

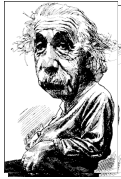
Expertise

- Novices and experts
- Expertise and perception
- Expertise and memory
- Expertise and judgment
- Expertise and domain-specificity

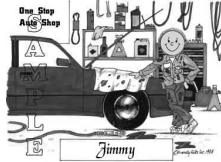
What is an expert?

- Experts are not just smart.

You would not go to Einstein for a toothache.



- Experts know about a particular domain.



Questions about expertise

- What does it mean to be an expert?
- Do experts see the world differently from novices?
- Do experts remember situations differently?
- How do you become an expert?
- Is any expertise domain-general?

What is an expert?

- Recognizes the problem in a new situation
 - Able to diagnose new problems
- Knows the answer to many problems
 - Has lots of prior experience
 - Need not start from scratch solving problems
- Knows how to solve new problems
 - Set of skills for solving unseen problems
 - For ill-formed problems, finds operators that can apply to new problems.

Expertise and perception

- Experts may see the world differently

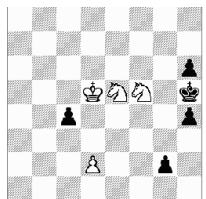
This is an MRI of a torn tendon.



- People must learn the relevant perceptual features in their domain.
 - Studies of Radiologists
 - Medical students look at different features than experts.

Expertise and perception

- Many domains provide this type of expertise



Why does perception change?

- Return to the issue of constraints
- The cognitive system wants to automatize as much as possible
 - Frees up working memory resources for hard cognitive work
- If perception can provide information useful for solving problems, tasks become easier.
- Perception limits the possibilities considered
 - Generally a good thing
 - Experts may miss novel features

Expertise and memory

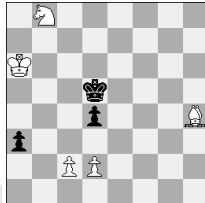
- The way experts perceive a situation influences what they recall.
 - DeGroot; Chase & Simon

Chess experts' memory for real board positions better than novices.

Experts could recreate a board position faster than novices

- Their chunks were meaningful.

Similar effects have been found in many other domains like sports.



Expert perception and categories

- Brooks and colleagues
- Doctors combine perception with other diagnosis information
 - May miss very obvious features without a case history or with a misleading case history
 - May be a confirmation bias.



A patient with jaundice

Expertise and judgment

- Are expert judgments always better?
 - Particularly in fuzzy domains
 - Stock market
- Two ways to answer that question
 - Compare experts to statistical models
 - Compare experts to novices
- How good are expert judgments?
 - Statistical models generally outpredict experts
 - Experts pay too much attention to rare events
 - Experts in combination with statistical models are better than either one alone.

Expert and novice judgment

- In some fuzzy domains, experts are no more accurate than novices
 - Interpreting Rorschach tests
- Experts are (usually) better calibrated than novices
 - Their confidence in judgments matches their accuracy
 - Experts may sometimes be more overconfident
- Why do experts perform poorly?
 - Expert rules may overweight the wrong cues
 - Experts may only search for particular cues in particular contexts

Becoming an expert

- Practice, practice, practice
- What kind of practice is needed?
 - Development of perceptual skills
 - Development of motor skills
 - Familiarity with problems in a domain
 - Diagnosing problems
 - Fixing problems
 - Some problems only arise in rare cases, so expertise may take a while to develop
 - Learning what you do and do not know
 - Expertise: 10 years to develop (Gardner)

Domain specificity of expertise

- Experts are experts in a domain
- An expert in science need not be an expert in other academic disciplines
 - An expert in one science need not be an expert in another science
- Attempts to teach general problem solving have been unsuccessful
 - Polya and heuristics
 - Heuristics are often too general to be used
 - “Find a similar problem”
 - How do you know what is similar without expertise?

This is an old idea

- Thorndike & Woodworth (1901)
 - Examined relationships among mental tasks
 - Improving in one task only improved performance in tasks that had “common components”
 - Skill in math improves skill in science
 - Skill in math is unrelated to skill in languages
- More recent models (e.g., Anderson)
 - ACT model
 - Cognitive skills involve components (called productions)
 - One skill improves another when they use the same productions.

Summary

- Expertise takes time to develop
- Experts see the world differently from novices
 - Influences their memory
- Experts have skills that novices do not
- Expertise is domain specific
 - Attempts to teach general problem solving strategies generally fail.