Notes on "How to be Creative?!"

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16th May 2007

- Creativity in science: mechanical/technical process or something else?

How do Mathematicians Think? [4]

- Andrew Wiles on proofing Fermat's Conjecture:

  > "Perhaps I can best describe my experience of doing mathematics in terms of a journey through a dark unexplored mansion. You enter the first room of the mansion and it's completely dark. You stumble around bumping into the furniture, but gradually you learn where each piece of furniture is. Finally after six months or so, you find the light switch, you turn it on, and suddenly it's all illuminated. You can see exactly where you were. Then you move into the next room and spend another six months in the dark. So each of these breakthroughs, while sometimes they're momentary, sometimes over a period of a day or two, they are the culmination of—and couldn't exist without—the many months of stumbling around in the dark that precede them."

- This describes the elements:
  - The furniture represents the techniques and theorems
    - Locating furniture is a quite mechanical task
  - The light switch understanding
    - This is in a quite different dimension!

- Thus,

  > "The ultimate goal of mathematics is to eliminate all need for intelligent thought." [Ronald L. Graham]

  - Mathematicians follow strict formal logic
  - Use definitions, axioms and apply logical deduction
  - Is mathematics algorithmic thinking?

- Most books about mathematics show the furniture
  - This is sufficient to do mathematics, but without turning on the light you never understand it
  - Is doing mathematics / science a step-by-step procedure?
  - Only part of the story: a way to justify and present the results

- Mathematics is not just certainty without ambiguity or contradictions; it is also art: complex, ambiguous, creative.
  - Role of mathematics: eliminate ambiguity, contradiction and paradox
    - Explains the deductive, not the creative

- Creativity and understanding come from the problematic, out of ambiguity, contradiction, paradox
- The more ambiguous, the more (potentially) expressive
- Dare to do what appears to be impossible and is impossible by any reasonable standard

Synectics [1]

- Making connections: semi-formal system for being creative
  - But no recipe for creativity—this cannot exist
- Personal creativity [7]
  - Children are naturally creative, so what happened later?
  - Parents, teachers, experience, etc.: Experiments can be harmful!
  - Rational thinking has similar problem:
    * It works on known concepts, limited by the underlying (mathematical) models
    * Does not produce new concepts or patterns
  - Leads to
    * self-censoring: gradually internalise external rules
    * self-punishment: extinguishes risk-taking behaviour
  - Self-esteem: needed for freer thinking
  - Ideas that Form in the Mind
    * from habitual, standard patterns (the "obvious")
    * to the unusual, surprising (provides a "direction")
  - Acting on an idea:
    * Potential and threat now escalates
    * Anticipating potential threats can avoid finding new ideas in the first place
- Five Stages of developing an idea [2]
  1. Problem framing
  2. Direct effort to solve
  3. Putting the problem away
  4. Connection-making™, analogies, associations
  5. Developmental thinking

I. Problem Framing

- "If at first an idea is not absurd, then there is no hope for it"
  [A. Einstein]

(a) Curiosity/Puzzlement, Paradox, Contradiction

- Polio vaccine:
  * "In 1936, somebody said something that seemed paradoxical to me meaning that the two things that were said didn't fit together. They had to do with whether or not you had to experience infection in order to develop immunity to a virus disease. I put that in the back of my mind."
    [Jonas Salk, 1936]

    - “Is it or is it not true that you must first be infected to become immune?” [Jonas Salk, 1939]
    - Approx. 20 year later this lead to polio vaccine
  - Quantum mechanics: complementarity
  - Pasteur:
    - Grapes did not ferment until their skins cracked
    - Lead him to conjecture that infection resulted from micro-organisms entering the body
  - Einstein:
    - observed that he appeared to be travelling backwards when another train going in the same direction passed his moving coach
  - Ambiguous contrasted to the deductive

(b) Problem recognition

  - Notice the unusual, irrational, beyond the current model / rationality of mathematics
  - State of sustained confusion
  - Einstein: six years of confusion before he felt he was right about relativity.

(c) Problem identification

  - Problem becomes fully defined: discover the right question

Creativity Exercises [7]

- State a problem
  - First state the problem, then give the details afterwards
  - Co-operation: Explain problem to other people
  - Too much information is not good, more confusing than helpful to find new ideas
  - People will form their own ideas, e.g. while listening to you
  - Results in list of initial ideas (headlines)
- Wishing, dreaming
  - Extravagant wishes of a child, not limited by what is possible
  - Suspend judgement!
  - Think of a problem and come up with 25 wishes in 10 minutes; stretch for a few
  - Polaroid

    ”I wish that pictures would develop themselves right in the camera” [wish of George Land’s daughter]
  - Post-it Notes: bookmarker in Art Fry’s hymnal wouldn’t stop slipping; wished it would stick to the page.
- Imaging
  - Describe images/senses: sights, sounds, smells, taste, touch
  - "Uncle Ebeneezer trudged in the ditch, jogging from side to side like an old ploughman coming home from work. He never said a word the whole way." [R. L. Stevensons]

  - What images come to mind? How did Uncle Ebeneezer look like? What was he wearing? What sort of day is it? What is the quality of the silence? Can anything be heard? Can you describe the smells and sounds and sight sin the scene?
  - Use excursion, improvisation, analogy and metaphor, based on images:
    * Image the problem as a scene in a movie.
    * Picture the entire scene in your mind.
    * Who are the main actors? Who are the secondary ones? What are their relationships? What is the main plot? Subplots?
    * Now play with the scene: new plot twists; different roles for characters

- Discontinuity
  - Mind aims to create order in confusion, based on known patterns
  - Get out of habitual patterns!
  - The exquisite corpse
    * Piece of paper folded several times
    * First artist starts drawing lines on one side, leaving lines to extend around the edges
    * Next artist does the same on new side connecting with lines from other side
    * Repeat and eventually unfold the paper
  - Verbal analogue:
    * Start telling a story, but add discontinuity in story
    * Next person continues, but has to increase the incidence of discontinuity

- Improvisation
  - Bring together thoughts that are incompatible, known *not* to cohabit mind easily
  - Exercise in creating and resolving ambiguity simultaneously
  - Use three random objects as the principle elements of a story; add more random objects as you continue writing up; write some objects out of the plot again, and so on...

- Insight
  - Stop seeing the usual way, and trust your insight: walk backwards, look at painting upside down, see music, feel prose, ...
  - Create confusion, ambiguous situation to find a new order
  - > "And this is the simple truth: that to live is to feel oneself lost. He who accepts it has already begun to find himself, to be on firm ground. Instinctively, as do the shipwrecked, he will look around for something to which to cling; and that tragic, ruthless glance, is absolutely sincere because it is a question of his salvation, will cause him to bring order into the chaos of his life. These are the only genuine ideas, the ideas of the shipwrecked. All the rest is rhetoric, posturing, farce."
    > [Soren Kierkegaard]

II. Direct Effort to Solve

(a) Preparation: fact find, consult, reflect

(b) Think about solution: attempt solutions through experiments using relevant information and logical processes

(c) Head against the wall: temporary failure, dissatisfaction with results, frustration and giving up

- Reframe evaluation
  - Follow learned way to evaluate ideas for relevance, and feasibility?!
    - Build a hypothesis, attack it with vigour, and repeat until a hypothesis can stand all attacks
  - Be friendlier to your ideas, do not find the faults!
  - Develop the wishes / ideas:
    - What if scenarios?
    - Ask: How to...
    - Try to answer with: What you do is...
    - Select an idea on intrigue, intuition, continue to develop
- Defer closure on final solution
  - Creative people go wherever a new idea takes them, change directions; final decisions are put off; work is seldom, if ever, considered to be completed, just put aside
  - Forced-plus / next-step exercise:
    - Given two solutions
    - List four benefits for each idea OR list next steps to execute the solutions
    - think about the ideas again, do you see them in a better light?
  - Serial building:
    - Choose an interesting idea
    - Think of a way to improve it, and then put it away
    - Come back to the idea later, add an improvement, put it away, repeat...
    - Synthesise all improvements into another solution

III. Putting the Problem Away

- Give up on solution temporarily and do something else
- There is more going on: subconsciousness still works on the problem and makes connections

IV. Connection-Making™

- Main idea to find ever new ideas
  - Connections are barely visible; just about conscious
  - Have to pass the self-censor to become conscious
  - Accidental connections
- Some connections:
  - George de Mestral: Velcro fastening from Burdock seed, which kept sticking to his clothes
- Alastair Pilkington: Plate glass-making process from soap film on water during washing up
- Thus,
  - Instead of using the often successful synthesising pattern, give up and put the problem out of mind
  - Allow new, seemingly irrelevant information to occupy your attention
  - Find ways in which the new information connects to the problem

  - Work on the connections to build a new idea for a solution to the problem
  - Use analogy, metaphor and absurdity, ambiguity to forge new connections

- Exercise:
  - Place some random objects on the table
  - Write down associations from looking at/feeling/smelling/tasting objects
  - Circle the third word/phrase from your notes
  - What new ideas does this word/phrase suggest regarding the task?
  - Express as a wish with some background, add to list

V. Developmental Thinking

- Structured reasoning about problem: rational, judgemental and critical thinking
- To be intelligent is to be critical, discerning, judgemental, able to draw conclusions, and to prove and disprove with reasons
- But that's only at most half the truth
- Iterative process of refinement:
  - Select an idea based on intuition
  - Identify benefits
  - Identify biggest concerns: How to...
  - Ideas to address concerns: What you do is...
  - Select from What you do is...
    and form headline/wish to modify original idea and form emerging solution
  - Repeat...

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