Do foreign language learners also have constructions?

Evidence from priming, sorting, and corpora*

Stefan Th. Gries and Stefanie Wulff
University of California, Santa Barbara, & Max Planck Institute for Evolutionary Anthropology / University of Bremen

In Construction Grammar, the ultimate grammatical unit is the construction, a conventionalized form-meaning pairing. We present interrelated evidence from three different methods, all of which speak in favor of attributing an ontological status to constructions for non-native speakers of English. Firstly, in a sentence-fragment completion study with German learners of English, we obtained a significant priming effect between constructions. Secondly, these priming effects correlate strongly with the verb-construction preferences in native speaker corpora: verbs which are strongly associated with one construction resist priming to another semantically compatible construction; more importantly, the priming effects do *not* correlate with verb-construction preferences from German translation equivalents, ruling out a translational explanation. Thirdly, in order to rule out an alternative account in terms of syntactic rather than constructional priming, we present semantic evidence obtained by a sorting study, showing that subjects exhibited a strong tendency towards a construction-based sorting, which even reflects recent explanations of how constructions are related.

Keywords: constructions, priming, sorting, corpora

1. Introduction

Much recent work in grammatical theory has abandoned the assumption of much of transformational-generative grammar that the grammatical/syntactic system and the lexicon (as the repository of all irregularities) are disparate modules. One such approach is Construction Grammar, whose adherents posit a continuum of linguistic elements of different degrees of linguistic complexity, a so-called constructicon, with morphemic/lexical elements at one end of the scale and grammatical constructions and sentence-level idioms at the other end. The basic element

Annual Review of Cognitive Linguistics 3 (2005), **182–200**.
ISSN 1572-0268 / E-ISSN 1572–0276

of linguistic organization is the construction, which Goldberg (1995, p. 4) defines as follows.

> C is a construction iff$_{def}$ C is a form-meaning pair <F_i, S_i> such that some aspect of F_i or some aspect of S_i is not strictly predictable from C's component parts or from other previously established constructions.

One question that proponents of Construction Grammar need to face is that of the ontological status, or psychological reality, of constructions. More precisely, while there is little doubt that lower-level constructions such as morphemes and words do have some mental representation, this is not equally obvious for sentence-level constructions such as argument structure constructions. Apart from some theoretical arguments (avoiding implausible word senses, circularity of reasoning; cf. Goldberg, 1995, pp. 9–16), there are also some previous studies discussing empirical evidence which can be easily integrated into, and thus lends credence to, a construction-based account rather than a more modular approach.

For example, Bates & Goodman (1997) cite several previous studies providing strong empirical evidence for a strong correlation between morphosyntactic development and vocabulary size in language acquisition and aphasics, which supports the conception of a unified constructicon where morphosyntactic constructions and lexemes are not qualitatively different. In addition, Tomasello and his colleagues demonstrate how the investigation of how children go beyond the holophrase stage benefits from a constructional perspective in which verb-island constructions are a major developmental step; cf. Braine & Brooks (1995) and Tomasello (1998) for a comprehensive overview.

Second, there is some recent work on syntactic priming that invokes the notion of constructions. The notion of syntactic priming refers to the fact that speakers tend to repeat syntactic structures they have just encountered (produced or comprehended) before. For example, it was found that speakers were more likely to use a passive sentence to describe some event if they had just heard or produced a passive before; the same holds for the production of ditransitive structures as opposed to their prepositional dative counterpart. Although some of the earliest studies did not provide evidence that such cases of structural repetition are due to structural reasons alone — rather than, say, lexical priming, metrical similarity, thematic characteristics etc. — much experimental work beginning with Bock (1986) has shown beyond reasonable doubt that the priming effects obtained in study after study must in fact be attributed to mental processes involving some kind of phrase structure construction or representation. Some more recent work, however, (e.g. Hare & Goldberg, 1999; Chang, Bock, and Goldberg, 2002) has demonstrated that some findings can be better explained on the basis of constructions, i.e. form *and* meaning, rather than on the basis of phrase structure representations alone.

Finally, Bencini & Goldberg (2000) report the results of a sentence-sorting experiment where they demonstrate that about half of the subjects who sorted

sentences according to their semantic similarity preferred a construction-based sorting over a perceptually simpler verb-based sorting; cf. below for details.

As these examples show, and in accordance with most work within theoretical linguistics, work in Construction Grammar has mostly focused on the linguistic system of native speakers be it still under development during acquisition or 'largely complete'. Of course, this does not constitute a weakness of the approach, but the case for the ontological status of constructions could be strengthened if constructions could be shown to also influence the linguistic system of second or foreign language learners. To that end, we investigate exactly this issue on the basis of two case studies which aim at the two aspects most relevant to the definition of a construction, namely their form (using a production task) and their meaning (using a comprehension task). Thus, the present paper explicitly follows the logic of Goldberg (2002), but differs from the latter (i) by investigating non-native speakers of English and (ii) analyzing the results in more detail and by relating them to recent work on the association of verbs and argument structure constructions (cf. Stefanowitsch & Gries, 2003; Gries & Stefanowitsch, 2004).

2. Evidence from production: A sentence completion study of form-priming

2.1 Introduction

As was mentioned above, syntactic priming refers to the repetition of syntactic structures. With few exceptions, this phenomenon has been investigated on the basis of native speakers, mostly in English and Dutch. It is only recently that priming effects have been studied in other languages and especially across languages. For example, Hartsuiker, Pickering, and Veltkamp (2002) demonstrate syntactic priming from comprehending Spanish to producing English, Salamoura (2002, Exp. 2) demonstrates priming from Greek (L1) structures to English (L2) structures, and Flett (2003) investigates syntactic priming of English L2 speakers of Spanish.

Our first case study focuses on the form aspect of constructions. We report the results of a syntactic priming study of datives with German foreign language learners of English using the sentence-completion paradigm of Pickering & Branigan (1998). First, such a study is interesting with respect to the ontological status of constructions: On the one hand, if foreign language learners exhibited no priming effects, one would doubt that they had the kind of representation of formal aspects of constructions that would be necessary for 'having constructions', which would of course not say anything about the linguistic system of native speakers. On the other hand, if it could be shown that foreign language learners exhibit priming effects similar to those of native speakers, then they could at least be considered

to have some representation of what would be necessary to represent the formal structures of argument structure constructions. Second, such a study is interesting with respect to priming since, with the few exceptions just mentioned, the vast majority of syntactic priming studies has so far neglected priming in foreign languages and across languages, and it would be interesting to see to what degree non-native speakers exhibit similar sensitivity to syntactic patterns. In addition, we will also go beyond that by demonstrating the important role individual verbs and their associations to particular argument structure constructions play in priming studies, which is why future work on priming would benefit from taking into consideration how verbs relate to argument structure constructions.

2.2 Methods

For our experiment, we chose to replicate experiments 1 and 3 to 5 from a well-known study by Pickering & Branigan (1998), a sentence completion paradigm. The general design of the study was as follows. Subjects received questionnaires with incomplete sentences, namely primes, targets and fillers. The primes were taken from the appendix of Pickering & Branigan (1998) and consisted of sentence fragments of two kinds. One kind, exemplified in (1), consisted of a fragment that, given that the postverbal NP is most naturally understood as a recipient, would be most naturally continued as a ditransitive. By contrast, the second prime type exemplified in (2) consisted of a fragment that, given that the postverbal NP is most naturally understood as a patient, would be most naturally continued as a prepositional dative.

(1) The racing driver showed [$_{NP}$ the helpful mechanic] …

(2) The racing driver showed [$_{NP}$ the torn overall] …

The targets then consisted of sentence fragments without a postverbal NP so that subjects had to decide on some scenario and some syntactic pattern themselves. The filler items were sentence fragments of several kinds: sentence fragments ending in an intransitive verb, NP fragments ending with a relative pronoun, complete clauses to which an adverbial or a second clause could be added, etc. 64 subjects participated in the experiment. They were all students of English at the University of Hamburg, i.e. advanced foreign language learners of English (mean number of years of English teaching: 11.1, interquartile range: 2.6 years) and unaware of the purpose of the experiment. They were asked to complete all sentence fragments such that the result is a grammatically correct sentence. The dependent variable of this design was, therefore, the ratio of ditransitive and prepositional dative target completions after ditransitive and prepositional dative primes.

In addition to the above general design, the replication of Pickering & Branigan (1998) also involved some lexical and morphological variation across primes and

target such that in their experiment 1, the verb forms in the prime and the target were identical; in their experiment 3, 4, and 5, the verbs differed with respect to tense, aspect, and number respectively to determine whether such morphological differences influence priming or not. Our main argument will, however, be concerned with the set of results when the data from all four experiments are collapsed.

2.3 Results

The subjects provided us with 1,024 responses for primes and targets. Out of these responses, 372 had to be discarded for the subsequent analysis because either the prime had neither elicited a prepositional dative nor a ditransitive or, even though the prime had elicited a prepositional dative or a ditransitive, the target fragment was not completed using either of the two constructions. This left us with 652 experimental sentences where both prime and target consisted of either of the two constructions. For the first most general result, consider Table 1, which provides the observed frequencies of the four possible combinations of primes and targets (with expected frequencies in parentheses).

As is immediately obvious, the observed distribution deviates strongly from the expected one ($\chi^2 = 34.55$, $\Phi = 0.23$, $df = 1$, $p < .001$). More precisely, we find a clear tendency such that the subjects tended to use the syntactic structure in the target which they had just produced themselves in the prime: ditransitives prime ditransitives and prepositional datives prime prepositional datives. That is to say, even though the foreign language learners do of course have much less input in the language in which they were tested here, they still exhibit a behavior that is very much in line with what we know about native speakers.

2.4 Verb-specific construction preferences

The first relevant point is that the foreign language learners exhibit syntactic priming effects in a replication that are comparable to those of native speakers in the original experimental study; obviously, foreign language learners do have some representations of the syntactic structures instantiated in the experimental sentences that are similar enough to that of the native speakers to allow for priming and constitute the formal basis for constructional knowledge.

Table 1. Observed and expected construction frequencies across all four priming experiments

	Target: prepositional dative	**Target: ditransitive**	**Row totals**
Prime: prepositional dative	186 (148.7)	146 (183.3)	332
Prime: ditransitive	106 (143.3)	214 (176.7)	320
Column totals	292	360	652

While this result is already interesting from a constructional perspective, the data allow for a much more fine-grained analysis of the priming effects. There is a large body of previous work on verb subcategorization preferences and their semantic correlates. A more theoretical example is Levin (1993), but there is also much empirical work that measured the association between verbs and syntactic patterns from psycholinguistics (Connine et al., 1984; MacDonald, Pearlmutter, and Seidenberg, 1994; Garnsey et al., 1997) and quantitative corpus linguistics (Lapata, Keller, and Schulte im Walde, 2001; Stefanowitsch & Gries, 2003, 2005; Gries & Stefanowitsch, 2004). In addition, recent work indicates that even a single verb presented in isolation can already result in priming effects (cf. Melinger & Dobel, 2002). From both these kinds of results, we expect to find that different verbs result in differently strong priming effects, an issue that has apparently been completely neglected in the experimental literature so far (but cf. Gries [to appear] and Szmrecsanyi [to appear] for corpus-based approaches to syntactic persistence which do integrate verb-specific preferences). It is therefore interesting to determine (i) to what degree the priming effects we obtained are in fact verb-specific and (ii), if such verb-specificity effects can be identified, whether they can be more easily explained with reference to the verbs' preferences in L2 as tested in the experiment (cf. Section 2.4.1) or the verbs' translation equivalents in L1 (cf. Section 2.4.2).

2.4.1 *Verb-specific construction preferences: English*

To determine whether verbs are differently sensitive to priming, we started out from the logic of distinctive collexeme analysis (DCA) by Gries & Stefanowitsch's (2004). A DCA serves to measure the association between a word and semantically similar argument structure constructions in which the word can occur. For example, Gries & Stefanowitsch (2004) investigate which verbs are most strongly associated with ditransitives (*give*, *tell*, *show*, …) and prepositional datives (*bring*, *play*, *take*, …). The main characteristic of this approach relevant to our present

Table 2. Constructional biases (ditransitive vs. prepositional dative) of the verbs used in the priming experiments (on the basis of data from Gries & Stefanowitsch, 2004)

Verb	Ditransitive vs. prepositional dative (% of occurrence)	Index of constructional bias (corpus data)
show	76.56 vs. 23.44	−118.5
give	75.95 vs. 24.05	−116.8
send	36.16 vs. 63.84	−3.2
lend	35 vs. 65	0.06
hand	19.23 vs. 80.77	24.3
sell	6.67 vs. 93.33	43.7
post	0 vs. 1	53.9
All verbs	35.04 vs. 64.96	0

Table 3. Indices of constructional bias (experimental data)

show	*give*	*send*	*lend*	*hand*	*sell*	*post*
−14.6	−30.2	44.4	1.8	27.1	60	50

purpose is that DCA does not simply count the frequency of occurrence of some word in some construction, but rather normalizes these frequencies of occurrence against the frequencies of the word and the constructions (cf. Gries, Hampe, and Schönefeld [to appear, submitted] for empirical evidence of the superiority of this approach over raw frequency counts).

Consider Table 2. The two left columns provide the experimental verbs and their relative frequencies of occurrence in the ditransitive and the prepositional dative in the British component of the International Corpus of English (from the data in Gries & Stefanowitsch, 2004). The third column summarizes these pairs of relative frequencies in the form of a single index for each verb, which can range from $-\infty$ (for verbs which only occur in the ditransitive) over 0 (for verbs occurring in both constructions as often as might be expected on the basis of the constructions' frequencies) to $+\infty$ (for verbs which only occur in the prepositional dative). The fact that this index takes into consideration the overall frequencies of each construction can be seen most clearly with *lend*, whose index is close to zero since its percentages in both constructions (35% vs. 65%) are nearly the same as the overall constructional frequencies (35.04% vs. 64.96%).[1]

Given these preferences, we expect that verbs that are strongly associated with the ditransitive construction should be more sensitive to priming to the ditransitive construction as target verbs; the reverse should hold for verbs that are strongly associated with the prepositional dative, i.e. the caused-motion construction. This expectation can be tested when the preferences of the verbs obtained experimentally in Section 2.3 are also transformed into an analogous index (cf. Table 3) and then correlated with the same verbs' corpus bias as already indicated in Table 2.

This correlation of the corpus bias of the verbs and the priming preference in the experiment is represented in Figure 1; each point represents one verb and the lines result from a linear regression with a 95% confidence interval.

As is obvious, there is a very strong and significant correlation between the verb-specific constructional frequencies in the corpus and the readiness with which these verbs undergo priming ($r^2 = 0.8$; $t = -4.47$; $df = 5$; $p = 0.007$): Verbs that are associated with a particular construction in the corpus are more likely to be primed to that construction, e.g. *give* and *show* towards the ditransitive, *post* and *sell* towards the prepositional dative, and *lend*, which does not have a corpus preference, does not exhibit a constructional preference in the priming experiment.

2.4.2 *Verb-specific construction preferences: German vs. English*

Given our discussion of the verb-specificity effects, it is necessary to address a potential objection: Since the English constructions investigated here have closely

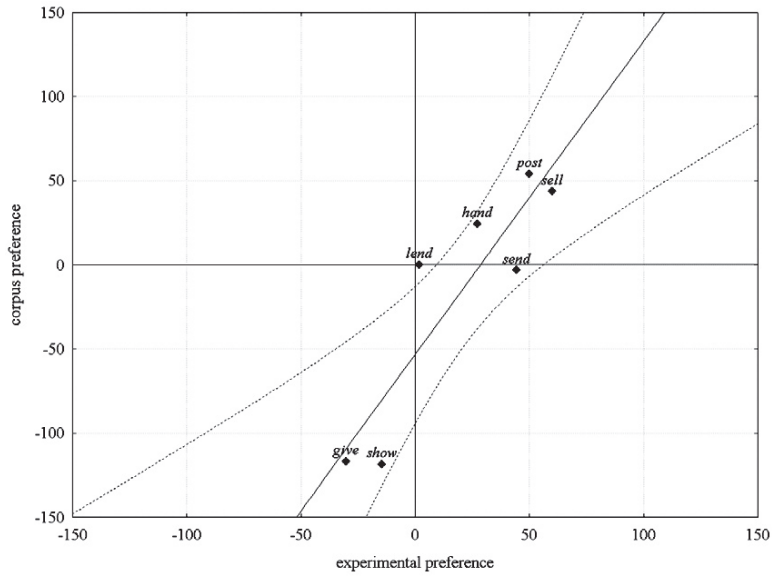

Figure 1. Correlation between corpus-based constructional preferences and experimentally obtained constructional preferences (with regression line and 95% confidence interval)

parallel constructions in the native language of the subjects, German, a potential counterargument might of course be that the subjects may have simply used their German patterns and that the experiment does not contribute to the question of whether foreign language learners have some representation of an English language construction. This is unlikely for several reasons. First, the results of the priming study yielded language-specific verb-specificity effects such that the German subjects' verb-specific constructional preferences strongly resemble (i) the verb-specific constructional preferences observed in naturalistic usage by English native speakers in the collostructional analyses by Gries & Stefanowitsch (2004) and (ii) the verb-specific priming effects of native speakers of English observed by Gries (to appear). This supports the idea that the English language system of the German native speakers somehow contains the same probabilistic information on how verbs are used.

Moreover, the results even show that the German subjects do not simply tap into their knowledge of German since the verbs' German translation equivalents exhibit very different constructional preferences (cf. also Schulte im Walde, 2003). This is obvious when we correlate the experimentally obtained preferences of our stimulus verbs from above on the one hand with corpus-based subcategorization frequencies of these verbs' German translation equivalents on the other hand.[2, 3]

The correlation between the experimentally obtained indices used above and the corpus-based indices from German is small ($r^2 = 0.05$; $df = 6$; $p = 0.577$); in fact, a Fisher z-transformation shows that the correlation between the experimental

Table 4. Constructional biases (ditransitive vs. prepositional dative) of the translation equivalents of the verbs used in the priming experiments (on the basis of data from Schulte im Walde, 2003)

Verb	Ditransitive vs. prepositional dative (% of occurrence)	Index of constructional bias (corpus data)
zeigen ('show')	62.71 vs. 37.29	−27.5
geben ('give')	37.78 vs. 62.22	22.5
senden ('send')	45.99 vs. 54.01	6.3
leihen ('lend')	97.85 vs. 2.15	−98.9
borgen ('lend')	82.34 vs. 17.66	−67.4
aushändigen ('hand')	92.5 vs. 7.5	−88
verkaufen ('sell')	43.94 vs. 56.06	10.3
schicken ('post')	42.19 vs. 57.81	13.8
All verbs	49.19 vs. 50.81	0

data and the corpus-based preferences in English is nearly eight times as large as the one between the experimental data and the corpus-based preferences in German; this difference is significant ($p_{one\text{-}sided} = 0.0439$).[4] This is exactly what would be expected when one assumes — as we do — that the German foreign language learners have built up some representation of the form of an English construction. Upon presentation of the English stimulus, one would not expect the Germans to access the German ditransitive but an English counterpart anyway because what are syntactically similar constructions in both languages differ in a variety of idiosyncratic and inextricably related semantico-syntactic properties, and such properties are what lies at the heart of the notion of construction and what is reflected in the distributional patterns identified in previous work on verb subcategorization preferences (e.g. Levin, 1993; Schulte im Walde, 2003). As one example, consider that *geben* ('give') and *werfen* ('throw') occur freely in the prepositional dative construction in English while this is hardly possible in German; by contrast, *schicken* ('post') and *verkaufen* ('sell') occur freely in both constructions in German, but have strong preferences in English.

2.5 Interim summary

In sum, our results are interesting in two respects. First, while the results do not yet provide incontrovertible evidence for foreign language learners processing argument structure constructions, they do indicate that at least the formal aspect of argument structure constructions is processed in a way similar to that of native speakers, for whose constructional knowledge we have sufficient and similar evidence. What is more, the likelihood that the foreign language learners have indeed built up some equivalent to the formal aspect of argument structure constructions is strongly increased: The German subjects not only exhibit the same preferences

of verbs to occur in one out of two semantically similar argument structure constructions as do native speakers of English in experimental and corpus studies, they also do *not* exhibit the preferences one might expect from the verbs' translational equivalents in German.

Second, the results have important implications for psycholinguistic studies since they indicate that overall priming effects like those reported in dozens of studies may in fact mask strong verb-specific effects, which must be taken into account to fully understand how constructional access is verb-dependent. Note in this connection that our argument is *not* that verb-specificity effects directly support a constructional approach — our argument is that it is possible to measure association strengths between words and syntactic patterns (or the constructions these instantiate) they (dis)prefer to occur in and that these can be different, similar, or identical across languages (here, L1 and L2) and our assumption that the German learners have some amount of constructional knowledge leads to the expectation that these associations should be at least similar. Since we find that they are in fact identical, we interpret this as evidence in favor of our assumption. We attempt no qualitative/theoretical interpretation of these verb-specificity effects in this study.

The next case study will now investigate whether the semantic correlate of syntactic structures can be observed equally well in foreign language learners.

3. Evidence from comprehension: A semantic sorting study

3.1 Introduction

Given that constructions are defined as a pairing of form and meaning, the second case study focuses more on the semantic aspect of constructions. We report the results of a replication of the sentence-sorting experiment of Bencini & Goldberg (2000) where German foreign language learner subjects sorted English sentences into groups. The sentences to be sorted crossed different verbs and different argument structure constructions allowing for — as extreme cases — a perceptually simpler fully verb-based or a less immediately transparent fully construction-based sorting. Native speakers have been shown to produce construction-based sortings about half of the time (cf. Bencini & Goldberg, 2000, pp. 644f., 647f.]), and if now even foreign language learners produced construction-based sortings when instructed to sort according to the perceived semantic similarity of sentences, this would constitute strong additional evidence for the kind of semantic representation required for 'having constructions'. This holds especially for the ditransitive and the caused-motion construction since these are used both in the priming and the sorting study, which is why both their formal and semantic properties are put to the test.

3.2 Methods

Twenty-two subjects (students of English language, literature and culture from the University of Hamburg) participated in the experiment. With one exception, all of them considered themselves native speakers of German; one student considered herself a native speaker of Russian, but was completely fluent in German. The subjects were all advanced learners of English (mean number of years of English teaching: 11.1, interquartile range: 2.5 years). None of them had participated in the priming experiment discussed above and none was aware of the purpose of the experiment. The subjects received a randomly shuffled set of sixteen cards, each with a different sentence printed on it. As in Bencini & Goldberg (2000), the sixteen sentences were generated by crossing four different verbs (*cut*, *get*, *take*, and *throw* in our case) with four different argument structure constructions (caused-motion, ditransitive, resultative, and transitive). The subjects were then instructed to sort the sixteen cards into four piles of four cards each based on the overall meaning of the sentence. As Bencini & Goldberg suspect that their first experiment was influenced by the kind of example they provided, no example as to how the sort may look like was given.

3.3 Results

The experimental results consisted of the four piles of four cards provided by each subject. Since the results of two subjects had to be discarded — because they failed to comply with the experimental instructions by sorting into more than four groups — we were left with 20 subjects' sortings for the subsequent analysis.

Let us first begin with the most general results, the sortings across verbs and constructions. Following the analysis by Bencini & Goldberg, we first determined for each subject the number of exemplars that would have to be reclassified into another category to arrive at a fully construction-based sorting and a fully verb-based sorting (cf. Lassaline & Murphy, 1996). The arithmetic mean of reclassifications necessary for a fully construction-based sorting was 3.45 (Md = 1), the corresponding figure for a fully verb-based sorting was 8.85 (Md = 11); that is, subjects exhibited a strong tendency towards a constructional sorting style. This difference between the two arithmetic means was then tested for significance. In spite of the small number of subjects, the difference of 5.4 reclassifications turned out to be significant both with a t-test for dependent samples ($t = 2.86$; $df = 19$; $p = 0.0099$) and a Wilcoxon test ($V = 153.5$; $p = 0.0143$). In other words, even though one might have expected the foreign language learners to resort to the perceptually simpler verb-based sorting, they rather focused on the constructions' semantic similarity (and even more so than Bencini & Goldberg's subjects), which provides strong semantically-based evidence for the semantic knowledge necessary for constructions of the foreign language learners. Interestingly, another replication

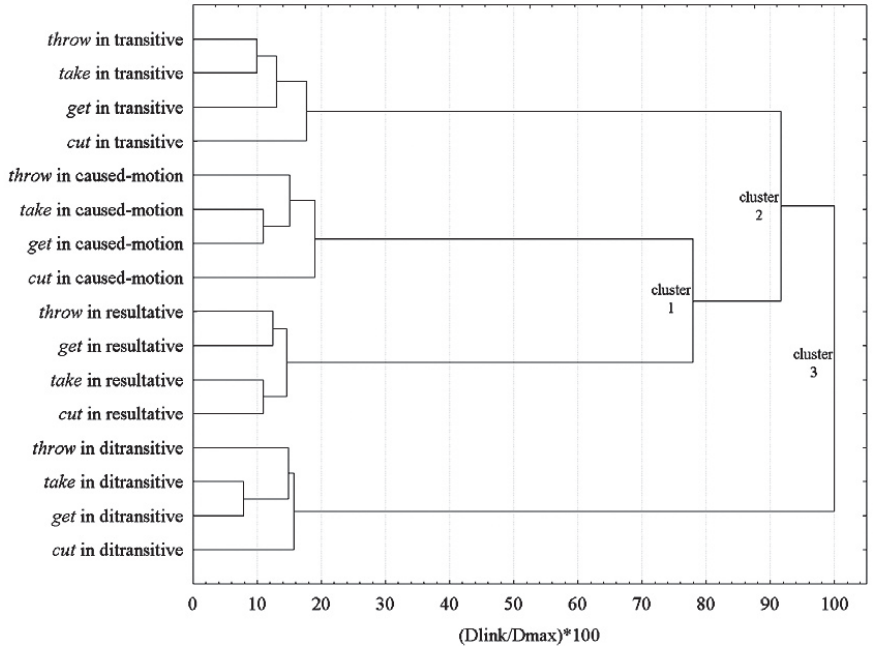

Figure 2. Horizontal dendrogram for the sorting experiment

of the sorting study conducted with Chinese learners of English yielded very similar results: Advanced learners of English exhibited average deviations of 4.9 and 8.2 from a pure constructional sorting and a pure verb-based sorting respectively (cf. Liang, 2002).[5]

In addition to the above, the results of such a design have even more to offer than Bencini & Goldberg have actually utilized. We therefore also investigated to what degree the overall preference of a constructional sorting was true for individual sentences used in the experiment. To that end, we determined for each of the sixteen experimental sentences how often it was sorted into one group with each of the other fifteen experimental sentences. This resulted in a symmetric similarity matrix with classification frequencies which was then investigated further using a hierarchical cluster analysis (distance measure: Euclidean distances; clustering algorithm: Ward's method). The analysis outputs four completely homogenous clusters (judging from applying the 'elbow criterion' to the line plot of the agglomeration schedule and the F-values for each experimental sentence in each cluster). The dendrogram output by the analysis illustrates the strong tendency towards constructional sorting since the four clusters obtained are pure constructional clusters (judging from the diagram as such and the t-scores for each sentence in each cluster).

In addition, a principal components analysis (with a Varimax normalized rotation) for the same data yielded results that are for all practical intents and purposes identical, namely four factors (amount of explained variance = 90.65%;

minimum Eigenvalue = 3.08) that are strongly dominated by the constructions. Since this result was already obvious from the cluster analysis, the only interesting aspect worth mentioning is that one of the verbs, *cut*, yielded slightly lower factor loadings on the four construction factors than the other verbs. Therefore, we looked at the individual verbs in more detail to determine whether some verbs lend themselves more easily to abandoning a simple verb-based sorting in favor of the construction-based sorting. From the raw data, we counted how often each verb was sorted together with another sentence with the same verb (rather than with a different verb) and tested the interaction Verb (*cut* vs. *get* vs. *take* vs. *throw*) × Sorting (together with same verb vs. together with other verb) for significance with an ANOVA. This interaction yielded no significant result ($F_{3, 232} = 1.78$; $p = 0.152$), which shows that no verb exhibited a significant preference to stick to itself, so to speak, but we found that *cut* does in fact tend to be sorted together with other cases of *cut* since its mean frequency of sticking together is more than 40% higher than that of all other verbs. While the study by Bencini & Goldberg yielded a similar uniformity of verb sortings (Goldberg, p.c.), it remains to be seen whether this is a theoretically interesting datum.

3.4 Interim summary

The experimental study has yielded several interesting results: First, we have seen that our foreign language learner subjects perceive sentences as much more similar to each other when they instantiate identical constructions than when they feature the same verbs. This tendency was surprisingly strong and clearly emerged both from the comparison of reclassification frequencies (across all experimental sentences) and, more graphically, from the dendrogram (for each experimental sentence). Apparently, then, the subjects relied more on the complement configurations and the corresponding semantics than on the superficial lexical similarity for sorting and that, even for language learners, argument structure constructions "are psychologically real linguistic categories that speakers use in comprehension" (Bencini & Goldberg, 2000, pp. 649f.).

4. Discussion

In sum, our results indicate that our German foreign language learners of English exhibit behavior that is fully compatible with a Construction Grammar account in several respects, namely

– the priming effects of syntactic patterns being similar to those of native speakers of English (cf. previous priming studies);

- the general verb-subcategorization preference / collostruction effects and the resulting the verb-specificity of priming effects (both incompatible with a mere translational approach); and
- the semantics of argument structure constructions.

While a sceptic might be tempted to explain the priming results away by arguing that the subjects only reacted to the syntactic patterns rather than the construction (in the Construction Grammar sense of the term), Hare & Goldberg (1999) as well as Chang, Bock, and Goldberg (2003) provided experimental evidence against this hypothesis (for native speakers). In addition, the sceptic could not explain away the above-mentioned semantic sorting preferences very similar to those of native speakers of English (cf. the previous study by Bencini & Goldberg). That is, if one calls into question the existence of constructions in general, one would predict that construction-based sortings should neither occur in general nor with non-native speakers in particular since the latter should be even more likely to resort to the simpler — unidimensional — verb-based sorting. If, on the other hand, even non-native speakers exhibit a strongly construction-based sorting style and, at the same time, verb-specific syntactic priming behavior like the native speakers, then this constitutes strong support for the constructional perspective positing a pairing of syntactic patterns with semantic structures and the ontological status that, among others, Bencini & Goldberg (2000, pp. 649f.) attribute to constructions:[6]

> The most important contribution of this study is that it provides a sufficiency proof that types of complement configurations play a crucial role in sentence interpretation, independent of the contribution of the main verb. The results suggest that constructions are psychologically real linguistic categories that speakers use in comprehension.

In addition to these results, there are some further implications. First, there are a few methodological implications of the present study that merit brief discussion. One is that the by now familiar fact that different verbs exhibit different and predictable degrees of sensitivity to priming adds to the growing body of experimental evidence supporting collostruction analysis; cf. also Gries, Hampe, and Schönefeld (to appear, submitted) for results from a sentence-completion experiment and a self-paced reading time study respectively. Another is that our way of evaluating the results of the sorting study opens up interesting perspectives for the analysis of constructions' properties: The cluster analysis of the at present limited number of constructions or, more precisely the amalgamation schedule of the constructions (to be discussed presently), conformed in such a way to theoretical predictions that it seems as if extending the methods to other constructions may make it possible to identify semantic patterns that ultimately may allow for choosing among different theoretical accounts of which construction derives from, or is (more) related to, some other construction (for related work, though not from a construction-grammar perspective, cf. Lapata [1999] or Schulte im Walde [2000, 2003]).

Apart from these methodological points, there are also several more theoretical ramifications of the present approach. For example, the dendrogram supports a Construction Grammar approach to the results of the sorting process. Note in particular how the four major constructional clusters are amalgamated. Our cluster-analytic results show that, of the four constructional clusters, the resultative and the caused-motion construction are amalgamated first into what is called cluster 1. This ties in with Goldberg's (1995, Section 3.4.1) analysis of the semantic similarity between the caused-motion construction and the resultative construction. In the next step of amalgamation, the transitive construction cluster is added to cluster 1, i.e. the cluster comprising the resultative construction and the caused-motion construction, yielding cluster 2. The perceived similarity of cluster 1 to the transitive construction is probably due to the facts that (i) all constructions in cluster 2 only have one object rather than two and (ii) the direct objects in the transitive construction and the cluster 1 are similar to patients, which tend to undergo a change of state as the result of the action denoted by the verb. Only then is the ditransitive construction, where the direct object does not normally change its state, added to the others, yielding the last cluster, cluster 3.[7]

Our results also have some (limited) bearing on the issue of input to acquisition. Although foreign language learners have much less input in the foreign language than native speakers have in their native language, they are still able to arrive at generalizations that lend themselves to construction-based explanations. Therefore, accounts arguing against constructions on grounds of limited input are apparently on the wrong track. In addition, in spite of the various differences between first and second/foreign language learning, the probabilistic nature of the results and their similarity to that obtained for native speakers provide strong additional support of exemplar-based theories of second/foreign language acquisition in which frequency of exposure to, and use of, constructions play a vital rule; cf. Ellis (2002, pp. 166–70) for recent discussion.

Finally, our results also offer an elegant way of establishing a link between Construction Grammar and recent psycholinguistic approaches to language production. Recall that our results indicated that priming effects are verb-specific such that the direction of priming is strongly contingent on individual verbs' probabilistic preferences, an issue that most, if not all, previous studies have not taken into consideration explicitly. Interestingly, this finding can be integrated elegantly into current lexically-driven psycholinguistic models of language production. For example, Pickering & Branigan's (1998) above-mentioned model involves links between individual verbs and so-called combinatorial nodes, and Hartsuiker, Pickering, and Veltkamp (2002, p. 10) extend this model by proposing that

> lemmas for English and Spanish verbs are both connected to the same category node and the same combinatorial node […] Activation of the lemma plus one of the combinatorial nodes leads to the activation of the grammatical structure, unspecified for language.

In a similar vein, we propose to extend Pickering & Branigan's model by positing (i) that the combinatorial nodes are not just syntactic in nature but rather constructional and (ii) that the links between individual verb lemmas and the combinatorial nodes they are connected to are differently weighted depending on (i) the language in which the connection exists and (ii) how strongly each individual verb is associated to each construction as measured by, say collostructional strength or other subcategorization-preference statistics. This way, we can begin to establish a psycholinguistic underpinning of Construction Grammar and, at the same time, offer a way of parsimoniously integrating our verb-specificity effects into existing models.

Notes

* The order of the authors is arbitrary. We thank (in alphabetical order) Benjamin K. Bergen and Adele E. Goldberg for their valuable feedback on an earlier version of this paper presented at the 3rd International Conference on Construction Grammar (Marseille, France) as well as Sabine Schulte im Walde for providing us with her results for German verb subcategorization preferences. The usual disclaimers apply.

1. For *loan*, no examples of ditransitives and prepositional datives were found in the corpus data; therefore, this verb is not dealt with in the discussion of verb-specificity.

2. Since there are two translation equivalents for *lend* in German, we included both into the analysis.

3. For the relative frequencies of the prepositional dative, we used what Schulte im Walde coded as *nap* and *ndp* (for nominative-accusative-prepositional phrase and nominative-dative-prepositional) irrespective of the actual preposition that was used because we were just interested in the syntactic pattern V NP PP; if only *nap* is used (to preserve the case of the prepositional dative), the results are identical. For the relative frequencies of the ditransitive, we summed the relative frequencies of the codes *nad*, *ndi*, *nar*, *ndr*, *nir*, *nds-w*, *nds-dass*, *nds-2*, *nrs-2*, *nrs-dass* (where the by far highest frequencies were provided by *nad* and *nar*; *r*, *i*, *s* stand for reflexive, non-finite verb phrases and sentence respectively).

4. Obviously, one may debate our proposals as to what the translational equivalents of particular verbs are; for example, one may suggest to translate both *send* and *post* as *schicken* rather than — as we did — as *senden* and *schicken* respectively. However, the results are not significantly affected by changing the indices accordingly.

5. We thank Adele Goldberg (p.c.) for this information.

6. This holds especially for ditransitives and the prepositional datives, which yielded the hypothesized results both in the (syntactic) priming study and the (semantic) sorting study.

7. Another well conceivable amalgamation schedule would have consisted of first amalgamating the caused-motion construction and the ditransitive construction since the former often involves what is considered the basic meaning of the ditransitive, namely transfer, and the latter often involves caused motion. Apparently however, the categorical syntactic commonality of

cluster 1 and the transitive construction (of having one object only) and/or the probabilistic semantic information about the roles of the participants have been more decisive than the probabilistic tendency of the caused-motion construction and the ditransitive construction to denote transfer by caused motion.

References

Bates, E. & Goodman, J.C. (1997). On the inseparability of grammar and the lexicon: Evidence from acquisition, aphasia and real-time processing. *Language and Cognitive Processes, 12*(5), 507–584.

Bencini, G., Bock, J.K., and Goldberg, A.E. (2002). How abstract is grammar? Evidence from structural priming in sentence production. Paper presented at the 15th CUNY Conference on Human Sentence Processing.

Bencini, G. & Goldberg, A.E. (2000). The contribution of argument structure constructions to sentence meaning. *Journal of Memory and Language, 43*(4), 640–651.

Bock, J.K. (1986). Syntactic persistence in language production. *Cognitive Psychology, 18*(1), 355–387.

Braine, M.D.S. & Brooks, P.J. (1995). Verb argument structure and the problem of avoiding an overgeneral grammar. In M. Tomasello & W.E. Merriman (Eds.), *Beyond names for things: Young children's acquisition of verbs* (pp. 353–76). Hillsdale, NJ: Lawrence Erlbaum.

Chang, F., Bock, J.K., and Goldberg, A.E. (2003). Can thematic roles leave traces of their places? *Cognition, 90*(1), 29–49.

Connine, C., Ferreira, F., Jones, C., Clifton, C., and Frazier, L. (1984). Verb frame preferences: Descriptive norms. *Journal of Psycholinguistic Research, 13*(4), 307–319.

Ellis, N.C. (2002). Frequency effects in language processing. *Studies in Second Language Acquisition, 24*(2), 143–188.

Flett, S. (2003). Syntactic priming in L1 and L2 Spanish. Paper presented at the 2003 Linguistics Postgraduate Conference.

Flett, S., Branigan, H.P., and Pickering, M.J. (2004). Similarities and differences in native and non-native sentence production. Poster presented at the 17th CUNY Conference on Human Sentence Processing.

Garnsey, S.M., Pearlmutter, N.J., Myers, E., and Lotocky, M.A. (1997). The contributions of verb bias and plausibility to the comprehension of temporarily ambiguous sentences. *Journal of Memory and Language, 37*(1), 58–93.

Goldberg, A.E. (1995). *Constructions: A construction-grammar approach to argument structure*. Chicago/London: University of Chicago Press.

Goldberg, A.E. (2002). Experimental support for a constructional approach to language. Paper presented at the 2nd International Conference on Construction Grammar.

Gries, St.Th. (to appear). Syntactic priming: A corpus-based approach. *Journal of Psycholinguistic Research*.

Gries, St.Th., Hampe, B., and Schönefeld, D. (to appear). Converging evidence: Bringing together experimental and corpus data on the association of verbs and constructions. *Cognitive Linguistics*.

Gries, St.Th., Hampe, B., and Schönefeld, D. (submitted). Converging evidence II: More on the association of verbs and constructions.

Gries, St.Th. & Stefanowitsch. A. (2004). Extending collostructional analysis: A corpus-based perspective on 'alternations'. *International Journal of Corpus Linguistics, 9*(1), 97–129.

Hare, M.L. & Goldberg, A.E. (1999). Structural priming: Purely syntactic?. In M. Hahn and S.C. Stones (Eds.), *Proceedings of the 21st Annual Meeting of the Cognitive Science Society* (pp. 208–211).

Hartsuiker, R.J., Pickering, M.J., and Veltkamp, E. (2002). Is syntax separate or shared between languages? Cross-linguistic syntactic priming in Spanish/English bilinguals. Paper presented at AMLaP 2002. (manuscript downloaded from http://allserv.rug.ac.be/~rhartsui/Taal/Veltkamp.pdf on 5 April 2004)

Lapata, M. (1999). Acquiring lexical generalizations from corpora: A case study for diathesis alternations. *Proceedings of the 37th Annual Meeting of the Association for Computational Linguistics* (pp. 397–404).

Lapata, M., Keller, F., and Schulte im Walde, S. (2001). Verb frame frequency as a predictor of verb bias. *Journal of Psycholinguistic Research, 30*(4), 419–435.

Lassaline, M.E. & Murphy, G.M. (1996). Induction and category coherence. *Psychonomic Bulletin and Review, 3*(1), 95–99.

Liang, J. (2002). *How do Chinese EFL learners construction sentence meaning: Verb-centered or construction-based?* M.A. thesis, Guangdong University of Foreign Studies.

Loebell, H. & Bock, J.K. (2003). Structural priming across languages. *Linguistics, 41*(5), 791–824.

MacDonald, M.C., Pearlmutter, N.J., and Seidenberg, M.S. (1994). Lexical nature of syntactic ambiguity resolution. *Psychological Review, 101*(4), 676–703.

Melinger, A. & Dobel, C. (2002). Lexically driven syntactic priming in sentence production. Paper presented at the 15th CUNY Conference on Human Sentence Processing.

Pickering, M.J. & Branigan, H.P. (1998). The representation of verbs: Evidence from syntactic priming in language production. *Journal of Memory and Language, 39*(4), 633–51.

Salamoura, A. (2002). Cross-linguistic structural priming and bilingual models of production. Paper presented at AMLaP 2002.

Schulte im Walde, S. (2000). Clustering verbs semantically according to their alternation behaviour. *Proceedings of the 18th International Conference on Computational Linguistics* (pp. 747–753).

Schulte im Walde, S. (2003). *Experiments on the automatic induction of German semantic verb classes*. Doctoral dissertation, University of Stuttgart. (Arbeitspapiere des IMS 9.2, Universität Stuttgart).

Stefanowitsch, A. & Gries, St.Th. (2003). Collostructions: Investigating the interaction of words and constructions. *International Journal of Corpus Linguistics, 8*(2), 209–243.

Stefanowitsch, A. & Gries, St.Th.(2005). Co-varying collexemes. *Corpus Linguistics and Linguistic Theory, 1*(1), 1–43.

Szmrecsanyi, B. (to appear). Language users as creatures of habit: A corpus-based analysis of persistence in spoken English. *Corpus Linguistics and Linguistic Theory, 1*(1), 113–149.

Tomasello, M. (1998). The return of constructions. *Journal of Child Language, 25*(2), 431–442.

Corresponding author's address

Stefan Th. Gries
Max Planck Institute for Evolutionary Anthropology
Department of Developmental and Comparative Psychology
Deutscher Platz 6
D-04103 Leipzig
Germany
E-mail: gries@eva.mpg.de

About the authors

Stefan Th. Gries did his PhD in English linguistics at the University of Hamburg, Germany. He is Assistant Professor for Linguistics at the University of California, Santa Barbara, and currently on leave at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. His research interests include corpus-based investigations of language within a broadly cognitive and constructionist framework.

Stefanie Wulff did her M.A. in English linguistics at the University of Hamburg, Germany and is currently a doctoral student at the University of Bremen, Germany, working on her PhD dissertation on idiomaticity. Her other current research interests include corpus-based investigations of language within a broadly cognitive and constructionist framework.

Appendix

Experimental stimuli used in the sorting study

Anita threw the hammer.
Audrey took the watch.
Barbara cut the bread.
Beth got Liz an invitation.
Chris threw Linda the pencil.
Dana got the mattress inflated.
Jennifer cut Terry an apple.
Kim took the rose into the house.
Laura got the ball into the net.
Lyn threw the box apart.
Meg cut the ham onto the plate.
Michelle got the book.
Nancy cut the tire open.
Pat threw the keys onto the roof.
Paula took Sue a message.
Rachel took the wall down.