Feature diagnosticity affects semantic representations of novel and common object categories

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INTRODUCTION

A central principle in feature-based theories of semantic memory is the differential weighting of some features over others [1-5]. Some of these features are diagnostic – they serve to distinguish or otherwise conspicuously differentiate one item from others [6,7]. In determining feature diagnosticity, we argue for a distinction between when a feature is available and needed, and when it is actually used.

Using color as the diagnostic feature, we used a paradigm to investigate how diagnostic features interact with semantic representations.

METHODS

Subjects learned one of two novel object sets over the course of four sessions:

COLOR + SHAPE:

<table>
<thead>
<tr>
<th>Color</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>lemon</td>
<td>knife</td>
</tr>
<tr>
<td>lime</td>
<td>bowl</td>
</tr>
<tr>
<td>red</td>
<td>spoon</td>
</tr>
<tr>
<td>green</td>
<td>fork</td>
</tr>
</tbody>
</table>

SHAPE:

<table>
<thead>
<tr>
<th>Color</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>purple</td>
<td>yield</td>
</tr>
<tr>
<td>blue</td>
<td>dart</td>
</tr>
<tr>
<td>yellow</td>
<td>task</td>
</tr>
<tr>
<td>brown</td>
<td>radar</td>
</tr>
</tbody>
</table>

Color is necessary in order to distinguish lemons and limes. Color is available but not needed in order to distinguish stop signs and yield signs.

RESULTS: BEHAVIORAL

When listing object adjectives, “color+shape” subjects (n = 29) listed color first 86% of the time, whereas “shape” subjects (n = 34) listed color first only 45% of the time (p < 0.01). Notably, the groups demonstrated comparable explicit object color knowledge.

“Color+shape” subjects assigned higher general similarity ratings to same-colored object pairs than did “shape” subjects (p < 0.03). We replicated this result when comparing stimuli shared across both groups.

RESULTS: GENERALIZATION

We examined the extent to which these results generalized to common object categories via fruits and vegetables (FV, color is diagnostic) and household items (HHI, color is diagnostic) through parallel behavioral and fMRI tasks.

If you flipped a CARROT over, would it stand up straight?

Like “color+shape” subjects, those subjects describing FV objects were more likely to list color first. When combining novel and common object categories, we found that prioritizing color positively correlated with left fusiform activation.

DISCUSSION

• Features can vary both in how well we know and use them, and this distinction taps into semantic representations.
• These results parallel previous work demonstrating differences in conceptual knowledge for blind versus sighted subjects [8].
• The neural instantiation of diagnostic features may vary along a posterior-anterior gradient in ventral temporal cortex.
• Preliminary results suggest a similar neural basis for the interaction of feature diagnosticity with representations of both novel and common object categories, supporting generalization of our findings.

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REFERENCES


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