- After eating food in a branded restaurant, you fell ill, then you stopped visiting all other outlets of that brand

- Fire alarm in a movie vs fire alarm in your building

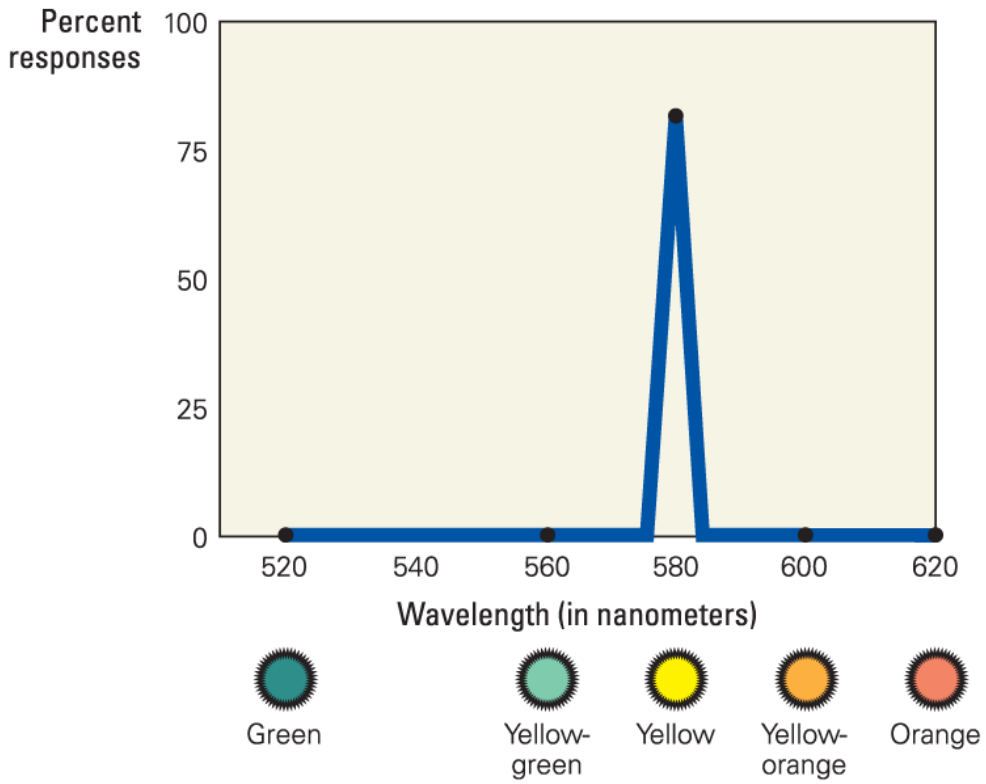
Can you compare?

Generalization & Discrimination

Why do we ?

Stimulus-Generalization Gradients in Pigeons

Ideal



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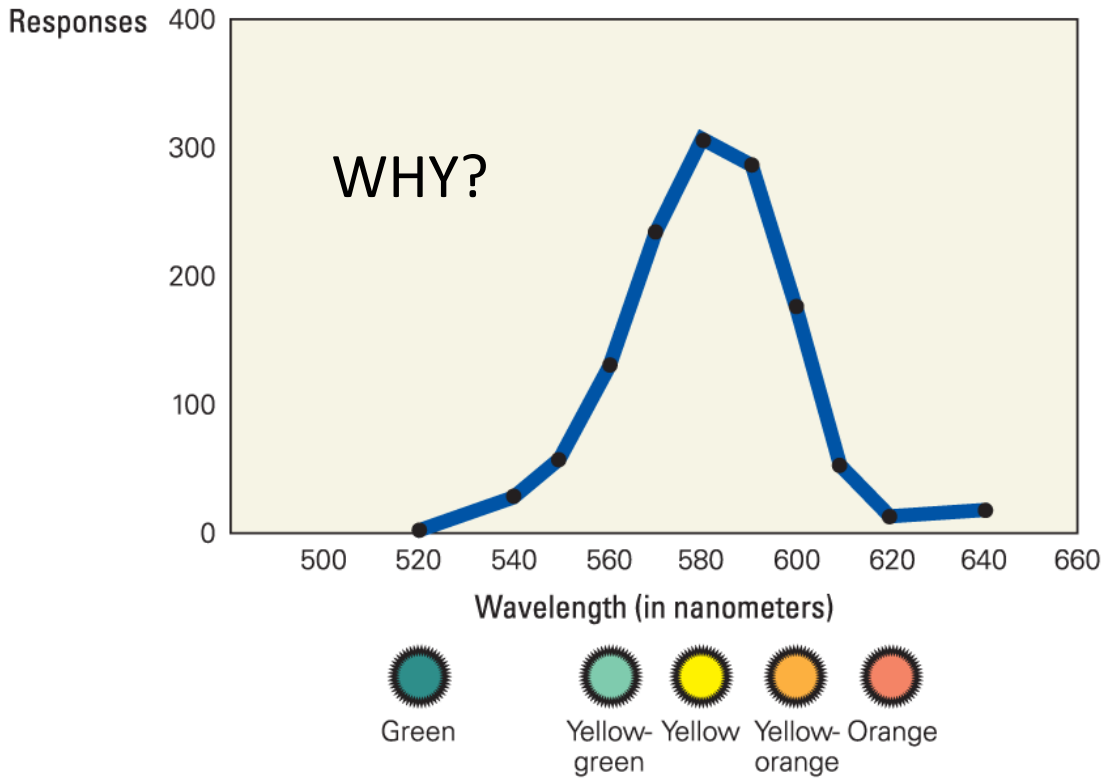
Realistic



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Less error in prediction

Similar stimuli might also be rewarding

Purpose of generalization - estimate probability of future events.

Behavioral Processes

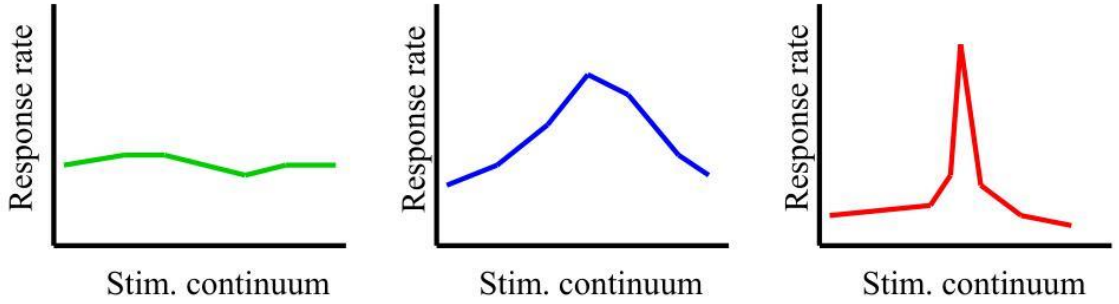
Generalization

transfer of past learning to novel events and problems

Discrimination

learn to respond differently to different stimuli

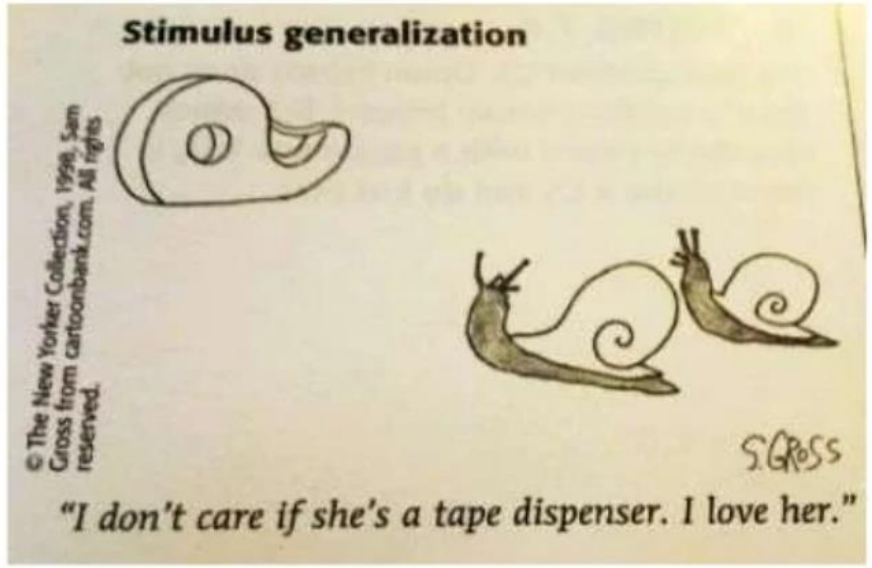
	Same outcome	**Different outcomes**
Similar stimuli	Similar stimuli → same outcome *Broccoli and cauliflower → nasty* **Moderate Generalization**	Similar stimuli → different outcomes *Broccoli → nasty* *Cauliflower → yummy* **High Discrimination**
Dissimilar stimuli	Dissimilar stimuli → same outcome *Broccoli and Brinjal → nasty* **High Generalization**	Dissimilar stimuli → different outcomes *Broccoli → nasty* *Brinjal →yummy*



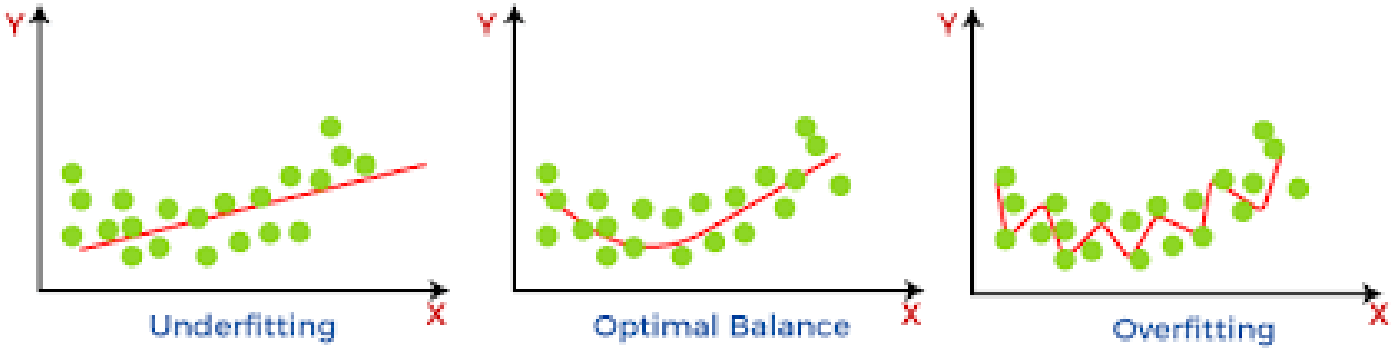
Flat: No discrimination/ high generalization

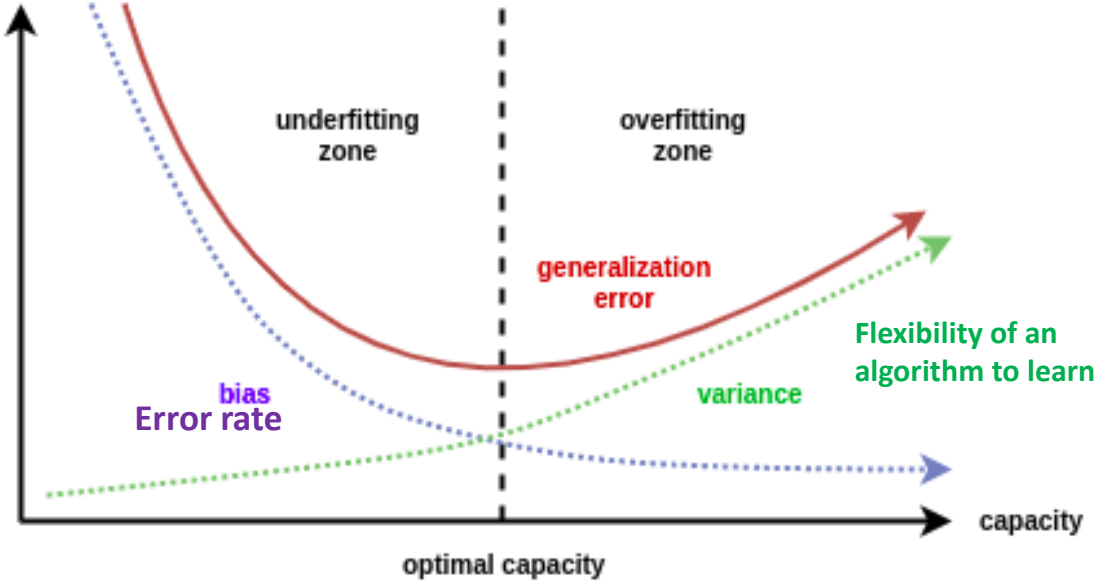
Broad: Some discrimination/ some generalization

Narrow: High discrimination/ low generalization



Generalization in machine learning



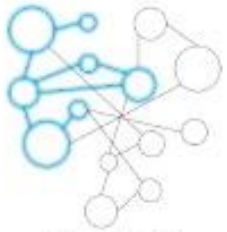
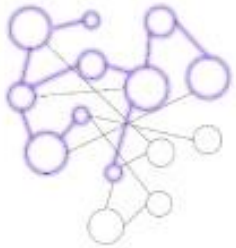
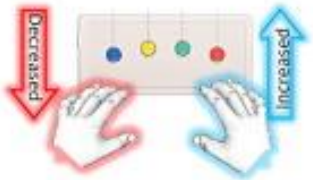
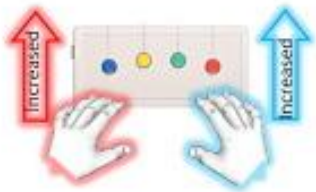


Training Data

Testing Data

how accurately an algorithm is able to predict outcome values for previously unseen data

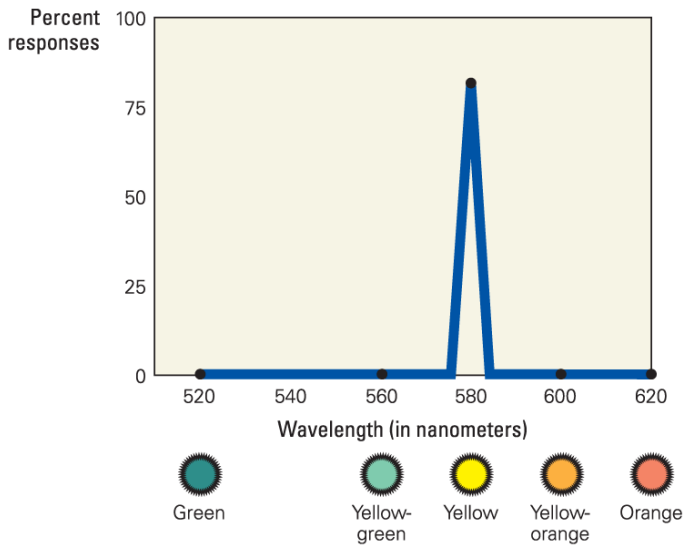
https://medium.com/@yixinsun_56102/understanding-generalization-error-in-machine-learning-e6c03b203036

	Memories	Interference	Generalization
Synaptic level	Memory A:  Memory B: 	One memory is enhanced, strengthening its representation on the expense of the other 	Both memories are linked, strengthening the overlapping representations 
Behavioral level	Memory A: Sequence learning (right hand)  Memory B: Sequence learning (left hand) 	A single memory is enhanced while the other is weakened 	Both memories are enhanced 

Generalization at the neural and behavioural level

https://www.sciencedirect.com/science/article/abs/pii/S030645221830544X

Discrete Response model



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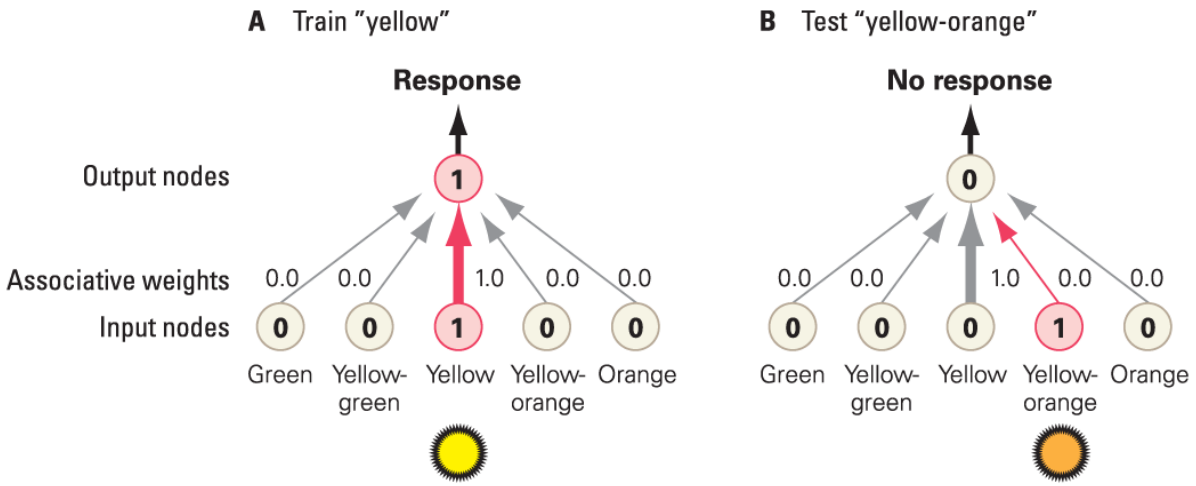

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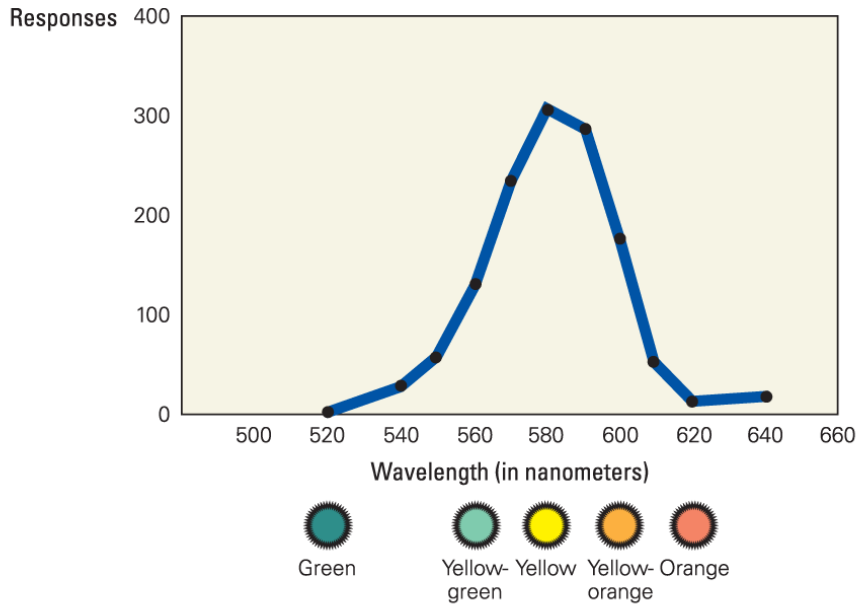
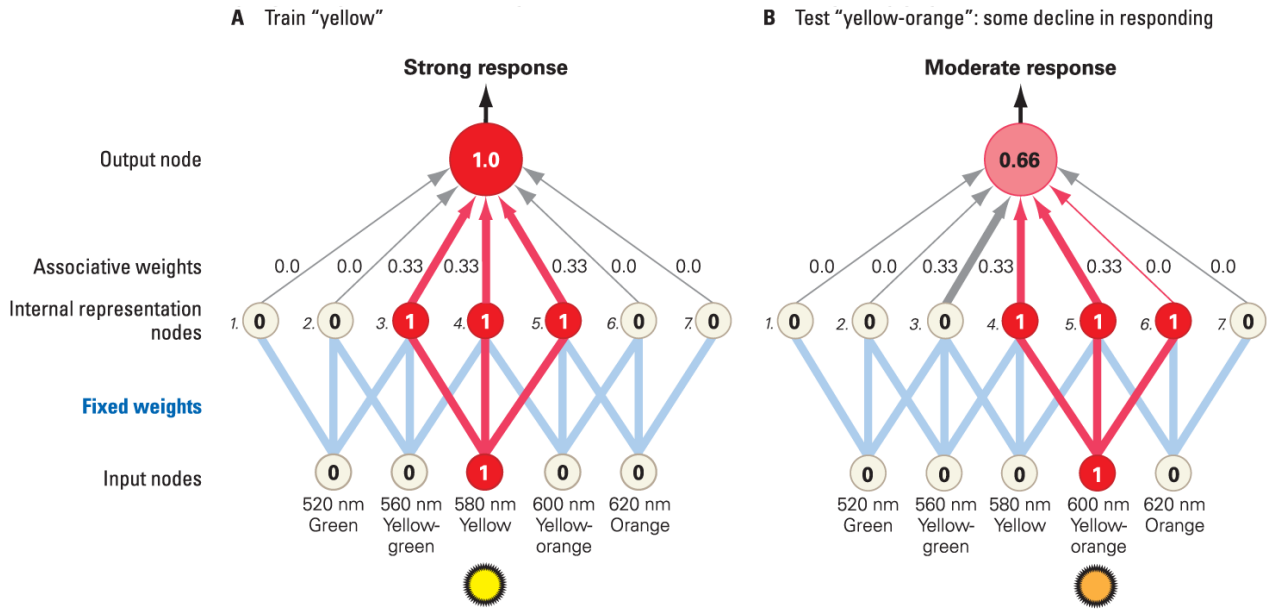
Distributed Response model





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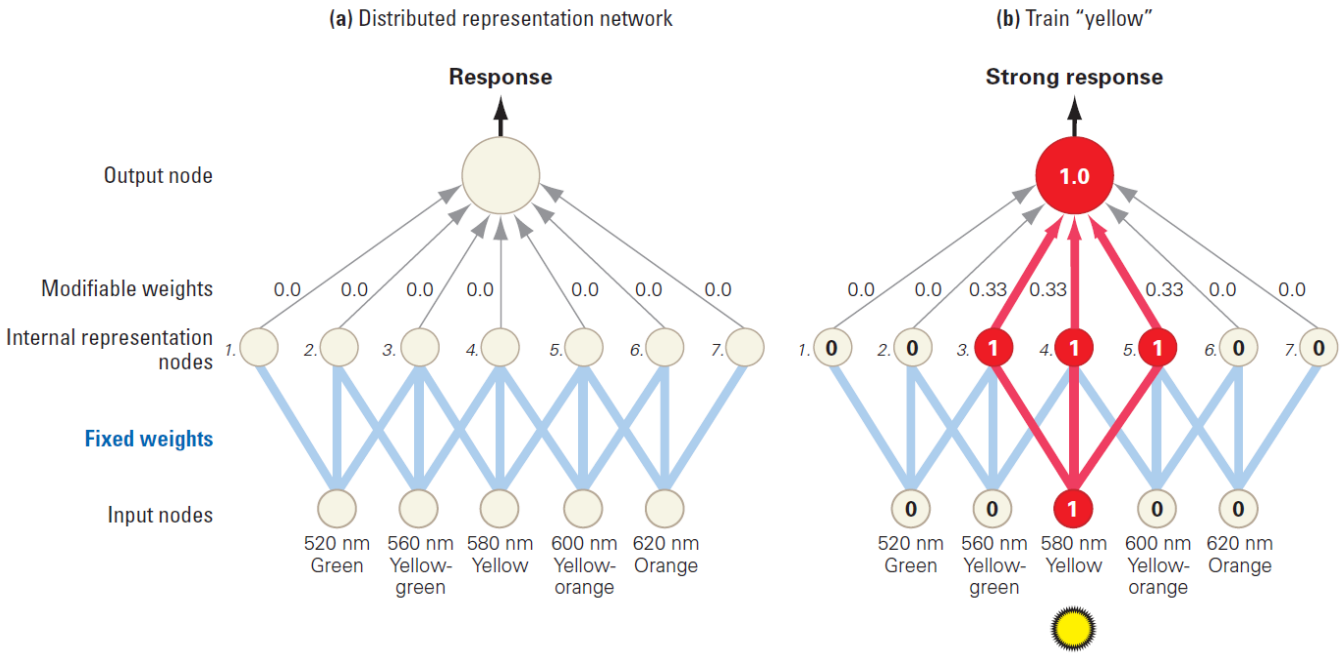
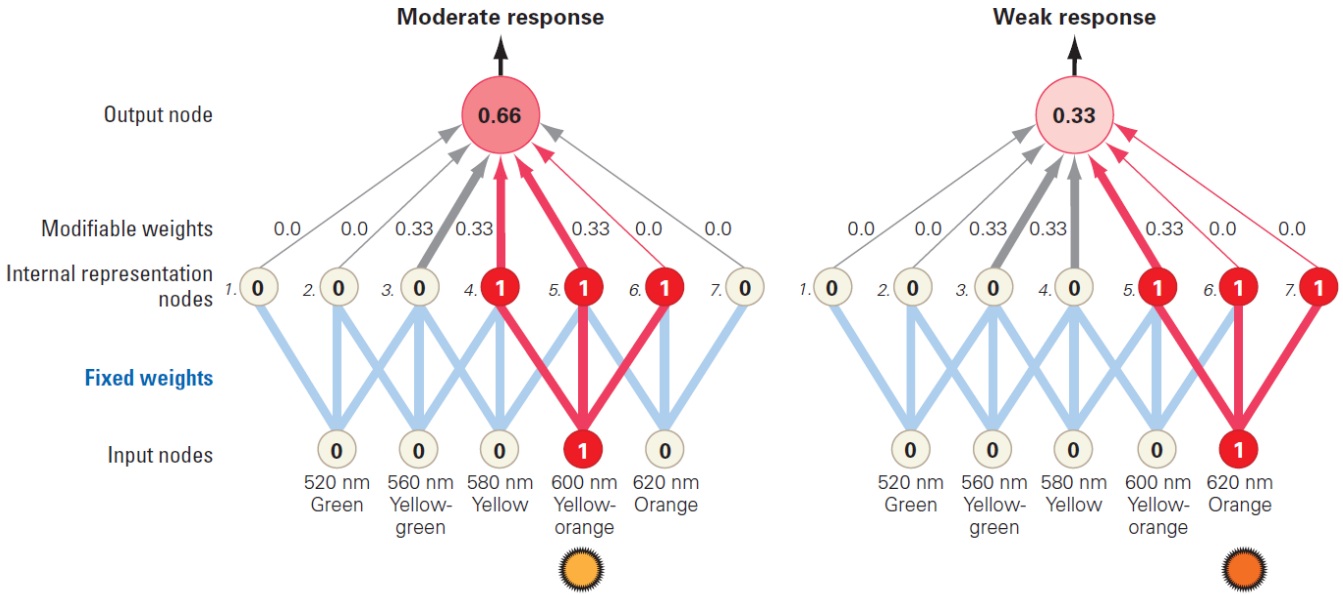




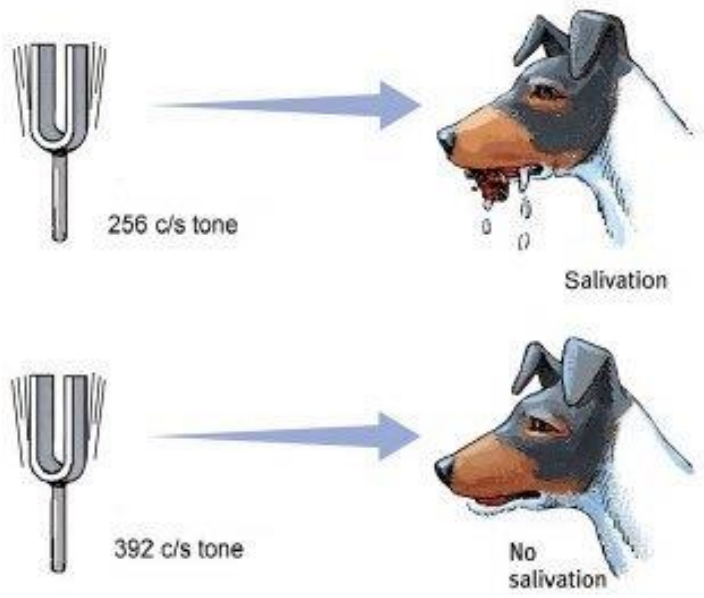
expect similar stimuli to have similar consequences

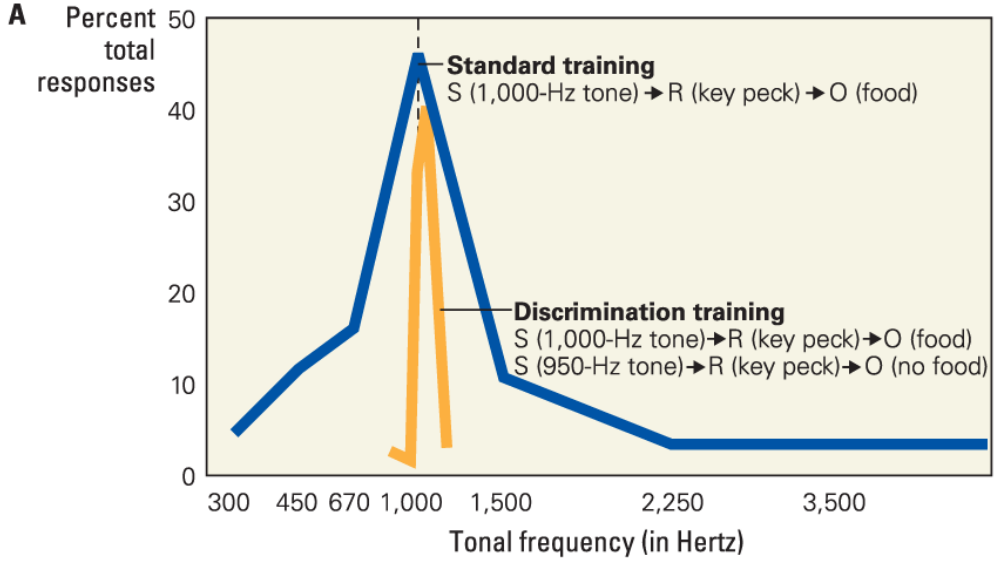
Distributed representation

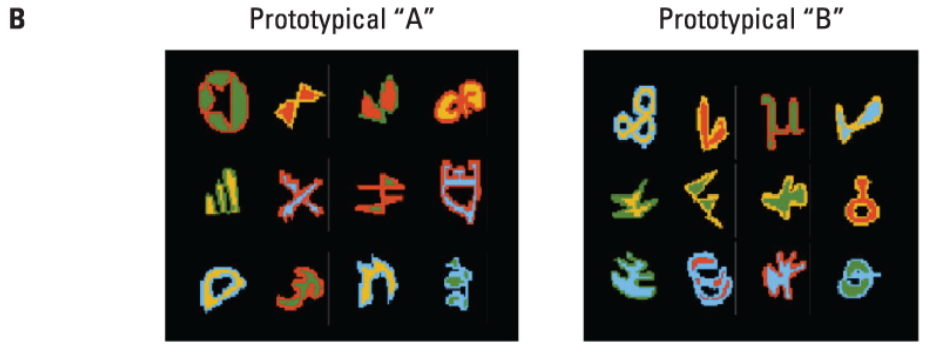
Discrete representation

Generalization or Discrimination?

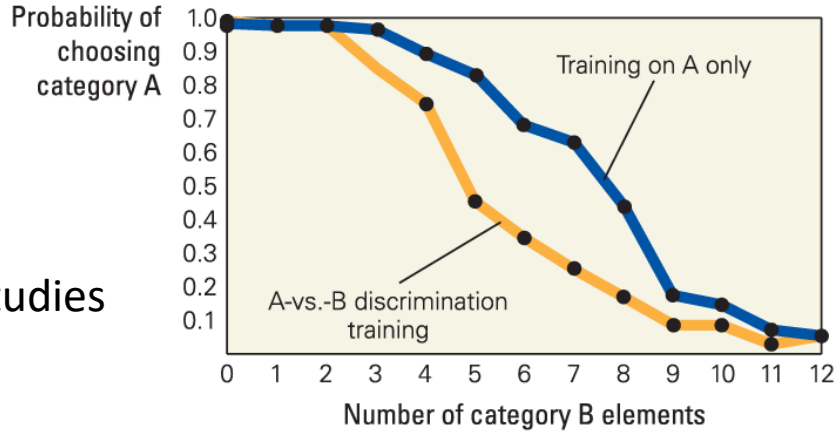
What determines whether two stimuli are to be treated as similar (generalization) or different (discrimination)?





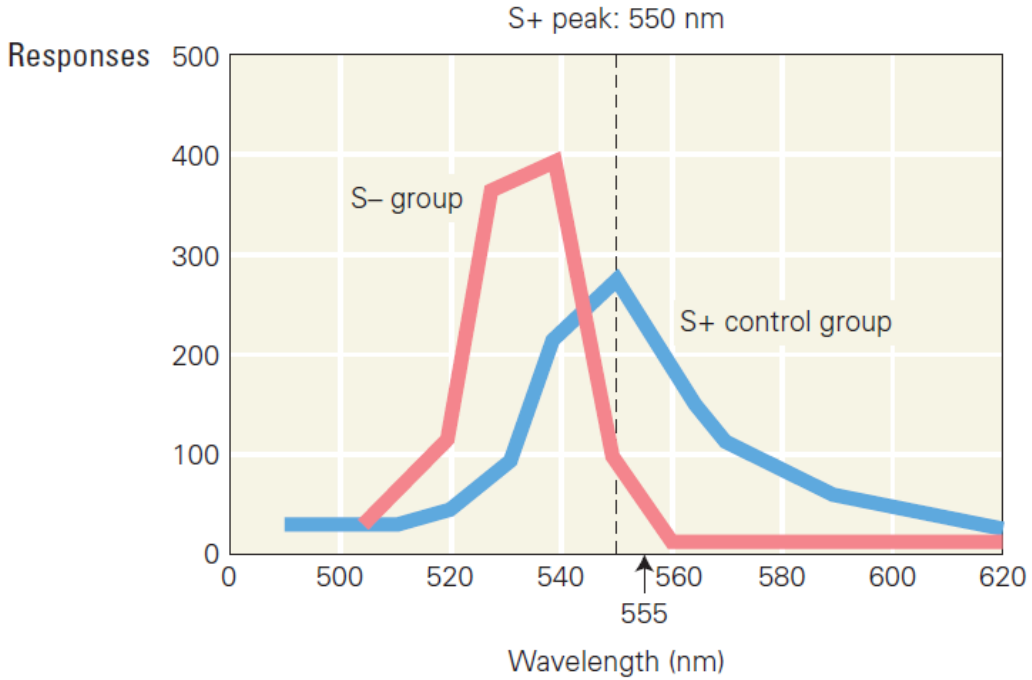


Human studies



Peak shift following discrimination training along a physical continuum

Pigeons were reinforced for pecking in the presence of a 550-nm light and then were divided into two groups. One group received only this training (the control group), while the other received discrimination training in which the 550-nm lights were rewards while a similar 555-nm light were paired with unpleasant/negative outcomes (the S- group).



Preconditioning:
Co-occurrence and Stimulus Generalization

meaning-based generalization

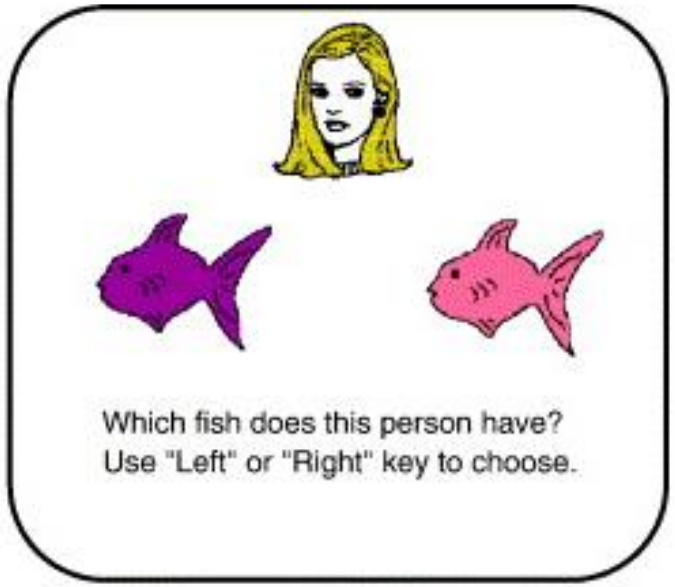
Generalization across two dissimilar stimuli → because of co-occurrence

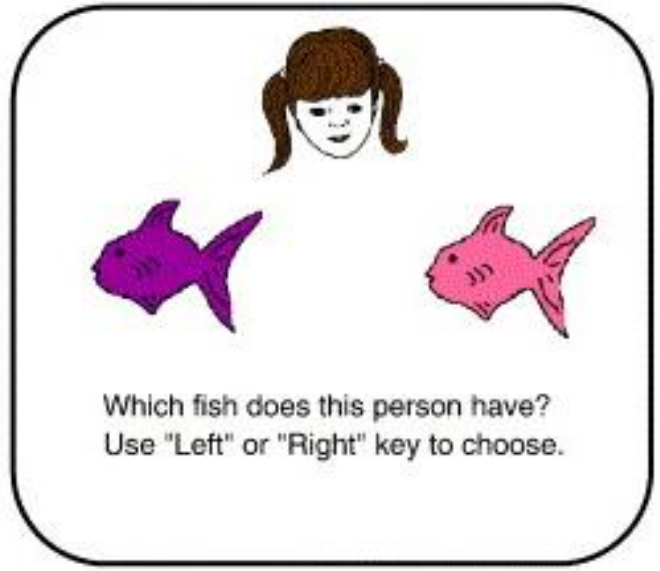
Group	**Phase 1**	**Phase 2**	**Phase 3: test**
Compound exposure	*Tone + light (together)*	Light → airpuff → blink!	Tone →
Separate exposure (control group)	*Tone, light (separately)*	Light → airpuff → blink!	Tone →

Reverse of blocking

In an unfamiliar area,
red light + other vehicles stop → reduce your speed
other vehicles stop → reduce your speed assuming a traffic light (when you can't see the red light)

Preconditioning can occur beyond the sensory level -


Which fish does this person have?
Use "Left" or "Right" key to choose.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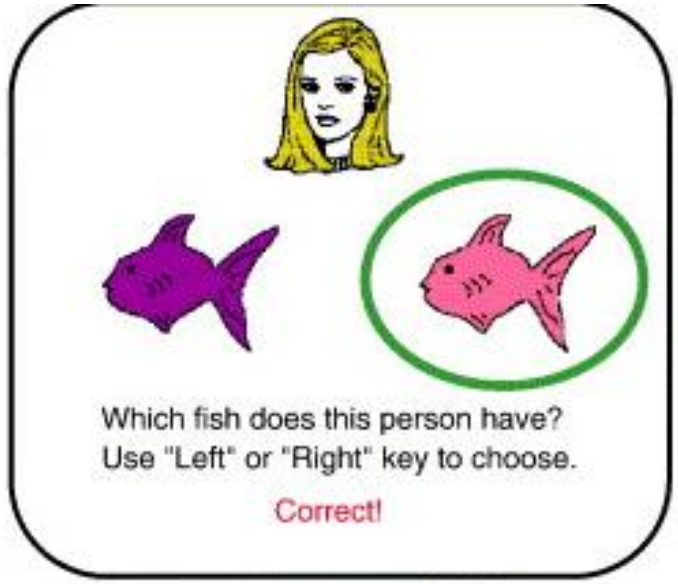
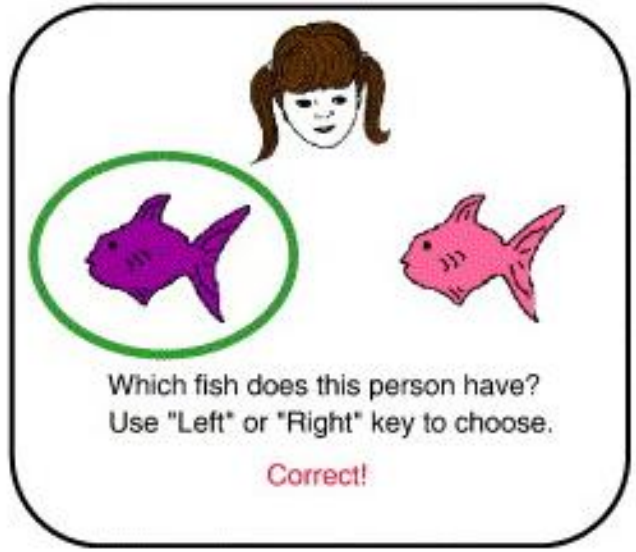

Which fish does this person have?
Use "Left" or "Right" key to choose.
Correct!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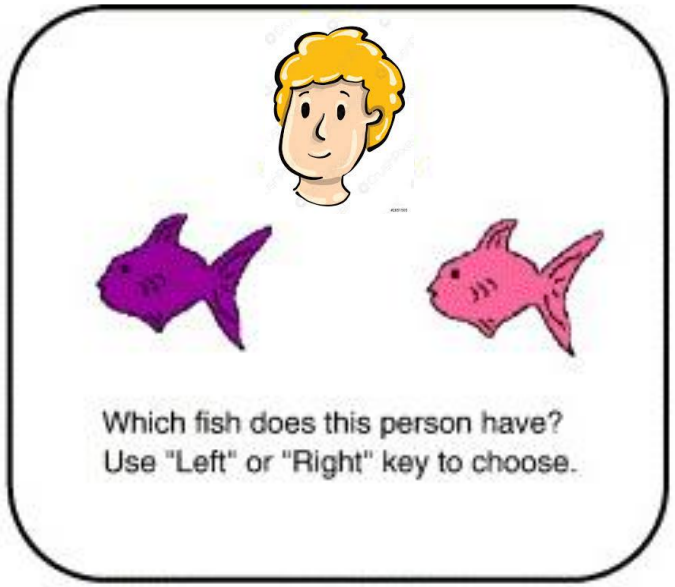
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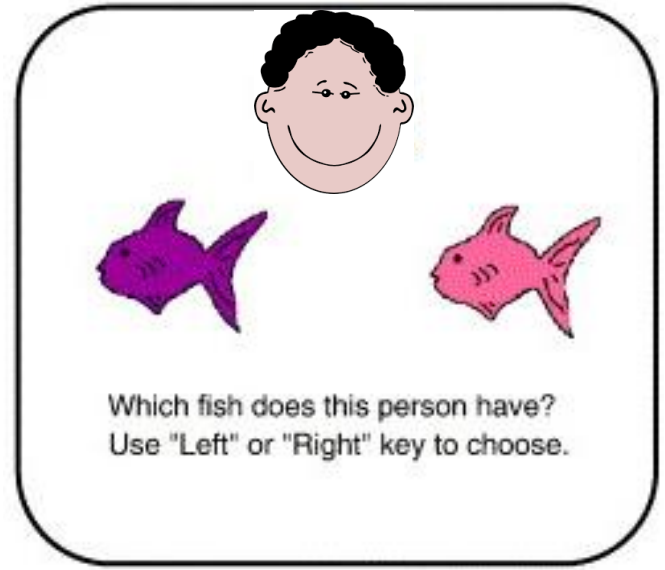
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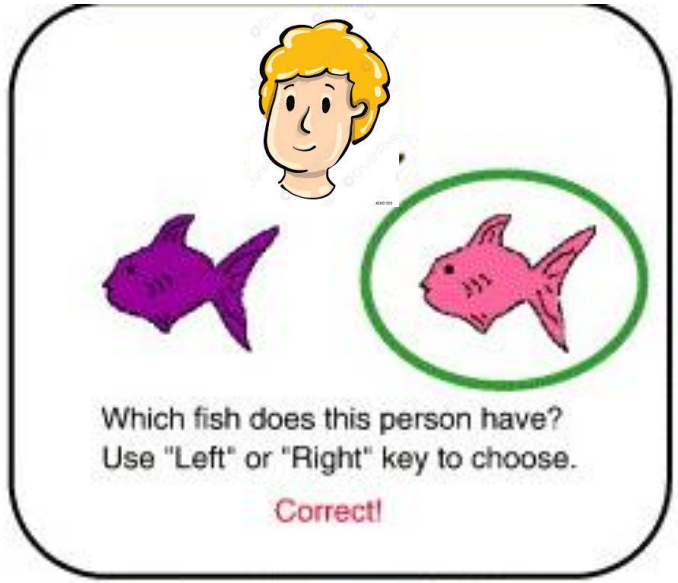
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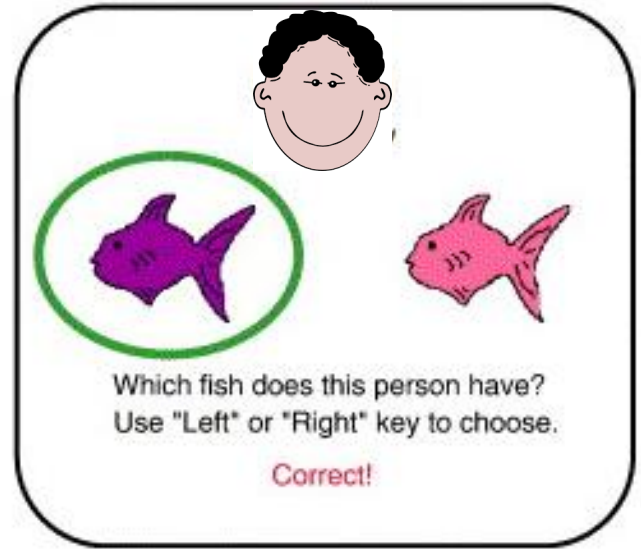
Correct!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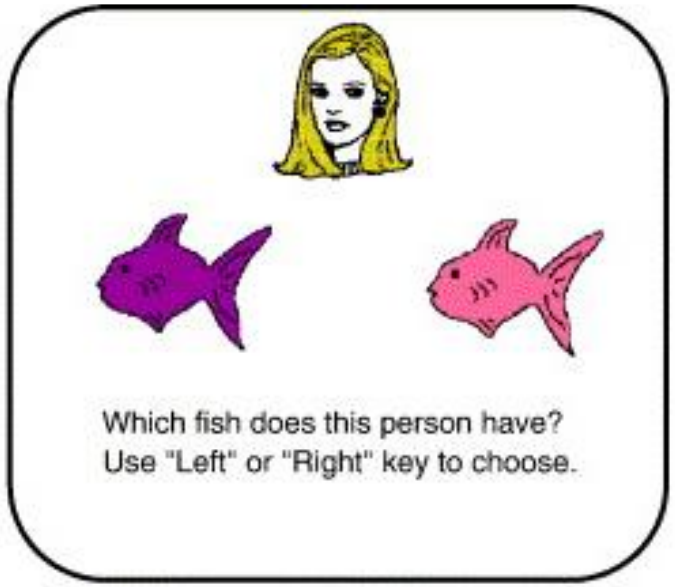
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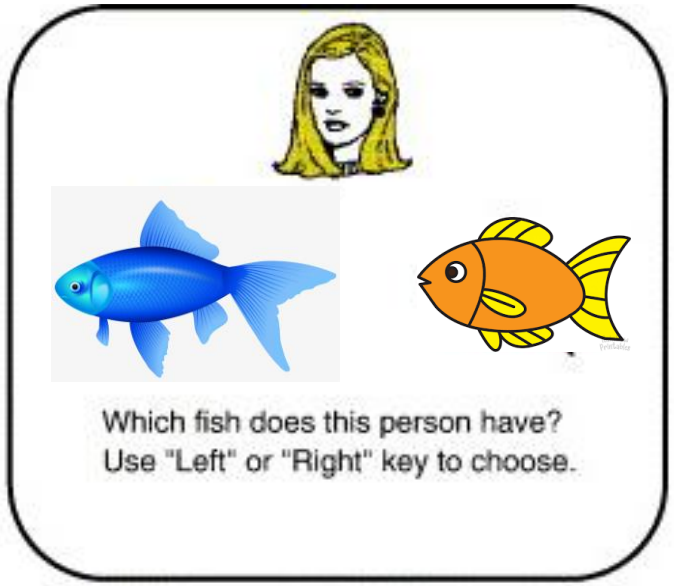
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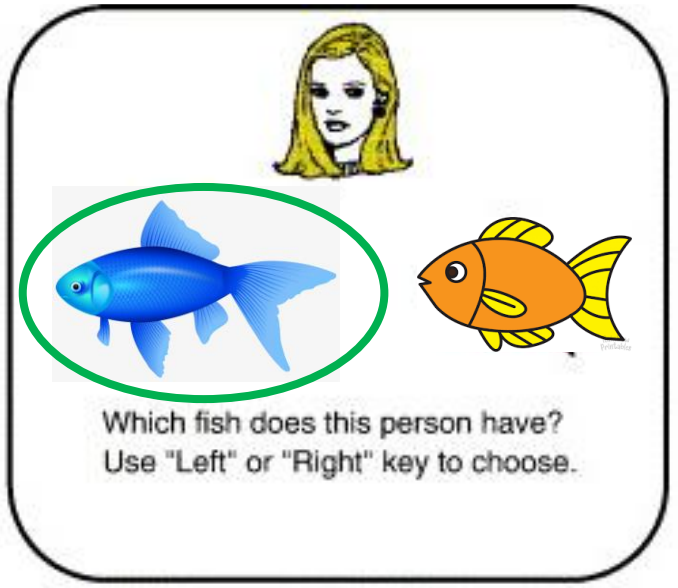
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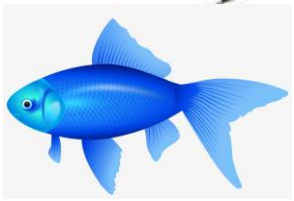

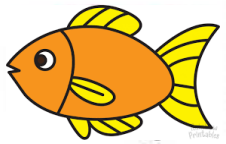

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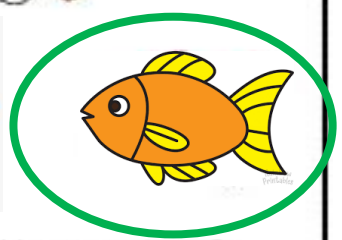

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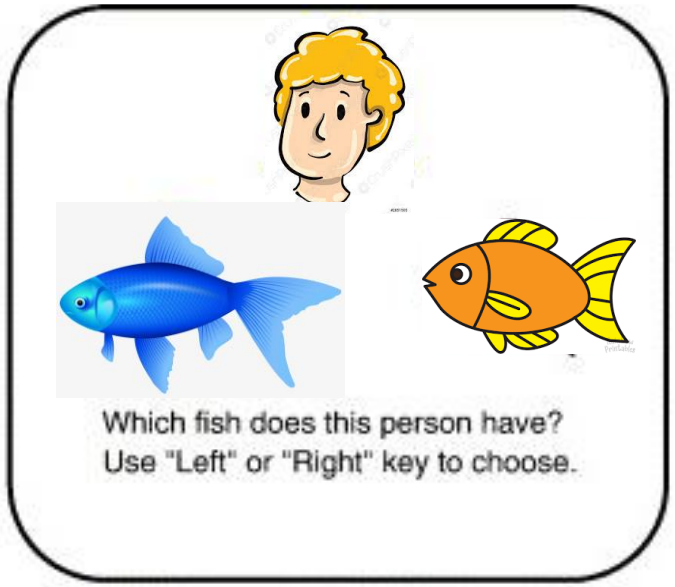
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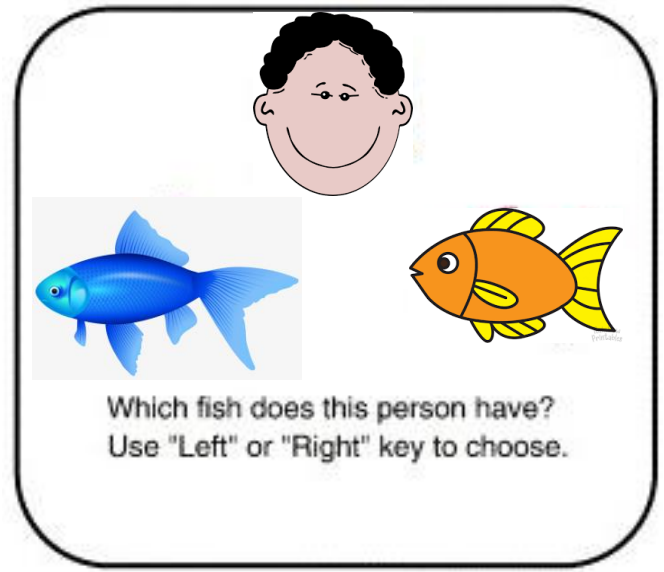

Which fish does this person have?
Use "Left" or "Right" key to choose.

Acquired Equivalence:
Novel Similar Predictions Based on Prior Similar Consequences

- **Acquired equivalence:** it is possible for generalization to occur between two very dissimilar stimuli even if they never co-occur

Phase 1 training	**Phase 2 training**	**Phase 3: test**
A1 →X1→ food A2 →X1→ food	A1→ food	A2: strong pecking response
B1→ Y1→ food B2 →Y1→ food	B1→ no food	B2: no strong response

Generalization of bad behaviour of black people by US police

Gender and Racial stereotyping

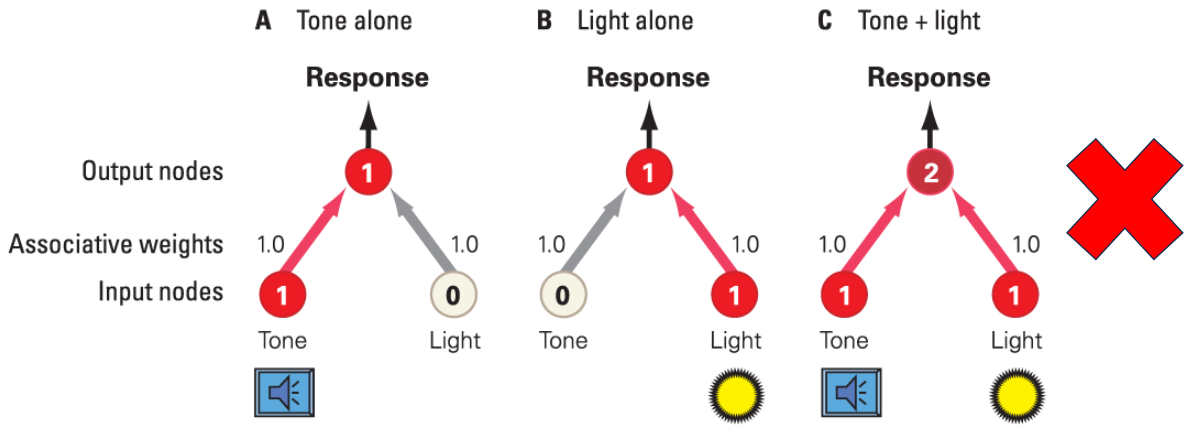
Negative Patterning: When the Whole Means Something Different Than the Parts

Tone ➔ airpuff
Light ➔ airpuff
Tone + light ➔ no airpuff

Headlights Off
Turning Left

Headlights Off
Turning Right

Headlights Off
Hazard Warning



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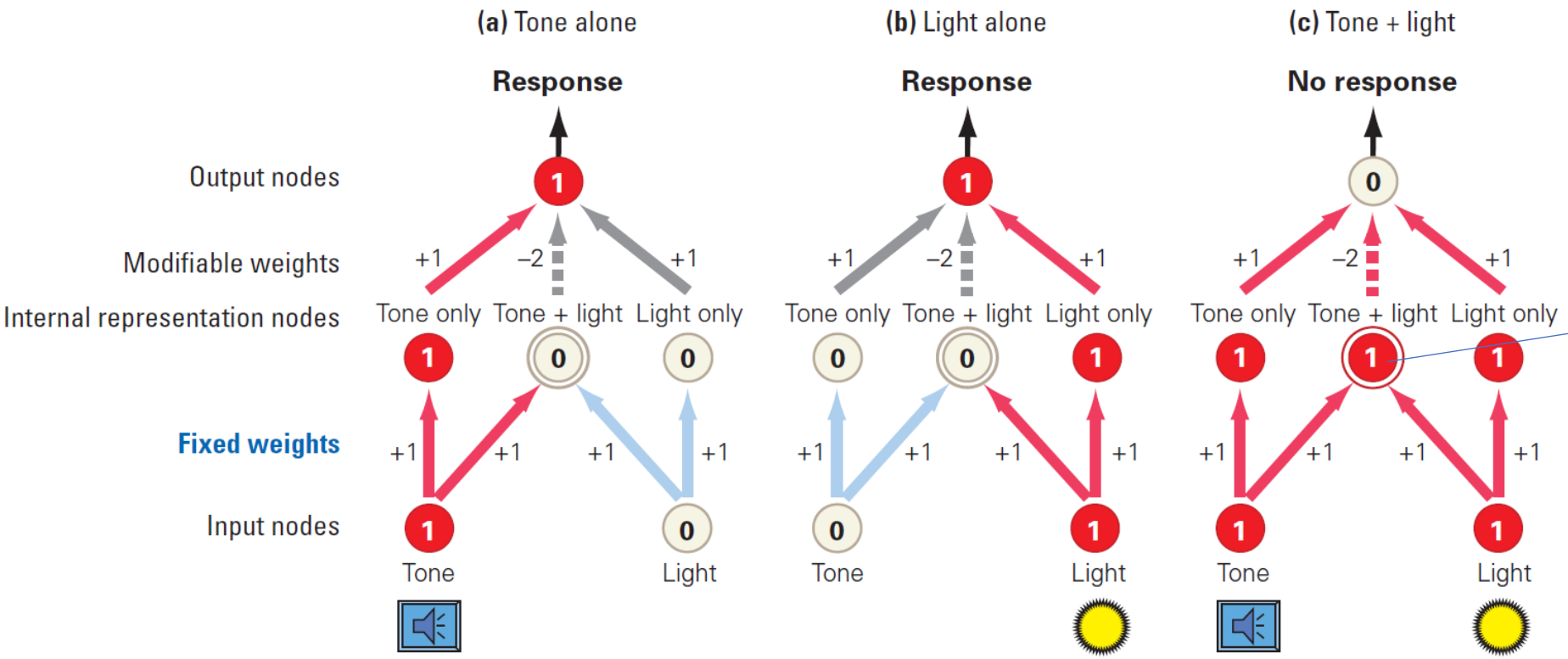
Generalization does not apply

Learned through experience or observation



configural node. Inhibitory neuron is activated

Various behavioral paradigms of generalization

a. discrimination training
b. preconditioning
c. acquired equivalence
d. negative patterning

1. Kareena is quite impressed by men who, on a first date, bring her either gifts or flowers. However, if a man shows up with both, she is turned off, feeling he is coming across too eager.
2. As a child, Karthik learned that people who have deep voices also tend to have beards. He later became convinced that men with beards are strong, and he inferred that a deep voice is also likely a sign of strength.
3. By playing snippets of music by Rahman, then Ilaiyaraja, and then Rahman again, a music teacher is able to teach his class how to recognize the style of each.
4. Two individuals launch a startup which takes off, makes huge profits. One of founders is hired by a competitor and expects the same growth.