

A Philosophy of Scientific Action



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The Scientist and Emotions



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Everyone has both of these types of thoughts from time to time. They are natural.



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7. Are they reliable? Are they to be trusted?
8. Are they devoid of value, or containing some value?



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How can we articulate the intermediate state of neither disregarding nor yielding to emotions?



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Please consider this proposition in the course of your own research and observe whether or not it brings benefit.



Qualities of Scientific Thought



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Here we will explore a simple framework for bringing different *types of thinking* or *qualities of thought* to bear on a problem.



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This is the “Six Thinking Hats” framework by Edward de Bono.

{Cheat sheet}

{Read the book— highly recommended}

We will refer to these as “lenses” rather than “hats”, because when we choose to employ them, they color our perception.



White

Objective, neutral, facts and figures



Yellow

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Black

Critical, skeptical, negative



Green

Creative, possibilities, alternatives



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Feelings, hunches, intuition



Blue

Wisdom, experience, perspective



Exercise: Role Playing

In this exercise we're going to see if we can train ourselves to put on each of these different colored lenses, and think along those lines.

We work in pairs, Person A and Person B. Person A will pull up a figure of their data on the laptop.

The job of Person B is to talk with Person A about Person A's data, while playing the role dictated by a particular color. We will work with one color at a time and stick with it for three minutes.

Person A does not do role-playing. Their job is to experience what it is like to be on the receiving end of the different energies from Person B's different modes of thinking.



Qualities of Mind

We explored six categories or types of thinking, represented as six different colored lenses: White, Yellow, Black, Green, Red, Blue.

This can be reframed somewhat. Instead of seeing these as *types* of thinking, we can think of them instead as *mental faculties* or *qualities of mind* that may or may not be present at any moment.



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Skepticism. (Black) Everyone wants to get results. But results are only results if they can withstand scrutiny. It is essential to have a healthy degree of skepticism in one's conclusions. This involves mentally playing the role of others and assessing their objections.



Qualities of Mind

Imagination. (Green) Looking at data is like putting together a puzzle in which you only have 5% of the pieces. Therefore, it is essential to exercise your imagination in order to fill in the blanks.



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Intuition. (Red) Trying to put together a story from data is like being a detective. A detective works to collect evidence, but the process of collecting evidence is based on hunches, suspicions, and gut feelings. It is not a wholly rational process.

Judiciousness. (Blue) It can take a lot of time to analyze data. There are “red herrings” or false paths, and there is a limit to the information that can be extracted. It is important to use time wisely.



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We're going to look at an informal classification of scientific energy that I've found to be very useful.



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This is inspired by “The Book of Five Rings”, a book on the art of swordsmanship written by great samurai Miyamoto Musashi around the year 1645.



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Answers: Fire, Emptiness, Earth, Air, Water, also Water



Exercise: Five Scenarios

In this exercise you are going to be given a scenario. Your job is to determine what class(es) of energy are most suitable and why.

Note, you're not asked to actually determine a particular course of action. You're only being asked to recommend a spirit or spirits with which the situation should be approached.

Keep in mind that there may be more than one class of energy that is suitable for each situation.

Furthermore, there might not be enough information given about the scenario to make a decision. In this case you are free to imagine other details and frame your answer depending on those details.

Finally, this is a group exercise. We will do it in groups of four. See if you can come to a collective judgement so that all four people in the group are on the same page about the recommendation.

Jot down your recommendations. We will go through all five, then discuss later.



Scenario 1

At your thesis defense, a committee member demands changes you find profoundly unfair. You need their signature to graduate.

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Scenario 2

Your project statement hinges upon working with a model, but after much effort, you can't get the model to produce sensible results.

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Scenario 3

You stumble upon a hot new research idea that you're not funded to work on. The door is wide open—for now.

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Scenario 4

You finally finish a massive project spanning many years. You are looking for your next step.

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Scenario 5

You know exactly what you should be working on. You clearly articulate your vision in proposals, which are definitively rejected.

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Discussion

What energy or energies are suitable in each case? Why?

Does this depend upon unknown details?

What course or courses of action are suggested?

In my experience, it is often easier to take a clear course of action if one first reflects on the quality of energy that is appropriate for the situation.

In addition, it makes it easier to see what courses of action are definitely not appropriate, as well as to stick with your decision if it leads down a challenging road.

For your consideration.



Quieting the Mind



Quieting the Mind

Yesterday we discussed the proposition that the attitude of an observational scientist is the attitude of a detective.

We discussed how to effectively employ the emotions without getting carried away by them.

Another way to say all of this is: A scientist has space from his or her own thoughts and feelings. A scientist does not act according to compulsions.



Quieting the Mind

We've been discussing the importance of obtain some distance or perspective on one's own thoughts and feelings for a scientist, particularly an observational scientist.

We've also discussed the benefits of being able to access emptiness as appropriate tactic in various situations.

The question was also raised, in regards to the term “de-focusing the mind”, how exactly one is supposed to do that.

These are all related in that they have to do with the quiet or receptive power of the mind.

You might say that our normal conceptual learning is like training a hand to be strong, to grab things, to skillfully manipulate things.

Where is the balancing training that teaches the mind to let go of things and become receptive?



Quieting the Mind

There is in fact a simple mental practice for clearing the mind and obtaining space.

This technique is today known as mindfulness of breathing or mindfulness meditation.

It is an ancient practice, handed down through generations unchanged for two and a half thousand years.

I practice this every day and now consider it to be an essential part of keeping a healthy and flexible mind—the mental equivalent of stretching, or of flossing your teeth.

Today I would like to do a brief experiment where we give this a try, and observe the results. Sound good?



Three Motivations



A Reflection Assignment

Please take a few minutes to write to yourself the answers to these questions. If one doesn't resonate, just go on to the next one.

1. What is my day-to-day motivation as a scientist? In other words, what is the thing that gets me out of bed in the morning and propels me forward?
2. Is this motivation always the same, or does it fluctuate in quality or intensity?
3. Is it pure, existing by itself, or is it mixed together with other motivations?
4. Does this motivation take energy or care to maintain, or is it self-sustaining?
5. Is this motivation a good match for all activities I need to do as a scientist, or is it a good match for some and a less good match for others?
6. Is this motivation something that always supports me in my science, or does it sometimes act as a hindrance?



Why Ask These Questions?

Our motivation is like the engine of a car. It is the thing that propels us forward. Like the engine of a car, it is something that can be tinkered with, tuned up, and even replaced.

It might not be obvious that the engine of a car can be modified or replaced. It is hidden from view and seems like the very heart of the car. But in fact it is a part like any other.

The car's engine is an essential factor in determining how it performs its function. Therefore it's important to pay attention to it.

The same holds for motivations.



Why Ask These Questions?

Our motivation is like the engine of a car. It is the thing that propels us forward. Like the engine of a car, it is something that can be tinkered with, tuned up, and even replaced.

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The same holds for motivations.

There are different possible motivations. To look in more detail at these, we will generalize them into three broad classes.



Positive Class Motivations

Benevolence / Goodwill / Altruism. It can be the case that our day-to-day motivation is wanting to make a difference in the world, wanting to help mankind or the environment, wanting to make other people's lives better, wanting to counteract some harm or injustice that has been done.



Negative Class Motivations

Fear / Anger / Greed. It can also be the case that actions in science are motivated by negative factors: fear of not getting a job, anger at something a reviewer said, just wanting to make money (well, not in this field!), wanting to acquire power over others, and so forth.



Neutral Class Motivations

Curiosity / Tenaciousness / Resolve. There are also motivations that are neither positive nor negative. These have in common an absence of emotional overtones. We will group these together into a neutral class.

Curiosity. This involves being interested in seeing what is actually in the data. Getting to know data is like getting to know a person. You want to let that person speak for him- or herself.

Tenaciousness / Resolve. This is the attitude of someone who is determined to climb a mountain, or of a detective pursuing a hunch. It is the spirit of just getting up again after a setback and continuing to try. As a mentor said with reference to getting a proposal declined, “Sometimes you have to just wear them down.”



A Quote from Einstein

“My scientific work is motivated by an irresistible longing to understand the secrets of nature and by no other feelings. My love for justice and the striving to contribute toward the improvement of human conditions are quite independent from my scientific interests.”

— A. Einstein

(Letter to F. Lentz, August 20, 1949, in answer to a letter asking Einstein about his scientific motivation. Einstein Archives 58–418, From *The Ultimate Quoteable Einstein*, p. 20)



A Quote from a Movie

From the movie “Lawrence of Arabia”, set during a time of guerrilla warfare in the Middle East during WW I.

“With Major Lawrence, mercy is a passion. With me, it is merely good manners. You may judge which motive is the more reliable.”

— Prince Feisal



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The relevant point for our purposes is a clear articulation of the idea that motivations based on strong emotions may be *less reliable* than more neutral ones.



A Personal Observation

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Of course, there is still an overarching motivation to do good. But day-to-day I have found benefit from simple curiosity together with resolve.

Submitted for your consideration in the laboratory of your own life experience.



The Two Inclinations



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In this quote, we we will replace “mathematics” with “science”.

“Some mathematicians are birds, others are frogs. Birds fly high in the air and survey broad vistas of mathematics out to the far horizon. They delight in concepts that unify our thinking and bring together diverse problems from different parts of the landscape. Frogs live in the mud below and see only the flowers that grow nearby. They delight in the details of particular objects, and they solve problems one at a time... Mathematics needs both birds and frogs. Mathematics is rich and beautiful because birds give it broad visions and frogs give it intricate details... It is stupid [ed: ‘unwise’] to claim that birds are better than frogs because they see farther, or that frogs are better than birds because they see deeper. The world of mathematics is both broad and deep, and we need birds and frogs working together to explore it.”

— from *Birds and Frogs* by Freeman Dyson



The Two Inclinations

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Birds, seeing the whole, tend to value diversification.
Frogs, seeing the parts, tend to value unification.



Discussion Questions

Birds incline to the big picture. **Frogs** incline to the details.

Birds: survey, quick, together, multi-tasking, temporal, destination

Frogs: immerse, slow, alone, mono-tasking, atemporal, direction

We'll have discussions in groups of three.



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4. What would our field be like if we had only birds? Only frogs?
5. Do you feel one of these inclinations describes you?
Or some of both? Does one describe your advisor?



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For this reason, it is important to know one's own character.



One Unifying Principle



A True Story

A junior scientist realized that she needed help and went to see her mentor, a very senior and successful scientist. When she arrived at her mentor's office, the young scientist found the older scientist in a distraught and agitated state.

“Is everything okay?” asked the young scientist.

“No, it's not!!” answered the older scientist. He was so upset, his hands were shaking. “I'm working on a proof, but I can't figure it out. I've tried everything! I don't know what to do. I should be able to do this. It's so frustrating!”

The junior scientist didn't know what to do, either. She did her best to console her mentor with encouraging words, telling him she was sure he would be able to figure out the proof soon, and suggesting he put it down and come back to it later.

After a little while, the older scientist calmed down and went back to his work. The younger scientist left without getting the help she had been seeking.



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Hearing stories like this can make one resolve to try to counterbalance such tendencies.



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“The true value of a human being is determined primarily by the measure and the sense in which he [or she] has attained liberation from the self.” —Einstein, in *The World as I see It*



Summary of these Notes

The unifying principle behind these notes and exercises is that of obtaining space from one's own thoughts and feelings.

It is proposed that having such space helps us to be better scientists.

This proposition is not of the type that amends itself to quantitative and objective testing. Therefore, it is presented to individuals, so that those who might be inclined to do so may evaluate this proposition through observation of their own life experience.

In our lives as scientists, it seems to me, we may either proceed in such a way that we become more open in heart and mind, or in such a way that we become more closed.

Whether it goes on way or another depends upon the manner one's internal orientation, and that, in turn, depends to a degree upon the ideas to which one has been exposed.



An Abstract Painting

Years ago I saw a painting in a museum. It did not appear to represent anything particular. Instead it was composed of simple abstract shapes, lines, and planes of light and color. I did not know what to make of it. Fascinated, I stared at it for a while.

After some time I began to notice how it felt to be looking at the painting. In the upper portion of the painting I felt a sense of rushing, energy, and motion. Then in the lower portion, I felt a sense stillness, calm, and quiet. Suddenly, something clicked. “It feels like a waterfall!” I thought.

I looked at the title: *Waterfall*, 1928, by Arthur Dove.



A Change in Perspective

Arthur Dove, a contemporary of Stieglitz and Georgia O'Keefe, is not very well known today. However, he is recognized as the first American abstract expressionist, a forerunner of artists like Rothko and Pollock.

In his writing, the artist described a transition point in his life. He gave up painting the way things *look* and started painting the way things *feel*.

After a while of painting in this way, he no longer saw things in terms of recognizable forms and individual objects. Instead he saw, and remembered, things in terms of simple abstract shapes, lines, and planes of light and color.

His practice as a painter altered his perception of reality. I found this to be very profound.



Perspective Training

The ideas that inhabit our mind influence our perception, whether we are aware of it or not.

If we have an idea of “mine” versus “yours”, we will tend to see things in this way, and our experiences will then reinforce that view. Over time it becomes more difficult to change.

If, on the other hand, we have a set of abstract, impersonal factors with which to analyze our experiences, then over time we gain more space from our personal habits, reactions, and preferences.

The ideas presented here have two purposes. On one level, they can perhaps aid us in everyday life as scientists by bringing attention to non-obvious distinctions, or by enumerating options we didn't know we had.

On another level, it is hoped that they can contribute to gaining space from ourselves through the use of an impersonal scaffolding, a perspective training for a different way of looking at things.

