Chapter 2: Signal Detection and Absolute Judgement

Multiple Choice Questions

Correct answers are indicated by *

1. What is the difference between a signal detection and identification (absolute judgement) task?

a. signal detection typically involves several stimulus states or categories, identification requires only two
b. there is no difference—the two terms are synonyms
* c. identification typically involves several stimulus states or categories, signal detection requires only two
d. signal detection occurs at a later processing stage than identification

2. When is signal detection theory (SDT) applicable?

* a. when there are two discrete states of the world that cannot easily be discriminated
b. when two discrete states of the world are easily discriminated
c. when there are several discrete states of the world
d. when a signal is presented and the user assigns a score to its magnitude

3. Which of the following is not one of the classes of joint events in signal detection theory (SDT)?

a. hit
b. false alarm
* c. false miss
d. correct rejection

4. A false alarm refers to:

a. when a signal is presented and the observer calls it a signal
b. when no signal is presented and the observer calls it “no signal”
c. when a signal is presented and the observer calls it “no signal”
* d. when no signal is presented and the observer calls it a signal

5. If 20 signal trials and 10 noise trials were presented and there were 2 hits and 18 misses, which of the following is the correct hit rate?

* a. 2/20 = .1
b. 18/20 = .9
c. 2/30 = .066
d. 18/30 = .60

6. Can the value of evidence variable X ever exceed the criterion X_C?

a. only when a signal is presented
b. only when noise is presented
* c. when either signal or noise is presented
d. no, X_C can never exceed evidence variable X

7. In SDT we represent signal and noise as a pair of distributions. Which of the following is a true statement concerning these distributions:

* a. there is always some overlap between the distributions and the distributions are normal
b. there is no overlap between the distributions and the distributions are normal
c. there is always some overlap between the distributions are the distributions are not normal
d. there is no overlap between the distributions and the distributions are normal

8. In SDT we represent signal and noise as a pair of distributions. Which of the following describes conservative responding?

a. X_C is placed to the left of where the distributions meet
* b. the observer says "no" (signal absent) much more often than she says "yes" (signal present)
c. the observer says "yes" (signal present) much more often than he says "no" (signal absent)
d. X_C is placed where the distributions meet

9. If signal-present trials are less frequent than signal-absent (noise) trials, how should the criterion be adjusted?

* a. raise the criterion
b. lower the criterion
c. keep the criterion the same
d. make the criterion more liberal

10. Which of the following defines β_{opt} in response to changes in signal probability?

* a. P(N) / P(S)
b. P(S) * P(N)
c. P(S) / P(N)
d. 2 * P(N) + ½

11. Optimal beta can be defined in terms of payoffs (costs and values). Which of the following should increase optimal beta?

* a. an increase in the value of a correct rejection
b. an increase in the value of a hit
c. an increase in the cost of a miss
d. a decrease in the cost of a false alarm

12. Sluggish beta refers to:

a. the optimal value of beta does not change with payoffs
b. empirical beta values are affected by probabilities
* c. as optimal beta is adjusted by probabilities or payoffs, there is a smaller shift in empirical beta values than is necessary
d. as optimal beta is adjusted by probabilities or payoffs, there is a larger shift in empirical beta values than is necessary

13. Which of the following statements about sluggish beta is false?

a. sluggish beta is more evident for probabilities than payoffs
b. sluggish beta is not related to an observer's sensitivity
* c. sluggish beta is a laboratory phenomenon and does not occur in the real world
d. sluggish beta means that people cannot adjust their criterion in an optimal manner

14. A key contribution of signal detection theory is that it:

a. predicts the response criterion for a particular individual
b. predicts the sensitivity for a particular observer in a particular context
* c. makes a clear distinction between response bias and sensitivity
d. shows that sensitivity is less important than response bias

15. A Receiver Operating Characteristic (ROC) curve plots:

a. hits against misses
b. hits against misses plus false alarms
c. false alarms against correct rejections plus hits
* d. hits against false alarms

16. How many points on the ROC can be generated from a 2 x 2 response matrix?

* a. one
b. two
c. four
d. eight

17. Points along a single ROC curve have the same:

a. bias
* b. sensitivity
c. sensitivity and bias
d. false alarm rate

18. Confidence levels offer a:

* a. more efficient means of collecting data from several criterion settings
b. way to demonstrate risky beta setting
c. method for determining which observers are more confident in their judgments
d. better way to measure sensitivity

19. A point on the positive diagonal on an ROC curve indicates which of the following:

a. extremely high sensitivity
b. a low criterion setting
* c. chance responding; i.e., zero sensitivity)
d. optimal beta

20. What happens when an ROC curve is plotted using z-scores?

* a. the ROC curve becomes a straight line
b. the ROC curve becomes more shallow
c. the ROC curve becomes straight and shallow
d. the ROC curve cannot be represented using z-scores

21. What does d' represent?

a. response bias
b. a non-parametric measure of bias
* c. sensitivity

d. accuracy

22. What does A' represent?

a. a non-parametric measure of response bias
b. a parametric measure of sensitivity
c. bias divided by sensitivity
* d. a non-parametric measure of sensitivity

23. Which of the following could be considered a fuzzy category:

a. an audible tone versus no tone
* b. an air traffic control "conflict"
c. a face shown during an earlier study period
d. a specific alarm versus no alarm

24. What is meant by "mapping function" in fuzzy SDT?

a. function that maps the degree of fuzziness to a concept
b. relationship between the number of signals and the number of responses
* c. function describing the degree of membership in a category
d. ratio between hits and misses

25. Which of the following statements is true for fuzzy SDT?

a. only stimuli can be classified as fuzzy using the mapping function
b. only responses can be classified as fuzzy using the mapping function
* c. both stimuli and responses can be classified as fuzzy using the mapping function
d. the mapping function does not determine whether a stimulus or response is fuzzy.

26. Which of the following statements best characterize fuzzy SDT?

a. an event is assigned to a category in absolute terms
* b. an event can belong to a category in graded terms, using a number between 0 and 1
c. once hit and false alarm values have been calculated, you need to apply fuzzy SDT equations to obtain sensitivity and bias values
d. hit and false alarm rates are not calculated in fuzzy SDT

27. A study described by Swets (1998) indicated that radiologists provided with a "reading aid" (checklist of features and a response scale) were better able to distinguish a cancerous tumor from a benign cyst than radiologists without the aid. In SDT terms, this means the radiologists _____.

a. with the reading aid were more conservative than those without
b. with the reading aid were more liberal than those without
c. without the reading aid were more influenced by disease prevalence than those who used the aid
* d. with the reading aid showed greater sensitivity than those without

28. A physician has to weigh the value of human life against financial and other costs when making medical decisions. Rather than consider the values of hits and correct rejections and the costs of misses and false alarms, Swets suggested that physicians:

a. ignore the costs
* b. develop a ratio of benefits and costs in the form of a statement
c. weight the values twice as much as the costs

d. ignore the costs and values and go with a gut judgment

29. Which of the following approaches to eyewitness identification tends to reduce false alarms?

a. a sequential lineup
b. a simultaneous lineup
* c. information the witness that the suspect might not be in the lineup
d. post-identification suggestions

30. What is the main reason that alarm and alert systems have a low beta setting?

a. to avoid the "cry-wolf effect"
* b. The cost of misses is typically greater than the cost of false alarms
c. the base rate of dangerous events is high
d. it is an inherent characteristic of automated detection systems

31. Which of the following is not a solution to the mistrust caused by alarm false alarms?

a. use multiple alarm levels
b. keep the human in the loop
c. improve operator understanding of alarm false alarm rates
* d. lower automated beta slightly

32. In the experiment by Mackworth (1948), a pointer moved in small jumps around a clock face. At intermittent intervals a target event occurred (a double jump of the pointer). What was the key result?

a. the target event was detected
b. the target event was not detected
c. it became easier to detect the target event over time
* d. it became harder to detect the target event over time

33. The vigilance decrement is a result of:

a. a decrease in sensitivity
b. a decrease in the response criterion (more liberal)
c. an increase in the response criterion (more conservative)
* d. both a decrease in sensitivity and an increase in the response criterion (more conservative)

34. Sensitivity in a vigilance task is higher when:

a. a target's signal strength is reduced
b. there is uncertainty about time or location of the signal
* c. targets and non-targets are presented simultaneously (rather than successively)
d. the event rate is increased

35. Which of the following theories accounts for the observed shift in the response criterion over the course of a vigil?

a. arousal theory
b. expectancy theory
c. sustained demand theory
* d. arousal theory and expectancy theory

36. Which of the following theories accounts for the sensitivity decrement over the course of a vigil?

a. arousal theory
b. expectancy theory
* c. sustained demand theory
d. arousal theory and expectancy theory

37. Sensitivity in a vigilance task can be improved by:

a. requiring the inspector to remember the target stimulus
b. decreasing target salience
c. increasing the event rate
* d. decreasing the event rate

38. Which of the following is NOT an effective method for shifting the response criterion downward towards an optimal level:

a. introducing false signals
b. providing feedback to the inspector (knowledge of results)
* c. training the observer to produce automating processing of the target
d. instructions about the costs of misses

39. Which of the following does NOT occur in an absolute judgment task?

a. multiple stimuli are presented
b. the subject gives its stimuli its name
c. the stimuli lie along some continuum (e.g., different brightnesses)
* d. the stimuli are presented in systematic order (e.g., from dimmest to brightest)

40. What is the limit of human performance in an absolute judgment task, in terms of information transmitted (HT)

* a. 2-3 bits
b. 2-3 stimulus levels
c. 7 plus or minus 2 bits
d. there is no limit

41. What are the implications of the bow effect for human absolute judgment?

* a. stimuli in the middle of a range are more likely to be misclassified
b. stimuli at the ends of a range are more likely to be misclassified
c. stimuli at the high end of the range are more likely to be misclassified
d. stimuli at the low to middle range are most likely to be misclassified

42. Which of the following pairs of dimensions are most likely to be orthogonal?

* a. weight and hair color
b. weight and height
c. weight and gender
d. height and gender

43. As dimensions are combined orthogonally, what happens to human information transmission (i.e., total H_T)?

a. it increases with the number of combined dimensions
b. it matches perfect performance

c. the number of bits per added dimension decreases
* d. it increases with the number of combined dimensions and the number of bits per added dimension decreases

44. As dimensions are combined redundantly (e.g., traffic light), what happens to human information transmission?

* a. it increases but is limited by the total amount of information in the stimulus
b. it increases with each increase in the number of combined dimensions
c. it decreases
d. it decreases but H_{loss} increases

45. In a Garner sort task, what are the indicators of integral dimensions?

* a. performance in orthogonal condition worse than control condition
b. performance in correlated condition worse than control condition
c. performance in orthogonal condition better than correlated condition
d. no differences between conditions.

46. In a Garner sort task, what are the indicators of separable dimensions?

a. performance in orthogonal condition worse than control condition
b. performance in correlated condition worse than control condition
c. performance in orthogonal condition better than correlated condition
* d. no differences between conditions.

47. Which of the following are not integral dimensions?

a. pitch and location (height)
b. color hue and color saturation
c. height and width of rectangle
* d. orientation and size

48. Which of the following are not separable dimensions?

a. size (area) and brightness
b. spatial location and temporal order
c. shape and color saturation
* d. color hue and saturation

49. Which of the following results describes configural dimensions?

a. the size of rectangles does not affect classification of their color
* b. classification performance is affected by how the dimensions of the height and width of rectangles are paired
c. classification performance is not affected by how the dimensions of the height and width of rectangles are paired
d. the height of different sized rectangles is easily classified

50. Which of the following does not affect the amount of information in a stimulus

a. the number of alternatives
b. its probability
c. its sequential context

* d. its salience

Short Answer Essay Questions

1. Discuss the difference between sensitivity and bias in conceptual terms.
2. Describe what is meant by “sluggish beta”.
3. Draw an ROC curve and label the axes. Indicate sensitivity and bias. What happens to the curve when z-scores are used?
4. Summarize the key differences between signal detection theory and fuzzy signal detection theory.
5. What is a Garner sort task? Specify the various conditions in your answer. How do the results indicate whether perceptual dimensions are integral or separable?
6. Summarize the implications of multidimensional absolute judgement for sorting/classification tasks. Be sure to discuss configural dimensions and emergent features in your answer.
7. Consider the application of signal detection theory to alarm systems. What is special about this situation, in a signal detection sense?
8. What is a vigilance task and what is meant by the vigilance decrement?
9. What are the key results in a vigilance task (consider both sensitivity and bias).
10. Describe some techniques to combat the loss of vigilance (again consider both sensitivity and bias in your answer).

Essay Questions

1. Summarize the implications of integral and separable dimensions for interface designers.
2. In his classic 1956 paper, George Miller discussed various experiments that used the absolute judgment paradigm. He concluded that there appears to be a limit to classification in this task. Explain how he arrived at this conclusion.
3. Describe how signal detection theory works and how it is relevant to many real-world tasks.
4. Summarize the major theoretical accounts of vigilance.
5. What is information, and how is it relevant to display design?