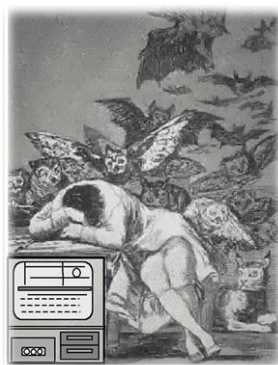


Yuri Tarnopolsky



Essays à la Montaigne



2001-2012

**Essay 58. Pattern chemistry of
rationality**

**All rational minds are alike; each
irrational mind is rational in its own
way**

Essays 1 to 56 (2001-2009) were previously published at:

<http://spirospero.net/simplicity.html> (contents and links to single Essays)

<http://spirospero.net/essays-complete.pdf> (Essays 1 to 56)

<http://www.scribd.com/doc/11607864/Essays-Part-1> (Essays 1 to 20)

<http://www.scribd.com/doc/12273800/Essays-Part-2> (Essays 21 to 40)

<http://www.scribd.com/doc/12529842/Essays-Part-3> (Essays 41 to 56)

<http://www.scribd.com/doc/17164855/Essays-a-la-Montaigne-complete>
(pdf, Essays 1 to 56)

[Essay 57. THE FEW AND THE MANY](#) , html (pdf)

MAIN SOURCES FOR PATTERN THEORY

Ulf Grenander, *General Pattern Theory: A Mathematical Study of Regular Structures*, Oxford University Press, 1994.

Ulf Grenander, *Elements of Pattern Theory*, The Johns Hopkins University Press, 1996.

Ulf Grenander, *A Calculus of Ideas: A Mathematical Study of Human Thought*, World Scientific Pub Co Inc , 2012.

Numerous sites on the Web.

PATTERN THEORY AND PATTERN CHEMISTRY:

Yuri Tarnopolsky, COMPLEXITY, <http://spirospero.net/complexity.html>



Yuri Tarnopolsky

**ESSAY 58: ALL RATIONAL MINDS ARE ALIKE;
EACH IRRATIONAL MIND IS RATIONAL IN ITS
OWN WAY**

Pattern chemistry of rationality

2012

PART ONE



While I am coming to the end of my Essays, the difference between light and heavy matter disappears. Two different sections of my website spirospero.net begin to partly converge. Starting with **Essay 57**, I place links to some new Essays into both [complexity](#) and [simplicity](#) and use pdf format.

The difference between complexity and simplicity is a matter of size. All possible states of small systems can be listed and counted within reasonable time. To list all possible states of a complex system is practically impossible because of the combinatorial explosion. For evolving complex systems (exsystems) it is impractical even if possible: the list will be out of date before completion. Besides, most of the complex system does participate in an act of change. Nowhere else is this as clear as in economics: economy is the largest evolving systems on earth, gradually encroaching on life, climate, landscape, and solar system. Nowhere else was it as successfully used for creating a theory as in chemistry. Pattern chemistry generalizes chemical ideas over other areas of complexity.

Pattern Theory of Ulf Grenander, the original author of the pattern approach to human mind, inspired most of my website spirospero.net, even some poetry. Grenander's recent book is *A Calculus of Ideas*.

Patterns reduce complexity of *exsystems*, (**e**volving **C**omplex **s**ystems) to the level of simple systems. Patterns are counterparts of physical equations for objects of non-physical nature, like ideas and social structures. We can make some abstract predictions about such systems because patterns are limited in number and have larger life spans than details. Besides, all exsystems start as simple systems and increase their complexity by simple steps. Therefore, it could be possible to explore universal patterns of change.

Chemistry is the science of structural transformation and its experience with atoms and molecules may have universal significance. After thirty years of observing, reading, and thinking, I have now much more confidence in pattern chemistry as a mode of understanding complex novelty arising daily in human evolution.

I promised in [Essay 57, *The Few and the Many*](#), (also [html](#)) to take a close look at the peculiar area of psychology that overlaps with economy and has been presented to wide audience by one of his creators, Daniel Kahneman, in *Thinking Fast and Slow*, (Farrar, Straus and Giroux, NY, 2011). It is not odd at all that its author, a psychologist, was awarded Nobel Prize in economics (2002): today everything is economy—climate change, next iPhone, God, and Presidential Elections. Psychology and economics of rationality are



just two sides of the dollar bill. The product of economy enters your life and money leaves your account through the revolving door in your mind.



The dominant part of an experiment in psychology of rationality consists of communication between the **experimenter** (sometimes, a team) and a number of participants (**subjects**), one on one or with a group. [Neuroeconomics](#) is a different related area of research that uses brain scanning during the communication.¹

The communication consists of speech, writing, and simple acts of behavior, like finding a chair to sit down. The verbal part can be preceded or accompanied by various visual images. For example, the subject can be “primed” to money by floating banknotes in a computer screensaver.

The fact that the psychological experiment is an interaction of two human minds seems to me of cardinal importance.



Verbal communication is uniquely human: it is the coarse backing of human life on which fate weaves its European tapestries and oriental carpets. A right person with the right words at the right time can change a human life. The peculiarity of the experiments based on verbal communication is that spoken and written phrases can be misunderstood by both subject and experimenter. Moreover, they can be false, confusing, intentionally misleading, and emotionally suggestive.



A king or dictator does not expect a response to a decree, but their spies are watching how population reacts. A criminal interrogator needs to hear confession. A military or state security interrogator cares not so much about the words as about the hidden thoughts. Psychotherapy promises a deep mind cleanup. Social media know what is on our mind better and faster than ourselves. Language conveys and hides thought. In the digital era, our thoughts are the equivalent of gold and precious stones of the old empires and of the coal and iron ore of the Industrial Revolution. A whole industry, with Google as its flagship, is busy with mining our minds and trading the stuff, good, bad, and trashy, delivered to the surface. Our thoughts, intentions, and decisions are turned into money and we are left with viruses, scams, and disposable short-living junk, happy with ourselves, our acquisitions, and our democracy. Silicon chips mediate human communication and impose on our imagination the incontestable, commanding language of menus.

¹ On the surface, it looks no different than any experimental science, but the whole situation is typically make-believe, even if the money reward is real. See, for example, K. Luan Phana, Chandra Sekhar Sripadaa, Mike Angstadta, and Kevin McCabec, [Reputation for reciprocity engages the brain reward center](#), (2010).

As far as personal thoughts are concerned, there are hard direct methods. Torture is the oldest, but not always reliable. Reading the mind by behavior and things under the clothes is already an accomplished technology. With no access to the mind, the airport scanner is looking for hard matter to recognize ill intent. There are a few remaining steps, if any at all, to the use of brain scan against terrorism and crime, as well as against freedom.

Figure 1 illustrates some methods of crude mind reading, none of them—thank God—fully reliable or universally applicable.

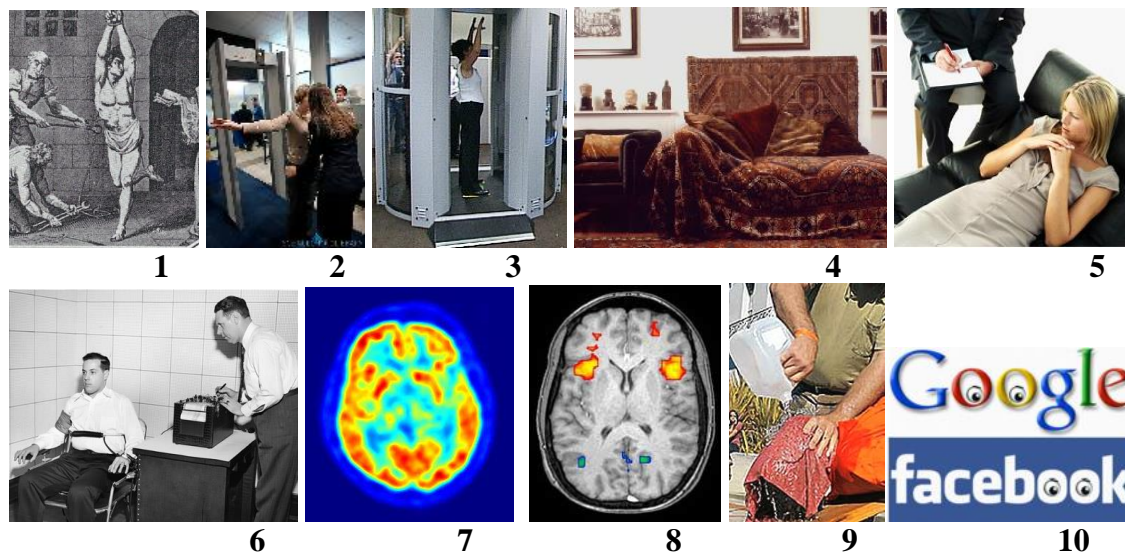


Figure 1. What's on your mind?

1. Inquisition. 2, 3. Body search. 4, 5. Sigmund Freud's original couch and modern psychoanalysis. 6. Lie detector. 7, 8. Brain imaging (PET and MRI scans). 9. Waterboarding. 10. Personal data collection.

Our conscious mind is a tiny part of the murky world below the surface. Mathematicians² describe a full lack of awareness during a major discovery. The current content of my consciousness is in the same relation to my subconscious as this computer window to the rest of the Web or my desk to the rest of the globe.

The big dark subconscious mind does not have either vocabulary or grammar of its conscious complement but it can express itself by twisting and tweaking the words already on the tip of the tongue. Keen observers, from Sigmund Freud to Douglas Hofstadter, have assembled a rich collection of accidental surface splashes of the deep water mental fish.

Politics is the greatest aquarium to observe the depth of the mind. In the 2012 season, for example, we could enjoy watching the minds of Michelle Bachman and Rick Santorum. The two presidential candidates were transparent to the bottom because they were consistent in ideas as well as emotions and body language. But who can penetrate the mind of Mitt Romney saying mutually contradicting things over time—anything that will make you vote for him—with no expression whatsoever, except for a half-smile?

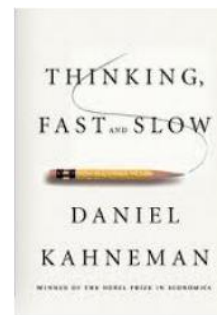
² Jacques Hadamard, *"The Mathematician's Mind,"* Henri Poincaré, *"Mathematical discovery."*

I am neither an economist, nor psychologist, nor linguist. I am lucky to be a chemist. Chemistry gives me a habit to see the world in terms of changing structure, build an inventory of combinatorial possibilities, distinguish probable from improbable, and do without numbers and equations, thinking instead in terms of MORE and LESS. In general, I cannot judge anything single on its own: I can only compare two instances. My world exists in time and space of Leibnitz. Time there does not move unless something changes and the minimal change is the unit of space.

My knowledge of the literature on other subjects is very selective and fragmentary. Thinking in patterns is my way to extract, borrow, steal, and appropriate patterns from knowledge as a whole, without borders and partitions, and in this way to compensate for the complexity of the past, urgency of the present, and the opacity of the future. I believe, together with Douglas Hofstadter, that we all think in patterns, although strikingly different ones.



Thinking, Fast and Slow by Daniel Kahneman is a captivating and engaging book. It is a rich and very artfully written accessible introduction into a vast, relatively new (although with old roots), less known (and all the more surprising) area of research of dramatic relevance for our lives and, even more, for the direction of human history. It is a book **about** how the mind works, how to manipulate it, and it is a product of human mind writing about (go to the previous **about**). A “strange loop” (Douglas Hofstadter) indeed.



A major part of Daniel Kahneman work was done together with Amos Tversky, who died in 1996. I will further refer to them both as K&T or Kahneman alone as the author of the recent book.

I was reading *Thinking, Fast and Slow* with feelings ranging from skepticism to disbelief to protest. It was for the first time that a long expected and highly praised book of an eminent scientist and Nobel Laureate clearly irritated me, although it fully confirmed my own pattern-chemical ideas on the subject.

For example, I could not accept the author’s assessment of human mind as typically irrational in “fast” decision making and problem solving. Even the very division into fast and slow thinking looked shaky to me. Slow thinking, i.e., the thinking of an informed, motivated, educated, and professionally skilled person can be slower than a casual guess simply because it consists of a larger number of steps. On the other hand, the professional can give a correct answer to a complex question in an instant simply because of his professional background. Which atom is heavier: magnesium or manganese? A chemist will answer in an instant, not even remembering the exact densities. But a top professional, thinking day and night about a problem, can be dead wrong as well.

Kahneman's book had a catch: it analyzed the mind in terms of LESS and MORE, but judged it in terms of RIGHT and WRONG. Can we say that the leopard is RIGHT to have its spots but the panther—the same leopard under the skin—is WRONG to be all black? In human matters, the words RIGHT and WRONG are inflammatory enough, but IRRATIONAL sounds truly offensive. What pops up in my Russian mind is the Soviet treatment of dissidents in psychiatric clinics. Isn't the entire American history of civil rights, now in its war-on-women stage, the record of the shifting frontier of rationality?



If we are prone to fallacies, illusions, biases, and all kind of mental defects, then who can put the U.S.D.A. "PRIME" stamp on the mind of a psychologist of rationality?

This is all irrelevant for the purpose of this Essay, however. I use psychology of rationality as a source of factual material and it is "PRIME" enough for pattern chemistry unconcerned with details.

Daniel Kahneman's book is intended for people like me and I can understand selected original scientific papers in the area of psychology. From time to time, I will vent my emotions by the right of not only the reader but also a lab rat. Sorry, the rationality research makes me bubble quite often.



My first pattern-chemical ideas about thinking go back to 1980. Since 2003, some results can be found in [complexity](#)³ and among the Essays. I do not repeat here all the basics of Pattern Theory and pattern chemistry. For major sources, see p.2.

I approach the problem of thinking from scratch, beginning with an experiment on myself. I am encouraged in this undertaking by the fact that I have all I need in my head to think about thinking because I do it every day, like anybody else.

Before starting this Essay, I decided, on a whim, to run my own introspective experiment. Since I have never been apt with mental calculations in general, I can consider myself general public for a psychological test with numbers. In this experiment, I am both the observer and the subject, so that misunderstanding is unlikely. I further describe it in stages as I remember it after a few days. I can guarantee only the overall logic.

³ For example: (1) Molecules and Thoughts: Pattern Complexity and Evolution in Chemical Systems and the Mind; (2) The Chemistry of Semantics; (3) Pattern Chemistry of Thought and Speech and their Hypothetical Ancestor; (4) Tikki Tikki Tembo: The Chemistry of Protolanguage. See [complexity](#) for links.

EXPERIMENT

1. I ask myself: What is larger, 345×254 or 354×245 ? I cannot give any reason why I asked this question, but I am sure there had been something about numbers in my mind.

My choice of numbers has an explanation. I quickly select 345 as the smallest three consecutive integers over somewhat atypical 1 and 2. Then I stumble. It is not so simple to find a second **not obvious** pair. " 345×254 or 545×524 " is obvious.

2. The selection of the second pair requires some work. I use the first pair as a template and invert the last two digits in both factors, intuitively expecting that their influence will be minor as compared with the change in the first digit (**first guess**).

3. In less than a second, an uneducated thought goes through my mind that if we multiply a larger and a smaller numbers, the larger factor (354) will have more influence on the product (**second guess**). My fast answer is: $354 \times 245 > 345 \times 254$.

4. My calculator tells me that I am wrong:

$345 \times 254 = 87630$; $354 \times 245 = 86730$; $354 > 345$ but $86730 > 87630$. The first pair of factors gives a larger product.

5. Having discovered my mistake, I realize, with no reason, that the smaller number has more influence because its variation is multiplied by large increments of the larger number (**third guess**).

6. I have no idea where I was right or wrong. I do not know which principles a mathematician would apply, but I suspect that he would give a very fast correct answer.

My experiment leads me to initial understanding of some aspects and conditions of thinking.

OBSERVATIONS AND COMMENTS

(1) Quick thinking needs some stimulus on hand to start. It is not the **heuristic** needed for finding an answer without an explicit inference. It is **activation**, the very beginning of thinking, like the turn of the key, a coin drop into the vending machine, a military order, or the change of

the traffic lights at the intersection. It can be just a question. For example, activation consists of the act of presenting a task to the cooperating subject. Normally, activation brings the mental cogwheels into motion in a very individual manner. Initiation could be a better term, but it has more connotations.

(2) Even if I used the calculator right away, it would take more time than the intuitive guess. If I was **strongly motivated**, I would do exactly that. But I was not. Nobody offered me \$5 for my answer. My life did not depend on the experiment.

(3) Not only a motivated but also an **educated** subject would have better chances to give a correct answer. In the experiment, the **trial** provokes an **error**, but not a chance to learn from it, which is the most unnatural thing about *economic psychology* (one of many names of rationality research).

(4) An objective and provable criterion of success must exist in the cognitive experiment. The assumption that the **correct answer exists** is yet another knowledge-dependent component of correct fast thinking. As a problem can have more than one solution, the subject could find a solution of which the experimenter is unaware but should be. I characterize this condition as **completeness**.

(5) If the topic is **new** for the subject of experiment, the expectations of “rationality” should be lowered. Since the word *education* is overused, I will use the term **novelty** instead of “lack of education.” Indeed, the purpose of education is to **convey new things**. To convey known things is propaganda. The virgin experiments with novelty cannot be repeated twice with the same person, even if they are not subsequently explained.

(6) To err is not only human, it is rational. Often vague “gut feelings” and instinctive hesitation let the subject know that something is wrong with the intuitive answer and it can be quickly re-examined and reconsidered.⁴ This is not the “trial and error” process because the right answer remains unknown. It looks like a signal from the subconscious, probably, of the same nature as the Freudian neurosis, i.e., unconscious conflict. It means that there is a hidden contradiction in the mind. In pattern terms, it is the instability caused by a negative bond (see further). Normally, hesitation returns the state of mind back to the beginning of the process. In chemical language, it is a reversible reaction.

(7) Since I asked myself the experimental question, there was **no misunderstanding or misarticulation of either question or answer**—an aggravation always possible between two minds, especially, because of ambiguity of language.

(8) The question of **intent, manipulation, and deceit** does not arise here, but is, in principle, possible even within one mind (cognitive dissonance, self-perception, denial).

⁴ The “error detector” in the brain was first suggested by Natalia Bechtereva (or Bekhtereva) in 1968. (Bechtereva, N.P., Shemyakina, N.V., Starchenko, M.G., Danko, S.G., Medvedev, S.V., 2005. Error detection mechanisms of the brain: background and prospects. *Int. J. Psychophysiol.* 58, 226–234). In my scheme of things, negative bonds in the subconscious can be the source of the “error feeling.” Neurosis might be the extreme case of the same phenomenon.

(9) The state of mind can be MORE or LESS stable. Clarity, absence of emotional, economic, career or status-related pressure, and, ultimately, sufficient **concentration** (cognitive effort) are needed for successful solution of the problem—if the solution itself is really needed.

(10) The **background, lifestyle, and experience** of a subject are crucial. Questions about money can have drastically different pathways to the answer for a spoiled son of a ... billionaire and for a coal miner's daughter. Men and women can have very different ideas of feminism.

(11) The subject brings to experiment not only his since long settled background, i.e., biography, but also the current **context**: his or her immediate problems, impressions, and most recent events, i.e., current state of flowing mind.

The problem with all experiments with verbal outcomes is that we know only what the person says but not what he thinks. Sometimes we ourselves do not know what to think or what we really want. I don't think that I am capable of reading—or speaking—my own mind during moments of stress, indecision, and passion. It is also a hard work to articulate my thoughts in these Essays and this is why I so often use pictures, quite like a caveman, and childishly prefer color.

Motivation, the important component of an action, is always in doubt for psychological experiments. "It is a game... It is only a game."

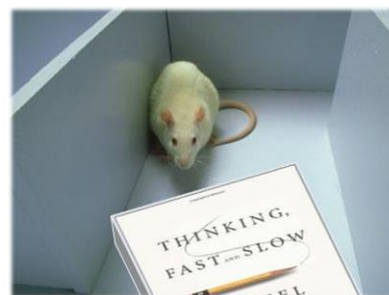
Therefore, the following components should be taken to consideration in psychological experiments based on interaction of two minds.⁵

COMPONENTS OF EXPERIMENT	
1. ACTIVATION	6. CONCENTRATION
2. INTENT	7. ERROR HANDLING
3. UNDERSTANDING	8. KNOWLEDGE
4. COMPLETENESS	9. BACKGROUND
5. MOTIVATION	10. CONTEXT

Obviously, if a group of subjects is recruited for research, the simple percentage of "failed" subjects leaves unexplored the most precious material about individual differences of the subjects (and the experimenter!) that could **elucidate the mental mechanisms**, the much prized ultimate goal of psychology. This could be done by testing larger diverse groups of subjects and subsequent covariance analysis. It may be too invasive and difficult, but this is none of my business, anyway. No wonder, artificial intelligence is far ahead of the artificial one: we understand what we can make.

⁵ The notion of [bounded rationality](#) recognizes that up to a point.

Rationality is not only defined differently for different areas of knowledge, but there is no consensus regarding what rationality means within the areas like psychology and philosophy dealing with thinking and behavior. What seems common for all known to me definitions is the need of the external arbiter of rationality. In other words, rationality is a normative notion. It is quite natural when we evaluate the rationality of a rat in a maze (is that the origin of the term *rationality*?) or a human trying to find an existing solution, like reaching a high hanging fruit. The human can surprise you, however, by inventing something never seen.



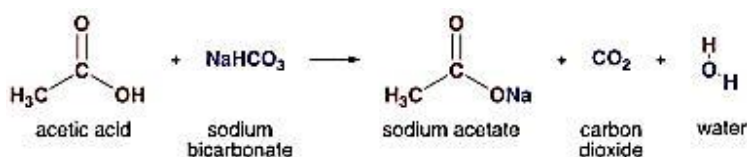
RATionality

Interaction of two minds is an excellent object to illustrate pattern-chemical ideas because it is *similar* (in pattern-theoretical sense) to a chemical interaction between two molecules. The process includes observable and invisible configurations:

1. OBSERVABLES: There is the base state before the interaction (**A**), the moment of presenting the question or problem (**B**), and the final state of response (**C**).

2. INVISIBLES: There is a transition state (**TS**) between **B** and **C** which is, actually, a short fleeting process with its own mechanism. It happens entirely in the mind, although some changes in facial expression, posture, and, physiological parameters are possible.

If the states can be represented as **structures** with elementary ideas and bonds between them, this is all we need in pattern chemistry. And this is what I want to deal with. The strategy borrowed from chemistry consists of representing physically invisible⁶ to humans **processes** in a visible symbolic language.



Indeed, a similarity is undeniable: we see bubbles and fumes in the flask, ask ourselves what they mean, what is there that we cannot see, and give an answer in letters connected

with lines: a chemical equation. “Wait a minute! There are no letters in the flask!” “Right, this is what symbol means: whatever there is.”

The chemist deals with inanimate matter that neither listens nor talks back. The actions of the chemist and the reactions of the **object in the flask** are measurable, recordable, and reproducible. The conditions of experiment can be varied along a continuous scale. There is no right or wrong response.

For somebody with a background in hard science, the experimental technique, typical for the rationality research, looks alien. The visible behavior is the only fogged up window into what probably happens underneath, but there is no language for describing the invisible mental process—no counterparts of atom, molecule, and bond or spring, gear, and ratchet. In short, there

⁶ Atoms and molecules were physically invisible when the foundations of chemistry have been developing.

is **no theory**, but there is a firm distinction between right and wrong. Well, who experiments on whom? I bet I can experiment on my experimenter, driving him crazy.

When an act of behavior of a **known in advance kind**, instead of verbal reaction, is observed and registered, the subject is usually verbally **primed**, i.e. induced to think in a certain direction by injecting some ideas in his mind. In rationality research, priming can be done by various means. Pictures of money or carefully crafted semi-literary surrogates of sad or joyful confessions are supposed to tune the subject up to the topic.

Regarding priming, there is a diminutive short story *A Horsey Name* (Лошадина фамилия) by Anton Chekhov. Ivan forgets the name of an urgently needed person. The only thing he remembers is that it is related to horses. People around are suggesting dozens of horsey names, but nothing matches. Finally, when it is too late, Ivan hears the word “oats” and remembers: Oats! (Овсоз). Ivan’s helpers were definitely “over-primed.” See [A Horsey Name](#), a good old literary English translation by Marian Fell.

I have nothing to wonder about in the natural contact of two minds on the street, in a bar, or at a business office, where each mind has clear goals. As an experimental scientist, however, I am struck by the difference between the “hard” experiment with two reagents in the flask and the “soft” contact between two human minds in a psychology lab where the psychologist is a human being who asks a question and issues a verdict about another human being who neither hears it nor care a bit. What is happening in the minds of both people who form a joint system for a short time?

Only a third party can decide on the rationality (if its definition exists) of both the subject and the experimenter. Obviously, this is an irrational way to evaluate rationality because a fourth arbiter would be needed to oversee the third, and so on. None of them would have an access to the mind content of the observed persons, their true goals, motivation, intent, concentration, and background. There is no universally accepted symbolic language to describe all that. There are, probably, dozens of systems of logic, each with its own notation, but logic is a totally different matter: it is detached from the content of thought and is concerned with its form. Money, love, life, success, failure, and death—it is content, not form.

Today, it seems, there is no such thing as pure psychology: it is always social in more than one sense. Here are three: (1) it takes a single mind to notice molecules and stars, while a mind needs another mind to be noticed; (2) social and educational background of both sides of an experiment do matter, see **Comments 10** and **11**, p.11, and the conclusion of this Essay; (3) like anything else, scientific community is part of economy where competition is in conflict with the drive to consensus.

In scientific practice, differences are reconciled simply by scientific community and arriving at some consensus in a mature area of research. Normative rationality, however, caused a real conflict, a Great Debate (Keith Stanovich *et al.*), a “fight” (between K&T and Gerd Gigerenzer), and even a war, as a psychologist (Helmut Jungermann) hinted by quoting the Greek philosopher: “As Heraclit[es] said, war is the father of all and the king of all.” Apparently, human mind is inherently divisive both as subject and object.

While I am writing these lines, another war for human mind is raging, see [Essay 57, The Few and the Many](#). One can see a full display of psychological trickery in the ads and debates and the fully fanned out peacock tail of human fallacies in the reaction of the public.

The scientific community remains split on rationality instead of ditching it. I am curious whether Daniel Kahneman and his opponent Gerd Gigerenzer would find this rational. I would, cynically. If something is good, it could be sold. If something is bad, a remedy can be sold.

The best way to deal with the controversy it is to ignore the term “rationality,” until it is clear what we all mean by that. Indeed, as I found out, this point of view was expressed by psychologists very early in the initial period of rationality research. Moreover, the human limitations of psychologists had been noticed even earlier.



Psychology is one of the youngest major sciences with one of the longest pedigrees. Its practice by far preceded its theory. It broke out of an egg laid by physiology only by the end of the nineteenth century, curiously, influenced by chemical analogies that Wilhelm Wundt borrowed from John Stewart Mill.⁷

Am I rational? What would Daniel Kahneman say? He is merciless. Just on four pages, 161 to 164, of his book we find the following invectives:

“Error”—“violation of logic”—“fallacy”—“misrepresentation of probability”—“absurdity”—“blatant violation of the logic of probability”—“flagrant violation of the conjunction rule” (Chapter 15, LINDA: LESS IS MORE , pp. 156-165).

The entire book is generously peppered by such or similar remarks because it is about our alleged errors and fallacies of judgment while thinking fast, although thinking slow can be no less fallacious. Besides, the entire direction of research, based on psychological experiments with groups of subjects, seems to have a major method flaw: the problems that subjects of psychological experiment had to tackle are in the absolute majority of cases totally irrelevant for the lives of the subjects and if occasionally rewards are paid, there are symbolic or just for participation. The typical experiment is a make-believe situation to which the participant had to react by telling how he or she *would* react.

Next, I am going to illustrate the reaction of the opposition.

⁷ The chemical influence was disputed, somewhat self-contradictory. “Further, he [Wundt] stressed that these elements [of psychological process] were to be taken as hypothetical constructs. Such elemental processes would never actually be observed, he thought, in pure isolation but would always be aspects or features of larger images or **configurations**. Here Wundt used the German word *Gebilde* [structure, **pattern**].” (Arthur L. Blumenthal, [A Reappraisal of Wilhelm Wundt](#), American Psychologist, Nov. 1975, p. 1083).

The critique of K&T by [Gerd Gigerenzer](#) is best known, can be easily googled, and I omit it here. I need to say that I was very impressed by Gigerenzer's position and logic, as well as by his practical efforts against deceitful medical advertisement. His books are widely available.

I want to mention here two other authors.

In his classical often quoted paper, [Helmut Jungerman](#) describes “the two camps on rationality.” He notes “Rationality is not a genuine term of scientific psychology but rather a concept of philosophy and economics.” It requires an established norm, for example, formal logic, which has a limited area of application in psychology. I quote:

In a somewhat exaggerated manner, I will distinguish two camps in this debate, one that points to the deficiency and one that argues for the efficiency of human judgment and decision. The *pessimists*, as I will call the members of the first camp, claim that judgment and decision making under uncertainty often show systematic and serious errors, due to in-built characteristics of the human cognitive system. Violations of rationality, particularly of the SEU model [Subjective Expected Utility], are interpreted as true deficits of the decision maker. The *optimists* of the other camp claim that judgment and decision are highly efficient and functional even in complex situations. Observed violations of rationality axioms are interpreted as unjustified evaluations based on inappropriate theoretical assumptions or empirical approaches on the part of the researcher.⁸

Helmut Jungermann presented a detailed summary, very much in agreement with the conclusions of my introspective experiment, provided I place myself in the camp of optimists, which I do, somewhat surprised. Here are his “optimistic” points of criticism, in short: (1) most experimental situations are unrealistic, (2) there is a lack of real life context, (3) no account of cognitive effort, (4) no account of misunderstanding by subjects, and (4) no definition of what error is. He sees the arguments of the pessimists as “defensive.” He does not mention the factor of the experimenter's bias, background, and intent, however.

[Keith Stanovich](#) following Helmut Jungermann's analysis, labeled “optimists” as Panglossians [happy with everything as it is in the best of the worlds] and “pessimists” as Meliorists, i.e. believers in the improvement of humanity [who can sell you a good tip, I cynically comment]. The title of his large and detailed paper, with Richard West, “[Individual differences in reasoning: Implications for the rationality debate?](#)” (Behavioral and Brain Sciences, 2000, **23**, 645–726), reveals the direction of his thought, which I fully accept. Although not the differences I expected, they are completely to the point. The authors note:

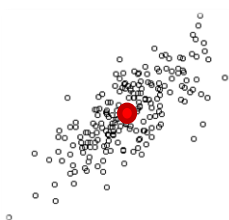
The so-called Great Debate about human rationality is a “high stakes controversy” because it involves nothing less than the models of human nature that underlie economics, moral

⁸ Jungermann, H. (1983). The two camps on rationality. In R.W. Scholz (Ed.), Decision making under uncertainty, (pp. 63-86). Amsterdam: Elsevier. Reprinted in: *Judgment and Decision Making: An Interdisciplinary Reader*, Second Edition, Cambridge University Press, 2000. [A poor and incomplete copy is available](#). See also [Google Books](#).

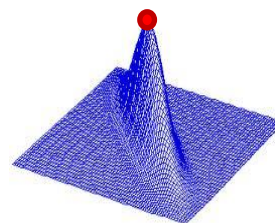
philosophy, and the personal theories (folk theories) we use to understand the behavior of other humans.

With high stakes, nobody wants to be on the wrong side in the economy of science.

The numerous ramifications of the “individual differences,” however, filled me with doubt. My first impression: maybe there is a norm, but if so, we all deviate from it in various ways. My “fast thinking” solution: the norm is as normal, i.e., fictional, as the “norm” in normal multivariate distribution. The problem is, therefore, what to consider normal: an abstraction or reality. There is nothing to reconcile: one does not contradict the other. But because psychology is social, what it notices, to what it pays attention, and what it finds important changes with time and, most importantly, with economy.



Figures on the left and right present bivariate distribution. The red dot of “norm” is just a mathematical point (the *mean*) in the space of our abilities, not our failures. I am not sure that our abilities have independent normal distributions, however.



Niels Bohr suggested that if a truth is profound, the opposite idea is also profound. As he could probably say to the two camps in cognitive science, “A Nobel on both your houses.”



With the above introduction, I leave psychology—not without regret. Its exciting and challenging landscape is still hot in the process of emergence, like the islands of Hawaii. I return to the solitary confinement of pattern chemistry.

In this Essay, I quote some selected experiments in the field, neither having the knowledge of the entire area nor using them not for the purpose of criticism. I attempt to interpret borrowed facts from the position of pattern chemistry, which currently exists only in my head. Yet I am inclined to believe that in the “talking” psychology of Freudian kind, nobody in possession of such a treasure as his or her mind is a complete outsider. Interrogative psychology is under the mild curse of the “strange loop” of Douglas Hofstadter and it is even stranger: it is a double loop.



PART TWO



1. Pattern chemistry framework

I start with the question coming from [Douglas Hofstadter and David Moser](#) (*To Err is Human; to Study error-Making is Cognitive Science*, *Michigan Quarterly Review* Vol. XXVIII, No. 2, Spring 1989, p.191)

What do cows drink?

The authors predict that “almost everybody finds that the answer “milk” jumps to mind virtually instantaneously, even though it is clearly wrong.”

For anyone in our culture, the concepts “cow” and “drink” are both neighbors of the concept “milk”, and since each of them has been activated by the question itself, some activation from each spreads to the concept “milk.” (Hofstadter and Moser)

Here is my introspective report, stage by stage, about how I reacted to the “cow” question.

1. INITIAL STATE. The moment I saw it (almost half a year ago), the question triggered the **initial state** of a process in my mind. No doubt, the idea or image of milk popped up in my mind in an instant, without thinking. I was ready to answer “milk”, but hesitated half way.

2. TRANSITION STATE. **Transition state** was short, ephemeral, and impossible to either clearly keep in mind, or describe, or repeat. The **transition state** barrier from the initial state to the **final state**, i.e., answer MILK, is very low. The elementary ideas COW and DRINK bring up MILK from the composite idea DRINK—COWS—MILK.

3. INTERMEDIATE STATE. My **final state** “milk” was **not stable** enough and I hesitated: something was wrong with it. It took some short time, but longer than the way to almost saying “milk” in the beginning. I have reached an **intermediate state**—of doubt, hesitation, and instability—which was more **stable** than the **transition state** but not stable enough to be the **final one**. Note that I am doing without numbers, satisfied with MORE and LESS.

4. SECOND TRANSITION STATE. Through the **second transition state**, on the way to “water,” another word/idea popped up: GRASS. With hindsight, I can hypothesize why “grass” was part of the transition state. When we see a cow, it is more often with grass, not water. Again, whatever I had in my mind was unstable. Subjectively, the instability of a mental transition state is often accompanied with a slight discomfort and feeling that something is wrong: a micro-neurosis, I would say.⁹

5. FINAL STATE. I reach the **final stable state** “water.” I feel relief.

⁹ While writing this Essay, I felt full of respect for Freud.

While finishing the above report almost half a year after running the “cow” experiment on myself, I suddenly realized that cows, indeed, drink milk: as calves. This is an example of the **incompleteness** of the experiment, which I noted in **OBSERVATIONS AND COMMENTS**: there is more than one solution. What is peculiar about this minor flaw, both the experimenter and the subject can defend with equal strength their positions of unequal imagination. I believe this is one of the key “individual differences” issue of the Meliorist-Panglossian divide: both sides in an experiment are humans with naturally different capacity of imagination, as well as all other abilities, in line with Keith Stanovich’ ideas. I am inclined to view imagination as the ability to analyze the situation, split it into components (generators), and find all their relevant, i.e., most probable combinations (configurations) and similarity relations between them.

Groups of similarity transformations define patterns. This is the essence of the method in Pattern Theory. Interestingly, analysis and synthesis in Pattern Theory need the participation of **individual** human mind. It cannot be fully algorithmic. This is why I see Pattern Theory of Ulf Grenander as the theory of human or artificial mind and not of the world around, which is the subject of specific sciences.

As we cannot perceive transition states **in either chemistry or cognition**, we have to imagine them and then select a few most stable ones. Moreover, we have to imagine the most stable final states. Since all configurations are combinations, this process can be algorithmic, at least partially. Imagination is the core of intellectual power, although it alone does not guarantee the power of achievement. The latter consists in increasing the stability of transition states leading to the goal and decreasing the stability of those leading away from it. Ultimately, it amounts to imagination, too. In daily life we speak about foresight, leaving imagination to fiction writers and poets. I am not familiar with IQ tests, but I wonder if they test imagination.

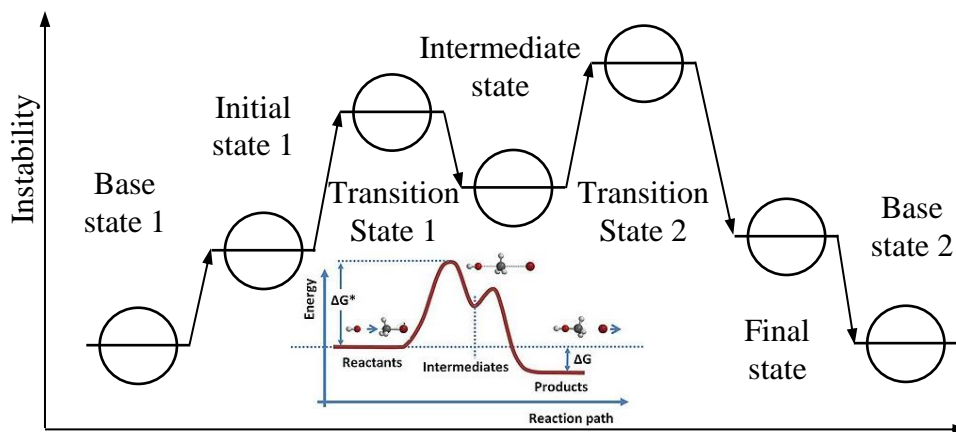


Figure 2. Stability change in a cognitive act with intermediate state.
Inset: same for a chemical reaction.

From state 1 to state 5, the content of the cow problem sits in my mind sticking its head into the conscious with most of the body in the subconscious mire. Before the initial activation¹⁰ and

¹⁰ I use the word “activation” not in the sense of spreading neurophysiological excitation, but closer to its meaning in chemistry: activation, for example, by collision or radiation, brings the system into state ready to a possible transformation. Transition state is a process and activation is its very beginning, like an accidental meeting that initiates a relationship. With molecules, it is not just sufficient energy, but also a particular position.

after the relief of the final state, the mind is in the **base state** concerning the cow, which means that it is out of my conscious mind and a new cognitive event can begin.

Figure 2 illustrates the change of instability along the pathway of a cognitive event. I inserted there a small illustration from a chemical text. The exact appearance of the connecting line, as well as the time line, in both cases is unknown. Transition states, by definition, cannot be isolated.

In order to complete the pattern-chemical picture, we need to reveal the structure behind the states: the generators.

Figure 3 represents some simple and composite ideas pictorially, verbally, and pattern-chemically. In terms of Pattern Theory, elementary ideas are **generators**, some of which are connected, producing **configurations**, i.e., **composite ideas**. This looks like atoms connected by bonds into molecules. The latter are material objects that can be observed through a special microscope.



Figure 3. Elementary and composite ideas related to COW.

The cardinal novelty of Pattern Theory is the formalization of the long known representation of thoughts as skeletal structures consisting of points and lines. It consists of attribution of probability to both generators and connecting bonds. There could be some issues with the meaning of probability for mental constructs and convertibility of probability to **energy** or its doppelganger **instability**. Nevertheless, this approach offers us a firm pattern-chemical ground, all the more attractive that we do not need to know any neurophysiological details and lose any ground for fight about inherently non-consensual matters¹¹.

Generators and bonds are just words of the language in which we can describe what we see going on between two minds as if it were happening between two magnets, or two mice in a cage, or two

protagonists in a silent movie. For as long as the language helps understand a mystery, does not create a new one, and causes defection of the opponents, we can trust it.

¹¹ Why is it possible to reach consensus in physics or physiology, but chronically impossible in economics, psychology, politics, and other human matters? (1) Scholars in human matters are humans; (2) they study humans; (3) humans are combative because life is competition; (4) competition means taking sides in a contest in order to win and get an advantage. Competition without a rival is meaningless and if there is no rival, it should be invented. In terms of **Essay 57**, for a crocodile to set foot among giraffes requires trampling some crocodiles, see [Essay 57, The Few and the Many \(pdf version\)](#).

The bond has the following meaning: the stability of two generators connected with a positive bond is higher (or energy is lower) than the stability of isolated generators. Negative bonds mean that two generators require energy to be connected because they repel each other and are more stable apart. The negative chemical bonds ([antibonding](#)) are as real as positive bonds. Just almost nobody is interested in them because of their instability. But, as I believe, they are absolutely crucial in a cognitive act because they signal that something is wrong, creating a vague mental discomfort. Compare with chemistry:

Another particular feature of antibonding is that the *antibonding orbital is more antibonding than the bonding orbital is bonding*. ([source](#))

The previous paragraphs omit significant and sometimes unresolved issues with this picture, but I cannot repeat all that here. Instead, I refer the curious to [Introduction to Pattern Chemistry](#) and the rest of [complexity](#), where much more can be found about pattern chemistry of thinking and its verbal expression.

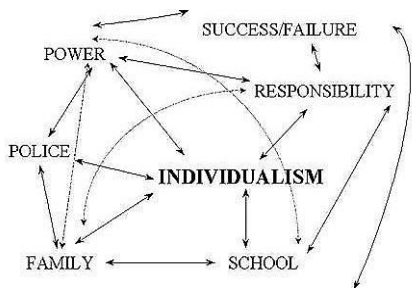
Next, let us take our cow by the horns. **Figure 3** shows what can happen when the mind is activated by cow-related pictures. In order not to get mired in terminology, definitions, and formalism, I will discuss **Figure 3** free-style.

The top row of **Figure 3** contains generators (elementary ideas) COW, MILK, WATER and DRINK. Each of the ideas has one of many possible pictorial presentations. A picture or words under it activate other bonded pictures or ideas—one or more, simple or composite.

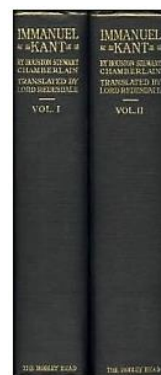
The pictures in the bottom row are selected configurations. They are relatively stable small “molecules” of thought that pop up from the mind content and disperse after the cognitive event ends.

Mind is a pattern-chemical flask with content disturbed and agitated by external events and internal spontaneous fermentation.

The relation between mind and reality has been subject of countless heavy volumes and we will get lost in just these two terms set side by side. Mind is real and reality is in the mind and it is better not to start another rationality war. Most of what I am going to say in this segment has been known for a long time and in many versions.

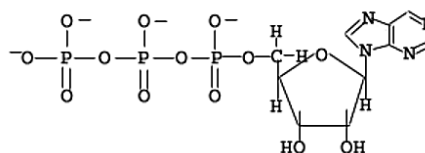


Everybody can invent a new way to express one of the oldest psychological concepts: associations, the crisscross links between components of mind and reality. All of them will have topology of graphs: points connected with lines, quite like molecules.



transformations with molecules before atom became a household name and molecules could be observed. In 1905, Albert Einstein was motivated by desire to prove reality of atoms in his work on Brownian motion. We still do not know what a thought, idea, and mind content

Chemists had been able to analyze and predict chemical





really are, not to mention what “really” means but we can understand how they behave. Jumping from molecules to words, it is the same way we understand the meaning of a word defined through other words in a dictionary.¹² But the notion of “individualism,” for example, will be divisive in one way or another because notions are individually grown in our minds on the soil of our life experience and are as diverse as American winter squash.

As an exercise, one can try to list all associations with any picture in **Figure 3** in the bottom row within half a minute, play the [Word Association](#) game, or travel in a time machine 100 years back and listen to the lectures of Carl Jung on his [association method](#). I also recommend the movie *A Dangerous Method* (David Croneberg, 2011), which seems to confirm the disrationality concept of Keith Stanovich.

Next, consider what can happen in the mind activated by “what” in the question “What do the cows drink?” DRINK can activate WATER and MILK, as well as TEA, COFFEE, WINE, BEER, MEDICINE, POISON, etc. What in fact will be activated, as I suspect, is the most probable/stable generators in the Jungian personal subconscious.

More probable generator is more stable in the sense that it is more probable to be in the conscious sphere, continuously or flickering, i.e., it has higher time frequency.

I can think about coffee in the morning, my medicine after meal, a glass of wine at dinner, and, probably, poison, if I am plotting murder, before falling asleep. In conjunction with COW, only WATER seems most probable. COW is an animal, and animals DRINK WATER. Other liquids, from TEA to COFFEE, would make the thought very unstable because of the negative bond, not just a lack of bond, with COW. They do not behoove there. COW, however, is *usually* associated with MILK, not in all contexts, but at least for somebody unrelated to farming. MILK behooves the COW.

Why do I use here the rarely used verb “behoove” for the first time in my life? Ten days ago I was watching Saudi Prince Turki al-Faisal using this word on his interview with Charlie Rose. I knew its meaning but it seemed so unusual that the word stuck in my mind. BEHOOVE has nothing to do with hooves.



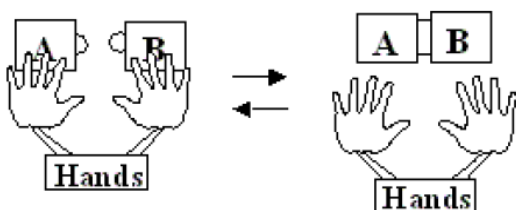
HOOVES

BEHOOVE BEHOOVEs the **COW** because of its **HOOVES**. Two positive bonds between three generators, of which BEHOOVE is just a sound, makes the triad stable enough in the current context because BEHOOVE is still “fresh in my memory,” as we say. FRESH has strong links to STABLE, pulling MILK into the triangle. Writing the beginning of this sentence I almost heard the HOOVES of a HORSE coming out its STABLE. In my mind, COW transmuted into HORSE.

What I think right now depends on the most stable (probable) part of the current content of my mind. It is a layered cake: upper crust changes by the minute and lower levels renew day by day.

¹² **EXAMPLES** (from [Merriam-Webster](#)): **hasband**: an ex-husband; **derecho**: a large and long-lasting wind storm that is associated with a band of rapidly moving thunderstorms; **webster**: a person who frequently uses the World Wide Web; **bankster**: a member of the banking or financial industry who engages in reckless or predatory financial practices.

Triplet $A-C-B$ takes a special place in chemistry and pattern chemistry. The enormously important in chemistry and biochemistry catalysis has a general mechanism $A + C + B \rightarrow A-C-B \rightarrow A-B + C$, where C is catalyst. It is not incorporated into any stable structure in this transformation. Formally, nothing happens to C regarding the initial and final states. It can repeatedly perform its catalytic function. All it does is to make the transformation of $A + B$ into $A-B$ more probable in time, i.e., faster. In chemistry, it makes both direct $A + B \rightarrow A-B$ and reversed $A-B \rightarrow A + B$ transformations faster.



There is a lot of popular stuff on catalysis on the Web. From pattern-chemical perspective, see [The Visible Hands: Homo Faber and the Chemistry of History](#) in **complexity**. I reproduce its representative picture here.

In a linear triplet $A-C-B$ both A and B are in the topological neighborhood of C , which increases the probability of bond between A and B .

Similarly¹³, in **Figure 3**, MILK bonded with DRINK and COW (blue lines), increases the bond strength between DRINK and COW. I show the “second-rate” bond with amber line. Conversely, DRINK and COW, if activated close in time, activate MILK, if there is nothing to compete with this course of cognitive event.



I expect, however, that the same question asked close in time or space with the picture of a COW near WATER, would leave very little stability to MILK. Similarly, not just the calf drinking milk, **Figure 3**, but also the picture of a cow and calf near water should increase the probability of MILK as answer. In rationality research, the priming by text, speech, and image is typical.



Anyway, those are my predictions. Such experiments cannot be run introspectively and I have to wait until somebody experimentally recombines an individual human mind with the brighter aspects of cow's life and see what happens.

The magic properties of a triangle have been noted in psychology and social psychology of small groups. This is a big topic, with which I am only superficially familiar. It straddles graph theory, topology, sociology, and cognitive psychology.

In graph theory and image recognition, full graph is a graph in which all nodes (points) are connected with each other. Single bond and triangle are the smallest full graphs. Four-node graphs can have some possible bonds missing. In a triangle, to use the language of topology, all

¹³ Similarity is the magic word of Pattern Theory. Analogy has a bad reputation: there are good, bad, and false analogies, but similarity, unlike analogy, is well defined. It is the only alternative to reductionism way to see the world as a whole.

points are in the neighborhood of each other. What I call triplet, however, is different: $B-A-C$ is a linear configuration, in which B and C are not connected.

I suggested (see [Pattern Chemistry of Thought and Speech and their Hypothetical Ancestor](#) or [this](#)) that the difference between thought and language is that former is non-linear, containing such fragments of the network of ideas as triangles and forks (reducible to triangles), speech is always linear, consisting of doublets and triplets. Therefore, a thought on its way to speech must undergo linearization. This is possible in more than one way, causing the divergence of languages at the earliest stage of their evolutions.

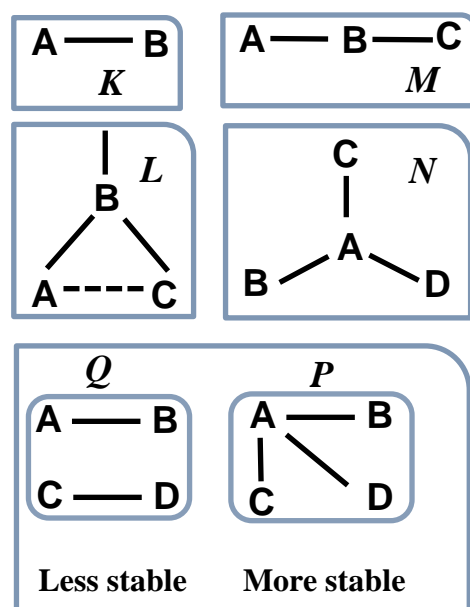


Figure 4. Configurations of simple thoughts

Figure 4 shows some of the simplest possible thoughts. Configurations *M* to *P* are superpositions of bonds of $A-B$ type (*K*) between just two generators.

In triplet *M* and configuration *L*, the central **B** has the peripheral **A** and **C** in its topological neighborhood. This makes them, so to speak, “neighbors of the second degree.” If **B** is activated, both **A** and **C** are activated, too, which makes them similar to the doublet *K*, although the strength of the bond $A-C$ depends on the properties of the bonds $B-A$ and $B-C$. This **triangle** configuration is unique in the sense that its three generators are always in the neighborhood of each other, although the probability distribution of the three bonds can vary. This is what catalysis means in chemistry, but it also naturally applies to pattern chemistry of the mind and its branched network of associations.

The concept of triangle found a place in social psychology long ago.

The theory of balance in social psychology is just another embodiment of the concept of pattern-chemical stability.

Georg Simmel had powerful encyclopedic imagination, which generated numerous and still underappreciated ideas in philosophy, economics, psychology, and humanities in general. I was greatly impressed by his [The Philosophy of Money](#) (1907), which also included psychological aspects.

I quote here an overview of an early idea with a pattern-chemical spirit.

[Georg] Simmel, writing at the very start of the 20th century, had a different view of the role of relationships in social settings. He began by noting that the dyad, the fundamental unit of analysis for anyone studying relationships, including social networkers, was not the best focus for understanding social behavior. Indeed, he argued that before making any predictions about how two people in a relationship might behave, it is important to understand their context. The context, Simmel continues, is determined by the set of third

others who also engage in various relationships with the two focal parties. In other words, Simmel argued that the triad, not the dyad, is the fundamental social unit that needs to be studied.

David Krackhardt and Mark S. Handcock, [Heider vs. Simmel: Emergent Features in Dynamic Structures](#).

In sociology, a third member added to the diad destabilizes the group. In pattern chemistry, the third generator increases stability.

As for context in relation to “irrationality”, Richards Heuer brings Panglossians and Meliorists together, in a curious way, separated only by a one way mirror:

To see the options faced by foreign leaders as these leaders see them, one must understand their values and assumptions and even their misperceptions and misunderstandings. Without such insight, interpreting foreign leaders' decisions or forecasting future decisions is often nothing more than partially informed speculation. Too frequently, foreign behavior appears “irrational” or “not in their own best interest.” Such conclusions often indicate analysts have projected American values and conceptual frameworks onto the foreign leaders and societies, rather than understanding the logic of the situation as it appears to them.

Richards J. Heuer, Jr, [Psychology of Intelligence Analysis](#), CIA, 1999

In other words, Panglossians can, actually, improve the world, while Meliorists—at least in foreign affairs—can destabilize it. I believe this is what is happening in Iraq, Afghanistan, and Middle East in general.

The Panglossians here are, actually, in the role of Meliorists. The deep roots of the Meliorist mindset were uncovered long ago:

The **psychologist's fallacy** is a [fallacy](#) that occurs when an observer presupposes the objectivity of their own perspective when analyzing a behavioral event. The fallacy was named by William James in the 19th century. It is a specific form of the "similar to me" stereotype: what is unknown about another person is assumed, for simplicity, using things the observer knows about themselves. ([Source](#))

This means that the Meliorists are, actually, Panglossians: optimists who think about the world and themselves better than both deserve. They believe that world can be improved and only they know how.

What makes any mindset unstable, indefensible, and ultimately militant is internal contradictions, logical as well as factual (see the end of [Essay 57](#)). They are destabilized by negative bonds between ideas that repel each other.¹⁴ Political and religious beliefs easily implant themselves in minds sparsely populated with ideas where nothing opposes them.

¹⁴ How can bonds be still called bonds if they mean repulsion? Because the generators in the mind are bound to remain close. They have no freedom of movement for the lack of Euclidean space.

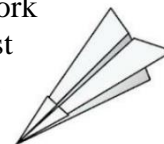
Speaking about psychologist's fallacies, more than one might apply:

- [Curse of knowledge](#) – when knowledge of a topic diminishes one's ability to think about it from a less-informed perspective.
- [Bias blind spot](#) – the tendency to see oneself as less biased than other people, or to be able to identify more cognitive biases in others than in oneself.
- [Confirmation bias](#) – the tendency to search for or interpret information in a way that confirms one's preconceptions.
- [Congruence bias](#) – the tendency to test hypotheses exclusively through direct testing, in contrast to tests of possible alternative hypotheses.
- [Denomination effect](#) – the tendency to spend more money when it is denominated in small amounts (e.g. coins) rather than large amounts (e.g. bills).
- [Experimenter's or Expectation bias](#) – the tendency for experimenters to believe, certify, and publish data that agree with their expectations for the outcome of an experiment, and to disbelieve, discard, or downgrade the corresponding weightings for data that appear to conflict with those expectations.
- [Ludic fallacy](#) - the misuse of games to model real-life situations.
- [Negativity bias](#) – the tendency to pay more attention and give more weight to negative than positive experiences or other kinds of information.
- [Projection bias](#) – the tendency to unconsciously assume that others (or one's future selves) share one's current emotional states, thoughts and values. (from Wikipedia)



2. LINDA

LINDA is the classical case from the very large body of early experimental work started by K&T. Having stirred up a lot of criticism, it remains the largest stumbling block of rationed rationalism. I am not going to throw another pebble at LINDA. She is already 40 years. I am not a psychologist. It is too late. Consider it a paper plane.



I am interested in pattern-chemical mechanisms, i.e., the sequences of elementary steps, in the mind of the first people to whom LINDA was first introduced.

In a series of psychological experiments the authors asked “a group of 88 undergraduates at UBC [University of British Columbia]” to rank the following statements by, I quote, “the degree to which Bill¹⁵ (Linda) resembles the typical member of this class:”

¹⁵ Bill was another imaginary person in a similar experiment, but in the annals of behavioral psychology Linda became famous, while Bill is almost forgotten.

Linda is a teacher in elementary school.
 Linda works in a bookstore and takes yoga classes.
Linda is active in the feminist movement. (F)
 Linda is a psychiatric social worker.
 Linda is a member of the League of Women Voters.
Linda is a bank teller. (T)
 Linda is an insurance salesperson.
**Linda is a bank teller and is active in
 the feminist movement. (T&F)**

Most of the participants (87%) of ranked **F > T&F > T** (“This finding is neither surprising nor objectionable,” comments Kahneman. “The description of Linda was construed to be representative of an active feminist (F) and unrepresentative of a bank teller (T).”

K&T found it “more surprising and less acceptable that the great majority of subjects also rank the conjunctions” (T&F) as more *probable* than their “less representative” answer (T).

Next, a group of 142 undergraduates at UBC were asked the following question:

- Which is more probable?*
1. *Linda is a bank **teller** (T).*
 2. *Linda is a bank **teller and** is active in the feminist movement(T&F).*

This is a clear version of LINDA, in which the information junk intended to confuse the undergraduates has been filtered off.

Still, subjects with richer imagination and wider knowledge base will remain perplexed. What does “*Linda is a bank **teller***” mean in the **context** of the test? The second part of the question brings the logical operator AND into the flask. She is a teller AND not active outside the bank? She is teller AND nothing else?

The stages of problem understanding, noise filtration, orientation, retrieving relevant information, are part of any mechanism of reasoning. Obviously, the muddled initial information

requires more cognitive effort than the filtered one. At a low motivation, the subject could choose a random answer in a multiple choice.

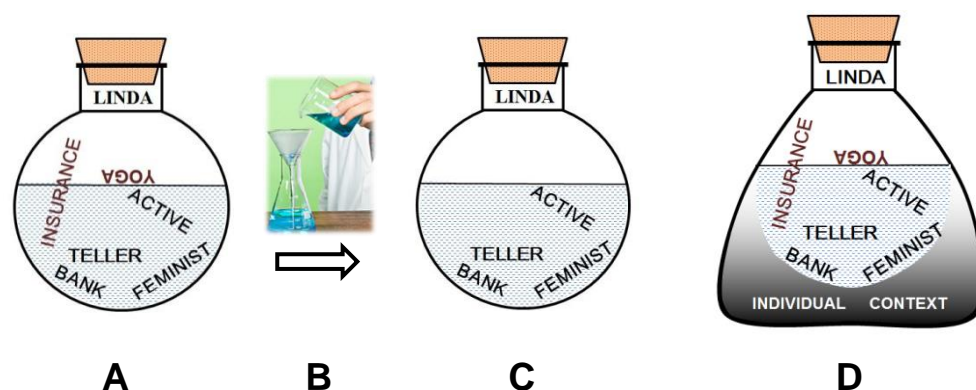
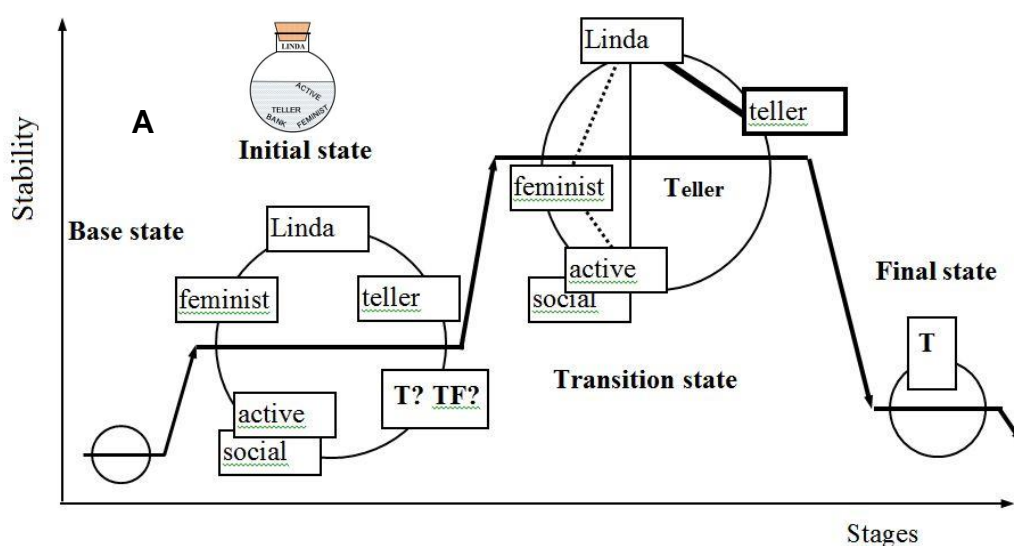


Figure 5. Mind content in LINDA.

A, B, C: Irrelevant matter is filtered off; D: Dark matter of individual context

“In a flagrant violation of the conjunction rule,” (K&T) 85% of them found (T&F) more probable than (T).

The pattern-chemical approach means the following. In order to explain what happens, possible transition and final states should be constructed in terms of generators and bonds. Their stabilities should be compared. The more stable the transition state, the more likely the corresponding outcome.



[Figure 6A. Transition state of LINDA leads to T[ELLER]

At least two mechanisms of reasoning are possible. Mechanism **A**, **Figure 6**, takes into account that the idea TELLER occurs 2 times in the initial state. It is the main factor of stabilization.

In the initial state, the mind (circle) is filled with relevant ideas and activated.

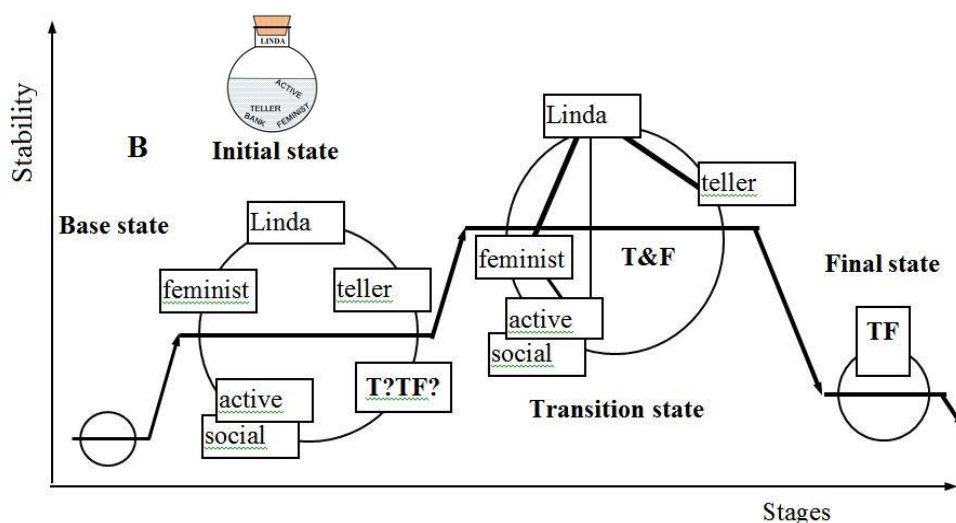


Figure 6B. Transition state of LINDA leads to T[ELLER]&F[EMINIST]

In mechanism **B**, the stabilization by the three bonds in the triangle LINDA-FEMINIST-ACTIVE plus the bond with TELLER cries out for TELLER & FEMINIST.

But this is not all, because the subject's mind contains a lot of personal information that can bond with the generators introduced by the question. "Individual differences" means not just parameters, constraints, and enhancements of intellectual abilities—the classical stuff of psychology—but also individual non-measurable and non-quantitative data, like some familiarity with probability or logic and Venn diagrams, being a female, feminist, or teller or having a boyfriend working in a bank, etc.

Figure 7 shows how **individual context**—background information, brought by the subject to the test in his head—interacts with the **current content**, i.e., information brought by the experimenter. This pattern-chemical reaction is what happens in any human mind initiated by a new situation.

The individual context of the subject's mind can be anything that he or she was preoccupied before the test, especially if the experimenter's content can have some associations with it.

A few out of an indefinite number of possible relevant associations:

1. BANK – MONEY – I-NEED
2. BANK – MONEY – COUNT – MATH
3. MATH – PROBABILITY
4. TELLER – MY-GIRLFRIEND
5. FEMINIST – ARTICLE – SEEN-YESTERDAY
6. MY-GIRLFRIEND – FEMINISM
7. MY-BOYFRIEND – ACTIVE
8. PROBABILITY – NUMBERS – TELLER

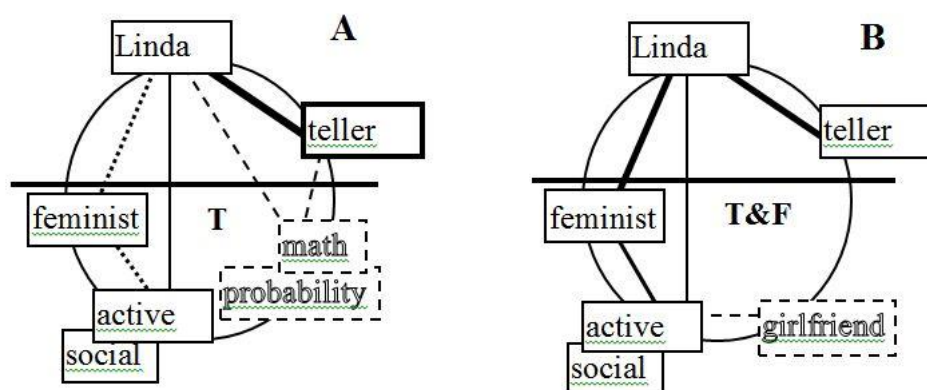
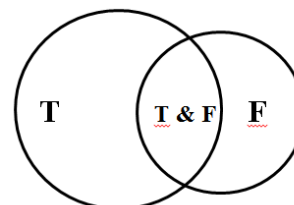


Figure 7. Individual context in the transition state.

I also wonder who the 15% of the rational guys were: half of the 30% who gave the answer at random or the 15 % who remembered logic and elements of set theory. Probability theory is not needed here because there is no event space for statistics. The stern rationalists were pestered for applying probability to one-time events. A mental image of a Venn diagram will do, even the subject never heard the term.



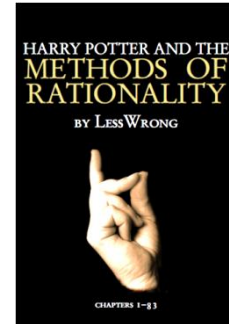
The famous LINDA and JIM experiments and their uncountable children that have populated the earth are pattern-chemically incomplete: they do not give enough space to imagination which is necessary for designing possible mechanisms. I cannot blame the authors. In molecular chemistry, all possible generators are listed in the Periodic Table. There is something more or less like Periodic Table for psychological properties of humans. But personal background is a realm of not just sociology, but the sociology of the current moment. Moreover, retrieving this background requires at least some good old talking association techniques and can be unjustifiably invasive.

I repeat that I am not qualified to judge professional academic psychology as an insider. I am, at best, a reader of Daniel Kahneman's book and maybe a dozen publications out of many hundreds or thousands. But I wonder why other than Meliorist possibilities have been so little explored in 30 years after LINDA. As an exception, I can mention Gerd Gigerenzer, who, instead of branding the college undergraduates with red hot iron, began

to fight, successfully, those who manipulate the minds of patients with probabilistic junk in medical advertisement. The world still can be improved.

The answer is, of course: the economy. Meliorism sells. It is the major driving force of economy: our product is the best, it will change your life overnight.

It happens not because of somebody's ill intent and dishonesty—those are just moral tags. It happens because more money means better life. It increases individual stability and what increases stability happens indeed, until inequality begins eroding stability. Life since the 1970's has been under a heavy and visible hand of economy which is heavier than ever before and pushes only in one stressful direction instead of dispensing blessings of equilibrium and stability.



3. Good news! You have \$1000!

I take this problem from [Investopedia](#) because the original work of K&T¹⁶ uses the term *probability*, which has a well-defined meaning, especially in the market context. Investopedia uses the vague word *chance*.

What is “chance?” Is it an outcome decided by tossing a coin once, with money on the table? Or is it the reality of a businessman who does it every day many times, for years, so that the probability makes sense? But then what kind of sense can such statistic mean if market rarely if ever has any regularity in a long run? In his book, however, Kahneman uses the word “chance,” the vaguest of all and full of mystique.

QUESTION 1. You have \$1,000 and you must pick one of the following choices:
Choice A: You have a 50% chance of gaining \$1,000, and a 50% chance of gaining \$0.
Choice B: You have a 100% chance of gaining \$500.

QUESTION 2. You have \$2,000 and you must pick one of the following choices:
Choice A: You have a 50% chance of losing \$1,000, and 50% of losing \$0.
Choice B: You have a 100% chance of losing \$500.

If the subjects had answered logically, they would pick either “A” or “B” in both situations.

¹⁶ Daniel Kahneman and Amos Tversky, [Prospect Theory: An Analysis of Decision under Risk](#). *Econometrica* ; March 1979; **47** (2) , 263, March 1979.

However, the results of this study showed that an overwhelming majority of people chose “B” for question 1 and “A” for question 2.

My answer for a one-time event: If I am rich, I take choice A for Question 1 and Choice A for Question 2. I can afford to gamble.

If I am financially constrained, I take choice B for Question 1 and refuse to take any chances for Question 2. What can you do, shoot me? Then I will toss a coin to choose between A and B. Still, in a real situation, my individual context could probably break the ties. Each irrational mind, therefore, is rational in its own way, depending on the individual context.

Interestingly, behavioral psychologists recognize that the rich and the poor have naturally different measures of money. In fact, the psychologists consider the discovery of this difference (known at least since Jesus Christ) one of their major accomplishment. Yet they keep designing experiments around the idea of money in the same normative framework as if everybody were already in a moneyless paradise, using the token money for playing Monopoly.

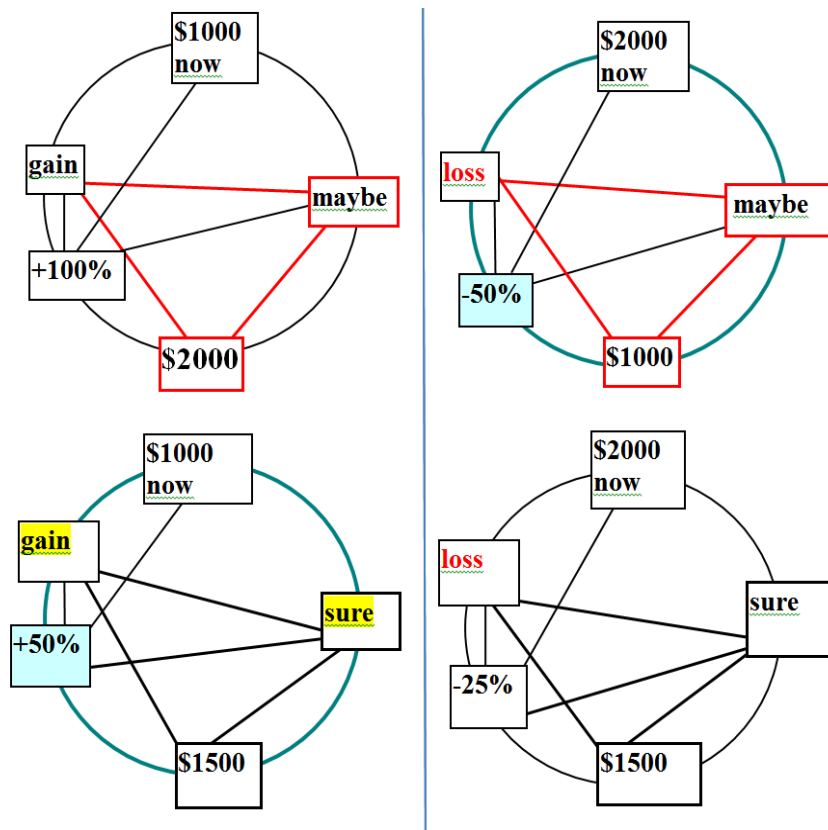


Figure 8. Mind configurations for Question 1 (left) and Question 2 (right)

As an outsider, I can afford a poisoned barb. The behavioral economics has an air of a make-believe Harry-Potter-esque fairy tale: it is funny and it sells.¹⁷

Figure 8 compares the basic elements of mind content for Questions 1 and 2. As I see it, the major qualitative difference is between MAYBE and SURE. What are they, anyway? MAYBE is appropriate only for a one-time choice. SURE is the limit to which MAYBE approaches when making up one's mind in such situations becomes the subject's profession and the law of large numbers kicks in. For the profession of a trader, nothing ever remains the same in a long run, however, from the market hysteries to the vagaries of personal fortune. Unlike fairy tales, real world does not guarantee a happy end. Moreover, philosophically, it guarantees an ultimate unhappiness in the longest possible run.

I will abuse my outsider position once again. Where should behavioral psychology go next? Zurück, zu Freud and Jung: vorwärts! Back, to Freud and Jung: forward, to individual context.



4. Love and money

There has been a big discussion about the “endowment effect,” or valuing something we own more than the same thing we want to buy. Note that the two things are never exactly comparable because we cannot have and have not the same thing and the content of our mind will be different before and after possession. Besides, the change in personal situation can change the personal rules of the trade. Nevertheless, here is, reportedly, not a make-believe but a modified real life story:

A wine-loving economist we know purchased some nice Bordeaux wines years ago at low prices. The wines have greatly appreciated in value, so that a bottle that cost only \$10 when purchased would now fetch \$200 at auction. This economist now drinks some of this wine occasionally, but would neither be willing to sell the wine at the auction price nor buy an additional bottle at that price. ([D. Kahneman, J. Knetsch, and R. Thaler](#). Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias, *The Journal of Economic Perspectives*, Vol. 5, No. 1. (Winter, 1991), pp. 193-206. Daniel Kahneman gives a longer and different version in his book.)

¹⁷ The early original works of K&T, in my opinion, really made both psychological and economic contributions because they were put forward in the context of the existing utility theories, with obvious difference between both. In turn, they may not be the last word. The economics of academic science can be as cruel and scoffing as the economics of Great Depressions.

I am not going to immerse into the professional discussion. I only note that a single real life story cannot be either generalized or put in the same basket with typical undergraduate experiments. I have my own pattern representation of what happens with the wine-loving economist whom I will call Eco.

Love is a bond between two persons, two things, or a person or a thing. Attraction means that the bonded state is more stable than the separated one. Regarding a human and a thing, the difference can be measured in money and, according to the assumed laws of the market, the willingness to pay for a bottle to add to a stock or to sell a bottle from the stock should be the same. In Eco's case the willingness is very low, but not zero. The problem is that the wine collector, unlike the wine trader, does not want make money on his old purchase.

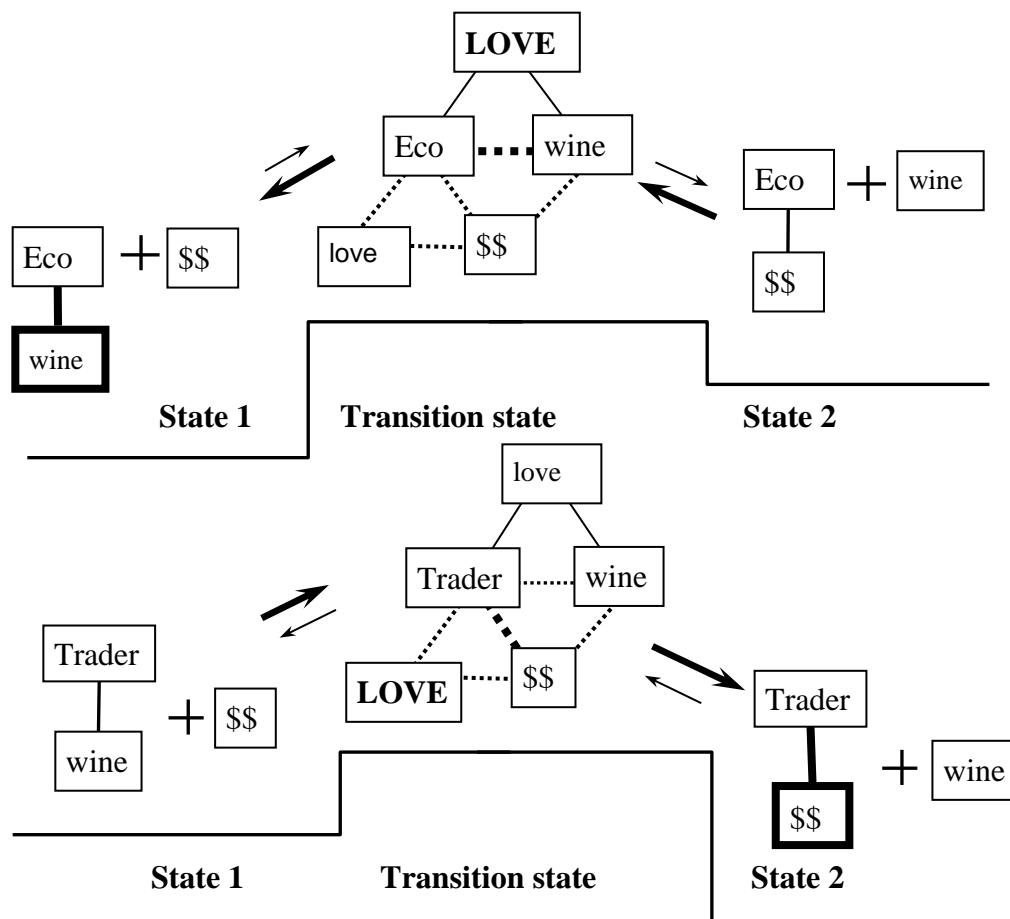


Figure 9. The case of a case of Bordeaux: states in equilibrium

Figure 9 illustrates the difference between wine collecting and wine trading.

It is easy to imagine various internal and external circumstances that can be bonded, positively or negatively, to the transition state, changing the outcome. This, however does not matter because the transaction is in both cases reversible, at least in the mind of the wine collector or the trader. Transition state is the same in both directions.

Neither adding a bottle to the existing stock nor subtracting from it will change the affection of the wine lover. Only a gain but not a loss of a part of monthly income will satisfy the affection of the trader.

Chemical reactions, which are mostly (in principle, all) reversible, reach equilibrium at a position depending not on the transition state but on the relative stability of both stable states.

For the wine collector, preoccupied, as most collectors with the object of his passion, wine is more prominent (probable) in the mind content. For the trader, it is money. Therefore, the equilibrium is **shifted**, as chemists say, to more stable configuration of the two. Yet this regularity is statistical. **Figure 9** also applies to cognitive dissonance.

This example might suggest a simple explanation why economic reality and realities of human behavior are not quite similar: the difference is between the statistically baseless world of one-time events and the swarming relentless unstoppable global economy with its statistical base. The enormous concentration of wealth in society after 1970's and the monstrous inequality of market players is, probably, the best explanation of clinical **irrationality** of American economic and consequently, political organisms. Ergo, the Great Depreciation. We are becoming the property of a small family.

My prediction is that everybody involved in systematic reversible transactions with unequal attraction to object of exchange will from time to time deviate from any entrenched habit. This is a good illustration of the possibility of individual statistical regularities along the time line—a far cry of psychological experiments which are always virgin.

No wonder, the endowment effect is one of the most disputed “fallacies” of behavioral psycho-economics. It is so simple that it will not pass for science without bells and whistles.

My purpose was to illustrate pattern chemistry with results borrowed from a single domain of research in psychology. To toss barbs is just part of my gain in the form of fun—one of very few valuables not measurable in dollars.

I must remind again (for the third time) that my judgment, background, and knowledge base are not professional and I am definitely not familiar with many important works in the field. I am outside the professional research area. I am interested only in Pattern Theory, where my credentials are also not too high, and pattern chemistry, where I am in solitary confinement. But I have a truly irrational hope that the latter may change.



RATIONALITY GAP

This is my first and last Essay driven by my skepticism regarding a big and thriving area of experimental research. However often (many times in this Essay) I emphasize that I am an outsider and my only qualification is being a reader of a recent popular book addressed to people like myself, I cannot hide my surprise at the uncomfortably low level of imagination, logic, and experimental rigor in this area, at least from the point of view of traditional hard experimental science like chemistry. This is a mess, and a few pearls in the mud do not make it shine.

The term “individual differences” of Keith Stanovich had deceived me. It turned out to be reclassified individual abilities, which can, naturally, give birth to new possible fallacies and shortcomings of human mind.

Something prevents psychologists from fully including into the picture the most important natural factor of human thinking: the individual content, created by entire previous life of the subject, of which only a small part shows on the surface of consciousness, like the top of the iceberg. The economic psychology for 99%-ers and 1%-ers should be two different sciences, not one. The Kansas Board of Education rationality and MIT rationality look like they come from the opposite wings of our Galaxy.



The most striking illustration of the rationality gap (don’t ask whose rationality) is the question “Would you prefer \$3,400 this month or \$3,800 next month?” used by Shane Frederick in his analysis of “Cognitive Reflection Test (CRT)¹⁸ results. In the low CRT group, 35% preferred next month, while in the high CRT group 60% showed more “patience,” as it was interpreted by the author. Note that high CRT group included well poised students of MIT, Princeton, and Harvard, while the group of the edgy ones attended Bowling Green, Michigan State (Dearborn), and University of Toledo.

In his [presentation on CRT](#), Shane Frederick denied the role of the wealth gap between the higher and lower grade GATTACA groups, in my view, unconvincingly.

¹⁸ Shane Frederick, [Cognitive Reflection and Decision Making](#), *Journal of Economic Perspectives*—Volume 19, Number 4—Fall 2005—Pages 25–42

Here is the comment of Daniel Kahneman in *Thinking Fast and Slow*:

Only 37% of those who solved all three puzzles [on which CRT is based] correctly have the same **shortsighted** preference for receiving a smaller amount immediately. (p.48)

What were the three fateful questions, quite like in a fairy tale? ¹⁹

- (1) A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost? _____ cents
- (2) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? _____ minutes
- (3) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? _____ days

I greatly sympathize with the millennium generation who will be tried at human resources by rationality tests, urine analysis, and saliva swab in their 40's and 50's.



I begin to think that breaking up with Freud and Jung was a misstep for psychology because it lost sight of what makes us individual as nations, artists, scientists, leaders, lovers, and spouses: our roots, genes, upbringing, biographies, and bedroom secrets. Like economics, psychology comprises all human matters. Although it is much more conservative and narrow-minded (sorry), it surpasses economy by primogeniture. Human nature is the oldest and most stable factor in the evolution of economy—more stable than even the climate and local geography. Whether human nature is good for economy (it is definitely good for politics) or its modification or even substitution will be even better is a separate big issue.

It is my impression, after a short reconnaissance, that behavioral economics, in spite of its enormous experimental material and numerical interpretations, is full of contradictions. Here are a few examples from Kahneman's book.

- (1) The example "\$3,400 now or \$3,800 later" obviously (maybe only to me) contradicts the central point of the prospect theory: the evaluation of gain or loss is rational not in absolute numbers, but relative to the reference point. If so, the position of the subject on the wealth ladder defines which decision is rational and which is not. Without personal data, the question does not make sense.
- (2) "The science of availability" (p.129) tells you that it is irrational to rely on your recent experience and, generally, on what is currently most active in your

¹⁹ "The boy is confronted with three questions on his journey, as he travels between two towns and across the river." ([The Devil with the Three Golden Hairs](#))

mind. That may be true regarding weather in the Windy City. But by the same logic, it must be irrational to rely on your current monetary reference point: it can change by next morning. Maybe it has already changed and you don't know about it. Or never knew. Exaggeration of your assets is another "fallacy."

(3) If you want to rely on statistics of diseases, accidents, crime, and other rare unpleasant things, you will be rebuked for exaggerating your own risks. Statistics, however, is based on data about large numbers of people who are complete strangers to you. What matters is where and how you live **your** life. In order to develop your own realistic statistics, you need to analyze your own lifetime behavior (time series). Using Daniel Kahneman's example, you can die in a Jerusalem bus only once (p.333). By the time you are finished analyzing, you will be finished indeed. This is why Plato warned not judge a man's life happy until he dies.



PLATO'S WARNING

In his book *What Intelligence Tests Miss: The Psychology of Rational Thought* (Yale U.P., 2009), Keith Stanovich refers to two life stories. Two very intelligent people, professor of mathematics John Allen Paulos and David Denby, a writer and film critic (whose reviews I greatly enjoy and trust) lost a lot of money in stock market, as they acknowledged, because of irrational trading. They wrote books about that (which I have not read).

The stories have a beginning and an end and are **diachronic** experiments run by nature, like any life story and any chemical transformation in the flask. Both people failed in achieving their accessory goals, but not of their primary ones. I am sure their stories can be counterbalanced by two others: of people who bought a single, at the time obscure stock, and made their fortunes without moving a finger. The names of the lucky ones are much better remembered than the names of the losers. In my opinion, the behavior of the two intellectuals was irrational only from the point of view of the rules of the trade, some of them as contradicting as any folk wisdom. But if the idiotic behavior of the majority of stockholders was **the norm** during the dotcom bubble, it cannot be generalized as irrationality.

I suspect that by a careful Freudian analysis on a couch, the behavior could be either explained by some personal circumstances (clear in the case of David Denby) or shown as a **pattern** repeating several times throughout life in different configurations.

In this Essay à la Montaigne, I easily acknowledge that I used to make mostly the same mistakes all my sufficiently long life. I had learned from some, but not all, by the time the lessons became useless.

I also suspect that both people, clearly of very sharp intelligence, simply did not love money enough to get a good market **education** and were unable to fully commit themselves to making money. I believe, their professional occupations were the biggest

distractions from their stock market exploits. Like the wine collector Eco, they probably loved mathematics, movies, and writing—and maybe just intensity of life—more than playing lottery.

Unlike **diachronic** tests, psychological rationality tests, however, are incomplete **synchronic** (one-time) experiments that neither allow for statistical generalization nor take to account the entire mind content, nor pay attention to the powerful factor of education.



ECONOMY OF ECONOMICS

In natural sciences, you are successful if you make everybody agree with your ideas and results. In humanities, you can make a career by opposing somebody's ideas. In economics... well, it is different.

When I ask myself about possible reasons for the “strangeness” of the situation as I see it, the answer is immediate: behavioral **economics** is morphing into **economy** of right behavior, joining the economies of well-being, good health, seductive beauty, and true religion. Its message seems to be: “Your behavior is wrong, your mind is full of fallacies, we can cure you and make your mind **less wrong**®, and you will prosper even more.”

Compare with “Your body is ugly, you are fat, your face is full of wrinkles, we can cure you and make you look less wrong, and you will shine.”

The [list of fallacies or biases](#) is long, growing, and growling at us. There are currently 92 “Decision-making, belief, and behavioral biases,” 24 “Social biases,” and 52 “Memory errors and biases,” the total of 168. The list, by the way, does not leave any doubt that fundamentalist, literalist, and politicized religion is the worst clump of fallacies, although it is not even mentioned²⁰.

Has anybody attempted to encompass the “biases,” which is a milder term for “fallacy,” within a single conceptual framework? I do not see any offer of a single theory, however tentative, and, according to my search, nobody does. This situation associates in my mind with the [medicalization](#) of human condition, especially, in psychiatry. I would call it irrationalization of common sense—a psychologist's fallacy to consider deviation from a vaguely defined arbitrary standard as a disorder or disability. Is an exceptional talent a

²⁰ John Allen Paulos wrote a book *Irreligion: A Mathematician Explains Why the Arguments for God Just Don't Add Up*. I haven't read it. I do not think science and religion have anything in common, although they, like animals and plants, came from the same seed: drive for understanding.

disability? So many great people occasionally or constantly manifested strangeness and “irrationality,” which in no way ruined their lives.

What does all that tell me? I believe that a united comprehensive and consensual psychological theory is possible. Psychology is one of the most attractive areas of science exactly because it is loose, contradictory, incomplete, and yielding to the pressure of economy. There are a lot of great things to do.

I believe in the most abstract, broad-minded, and comprehensive approach to the mind. I believe in Pattern Theory as the most abstract and rigorous theory of the human mind, inexplicably overlooked even by those who write about patterns.

Why chemistry is the right pattern paradigm of treating complexity of the mind is beyond this Essay. I can only give three hints.

(1) Life has a chemical origin; mind is a product of evolution of life; evolution of exsystems—evolving complex systems—follows the principle of simplicity: complex systems emerge from a simple beginning through a sequence of simple steps because only simple objects can emerge accidentally and simple steps can be made spontaneously.

(2) Chemistry is diachronic: its main problem is the process with the beginning and an end, moreover, with several possible ends. The outcome depends on the speed of competing scenarios. The fastest runner wins, most of the time. The difference of psychology from chemistry is that there is only one runner instead of zillions. Psychology of the American elections and popular choice in general is more “chemical.” This is a big opaque flask. See [Essay 57](#).

(3) It has been noted quite often, that nature, having once invented some evolutionary trick, tends to repeat it again and again. Chemical evolution had been the first trick and it was generalized and appropriated by all subsequent stages of evolution.

PARTING WORDS TO A YOUNG PSYCHOLOGIST (and more stone)



Economics and business management recommend a beginner businessman to find a market niche. As many as 168 possible niches of cognitive “fallacies,” with more on the ways, are better than a single congested marketplace where the winner sooner or later takes all.

Ambitious young psychologist dreaming of conquering highest peaks of science and loathing to rent a niche in a cliff, pattern chemistry is yours. Have in mind, however, that such exalted goals are irrational, we are told by theory of rationality, because their probabilities of realization for a person taken at random are practically zero.



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