Teaching Statistics for Students with Different Learning Styles

Jessica Utts

Department of Statistics

University of California, Irvine

jutts@uci.edu

SOME PERSONAL STORIES

- Statistics and my mother
- "Professors for the Future" Program
- Watching colleagues teach

From these experiences, I learned that:

- Not everyone learns the same way
- Not everyone teaches the same way

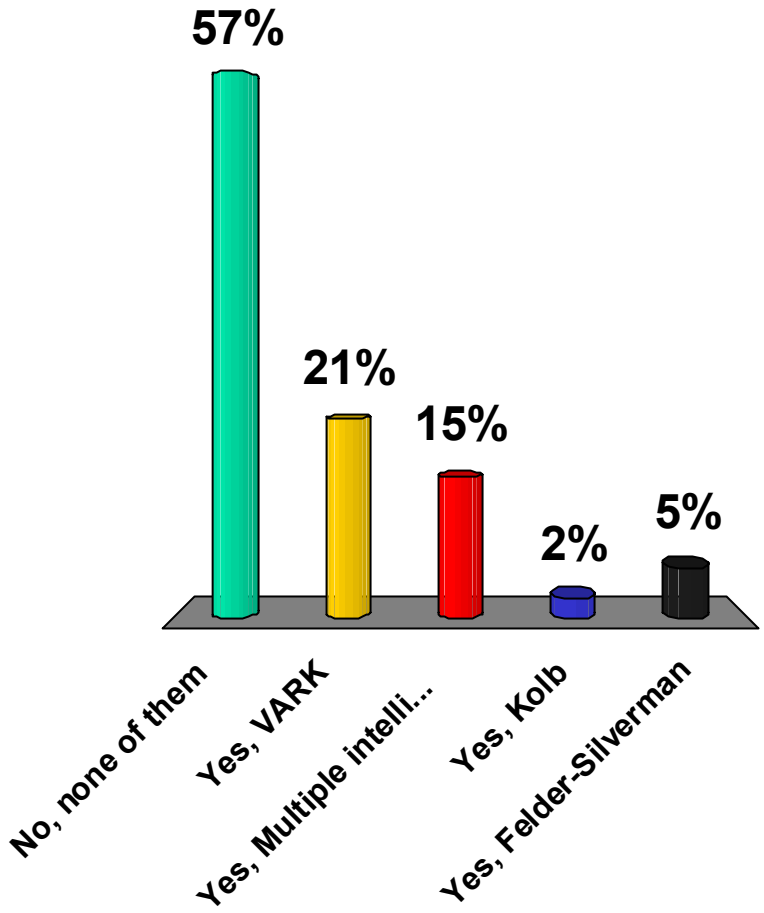
WHAT ARE LEARNING STYLES?

- The way a learner receives, sorts, interacts with and processes information.
- There are 70 to 80 assessment instruments representing over a dozen different learning style models and theories.
- I will discuss four of them:

  VARK, MI, Kolb and Felder-Silverman

Have you used any of these in teaching?

1. No, none of them
2. Yes, VARK
3. Yes, Multiple intelligences
4. Yes, Kolb
5. Yes, Felder-Silverman



"Clicker" responses of a few hundred statistics educators

WHY CONSIDER LEARNING STYLES?

- To understand how our students differ from us and from each other.
- To provide learning tools for different styles of learners.
- To help students strengthen their weaker modes of learning.
- To help us strengthen our weaker modes of teaching.

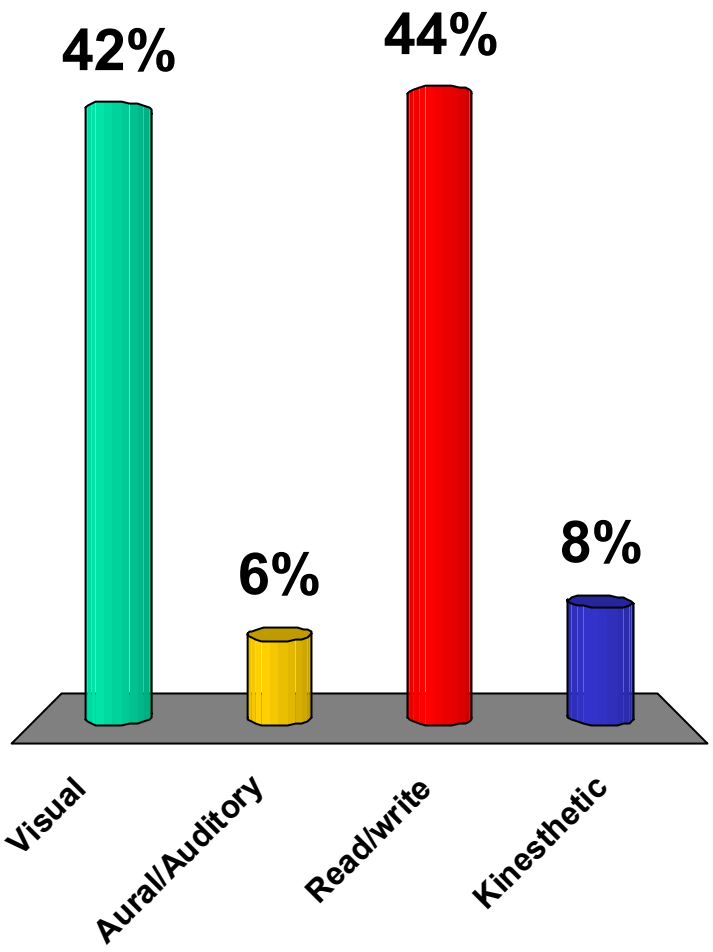
1. SIMPLEST MODEL: VA(R)K

SOURCE: www.vark-learn.com

- Visual, Aural/Auditory, Read/write, Kinesthetic
  - *Preference for taking in and putting out information in learning*
- 16 Question assessment online
- Provides strategies for using preferred style in context of a Read/write educational system.
- Example: Visual learners use colored highlighters when reading textbook.

Which One Is Strongest for You?

1. Visual
2. Aural/Auditory
3. Read/write
4. Kinesthetic



2. MULTIPLE INTELLIGENCES

Howard Gardner's research, based on physiology of the brain.

Book called "7 [8] Kinds of Smart:

Identifying and Developing Your Multiple Intelligences"

Thomas Armstrong, Ph.D.

The 8 Kinds of Intelligence

- Linguistic
- Logical-mathematical
- Spatial
- Bodily-kinesthetic
- Musical
- Interpersonal
- Intrapersonal
- Naturalist

Characteristics of Each Type

From Armstrong's book

- Linguistic

  Likes words, language, reading, writing, puns

- Logical-mathematical

  Can discern logical/numerical patterns

  Try: Insert missing number in 11 12 14 __ 26 42

- Spatial

  Can manipulate visual/spatial world, see pictures

- Bodily-kinesthetic

  Good body coordination, balance, etc.

Characteristics, continued…

- Musical

  Can produce and appreciate rhythm, pitch, music

- Interpersonal

  Empathetic, social, likes working in groups

- Intrapersonal

  Knows own emotions, values solitude

- Naturalist

  Loves nature, gardening, etc.; appreciates diversity of species

"I'm not good at" and "I enjoy"

"I'm not good at____"

- Writing
- Math
- Art
- Dancing/sports
- Music
- Socializing
- Sitting still/meditating
- Growing things

"I enjoy_____"

- Reading/writing
- Math/puzzles
- Art/sewing/woodwork
- Dancing/being active
- Singing/playing music
- Parties
- Solitude
- Being in nature

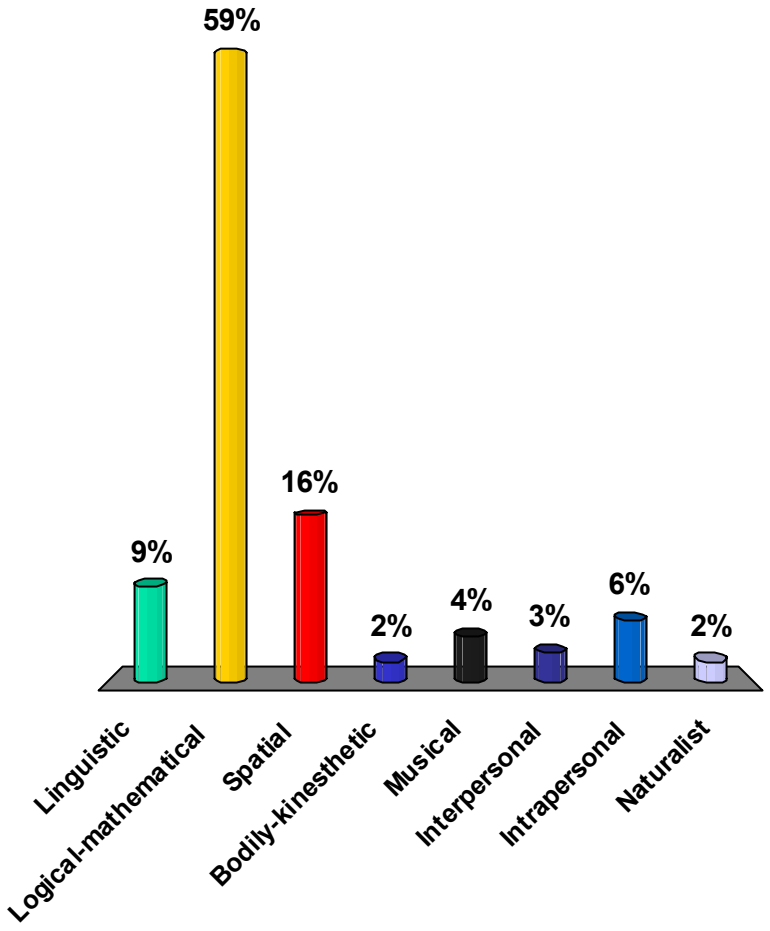
Example of Using this in Teaching

Explaining why Probability of (H, H) = 1/4

- Linguistic: Explain in words
- Math: Use formulas
- Spatial: Show picture of 4 possible outcomes
- Kinesthetic: Give 8 coins to line up 4 outcomes
- Musical: Ask them to create a jingle about it (alphabet)
- Interpersonal: Pair students to discuss and solve
- Intrapersonal: Give answer, ask them to figure out why
- Naturalistic: Formulate in terms of biology instead, e.g. blood types for two people

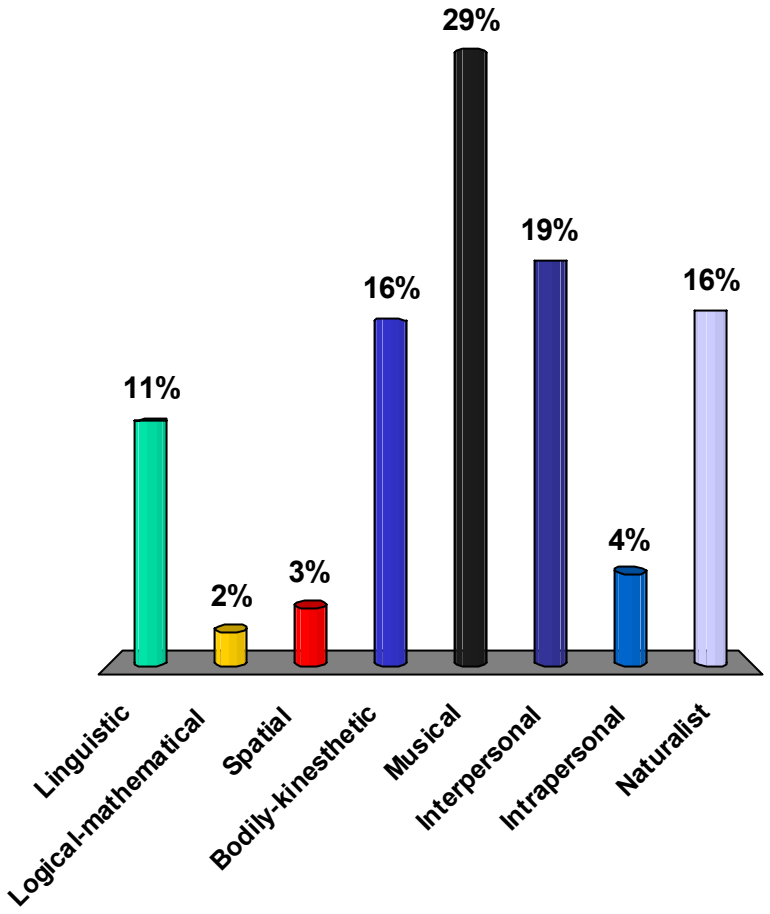
What is Your Strongest Intelligence?

1. Linguistic
2. Logical-mathematical
3. Spatial
4. Bodily-kinesthetic
5. Musical
6. Interpersonal
7. Intrapersonal
8. Naturalist



What is Your Weakest Intelligence?

1. Linguistic
2. Logical-mathematical
3. Spatial
4. Bodily-kinesthetic
5. Musical
6. Interpersonal
7. Intrapersonal
8. Naturalist



3. Kolb's Learning Style Inventory

	Process information by:	
Perceive via:	Watching (Reflective)	Doing (Active)
Thinking (Abstract)	Prefer working alone Assimilate diverse data into integrated whole Do well in lectures WHAT?	Work with things Converge quickly to reach conclusion Prefer hands-on HOW?
Feeling (Concrete)	Prefer work in groups View life from many perspectives Brainstormers WHY?	Work with people Adapt well to new circumstances Problem-solvers & risk-takers WHAT IF?

Names (from Kolb) and Occupations

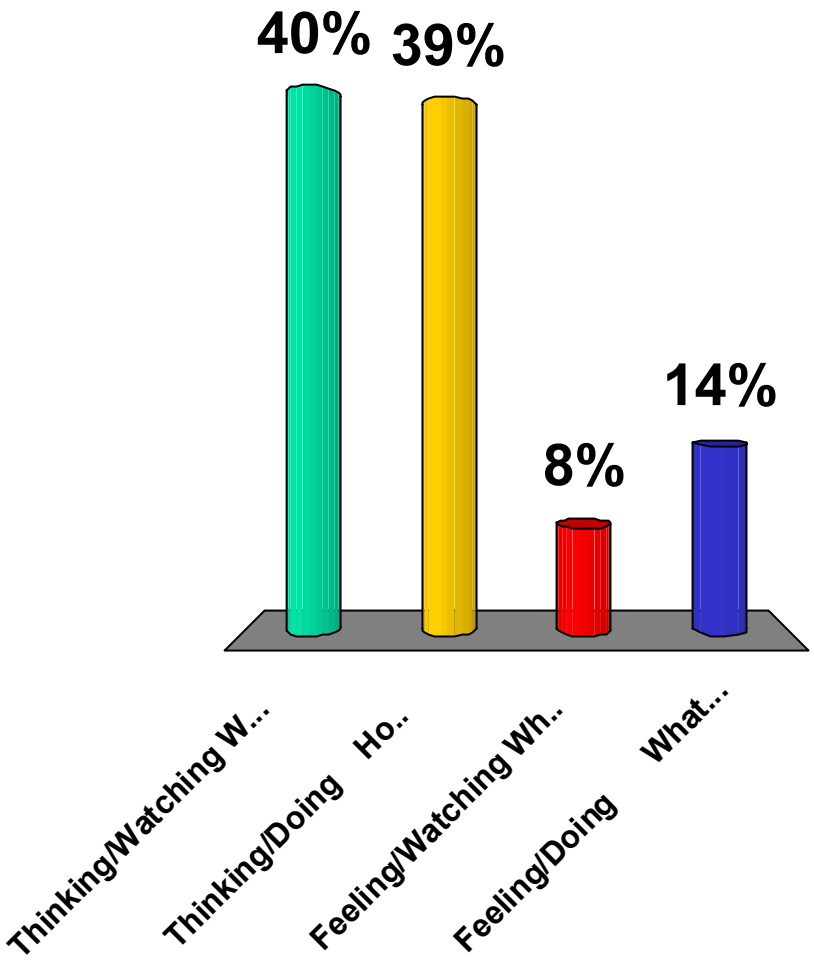
	Process information by:	
Perceive via:	Watching (Reflector)	Doing (Pragmatist)
Thinking (Abstract)	Assimilating Math, Sociology, Education research, Theology, Chemistry Do well in lectures	Converging Engineering Economics Technical issues Prefer hands-on (things)
Feeling (Concrete)	Diverging English Psychology Brainstorm in groups	Accommodating Business, Management Education administration Problem-solvers/risk-takers

Learning Activities

	Process information by:	
Perceive via:	Watching (Reflector)	Doing (Pragmatist)
Thinking (Abstract)	Lectures Reading textbook Doing traditional homework and papers Faculty as Expert	Hands-on projects that require thought, preferably alone or with one partner Faculty as Coach
Feeling (Concrete)	Discussion groups where everyone contributes Faculty as Motivator	Group projects and problem-solving with minimal direction from teacher Faculty on side-line

Which Teaching Style Do You Prefer?

1. Thinking/Watching
   What? (Faculty Expert)
2. Thinking/Doing
   How? (Faculty Coach)
3. Feeling/Watching
   Why? (Faculty Motivator)
4. Feeling/Doing
   What if? (Faculty Side-line)



4. Felder/Silverman Index of Learning Styles

- Initial Publication in 1988 for Engineering:
  - Felder and Silverman (1988) "Learning and Teaching Styles in Engineering Ed.," *Engineering Education*, 78(7), 674-81
- Recent Publication summarizing research:
  - Felder and Spurlin (2005) "Applications, Reliability and Validity of the Index of Learning Styles," *International Journal of Engineering Education*, 21(1), 103-112
- Good overall summary of this index and others:
  - Felder and Brent (2005) ""Understanding Student Differences." *Journal of Engineering Education*, 94(1), 57-72
- Most of the research has been done on engineering students and faculty.

Preferences on Four Dimensions

Source for explanations is Felder and Spurlin (2005)

- Sensing vs Intuitive
  - Preference for *perceiving* information
- Visual vs Verbal
  - *Sensory information* most *remembered*
- Active vs Reflective
  - Preference for *processing* information
- Sequential vs Global
  - Progression toward *understanding*

The Index of Learning Styles

- Can take the questionnaire online:
  http://www.ncsu.edu/felder-public/ILSpage.html
- 44 items, scored online, free for personal use and for educators for teaching, advising, research
- 11 items for each dimension, scored as -1 and +1 (for instance, Visual = -1, Verbal = +1)
- Possible score ranges from -11 to +11 on each dimension (only odd scores are possible)

EX: I understand something better after I:

A) Try it out B) Think it through

DATA ON STATISTICS STUDENTS

- Data collected on over 2000 students at Ohio State University
- Thanks to Roger Woodard and Dennis Pearl for collecting the data
- Thanks to Roger Woodard for providing slides with the data!

Results From OSU Students

- Felder ILS has been administered to over two thousand students who were:
  - Part of two statistics courses
  - Liberal arts students and business students.
- Distributions essentially identical.

Slide courtesy of Roger Woodard, NCSU

Perceiving Information

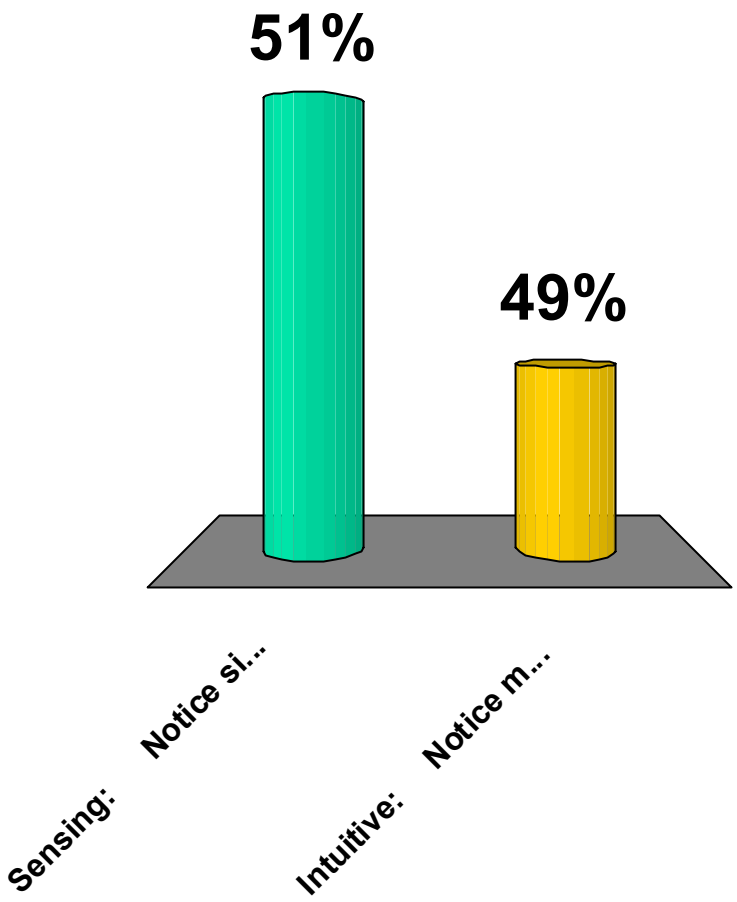
- Sensing
  - Notice sights, sounds, physical sensations
  - Concrete thinker
  - Practical
  - Like facts and procedures
- Intuitive
  - Notice memories, thoughts, insights
  - Abstract thinker
  - Innovative
  - Like theories and underlying meanings

EX: I would rather be considered:

A) Realistic B) Innovative

Which Fits You Better?

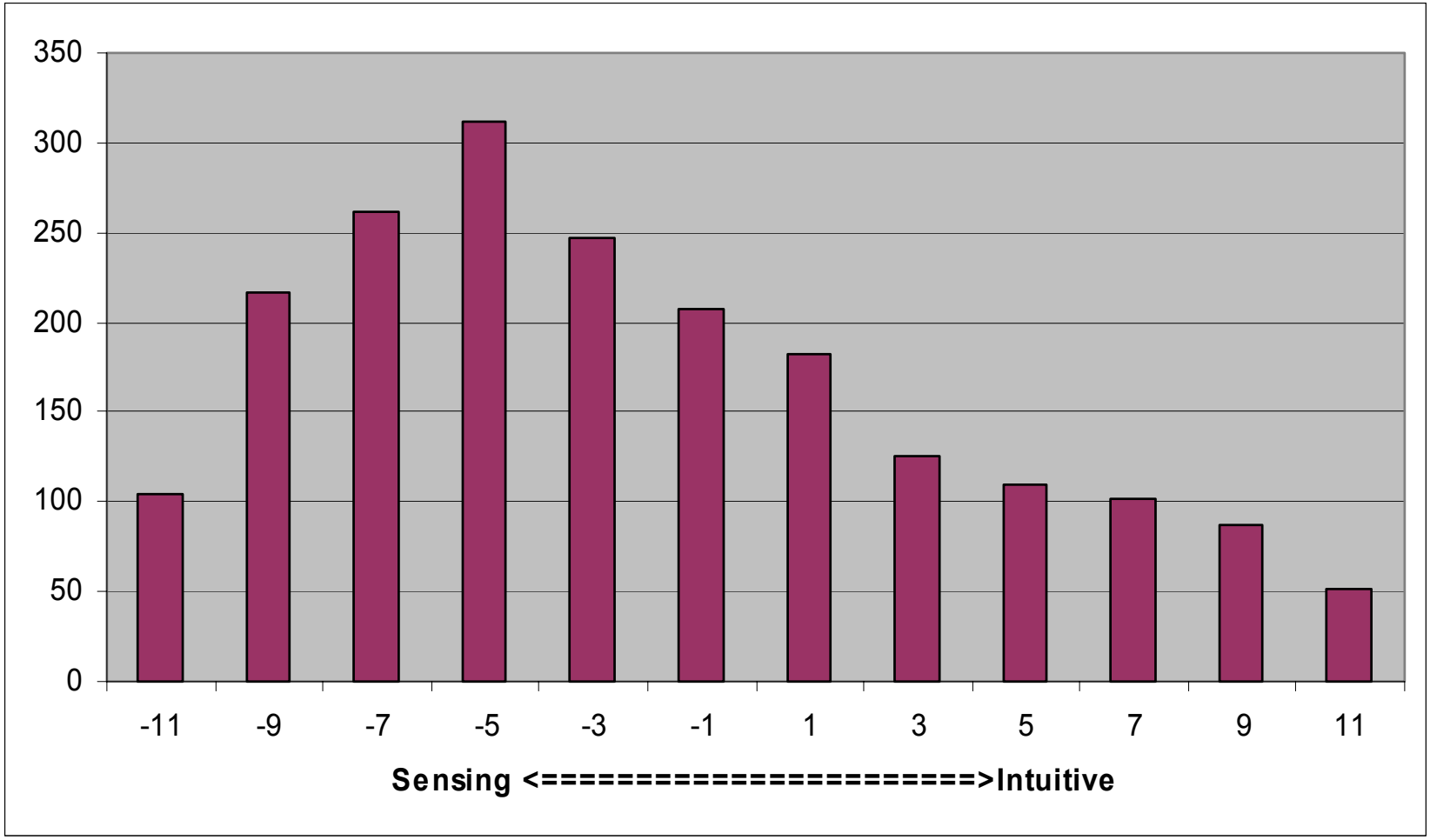
1. **Sensing:**
   Notice sights, sounds, physical sensations; Concrete thinker; Practical; Like facts and procedures
2. **Intuitive:**
   Notice memories, thoughts, insights; Abstract thinker; Innovative; Like theories and underlying meanings



Disclaimer: I did not create this picture!

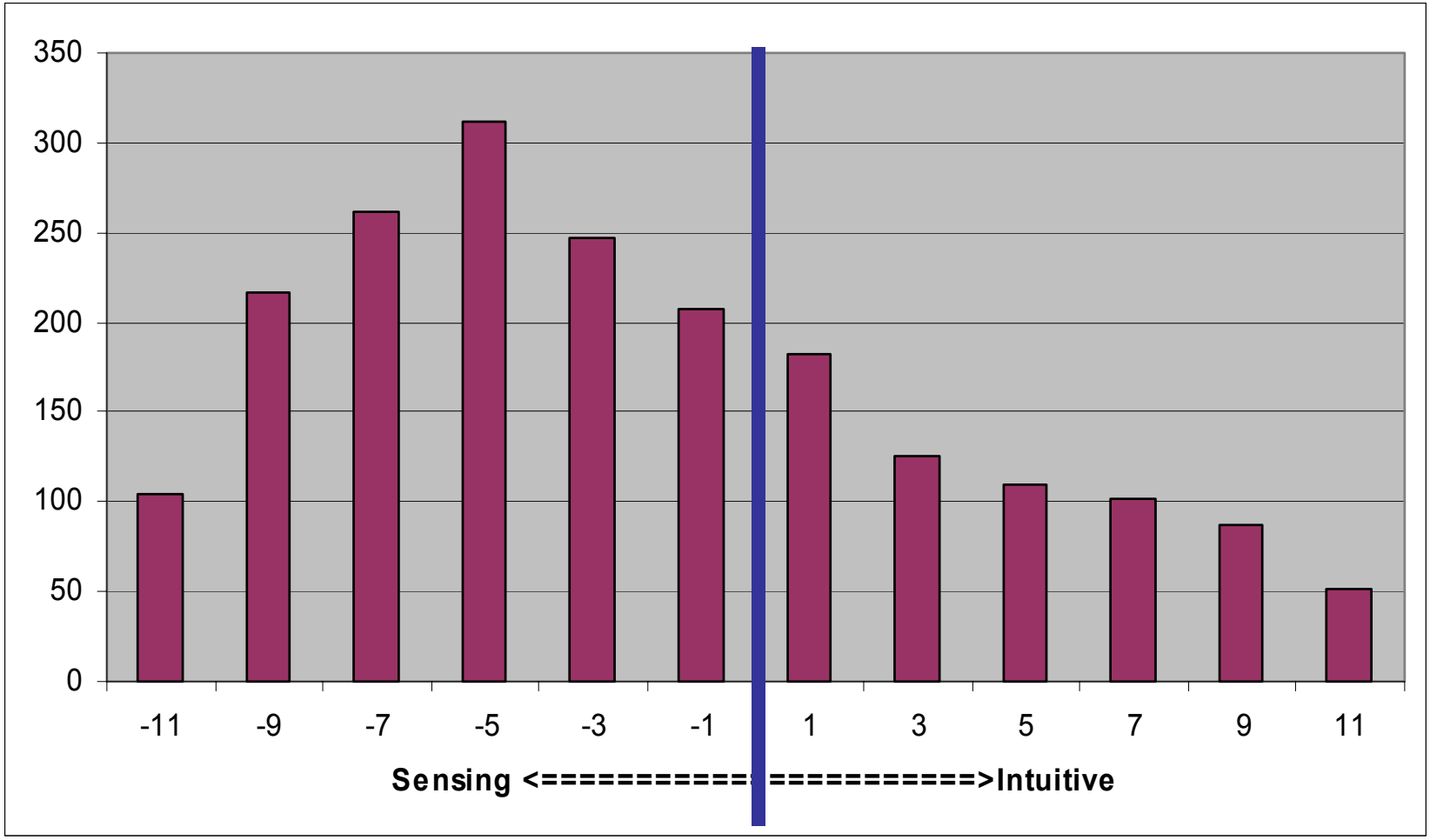
Slide courtesy of Roger Woodard, NCSU

Sensing vs. Intuitive



Slide courtesy of Roger Woodard, NCSU

Sensing vs. Intuitive: About 2/3 and 1/3



Prefer to Receive Information As:

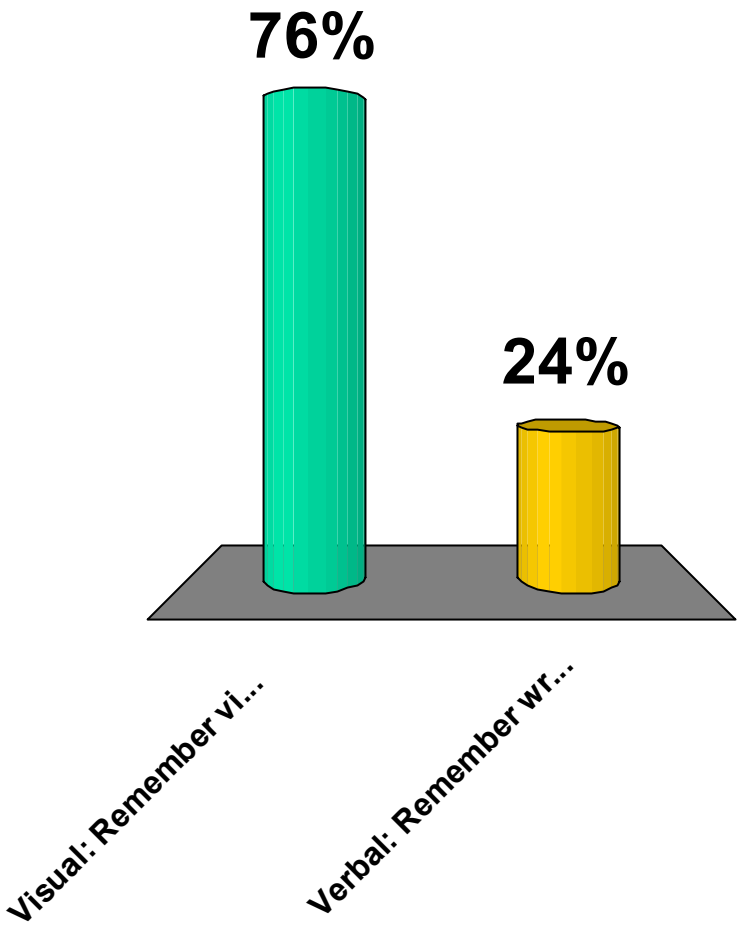
- Visual
  - Remember visual representations
  - Pictures, diagrams and flow charts
  - Would prefer a map instead of directions
- Verbal (Note: not the same as Auditory)
  - Remember written and spoken explanations
  - Would prefer directions instead of a map

EX: I remember best:

A) What I see B) What I hear

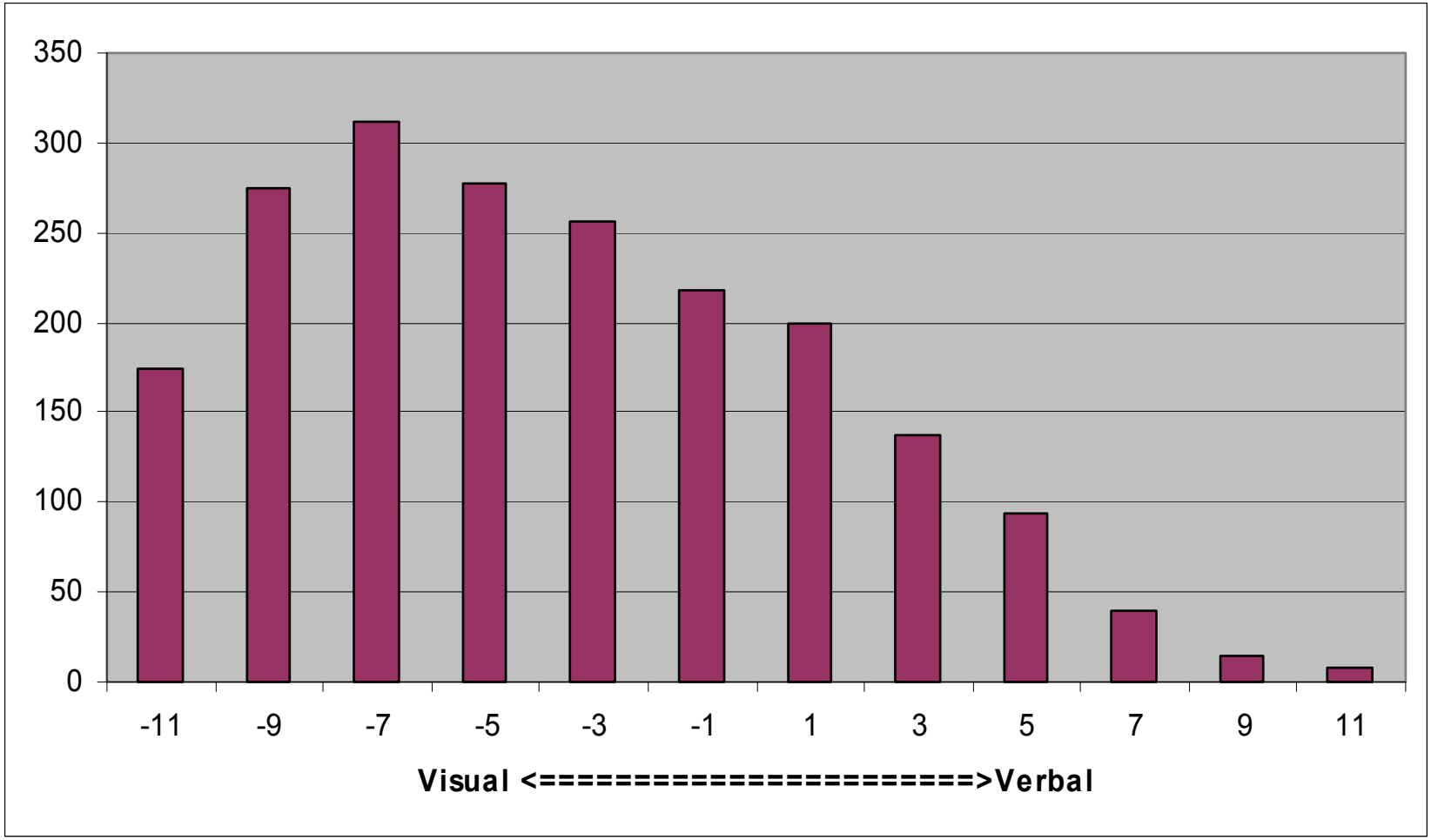
Which Do You Prefer?

1. Visual: Remember visual representations; Pictures, diagrams and flow charts; Would prefer a map instead of directions
2. Verbal: Remember written and spoken explanations; Would prefer directions instead of a map



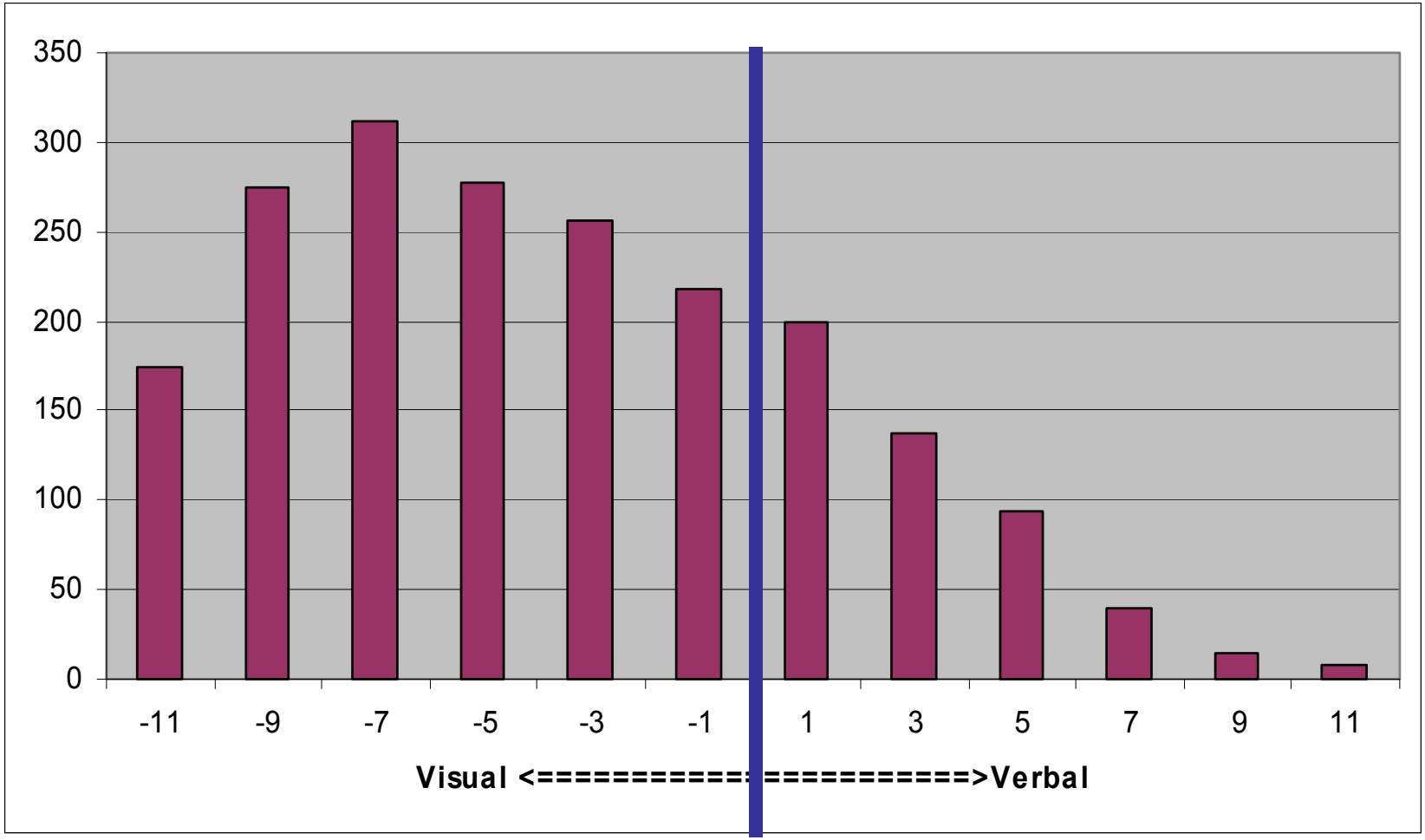
Slide courtesy of Roger Woodard, NCSU

Visual vs. Verbal



Slide courtesy of Roger Woodard, NCSU

Visual vs. Verbal: About ¾ and ¼



Preference for Processing Information

- Active
  - Learn by trying things out
  - Enjoy working in groups, discussing
- Reflective
  - Learn by thinking things through
  - Prefer working alone or with a single familiar partner
  - Introspective

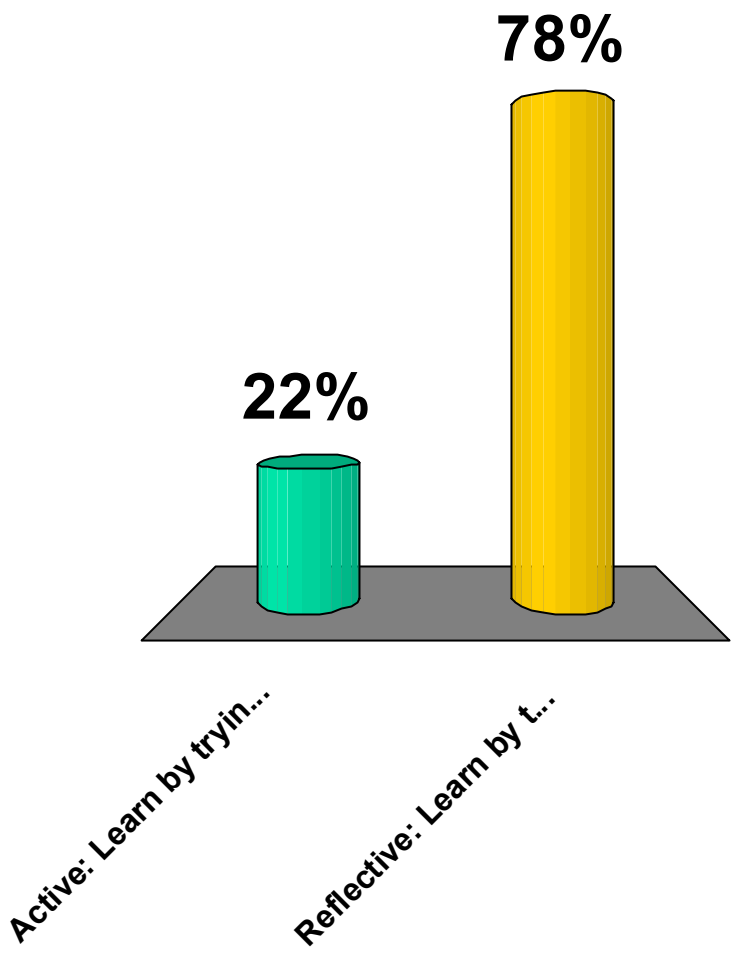
EX: When I start a homework problem, I am more likely to:

A) Start working on the solutions immediately.

B) Try to understand the problem first.

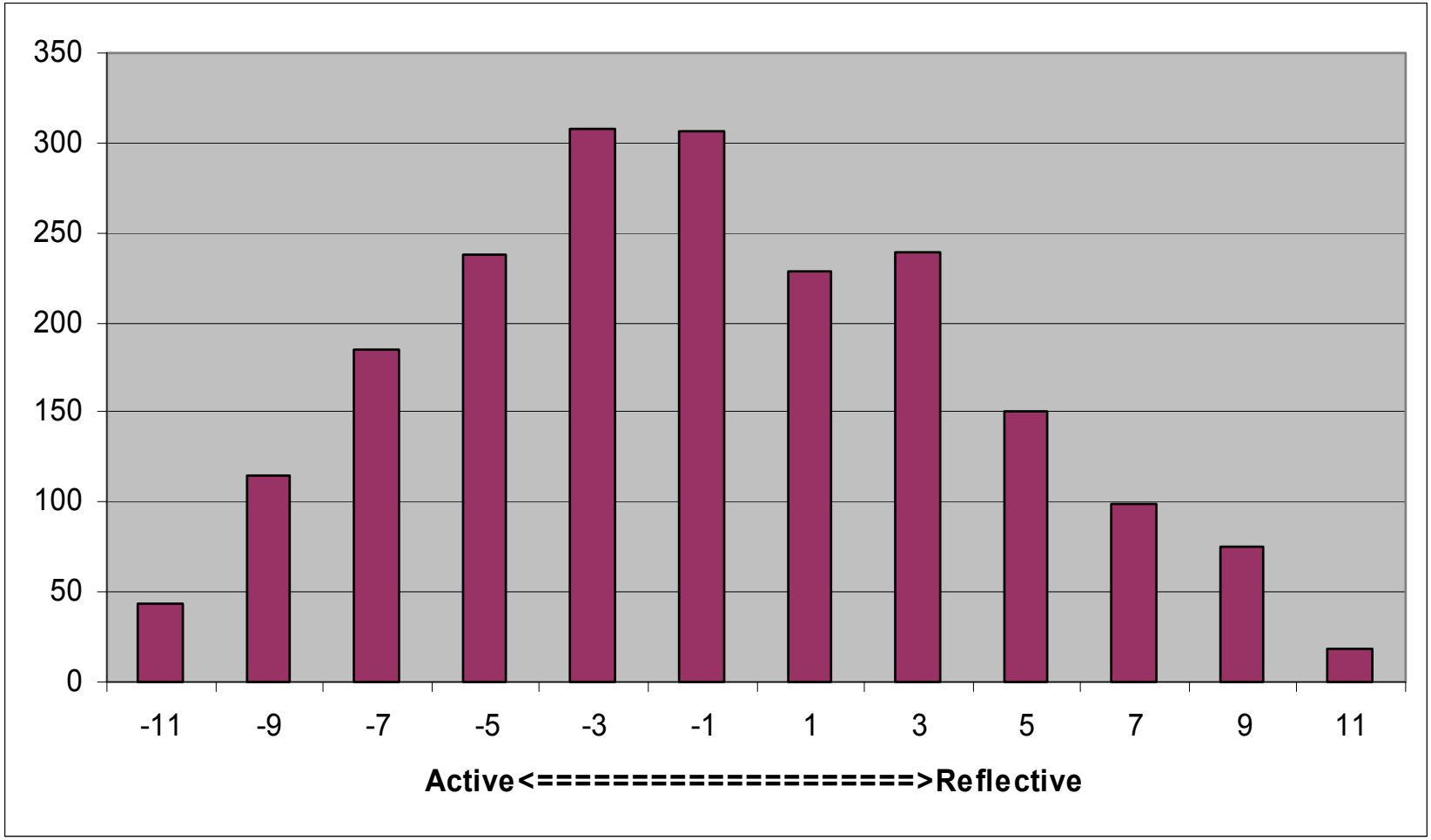
How Do You Process Information?

1. Active: Learn by trying things out; Enjoy working in groups, discussing
2. Reflective: Learn by thinking things through; Prefer working alone or with a single familiar partner; Introspective



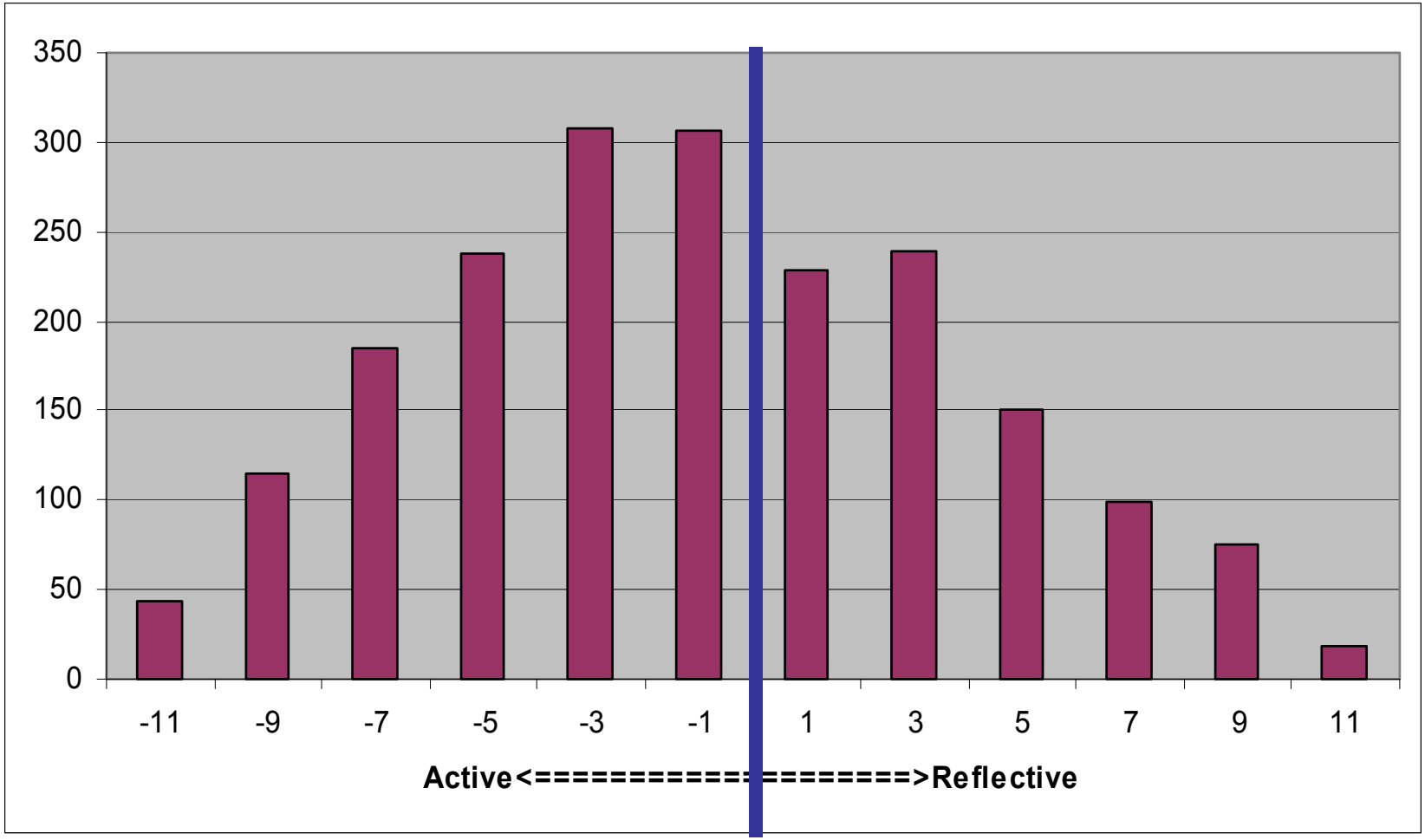
Slide courtesy of Roger Woodard, NCSU

Active vs. Reflective



Slide courtesy of Roger Woodard, NCSU

Active vs. Reflective: About 6/10 and 4/10



Gaining Understanding

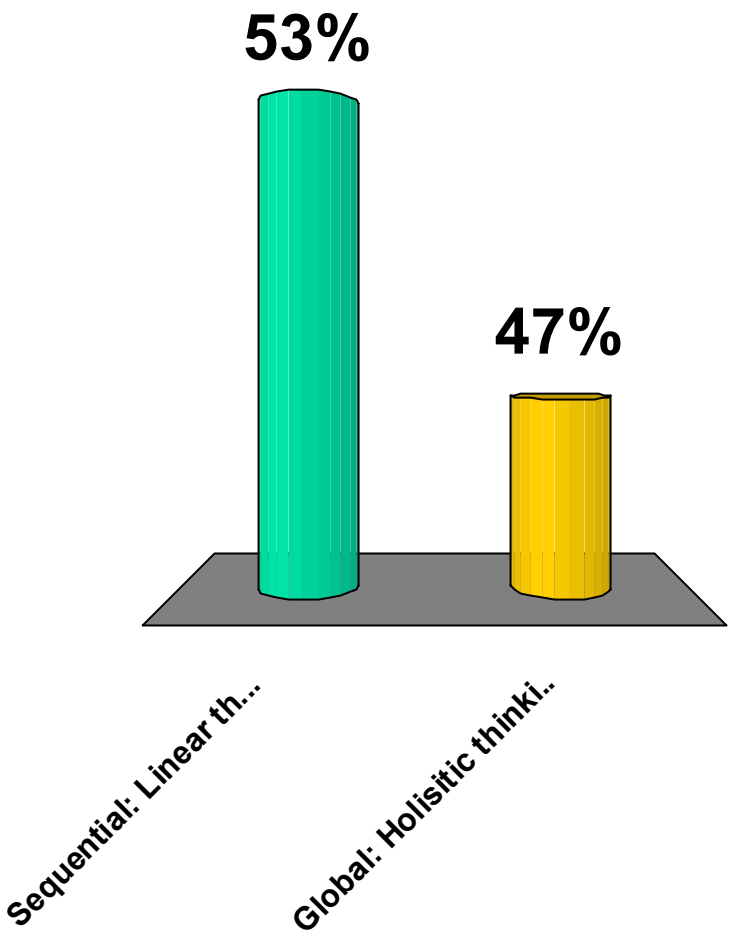
- Sequential
  - Linear thinking process
  - Learn or "get it" in small incremental steps
  - Comfortable with partial information
- Global
  - Holisitic thinking process
  - Learn or "get it" in large leaps
  - Uncomfortable until they fully understand and see the big picture

EX: It is more important to me that an instructor:

A) lay out the material in clear sequential steps.
B) give me an overall picture and relate the material to other subjects.

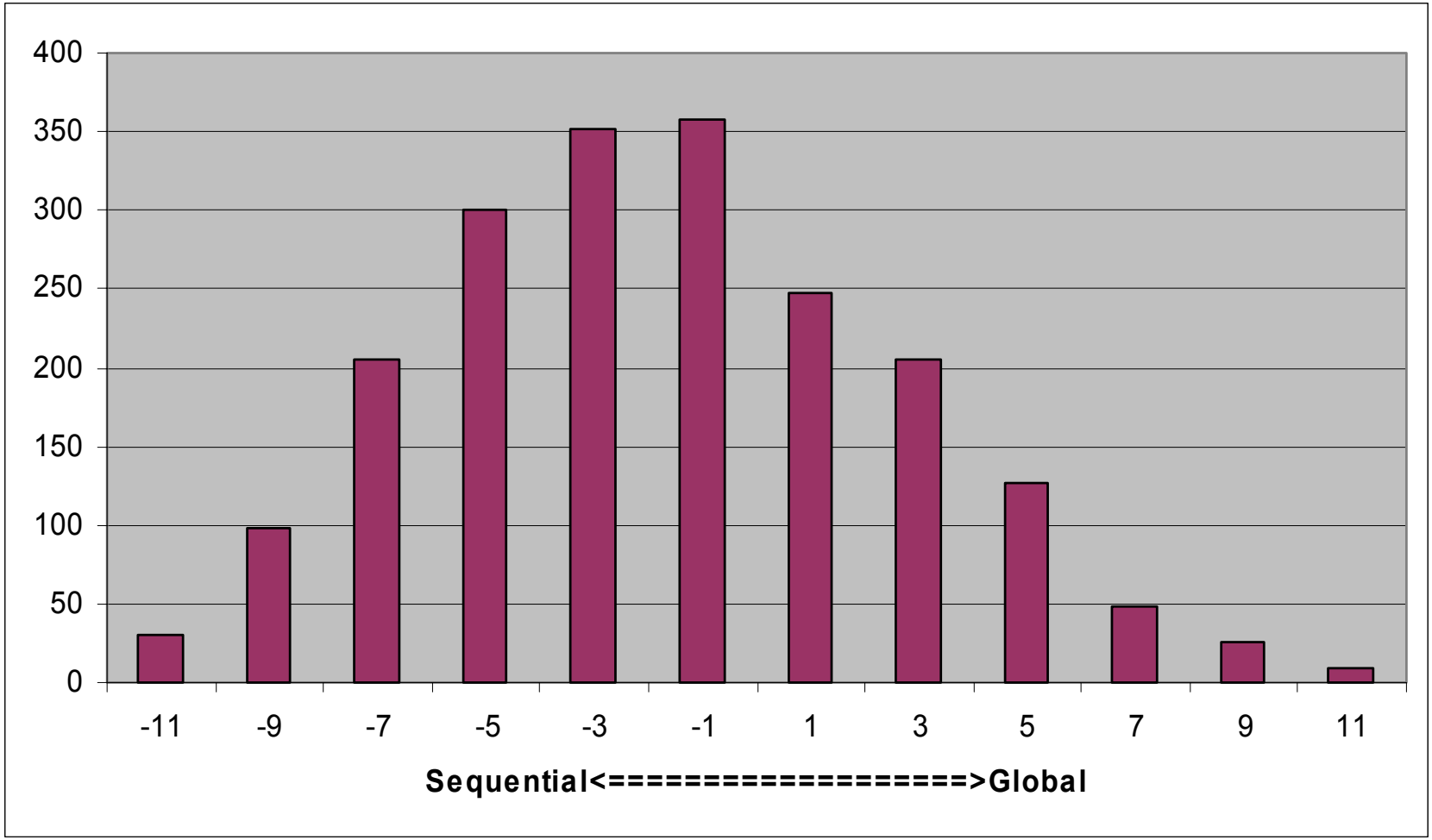
How Do You Gain Understanding?

1. Sequential: Linear thinking process; Learn or "get it" in small incremental steps; Comfortable with partial information
2. Global: Holisitic thinking process; Learn or "get it" in large leaps; Uncomfortable until you fully understand and see the big picture



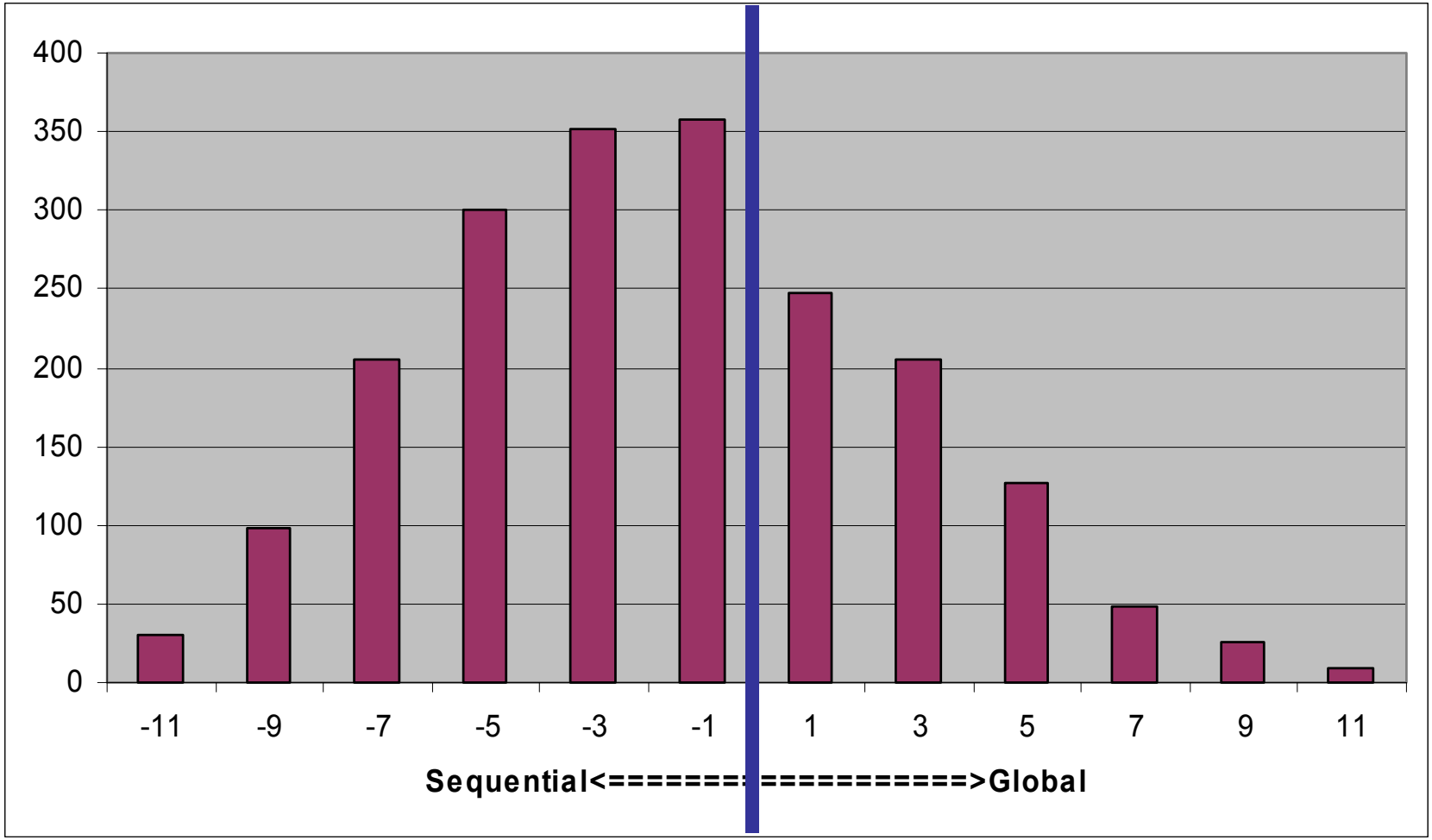
Slide courtesy of Roger Woodard, NCSU

Sequential vs. Global



Slide courtesy of Roger Woodard, NCSU

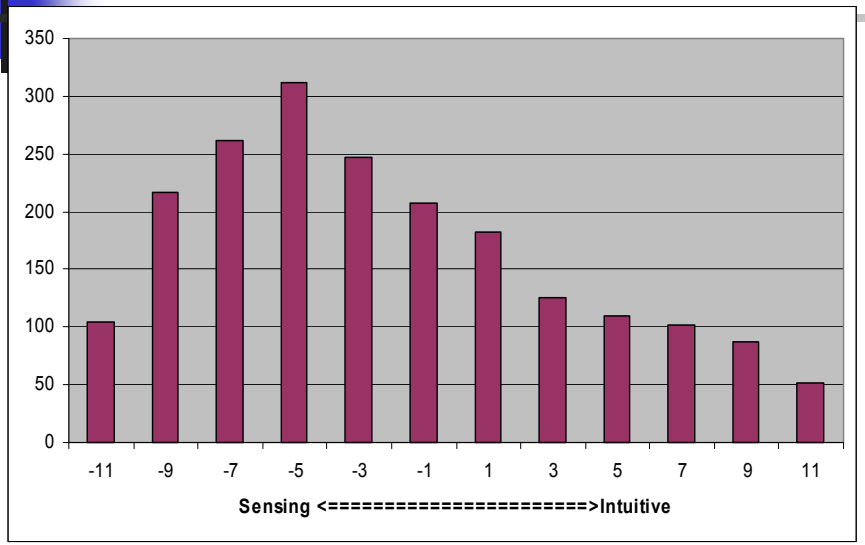
Sequential vs. Global: About 7/10 and 3/10

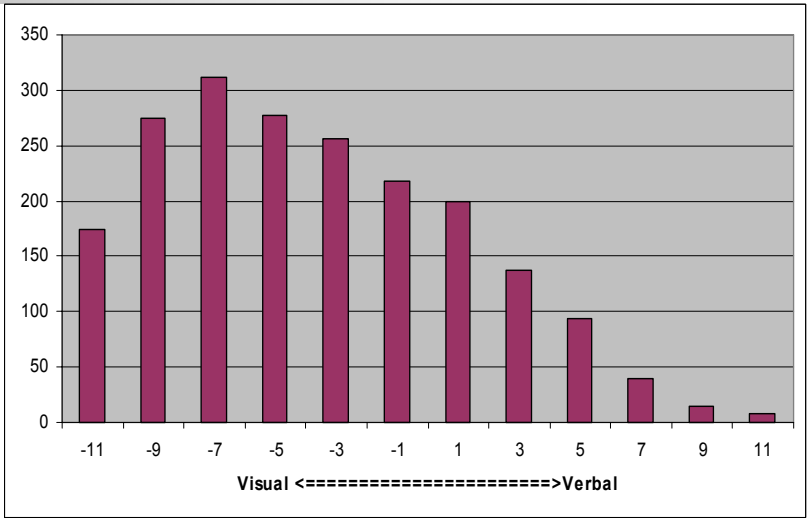


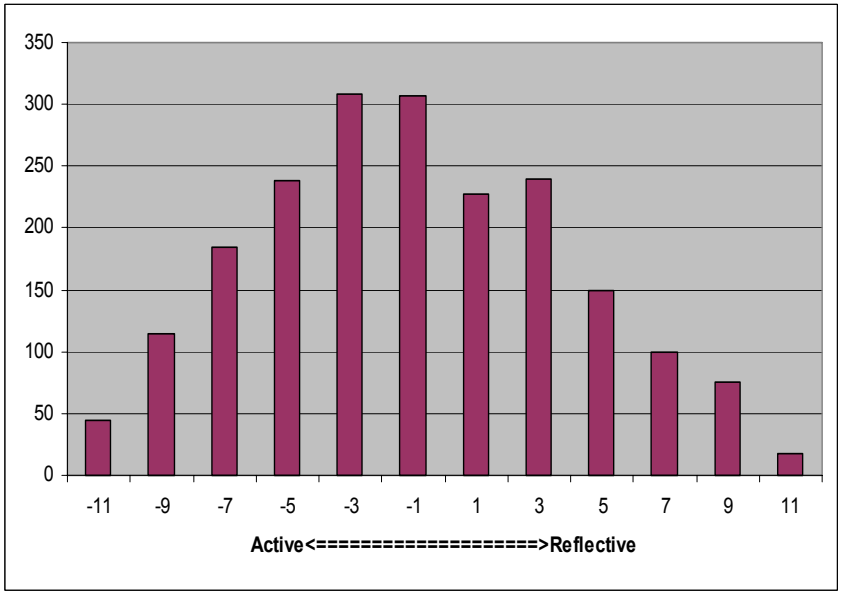
SUMMARY FOR STATISTICS STUDENTS

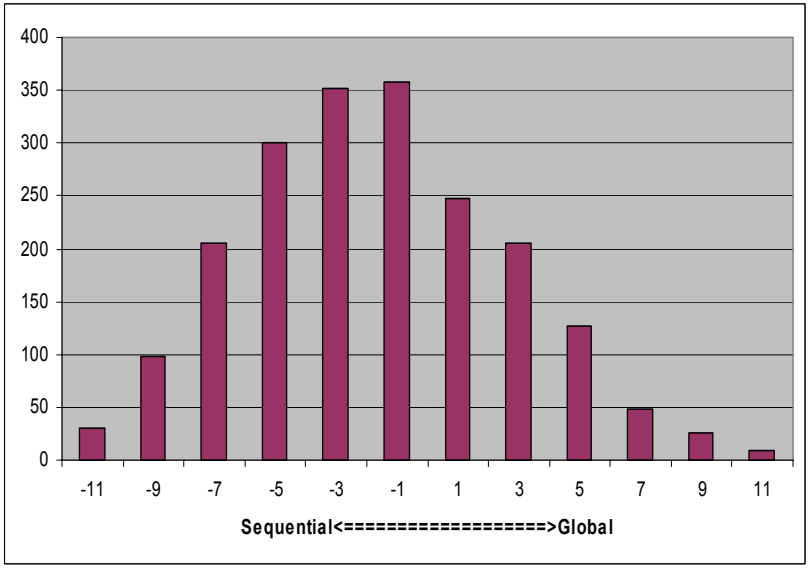
- **Sensing** or Intuitive (notice)
  - About 2/3 and 1/3; median = -3
- **Visual** or Verbal (remember)
  - About ¾ and ¼; median = -5
- **Active** or Reflective (process)
  - About 6/10 and 4/10; median = -1
- **Sequential** or Global (understand)
  - About 7/10 and 3/10; median = -1 (close)

Sensing and Visual more Skewed









Faculty Results (mostly engineering) AND Teaching Aspect (Felder & Spurlin)

- Sensing/**Intuitive** (Concrete/abstract content)
  - About 4/10 and 6/10 Stat Ed: 51% and 49%
- **Visual**/Verbal (Visual/verbal presentation)
  - About 94% and 6% Stat Ed: 76% and 24%
- Active/**Reflective** (Act./passive student participation)
  - About 45% and 55% Stat Ed: 22% and 78%
- **Sequential**/Global (Atomistic/holistic perspective)
  - About 55% and 45% Stat Ed: 53% and 47%

Engineering (Stat) Faculty/ Stat Students

	Reflective Fac: 55% (78%) Students: 40%	Active Fac: 45% (22%) Students: 60%
Intuitive Fac: 60% (49%) Students: 33%	Lectures Reading textbook Doing traditional homework and papers Faculty as Expert	Hands-on projects that require thought, preferably alone or with one partner Faculty as Coach
Sensing Fac: 40% (51%) Students: 67%	Discussion groups where everyone contributes Faculty as Motivator	Group projects and problem-solving with minimal direction from teacher Faculty on side-line

Results from Schroeder, 1993

- Sensing makes up about:
  - 75% of general population
  - 60% of entering college students
  - 25% of college faculty
- Sensing, active makes up:
  - About 50% of high school seniors
  - Less than 10% of college faculty
- Intuitive, reflective makes up:
  - About 10% of high school seniors
  - The “vast majority” of college faculty
- Mean SAT scores (research at U of MO, Columbia):
  - 1110 for Intuitive, reflective students
  - 932 for Sensing, active students

CONCLUSIONS

- Faculty are more Intuitive, Reflective
- Students are more Sensing, Active
- Intuitive, reflective people prefer traditional teaching methods, concepts and ideas.
- Sensing, active people prefer direct, concrete experience, with practical, physical, immediate application.
- We should teach using all learning styles at varying times. Students need to become comfortable with their weak styles, but should have the benefit of some instruction in their strong ones.

SOME TEACHING RESOURCES
http://www.ics.uci.edu/~jutts

Consortium for the **A**dvancement of **U**ndergraduate **S**tatistics **E**ducation

Amazing collection of resources for the classroom, data sets, professional development opportunities, etc.

- www.causeweb.org

Guidelines for Assessment and Instruction in Statistics Education (GAISE)

American Statistical Association recommendations for teaching a modern introductory Statistics course.

- http://www.amstat.org/Education/gaise/GAISECollege.htm

Stat Pages: A general collection of resources for statistics including applets, online calculators, and much, much more.

- http://statpages.org

ARTIST = **A**ssessment **R**esource **T**ools for **I**mproving **S**tatistical **T**hinking

- https://app.gen.umn.edu/artist/