



*"Good news.
The test results show it's a metaphor."*

Metaphor as a Medium for Emotion: An Empirical Study

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Metaphor

A figure of speech that refers to something as being the same as another thing for rhetorical effect.

- Stab someone in the back
- Rollercoaster of emotions
- Books are keys to your imagination
- He shot down all of my arguments
- Thoughts tumbled in my head, making and breaking alliances



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A figure of speech that refers to something as being the same as another thing for rhetorical effect.

- Stab someone in the back
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- Thoughts tumbled in my head,
making and breaking alliances

Brown font: concepts from another domain (source)

Metaphor: Knowledge Projection (Lakoff and Johnson, 1980)

Source domain

physical
closely experienced



Target domain

more abstract
more vague

Example: He **shot down** all of my arguments

Projects knowledge and inferences:

from the domain of **battle** (**source domain**)

onto the domain of **arguments and debates** (**target domain**).

Metaphor: Knowledge Projection (Lakoff and Johnson, 1980)

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physical
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Target domain

more abstract
more vague

Example: He shot down all of my arguments

Projects knowledge and inferences:

from the domain of battle (source domain)

onto the domain of arguments and debates (target domain).

- preserves the core meaning of the sentence
- emphasizes certain aspects of the target domain, while downplaying others: **framing**
 - e.g., crime as a virus or crime as predator
 - allows us to introduce additional connotations

The Interplay of Metaphor and Emotion

Studied in:

- linguistics (Blanchette et al., 2001; Kovecses, 2003)
- political science (Lakoff, 1980; Lakoff and Wehling, 2012)
- cognitive psychology (Crawford, 2009; Thibodeau and Boroditsky, 2011)
- neuroscience (Aziz-Zadeh and Damasio, 2008; Jabbi et al., 2008)
- computational linguistics
 - sentiment polarity classification of metaphorical language (Veale and Li, 2012; Kozareva, 2013; Strzalkowski et al., 2014)

However, no quantitative study establishing:

- the extent to which metaphorical language is used to express emotion
- the mechanisms by which this happens.

Research Questions

Q. Is a metaphorical statement likely to convey a stronger emotional content than its literal counterpart?

- to what extent?

Q. How does this emotional content arise in the metaphor:

- from the source domain,
- from the target domain, or
- compositionally through interaction of the source and the target?

Our Experiments: human subjects asked to judge metaphoricity and emotionality of sentences in a range of settings.

Hypotheses

Hypothesis 1: metaphorical uses of words tend to convey more emotion than their literal paraphrases in the same context.

Example:

- a. Hillary brushed off the accusations. METAPHORIC
- b. Hillary dismissed the accusations. LITERAL

Hypothesis 2: the metaphorical sense of a word tends to carry more emotion than the literal sense of the same word.

Example:

- a. Hillary brushed off the accusations. METAPHORIC
- b. He brushed off the snow. LITERAL

Underline: verb

Green font: text that is common across a. and b.

Data for Our Experiments

- Focus on metaphors expressed by a **verb**
 - most frequent type of metaphor (Cameron, 2003; Shutova and Teufel, 2010)
- Extract verbs, senses, and sentences from WordNet
 - WordNet organizes senses in synsets
 - each synset has a gloss and example sentence

Metaphors

- We extracted instances of the form shown below:

Instance 1

Target verb: erase

Sentence: The Turks erased the Armenians.

Here, erase is used metaphorically. We will refer to such instances as **metaphorical instances**.

- Now consider an instance where the target verb is replaced by its near-synonym or hypernym:

Instance 2

Target verb: kill

Sentence: The Turks killed the Armenians.

Here, kill is used literally. We will refer to such instances as **literal instances**.

Setup for Testing Hypothesis I

Instance 1: metaphorical

Target verb: erase

Sentence: The Gomas erased the natives.

Instance 2: literal

Target verb: kill

Sentence: The Gomas killed the natives.

To test Hypothesis 1:

- we will ask human annotators to examine these instances both individually and in pairs
 - to determine how much emotion the target verbs convey in the sentences

Setup for Testing Hypothesis II

Instance 1: metaphorical

Target verb: erase

Sentence: The Gomas erased the natives.

Instance 2: literal

Target verb: erase

Sentence: Erase the formula on the blackboard.

To test Hypothesis 2:

- we will ask human annotators to examine these instances both individually and in pairs
 - to determine how much emotion the target verbs convey in the sentences

Compiling Pairs of Instances for the Hypotheses

- Need to determine whether WordNet verb instances are metaphorical or literal
- Chose verbs with
 - at least three senses
 - so that there is a higher chance of at least one sense being metaphorical
 - less than ten senses
 - to avoid highly ambiguous verbs
 - took example sentences directly from WordNet synsets

In total, 440 verbs satisfied this criterion, yielding 1639 instances.

Questionnaire 1: Literal or Metaphorical?

Instructions

You will be given a focus word and a sentence that contains the focus word (highlighted in bold). You will be asked to rate whether the focus word is used in a literal sense or a metaphorical sense in that sentence. Below are some typical properties of metaphorical and literal senses:

Literal usages tend to be:

- more basic, straightforward meaning; more physical, closely tied to our senses: vision, hearing, touching, tasting

Metaphorical usages tend to be:

- more complex; more distant from our senses; more abstract; more vague; often surprising; tend to bring in imagery from a different domain

Questionnaire 1: Literal or Metaphorical?

Example 1

Focus Word: *shoot down*

Sentence: *The enemy **shot down** several of our aircraft.*

Question: In the above sentence, is the focus word used in a literal sense or a metaphorical sense?

- the focus word's usage is metaphorical
- the focus word's usage is literal

Solution: the focus word's usage is literal

Example 2

Focus Word: *shoot down*

Sentence: *He **shot down** the student's proposal.*

Question: In the above sentence, is the focus word used in a literal sense or a metaphorical sense?

- the focus word's usage is metaphorical
- the focus word's usage is literal

Solution: the focus word's usage is metaphorical

Master Set of Literal and Metaphorical Instances

- Annotated through the crowdsourcing platform CrowdFlower.
- Instances presented in random order
- Each instance annotated by at least ten respondents
- For our experiments, we considered an instance to be metaphorical or literal if 70% or more of the responses agreed
- Selected only those verbs that had at least one metaphorical sense and at least one literal sense

This resulted in a **Master Set** of 176 metaphorical instances and 284 literal instances from 133 verbs.

Instances to Test Hypothesis 1

compare instances with the same context

- For each of the 176 metaphorical instances in the Master Set:
 - the authors chose a synonym of the target verb that would make the instance literal
 - from near-synonyms in same synset
 - from hypernym synset

Instance 1: metaphorical

Target verb: erase

Sentence: The Gomas erased the natives.

Instance 2: literal

Target verb: kill

Sentence: The Gomas killed the natives.

- 5 instances discarded (lack of agreement)
- 171 pairs of instances created: **Hypothesis 1 Instances**

Instances to Test Hypothesis 2

compare instances with the same target verb

- We use all of the 460 (176+284) instances in the Master Set, and refer to them as **Hypothesis 2 Instances**.
- For each verb, all possible pairs of metaphorical and literal instances were generated. For example:
 - if a verb had two metaphorical instances and three literal instances, then $2 \times 3 = 6$ pairs of instances were generated

In total, 355 pairs of instances were generated: **Hypothesis 2 Cross Pairs** (one instance is metaphoric and the other is literal).

A Graded Notion of Metaphoricity

a scale from most literal to most metaphorical

- Instances not explicitly labeled as metaphorical or literal
- For each verb in the Master Set:
 - all possible pairs of instances were generated
 - e.g., if a verb had five instances, then ten pairs of instances were generated
- We ask annotators which instance in the pair is more metaphorical

In total, 629 pairs of instances were generated: [Hypothesis 2 All Pairs](#) (all possible pairs of instances, without regard to their labels).

Summary of Instance Pairs

- Hypothesis 1 Pairs
 - same context, synonym verbs
 - one metaphorical, one literal
- Hypothesis 2 Cross Pairs
 - same verb, different contexts (senses)
 - one metaphorical, one literal
- Hypothesis 2 All Pairs
 - same verb, different contexts (senses)
 - one more metaphorical than the other OR both are equally metaphorical/literal

Now we look at emotionality across each of these pairs.

Absolute Emotion Annotation

For each of the Hypothesis 1 and Hypothesis 2 instances

Questionnaire 3: Does the focus word convey emotion?

Instructions

You will be given a focus word and a sentence that includes the focus word. You will be asked to rate whether the focus word conveys some emotion in the sentence.

Your Task

Focus Word: *answer*

Sentence: *This steering wheel **answers** to the slightest touch.*

How much emotion is conveyed?

- the focus word conveys some emotion
 - the focus word conveys no emotion
-

Relative Emotion Annotation

For each of the Hypothesis 1 pairs and Hypothesis 2 pairs

Questionnaire 4: Which of the two given sentences conveys more emotion?

Instructions

You will be given two sentences with similar meanings. Each sentence contains a focus word. You will be asked to compare how the focus words are used in the two sentences and whether the focus word conveys more emotion in one sentence than in the other sentence.

Your Task

Focus Word 1: *attack*

Sentence 1: *I **attacked** the problem as soon as I was up.*

Focus word 2: *start*

Sentence 2: *I **started** on the problem as soon as I was up.*

Which conveys more emotion?

- focus word in first sentence conveys more emotion
 - focus word in second sentence conveys more emotion
 - focus words in the two sentences convey a similar degree of emotion
-



Results

Results for Hypothesis 1 Instances (same context, synonym verbs): Absolute Metaphoricity & Absolute Emotionality

instances that are:

emotional 191 (55.8%)

not emotional 151 (44.2%)

Total 342 (100%)

instances that are:

metaphorical and emotional 136 (39.8%)

metaphorical and not emotional 35 (10.2%)

literal and emotional 55 (16.1%)

literal and not emotional 116 (33.9%)

Total 342 (100%)

Results for Hypothesis 1 Pairs (same context, synonym verbs): Absolute Metaphoricity & Relative Emotionality

instances that are:

metaphorical and more emotional 143 (83.6%)

literal and more emotional 17 (09.9%)

similarly emotional 11 (06.4%)

Total **171 (100%)**

Overall, these results support Hypothesis 1, that metaphorical uses of verbs tend to convey more emotion than their literal paraphrases in the same context.

Results for Hypothesis 2 Instances (same verb, different senses): Absolute Metaphoricity & Absolute Emotionality

instances that are:

emotional 82 (17.8%)

not emotional 378 (82.2%)

Total 460 (100%)

instances that are:

metaphorical and emotional 65 (14.1%)

metaphorical and not emotional 111 (24.1%)

literal and emotional 17 (03.7%)

literal and not emotional 267 (58.0%)

Total 460 (100%)

Results for Hypothesis 2 Cross Pairs (same verb, different senses): Absolute Metaphoricity & Relative Emotionality

instances that are:

metaphorical and more emotional 211 (59.4%)

literal and more emotional 31 (08.7%)

similarly emotional 113 (31.8%)

Total **355 (100%)**

Results for Hypothesis 2 All Pairs (same verb, different senses): Relative Metaphoricity & Relative Emotionality

# instances that are more metaphorical and more emotional	227 (36.1%)
# instances that are more metaphorical but less emotional	28 (04.4%)
# instances that are more metaphorical but similarly emotional	119 (18.9%)
# instances that are similarly metaphorical and similarly emotional	196 (31.2%)
# instances that are similarly metaphorical but differ in emotionality	59 (09.4%)
Total	629 (100%)

Overall, these results support Hypothesis 2, that metaphorical senses of the same word tend to carry more emotion than its literal senses.

Visualization for Hypothesis 2 Instances: Absolute Metaphoricity & Absolute Emotionality

WordNet Verb Instances Examined for Metaphoricness and Emotionality

No Emotion or Some Emotion

no emotion
some emotion

1. Instances

Focus Term	Sense	Sentence	Literal/Metaphorical	
abuse	abuse#v#1	This boss abuses his workers.	literal	■
	abuse#v#4	Her husband often abuses alcohol.	metaphorical	■
amount	amount#v#1	Her action amounted to a rebellion	literal	■
	amount#v#2	The bills amounted to \$2,000	literal	■
	amount#v#3	This idea will never amount to anything	metaphorical	■
answer	answer#v#1	She didn't want to answer	literal	■
	answer#v#2	answer the telephone	literal	■
	answer#v#4	The question concerning the meaning of life cannot be answ..	literal	■
	answer#v#5	The defendant answered to all the charges of the prosec..	literal	■
	answer#v#6	She must answer for her actions	literal	■
	answer#v#7	A few words would answer	literal	■
	answer#v#7	A few words would answer	literal	■

2. Literal - Metaphorical

literal 284	metaphorical 176
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3. No Emotion - Some Emotion

no emotion 378	some emotion 82
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4. WordNet Verbs

push 9	talk 6	rail 5		flash	hunt	suck	taste		glow	leak		salute							
	poison	relax 5		puff	float	prick	drown		grab	lie		blur							
answer 8	look	shower 5		buzz	crush	drift	sign	dull	grobe		recast	shake	swell						
land 7	cloud	tug 5			melt	drink	splash	twist	fasten	guard	map	attack	color						
fracture 7	lock	want 5			deflate	reflect	back	visit	flood	hack	mold	blaze	bolt						
stagger 7	clap	level				nod	ascend	swim	fuel	ignite		rip		crawl		tax			
									sell	paste	blister	sing							
									glare	juggle	pierce	salt		dawn		buy			

Visualization for Hypothesis 2 Cross Pairs: Relative Metaphoricity & Relative Emotionality

WordNet Verb Instance Pairs Examined for Relative Metaphoricness and Relative Emotionality

Instance Pairs

Pair ID	Focus Term	Sense	Sentence	Metaphoricness	
1	abuse	abuse#v#1	This boss abuses his workers.	equally metaphoric	■
		abuse#v#4	Her husband often abuses alcohol.	equally metaphoric	■
2	amount	amount#v#1	Her action amounted to a rebellion	equally metaphoric	■
		amount#v#3	This idea will never amount to anything	equally metaphoric	■
3	amount	amount#v#1	Her action amounted to a rebellion	more metaphoric	■
		amount#v#2	The bills amounted to \$2,000	less metaphoric	■
4	amount	amount#v#2	The bills amounted to \$2,000	less metaphoric	■
		amount#v#3	This idea will never amount to anything	more metaphoric	■
5	answer	answer#v#2	answer the telephone	less metaphoric	■
		answer#v#9	This may answer her needs	more metaphoric	■
6	answer	answer#v#1	She didn't want to answer	equally metaphoric	■
		answer#v#9	This may answer her needs	equally metaphoric	■
7	answer	answer#v#1	She didn't want to answer	less metaphoric	■
		answer#v#10	The steering of my new car answers to the slightest touch	more metaphoric	■
8	answer	answer#v#4	The question concerning the meaning of life cannot be answered	less metaphoric	■
		answer#v#10	The steering of my new car answers to the slightest touch	more metaphoric	■

Emotionality

- less emotional
- equally emotional
- more emotional

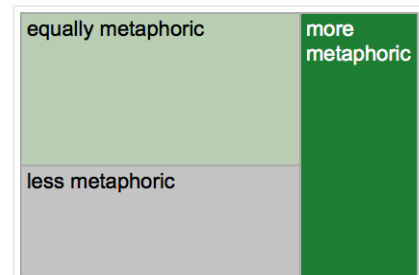
Metaphoricness

- less metaphoric
- equally metaphoric
- more metaphoric

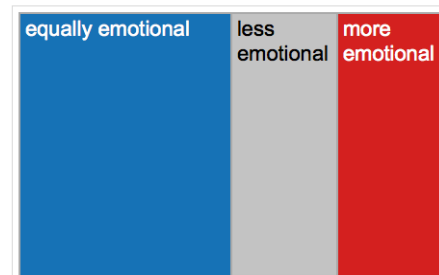
Notes:

1. Click on the legend items (top right) to highlight corresponding information.
2. Click on the tiles (in the treemaps at the bottom) to select and filter data. Click again to deselect. You can also use the reset button below the visualization.
3. Filtering often results in removal of one of the sentences in a pair. Simply hover (move mouse pointer) over the red/blue/grey squares to view the instance being compared to.

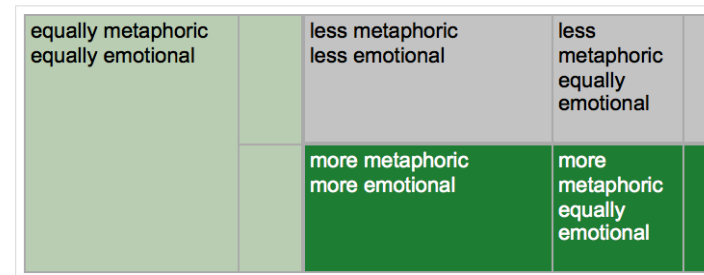
Metaphoricness



Emotionality



Metaphoricness-Emotionality Combination



Discussion: Metaphors are More Emotional

- Our results confirm both hypotheses:
 - metaphorical uses of words carry stronger emotions than
 - their literal uses,
 - as well as their literal paraphrases.
- This is inline with recent findings in neuroscience: Citron et al. (2016)
 - Examined metaphoric and literal sentences that had one word different
 - Metaphors (even conventional ones) in textual passages evoked stronger affective brain response

Discussion: Mechanism of Emotionality in Metaphors

Emotional content:

- not merely a property of the source or the target domain
- but rather, it arises through metaphorical composition.

The spaceship *blazed* out into space. MET some emot.
The spaceship *departed* out into space. LIT no emotion
The summer sun can cause a pine to *blaze*. LIT no emot.

This is the first such finding, and it highlights the importance of metaphor as a mechanism for expressing emotion.

- joint models of metaphor and emotion useful for metaphor interpretation and sentiment analysis systems.

Discussion: Polysemy is Regular

- For example, two meanings of both **bank** and **university**
 - institution
 - building that houses the institution
- Similarly, three meanings of both **window** and **door**
 - path
 - opening
 - concrete object that can close an opening

Examples from **Lexikalische Semantik**, by Manfred Krifka, Professor of General Linguistics, Humboldt University, Berlin.

Discussion: metaphors and regular polysemy

- **Belief:** the senses of a word can be divided into a metaphorical subset and a literal subset (Kilgarrriff, 1997)
 - How common is this across words?
- **Our annotations confirm:** the metaphorical/literal distinction is a **common** pattern for polysemous verbs
 - ~38% of all verb senses we annotated were metaphorical

First study that gives an empirical foundation to the belief that the metaphorical-literal distinction is a central form of regular polysemy.

- A system able to systematically capture metaphorical sense extensions will be in a better position to generalize to unseen metaphors

Conclusions

- Our results confirm both hypotheses:
 - metaphorical uses of words carry stronger emotions than
 - their literal uses,
 - as well as their literal paraphrases
- Emotional content:
 - not merely a property of the source or the target domain
 - but rather, it arises through metaphorical composition
- Implication to regular polysemy:
 - the metaphorical/literal distinction is a common pattern for polysemous verbs

Future Work

- **Research problems:**
 - Do hypotheses 1 and 2 hold for metaphors formed by other parts of speech?
 - Do literal paraphrases in general tend to express less emotion than their metaphorical counterpart?
 - even the ones where more than one word across the pair are different?
- **Automatic systems:**
 - sentiment analysis using metaphoricity as features
 - metaphor detection/interpretation with emotionality features
 - joint models for emotionality and metaphoricity
- **Data annotation:**
 - Annotate data for all WordNet senses

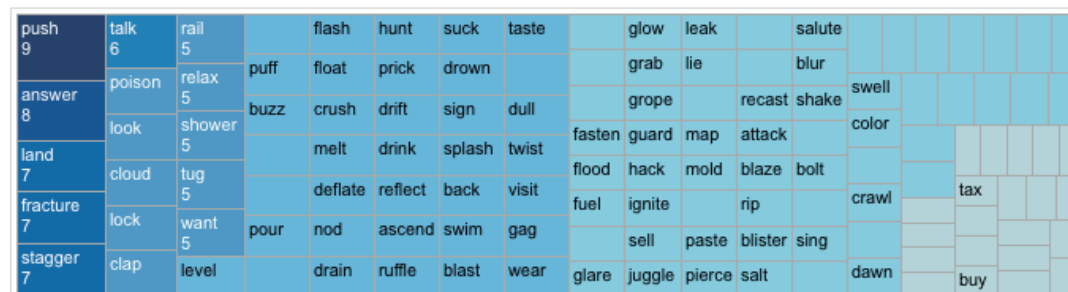
<http://saifmohammad.com/WebPages/metaphor.html>

No Emotion or Some Emotion

no emotion

■ some emotion

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abuse	abuse#v#1	This boss abuses his workers.	literal	■
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	amount#v#3	This idea will never amount to anything	metaphorical	■
answer	answer#v#1	She didn't want to answer	literal	■
	answer#v#2	answer the telephone	literal	■
	answer#v#4	The question concerning the meaning of life cannot be answ..	literal	■
	answer#v#5	The defendant answered to all the charges of the prosec..	literal	■
	answer#v#6	She must answer for her actions	literal	■
	answer#v#7	A few words would answer	literal	■



Complete Annotation Cycle for the verb drain

LIT stands for literal and MET for metaphoric

Q1: drain-v-1 The rain water *drains* into this big vat. LIT 0.9

drain-v-2 The [...] class *drains* me of energy. MET 0.8

drain-v-3 We *drained* the oil tank. LIT 0.9

drain-v-4 Life in the camp *drained* him. MET 0.91

Q1 and Q3, Hypothesis 1 (Table 1):

Life in the camp *drained* him. MET some emotion

Life in the camp *weakened* him. LIT some emotion

The [...] class *drains* me of energy. MET some emotion

The [...] class *depletes* me of energy. LIT some emotion

Q1 and Q4, Hypothesis 1 (Table 2):

Life in the camp *drained* him. MET

Life in the camp *weakened* him. LIT

– the first sentence conveys more emotion

The exercise class *drains* me of energy. MET

The exercise class *depletes* me of energy. LIT

– the first sentence conveys more emotion

Q1 and Q3, Hypothesis 2 (Table 3):

Life in the camp *drained* him. MET some emotion

The rain water *drains* into this big vat. LIT no emotion

The [...] class *drains* me of energy. MET some emotion

We *drained* the oil tank. LIT no emotion

Q1 and Q4, Hypothesis 2 (Table 4):

Life in the camp *drained* him. MET

The rain water *drains* into this big vat. LIT

– the first sentence conveys more emotion

We *drained* the oil tank. LIT

The exercise class *drains* me of energy. MET

– the second sentence conveys more emotion

Use of the Data

For metaphor identification:

- **Shutova et al. (2016)** simultaneously draw knowledge from linguistic and visual data

Ekaterina Shutova, Douwe Kiela and Jean Maillard. 2016. [Black Holes and White Rabbits: Metaphor Identification with Visual Features](#). In Proceedings of NAACL-HLT 2016, San Diego, CA, 2016. [Runner up for Best Paper Award](#).

Questionnaire 1: example annotations

Q1: drain-v-1 The rain water *drains* into this big vat. LIT 0.9

drain-v-2 The [...] class *drains* me of energy. MET 0.8

drain-v-3 We *drained* the oil tank. LIT 0.9

drain-v-4 Life in the camp *drained* him. MET 0.91

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The [...] class *depletes* me of energy. LIT some emotion