A basic-level disadvantage for speeded category-verification

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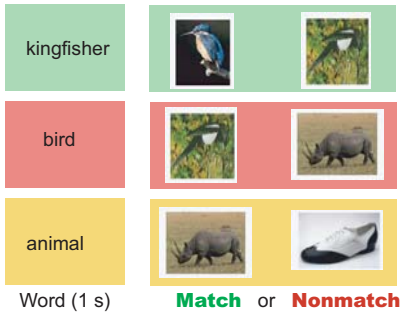
Introduction

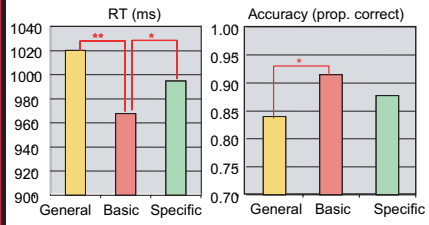
People are generally faster and more accurate to name or categorize objects at an intermediate ("basic") level of specificity such as "bird," relative to more general ("animal") or specific ("kingfisher") levels. The robustness of the basic-level advantage might suggest a dual-process account of knowledge retrieval in which objects first activate basic-level categories directly, and later engage more general or specific categories through the spread of activation in a processing hierarchy. This standard account is challenged, however, by data from patients with semantic dementia (SD), a progressive disorder that erodes semantic memory. Such patients can frequently categorize at the general- but not the basic-level. In this project, we seek to reconcile these seemingly contradictory pieces of data, using insights from a connectionist model of semantic knowledge.

Experiment 1



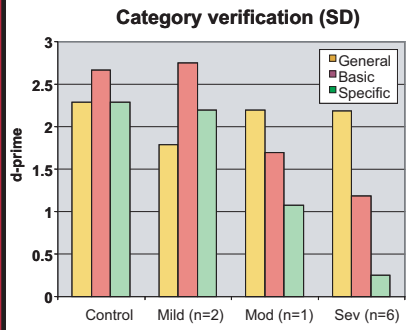
- Ss viewed a word followed by a matching or non-matching picture.
- Words were specific, basic-level, or general category names.
- Normal Ss, age-matched to the patients, indicated match or nonmatch as quickly and accurately as possible.
- 9 patients with SD made the same judgment without time pressure

Results: Healthy Ss



- Healthy Ss showed the standard basic-level advantage, responding most quickly and most accurately for basic-level names.
- There was no significant difference in reaction time or accuracy between specific and general name conditions.

Results: Patients with SD

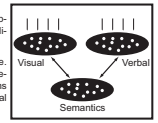


- SD patients were classified as Mild, Moderate or Severe on the basis of word-picture matching scores (Mild: > 75% correct; Moderate: 50-75% correct; Severe: < 50% correct)
- Patients showed increasingly severe impairments for more specific category names, but no impairment at the general level.
- The basic-level advantage is observed in the mildest patients, but basic-level performance is reliably worse than general-level performance in the most severe patients.

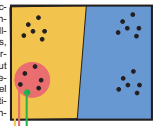
Explanation (Rogers & McClelland, 2004)

Semantic representations are used to map between perceptual, motor, and language representations in different modalities.

Such representations capture conceptual similarity structure. Items from the same basic level category are therefore represented with very similar patterns of activity, whereas items from different basic categories within the same general domain have less, but still somewhat, similar patterns.



Basic-level effects reveal the influence of this similarity structure on name-learning. Learning to call a canary a "bird" generalizes to all other birds and benefits name acquisition. Calling a canary a "canary" also tends to generalize to other birds, so that learning specific names suffers from cross-item interference. Calling a canary an "animal" benefits other birds, but not the many other items that are also called "animals," because these have dissimilar representations. Basic-level names thus are most quickly learned and most strongly activated because they reflect the most systematic mapping to underlying conceptual representations.



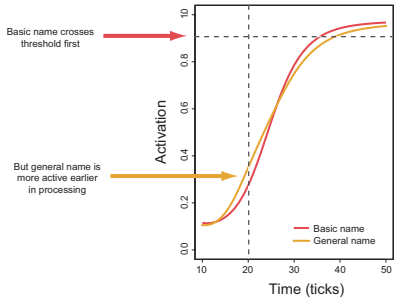
General-level names are more robust to damage because, once learned, they span a broader region of the representation space. The model must learn to activate "animal" from items with widely-varying representations. In contrast, the name "bird" applies to a somewhat less variable set of representations, and the name "canary" to a still more restricted set. Small amounts of degradation to the representations thus erode specific naming abilities, but very general names will be preserved even when representations are fairly seriously degraded.

Canary: Spans a narrow range of space; similar items have a different name.

Bird: Spans an intermediate range of space, similar items have the same name.

Animal: Spans a broad range of space, but applies to dissimilar items.

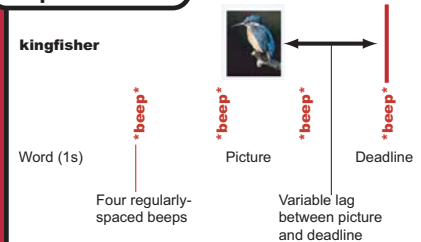
Prediction



- If general names span a broader region of the representation space, they should begin to activate earlier, when the settling representation is in the right general neighborhood but not yet in the basic-level cluster.
- Once the representation is close enough to the basic-level cluster, basic-level names activate more rapidly than general-level names, so basic-level names are the first to cross threshold.

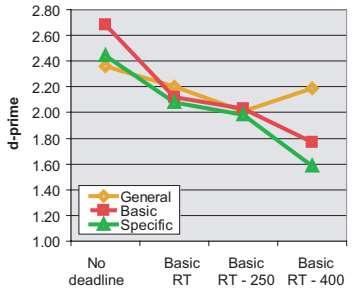
Prediction: If participants are forced to respond faster than usual, the basic-over-general advantage should be reversed.

Experiment 2



- The same healthy Ss from experiment 1 participated in a deadline-matching version of the same experiment with the same materials.
- After reading the word, sjs heard four regularly paced tones. They were instructed to time their responses exactly with the last tone.
- The time between the onset of the picture and the deadline was manipulated, so that Ss responded i) with their previous basic-level RT, ii) 250 ms faster and iii) 400 ms faster.

Results & conclusion



- As the lag between picture onset and response deadline grew shorter, the basic-over-general advantage was first eliminated and then reversed. At the shortest lag, participants showed a reliable advantage for the general level over the basic level.
- This finding is in concert with data from SD and was predicted by the model. The results suggest that basic-level effects reflect the influence of semantic similarity structure on name learning, in a system that uses distributed semantic representations to map between visual images and names.