

# The influence of processing on syntactic variation: Particle placement in English\*

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## 1. Introduction

A linguistic phenomenon that has attracted considerable interest in linguistics over the last decades is the existence of what Lambrecht (1994: 6), following Daneš (1966), has referred to as allo-sentences, that is “semantically equivalent but formally and pragmatically divergent sentence pairs.” I will investigate a particular instance of syntactic variation, namely the word order alternation that is possible for English transitive phrasal verbs (TPVs). As an example consider (1).

- (1) a. *John picked up the book.* construction<sub>0</sub> (C<sub>0</sub>)  
b. *John picked the book up.* construction<sub>1</sub> (C<sub>1</sub>)<sup>1</sup>

This alternation has frequently been referred to as *particle movement* – in this study, I will, as in Gries (1999, 2000) use the term *particle placement* (PrtPl) in order to avoid the movement metaphor and its theoretical implications. Over the last 100 years, a very large number of studies was devoted to exploring this alternation. More precisely, it was attempted (i) to provide an adequate structural description of the two possible constituent orders and (ii) to find the variables that determine native speakers’ choices governing the alternation;<sup>2</sup> it is the latter goal to which I want to contribute.

Two things are remarkable about previous analyses of PrtPl: First, it is interesting to see that (at a superficial glance) a simple word order alternation has been found to be influenced by a large number of variables from many subdisciplines of linguistics: researchers have identified phonological, morphosyntactic, semantic and pragmatic determinants as well as some other variables that defy simple

classification. Table 1 gives an overview of variables that have been claimed to contribute to PrtPI, most of which refer to the direct object (DO) of the phrasal verb. The middle column names the variable that has been claimed to influence PrtPI whereas the other columns provide the values/levels purportedly correlating with a preference for construction<sub>0</sub> and construction<sub>1</sub>.

Table 1. Some variables governing PrtPI

Value/Level for C <sub>0</sub>	Variable	Value/Level for C <sub>1</sub>
stressed DO	stress pattern of VP phonetic shape of V	stressed particle no initial stress
definite	NP type of DO determiner of DO	(semi-)pronominal indefinite / none
long	length of the DO	
complex	complexity of the DO	
idiomatic	meaning of the VP <sub>1</sub>	
inanimate	animacy of the DO <sup>3</sup>	animate
abstract	concreteness of the DO	concrete
low	entrenchment of the DO	high
long	distance to last mention of the DO	short
low	times of preceding mention of the DO	high
low	cohesiveness of the DO to the preceding discourse	high
short	distance to next mention of the DO	long
high	times of subsequent mention of the DO	low
high	cohesiveness of the DO to the subsequent discourse	low
	foll. directional adverbial	yes
high	production difficulty	Low

Second, it is also interesting to note in passing that nearly all of these variables have already been identified single-handedly by Van Dongen (1919). Put differently, not much progress has been made since then, unfortunately, as many analyses have failed to notice this and other early traditional grammarians' insightful works.

However comprehensive this list of variables may seem at first sight, there are three methodological issues I would like to address (for a conceptual critique of some of these variables, cf. Gries 2000).

First, nearly all of the analyses have been monofactorial in nature. That is, most scholars have concentrated on one variable at a time and have attempted to support its assumed effect on PrtPI. Note that this does not mean they have not acknowledged that several variables are important – it only means that each variable's effect has been investigated in isolation without concern for the simultaneous effect of other variables. Let us consider an example. Fraser (1974: 571) has argued that verbs without initial stress entering into TPVs are preferred in construction<sub>1</sub>. In order to substantiate his claim, he provides the following minimal pairs and acceptability judgements:

- (2) a. ?*I will insult back the man.*  
b. *I will insult the man back.*
- (3) a. ?*We converted over the heating to steam.*  
b. *We converted the heating over to steam.*
- (4) a. ?*They attached up the tag on the wall.*  
b. *They attached the tag up on the wall.*

However, the question arises how does Fraser know that it is the phonetic form of the verb that is responsible for the purported preference of the (b) sentences rather than some other variables he also discusses in the same paper?

- In (2), the (DO) is simple, very short and definite.
- In (3) and (4), the DO is simple, very short and definite and the TPV is followed by a directional adverbial.

In other words, the data Fraser cites do not warrant his conclusion at all as they fail to take into consideration these additional variables. This instance shows that in complex cases like particle placement, minimal pairs can distort the picture more than they are helpful in spite of their time-honoured place in linguistics.

What is more, it is uncontroversial that in complex phenomena such as PrtPI (given the large number of variables mentioned above), independent variables can interact with one another with respect to

the impact they have on the dependent variable. That is, the effect one independent variable (e.g. the following directional prepositional phrase) has on *PrtPl* can depend on another independent variable (e.g. the idiomaticity of the VP). More specifically, it is possible that following directional prepositional phrases only exhibit a preference for construction<sub>1</sub>, if the meaning of the VP is non-idiomatic. Phenomena like these can hardly be found out by using classical minimal pair tests, which contributes further to the lack of an adequate description of *PrtPl*. Therefore, I advocate the use of multifactorial techniques, which enable the researcher to describe *PrtPl* more efficiently.

Moreover, with few notable exceptions (Chen 1986; Gries 1999, 2000; Hawkins 1991, 1994) analyses of *PrtPl* have been based on intuitive and introspective analyses of grammaticality/acceptability judgements alone. This methodology may be found acceptable (and even rewarding) in particular research traditions (most notably transformational-generative grammar) – from my point of view, however, this methodology is fundamentally flawed. It does not do justice to the complexity of the phenomenon since, say, minimal pair test may fail to identify individual variables' effect and their interactions. Furthermore, as numerous publications have shown (cf., e.g. Labov 1975; Schuetze 1996), relying on grammaticality/acceptability judgements alone does not meet well-established standards of scientific research (objectivity, validity and reliability). Thus, my analysis will rely solely on naturally-occurring instances from the British National Corpus (BNC) of the two constructions.

Second, in spite of many decades of research, there is still no account of particle placement that tries to explain why speakers choose one construction over the other in a particular discourse situation. Such an account would (i) identify all relevant variables and subsume them under a (probably) small set of factors and (ii) identify all irrelevant variables on a principled basis and eliminate them from further consideration. There are several analyses going in the right direction as they have attempted to provide an unifying hypothesis for the main motivation of the alternation related *PrtPl* to issues of givenness/topicality (which boils down to degree of activation) of the DO's referent (Erades 1961; Chen 1986) or purely syntactically con-

ditioned processing effort (Hawkins 1991, 1994) – however, these proposal and its previous investigations do not go far enough since they fail to incorporate all relevant variables discovered so far.

On the one hand, there are only two empirical analyses of *PrtPl* (Chen 1986 and Hawkins 1991, 1994) and both suffer from several drawbacks (the following discussion will only deal with two problems, for a more comprehensive critique, cf. Gries 2000). Both Chen and Hawkins operationalise the givenness of the DO's referent by counting co-referential expressions in the preceding context, a methodology advocated in numerous papers by Givón (e.g. 1983, 1988). However, it has been shown beyond any reasonable doubt that the referent X of some expression is not only activated by strictly co-referential items – rather, the inferential processes on the part of hearer in particular discourse situations also activate related concepts. While the notion of “related concept” can be criticised as being fairly vague, studies such as Clark (1977) on bridging and by Bolkestein as well as Bolkestein and Risselada on cohesiveness (Bolkestein 1985; Bolkestein and Risselada 1987) have shown that the referent X of some expression can in fact (depending on the particular characteristics of the discourse) be activated by hyperonyms of X, hyponyms of X, co-members of X's level of categorisation, parts of X, the function of X, reasons leading to X, consequences following from X etc. Therefore, analyses of the influence of givenness/topicality had better incorporate these variables if the investigation of givenness is to be valid. What is more, both the analyses by Chen and Hawkins have been carried out with little degree of statistical sophistication as, e.g. both analyses do not use any significance tests to support their far-reaching conclusions.

On the other hand, Chen's and Hawkins's proposals also fail to account for a variety of factors which cannot so easily (if at all) be related to givenness/topicality or purely syntactically conditioned processing effort, namely the idiomaticity of the VP, VP-final directional adverbials, production difficulty and concreteness of the DO, to name some examples. Due to these and some other drawbacks, an explanatory account of *PrtPl* that is both coherent and empirically supported is difficult to find.

Third, given the shortcomings just discussed, it comes as no surprise that it has not been possible to predict which construction a native speaker of English will choose, a problem that derives from the lack of truly multifactorial treatments of the subject matter.

In the remainder of this paper, I will propose a hypothesis that explains the constructional choices of speakers given a particular discourse context (cf. Section 2) and I will show how, by means of using multifactorial statistics, native speakers' choices of a construction can be predicted with a high degree of accuracy (cf. Section 3).

## 2. The processing hypothesis

In this section, I propose a hypothesis in order to explain the distribution of the two constructions and I will outline which variables are, according to this hypothesis, relevant and which are not.

The Processing Hypothesis (PH): By choosing one of the two constructions for an utterance *U* a speaker *S* subordinates to different processing requirements of both constructions in that he formulates *U* in such a way as to communicate the intended message with as little processing effort as possible. More specifically, for most variables at least, this means that construction<sub>0</sub> will be preferred for verb-particle constructions with DOs requiring a lot of processing effort – construction<sub>1</sub> will be preferred for verb-particle constructions with DOs requiring little processing effort.<sup>4</sup>

In order to support this hypothesis, two different steps are necessary. On the one hand, it must be shown how the above-mentioned variables relate to processing effort; from this it follows that variables that cannot be related to processing effort are not relevant to PrtPl. This will be done in the remainder of this section. On the other hand, it must be shown empirically, that (i) the variables included by the PH correlate with PrtPl as predicted and (ii) the variables excluded by the PH do not correlate with PrtPl; this will be the topic of Section 3.

### 2.1 Phonological variables

The stress pattern of the VP can be straightforwardly related to processing requirements: in functional analyses of information structure, it has been useful to distinguish two kinds of information, namely given and new information. Generally, in English the new (and/or important) information is positioned sentence-finally. Moreover, it is by now common ground that stress on a linguistic expression typically serves to indicate the newness or importance of the referent of this linguistic expression, i.e. to direct the attention of the hearer to the respective referent, thereby increasing the processing cost associated with that referent. Combining these two findings results in the distribution predicted in the PH: the expressions whose referents are to be processed thoroughly occur clause-finally and are stressed.

### 2.2 Morphosyntactic variables

As far as the TPV is concerned, construction<sub>0</sub> facilitates processing because the speaker can complete (and thus disambiguate) the TPV earlier if the particle immediately follows the verb and need not be borne in mind until the DO has been uttered completely (cf. Rohdenburg 1996). But what about the DOs of TPVs? Let us start with the NP type of the DO.

This variable is in fact quite closely connected to utterance processing: personal pronouns and semi-pronominal/referentially vague nouns are only used when their referents are identifiable and active whereas lexical noun phrases are much more likely to be used with unused and brand-new referents. Again, the distribution is as predicted in the PH: active referents of personal pronouns require little processing effort and correlate with construction<sub>1</sub> strongly (though not absolutely as contrastive stress can override this preference: *He brought back HIM, not her*; cf. also Bolinger 1971) – referents of lexical DOs are, on the whole, more likely to require more processing and occur preferably in construction<sub>0</sub>.

Likewise, the determiner of the DO noun phrase is also concerned with processing aspects: speakers do not decide randomly in favour

of definite or indefinite determiners – instead, one can find a fairly clear pattern:

Linguists traditionally deal with the binary distinction between definite and indefinite, with the former marking topics which the speaker assumes the hearer can identify uniquely, is familiar with, are within his file (or register) and thus available for quick retrieval. On the other hand, indefinites are presumably topics introduced by the speaker for the first time, with which the hearer is not familiar, which therefore are not available to the hearer readily in his file. (Givón 1983: 9f.)

Comment is hardly called for: definite determiners (used for active referents barely requiring extra attention) prevail in construction<sub>1</sub> and indefinite determiners (used for unused or even brand-new referents requiring conscious activation) prevail in construction<sub>0</sub> so that the pattern found is as expected.

*Length of the DO* and *complexity of the DO* (irrespective of how these are measured; cf. Wasow 1997) can be dealt with simultaneously. Self-evidently, longer/more complex NPs require more processing effort while shorter/less complex noun phrases can be more easily processed. But apart from this purely structurally motivated approach, there is also a functional principle at work: “the new information often needs to be stated more fully than the given (that is, with a longer, ‘heavier’ structure)” (Quirk et al. 1985: 1361). Thus, if the newness of a referent, on average, renders DOs long and complex (in order to provide the necessary information for the hearer to establish a new referential file), the larger amount of linguistic material requires more processing effort than the one needed for given information. Ultimately, both the structural variable and its functional motivation go hand in hand so that again much processing effort is linked to construction<sub>0</sub> and little processing effort to construction<sub>1</sub>.

### 2.3 *Semantic variables*

We know that verb-particle constructions come in two different word orders, and we also know that their meanings range from literal to

idiomatic. Even if we did not already know from the literature which of the two word orders is more common or acceptable with which degree of idiomaticity of the verb phrase, we could already make a quite educated guess: in construction<sub>1</sub>, the particle is positioned in the canonical clause-final position for focal elements, so that the particle is processed more intensively than the DO. Thus, the word order of construction<sub>1</sub> naturally underscores the (commonly) spatial contribution particles such as *up*, *out*, *away*, *back* etc. make to the compositional meaning of the TPV in the utterance. Therefore, construction<sub>1</sub> is the natural choice for a speaker who intends to communicate a state of affairs where the spatial meaning is prominent.<sup>5</sup>

In the case of idiomatic constructions, the meaning of the TPV is little compositional, if at all. The particle does not just add some spatial information to a straightforward sense of the verb (as with literal TPVs), but the idiomatic TPV conveys a meaning that is not a function of the meaning of its parts and their interrelations, but must be stored on its own. In other words, when the speaker accesses the meaning of the TPV for production, then the complete idiomatic TPV (i.e. verb and particle) are simultaneously accessed. Thus, it is only natural that the verb and the particle are uttered following one another directly: it would be uneconomical to process the opaque meaning of a TPV, but produce the parts that trigger this opaque meaning in possibly widely disparate positions of the sentence.<sup>6</sup>

Turning to the next variable, no significant effect of *animacy of the referent of the DO* on particle placement is to be expected according to the PH: there is no reason to assume that animate referents yield context-dependent processing requirements substantially different from inanimate referents,<sup>7</sup> and there is also no reason to assume that animate referents are more likely to undergo a literal change of location (due to caused motion) or a change of state. Therefore, while the variable will be investigated, I claim it will not contribute to the constructional alternation.

Finally, the entrenchment of the DO (where entrenchment refers to strength of the concept due to its frequency of successful use) will not be analysed as the entrenchment hierarchies offered in Deane (1992) and Gries (1999) comprise several variables that will be dealt with separately (and thus much more precisely) in this analysis.

### 2.4 Discourse-functional variables

The discourse-functional variables concerning the preceding context relate straightforwardly to matters of processing effort. Information that is given as a result of having been (frequently) evoked in the preceding discourse or being readily inferable from the preceding context requires less processing effort than discourse-new or even hearer-new information. Thus the distribution of the two constructions (and their processing cost) relative to these variables is obviously the one given above in Table 1. However, the discourse-functional variables concerning the subsequent context cannot be related to the processing cost of the verb-particle construction. Even if it was true that these variables measure the importance of the DO's referent, it is difficult to see how a speaker should be able to foresee precisely the development of the discourse to follow (cf. also Hawkins 1994: 225). Thus, I claim that these variables will not be relevant to and correlate with the processing cost of the utterance.

### 2.5 Other variables

The next variable is concerned with the presence of a directional adverbial following either the verb or the particle. If a directional adverbial follows, then it typically serves to either elaborate the path along which the referent of the DO is being moved (cf. [5a]) or the resultant location of the referent of the DO (cf. [5b]).

- (5) a. *So Tom took Peter along past the new Pump House.*  
 b. *Fred put the book down on the table.*

For construction<sub>1</sub>, where the spatial meaning is foregrounded (cf. above Section 2.3), it is therefore quite natural to expect additional material (in the form of a directional adverbial) providing additional information on the direction or the endpoint of the movement process. On the other hand, construction<sub>0</sub> does not normally denote a movement process that can be further elaborated with information concerning directionality so following directional adverbials are,

though not strictly ruled out, not to be expected. Thus, the distribution predicted in the PH seems to be fully justified.

Finally, consider Arnold and Wasow's (1996) evidence on how production and planning constraints influence particle placement. Their observation is related to the length of the DO and ties in nicely with the PH. It is natural to assume that (long) DOs that are difficult to plan and produce require more processing effort while their exact formulation has to be figured out – on the other hand, (short) DOs that are easy to plan and produce require less processing effort. Since Arnold and Wasow found that difficult and simple DOs tend to occur in construction<sub>0</sub> and construction<sub>1</sub> respectively, this variable makes predictions that perfectly fit those of the PH.

## 3. The statistical investigation: Data and results

In order to empirically test the PH conforming more to the standards mentioned in Section 1, I collected a set of 403 verb-particle constructions from the BNC; cf. Table 2 for an overview over the data.

Table 2. Corpus Data<sup>8</sup>

	Spoken	Written	Row Totals
Construction <sub>0</sub>	67	127	194
Construction <sub>1</sub>	133	76	209
Column Totals	200	203	403

By analysing the 403 sentences and their context (the 10 preceding and 10 subsequent clauses),<sup>9</sup> each verb-particle construction was assigned values representing the values/levels of the variables in Table 1. Then, two different procedures were used: first, for each variable, a monofactorial correlation coefficient was calculated (Section 3.1). This may seem surprising, given that I have devoted some space to arguing that monofactorial analyses are ill-fitted for problems of such a level of complexity. The reason for including monofactorial correlations is that I wanted to subject all variables to an empirical test, since many variables have never been tested on naturally-occurring data before. Second, a multifactorial analysis was conduc-

ted in order to (i) find out how much variance of the alternation we can account for (given the variables we know of) and (ii) try to predict native speakers' choices of a construction in natural discourse (Section 3.2).

### 3.1 Monofactorial results

Due to the different levels of the variables within the analyses, a variety of different coefficients of correlation had to be computed. To cut a long story short, Table 3 contains the correlation coefficients for each variable.

Table 3. Monofactorial results of the analysis<sup>10</sup>

Variable	Corr. coefficient
Complexity of the DO (COMPLEX)	$\gamma = -0.8$ ***
Idiomacity of the verb phrase (IDIOMATICITY)	$\gamma = -0.6$ ***
NP Type of the DO (TYPE)	$\phi = 0.49$ ***
Length of the DO in syllables (LENGTHS)	$r_{pbis} = -0.5$ ***
Length of the DO in words (LENGTHW)	$r_{pbis} = -0.45$ ***
Distance to last mention of the DO (ACTPC)	$r_{pbis} = 0.45$ ***
DO's cohesiveness to the prec. discourse (COHPC)	$r_{pbis} = 0.43$ ***
Times of preceding mention of the DO (TOPM)	$r_{pbis} = 0.42$ ***
Last mention of the DO (LM)	$\phi = 0.41$ ***
Overall mention of the DO (OM)	$r_{pbis} = 0.36$ ***
Concreteness of the DO (CONCRETE)	$\phi = 0.34$ ***
Determiner of the DO (DET)	$\phi = 0.32$ ***
Directional adverbial following the DO (PP)	$\phi = 0.28$ ***
Times of subsequent mention of the DO (TOSM)	$r_{pbis} = -0.19$ ***
Animacy of the DO (ANIMACY)	$\phi = -0.17$ ***
DO's cohesiveness to the subs. discourse (COHSC)	$r_{pbis} = 0.14$ **
Next mention of the DO (NM)	$\phi = 0.1$ *
Distance to next mention of the DO (CLUSSC)	$r_{pbis} = 0.1$ *
Production and planning effects (DISFLUENCY)	$r_{pbis} = -0.01$ ns
Particle = Preposition of following PP	$r_{pbis} = -0.003$ ns

How are these values to be interpreted? Each variable in the left column is an independent variable; they are correlated with the constructional choice (construction<sub>0</sub> vs. construction<sub>1</sub>). Since negative correlation coefficients are indicative of inverse relations (the more/higher

..., the less/lower ... and vice versa), the negative correlation coefficient of COMPLEX means: the higher the degree of complexity of the direct object NP, the lower the number for the construction that will be chosen, i.e. construction<sub>0</sub> (and vice versa). This made it possible to test the influence of variables on both constructions and express the result in a single value. Generally speaking, the higher the absolute value of the correlation coefficient, the more important this variable is for PrtPl. But before we begin to interpret these results, a comment is necessary concerning the significant correlation between the variable ANIMACY and PrtPl. This result might be taken as evidence that the PH is not fully correct since I have predicted that ANIMACY should not play a role. This, however, would be mistaken since the variable ANIMACY not only tells us whether the referent of the DO is animate or not – it also tells us something about the concreteness of the DO: if the referent is animate, it must be concrete. Thus, if we want to test the influence of ANIMACY alone, we need to take out the influence of CONCRETE on ANIMACY. There is a statistical technique serving exactly this purpose, namely that of partial correlations, and if we do that, then ANIMACY does not have any influence on PrtPl anymore:

$r_{ANIMACY\ construction \cdot CONCRETE} = 0.04$ ;  $t_{400} = 0.757$ ;  $p = 0.449$  ns.

In less technical terms: ANIMACY only had a significant effect because it tells us something about the concreteness of the DO's referent – if we take out that information, ANIMACY turns out to be irrelevant while CONCRETE remains important (as predicted by the PH). This is a good example for how monofactorial analyses can result in 'statistical evidence' that, on closer inspection, turns out to simply result from the artificial separation of variables that in fact belong together closely.

While it is not possible to go through all of the results in detail, some important conclusions of the monofactorial analysis can be drawn. First, we find a rough ranking of variable groups: morphosyntactic variables are the most important ones, followed by semantic variables and discourse-functional variables pertaining to the preceding context; least important are the discourse-functional variables concerned with the subsequent discourse. Second, on the whole, the PH receives strong support: the variables included by the PH all

correlate with PrtPI (i) significantly and (ii) in the predicted direction. Third, there are some variables (TOSM, COHSC, NM and CLUSSC) which correlate significantly with PrtPI although the PH has predicted otherwise (interestingly the correlation is exactly the opposite one than that observed by Chen 1986). In this respect, the PH is not supported, but we will return to these variables below. Finally, we have, for the first time, a clue as to the strength of the individual variables in isolation, a level of precision not attained so far. The following section, however, will approach PrtPI in yet a different way.

### 3.2 Multifactorial results

While the results of Section 3.1 are already a major leap forward (given the absence of similarly thorough analyses so far), it is still not quite appropriate. The problem is, as was already mentioned, that monofactorial analyses do not enable us to address the issue rewardingly. Consider the choice of construction from the perspective of speech production: Self-evidently, neither does any given native speaker compute a series of monofactorial correlations nor does he weigh variables independently in order to reach a decision as to the construction to be uttered (although the method of monofactorial analyses seems to imply just that). Rather, for the native speaker, all variables' values/levels are present at the point of time where the constructional choice takes place. Thus, any account attempting to be cognitively realistic needs to incorporate all the variables simultaneously rather than artificially isolated.

Let us first try to measure the overall success of the research on PrtPI in a multifactorial way. Using the General Linear Model (a generalisation from correlational models like regression analysis and techniques such as analysis of variance), we can assess the amount of variance of the dependent variable PrtPI that can be explained both by all variables ever postulated and, more interestingly for our present purposes, for the PH. Consider Table 4 for the results.<sup>11</sup>

Table 4. Multifactorial results of the analysis

Statistical index	All variables	Variables of the PH
R	0.79	0.76
R <sub>c</sub>	0.72	0.72
F	F <sub>94, 308</sub> =5.58	F <sub>53, 349</sub> =9.07
p		<0.001 ***

In sum, the (most relevant) adjusted multiple correlation coefficient R<sub>c</sub> for the variables included in the PH is not only highly significant – it is even as high as R<sub>c</sub> for all variables ever postulated to influence the alternation. Once more in less technical terms, if we include variables into the analysis other than those required by the PH, what we get is random noise. Thus the PH receives in this case overwhelming support. However, we would still like to know exactly how the variables behave and how we can predict speakers' choices.

With a so-called discriminant analysis, we can enter all variables into an equation and figure out how important each variable is (by means of a so-called factor loading that is conceptually similar to correlation coefficients) and what choice of construction the analysis would predict. Table 5 provides the results of a discriminant analysis for all variables with PrtPI as the dependent variable.

Given space limitations, three findings deserve attention: first, again all variables included into the PH correlate with PrtPI strongly and in the predicted direction. Second, the overall ranking of the variable groups found in the monofactorial analysis is preserved. Lastly, the most realistic multifactorial analysis further supports the PH in that all the variables that I argued to be irrelevant (namely Animacy and all the discourse-functional variables concerned with the following context) do indeed get only very low factor loadings.

Table 5. Results of the discriminant analysis for all variables

Variable	Loading	Effect on PrtPI
Length of the DO in syllables	-0.55	high variable values ⇒ construction <sub>0</sub>
Lexical DO	-0.5	
intermediate complexity of the DO	-0.48	low variable values ⇒ construction <sub>1</sub>
Length of the DO in words	-0.47	
Idiomatic VP	-0.32	
Indefinite determiner of the DO	-0.28	

High complexity of the DO	-0.18	due to the low factor loadings (fl) (-0.22 < fl < 0.22), these variables do not discriminate well between the two constructions
Metaphorical VP	-0.04	
Proper name as DO	-0.02	
Definite determiner of the DO	-0.02	
Production/Planning difficulty	-0.01	
Particle – Preposition of foll. PP	-0.002	
Semipronominal DO	0.09	
Distance to next mention of the DO	0.09	
Is there a next mention of the DO?	0.1	
DO's cohesiveness to the subs. disc.	0.13	
Animacy of the DO	0.16	
Times of subs. mention of the DO	0.18	
No determiner of the DO	0.22	high variable values ⇒ construction <sub>1</sub>
VP-final directional adverbial	0.28	
Literal VP	0.31	
Concreteness of the DO	0.34	
Is there a last mention of the DO?	0.42	
Times of prec. mention of the DO	0.43	
DO's cohesiveness to the prec. disc.	0.44	
Distance to last mention of the DO	0.47	
Pronominal DO	0.49	
Simple DO	0.57	
Wilks' Lambda=0.47; canonical correlation=0.73; p<0.001 ***		

What is more, when we perform a second discriminant analysis including only the variables of the PH, then we can test how accurate the predictions of constructional choices from the PH really are. If we enter all 403 cases into the analysis, the discriminant analysis computes a constructional choice, and we can compare the accuracy of this classification with the 'real' choices by native speakers in their discourse settings. The classification accuracy resulting from this procedure is very high: 85.9% of all the 403 utterance are classified correctly. However, one might object to this result by pointing out that this is not really prediction since the cases to be classified also figured in the analysis from which the discriminant function was derived. Therefore, I have pursued two ways to further support the argument of the predictive power of the PH.

First, I split the sample into two parts, one consisting of 350 cases, the other of 53 cases. The former sample was a learning sample to which I applied a discriminant analysis to obtain a discriminant func-

tion; the latter sample was a prediction sample whose constructions were predicted on the basis of the discriminant function derived from the learning sample. In order to anticipate criticism of my possibly biased choice of the samples, I performed this test three times with different learning and prediction samples. Table 6 shows the composition of the samples and the results.

Table 6. Prediction accuracy of three analyses<sup>12</sup>

Composition of the learning sample	Composition of the prediction sample	Correct predictions
200 oral + 150 written	53 written	81.1% ***
150 oral + 200 written	53 oral	67.9% **
174 oral + 176 written	26 oral + 27 written	88.7% ***

Obviously, the cross-validation also strongly supports the PH: on the whole the constructional choices in the prediction sample can be predicted quite accurately on the basis of the learning sample (with oral data being most difficult to predict, which is probably due to the more spontaneous, context-dependent and interactive nature of conversation).

Another very widely used way of testing the predictive power of models is via cross-validation, using the leave-one-out method (also called U-method). If we apply this procedure to the present data, we perform 403 analyses in each of which we predict the choice of construction in a single case on the basis of the remaining 402 cases. This again guarantees that no case is used for its own prediction. The result of this cross-validation for the present analysis is a prediction accuracy of 83.9% (this result is virtually impossible to achieve by chance: the exact binomial test shows that the chance of guessing one out of two constructions correctly in 338 out of 403 cases is  $p \approx 6.819 \cdot 10^{-46}$  \*\*\*). This result is for all practical purposes very much the same as the one we had for the classification accuracy and the split-sample technique, which shows that the results are quite robust and the predictive power of all the variables together is indeed exceptionally high.

#### 4. Discussion/Conclusion

We have seen that the Processing Hypothesis subsumes more variables under a single explanatory account than any other previous hypothesis. We have also seen that the PH excludes several variables from further consideration. Both of these predictions are borne out by the data to such an extent that we can now, on the basis of an argumentatively sound hypothesis correctly predict about 84% of native speakers' choices for a particular construction in a natural discourse setting.

More importantly, however, are probably the methodological ramifications. The study has shown that multifactorial analyses of naturally-occurring data can go way beyond previous kinds of analyses. Not only are these techniques more likely to yield cognitively realistic results, they also enable us to identify spurious correlations (i.e. statistical artefacts, recall the variable ANIMACY) and, last but not least, compare the predictive power of competing analyses. Suppose that some researcher claims to have found additional variables influencing PrtPl or a hypothesis making different predictions. In that case, we simply analyse a set of naturally-occurring sentences with respect to all variables (his and mine) again and test which hypothesis results in a higher prediction accuracy. In the absence of additional indications to the contrary, the analysis with a higher degree of predictive power is to be preferred. In conclusion, I hope to have also shown how rewarding a truly multifactorial perspective on the analysis of syntactic variation can be.

#### Notes

\* I thank Ray Jackendoff and an anonymous reviewer for their comments, as a result of which I hope the paper has become more accessible. Naturally, I alone am responsible for any remaining inadequacies.

1. The reason for this admittedly counterintuitive labelling of the two constructions will become clear later. As a mnemonic help, the subscript indicates the number of constituents between the verb and the particle.
2. Here and in the rest of the paper, the expressions choice of construction or

speakers' decisions are not to be understood as implying that there is necessarily a conscious choice on the part of the speaker.

3. Of course, animacy and concreteness of the DO refers to the animacy and the concreteness of the referent of the DO.
4. The question of whether I am concerned with the processing effort of the speaker or the hearer is not decisive here. While I tend to place emphasis on the speaker, Arnold et al. (2000) have argued for some phenomena that what is beneficial to the speaker (in terms of processing) is also beneficial to the hearer so, in these cases at least, no further differentiation is required.
5. Construction1 apparently instantiates a subtype of the caused-motion construction in Construction Grammar (cf. Goldberg 1995: Ch. 3, 8), which is defined as follows (for expository reasons slightly changed): [SUBJcauser [V OBJtheme OBJdirectional]] as in *Frank sneezed the tissue off the table*. This structural configuration is argued to have the following basic meaning: "the causer argument directly causes the theme argument to move along a path designated by the directional phrase: that is, X causes Y to move Z" (Goldberg 1995: 152). Similarly, in TPVs like, say, *Fred brought the book back*, the causer (Fred) directly causes the theme argument (the book) to move along a path or up to a point designated by the directional phrase (back). From this parallel, it also follows that concrete referents of DOs will preferably occur in construction1 while abstract objects will probably not: concrete referents can undergo caused motion whereas abstract referents cannot. In sum, we have seen that the notion of end-focus is responsible for the literal/spatial interpretation of construction1, which is in turn correlated with the preference of concrete referents to occur in construction1.
6. This claim is supported by the independent observation that idiomatic expressions are in general much less susceptible to syntactic rearrangements than literal expressions.
7. This is not to deny that animacy can have an effect on constituent ordering in general, but, as I will show below, animacy and concreteness need to be carefully disentangled in order not to jump to unwarranted conclusions (cf. also Bock 1982: 20).
8. The majority of the constructions investigated consist of the most frequent verbs and particles entering in verb-particle constructions. The required frequency data result from my own collection of 1,357 different TPVs. The question may arise why 'only' 403 examples were used for the analysis. First, it has to be observed that, with 403 cases, this is by far the largest quantitative corpus-based analysis of particle placement ever reported (cf. Hawkins's (1994) analysis of a mere 179 cases or Chen's (1986) analysis of only 239 cases). Additionally, the results will show that the predicted effects are all quite strong and highly significant, supporting my claim that the number of cases is in fact not too small at all.
9. In order not to overly minimise the context, I did not count questions tags, discourse markers (e.g. you know, I mean) and repetitions / false starts.

10. The variable semantic modification of the particle (with words like *right*) was not investigated because the corpus data did not contain a single example of such cases. The influence of stress was not investigated since the available corpus data were not phonologically annotated.
11. The analysis included two- and three-way-interactions; full-factorial designs of this complexity are difficult to calculate and even more difficult to interpret.
12. This also shows that the sample size is not too small since successful prediction is even possible with a learning sample of only 350 sentences. The asterisks indicate the level of significance for the obtained prediction accuracies as determined by an exact binomial test.

## Accessing and parsing phrasal predicates

Dieter Hillert and Farrell Ackerman

### 1. Introduction

Much psycholinguistic research refers to the notion *lexical access* in its effort to provide insight into both word-level processing and the role of words in sentence-level processing. For the most part, such research relies on an intuitive understanding of wordhood. According to this view, lexical entries are realized by a single (if sometimes internally complex) wordform occupying a terminal node in a phrase structure representation: such expressions are often referred to as *synthetic* forms of words in the linguistic literature. In addition, synthetic forms are interpreted as *syntactic atoms* by the linguistic research tradition known as lexicalistic approaches most prominently represented by *lexical functional grammar* and *head driven phrase structure grammar*. For example, the English inflected nominal word *frogs* and the derived nominal *frog-eater* are alike in that their internal composition is generally agreed to be opaque or inaccessible to syntactic operations: in accordance with the *lexical integrity hypothesis* (see Bresnan and Mchombo 1995), for example, the pieces of these wordforms cannot be separated from one another by whatever syntactic operations account for different permutations among the independent constituents of a clause. Moreover, the terminal nodes of syntactic trees can only be associated with fully formed words which themselves can only be associated with a single node in a tree: both *frogs* and *frog-eater* occupy terminal nodes in syntactic representations.

A basic assumption within lexicalist (and several other) frameworks is that the wordforms expressing lexical representations exhibit these properties of lexical integrity. As a consequence, it seems reasonable to assume that it is synthetic forms of words which are available to lexical access. The operative notion of word,