

- 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 ?

Why Generalize?

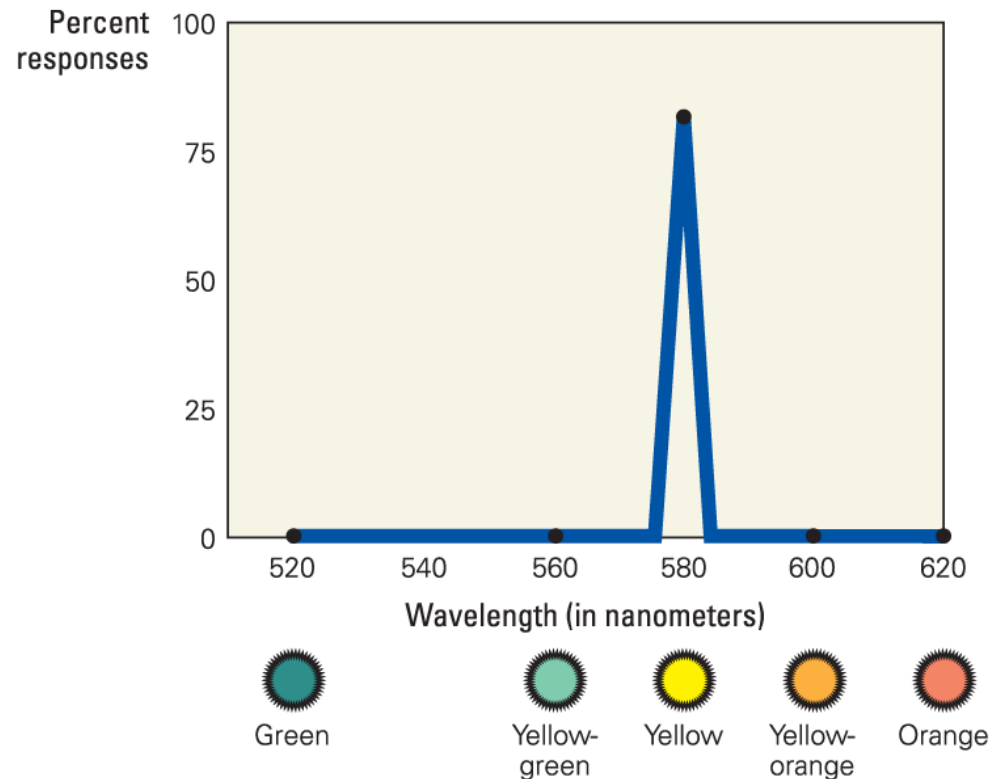
Generalization helps organisms predict future events more accurately by assuming that similar stimuli will have similar outcomes.

This is a survival mechanism because it allows individuals to make quick decisions without needing to learn everything from scratch.

Less Error in Prediction: By generalizing, an organism can make educated guesses about new situations based on past experiences, reducing the likelihood of making mistakes.

Stimulus-Generalization Gradients in Pigeons

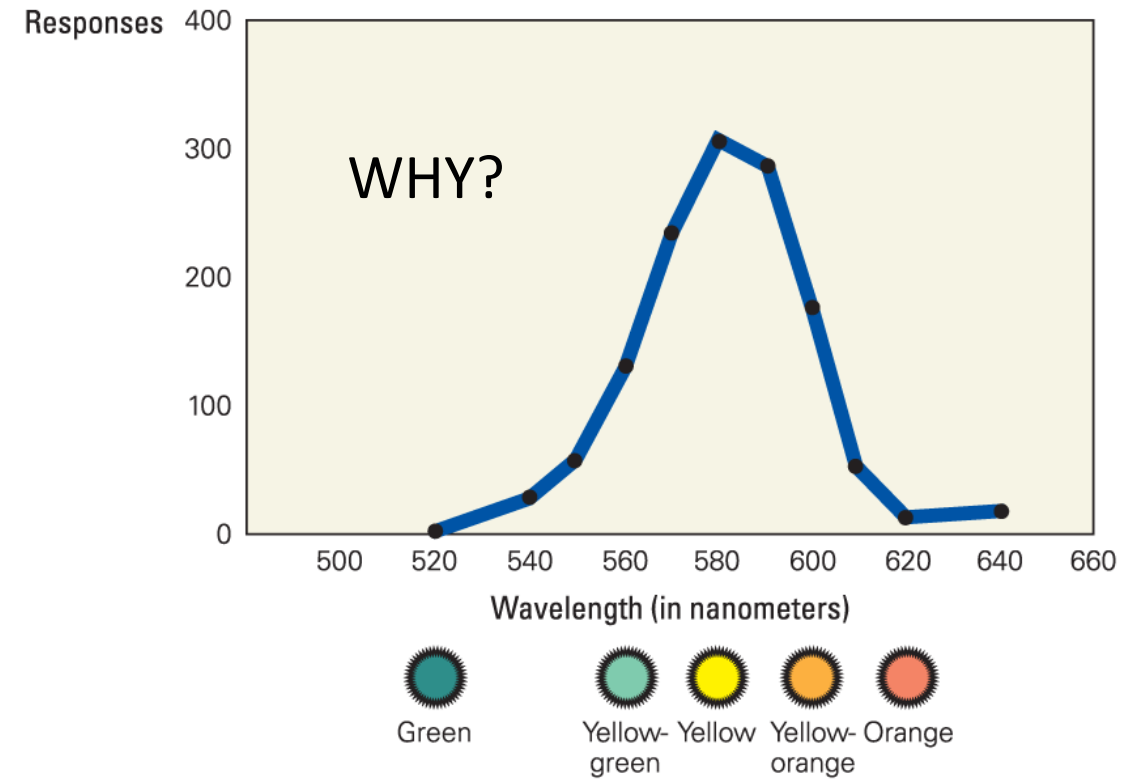
Ideal



Gluck et al., *Learning and Memory*, 4e, © 2020 Worth Publishers

Less error in prediction

Realistic



Gluck et al., *Learning and Memory*, 4e, © 2020 Worth Publishers

Similar stimuli might also be rewarding

Purpose of generalization - estimate probability of future events.

Behavioral Processes

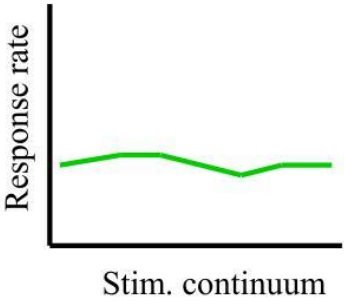
Generalization

transfer of past learning to novel events and problems

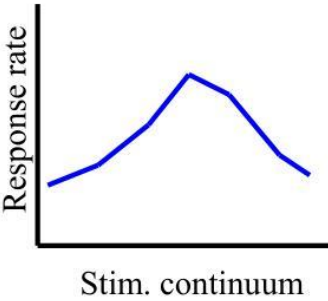
Discrimination

learn to respond differently to different stimuli

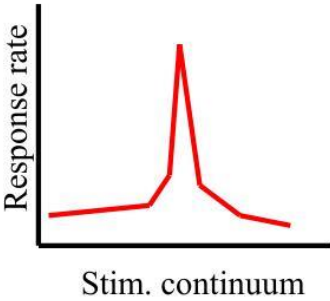
	Same outcome	Different outcomes
Similar stimuli	Similar stimuli → same outcome <i>Broccoli and cauliflower → nasty</i> Moderate Generalization	Similar stimuli → different outcomes <i>Broccoli → nasty</i> <i>Cauliflower → yummy</i> High Discrimination
Dissimilar stimuli	Dissimilar stimuli → same outcome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



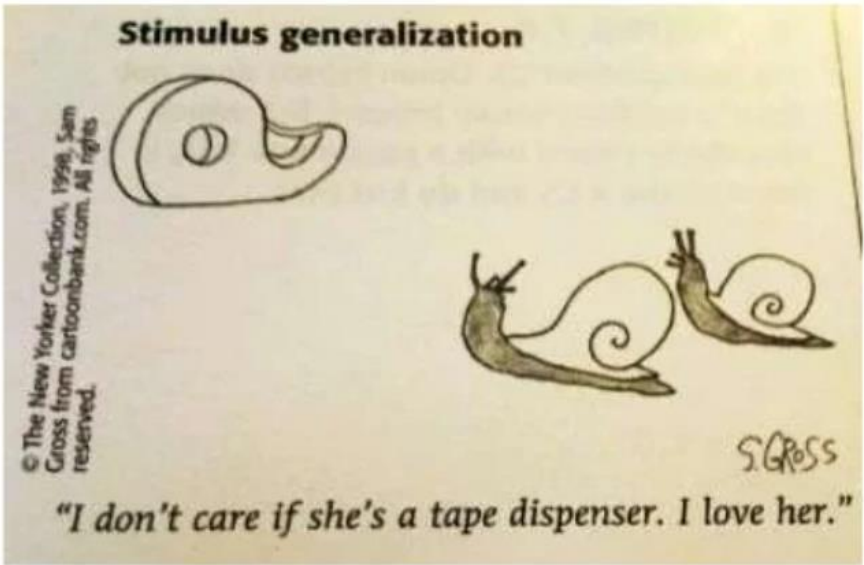
Flat:
No discrimination/
high generalization



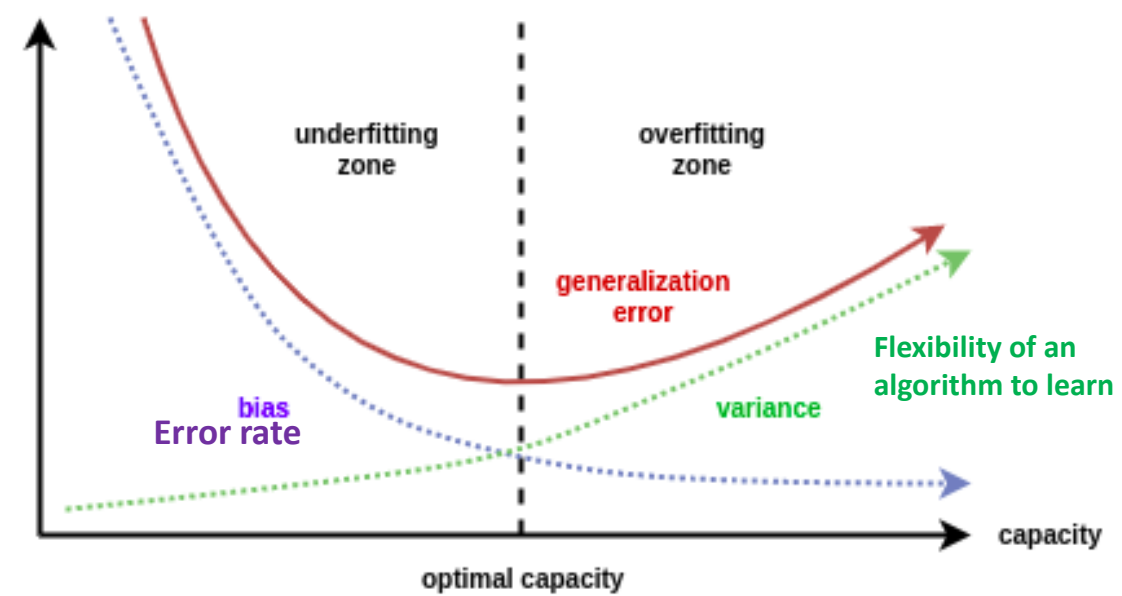
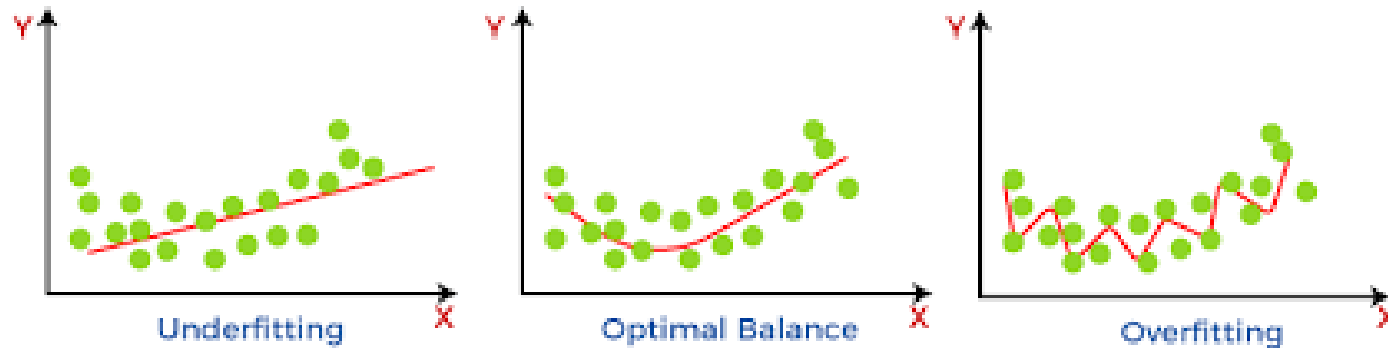
Broad:
Some discrimination/
some generalization



Narrow:
High discrimination/
low generalization



Generalization in machine learning

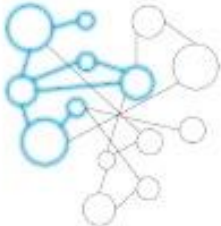


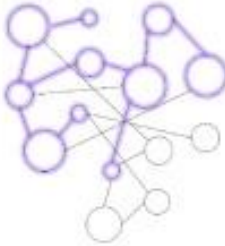


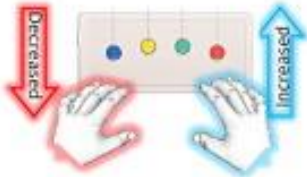
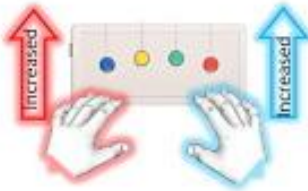


Training Data



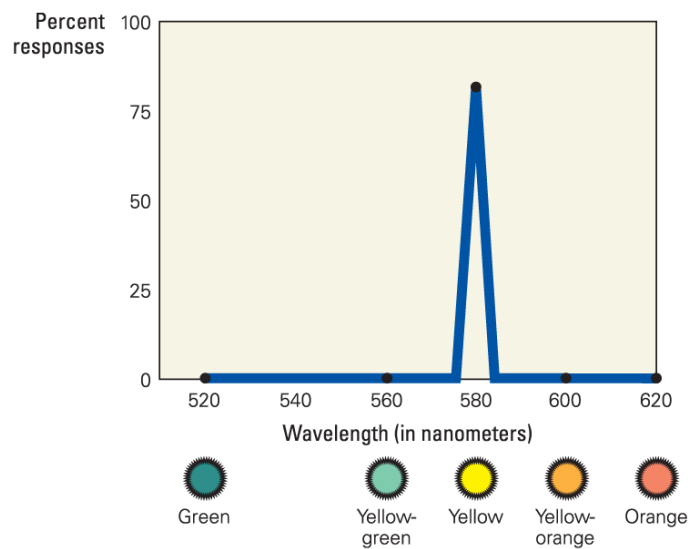
Testing Data

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

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

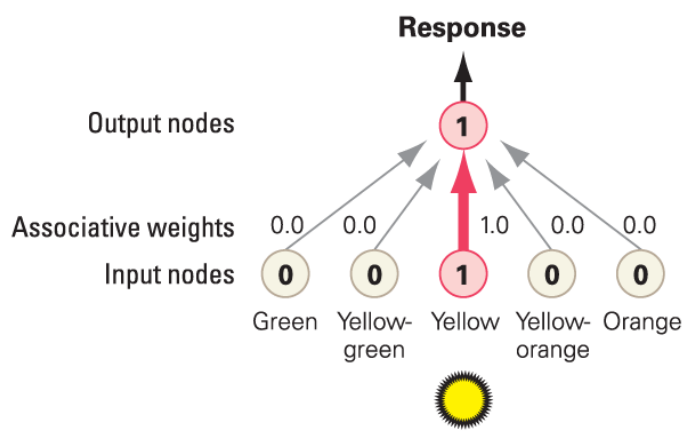
Generalization at the neural and behavioural level

Discrete Response model

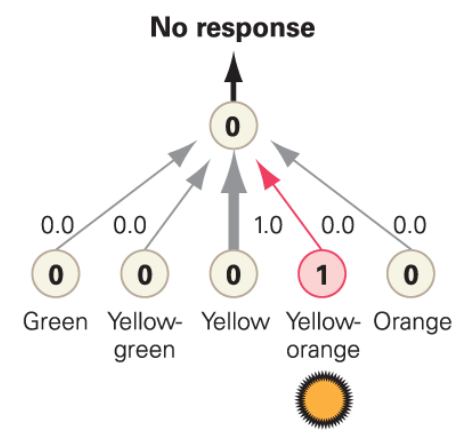


Gluck et al., *Learning and Memory*, 4e, © 2020 Worth Publishers

A Train "yellow"

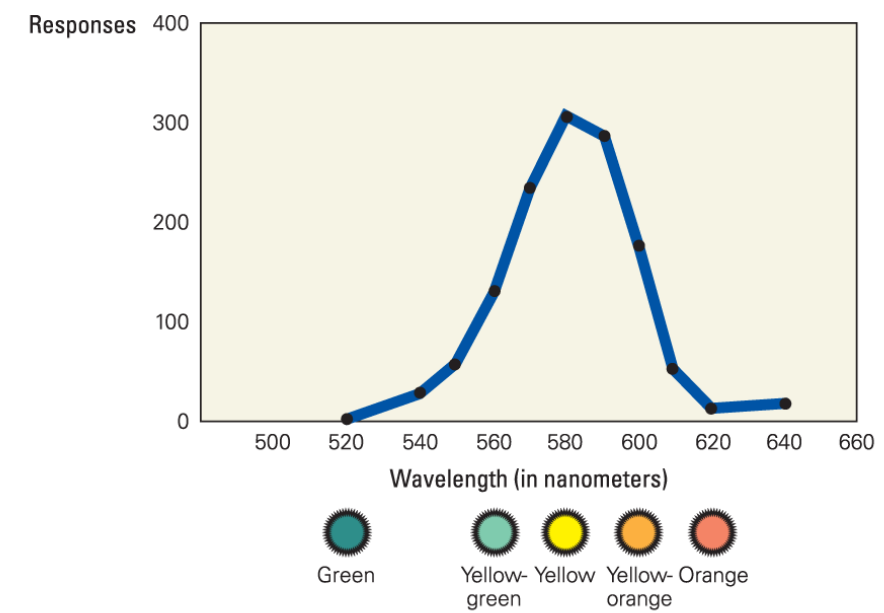


B Test "yellow-orange"



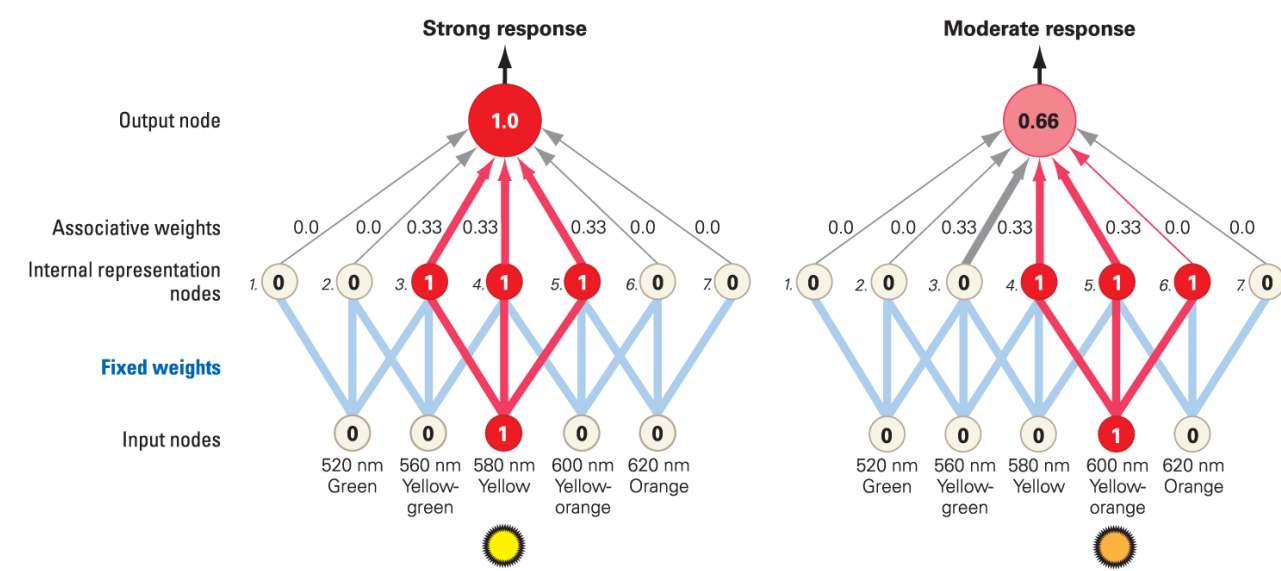
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Distributed Response model

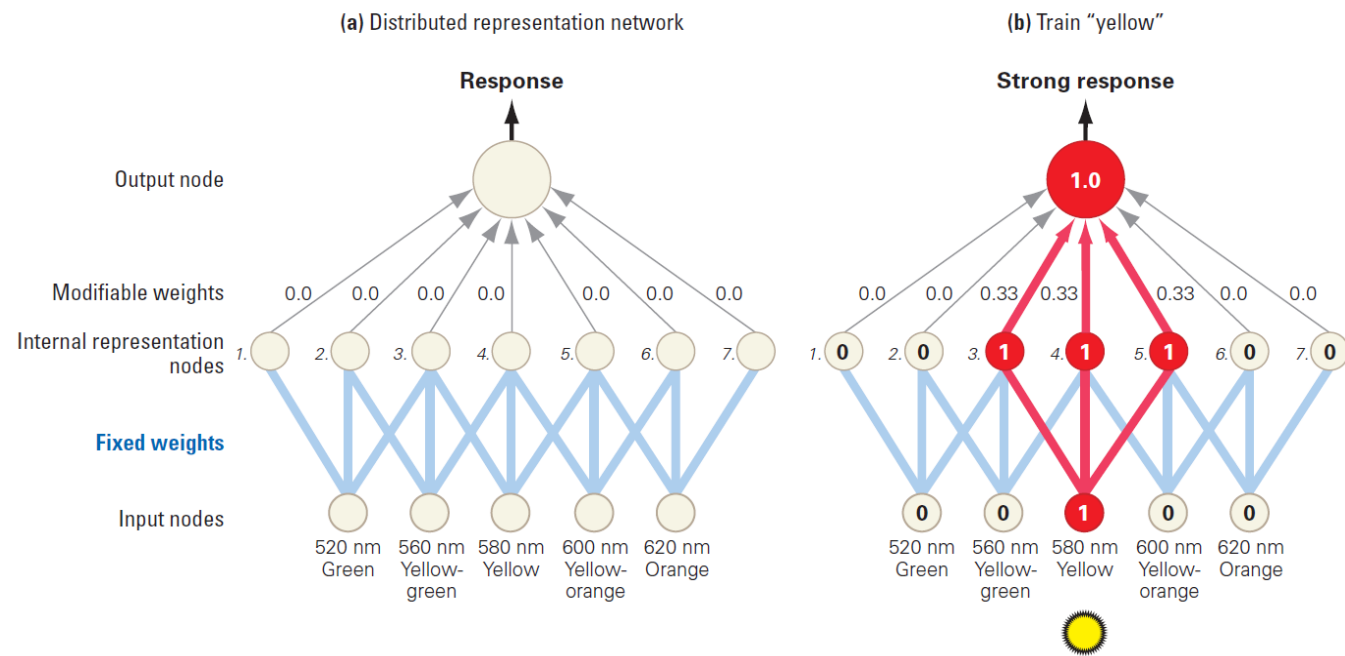


A Train "yellow"

B Test "yellow-orange": some decline in responding



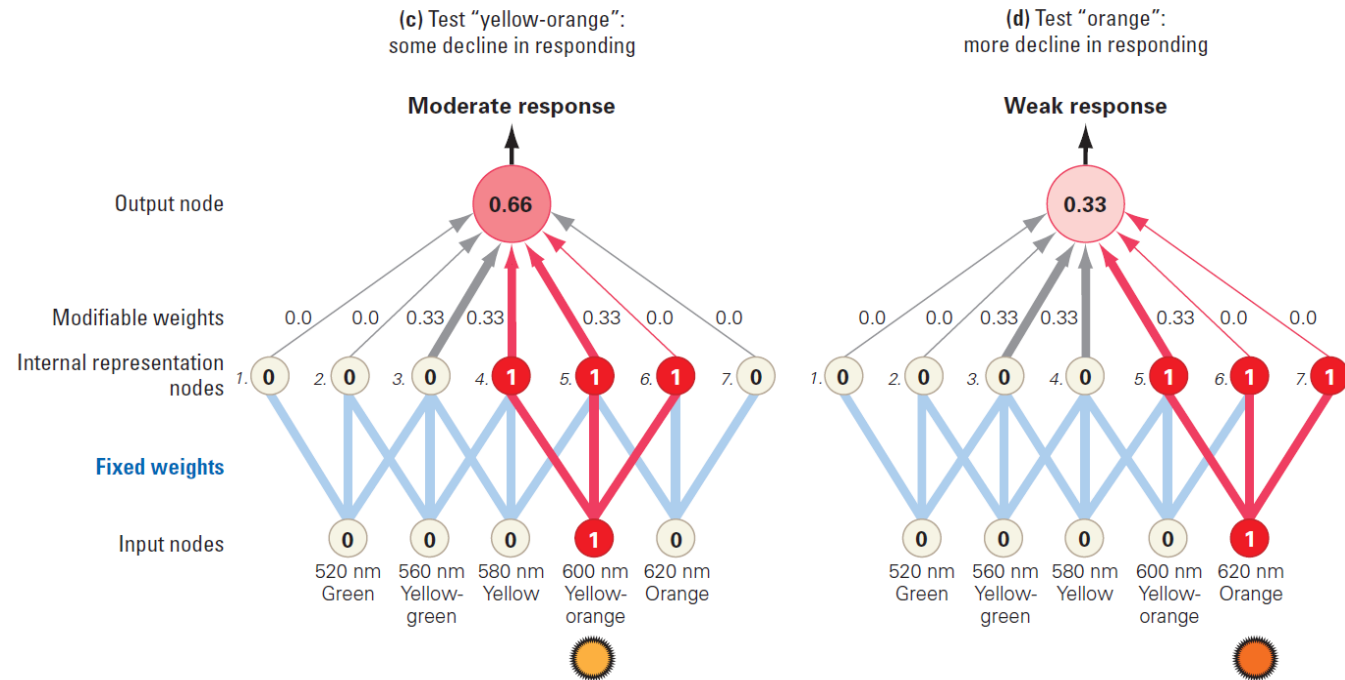
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expect similar stimuli to have similar consequences

Distributed representation

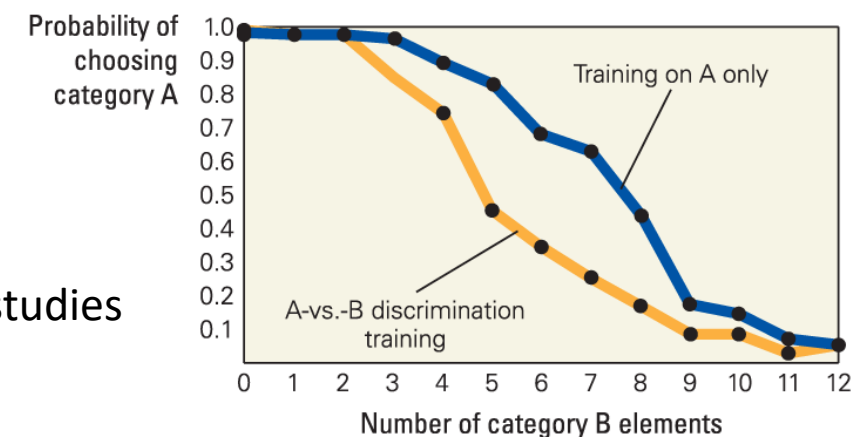
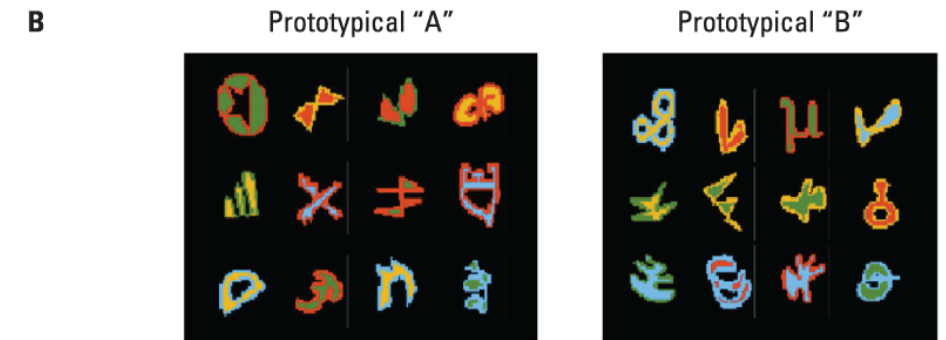
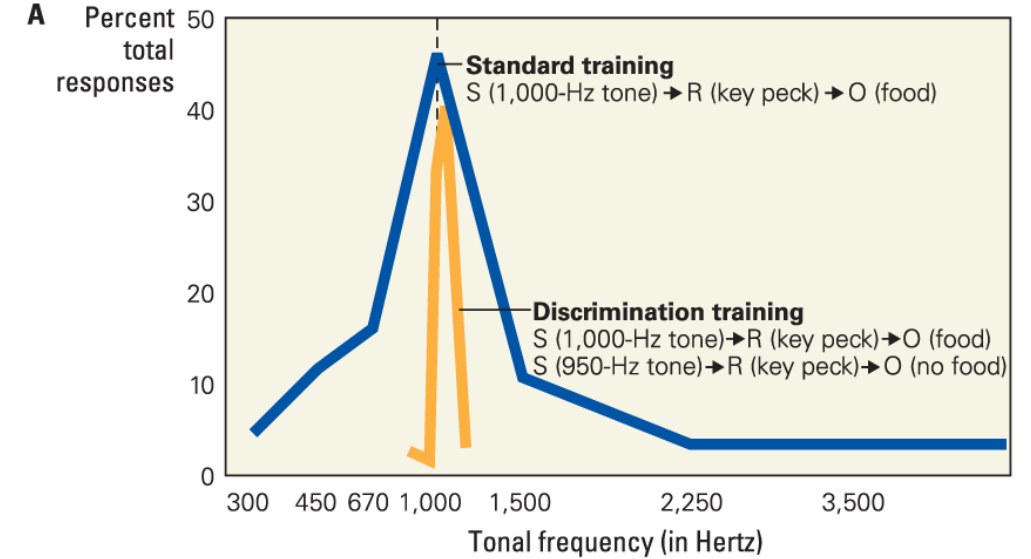
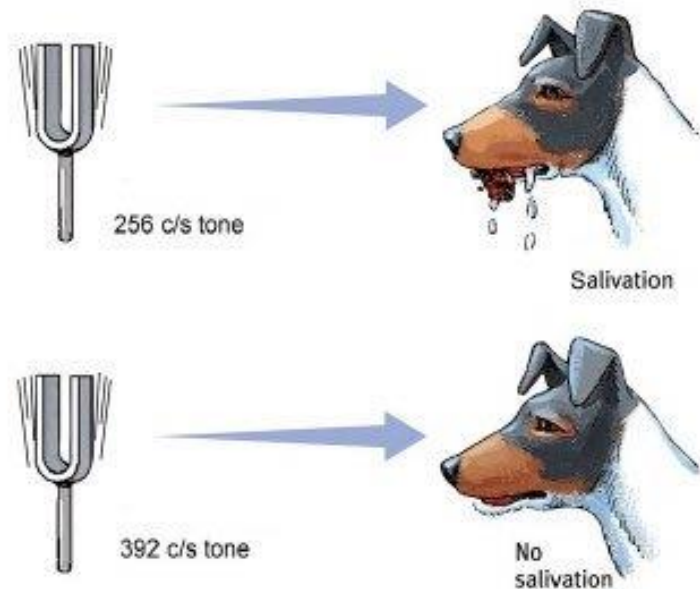
Discrete representation



Generalization or Discrimination?



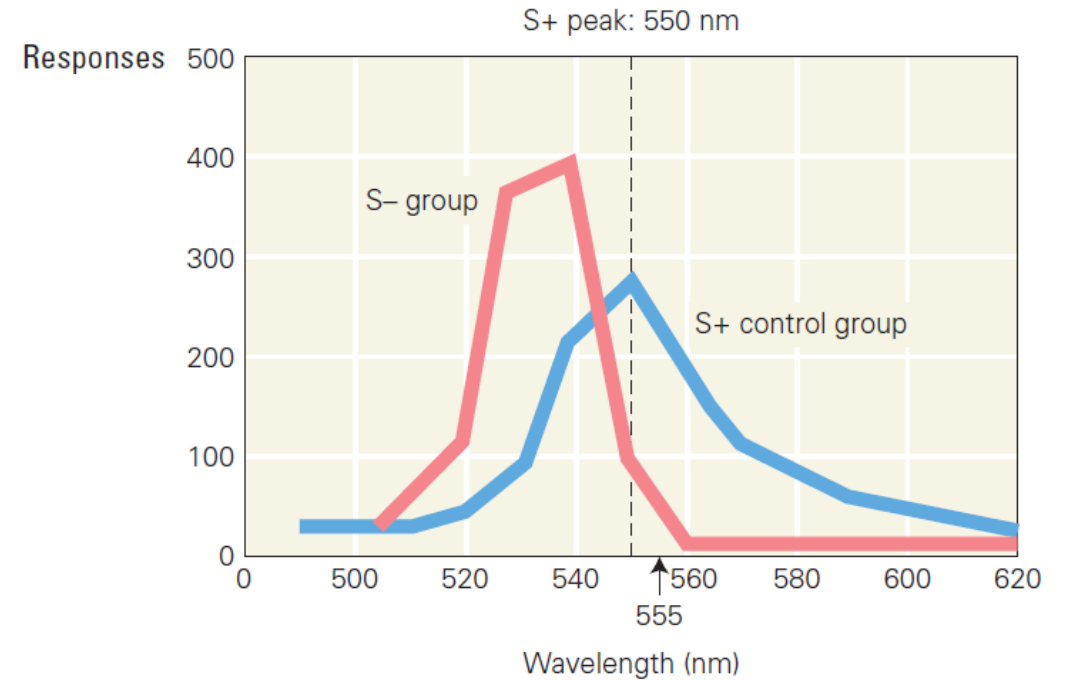
What determines whether two stimuli are to be treated as similar (generalization) or different (discrimination)?



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	<i>Tone + light (together)</i>	Light → airpuff → blink!	Tone →
Separate exposure (control group)	<i>Tone, light (separately)</i>	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 -

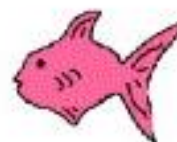


Which fish does this person have?
Use "Left" or "Right" key to choose.



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

Correct!

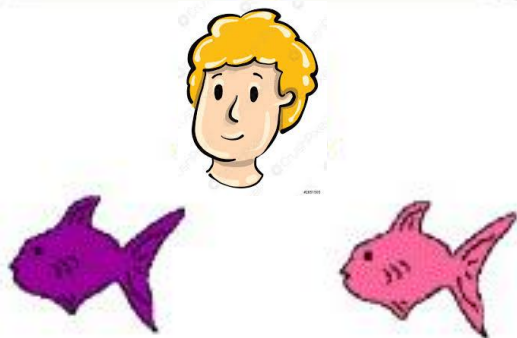


Which fish does this person have?
Use "Left" or "Right" key to choose.

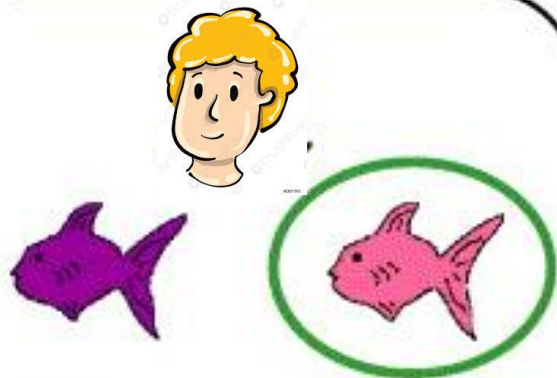


Which fish does this person have?
Use "Left" or "Right" key to choose.

Correct!

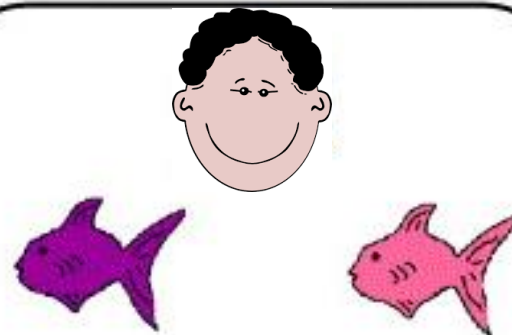


Which fish does this person have?
Use "Left" or "Right" key to choose.

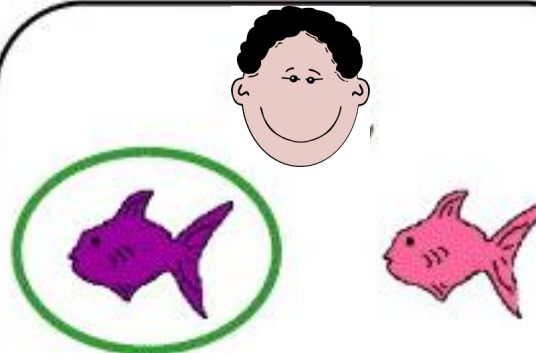


Which fish does this person have?
Use "Left" or "Right" key to choose.

Correct!



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

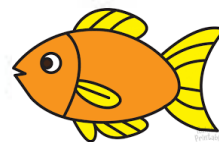
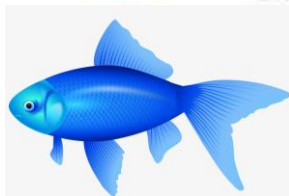


Which fish does this person have?
Use "Left" or "Right" key to choose.

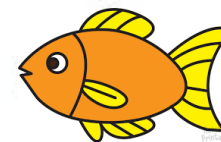
Correct!



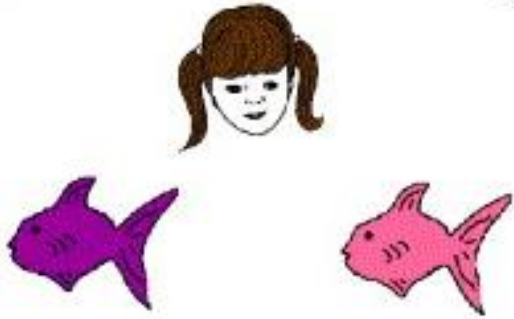
Which fish does this person have?
Use "Left" or "Right" key to choose.



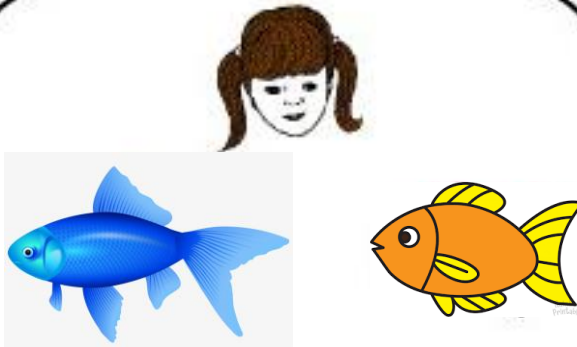
Which fish does this person have?
Use "Left" or "Right" key to choose.



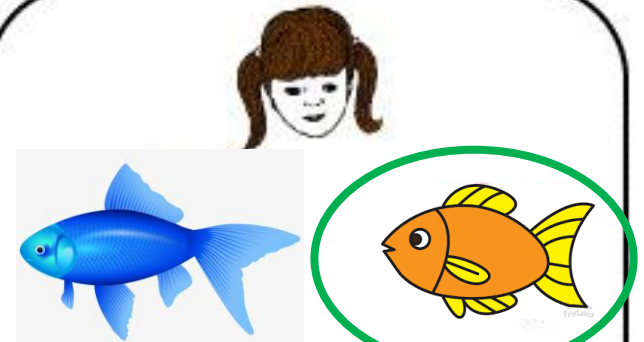
Which fish does this person have?
Use "Left" or "Right" key to choose.



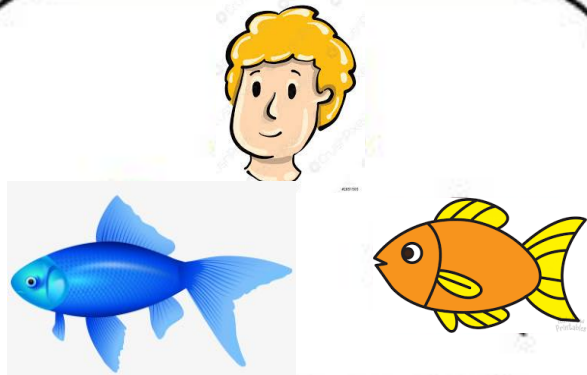
Which fish does this person have?
Use "Left" or "Right" key to choose.



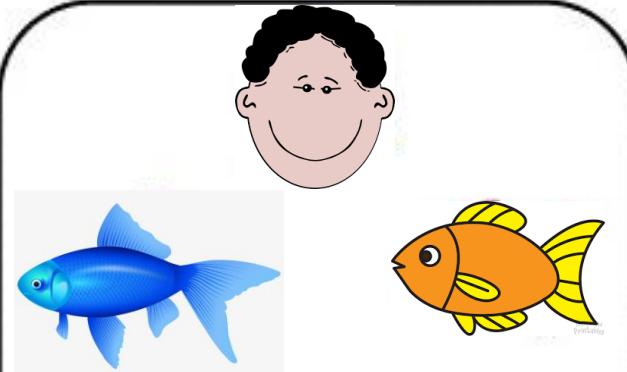
Which fish does this person have?
Use "Left" or "Right" key to choose.



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



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



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



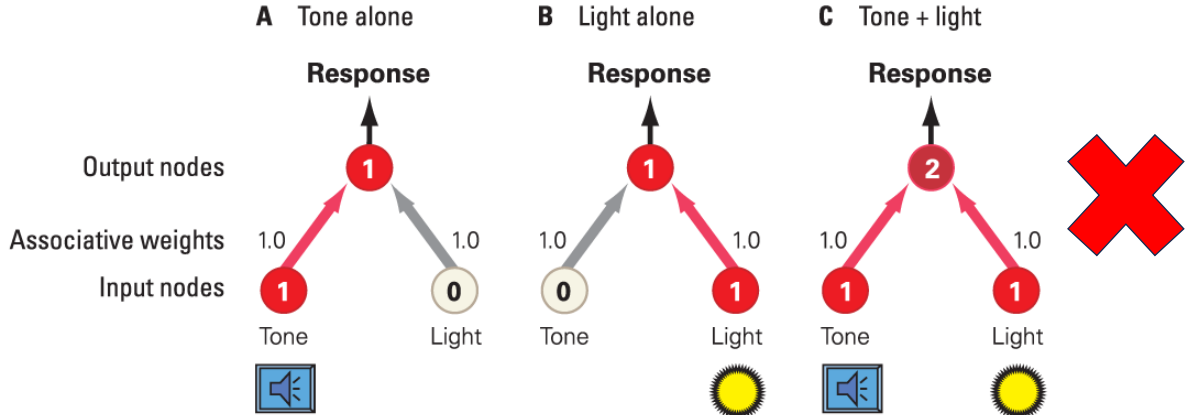
Headlights Off
Turning Left



Headlights Off
Turning Right

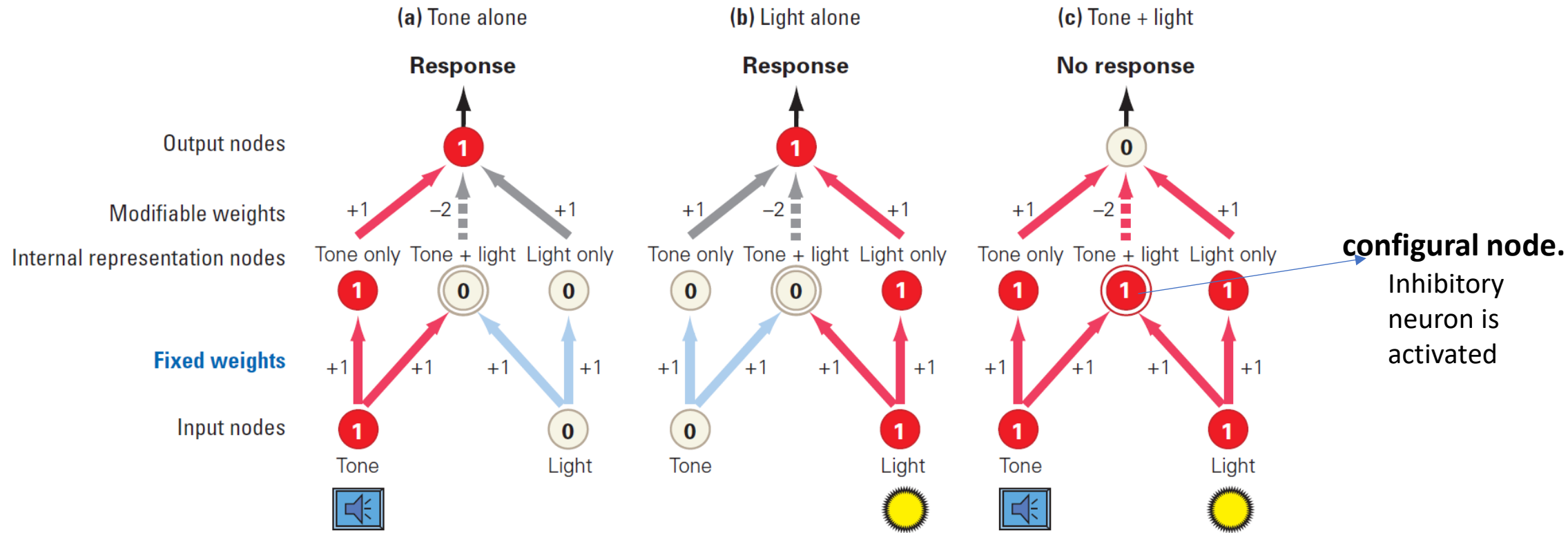


Headlights Off
Hazard Warning



Generalization does not apply

Learned through experience or observation



Various behavioral paradigms of generalization

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

Negative Patterning: Combines stimuli resulting in a different reaction than individual stimuli.

Acquired Equivalence: Creates an association between two different stimuli based on similar outcomes.

Discrimination Training: Teaches the differentiation between stimuli through experience.

Preconditioning: Leads to generalized expectations based on past similar outcomes.

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.