

# Efficient Category Learning



# What do I mean by category learning?

Category learning is "the search for and listing of attributes that can be used to distinguish exemplars from non exemplars of various categories"

Bruner, Goodnow, & Austin (1967)

# What strategies are there for learning a category?

Supervised: Feedback provided

Unsupervised: No feedback provided

# What is the best method for teaching?

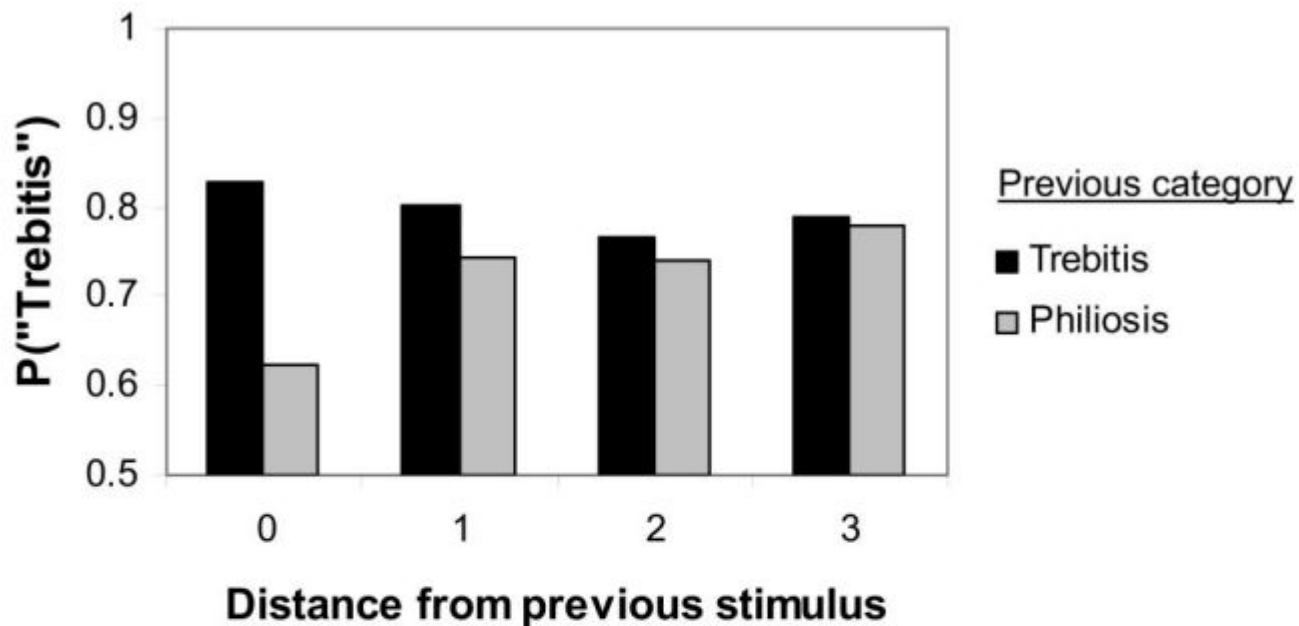
Supervised learning is shown to encourage explicit rule formation. Love (2002)

This should be best for teaching concrete concepts such as math equations, state boundaries, or temporal organization.

# Previous research has shown...

Love & Maddox (2006) suggest that recent stimuli not only have a stronger effect on perception but that knowledge transfer(i.e. category knowledge) is more prominent than older stimuli.

More recently presented stimuli make us perceive current stimuli to be more like them. The more 'distant' the stimuli the less likely we are to perceive current stimuli as similar to that previous stimuli. Jones & Sieck (2003)



*Figure 1.* Effects of previous trial from Jones and Sieck (2003, Experiment 2, control condition). Shown are response rates to a single stimulus (configuration  $S_3$  in their notation) as a function of the previously correct category and the distance between present and previous stimuli. “Distance” is defined here as the number of mismatching cue dimensions (stimuli were composed of three binary cues). All six stimuli show the same qualitative pattern as seen here. *Trebitis* and *Philiosis* are the two category labels.

Love and Maddox argue that this also means more recent stimuli show a greater amount knowledge transfer to current stimuli than older stimuli.



# What is knowledge transfer?

Also known as *stimulus generalization* this is the use of previous stimuli's information to make a decision about a current stimuli.

This could involve gathering features to make a rule about category membership.



# What does this mean?

Ordering of category items is very important as we want the most item transfer from item to item. Which suggests we place the most similar stimuli next to each other.

But what about when we have many categories and memory retention becomes a factor? Ordering similar stimuli farther away seems to be the better method.

# How should category pairs be ordered?

Blocked-sudden scheduling: All of the items in one category are presented by incrementing along the irrelevant dimension. Then starting with the item with the biggest difference in the irrelevant dimension all of the items in the next category are presented by incrementing along the irrelevant dimension.

Blocked-gradual: Same as above except when a new category is introduced the first item chosen has the smallest difference in the irrelevant dimension.

Zipper Scheduling: Sequential items are chosen based on the greatest difference on the relevant dimension.

ZEITHAMOVA AND MADDOX

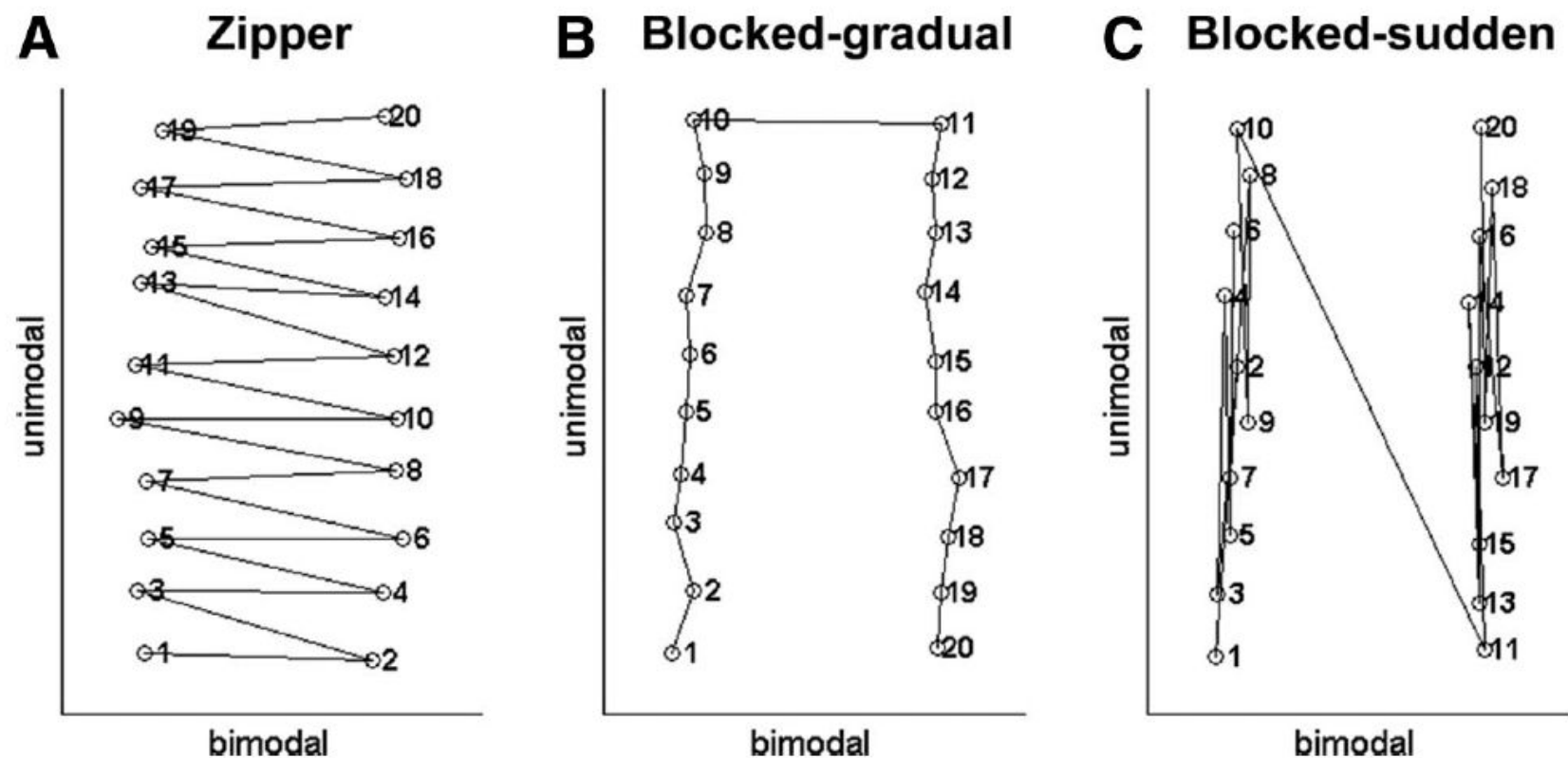


Figure 5. A schematic of the stimulus sequence order (1–20) for the 20 training trials in each condition of Experiment 3.

# Which is the most effective for supervised learning?

Blocked-sudden is better for unsupervised learning.

The Zipper method appears to be the most effective for supervised learning because it led to bimodal categorization (rather than unimodal categorization) right away.

Zeithamova & Maddox (2009)

# How will pairs be chosen?

Each category in a pair should try be the farthest apart from one another in the relevant dimensions because this allows the greatest knowledge transfer.(i.e. the most inclusionary rules for a category and the most exclusionary rules).

# Spacing vs ordering?

Ordering is the order in which the categories appear after each other.

Spacing is the distance between a like category.



# How does adaptive spacing fit into this?

Can Kellman's idea that adjusts spacing based on response latency lead to more efficient learning?

How about Pavlik & Anderson's model(2008) that spacing should be shorter for at first for studying items, but longer for as knowledge of them accumulates?



Which one is the best?

# How about a mixture of both?

Since knowledge transfer is important before category mastery is sufficient we can use very minimal spacing between items. As an item becomes mastered, then we increase the spacing between its next presentation.

Mastery of a category will be based on correctness and response latency.

# In addition...

Kellman - Tested perceptual categorization with items that contained many irrelevant features.

Athyma

Which of the following images matches the genus shown above?



Left  
press  
'z'



Right  
press  
'v'

Is it possible to make this learning process more efficient?

Zeithamova & Maddox(2009) presented one category per trial but...

## Why present two categories at a time?

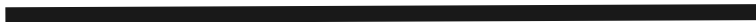
Participants would have to make rules not only about what a category consists of but would have to process and transfer more information such as relevant category exceptions.

This would reduce the effect of the distance of stimuli.

# Why don't we start testing simple perceptual categories?

Complex: Many irrelevant dimensions of difference. (Comparing two butterfly)

Simple: Not that many irrelevant dimensions (i.e Line Length)



# Why use simple categories over more complicated?

Simple categories provide the least noise.

Simple categories seem to rely on a few concrete rules.

This allows the most efficient knowledge transfer with the least interference from item to item. This way we can find which methods are best at transferring category rules rather than which best allows us to sort through relevant and irrelevant dimensions.

# Proposal

Try testing category mastery with a mixture of Kellman's model and the Pavlik & Anderson model using simple categories.

In addition, test whether two categories presented at a time reduces the amount of time to proficiently retain a category in memory.