Great Minds Are Not All The Same, 3rd Edition

Temple Grandin, Distinguished Professor of Animal Science
Colorado State University
We Need The Skills of People Who Think Differently
First Step is learning that different kinds of thinking exist

I was shocked to learn that other people thought in words and did not think in pictures like me
Visual Thinking Helped Me In My Animal Behavior Work
I looked at what cattle were seeing.
I saw something that should not be in the launch pad that was a risk
I Visualized The Raccoon Chewing on Wiring

Wikimedia
Different Approaches to Solving Problems

✓ Object Visualizers
  See Risk

✓ Mathematicians
  Calculate Risk

✓ Verbal Thinkers
  Discuss Risk
3 Types of Different Ways of Thinking
Object Visualizer Thinks in Photo Realistic Pictures

Careers

• Inventor of Mechanical Equipment
• Art-Graphic Design
• Photography
• Working With Animals
• Highly Skilled Trades, Welding, Car Repair, Electrician
Object Visualizer Sees the Flower in the Metal Parts
Spatial Visualizer
Thinks in Patterns

Careers

• Computer Programming
• Engineering
• Chemistry - Physics
• Music
• Mathematics – Data Analytics
Verbal Mind Thinks in Words

Careers

- Writer
- Sales and Marketing
- Finance - Banking
- Psychologist
- Lawyer
- Teacher
Groundbreaking Scientific Study Provides Scientific Evidence That Different Types of Thinking Exist

Kozhevnikov et al., 2002
Revising the Visualizer-Verbal Dimension Evidence for Two Types of Visualizers
Cognition and Instruction, Vol. 70(1):47-77
Some People May Be Mixtures of Different Types of Thinking
Brain Scans of Large Visual Thinking Circuit

Control

T. Grandin

Humphreys, Minshew, Behrmann, and Cibu, 2006
Brain Scans

T. Grandin

Control

Humphreys, Minshew, Behrmann, and Cibu, 2006
Eye Gaze Study For Preferred Sources of Information

✓ Object Visualizer looks at pictures
✓ Verbal Thinker looks at written text
✓ Visual Spatial looks at both

Hoffler et al., 2016
Create a Planet

- Art students made fantastic planets with pictures
- Science students made round planets lack imagery
- Humanities students used words and splashes of color
- Art and science students carefully planned their planets
- Verbal thinkers lacked planning

Blazhenkova and Kozhevnikov, 2016, 2020

Photo credit NASA
➢ Verbal Thinkers overgeneralized with top-down linear thinking that leaves out details

➢ Object Visualizers and Spatial Visualizers are bottom-up thinkers and keep too many details
Great Early Inventors, Such as Cyrus McCormick, Were Clever Engineers

Grain Harvesting Equipment in 1884
Today We Don’t Make it Anymore!
Where are the Clever Engineers?
Today, Over Half of Large Industrial 3D Printers Sold To Industry Are European

Credit – Force Technology
State-of-the-Art Electronic Chip Making Machine From Holland
Visual thinkers are required to build this

Source: ASML
Newest Electron Microscope from Germany
We Have Lost the Skills to Build This
Mars Landing Parachutes

✓ Fabric made in the U.K., Sewn in the U.S.
✓ High tech looms from Europe

Dare Mighty Things
A Visit to the Mother Ship
We Paid The Price for Taking All the Hands-On Classes Out of the Schools Where Visual Thinkers Really Thrived

- Art, sewing, cooking
- Playing musical instruments
- Woodworking
- Welding – Create new devices
- Theater
- Auto shop
TACT Denver, Colorado

- 2-week trade exploration camp
- Small classes – 6 students
- Extensive job coaching when you begin employment
Autistic Actors in a Broadway Show
Grandfather Co-Invents Auto Pilot

Different Kinds of Minds Complemented Each Other

- Visual Thinker
- Mathematical Engineer
- A Verbal Thinking Lawyer would have prevented theft of their invention
Educational System is Screening Out Object Visualizers

✓ I could not do Algebra
✓ Sixty percent of Community College students need remedial math
✓ Only 30% need remedial English
The Owner is a Brilliant Object Visualizer Who Cannot Do Algebra
He is a Mechanical Genius Who Designs and Builds Hydraulic Power Systems
Autistic and Dyslexic People Worked with Me on the Center Track Restrainer That is Used in Large Beef Plants
Collaboration Required to Build Large Food Processing Plants?

- **Object visualizer Picture Thinkers** – Design plant layout and invent highly specialized mechanical equipment

- **Visual Spatial Math Thinkers** – Engineer, boilers, refrigeration, calculate roof trusses, power and water

Huge shortage of electricians, mechanics, and welders who can read drawings.
Collaboration on the Book Visual Thinking

➢ I wrote the first drafts by associating pictures
➢ Betsy Lerner re-organized my thoughts with her linear verbal thinking
➢ Together we kept the right amount of detail
Collaboration Required to Construct Buildings

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Twenty Percent of People I Worked With Were Either Autistic, Dyslexic or ADHD

✓ Owned metal companies
✓ Multiple patents
✓ Designed and built complex mechanical equipment
✓ Most of them were poor at algebra
Grandparents and parents often tell me they have autism after a child was diagnosed.

Most had successful careers. Learned work skills as children.

Diagnosis helps fully verbal teens and adults with relationships.
• What would happen to top innovators in today’s educational system or workplace?
• Many of them had an unconventional educational path
• If born today, would their lives have been less successful?
Michelangelo

➢ Dropped out of school at age 12

➢ Exposed to both art and stone cutting tools

➢ Mentoring occurred after exposure got him started
These Innovators Had Creative Hobbies

Bullied in school
Learned calligraphy
Tinkered in a neighbor’s garage

No speech until age 3
Played the violin
Thomas Edison

- High School drop out
- Probably had autism
- Learned how to work
- Mentored in New Technology
Elon Musk

- SpaceX
- Tesla Electric Car
- Bullied in school
- Is on the autism spectrum
Arts Foster Scientific Success

➢ Nobel prize winners 50% more likely to have an arts and craft hobby compared to other scientists

➢ They were painters, musicians, actors, dancers, composers, poets, photographers or craftsman

Robert Root Bernstein et al., 2008
Tips for Working with Minds That are Different

✓ Never overload working memory with rapid multi-tasking
✓ Provide a written Pilot’s Checklist for tasks with multiple steps. It is an external working memory
✓ Avoid long strips of verbal instruction
✓ Stretch them slightly out of their comfort zones
✓ Limit video games and replace with mechanics
✓ Provide choices of hands-on activities
✓ Do not use vague instructions
Ultimate Goal of Education

➢ Where is a student ten years after high school graduation?
➢ I was doing my first big livestock design projects
Sold My Work By Showing My Portfolio
Drawing From My Portfolio
An Interview For Me Was Showing The Client Photos and Drawings
Replica Used in HBO Movie Temple Grandin
LIVESTOCK HANDLING SYSTEMS

A Well Designed Facility will help make your Livestock Operation More Profitable.

CUSTOM DESIGNED
To Fit Your Operation:

Working, sorting, loading and hospital facility at A. Glen Klack Feedlots in Richland, Nebraska. The system has a curved level loading chute, herringbone sorting pens, scale, covered hospital pens, working circle and horse pens. Curved chutes and smooth traffic flow reduce stress and improve efficiency. The covered working circle is designed for easy washdown. Employees will do a better job of processing in clean facilities which protect them from the weather. Careful gentle processing will improve cattle performance.

CURVED WORKING CHUTES
For Greater Efficiency:

A curved single file chute, round crowding pen and wide curved alley are labor saving and reduce stress at Alan Vertishine’s cow calf operation in Saskatoon, Canada. A handler working from the catwalk along the inner radius can move cattle easily into the round crowd pen and squeeze. Cattle can be sorted 3 ways after the squeeze chute. Grandin designs handling facilities for all types of ranch and feedlot operations.

Consultant & Designer of livestock handling facilities for feed lots, ranches, packing plants & auctions.

GRANDIN LIVESTOCK HANDLING SYSTEMS, INC.

NEW ADDRESS:
1205 W. Elizabeth Suite E122
Fort Collins, CO 80521

Suite 3, 1401 Silver St.
Urbana, IL 61801 217-384-4815
Half the Cattle in North America are Handled in Systems I Designed
Get Lots of Exercise

I do 100 sit-ups every night
My Work Experience

- 13 years of age - Sewing job
- 15 years of age – Cleaning horse stalls
- 16 years of age – Aunt’s ranch
- 16 years of age – Roofing
- 17 years of age – Sign painting
- College – Research Lab – Rent houses
- College – Aid Child With Autism
Find Back Doors to Jobs

✓ Friend’s Business
✓ Contacts in Your Industry
✓ Half of All Good Jobs Back Door
My Elementary School
Life Skills Training

- Party hostess at family parties and shake hands with guests
- Sold candy to neighbors for charity
- Shopped by myself for small toys and snacks
- Learned saving money
Friends Through Shared Interests
in Art, Carpentry, and Horses
I was a poor student but I learned lots of valuable work skills in high school. I did building projects that other people appreciated.

Before

After
Freelance Sign Painting at the Carnival

Photo by Leo
Driving Slow and Gradual Approach

Kristina et al., 2018
Slow Transition to the World of Work

- Jobs on a schedule outside the home at age 11 to 12
- Learn basic life skills such as shopping
- Do not overprotect or over accommodate
- Learn to keep a real job before graduation from high school
Jim Uhl, the Contractor – An Important Work Mentor

Got on the Phone Fast to Find the Drawings for This
Finding Mentors and Teachers

- My Mother – Taught me to read at age 8

- Elementary School Teachers

- Mr. Carlock, High School Science Teacher

- Jim Uhl – Agate Construction
Sensory Over Sensitivity

- Highly variable
- Give the individual control of the sound they hate
- Do not wear headphones all the time because they will make sound sensitivity worse
- Thrift shops have soft clothing
- Autism Environmental Enrichment
Signs of Visual Processing Problems in Autism, Dyslexia, and Sensory Processing Disorder

✓ Hates escalators
✓ Print jiggles on the page during reading
✓ Eye exam may be normal
Visual images break up and fragment similar to migraine headaches

Fig. 4. The stages of “mosaic” vision, as experienced during migraine aura (see text)

Oliver Sacks
Perspectives  J. Stein and V. Walsh – Temporal processing and dyslexia

Words can be hard to read for several different reasons.

Fig. 1. Words can be hard to read for several different reasons. Visual confusions can cause letter reversals (‘worbs’), distortion and blurring (‘can be hard to read’) and superimposition (‘for several different’).

Dyslexia is caused by defects in brain circuits which process fast moving auditory and visual information. Reading and doing number work with one eye may improve reading and help stabilize abnormal eye movements.
Interventions for Visual Processing Problems

Non-flickering LED lamp by desk or natural light

Block flicking LED lights with a hat

Locate flickering LEDs and screens with slow motion video

Gray, tan, or pastel paper for reading

Irlen lenses or pale colored glasses
Severe Sensory Problems

➢ Extreme effort required to screen out background noise and visual distractions
➢ Needs frequent breaks to prevent sensory overload
➢ Mono-channel – Eye contact may be difficult
➢ Body boundary problems
➢ Often an auditory thinker
Environmental Enrichment is an Effective Treatment for Autism

- Stimulate two senses simultaneously
- Adjunct to ABA and speech therapy
- One of the senses is always smell or touch
- Novelty and keep changing the stimulation
- Use simple economical things. Two 15 minute sessions per day
Nonverbal Individuals who Type Independently Describe Severe Sensory Problems

- *How Can I Talk if my Lips Don’t Move* by Tito Rajarish Muhopadhyay
- *Carly’s Voice* by Arthur Fleischmann with Carly Fleischmann
- *The Reason I Jump* by Naoki Higashida
- *Fall Down 7 Times Get up 8* by Naoki Higashida
Slow Processing Speed Explains Difficulty With:

- Rapid conversation
- Rapid multi-tasking
- Rapid response to a question
- Remembering long verbal instructions
- Problems with interrupting conversations
Attention shifting slowness occurs with many disorders
Takes longer to shift back and forth between two different things

Slow Processing Speed
Viewer with Autism (Red Line)
Normal Comparison Viewer (Yellow Line)
 Shows Attention Shifting Slowness
Teaching Young Kids

- Slow down when you talk
- Encourage use of words
- Give them more time to respond
- Use teachable moments
- Give instruction instead of saying *No*
- Teach turn taking so kids learn to wait
Abnormalities in Left Hemisphere

Working Memory and Algebra Department Failed to Develop

University of Utah, 2010
Fear is the main emotion in Autism. My amygdala (fear center) is three times larger.

University of Utah, 2010
Things I was Afraid of in My 20’s

✓ Airplanes
✓ Public speaking – walked out during my first talk
Got Over It When an Airplane Became Interesting
Fear is the main emotion in autism. My amygdala (fear center) is three times larger (University of Utah, 2010)

A low doses of antidepressant has controlled my anxiety – Started early 30’s

Thinking in Pictures – Chapter “A Believer in Biochemistry”

High doses of antidepressants may cause insomnia or agitation
Using pressure to calm the nervous system during therapy
Show Kids Interesting Things

Put business and science magazines in the school library
Penrose Tiling

Credit: Wikimedia
Fractals

Source: Mandelbrot-Wikipedia
The Mathematical Mind Finds Patterns in Everything

Aloe Plant Polyphylla Spiral, Wikimedia
Educational Materials

- Code.org
- Protein Symmetry
- Scratch Programming
- Khan Academy
- National Geographic Citizen Science
- NASA Education