Problem solving

PSY 200

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Lecture 34

What does that "aha" feeling mean?

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Problem solving

- A hallmark of intelligence
  - often used as a definition of intelligence
- Seem to get something from nothing
- We will not explain exactly how it happens
  - but we can look at some characteristics of problems and problem solving
    - » what makes for an easy (or hard) problem?
    - » what makes for a good (or bad) problem solver?

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Topics

- We will look at a number of factors that influence our ability to solve problems
  - expertise
  - analogy
  - set effects
    - » priming
    - » incubation
    - » *functional fixedness*
  - insight

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Experts

- Some people learn how to solve particular types of problems
- What makes an expert different from a novice?
- Experts know how to describe problems
  - other than that, there seems to be no fundamental difference (even for geniuses!)

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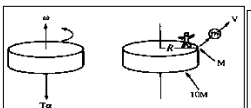
An example of experts

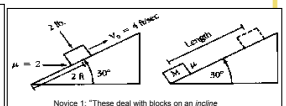
- Chi, Feltovich & Glaser (1981)
- Take second year physics students (novices) and ask them to classify a bunch of physics problems
  - they tend to group them by surface similarities



Novice 2: "*Angular* velocity; *momentum*, circular things"

Novice 3: "*Rotational* kinematics, *angular* speeds, *angular* velocities"

Novice 6: "Problems that have something *rotating*, *angular* speed"



Novice 1: "These deal with blocks on an *incline plane*"

Novice 5: "*Inclined plane* problems, coefficient of *friction*"

Novice 6: "Blocks on *inclined planes* with angles"

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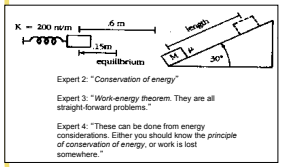
An example of experts

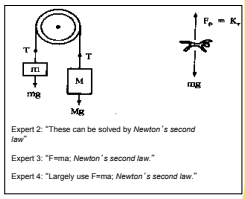
- Have experts (PhDs) classify the same problems
  - grouped according to how to solve



Expert 2: "*Conservation of energy*"

Expert 3: "*Work-energy theorem*. They are all straight-forward problems."

Expert 4: "These can be done from energy considerations. Either you should know the *principle of conservation of energy*, or work is lost somewhere."



Expert 2: "These can be solved by *Newton's second law*"

Expert 3: "F=ma; *Newton's second law*."

Expert 4: "Largely use F=ma; *Newton's second law*."

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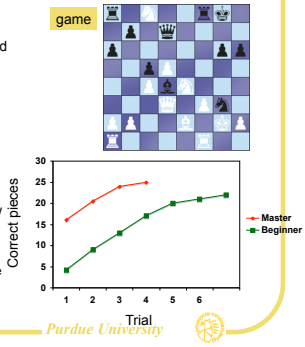
Chess experts

- Chase & Simon (1973)
- Show subjects a chess board and then clear it
  - have subjects recall positions of the chess pieces on the board
- Master players are better than beginners when the pieces are positioned as in the middle of a real game
- Experts have *schemas* that allow them to organize the piece positions
  - They only need to remember the schema



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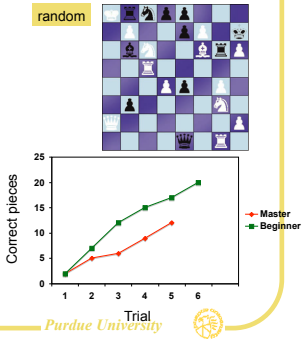
Chess experts

- Chase & Simon (1973)
- Show subjects a chess board and then clear it
  - have subjects recall positions of the chess pieces on the board
- Master players are *worse* than beginners when the pieces are positioned randomly
- Experts try to use the schemas, but they end up misremembering the actual piece positions



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Expert schemas

- In general, experts have lots of problem solving schemas specific to their domain of expertise
  - given such and such; do such and such
  - allows them to organize information in a way that allows for easy recall and easy use
- Expertise in one domain does not transfer to another
  - except for especially useful skills

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Analogy: Attack-Dispersion Story

- The many roads to a dictator's fortress are mined so that small groups of men may pass, but a large group will be destroyed. A general knows that his army can defeat the fortress if he can get his entire army to attack at once, but he cannot take his army down a single road all at once without losing too many men.
- What should he do?

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Solution

Analogy: Parade-dispersion

- A dictator wants to show off his army so he tells a general to plan a parade of the army. He demands that the general insure that the army is seen and heard across the entire kingdom simultaneously. The dictator also demands that the parade be the most impressive ever at the fortress. Splitting up the army would allow it to be seen everywhere, but would make the display at the fortress unimpressive.
- What should the general do?

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Analogy

- The solution is the same
- Glick & Holyoak (1980)
  - subjects read stories like these and were asked to solve the problems
  - even when shown one solution and told that it could be applied by analogy to another
  - subjects used analogies only 20% of the time

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Analogy

- Analogies are actually very difficult to apply
  - need to identify what is common between two problems
- Analogies are often applied *after* two problems are solved and well understood
  - it is then easier to see what is common
- One of the problems handed out can be solved by analogy to these two problems

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Set effects

- "Set" refers to "mind set" (or something like that)
  - negative set: bias toward solving a problem makes it more difficult
  - positive set: bias toward solving a problem makes it easier
- You can be biased by lots of things
  - problem statement
  - previous methods of reaching solution
  - general knowledge

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Past experience

- Buddhist monk problem
  - One morning, exactly at sunrise, a Buddhist monk began to climb a tall mountain. The narrow path, no more than a foot or two wide, spiraled around the mountain to a glittering temple at the summit. The monk ascended the path with an average speed of 3 mph. He reached the temple shortly before sunset. After several days of fasting and meditation he began his journey back along the same path, starting at sunrise and walking an average speed of 5 mph. Is there a spot along the path that the monk occupied on both trips at precisely the same time of day?

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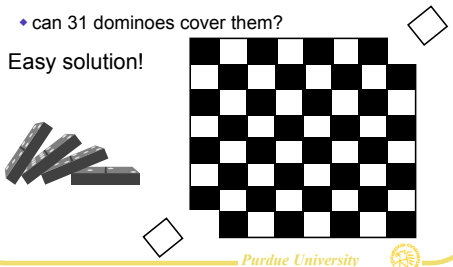
Self-imposed limits

- Nine dots problem
  - Draw four straight lines, passing through all nine of these dots, without lifting your pencil from the page.

Set effects: Representation

- Mutilated chessboard
  - 62 squares remain
  - can 31 dominoes cover them?
- Easy solution!



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Set effects: Priming

- Safren (1962)
- Unscramble the following anagrams
- 12.2 seconds per word

KOBO CTURK STTE

CHUOC ANCYD DRINEF

7.4 seconds per word

KMLI GRAUS RECMA

FOEFCE TEESW IKRDN

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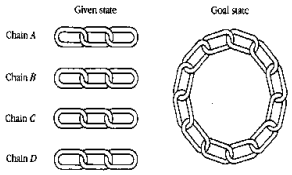
Set effects: Incubation

- Cheap necklace problem
- Opening a link costs $2
- Closing a link costs $3
- Go from given to goal state for no more than $15



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Set effects: Incubation

- Silveira (1971)
- Control: Work on problem for half an hour
  - 55% solve problem
- Exp A: Work on problem for half an hour in 15 minute sections, half-hour distracter task
  - 64% solve problem
- Exp B: Work on problem for half an hour in 15 minute sections, 4 hour distracter task
  - 85% solve problem

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Set effects: Incubation

- Subjects often get stuck using an approach that goes nowhere (set)
- After a break they are more likely to try a different approach
- Brainstorming tries to avoid set effects by allowing free "dreaming" of solutions
  - most of the ideas are worthless, but the approach is still beneficial

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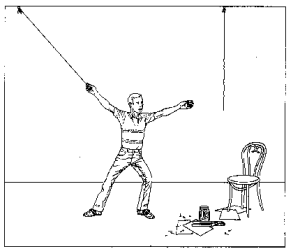
Set effects: Functional fixedness

- How can you tie two strings together?
- Dunker (1945)
  - "MacGyver"



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Insight

- Intuitively, we sometimes feel as if we have a strong insight into a problem and its solution becomes obvious
  - the "aha" feeling
  - is it real?
  - what does it correspond to?

- Using problems like the "Bronze coin" and the "Tree planting" problems (Metcalf, 1986)
  - subjects judge their progress with a "warmth" rating, every 10 seconds, over 5 minutes

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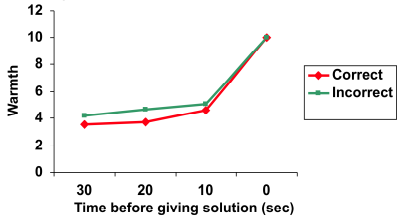
Insight

- Warmth stays mostly steady, right up to proposing a solution
  - the "aha" feeling

Unfortunately, the feeling does not necessarily indicate a correct solution



Conclusions

- Effects on problem solving
- Expertise
- Analogy
- Set effects
- Insight
- Solve remaining problems
  - Tumor problem

Next time

- Wrapping up the course
- Other courses to take/avoid
- Paths to pursue
- Graduate school

- *Advice for further exploration*