

Psychology and other sciences

Ancient Greece

Physics:

- Air
- Earth
- Fire
- Water

Physiology:

- Blood
- Black bile
- Yellow bile
- Phlegm

Temperament:

- Sanguine
- Melancholic
- Choleric
- Phlegmatic

Today

Physics:

- General Relativity

Physiology:

- DNA double helix

Temperament:

- Neuroticism
- Extraversion
- Openness
- Agreeableness
- Conscientiousness

Cognitive Science

Quotation removed due to copyright reasons. Please see:

Searle, John R. *Minds, Brains, and Science*.

Cambridge, MA: Harvard University Press, 1984, p.11. ISBN: 0674576314.

Psychology

- Compared with the sciences of matter, psychology and social science have as yet given the world remarkably little cause for amazement.

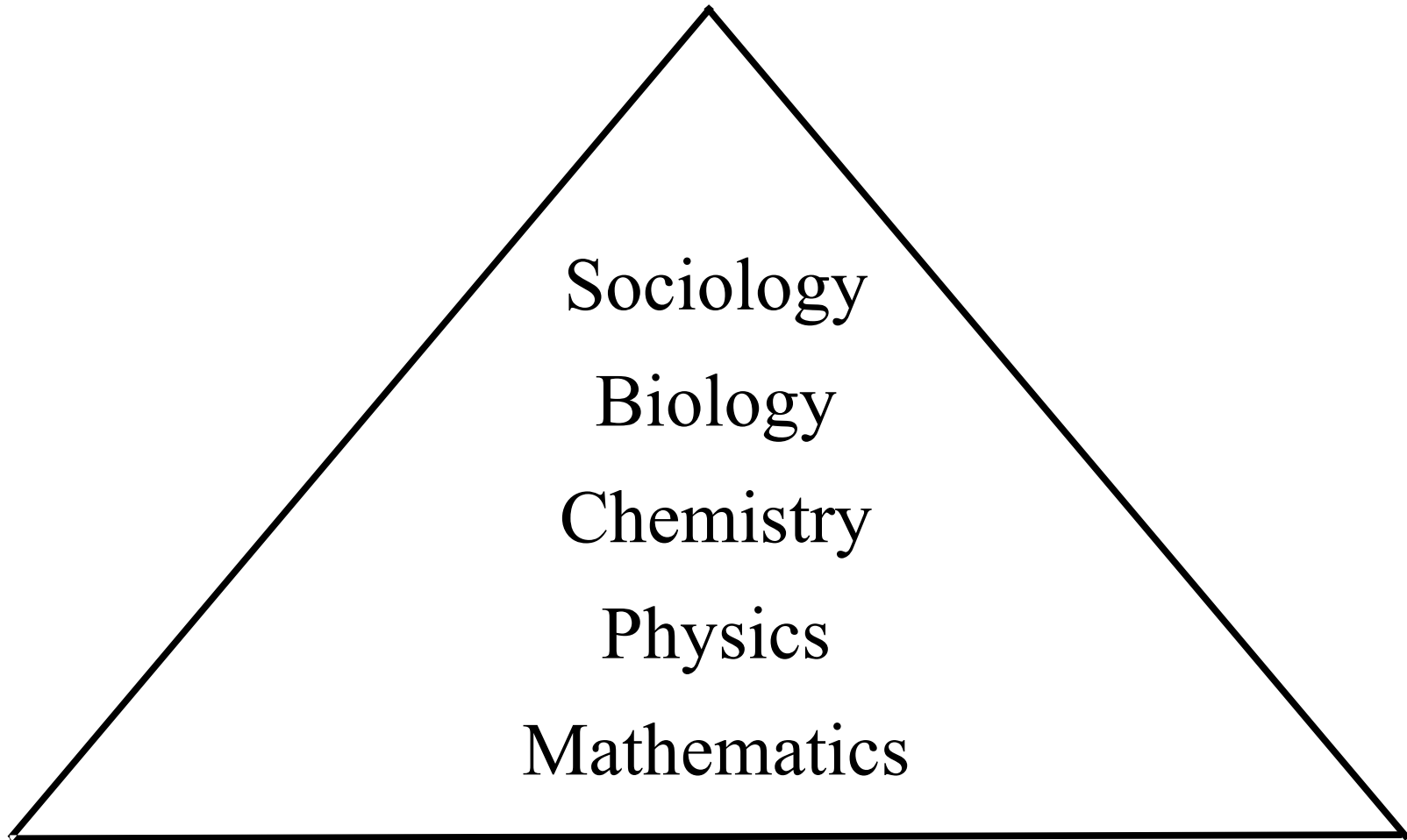
(HG Wells)

Golden Fleece Awards (Proxmire)

“Senator William Proxmire’s Golden Fleece Award embodied both outrage and humor as it put the public spotlight on waste and abuse of taxpayer money.”

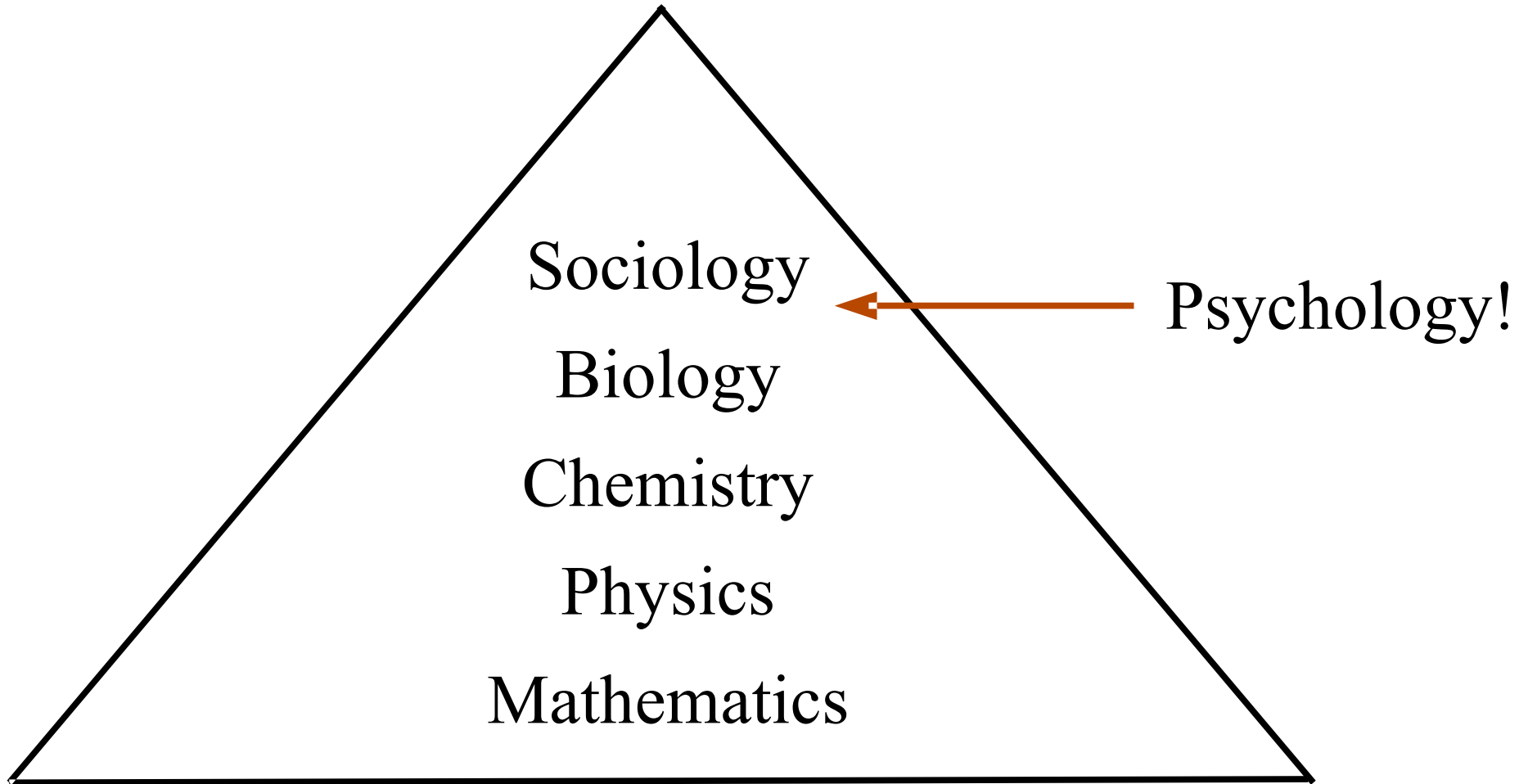
- 1975, NSF: For squandering \$84,000 to try to find out why people fall in love.
- 1976, NSF: For a grant to study “Environmental Determinants of Human Aggression of drivers (Specifically, aggression caught in traffic jams).

Pyramid of the sciences



(Comte)

Pyramid of the sciences



(Comte)

Psychology

- Compared with the sciences of matter, psychology and social science have as yet given the world remarkably little cause for amazement.

(HG Wells)

Is this fair??

What makes psychology difficult

What makes psychology difficult

- Sheer number of possible variables
- Randomness and feedback
- Individual differences
- Many experiments are unethical

Sheer number of variables

- There are many different variables and they interact with each other in subtle ways
- Eg: what affects Tim's mood this morning?
 - Upbringing
 - Many genetic factors
 - Did he get any sleep last night?
 - Does he have caffeine in his system?
 - Did he break up with his girlfriend last week?

Randomness and feedback

- Given two identical twins – one develops schizophrenia and the other wins a Pulitzer prize. What explains the difference?
- Quotation removed due to copyright reasons. Please see:
Meehl, P. E. "Theoretical Risks and Tabular Asterisks: Sir Karl, Sir Ronald and the Slow Progress of Soft Psychology." *Journal of Consulting of Clinical Psychology* 42 (1978): 806-834.

Individual differences

Quotation removed due to copyright reasons. Please see:

Meehl, P. E. "Theoretical Risks and Tabular Asterisks: Sir Karl, Sir Ronald and the Slow Progress of Soft Psychology." *Journal of Consulting of Clinical Psychology* 42 (1978): 806-834.

Many experiments are unethical

- Language learning
 - Train children only on artificial languages
- Lesion studies in humans

Experiments in other sciences

- How do the methods and approaches we've discussed in this class differ from those in other sciences?

Lab Classes

Physics

Cog Sci

Lab Classes

Physics

- Linear regression, confidence intervals
- Formal theories
- Classic experiments

Cog Sci

- t-tests, ANOVA
- Qualitative hypotheses
- Design your own expts

Experiments in other sciences

- How do the methods and approaches we've discussed in this class differ from those in other sciences?
- Other sciences:
 - Significance tests are less common
 - Formal models are more common
 - Paradigms are better accepted

Formal models

- Other sciences
 - Newton's laws, stoichiometry, genetic drift, ...
- Formal models allow strong experimental tests.
 - Schmewton: “The acceleration of an object changes significantly when a force is applied ($p < 0.001$)”
 - Newton: “ $F = ma$ ”

Why formal models are valuable

- Meehl's theory of the climate predicts:
 - It will rain more in April than May
 - It will rain on April 3, 9, 12, 13, and 17
 - It will rain 1.2 inches on April 3, 0.8 inches on April 9, etc

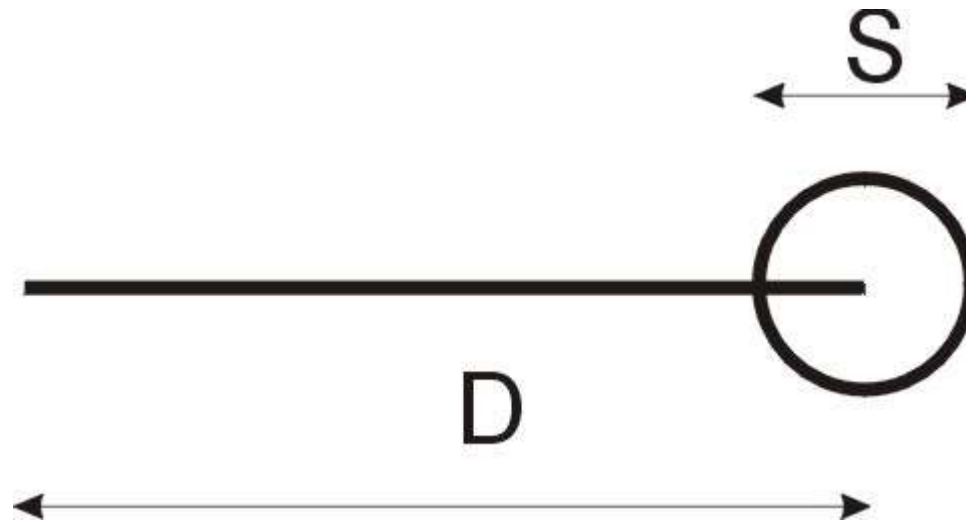
Why hypothesis tests are often unrevealing

- A two group design usually gives you one bit of data:
 - The null hypothesis is usually false – the bit tells you in which direction it is false
- There are often theories other than your preferred theory that will explain that bit of data
- Just because an effect exists doesn't mean it is important.

Formal models in cognitive science

- Motor control
 - Reaching behavior, eye movements, ...
- Vision
 - Depth perception, object recognition, ...
- Language
 - Psycholinguistics, language learning, ...
- High level cognition
 - Categorization, forgetting, analogy, ...

Fitt's Law



- $T = a + b \log(1+D/S)$
 - T: movement time
 - A: distance of movement
 - S: width of the target

Graph removed due to copyright reasons.

Shepard's Universal Law of Generalization

Figure removed due to copyright reasons.

Figure removed due to copyright reasons.

Non-metric multidimensional scaling

- Goal: place the elements in a two dimensional space so that generalization is a monotonic function of distance

Generalization

Figures removed due to copyright reasons

Distance in psychological space

Universal Law of Generalization

- Quotation removed due to copyright reasons. Please see:
Shepard, R. N. Abstract in "Toward a universal law of generalization for psychological science." *Science* 237 (1987): 1317-23.
- Asimov: “ I don't really understand this but I have the feeling Hari Seldon would understand it without trouble.”

Conclusions

- Psychology is an undeveloped science – the fundamental breakthroughs are yet to be made
- Formal models are valuable if they can be developed.
- Asimov quotation removed due to copyright reasons.