Systematicity, motivatedness, and the structure of the lexicon

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Central Questions

1) How do words get their meanings?

2) Is the relationship between words and meanings important?
How do words get their meanings?

Plato - “...things have names by nature...”

Shakespeare - “A rose by any other name would smell as sweet.”

de Saussure - “The symbol is arbitrary.”
The Arbitrariness of the Sign

Word-meaning associations are arbitrary

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<tr>
<th>English</th>
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<th>Belarusian</th>
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Not all word-meaning associations are arbitrary
Words can be more or less natural for their meaning

Onomatopoeia - straightforward, imitative

Underpinned by shared perception and cognition

Motivatedness -

Any direct connection between some feature of the word’s meaning and a feature of its representation
Motivatedness

Swearing!
Motivatedness

Natural structure in call acoustics holds across wide range of species
  - harsh spectrally chaotic calls in aggressive contexts
  - mellifluous softer calls in affiliative contexts
Motivatedness

1) Onomatopoeia (imitation)
2) Swearing (association between sound and affect/emotion)
3) Size-sound symbolism
   - ‘huuge’ vs. ‘teeny’
4) Shape-sound symbolism
   - Bouba-kiki effect

Which of these is Bouba?
Which is Kiki?
Motivatedness: a direct relationship between a feature of a word and a feature of its meaning (e.g. onomatopoeia)

Systematicity: A mapping between a feature of a set of similar words and a set of similar meanings
Systematicity

An example of a systematic language:

Real world example: phonaesthemes - e.g. ‘glimmer’, ‘glitter’, ‘glisten’, ‘glint’, etc.
2) Is the relationship between words and meanings important?

Languages need to be learnable
Languages need to be expressive
Languages need to be communicatively functional
Motivated associations between words and meanings are easier to learn:

‘nosunosu’
How can systematicity aid language learning?

1) Systematic associations allow for generalization

2) Systematic associations make underlying category structure more obvious

What kind of animal is this →
Motivatedness = Increased learnability due to relationship between word and meaning leveraging perceptual or cognitive biases

Systematicity = Increased learnability due to generalization

So, why is language still largely arbitrary, rather than motivated and systematic?
Limitations of Motivatedness

1) Not all meanings can be expressed in a motivated way.

2) Motivated mappings are constrained by the language they are embedded in.
Limitations of Systematicity

1) Makes words less contrastive, potentially easier to confuse

- ‘pig’
- ‘chig’
- ‘kig’
- ‘gig’
- ‘hig’
- ‘horg’
<table>
<thead>
<tr>
<th></th>
<th><strong>Non-Arbitrary</strong></th>
<th><strong>Arbitrary</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivated associations between words and meanings are easier to learn</td>
<td>Motivated associations are limited in their expressivity</td>
<td></td>
</tr>
<tr>
<td>Systematic associations between words and meanings are easier to learn</td>
<td>Too much systematicity makes learning more difficult</td>
<td></td>
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</table>
Is the relationship between words and meanings important?

Bootstrapping - the acquisition of words that are motivated and/or systematic enhances the subsequent learning of arbitrary associations.

Aligns with general structure of lexicon, but also developmental trajectory (Monaghan et al., 2014)
Experiment

Experiment Goal:
Test the bootstrapping hypothesis

Requirements:
Teach participants a motivated systematic language
Test subsequent learnability of additional arbitrary tokens

Predictions:
Participants who learn motivated systematic language early, then transition to learning arbitrary words should learn better
Experiment Design

Participants learn a small initial language

Given additional rounds of training and testing: 16 words overall
Experiment Design

2 (Early language: motivated systematic vs. arbitrary) x 2 (Late language: motivated systematic vs. arbitrary) design

<table>
<thead>
<tr>
<th>Condition 1-</th>
<th>Early Language-</th>
<th>Motivated Systematic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Late Language-</td>
<td>Motivated Systematic</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition 2-</th>
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<th>Motivated Systematic</th>
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<tbody>
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<table>
<thead>
<tr>
<th>Condition 3-</th>
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<tbody>
<tr>
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<table>
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<tr>
<th>Condition 4-</th>
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<tbody>
<tr>
<td></td>
<td>Late Language-</td>
<td>Motivated Systematic</td>
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## Experiment Design

<table>
<thead>
<tr>
<th>Early Learned</th>
<th>Motivated Systematic</th>
<th>Arbitrary</th>
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<tbody>
<tr>
<td></td>
<td>Jagged</td>
<td>Curved</td>
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<tr>
<td>tahtoh</td>
<td>mohnay</td>
<td></td>
</tr>
<tr>
<td>taypay</td>
<td>maymuh</td>
<td></td>
</tr>
<tr>
<td>pohtah</td>
<td>maymah</td>
<td></td>
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<tr>
<td>taytay</td>
<td>nahmay</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Learned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tuhtah</td>
<td>nuhnah</td>
<td>shaythay</td>
</tr>
<tr>
<td>pohpuph</td>
<td>nahmoh</td>
<td>thaythay</td>
</tr>
<tr>
<td>tuhpoh</td>
<td>mohmoh</td>
<td>fohsah</td>
</tr>
<tr>
<td>pahpuph</td>
<td>nuhnuh</td>
<td>saysay</td>
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</tbody>
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Predictions

-Motivated Systematic Early -> Arbitrary Late should perform better on late trials than Arbitrary Early -> Arbitrary Late
Experimental Design

Trial Type:

<table>
<thead>
<tr>
<th></th>
<th>Early Acquired Early Tested</th>
<th>Early Acquired Late Tested</th>
<th>Late Acquired Late Tested</th>
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<tbody>
<tr>
<td>Rounds Trained</td>
<td>1-3</td>
<td>1-3</td>
<td>4-7</td>
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<tr>
<td>Rounds Tested</td>
<td>1-3</td>
<td>4-7</td>
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Predictions:

- Motivated Systematic Early -> Arbitrary Late should perform better on late trials than Arbitrary Early -> Arbitrary Late
Results

Significant main effect of Experimental condition:

MS Early -> Arbitrary Late
> Arbitrary Early -> Arbitrary Late
MS Early -> MS Late

Interaction of Trial Type x condition:
MS Early -> Arbitrary Late better on late learned, late tested trials (the arbitrary part of their language) than MS Early -> MS Late learners

Both support the bootstrapping hypothesis
Results

BUT!

Arbitrary Early -> MS Late

>  

Arbitrary Early --> Arbitrary Late

MS Early -> MS Late

So, does learning arbitrary associations early bootstrap the learning of motivated systematic associations later?
An alternative explanation

Contrastiveness and confusability

MS Early -> MS Late learns all words that are quite similar
Same is true for Arb Early->Arb Late condition

Mixed languages learn more distinct words later (Late Learned, Late tested trials)
Similarity of words to each other in each condition shows this

Late acquired- Late tested words are more contrastive (less confusable) in mixed languages
Analysis including confusability as a factor eliminates main effect of condition.

Confusability, not bootstrapping, accounts for observed effects.
Conclusions

1) How do words get their meanings?
   a) Linguistic convention
   b) Relationship between features of words and features of meaning (motivatedness)
   c) Relationship to other words and meanings (systematicity)

2) Is the relationship between words and meanings important?
   Yes, but:
   a) No support for this version of the bootstrapping hypothesis

Lots more work to do- questions answered, more questions raised!