Our Strange Mental World
Identity and Typicality

Long History of Discovering
What is Normatively Correct
- In the 17th century, Italian gamblers bet on the total number of “spots” rolled with three dice.
  - What are the chances of rolling a total of 9 spots?
  - What are the chances of rolling a total of 10 spots?
- Italian gamblers reasoned that there are 6 combinations that produce a 9:
  1 2 6
  2 3 4
  1 3 5
  2 2 5
  1 4 4
  3 3 3
- Likewise, they reasoned that there are 6 combinations that produce a 10:
  1 4 5
  2 3 5
  1 3 6
  2 4 4
  2 2 6
  3 3 4

Figuring out What is Normative
- However, experience showed that gamblers were more likely to win if they bet on 10 than 9
- But, they couldn’t figure out why.
- So, they asked Galileo for help. His strategy:
  - Color the dice: one white, one grey, one black.
  - 6 ways for white to fall
  - 6 ways for grey to fall
  - 6 ways for black to fall
  - So 6 x 6 x 6 = 216 combinations
  - Galileo wrote down all possibilities and counted them
New Normative Discovery

- Outcome = 9
  - 1 3 6
  - 1 3 5
  - 1 4 4
  - 2 2 5
  - 3 1 3
  6
  6
  1
  3
  1
  Total: 25 out of 216 or .116

- Outcome = 10
  - 1 4 5
  - 1 3 6
  - 2 2 6
  - 2 1 5
  - 3 1 4
  6
  6
  3
  3
  1
  Total: 27 out of 216 or .125

Attempts to Secure Certainty

- 19th Century Strategy: Secure the certainty of arithmetic by deriving it from logic via set theory
- Russell and the discovery of paradoxes:
  - Liar Paradox: This sentence is false
  - The set consisting of items which are not a member of the set
  - Still aspired to the reduction of arithmetic to logic
- Gödel and incompleteness:
  - Given any consistent set of axioms, there will be a true statement of arithmetic that is not derivable from those axioms
- Objective limitations to our quest for certainty

Cognitive Limitations

- The limitations established by Russell and Gödel are objective limitations
  - They apply to the formal systems themselves, not to our cognition
- Piattelli-Palmarini focuses instead on limitations due to our cognitive system
  - We operate in ways that differ from the norms set in our formal systems
  - Our concepts do not operate like sets
  - May not respect the principle of identity
Concepts and Sets

- Gottlob Frege:
  - Intension determines extension
  - Meaning determines reference
- Classical theory: categories and concepts defined by conditions for category membership
- A bachelor is, by definition, an unmarried male human being

Who is a bachelor?

- Alfred is an unmarried adult male. He has been living with his girlfriend for the past 23 years. Is Alfred a bachelor?
- Bernard is an unmarried adult male and does not have a partner. Bernard is a monk living in a monastery. Is Bernard a bachelor?
- Charles is a married adult male, but he has not seen his wife for many years. Charles is earnestly dating, hoping to find a new partner. Is he a bachelor?
- Donald is a married adult male, but he lives in a culture that encourages males to take two wives. Donald is earnestly dating, hoping to find a new partner. Is he a bachelor?

Typicality Judgments

- People happily judge typicality of members of categories
  - How typical a bird is chicken?
  - How typical a bird is blue jay
  - How typical a bird is a cocker spaniel?
  - How typical a bird is a Space Shuttle?
Problem with classical view
• Typicality effects
• Typicality Demo
  – will see X --- Y.
  – need to judge if X is a member of Y.
    • finger --- body part
    • pansy --- animal
  – If YES, clap your hands as FAST as you can!

turtle – precious stone
pants – furniture
robin – bird
dog – mammal
turquoise --- precious stone
ostrich -- bird
poem – reading materials
rose – mammal
whale – mammal
diamond – precious stone
book – reading material
opal – precious stone

Typicality Effects
• typical
  – robin-bird, dog-mammal, book-reading, diamond-precious stone
• atypical
  – ostrich-bird, whale-mammal, poem-reading, turquoise-precious stone
• Faster, more accurate with more typical members of a category
Typicality

- Rankings of fruits in terms of typicality on a 1 to 7, with 7 as highest typicality:
  - Apple 6.25
  - Peach 5.81
  - Strawberry 5.00
  - Watermelon 4.06
  - Fig 3.38
  - Olive 2.25

Prototype Theories

- Categories defined in terms of central tendency
- Learning involves abstracting a prototype from actual instances

Prototype Theories

- Prototype identifies a (usual non-real) entity that serves as the reference point for the category
- Seems to make the category representation an instance of the category
Exemplar Theories
- Exemplar = a specific remembered instance
- Your representation of “dog” consists of all the examples of dogs that you have encountered
- Typical items are encountered more frequently, so you will have many stored representations of them
- Exemplar theories can explain typicality effects
- Recognition task: typical items are more quickly recognized because memory search for a matching exemplar will be fast
- Production task: when asked to list items in a given category, typical items are more frequently represented in memory

Ad hoc categories
- It is easy to rate typicality for newly made up categories
  - Things to take with you when your house is on fire
  - Things to take on vacation
  - Things to see in Paris
- These are not likely to exist pre-structured in your mind
- Maybe all categories are constructed on the fly from more basic representations—Barsalou

Beyond Mere Similarity
- Similarity (or resemblance) is crucial to both prototype and exemplar theories of categorization
- Categorization by similarity is a useful heuristic
- However, we rely on more than similarity when judging category membership
  - A painted, flattened lemon is still a lemon
  - A well-done counterfeit bill is not a $20 bill
  - A raccoon with a strip painted on it is still a raccoon, not a skunk
- We seem to invoke theoretical knowledge: “genetics” determines animal categories
Categories in Other Cultures

BAYI: men, kangaroos, possums, bats, most snakes, most fish, some birds, most insects, the moon, storms, rainbows, boomerangs, some spears, etc.

BALAN: women, dogs, platypus, echidna, some snakes, some fish, fireflies, scorpions, crickets, the hair mary grub, anything connected with water or fire, sun and stars, shields, some spears, some trees, etc.

BALAM: all edible fruit and the plants that bear them, tubers, ferns, honey, cigarettes, wine, cake
Categories in Other Cultures

BALA: parts of the body, meat, bees, wind, yamsticks, some spears, most trees, grass, mud, stones, noises and language, etc.

Problems with Similarity Judgments

- Context Effects:
  - On a 5 point scale, how similar are Italy and Switzerland?
  - Comparing Italy, Switzerland, and Brazil
  - How similar are Italy and Switzerland?
  - In this context, people's similarity rating for Italy and Switzerland goes up

Similarity and Multi-dimensional spaces
Failure of Symmetry

- Symmetry Principle: \( d(x,y) = d(y,x) \).
- If symmetry held:
  - \( d(\text{Cuba, China}) = d(\text{China, Cuba}) \)
  - \( d(\text{butcher, surgeon}) = d(\text{surgeon, butcher}) \)
  - \( d(\text{FDR, W}) = d(W, \text{FDR}) \)
  - \( d(\text{pomegranate, apple}) = d(\text{apple, pomegranate}) \)
- But people judge:
  - Cuba is more like China than China is like Cuba
  - A butcher is more like a surgeon than a surgeon
  is like a butcher
  - W is more like FDR than FDR is like W
  - A pomegranate is more like an apple than an apple
  is like a pomegranate

Failure of Triangle Inequality

- Spatial representations predict that if A and B are similar, and B and C are similar, then A and C have to be somewhat similar as well (triangle inequality)
  \[
  d(a,b) + d(b,c) \geq d(a,c)
  \]
- However, you can find examples where A is similar to B, B is similar to C, but A is not at all similar to C
  - Violation of the triangle inequality
- Example:
  - Watch is similar to bracelet
  - Watch is similar to clock
  - Bracelet is not similar to clock
Failure of Identity

- Markman and Gentner—cross-mapping analogy
  - Man from food bank gives food to woman
  - Same woman gives food to squirrel
  - Woman in first picture maps to (more similar to) squirrel than herself