Systems Engineering and the Art Of Seeing

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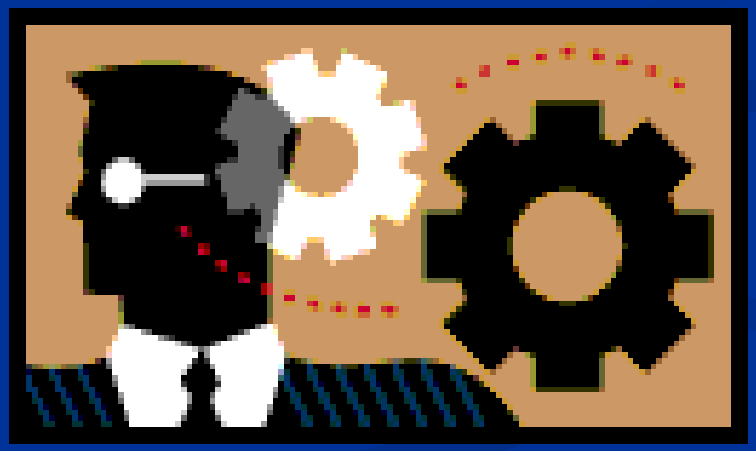
Summary

- What are systems?
- Why do we need to see a more complete picture?
- The Art of Seeing
- Whole Brain Reasoning
- Design on the Right Side of the Brain
- The Art of Systems Engineering

Systems = "wholes"

- A system is a collection of related parts that interact in an organized way for a purpose.
- Key words:
  - Related parts
  - Organized
  - Purpose



What is a system?

- A definition as offered by Gregory Watson in his book, *Business Systems Engineering*: "**System means a grouping of parts that operate together for a common purpose.**" (Watson, 1994).

What is a System? (Cont'd)

- Definition as adapted from Random House Dictionary: A ***system*** is an assemblage or combination of elements or parts forming a complex or unitary whole, such as a river system or a transportation system; any assemblage or set of correlated members, such as a system of currency; an ordered and comprehensive assemblage of facts, principles, or doctrines in a particular field of knowledge or thought, such as a system of philosophy; a coordinated body of methods or a complex scheme or plan of procedure, such as a system of organization and management; any regular or special method of plan or procedure, such as a system of marking, numbering, or measuring (Blanchard & Fabrychy, 1998).

Connectedness

- "If you wish to understand a system, and so be in a position to predict its behavior, it is necessary to study the system as a whole. Cutting it up into bits for study is likely to destroy the system's connectedness, and hence the system itself." (Sherwood, 2002)

Connectedness

- "If you wish to influence or control the behavior of a system, you must act on the system as a whole. Tweaking it in one place in the hope that nothing will happen in another is doomed to failure—that's what connectedness is all about." (Sherwood, 2002).

What differentiates success from failure?

- Projects are required to be
  - Comprehensive
  - Cohesive
  - Creative
- Typically the first two are taught in the technical curriculum, left side of the brain
- The third is taught in the arts, on the right side of the brain

A Mystery…

Dr. Haledjian was speaking with a close friend of his at a local dinner party. His friend told a story about when he acted as a border guard during the cold war between East and West in Germany.

"We had certain known individuals who had a pass to cross the border for various reasons, although we knew that many of them were really smuggling goods across the line."

"One of the most colorful fellows always crossed the border from the West to the East very early in the morning, driving his flashy red sports car. He always pulled up to the guard house and flashed his million-dollar smile. We of course would inspect his papers very carefully, and check over his car as closely as we could" he said.

"The curious thing was that he always had three large glass jars sitting on the front seat of his car, which we always inspected carefully but could never find any contraband. The jars were all about fourteen inches high and held about 2 gallons each. The first jar was filled with honey, the second with bits of broken glass, and the third was filled with coffee grounds. Each was filled absolutely to the brim. We emptied each of those jars and inspected the contents many times, but we could never discover what he was smuggling. To this day I don't even know if he was a smuggler."

Haledjian responded, "I think perhaps I can help you with that, my friend, your traveler was obviously a smuggler, and I can even tell you what he was smuggling!"

Discussion of Solution

- We all had the same information
- We all were given the same scenario
- There was very little specialized knowledge required
- Some of the us can use the same inputs to reach a dramatically different conclusion
- Why is this important?

Creativity = Different = Leadership

Another mystery…

Dr.Haledjian was in Inspector Winters' office waiting for the next case to solve when Inspector Winters came in with Jacques Strap. "He's charged with murdering Frank Buzz," snapped the Inspector.

"It's a mistake," cried Jacques.

"So then what were you doing in an alley with a gun and a dead man?" asked the Inspector.

"It wasn't my gun , and I'll tell you the truth. I was walking past the theater when I saw two men run past me. The second man was carrying a gun. So I followed them. They turned into an alley and the second man fired six shots at the other. The first man dropped dead to the ground. The murderer was about to walk away when he caught a glimpse of me. Knowing there was no escape, he threw his Colt .45 at me and ran to the fire exit door of the theater. There he pushed open the door and went inside. I picked up the gun and was still holding it when a cop came running up the alley," finished Jacques.

"I tell you I'm innocent."

"Give me a break", said Dr.Haledjian. "This story is impossible."

Discussion of Solution

- We all had the same information
- We need to consider non-traditional thought paths

How do we do this?

The Art of Seeing

- Looking at all the information presented
- Looking at the bigger picture
- Looking away from where our eye or attention is drawn, and understanding why
- Ask ourselves:
  - Why is the information presented in this manner?
- Ask why, ask why again
- This enables us to see things more fully than before

Music is the deepest channel of communication

To solve a problem

- To solve a problem one has to
  - See exactly what the problem is
  - Imagine the system and the problem
  - Imagine the solution to the problem
  - With your eyes you see what isn't working, you make it work in your mind, and you simply have to identify the difference
- This is 'Whole-Brain' Reasoning

Whole Brain Reasoning

- Nuts and bolts observational analysis from the left side of the brain
- Free association image building from the right side of the brain
- This is a departure from traditional linear-thinking, sequential models
- A mixture of **art** and **science**

Results of the mixture of art and science

- Study of 37 student's IQ scores over 8mos
  - First group given no music lessons – 6% increase in spatial reasoning scores
  - Second group given music lessons – 46% increase in spatial reasoning scores
- Medical School acceptance
  - 66% of music majors accepted (highest %)
  - 44% of biochemistry majors accepted

More results

- Music and visual arts education given to first graders who underperformed in Kindergarten
  - After one year were 22% better at mathematical competency than their peers
- 93-95 study on three groups of preschoolers
  - 1st group – no training – IQ ^ .5 pts
  - 2nd group – computer lessons – IQ ^ .35 pts
  - 3rd group – music lessons – IQ ^ 3.62 pts

More results…

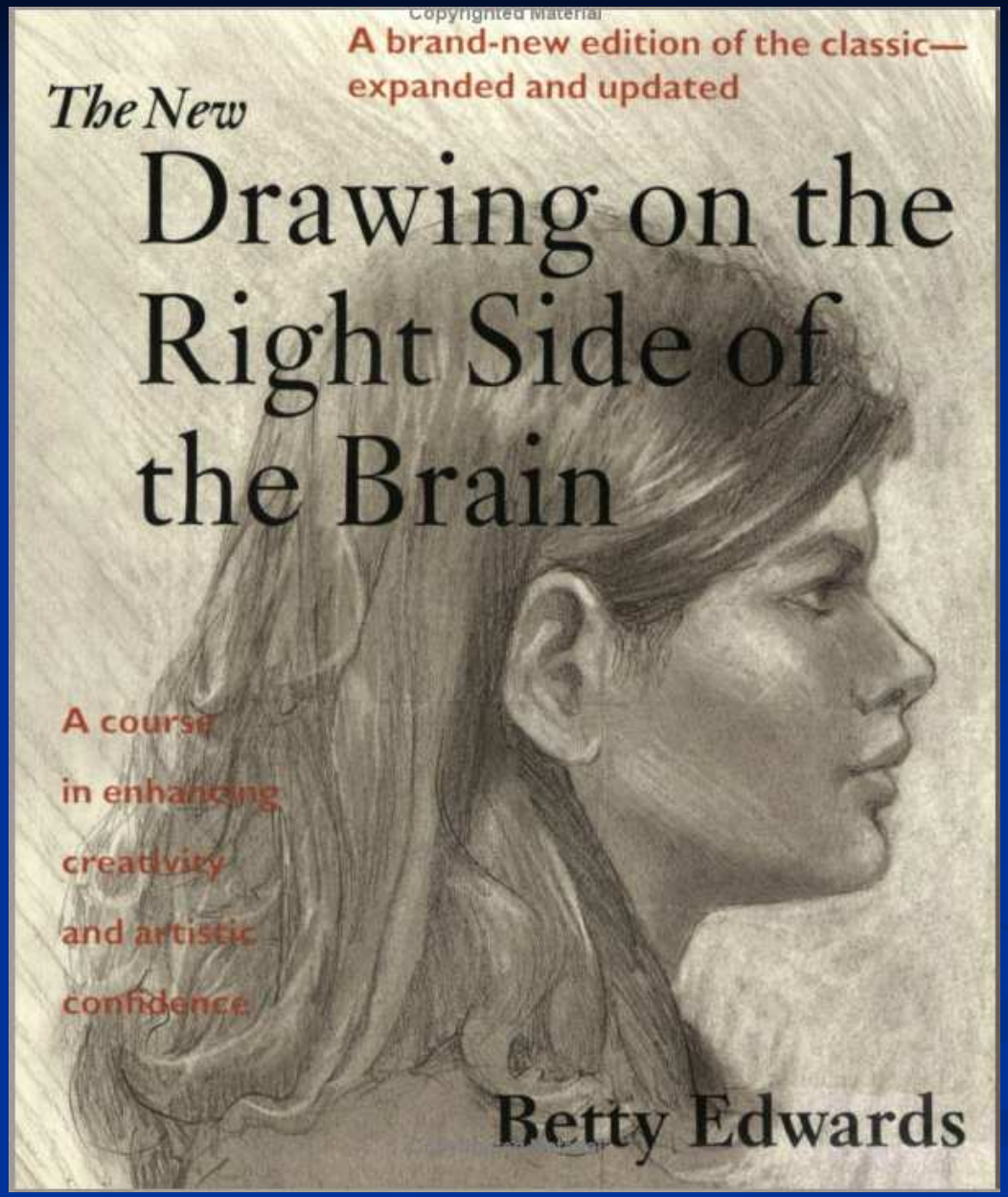
- Students with musical performance experience
  - 53 points higher on SAT verbal portion
  - 39 points higher on SAT math portion
  - Than students without musical performance exp
- Students with coursework in music appreciation
  - 61 points higher on SAT verbal portion
  - 42 points higher on SAT math portion
  - Than students without music appreciation courses
- Clearly there is more to be seen here…

Left Brain Style

- Responds to verbal instructions
- Problem solves logically and sequentially
- Looks at differences
- Is planned and structured
- Prefers established, expected information
- Prefers talking and writing
- Prefers multiple choice tests
- Controls feelings
- Prefers ranked authority structures
- Sees cause and effect
- Is a splitter, distinction is important
- Draws on previously accumulated, organized information

Right Brain Style

- Responds to demonstrated instructions
- Problem solves with hunches, looks for patterns
- Looks at similarities
- Is fluid and spontaneous
- Prefers elusive, uncertain information
- Prefers drawing and manipulating objects
- Prefers open ended questions
- Free with personal feelings
- Prefers collegial authority structures
- Is a lumper, connectedness important
- Is analogic, sees correspondences, resemblances
- Draws on unbounded patterns, clustered around images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A brand-new edition of the classic—
expanded and updated
The New
Drawing on the
Right Side of
the Brain
A course
in enhancing
creativity
and artistic
confidence
Betty Edwards

Five basic skills of drawing

- The perception of edges
- The perception of spaces
- The perception of relationships
- The perception of lights and shadows
- The perception of the whole, or gestalt

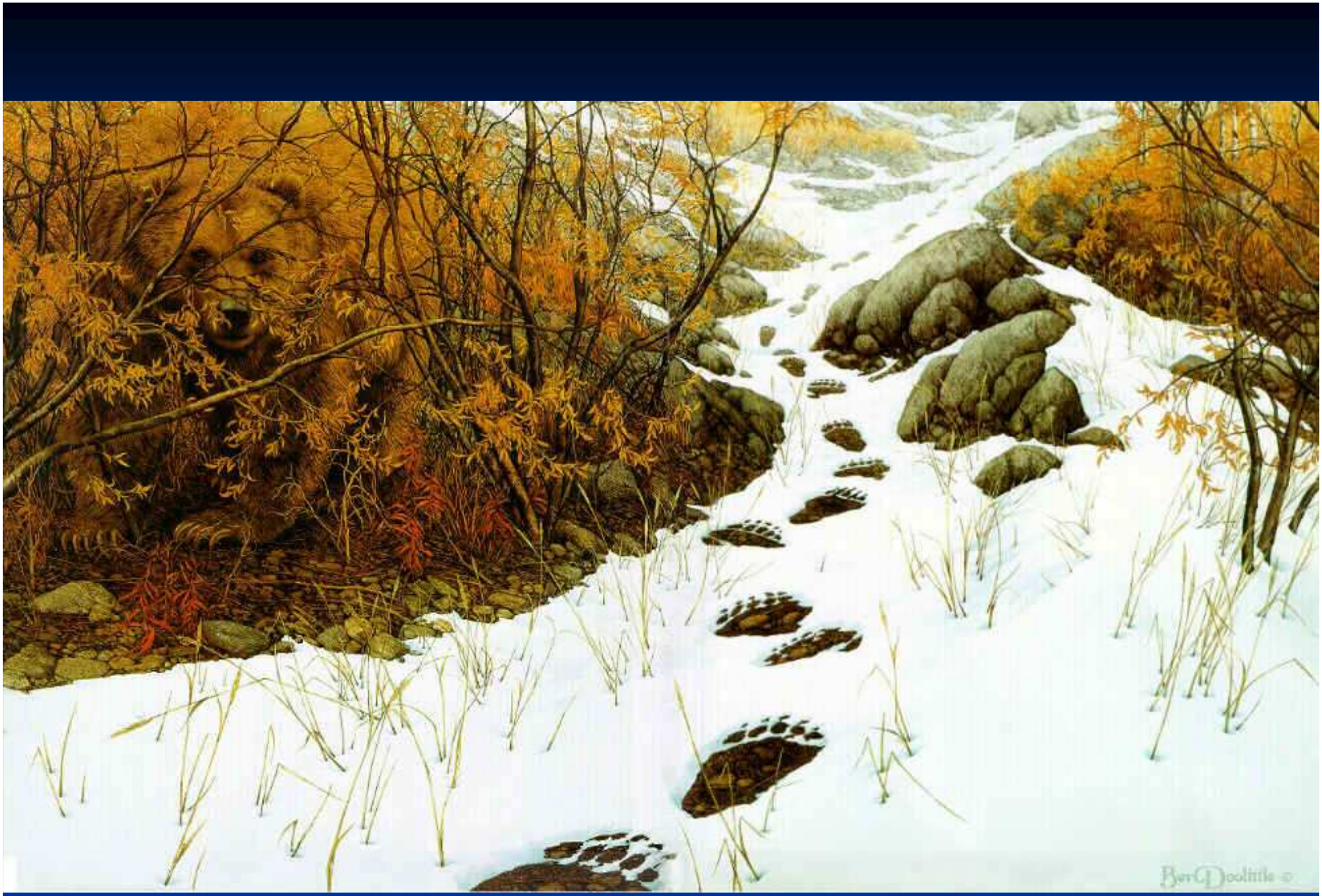
Translating that into the five basic skills of Design

- The perception of interfaces
- The perception of context
- The perception of relationships
- The perception of light and dark, with regard to design intent
- The perception of the whole, or gestalt

This is what Systems Engineering is all about

- The combination of art and science to create:
  - Comprehensive
  - Cohesive
  - Creative
- The ability to combine the art and science is what differentiates the star performers from the average performers

Understanding what we can see…



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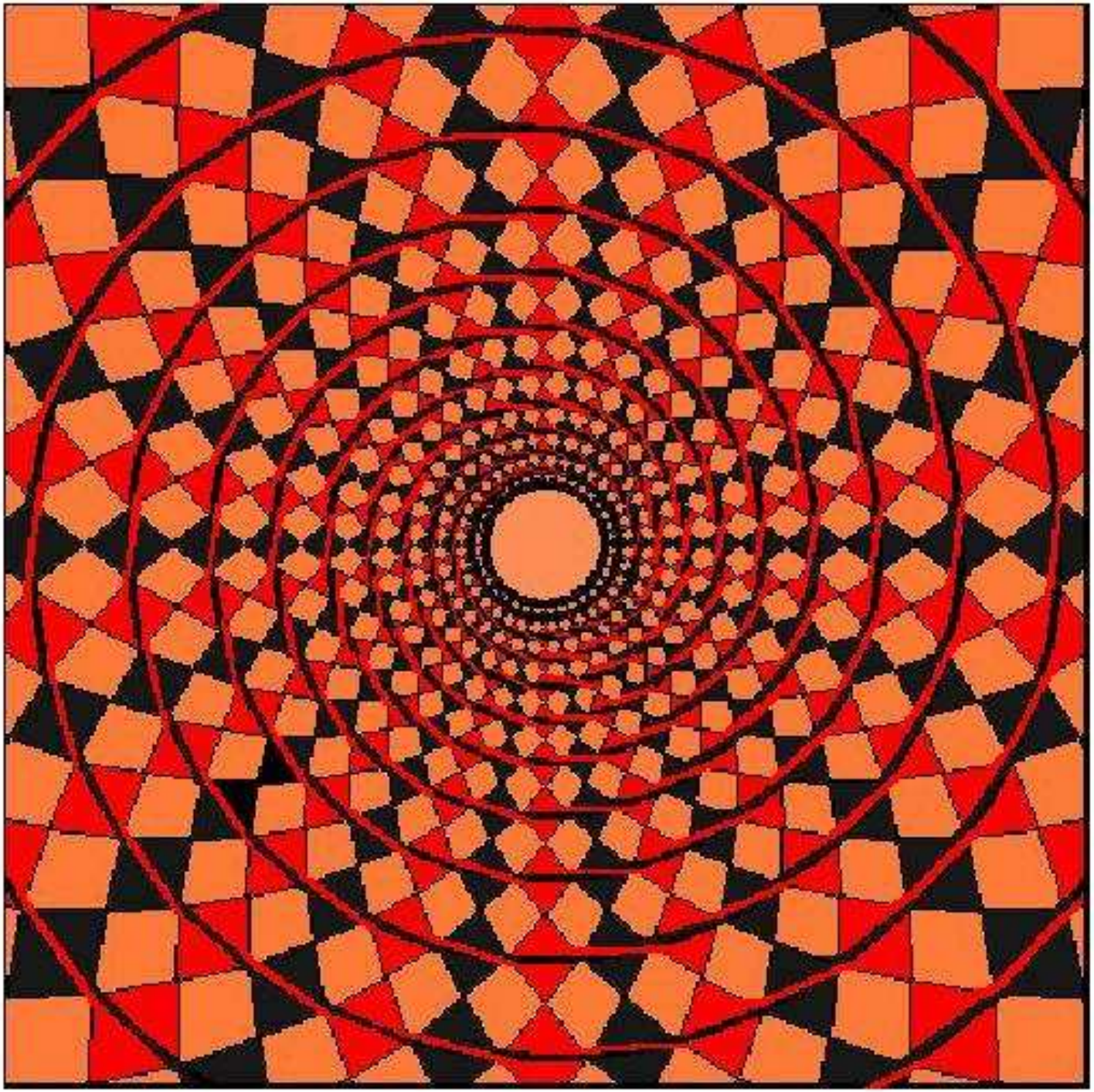

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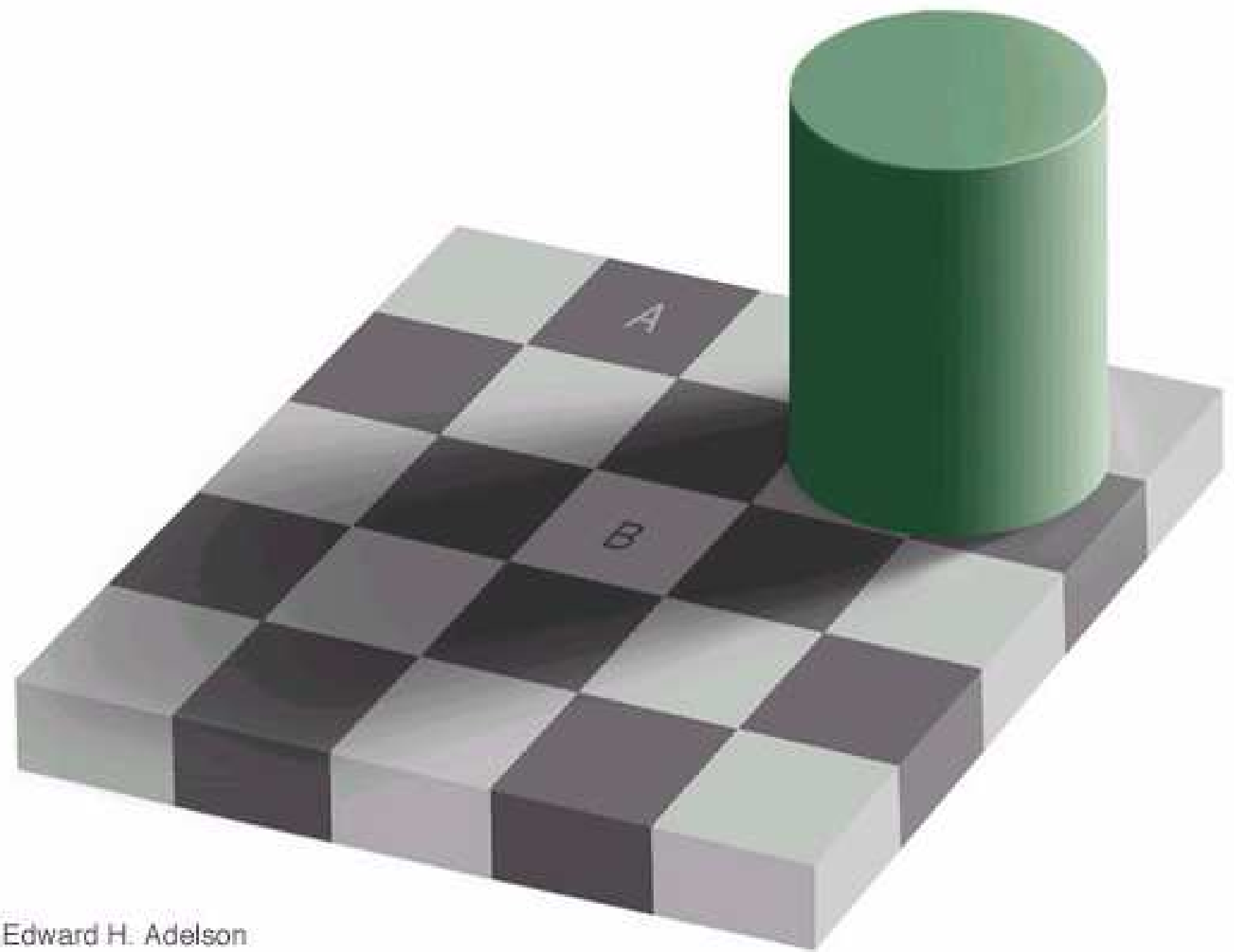
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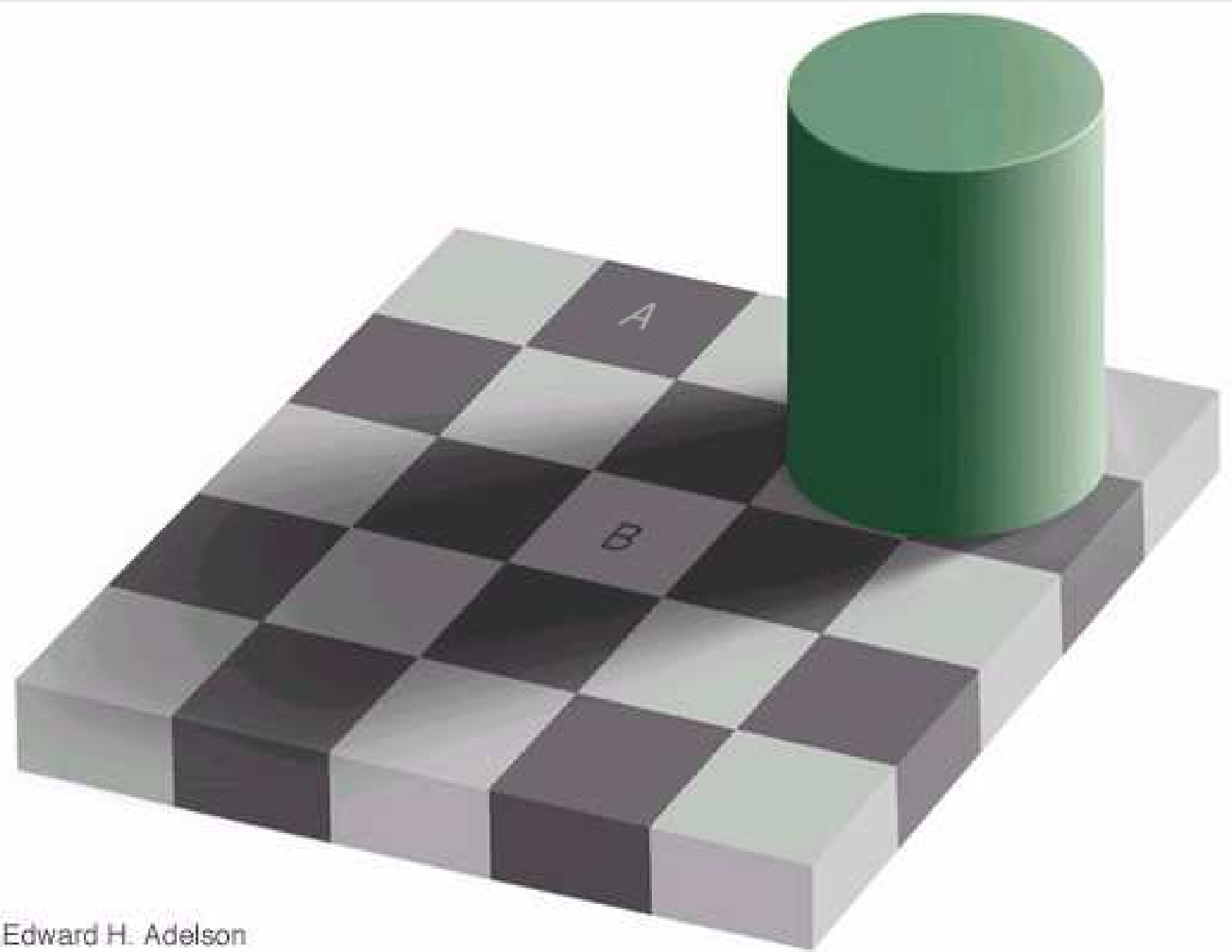
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"Haledjian, could you come over to the station house?", Winters asked his friend on the phone. I know that it is Saturday evening and that you want to be with your family, but I think that I have got a little problem that might prove to be a challenge even for your great deductive skills," the detective exclaimed.

"Well, it must be important or else you wouldn't have called. I'll be right over. With any luck, we'll solve your 'little problem' in time for me to get back home to enjoy the delicious pot roast that my wife has in the oven," the sleuth concluded.

Winters met Haledjian at the door to the station house and led him to the interrogation room where Henry Watchman was sitting at the table cracking his knuckles. "Did you hear about the robbery at the Chocolate Warehouse last night?" Winters asked the famous sleuth. "Someone broke in and stole the entire inventory of chocolate eggs. Mr. Watchman, the company's security guard, was on duty last night. I've asked him to tell us what he saw."

"As the Inspector stated," Mr. Watchman began, "I was on duty last night when the Chocolate Warehouse was broken into. Unfortunately, I wasn't able to prevent the robbery because it occurred while I was on my coffee break, but, as I was returning to the warehouse from the coffee shop down the street, I did see one of the people who did it. It was John O'Henry, a man who was recently laid off. I saw him making off with the goodies. The light of the full moon clearly revealed his features. There was another person with him, but this person had a wide brim hat on, shading the light of the moon. I guess that this was O'Henry's idea of getting revenge on the company for laying him off. Luckily, Easter was last Sunday. If the robbery had occurred a week earlier, there would have been a lot of disappointed kids on Easter morning," Watchman mused.

"The little problem that I mentioned to you on the phone," Winters pointed out to Haledjian after the security guard had left the room, "is that O'Henry has an alibi. We interviewed him earlier this afternoon, and he claims that he was home last night watching the video "Titanic" with his wife. His wife supports his story. Perhaps they decided to get some 'snacks' at the Chocolate Warehouse to go with their movie, but how do I prove it? The video store owner remembers renting that film to them. What do you think of this puzzle, old friend?

"I think that I will get back home in plenty of time for my wife's famous pot roast," Haledjian remarked. "Forget about O'Henry and ask the security guard what he was really doing on his coffee break."

Discussion of Solution

- The Art of Seeing
  - Looking at all the information presented
  - Looking at the bigger picture
  - Looking away from where our eye or attention is drawn, and understanding why
- Ask ourselves:
  - Why is the information presented in this manner?
- Ask why, ask why again
- This enables us to see things more fully than before

This is Systems Engineering

- The perception of interfaces
- The perception of context
- The perception of relationships
- The perception of light and dark, requirements, verification, validation
- The perception of the whole, or gestalt

Systems Engineering

- Has an existing methodology
- But requires us to see things differently
- And requires us to combine elements and perceive the system in ways not normally familiar to us
- We can borrow from the artistic world to better understand Systems from a whole-brain perspective

Summary

- What are systems?
- Why do we need to see a more complete picture?
- The Art of Seeing
- Whole Brain Reasoning
- Design on the Right Side of the Brain
- The Art and Science of Systems Engineering

In Closing

He who works with his hands is a laborer

He who works with his hands and head is a craftsman

He who works with his hands, head and heart is an artist.

- St. Francis of Assisi