (1970) [5] discusses the verb *hit* from this perspective. In most of the analyses of *hit*, the meaning components 'motion', 'contact' and 'force' are identified as basic (cf. [12], Levin 1993, [6], Gao and Cheng 2003, among others).

Hit-verbs are described by Levin (1993:150) [12] as involving the movement of one entity leading to contact with another entity. Although Levin does not speak explicitly of a force component associated with these verbs, the choice of the name for the class, 'contact by impact', clearly indicates that she takes the presence of a (high) force to be crucial, especially as there is also a class of 'verbs of contact' ([12], Levin 1993:155f). Furthermore, authors like Erteschik-Shir and Rapoport (2010:59) [4] a.o. use notions like "forceful contact" in analyzing verbs like *hit*. Gao and Cheng (2003:494) [6] also observe that English verbs of contact by impact have a force component which "is specified in all the verbs" as again already indicated by the name of the class. What is more, the authors also state that actions referred to as hitting are characterized by the exertion of high force ([6], Gao and Cheng 2003:494). This force needs a source, which, on a cognitive linguistic view, is typically the agent represented by the subject in English ([10], Kim 2009:46f). Besides the source or the subject, there is also a patient/an object receiving the force, which makes *hit* a standard case of a transitive verb (cf. [10], Kim 2009:50; [5], Fillmore 1970:128).

When looking for 'contact by impact' verbs in German, the most prominent representative is the verb *schlagen*, which is commonly treated as the translational equivalent of *hit*, but may often correspond more closely to English verbs like *beat*, *strike*, *knock*, *deliver a blow* (which are usually neglected in the literature on *hit*). There are five relevant constructional variants of *schlagen* (other variants as intransitive or particle verbs may have additional meaning components or figurative meanings) which can be differentiated (following Geuder and Gabrovska, ms. [7]):

Unaccusative construction: A theme argument (i.e., a moving entity, esp. in ballistic movement) is realized as subject, typically combined with a PP that encodes a target.

(1)   Die Gitarre schlug   gegen   die Tischkante.
        The guitar   hit(PAST) against the edge.of.the.table
        'The guitar hit the edge of the table.'

Agentive-resultative construction: An agent argument is realized as subject co-occurring with an accusative object introducing the theme and a resultative predicate (often a directional PP).

(2)   Er schlug   die Gitarre gegen   die Tischkante
        He hit(PAST) the guitar   against the edge.of.the.table
        'He hit the guitar against the edge of the table.'

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Simple transitive construction: Prototypically an agentive subject plus a patient (i.e. receiver of a blow, frequently animate), realized as accusative object. A transitive construction also occurs with a number of idiomatic meanings which we do not consider here.

(3)   Wenn ein Bauer   einen   Esel   hat, dann schlägt er   ihn
      If   a   farmer a.ACC donkey has then beats   he him
      'If a farmer has a donkey, then he beats it.'

Agentive oblique construction: Agentive subject, with adverbial goal complement (mostly PP).

(4)   Er schlug   (mit der Faust) auf den Tisch.
      He hit(PAST) with the fist   on the table
      'He hit the table (with his fist).'

Double complement construction: Agentive subject, with accusative[1] or dative patient plus PP goal complement.

(5)   a.   Er schlug   mich   auf den Rücken
           He hit(PAST) me.ACC on the back
      b.   Er schlug   mir   auf den Rücken
           He hit(PAST) me.DAT on the back
           'He hit me on the back.'

In this paper we concentrate on the first and the third of these variants, where either two inanimate and therefore non-agentive entities are involved (first variant) or two animate entities, including a volitional agent (third variant). These variants represent the two most extreme cases with respect to agentivity.

Based on a questionnaire study we will show that in German, the meaning component 'force' is not always specified with a high value, contrary to what is assumed for English *hit*. We propose that *schlagen* comes with a force attribute which can receive any value: a high one (prototypical in the simple transitive construction), or a low one (not prototypical in any construction, but possible with all of them). As will be seen, the value of the force attribute is subject to influences from adverbial modification and contextual inference.

The paper is structured as follows: In Sect. 2, we will explain how we use adverbial modification to tease apart the meaning components of *schlagen*. Furthermore we present and analyse the empirical data from the questionnaire study, which illustrate the behavior of *schlagen* with respect to the force component in the above constructions. In Sect. 3, we will give a first sketch of a frame semantic analysis of *schlagen* along the lines of e.g. [14], Petersen 2015, integrating the basic meaning components 'force' and 'motion/contact' and the argument structure of the verb, as well as illustrating the effects of adverbial modification.

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[1] Following Vogel (2016) [17], the variant with an accusative object plus a goal PP can be subsumed here as an extended version of the simple transitive construction.

2   *Schlagen* and the Force Component

2.1   Adverbial Modification as a Tool to Tease Apart Verb Meanings

The German verb *schlagen* can appear in a number of grammatical constructions (cf. Sect. 1). In order to map out its behaviour with respect to the force component, we conducted a questionnaire study focusing (i) on the unaccusative construction, involving an inanimate entity as theme argument in subject position and a target-encoding PP (cf. 6), and (ii) on the simple transitive construction with an animate agent in subject position and an animate patient as accusative object (cf. 7). These two variants represent the two most extreme cases with respect to agentivity (cf. Sect. 1). We chose them in order to explore effects of agentivity on the force component.

(6)   Die Gitarre schlägt gegen   die Tischkante.
       the guitar   hits   against the edge.of.the.table
       'The guitar hits the edge of the table.'

(7)   Sophia schlägt Simon.
       Sophia hits   Simon
       'Sophia hits Simon.'

Since *hit*-verbs are generally described as 'verbs of forceful contact', one might assume that the two variants should display the same force feature. On the other hand, the construction in (7) is said to encode an action that especially affects the object (more detailed discussion in [7], Gabrovska and Geuder ms.), hence a difference in strength or kind of force might ensue. The first thing to test, therefore, is whether the force feature is uniformly present with agentive and non-agentive constructions.

We propose that questions like this can be addressed by examining the patterning of modifiers that occur with a verb. In this paper, we use adjectives (in adverbial function, which in German remains morphologically unmarked) whose lexical meaning specifies features like force and agentivity. We presume that modifiers can be divided, just like verb meanings, along these lines into those that are specified for agentive traits and others that target a pure force feature (Schäfer 2013 [16] speaks of a class of 'pure manner adverbs'). Hence, we can compare modifier-verb pairs of the type *hart/leicht schlagen* (hit hard/lightly) — in which only the force feature should be addressed — with constructions like *spielerisch schlagen* (hit playfully) in which an agentive feature of the verb is addressed, since playing requires an agent. We expect compatibility restrictions that derive from the semantic representations, for instance, the agentive modifier *spielerisch* (playfully) should be unable to occur with the unaccusative construction (cf. 6).

A more tricky question is what to expect of modifiers that target different values on the forcefulness scale, i.e. *hart/leicht*. It is immediately apparent that modifiers which denote low force are in principle compatible with *hit*-verbs, although standard descriptions of the verb meaning do not really seem to leave room for this. This leads us to the question of prototypical expectations, and

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generally speaking, to the role of inferencing in the interpretation of modifiers. Hence, over and above simple semantic compatibility, we want to test whether verb-modifier pairs lead to preferential assumptions in the course of interpretation (which can be overridden). A tool to test this is the so-called denial-of-expectation construction with the conjunction *but* (cf. [11], Lakoff 1971).

In order to address these questions, we conducted a questionnaire study that examined the following contrasts. First, we are interested in the behaviour of the pure manner adverbs:

Question A: Do the constructional variants of *schlagen* differ with respect to the meaning component "forceful contact" — especially in the sense that the transitive construction is specified for high force?

Question B: Do the constructional variants give rise to inferences about forces in different ways?

These questions can be tested in terms of the following hypotheses.

2.2   Hypotheses

Firstly, in the denial-of-expectation construction, of the pure manner adverbs we expect only *leicht* (lightly) in a simple transitive sentence to be acceptable, i.e. no expectations that can be contrasted through the use of *aber* (but) should arise in unaccusative sentences. The only expectation that we assume to arise is that of high force in simple transitive sentences. This expectation can then felicitously be "denied" by the use of *leicht* in combination with *aber* (cf. Table 1).

Table 1. Contrasts to be investigated with pure manner adverbs *leicht* (lightly) and *hart* (hard)

	(A) testing for semantic compatibility of modifiers	(B) testing for a (default) expectation
Agentive, transitive cases	Sie schlägt ihn √leicht/√hart She hits him √lightly/√hard	Sie schlägt ihn, aber √leicht/??hart She hits him, but √lightly/??hard
Non-agentive, unacc. case	Die Gitarre schlägt √leicht/√hart gegen die Tischkante The guitar hits the edge of the table √lightly/√hard	Die Gitarre schlägt gegen die Tischkante, aber ??leicht/??hart The guitar hits the edge of the table, but ??lightly/??hard

Secondly, we examine the behaviour of *spielerisch* (playfully) as an example of an agent-oriented modifier. While the reference to agentivity should be part of its semantic representation, we presume that *spielerisch* is also able to indicate a low amount of force used when combined with *schlagen*. This leads to the more specific question of whether this "force effect" is a feature of the semantic representation or an inference triggered by meaning components of other types. That the reference to agentivity is part of the semantic representation of *spielerisch* can easily be confirmed with our method:

Agentivity Hypothesis: Agent-oriented manner adverbs such as *spielerisch* (playfully) can only apply to *schlagen* in the case of an animate agent in the simple transitive construction (and not in the unaccusative construction with a non-agentive theme as subject).

The predictions that can be derived from the agentivity hypothesis, illustrated with some example sentences, can be found in Table 2 (the sentences with *leicht* (lightly) are given for comparison, they should be acceptable with both constructions).

Table 2. Predictions derivable from the agentivity hypothesis

Simple transitive construction	Unaccusative construction
√ Sie schlägt ihn spielerisch	# Die Gitarre schlägt spielerisch gegen die Tischkante
√ She hits him playfully	# The guitar hits the edge of the table playfully
√ Sie schlägt ihn leicht	√ Die Gitarre schlägt leicht gegen die Tischkante
√ She hits him lightly	√ The guitar hits the edge of the table lightly

Moreover, we are testing the assumption that the indication of low force in the case of *spielerisch* is a defeasible inference:

Force Inference Hypothesis: Modifiers of the type of *spielerisch* (playfully), when combined with *schlagen*, have an effect on the force component of *schlagen*, i.e. indicate a low value. However, this is an inferential process, and hence defeasible.

For the test sentences relating to the force inference hypothesis, we again make use of the denial-of-expectation construction with *aber* (but). The idea is that an adverb such as *spielerisch*, which results in a force decrease inference, cannot be opposed to an adverb that also indicates a decrease of the force magnitude such as e.g. *leicht* (lightly). Since both modify the force magnitude in the same direction, they should not be contrastable in a denial-of-expectation construction with *aber* (but). However, since *spielerisch* triggers a defeasible and hence cancellable inference on the force component, it should be acceptable with an adverb modifying the magnitude of the force in the opposite direction, e.g. *hart* (hard). In this case, the inference should be cancelled. The predictions derivable from the force inference hypothesis are given in Table 3.

Table 3. Predictions derivable from the force inference hypothesis

Contrast in opposite direction	√ Sie schlägt ihn spielerisch, aber doch recht hart
	√ She hits him playfully, but still rather hard
Contrast in same direction	?? Sie schlägt ihn spielerisch, aber doch recht leicht
	?? She hits him playfully, but still rather lightly

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2.3   Questionnaire Design and Materials

The questionnaire comprised 95 test sentences, distributed over seven questionnaires á 21–22 sentences, including two control sentences that were direct contradictions (e.g. *hit hard and lightly*). The sentences were randomized, and all questionnaires were distributed among German native speakers in two versions, one of which contained the test sentences in reversed order.

The sentences had to be rated on a 4-point Likert scale, where a 4 means "clearly good", a 3 "maybe good", a 2 "maybe bad" and a 1 "clearly bad". This way, speakers were forced to make a commitment as to whether a sentence was more on the acceptable side or more on the unacceptable side. The rating task was preceded by an introduction, which included an example sentence from an unrelated domain (speed) and asked speakers to rate sentences according to their first intuition. Following the rating task, information about speakers' language background was collected via four questions relating to their language(s) and place(s) they have been raised/lived.

15–20 participants were tested for each version of all seven questionnaires. Participants who rated either of the direct contradictions in the two control sentences higher than 1 were excluded from the analysis, as were participants whose native language was not German. 165 participants in total were included in the analysis.

2.4   Data and Results

An overview of the results can be found in Table 4.

At first glance, all of our expectations have been confirmed. The sentences testing expectations arising about the force magnitude in either simple transitive construction or unaccusative construction, making use of pure manner adverbs *hart* (hard) and *leicht* (lightly) as well as the contrastive conjunction *aber* (but), have received a visibly lower percentage of ratings 3 "maybe good" and 4 "clearly good" than their counterparts without *aber* (65% and 44% vs. > 90%). The exception are sentences of the type *Sie schlug ihn, aber leicht* (She hit him, but lightly), which were judged just as good as their counterparts without *aber* (100% vs. 93%).

This confirms our prediction that *schlagen* in transitive construction with an animate agent prototypically denotes high force, and that no such default interpretation is available for *schlagen* in the unaccusative construction with an inanimate entity as subject.

It also seems true that adverbs of the type *spielerisch* (playfully) can only be used to modify *schlagen* if the verb appears in a simple transitive construction with an animate agent, and not if it is used in the unaccusative construction (88% ratings 3 & 4 vs. 32%).

Finally, we can see that sentences of the type *spielerisch, aber doch recht hart* (playfully, but hard) receive much higher ratings than sentences of the type *spielerisch, aber doch recht leicht* (playfully, but lightly) (76.5% ratings 3 & 4 vs. 28%). This shows that modifiers of the type of *playfully* do indeed result in

Table 4. Percentages of ratings 3 "maybe good" and 4 "clearly good" for all hypotheses (observed, not estimated)

Hypothesis	Example sentences	%
Force expectations transitive case	Sie schlägt ihn, aber leicht	100%
	She hits him, but lightly	
	Sie schlägt ihn, aber hart	65%
	She hits him, but hard	
	Sie schlägt ihn leicht	92.9%
	She hits him lightly	
	Sie schlägt ihn hart	95%
	She hits him hard	
Force expectations unaccusative case	Die Gitarre schlägt gegen den Tisch, aber leicht	65.8%
	The guitar hits the table, but lightly	
	Die Gitarre schlägt gegen den Tisch, aber hart	44.1%
	The guitar hits the table, but hart	
	Die Gitarre schlägt leicht gegen den Tisch	90.4%
	The guitar hits the table lightly	
	Die Gitarre schlägt hart gegen den Tisch	92,5%
	The guitar hits the table hard	
Agentivity hypothesis	Sie schlägt ihn spielerisch	88%
	She hits him playfully	
	Sie schlägt ihn leicht	89.5%
	She hits him lightly	
	Die Gitarre schlägt spielerisch gegen den Tisch	32%
	The guitar hits the table playfully	
	Die Gitarre schlägt leicht gegen den Tisch	87%
	The guitar hits the table lightly	
Force inference hypothesis	Sie schlägt ihn spielerisch, aber doch recht hart	76.5%
	She hits him playfully, but still rather hard	
	Sie schlägt ihn spielerisch, aber doch recht leicht	28%
	She hits him playfully, but sill rather lightly	

a force decrease inference, as they can felicitously be contrasted with *hard* (a force increasing adverb), but not with *lightly* (a force decreasing adverb).

In order to test whether the observed results are significant, we have run a general linear mixed effects model for all hypotheses. Unfortunately, we had too few observations to be able to create a general linear mixed effects model testing the force expectations in the transitive case (cf. first hypothesis in Table 4).

The model testing the force expectations in the unaccusative case (cf. second hypothesis in Table 4), while confirming the general trend observable in Table 4 above, shows that the differences are not significant: the odds of rating a sentence with contrastive *but* 3 (maybe good) or 4 (clearly good) are 0.042 times (*but hard*, p = .06) and 0.116 times (*but lightly*, p = .21) the odds of rating a sentence without contrastive *but* 3 or 4. That means there is a trend that participants liked sentences with *but* less than sentences without *but*, i.e. there don't seem to be any expectations about the force magnitude that can be contrasted ("denied")

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with *hard* or *lightly* in the unaccusative construction with an inanimate entity as subject.

The model for the agentivity hypothesis yields significant results: the odds of giving a sentence with *schlagen* ratings 3 (maybe good) or 4 (clearly good) are significantly higher for a sentence in unaccusative construction with a force-related adverb such as *lightly* (p < .001) or for a sentence in simple transitive construction with any adverb (p = .002): more than 30 times the odds of giving a sentence with *schlagen* in unaccusative construction and with an adverb of the type *playfully* ratings 3 or 4. I.e. participants mostly did not accept agent-oriented manner adverbs with inanimate subjects in unaccusative construction.

Lastly, the model for the differences in rating for the force inference hypothesis, while confirming the trend observable in Table 4, also does not show significant results: the odds of giving ratings 3 (maybe good) or 4 (clearly good) for sentences of type *playfully, but lightly* are 0.063 (p = .057) times the odds of giving sentences of type *playfully, but hard* ratings 3 or 4. That means that sentences of the type *playfully, but lightly* are less acceptable than sentences of the type *playfully, but hard*, which provides evidence for the prediction that the low force reading of *playfully* is a cancellable inference.

To sum up: while we have evidence for all our predictions, it seems that the observations about expectations relating to the magnitude of the force of *schlagen* in transitive and unaccusative constructions (without modification) are not as strong as expected. On the other hand, the force decrease inference that playfully-type adverbs trigger when combined with *schlagen* is clearly observable in our data (only just not significant). And it is very clearly the case that agent-oriented manner adverbs cannot combine with *schlagen* in the unaccusative construction with an inanimate theme in subject position.

In the next section, we will present a model of *schlagen* in the framework of Frame Semantics à la Petersen (2015) [14], which can integrate these findings about *schlagen* in both constructions (simple transitive and unaccusative), as well as explicitly model its other meaning components (movement and contact).

3   A Frame Semantic Model of *hit*-verbs

In this section, we discuss the modelling of our findings in a Frame representation, a relational model of conceptual structure that is built on functional attributes ([14], Petersen 2015). In contrast to lexical decomposition models that focus on event structure (ultimately elaborating on the insights of Dowty, 1979 [2]), a Frame model is able to include a detailed analysis of the manner component of a verb's meaning and the way it relates to arguments, including implicit arguments, of the event. The manner component of *schlagen* will be characterised as based on notions of force exertion. As already pointed out by Levin (1993) [12], however, movement is another component that has to be factored in. Hence, the meaning of *schlagen* will involve at least two entities, dubbed here THEME and RECIPIENT, and a movement of the theme towards the recipient (or: 'target', 'patient'), leading up to contact, the whole process being marked by a notion of force transmission.

There are various different scenarios of *schlagen* that would require variants of the representation, but for our purposes here, we concentrate on a single prototypical case in which a number of parameters is fixed that would have to be variable to yield a fully general account. It is possible to integrate a frame model in a compositional semantics with a fully-developed syntax-semantics interface, but we are bypassing this aspect for simplicity (see e.g. [9], Kallmeyer & Osswald 2013, for compositional aspects of frame theory). Our main goal with the following model is merely to sort out which attributes are basically involved in the concept *schlagen*, how they are interrelated, and how, in principle, modifiers are able to create the effects demonstrated above in our empirical study.

The final result will be a complex frame (cf. Fig. 1). In the following, we will discuss each part of the frame in some more detail, and then explain the effects of the various modifiers.
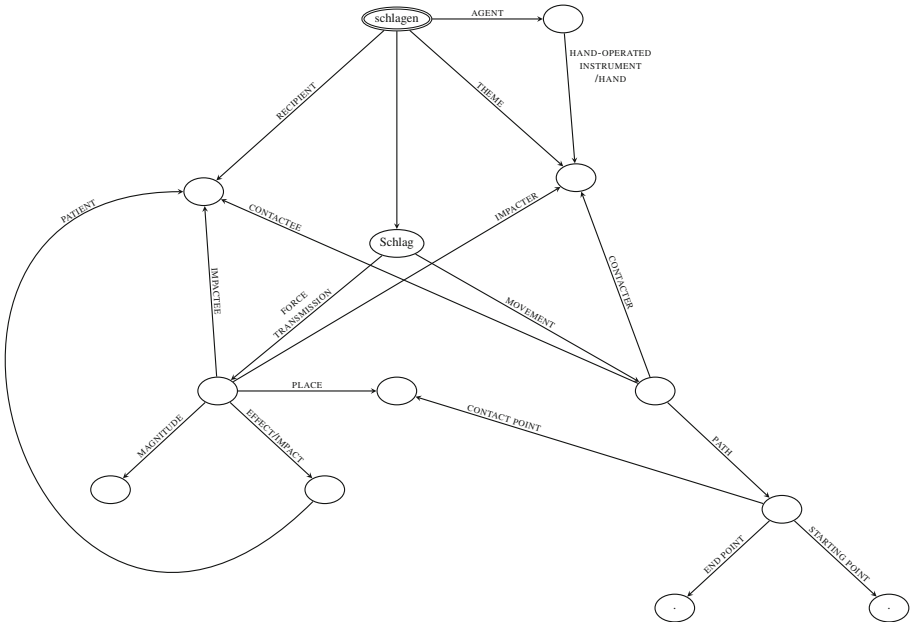
Fig. 1. The complete frame of the verb *schlagen* (to hit)

3.1   Argument Roles

At a coarse level of analysis, we can identify the scene as an interaction between individuals (but note that this view will be refined presently). As pointed out in the introduction, different uses of *schlagen* differ in the way how arguments are realised. It is also possible to gather more arguments than were seen in our standard examples (8a/b), cf. (8c), which may indicate that sometimes implicit

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arguments have to be taken into account in a full representation even of simple examples like (8a):

(8)   a.   Sophia schlägt Simon. [Agent, Recipient/Patient]
              Sophia hits   Simon
       b.   Die Gitarre schlägt gegen   die Tischkante.
              The guitar   hit   (against) the edge.of.the.table
              [Theme, Recipient/Target]
       c.   Katja schlägt die Flasche gegen   den Tisch.
              Katja hit   the bottle   against the table
              [Agent, Theme, Recipient/Target]

A role label like 'agent' can directly be used as an attribute in the sense of Frame theory – its status as a functional notion is already evident in the standard event-semantic notation agent(e,x) (cf. [13], Parsons 1990), which means a mapping of events onto individuals. In the graphic frame representation (adopted in [14], Petersen 2015) attributes are shown as labels of the arcs of a graph, and their values as nodes (cf. Fig. 1). Hence, the attribute AGENT leads to a node that introduces the relevant individual. Due to the recursive nature of the attribute-value structure used in Frame Semantics, more information can be added as a next step, e.g. if the agent also controls an instrument, is in a particular intentional state in the event, etc. Conversely, the same individuals can be the value of other attributes, too. This latter case becomes important as soon as an event description is more finely decomposed: the classic thematic roles may in fact sum up information from different aspects of the description (mirroring a set of "proto-role entailments" in the sense of Dowty 1991 [3]). This is why we set up the participant roles as a separate array, beside the core description of the event. The thematic roles are focal parts of the representation but not primitives: they can be linked in various ways to different parts of the decomposed event description. In the frame fragment in Fig. 2, AGENT and THEME are shown as arguments of *schlagen* (the central node). But THEME has at the same time incoming arrows from (i.e., is the value of) diverse attributes, stating that the moving object may simultaneously also be an instrument in the sense that it is manipulated by an agent ("hit the table with the bottle").

We will next specify the movement/contact and force transmission components of *schlagen* in the frame.
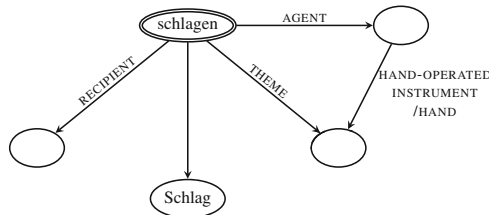

Fig. 2. The argument roles in the frame of *schlagen*

3.2 Components of the Event Description

In line with standard views of *hit*-verbs, we distinguish between a 'movement' component and a 'force transmission' component in their description. The illustration in Fig. 3 shows these as attributes of the node "Schlag" (hit); the values in each case are events. The force-transmission component specifies force-related attributes of the participants (in terms of the roles of IMPACTER and its force-dynamic antagonist, called IMPACTEE). Similarly, the movement component assigns its own semantic roles which we have dubbed here, with some amount of foresight, 'contacter' and 'contactee'.
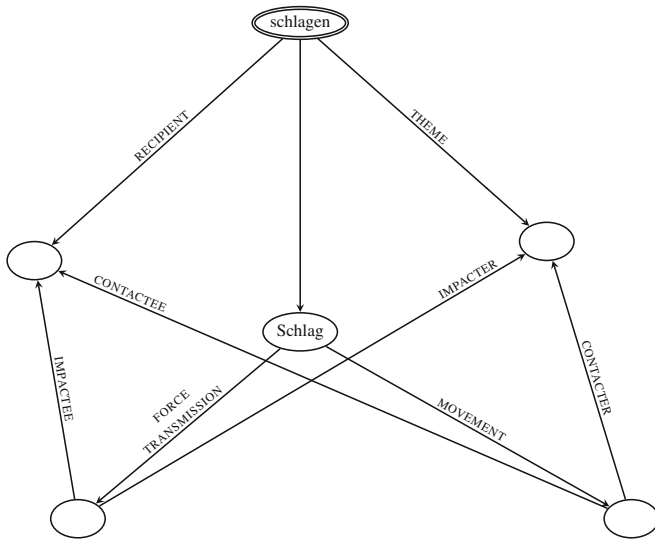

Fig. 3. The argument roles of the MOVEMENT and FORCE TRANSMISSION components

The contactee role derives from the presence of a reference object that serves to localise the movement path, as in "hit the bottle *against the table*". However, in order to simplify the discussion, we do not represent the semantic composition of *schlagen* with prepositional phrases, rather, we present the movement node as having already inherited all the relevant information about a movement that leads up to contact. The resulting network of attributes now says that the moving object is at the same time the IMPACTER, the source of a forceful impact, and that the goal of the movement is the IMPACTEE, the target of the impact. As shown before, the moving object may also be under the control of an agent in some particular scenario, making it also the agent's instrument.

The two subcomponents MOVEMENT and FORCE TRANSMISSION can now be considered in more detail (cf. Fig. 4).

MOVEMENT is described in terms of the two arguments just shown and the PATH. The path is described as a linear order of points in space, as is standardly

done (e.g. [18], Zwarts 2005). Some kind of path is always present due to the verb meaning, irrespective of the addition of PPs in the syntax. Its linear ordering of points specifies a designated starting point and endpoint, among other things, which we can encode as attributes of the path. Furthermore, there is one point on the path on which an impact takes place, i.e. a force transmission event between impacter and impactee. In the typical case, this would be the endpoint (as e.g. specified in the path description "against the table"), but our representation leaves it open in principle whether this or some other point of the path will be identified with the value of the attribute CONTACT POINT.
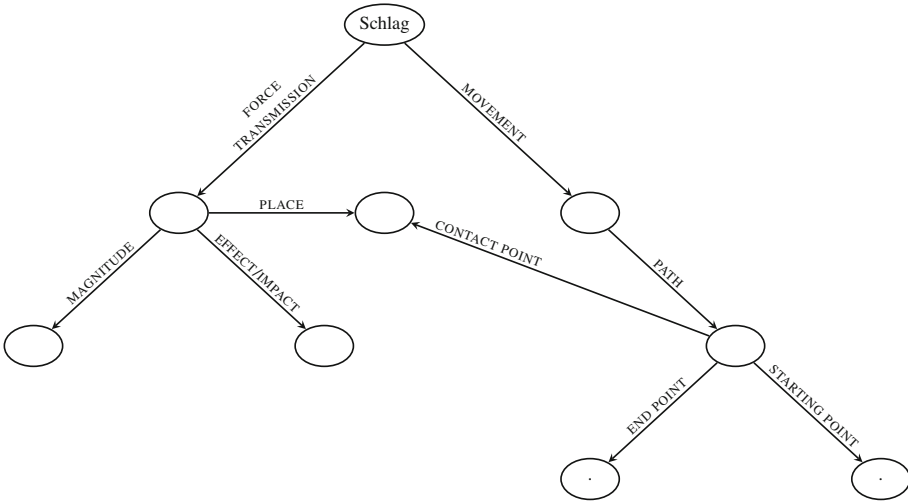
Fig. 4. The MOVEMENT and FORCE TRANSMISSION components

On the left hand side of the representation in Fig. 4, the force transmission event is described in terms of the attributes PLACE (of impact, as just mentioned), potential causal effects, the participant roles (cf. Fig. 3), and, as we additionally assume here, a measure function that directly maps the force transmission event onto a value for the magnitude/strength of its impact (which has to be distinguished from the question of effects such as doing damage or not). This, in sum, is a preliminary proposal for encoding the distinction of the two domains force dynamics and spatial description in *schlagen* events, and their interaction. Let us now consider how the functioning of modifiers could be understood on such a basis.

3.3   Modification

In general, (manner) modification in frames can be understood as a mechanism that narrows down admissible values of the attributes in an event description,

but it may also lead to the addition of new attributes (a sketch of adverbial modification in frames can be found in [8], Geuder 2006). The process is driven by the lexical semantics of the modifiers, i.e. the adjectives that underlie adverbial forms. Additionally, however, many effects of manner modification are not due to hard-wired semantic features, but to inferential processes. This could be observed in Sect. 2 above, where we showed that adverbial modifiers like *spielerisch* (playfully), when combined with *schlagen*, lead to a defeasible inference of low force. Hence there are two things that we want to explain here: How do we get from the lexical meaning of a modifier to the effect of manner modification, and how do we distinguish between inferred and hard-wired effects of modification?

For reasons of space, we will only look into modification with *spielerisch* in some detail. For cases like *hart schlagen* (hit hard) let us simply point out that the lexical meaning of this adjective indeed seems to consist in a specification of a (high) force value of some impact, and remain vague about potential further meaning components, like the kind of interaction of two surfaces or materials (but especially German *hart* seems to suggest some specific kind of mechanical interaction of two non-elastic bodies, which may be less prominent in the case of its English cognate). Hence, we have to formulate a rule such that the modifier *hart*, by its lexical meaning, interacts with the attribute MAGNITUDE (of a force transmission) so as to restrict the set of feature values admissible here.[2] In other words, it is a subsective modifier acting on a feature set (instead of on an extension of a predicate, as it would be in a neo-Davidsonian framework; for some more details we refer the reader to [8], Geuder 2006).

A more tricky case is the adverb *spielerisch*. We have seen that it presupposes an animate agent (cf. the agentivity hypothesis in Sect. 2). Furthermore, it does have an effect on the magnitude of the force posited for the hit, but only a defeasible one, in contrast to *hart*. So we conclude, in the first place, that it contributes a property of the event's agent, and the force-dynamic effects must be inferred on the basis of the adjective's lexical representation and its effect on the network of attributes in the frame of *schlagen*. Hence, we now need a second frame representation of the adjective in order to combine it with the event frame, and a preliminary inspection of corpus data shows us that this adjective is highly variable in its meaning as a modifier. We will therefore confine ourselves to formulating an approximation of the meaning that it assumes in the present context together with the verb *schlagen*, without attempting a more generalisable lexical representation. In the context of *spielerisch schlagen* (hit playfully), the outcome is obviously the description of an action that is a hitting, but one that is not an attack and is not marked by an intention to harm the patient. Rather, it transports a communicative intention to evoke the possibility of a real, aggressive hit which constitutes a kind of joke. Hence, we want to take serious the meaning of the stem *play* that is present in the adjective. Playing is arguably an activity that takes place in the real world but whose relevance and goals reside in a fictional representation. In this way, playing is often (though not always) an activity that simulates something else. Here, the overall contribution

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[2] Technically, a feature can be defined as an attribute-value pair.

of this use of *spielerisch* involves an intention not to produce the full, real-life effects of the event that is modified by this adjective, i.e. the "Schlag" or hit. What the adjective as such is about is rather that the agent intends a "play" consisting of the simulation of a hit.

Therefore, we propose that the simplified representation in Fig. 5 contains the essential aspects of this modifier meaning.
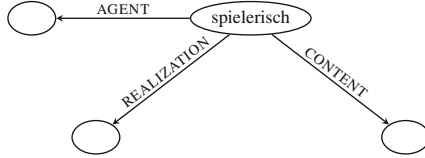
Fig. 5. A frame representation for *spielerisch* (playfully)

First of all, we assume that *spielerisch* selects an argument which is an agent. Thus, *spielerisch* always implies that some agent is playing something. Secondly, we assume an argument role, dubbed here REALISATION, which introduces the activity that is really performed in playing. And finally, there is the aspect that playing aims at a fictional sphere, this is what the activity "means", shown here as the CONTENT attribute. Now, let us combine this representation with the event frame for *schlagen* (cf. Fig. 1) and see what we get from it (cf. Fig. 6).

Resolving the agentivity condition in the modification looks straightforward: The player must be identified with the hitter. Second, the activity that constitutes the play is the hitting (the REALISATION attribute). When we say *jemanden spielerisch schlagen* (to hit somebody playfully), then in this case *spielerisch* seems to point to a communicative act, a joking activity. Therefore, for this specific case we take the CONTENT feature of the play to be the aggressive act, which is communicated as an absurd possibility and therefore as a friendly joke. (In other contexts, the application of the basic concept of playing may lead to different results). What we get for our specific case is that the value of the attribute CONTENT of *spielerisch* is another event description of the type *Schlag*, but this time the fully-fledged, aggressive one (which, as just said, is being simulated by the playful hitting). Therefore, it has all the attributes that are seen in the main part of the frame (for reasons of space not represented twice in Fig. 6, i.e. the empty node of the CONTENT attribute is taken to be the whole frame of *schlagen* again, from the node 'Schlag' downwards). If the hit that really occurs is a playful version of a fully-fledged hit, we can posit a correlation: we can reasonably expect that the force magnitude of the playful hit will be lower than that of the simulated fully-fledged hit. This use of correlations between values of certain attributes is part and parcel of frame theory (cf. Barsalou 1992 [1] who introduces correlation as a technical term) and plays an important role throughout in the analysis of manner modification (as also pointed out in [8], Geuder 2006; see also [15], Petersen & Gamerschlag 2014, for a slightly different application). Such
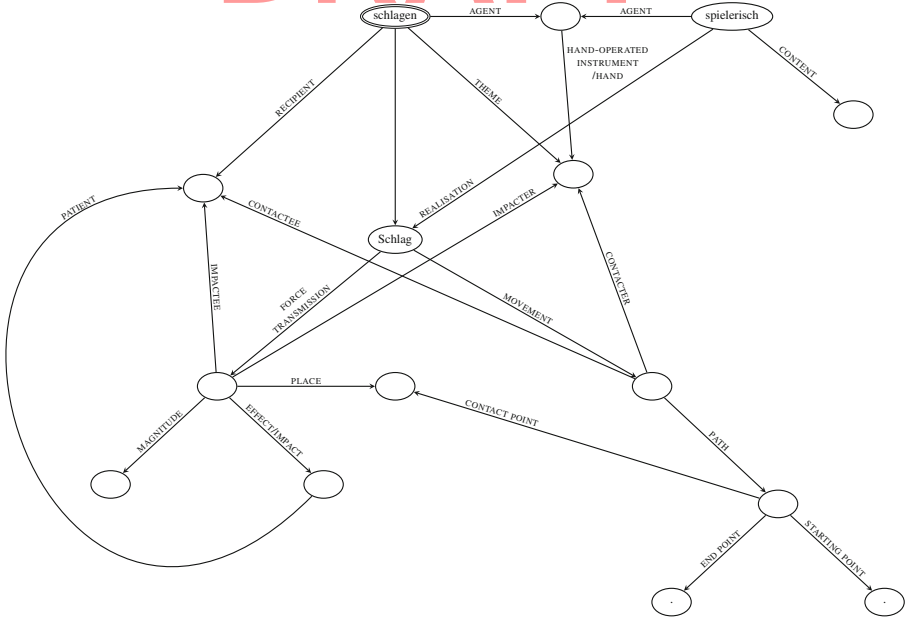
Fig. 6. Combination of the frames for *spielerisch* (playfully) and *schlagen* (hit)

correlations can be due to strict laws (of nature, for instance), but others can also be typical correspondences which are defeasible. We are dealing here with the latter case. It is simply the felicitous course of events if the playful hitting does not do any harm. In our questionnaire study above, it was demonstrated that this is a defeasible inference.

Hence *spielerisch* as a manner modifier works differently from *hart* as a manner modifier, and we have now shown the reason for this: *hart* applies directly to the force magnitude to change its value. In contrast, *spielerisch*, while it does have an influence on the same value, does so only via a prototypical correlation. The parts of the frame that it directly applies to are different ones than those that *hart* directly applies to. However, the frame representation also shows the way in which the correlation plays itself out: this is the link (arc) from *spielerisch* to the node "Schlag", stating that the hit is realised as a play.

This concludes our sketch of how Frame theory is applied to modelling adverbial modification, both with respect to the semantic representation and to the explanation of inferential effects. Of course our present account only presents a single and fairly narrow case study, but the mechanisms demonstrated here can be exploited in a more general way. And while we have glossed over a number of finer points, these could be integrated thanks to the flexibility of the framework that allows one to 'zoom in' and add more details. For example, we have left implicit the semantic intuition that the hitting in our example would have to be

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an intentional hitting by the agent, and that likewise playing is an intentional activity; but such points could be added in more fine-grained versions.

4 Summary and Conclusion

In this paper, we have presented a couple of observations about the force component and modification of German *hit*-verbs, and how these can be modelled within Frame Semantics.

Firstly, in Sect. 2, we showed how the denial-of-expectation test with *but* can be used to test native speakers' expectations about certain defaults. We were able to show that when *schlagen* (hit) is used in the unaccusative construction with an inanimate theme in subject position, no expectations arise as to the magnitude of the force (cf. the relative oddness of *Die Gitarre schlägt gegen die Tischkante, aber leicht/hart* (The guitar hits the edge of the table, but lightly/hard)). But when *schlagen* is used in the simple transitive construction with an animate agent and patient, there is a tendency to expect the hitting to be done with high force (cf. the acceptability of the sentence *Sie schlägt ihn, aber leicht* (She hits him, but lightly)). Thus, we have shown that German *schlagen* does not lexically specify a high amount of force.

Secondly, we were interested in the interaction between the force component and two distinct types of modifiers, pure manner adverbs such as *hart/leicht* (hard/lightly) on the one hand, and agent-oriented adverbs such as *spielerisch* (playfully) on the other hand. Crucially, both are able to modify the force component of the verb, though they do so via different mechanisms. When *schlagen* is combined with modifiers such as *spielerisch* (playfully), a defeasible inference arises that the hitting was done with little force. This was again tested through the use of *but* in denial-of-expectation construction (cf. the force inference hypothesis in Sect. 2). However, this effect is only observable for the simple transitive construction, since agent-oriented modifiers of the type of *spielerisch* can only apply to *schlagen* in this construction (with an animate agent, cf. the agentivity hypothesis in Sect. 2).

These observations were modelled within Frame Semantics (cf. Sect. 3), a form of meaning representation based on recursive attribute value structures. Frame Semantics allows to combine the various meaning components of *hit*-verbs, such as force and movement/contact, with the general argument structure of the verb. We showed that the different grammatical constructions of *schlagen* can all be modelled in one frame, and that this mode of representation makes explicit the connections between the lexical content of the verb and other words in the sentence (e.g. the recipient of the hit is also characterised as the contactee of the movement/contact component, the impactee of the force component, and the patient of the force impact). Furthermore, we were able to integrate the frame for *spielerisch* into the verb frame and show explicitly how the defeasible inference about low force is computed, rooting it in the semantics of the modifier itself.

A   Appendix — Example Sentences from the Questionnaires

Sentences testing expectations arising about the force magnitude in the transitive and unaccusative constructions:

– Sophia schlägt Simon hart.
  'Sophia hits Simon hard.'
– Chris schlägt Alex leicht.
  'Chris hits Alex lightly.'
– Julia schlägt Tobias, aber hart.
  'Julia hits Tobias, but hard.'
– Tobias schlägt Maike, aber leicht.
  'Tobias hits Maike, but lightly.'
– Die Gitarre schlägt hart gegen die Tischkante.
  'The guitar hits the edge of the table hard.'
– Die Gitarre schlägt leicht gegen die Tischkante.
  'The guitar hits the edge of the table lightly.'
– Der Zweig schlägt gegen die Hauswand, aber hart.
  'The branch hits the wall of the house, but hard.'
– Der Zweig schlägt gegen die Hauswand, aber leicht.
  'The branch hits the wall of the house, but lightly.'
– Die Wellen schlagen hart gegen den Deich.
  'The waves hit the dyke hard.'
– Die Wellen schlagen gegen den Deich, aber leicht.
  'The waves hit the dyke, but lightly.'

Sentences testing predictions of the agentivity hypothesis:

– Andrea schlägt Jan spielerisch auf den Arm.
  'Andrea hits Jan playfully on the arm.'
– Chris schlägt Alex leicht auf den Arm.
  'Chris hits Alex lightly on the arm.'
– Die Gitarre schlägt spielerisch gegen die Tischkante.
  'The guitar hits the edge of the table playfully.'
– Der Zweig schlägt leicht gegen die Hauswand.
  'The branch hits the wall of the house lightly.'

Sentences testing predictions of the force inference hypothesis:

– Andrea schlägt Jan spielerisch, aber doch recht leicht, auf den Arm.
  'Andrea hits Jan playfully, but still rather lightly, on the arm.'
– Andrea schlägt Jan spielerisch, aber doch recht hart, auf den Arm.
  'Andrea hits Jan playfully, but still rather hard, on the arm.'

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