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Experimental Evidence for Multiple-Mappings in Word Learning

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Multiple Mappings

Children easily learn names for things sometimes after hearing words only once or twice. This process of fast mapping allows children to quickly increase their vocabularies. However, dimension terms, such as color and texture are much more difficult for children to learn and not as likely to be employed in fast mapping tasks as shape terms (Heibeck & Markman, 1987). Studies designed to train children on dimension terms require as many as 2000 trials to teach 6 dimension words (Rice, 1980).

One reason for this difficulty may be the multiple-mappings required to learn labels for object properties. Specifically, to learn dimension terms children must make three kinds of mappings: 1) Word-Word maps: mapping the dimension label and a set of dimension terms to each other, e.g., knowing to answer questions like "What size is this?" with a size word, and not a color word or object name 2) Word-Property maps: mapping the dimension word to an appropriate property in the world, and 3) Property-Property maps: mapping the dimensional properties to other dimensional properties, e.g., knowing that one instance of red is like another instance of red. Note mappings (2) and (3) would seem to require selective attention -- ignoring some aspects of an object and attending to the relative properties.

The Network

Smith, Gasser & Sandhofer (in press) describe a network that models developmental learning of dimensions. The network consisted of four layers: a sensory input layer and a linguistic input layer, a hidden layer, and a linguistic output layer. The network was first trained by learning to answer questions like "What color is this?" The network learned to correctly respond to such requests, learning word-word maps first and word-property maps second. However, despite perfect labeling of properties the network did not learn to selectively attend well enough to make property-property maps. Apparently, the perceptual isolation of properties is not required for learning to label them.

The Experiment

The experiment was designed to provide a behavioral test of the model's predictions. Adult subjects were trained to simultaneously classify Munsell chips on by brightness(value) and saturation (chroma). Value was subdivided into three levels (bright, medium, and dark) and chroma was also subdivided into three levels (high saturation, medium saturation, and low saturation). Each of the levels was assigned a novel dimension name (e.g. dax).

Methods

20 adults subjects participated in this four sessions study. The study consisted of a pretest, training trials, and testing trials.

Training Trials At each of the four sessions subjects were given 72 training trials. Training consisted of the experimenter asking either "What value is this?" or "What chroma is this?" and providing feedback, e.g. "Yes, that value is wug" or "No, that chroma is dax".

Testing Trials Testing was designed to indicate whether the subjects were making word-word, word-property, and property-property maps. Testing thus consisted of three tasks: a production measure, e.g. "What chroma is this?", a multiple choice measure, e.g. "Find the dax one", and a property-property task e.g. "Find the one that matches this."

Results

Adults show the same developmental trajectory learning about novel dimensions that the network did. Subjects quickly learned to make word-word maps, between questions like "What chroma is this?" and the set of possible answers. Subject also learned word-property maps and were able to correctly answer questions like "What chroma is this?" with a high degree of accuracy by the end of the study. However although subjects could readily identify the value and chroma of the stimuli, they experienced considerable difficulty on the property-property task. Subject interviews indicated that those who were solving the task with at least moderate accuracy were labeling all of the stimuli and making comparisons based on those labels.

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