

Learning and Memory (Cognitive core course) - Todd M. Gureckis and Lila Davachi - Midterm Exam

Long Answer Questions (choose 5 of the 10 to answer). Note: the target length for the responses is 1 page. The absolute max is 2 pages. We can't read more than that, so be concise.

Question 1. In our first class lecture, we discussed the challenge of coming up with a satisfactory definition of learning. If you were hired to write an introductory textbook on the topic, how would you go about defining learning behavior? Explain the suitability of your definition by discussing how it excludes non-learning behaviors (getting drunk) but includes things that are more clearly agreed to be examples of learning. Your response should reference the issue raised by the Phattanasri, et al. (2007) paper (i.e., that non-plastic systems can exhibit forms of adaptive learning). Do you believe the system studied by Phattanasari, et al. is "learning" and would it count in your definition of learning? [1000 words max]

Question 2. Lashley (1950) conducted a series of experiment attempting to isolate the "engram" or the pathway between stimulus and response. Despite many attempts, he was forced to conclude that "learning is just not possible." Why do you think that Lashley failed to isolate the "engram"? What parts of his experiments appear consistent with our contemporary understanding of the neural organization of learning and memory and which appear to diverge? Use the specifics of Lashley's methods, the brain regions he investigated, the other readings we have considered so far in class, and what we have learned so far about the neural systems supporting learning to inform your response. [1000 words max]

Question 3. In our discussion about the structure of the nervous system, we discussed a number of simple neural mechanisms that might support learning. These included the processes underlying sensitization and habituation discovered by Kandel and colleagues, long-term potentiation and depression (LTP/LTD), the neural processing underlying classical conditioning in *Aplysia*, as well as the dopaminergic prediction-error response modeled by temporal-difference. Choose two of these processes and explain them in depth. Your response should detail what events are assumed to drive learning, the changes that take place within or between neurons as a result of learning, and the relationship between these changes and observable learning behavior. [1000 words max]

Question 4. The work of Tolman has loomed large in a number of our lectures and readings. In particular, we have discussed two related aspect of his theoretical work. First, he advocated the idea of "latent learning." Second, was his idea of "cognitive maps." Both of these ideas offer a perspective on behavior that sharply diverges from traditional Behaviorist theories of S-R learning. Summarize the major contributions to the field of learning by Tolman. In particular, in your response be sure to define what both "latent learning" and "cognitive maps" are. Explain how such views of behavior diverge from those of Thorndike, Pavlov, and Skinner. Cite specific evidence that supports the "cognitive map" idea (as distinct from simple S-R learning). Your response should draw from both behavioral findings, neuroscientific results, lesion studies, and modern computational theories. [1000 words max]

Question 5. Discuss the four principals of perceptual learning laid out by Goldstone (1998). In each case, give examples of empirical phenomena that are consistent with each mechanism. We discussed perceptual learning in our lecture on "non-associative" learning. However, some mechanisms of perceptual learning are in fact "associative". In your discussion of each example, highlight the degree to which you think the phenomena can meaningfully be described as "non-associative." [1000 words max]

Question 6. The Rescorla-Wagner Model

a. Philosophical ideas about associative learning going back to Aristotle focused on concepts like contingency and contingency. In 2 paragraphs (max) explain how each of these concepts are in turn

insufficient to explain learning in the Pavlovian paradigm, and how the Rescorla-Wagner model defines the primary “driver” of learning.

- b. Explain why the reward predictions learned by the Rescorla-Wagner model will converge to the same values regardless of the learning rate (i.e., the learning curve will have the same asymptote). What is the effect of the learning rate on the learning curve?
- c. Explain why the “learning rate” (η) in R-W can also be thought of as a “forgetting rate”
- d. How does R-W explain blocking?
- e. Imagine an experiment where animals were conditioned with three types of trials (randomly interleaved):

CS1 → US
CS2 → US
CS1+CS2 → no US

After conditioning, animals show a CR to each stimulus presented separately, but not to the simultaneous presentation of both CS1+CS2. Can the Rescorla-Wagner theory explain this pattern? If no, why not? Also, if your answer is no, how might you extend the Rescorla-Wagner model to account for this pattern?

Question 7: The temporal-difference learning model explains a number of phenomena not addressed by the Rescorla-Wagner theory. Describe the motivation for the temporal-difference equation from both the empirical and computational perspective. In other words, what behavioral data does the temporal difference learning equation account for that Rescorla-Wagner does not? Computationally, what is the goal of TD (as distinct from RW)? What, ultimately, are the crucial differences between TD and RW? In your answer explain how the specific firing pattern of dopamine neurons conforms to the predictions of the TD model. Finally, what are the limitations of the TD model, what does it likely get wrong? Be sure to explain why the TD model predicts a spike in neural firing on the presentation of the CS after extensive training. [1000 words max]

Question 8: As noted extensively in lecture, the Rescorla-Wagner theory essentially assumes that learning results in changes in US effectiveness. Alternative theories (such as Pearce-Hall model) assume that learning results in changes in CS effectiveness. Explain what this distinction means. Furthermore, explain the limitations of Rescorla-Wagner that motivate this alternative conception of learning. Finally, explain how alternative theories (such as Pearce-Hall) address these limitation in the R-W theory. In your response, discuss modern theories of CS modulation including the ideas described in the Dayan, Kakade, & Montague (2000) paper. [1000 words max]

Question 9: A number of modern theories of classical and instrumental condition have adopted a “latent” cause approach. What does the “latent cause” approach offer that is missing from more traditional models such as T-D? What do these approaches get wrong? Discuss the relationship of latent cause models and Tolman’s idea of a “cognitive map”. Describe three empirical studies and how they support the specific latent cause models we considered (in particular either the Courville, et al. paper for the Gershman, et al. paper). [1000 words max]

Question 10: A central theme in all of our readings this semester has been that learning is not a unitary processes but is supported by multiple brain systems. Review the empirical support for this idea using two examples taken from our readings. In other words, choose two learning phenomena and argue why they supports a “multiple learning systems” view of the brain. Where appropriate use both neural data

(e.g., lesion studies, imaging results) as well as behavioral findings to make the point that different forms of learning are indeed dissociable. [1000 words max]

Multiple Choice/Short Answer

Please use the Excel file posted on the class webpage to get the link:

1. The conditional stimulus is an event that
 - a. naturally elicits a reliable and measurable response.
 - b. eventually elicits a reliable and measurable response after enough pairings.
 - c. initially elicits its own response but with enough pairings can elicit other responses as well.
 - d. will elicit a reliable and measurable response but only if it has first been preexposed to the subject.

Questions 2-7 refer to the following: While you are stopped at a traffic light and listening to a new song on the radio, the driver behind you accidentally hits your car. You suffer mild whiplash, minor bruising, and are terribly frightened by the accident. Weeks later, you still get anxious whenever you hear the song that was on the radio at the time of the accident.

2. From a classical conditioning perspective, the car that hit you would be classified as the
 - a. unconditional stimulus.
 - b. unconditional response.
 - c. conditional stimulus.
 - d. conditional response.
3. The pain and fear you experienced from the collision would be classified as the
 - a. unconditional stimulus.
 - b. unconditional response.
 - c. conditional stimulus.
 - d. conditional response.
4. The song playing on the radio at the time of the accident would be classified as the
 - a. unconditional stimulus.
 - b. unconditional response.
 - c. conditional stimulus.
 - d. conditional response.
5. The fear you now experience whenever you hear the song that was playing at the time of the accident would be classified as the
 - a. unconditional stimulus.
 - b. unconditional response.
 - c. conditional stimulus.
 - d. conditional response.
6. You are in an elevator and an instrumental version of the song you heard on the radio during the car accident is playing while you ride to the tenth floor. Although you are not afraid of small spaces, heights or elevators, you become increasingly anxious during the elevator ride. As another song begins to play you relax and realize that your anxiety in the elevator was likely a case of
 - a. spontaneous recovery.
 - b. acquisition.
 - c. generalization.
 - d. habituation.

7. One explanation of what is learned in classical conditioning studies is that the subject forms an association between the song and the fear generated by the accident, illustrating the phenomenon of _____ learning.
- S-R
 - S-S
 - R-S
 - R-R

Questions 8-9 refer to the following: Clicker training, which involves pairing a metallic clicking sound with a food treat, is currently a popular method for training zoo animals and pets. Initially the click is meaningless, but as the number of click–food treat pairings increases, the animal (e.g., a dog) appears to develop an expectation that a click signals a food treat. Thus the dog approaches, looks at the handler, and appears excited (e.g., wagging tail, drooling, etc.).

8. One explanation of —what is learned in classical conditioning studies is that the subject forms an association between the clicker and excitement, drooling, and attention, illustrating the phenomenon of _____ learning.
- R-S
 - R-R
 - S-R
 - S-S

9. One explanation of what is learned in classical conditioning studies is that the subject forms an association between the clicker and the food treat, illustrating the phenomenon of _____ learning.
- R-S
 - R-R
 - S-R
 - S-S

10. You are watching TV when a commercial comes on for an easy-bake brownie mix. The commercial shows a young woman mixing the ingredients in a bowl, stirring in the dark, thick chocolate fudge, and placing the batter in the microwave oven. Seconds later, the brownies are removed from the microwave with steam rising and the chocolate fudge bubbling. A brownie is cut and placed on a plate as the fudge flows around it. Because of your previous experiences with freshly baked desserts, your tendency to salivate and feel cravings for brownies after watching the commercial would be characterized as an example of
- spontaneous recovery.
 - acquisition.
 - generalization.
 - habituation.

11. Generalization is a process by which subjects respond
- in a similar fashion to similar stimuli.
 - differently to stimuli that differ.
 - initially, but then quickly stop responding.
 - initially with a standard response, and then increase the response vigor.
12. At the start of classical conditioning, the conditional stimulus typically elicits
- a reliable and measurable response.
 - an orienting response.
 - no response of any type.
 - an exaggerated response that with training becomes a smaller version of the UR.

13. Although current research indicates that a variety of associations can be formed in classical conditioning procedures, the most usual association is an _____ association.

- a. S-R
- b. R-S
- c. S-S
- d. R-R

14. For one week, a 15-second cartoon keeps appearing on TV showing an animated purple frog hopping and dancing around to some unfamiliar zyedeco music. The frog and music capture your attention, but you cannot figure out why the segment is being shown. The next week, you see a new commercial showing people eating and partying at a New Orleans-style restaurant with wait staff wearing the same purple frog on their shirts. A voiceover gives the name of the new restaurant—The Purple Frog—and describes specialties on the menu. You decide to try the new restaurant for yourself. Later that week, you are in the car when the zyedeco music from the first week's cartoon plays on the radio. You immediately turn to your friend and say —Hey, that's an ad for the Purple Frog Restaurant, let's go there for lunch. Although the zyedeco music was not actually played either in the commercial or at the restaurant itself, you assume that you are hearing a commercial for the restaurant because of the classical conditioning process of

- a. stimulus generalization.
- b. higher-order conditioning.
- c. sensory preconditioning.
- d. conditioned emotional responding.

15. Cents-off manufacturers' coupons for brand-name products (e.g., ice cream) regularly appear in the newspaper. If you use the coupon to purchase the particular brand or flavor of ice cream, eat the ice cream, and find it exceptionally tasty, you will develop a preference for that brand and flavor. In the future, when you see cents-off coupons for that brand or flavor of ice cream you remember the delicious taste, despite the fact that the eating of the ice cream has never been paired with the cents-off coupon. Your response is due to the classical conditioning process of

- a. sensory preconditioning.
- b. stimulus generalization.
- c. second-order conditioning.
- d. conditioned emotional responding.

16. Which of the following classical conditioning phenomena is thought of as illustrating a case of purely S-S learning because the CS that elicits a response is never paired with a US?

- a. Stimulus generalization
- b. Second-order conditioning
- c. Sensory preconditioning
- d. Conditioned emotional responding

17. Businesses typically have distinct logos that serve as their signature or trademark for the kind and quality of product or service they deliver. While driving on the interstate, you often see large road signs displaying groupings of logos for specific vendors of gasoline, lodging, and food. Your reaction to these road signs (e.g., with relief, disappointment, fatigue, hunger, etc.) that have been paired with logos of businesses you know and have had experience with nicely illustrates the classical conditioning phenomenon of

- a. stimulus generalization.
- b. higher order conditioning.
- c. sensory preconditioning.
- d. conditioned emotional responding.

18. A researcher studying rats uses a tone to signal that food is available in the food magazine. After a number of tone-food pairings, the researcher pairs an illuminated light with just the tone. The rat paws,

licks, and chews on the illuminated light when the tone is sounded, even though no food is provided in this training stage. This conditioning procedure illustrates the phenomenon of

- a. sensory preconditioning.
- b. conditioned emotional responding.
- c. stimulus generalization.
- d. higher order conditioning.

19. Using cats, a researcher presents a tone to signal that foot shock will occur. After a number of tone-foot shock pairings, the researcher now pairs a flashing light with just the tone. To test if higher order conditioning has occurred, the researcher would present only the _____ and expect it to produce fear and a withdrawal response.

- a. tone
- b. flashing light
- c. flashing light-tone combination
- d. flashing light-foot shock combination

20. Which of the following features of standard eyeblink conditioning in rabbits does *not* contribute to the general appeal of this conditioning preparation to researchers?

- a. The eyeblink is a much simpler type of response than the one found in most other conditioning preparations.
- b. Researchers have extensive knowledge regarding the variables that affect eyeblink in rabbits.
- c. Eyeblink can be used to study the neural basis of conditioning and learning.
- d. Researchers can use pleasant or aversive USs to elicit the eyeblink.

21. In the standard eyeblink conditioning preparation in rabbits, the eyeblink is the

- a. CS.
- b. US.
- c. UR.
- d. CR.
- e. UR and the CR.

22. At her family's annual reunion Traci eats pickled pigs' feet, fried chicken, potato salad, and baked beans for lunch. For dinner she eats a hamburger, two hot dogs, salad, deviled eggs, corn on the cob, coleslaw, chocolate cake, and homemade ice cream. In the middle of the night she awakens with a stomach ache and attributes it to the pickled pigs' feet. Traci's development of a taste aversion to pickled pigs' feet is based on a real-life version of the _____ pairing procedure.

- a. trace
- b. backward
- c. delay
- d. simultaneous

23. You are talking on your cell phone while driving your younger sister to soccer practice. Because you are distracted, you do not notice that the driver in front of you is slowing down to make a right turn. Just as your younger sister screams —Look out!!! you hit the car in front of you. Despite the fact that your sister's warning does not prevent the collision, you react quickly the next time someone yells —Look out!!! This example represents _____ conditioning.

- a. trace
- b. backward
- c. delay
- d. simultaneous

24. In general, the most effective procedure for producing most classically conditioned associations is the _____ conditioning procedure.

- a. trace

- b. backward
 - c. delay
 - d. simultaneous
25. Which of the following does *not* facilitate the formation of a classically conditioned association?
- a. Novel CS or US
 - b. Intense CS or US
 - c. Relatively short interval between the CS and US
 - d. Massed-trials training procedure
26. The time period between different CS-US pairings is referred to as the
- a. training session.
 - b. intertrial interval.
 - c. interstimulus interval.
 - d. trace interval.
27. Preexposing a CS _____ to the CS.
- a. has no effect on the subject's tendency to pay attention
 - b. increases the subject's tendency to pay attention
 - c. decreases the subject's tendency to pay attention
 - d. creates a strong inhibitory response
28. Preexposure has
- a. a negative effect just on CS salience.
 - b. a negative effect just on US salience.
 - c. no effect on CS or US salience.
 - d. negative effects on both CS and US salience.
29. Preexposure of a CS or US typically
- a. produces interference.
 - b. produces inhibition.
 - c. produces excitation.
 - d. has no effect on conditioning.
30. CS-only and US-only control groups are often run as part of a classical conditioning experiment to demonstrate
- a. the effects of spaced versus massed trial training procedures.
 - b. the effects of CS or US preexposure.
 - c. the difference between true classical conditioning, pseudoconditioning, and sensitization.
 - d. All of the above
31. Conditioned inhibition is the opposite of
- a. conditioned excitation.
 - b. pseudoconditioning.
 - c. latent inhibition.
 - d. sensitization.
32. In the summation test for conditioned inhibition, the researcher pairs a presumed conditioned inhibitor with _____ and then measures the amount of _____.
- a. a known conditioned inhibitor; inhibition
 - b. a novel stimulus; inhibition
 - c. a known conditioned excitor; inhibition
 - d. an operant response; suppression

33. When researchers pair two conditioned excitors or two conditioned inhibitors, they typically observe
- a. double the amount of excitation or inhibition, respectively.
 - b. half the amount of excitation or inhibition, respectively.
 - c. a somewhat greater amount of excitation or inhibition than either stimulus produces individually.
 - d. an exponential increase in excitation or inhibition, due to the compound's novelty.
 - e. a dramatic reduction in the amount of excitation or inhibition, due to the compound's novelty.