

## **UC Merced**

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

### **Title**

Learning abstractions from discrete sequences

### **Permalink**

<https://escholarship.org/uc/item/9hx9g7n0>

### **Journal**

Proceedings of the Annual Meeting of the Cognitive Science Society, 46(0)

### **Authors**

Wu, Shuchen

Thalmann, Mirko

Schulz, Eric

### **Publication Date**

2024

Peer reviewed

# Learning abstractions from discrete sequences

**Shuchen Wu**

Max Planck Institute for Biological Cybernetics, Tuebingen, Germany

**Mirko Thalmann**

Max Planck Institute for Biological Cybernetics, Tuebingen, Baden-Wuerttemberg, Germany

**Eric Schulz**

Max Planck Institute for Biological Cybernetics, Tübingen, Germany

## Abstract

Understanding abstraction is a stepping stone towards understanding intelligence. We ask the question: How do abstract representations arise when learning sequences? From a normative perspective, we show that abstraction is necessary for an intelligent agent when the perceptual sequence contains objects of similar interaction properties appearing in identical contexts. A rational agent should identify categories of objects of similar properties as an abstract concept, enabling the discovery of higher-order sequential relations that span a longer part of the sequence. We propose a hierarchical variable learning model (HVM) that learns chunks and abstract concepts from sequential data in a cognitively plausible manner. HVM gradually discovers abstraction via a conjunction of variable discovery and chunking, resembling the process of concept discovery during development. In a sequence recall experiment that demands learning and transferring variables, we observe that the model's sequence complexity can explain human behavior in a sequence memorization experiment.