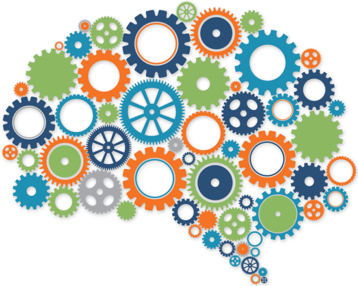

Critical Thinking & Innovation

Jake Chandler

Probabilistic Reasoning, Part 3

LA TROBE UNIVERSITY

Common Fallacies In Probabilistic Reasoning

(2) Conjunction fallacy

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- Question:

  Linda is 31 years old, single, outspoken and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations. Which of the two following claims is the most probable?

  (1) Linda is a bank teller.

  (2) Linda is a bank teller and is active in the feminist movement.

- Common answer: (2) (K&T 1983)
- Not just an academic curiosity: similar results for medical diagnoses in physicians!

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- Incorrect!
  - (2) is *not* more probable!
  - For any sentences A and B, $\Pr(A \wedge B) \leq \Pr(A)$!

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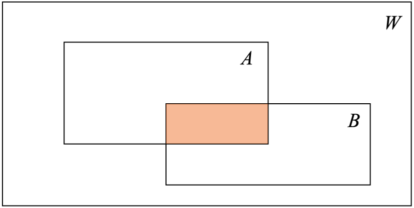

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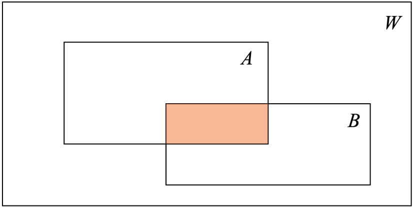

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(1) Linda is a bank teller.

as:

(1*) Linda is a bank teller and is NOT active in the feminist movement.

- Plausibly not, since, in another study from K&T, most still rate (2) higher than:

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  - As with Prosecutor's Fallacy: confusing posterior probabilities and likelihoods
  - Instead of comparing:

    $$\Pr(B \wedge F \mid E) \text{ and } \Pr(B \mid E)$$

    they are comparing:

    $$\Pr(E \mid B \wedge F) \text{ and } \Pr(E \mid B)$$

  - Furthermore, our assessments of the latter are based on how typical Linda is of B vs of $B \wedge F$
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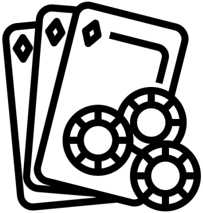

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- Question:

  We have drawn a card at random out of a standard pack 4 times, replacing it on each occasion and it has been red each time. On the 5th draw, is the card more likely to be red or to be black?

- Common answer: It is now more likely to be black
- Incorrect!

  It is equally likely to be black as it is to be red, since the draws are

  - Independent: $\Pr(R_5 \mid R_1 \wedge \ldots \wedge R_4) = \Pr(R_5)$
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(3) Gambler's fallacy (ctd)

- It is sometimes OK to think the tide will turn

  We have drawn a card at random out of a standard pack 4 times, *without replacing it* and it has been red each time. On the 5^{th} draw, is the card more likely to be red or to be black?

- As you remove red cards, black draws become more likely
- But this is a very different situation!
- Gambler's Fallacy-style reasoning is very common:
  - People are less likely to choose recent winning lottery numbers
  - People tend to hold on to stocks that have depreciated for a while
- What's going on?!

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- K&T (1972) blame the representativeness heuristic again:

  RRRRB is judged more representative of the class of random card draws than RRRRR and hence judged more probable

- Note: they don't *define* representativeness
- Clearly representativeness $\neq$ conditional probability
  - RRRRB > RRRRR (has to do with observed frequency of R being closer to the probability of R)
  - RBBRB > RRBBB (has to do with the sequence looking more "random")
- Without a definition, it is hard to show that the heuristic is a useful one

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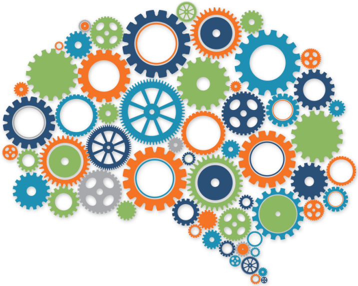

Critical Thinking & Innovation

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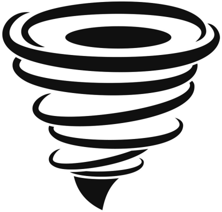
(4) Availability fallacies



(4) Availability fallacies

- Question:

  Which is the more likely cause of death in the USA?

  (1) Tornado

  (2) Lightning

- Common answer: (1) (Lichtenstein *et al* 1972)
- Incorrect!

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- Why this works to an extent:

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  - (b) As above but with the form _ _ _ _ i n g (seven-letter words that end with “ing”)?
- Median estimates : (a) 4.7, (b) 13.4 (K&T 1983)
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  $\Pr(A) = 0.5$

  $\Pr(B) = 0.9^7 \approx 0.48$ (since the draws are independent)

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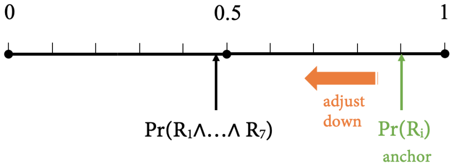

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- Anchoring is well documented in other domains (and exploited!)
  - Negotiation
  - Sentencing
  - Sales
- Anchoring affects other probability judgments (K&T 1974):

  A random number n is selected: 10% or 65%

  Subjects are then asked two successive questions about the probability that a randomly chosen UN country is African:

  (1) Is it higher or lower than n?

  (2) What is its approximate value?

  Median estimates: for $n = 10\%$: 25%; for $n = 65\%$: 45%

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  (1) Is it higher or lower than n?

  (2) What is its approximate value?

  Median estimates: for $n = 10\%$: 25%; for $n = 65\%$: 45%

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  - high uncertainty
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