Comprehensive Annotation of Multiword Expressions in a Social Web Corpus

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Abstract

Multiword expressions (MWEs) are quite frequent in languages such as English, but their diversity, the scarcity of individual MWE types, and contextual ambiguity have presented obstacles to corpus-based studies and NLP systems addressing them as a class. Here we advocate for a comprehensive annotation approach: proceeding sentence by sentence, our annotators manually group tokens into MWEs according to guidelines that cover a broad range of multiword phenomena. Under this scheme, we have fully annotated an English web corpus for multiword expressions, including those containing gaps.

Keywords: multiword expressions, corpus annotation, social media

1. Introduction

We present a 55,000-word corpus of English web text annotated for multiword expressions (MWEs) with the aim of full corpus coverage. It uses a novel annotation scheme that emphasizes:

• heterogeneity—the annotated MWEs are not restricted by syntactic construction;
• shallow but gappy grouping—MWEs are simple groupings of tokens, which need not be contiguous in the sentence; and
• expression strength—the most idiomatic MWEs are distinguished from (and belong to) weaker collocations.

We examine these characteristics in turn below. Details of the annotation process appear in §2 and an overview of the resulting corpus in §3. The annotations are available for download at http://www.ark.cs.cmu.edu/LexSem

1.1. Heterogeneity

By “multiword expression,” we mean a group of tokens in a sentence that cohere more strongly than ordinary syntactic combinations: that is, they are idiosyncratic in form, function, or frequency.† As fig. 2 shows, the intuitive category of MWEs or idioms cannot be limited to any syntactic construction or semantic domain. The sheer number of multiword types and the rate at which new MWEs enter the language make development of a truly comprehensive lexicon prohibitive. Therefore, we set out to build a corpus of MWEs without restricting ourselves to certain candidates based on any list or syntactic category. Rather, annotators are simply shown one sentence at a time and asked to mark all combinations that they believe are multiword expressions. Examples from our corpus appear in figs. 1 and 3.

Given that automatic detection of multiword expressions has shown promise for such diverse applications as machine translation (Carpuat and Diab 2010), keyphrase/index term extraction (Newman et al. 2012), and language acquisition research (Ellis et al. 2008), a common corpus with MWEs would be useful to develop and compare techniques that would cut across applications. To our knowledge, however, none of the corpus resources to encode multiword expressions have done so in a general fashion. For English, resources marking some kinds of lexical idioms include: lexicons such as WordNet (Fellbaum 1998), SAID (Kuiper et al. 2003), and WikiMwe (Hartmann et al. 2012); targeted lists (Baldwin 2005, 2008; Cook et al. 2008; Tu and Roth 2011, 2012); websites like Wiktionary and Phrases.net; and large-scale corpora such as SemCor (Miller et al. 1993), the French Treebank (Abelle et al. 2003), the Szeged-ParallellFX corpus (Vincze 2012), and the Prague Czech-English Dependency Treebank (Cmejrek et al. 2005). But each of these prioritizes certain kinds of MWEs to the exclusion of others. Consequently, the computational literature on multiword expressions (reviewed in Baldwin and Kim 2010) has been fragmented, looking (for example) at subclasses of phrasal verbs or nominal compounds in isolation. With regard to the aforementioned corpora, annotations of multiword compounds in the French Treebank and light verb constructions in SzegedParallellFX have been used as a testbed for statistical learning of sequence taggers (Constant and Sigogne 2011; Constant et al. 2012; Vincze et al. 2013) and MWE-aware parsers (Green et al. 2011, 2012; Constant et al. 2012), while the SemCor-driven task of noun and verb supertagging (Ciaramita and Altmun 2006; Paaß and Reichertz 2009) involves the identification of some multiword expressions. We hope a resource with more comprehensive MWE annotations will lead to more general-purpose approaches to MWEs.

(1) My wife had taken her '07 Ford Fusion in for a routine oil change.

(2) he was willing to budge a lot on the price which means a lot to me.

Figure 1: Two sentences from the corpus. Subscripts and text coloring indicate strong multiword groupings; superscripts and underlining indicate weak groupings. Boxes indicate gaps.
1. MW named entities: Chancellor of the Exchequer Gordon Brown
2. MW compounds: red tape, motion picture, daddy longlegs, Bayes net, hot air balloon, skinny dip, trash talk
3. conventionally SW compounds: snapdragon, overlook (v. or n.), blackjack, shootout, sunscreen, somewhere
4. verb-particle: pick up, dry out, take over, cut short
5. verb-preposition: refer to, depend on, look for, prevent from
6. verb-noun-(preposition): pay attention (to), go bananas, lose it, break a leg, make the most of
7. support verb: make decisions, take breaks, take pictures, have fun, perform surgery
8. other phrasal verb: put up with, miss out (on), get rid of, look forward to, run amok, cry foul, add insult to injury, make off with
9. PP modifier: above board, beyond the pale, under the weather, at all, from time to time, in the nick of time
10. coordinated phrase: cut and dry, more or less, up and leave
11. conjunction/connective: as well as, let alone, in spite of, on the face of it, on its face
12. semi-fixed VP: smack <one’s> lips, pick up where <one> left off, go over <thing> with a fine-tooth(ed) comb, take <one>’s time, draw <one>’s up to <one>’s full height
13. fixed phrase: easy as pie, narrow escape, close call, close shave, close shave
14. phatic: You’re welcome. Me neither!
15. proverb: Beggars can’t be choosers. The early bird gets the worm. To each his own. One man’s <thing1> is another man’s <thing2>.

Figure 2: Some of the classes of idioms in English. The examples included here contain multiple lexicalized words—with the exception of those in (3), if the conventionally single-word spelling is used.

1.2. Shallow token groupings

Concretely, we represent each MWE as a grouping of tokens within a sentence. The tokens need not be contiguous: gappy (discontinuous) uses of an expression may arise due to internal arguments, internal modifiers, and constructions such as passives. For example, sentence 1 in fig. 1 contains a gappy instance of the verb-particle construction take in. It also contains two contiguous MWES, the named entity ’07 Ford Fusion and the noun-noun compound oil change. Syntactic annotations are not used or given as part of the MWE annotation, though MWES can be syntactically categorized with part-of-speech tags (as in table 2 and fig. 2) or syntactic parses.

1.3. Strength

Qualitatively, the strength of association between words can vary on a continuum of lexicality, ranging from fully transparent collocations to completely opaque idioms (Hermann et al. 2012). In the interest of simplicity, we operationalize this distinction with two kinds of multiword groupings: strong and weak. For example, the expression close call describes a situation in which something bad nearly happened but was averted (He was late and nearly missed the performance—it was a close call). This semantics is not readily predictable from the expression: the motivation for call in this expression is opaque; and moreover, *near call and *far call and *far call are not acceptable variants nor can the danger be described as *closely calling or *calling close. We therefore would treat close call as a strong MWE. On the other hand, the expression narrow escape is somewhat more transparent and flexible—one can narrowly escape/avoid an undesirable eventuality, and the alternative formulation close escape is acceptable, though less conventional—so it would therefore qualify as a weak MWE.

While there are no perfect criteria for judging MWE-hood, several heuristics tend to be useful when a phrase’s status is in doubt. The strongest cues are semantic opacity and morphosyntactic idiosyncrasy: if a word has a function unique to a particular expression, or an expression bucks the usual grammatical conventions of the language, the expression is almost certainly an MWE. It often helps to test how fixed/fossilized the expression is, by substituting words with synonyms/antonyms, adding or removing modifiers, or rearranging the syntax. Another strategy is to search large corpora for the expression to see if it is much more frequent than alternatives. In practice, it is not uncommon for annotators to disagree even after considering these factors, and to compromise by marking something as a weak MWE. For purposes of annotation, the only constraints on MWE groupings are: (a) a group must consist of two or more tokens; (b) all tokens in a group must belong to the same sentence; (c) a given token may belong to at most one strong group and at most one weak group; and (d) if a token belongs to both a strong group and a weak group, all other tokens in the strong group must belong to the same weak group.

2. Annotation

Over the course of 5 months, we fully annotated the 55,000-word REVIEWS section of the English Web Treebank (Bies et al. 2012). Annotators were the first six authors of this paper. All are native speakers of English, and five hold undergraduate degrees in linguistics. The annotation took three forms: (a) individual annotation (a single annotator working on their own); (b) joint annotation (collaborative work by two annotators who had already worked on the sentence independently); and (c) consensus annotation (by negotiation among three or more annotators, with discussion focused on refining the guidelines). Initially, consensus annotation sessions were held semi-weekly; the rate of these sessions decreased as agreement improved. Though consensus annotations are only available for 1/5 of the sentences, every sentence was at least reviewed independently and jointly. The annotation software recorded the full version history of each sentence; during some phases of annotation this was exposed so that analyses from different annotators could be compared.

The judgment of whether an expression should qualify as an MWE relied largely on the annotator’s intuitions about its semantic coherence, idiosyncrasy, and entrenchedness in the language. As noted in §15 the decision can be informed by heuristics. Judgments about the acceptability of syntac-

\footnote{But note that close shave and near miss are other idioms using the same “proximity to danger” metaphor.}
The guidelines document describes general issues and con-
strains that the construction of MWEs can be made more precise in the future to make the decision more rigorous. **Annotation guidelines.** Annotation conventions were recorded on an ongoing basis as the annotation progressed. The guidelines document describes general issues and considerations (e.g., inflectional morphology; the spans of named entities; date/time/address/value expressions; overlapping expressions), then briefly discusses about 40 categories of constructions such as comparatives (as X as Y), age descriptions (N years old), complex prepositions (out of, in front of), discourse connectives (to start off with), and support verb constructions (make a decision, perform surgery).

Some further instructions to annotators include:

- **Groups should include only the lexically fixed parts of an expression (modulo inflectional morphology); this generally excludes determiners and pronouns:** *made the mistake, pride themselves on*.

- **Multiword proper names count as MWEs.**

- **Misspelled or unconventionally spelled tokens are interpreted according to the intended word if clear.**

- **Overtokenized words (spelled as two tokens, but conventionally one word) are joined as multiwords.** Clitics separated by the tokenization in the corpus—negative n’t, possessive ’s, etc.—are joined if functioning as a fixed part of a multiword (e.g., T’s Cafe), but not if used productively.

- **Some constructions require a possessive or reflexive argument (see semi-fixed VP examples in fig. 2).** The possessive or reflexive marking is included in the MWE only if available as a separate token; possessive and reflexive pronouns are excluded because they contain the argument and the inflection in a single token. This is a limitation of the tokenization scheme used in the corpus.

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3 In some cases idiosyncratic constructions were rejected because they did not contain more than one lexicalized element: e.g., the construction have + <evaluative adjective> + <unit of time> (have an excellent day, had a bad week, etc.).

4 Our measure of inter-annotator agreement is the precision/recall–based MUC criterion [Vilain et al. 1995]. Originally developed for coreference resolution, it gives us a way to award partial credit for partial agreement on an expression.
weak MWE instances. 82 weak MWEs (18%) contain a strong MWE as a constituent (e.g., means
Table 1: BS to
table 1. Among the highlights:
Summary statistics of the MWEs in the corpus are given in
expressed in many reviews). Summary statistics of the MWEs in the corpus are given in
tables. The writing style of these reviews is
informal, so we would expect a lot of colloquial idioms, per-
These figures demonstrate (i) that MWEs are quite frequent
in the web reviews genre, and (ii) that annotators took ad-
Many patterns are attested with and without gaps; a handful
occurs more frequently with gaps than without. About 78%
of gaps are immediately preceded by a verb.

Figure 4 shows the distribution of intra-MWE and extra-
MWE words by part of speech. The MWE words are syntac-
tically diverse: common nouns, verbs, proper nouns, prepo-
sitions, adverbs, adjectives, determiners, and particles account
for most of them. Nearly all particles and nearly two thirds
of proper nouns were marked as part of an MWE.
Categorizing MWEs by their coarse POS tag sequence, we
find only 8 of these patterns that occur more than 100 times:
common noun–common noun, proper noun–proper noun,
verb-preposition, verb-particle, verb-noun, adjective-noun,
and verb-adverb. But there is a very long tail—460 patterns
in total. For the interested reader, table 2 shows the most
frequent patterns, with examples of each.

6 They are: offers a decent bang\textsuperscript{1}, for the buck\textsuperscript{2}, taking this as\textsuperscript{3}, far as\textsuperscript{4} we can\textsuperscript{5}; passed\textsuperscript{6} away silently in\textsuperscript{7} his sleep; asked\textsuperscript{8} Pomper for\textsuperscript{9} my money back\textsuperscript{6}; putting\textsuperscript{10}; me at\textsuperscript{11}; my ease;\textsuperscript{12} tells\textsuperscript{13} me BS to\textsuperscript{14} my face\textsuperscript{15}.

5 See, e.g., Nunberg et al.\textsuperscript{16} p. 493: “idioms are typically associated with relatively informal or colloquial registers and with popular speech and oral culture”], [Moon\textsuperscript{17} 1998] p. 267: “[fixed expressions/idioms] can be seen as part of a discourse of familiarity…[they can] increase solidarity between the speaker/writer and hearer/reader”, and Simpson and Mendis\textsuperscript{18} [2003] p. 434: “possible communicative effects [of idioms] include exaggeration, informal-
ity, and rhetorical flair”).

• 65% of the gaps are one word long; another 25% are two

words long.

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vantange of the flexibility of the scheme to encode gappy
expressions and a strength distinction.

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There are 2,378 MWE types\textsuperscript{17} 82% of these types occur
only once; just 183 occur three or more times. The most
frequent are highly recommend(ed), customer service, a lot,
work with, and thank you. The longest are 8 lemmas long,
e.g. do n’t get catch up in the hype and do n’t judge a book
by its cover.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
\textbf{constituent tokens} & \textbf{2} & \textbf{3} & \textbf{4} & \textbf{≥5} & \textbf{total} \\
\hline
\textbf{strong} & 2,257 & 595 & 126 & 46 & 3,024 \\
weak & 269 & 121 & 44 & 25 & 459 \\
\hline
\textbf{number of gaps} & & & & & \textbf{gap length} \\
\hline
\textbf{0} & 2,626 & 394 & 4 & & \\
\textbf{1} & 322 & 135 & 2 & & \\
\textbf{2} & 2,948 & 529 & 6 & & \\
\textbf{≥3} & 259 & 98 & 45 & & \\
\hline
\end{tabular}
\caption{Annotated corpus statistics over 723 documents (3,812 sentences). 57% of sentences (72% of sentences over 10 words long) and 88% of documents contain at least one MWE. 8,060/55,579=15% of tokens belong to an MWE; in total, there are 3,024 strong and 459 weak MWE instances. 82 weak MWEs (18%) contain a strong MWE as a constituent (e.g., means a lot to me in fig. \textsuperscript{1} and get in touch with in fig. \textsuperscript{3}). \textbullet Gaps: 15% of MWEs contain at least one gap, and 35% of gaps contain more than one token. 1.5% of tokens fall within a gap; 0.1% of tokens belong to an MWE nested within a gap; (like '07 Ford Fusion and a little in fig. \textsuperscript{1}).}
\end{table}
Table 2: All POS sequences occurring in at least 10 MWEs in the corpus (49 patterns). Contiguous and gappy MWE instances are counted separately. POS groupings are abbreviated with a single character (N for common nouns, * for proper nouns, T for particles, etc.). Strong MWEs are joined with _ and weak MWEs with ~; weak MWE examples are italicized. MWE types occurring at least 10 times are bolded.

<table>
<thead>
<tr>
<th>POS pattern</th>
<th>MWEs contig. gappy</th>
<th>most frequent types (lowercased lemmas) and their counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.N</td>
<td>331 1</td>
<td>customer service: 31 oil change: 9 wait staff: 5 garage door: 4</td>
</tr>
<tr>
<td>*_.A</td>
<td>325</td>
<td>santa fe: 4 dr. shady: 4</td>
</tr>
<tr>
<td>V.P</td>
<td>217 44</td>
<td>work with: 27 deal with: 16 look for: 12 have to: 12 ask for: 8</td>
</tr>
<tr>
<td>V.T</td>
<td>149 42</td>
<td>pick up: 15 check out: 10 show up: 9 end up: 6 give up: 5</td>
</tr>
<tr>
<td>_A.N</td>
<td>133 3</td>
<td>take time: 7 give chance: 5 waste time: 5 have experience: 5</td>
</tr>
<tr>
<td>V.R</td>
<td>103 30</td>
<td>come in: 12 come out: 8 take in: 7 stop in: 6 call back: 5</td>
</tr>
<tr>
<td>D_N</td>
<td>83 1</td>
<td>a lot: 30 a bit: 13 a couple: 9</td>
</tr>
<tr>
<td>P.N</td>
<td>67 8</td>
<td>on time: 10 in town: 9 in fact: 7</td>
</tr>
<tr>
<td>R.R</td>
<td>72 1</td>
<td>at least: 10 at best: 7 as well: 6 of course: 5 at all: 5</td>
</tr>
<tr>
<td>V_D_N</td>
<td>46 21</td>
<td>take the time: 11 do a job: 9 waste time: 4</td>
</tr>
<tr>
<td>V~N</td>
<td>7 56</td>
<td>home delivery service: 3 lake forest tots: 3</td>
</tr>
<tr>
<td>R~V</td>
<td>49</td>
<td>highly recommend: 43 well spend: 1 pleasantly surprise: 1</td>
</tr>
<tr>
<td>P.D_N</td>
<td>33 6</td>
<td>over the phone: 4 on the side: 3 at this point: 2 on a budget: 2</td>
</tr>
<tr>
<td>A.P</td>
<td>39</td>
<td>pleased with: 7 happy with: 6 interested in: 5</td>
</tr>
<tr>
<td>P_P</td>
<td>39</td>
<td>out of: 10 due to: 9 because of: 7</td>
</tr>
<tr>
<td>V_O</td>
<td>38</td>
<td>thank you: 26 get it: 2 trust me: 2</td>
</tr>
<tr>
<td>V.V</td>
<td>8 30</td>
<td>get do: 8 let know: 5 have do: 4</td>
</tr>
<tr>
<td>N~N</td>
<td>34 1</td>
<td>channel guide: 2 drug seeker: 2 room key: 1 bus route: 1</td>
</tr>
<tr>
<td>A~N</td>
<td>31</td>
<td>hidden gem: 3 great job: 2 physical address: 2 many thanks: 2 great guy: 1</td>
</tr>
<tr>
<td>V.N.P</td>
<td>16 15</td>
<td>take care of: 14 have problem with: 5</td>
</tr>
<tr>
<td>N.V</td>
<td>18 10</td>
<td>mind blow: 2 test drive: 2 home make: 2</td>
</tr>
<tr>
<td>_~~*</td>
<td>28</td>
<td>bj s: 2 fraiser ’s: 2 ham s: 2 alan ’s: 2 max ’s: 2</td>
</tr>
<tr>
<td>D_A</td>
<td>28</td>
<td>a few: 13 a little: 11</td>
</tr>
<tr>
<td>R.P</td>
<td>25 1</td>
<td>all over: 3 even thought: 3 instead of: 2 even if: 2</td>
</tr>
<tr>
<td>V.A</td>
<td>19 6</td>
<td>make sure: 7 get busy: 3 get healthy: 2 play dumb: 1</td>
</tr>
<tr>
<td>V.P.N</td>
<td>14 6</td>
<td>go to school: 2 put at ease: 2 be in hands: 2 keep in mind: 1</td>
</tr>
<tr>
<td>_.#</td>
<td>20</td>
<td>5 star: 9 2 star: 2 800 number: 1 one bit: 1 ten star: 1 360 restraint: 1</td>
</tr>
<tr>
<td>N_A</td>
<td>18</td>
<td>year old: 9 month old: 3 years old: 2 cost effective: 1 lightning fast: 1</td>
</tr>
<tr>
<td>V~R</td>
<td>11 6</td>
<td>stay away: 3 go in: 2 bring back: 2 recommend highly: 2 work hard: 1</td>
</tr>
<tr>
<td>N_P.N</td>
<td>14 2</td>
<td>chest of drawers: 2 man of word: 1 bang for buck: 1 sister in law: 1</td>
</tr>
<tr>
<td>N~V</td>
<td>6 10</td>
<td>job do: 2 work do: 2 picture take: 1 care receive: 1 operation run: 1</td>
</tr>
<tr>
<td>R.V</td>
<td>15 1</td>
<td>well do: 4 never mind: 2 better believe: 1 well know: 1</td>
</tr>
<tr>
<td>N.R</td>
<td>15</td>
<td>night out: 3 hands down: 3 thanks again: 3</td>
</tr>
<tr>
<td>N_.~_N</td>
<td>14</td>
<td>a / c: 2 jiu - jitsu: 2</td>
</tr>
<tr>
<td>P<del>D</del>N</td>
<td>14</td>
<td>in the world: 3 around the corner: 2 for some reason: 2</td>
</tr>
<tr>
<td>V_R.P</td>
<td>12 1</td>
<td>look forward to: 3 talk down to: 2 have yet to: 1 be there for: 1</td>
</tr>
<tr>
<td>A_A</td>
<td>13</td>
<td>west indian: 3 old fashioned: 1 up front: 1 spot on: 1 tip top: 1 dead on: 1</td>
</tr>
<tr>
<td>V.T.P</td>
<td>11 2</td>
<td>watch out for: 2 make up for: 2 put up with: 2 turn over to: 1</td>
</tr>
<tr>
<td>P_P.N</td>
<td>10 2</td>
<td>out of business: 3 out of town: 2 out of date: 1</td>
</tr>
<tr>
<td>N_P</td>
<td>12</td>
<td>nothing but: 2 increase in: 1 damage to: 1</td>
</tr>
<tr>
<td>P.N..P</td>
<td>11</td>
<td>in front of: 3 on top of: 2 in need of: 1 in spite of: 1 in search of: 1</td>
</tr>
<tr>
<td>A.N.N</td>
<td>10</td>
<td>criminal defense lawyer: 2 purple hull pea: 1 social security numbers: 1</td>
</tr>
<tr>
<td>N.N.N</td>
<td>11</td>
<td>search engine optimization: 2 kung pao chicken: 1</td>
</tr>
<tr>
<td>N_.&amp;.N</td>
<td>10</td>
<td>spay and neuter: 2 give and take: 1 bar and grill: 1 hit or miss: 1</td>
</tr>
<tr>
<td>G.A</td>
<td>10</td>
<td>over priced: 4 over cooked: 1 miss informed: 1 out standing: 1</td>
</tr>
<tr>
<td><del>_</del><em>~</em><del>_</del></td>
<td>10</td>
<td>bexar county tax office: 1 anna maria jose mudo: 1</td>
</tr>
<tr>
<td>P.R</td>
<td>10</td>
<td>by far: 8 if ever: 1 of late: 1</td>
</tr>
</tbody>
</table>

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4. Conclusion

We have described a process for shallow annotation of heterogeneous multword expressions in running text. The annotation guidelines and our annotations for the English Web Treebank can be downloaded at [http://www.ark.cs.cmu.edu/LexSem](http://www.ark.cs.cmu.edu/LexSem). An MWE identification system trained on our corpus is presented in [Schneider et al. (2014)](http://www.ark.cs.cmu.edu/LexSem). Other ongoing and future work includes extending the annotation scheme to new datasets; developing semi-automatic mechanisms to detect or discourage inconsistencies across sentences; and integrating complementary forms of semantic annotation of the offsets in the original corpus. Tokens within the span of an MWE are retained.

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8 Licensing restrictions prevent us from publishing the full text of every sentence, so we provide annotations in terms of token.
MWEs (such as WordNet synsets). These improvements will facilitate NLP tools in more accurately and informatively analyzing lexical semantics for the benefit of downstream applications.

Acknowledgments
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References


