

Acquiring English dative verbs: proficiency effects in German L2 learners

Christoph Wolk* (christoph.wolk@frias.uni-freiburg.de), Sascha Wolfer†, Peter Baumann†,
Barbara Hemforth‡, Lars Konieczny*†

*Freiburg Institute for Advanced Studies, Starkenstr. 44
D-79104 Freiburg i. Br., Germany

†Center for Cognitive Science, University of Freiburg, Friedrichstr. 50
D-79098 Freiburg i. Br., Germany

‡Laboratoire de Psychologie et de Neuropsychologie Cognitives, CNRS, Université Paris Descartes,
71 ave Edouard Vaillant, 92100 Boulogne-Billancourt, France

Abstract

This paper investigates the influence of probabilistic information in the second language on the processing of English dative alternation constructions in German learners of English. We present two eye-tracking studies (visual world and reading) with evidence that the probabilistic patterns of the target language influence L2 processing when the initial preference is violated, and indications that these patterns have a greater effect on more experienced speakers. We also observed a contrast-effect of L1, such that comprehenders expected constructions that occur more often in L2 than in L1, even if L2 lexical statistics suggested otherwise.

Keywords: Sentence processing, dative alternation, second language acquisition, expectation-based language processing

Introduction

In many languages, semantically dative sentences can be realized with two different object orders that only slightly differ in meaning, one in which the recipient comes before the theme and one where the reverse is true. In English, the former ordering is achieved by two bare noun phrases, as in (1-a), and the latter by having the recipient as a prepositional phrase, as in (1-b).

- (1) a. *double object dative (DO)*
I gave [her]_{recipient} [the book]_{theme}.
- b. *prepositional dative (PO)*
I gave [the book]_{theme} to [her]_{recipient}.

The dative alternation has received considerable attention from first- and second language acquisition researchers during the 1980s, especially from the perspective of generative grammar. These studies focused primarily on investigating the following two questions by means of grammaticality judgments and sentence completion tasks: First, how well do learners acquire hard constraints on the possibility of alternation, such as the fixed prepositional realization of most verbs of Latin origin such as *donate*; second, what is the order in which speakers acquire the possible realizations for verbs that do alternate. Major results (e.g. in Mazurkewich, 1985; Mazurkewich & White, 1984) were that verb-specific constraints are acquirable as hard constraints for first language learners with rare errors, but are only learned as softer constraints — or sometimes not learned at all — for second language learners. With regard to acquisition order, the prepositional dative realization tends to be acquired earlier and easier for second language learners.

Recent research on first language (L1) dative alternation patterns, however, has switched the focus from presumably 'hard' constraints on the possibility of alternation to the softer, probabilistic determinants of actually observed variation. This was motivated by cross-linguistic similarities in grammatical preferences (Bresnan, Dingare, & Manning, 2001) as well as the fact that in both naturally occurring language and experimental investigation 'hard' constraints turn out to be surprisingly violable (Bresnan & Nikitina, 2008; Bresnan, 2007) while simultaneous consideration of multiple 'soft' constraints led to considerable success in prediction of realizations, reading time, and fluency of production (Bresnan, Cueni, Nikitina, & Baayen, 2007; Bresnan & Ford, 2010; Tily et al., 2009). With regard to acquisition, children have been shown to mirror the probabilistic realization patterns of their environment (Marneffe, Grimm, Arnon, Kirby, & Bresnan, to appear). Second language studies within this probabilistic paradigm, however, are still rare; one exception is the study by Frishkoff, Levin, Pavlik, Idemaru, and Jong (2008), who used the results of (Bresnan et al., 2007) to investigate how both native and second language (L2) speakers learn to predict dative choice from examples, and found that L2 learners improve quickly when presented with stimuli containing a high degree of contrast between alternation preferences. Individual factors that were found to be reliable predictors for L1 speakers in corpus models have, however, also been shown to influence L2 learning at various proficiency levels. These include among others pronominality (Le Compagnon, 1984), givenness and persistence (Marefat, 2005), and weight (Tanaka, 1968; Callies & Szczesniak, 2008).

The goal of this paper is to investigate how attuned L2 learners are to fine probabilistic details of their target language. One predictor that is, due to its inherently probabilistic nature, especially suited for this research question is verb bias. More specifically, each dative verb has a specific idiosyncratic degree of preference in alternation choice; this preference is in general not predictable from semantics or morphology. A learner's acquisition of verb bias should thus be seen as direct instances of fundamentally experience-based learning. The experiments reported here are based on English L2 learners with German as L1. Like English, and unlike most L1s of previous studies, German has a double object dative; in contrast, the use of the prepositional dative is limited

to certain verbs.

Visual World Study

Tily et al. (2008) conducted a visual world eye-tracking experiment capable of tapping into very early and fine-grained expectations built up during sentence comprehension. Participants were looking at visual stimuli with depictions of the agent, recipient and theme of the sentence they were listening to simultaneously. Using verbs that either had a double object or prepositional object bias they found that participants were sensitive to the statistic information conveyed by the verbs. Anticipatory eye-movements (Altmann & Kamide, 1999) towards the depiction of the first argument arrived reliably earlier when it was compatible with the argument order suggested by the verb bias (Tily et al., 2008). The expectation effect showed up even at the second argument, where animacy information already could have disambiguated the arguments' thematic role as recipient (animate) or theme (inanimate). Since this paradigm and the experiment established very early and subtle effects of statistical biases, they seem very well suited for our purpose of investigating interference effects in second language learners. We therefore reran Tily et al. (2008)'s study in our lab in Freiburg with German L2 learners of English, varying in L2 proficiency.

Materials and Design

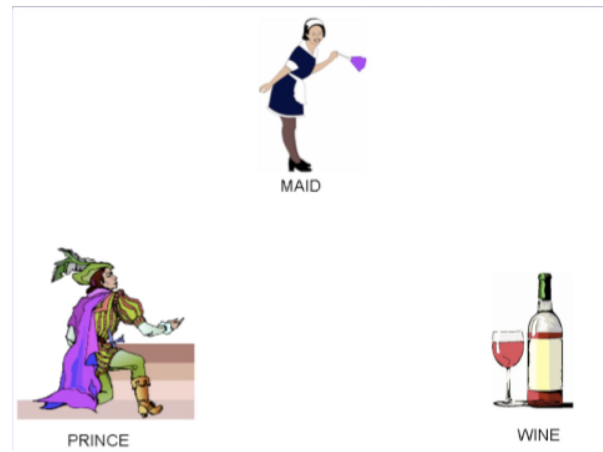
The materials contained seven pairs of verbs, which were picked to allow sentences to be constructed with the same nouns as recipient and theme. For each pair of verbs, four sets of subject, theme and recipient nouns were chosen, yielding 28 sentence pairs. From each sentence pair four versions were constructed along a 2×2 design (see sentences (2)) crossing the factors *verb bias* (towards prepositional object construction vs. towards double object construction) and *construction* (prepositional object, *PO* vs. double object, *DO*), yielding 112 sentences. Stimuli were rotated and distributed onto four lists such that each list contained exactly one condition of each item, and in any given list, each condition occurred the same number of times. Forty-four filler items not containing datives were added. The order of items in each list was randomized. To avoid subtle auditory cues, sentences were cross-spliced so that the part up to and including the verb was standardized across conditions.

- (2) a. *PO/DO bias, PO construction*
The maid will offer/serve the wine to the prince.
- b. *PO/DO bias, DO construction*
The maid will offer/serve the prince the wine.

Participants and Procedure

We tracked gaze positions from 38 participants on depictions of the subject, recipient and theme of the stimulus sentences. The picture of the subject always appeared at the top of the

Figure 1: Visual stimuli example (Tily et al., 2008)



screen, the recipient and theme appeared at the bottom, their position (left or right) was cross-balanced over all trials. At the beginning of each trial, the depictions were presented visually with corresponding words for two seconds (Figure 1). After the appearance of a fixation cross, the visual stimulus was presented without words, and the target sentence was presented auditorily. Gaze position was recorded with an Eye-Link 1000 (SR Research) and participants were paid €7.50 or received course credit for their participation. After the experiment, participants' scores in a subset of the TOEFL test (structure section) were collected.

Participants were assigned into two proficiency groups by means of a median split (a score of 15 out of 20) on the test scores.

Hypotheses

If German L2-learners have captured the subtle statistical biases of English, we would expect a pattern similar to that of native English speakers. However, depending on their proficiency level, they might not yet have picked up all those subtleties, and should then exhibit one of several behaviors:

1. Beginners might exhibit a general bias towards the word order predominant in L1 (German). That would predict a general expectation of Double-Object constructions, i.e. the expectation of the recipient in first argument position, and the expectation of the theme in second argument position.
2. More proficient learners might have captured some more fine grained differences between English and German, e.g. the fact that prepositional objects are far more common in English than in German. In that sense, PO-constructions might just in general sound more English (contrast effect).
3. Highly proficient learners might have captured even the fine-grained statistical biases of the L2.

Results

Figures 2 & 3 show a clear general tendency to look at the recipient (black lines) first, irrespective of the construction. In

Figure 2: Looks to argument-depictions in double object construction. (a) High-proficiency group (b) Low-proficiency group

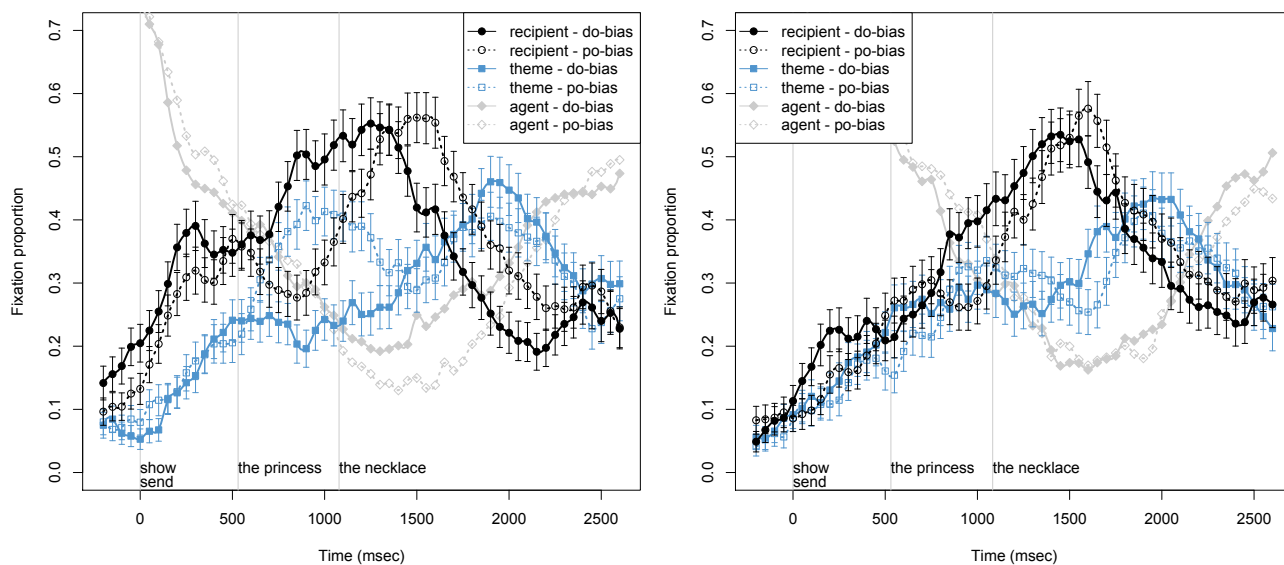
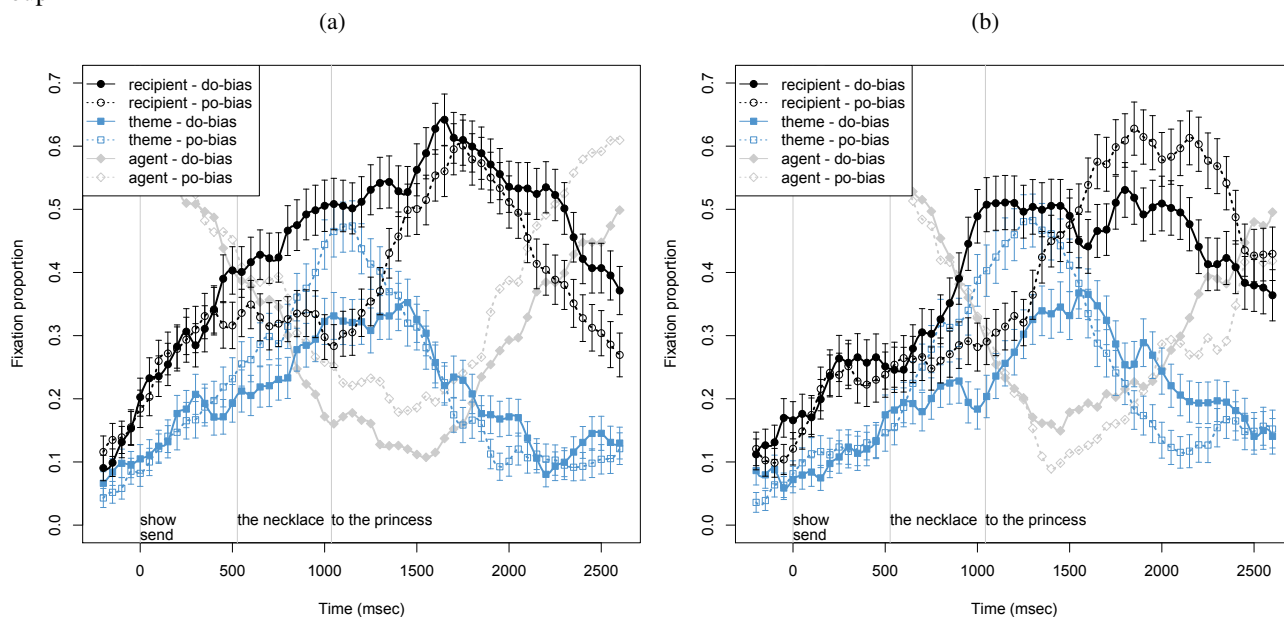


Figure 3: Looks to argument-depictions in prepositional object construction. (a) High-proficiency group (b) Low-proficiency group



sentences with PO datives (Figure 3) the recipient is looked at the most during the whole sentence for DO bias verbs (solid lines), while for PO verbs (dotted lines), there are early looks at the theme (light blue lines), which is the actual first argument in the PO construction. This pattern can be observed for both proficiency groups.

For DO dative realizations, there is a clear difference between proficiency groups: In the low-proficiency group (Figure 2b), gazes follow the constituents of the sentence, with

almost no difference between verb biases (solid vs. dotted lines). For the high-proficiency group, there is a clear difference depending on verb preference, such that PO-aligned verbs lead to more and earlier gazes toward the theme, as indicated in the difference between the solid and dotted blue lines in Figure 2a.

Discussion

As a first result, participants consistently look at the recipient earlier and longer compared to the theme. This could be

attributed to the fact that the recipient is animate, and thus visually more interesting: Tily et al. (2008) report a similar effect for English native speakers. Another explanation for this pattern is that German learners of English might generally expect dative sentences to follow the familiar recipient-theme pattern from their native language.

In PO dative constructions, verb bias shows a similar effect across proficiency groups, indicating that learners acquire subtle probabilistic patterns in the target language rather early. This contrasts with the DO datives, where no effect of verb bias for less proficient speakers was found. How could this be? Consider that, as noted earlier, participants tend to look at the recipient first, probably for non-linguistic reasons. In the PO condition (theme-first), this is incompatible with the actual linguistic realization, hence triggering an early re-direction of attention. Apparently, learners can make better use of stored statistical knowledge about language during this phase. DO datives behave differently, in that their order matches the default order. Less experienced speakers can just ignore verb bias, as they are already looking at the correct image. Learners with more experience, on the other hand, are led astray by their probabilistic expectations, leading to more gazes towards the argument matching the bias, but not the observed realization. In general, the results are consistent with the hypothesis that less proficient speakers are more strongly affected by L1 generic construction-biases, and even more so when the construction meets the expectation, although it is not possible to disentangle the influence of structural bias and visual interestingness on the basis of this experiment. More proficient speakers have captured more lexically specific statistic biases of the L2 and exhibit these across constructions.

Reading Study

It is still an open question whether verb bias influences L1 comprehenders' reading of dative sentences. Moreover, the effects in the visual world study could have been influenced by the presentation of the visual stimuli before the spoken target sentence, so that participants could start building expectations even before the sentence was uttered. Finally, by using written stimuli we could avoid the confounding of animacy and structural bias that was present in the Visual World experiment. We therefore conducted an eyetracking reading study. In this study, we also used a more fine-grained representation of verb-biases, which were taken from the entire spectrum and entered the model as a continuous variable.

Design and Materials

We constructed 36 English sentences in a 2×3 design (see the sentences in (3)), crossing the factors dative construction (prepositional object, *PO* vs. double object, *DO*) and type of recipient (singular animate, *ani* vs. collective, *col* vs. pronoun, *pro*). Stimuli were distributed across six lists according to a latin square rotation scheme such that each participant read each item in only one of the conditions.

Verb bias was captured by the best linear unbiased predictors (BLUPs). The BLUPs were calculated based on the large regression model reported in Bresnan et al. (2007). Verbs across the whole range of attested verb biases, i.e. from almost exclusively prepositional object to almost exclusively double object, were used.

- (3) a. *animate/collective/pronominal recipient, PO construction*
The delivery man | will | offer | the materials | to the worker/the factory/him | before the end of the week.
- b. *animate/collective/pronominal recipient, DO construction*
The delivery man | will | offer | the worker/the factory/him | the materials | before the end of the week.

Participants and Procedure

The results reported here stem from 29 participants, who received € 7.50 or took part for course credit. 36 target sentences together with 64 filler sentences were presented to the participants, preceded by 4 training trials. Before each sentence, a fixation target appeared at the position of the first letter of the sentence, then each sentence was presented in whole. Each sentence was followed by a comprehension question. After the experiment, participants completed the same subset of the TOEFL test as in the first experiment. Data was collected using an EyeLink 1000 (SR Research) with chinrest, sampling the pupil position and the cornea reflection at a 1000 Hertz rate.

Results

For data analysis sentences were divided into 6 interest areas as indicated by " | " in (3) (which were not present in the actual stimuli). The first area comprised all words up to *will*, the second area consisted only of *will*, followed by an area which contains only the verb and then two areas consisting of the first and second verb-argument. The sixth area covered the rest of the sentence. Only results from the first and the second argument areas will be reported.

Table 1: Mean reading times.

	First argument					
	PO _{ani}	PO _{col}	PO _{pro}	DO _{ani}	DO _{col}	DO _{pro}
FPRT	563	551	543	618	517	249
RPD	673	664	755	846	681	307
TRT	920	1126	1126	1388	1258	464
	Second argument					
	PO _{ani}	PO _{col}	PO _{pro}	DO _{ani}	DO _{col}	DO _{pro}
FPRT	741	729	388	587	619	519
RPD	834	815	453	766	916	629
TRT	1213	1311	723	1224	1402	978

Whole trials were discarded if *First Pass Reading Times* for any of the postverbal dative arguments exceeded 2000 ms, or if no reading time measures were available for either postverbal dative argument or the two preceding regions, which were used to calculate spill-over covariates, leading to the removal of the data of three participants.

We fitted¹ separate linear mixed effects models (Pinheiro & Bates, 2000) for *First Pass Reading Times* (FPRT), *Regression Path Durations* (RPD) and *Total Reading Times* (TRT). Our baseline model consisted of the log number of characters in the interest area, as well as the log regression path durations of the 2 preceding areas as spill-over covariates to control for possible influences of reading difficulties on prior regions. Random effects for items and participants as well as participant-specific random slopes for interest area length were also included in the baseline model.

We then enriched this baseline model in a stepwise manner. The experimental factors *construction* and *recipient* as well as the verb bias BLUPs and the TOEFL scores of the participants were consecutively included as fixed effects. Furthermore, we tested all interactions between these factors. Effects were only included in the model if they improved the overall fit of the model (as determined by a likelihood-ratio test). We will restrict our reporting of statistical values to TRTs, as the effects here are the most consistently reliable; in FPRTs and RPDs, the predictors usually either reach significance as well, or trend in the same direction.

Construction had a reliable effect on the first argument ($|t| = 3.401, p > 0.001$), and a marginally significant effect on the second argument ($|t| = 1.941, p < 0.0533$): in the *prepositional object* condition, the first argument (being the theme, e.g., *the materials*) was read faster than the first argument in the *double object* condition (being the recipient, e.g., *the worker/the factory/him*), and the same is true for the second argument. Unsurprisingly, learners with higher TOEFL scores read faster (first argument: $|t| = 2.713, p < 0.001$, second argument: $|t| = 2.064, p < 0.05$). There was also a reliable two-way interaction between *verb bias* and *construction*. In the *prepositional dative* construction, *verb bias* did not reliably affect reading time (first argument: $|t| = 1.629, p > .1$, second argument $|t| = 0.463, p > .6$). In the *double object* construction, however, participants read both the first ($|t| = 2.592, p < .001$) and second ($|t| = 2.267, p < .05$) argument faster, the more the verb was biased toward the double object dative. Finally, we found an effect of *recipient type* on the second argument. While there was no difference between animate and collective recipients ($|t| = 0.084, p > .9$), reading times in sentences with pronominal recipients ($|t| = 2.424, p < .05$) were reliably faster. In other words: in prepositional datives, pronominal recipients are read faster than other recipients, and in double object datives, themes

are read faster after prepositional recipients than after other recipients. The interaction that could distinguish between these two cases did not reach significance (likelihood-ratio test, $p < .172$); the trend suggests, however, that the effect results primarily from double object themes being read faster after pronominal recipients.

General Discussion

The results of the eyetracking-while-reading study share some similarities with those of the visual world study: both studies found that learners can make use of subtle statistical properties of the target language. In the visual world study, we found an effect of L2 proficiency on the gaze patterns for the two groups in the DO construction (see Figure 2). More precisely, proficient learners show eye movement patterns that are influenced by the verb bias; in contrast, such a difference was not observed for the less proficient group. For PO datives, both groups showed an effect of verb bias. We argued that this difference results from a general trend toward looking at the recipient first, which matches the word order in the double object dative. If the actual realization is not compatible with this tendency, speakers need to change their gaze pattern, and the speed of this change is faster if the verb prefers the prepositional dative. In the DO case, the initial looking-preference toward the recipient is supported by the sentence, and an effect of verb bias would require speakers to look away from the image that matches what they are hearing. This does not happen for less proficient learners; as they gain more second language experience, however, the relative importance of stored statistical information increases, so that it is not only used for repairing gazes that do not fit the expectation, but can actually lead comprehenders astray from the correct gaze pattern. We provided two possible causes for the tendency to look at the recipient first: that recipients, which are animate, are more visually interesting than the inanimate themes, or that this tendency matches typical pattern of dative realizations in German, where the prepositional dative is very restricted and the overall word order pattern is strongly biased towards recipient-theme order.

In the reading study, we found a reliable effect of verb bias on the total reading times of both the first and the second argument in double object datives, such that a better match between bias and actual realization leads to faster reading times. While this does indicate that verb bias plays a role while reading, the details of this result seem to be the inverse of those of the visual world study: instead of a consistent effect in PO datives, we find an effect on DO datives only. This can, however, be explained by a similar reasoning. Let us assume that readers tend to expect the theme-first order. This expectation is correct in PO dative sentences, and verb bias does not have an effect there. In DO datives, the expectation does not match the realization, and verb bias has an effect on the subsequent repair. This assumption is supported by the fact that reading times in the PO condition were lower for both post-verbal arguments, and it is consistent with the findings

¹All models were fitted using the statistical software package R (R Development Core Team, 2011) version 2.12.1, using the `lme4` package version 0.999375-33. The reported p values were determined via MCMC sampling, using the function `mcmcSamp` from the package `lme4`.

of previous research that the PO realization tends to be acquired earlier and more easily. Looking back at the interpretation of the visual world study, this suggests that L1 structural bias does not have an effect, and that the recipient-first patterns observed there are rooted in the visual characteristics of the stimuli. On the other hand, these results would also be consistent with the three-stage development process suggested in the hypothesis section of the visual world experiment. The median test scores were rather high for both experiments (15 out of a possible 20); thus it may be that we are primarily observing differences between learners who have already built up hypotheses on the 'Englishness' of the PO dative. This is, however, not unusual for English as a Second Language research on the dative alternation, which generally tends to focus on advanced learners. Still, a broader spectrum of learners would allow a more complete description of the interplay and development of probabilistic determinants in second language acquisition. Finally, differences in method and modality of presentation make arguments across both tasks somewhat difficult, and it would be preferable to fully tease apart visual animacy and structural bias in the visual world paradigm. Doing so would, however, require equal animacy status of both roles in the stimuli, which is difficult to realize given the meaning of typical dative verbs and the need for simple, clear visualization.

Conclusion

We presented two experiments providing evidence that L2 learners are capable of capturing subtle statistical lexical biases in the second language. These effects show up in both spoken and written language processing, indicating a complicated interaction of statistical biases of lexical and sentential entities. Acquisition appears to progress from capturing course grained contrasts to L1 (PO-bias) to more fine grained construction statistics, including lexical biases.

Acknowledgments

We want to thank Daniel Mueller, Anne Karina Feldmeth, and Julia Schuldes for many fruitful discussions and their support in running the experiments.

References

- Altmann, G., & Kamide, Y. (1999). Incremental interpretation at verbs: Restricting the domain of subsequent reference. *Cognition*, 73, 247-264.
- Bresnan, J. (2007). Is syntactic knowledge probabilistic? Experiments with the English dative alternation. In S. Featherston & W. Sternefeld (Eds.), *Roots: Linguistics in search of its evidential base*. (pp. 77-96). Berlin: Mouton de Gruyter.
- Bresnan, J., Cueni, A., Nikitina, T., & Baayen, H. R. (2007). Predicting the dative alternation. In G. Boume, I. Kraemer, & J. Zwarts (Eds.), *Cognitive Foundations of Interpretation* (p. 69-94). Amsterdam: Royal Netherlands Academy of Science.
- Bresnan, J., Dingare, S., & Manning, C. D. (2001). Soft constraints mirror hard constraints: voice and person in English and Lummi. In *Proceedings of the lfg 01 conference* (pp. 13-32). Stanford: CSLI Publications.
- Bresnan, J., & Ford, M. (2010). Predicting syntax: Processing dative constructions in American and Australian varieties of English. *Language*, 86(1), 186-213.
- Bresnan, J., & Nikitina, T. (2008). On the gradience of the dative alternation. In *Reality exploration and discovery: Pattern interaction in language and life*. (pp. 1-23). Stanford: CSLI Publications.
- Callies, M., & Szczesniak, K. (2008). Argument realisation, information status and syntactic weight – a learner-corpus study of the dative alternation. In M. Walter & P. Grommes (Eds.), *Fortgeschrittene lernervarietäten korpuslinguistik und zweitsprachenerwerbsforschung* (pp. 165-187). Tübingen: Niemeyer.
- Frishkoff, G., Levin, L., Pavlik, P., Idemaru, K., & Jong, N. de. (2008). A model-based approach to second-language learning of grammatical constructions. In *Proceedings of the 30th conference of the cognitive science society* (pp. 916-921). Washington, D.C..
- Le Compagnon, B. (1984). Interference and overgeneralization in second language learning: the acquisition of english dative verbs by native speakers of french. *Language Learning*, 34, 39-57.
- Marefat, H. (2005). The impact of information structure as a discourse factor on the acquisition of dative alternation by L2 learners. *Studia Linguistica*, 59(1), 66-82.
- Marneffe, M.-C. de, Grimm, S., Arnon, I., Kirby, S., & Bresnan, J. (to appear). A statistical model of the grammatical choices in child production of dative sentences. *Language and Cognitive Processes*.
- Mazurkewich, I. (1985). Syntactic markedness and language acquisition. *Studies in Second Language Acquisition*, 7(1), 15-35.
- Mazurkewich, I., & White, L. (1984). The acquisition of the dative alternation: Unlearning overgeneralizations. *Cognition*, 16, 261-283.
- Pinheiro, J. C., & Bates, D. M. (2000). *Mixed-effects models in S and S-PLUS*. New York: Springer.
- R Development Core Team. (2011). *R: A language and environment for statistical computing*. Vienna, Austria.
- Tanaka, S. (1968). The selective use of specific exemplars in second-language performance: The case of the dative alternation. *Language Learning*, 18(1-2), 63-88.
- Tily, H., Gahl, S., Arnon, I., Snider, N., Kothari, A., & Bresnan, J. (2009). Syntactic probabilities affect pronunciation variation in spontaneous speech. *Language and Cognition*, 1(2), 147-165.
- Tily, H., Hemforth, B., Arnon, I., Shuval, N., Snider, N., & Wasow, T. (2008). Eye movements reflect comprehenders knowledge of syntactic structure probability. In *Architectures and mechanisms for language processing*. Cambridge, UK.