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
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

**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)

- **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).

- 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.

Saif M. Mohammad, Ekaterina Shutova, and Peter D. Turney.
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 \((\text{Cameron, 2003; Shutova and Teufel, 2010})\)

- 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 1

**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 metaphorical 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

<table>
<thead>
<tr>
<th># instances that are:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>emotional</td>
<td>191 (55.8%)</td>
</tr>
<tr>
<td>not emotional</td>
<td>151 (44.2%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>342 (100%)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># instances that are:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>metaphorical and emotional</td>
<td>136 (39.8%)</td>
</tr>
<tr>
<td>metaphorical and not emotional</td>
<td>35 (10.2%)</td>
</tr>
<tr>
<td>literal and emotional</td>
<td>55 (16.1%)</td>
</tr>
<tr>
<td>literal and not emotional</td>
<td>116 (33.9%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>342 (100%)</strong></td>
</tr>
</tbody>
</table>
Results for Hypothesis 1 Pairs (same context, synonym verbs):
Absolute Metaphoricity & Relative Emotionality

<table>
<thead>
<tr>
<th># instances that are:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>metaphorical and more emotional</td>
<td>143 (83.6%)</td>
</tr>
<tr>
<td>literal and more emotional</td>
<td>17 (09.9%)</td>
</tr>
<tr>
<td>similarly emotional</td>
<td>11 (06.4%)</td>
</tr>
<tr>
<td>Total</td>
<td>171 (100%)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th># instances that are:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>emotional</td>
<td>82 (17.8%)</td>
</tr>
<tr>
<td>not emotional</td>
<td>378 (82.2%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>460 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># instances that are:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>metaphorical and emotional</td>
<td>65 (14.1%)</td>
</tr>
<tr>
<td>metaphorical and not emotional</td>
<td>111 (24.1%)</td>
</tr>
<tr>
<td>literal and emotional</td>
<td>17 (03.7%)</td>
</tr>
<tr>
<td>literal and not emotional</td>
<td>267 (58.0%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>460 (100%)</td>
</tr>
</tbody>
</table>
Results for Hypothesis 2 Cross Pairs (same verb, different senses): Absolute Metaphoricity & Relative Emotionality

<table>
<thead>
<tr>
<th># instances that are:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>metaphorical and more emotional</td>
<td>211</td>
</tr>
<tr>
<td>literal and more emotional</td>
<td>31</td>
</tr>
<tr>
<td>similarly emotional</td>
<td>113</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>355</strong></td>
</tr>
<tr>
<td></td>
<td>(100%)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td># instances that are more metaphorical and more emotional</td>
<td>227</td>
<td>(36.1%)</td>
</tr>
<tr>
<td># instances that are more metaphorical but less emotional</td>
<td>28</td>
<td>(04.4%)</td>
</tr>
<tr>
<td># instances that are more metaphorical but similarly emotional</td>
<td>119</td>
<td>(18.9%)</td>
</tr>
<tr>
<td># instances that are similarly metaphorical and similarly emotional</td>
<td>196</td>
<td>(31.2%)</td>
</tr>
<tr>
<td># instances that are similarly metaphorical but differ in emotionality</td>
<td>59</td>
<td>(09.4%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>629</td>
<td>(100%)</td>
</tr>
</tbody>
</table>

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

1. Instances

<table>
<thead>
<tr>
<th>Focus Term</th>
<th>Sense</th>
<th>Sentence</th>
<th>Literal/Metaphorical</th>
</tr>
</thead>
<tbody>
<tr>
<td>abuse</td>
<td>abuse1</td>
<td>This boss abuses his workers.</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>abuse4</td>
<td>Her husband often abuses alcohol.</td>
<td>metaphorical</td>
</tr>
<tr>
<td>amount</td>
<td>amount1</td>
<td>Her action amounted to a rebellion</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>amount2</td>
<td>The bills amounted to $2,000</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>amount3</td>
<td>This idea will never amount to anything</td>
<td>metaphorical</td>
</tr>
<tr>
<td>answer</td>
<td>answer1</td>
<td>She didn’t want to answer</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>answer2</td>
<td>She answered the telephone</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>answer4</td>
<td>The question concerning the meaning of life cannot be answered</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>answer5</td>
<td>The defendant answered to all the charges of the prosecutor</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>answer6</td>
<td>She must answer for her actions</td>
<td>literal</td>
</tr>
<tr>
<td></td>
<td>answer7</td>
<td>A few words would answer</td>
<td>literal</td>
</tr>
</tbody>
</table>

2. Literal - Metaphorical

<table>
<thead>
<tr>
<th></th>
<th>literal</th>
<th>metaphorical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>284</td>
<td>176</td>
</tr>
</tbody>
</table>

3. No Emotion - Some Emotion

<table>
<thead>
<tr>
<th>No Emotion or Some Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>no emotion</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

4. WordNet Verbs

<table>
<thead>
<tr>
<th>push 9</th>
<th>talk 6</th>
<th>nail 5</th>
<th>flash 1</th>
<th>hunt 1</th>
<th>suck 1</th>
<th>taste 1</th>
<th>glow 1</th>
<th>leak 1</th>
<th>salute 1</th>
<th>grab 1</th>
<th>lie 1</th>
<th>blur 1</th>
<th>swell 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>answer 6</td>
<td>poison 5</td>
<td>relax 5</td>
<td>puff 1</td>
<td>float 1</td>
<td>pick 1</td>
<td>drown 1</td>
<td>grope 1</td>
<td>recast 1</td>
<td>shake 1</td>
<td>attack 1</td>
<td>color 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>land 7</td>
<td>cloud 5</td>
<td>lug 5</td>
<td>deface 1</td>
<td>reflect 1</td>
<td>back 1</td>
<td>visit 1</td>
<td>fasen 1</td>
<td>guard 1</td>
<td>map 1</td>
<td>attack 1</td>
<td>color 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fracture 7</td>
<td>lock 5</td>
<td>want 5</td>
<td>pour 1</td>
<td>nod 1</td>
<td>ascend 1</td>
<td>swim 1</td>
<td>gag 1</td>
<td>soil 1</td>
<td>paste 1</td>
<td>bister 1</td>
<td>sing 1</td>
<td>tax 1</td>
<td></td>
</tr>
<tr>
<td>stagger 7</td>
<td>clap 5</td>
<td>level 1</td>
<td>drain 1</td>
<td>ruffle 1</td>
<td>blast 1</td>
<td>wear 1</td>
<td>glare 1</td>
<td>juggel 1</td>
<td>pierce 1</td>
<td>salt 1</td>
<td>dawn 1</td>
<td>buy 1</td>
<td></td>
</tr>
</tbody>
</table>
Visualization for Hypothesis 2 Cross Pairs: Relative Metaphoricity & Relative Emotionality

WordNet Verb Instance Pairs Examined for Relative Metaphoricness and Relative Emotionality

<table>
<thead>
<tr>
<th>Instance Pairs</th>
<th>Metaphoricness</th>
<th>Emotionality</th>
<th>Metaphoricism-Emotionality Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair ID</td>
<td>Focus Term</td>
<td>Sense</td>
<td>Sentence</td>
</tr>
<tr>
<td>1</td>
<td>abuse</td>
<td>abuse#v#1</td>
<td>This boss abuses his workers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>abuse#v#4</td>
<td>Her husband often abuses alcohol.</td>
</tr>
<tr>
<td>2</td>
<td>amount</td>
<td>amount#v#1</td>
<td>Her action amounted to a rebellion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>amount#v#3</td>
<td>This idea will never amount to anything</td>
</tr>
<tr>
<td>3</td>
<td>amount</td>
<td>amount#v#1</td>
<td>Her action amounted to a rebellion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>amount#v#2</td>
<td>The bills amounted to $2,000</td>
</tr>
<tr>
<td>4</td>
<td>amount</td>
<td>amount#v#2</td>
<td>The bills amounted to $2,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>amount#v#3</td>
<td>This idea will never amount to anything</td>
</tr>
<tr>
<td>5</td>
<td>answer</td>
<td>answer#v#2</td>
<td>&lt;b&gt;answer&lt;/b&gt; the telephone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>answer#v#9</td>
<td>This may &lt;b&gt;answer&lt;/b&gt; her needs</td>
</tr>
<tr>
<td>6</td>
<td>answer</td>
<td>answer#v#1</td>
<td>She didn’t want to &lt;b&gt;answer&lt;/b&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>answer#v#9</td>
<td>This may &lt;b&gt;answer&lt;/b&gt; her needs</td>
</tr>
<tr>
<td>7</td>
<td>answer</td>
<td>answer#v#1</td>
<td>She didn’t want to &lt;b&gt;answer&lt;/b&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>answer#v#10</td>
<td>The steering of my new car &lt;b&gt;answers&lt;/b&gt;</td>
</tr>
<tr>
<td>8</td>
<td>answer</td>
<td>answer#v#4</td>
<td>The question concerning the meaning of life cannot be &lt;b&gt;answered&lt;/b&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>answer#v#10</td>
<td>The steering of my new car &lt;b&gt;answers&lt;/b&gt;</td>
</tr>
</tbody>
</table>

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.
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 *(Kilgarriff, 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
WordNet Verb Instances Examined for Metaphoricness and Emotionality

1. Instances

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

2. Literal - Metaphorical

<table>
<thead>
<tr>
<th>Literal</th>
<th>Metaphorical</th>
</tr>
</thead>
<tbody>
<tr>
<td>264</td>
<td>175</td>
</tr>
</tbody>
</table>

3. No Emotion - Some Emotion

<table>
<thead>
<tr>
<th>No Emotion</th>
<th>Some Emotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>379</td>
<td>85</td>
</tr>
</tbody>
</table>

4. WordNet Verbs
Complete Annotation Cycle for the verb drain

LIT stands for literal and MET for metaphorical

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

**Questionnaire 1: example annotations**

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

Q1: drain-v-2 The [...] class *drains* me of energy. MET 0.8

Q1: drain-v-3 We *drained* the oil tank. LIT 0.9

Q1: 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