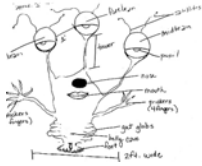


COGNITIVE APPROACH TO CREATIVITY



Cognitive View of Creativity

- Everybody has the ability to be creative
- Normal cognitive processes
 - Memory retrieval, analogy, problem solving
- Normal knowledge structures
 - Schemas, category knowledge, episodic memory
- Focus on psychological creativity
- Focus on problem solving

Problem Solving

- Creativity occurs during problem solving
 - Poets
 - Painters
 - Actors



Problem Solving

- Poets
 - Expressing feelings within constraints of a poem



William Blake

“I was angry with my friend:
I told my wrath, my wrath did end.
I was angry with my foe:
I told it not, my wrath did grow.”

Problem Solving

- Painters
 - Problems of design, balance, expression



Salvador Dali

Problem Solving

- Actors
 - Expressions and movements to convey the character
- Creative solutions to problems within a domain



Al Pacino

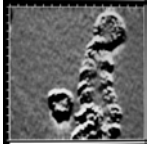


Problem Solving

- Scientists
 - Experiments, theories



Watson & Crick



Predictions of the Cognitive View

- Problem Solving → • Same characteristics for Creative and Normal
- Cognitive Processes → • Operate similarly for both types
- Knowledge Structures → • Should be evident in creative products

History of Cognitive Approach to Creativity

- Problem Solving research
 - Spurred by advent of computers
- Realization that computers have capacity for intelligent thought
 - Search for Artificial Intelligence (AI)



History of Cognitive Approach : Turing Test

- Operational definition of intelligence
 - Ability to achieve human – level performance on cognitive tasks



History of Cognitive Approach : Turing Test Skills

- Natural language processing
 - Communicate successfully
- Knowledge representation
 - Store information
- Automated reasoning
 - Answer questions/draw conclusions
- Machine learning
 - Adapt to new circumstances



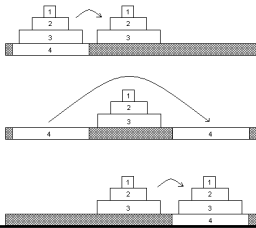
Cognitive Modeling of Problem Solving

- Designing programs that think like humans
- Need to determine human thought processes
 - Introspection
 - Human experimentation
- Express theories as programs



Cognitive Modeling of Problem Solving: GPS

- General Problem Solver (GPS)
- Uses means-ends approach
- Used to solve well-defined problems



Cognitive Modeling of Problem Solving: GPS

- GPS mimicked human problem solving processes including mistakes
- Newell & Simon's approach developing GPS
 - Started field of Cognitive Science
 - Terminology and framework for problem solving



Problem Solving: Terminology

- Problem solving
 - Goal is not readily available
 - Use knowledge to reach goal
- Initial state
 - State you are in when you encounter problem

Problem Solving Terminology: Problem Space

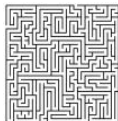
- Set of choices
 - Found at each step of solving the problem
- Includes
 - Initial, intermediate, and goal states
 - Knowledge being applied to problem
 - Knowledge that *could* be applied
 - External devices, objects, resources
- Range on continuum from large to small
 - YBO versus LSOCOYYHGP

Problem Solving Terminology: Operators

- Legal operators or moves performed during problem solving
- Classes
 - Algorithms
 - Heuristics

Problem Solving Terminology: Algorithm

- Precise rule
 - Always yields a correct solution to the problem
- Frequently slow and inefficient
 - Exhaustive search
 - Search entire problem space
 - Difficult for humans
 - Easy for computers



Problem Solving Terminology: Heuristic

- Rule of thumb
 - Likely, but not guaranteed, to generate solution
- Selective search of problem space
 - Examine only those parts likely to lead to solution

Problem Solving Terminology: Goal state

- Ultimate solution to problem
- Problem defined in terms of goal state specification
 - Well-defined problems
 - Ill-defined problems

Well-defined and Ill-defined Problems

- Well-defined
 - Clear goal
 - Small set of information to start
 - Guidelines or rules
- Ill-defined
 - Unclear goal
 - Starting information, operators or both are vaguely specified
 - Many real world problems



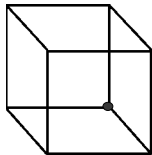
Gestalt View of Problem Solving

- Gestalt psychologists
 - Perception and the structure of patterns
 - Arrangement problems
- Kohler (1925) & Sultan
 - Cage contained sticks and boxes
 - Rearrange objects to get fruit



Gestalt View of Problem Solving

- Problem solving theories based in perception theories
 - Global restructuring of knowledge
 - Associated with “flash” of insight



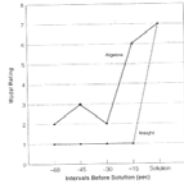
Insight Problems

- Insight problems (Radiation problem)
 - Solution suddenly enters the mind
 - Immediately recognized as correct
 - Accompanied by an “AHA!” experience
- Non-insight problems (Anagram problem)
 - Solve problem gradually
 - Reasoning skills and routine procedures



Insight vs. Non-insight Problems

- Metcalf & Wiebe (1987) studied insight problems
- Compared insight to algebra problem solving
 - “Warmth ratings”



Characteristics of Insight Problems

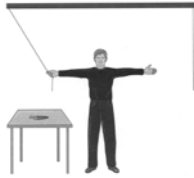
- People initially have no idea how to solve problem
- No linear “feeling of warmth”
 - No sense one is getting closer to the goal
- Period of incubation
 - Time spent away from problem
- Solution appears suddenly
 - Solution is fully formed

Insight Problem Solving Explanations

- Special Processes Explanations
 - Unconscious work hypothesis
 - Chance encounter hypothesis
- “Business as Usual” Explanations
 - Insight “feels” different
 - Restructure representation of problem
 - Fixation explanation

Special Processes Explanations

- Unconscious Work
 - Incubation
 - Discussed further in “Brain influences” lecture
- Chance encounter
 - Maier “two string problem”



Business as Usual Explanations

- Some researchers (Weisberg) question the concept of insight
- Propose
 - Gradually work towards a solution
 - Solution just “feels” different
- Some non-insight problems solved by restructuring

Business as Usual Explanations: Restructuring

- Change mental representation of problem
 - Problem space
 - Initial or goal states
 - Available operators
 - Constraints



If a pond lily doubles every day and it takes 30 days to completely cover a pond, on what day will the pond be 1/2 covered?

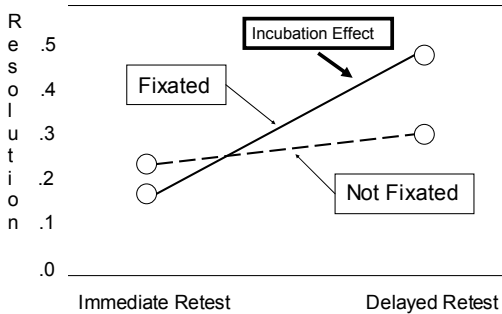
Business as Usual Explanations: Mental Activation

- Spread of activation
- Incorrect solution/representation activated
- Causes impasse
 - Inability to solve problem

Stimuli from Smith & Blankenship (1991)

Remote Associates Test Problems			Blockers	Solutions
SALAD	HEAD	GOOSE	<i>lettuce</i>	egg
BED	DUSTER	WEIGHT	<i>room</i>	feather

Incubation & Fixation in RAT Problem Solving



From Smith & Blankenship (1991)

Barriers to Problem Solving

- Problem solving involves some sort of obstacle to overcome in the process of reaching a goal
- Fixation
 - An impediment to problem solving

Perceptual fixation

- Involves perceptual (visual/spatial) assumptions about the problem domain that blocks your ability to reach a solution

Mental Set

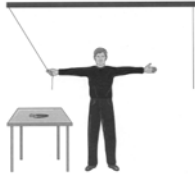
- Rule-based fixation
- Getting stuck on a set of rules to solve a problem

Problem	Given jugs of these sizes:			Measure out this much water:
	A	B	C	
1	21	127	3	100
2	14	46	5	22
3	18	43	10	5
4	7	42	6	23
5	20	57	4	29
6	23	49	3	20
7	15	39	3	18



Functional Fixation

- Getting stuck on a particular use for an object
- Can't see different use for an object which will enable you to solve the problem

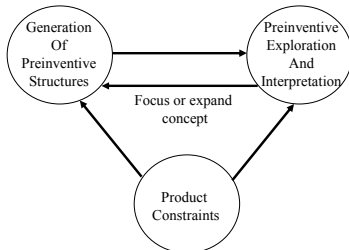


Creative Cognition (Finke, Ward, Smith)

- Adapted from cognitive psychology paradigms
- Examples
 - Visual Imagery – Creative imagery (Finke)
 - Mental set – Fixation (Smith)
 - Concept generation – Conceptual expansion (Ward, Sifonis)
 - Analogy – Creative analogy (Sifonis)

Geneplore Model

- Heuristic model of creative functioning
- Two stage model
 - Generate ideas
 - Explore ideas
- External constraints
 - Influence both stages



Geneptore Model: Processes

- Idea generation
 - Supported by generative processes
- Idea Exploration
 - Searching the generated ideas
- Creative thinking = various combinations of the two processes

Geneptore Model: Structures

- Operated on by processes
- Existing knowledge
- Preinventive structures
 - Formed in generative stage
 - Incomplete ideas that show promise
 - Symbolic visual patterns, 3-d forms, mental blends....

Geneptore: Assumptions

