

The processing and representation of light verb constructions

Eva Wittenberg,^{1,2,3} Ray Jackendoff,¹ Gina Kuperberg,¹
Martin Paczynski,¹ Jesse Snedeker² and Heike Wiese³
¹ Tufts University / ² Harvard University / ³ Potsdam University

This article gives an overview of our ongoing research on the processing and representation of light verb constructions. Light verb constructions consist of a light verb, which is semantically bleached, and an event nominal, which identifies the kind of event. Together the noun and the verb determine the structure of that event (the number of participants and their roles). Critically, in light verb constructions the canonical mapping from surface syntactic structure to event structure is disrupted. The present studies examine this phenomenon through the lens of language processing. We summarize several behavioral and neurolinguistic studies that show that the interpretation of light verb constructions relies on noncanonical mappings between syntax and semantics, while their syntactic structure is not different from non-light constructions.

Introduction

Light verb constructions are complex predicates in which the verb is semantically bleached. It merely expresses aspect, directionality or aktionsart of the predicate, while the bulk of the predicative meaning stems from an event nominal within the construction (Butt, 2010; Wiese, 2006).¹ For example, in a sentence like *Henry took a walk*, the character associated with the subject (*Henry*) is not transferring a concrete thing into his possession, as in *Henry took a spoon*. Instead, *take a walk* describes the same kind of event as the verb *walk*. The event nominal *walk* is part of the predicate and assigns semantic roles to the subject, just like *take*. Thus, the subject of the sentence is not only understood as the Agent of the verb *take*, but also as the Agent of the event nominal *walk* – a phenomenon known as “argument sharing” (Baker, 1989; Durie, 1988; Jackendoff, 1974; see also Alsina, 1996; Butt, 1995).²

Light verb constructions have inspired research in a large number of languages, from a vast array of theoretical perspectives, and with a variety of goals, resulting in a heterogeneous set of terminology, definitions, and analyses (Winhart, 2002; Butt, 2010). A detailed examination of this literature is beyond the scope of this paper. Here, we focus on the syntactic and semantic structure of some of the most clear cut cases of light verb constructions, providing a summary of studies that test how they are processed in English and German and discussing the implications of these studies for theoretical accounts.

In languages such as English and German, the surface syntax of light verb constructions usually does not differ from the surface syntax of non-light constructions using the same verb. The subcategorization frame of the light verb generally determines the syntactic argument structure of the sentence, just as in non-light constructions. The event nominal occupies a syntactic argument position within this subcategorization frame, usually one associated with the semantic role Theme (see Winhart, 2002, for discussion). For instance, *take* is normally a transitive verb whose object is the Theme; in the light verb construction *take a walk*, *a walk* appears in direct object position, though it is not the Theme of the event, but rather part of the predicate. Similarly, *give* is normally a ditransitive verb that can appear with its Theme in one of two places depending on whether the double object or prepositional object construction is used. Most light verb constructions with *give* participate in the dative alternation, with the event nominal always appearing where the Theme would be (*give a hug to Harry/give Harry a hug*).

In contrast, the semantic structure of light verb constructions is clearly distinct from that of non-light constructions. Compare (1a–d).

- | | | | |
|-----|----|---------------------------------|-------------|
| (1) | a. | Henry gave a book to Elsa. | [non-light] |
| | b. | Henry described a kiss to Elsa. | [non-light] |
| | c. | Henry gave a kiss to Elsa. | [light] |
| | d. | Henry kissed Elsa. | [non-light] |

First consider event structure: In the non-light construction (1a), the book is a physical object, independent from the act of giving, but in the light verb construction (1c), the kiss is an event type. Non-light constructions can also contain verbs followed by event nominals like (1b). However, such constructions refer to two independent actions, a describing and a kissing (which is being described), while the light construction (1c) does not refer to two independent actions, one of giving and one of kissing, but only one, just like (1d).

Next, consider the semantic roles in these events. In (1a), *Henry* is Agent, *a book* is Theme, and *Elsa* is Recipient or Beneficiary. In the non-light construction (1b), the event nominal *kiss* implies a kisser and kissee, but their identities are

indeterminate. By contrast, in (1c), *Henry* is clearly the kisser (Agent) and *Elsa* is the kissee (Patient), just as with the verb *kiss* in (1d). This difference between (1b) and (1c) is the manifestation of argument sharing in the light verb construction.

The issues raised by light verb constructions, then, are (a) how the combination of light verb and event nominal is interpreted as denoting a single event, and (b) how the shared semantic roles of the event nominal are determined. An approach that we find attractive (though we will discuss others below) is that when a verb appears in a light verb construction with an event nominal, the event nominal is not assigned a standard thematic role such as Theme or Patient, but what we might call a “co-event” role. A co-event, unlike a Theme or Patient, is not a semantic argument of the event denoted by the verb, but rather a further specification of the event type itself: the event denoted by (1c) is both a giving (of sorts) and a kissing.³ The difference between a verb in its light and in its non-light use, then, is that, in its light use, it has a co-event instead of a Theme, and thus there is a noncanonical mapping between syntax and semantics. We will call this proposal the *co-event hypothesis*.

The co-event hypothesis leads directly to an account of argument sharing. If *give* and *kiss* in (1c) together describe a single event, this event must have a single grid of thematic roles, incorporating the thematic roles individually specified by *give* and *kiss*. Thus the thematic roles assigned to *kiss* depend (at least in part) on the thematic roles of the main verb. This prediction is correct: contrast (2a and 2b).

- | | | |
|---------------------------|-----------------|----------------------------|
| (2) a. | Henry gave Elsa | a kiss. |
| roles of <i>give</i> : | Agent | Beneficiary co-event |
| roles of <i>kiss</i> : | Agent | Patient |
| b. | Elsa | received a kiss from Henry |
| roles of <i>receive</i> : | Beneficiary | co-event Agent |
| roles of <i>kiss</i> : | Patient | Agent |

(2) illustrates a general principle governing the thematic grids of light verbs and event nominals: Agents align with Agents, and Patients align with Patients or Beneficiaries – regardless of how these roles are expressed syntactically. (3) and (4) are further illustrations of variation in alignment that depend on the thematic roles assigned by the light verb.

- | | | |
|--------|------------------------------------|---------------------------------|
| (3) a. | Joan did an operation on Harry. | (= ‘Joan operated on Harry’) |
| b. | Harry had an operation. | (= ‘someone operated on Harry’) |
| (4) a. | The dinner gave Bill pleasure. | (= ‘the dinner pleased Bill’) |
| b. | Bill got pleasure from the dinner. | (= ‘the dinner pleased Bill’) |

The light verb can also affect the number of thematic roles of the event: (5a) is a simple one-character event, but (5b) adds a causative agent.

- (5) a. Olive took a bath. (= ‘Olive bathed’)
 b. Tom gave Olive a bath. (= ‘Tom bathed Olive’)⁴

In addition, the light verb influences the aspectual properties of the overall event. For instance, a kissing event may be telic (cf. *She kissed him in 5 minutes*) or atelic (cf. *She kissed him for 5 minutes*). But since *give* is telic, *give a kiss* can only be telic (*She gave him a kiss in 5 minutes/*for 5 minutes*).⁵ (See Folli, Harley, and Karimi, 2002, for a discussion of these points for Persian light verbs; McGinnis, 2002, for similar behavior in VP idioms). Thus the light verb plays an important role in the overall construal of the event.

Overall, then, the co-event hypothesis permits a rather natural account of the event structure of light verb constructions and of argument sharing (see Wiese, 2006, for a formal semantic representation that captures this, and Culicover and Jackendoff, 2005, Section 6.5.1 for a different formal approach based on similar intuitions).

A further complication in of light verb constructions is that not any light verb can combine with any event nominal (e.g. **make a shower*, **give a jog*). Some combinations and limitations are idiosyncratic (e.g. American/British *make a decision* vs. British-only *take a decision*). Nevertheless, there are pockets of (relative) productivity, defined by fine-grained semantic constraints. For example, *give* readily combines with any kind of noun denoting deliberate contact (*Andrew gave Holly a push/kick/kiss/hug*). Likewise, *have* combines with event nominals in constructions where the sentential subject is construed as Patient or Experiencer of the event nominal (*Joe had an operation/accident/collision*), while it does not combine so readily with contact event nominals (**Fanny had a kick/stab/punch/kiss at Gerry*; see Wierzbicka, 1982; Brugman, 2001; Newman, 1996 for very detailed case studies). Thus these pockets of productivity depend on the interaction between the light verb and the meaning of the event noun. Furthermore, at least some instances of the construction must be stored in memory as quasi-idioms.

The problems of co-event structure, argument sharing, and semi-productivity pose interesting problems for theories of grammar; we will discuss some of these below. But they also raise questions about sentence processing. On the co-event hypothesis, light verb constructions have the same syntactic structure as non-light constructions but the mapping between syntax and semantics differs. Specifically, the argument that would typically be assigned the role of Theme is assigned the role of co-event, inducing a process in which the semantic roles of both predicates are aligned. Thus, on this hypothesis, light verb constructions make use of the same syntactic structures and structure building operations as non-light

constructions, but they require an additional operation to align the semantic roles of the verb and the event nominal: *Jan gave Julius an order* has the same syntactic form as *Jan gave Julius an orange*, but the event representation differs. The predictions that we make about the processing of light verb constructions will depend upon the factors that we deem most relevant to comprehension or production.

- Since the verbs in question are more frequent as light verbs than as non-light verbs, processing effort might be decreased (see remarks below.)
- Aligning the thematic grids of the light verb and event nominal may require more processing resources. Since under the co-event hypothesis, the proper alignment depends on the semantics of the light verb and event nominal rather than (or at least more than) their syntax, the processing burden should be primarily in the course of semantic composition, not in syntactic parsing.

The experiments reported in the next section investigate these predictions.

Investigating the processing of light verb constructions

As in any processing study, one factor that must be addressed is the frequency of the construction under investigation. Both lexical frequency and cloze probability are inversely related to processing effort (Bicknell and Levy, 2012). In most languages, light verbs are actually among the most frequent verbs in the lexicon. For instance, the light verbs *take*, *have*, *make*, *do*, and *give* are among the twenty most frequent verbs in English (PropBank corpus, Palmer, Gildea, and Kingsbury, 2005). Also, the frequency of particular combinations of light verbs and event nominals is significantly higher than that of non-light verb–noun combinations, and a some verbs such as *give* are more frequent in light constructions than in non-light constructions (Piñango, Mack, and Jackendoff, to appear; Wittenberg and Piñango, 2011). Consequently, all other things being equal, we might expect that light verb constructions would be processed more easily than non-light constructions.

In the first psycholinguistic study investigating the processing of light verb constructions, Piñango et al. (to appear) used a cross-modal lexical decision task. Participants listened to light verb constructions such as *Mr. Olson gave an order to the produce guy*, as well as to non-light constructions using the same verbs (*gave an orange*) or the same nouns (*typed an order*). After the object noun (*order/orange*) was heard, letter-string probes appeared on the screen. Participants were required to make a lexical decision about whether these strings were words or non-words. Piñango et al. found that participants were slower to respond to probes appearing 300 ms after the end of a light verb construction than after a

non-light construction using the same object. No differences were seen when the probes were presented immediately after the offset of the object noun.

In a follow-up experiment, Wittenberg and Piñango (2011) used the same methodology, using German subordinate clauses, which have a verb-final sentence structure (6):

- | | | |
|-----|-------------------------|--|
| (6) | Während der Demonstrant | ‘While the protester |
| a. | einen Vortrag hielt, | a speech held, [light] |
| b. | eine Fahne hielt, | a flag held, [non-light, same verb] |
| c. | einen Vortrag hörte, | a speech heard, [non-light, same noun] |
| | schritt die Polizei ein | intervened the police ³ |

In this context, all arguments could be presented before the verb. When the probe appeared 300ms after the offset of the verb, the reaction times for light verb constructions were longer than those for both of the other constructions. Again, there was no difference in reaction times when the probe appeared immediately at the end of the verb.

The increased reaction times to light verb constructions can be taken as evidence for increased processing costs. That these costs only arose after a certain time, and not immediately after the construction, suggests that the higher cost of processing a light verb construction is attributable to complex operations in the mapping between syntactic and semantic argument structures, as predicted by the co-event hypothesis, and is not a consequence of arguably faster processes, such as lexical access or a first-pass parsing (Embick, Hackl, Schaeffer, Kelepir, and Marantz, 2001; Boland, 1997; McElree and Griffith, 1995).

The results of both studies are important first steps for our understanding of how light verb constructions are processed. However, while the findings do show that these constructions incur processing costs by 300 ms after the end of the construction, nothing can be said about the more fine-grained mechanics of processing.

One study that could have shed light on this was conducted by Briem, Balliel, Rockstroh, Butt, Schulte im Walde, and Assadollahi (2010). They carried out three MEG experiments in German, contrasting potential light verbs like *geben* (‘give’) with non-light verbs like *erwarten* (‘expect’). Experiment 1 presented isolated verbs in third person singular present tense. They found that non-light verbs were associated with more activity than light verbs in a central occipito-parietal region. Experiment 2 presented these verbs together with a subject pronoun (*Er gibt*, ‘he gives’). The same effect was found, as well as an increased signal for non-light verbs between 160–200 ms in a left visual region. In Experiment 3, verbs in non-light verb constructions evoked more activity than verbs in light constructions between 270–340 ms in left temporal regions.

Thus, in all three experiments, non-light verbs elicited more neural activity than light verbs. These findings seem to directly contradict the predictions of the co-event hypothesis, as well as the behavioral findings of Piñango et al. (to appear) and Wittenberg and Piñango (2011) described above, namely more cost associated with light verb constructions than with non-light constructions. However, as Wittenberg, Paczynski, Wiese, Jackendoff and Kuperberg (under review) discuss in detail, several confounds restrict the interpretation of Briem and colleagues' study: verbs were imbalanced in terms of length and morphological complexity, several of the non-light items were of questionable grammaticality, and the two classes of verbs differed in imageability. Moreover, in Experiment 3, the stimuli used object-verb-subject order, which is a marked word order for isolated sentences in German.

However, for our present purpose, the most critical limitation of these studies is that they were not designed to address processes related to argument sharing, which necessarily involves the interaction of the verb, the event nominal, and all arguments, rather than just the verb alone. Experiments 1 and 2 did not include the event nominal; the results may simply reflect the higher frequency of light verbs. Experiment 3 did include all arguments, but critically the researchers did not analyze activity *after* the verb, which is where the studies described above found evidence for greater processing effort.

To help close this gap, Wittenberg et al. (under review) investigated the processing of light verb constructions using Event-Related Potentials, which measure brain activity during sentence comprehension. In this study, participants first saw a context sentence like (7), presented as a whole. Then they saw a verb-final subordinate clause that was either a light verb construction (8a), a non-light construction using the same verb (8b), or an anomalous construction using the same verb (8c). This was followed by the matrix clause (9). Both the subordinate and matrix clause were presented word-by-word. Cloze probabilities, as determined in a separate test, were highest for the light condition, lower for the non-light condition, and zero for the anomalous condition. Our analyses focused on the response to the verb (underlined in the examples).

- (7) *Das Flugzeug war bereits hoch über den Wolken.*
 The airplane was already high over the clouds.
 'The airplane was already high in the sky.'
- (8) a. *Als die Stewardess eine Ansage machte,*
 When the stewardess an announcement made
 'When the stewardess made an announcement'

- b. *Als die Stewardess einen Kaffee machte.*
 When the stewardess a coffee made
 ‘When the stewardess made a coffee’
- c. **Als die Stewardess ein Gespräch machte.*
 When the stewardess a conversation made
 ‘When the stewardess made a conversation’ (unacceptable in German)
- (9) *ging gerade die Sonne auf.*
 went just the sun up
 ‘the sun was just rising.’

Examining the waveforms at the verb, we found no differences between sentence types in the classic N400 time window (300–500 ms). The anomalous sentences evoked a posteriorly-distributed positivity effect (a P600) relative to the other two sentence types. The light verb constructions, however, in contrast to the other two constructions, evoked a widespread negativity from 500–900 ms with an anterior focus. Since the same verb was used for all three sentence types, we can rule out the possibility that lexical factors drove these effects. This cannot be an N400 response to difference in cloze probability; if it were the negativity would be smaller for the light verbs, since they are more predictable.

As we discuss in Wittenberg et al. (under review), these findings are consistent with the behavioral results from Piñango et al. (to appear) and Wittenberg and Piñango (2011). Both studies found longer reaction times for making a lexical decision to a probe after light verb constructions than after non-light constructions. Crucially, the probes in the behavioral experiments were placed 300 ms after the *offset* of the constructions. Assuming that the critical word lasted 200–300 ms, this slowdown correlates with the onset of negativity effect that was observed 500–600 ms after the *onset* of the critical word in the ERP study. The negativity evoked by the light verb constructions could reflect the mapping operations involved in argument sharing. During sentence comprehension, predictions are made about the roles that the arguments are to receive; once the verb is encountered and a light verb construction detected, the semantic roles have to be distributed both from the light verb and the event nominal. Specifically, under the co-event hypothesis, the event nominal has to be integrated as a co-event with the main verb, and the thematic grids of the two predicates have to be aligned with the resulting composite event.⁶

The results in these studies offer an interesting parallel with coercion operations such as aspectual coercion (10).

- (10) The light flashed until dawn. (= ‘The light flashed repeatedly until dawn’)

In this case, it has been argued that extra semantic material (underlined in the gloss) is introduced in the course of mapping from syntax to semantics (Talmy, 1978 and Jackendoff, 1991, among others). Experiments on aspectual coercion have found effects that have similar scalp distributions and similar timing to the effects that we found for light verb constructions, a pattern which is different from the classic N400 pattern (Bott, 2010; Paczynski and Kuperberg, to appear). Thus our ERP results add to a growing body of data showing processing costs for constructions that involve noncanonical mappings between syntax and semantics.

The co-event hypothesis claims that while non-light and light verb constructions have different syntax-semantics mappings, they share the same syntactic structure. Wittenberg and Snedeker (in prep.) used structural priming to test this claim. This paradigm exploits the fact that during language production, people tend to automatically repeat structures that they have recently encountered. In particular, it has been shown that hearing Double Object (DO) word order (*Henry gave Elsa a rose*) primes production of semantically unrelated DO constructions (*Joan showed Harry her stamp collection*), and hearing Prepositional Object (PO) word order (*Henry gave a rose to Elsa*) primes production of semantically unrelated PO constructions (*Joan showed her stamp collection to Harry*). Crucially, syntactic priming during production appears to be attributable to the syntactic surface structure of the sentence (Bock, 1986, 1989; Bock and Loebell, 1990).

Light verb constructions with *give* undergo the dative alternation just like non-light ditransitive constructions. However, prior studies of dative priming have focused exclusively on non-light datives. We tested whether light verb ditransitives would prime the word order of non-light ditransitives as effectively as other non-light ditransitives. We reasoned that if the difference between light and non-light verbs is one of semantic structure, and not syntactic structure, then their priming behavior should not differ. On the other hand, if light verb constructions have a different syntactic structure from non-light constructions, they should serve as less effective primes for non-light constructions, since the degree of representational overlap is decreased.

Participants read out loud prime sentences that were either light or non-light and that employed either DO word order (*Henry gives Elsa a kiss/rose*) or PO word order (*Henry gives a kiss/rose to Elsa*). Then they described target pictures that could be described equally well with a PO or a DO construction. To disguise the purpose of the experiment, a distractor memory task was used (cf. Bock and Loebell, 1990).

We found that both light and non-light DO primes resulted in more DO targets than did PO primes, with a robust main effect of dative type that was reliable for both the light and the non-light sentence types. There was no significant interaction between sentence type and prime type. Thus, even though the semantic

argument structures of light and non-light verb constructions differ dramatically, they both prime non-light targets equally, suggesting that light and non-light constructions have the same syntactic form.

The interpretation of these findings depends on our understanding of structural priming. As we noted above, most of the prior research suggests that structural priming during production primarily results from an overlap in syntactic structure of the utterance. Critically, priming can occur between utterances which have similar surface structures despite having very different semantic structures (Bock and Loebell, 1990; see also Pickering and Ferreira, 2008, for a review). Our findings are fully consistent with this literature: light dative sentences prime non-light datives because they share the same syntactic structure, even though their semantic structures appear to be quite different.

This is not the pattern that we would expect to find if structural priming during production primarily reflected semantic structure or how it maps onto syntactic structure. The light verb primes necessarily had less semantic overlap with the non-light targets than the non-light primes: the argument that plays the Theme role in the non-light constructions plays the role of co-event in the light constructions, and, in the light constructions, argument sharing introduces new thematic roles from the event nominal which are not present in canonical non-light constructions. For example, between a non-light prime sentence like *The grandfather is reading the book to the toddler* and a target sentence like *The girl is tossing the ball to the boy*, the syntactic and thematic structures are identical, involving in both cases an Agent, Theme, and Recipient, in that order. On the other hand, if the prime sentence is the light verb construction *The husband is giving a kiss to his wife*, then the direct object is a co-event rather than a Theme, and the object of *to* is a Patient, rather than a Recipient, resulting in less overlap with the target *The girl is tossing the ball to the boy*. Thus, if structural priming was highly influenced by thematic roles, one would have expected different results.

At first glance, these findings may appear to contradict a small set of prior studies, which demonstrate that priming at the level of semantic structure or thematic mappings can occur (Chang, Bock, and Goldberg, 2003; Thothathiri and Snedeker, 2012). But this contradiction disappears when we look carefully at the contexts in which thematic priming appears. Thematic priming has been observed in contexts in tasks that involve comprehension, either as a step toward production (the RSVP task, Chang et al., 2003) or as the ultimate measure (Thothathiri and Snedeker, 2012). Picture description tasks, like the present one, which do not involve comprehension of the sentence to be produced, appear to be more sensitive to syntax than to semantics (e.g., Bock and Loebell, 1990). This may reflect the different pathway that information travels along during the two processes (from meaning to form in production, from form to meaning in

comprehension). In addition, effects of thematic structure during production may emerge only when the effects of syntax have been neutralized. The Chang study explored locative priming, where both forms share the same surface syntax and differ only in the ordering of thematic roles. In contrast, in studies like the present one (where syntactic variation cuts across differences in semantic form) researchers have consistently found robust effects of syntax on priming which are not mediated by differences in meaning (see Pickering and Ferreira, 2008, for review).

To summarize, the experimental studies reviewed here provide data that constrain our understanding of light-verb constructions and how they are processed: The cross-modal lexical decision studies and the ERP study suggest that light verb constructions call for more processing resources. The cross-modal lexical decision studies suggest that this extra effort occurs late in processing; results from syntactic priming suggest that light verb constructions do not differ from non-light in their syntax. Altogether, these studies are consistent with the co-event hypothesis. Below we consider the degree to which these findings uniquely support the co-event hypothesis by examining how they would be explained under other theories about the representation of light verbs.

Repercussions for grammatical theories of light verb constructions

In this section we explore how these experimental results might bear on three different grammatical theories of the light verb construction. Differentiating between syntactic and semantic mechanisms in processing crucially depends on which model of the linguistic architecture one is assuming. Phenomena that are firmly anchored in the syntactic waters of one theory are often regarded as semantic in the next. The connection between theoretical linguistic models and psycholinguistic data is notoriously hard to tie down (Phillips & Lewis, to appear), although successful experimental tests of linguistic theories can and do occur (e.g. Pinker, 1999 on the existence of morphological rules; Hofmeister and Sag, 2010 on extraction constraints, among many others). For the purposes of bridging the gap between approaches strictly focusing on linguistic theory and those that investigate the linguistic system by observing language processing, we believe it is critical to evaluate any theory of representation in terms of processing.

Our interpretation of the experimental results has been based on the co-event hypothesis, which is rooted in Jackendoff's Parallel Architecture framework (Jackendoff, 1997, 2002; Culicover and Jackendoff, 2005). In this theory, the structure of a sentence is a triple of phonological, syntactic, and semantic structures, each characterized by its own set of generative principles. The relationship

among these structures is established by interface principles that link pieces from multiple components. In particular, a word is thought of as an interface rule that links a small piece of phonology, a set of syntactic features, and a piece of semantics. Above the level of words, the canonical mapping between syntax and semantics says that semantic functions are associated with syntactic heads, semantic arguments are associated with syntactic positions such as subject and object, and semantic modifiers are associated with syntactic adjuncts. However, there are also many noncanonical mappings between syntax and semantics. For instance, in the phrase *that gem of a theory*, the syntactic head is *gem*, but the semantic head is *theory*, as can be seen from the paraphrase in more canonical form: ‘that theory, which is a gem.’ Thus this construction requires a special interface rule to effect such a linking.

A light verb construction is another such noncanonical mapping between syntax and semantics. According to the co-event hypothesis, the direct object is not interpreted as a canonical semantic argument, but rather as a co-event with the light verb; in effect the two words map into a single semantic constituent. We have proposed here that argument sharing is an automatic consequence of this mapping, in that the single semantic constituent can have only one set of thematic roles. We have observed that the Agent of the light verb aligns with the Agent of the event nominal, and that the Patient of the light verb aligns with the Patient of the event nominal – regardless of their syntactic position in the clause. The result is that the syntactic arguments of the main verb acquire thematic roles associated with the event nominal, based not on the syntax, but on the semantics of the light verb and the nominal. The co-event hypothesis has been partially formalized in the Parallel Architecture framework by Culicover and Jackendoff (Section 6.5.1) though they do not work out the details of argument sharing.

The format of the Parallel Architecture lends itself to a direct relation between grammatical theory and theories of processing (Jackendoff, 2002, 2007). In particular, noncanonical interface relations in which the syntactic and semantic structure diverge are predicted to create greater processing load. This is what we find in the studies on the light verb construction described here.

Another account of light verb constructions is rooted in the framework of Construction Grammar. Construction Grammar is an umbrella term for a range of theories that share the basic assumption that the primary units of grammar are constructions: stored pairings of form and function (Croft, 2001; Goldberg, 1995, 2009; Kay, 1995). There are no independent modules of grammar interacting with each other; all composition is in terms of full constructions (Fried and Östman, 2004). Thus there is no necessary distinction between canonical and noncanonical pairings of form and function, except in terms of frequency.

Goldberg (2003) works out an analysis of Persian light verb constructions in this framework. She concludes that light verb constructions must be stored as linguistic units: each noun that can enter a light verb construction is stored together with its respective light verb, and each of these stored structures is associated with a distinct meaning; alternatively, groups of light verb constructions can be represented as sub-constructions of other constructions in an inheritance hierarchy (Family, 2009).

In terms of processing, the most important factor for Construction Grammar has been frequency: the more frequent a construction, the easier it should be to process. We noted above that the light verb constructions under consideration are more frequent than non-light constructions with the same verbs. This would suggest a prediction that light verb constructions should require less processing effort than cognate non-light constructions (and Goldberg has verified [p.c.] that this is what her analysis predicts).⁷ The experimental results reported here falsify this prediction.

However, this prediction is based on the specific co-occurrence frequency (corresponding to cloze probability) reported in Piñango et al. (to appear) and Wittenberg and Piñango (2011). Which measures of frequency are most relevant to this aspect of sentence processing will depend on the underlying theory of representation. If light verb constructions are represented as broader mappings that generalize across event nominal (*give a kiss, give a punch, give a pinch*), then processing costs could depend on frequency measures that are pooled across this class, total token frequency across types, the number of types, and the distribution of token frequencies across these types. Some of these measures could generate the prediction that light verbs would have greater processing costs – just like the co-event hypothesis. For example, light verbs have less variability, resulting in fewer types. Unlike the co-event hypothesis, however, that cost would not arise from complex mapping operations, because in the Construction Grammar framework, all syntactic structure is taken to be a consequence of precompiled form-meaning pairings. Thus, the higher cost for light verb construction would entirely arise in the realm of lexical access – a process that is thought to be rapid (Embick et al., 2001), contradicting the behavioral data in Piñango et al. (to appear) and Wittenberg and Piñango (2011), and, in the ERP literature, associated with a modulation of the N400 signature (contradicting the findings in Wittenberg et al., under review).

A third account of the grammar of light verbs is rooted in Principles and Parameters theory and the Minimalist Program (Chomsky, 1981, 1995), in particular the work of Hale and Keyser (1993, 2002). In this configurationally defined approach to argument structure, semantic roles in a sentence are assigned based on the arguments' position in the syntactic tree, and the correspondence

between syntactic and semantic roles is strictly homomorphic (Levin and Rappaport Hovav, 2005). According to this model, a surface verb like *walk* is derived from an underlying structure [V [_{DP} *walk*]], which Hale and Keyser gloss with a light-verb-like construction ‘DO a walk’ or ‘TAKE a walk.’ The verb is an “abstract V” or, in some formulations, “little *v*” – the same sort of abstract verb involved in Larson’s (1988) VP-shells. By head-to-head raising, *walk* is incorporated or “conflated” with the abstract verb to form the surface verb in its surface position.

Notice how this approach bears some resemblance to our treatment of the light verb and event nominal as specifying co-events: the abstract verb, whose only semantic content is its specification of argument roles, is combined with the nominal, which provides the meat of the surface verbs’ semantic content. However, in Hale and Keyser’s model, this combination takes place in syntactic structure rather than in the mapping between syntax and semantics.

The conflation operation is treated as a rule that takes place “in the lexicon” (Hale and Keyser, 2002: 47). It is not clear whether the conflation is conceived of as precompiled, so that for all intents and purposes there is a lexical verb *walk*, or whether the conflation is considered to be a step that takes place prior to lexical insertion in the derivation of a sentence. (See Culicover and Jackendoff, 2005, for a critique of this approach.)

Hale and Keyser (1993, 2002) do not make specific proposals about the derivation of the light verb construction, but their analysis can be extended in a straightforward way to account for these constructions. In fact, just such an extension has been proposed by Folli, Harley, and Karimi (2004) to account for Persian light verb constructions. Their starting point, however, deviates from Hale and Keyser’s in one respect: they treat the operation of conflation not as a “lexical” operation but as part of the syntactic derivation, following Larson (1988) and many others (see also Jung, 2002, on Korean).

Hale and Keyser’s theory is not intended to make explicit predictions about the processing of light verb constructions, and neither is Folli et al.’s extension of it. Nevertheless, we believe that a theory of the linguistic system should have a bearing on how it is actually put in use through language processing. If we look at this account from this perspective, it is reasonable to suppose that derivational complexity in this case should correspond to processing complexity.

Example (11) compares the derivation of a light verb construction with two non-light verb constructions under Folli et al.’s approach; many details are simplified.

- (11) a. Light verb construction:
 [V [_{DP} order]] → [give [_{DP} (an) order]] [by spell-out]

- b. Non-light verb construction with *order*
 $[V \text{ } [_{DP} \text{ order}]] \rightarrow [[V+\text{order}_i] \text{ } [_{DP} \text{ } t_i]]$ [by head movement]
- c. Non-light verb construction with *give*
 $[V \text{ } [_{DP} \text{ give}]] \text{ } [_{DP} \text{ an orange}] \rightarrow [[V+\text{give}_i] \text{ } [_{DP} \text{ } t_i] \text{ } [_{DP} \text{ (an) orange}]]$
 [by head movement]

Assuming the spell-out of the abstract V as *give* in (11a) is a phonological operation, light verb constructions actually have a simpler syntactic derivation than non-light constructions, since they involve no operation of head movement. On this account, then, a non-light verb construction such as *walk_V to the park* would be syntactically more complex than a light verb construction such as *take a walk to the park*, in that it has undergone the derivational step of head-to-head raising. If derivational complexity were taken to correspond to processing effort, this would predict that light verb constructions would be easier to process than non-light. The experiments reported here falsify that prediction; the reverse is the case.

Also, the head movement account says that light and non-light constructions have different syntax, both in underlying and in surface structure, as can be seen by comparing (11a) and (11c). However, the structural priming results give us no evidence that the degree of structural overlap is reduced in these cases. In short, to the extent that we can derive predictions about processing from the head movement account, they are all not borne out.

Conclusions

This chapter has presented a summary of ongoing research on the processing and representation of light verb constructions. In these constructions, the light verb and the event nominal establish a shared argument structure, while the syntactic structure is indistinguishable from non-light sentences. Light verb constructions are challenging for linguistic theories because they violate the general pattern of the verb as the sole predicate, resulting in complex event structures and a mismatch between syntactic and semantic structure.

Different theoretical attempts have been made to model the mechanism of argument sharing. One solution is to posit hidden syntactic structure which establishes a one-to-one mapping from syntactic to semantic arguments and derives the surface form by head movement (Hale and Keyser, 1993, 2002). Alternatively, one can conceive of light verb constructions as units that are stored in memory with fully specified syntactic and semantic information (Goldberg, 2003). Finally, a third approach acknowledges the independence of syntactic and semantic structure, allowing the mechanism of argument sharing to be a complex semantic

operation, not affecting syntactic structure (Jackendoff, 2002; Culicover and Jackendoff, 2005).

Each of these representational models can be used to make different predictions about the processing of light verb constructions: The head movement model suggests that light verb constructions should be easier to process than non-light constructions, since in the syntactic interpretation of that theory, light verb constructions are associated with less structural and derivational complexity. A constructionalist model makes the same prediction, but bases it on the higher frequency of the light verb construction, which should facilitate processing. The Parallel Architecture, however, predicts that the more complex semantic operations involved in argument sharing would lead to more processing load for understanding light verb constructions.

Behavioral and electrophysiological processing studies in English and German show that the particular way in which light verb constructions are processed in comprehension is rooted in complex semantics-to-syntax mapping operations. These studies report increased reaction times (Piñango, Mack, and Jackendoff, to appear; Wittenberg and Piñango, 2011) and sustained negativities in Event-Related Potentials (Wittenberg et al., under review) to light verb constructions, compared to standard verb-object constructions. The production priming study (Wittenberg and Snedeker, in prep.) and electrophysiological evidence (Wittenberg et al., under review) support the view that there is no syntactic cost associated with light verb constructions, and their syntactic structure does not differ from non-light constructions.

These findings raise some interesting questions for future research. First, most of the studies so far have focused on the comprehension of light verb constructions, while production has not yet been addressed extensively. It is crucial to understand what factors lead to the frequent usage of light verb constructions, despite the complex semantic operations that characterize them. One consideration could be information structure or utterance planning preferences. We are planning to investigate this by looking at circumstances of light verb production in corpora. Other aspects include very subtle differences in meaning between a light verb construction (*to give a kiss*) and its underlying base verb construction (*to kiss*), such as aspectual features, directionality, agentivity, or aktionsart. We are also investigating this possibility, looking closer into the conceptualization of events described by light verb constructions.

In short, light verb constructions give us crucial insight into the interface of syntax and semantics. The richness of theoretical problems associated with them, together with their centrality in everyday language use, make them a superb object of theoretical investigation. Moreover, light verb constructions pose interesting questions relevant to research on language processing and its ties to

how we conceptualize and express events. We have shown that psycholinguistic techniques can shed light on these questions, both in terms of processing and representation.

Notes

1. We thank the participants of the workshop “Structuring the Argument” (Paris 2011), the editors of this volume and two anonymous reviewers for helpful comments and suggestions.
2. We use the term “event nominal” for convenience; recognizing that the nominal in some light verb expressions does not denote an event, e.g. *have an ability*.
3. To what degree is the composite event an act of giving? A great deal of the content of non-light *give* is “bleached out” from light *give*. What remains is at least the grid of thematic roles and its aspectual/aktionsart features. What there is beyond that is a question we will not try to resolve here, but we begin to explore this issue in our ongoing work testing the conceptualization of light verb constructions as compared to non-light constructions.
4. Notice that the noun *bath* cannot itself take a causative argument: **Tom’s bath of Olive* is out, and *Tom’s bath* can only mean the bath that Tom took, not the bath that he gave to Olive.
5. Note that the telic event can be iterated by pluralizing the event nominal: *She gave him kisses for 5 minutes*. This parallels similar effects in non-light constructions: *She handed him tools for 5 minutes*.
6. As a reviewer points out, it is not clear whether this extra processing should be construed as a repair or simply as an alternative way of mapping a direct object plus verb into semantics. In either case, the normal route to interpreting the syntactic combination has to be overridden and the thematic grids must be aligned. However, the fact that the P600 is not elevated with grammatical light verbs, unlike anomalous light verbs, suggests that the extra processes are distinct from those involved in resolving a (syntactic) anomaly.
7. We noted above that some light verb constructions (such as *make a decision*) have to be stored in the lexicon – but not all, as Goldberg’s analysis posits. Under the co-event hypothesis, it is an open question whether stored light verb constructions have to undergo argument sharing, or whether they store the result “pre-compiled.” If the latter, stored light verb constructions might behave differently from those that are processed online. Alternatively, just as for some frequent multimorphemic words, parallel access and computation routes are conceivable (Baayen, Dijkstra and Schreuder, 1999).

References

- Alsina, Alex. 1996. *The Role of Argument Structure in Grammar*. Stanford, California: CSLI Publications.

- Baayen, R. R., Dijkstra, T., and Schreuder, R. 1997. Singulars and plurals in Dutch: Evidence for a parallel dual route model. *Journal of Memory and Language*, 36: 94–117. DOI: 10.1006/jmla.1997.2509
- Baker, Mark C. 1989. *Incorporation: a theory of grammatical function changing*. Chicago: University of Chicago Press.
- Bicknell, Klinton and Roger Levy. 2012. Word predictability and frequency effects in a rational model of reading. *Proceedings of the 34th Annual Meeting of the Cognitive Science Conference*.
- Bock, Kay. 1986. Syntactic persistence in language production. *Cognitive Psychology*, 18: 355–387. DOI: 10.1016/0010-0285(86)90004-6
- Bock, Kay. 1989. Closed-class immanence in sentence production. *Cognition*, 31: 163–186. DOI: 10.1016/0010-0277(89)90022-X
- Bock, Kay, and Loebell, Helga. 1990. Framing sentences. *Cognition*, 35: 1–39. DOI: 10.1016/0010-0277(90)90035-I
- Boland, Julie. 1997. The relationship between syntactic and semantic processes in sentence comprehension. *Language and Cognitive Processes*, 12(4): 423–484. DOI: 10.1080/016909697386808
- Bott, Oliver. 2010. *The Processing of Events*. Philadelphia, PA: John Benjamins Publishing Company. DOI: 10.1075/la.162
- Briem, Daniela, Balliel, Britta, Rockstroh, Brigitte, Butt, Miriam, Schulte im Walde, Sabine and Assadollahi, Ramin. 2010. Distinct processing of function verb categories in the human brain. *Brain Research*, 1249: 173–180. DOI: 10.1016/j.brainres.2008.10.027
- Brugman, Claudia. 2001. Lights verbs and polysemy. *Language Sciences*, 23: 551–578. DOI: 10.1016/S0388-0001(00)00036-X
- Butt, Miriam. 1995. *The Structure of Complex Predicates in Urdu*. Stanford, California: CSLI Publications.
- Butt, Miriam. 2010. The Light Verb Jungle: Still Hacking Away. In *Complex Predicates in Cross-Linguistic Perspective*, Mengistu Amberber, Mark Harvey and Brett Baker (eds), 48–78. Cambridge University Press.
- Chang, Franklin, Bock, Kay, and Goldberg, Adele. 2003. Can thematic roles leave traces of their places? *Cognition*, 90: 29–49. DOI: 10.1016/S0010-0277(03)00123-9
- Chomsky, Noam. 1981. *Lectures on Government and Binding*. Dordrecht: Foris.
- Chomsky, Noam. 1995. *The Minimalist Program*. MIT Press.
- Croft, William. 2001. *Radical construction grammar: syntactic theory in typological perspective*. Oxford; New York: Oxford University Press. DOI: 10.1093/acprof:oso/9780198299554.001.0001
- Culicover, Peter, and Jackendoff, Ray. 2005. *Simpler Syntax*. Oxford University Press. DOI: 10.1093/acprof:oso/9780199271092.001.0001
- Durie, Mark. 1988. “Verb serialization and verbal prepositions”. *Oceanic Linguistics*, 27: 1–23. DOI: 10.2307/3623147
- Embick, D., Hackl, M., Schaeffer, J., Kelepir, M., & Marantz, A. 2001. A magnetoencephalographic component whose latency reflects lexical frequency. *Cognitive Brain Research*, 10(3): 345–348. DOI: 10.1016/S0926-6410(00)00053-7
- Family, Neiloufar. 2009. Mapping semantic spaces: A constructionist account of the light verb eat in Persian. In *From polysemy to semantic change: Towards a typology of lexical semantic associations*. M. Vanhove (ed.). Amsterdam: John Benjamins Publishing Company.

- Folli, Raffaella, Harley, Heidi and Karimi, Simin. 2004. Determinants of event type in Persian complex predicates. *Lingua*, 115(10): 1365–1401. DOI: 10.1016/j.lingua.2004.06.002
- Fried, Mirjam and Östman, Jan-Ola. 2004. Construction Grammar: A thumbnail sketch. In *Construction Grammar in a cross-language perspective*. Mirjam Fried and Jan-Ola Östman. 11–86. Amsterdam: John Benjamins. DOI: 10.1075/cal.2
- Goldberg, Adele. 1995. *Constructions: A Construction Grammar Approach to Argument Structure*. University of Chicago Press.
- Goldberg, Adele. 2003. Words by default: The Persian complex predicate construction. In *Mismatch: form-function incongruity and the architecture of grammar*, Elaine Francis and Laura Michaelis (eds.), 117–149. Stanford, CA: CSLI Publications.
- Goldberg, Adele. 2009. The Nature of Generalization in Language. [Target Article] *Cognitive Linguistics*, 20(1): 93–127.
- Hale, Kenneth L., and Keyser, Samuel J. 1993. On argument structure and the lexical expression of syntactic relations. *The view from building 20: Essays in linguistics in honor of Sylvain Bromberger*, 53–100. Cambridge, MA: MIT Press.
- Hale, Kenneth L., and Keyser, Samuel J. 2002. *Prolegomenon to a theory of argument structure*. Cambridge, MA: MIT Press.
- Hofmeister, Philip and Sag, Ivan. 2010. Cognitive constraints and island effects. *Language*, 86: 366–415. DOI: 10.1353/lan.0.0223
- Jackendoff, Ray. 1974. A deep structure projection rule. *Linguistic Inquiry*, 5(4): 481–505.
- Jackendoff, Ray. 1991. Parts and boundaries. *Cognition* 41: 9–45. DOI: 10.1016/0010-0277(91)90031-X
- Jackendoff, Ray. 1997. *The Architecture of the language faculty*. Cambridge: MIT Press.
- Jackendoff, Ray. 2002. *Foundations of Language*. Oxford University Press. DOI: 10.1093/acprof:oso/9780198270126.001.0001
- Jackendoff, Ray. 2007. A Parallel Architecture Perspective on Language Processing. *Brain Research*, 1146: 2–22. DOI: 10.1016/j.brainres.2006.08.111
- Jung, Dukkyo. 2002. Light Verb just as a Little v. *Kansas Working Papers in Linguistics*, 59–74.
- Kay, Paul. 1995. Construction Grammar. In *Handbook of Pragmatics*. Jef Verschueren, Jan-Ola Östman, and Jan Blommaert (eds), 171–177. Amsterdam/Philadelphia: John Benjamins. DOI: 10.1075/hop.m.con2
- Larson, R. 1988. On the Double Object Construction. *Linguistic Inquiry*, 19: 3.
- Levin, Beth and Malka Rappaport Hovav. 2005. *Argument Realization*. Cambridge: Cambridge University Press. DOI: 10.1017/CBO9780511610479
- McElree, Brian, and Griffith, Teresa. 1995. Syntactic and thematic processing in sentence comprehension: Evidence for a temporal dissociation. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 21(1): 134–157. DOI: 10.1037/0278-7393.21.1.134
- McGinnis, M. 2002. On the systematic aspect of idioms. *Linguistic Inquiry*, 33.4: 665–672. DOI: 10.1162/ling.2002.33.4.665
- Newman, John. 1996. *Give: A Cognitive Linguistic Study*. (Cognitive Linguistics Research 7.) Berlin: Mouton de Gruyter.
- Paczynski, Martin, and Kuperberg, Gina. To appear. When events change their nature.
- Palmer, Martha, Gildea, David, and Kingsbury, Paul. 2005. The proposition bank: An annotated corpus of semantic roles. *Computational Linguistics*, 31(1): 71–206. DOI: 10.1162/0891201053630264

- Phillips, Colin, and Lewis, C. To appear. Derivational order in syntax: Evidence and architectural consequences. In *Directions in Derivations*, C. Chesi (ed.). Elsevier, DOI: 10.4153/CJM-1981-105-7
- Pickering, Martin, and Ferreira, Victor. 2008. Structural priming: A critical review. *Psychological Bulletin*, 134: 427–459. DOI: 10.1037/0033-2909.134.3.427
- Piñango, Maria M., Mack, Jennifer, and Jackendoff, Ray. To appear. Semantic combinatorial processes in argument structure: Evidence from light verbs. *Proceedings of the annual meeting of the Berkeley Linguistics Society*, 2006.
- Pinker, Steven. 1999. *Words and Rules*. New York: Perennial.
- Talmy, Leonard. 1978. The relation of grammar to cognition: A synopsis. *Theoretical Issues in Natural Language Processing 2*, D. Waltz (ed.). New York: Association for Computing Machinery. Revised version in Talmy, *Toward a Cognitive Semantics*, MIT Press.
- Thothathiri, Malathi and Snedeker, Jesse. 2012. The Role of Thematic Roles in Sentence Processing: Evidence from Structural Priming in Young Children. Unpublished Manuscript.
- Wierzbicka, Anna. 1982. Why can you have a drink when you can't *have an eat? *Language*, 58(4): 753–799. DOI: 10.2307/413956
- Wiese, Heike. 2006. „Ich mach dich Messer“ – Grammatische Produktivität in Kiez-Sprache („Kanak Sprach“). *Linguistische Berichte*, 207: 245–273.
- Winhart, Heike. 2002. Funktionsverbgefüge im Deutschen. Zur Verbindung von Verben und Nominalisierungen. Dissertation, Universität Tübingen.
- Wittenberg, Eva, and Piñango, Maria M. 2011. Processing light verb constructions. *The Mental Lexicon*, 393–413. DOI: 10.1075/ml.6.3.03wit
- Wittenberg, Eva, and Snedeker, Jesse. In preparation. Syntactic Priming Across Constructions: Light Verbs.
- Wittenberg, Eva, Paczynski, Martin, Wiese, Heike, Jackendoff, Ray and Kuperberg, Gina. Under review. Light Verbs Make Heavy Work: An ERP Study of Processing an Argument Structure Mismatch.