# New Explorations of Cobweb as a Model of Human Concept Formation

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## Abstract

*Cobweb*, a tree-like non-parametric model of categorization, performs concept learning incrementally and rapidly by utilizing the *category utility* metric. Despite its brief study as a cognitive science theory (Iba and Langley 2011), its full potential within cognitive science remains relatively underexplored. This prompts key inquiries into its correlation with prior categorization models, and its alignment with human categorization performance, particularly for prototype and exemplar effects.

Early research by Fisher and Langley (1990) applied Cobweb to explain empirical findings associated with prototype theory (Rosch et al. 1976): basic-level effects, typicality effects. The key linking construct was that of *category match*, which connects category utility to the continuous behavioral measure of response time. However, most of the important empirical findings in cognitive science literature concern the probability of classifying a stimulus as belonging to a concept and the rate at which new concepts are learned. These findings reveal how concepts are rule-like and how they are instance-based. Capturing all of these dimensions of human categorization is an important goal for cognitive science.

The current research addresses this goal by using the Cobweb model in its classical form, which incorporates information-theoretic measures (Corter and Gluck 1992). In its categorization process, it seeks either its subordinate-level (leaf) or *basic-level* concepts (Corter and Gluck 1992).

We evaluate Cobweb's potential as a human-plausible categorization model by evaluating it against two classic datasets in the cognitive science literature. The first is from Medin and Schaffer (1978); it was introduced to distinguish whether humans adopt prototype or exemplar concept representations. Cobweb can account for the classification probabilities (and response times) from this paradigm and has prototype- or exemplar-like concept representations at different levels of concepts, showing its potential unity in prototype- and exemplar-based concepts. The second dataset is from Shepard, Hovland, and Jenkins (1961). Cobweb can account for the finding of slower learning rates for concepts defined by boolean expressions of increasing complexity, and is thus more aligned with rule-based accounts of concept acquisition and representation.

We end by discussing the limitations of the current implementation of Cobweb and by sketching the next steps in its evaluation as a human-plausible model of concept acquisition and classification.

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