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EMPIRICAL STUDY

Particle Placement in Learner Language

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This study presents the first multifactorial corpus-based analysis of verb–particle constructions in a data sample comprising spoken and written productions by intermediate-level learners of English as a second language from 17 language backgrounds. We annotated 4,911 attestations retrieved from native speaker and language learner corpora for 14 predictors, including syntactic complexity, rhythmic and segment alternation, and the verb framing of the speaker's native language. A multifactorial prediction and deviation analysis using regression (Gries & Deshors, 2014), which stacks multiple regression analyses to compare native speaker and learner productions in identical contexts, revealed a complex picture in which processing demands, input effects, and native language typology jointly shape the degree to which learners' choices of constructions are nativelike or not.

Keywords verb–particle construction; particle placement; learner corpus research; multifactorial regression; mixed-effects model; second language

Introduction

The acquisition of multiword units constitutes a challenging aspect of learning a language, be it a learner's first language (L1) or second language (L2). One type of multiword unit in English is verb–particle constructions (VPCs; also called transitive phrasal verbs), that is, combinations of a verb and a particle such as *pick up* NP, *take out* NP, or *throw away* NP (where NP stands for a noun phrase). VPCs are particularly difficult to acquire for several reasons. For one, they, although ubiquitous in English, are not particularly frequent in non-Germanic languages, so many L2 learners of English do not benefit from having

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a structural equivalent in their L1 from which they can transfer it to English (Larsen-Freeman & Celce-Murcia, 2015, p. 441). Second, although many VPCs are compositional such that their meaning can be derived from the meaning of the constituent verb and particle combination, many others are not, and often they are polysemous. According to Gardner and Davies (2007), the 100 most frequent VPCs in the British National Corpus (British National Corpus, 2001) instantiate 559 distinct senses, and their senses of course depend on, or correlate with, context. For instance, Example 1a, which instantiates a literal sense of *hold up* NP, contrasts with Example 1b, which triggers a figurative reading.

Example 1
a. The squirrel held up the nut to inspect it.
b. The squirrel held up traffic by dashing across the road.

To complicate matters further, the vast majority of VPCs alternate with regard to the position of the particle: It can either be placed in front of the direct object as in Examples 2a and 2c, or it can be stranded, that is, it can follow the direct object as in Examples 2b and 2d. However, Example 2d is less readily acceptable than Examples 2b and 2c, indicating a relation between particle placement and whether the VPC in question instantiates a literal or figurative sense.

Example 2
a. Verb–Particle–Object
The squirrel held up the nut to inspect it.
b. Verb–Object–Particle
The squirrel held the nut up to inspect it.
c. Verb–Particle–Object
The squirrel held up traffic by dashing across the road.
d. Verb–Object–Particle
The squirrel held traffic up by dashing across the road.

Given these idiosyncrasies, VPCs constitute a special challenge for many core components of linguistic theory, from acquisition to processing to mental representation. They behave like words in some respects but more like regular phrases in others. Consequently, VPCs have been the subject of numerous theoretical and empirical studies (Cappelle, Shtyrov, & Pulvermüller, 2010; Chen, 1986; Dehé, Jackendoff, McIntyre, & Urban, 2002; Gries, 2003).

In contrast to the abovementioned wealth of studies on particle placement in adult L1 speaker data, we know comparatively little about how this alternation is acquired by child L1 speakers (Diessel & Tomasello, 2005; Gries, 2011; Sawyer, 2001) or L2 learners. A striking observation repeatedly made is that although the Verb–Particle–Object (VPO) construction is the less marked, more basic cognitively, more easily parsed construction, and consequently perhaps the default constructional choice for adult L1 speakers (Gries, 2003; Hopper & Thompson, 1980), children acquire the Verb–Object–Particle (VOP) construction first and use it more than 95% of the time. This may be due to children's encoding one kind of event particularly often because it is especially salient to them: human agents that cause objects to move. Other findings from L1 acquisition data that stand at odds with adult preferences are, for example, that the definiteness of the direct object does not seem to matter too much to children (Gries, 2007). Not only is it much more difficult to account for this finding in a straightforward manner, it also raises the questions of whether and to what extent similar results can be found in L2 acquisition data.

However, even less is known about how particle placement is acquired by L2 learners. Several studies have pointed out that English L2 learners from Germanic and non-Germanic language backgrounds alike avoid VPCs and that L2 learners' intuitions about what a VPC means are often not completely accurate (Dagut & Laufer, 1985; Hulstijn & Marchena, 1989; Laufer & Eliasson, 1993; Liao & Fukuya, 2004). Yet research into the contexts in which L2 learners do in fact use VPCs, and/or when they choose to place the particle before or after the direct object, is very scarce to date.

One exception is Gilquin's (2015) study, in which she contrastively examined data from intermediate to advanced French learners of English as captured in the respective subsections of the Louvain International Database of Spoken English (Gilquin, De Cock, & Granger, 2010) and the International Corpus of Learner English (Granger, Dagneaux, Meunier, & Paquot, 2009) with L1 speaker data obtained from the Louvain Corpus of Native English Essays and the Louvain Corpus of Native English Conversation, both of which are part of the Louvain Database of Spoken English (see Gilquin et al., 2010). Her results suggested that in contrast to L1 speakers, the French learners employed VPCs more frequently in writing than in speech. More specifically, Gilquin noted that learners indeed made a variety of idiosyncratic choices as far as the choice of verbs and particles was concerned: They overused *together* and *back*, and they generally stuck with high-frequency verbs, which resulted in a less diverse repertoire of VPCs compared to the L1 speakers. As far as particle placement was concerned, however, her results indicated that "[t]he tendencies shown by the [V OBJ Prt] and [V Prt OBJ] alternation are also surprisingly similar in [L1] and [L2]" and that both constructions "appear to be quite well entrenched in the learners' constructions, where they seem to be stored with indications as to the types of verbs that each of them favours" (Gilquin, 2015, p. 81).

Deshors (2016) used the same methodological approach to examine prominent verb–particle combinations in the French and German subsections of International Corpus of Learner English in contrast with the Louvain Corpus of Native English Conversation. Among other things, her findings suggested that verb–particle associations were L1-specific such that the German learners showed a preference for a different set of verb–particle combinations than their French peers. Furthermore, the preferred verb–particle pairings were construction specific. As we discussed above, there are indeed lexico-constructional preferences such that the VPO and the VOP construction attract different verbs. A third finding was that contrary to the abovementioned observation in child L1 acquisition, the VOP construction appeared to be the more problematic variant for the German and French L2 learners. Deshors surmised that, unlike children, "[a]dult learners . . . have to immediately make the connection between the two syntactic patterns and ultimately, this makes the discontinuous construction harder for learners" (Deshors, 2016, p. 22).

Building on the extensive research on particle placement in L1 speaker production and expanding upon the far fewer studies on this alternation in L2 production, our study represented the first large-scale corpus analysis of particle placement in learner language. Specifically, this analysis has gone beyond the previous research discussed above in that

- it included data from L2 learners from many more different L1 backgrounds; as such it was the first crosslinguistic contrastive analysis of particle placement that could begin to disentangle potential transfer effects from more universal learning patterns;
- we presented a much more state-of-the-art statistical analysis, one that included much more linguistic/contextual features than previous work, namely, a multifactorial prediction and deviation analysis using a regression approach based on mixed-effects regression modeling (Baayen, 2008; Gries, 2015) to identify and quantify where and to what extent learner preferences deviated from L1 speaker preferences and to control for potential lexically specific effects (Gries & Adelman, 2014; Gries & Deshors, 2014);
- next to a host of predictors that have been shown to impact L1 speakers' choice of construction, we considered phonological variables such as rhythmic and segment alternation, effects of which have been observed in L1 acquisition of particle placement and in L2 acquisition of other alternations but have not been considered at all in L2 studies of particle placement.

Variables Known to Impact Particle Placement

L1 English

Like many other syntactic alternations in English, particle placement is correlated with a large number of (interrelated) linguistic and contextual variables, which can in turn be grouped according to what they (probably) operationalize. These variables include weight, information status, phonological predictors, semantics, and others. Weight-related variables correlated with particle placement are the length of the direct object (however measured, syllables, morphemes, words, syntactic nodes) and the complexity of the direct object but also, more indirectly however, pronominality because pronouns are by definition short and syntactically simple, whereas lexical direct objects can take on various lengths. Studies have consistently found that the longer the direct object is, the likelier it is that the speaker chooses to front the particle (e.g., Gries, 2003; Hawkins, 1994). Accordingly, disregarding all other potential determinants, Example 3a is preferable to Example 3b.

Example 3
a. The squirrel picked up the biggest hazelnut it could find.
b. The squirrel picked the biggest hazelnut it could find up.

Obviously, in this particular case, the direct object is also complex by virtue of its containing a relative clause, which is why the variable complexity would here lead to the same constructional choice. By contrast, with pronominal direct objects, we see that stranding the particle is virtually obligatory. Example 4a is the only acceptable choice for L1 speakers.

Example 4
a. The squirrel picked it up.
b. *The squirrel picked up it.

Previous studies have shown that the information status of the referent of the direct object is also relevant (e.g., Chen, 1986; Gries, 2003): Discourse-given or inferable referents of the direct object lead to the object intervening between verb and particle, whereas discourse-new referents prefer to follow the particle. Obviously, this set of variables is also correlated with the direct object's weight: Highly discourse-given referents will often be encoded with short, perhaps even monosyllabic, pronominal objects. Similarly, information status is correlated with definiteness where discourse-given and discourse-new referents are often encoded with definite and indefinite object noun phrases, respectively, resulting in a correlation between definiteness and particle placement. Finally, contrastive stress of the direct object, which marks the newness, unexpectedness, or importance of an object referent, strongly prefers verb–particle contiguity. In fact, contrastive stress is the only variable that can overrule the otherwise very strong preference of pronominal objects preceding the particle, as Example 5 shows (where the underlined word carries contrastive stress).

Example 5
He picked up him, not her.

Recent research has shown that there is a set of phonological variables unrelated to length or information status that seems to impact both L1 and L2 speakers' choices in other alternations, such as the genitive alternation or prenominal adjective order. These have hitherto not been examined in L2 particle placement data: rhythmic alternation and segment alternation. As far as rhythmic alternation is concerned, speakers generally prefer sequences that alternate between stressed (S) an unstressed (u) syllables as much as possible. Accordingly, for particle placement, one can hypothesize that Example 6b should be preferred to Example 6a because when one considers specifically the stress transitions between verb, object, and particle, there is a stress clash—two or more stressed syllables in direct sequence—in Example 6a, *pried* and *o(pen)*, but Example 6b alternates more strictly between stressed and unstressed syllables.

Example 6

a. The squirrel	pried	open	the hazelnut.
	S	Su	uSuu
b. The squirrel	pried	the hazelnut	open.
	S	uSuu	Su

Much as speakers prefer to alternate stressed and unstressed syllables, there seems to be a universal tendency to alternate consonant and vowels wherever possible (Couper-Kuhlen, 1986; Gries, 2007, 2011; Gries & Wulff, 2013; Schlüter, 2003; Wulff & Gries, 2015). Applying segment alternation to particle placement, one can hypothesize that Example 7a should be preferred to Example 7b because *climbed a pine tree up* contains a consonant–vowel alternation at the boundary between the verb and the direct object, and a vowel–vowel sequence at the boundary between the direct object and the particle, but *climbed up a pine tree* contains consonant–vowel alternations at both junctures.

Example 7

a. The squirrel climbed up a pine tree. [d ʌ] and [p ə]
b. The squirrel climbed a pine tree up. [d a] and [i: ʌ]

Yet another set of variables suggested in previous studies revolves around the semantic properties of the direct object and/or the construction at large. On a smaller scale, there is a correlation between particle placement and the abstractness, or concreteness, of the referent of the direct object such that abstract and concrete referents prefer pre-object and post-object particles, respectively (Gries, 2003). Accordingly, Example 8b should be preferred to Example 8a and Example 9a to Example 9b.

Example 8

a. Charlie held his principles up.
b. Charlie held up his principles.

Example 9

a. Charlie held the book up.
b. Charlie held up the book.

This in turn is also related to a larger-scale characteristic of the construction, namely, its degree of idiomaticity: Compositional VPCs that predictably denote the movement of the concrete referent of the direct object to the location or along the path denoted by the particle prefer the stranded order of VOP, whereas more metaphorical or even fully idiomatic VPCs usually prefer the particle following the verb, that is, VPO (see also Schnoebelen, 2008, for an information-theory–driven approach to measuring the compositionality of phrasal verbs in which non-compositional phrasal verbs predict the VPO construction).

Finally, some variables that correlate with particle placement do not easily fit any of the above categories although they, just like many of the above, are arguably related to processing characteristics. These include lexically-specific preferences that particular transitive phrasal verbs have for either the VPO or VOP construction. For instance, Gries and Stefanowitsch (2004) showed that *carry out* and *find out* are strongly attracted to VPO whereas *get back* and *get out* are strongly attracted to VOP. Given instances such as Examples 8 and 9 above, however, it is probably more appropriate to consider these to be verb–sense preferences instead. It is not so much the combination of a verb and a particle that entails a preference but the combination of a verb, a particle, and a meaning. Finally, as with many other alternations, Szmrecsanyi (2006) found that particle placement is sensitive to constructional priming. The occurrence of one particular ordering increases the likelihood of another instance of that ordering in subsequent discourse.

L2 English

From a usage-based perspective like the one that we have adopted here, L1 and L2 learning are not fundamentally different: The same cognitive machinery and processes are recruited (see Ellis & Wulff, 2015). That said, in sequential L2 learning at least, the learning of the L2 is assumed to be impacted by the fact that a L1 has already been acquired, that is, L2 learning is in many ways about overcoming predispositions imposed by the L1, and consolidating L1 and L2 knowledge. In the context of the present study, we thus assumed that, generally speaking, any of the predictors summarized in the previous section should also impact L2 learners, yet whether a given predictor surfaces as relevant at all, or the extent to which it impacts particle placement (compared to a monolingual speaker), was assumed to vary depending on both a L2 learner's L1 as well as the learner's L2 proficiency. To give a concrete example of crosslinguistic influence of the L1 (mentioning only languages represented in the present data sample), L1 speakers of Bulgarian, Czech, Polish, Russian, French, Spanish, Chinese, Finnish, Greek, Japanese, and Tswana might have more difficulty with particle placement than L1 speakers of Dutch, German, Italian, Norwegian, Swedish, and Turkish, because the former languages do not have particle verbs but the latter do (and for some languages like Greek, there is in fact discussion in the field as to whether they have particle verbs akin to those in English, or rather something else).

To complicate matters, even if a language has particle verbs, it need not have particle placement as defined for English. In German, for instance, the particle is obligatorily separated from the verb when the verb is inflected for present tense and person, but this happens regardless of whether a direct object follows the verb or not. From what we were able to glean from the literature, the only L1 represented in our data sample that has particle placement unambiguously analogous to how it works in English is Norwegian. One could hypothesize, then, that of all the learners represented in our data sample, Norwegian speakers should have the least difficulty with acquiring English particle placement. Speakers of Dutch, German, Italian, Norwegian, Swedish, and Turkish should fall in the middle range because, although they do not have particle placement in their L1s, they do have (separable) particle verbs. And speakers of Bulgarian, Czech, Polish, Russian, French, Spanish, Chinese, Finnish, Greek, Japanese, and Tswana should have the most difficulty because their languages (likely) do not include particle verbs at all. However, it needs to be borne in mind that this is of course still somewhat of a simplification, given that the degree to which learners master a construction(al choice) in a L2 is not only dependent on whether they have an analogous or similar structure in their L1 but also on how similar the relevant constructions' patterns are in their L1 to those of the L2. Nonetheless, our overall expectation from above still held.

Accordingly, we would have liked to include the participants' L1s as a predictor variable in our analysis to see if these predictions panned out. Unfortunately, however, some L1s were represented with many fewer data points than others (94 and 105 Greek and Turkish L1 data points vs. 427 and 743 German and Chinese data points), which resulted in model fitting problems. An alternative idea was to group languages by overall typological similarity. Previous work has indeed found differences between, say, Germanic and Romance L1s for learners of English (see Gries, 2018, for a mixed-effects model analysis of the data of Hasselgârd & Johansson, 2011). However, this decision would have resulted in grouping languages together that are known to differ in terms of whether they allow particle placement or not. The two Nordic languages in our data sample were Norwegian and Swedish; however, as we stated above, Norwegian has particle placement, but Swedish does not. We thus discarded the global typology grouping.

Considering that verb–particle constructions, and particle placement in turn, are in essence about encoding (nonliteral) motion events, it seemed much more meaningful to group language not by overall typological similarity but instead more specifically in terms of how motion and path encoding is realized in these different languages. We thus opted to group the L1s according to their verb framing. Specifically, we employed Talmy's (1991) distinction between satellite-framed, verb-framed, and equipollent languages. In satellite-framed languages like English, motion events are typically expressed with verbs that may encode the motion and manner lexically, with the path of motion encoded using a satellite particle or prepositional phrase. In *Steffi walked to school*, for instance, *walked* encodes motion and manner of motion (walking being one of several possible ways of realizing pedestrian movement, different from, say, running, moseying, or skip-hopping), but the path of motion is encoded separately in the prepositional phrase *to school*. In contrast, in a verb-framed language like Spanish, for example, verbs conflate the motion and path dimensions in their lexical semantics, and the manner of motion has to be encoded externally: *entrar*, *salir*, and *bajar* mean *go in*, *go out*, and *go down*, respectively. Manner of motion is typically expressed through participles as in *entró corriendo* (literally "he entered running") or *salió flotando* ("it exited floating"). In recognition of the fact that, as with any typological dichotomy, many languages fall squarely in between, the term equipollent is reserved for languages like Chinese that seem to variably conflate motion, manner, and path.

We labeled the 17 L1s in our data sample as equipollent, satellite-framed, or verb-framed based on existing classification in Egan (2015), Iacobini and Masini (2007), Liao and Fukuya (2004), Montero-Melis et al. (2017), Pasanen and Pakkala-Weckström (2008), Treffers-Daller (2011), and Yasuda (2010) to create three language families. The only equipollent language in our data sample was Chinese; satellite-framed languages included Bulgarian, Czech, Dutch, Finnish, German, Norwegian, Polish, Russian, Spanish, and Swedish; and we classified French, Greek, Italian, Japanese, Spanish, Tswana, and Turkish as verb-framed languages.

As we stated earlier, when L2 learning is defined as, in many ways, the unlearning of L1 predispositions, then the potential negative impact of the L1 should diminish with increasing L2 proficiency. Although our data sample was not longitudinal in nature and thus did not allow us to examine developmental trajectories, we can at least assume that because all participants were at intermediate–advanced level, the impact of the L1 should have been moderate overall.

Method

Data Retrieval and Annotation

We based our data retrieval on Gries and Stefanowitsch (2004), who retrieved VPCs from the British component of the International Corpus of English (https://ice-corpora.net/ice) using the Fuzzy Tree Fragment query option. We identified all verb lemmas and particles used in a VPC at least once in Gries and Stefanowitsch's data. We then retrieved all inflectional forms of all those verb lemmas and particles in the British National Corpus (British National Corpus, 2001).

Next, we used R scripts (Version 3.5.1; R Core Team, 2018) to, first, tag all instances of all the verb forms and particles and, second, retrieve all instances of something tagged as a verb followed somewhere later by something tagged as a particle in the following corpora:

- International Corpus of Learner English;
- Louvain International Database of Spoken English Interlanguage;
- Louvain Corpus of Native English Essays;
- Louvain Corpus of Native English Conversation.

We then manually checked the resulting matches for whether they constituted instances of either VPC (as opposed to intransitive prepositional verbs,

Table 1 Attestations of the Verb–Particle–Object (VPO)/Verb–Object–Particle (VOP) constructions in the data sample

Corpus	VPO	VOP	Total
Learner			
ICLE	2,760	1,021	3,781
LINDSEI	416	274	690
Subtotal	3,176	1,295	4,471
L1 speaker			
LOCNESS	212	101	313
LOCNEC	60	67	127
Subtotal	272	168	440
Grand total	3,448	1,463	4,911

Note. ICLE = International Corpus of Learner English; LINDSEI = Louvain International Database of Spoken English Interlanguage; LOCNESS = Louvain Corpus of Native English Essays; LOCNEC = Louvain Corpus of Native English Conversation.

phrasal prepositional verbs, etc.). Table 1 displays the final number of attestations of each construction in the four corpora.

The frequencies in Table 1 indicate that the participants used VPO slightly more frequently than the L1 speakers (71% vs. 62%), an overuse finding that, however, did not reveal much because it did not control for any predictors. We annotated all 4,911 attestations for a variety of predictor variables that previous research on particle placement had identified as co-determining this alternation (see Gries, 2003). First, we coded all L1 speaker and participant data for the following predictors:

- The order of constituents in the VPC: VPO (e.g., *Commander Riker beamed back Captain Picard*) or VOP (e.g., *Commander Riker beamed Captain Picard back*).
- The lengths of the particle and the direct object noun phrase in characters as well as the logged pairwise length difference between them for each construction (however, see below).
- The complexity of the direct object: whether it was a pronoun or a name (e.g., *beamed him up from the station*), a simple noun phrase (e.g., *beamed the officer up from the station*), or a modified noun phrase (e.g., *beamed a very angry Captain Picard up from the station*). This classification conflated two different kinds of modification (phrasal and clausal) for data sparsity reasons. Also, this variable was correlated very highly with the length difference

variable from above, which is why we retained only this complexity variable in the final analysis.

- The definiteness of the direct object noun phrase: definite versus indefinite.
- The concreteness of the direct object referent: concrete (e.g., *Riker brought the phaser back to the ship*) versus abstract (e.g., *The Enterprise brought back peace to the region*).
- Whether a prepositional phrase followed the VPC (e.g., *Commander Riker beamed Captain Picard back [*$_{\mathrm{PP}}$ *to the Enterprise]*) or not.
- The idiomaticity of the VPC: literal (e.g., *Commander Riker carried out the box to Commander Data*) versus metaphorical/idiomatic (e.g., *Commander Riker carried out Captain Picard's instructions*).
- Segment alternation in the VPC: This was coded by considering two transition points in each VPC—one between the final segment of the verb and the first segment of the next word (direct object or particle) and one between the final segment of the direct object or the particle and the particle or the first word of the direct object, respectively. We coded both transition points for whether they involved a strict consonant–vowel (CV) alternation, in which case it was coded as 0, a sequence of two different consonants (C_1C_2) or vowels (V_1V_2), to both of which we assigned a value of 1, or a sequence of identical consonants (C_1C_1) or vowels (V_1V_1), to both of which we assigned a value of 2. For each observed attestation in our dataset, we then added up the values arising from this coding of the two transition points, captured that value in a variable called SegAltObs, and then added up the values that would have arisen from the other ordering of the VPC and stored that in a variable SegAltAlt. The variable SegAltDiff was then computed as SegAltAlt minus SegAltObs: (a) positive values indicated that the actually chosen order of the VPC was more compatible with segment alternation than the theoretically possible reverse order; (b) negative values indicated that the actually chosen constituent order of the VPC was less compatible with segment alternation than the theoretically possible reverse order (e.g., *beamed*–$_{\mathrm{CC}}$–*the crew*–$_{\mathrm{VC}}$–*back* was better than *beamed*–$_{\mathrm{CC}}$–*back*–$_{\mathrm{CC}}$–*the crew*); and (c) values of 0 indicated that both were equally (in)compatible with segment alternation (e.g., *beamed*–$_{\mathrm{CC}}$–*the box*–$_{\mathrm{CC}}$–*back* and *beamed*–$_{\mathrm{CC}}$–*back*–$_{\mathrm{CC}}$–*the box*).
- Rhythmic alternation in the VPC: We coded this as the sequence of stressed (*S*) and unstressed (*u*) syllables of the actually observed ordering (as in *lock up his imagination* → SuuuSuSu), which we stored in a variable called RhythAltObs; the sequence of stressed (*S*) and unstressed (*u*) syllables of the theoretically possible alternate ordering (*lock his imagination up* → *SuuSuSuS*) we stored in a variable called RhythAltAlt. For both these

variables, we converted the sequences of *S*s and *u*s into a number between 0 and 1 that quantified the degree to which the sequence exhibited stress clashes (i.e., sequences of 2+ *S*s) or stress lapses (i.e., sequences of 3+ *u*s), which we then normalized against the length of the sequence. For example, (a) a (hypothetical) sequence such as *SSSSuuuuuu* violated rhythmic alternation maximally, and we scored it as 1; (b) a sequence such as *SuSuuSuSu*, which adhered to rhythmic alternation perfectly, we scored as 0; and (c) a sequence such as *uuSuSS*, which violated rhythmic alternation a bit, was scored as 0.4. Finally, we then computed a RhythAltDiff value, namely, the result of RhythAltAlt minus RhythAltObs, whose sign, as with SegAltDiff, indicated whether the actually chosen constituent order in the VPC was more compatible or not with rhythmic alternation than the theoretically possible reverse order (e.g., *lock his imagination up* is better than *lock up his imagination*) or whether there would be no difference.
- The corpus (parts) and hence the mode (spoken vs. written) of the utterance.
- The verb and the particle lemma of the VPC for random intercepts.

Second, we additionally coded the learner data for the following predictors that applied only to L2 speakers:

- The L1 of the learners (Bulgarian, Chinese, Czech, Dutch, Finnish, French, German, Greek, Italian, Japanese, Norwegian, Polish, Russian, Spanish, Swedish, Tswana, and Turkish).
- The verb framing of the L1: equipollent, satellite-framed, or verb-framed.
- A measure of the lexical diversity of the utterances produced by the learners (without the data of the L1 speaker interlocutors) as a proxy for learners' proficiency level, for which we wanted to control (Bulté & Housen, 2012; Ortega, 2012; Paquot, 2019; Wulff & Gries, in press). To do this and to go beyond simple type–token ratios, we computed both Yule's *I* and the Guiraud statistic for each learner/file and condensed them into a single factor score using a principal component analysis (which retained more than 95% of the variance of both lexical diversity measures).

We originally intended to include a priming predictor as well, which would have had three levels: *none* for all and only all first occurrences of a verb–particle construction per speaker, and VOP or VPO for cases where either one was used the previous time. However, there are too few data points per speaker in our dataset to include a priming predictor that would not lead to data sparsity problems. In the L2 speaker data, one third of the speakers used only a single verb–particle construction, and another one third of the speakers used only two.

Consequently, a priming predictor would have been mostly no priming when, of course, the only two interesting levels of such a predictor would be VPO and VOP. Thus, priming awaits a dataset with more instances per speaker, which in turn will increase the numbers with which the two interesting levels of that predictor can be attested.

The Multifactorial Prediction and Deviation Analysis Using a Regression Approach

In an attempt to go beyond much previous learner corpus research, we decided to apply a fairly new approach called multifactorial prediction and deviation analysis using regression (see Gries & Adelman, 2014; Gries & Deshors, 2014), which, instead of solely relying on decontextualized overuse/underuse frequencies for corpora representing different L1s, involves a two-step regression procedure that (a) computes for every learner choice what a L1 speaker would have chosen in the same context and then (b) explores where and why the learner choices deviate from the L1 speaker choices. The logic of this approach is visualized as a flowchart in Figure 1.

In our case, we first fit a generalized linear mixed-effects model on the L1 speaker data only (Regression Model 1). We then checked whether this model had sufficiently high predictive power to be used to impute L1 speaker choices for the learner data, which it did. We then applied this regression model to all the learner data to determine the constructional choices L1 speakers would have made in the exact same situations in which the learners were, and to determine whether the learners had in fact made nativelike choices or not. The latter was captured in a binary variable (*no* vs. *yes*). This variable was then the response variable in the second regression (Regression Model 2) based on all the learner data to see which variables, if any, appeared to be responsible for the learners' making nonnativelike choices. We explored that regression model both numerically (summary statistics as well as classification accuracies) and visually (using effects plots of predicted probabilities of nativelike choices).

Regression Model 1

We fit the first regression on the L1 speaker data with the constituent order as the binary dependent variable and all pairwise interactions of direct object definiteness, direct object concreteness, direct object complexity, following prepositional phrase, literalness/idiomaticity, mode, polynomials to the second degree of SegAltDiff and RhythAltDiff (to allow for curvature) as fixed effects and allowed intercepts for verb lemmas and particles as random effects to vary.

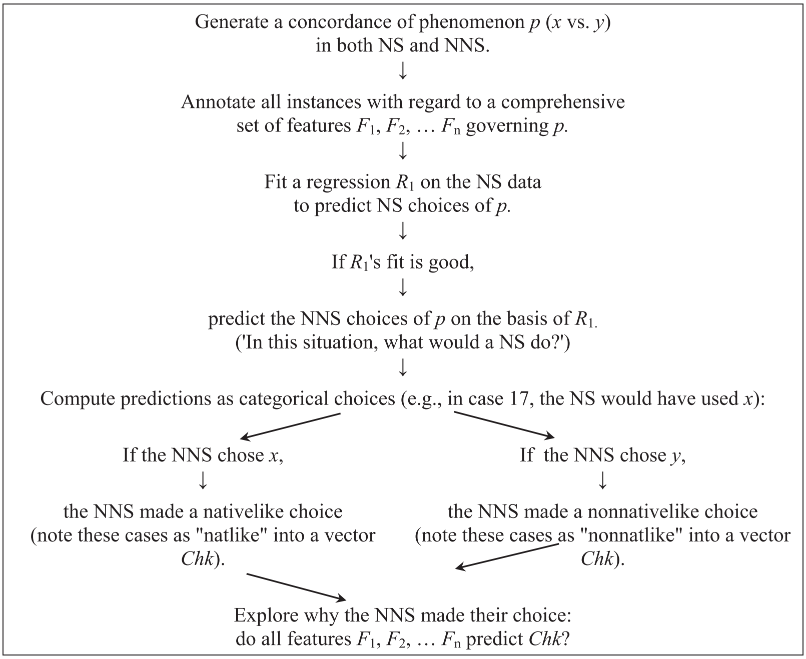

Figure 1 Flowchart of the multifactorial prediction and deviation analysis using a regression approach as applied to the present data. NS = native speaker; NNS = nonnative speaker.

We did not fit varying intercepts for speakers because more than 90% of the files of the L1 speaker corpora contained a mere three or fewer VPCs.

The results showed a satisfactory classification accuracy of the model both with and without random effects. The classifications of the model with random effects achieved an accuracy of 96.6% with a *C*-score of 0.99 (i.e., much better than the commonly used threshold value of 0.8). The model without random effects achieved an accuracy of 80% with a *C*-score of 0.88 (i.e., still quite a bit better than 0.8). Obviously, the random effects boosted model performance considerably, and the lion's share of that boost was due to verb lemmas, which helped performance much more than did the particles.

Because these values represent classification, not prediction, accuracies, we followed Lester's (2019) suggestion to also explore cross-validation with prediction accuracies. For that, we did the following 200 times: We split the L1 speaker data into a 90% training sample and a 10% test sample, fit the above

Table 2 Frequencies for L2 learners' observed Verb–Particle–Object (VPO)/Verb–Object–Particle (VOP) constructions compared to frequencies predicted from L1 speaker use

	Predicted		
Observed	VPO	VOP	Total
VPO	2,691	485	3,176
VOP	352	943	1,295
Total	3,043	1,428	4,471

regression model to the training data to achieve training coefficients, applied those to the test sample, and collected the *C*-score of the model. After 200 runs, we explored the distribution of the *C*-scores of the predictions; the mean *C*-score was 0.85 with a 95% CI [0.84, 0.86], which was sufficiently good to proceed.

Applying Regression Model 1 to the L2 Learner Data

We then applied the model coefficients from Regression Model 1 to the learner data (including the varying intercepts for verb lemmas and particles) to impute L1 speaker choices for each learner VPC; then, we compared the learners' choices to what the L1 speaker would have produced. Table 2 displays these results. Regression Model 1 achieved a prediction accuracy of 81.2% on the learner data, which, as we had expected, was lower than the classification accuracy for the L1 speaker data. It is this difference between the L1 speakers' and the L2 speakers' choices that we explored in the next step.

Regression Model 2

We then proceeded with Regression Model 2, fitting a model based on whether the learners had made nativelike choices or not. For Regression Model 2, we used all fixed and random effects from Regression Model 1 and added three further predictors: the lexical diversity scores for each speaker/file, the L1 of the learner, and the L1 family of the learner.

The percentages of nonnativelike choices differed between the languages from the lowest of 12.6% of the Spanish L1 learners to the highest of 22.6% of the French L1 learners, but no systematic pattern emerged from these differences. The differences between the language families as defined above were even smaller. Apart from the Slavic L1 learners, who exhibited the lowest rates of nonnativelike choices (16.8%), all other language families scored around 19%; neither of those percentages correlated with VPC frequency of use.

We then fit a model selection process with L1 family as a predictor that could interact with all others. Our stepwise model selection followed this process:

- We started out with a model that only included an overall intercept, the predictor of L1 family, the control variable of lexical diversity (as a polynomial to the second degree), and random effects in the form of varying intercepts for verb lemmas and particles.
- We proceeded to add or drop any predictor from Regression Model 1 to this model depending on which next step—addition or subtraction of a predictor—would most improve the Akaike information criterion. However, L1 family was kept in the model at all times to detect potential interactions with other predictors; likewise, lexical diversity was kept in the model at all times to function as a control.
- We checked for multicollinearity and overdispersion of the model at every step. We did not add predictors that would too much increase multicollinearity that was not merely due to interactions and to their constituent terms as measured by variance inflation variables.
- We concluded the analysis when neither the addition nor deletion of another predictor improved the model any further.

Our final model was thus highly significant, $G^2(39) = 692.21$, $p < .001$, compared to the starting/null model. R^2 values were moderate only, $R^2_{\text{marginal}} = .30$, $R^2_{\text{conditional}} = .40$, but the *C*-score was an encouraging 0.83. The classification accuracy amounted to 83.2%, which was significantly better than the baselines of always choosing the more frequent level of the response variable or its proportional sampling (both $p_{\text{binomial test}} < .001$). Interestingly, there was no significant effect of proficiency—*p*s of the linear and the quadratic effect were both greater than .23, which was why we do not discuss that predictor any further.

In what follows, we discuss a variety of effects obtained in Regression Model 2. We begin with six interactions that involve numeric predictors, followed by another five interactions involving categorical predictors. Finally, there is a brief presentation of the results for the random effects. For the fixed-effects results, we have used effects plots (Fox, 2003), which we believe are much more useful for understanding a regression model than long tables or even summary dotcharts of, in the present case, 44 coefficients, which usually only speak to a certain kind of contrast given one combination of conditions

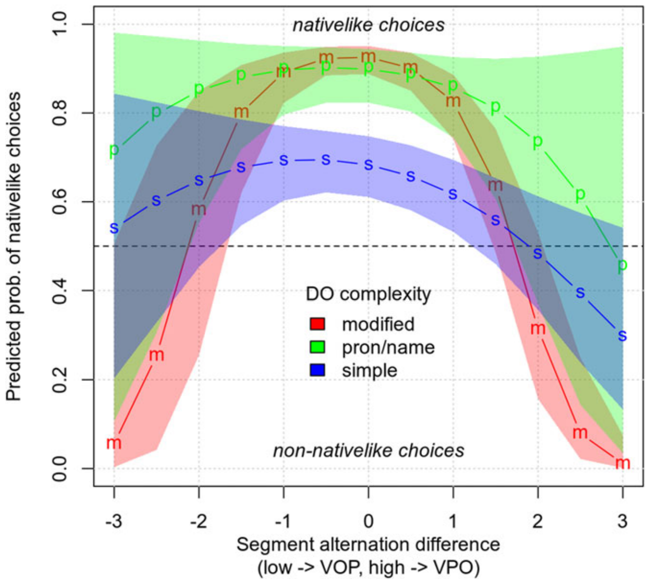

Figure 2 Learners' predicted probabilities of nativelike choices in the interaction of segment alternation difference and direct object (DO) complexity measures. VOP = Verb–Object–Particle; VPO = Verb–Particle–Object. [Color figure can be viewed at wileyonlinelibrary.com]

from other predictors. A full summary of the regression analyses appears in Appendix S1 in the Supporting Information online.

Results

Interactions Involving Numeric Predictors

In the effects plots of interactions, we show the numeric predictor involved on the *x*-axes and display the levels of the categorical predictor involved in different colors, with similarly colored confidence bands and letters representing the levels of the predictor in question. We summarize the first interaction as shown in Figure 2—segment alternation and direct object complexity ($p < .001$)—as follows: When segment alternation led to no preference, then the learners were very nativelike, particularly with pronouns and names as direct objects, strongly preferring VOP as did the L1 speakers, and with modified direct objects, strongly preferring VPO as did the L1 speakers. However, learners did less well with simple noun phrases, which were more variable in the L1 speaker data and, more interestingly, they did

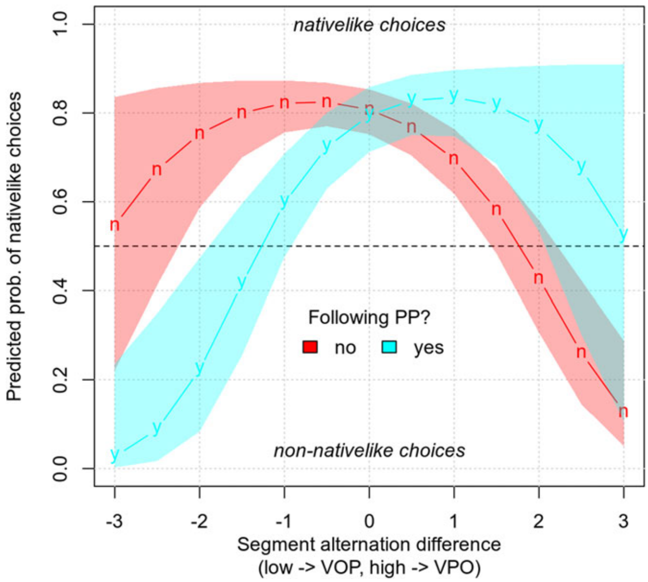

Figure 3 Learners' predicted probabilities of nativelike choices in the interaction of segment alternation difference and the absence/presence of a following prepositional phrase (PP). VOP = Verb–Object–Particle; VPO = Verb–Particle–Object. [Color figure can be viewed at wileyonlinelibrary.com]

less well with cases where segment alternation suggested a strong preference (i.e., very much on the left and on the right), even with the pronominal and modified direct objects that they otherwise managed well. Example 10 is typical of a learner's opting for the VPO construction with a simple direct object and a segment alternation sequence that would be dispreferred by L1 speakers.

> Example 10
> Some even lost sleep and depressed about how to pay off the debts.
> [L1 Chinese]

The second interaction involving segment alternation—segment alternation and following prepositional phrase ($p < .001$)—was also complicated (see Figure 3). In general, learners again did best when segment alternation made no strong prediction. However, they overused VPO regardless of whether a prepositional phrase was present or not, and choices were particularly nonnativelike (on the left side of the plot) where learners opted for VPO when both segment

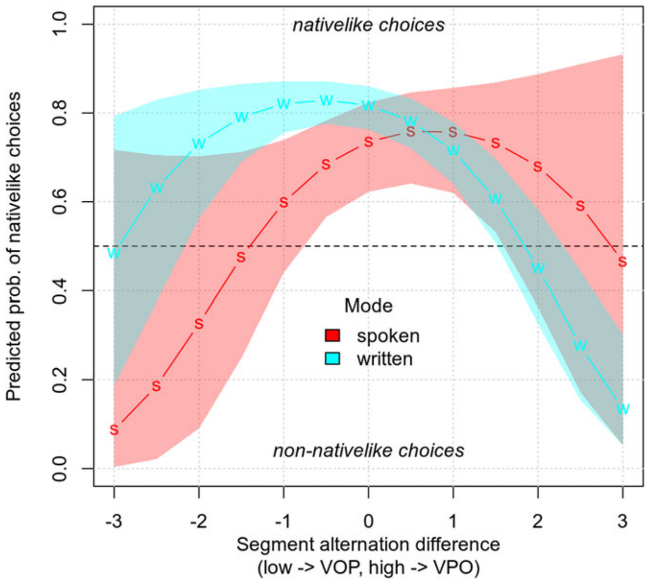

Figure 4 Learners' predicted probabilities of nativelike choices in the interaction of segment alternation difference and mode. VOP = Verb–Object–Particle; VPO = Verb–Particle–Object. [Color figure can be viewed at wileyonlinelibrary.com]

alternation and a following prepositional phrase made L1 speakers strongly favor VOP. Examples 11a and 11b illustrate this choice of VPO over VOP.

Example 11

a. Many people throw away things in the forest without thinking about the consequences. [L1 German]

b. The Austrian government, which used to carry out the death sentences by hanging . . . [L1 German]

A third interaction shown in Figure 4 involved segment alternation and mode ($p < .002$). As in the previous two interactions, learners did best when segment alternation made no strong prediction (i.e., in the middle of the plot). In writing, the learners did better when segment alternation would prefer VOP (see the left half of the plot). In speaking, they did better when segment alternation would prefer VPO (see the right half of the plot). The main interesting and clearly interpretable point about this effect might just be that there was an effect of segment alternation at all that involved the written mode given the phonological/spoken nature of segment alternation.

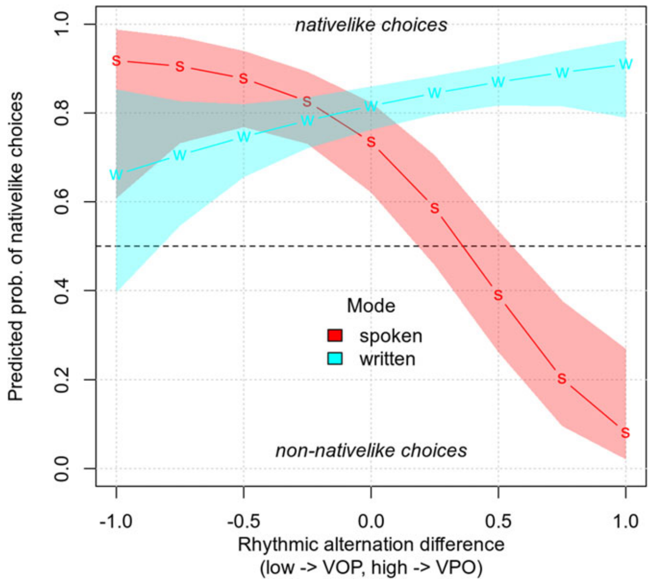

Figure 5 Learners' predicted probabilities of nativelike choices in the interaction of rhythmic alternation difference and mode. VOP = Verb–Object–Particle; VPO = Verb–Particle–Object. [Color figure can be viewed at wileyonlinelibrary.com]

Mode also interacted significantly with rhythmic alternation ($p < .001$); see Figure 5. Rhythmic alternation appeared to have quite some effect on VPCs in both L1 speaker and L2 speaker data (monofactorial $p = .35$ in both datasets). Intriguingly, rhythmic alternation had less of an effect in writing (see the smaller slope of the written regression line), but the more rhythmic alternation led to a preference of VPO (on the right), the more aligned the learners' choices were. In speaking, in contrast, a strikingly different picture emerged. The more rhythmic alternation preferred VPO, the worse the learners did. This may seem surprising, but it was due to the fact that the learners strongly overused VPO in speaking. The L1 speakers preferred VPO in writing and VOP in speaking, but the learners preferred VPO everywhere. In other words, in L1 speaker speech, VPO is rarer (even if rhythmic alternation might support it), which means the learners' general overuse of VPO in speaking ran most strongly counter to L1 speaker choices. Examples 12a and 12b illustrate learners using VPO in speaking when rhythmic alternation would suggest VOP.

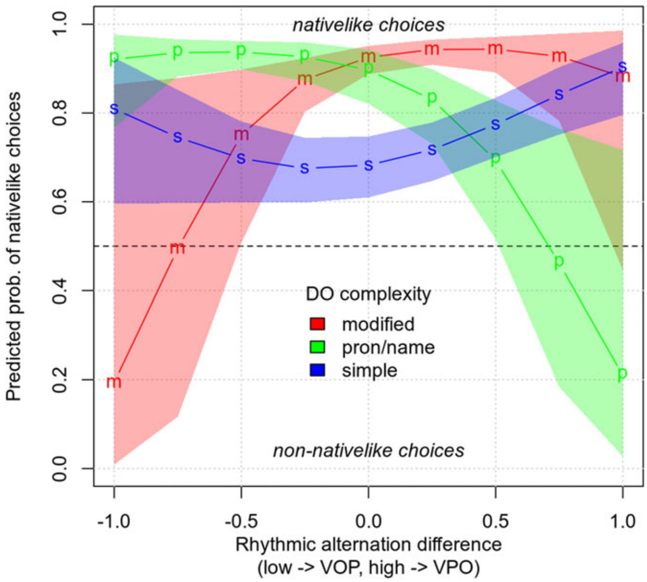

Figure 6 Learners' predicted probabilities of nativelike choices in the interaction of rhythmic alternation difference and direct object (DO) complexity. VOP = Verb–Object–Particle; VPO = Verb–Particle–Object. [Color figure can be viewed at wileyonlinelibrary.com]

Example 12

a. . . . so she took back the picture and . she showed to her colleagues and her friends. [L1 Belgian Dutch]

b. . . . each time (em) Frodo puts on the ring there's . like this huge eye and fire around it. [L1 Czech]

Another interaction occurred between rhythmic alternation and direct object complexity ($p < .001$); see Figure 6. With simple direct objects, learners did relatively well regardless of rhythmic alternation, but the results were different for other direct objects. With modified direct objects, for which L1 speakers strongly preferred for VPO, it seemed as if the learners were overly sensitive to rhythmic alternation: When rhythmic alternation preferred VOP (on the left), learners' performance worsened, that is, they picked VOP—maybe because of rhythmic alternation—more than they should have given the strong preference of VPO that comes with modified direct objects. Example 13 illustrates a Japanese learner's opting for VOP when rhythmic alternation and the modified direct object would have suggested VPO. With pronominal objects, it was the

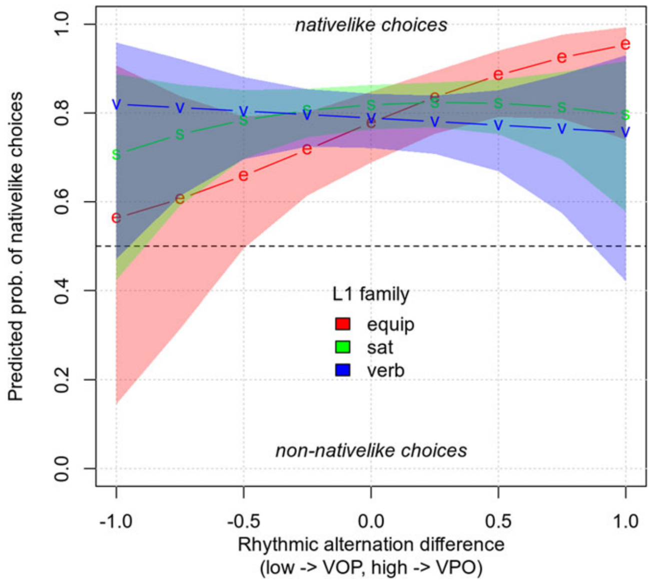

Figure 7 Learners' predicted probabilities of nativelike choices in the interaction of rhythmic alternation difference and first language (L1) family. VOP = Verb–Object–Particle; VPO = Verb–Particle–Object. [Color figure can be viewed at wileyonlinelibrary.com]

other way around: Learners should have used VOP all the time, but they did not, and they did not in part when rhythmic alternation pushed them toward VPO. Example 14 illustrates a Japanese learner's choosing VPO with a pronominal direct object, which should have triggered VPO, but the rhythmic alternation sequence supported VOP.

Example 13
First, these rules to wear school uniforms are take students' personalities away. [L1 Japanese]

Example 14
The internet improved very rapidly, the law and regulations don't catch up it. [L1 Japanese]

We also found a (weak) interaction between rhythmic alternation and L1 family ($p = .044$); see Figure 7. In the verb-framed L1s, rhythmic alternation had very little effect. In both the Chinese/equipollent and the satellite-framed

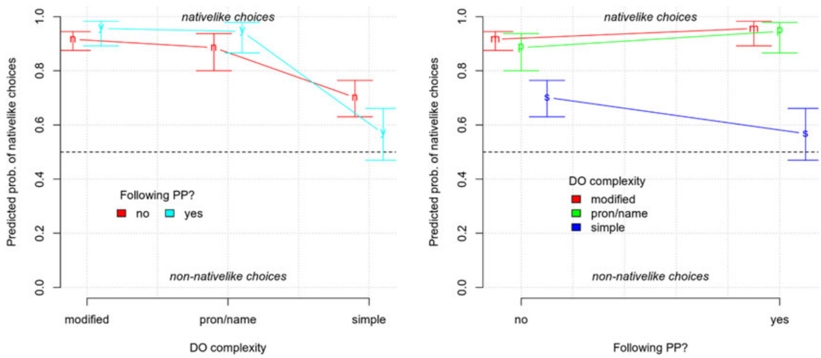

Figure 8 Learners' predicted probabilities of nativelike choices in the interaction of direct object (DO) complexity and absence/presence of a prepositional phrase (PP). [Color figure can be viewed at wileyonlinelibrary.com]

data, there was a weak effect such that the more rhythmic alternation pushed toward VPO, the better were the learners' choices (especially for the Chinese L2 speakers).

Interactions Involving Categorical Predictors

For each of these, we show both possible interaction plots. The left panel features one categorical predictor on the *x*-axis, and we show the other by colors; we adopt the reverse perspective in the right panel. The first such interaction as shown in Figure 8 was the (weak) interaction between complexity and following prepositional phrases ($p < .001$). Learners did well, sometimes nearly at ceiling, with modified direct objects, which they recognized as usually requiring VPO, and pronominal direct objects/names, which they recognized as needing VOP, but faced difficulties with regular simple objects, especially when there was a following prepositional phrase. This was because L1 speakers use VOP more often in the presence of a following prepositional phrase, but the effect of prepositional phrases was weaker for learners, so their general overuse of VPO surfaced here, too, namely, in conditions that for L1 speakers correlated well with VOP, which included simple direct object and following prepositional phrase. Examples 15a and 15b illustrate this overuse of VPO.

Example 15

a. The list can be fulfilled by many other positive aspects of bringing up children in a homosexual family . . . [L1 Polish]

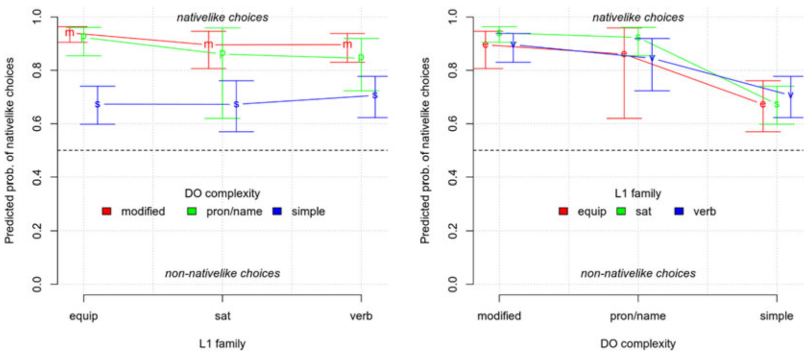

Figure 9 Learners' predicted probabilities of nativelike choices in the interaction of first language (L1) family and direct object (DO) complexity. [Color figure can be viewed at wileyonlinelibrary.com]

b. Some people consider that the death penalty is necessary as it holds back a person from committing crime. [L1 Russian]

There was also an interaction between complexity and L1 family ($p = .012$); see Figure 9. Again, we found that participants were near ceiling with modified and pronominal direct objects, but performed noticeably worse with simple direct objects. This was especially true of the Chinese learners (whose L1 alone represented the equipollent language family in our dataset), who performed a bit worse than the learners with satellite-framed L1s, who in turn performed a bit worse than the L2 speakers with verb-framed L1s. Examples 16a and 16b illustrate Chinese learners' opting for VPO when L1 speakers preferred VOP in these contexts.

Example 16

a. . . . as the mainland professionals would take away jobs from Hong Kong's people. [L1 Chinese]

b. . . . and thus the government needs to wait for a long time to get back the fund. [L1 Chinese]

An interaction also occurred between following prepositional phrases and L1 family ($p = .002$); see Figure 10. The one clear effect here was that, when no prepositional phrase followed, all learner groups performed equally well, but the equipollent/Chinese learners did not at all benefit from the cue of a following prepositional phrase: Although the other learners appeared to adjust by more

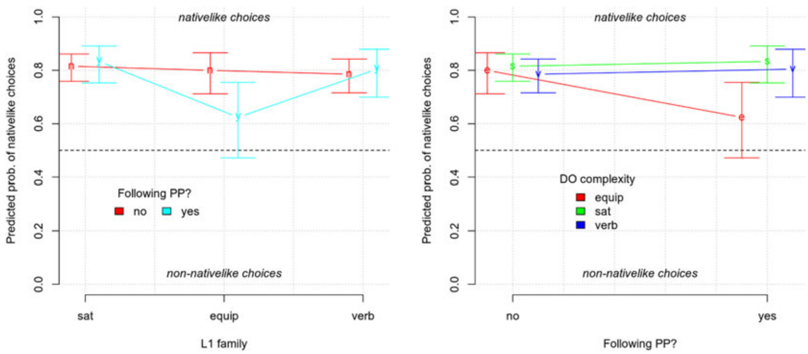

Figure 10 Learners' predicted probabilities of nativelike choices in the interaction of first language (L1) family and absence/presence of a prepositional phrase (PP). [Color figure can be viewed at wileyonlinelibrary.com]

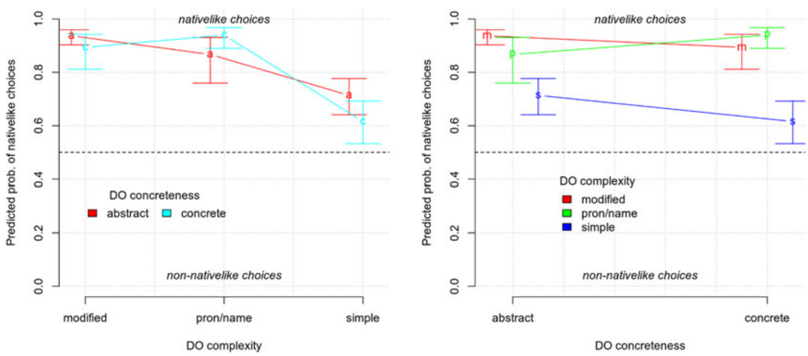

Figure 11 Learners' predicted probabilities of nativelike choices in the interaction of direct object (DO) complexity and direct object concreteness. [Color figure can be viewed at wileyonlinelibrary.com]

often using VOP—like the L1 speakers—the Chinese learners seemed to stick to their (over)use of VPO, which decreased their nativelikeness considerably.

Next was the interaction between direct object concreteness and complexity as shown in Figure 11 ($p < .001$). We had found previously that learners did their worst on the simple direct objects, but here found that there was also an additional effect of concreteness: With modified and pronominal direct objects, concreteness did not make much of a difference; however, with simple direct objects, learners did worse with concrete simple direct objects than with abstract simple direct objects. Examples 17a and 17b illustrate where learners made nonnativelike choices with concrete simple direct objects. By contrast,

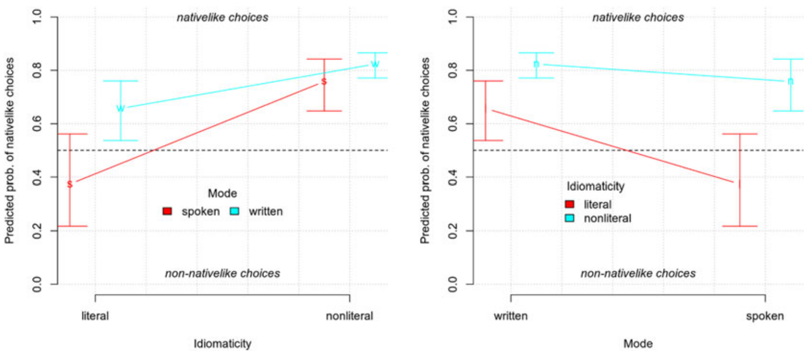

Figure 12 Learners' predicted probabilities of nativelike choices in the interaction of idiomaticity and mode. [Color figure can be viewed at wileyonlinelibrary.com]

learners did best with concrete pronominal direct objects (most likely literal directed-movement clauses) and abstract modified direct objects (most likely idiomatic as well as more frequent clauses; see the small confidence interval of abstract modified direct objects).

Example 17
a. "Strange people," I said and called back my dog. [L1 Czech]
b. The woman put out her cigarette and fastened her seat belt. [L1 Finnish]

Figure 12 displays the interaction between idiomaticity and mode ($p < .047$). In general, learners did much better with (the also more frequent) nonliteral clauses. That was particularly true in speaking: Learners' performance with spoken literal VPCs was not very nativelike. Another way of putting this is that idiomaticity did not appear to be a particularly strong cue. Although for the L1 speakers, nonliteral meaning was strongly related to VPO, that connection was much weaker for learners, especially in writing.

As for the random effects, the verbs were more important than the particle for learners' nativelike or nonnativelike choices. Figure 13 provides plots for the verbs (left panel) and for the particles (right panel) with their frequency in the data on the x-axis and their adjustment to the intercepts on the y-axis, with green and red reflecting whether a certain verb/particle was used better than the average of all verbs and particles. Examples 18a and 18b are a few illustrations with verbs and particles often used in a nonnativelike fashion.

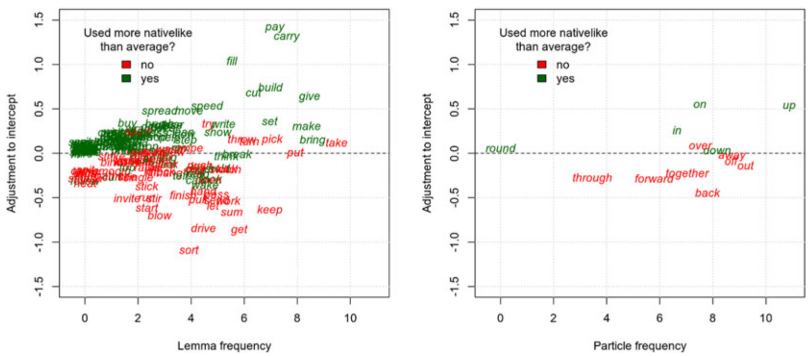

Figure 13 Degree of nativelikeness of learners' choices for different verb lemmas (left panel) and particles (right panel). [Color figure can be viewed at wileyonlinelibrary.com]

Example 18

a. The inhabitants complain of crows. So they drive away them. [L1 Japanese]

b. The school director should arrange meetings with the parents and should rigeur [sic] the parents involvement in keeping away the children from cheating . . . [L1 Turkish]

Discussion

The results of the multiple regression approach paint a complex picture in which processing demands, input effects, and L1 typology jointly shaped the degree to which learners' choices of constructions were nativelike or not. In that regard, this study aligns with previous corpus research on alternations in L2 production, including the genitive alternation, prenominal adjective order, the double object alternation, gerundial versus infinitival complementation, and the variable realization of the complementizer *that* in subject, adjectival, and direct object relative clauses (Gries & Wulff, 2013; Martinez-Garcia & Wulff, 2012; Wulff, 2016, 2017; Wulff & Gries, 2015, in press; Wulff, Gries, & Lester, 2018; Wulff, Lester, & Martinez-Garcia, 2014).

Maybe the most striking finding is that learners overused the VPO construction across nearly all contextual conditions. The only exception was learners' overuse of the VOP construction with modified direct objects when rhythmic alternation did not provide a strong clue. This mirrors previous findings focusing on other alternations in learner language, and it can be interpreted as an effect of processing cost: The VPO construction is the more unmarked, conservative choice from a processing perspective. This is because the particle following the verb directly obeys the principles of least effort (Zipf) and what Hagoort and Meyer's (2013) discussion of MacDonald (2013) called the rule of "what belongs together goes together." If the particle immediately follows the verb, then (a) the speaker is relieved of the memory burden of producing a potentially longer object while having to keep in mind this requirement to still produce the particle and (b) the hearers are relieved of syntactic processing costs because the particle right after the verb indicates what kind of verb they are hearing, which in turn is valuable signposting for the structure of the upcoming material, the direct object (see again especially Hawkins, 1994).[1] Thus, stranding the particle, as is the case in the VOP construction, in contrast, entails a higher processing cost both from a speaker-oriented and a hearer-oriented processing account. The fact that learners deviate from L1 speakers more strongly in speech than in writing likewise suggests learners' choices can be negatively impacted by the demands of online processing in speech.

For L1 speakers, the presence of a following prepositional phrase was a strong contextual trigger for the VOP construction, yet the L2 learners did not seem to have picked up on that (yet). It stands to reason that this reflects processing constraints as well. Possibly, given the increased processing cost involved with speaking or writing in the L2, learners may have a smaller processing window, paying less attention to material further down the processing stream. In more computational parlance, their *lookahead* is shorter, and thus a potentially following prepositional phrase does not later enter into the computation of the earlier constructional choice. Compatible claims have been established for language comprehension processing in L2 learners. According to Clahsen and Felser's (2006) shallow structure hypothesis, for example, L2 learners do not analyze long-distance dependencies in syntactic comprehension processing but only focus on local relations. In a similar vein, Kaan (2014) argued that the anticipatory processing mechanisms in L2 learners operate more slowly compared to those of L1 speakers. On the basis of our production corpus data, we cannot discern whether the effects that we observed were due to a shorter processing window, slower processing, or both. We hope to address this question in experimental follow-up studies.

When we considered the interactions involving the complexity of the direct object and absence/presence of a prepositional phrase, we interpreted these to reflect the distributional patterns in the input as well as the processing thereof. The fact that learners' shares of VPO were especially high with concrete and semicomplex objects might have been due to the correspondingly higher shares of variability in the input that the learners had received. With pronominal noun phrases, the VPO order was often ungrammatical (**She picked up it*), so at the intermediate–advanced levels of proficiency captured in the learner corpora here, learners had long moved beyond possible confusion at very initial stages of acquisition and had processed sufficient amounts of unambiguous input. Similarly, with highly complex direct objects, the input is also unambiguous because processing constraints lead to an overwhelming preference of the VPO construction even in L1 speakers, who have more cognitive resources at their disposal than bilinguals because they do not have to toggle between or selectively inhibit another language during processing. Outside of these extreme margins of the complexity continuum, however, the input learners receive is most varied and, hence, ambiguous or uncertain, opening more opportunities for nontargetlike choices. In fact, in our data, constructional variability (and hence unpredictability) was highest for simple (i.e., intermediately complex) direct objects. The finding that learners made more targetlike choices with idiomatic clauses (in speaking at least) also fits in with this interpretation: Idiomatic strings are typically more formulaic, that is, learners are likely to hear them in one order exclusively, so constructional variability is low and predictability of what constitutes the right choice correspondingly is high. Furthermore, most idiomatic constructions favor the VPO order, which learners strongly prefer by default anyway. Input effects were also obvious in the random effect of the verb lemmas that we observed. Clearly, the learners at intermediate–advanced levels of proficiency, as captured in the present data sample, had picked up on the specific constructional preferences that different verbs display.

A third set of results speaks to the effect of the learners' L1 background. Honing in on the instances where learners deviated the most from L1 speakers, learners whose L1 was an equipollent language (in our sample only Chinese) deviated most strongly from L1 speakers' choices, learners whose L1 was satellite-framed deviated a little less, and learners whose L1 was a verb-framed language were most closely aligned with L1 speakers' choices. This finding is another example of transfer effects from the L1, which, from the usage-based perspective that we adopted here, are interpreted as follows: The learning of form–function mappings in the L2 is shaded by prior associations made in the L1, and difficulty in unlearning the L1 associations to accommodate L2 associations can be predicted based on the extent that the mappings between the L1 and the L2 deviate from each other (see Ellis & Wulff, 2015).

Last, how our findings relate to phonological variables deserves some discussion. Both rhythmic alternation and segment alternation were involved in three interactions. Generally speaking, this underscores the importance of including phonological predictors even in the analysis of written data. More specifically, for rhythmic alternation, we found that learners aligned with L1 speakers in written production in that they favored strictly alternating sequences. However, and surprisingly, in speaking, learners' favoring the VPO construction overrode any rhythmic alternation concerns even when the direct object was a pronoun, which by itself was strongly associated with the VOP construction in L1 speaker production. A similar picture emerged for constructional preferences suggested by segment alternation. One possible interpretation of these results is that syntactic planning is less responsive to preferences arising at late-stage articulatory processing in learners compared to L1 speakers, at least in the case of particle placement. Not only has recent research suggesting that phonological advance planning varies between individuals generally as well as by task demand (Damian & Dumay, 2007) lent credence to this interpretation—it would also fit with the account outlined above, that is, that across various context configurations, from phonology to syntax, learners' productions are impacted by a shorter processing window and/or slower processing, which favors conservative production choices overall.

Conclusion

In conclusion, our study's results suggest that L2 learners (at intermediate–advanced levels of proficiency) generally prefer to keep the verb and particle together. We submit that learners stick with this order mainly to minimize cognitive effort, but this strategy is modulated by learners' L1 and input effects.

Final revised version accepted 26 March 2019

Note

1 The fact that English L1 children acquire the VOP order first is not counterevidence to this processing-based perspective and especially not in a foreign language learner corpus study because the earliest verb–particle constructions are largely cases where the referent of the typically short direct object moves along the path denoted by the verb to the location denoted by the particle, a semantic scenario that strongly prefers the VOP order. However, more idiomatic or less spatial constructions, which are already less compositional and often come with longer direct objects—all things that increase processing effort—strongly prefer the construction that softens the processing blow, so to speak, by leaving verb and particle together. In the learner data that we studied, the verb–particle constructions were overwhelmingly not simply spatial but metaphorical or idiomatic (see Gries, 2003, Section 4.2 and Chapter 7, for more discussion).

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Appendix S1. Summary of Regression Analyses.

Appendix: Accessible Summary (also publicly available at https://oasis-database.org)

Max Picked Up the Book **or** ***Max Picked the Book Up*****? Comparing English Native Speakers' and Second Language Learners' Choices**

What This Research Was About and Why It Is Important

On average, an English speaker produces 2.5 words per second. To enable speech at this rapid rate, our brains have to make numerous choices in split seconds: sounds, words, and structures have to be selected, sequenced, and articulated. Just what constitutes the "right" choice of sound, word, or structure depends on a complex network of factors. In this study, the researchers examined how these factors conspire and compete to yield a final decision, and how this decision process differs between native speakers and second language learners of English. Addressing these questions is key to understanding how language is represented in the human mind, whether native speakers and learners process language in different ways, and how language learning works. One example in English where speakers need to choose between two competing structures are particle verbs: the particle can either follow the verb immediately (as in *Max picked up the ball*), or the particle can be "stranded" at the end of the sentence (as in *Max picked the ball up*). Previous research has shown that native speakers of English consider various factors to decide which variant to choose, including which verb is being used, how long and complex the clause is, and so on. In this study, the researchers wanted to know if and to what extent second language learners of English consider the same factors as native speakers. Among other things, the researchers found that learners generally prefer to use the verb and particle right next to each other, even when a native speaker would not. This is likely due to the fact that keeping the verb and particle together is much easier than holding the particle in memory to produce it later in the sentence. And because speaking in a second language is cognitively demanding to begin with, it just makes sense that learners take "the least costly route."

What the Researchers Did

- The researchers extracted 4,911 examples of particle verbs from native speaker and several English learner corpora (large collections of written and transcribed spoken language produced by native speakers and second language learners of English). The corpora included both written and spoken language from 2,695 adult university-level second language speakers of English representing 17 native language backgrounds.
- The researchers then annotated each example for 13 variables identified as influencing speakers' decisions in previous research (such as which verb is being used, how long and complex the clause is, etc.), keeping track of how native speakers and second language learners used particle verbs (*Max picked up the book* vs. *Max picked the book up*).
- The researchers ran a comprehensive statistical analysis to compare the native speaker and the learner data. The analysis is a fairly new kind of comprehensive statistical procedure (multifactorial prediction and deviation analysis using regression) allowing for a detailed comparison of language use patterns.

What the Researchers Found

- Second language speakers of English preferred to use the verb and particle together (in other words, they were more likely to use *Max picked up the book* than *Max picked the book up*), and this preference was statistically greater than that shown by native speakers.
- Second language speakers of English were also influenced by their first (native) language. If the first language did not have such structures, the learners were found to be less likely to make "nativelike" choices.

Things to Consider

- Because second language learners did not prefer to separate particles from the verbs, it seems that learners might prefer to make choices in second language production that minimize cognitive effort. In other words, keeping the verb and the particle together (as in *Max picked up the book*) does not require as much mental effort as separating the verb and the particle (as in *Max picked the book up*).

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