



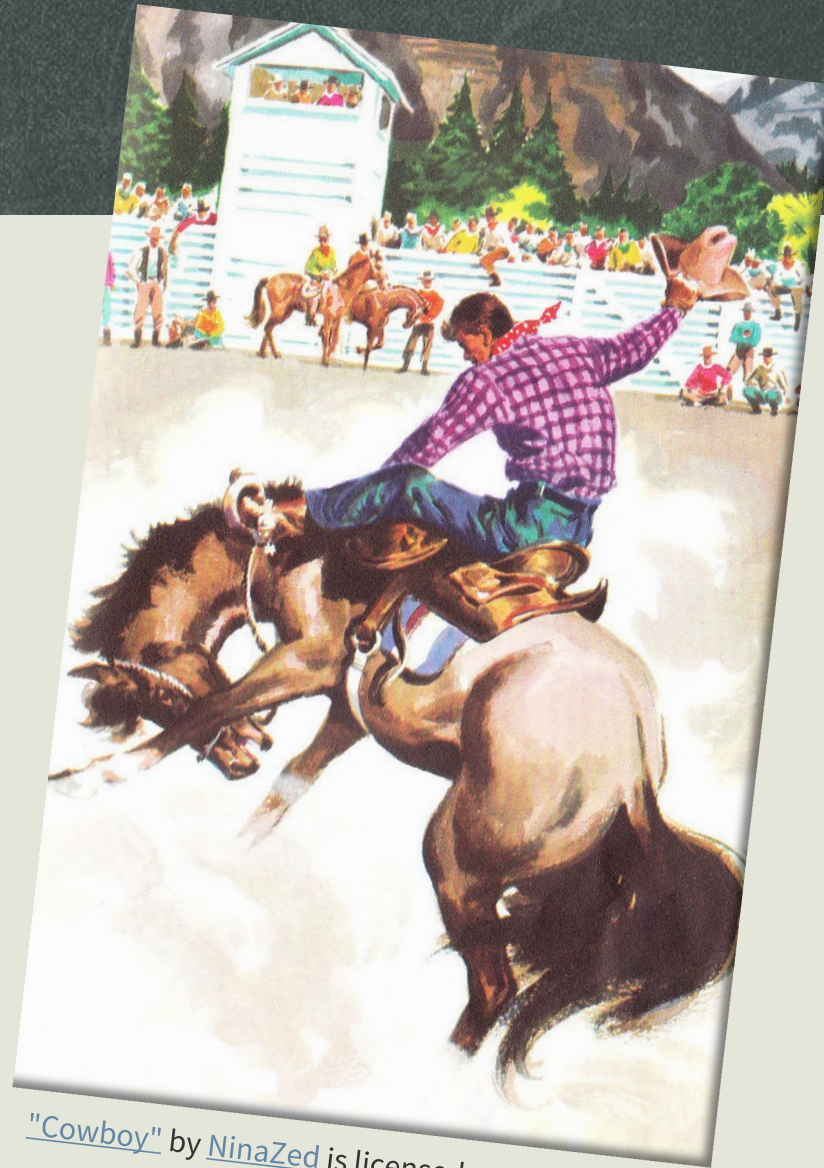
# Differing Abilities in STEM

March 25, 2021



## Disclaimer

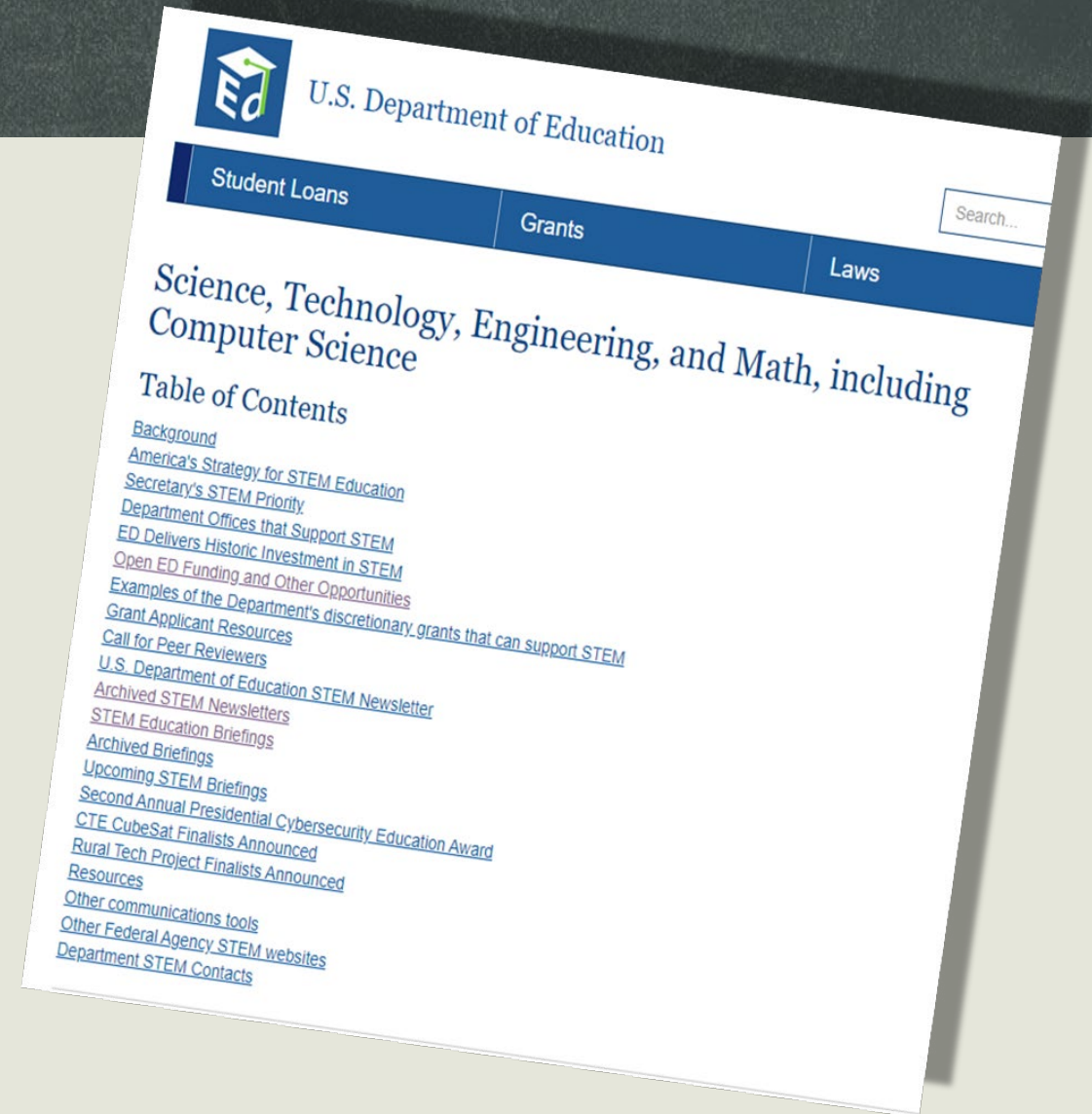
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*"Cowboy" by [NinaZed](#) is licensed under [CC BY 2.0](#)*

# ED STEM Resources

- STEM Webpage [www.ed.gov/STEM](http://www.ed.gov/STEM)
- STEM Newsletter [www.ed.gov/subscriptions](http://www.ed.gov/subscriptions)
- Next STEM Webinars:
  - Summer STEM Learning, early May
  - Advanced Manufacturing, June
- [Ready Now Special Ed Technologies](#)
- [Special Ed Technologies Webinar/Recap](#)

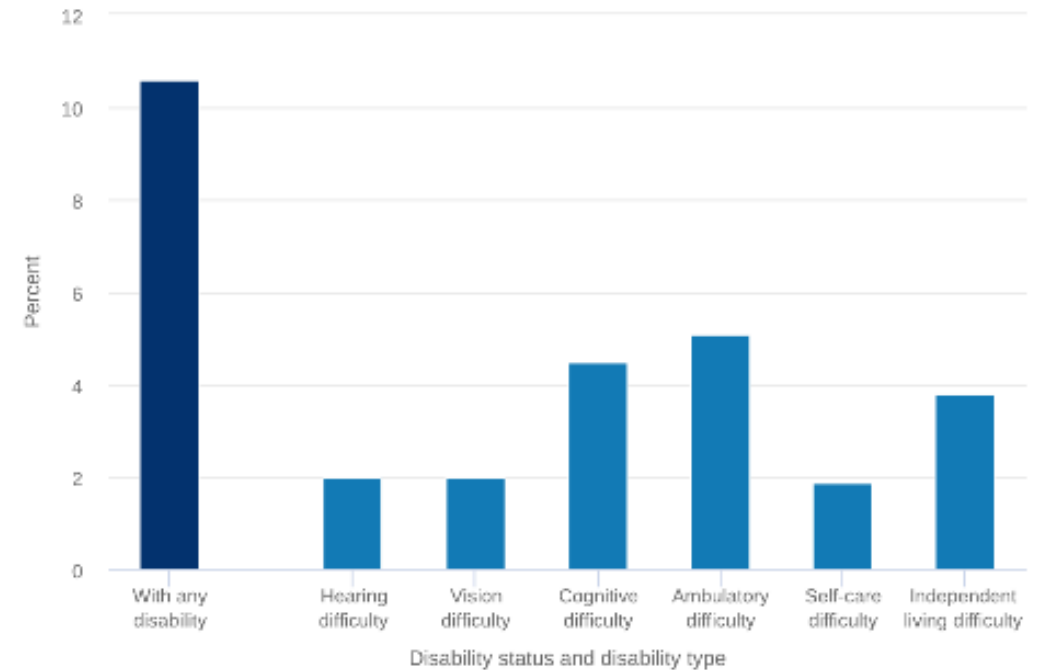


# Snapshot: Students with Disabilities or Differing Abilities

- SWD score lower on NAEP
- SWD = 12% of HS population but less than 1% in AP courses
- Fewer SWD graduate HS
- ~20% undergrads report a disability, often older
- 28% of undergrad SWD in S&E fields, on par
- SWD leave college w/o degree at higher rates
- S&E w/ disability more likely to be unemployed

National Center for Science and Engineering Statistics | NSF 19-304

FIGURE Intro-B  
U.S. population 18–64 years old with a disability and type of disability: 2016



**Note(s)**

Respondents can report more than one disability. Age categories drawn from published Census tables.

**Source(s)**

U.S. Census Bureau, 2016 American Community Survey, tables B18101–B18107, 1-Year Estimates, <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>, accessed 2018 July 3. Related detailed data: WMPD table 1-3.



# Larry Wexler

Director, Research to Practice  
Division, Office of Special  
Education Programs, U.S.  
Department of Education



# OSEP Resources Related to Autism

- ▶ IDEA requires every child with a disability be provided a free appropriate public education (FAPE). FAPE services are provided based on needs rather than based on a disability label
- ▶ Intensive Intervention: Interventions for students with disabilities, many of whom have autism, who have severe and persistent learning or behavior difficulties who require intensive specialized instruction to succeed in school and be prepared for postsecondary opportunities



# OSEP Resources Related to Autism

- ▶ OSEP funds grants to support children with disabilities with the most intensive needs: Includes children with autism
  - Personnel Preparation Grants: Some focused on autism content.
  - Funded TIES Center to provide Technical assistance to States & Districts to support children with the most significant cognitive disabilities in the general education environment.
  - Funded AFFIRM autism professional development training modules: 200,000 new users during pandemic.
  - IRIS: Autism training modules, Assistive technology training modules.
  - Data: Published autism longitudinal data to drive discussion: [OSEP Fast Facts: Children Identified With Autism.](#)

# Joyce Ward

Director, Office of Education, U.S.  
Patent and Trademark Office

[National Council for Expanding American  
Innovation](#)

[https://www.uspto.gov/kids/Cards-  
Temple.html](https://www.uspto.gov/kids/Cards-Temple.html)

<https://www.uspto.gov/kids/activities.html>

<https://www.uspto.gov/kids/parents.html>

[Student Programs](#)





# Dr. Temple Grandin

Professor, Animal Science,  
Colorado State University

Inventor

Autism Advocate



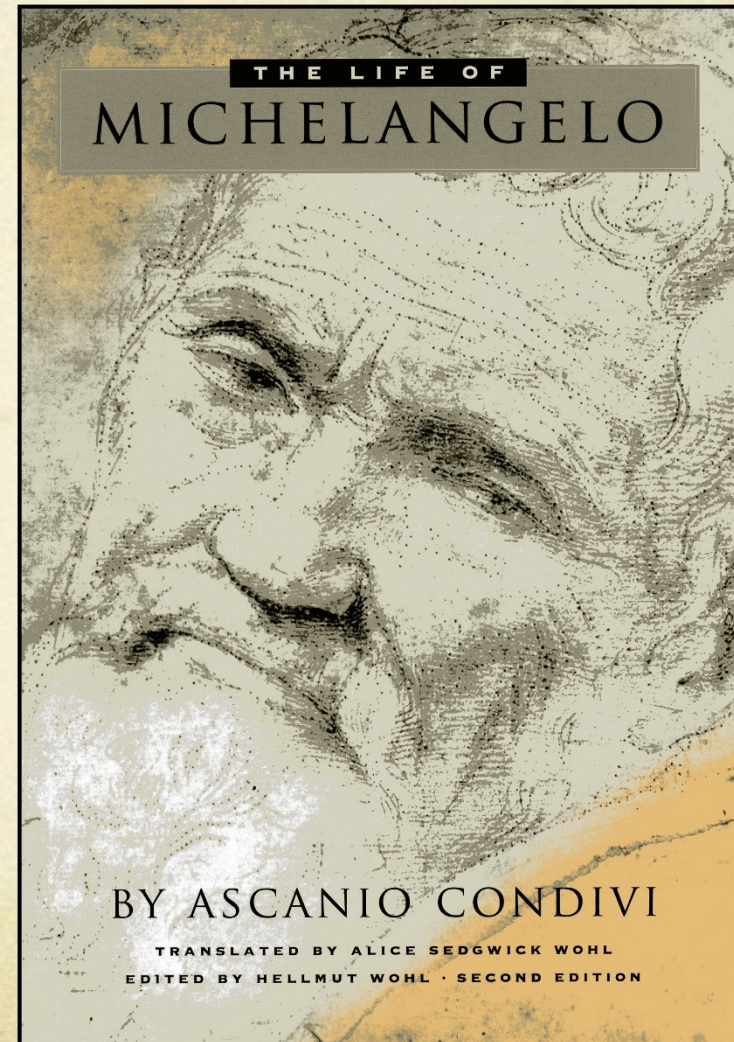
Photo by Rosalie Winard



# The World Needs All the Different Kinds of Minds

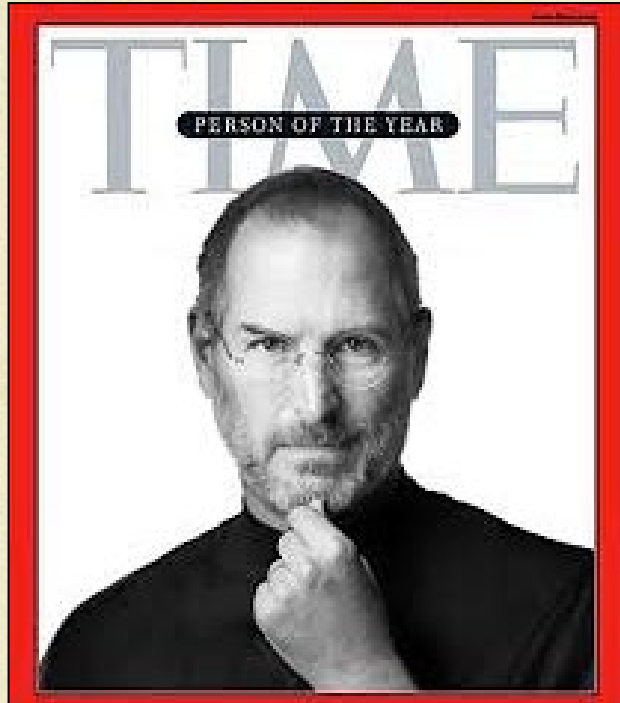
**Temple Grandin,  
Professor of Animal  
Science**

**Colorado State  
University**

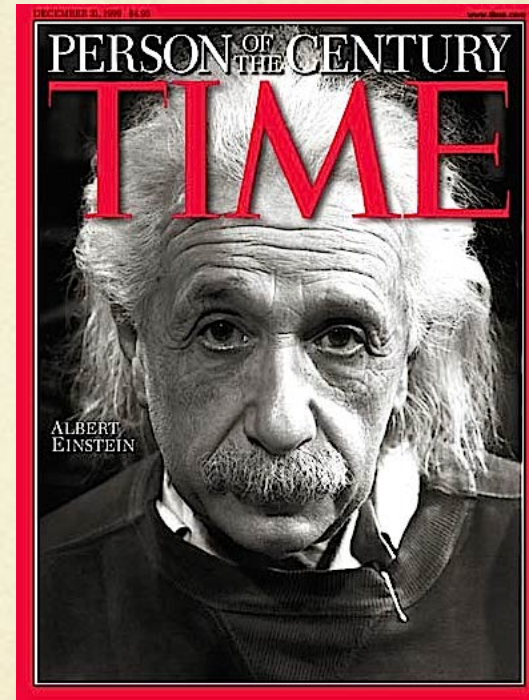




# These Innovators Had Creative Hobbies

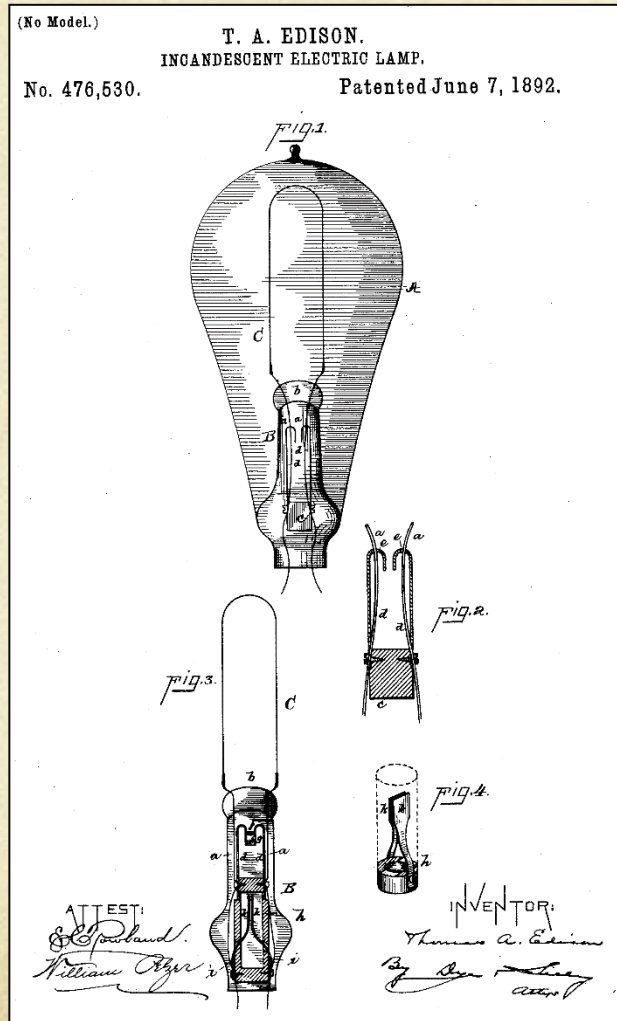


Bullied in school  
Learned calligraphy



No speech until age 3  
Played the violin

# Thomas Edison



- Labeled addled by a teacher
- Hyperactive High School drop out
- Probably had autism



# Jane Goodall

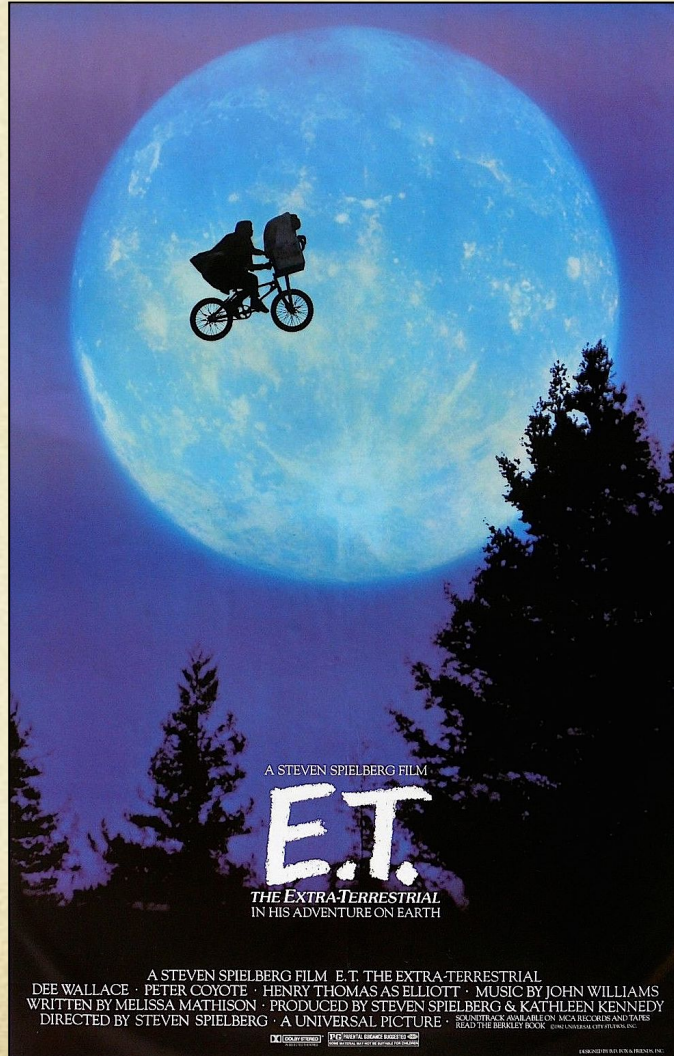


Credit Jane  
Goodall Institute

- Had a two-year secretarial degree
- Obtained her Ph.D. without a Bachelor's Degree
- Difficulty remembering faces
- Loved solitude in the trees



# Stephen Spielberg



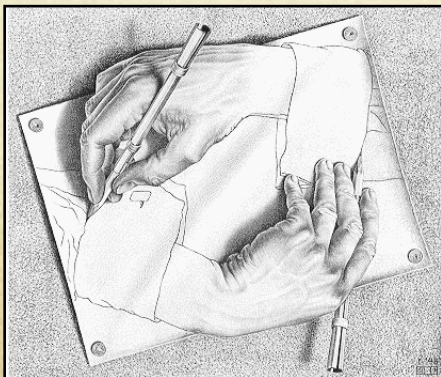
- Rejected from a top film school due to poor grades
- Bullied in school
- Dyslexic
- Childhood Super 8 Movie Camera



# Four Different Types of Thinking

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1. Photo Realistic Visual Thinking **Object Visualizer** – Poor at algebra
2. Pattern Thinker **Visual Spatial** Music and Math – Poor in reading
3. Verbal Facts Language Translation – Poor at drawing
4. Auditory Thinker – Visual perception fragmented



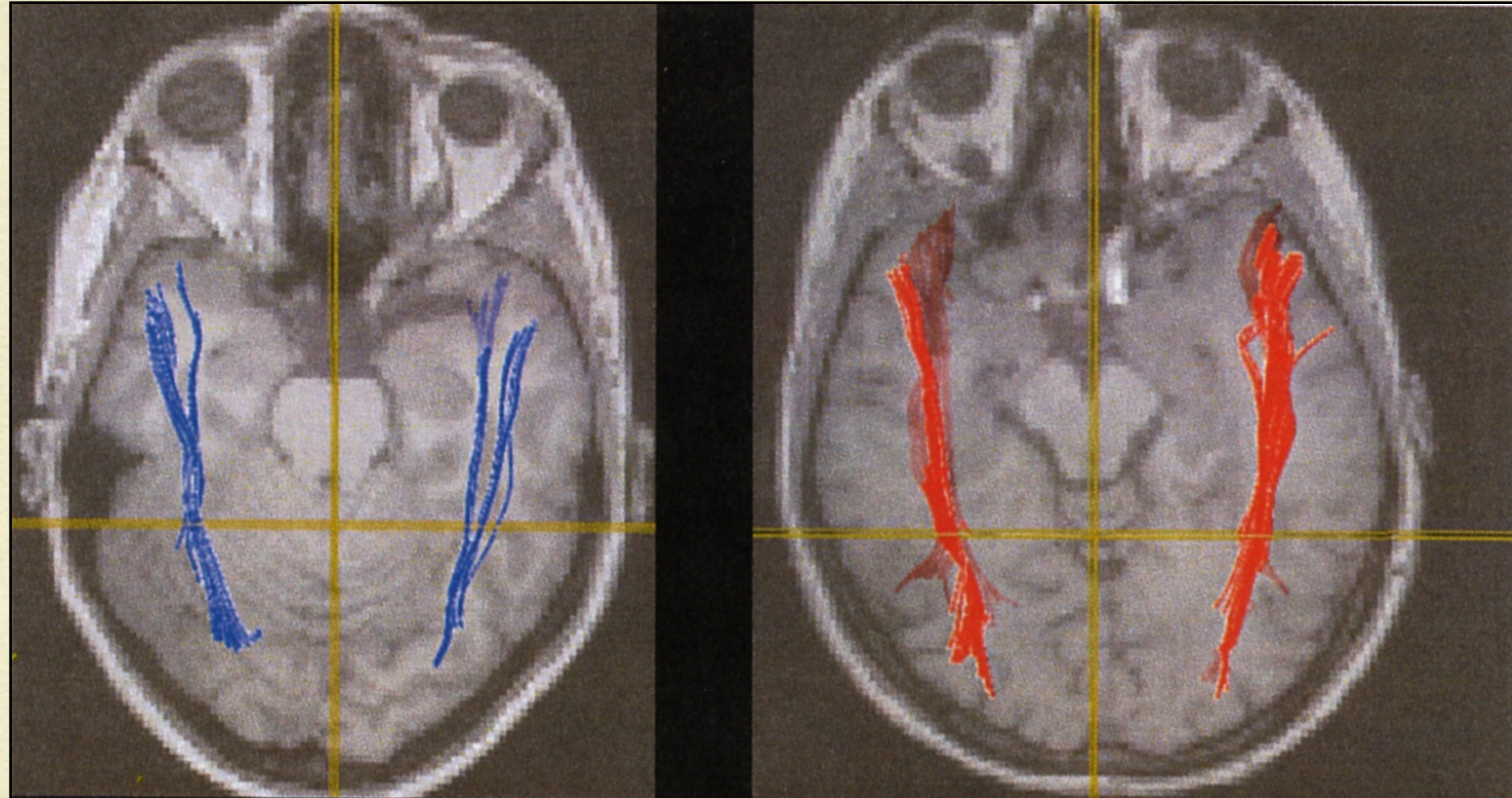
There can be mixtures of these thinking types



# Brain Scans of Large Visual Thinking Circuit

Control

T. Grandin



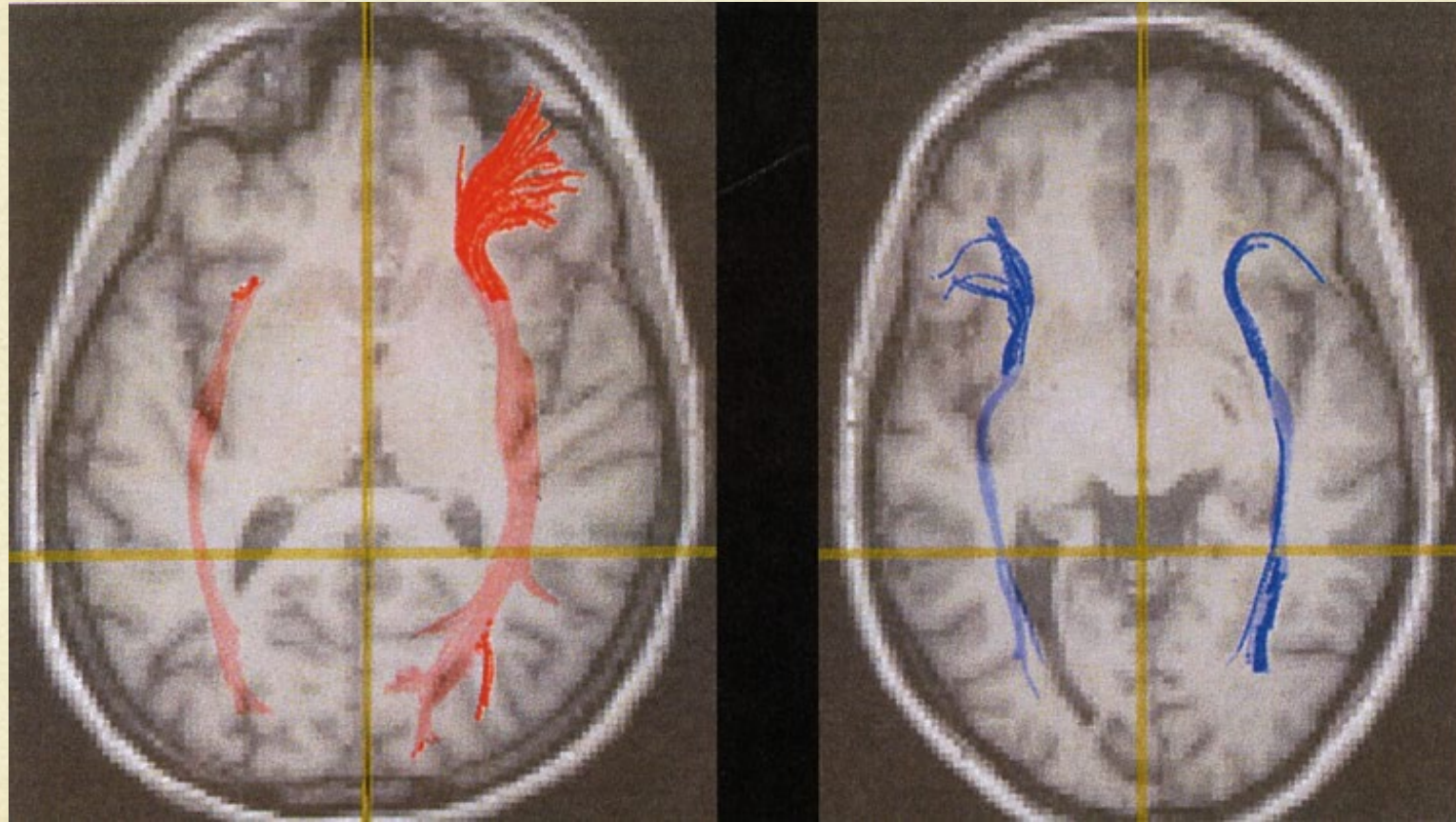
Humphreys, Minshew, Behrmann, and Cibu, 2006



# Brain Scans

T. Grandin

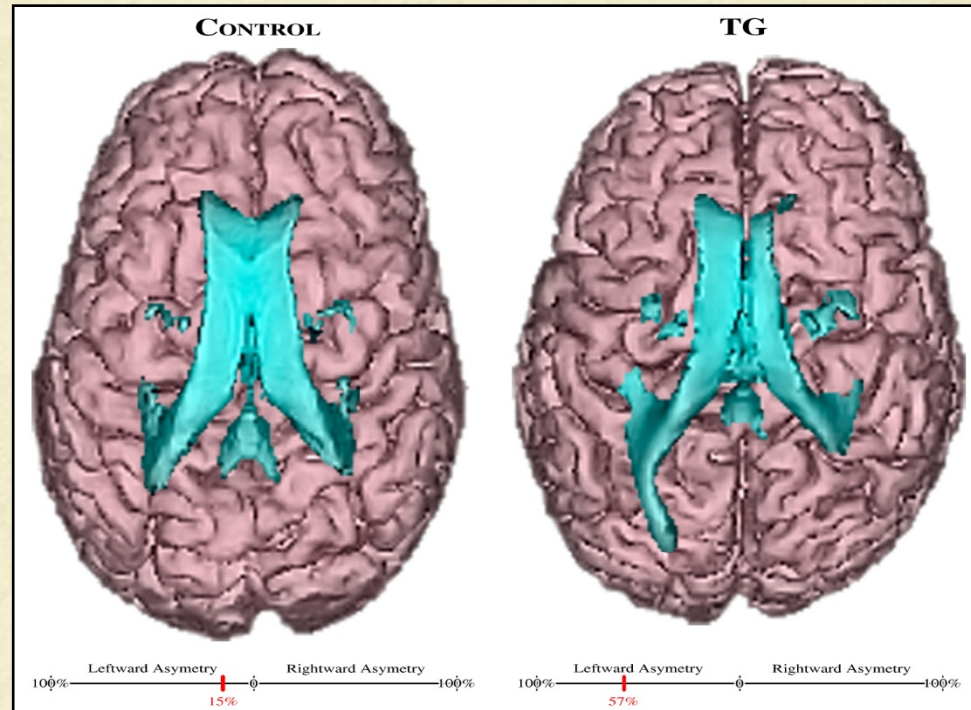
Control



Humphreys, Minshew, Behrmann, and Cibu, 2006



# Abnormalities in Left Hemisphere



Working Memory and Algebra Department  
Failed to Develop

University of Utah, 2010

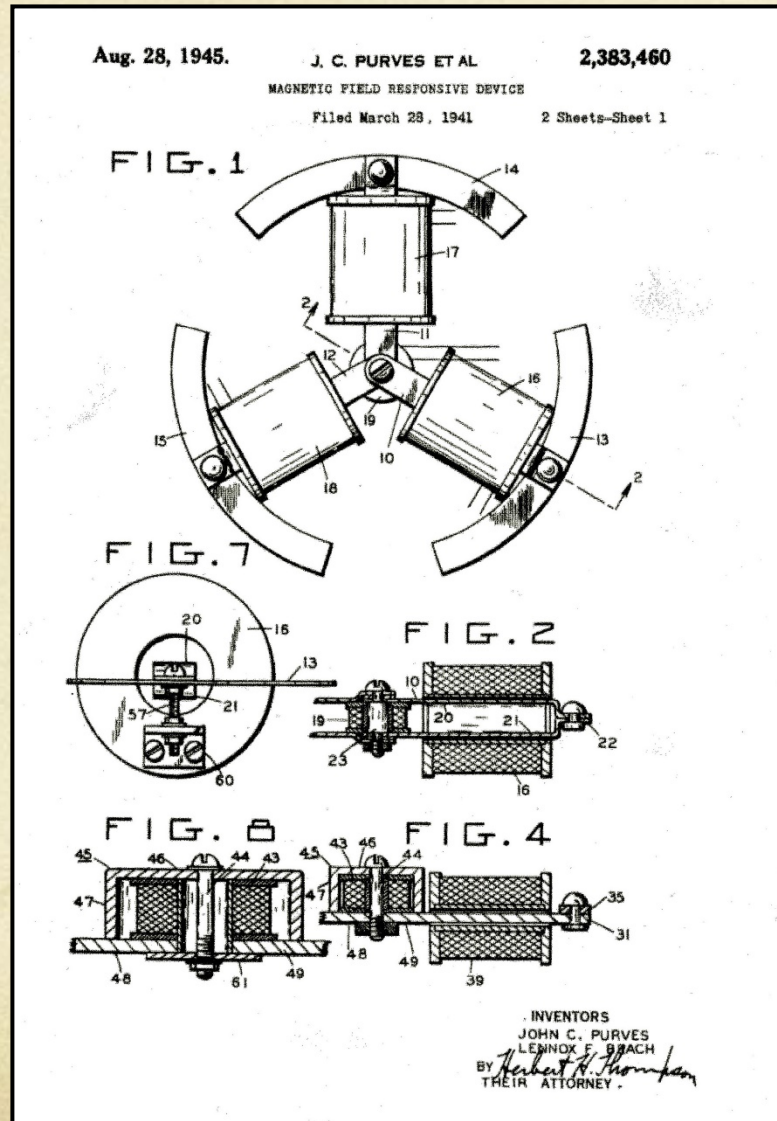


# How to Determine Types of Thinkers in Children

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- **Visual Thinker** – Art, building things, and mechanical ability
- **Math Thinker** – Mathematics, building things, computer programming, music
- **Verbal Thinker** – Love facts, history

# Grandfather Co-Invents Auto Pilot



Different Kinds of Minds  
Complemented Each Other

- Visual Thinker
- Mathematical Engineer



# Schools Need to Keep Classes that Foster Creativity and Problem Solving

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- Art, sewing, cooking
- Playing musical instruments
- Woodworking
- Theater
- Welding
- Auto Shop
- Creative writing

# Arts Foster Scientific Success

- Nobel prize winners 50% more likely to have an arts and craft hobby compared to other scientists
- Painter, musician, actor, dancer, composer, poet, photographer or craftsman

Robert Root Bernstein et al., 2008



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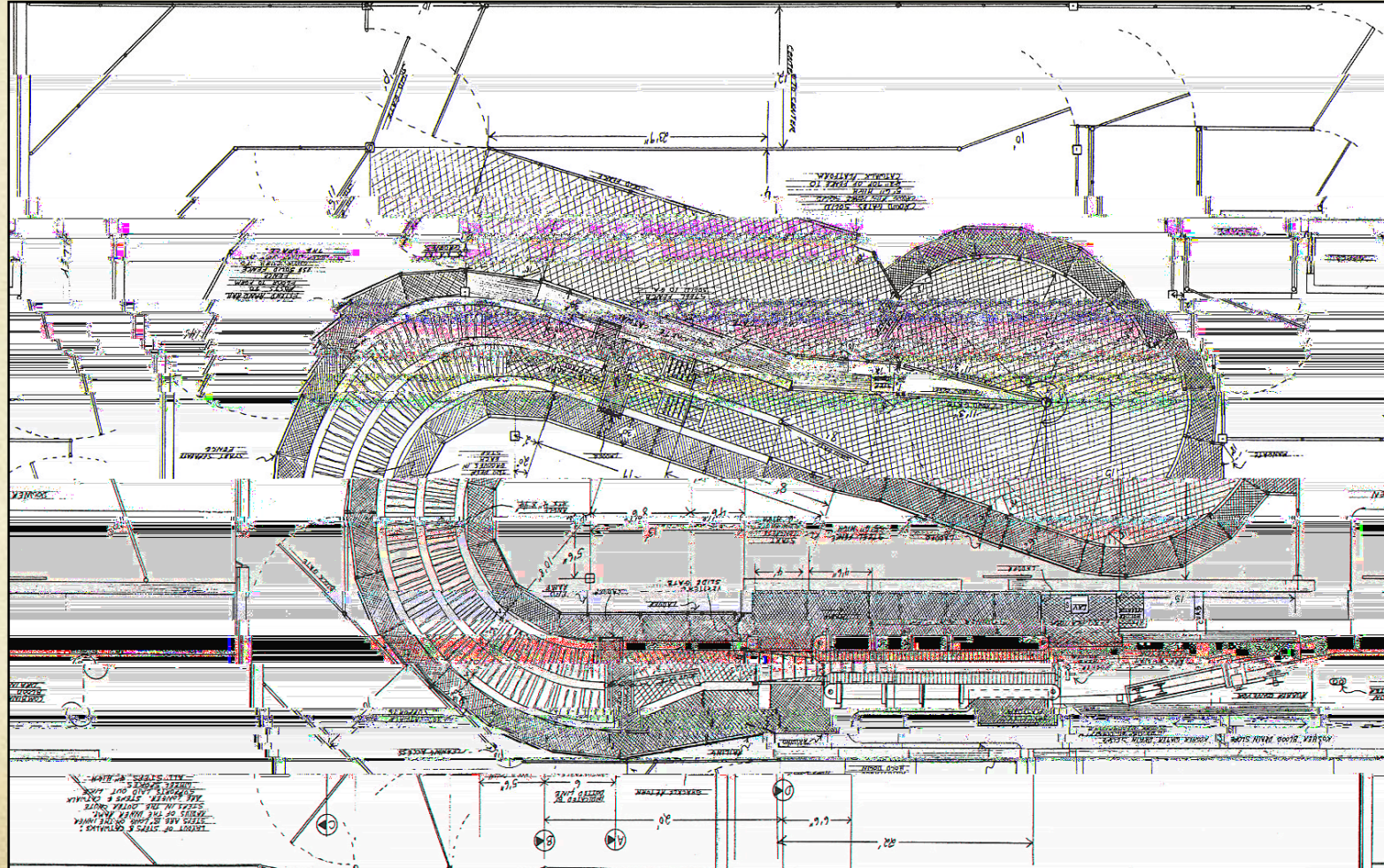
**Since I was weird, I learned  
how to impress potential  
customers by showing a  
portfolio of my work**

---





# People Need to Touch in Order to Perceive





# Picture From My Original Portfolio





# Replica Used in HBO Movie *Temple Grandin*





**Put it on  
your phone**

**30 Second  
WOW**

## LIVESTOCK HANDLING SYSTEMS

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

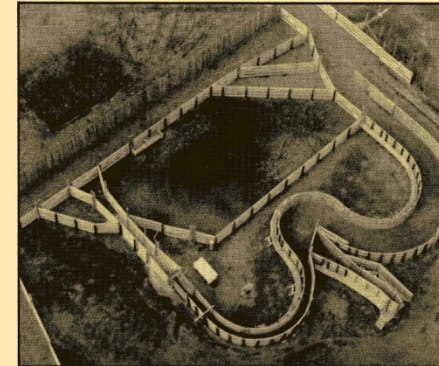


### **CUSTOM DESIGNED To Fit Your Operation:**

Working, sorting, loading and hospital facility at A. Glenn Kluck 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 Verishine'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.**

Suite 3, 1401 Silver St.  
Urbana, IL 61801 217-384-4815

#### **NEW ADDRESS:**

1205 W. Elizabeth Suite E122  
Fort Collins, CO 80521



# Half the Cattle in North America are Handled in Systems I Designed



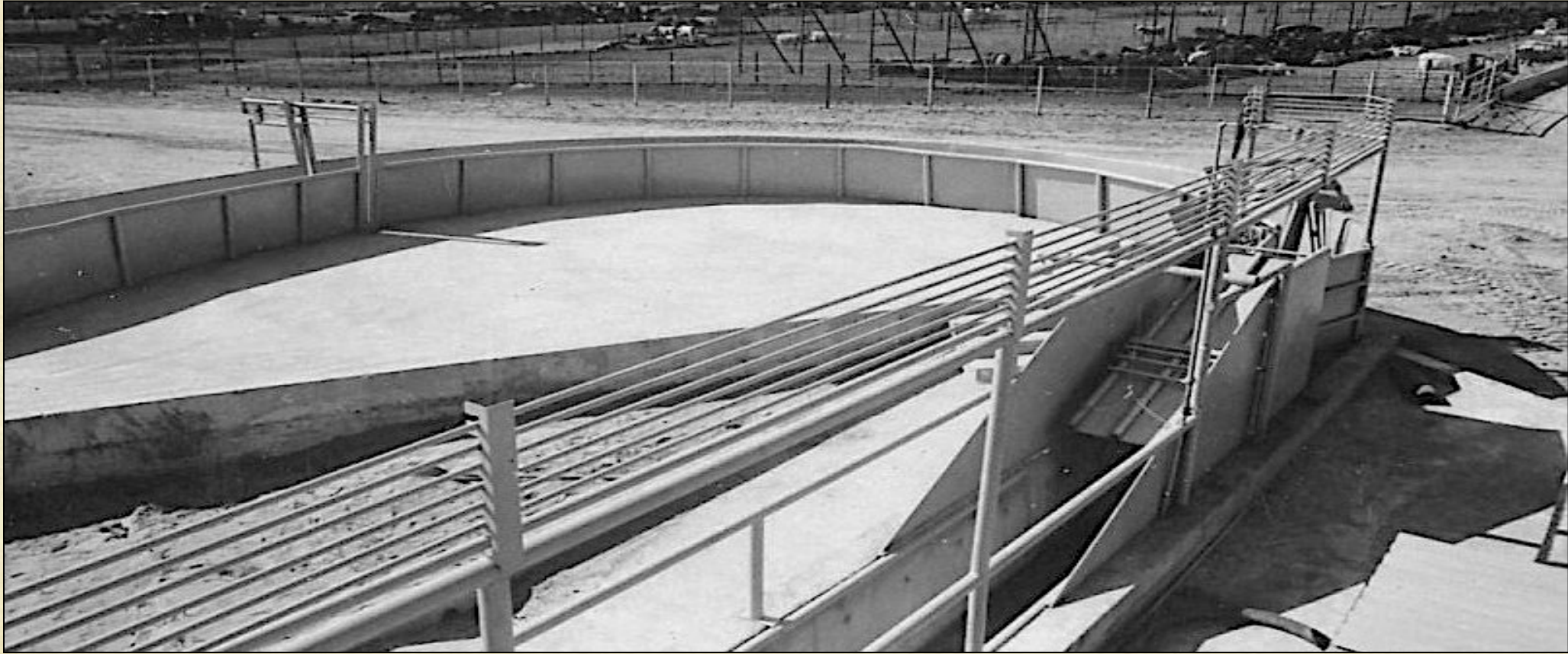


# Aerial Photo of Early Major Project





# First Dip Vat Project - 1976





- 
- Worried our educational system is screening out visual thinkers with strict algebra requirements
  - Visual Thinkers needed to prevent serious problems such as Fukushima reactor meltdown and aviation accidents
-





**FAA**  
**Aviation Safety**

**EMERGENCY  
AIRWORTHINESS  
DIRECTIVE**

[www.faa.gov/aircraft/safety/alerts/](http://www.faa.gov/aircraft/safety/alerts/)

**DATE: November 7, 2018**

**AD #: 2018-23-51**

Emergency Airworthiness Directive (AD) 2018-23-51 is sent to owners and operators of The Boeing Company Model 737-8 and -9 airplanes.

Mathematicians **Calculate** Risk

Visual Thinkers **See** Both Risk  
and Solutions to Problems

Possible Impact with Terrain



# A Visual Thinker Would See Ways the Small Fragile Sensor Could Break





# We Have Lost the Skills to Build This





# Who Builds Large Food Processing Plants?

- ❑ **Visual thinkers** – Design plant layout and build highly specialized mechanical equipment
- ❑ **Math Thinkers** – Engineers, boilers, refrigeration, calculate roof trusses
- ❑ **Retiring Visual Thinkers** - Not getting replaced



- Visual thinkers, AI, and some people with autism, ADHD or dyslexia are all bottom up thinkers.
- Concepts are formed from specific examples
- Top down verbal thinkers tend to overgeneralize
- Sensory Based *not* Word Based notices detail



# Tips for Working with Minds That are Different

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- ✓ Never overload working memory
- ✓ Provide Pilot's Checklist for tasks with multiple steps
- ✓ Stretch them slightly out of their comfort zones
- ✓ Limit screen time
- ✓ Provide choices of hands-on activities



# Ultimate Goal of Education

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- Where is a student ten years after high school graduation?
  - Learn to be a life-long learner
-



# Dr. Megan Vinh

Co-Director, STEM Innovation  
for Inclusion in Early Education  
Center (STEMIE) and the Early  
Childhood Technical Assistance  
Center





# Stay Connected



[stemie.fpg.unc.edu](http://stemie.fpg.unc.edu)



[facebook.com/STEMIIEE/](https://facebook.com/STEMIIEE/)



[twitter.com/stemiiee](https://twitter.com/stemiiee)



[stemie@unc.edu](mailto:stemie@unc.edu)



[pinterest.com/stemie\\_FPG/](https://pinterest.com/stemie_FPG/)



STEM INNOVATION FOR INCLUSION IN EARLY EDUCATION







# STEMIE<sup>2</sup>Fest

INNOVATION FOR INCLUSION IN EARLY EDUCATION

SAVE  
*the*  
DATE

OCT  
4-8  
2021



*a Virtual Experience*

Cultivating Inclusive  
STEM



STEMIEFest 2020 archives available at  
<https://stemie.fpg.unc.edu/stemiefest>



Cary Supalo

Research Developer,  
Educational Testing Service





# My life changed at age 7...



I had a normal day, went to bed, then woke up blind...





*“...you have been problem-solving your whole life...”*  
*Dr. Mallouk, Penn State*

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**break barriers**  
assistant professor of chemistry  
(2012 – 2014)

ILLINOIS STATE  
UNIVERSITY

**innovate Access Technology  
for teaching STEM**

Founder (2009)  
President (2009 –2016)



**do education research**

Bodner Group  
(2014 – 2018)



PENNS<sup>TATE</sup>®



**Accessible assessment  
systems for education**  
Research Developer (2016-curr.)







Full integration into education needs access to learning tools, resources, assessments, and mentorship.

---





We can move the needle on access and inclusion in quality education by shifting the assessment lever.

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**Born-  
Accessible  
Inclusive  
Test Item  
Design:**  
*Some Research  
Areas*

---

Leveraging commercially available access technologies with appropriate braille and raised line drawing supplements.

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Multi-modal interfaces to access math and science assessments

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Efficacy of computer-based inclusively designed science simulations



# Removing Access Barriers in STEM: *Some Research Areas*

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Efficaciously delivered real-time electronic math and science content.

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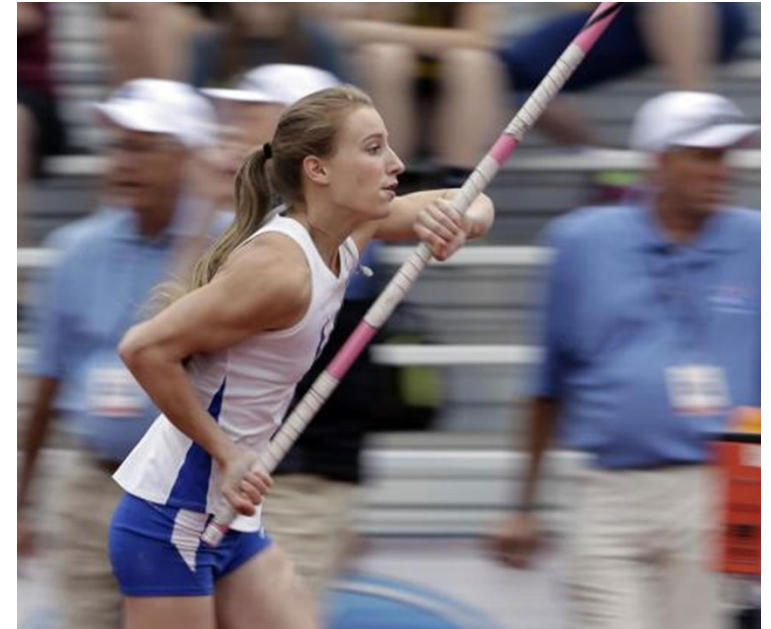
Non-ambiguous teaching methodologies to shift vision-normative STEM instruction.

---

Shifting STEM teachers' expectations of the capabilities of the blind in K12+HE contexts.

---

Developing next generation science access tools.



Inclusion is increasingly a trend in spaces where it was once thought impossible. Live the life you want!

---



# Allyson Knox

Education Policy Lead,  
Microsoft Philanthropies

[Microsoft Neurodiversity Hiring](#)

[Commitment to Diversity](#)

[Code.org Accessibility](#)





**Q & A**



# Resources

- [National Center for Special Education Research \(incl. STEM\)](#)
- [Compendium of Math & Science Research by NCES & NCSEER \(2002-2013\)](#)
- [OSEP Fast Facts: Children Identified With Autism](#)
- [Ready Now Special Ed Technologies](#)
- [IES Special Ed Technologies Webinar/Recap](#)
- [Zero Barriers in STEM Education](#)
- [INCLUDES Network](#)
- [Disabilities, Opportunities, Internetworking and Technology \(DO-IT\)](#)
- [Research in Disabilities Education Collaborative Dissemination](#)
- [STEMIE](#)
- [STEM for All Multiplex: Including Individuals with Disabilities in STEM](#)
- [PhET Interactive Simulations](#)