Scientific Creativity
(by example)

Marek J. Drużdżel

Politechnika Białostocka

Wydział Informatyki

m.druzdzel@pb.edu.pl
http://www.wi.pb.edu.pl/~druzdzel/

Eighteen fundamental skills of a scientist

1. How does science work?
2. What is research?
3. Identifying good research problems
4. Writing papers
5. Presentation in front of an audience
6. Obtaining funding
7. Reviewing/refereeing the work of others
8. Teaching
9. Guiding students, running a lab, managing projects
10. Scientific creativity
11. Information finding
12. Career planning
13. Interacting with people and networking
14. Marketing your skills: job hunt
15. Balancing your life between work and family
16. Coping with stress
17. Ethics in science
18. Appreciation for quality rather than quantity

Overview

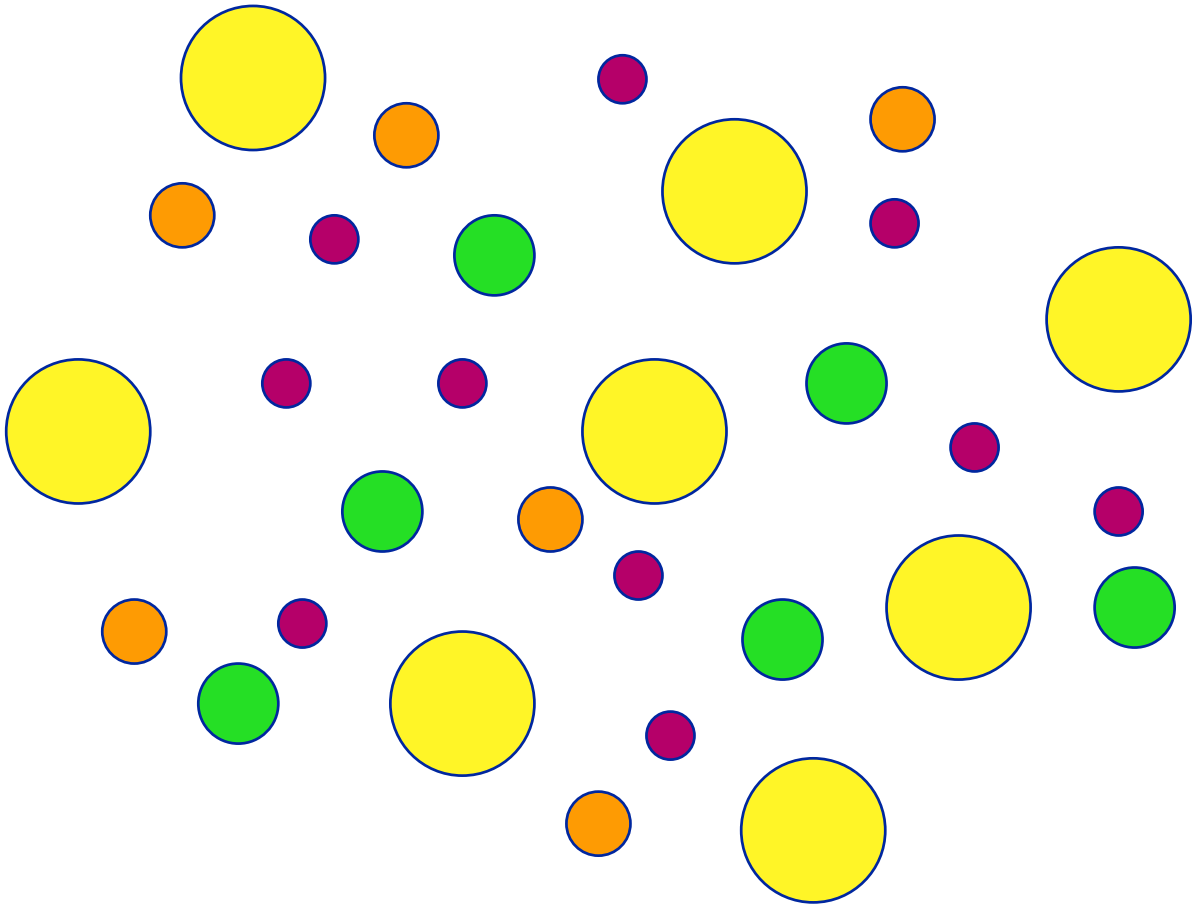
- Creativity
- Craig Kaplan's work on incubation
- Marcin Druzdzel's writings
- Adolf Grünbaum's work on Freud
- Concluding remarks

Green dots

I'll show you a picture with dots

Could you answer how many green dots are there on the picture?

Green dots



Green dots

How many yellow dots were there in the picture?

Please note that the yellow dots were much bigger and should have drawn your attention!

Why is creativity important?

You say you are in the 99th IQ percentile?

That's quite smart!

Only 55,000,000 people are smarter than you!

Being creative is more valuable than being smart.

Correlation between intelligence and creativity seems low enough to justify treating these two as distinct concepts.

Why creativity?

If I was able to bias your perception with a 10 second indoctrination. Think about the effect that your 14+ years of schooling had on you ...

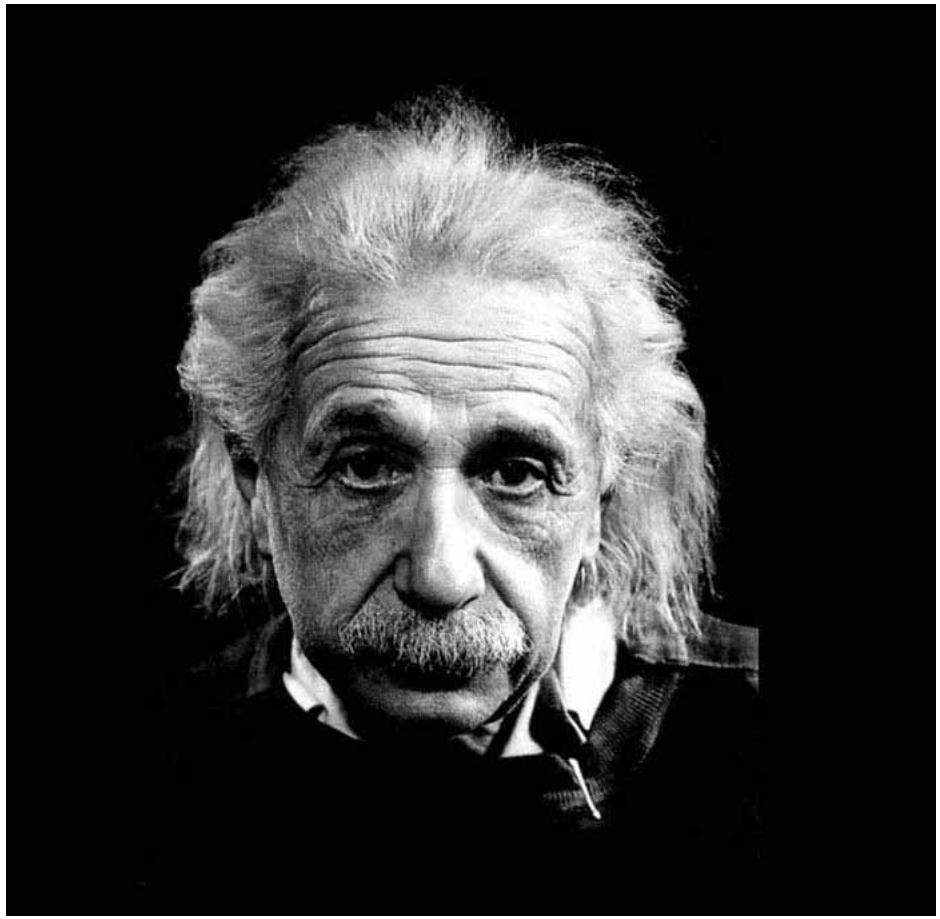
Why creativity?

- You have spent years learning how to solve problems ...
- ... but not how to find them
- … or how to find novel solutions to known problems.
- Creativity should pay off generously in your scientific output.

Why creativity?

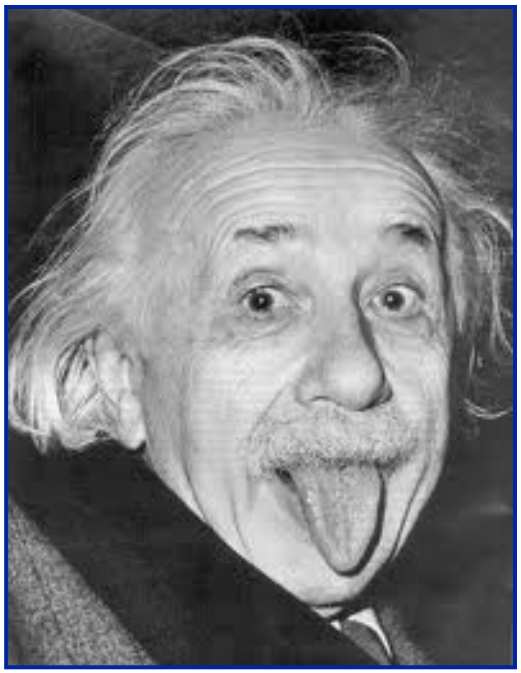
"Imagination is more important than knowledge. For while knowledge defines all we currently know and understand, imagination points to all we might yet discover and create."

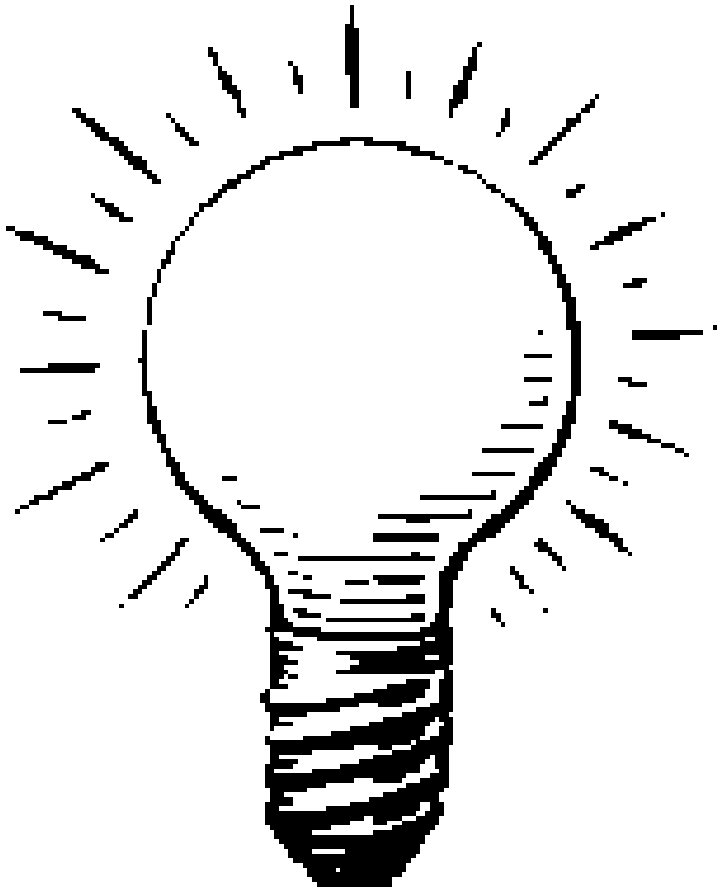
Albert Einstein (1879-1955)



The importance of creativity

- Creativity is very important in doing almost everything
- How do you become creative?





What is creativity?

Creativity: The ability to develop novel, insightful, clever, unique, different, or imaginative idea.

(Must be effective in the sense of satisfying objectives!)

Source: Robert T. Clemen "Making Hard Decisions: An Introduction to Decision Analysis"

Theories of creativity

Psychoanalytic theories:

- Creative productivity is the result of preconscious mental activity.
- Our brain processes information at a level that is not accessible to our conscious thoughts.

Behaviorist theories:

- Our behavior (including creative behavior) is a conglomerate of responses to environmental stimuli.
- Appropriate rewards (stimuli) can lead to more creative behavior.

Cognitive theories:

- Creativity stems from a capacity for making unusual and new mental associations of concepts.
- Creative responses arise from novel combination of stimuli.

Creativity as self-actualization:

- Relates creativity to other qualities of human personality.
- Self-actualization, mental health, and happy lives go together.
- Everyone can develop creativity and work toward self-actualization and the enhanced creative potential it entails.

Phases of the creative process

Four Stages of the Creative Process

1. **Preparation or Problem Definition**
   - Obtain a broader perspective through a wide search for information.
   - Clarify the problem that needs to be solved.
   - Analyze the resources for addressing the problem.
   - Identify missing resources.
   - Gather additional resources.
   - Assess assumptions made about the problem.

Consequences of lack of preparation

- Solve the wrong problem.
- Make assumptions that obscure the real solutions.
- Work on problem without adequate resources.
- Solve the short term but not the long term problem.
- Cannot identify interesting and significant problems.

Phases of the creative process

2. Incubation

- A lateral thinking process cf. a vertical, logical, analytical process.
- Explore unusual alternatives.
- Eliminate restrictive assumptions.
- Elaborate problem definition.
- Think about problem in divergent ways.
- Focus on low-probability, high-payoff alternatives and think creatively and flexibly.

3. Illumination

- Culmination of the incubation stage.
- New ideas appear in a flash of insight.
- All of the pieces fall into place.

4. Verification

- Apply logical and reasoning steps to rigorously test the validity of the innovation.
- May fall prey to the confirmatory trap and overconfidence.
- Should search for disconfirming evidence.

Blocks to creativity

- Creativity is impaired by several heuristics and assumptions that are normally helpful in our lives but that have the potential to block creativity.
- The key to being creative is to break these blocks.
- Need to systematically address the biases to solve problems that require novel solutions.

Blocks to creativity

Perceptual blocks:

Result in failures to see and understand problems in ways that allow for new solution approaches.

Emotional blocks:

Uncomfortable emotions that prevent creative activity.

Cultural blocks:

Valuable alternatives may be impossible to see because they violate some of the cultural norms.

Environmental blocks:

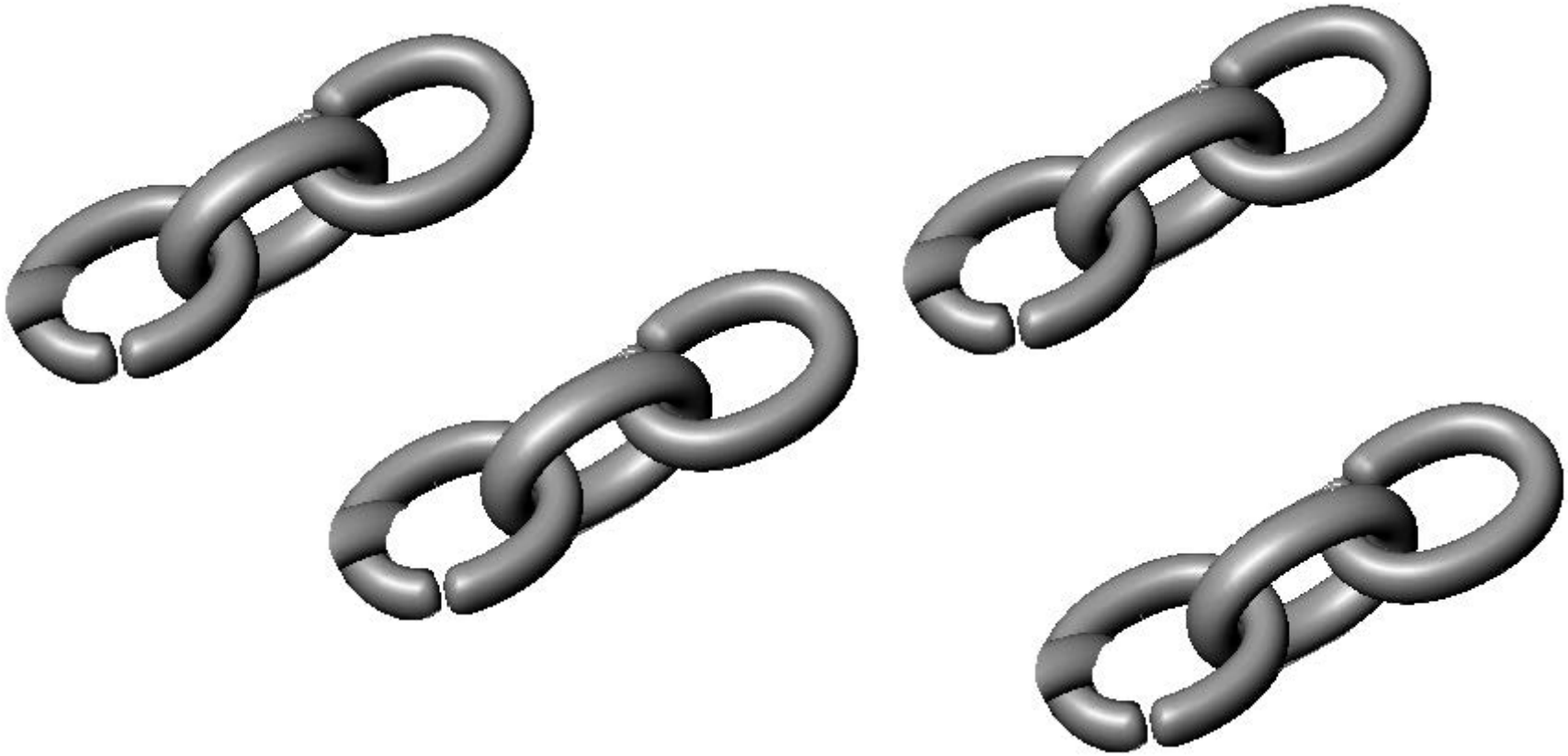
Work environment or problem situation may affect creativity.

Blocks to creativity: Perceptual blocks

Result in failures to see and understand problems in ways that allow for new solution approaches

1. **Stereotyping.**
   - Fit observations into a standard category or stereotype
   - Cannot adapt when new information presents itself
2. **Tacit assumptions.**
   - Are the constraints that you impose on yourself appropriate? Haven't you delimited the problem area too closely?
3. **Inability to understand a problem at different levels.**
   - Inability to isolate the precise decision context.
4. **Inability to see the problem from another person's perspective.**
   - Important when decisions involve multiple stakeholders. For example, finding a meaningful way to achieve peace in the Middle East requires the parties to consider the interests of Israelis, Palestinians, and other nations in the region.
5. **Saturation.**
   - Attention to a large amount of information may be overwhelming.

Opening the links



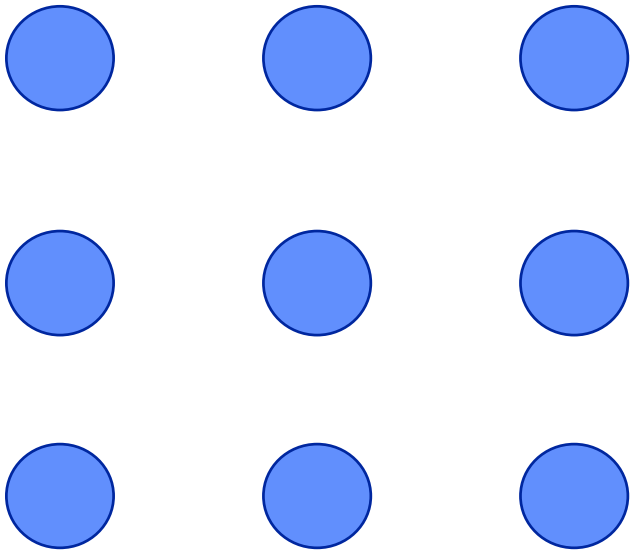
Connect the four segments into one chain (a loop) by opening and closing only three links.

Monk and the mountain

At down one day, a monk begins to walk along a path from his home to the top of the mountain. Never straying from the path, he takes time, traveling at various speeds, stopping to rest here and there, and arrives at the top of the mountain as the sun sets. He meditates at the top of the mountain overnight and for the next full day. At dawn the following morning, he begins to make his way back down the mountain along the same path, again relaxing and taking his time, and arrives home in the afternoon.

Prove that there is a spot along the path that the monk occupies at the same time of day going up and coming down.

Nine dots problem



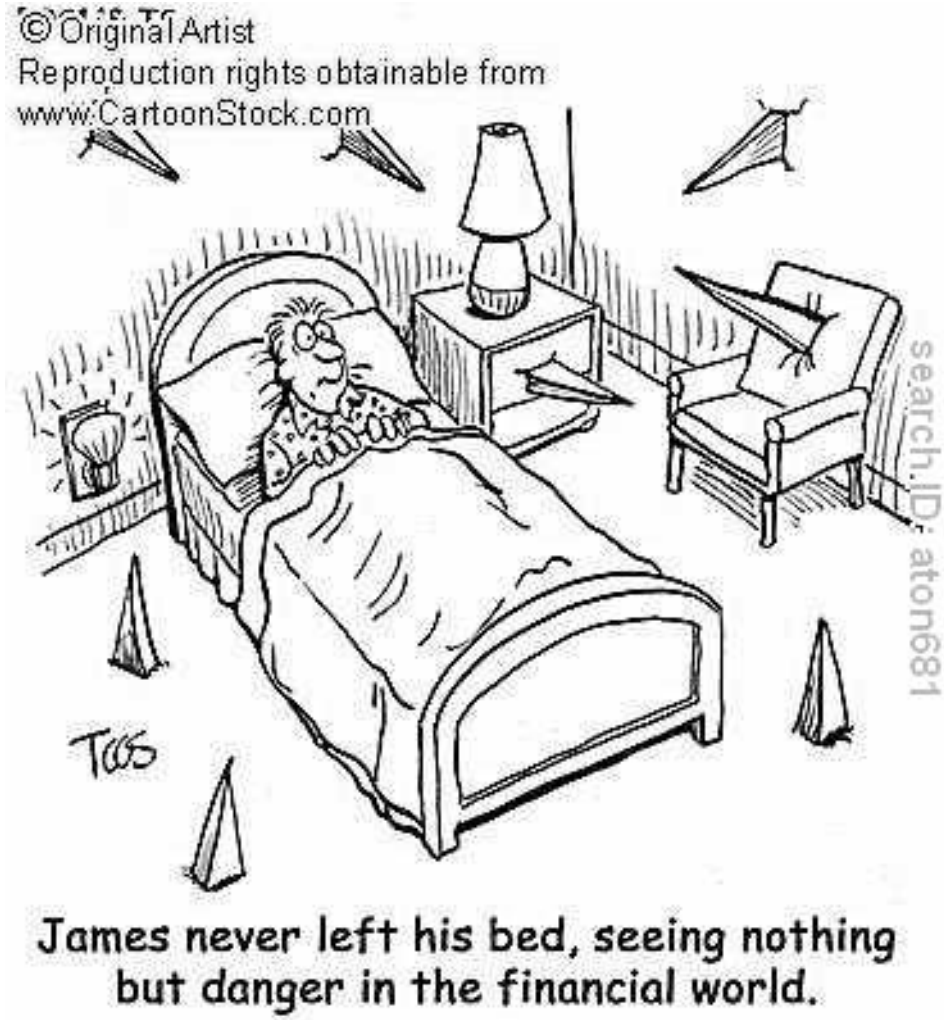
Connect the nine dots with only four lines (without lifting your pen off the paper).

Blocks to creativity: Emotional blocks

Uncomfortable emotions that prevent creative activity

1. Fear of taking a risk.

Being afraid to offer a creative alternative because it appears "far out" may be counterproductive.



Blocks to creativity: Emotional blocks

2. **Status quo bias.**

   Many people have built-in bias towards status quo. The stronger the bias, the more difficult it may be to come up with creative alternatives.

3. **Reality versus fantasy.**

   Individuals may have a psychological block that prevents fantasizing.

   Creative people must be able to control their imagination, and they need complete access to it.

Blocks to creativity: Emotional blocks

4. **Judgment and criticism.**

   Prematurely judging ideas can prevent new ideas from maturing and gathering enough detail to become usable.

Blocks to creativity: Emotional blocks

5. Inability to incubate.

Incubation requires allowing ideas to develop in a non-restrictive way; relaxation and getting away from the problem may be necessary sometimes.

People who feel that they must work at the problem all the time until they find a solution may eliminate the creative potential of incubation.

"There's no time for thinking. We have to make a *management decision*."

Blocks to creativity: Cultural blocks

Valuable alternatives may be impossible to see because they violate some of the cultural norms

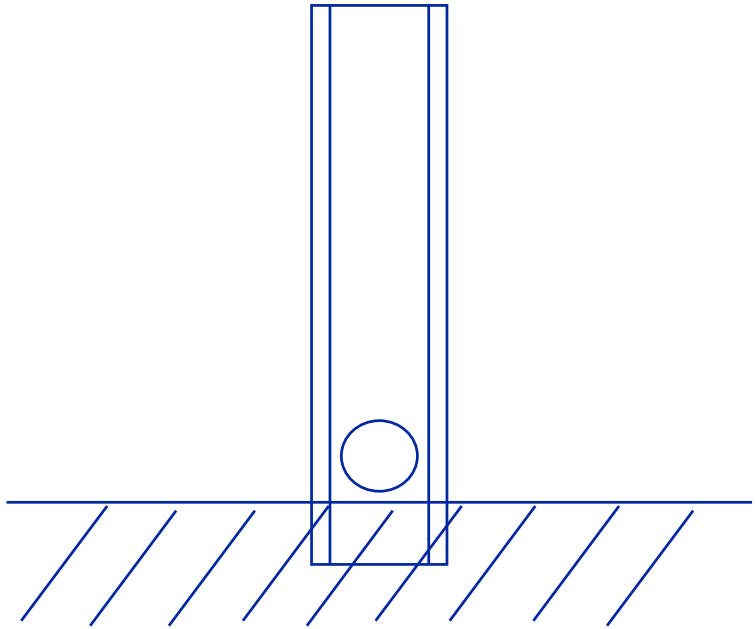
1. **Taboos.**

   Proper or acceptable behavior in a culture may prevent some creative solutions to be considered

Assume that a steel pipe is embedded in the concrete floor of a bare room. The inside diameter is 0.06 inches larger than the diameter of a ping-pong ball that is resting gently at the bottom of the pipe.

You are one of six people in the room, along with the following objects:

100 feet of clothesline, a hammer, a chisel, a box of corn flakes, a file, a wire coat hanger, a monkey wrench, a light bulb.



Blocks to creativity: Cultural blocks

2. **Humor, playfulness, fantasy, and reflection.**

   Characteristics are usually not encouraged in many cultures or organizations that deal with "serious problems."

3. **Prevalence of reason and logic.**

   Block against using feelings, intuitions, and emotions in many "serious" problem solving situations.

4. **Artistic thinking skills.**

   Too much emphasis on analytical thinking.

   Little effort is put into more artistic thinking skills involving attributes such as beauty, sensitivity, playfulness, openness, subjectivity, and imagery.

   Ability to switch thinking skills permits creative development of potential solutions and subsequent careful analysis of the possibilities.

5. **Tradition and change.**

   Ability to learn from history and to adapt for new changes is crucial for effective decision making.

   People are often reluctant to deviate from traditions.

Blocks to creativity: Environmental blocks

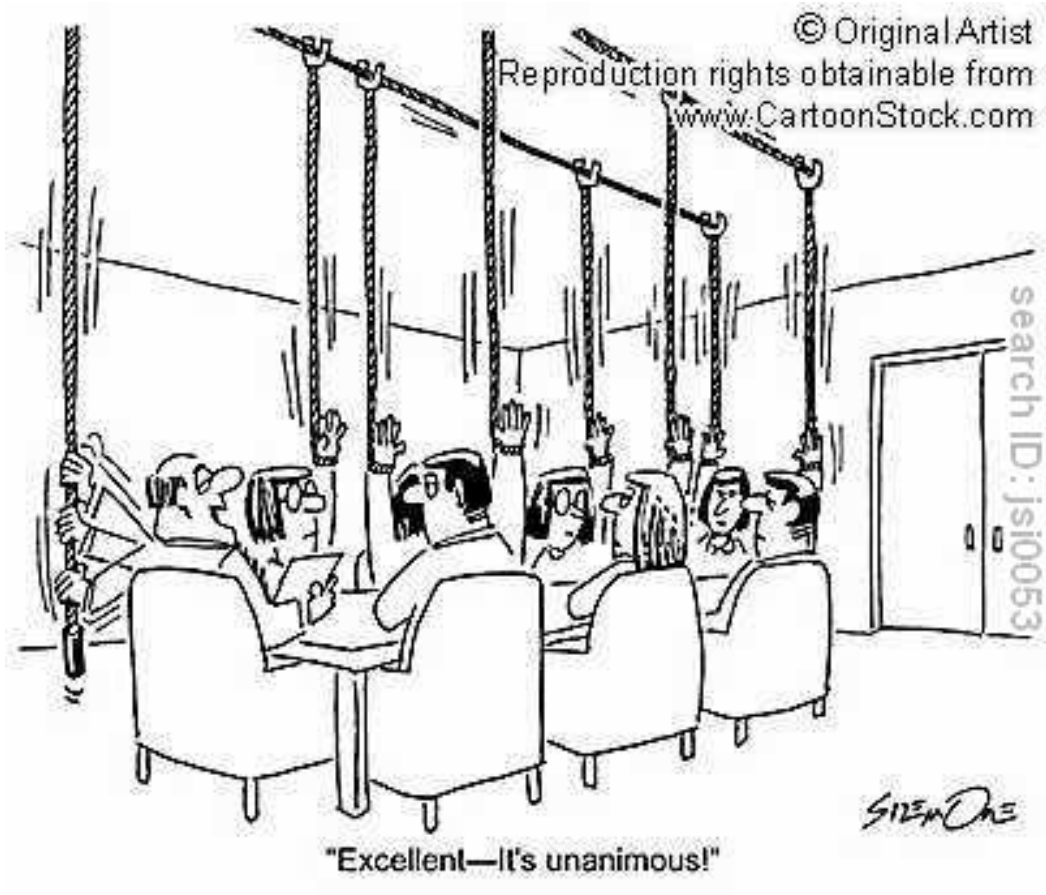
Work environment or problem situation may affect creativity

1. **Non supportive environment, criticism, and judging.**
   - **Supportive environment and good interpersonal relationships encourage creativity**
   - **Excessive red tape, lack of trust and cooperation among workers, excessive judgment of new ideas, and general intolerance of change all contribute to a non-supportive environment**

Blocks to creativity: Environmental blocks

2. Autocratic bosses.

Who may be creative themselves but stifle the creativity of the staff members



Blocks to creativity: Environmental blocks

3. Organizations.

Hierarchical structure and bureaucracy may suppress creativity

There is a natural tendency for organizations to routinize, decrease uncertainty, increase predictability, and centralize functions and controls

Creativity enhancement techniques

- A questioning attitude
- Assumption breaking
- Sub-goal identification
- Process analysis
- Fluent and flexible thinking
- Idea checklist
- Brainstorming
- Metaphorical thinking

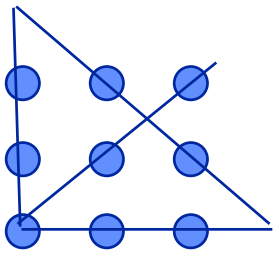
Assumption breaking

Our limited rationality le ptions that reduce the complexity of the proble ame time block creativity.

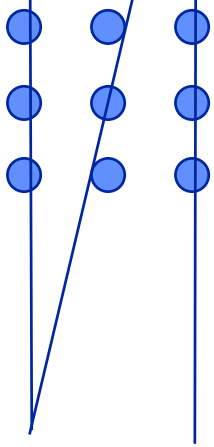
We may miss the optimal sol we never considered the optimal solution as feasib

An awareness of the assumption-f cess can reduce this limitation by cognitively searc ssumptions behind a decision.

Example: Answer to the nine-dot problem



If we make the dots larger and lines thicker, we can do it with three lines.



… or even one line

Assumption breaking

Process analysis

Used in situations in which we cannot understand how a particular circumstance arose.

Gain insights by separately thinking about the processes that are involved.

Go beyond surface evidence used in rational models.

Example:

Ten male senators are on their way to the Inaugural Ball. A crowd of disgruntled taxpayers attacks them with a volley of snowballs, knocking each senator's top hat to the ground. A helpful page retrieves the hats and hands one to each senator –but without checking to see who owns which one. What is the probability that exactly nine senators will receive their own hats?

Fluent and flexible thinking

Fluency:

Ability to come up with many new ideas quickly.

Flexibility:

Stimulates variety among these new ideas.

A flexible thinker may have a shorter list of ideas, but the ideas would tend to cover a broader range of possibilities.

Example:

Marketing ideas that a brickyard owner could pursue to get out of financial difficulties:

Fluency – A list with many uses that are variations on a common theme, e.g., ways to use brick to build things; uses that take advantage of a brick's weight

Flexibility – A list with a lot of variety in different attributes of the bricks, e.g., uses that take advantage of many attributes of the brick such as strength, weight, color, texture, hardness, shape, etc.

Idea checklist

Use checklists that cover many potential sources of creative solutions to problems.

- Idea-spurring questions

Write down attributes of a problem, list alternative options under each attribute, and then consider various combinations and permutations of the alternatives.

- Morphological forced connections technique: framework within which all imaginable combinations of ideas can be screened easily to determine the most appropriate candidates.
- Strategy-generation tables: list mutually exclusive possibilities with respect to each attribute in columns of a table; create a strategy by choosing one of each column.

Brainstorming

A quick way of generating long lists of ideas quickly by a group of people (at least two and no more than 8 or 10).

The rules for a brainstorming session:

- No evaluation of any kind is permitted.
- All participants should think of the wildest ideas possible.
- The group should be encouraged to come up with as many ideas as possible.
- Participants should try to build upon or modify the ideas of others.

Lack of judgment eliminates an important block for many people. The enthusiasm of a few individuals tends to be contagious. Usually the first phase generates common solutions, later new concepts emerge.

Craig Kaplan's work on incubation

It is, I believe, an excellent example of a creative piece of work. It happened right in front of our nose and quite recently (1989)

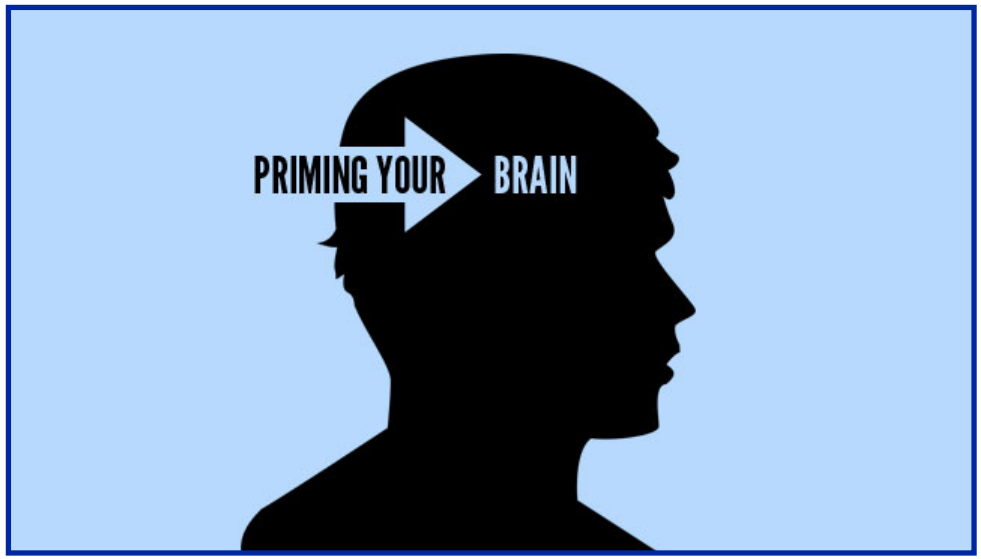
Craig Andrew Kaplan,
Ph.D. Dissertation
Department of Psychology
Carnegie Mellon University

Goals of the dissertation

- **Situation:**
  - We have all experienced situations when we have been working on a tough problem that we couldn't figure out. After taking a break, we find that the answer is very obvious.
- **Question:**
  - "Does putting a problem aside to 'incubate' really help?"
- **Goals:**
  - Establish incubation as a reliable phenomenon
  - Understand the cognitive mechanisms that underlie incubation effects
  - Introduce new methodology for studying incubation in valid settings
  - Illustrate the power of a unified theoretical approach for explaining literature

Theories of incubation

- Unconscious work
- Conscious work that is later forgotten
- Recovery from fatigue
- Forgetting
- Priming
- Maturation
- Statistical regression



Unconscious work theory

- **Oldest theory** of incubation (Poincare 1908)
- Based on the view of attaining insight **"out of the blue"** when we were not thinking about a problem
- Poincare suggests the **"subliminal self"** forms combinations of ideas that have been "mobilized" by previous conscious work
- **Problem** of this theory – vagueness makes unconscious work unsatisfactory explanation of incubation

Conscious work theory

- Opposite spectrum of unconscious work theory
- Individuals periodically work consciously on a problem during their break (during incubation)
- **Example** – while reading a book, you stare at the same page for an hour because your mind keeps going back to the problem you were working on
- **Problem** – incubation studies control the ability of one reverting to thinking about the problem they were working on by providing subjects with demanding tasks during the interruption period

Recovery from fatigue theory

- People revert to incubation because of fatigue and the need to recover from it
- Fatigue definitely affects problem solving
- Problem – fatigue is an ill defined term. Everyone has a different level of fatigue

Forgetting theory

- Getting rid of false leads and bad assumptions in order to approach the problem with an open mind (Woodworth, 1938)
- When one removes themselves from the task for a time, information held in short-term memory begins to disappear. When the person begins to work on the task again, the finer twigs of the "goal tree" has disappeared. The person is forced to begin their thinking at a higher level of the tree, thus they have a "renewed examination" of the problem (Simon, 1966)
- Knowledge gained during the initial failures allows the re-evaluation of the problem at a more intelligent level
- There must be time for entanglement in a wrong approach before forgetting can assist the problem solver

Priming theory

- Between the time work is stopped and the time it is resumed, the problem solver may have unrelated experiences that help solve the problem
- Example – Franklin desired to show lighting was electricity by attaching a lighting rod to a spike. The spike construction was delayed. During that time, Franklin thought of relaxing moments during childhood when he floated on his back in a lake being pulled by a string attached to a kite. Such memory gave Franklin the idea of sending a kite up into an electrical storm (Koestler, 1964)
- Irrelevant events can affect problem solving behavior

Maturation theory

- Maturation in terms of "gained experience" and "biological growth" may have a place in incubation
- Changes in perspective that accompany aging and expertise plays a role in problem discovery
- Problem – experiments do not last a sufficient time to prove this theory

Statistical regression theory

- If an initial attempt to solve a problem results in failure due to the problem solver performing below their normal ability, the next attempt will be more successful due to regression
- "People have good days and bad days." A bad day followed by a good day often looks like incubation
- Problems
  - Specification of "good day" and "bad day" is not absolute
  - Most studies compare mean performance of groups of subjects

Incubation in an ecologically valid setting

- Incubation studies often are performed in a lab setting for a couple of hours – not long enough to speak of incubation
- The question is do the results obtained in such a setting adequately describe what occurs in the real world?
- A better setting might be for subjects to be observed while working on problems for several days or weeks
- One of the experiments described within this paper attempts to discover if the theories of "forgetting" and "priming" are responsible for incubation

Incubation experiment

- **Subjects**
  - Four professors in the Psychology Department at Carnegie Mellon University
- **Materials Used**
  - Pocket pager
  - Compact cassette recorder / lapel microphone
  - 14 puzzles and riddles
  - Chalkboards in bathroom stalls
  - Polaroid camera
  - Telephone and computer access in subjects' office

Incubation experiment

Procedure:

- Subjects were to participate in experiment for five consecutive days
- Subjects carried beepers and recorders
- Subjects were asked to read and attempt to solve the 14 puzzles and riddles at least once a day
- Computer program would randomly beep each subject 10 times (on average) a day during a 12 hour period – no sooner than 40 minutes; no longer than 2 hours, from previous beep
- When beeped, subjects were to record what they were thinking at the time they were beeped
- Before turning off the recorder, subjects were to state the time and indicate where they were at

Incubation experiment

Procedure (continued)

- Subjects were encouraged to record themselves when reviewing the puzzles, or when they had insight on a puzzle or a real world problem
- Subjects were primed on puzzle solutions via
  - Graffiti on chalkboards
  - Telephone calls from strangers
  - Posts on the psychology department's computer bulletin board
- Priming began on the third day of the experiment and grew progressively more directive as the study continued
- One week after the start of the experiment, subjects were debriefed.
- 12 and 30 days later, they were given a recall memory test

Incubation experiment

Stated Hypothesis

- Subjects were told the study would answer questions such as
  - What is the relationship between a person's environmental context and their thoughts at a given moment?
  - Do problems recur from time to time until they are solved?
  - What distinguishes problems that recur from those that are forgotten?
  - Under what circumstances are people likely to have their most creative thoughts?

"Secret" Hypothesis

- Subjects would under estimate the amount of time devoted to some of the puzzles and real world problems (during the recall session)
- Priming might occur without the subject being aware of the source

Experimental results

Forgetting Expectation

- Over time subjects forget the details of what they do
- The amount of time one spends on something is underestimated

Actual Results

Subject	Days after debriefing	Beeps Recalled / Actual Beeps	Estimate of time taping / Actual time spent taping
1	12	12 / 34 (35%)	No Taped work
2	13	11 / 33 (33%)	113 / 49
3	17	19 / 45 (42%)	19 / 22
4	30	10 / 49 (20%)	23 / 22

Subjects did seem to forget the details of work episodes, but did not underestimate the time spent on problem solving.

Experimental results

Priming Expectation

- Subtle primes could produce incubation effects

Actual Results

- 64% of primed puzzles were solved
- 25% of unprimed puzzles were solved
- Subjects did not connect the "primes" with the puzzles until after they arrived at a solution

Priming more than doubled problem solving success rate.
Priming does result in incubation effects.

Experimental results

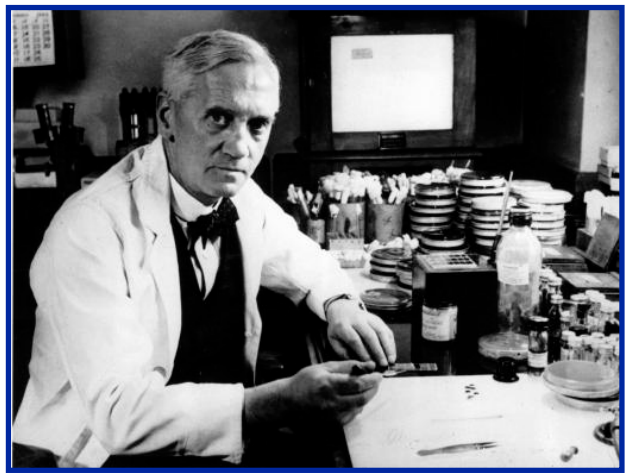
Summary

- Experiment was designed to test if the mechanisms of forgetting and priming might account for incubation effects over a period of days
- Limited support was found for the hypothesis that incubation may be due to forgotten conscious work
- The hypothesis that primes could cause incubation effects was strongly supported by the problem solution results
- It is confirmed that priming operates over ecologically valid time periods
- Often priming didn't result in a solution until a few days had passed – this may explain why so many insights appear to come "out of the blue"

Surprise comes to a prepared mind: Fleming and the discovery of penicillin

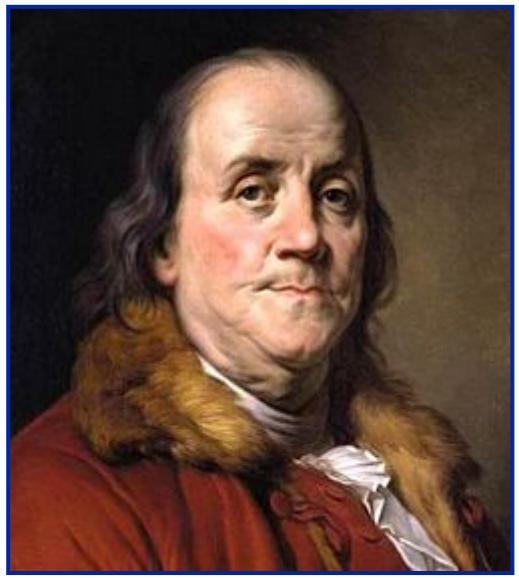
Alexander Fleming (1881-1955)

- Built a reputation of a brilliant researcher, although quite untidy.
- In 1928, after a month-long vacation, he returned to his lab to find quite a lot of "development" around his cultures.
- He examined what has grown around the cultures
- Fungus that formed on one of them seemed to kill bacteria around it.
- The rest is history (knighthood in 1944, Nobel 1945, his discovery has been called one of the most influential discoveries in the history of science).



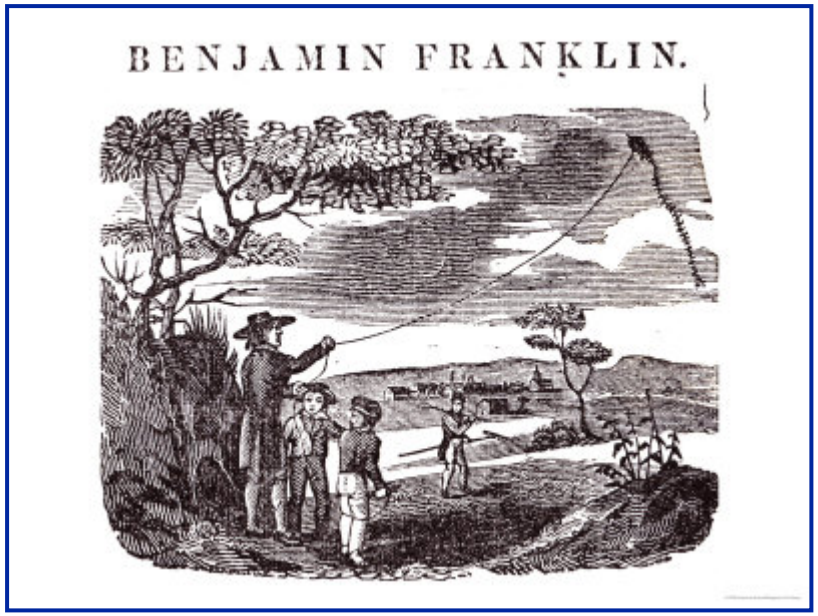
Fleming's discovery of penicillin

Example of personal experiences: The kite experiment



Benjamin Franklin (1706-1790)

- In 1750 he published a proposal for an experiment to prove that lightning is electricity by flying a kite in a storm that appeared capable of becoming a lightning storm.

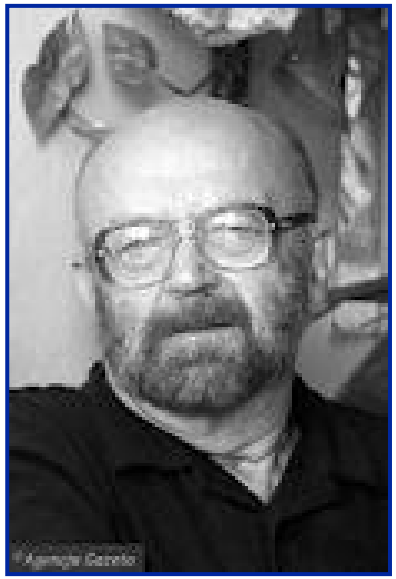


Example of personal experiences: Are people utility maximizers?

Herbert A. Simon (1916-2001)

- During an internship at a local Milwaukee government he observed a serious discrepancy between economic theories (based on the assumption that humans maximize their utility) and reality.
- Developed the theory of bounded rationality: Humans do not optimize, they "satisfice"
- Once he saw a computer, he quickly realized its potential and adopted it as a "secret weapon"
- Pursued this idea through theory of organizations, economics (Nobel Prize in Economics, 1978), artificial intelligence (Turing Award, 1975; von Neumann Theory Prize, 1988), and psychology (National Medal of Science, 1986)

A surprising set of consequences of a childhood experience.

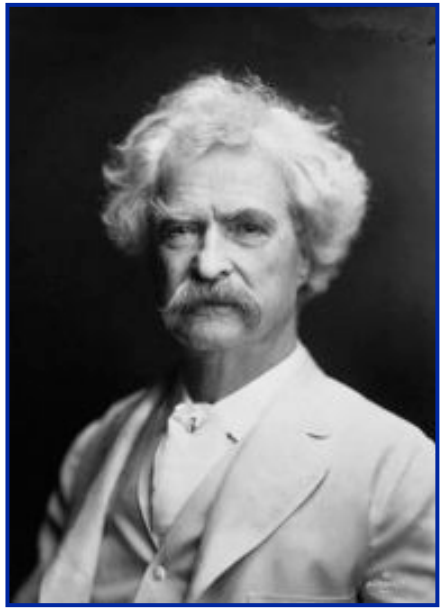


Bogdan Adamczyk (1930-2011)

- Stuttered as a child
- Discovered that stuttering ceased when he talked to a well in his parents' garden
- As a physicist, focused on finding therapy for stuttering, created an original method of "echo therapy" based on providing patients their own voice with a small delay
- Very successful as a scientist

"Chance prefers a prepared mind"

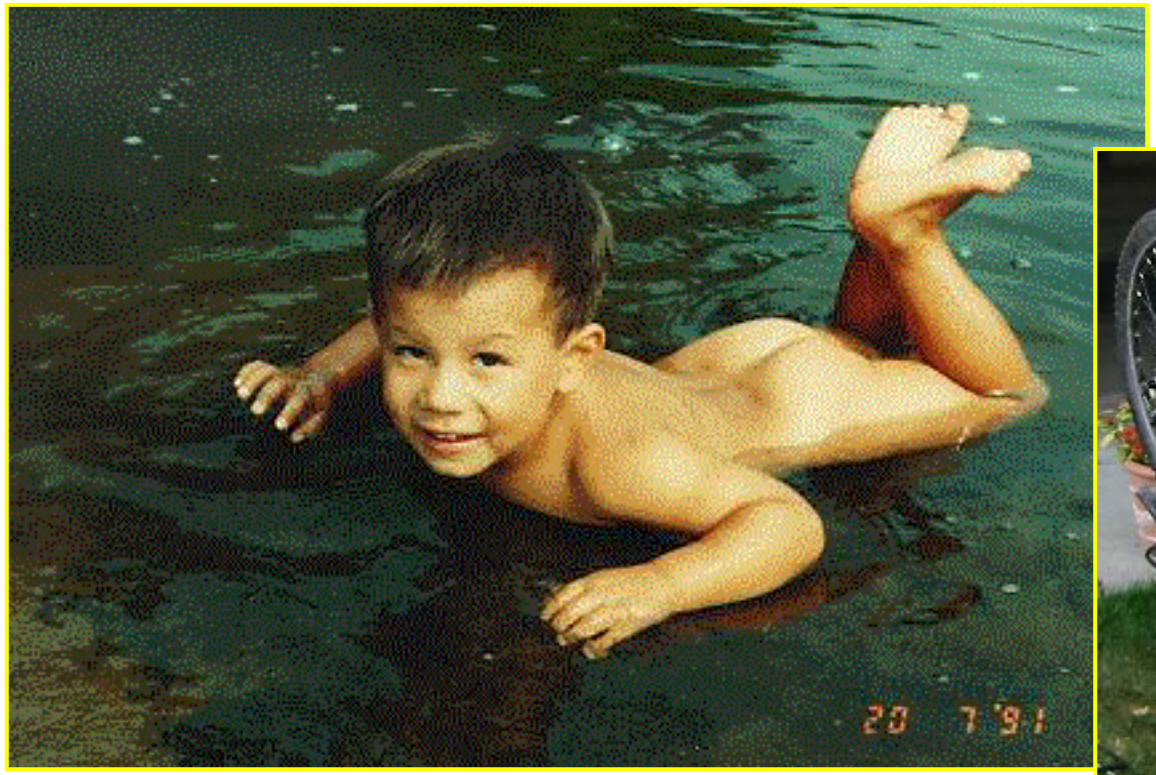
"The man who does not read has no advantage over the man who cannot read." [Mark Twain]



What made Fleming look at the dishes and notice something unusual?

Learn as much as you can and as diverse knowledge as you can!

Marcin Druzdzel's early writings



"The Story of the Ship That Blew Up in a Storm"
(proudly primed by Disney's "Little Mermaid")

Grünbaum's work on Freud

Grünbaum's work on Freud

The paper is a little hard (I find it hard myself) but it is part of the culture — philosophers use difficult language, they never use visual aids, seldom talk without reading a paper. You are supposed to be able to catch the meaning and follow the argument by just listening.

Freud was an excellent writer, but he was at the same time a sloppy thinker.

The paper attacks something that might seem very hard to attack: Freud's theory of dreams. Freud was considered by Popper not scientific because his theories did not seem falsifiable, like Marxism, you can explain everything using his theory and there is no way to test it. Grübaum does it much smarter. He says "well, Freud's theories are testable and falsifiable, but unfortunately for Freud, most tests come out unfavorably."

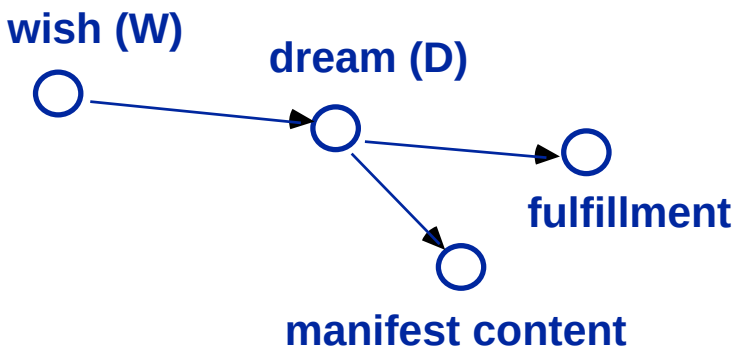
Grünbaum's work on Freud

What is the theory of dreams? It says that all dreams are fulfillment of unconscious wishes. In Freud's theory, dreams have two contents. The latent content consists of ideas, thoughts, and wishes behind the dream. The manifest content is the dream itself. The latent content translates into manifest content by the dream.

Experimental method used by Freud: free association.

Two theses of Freud's theory are: For every dream D, there is at least one wish W such that

(1) W is the motivational cause of D, and
(2) The manifest content of D displays the state desired by W.



He effectively says if D then W, or in probabilistic terms, that Pr(W|D)=1.

In other words, Pr(~W|D)=0.

To falsify this claim it is sufficient to find an instance of a dream that was not caused by a wish.

Grünbaum's work on Freud

Grünbaum develops two grounds for presuming the theory to be wrong:

(1) counter-wish dreams

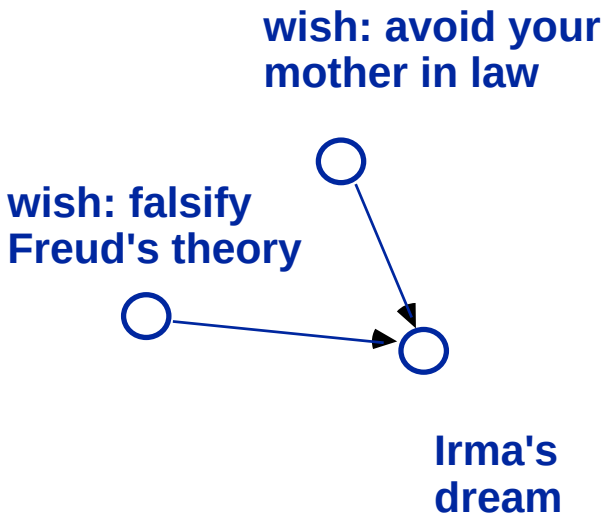
(2) the failure of dream reduction in long-term analysis

and criticizes Freud's 1920 and 1933 revisions of his dream theory.

Grünbaum's work on Freud

Counterwish dreams

Such dreams feature "the frustration of a wish or the occurrence of something clearly unwished for."
There is an example of a counter-wish dream experienced by one of Freud's patients. The patient (Irma, therefore the whole case is known as Irma's dream) dreamed that "she was traveling down with her mother-in-law to the place in country where they were to spend their holidays together." When she was awake she did not want to spend the holidays with her mother-in-law.
So this apparently contradicts Freud's theory of dreams saying that every dream is fulfillment of wishes. But Freud says that she dreamed this to prove him wrong. Since this was her wish (i.e., to prove him wrong), her dream was in agreement with his theory.



Grünbaum's work on Freud

Freud established three results:

(1) the patient harbored the wish to prove him wrong;
(2) this wish, in turn, was the motive that had generated counterwish dream; and
(3) the dream's manifest content displayed the fulfillment of that wish.

Freud says that unfulfillment of one wish means fulfillment of another. He effectively classifies the world population into three groups: (1) normal people, who have satisfying and fulfilling dreams, (2) masochists, and (3) those who do not wish him and his theories well.

Grünbaum's work on Freud

Grübaum finds that there are the following flaws in the inferences conducted by Freud:

(1) His first inference was that the vacation dream contradicted his theory sharply (Freud writes: "Was this not the sharpest possible contradiction of my theory?"). Grübaum answers: "Not, it was not even a contradiction, let alone sharpest!" One possible explanation that is very simple and does not contradict the theory at all is that Irma unconsciously loved her mother in law. Freud's explanation is bizarre, because he also wants to explain this dream as a wish-fulfilling positive instance of his theory after all. There is nothing at all in the manifest content that would deductively rule out its fulfilling the wish for the mother-in-law's company as required by the theory; therefore, this manifest dream content cannot itself deductively contradict this wish-fulfillment theory. Now suppose that the dream content contradicts the theory (i.e., we grant Freud right in supposing so and supposing that Irma indeed hates her mother in law and wishes him and his theories wrong: "Her wish was that I was wrong."). If so, the counterwish dream would be genuine rather than a trick to refute his dream theory (i.e., the question is why the dream was so disguised).

Grünbaum's work on Freud

(2) This claim of motivational causation of the dream is not correct. The patient had intellectual desire that Freud's theories might be generally wrong. This desire was the motive of the dream.

(3) The conclusion of this inference was that the vacation dream fulfilled the patient's wish that Freud be wrong, and it did so both graphically and motivationally. According to Grübaum, it did neither. First, the manifest content did not display graphically to the patient the actual fulfillment of her presumed wish that he be wrong. But a manifest content scenario that could be said to display graphically the fulfillment of the dream that Freud be wrong can easily be imagined. Second, consider the presumed dream motive. What evidence does Freud offer toward establishing that the putative hostile wish produced the vacation dream? None.

Hence, for any given counter-wish dream, the question is:
Is there such a wish at all?

Grünbaum's work on Freud

Grünbaum, page 367:

> ***"It does not even seem to have occurred to Freud to ask himself how often his cleverest female patient had experienced counterwish dreams before having heard of his wish-fulfillment theory. I can report as an unanalyzed person, that most of my own recalled dreams are counterwish dreams, such as examination dreams in which I come unprepared for the finals. And, as we saw, the wish-contravening manifest content of these distressing dreams does not graphically portray Freud to be wrong, although I do believe him to be. But even if I had ulterior motives for wishing him to be wrong, there is no evidence at all that this putative wish actually engendered my counterwish dreams. In fact, I had lots of them even before I had read Freud and took up a critical attitude toward him. Nor is there any evidence, as far as I know, that I have a masochistic need for mental torture and humiliation."***

Grünbaum does not falsify the theory in the sense of proving that it is false. He rather shows grounds for presuming falsity of the theory.

Grünbaum's work on Freud

The failure of dream reduction in long-term analysis

Freud's theory says that the manifest dream contents are similar to neurotic symptoms. In case of a dream, a repressed wishful impulse is the actual constructor of the dream. In case of neurosogenesis, the crucial pathogen is a sexual repression of some sort. A therapeutic corollary is derivable from assimilation of dreams to neurotic symptoms. According to this corollary, his dream theory predicts a reduction in the frequency of dreaming among extensively analyzed patients. The therapeutic effect of lifting repression on neurotic symptoms should be paralleled by some effect on dream formation: Lifting the infantile repression to which Freud attributed dream generation should undermine or dissipate the very formation of dreams.

Concluding Remarks

- Some of this work not only shows us creative ways of setting up empirical studies, but also shows us results that are useful for us as scientists.
- Kaplan's work is a great example. The way I read his result on priming is that it is a good idea to expose yourself to various ideas so that you have a chance of being primed either by your old or new experiences.
- Marcin Druzdzel's early writings provide some support to this idea.
- Wason and Johnson-Laird's milestone study on human cognition, showing that there are no context-free rules in human reasoning. Hence, expose yourself to different environments and ideas, indulge yourself in activities that give you inspiration. Don't be afraid to be crazy.

Are there domain independent rules of logic in human reasoning?

[Wason & Johnson-Laird]

Each of the following cards has a letter on one side and a number on the other side.

E	K	4	7

Which of the above cards need to be turned over to test the following rule?

If a card has a vowel on one side then it has an even number on the other side

Rules of logic in human reasoning

Consider the following isomorph of this problem:
Each card has a name of a scientific meeting on one side and a means of transportation on the other side.

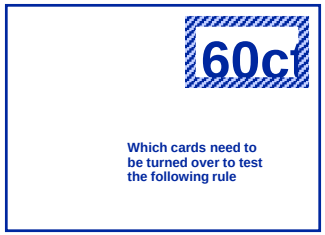
New York City	Washington DC	train	car

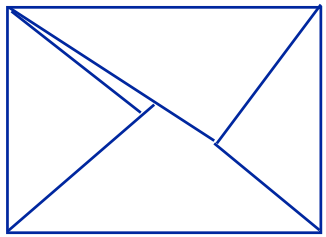
Which of the above cards need to be turned over to test the following rule?

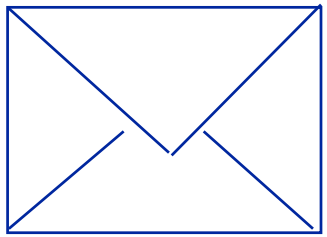
Every time I go to a New York City, I travel by train

Rules of logic in human reasoning

Consider the following isomorph of this problem:







Which of the above envelopes need to be turned over to test the following rule?

If an envelope is sealed, it has a 60ct stamp on it

Rules of logic in human reasoning

The original problem (letters and numbers) is solved correctly by about 12% of the subjects, its isomorphs by over 60% of the subjects [Wason & Johnson-Laird].

The results of these (and other) experiments suggest strongly that human reasoning is not based on abstract, domain independent rules, but rather depends heavily on the content.

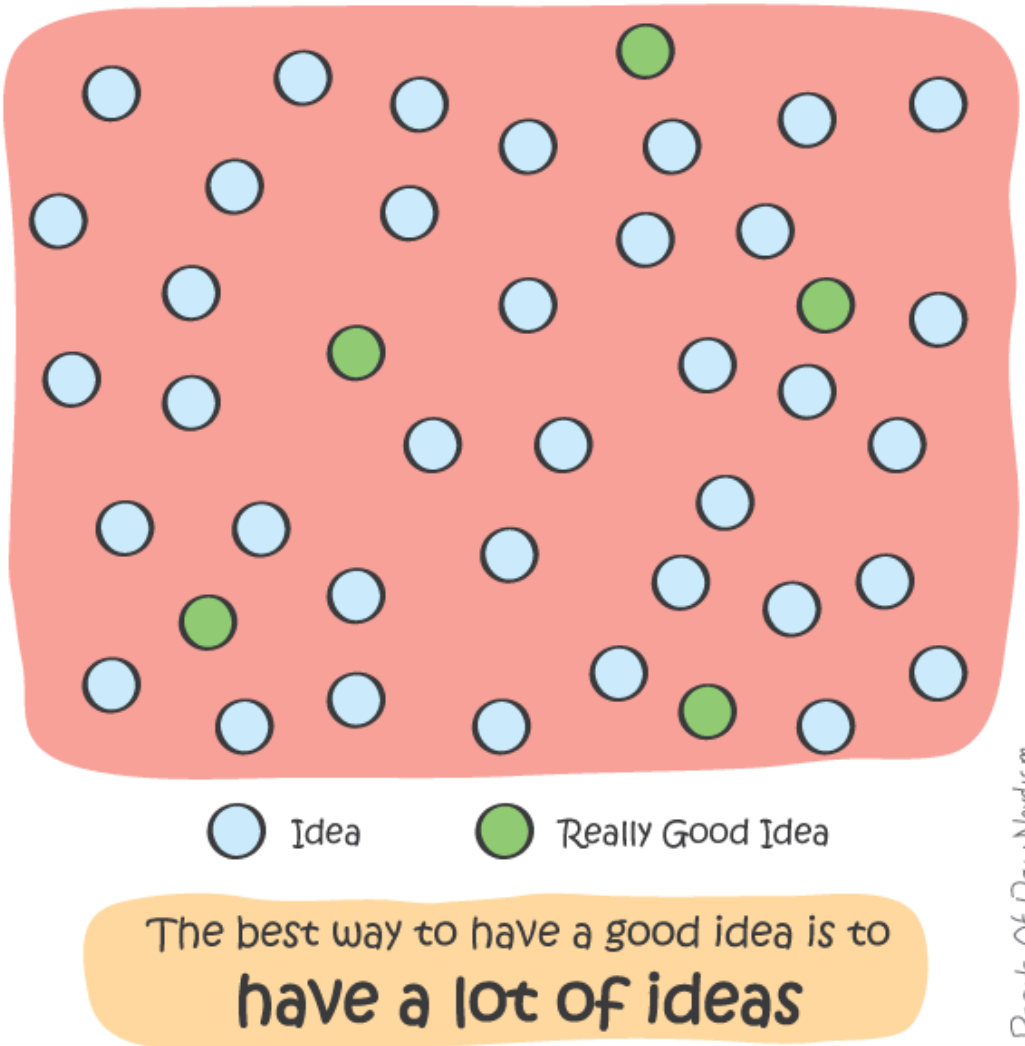
Concluding Remarks

Study cognitive psychology to learn your problem solving better and also apply what you have learned (e.g., Disney's storyboard).

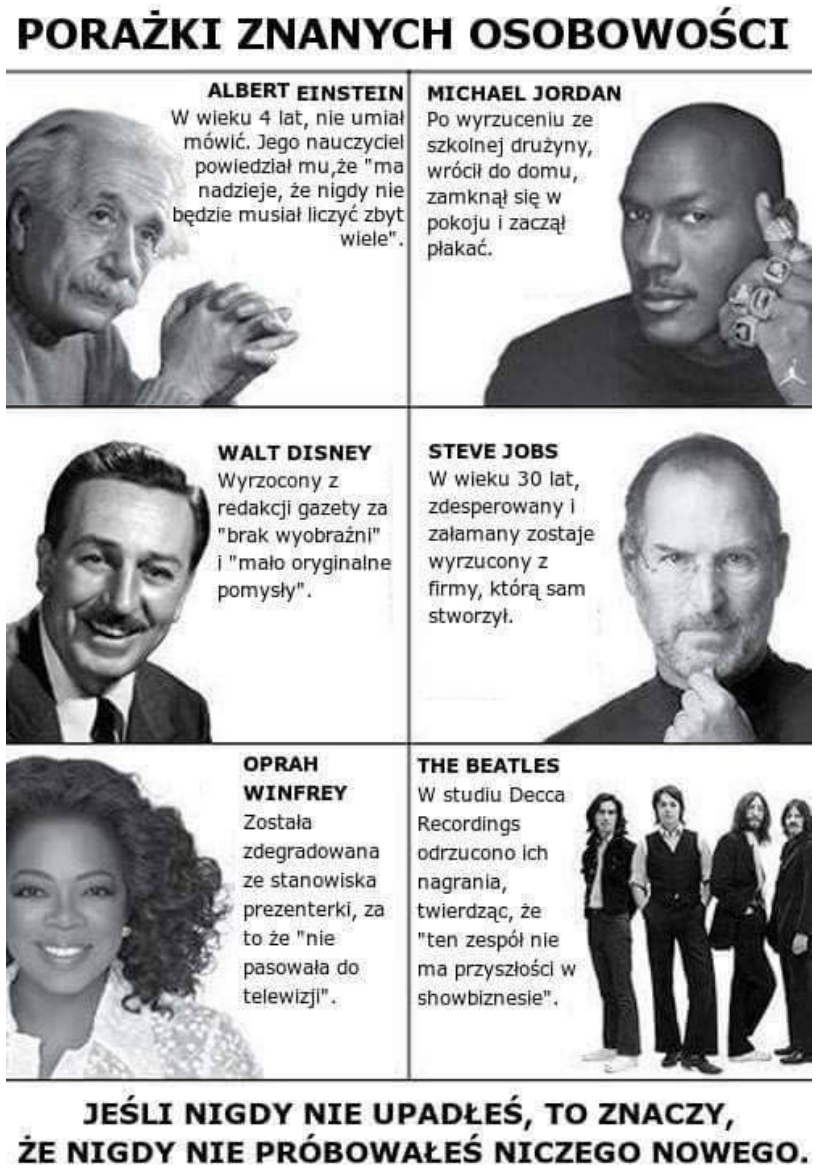
Concluding Remarks

- **Wason and Johnson-Laird's milestone study on human cognition, showing that there are no context-free rules in human reasoning. Hence, expose yourself to different environments and ideas, indulge yourself in activities that give you inspiration. Don't be afraid to be crazy.**

The best way to have a good idea is to have a lot of ideas



Do not be afraid of failure: Many brlliant people have failed before you



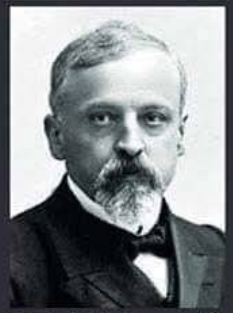
Słabi uczniowie?

"Słabe" oceny nie zawsze są współmierne do możliwości ucznia. Nie ma "złych", "słabych" uczniów, są nieadekwatne metody nauczania.

Stefan Żeromski

Stefan Żeromski po piątej klasie miał poprawkę z matematyki, w gimnazjum spędził 12 lat (trzykrotnie powtarzał trzy klasy: I, II i VI), a do matury nie przystąpił w ogóle.

Henryk Sienkiwiecz

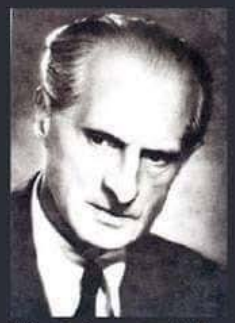


Henryk Sienkiewicz wprawdzie świadectwo dojrzałości otrzymał, ale z większością ocen dostatecznych.

Bolesław Prus

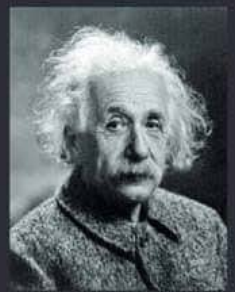
Bolesław Prus z kolei powtarzał drugą klasę. Świadectwo, które uzyskał, kończąc gimnazjum, wskazuje, że miał problemy z językami (polskim, rosyjskim, łacińskim, francuskim), przedmiotami wymagającymi zdolności manualnych – kaligrafią i rysunkiem.

Julian Tuwim



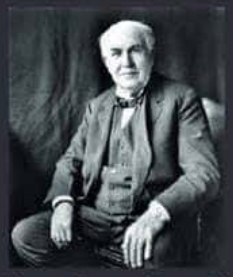
Julian Tuwim powtarzał klasę czwartą z powodu problemów z matematyką.

Albert Einstein



Albert Einstein jako dziecko nie potrafił łączyć słów, czytać nauczył się dopiero jako 9-latek, natomiast trudności z pisaniem pozostały mu do końca życia.

Thomas Edison

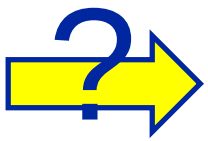


Thomas Edison w szkole spędził zaledwie trzy miesiące – ówczesne metody przekazywania wiedzy były udręką dla Edisona, który wielu rzeczy nie potrafił zapamiętać. Jego nauczyciel określił go „niedorozwiniętym umysłowo".

NHE NOWE HORYZONTY EDUKACJI
PORTAL NOWOCZESNEJ EDUKACJI

Eighteen fundamental skills of a scientist

Next meeting



1. How does science work?
2. What is research?
3. Identifying good research problems
4. Writing papers
5. Presentation in front of an audience
6. Obtaining funding
7. Reviewing/refereeing the work of others
8. Teaching
9. Guiding students, running a lab, managing projects
10. Scientific creativity
11. Information finding
12. Career planning
13. Interacting with people and networking
14. Marketing your skills: job hunt
15. Balancing your life between work and family
16. Coping with stress
17. Ethics in science
18. Appreciation for quality rather than quantity