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# Disambiguating phrasal verbs

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## Introduction

In Natural Language Processing (NLP), there has been much recent interest concerning phrasal verbs and other multiword expressions (Dehé 2002, Guenther & Blanco 2004, Sag et al. 2002). Transitive phrasal verbs for the most part exhibit a continuous and discontinuous form:

- (1) *We **cleared up** the problem* ⇔ *We **cleared** the problem **up***

Furthermore, in the case of a pronominal direct object, only the discontinuous form is grammatical:

- (2) *We **cleared it up*** ⇔ *\*We **cleared up** it*

Linguists debate where and how to store these expressions in the lexicon, how to electronically identify discontinuous strings in a corpus, and if the underlying form should theoretically be considered the continuous or discontinuous one. However, one very practical problem for NLP remains: disambiguating lexically identical, but semantically different expressions. The difference in meaning is by and large determined by the nature of the object rather than the subject, as the following examples show:

- (3)
- |   |                       |
|---|-----------------------|
| a. <i>The mother <b>picked up</b> the children</i>      | [= stop for]          |
| b. <i>The police <b>picked up</b> the drug dealer</i>   | [= arrest]            |
| c. <i>The student <b>picked up</b> a new language</i>   | [= acquire/learn]     |
| d. <i>The gentleman <b>picked up</b> the young lady</i> | [= make contact with] |
| e. <i>The editor <b>picked up</b> the errors</i>        | [= notice]            |
| f. <i>Anne <b>picked up</b> dinner</i>                  | [= buy]               |

This study enlarges the systematic description of the most productive particle used in English phrasal verb constructions: *up*. The initial database, composed of

300 transitive occurrences of *up*, collected from *The American Heritage Dictionary* and Spears 1996, was expanded to over 700 occurrences with the help of Fraser (1976) and two other phrasal verbs dictionaries: *The Longman Phrasal Verbs Dictionary* (2000) and *The Cambridge International Dictionary of Phrasal Verbs* (1997).

In this expansion, we also included some support verbs (e.g., *throw*, *put*) involving particle movement, such as:

- (4) a. *The engineers quickly (threw up + put up) the building* ⇔  
*The engineers quickly (threw + put) the building up* [= assemble]  
 b. *The building is finally up* [= finished being built or assembled]

Since they may also be continuous or discontinuous, we integrated adverbials, or spatial particles (Jackendoff 2002), in our database, as well:

- (5) *Max (kicked + threw + tossed) up the ball* ⇔  
*Max (kicked + threw + tossed) the ball up*  
 (6) *Mary flipped up the switch* ⇔ *Mary flipped the switch up*

Finally, to highlight all possible ambiguity, we included what are often called prepositional verbs. These are similar to phrasal verbs, but they do not involve movement of the particle or preposition *up*, such as:

- (7) a. *Women make up* [= comprise] *90% of the applicants, while men make up the rest*  
 b. \**Women make 90% of the applicants up, while men make the rest up*  
 (8) a. *The Florida Marlins rang up* [= accomplish] *6 runs in the last inning*  
 b. \**The Florida Marlins rang 6 runs up in the last inning*

We also incorporated some reduced structures as well, but obvious prepositional phrases, such as:

- (9) *The hurricane chugged up the peninsula*

were not included in our data.

## 1. Compositionality and neutrality

The particle *up* appears to be often used as an intensifier or as an aspect marker, which changes the activity into one of accomplishment, and can be deleted in almost 40% of the cases examined. We refer to these as compositional<sup>1</sup> phrasal verbs, since in most cases they are clearly not frozen expressions, but rather regular verbs that can be modified with a particle:

- (10) *They **drank up** the soda* ⇔ *They **drank** the soda **up***  
 ⇔ *They **drank** the soda*
- (11) *Max **heated up** the water* ⇔ *Max **heated** the water **up***  
 ⇔ *Max **heated** the water*

Furthermore, 25% of the expressions listed exhibit neutrality (Boons, Guillet, & Leclère 1976) or the causative alternation (Levin 1993) such as:

- (12) *We **cleared up** the problem* ⇔ *The problem **cleared up***
- (13) *Laura **burned up** the house* ⇔ *The house **burned up***

In many cases, typically neutral verbs (e.g., *burn*, *break*, etc.), remain neutral when followed by the particle *up*:

- (14) *The decision **burned up** Max* [= make angry] ⇔ *Max **burned up***
- (15) *The comic **broke up** the audience* [= cause to laugh]  
 ⇔ *The audience **broke up***

This is not always the case, though:

- (16) *The driver **burned up** the track* [= travel at high speed]  
 ⇔ *\*The track **burned up***

An unanticipated observation, however, was that a large number of transitive verbs that are typically not neutral, took on the property of neutral verbs when followed by *up*. For example, transitive verbs such as *hike*, *line*, and *power* are not generally classified as neutral verbs, but with the added particle they can become neutral:

- (17) a. *Max **hiked** the trail* ⇔ *\*The trail **hiked***  
 b. *The company **hiked up** gas prices* [= increase] ⇔ *Gas prices **hiked up***
- (18) a. *FPL **powered** the building* ⇔ *\*The building **powered***  
 b. *Max **powered up** the engine* [= start] ⇔ *The engine **powered up***

Conversely, in a few cases, some typically neutral verbs did not accept the intransitive when the particle was added:

- (19) *The cook **boiled** (E + **up**) the water*  
 ⇔ *The water **was boiling** (E + **\*up**)*
- (20) *The garlic **smells** (**\*E** + **up**) the kitchen*  
 ⇔ *The kitchen **smells** (E + **\*up**)*

These exceptions confirm the necessity of listing each expression in lexicon-grammar tables.

## 2. Lexicon-Grammar tables

Originally, we had divided the data into five separate tables, depending on whether the particle was optional and if the expression exhibited neutrality:

Transitive verb + <i>up</i>	356 cases	49.5%	bring up N <sub>1</sub>
Neutral verb + <i>up</i>	92 cases	12.5%	clear up N <sub>1</sub>
Transitive verb + optional <i>up</i>	176 cases	24.5%	drink (E + up) N <sub>1</sub>
Neutral verb + optional <i>up</i>	89 cases	12.5%	burn (E + up) N <sub>1</sub>
Other: Neutral in N <sub>1</sub> V only	8 cases	1%	boil (E + up) N <sub>1</sub> , smell up N <sub>1</sub>

For this study, however, we combined all the tables into one large database in order to consider the problem of ambiguity involving homonyms from different tables. As can be seen in the following sample tables, extracted from the general database, these various syntactic possibilities are indicated via transformations along with the nature of the subject and object. The transformations categorized include particle deletion, the causative (or neutral) alternation with particle, and the causative (or neutral) alternation without particle. Finally, semantic information in the form of a synonym is included.

In the final database of 721 *up* expressions, 64% are ambiguous. Of these ambiguous expressions, over 60% involve just two or three homonyms, such as *crack up the audience* [= make laugh] vs. *crack up the car* [= damage], whereas about 20% comprise four or five homonyms, such as *bring up* or *burn up* (cf. Tables 6 & 7). But some include nine or ten cases, such as *throw up* (cf. Table 8), while the expression *pick up* has at least fourteen distinct meanings, as can be seen in Table 1, where a French translation is also provided to underscore the difficulties this presents to NLP.

Since phrasal verbs, like regular one-word verbs, can be ambiguous in the lexicon, explicit selectional restrictions and other semantic features are needed in our lexicon-grammar in order to distinguish the various uses of the same expression in NLP. In some cases, the selectional restrictions of the direct object, which were limited to the features of [+ human] and [- human] in this classification, seemed to suffice. But, since differences in meaning are most often determined by the nature of the object, we have recently begun to expand our categorization to describe the object more fully.

$N_0 = N_{hum}$	$N_0 = N_{-hum}$	Verb	Particle	Example of $N_1$	$N_1 = N_{hum}$	$N_1 = N_{-hum}$	Without particle	$N_1 V$ Part	$N_1 V$	Synonym	French Translation
+	-	pick	up	a new language	-	+	-	-	-	acquire / learn	apprendre
+	-	pick	up	the drug dealer	+	-	-	-	-	arrest / take into custody	arrêter, placer en détention préventive
+	-	pick	up	dinner	-	+	-	-	-	buy / acquire	acheter
+	+	pick	up	the debris	+	+	-	-	-	collect / lift / gather	ramasser, soulever
+	+	pick	up	the phone	-	+	-	-	-	answer phone / get messages	décrocher
+	-	pick	up	the young lady	+	-	-	-	-	make contact with (sexual intentions)	draguer
+	+	pick	up	the error	-	+	-	-	-	notice	relever
+	+	pick	up	the children	+	+	-	-	-	stop for (passenger or item) / call for	passer prendre
+	+	pick	up	Max	+	-	-	-	-	invigorate	remonter, améliorer
+	-	pick	up	the bedroom	-	+	-	-	-	clean	nettoyer
+	-	pick	up	the discussion	-	+	-	-	-	continue	reprendre
+	+	pick	up	the award	-	+	-	-	-	win / earn	gagner
+	+	pick	up	the radio station	-	+	-	-	-	obtain signal	capter
+	-	pick	up	a cold	-	+	-	-	-	get an infectious disease	attraper

Table 1. Ambiguity involving the phrasal verb *pick up*

### 3. Semantic distinctions: Hyperclasses, semantic classes, domains

Gaston Gross (1994, 2004) and other researchers at LLI (e.g., Le Pesant & Mathieu-Colas 1998) have previously introduced semantic factors or “*classes d’objets*” into linguistic data. Basically, arguments are classified according to semantic classes, which in turn correspond to semantic classes that predicates may take. Thus the meaning of a polysemous predicate can be automatically recognized in a text, if the arguments are also catalogued in this manner. But classifying each phrasal verb as accepting certain general hyperclasses or “*traits*” and more refined semantic classes or “*classes d’objets*” was so overwhelming for this initial study in ambiguity that we decided to see if a limited number of features associated with acceptable objects would suffice to mitigate the ambiguity with the phrasal verbs in question. We started with the eight hyperclasses from Gross 1994: *human, animal, plant, inanimate (concrete), inanimate (abstract), location, time, and event*. We then developed basic semantic classes as we sifted through our data of ambiguous phrasal verbs, such as *beverage, body part, business, clothing, food, fuel, hobby/skill, information, machine, money, musical instrument, vehicle*, and so forth, along with other semantic information, such as *energy, false, hostile, list, undesirable*, etc.

Let us start with some of the straightforward cases, i.e., those involving just two distinct meanings. Objects identified as only accepting [+ human] complements were simply marked as *human* under hyperclass. Likewise those only taking [- human] complements were merely labeled as *concrete*. In fact, some ambiguous pairs of phrasal verbs can be distinguished in this straightforward manner, as can be seen in Table 2. But this only happens in 16% of the cases examined: i.e., only 13 out of 83 pairs can be disambiguated in this fashion.

Next we looked at cases involving two homophonous phrasal verbs both requiring direct objects that are [- human]. Here we tried to hone in on the various groups of possible lexical items associated with each meaning. In some cases, the hyperclasses were sufficient to disambiguate; in others, semantic classes were necessary, as can be seen in Table 3. It is obvious that if we look at this on a continuum, the more free the expression, the more vague the semantic information can be, whereas, the more frozen the expression, the easier it is to define a limited semantic class of possible objects.

After that, we tried to distinguish cases where one expression accepts only [- human] complements and the other takes both [+ or - human], such as *tune up*, which can mean both “adjust engine” as well as “adjust musical pitch”, as in Table 4. Again, more specific semantic features such as *body part, drug, coin*, and *vehicle*, along with the hyperclass helped to alleviate the ambiguity between

the two separate connotations. In some cases, however, only pragmatics, a longer chunk of text, or the identification of an elision can resolve all ambiguity:

- (21) a. *Max **lifted up** the patient*  
 [= raise the patient (literally, e.g., out of bed)]
  - b. *Max's good humor **lifted up** the patient*  
 [= increase (emotionally) the patient's spirits]
- (22) a. *Ann decided to **look up** Max*  
 [= find Max's name in the telephone book]
  - b. *Ann decided to **look up** Max* [= visit Max]

Subsequently, we examined cases of ambiguity involving more than two distinct meanings. In some cases, hyperclasses in themselves were sufficient to disambiguate, as in Table 5. Even though the various meanings of *brighten up* are very closely connected, and perhaps might not be considered homophonous by all, we do observe divergent syntactic behavior, either in terms of transformations or selectional restrictions between the various shades of meaning.

$N_0$ =: Nhum	$N_0$ =: N-hum	Verb	Particle	Example of $N_1$	$N_1$ =: Nhum	$N_1$ =: N-hum	Without particle	$N_1$ V Part	$N_1$ V	Synonym	Hyperclass
+	+	bundle	up	the magazines	-	+	+	-	-	bundle	concrete
+	-	bundle	up	the child	+	-	+	+	-	dress warmly	human
+	+	bust	up	the audience	+	-	-	+	-	make laugh	human
+	+	bust	up	the machine	-	+	+	-	-	break	concrete
+	+	choke	up	the pipes	-	+	-	-	-	clog	concrete
+	+	choke	up	the audience	+	-	-	+	-	cause to feel sad	human
+	+	crack	up	the audience	+	-	-	+	-	make laugh	human
+	+	crack	up	the car	-	+	-	-	-	damage	concrete
+	-	get	up	a committee	-	+	-	-	-	organize / form	concrete
+	+	get	up	Max	+	-	-	+	-	awaken	human

Table 2. Disambiguation through human or concrete direct objects



$N_0$ =: Nhum	$N_0$ =: N-hum	Verb	Particle	Example of $N_1$	$N_1$ =: Nhum	$N_1$ =: N-hum	Without particle	$N_1$ V Part	$N_1$ V	Synonym	Hyper-class	Semantic Class
+	-	brew	up	a plot	-	+	+	-	+	concoct	abstract	
+	-	brew	up	the tea	-	+	+	+	+	make	concrete	beverage
+	-	cook	up	an explanation	-	+	-	-	-	fabricate	abstract	false
+	-	cook	up	some food	-	+	+	-	-	prepare	concrete	food
+	+	jam	up	the exits	-	+	+	+	-	block	location	
+	+	jam	up	the machine	-	+	+	+	-	make stop working properly	concrete	machine
+	-	lap	up	praise	-	+	-	-	-	accept / receive eagerly	abstract	
+	+	lap	up	the milk	-	+	-	-	-	drink	concrete	food
+	+	spice	up	the novel	-	+	-	-	-	make interesting or sexy	concrete	reading material / image
+	+	spice	up	the dish	-	+	-	-	-	make more spicy	concrete	food
+	+	wrap	up	the package	-	+	+	-	-	wrap	concrete	
+	-	wrap	up	the session	-	+	+	+	-	end	event	meeting / activity

**Table 3. Disambiguation through semantic classes when object is [- human]**

For other cases of ambiguity involving more than two meanings, a larger context is needed to fully distinguish these expressions. In these cases, we followed Le Pesant & Mathieu-Colas 1998 and introduced domains, along with hyperclasses and semantic classes, as seen in Table 6.

$N_0$ = Nhum	$N_0$ = N-hum	Verb	Particle	Example of $N_1$	$N_1$ = Nhum	$N_1$ = N-hum	Without particle	$N_1$ V Part	$N_1$ V	Synonym	Hyper-class	Semantic Class
+	+	jack	up	the car	+	+	-	-	-	raise	human / concrete	vehicle / heavy object
+	+	jack	up	the prices	-	+	+	+	-	increase	concrete	money / rate
+	-	look	up	the phone number	+	+	-	-	-	find in a book, list, index, etc.	human / concrete	information / list
+	-	look	up	Max	+	-	-	-	-	visit	human	
+	+	loosen	up	the wire	-	+	+	+	+	make less tight	concrete	
+	+	loosen	up	my shoulders	+	+	+	+	-	relax	human / concrete	body part / human
+	+	shoot	up	the village	+	+	-	-	-	damage by gunfire	human / concrete	human / location
+	-	shoot	up	heroin	-	+	+	-	-	inject (drug)	concrete	drug
+	+	tighten	up	the muscles	+	+	-	+	+	make tense	human / concrete	body part
+	+	tighten	up	the wire	-	+	+	+	+	tighten	concrete	
+	+	toss	up	the blanket	+	+	-	-	-	throw upwards	concrete	
+	-	toss	up	the penny	-	+	+	-	-	throw in air to determine outcome	concrete	coin
+	-	tune	up	the car	-	+	+	-	-	adjust engine	concrete	vehicle
+	-	tune	up	the brass section	+	+	+	+	+	adjust pitch	human / concrete	musical instrument / musician

**Table 4. Disambiguation when object can be either [+ human] or [- human]**

$N_0 = N_{hum}$	$N_0 = N-hum$	Verb	Particle	Example of $N_1$	$N_1 = N_{hum}$	$N_1 = N-hum$	Without particle	$N_1$ V Part	$N_1$ V	Synonym	Semantic Class
+	+	brighten	up	the day	-	+	+	+	-	make happier	time
-	+	brighten	up	the room	-	+	+	+	-	make more attractive	location
+	+	brighten	up	Mary	+	-	-	+	+	make more cheerful	human

Table 5. Disambiguation of *brighten up*

$N_0 = N_{hum}$	$N_0 = N-hum$	Verb	Particle	Example of $N_1$	$N_1 = N_{hum}$	$N_1 = N-hum$	Without particle	$N_1$ V Part	$N_1$ V	Synonym	Hyper-class	Semantic Class	Domain
+	-	bring	up	the criminal	+	-	-	-	-	accuse of crime	human	un-desirable	law
+	+	bring	up	the issue	+	+	-	-	-	mention	abstract	abstract	conversa-tion
+	-	bring	up	Max	+	-	-	-	-	raise / educate	human	young	educa-tion
+	-	bring	up	breakfast	-	+	-	-	-	vomit	concrete	food	sickness
+	+	bring	up	the package	+	+	+	-	-	bring / carry	concrete	concrete	delivery

Table 6. Disambiguation of *bring up*

Here, in Table 6, the phrasal verb *bring up* translates into French as “accuser,” “soulever,” “élever,” “vomir,” or “apporter,” depending on the domain or context. Although it remains to be seen how we can precisely identify these domains by way of NLP programming, that information can nevertheless help disambiguate a sentence such as:

- (23) a. *The parents brought up the baby* [= mention in a conversation]
- b. *The parents brought up the baby* [= raise / educate, as a child]
- c. *The parents brought up the baby* [= carry up to a specific location]

**4. Semi-frozen vs. free expressions**

There are many cases where the verb-particle combination along with the complement is indisputably idiomatic or frozen since only one complement is possible, as in *live it up* “party extravagantly” or where only a couple of complements are possible, as in *pick up (speed + steam)* “go faster”. However, some phrasal verbs exist in very limited paradigms and might be construed as semi-idioms, whereas others accept a variety of complements and can be considered freer. For example, in Table 7, the first three cases have very limited domains – *burn up the (raceway + speedway + track)*, *burn up (energy + fat + calories)*, and *burn up (fuel + gas + money)* – while the last two meanings “destroy by fire” and “make angry” are less restricted as to possible complements, are able to be composed without the particle, and can be considered compositional.

$N_0$ =: Nhum	$N_0$ =: N-hum	Verb	Particle	Example of $N_1$	$N_1$ =: Nhum	$N_1$ =: N-hum	Without particle	$N_1$ V Part	$N_1$ V	Synonym	Hyper-class	Semantic Class	Domain
+	+	burn	up	the track	-	+	-	-	-	travel at high speed	concrete	roadway	racing
+	+	burn	up	money	-	+	-	-	-	use too much	concrete	money / fuel	spending
+	-	burn	up	calories	-	+	+	-	-	consume	concrete	energy	exercise
+	+	burn	up	the barn	+	+	+	+	+	destroy by fire	human / concrete	location	fire
+	+	burn	up	Max	+	-	+	+	-	make angry	human	human	emotional state

**Table 7. Disambiguation of *burn up***

Finally, in Table 8, while the first case of “throw upwards” can be construed as compositional, accepting many possible complements and difficult to distinguish from some of the more idiomatic senses, the other eight cases can be clearly distinguished by semantic classes.

$N_0 = N_{hum}$	$N_0 = N_{-hum}$	Verb	Particle	Example of $N_1$	$N_1 = N_{hum}$	$N_1 = N_{-hum}$	Without particle	$N_1$ V Part	$N_1$ V	Synonym	Hyper-class	Semantic Class
+	-	throw	up	the ball	+	+	+	-	-	throw upwards	human / concrete	
+	-	throw	up	POSS-0 hands	-	+	-	-	-	raise upwards suddenly	concrete	upper body part
+	+	throw	up	the building	-	+	-	-	-	erect quickly	concrete / location	building
+	-	throw	up	dinner	-	+	-	-	-	vomit	concrete	food
-	+	throw	up	dust	-	+	-	-	-	cause to rise	concrete	cloud / haze
+	-	throw	up	the campaign	-	+	-	-	-	abandon	concrete	job/project
+	+	throw	up	the slides	-	+	-	-	-	project	concrete	recorded image
+	-	throw	up	the past	-	+	-	-	-	refer repeatedly to	abstract	old
+	+	throw	up	some ideas	-	+	-	-	-	produce	abstract	new

**Table 8. Disambiguation of *throw up***

## 5. Conclusion

We conclude that subcategorization refinements, such as hyperclasses, semantic classes, and domains help mitigate ambiguity involving English phrasal verbs.

However, some uncertainty still remains, when the ambiguity involves subject commutation, as the following examples show:

- (24) a. *The police **broke up** the crowd* [= scatter or disperse]  
 b. *The comedian **broke up** the crowd* [= cause to laugh]  
 (25) a. *Max **took out** Mary* [= date]  
 b. *The hit men **took out** Mary* [= kill]  
 (26) a. *The student **marked up** the textbook* [= make marks in / write on]  
 b. *The bookstore manager **marked up** the textbook* [= raise the price of]

Expanding the selectional restrictions of the subject in the lexicon-grammar will clearly help solve the issue of ambiguity, but better defining context or domains is the only way to fully distinguish diverse meanings of lexically uniform phrasal verbs. Our data nevertheless underscore the importance of a lexicon-grammar approach to English phrasal verbs.

## Note

1. We refer to these as compositional, since the particle can basically be viewed as an intensifier (*beat up the kids*), an aspect marker (*boot up the computer*), or an adverbial (*drive up prices*) that is added to the one-word verb. Some cases where the particle can be deleted, however, do involve idiomatic or non-compositional expressions, such as the following:

- i. *The administrator backed (up + E) the teacher* [= support]  
 ii. *The situation was eating (up + E) Mary* [= bother]

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## Summary - Disambiguating phrasal verbs

Like regular one-word verbs, verb-particle combinations or phrasal verbs can be ambiguous in the lexicon. This study examines ways to disambiguate by adding specific semantic features or “*classes d'objets*” to the lexicon-grammar, along with characteristic syntactic selectional restrictions. We first enlarged the systematic description of the most productive particle used in English phrasal verb constructions: *up*. The initial database, composed of 300 transitive and neutral occurrences of phrasal verbs with *up* was expanded, and in the final database of 721 *up* expressions, 64% were shown to be ambiguous. Of these ambiguous expressions, over 60% involve just two or three homonyms, such as ***crack up the audience*** [= make laugh] vs. ***crack up the car*** [= damage], while another 20% comprise four or five homonyms. The rest involve six or more homonyms, with the expression *pick up* having fourteen distinct meanings. Following Gaston Gross (1994, 2004), Le Pesant & Mathieu-Colas (1998), and other researchers at LLI, we introduce hyperclasses, semantic classes, and domains to the object description of some of our data. These subcategorization refinements seem to help mitigate ambiguity and underscore the importance of a lexicon-grammar approach, which includes both syntactic and semantic information, to English phrasal verbs.

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