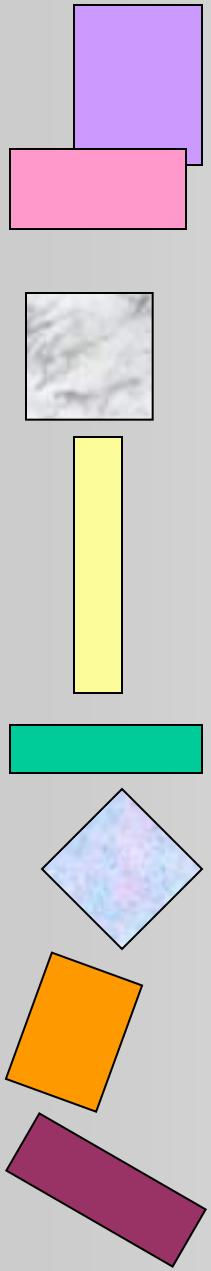
Concept Learning

Analyzing Concepts



Concepts are categories of stimuli that have certain features in common.

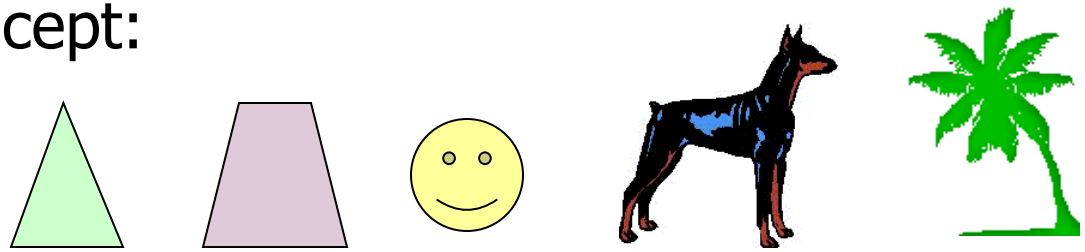
The shapes on the left are all members of a conceptual category: rectangle. Their common features are (1) 4 lines; (2) opposite lines parallel; (3) lines connected at ends; (4) lines form 4 right angles.

The fact that they are different colors and sizes and have different orientations is irrelevant. Color, size, and orientation are not defining features of the concept

Concept Learning

Analyzing Concepts

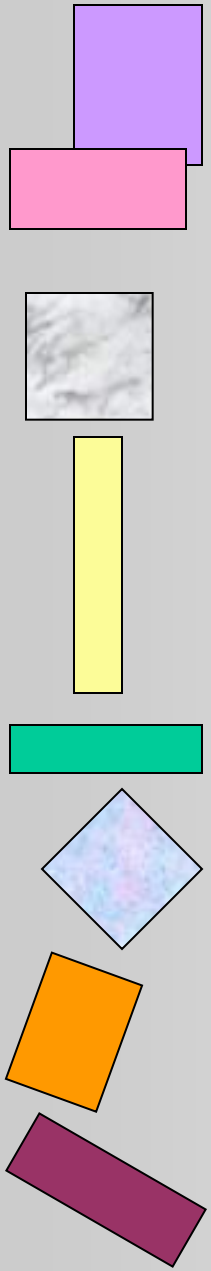
If a stimulus is a member of a specified conceptual category, it is referred to as a "positive instance". If it is not a member, it is referred to as "negative instance". These are all negative instances of the rectangle concept:



As rectangles are defined, a stimulus is a negative instance if it lacks any one of the specified features.

Concept Learning

Analyzing Concepts



Every concept has two components:

Attributes: These are features of a stimulus that one must look for to decide if that stimulus is a positive instance of the concept.

A rule: This a statement that specifies which attributes must be present or absent for a stimulus to qualify as a positive instance of the concept.

For rectangles, the attributes would be the four features discussed earlier, and the rule would be that all the attributes must be present.

Concept Learning

Analyzing Concepts

The simplest rules refer to the presence or absence of a single attribute. For example, a "vertebrate" animal is defined as an animal with a backbone. Which of these stimuli are positive instances?

\+ \+ − \+

This rule is called affirmation. It says that a stimulus must possess a single specified attribute to qualify as a positive instance of a concept.

Concept Learning

Analyzing Concepts

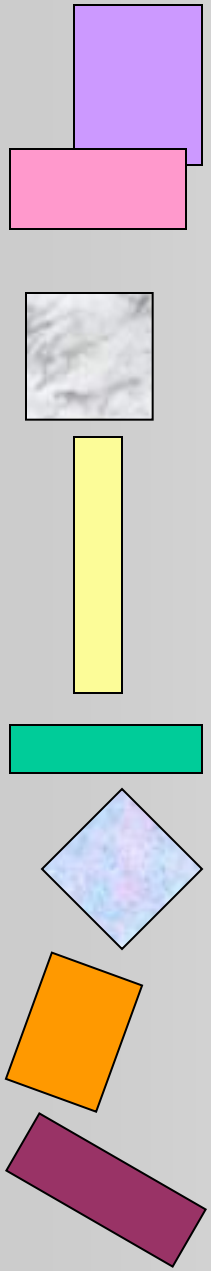
The opposite or "complement" of affirmation is is negation. To qualify as a positive instance, a stimulus must *lack* a single specified attribute.

− − + −

An invertebrate animal is one that lacks a backbone. These are the positive and negative instances when the negation rule is applied.

Concept Learning

Analyzing Concepts

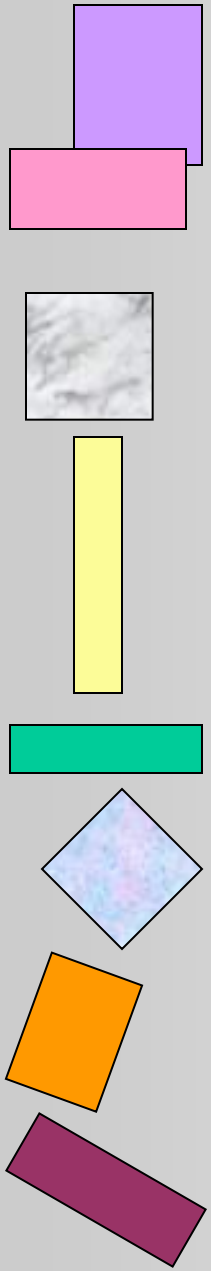


More complex conceptual rules involve two or more specified attributes. For example, the conjunction rule states that a stimulus must possess two or more specified attributes to qualify as a positive instance of the concept.

This was the rule used earlier to define the concept of a rectangle.

Concept Learning

Behavioral Processes



In behavioral terms, when a concept is learned, two processes control how we respond to a stimulus:

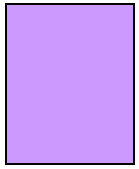
Generalization: We generalize a certain response (like the name of an object) to all members of the conceptual class based on their common attributes.

Discrimination: We discriminate between stimuli which belong to the conceptual class and those that don't because they lack one or more of the defining attributes.

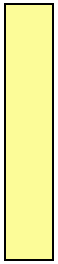
Concept Learning

Behavioral Processes

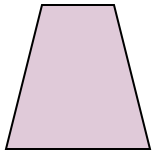
For example, we generalize the word "rectangle" to those stimuli that possess the defining attributes...


rectangle


rectangle


rectangle

...and discriminate between these stimuli and others that are outside the conceptual class, in which case we respond with a different word: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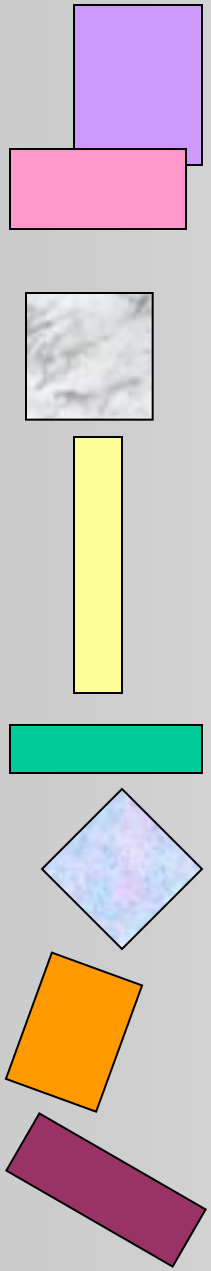
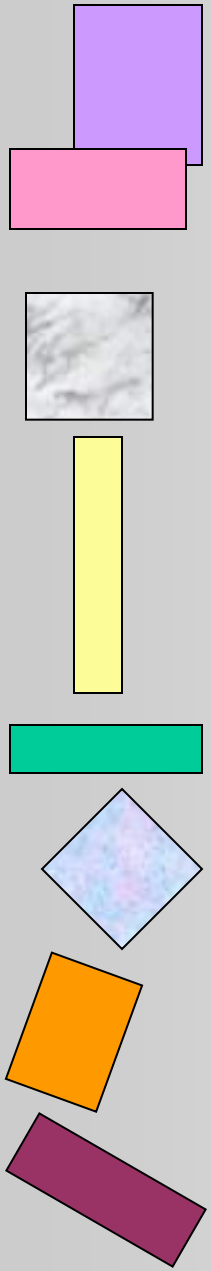
Concept Learning



Rote learning is learning without understanding the meaning of what is learned. For example, you can learn to make the correct response to a stimulus without discovering the conceptual category to which the stimulus belongs.

More technically, you make the correct response without detecting the attributes that the stimulus shares with other members of the conceptual class.

Concept Learning

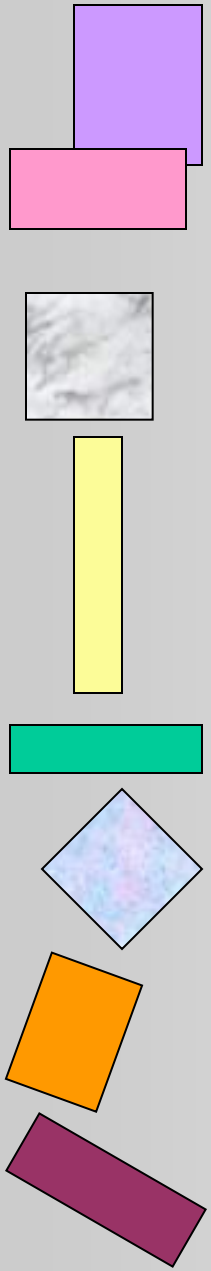


It's like memorizing the term that goes with an example without understanding why they go together.

The next time you see that example, you may give the correct term. But what if you are given an example you haven't seen before?

This is the real test of concept learning: Can you recognize (respond appropriately to) novel instances of the concept?

Concept Learning



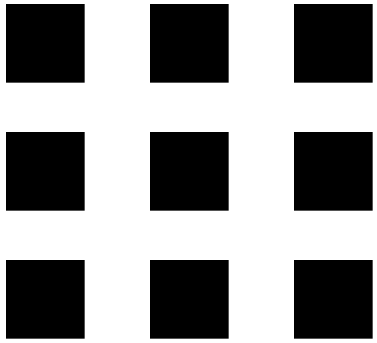
An operant conditioning experiment with chimpanzees (Kelleher, 1958) illustrates the distinction between rote learning and concept learning.

The procedure was a form of discrimination training in which there were 13 discriminative stimuli (+ instances of a concept) and 13 delta stimuli (- negative instances of the concept).

The stimuli were presented in a random order. During + stimuli, responses on a button were reinforced on VR 100. During – instances, responses were not reinforced.

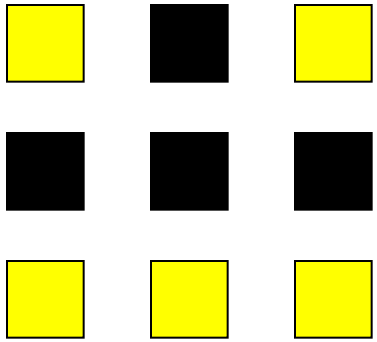
Concept Learning

Each stimulus involved 9 small windows arranged in 3 rows, with 3 windows per row:



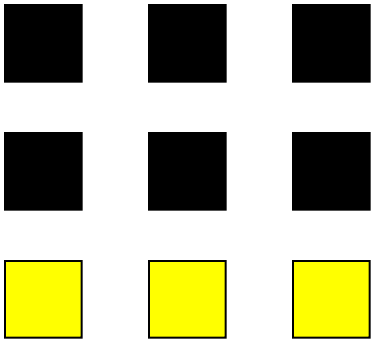
Each window could be lit or left dark, for example:

Concept Learning



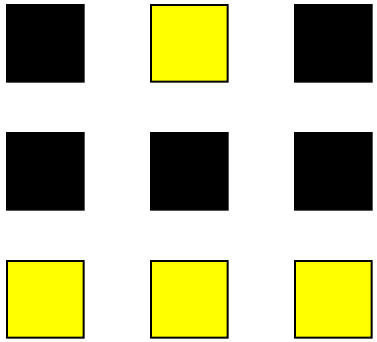
The array, above was one of the + instances of the concept. Here are two more:

Concept Learning



+2

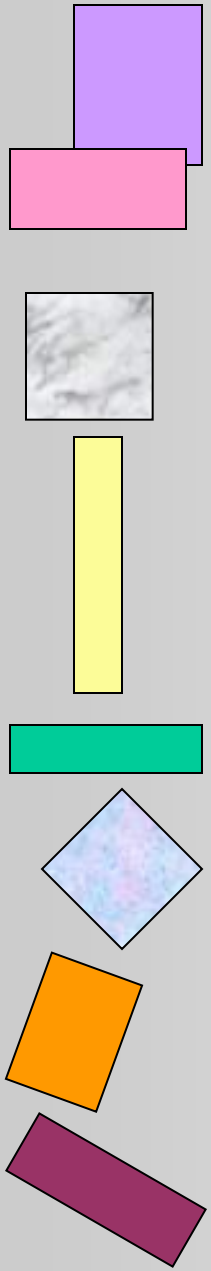
Concept Learning



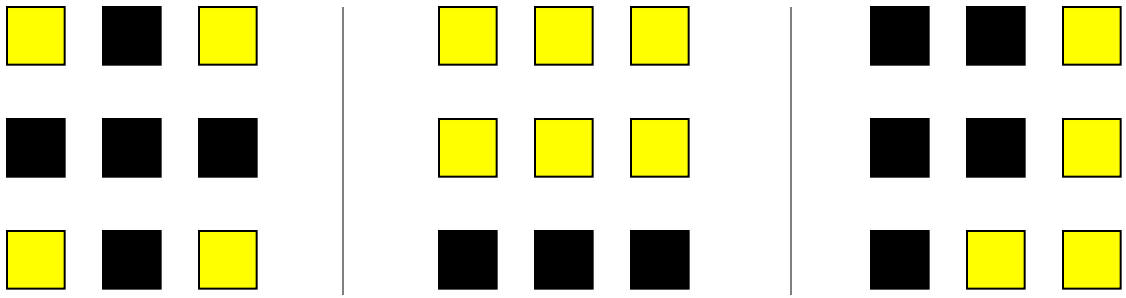
The positive instances all had common attributes. The negative instances lacked one or more of these attributes. Here are some of the negative stimuli:

+3

Concept Learning



Negative Instances (Delta Stimuli)



The common attributes of the positive instances defined the concept. It was...?

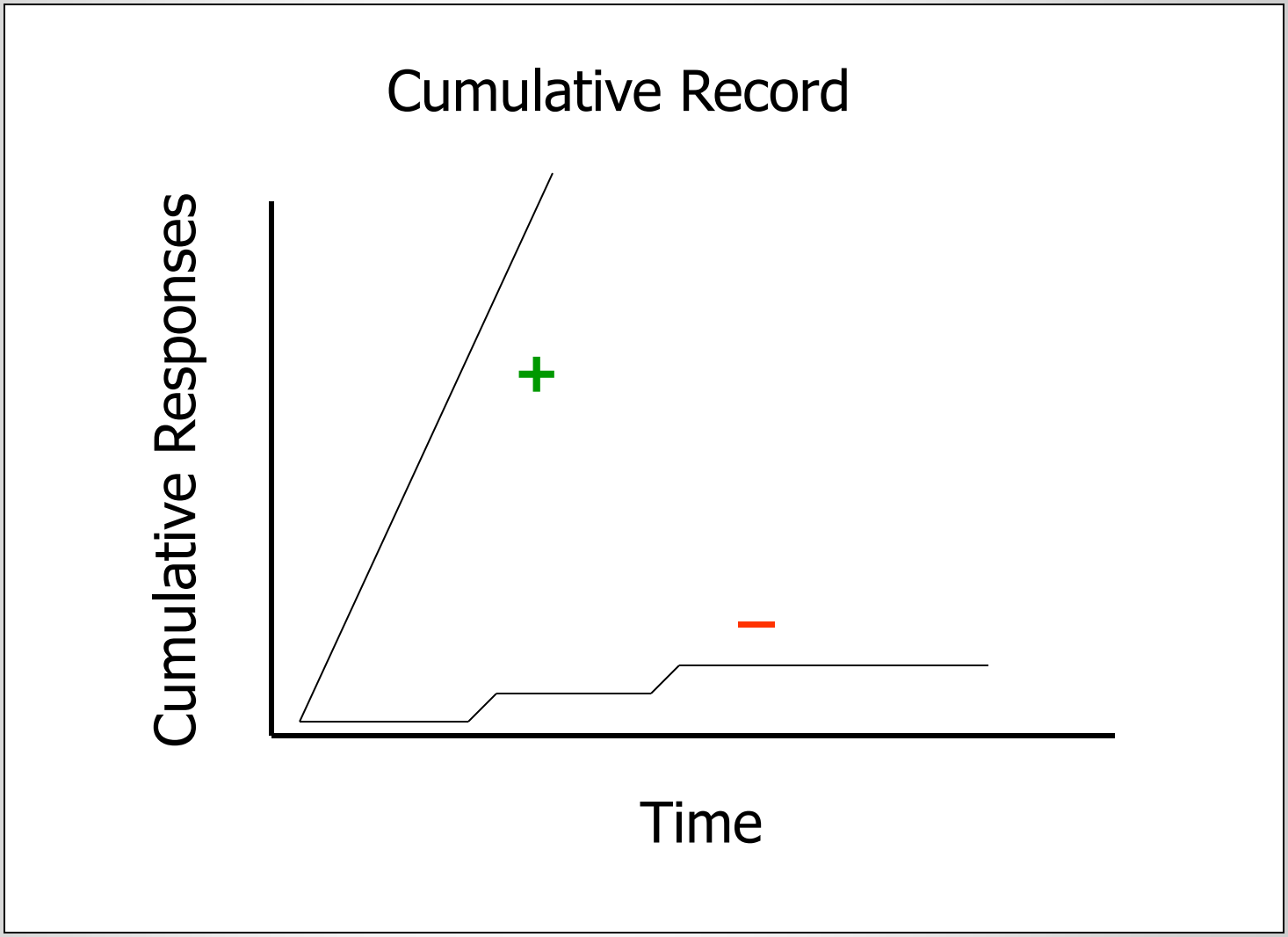
Bottom three windows lit.

Concept Learning

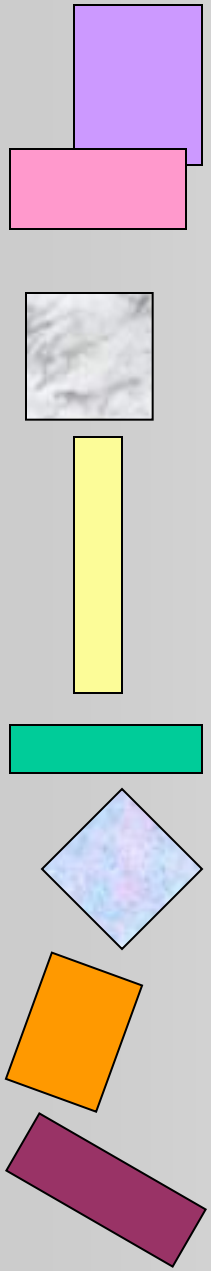
Thirteen positive and thirteen negative stimuli were presented until a strong discrimination developed: constant, rapid responding during positive stimuli; little or no responding during negative stimuli.

Then the sequence was changed but the stimuli stayed the same. There was no disruption in performance. Here is a typical cumulative record of responding from the first sequence:

Concept Learning



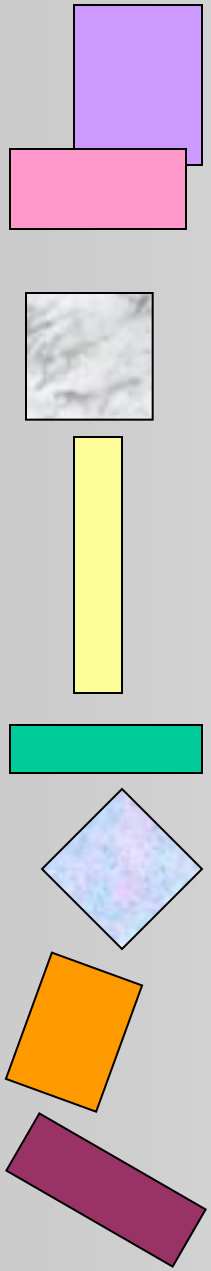
Concept Learning



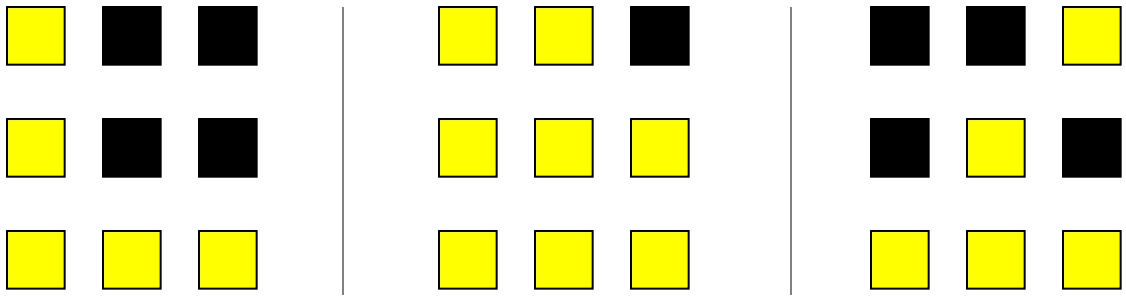
In Phase 2 of this discrimination problem, 6 positive and 6 negative stimuli were removed and replaced with new ones *while keeping the concept the same*.

Here are examples: three of the new positive instances and three of the new negative instances.

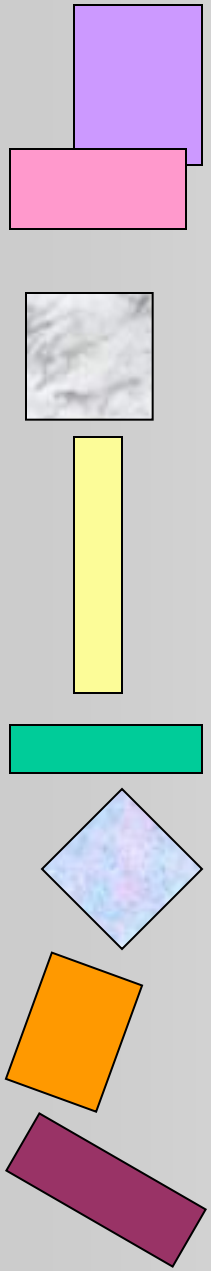
Concept Learning



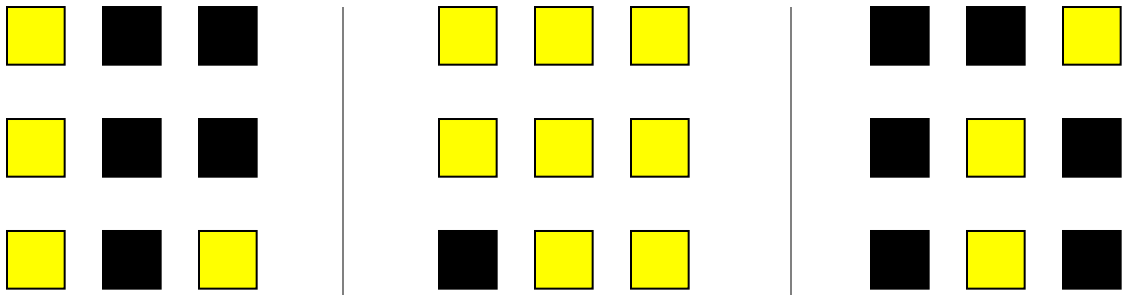
New Positive Instances (Phase 2)



Concept Learning



New Negative Instances (Phase 2)



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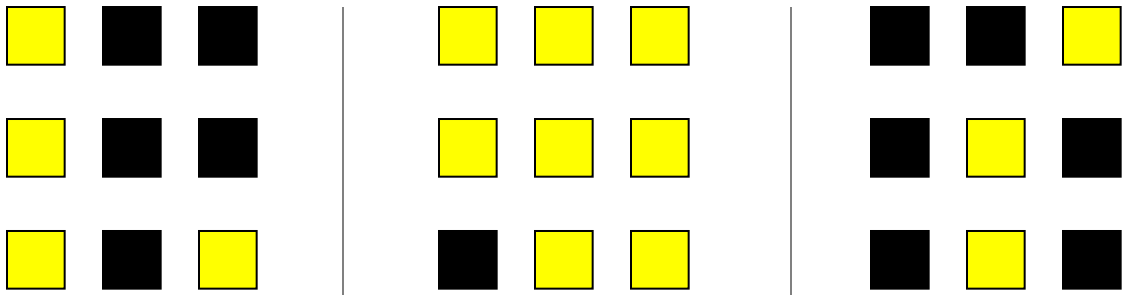
The question was: Would the chimps respond appropriately to the new stimuli even though they never saw those exact patterns before?

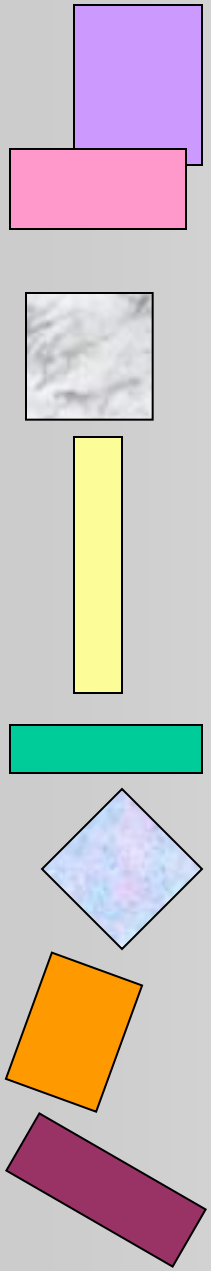
Concept Learning

New Negative Instances (Phase 2)



Result: Yes, they showed rapid responding to the + instances and little or no responding to the negative instances.

Concept Learning

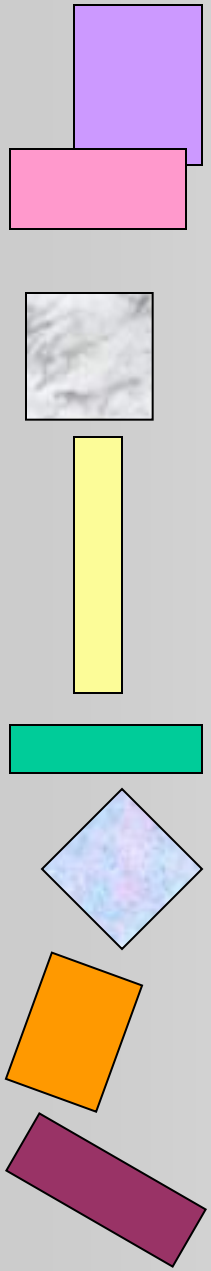


This showed that the chimps had learned a concept in Phase 1. Whatever the pattern was, they looked at the bottom 3 windows, and if all 3 were lit, they pressed the button.

Pressing the button was like saying, "Yes, this is an example of the concept."

This illustrates the advantage of solving problems conceptually: You can respond appropriately to new situations. You focus on just the relevant attributes.

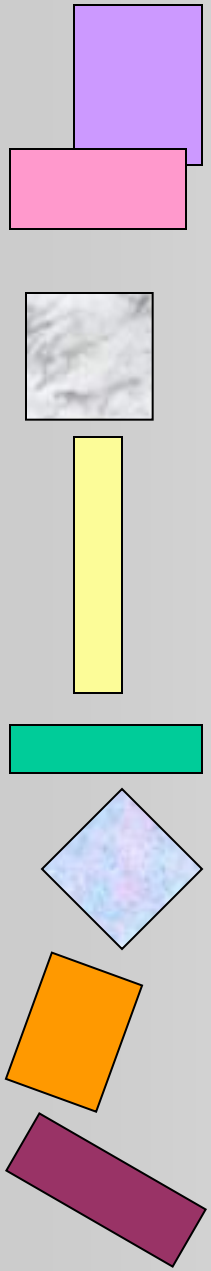
Concept Learning



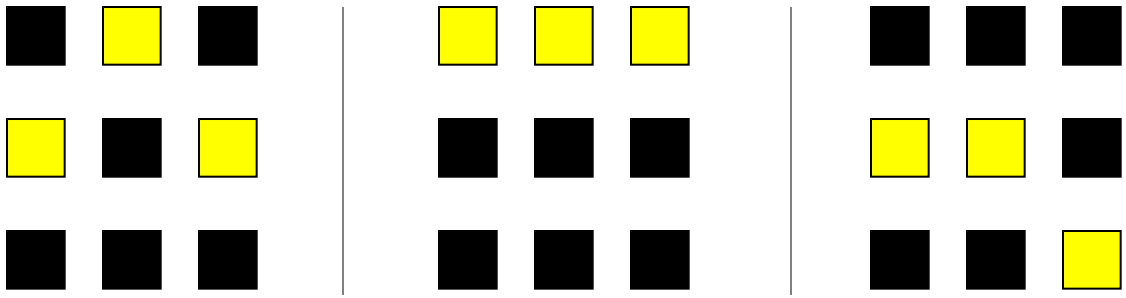
Example of Rote Learning

The chimps were given a second concept problem involving 13 new + instances and 13 new – instances. Here is a sample of these stimuli. What would you say the concept was?

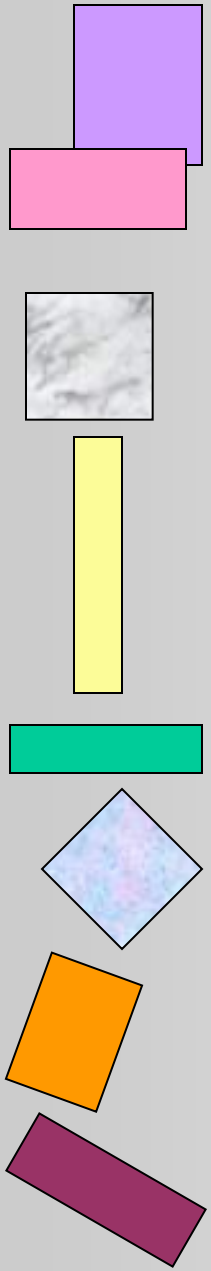
Concept Learning



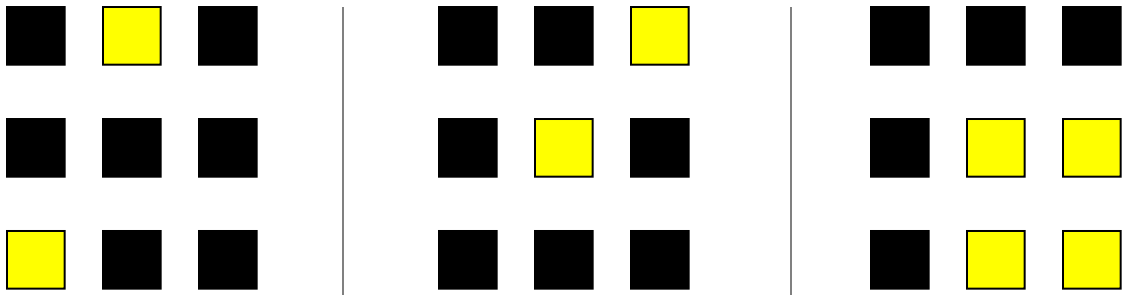
New Positive Instances (Problem 2)



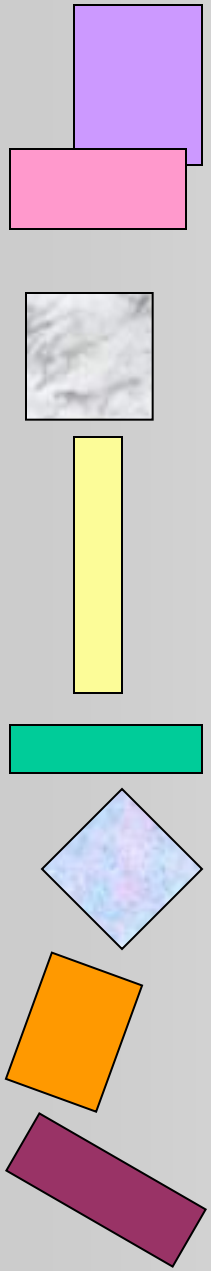
Concept Learning



New Negative Instances (Problem 2)



Concept Learning

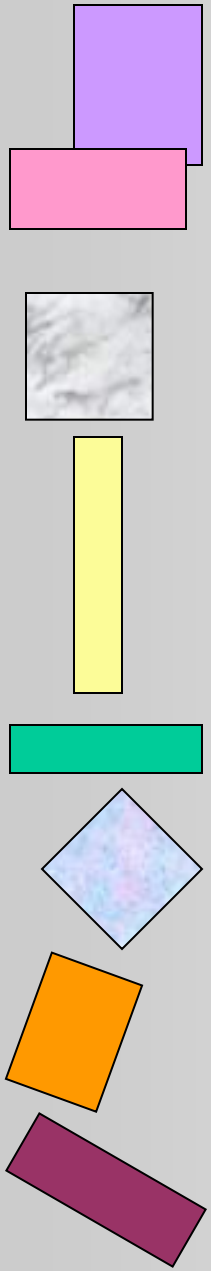


Example of Rote Learning

The concept was "any 3 windows lit." Negative instances had 2 or 4 windows lit.

The procedure was the same as in Problem 1. The 13 + and 13 – instances were presented until a strong discrimination was learned: rapid responding during + stimuli, little or no responding during – stimuli.

Concept Learning



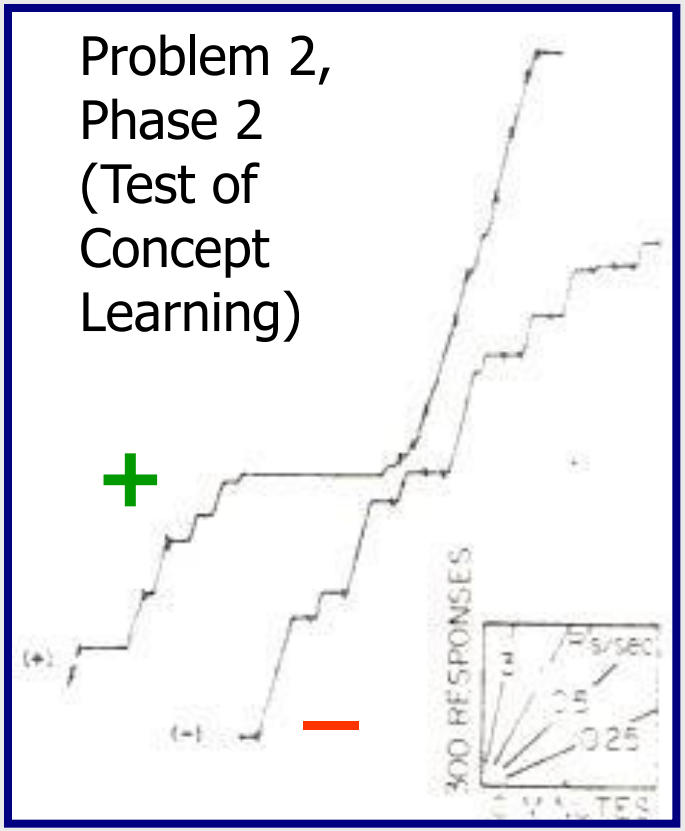
Example of Rote Learning

Then came the test of concept learning: 6 new + instances and 6 new – instances were presented. Would the animals keep responding appropriately?

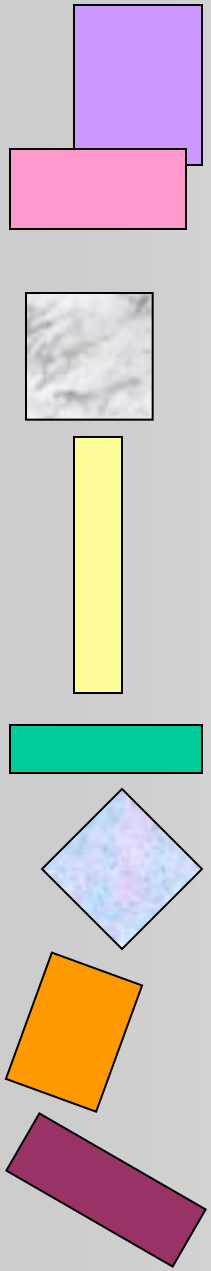
You can see for yourself. Here is a sample of the actual cumulative record during positive and negative stimuli.

Concept Learning

Example of Rote Learning



Concept Learning



Example of Rote Learning

Performance was disrupted during the new stimuli, with frequent pauses during positive stimuli and bursts of rapid responding during negative stimuli.

The chimps solved the problem by "memorizing the answers" without discovering what the positive stimuli had in common. This may be because the concept was abstract: The 3 lit windows were not tied to a specific location. The animals had to respond to the number "3".