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### **Proceedings of the Annual Meeting of the Cognitive Science Society**

#### **Title**

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#### **Permalink**

<https://escholarship.org/uc/item/6nm577w6>

#### **Journal**

Proceedings of the Annual Meeting of the Cognitive Science Society, 38(0)

#### **Author**

Munro, Paul

#### **Publication Date**

2016

Peer reviewed

# A Model of Language-Guided Concept Formation using a Common Framework for Unsupervised and Supervised Learning

Paul Munro  
University of Pittsburgh

**Abstract:** A general learning rule, “BCM- $\delta$ ”, is proposed that subsumes both unsupervised learning as a form of the BCM rule (Bienenstock, Cooper, Munro, 1982; Munro, 1984) and the delta rule (Rosenblatt, 1958; Rumelhart, Hinton, and Williams, 1986). The “BCM- $\delta$ ” unit is composed of two subunits, T and L, each integrating distinct input streams across distinct sets of synapses. The two subunits follow a common Hebb-like learning procedure that reduces to an unsupervised rule for the T subunit and a supervised rule for the L subunit in which the T response is the training signal. This model suggests a neurally plausible mechanism for the shaping of concepts by labels. More generally, stimuli from one modality can shape the response properties of a unit to another modality using a framework that is biologically plausible and gives clues to the source of a teaching signal for supervised learning.