A corpus-based construction of emotion verb scales

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Abstract

We examine subclasses of English verbs of emotion, in particular Experiencer verbs like *surprise, fear* and *astonish,* which express the causation of gradable emotions. The gradation is richly lexicalized by verbs that denote different degrees of intensity of the same emotion (e.g., *surprise, strike, dumbfound, flabbergast*). We examine manually constructed groups of verbs expressing different degrees of intensity of one underlying emotion in the light of corpus (Web) data. We employ lexical-semantic patterns that were previously identified as discriminating between the members of pairs of scalar adjectives and apply them to verbs that belong to three broad emotion verbs classes. The results show, first, that the chosen verbs indeed possess scalar qualities; second, they confirm the prior assignment of the verbs into broad classes based on a common underlying emotion; finally, the Web data allow us to construct consistent scales with verbs ordered according to the intensity of the emotion. Future extensions to additional verb classes will lead to a more subtle analysis of the semantics of emotion verbs and their improved representation in lexical resources with potential benefits for translation, language pedagogy and automatic inferencing.

1 Introduction

The lexicon of emotions presents significant challenges for systematic investigation and lexical encoding. Psychologists have identified a small number of basic emotions that are maximally distinct from one another and arguably have universal status, independent of cultural or linguistic diversity (e.g., Johnson-Laird and Oatley, 1989). Emotion verbs have been classified semantically and syntactically for different languages (Belletti and Rizzi, 1988, Levin 1993, Mathieu 2005, *inter alia*), but there is little agreement among the different semantic analyses. We examine a classification that is based both on intuition and information gathered from traditional dictionaries, and evaluate it against corpus data. Our goal is to empirically validate a semantic classification of English emotion verbs that

(1) provides a subtle analysis of an important component of the English verb lexicon;

(2) serves as the basis for appropriate representations in lexical resources serving NLP, such as WordNet;

(3) has the potential to improve automatic text understanding by facilitating inferencing and the detection of lexically-based cohesion.[1]

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[1] We are not concerned here with the semantic orientation of the verbs, i.e., the question as what constitutes a "positive" or a "negative" emotion. Lexemes were classified for polarity by Hatzivassiloglou and McKeown (1997), Esuli and Sebastiani (2006) and Wilson, Wiebe and Hwa (2004) *inter alia*. Anscombre and Ducrot (1983) noted the constraints on conjoining adjectives with opposing orientation by means of conjunctions such as *and* and *but.*

2 Emotion Verbs

Emotion verbs have been classified by psychologists and linguists with surprisingly little agreement (Johnson-Laird and Oatley 1989, Martin and White 2005, Mathieu 2005, Ortony 1988, Wierzbicka 1996, *inter alia)*. Mathieu (2005) classified French emotion verbs with the help of standard lexical resources such as Le Grand Robert (2007) and Le Trésor de la Langue Française informatisé. A manual translation of this classification by Mathieu and Fellbaum (2010) yielded analogous English verb classes with significant crosslinguistic overlap. Our goal here is to check these classifications against corpus data.

We depart from the grouping of 370 English emotion verbs into twenty-seven broad classes by Mathieu and Fellbaum (2010). We are aware that emotion verbs are not always easily distinguishable from cognition verbs. Thus, *shock* and *scandalize* denote events that can evoke both judgments and emotions (Martin and White 2005) and the groups we consider are therefore relatively broad. However, the possible overlap with cognition verbs does not affect our goal of ranking the verbs in terms of their intensity.[2]

All classes consist entirely of Experiencer psych verbs. As (1) shows, the transitive use of the verbs in this syntactically defined class requires a structural subject that refers to the Stimulus or Cause of the emotion, while the object expresses the Experiencer (Belletti and Rizzi 1988, Levin 1993). Thus our class of *frighten* verbs includes the verbs *intimidate, scare* and *alarm* but not verbs like *fear*, whose subject in a transitive construction denotes the Experiencer, as in (2):

(1) *Lightning frightens/scares   Mary*
      CAUSE   EXPERIENCER

(2) *Mary   fears   lightning*
    EXPERIENCER   CAUSE

The verbs in the *frighten* class can form Middles, intransitive constructions where the Experiencer appears in subject position, as in (3)

(3) *Mary frightens/scares/intimidates easily*

In these constructions, no Stimulus or Cause argument is overtly expressed.

The work reported here is based on the observation that within each semantic class, the verbs express different degrees of intensity of the basic emotion that represents the class. For example, *terrify* seems intuitively to express a stronger degree of *frighten* than *scare*. Similarly, *love* seems more intense than *like*, and *adore* in turn is stronger than *love,* though all three verbs are similar in referring to feelings of affection and they are therefore arguably members of the same broad semantic class. One can think of these verbs as representing different points on a scale, similar to gradable adjectives like *good-fine-superb* that express greater or smaller degrees of a common property (Bierwisch and Lang 1989, Kennedy 1999, *inter alia*).

While gradability has been studied primarily for properties, which are typically expressed by adjectives, this semantic attribute extends to concepts lexicalized by other parts of speech. Nouns like *fear* and *terror* and adjectives like *afraid* and *terrified* similarly differ in the strength of the emotion they express. In this paper, we limit ourselves to the consideration of verbs.

We undertake a corpus search to determine the relative degree of intensity of emotion verbs within a predefined class and, for semantically related classes, across classes.

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[2] We focus on the core emotion reading of the verbs and disregard other possible meanings. For example, we exclude the contact verb reading of *strike*; similarly, we focus on the reading of *fear* whose causative counterpart is *frighten*, thus excluding the "apologetic" and "reverential" meanings in sentences like *I won't be able to attend the party, I fear* and *We were taught to fear God*, respectively.

3   Lexical-Semantic Patterns

To determine the relation between semantically similar words, lexical-semantic patterns can be evoked. For example, Cruse (1986) noted that the patterns *Xs and other Ys* and *Ys such as Xs* establish that *Y* is a superordinate (more general) concept than *X*, and conversely, that *X* is a kind of *Y*. The application of these patterns in examples (4) and (5) shows that *rose* is a member of the superordinate category *flower*:

(4) *roses and other flowers*
(5) *flowers such as roses*

Lexical-semantic patterns can serve as tests for the construction and verification of relations among lexemes in a semantic network like WordNet (Miller 1995, Fellbaum 1998). WordNet is largely constructed around conceptual-semantic relations like hyperonymy, which links more general to increasingly specific words. Furthermore, lexical-semantic patterns are valuable for augmenting a resource via a corpus-based retrieval of terms that are candidates for structured inclusion (e.g., Snow and al. 2006); finally, new lexical-semantic relations can be identified and applied to massive amounts of data (Hearst 1992, Fellbaum 2002, Chklovski and Pantel 2004). In most cases, the discovery and application of lexical-semantic patterns have focused on nouns, perhaps due to a combination of their preponderance in the lexicon and their relatively straightforward semantics. Focusing on gradable adjectives in order to determine their relative position on a scale, Sheinman and Tokunaga (2009) induce lexical-semantic patterns from the Web. They assume WordNet's organization of adjectives into "dumbbell" structures, with a pair of frequent and strongly associated "direct antonyms" such as *wet* and *dry* partitioning a scale into two. Each direct antonym is associated with a number of "semantically similar" adjectives, such as *drenched, soaked* at one side of the scale and *arid, parched* on the other (Miller 1998).

From a given scale (e.g., "goodness"), Sheinman and Tokunaga (2009) select adjectives pairs, choosing first one of WordNet's direct antonyms (e.g., *good*) and one of its semantically similar adjectives from the same side of the scale (e.g. *great*). A search of the Web for occurrences of the expression *good*great* (where * is a lexically unspecified wildcard) yields lexical-semantic patterns consisting of single words or short phrases, such as *(perhaps) even* and *if not*. Horn (1989) had previously suggested that *even* serves to discriminate between more and less intense adjectives to the left and right of this word, respectively. Inverting the order of the adjectives returns patterns like *if not…then* as in (6) and (7):

(6) *good if not great*
(7) *if not great, then good*

Sheinman and Tokunaga apply the patterns they induced to pairs of "semantically similar" adjectives and derive a relative ordering for them, which they subsequently evaluate against human judgments. Schulam and Fellbaum (2010) show the crosslinguistic applicability of Sheinman and Tokunaga's adjective scale patterns by extending it to German.

4   Ordering Verbs of Emotion on a Scale

We asked whether the patterns identified by Sheinman and Tokunaga (2009) for adjectives could be applied to emotion verbs, since many of these verbs resemble adjectives in exhibiting scalar properties and expressing different degrees of intensity of a common basic feeling.

As an initial proof of concept, we studied three broad classes that we judged to be clearly distinct and non-overlapping representatives of the emotion lexicon: *surprise*, *fear* and *annoyance*. The classes comprised ten, five and nine members, respectively. We manually ordered the verbs within each group based on their intensity using our intuition, as shown in Figures 1-3.

astonish< surprise< amaze< astound< strike< stun< floor< dumbfound<flabbergast< stupefy

Figure 1. **Surprise** verbs scaled according to intensity

intimidate < scare < frighten < alarm < terrify

Figure 2. **Fear** verbs scaled according to intensity

irk < nettle < irritate <annoy< anger< exasperate< infuriate< enrage< incense

Figure 3. **Annoy** verbs scaled according to intensity

It is important to note that we are merely interested in the relative ordering of the verbs on a scale and not making any claims as to the semantic distance between them. Quite possibly, some verbs are more similar to one another in terms of their intensity than others, and the distance among the verbs on the scale is not uniform, as seems to be generally the case with gradable adjectives.

Bierwisch and Lang (1989) showed that adjectives scales are open-ended, independently of the lexical encoding of values on the scales. The same seems to apply to gradable emotion expressions. Thus, if *terrify* were correctly placed as the rightmost verb on the *frighten* scale based on its intensity with respect to other verbs of fear, this does not imply that *terrify* expresses the highest degree of fear a person may experience. Although English may not have a simple lexical item denoting a more intense form of causing fear than *terrify*, greater intensity can straightforwardly be expressed with modifiers like *utterly, exceedingly* or *extremely*.

In contrast to adjectives, however, most of the emotion verbs that can be placed on a scale do not have antonyms. For example, there appears to be no obvious word that expresses either the absence of *surprise* or an emotion that contrasts with *surprise* in a meaningful way. Similarly, *calm* may suggest itself as the opposite of *fear*, but *agitate* or *worry* are at least equally good candidates as opposites of *calm*. An exception appears to be the noun/verb pair *love* and *hate*, which arguably constitutes a contrasting pair whose members, like antonymous adjectives, are strongly associated with each other both linguistically and psychologically (Fellbaum 1995).

To test our initial placement of verbs on their respective scales (Figures 1-3), we applied Sheinman and Tokunaga's (2009) patterns. Like Sheinman and Tokunaga, we used the Web as a corpus, as its size constitutes an obvious advantage over balanced but relatively small corpora like the British National Corpus. We selected three patterns:

(P1) V_1 *(perhaps) even* V_2
(P2) V_1*, not to say* V_2
(P3) *If not* V_1 *then* V_2

First, note that these patterns return verbs from the same syntactic class (Experiencer verbs with the Cause argument in subject position) on either side; the queries did not return hits with syntactically distinct emotion verbs, such as *she feared, even frightened him*.

Second, the directions of the patterns differ. In the case of the first and the second pattern, the more intense verb is found to the right of the phrase:

(8) *annoy even infuriate*
(9) *anger, not to say incense*

while in the third pattern, the verb expressing the more intense emotion is to the left:

(10) *if not terrify then scare*

5   Experimental validation

For the members of each group preclassified by Mathieu and Fellbaum (2010), we manually searched all possible pairwise combinations, with both orders for each pair. Thus, for the five verbs we assigned to the *fear* class (*alarm, frighten, intimidate, scare, terrify*) twenty pairs were searched for each patterns shown Table 1.

For each of the pairs, queries were written with each of the three patterns.

The results show for most pairs, one verb expresses a stronger degree of the same basic emotion than the other verb. The asterisks indicate the pairs for which either no example or only a single one were found. For the remaining cases, the number of hits ranged from dozens to hundreds. In the latter cases, we manually inspected at least a dozen returns to assure that the searches had returned valid examples.

Adj₁-Adj₂	*Adj₂-Adj₁*
alarm-frighten	*frighten-alarm
*alarm-intimidate	*intimidate-alarm
alarm-scare	*scare-alarm
alarm-terrify	*terrify-alarm
intimidate-frighten	*frighten-intimidate
intimidate-scare	scare-intimidate
intimidate-terrify	*terrify-intimidate
frighten-terrify	*terrify-frighten
scare-frighten	*frighten-scare
scare-terrify	*terrify-scare

Table 1: pairs of frighten verbs

5.1 Results

Several points are worth noting. First, the *even* pattern was by far the most productive. This is not surprising given that it is roughly equivalent in meaning to the other two patterns while being lexically and syntactically much less complex and thus likely preferred by speakers.

Second, the majority of the hits that were returned contained the target not in its active verb form but as an adjectival past participle. Although we have no good explanation for this fact, we believe that the participles encode the respective strength of the emotions in the same way as their underlying verbs, and thus our results are not impaired by the preponderance of adjectival rather than verbal forms. It is quite possible that the patterns we used tend to favor adjectives over verbs as their collocates, as these patterns had been specifically identified by Sheinman and Tokunaga (2009) to occur with contrasting adjectives. Some of the target verbs have homographic nouns (*alarm, scare*) and a search for the base form of the verb often returned hits with the nouns.

Below we illustrate our findings with representative examples from the group of five verbs expressing fear-causing events. We present examples for each of the pairs we found from the set of twenty possible pairs listed in Table 1. The data are similar to those for the two other verb groups that we examined (*surprise, annoy*) but that will not be presented and discussed here in detail.

(11) Truly, a cold chill gripped me, my heart rate increased, and I became **alarmed, even frightened**.

(12) She looked **alarmed, even scared** by our festive look.

(13) Now, when money is tight, the Government seeks to claw back the entitlements and does so in a way that **alarms, even terrifies**

(14) The ticking clock **intimidates us, even frightens us**

(15) I am still dealing with some level of doubt and fear, the assignment **intimidates and even scares me** a little.

(16) However, for some people, anger is a constant companion that defines their personality **and intimidates - even terrifies -** their loved ones,

(17) The prospect of change and evolution **frightens, even terrifies,** many people around the world

(18) For the first time since she had crossed him Annabeth looked **scared, even frightened**. ...

(19) see something in McCain that others don't; something that **scares - even terrifies** - many of those who know McCain on a personal basis.

(20) When she first became an agent on his team she felt **scared even intimidated** by them

5.2 Outliers

Scare and *intimidate* were found on both sides of the patterns, as exemplified in (15) and (20). Although our search returned several hundred examples where *scare* expressed a stronger emotion than *intimidate,* only six examples with the inverse order, such as (20), were found, all with the *even* pattern. A possible explanation for the fact that *scare* and *intimidate* do not seem to exhibit a clear asymmetry might be that their meanings differ not just with respect to the intensity of the same underlying emotion but that there is an added subtle meaning difference indicating that the two verbs, though related semantically, might not fall neatly on the same linear scale of intensity.

This explanation receives some support from the results for the pair *alarm-intimidate*, which did not co-occur in either order, with the exception of one single example. This case, too, suggests that the verbs, though similar, are not members of the same broader *frighten* class. Given the overall results, *intimidate* seems to be the outlier.

Moreover, we did find numerous examples there these verbs occur in a coordinate structure:

(21) being ignorant and illiterate, he was **alarmed and intimidated** by the fear that his land would be taken from him by Fletcher,

(22) If you receive a "reservation of rights" letter from the insurance company, don't be **alarmed or intimidated**

And and *or* do not specifically discriminate among scale mates. These examples indicate further that the paired verbs here are semantically similar but not necessarily in a relation of different intensity.

In other cases, the verbs occurred in a "list" pattern:

(23) Intimidation related to prejudice and discrimination may include conduct "**which annoys, threatens, intimidates, alarms**, or puts a person in fear of…

(24) If someone else's behavior makes you feel **alarmed, intimidated, embarrassed, or annoyed**, there are many resources available

(25) Since anybody at anytime can be **alarmed/intimidated** and feel unsafe at the sight of a weapon

Such "listing" or separation with slashes does not reveal an asymmetry in the strength of the emotion, though it indicates that the emotions are similar and are evoked by a common Cause or Stimulus.

5.3 Establishing a scale

The data summed up in Table 1 show asymmetries among the members of the verb pairs, as suggested by the lexical-semantic patterns. Considering our data in the light of the two different kinds of patterns—two in which the more intense verb occurs on the right and one where it occurs to the left—we can construct a scale.

For example, we can place *scare* (less intense) to the left of *terrify* (more intense) on the basis of examples like the following:

(26) Are there other women out there with SA **who are scared (even terrified)** of becoming pregnant and being responsible for a new life

(27) during rehearsals that he is terrified of being on stage - **if not terrified then scared**, worried, mildly anxious, you get the drift.

And we can place *scare* to right of *alarm*, since it seems stronger:

(28) However, your solution of involving the private sector is one that the public should be very **alarmed, if not scared**

Based on such examples indicate we construct a linear scale:

> Intimidate>alarm>scare>frighten>panic>terrify

For the class of surprise verbs, which comprised ten verbs, queries involving the verbs *amaze, astonish* and *surprise* returned large numbers of hits where these verbs appear on both sides of the patterns. We interpret this to suggest that speakers use these verbs to refer to very similar, if not identical, degrees of surprise. Moreover, these three verbs also pattern identically with respect to the other verbs on the scale (i.e., *amaze, astonish* and *surprise* were all consistently weaker than *stun* and *dumbfound*, for example).

5.4 Cross-class pairs

We applied the patterns with only a single verb from our classes on either side. In some cases, these searches returned hits where the second verb did not come from the same group of emotion verbs identified by Mathieu and Fellbaum (2010).

(29) **offended** and **alarmed, if not threatened** by the song

(30) The Philadelphia Fringe Festival is growing, but many intelligent theater-lovers are **puzzled** and **even intimidated** by it

Such data may suggest that the assignment of verbs to their classes needs to be reconsidered. However, it seems more likely that the verbs belong to different but semantically similar classes that may have fuzzy boundaries. We did not find examples where the verbs on either side of the pattern were in completely unrelated classes. For example, no hits of the kind **this surprised, not to say exhausted/reminded me* were returned.

6   Limitations

The work reported here is preliminary; many more verbs and patterns need to be investigated. Our goal was to investigate whether emotion verbs can be shown to have scalar properties that are revealed by the same kinds of lexical-semantic patterns used for gradable adjectives by Sheinman and Tokunaga (2009).

The number of hits for a given pair is of course dependent on the frequency of the verb(s) in the query, for which frequency counts in the British National Corpus serve as a guideline. Thus, for the *surprise* class, queries including the verb *flabbergast* returned far fewer hits than queries involving *astonish* and *amaze*.

We did not include some verbs that are arguably members of our three classes. For example, we did not consider *buffalo* and *panic* in the *frighten* class. *Buffalo* is not used frequently as a verb, and virtually all hits contained the noun use of this word. Web data indicated that *panic*, though it can be an Experiencer verb, is predominantly used intransitively (and even more frequently as a noun).

In future extension of this work, additional patterns should be applied so that the results can be scaled up and be considered more robust.

7   Related Work

We set off our work against three similar areas of related research. First, sentiment analysis often classifies verbs of emotion that may characterize a speaker's or writer's attitude towards a particular issue in a binary fashion, distinguishing only "positive" from "negative" emotions (Turney 2002, Yu and Hatzivassiloglou 2003) and sometimes a neutral value (Wilson, Wiebe and Hwa 2004). However, a binary or ternary classification seems overly coarse-grained, given the frequently large number of verbs that denote varying strength of a common emotion. In some cases, verbs cannot be clearly assigned to either a "positive" or a "negative" category. For example, surprise is neutral with respect to whether or not the surprise carries a positive or a negative connotation, and one must rely on the context to interpret the orientation of the surprise; even allowing for a category "neutral" cannot accommodate specific context-sensitive readings. Rather than assigning verbs to one of two opposed poles and a neutral middle ground, we consider our work to make a contribution towards determining more fine-grained distinctions among semantically similar verbs of emotions.

Second, our work is corpus-based and thus empirical rather than purely intuitive. Mel'čuk and Wanner (1996) study German emotion lexemes, distinguishing more or less intense ones in terms of a Lexical Function. However, the distinctions are not based on data mining and an empirical discovery of intensity relations.

Third, Mass, Ng and Potts (2011) propose a model that learns vector space representations of emotion words. Their purely statistical approach differs from ours, which applies lexical-semantic patterns. Moreover, Mass et al. go beyond our attempts to construct scales in identifying sentiment expressions across different parts of speech in a "blended, continuous" way, while our patterns necessarily retrieve only lexemes belonging to the same category.

8   Future Work and applications

Our work so far has been limited to three broad classes comprising a total of twenty-four verbs. We believe that the results furnish a proof of concept, and we plan to extend the approach to additional emotion verbs.

A crosslinguistic examination of scalar properties of emotion verbs might reveal interesting differences with respect to lexicalization. Different languages are likely to encode different degrees to which emotions like *fear, surprise* and *anger* can be evoked and they may do so with fewer or more lexemes than other languages. While such work cannot reliably reveal crosslingual matches, it will show how densely the semantic space around a given emotion is lexically labeled and distinguished.

We are currently testing the scales constructed on the basis of Web data against human intuitions. To this end, we constructed a questionnaire and asked native speakers to rank the twenty-four adjectives on a scale of intensity, allowing for the option of creating several scales within a given class (reference omitted to preserve anonymity).

The construction of scales for emotion verbs suggests a new representation of at least this part of the verb lexicon in WordNet. The current hierarchical structure of emotion verbs is based purely on intuition and seems otherwise unmotivated. Thus, a synset containing {*amaze, astonish astound*} is assigned to the superordinate *surprise*, as are *flabbergast* and *floor*, while *startle* is considered a more specific sense of *floor*.

Rather than subsuming the members of a class as subordinates of a shared superordinate and assigning them seemingly randomly to different layers in the tree, a representation along the lines proposed in Sheinman et al. (in press) might be more appropriately reflect the meanings of verbs with scalar properties. Verbs expressing different degrees of one emotion would be represented as a cluster with a pointer from each verb to a point on a scale.

Representing the scalar properties of some verbs will, first of all, allow a more precise representation of verb meanings in lexical resources. By extension, this will benefit human and machine translation as well as language pedagogy. Moreover, our work has the potential to contribute to the inferencing power of automatic systems. Just as in the case of gradable adjectives, knowing that a verb v_1 is placed to the right of another verb v_2 on the same scale of intensity allows one to infer that v_1 is stronger or more intense than v_2, and that if X v_1 –s Y then X necessarily v_2 –s Y. Thus, if the fact that Slovakia knocked England out of the World Cup dumbfounded John, it necessarily surprised him.

9   Conclusion

We have taken initial steps towards an empirically-based construction of scales of emotion verbs. We showed that Sheinman and Tokunaga's (2009) method developed for scalar adjectives, based on searching a corpus with lexical-semantic patterns, can be fruitfully applied to verbs that lexicalize different degrees of intensity of a shared on underlying emotion. The method, which does not rely on lexicographers' intuitions and judgments, discriminates reliably among adjectives of different and similar strength. We believe that a multi-valued scalar representation is superior to present three-way "positive-neutral-negative" classifications and we are confident that the finer-grained semantic analysis of verbs based on intensity will be beneficial for a wide range of applications, from language pedagogy to translation and automatic reasoning. Scalarity in the lexicon requires further investigation and analysis. While the method employed here is extensible to a wider range of verbs and possibly nouns as well, it will likely need to undergo refinements.

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