

How to Become a Thinker

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There Is No Substitute for Thinking

- We can work very hard, but unless we think deeply our efforts will yield no unique value to the society
- Deep thinking is hard. It takes energy and requires self-discipline. There is no substitute for it

A Story of Newton and Einstein on the Speed of Gravity

- Isaac Newton believed that gravity traveled instantaneously
- Albert Einstein's general theory of relativity assumes that gravity travels at the speed of light
- Scientists now generally believe that Einstein was right. An international team in 2002 actually managed to measure gravity's speed and confirm Einstein's assumption by using a powerful intercontinental array of radio telescopes
- Einstein came to his conclusion through deep and careful thinking. (He actually did not do physics experiments by himself.) It must have been very stressful calculation and analysis given that he had no computers to use then

Advices for Students Starting on Research or Wanting to Be Serious with Their Life

Based on what I read about and learned from other researchers, as well as my own personal experience, I offer four pieces of advice:

- 1. Aim High Intellectually**
- 2. Figure Out Your Own Thinking Methods**
- 3. Seize the Moment and Be Diligent in Thinking**
- 4. Find Solitude**

Advice 1: Aim High Intellectually

- Beyond getting a degree and good grades, you would want to make substantive **intellectual contributions** in your career, which in EECS could be a new theory, algorithm, architecture, design, technology, software, tools and methodologies, innovative company, etc., that can have lasting value
- You should be prepared to do much better than your teachers. Don't take authority's word for granted
- If you aim high, you will be hungry intellectually. You will do well in the era of so-called "information society" and "knowledge workers"
- This also means that you will stop wasting your time and energy doing bogus stuff. Usually you can recognize bad stuff without much difficulty. In this situation, you need to **make a decision and move on to serious intellectual pursuits**

Advice 2: Figure Out Your Own Thinking Methods

- Everyone has his or her **own bag of “tricks”** to help them do deep thinking, such as:
 - Talk/brainstorm/debate
 - Respond to pressure/disappointment (e.g., Viterbi’s story on responding to severe criticisms on CDMA)
 - Sketch idea visually
 - Organize/present/write
 - Model/analyze/calculate
 - Experiment/simulate
 - Survey literature (to get inspired mainly)
 - Think from first principles
- Different tricks work differently for different people. The earlier you can figure out those tricks which work for you, the better off you will be

Advice 3: Seize the Moment and Be Diligent in Thinking

Deep thinking requires discipline

- When you feel like you want to think, do it right away (no email, web surfing, phone calls, eating, rest, etc.)
 - A two-hour thinking at the right moment could yield some of the best work in your life
 - Modern mobile devices such as smartphones and tablets let you sketch and record ideas anytime and anywhere
- When you come up an idea, write it down and expand it immediately using your own bag of tricks. Otherwise it can be gone forever. (I had too many these unfortunate experiences)
- Try to think before you go to bed. Hard thinking with an objective is tiring and can make you fall into sleep quickly. Yet, when you wake up, you often have some flesh ideas. In this case, follow up them immediately before they are forgotten
- When you feel that your current environment is inspiring, exploit it as much as possible. A good environment is rare and you need some luck to have one. Because similar conditions may not be available to you again for a long time, you must seize the opportunity

Advice 4: Find Solitude

- For serious and deep intellectual work, you need a quiet environment where you can listen to your brain and feeling
- **“Creativity flourishes in solitude.”** Breakthroughs almost always started with an idea of a single individual. This is a reason why artistic work seldom has joint authorship
- Thus it is okay, or even necessary, to find solitude when you are deep into thinking
- **Devote one or two best hours each day for proactive intellectual tasks by yourself, rather than doing reactive things**
- This does not mean that we don't support and learn from each other; in fact, a supporting environment is critical for intellectual pursuits. Here we only recognize that root inspirations or ideas must come from individuals in solitude. In any research group, there must be such individuals capable of offering deep insights or identifying “gains;” otherwise the group is just doing busy work, wasting everyone's time
- Living in solitude may be hard, but this is a price to pay for great intellectual work (consider, e.g., Einstein, Mozart, Picasso, etc.)

Conclusion

- Intellectual efforts can yield the highest and most lasting value. In addition, they can profoundly satisfy a person (a secret not often told). To excel, you need to be able to think deeply
- You should learn to be a deep thinker early in your life. The practice requires experience and confidence. The earlier you become a thinker, the earlier you benefit from the result
- I wish you all become great intellectuals