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COVER SHEET

Honor code:

“My responses to these questions represent my own ideas and I have not received undue assistance from any source”

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Please choose one of the following options:

☐ I would like to pick up my graded assignment at the end of class. The final grade will be written on the underside of the first page, but I understand that others may see my graded work.

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1) A heuristic is a reasoning or problem-solving strategy that is relatively easy to apply, and that often but not always produces a good answer. The “heuristics and biases” research program developed by Tversky and Kahneman aims to describe the heuristics that people use to solve reasoning problems and to characterize the biases or the errors that these heuristics can produce.

Tversky and Kahneman focus on three heuristics. Fill out the following table by describing these heuristics and the errors that they can produce. As an example, the first row is based on a heuristic described on the first page of the article.

You should aim to write just one sentence in each empty cell of the table. Please put your ideas in your own words.

Heuristic	Problem to be solved	Heuristic-based approach	Biases or errors produced by the heuristic
Example on opening page	Estimate the distance of an object.	Use clarity: the clearer the object, the closer it is	When visibility is poor, distance is often overestimated
Representativeness	Determine the probability that object A has property B.	Compare object A to a typical object C with property B; the more similar A is to C, the more likely A is to have property B.	Ignores the prior probability of having property B (especially how sample size affects the probability)
Availability	Determine the probability that object A has property B.	Compare available examples of A, and determine the probability by the fraction having B.	Availability may depend on having property B,
Adjustment and anchoring	Estimate a quantity	Begin with an initial estimate and adjust it as data accumulates	Adjustments tend to be insufficient

2) Tversky and Kahneman suggest that heuristics are “quite useful” in general (p 1124) and are “usually effective.” (p 1131)

Consider two of the heuristics they describe: representativeness and adjustment and anchoring. For each one, describe a real-world setting where this heuristic produces an accurate answer to a real-world reasoning problem.

(a) Describe a real-world problem that can be solved using the representativeness heuristic

After observing a large number of flips of a (not necessarily fair) coin, predict the next flip.

Using the representativeness heuristic, the sensible prediction should be the more common of “heads” and “tails” over the previous observations.

(b) Explain why the representativeness heuristic produces an accurate answer in this case.

Since the number of observed flips is large, with high probability, if the coin is biased, with somewhat high probability ($>50\%$), the next flip is the more common of the flips observed so far.

(c) Describe a real-world problem that can be solved using anchoring and adjustment.

Suppose you first observe the price of an expensive pair of pants, and then observe the prices of many pairs of cheap pants. Predict the cost of an average pair of pants.

Use the price of the expensive pair of pants as an anchor estimate and reduce the estimate as each cheap pair is observed.

(d) Explain why anchoring and adjustment produces an accurate answer in this case.

Since the anchor price is high and the subsequent observations are low, conservative adjustments should end up around the price of an average pair of pants.

3) Rule R indicates that “if a card has p on one side, then it has q on the other side.” Consider a task where people are shown the following four cards, and asked to decide which ones must be turned over in order to decide whether the rule is true.



- (a) Circle the two cards that people are most likely to turn over if you give them this task in the lab.
(b) Explain why the response that you described in (a) has been taken as evidence of irrational behavior.

While turning over the “p” is necessary, turning over the “q” card does not help in verifying the rule. Instead, one should turn over the “not q” card, as the rule would fail if the other side of the card were a “p”.

- (c) Why do Chater and Oaksford think that selecting the “q card” is rational? Summarize their argument in your own words.

Chater and Oaksford suggest that the rational behavior is not necessarily to attempt to refute the given rule, and may include attempting to confirm the rule. If the “q” card had a “p” on the other side, this would serve as a sort of confirmatory evidence. Their argument is based on the fact that many things we believe true about the world are gleaned by observing consistent evidence, rather than by failing to observe contradictory evidence.

4) (a) What important assumption of Chater and Oaksford's rational analysis can be challenged on the basis that the standard version of the Wason card selection task refers to rules about vowels/consonants and odd/even numbers?

The important assumption that can be challenged is: that properties are rare.

Explain why this assumption can be challenged.

50% of single-digit numbers are odd, and so the property "odd" is not rare (the paper's reasoning requires the probability of the rule's conclusion to be less than 25%).

(b) Imagine that you are required to defend Chater and Oaksford's approach. Explain why their approach still helps to explain why people choose the q card in the letter/number version of the Wason task even though one of their important assumptions does not apply in this case.

The essence of the Chater and Oaksford argument is that human reasoning is not scientific in the sense of Popper: humans are willing to accept confirmatory evidence as informative, alongside contradictory evidence. Seeing a letter/number corresponding to "p" (or "not p") on other side of the "q" card will thus be considered informative, even though it does not help in logically verifying the rule.

5) Tversky and Kahneman suggest that cognition is subject to “severe and systematic errors” (1124). Chater and Oaksford suggest that cognition is “superbly adapted to serve practical and computational ends” (58). Are these approaches contradictory or can they be reconciled? Explain your answer.

The papers' views are entirely consistent. Although there exist tasks in which humans fail systematically and severely to reason well, there exists a set of tasks, more representative of the conditions in which humans evolved, at which humans outperform any system we can design.

A relevant point of comparison is how humans perform relative to computers, since the latter operate according to our notion “rationality.” On some tasks (primarily those which humans would not have had to perform for most of the species' existence: arithmetic with large numbers, memorization of large strings, etc.), computers dramatically outperform humans, whereas, for a number of tasks (primarily those that have been useful to the survival of our species: image classification, locomotion, etc.), humans presently outperform computers.