Session 11
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TA: Rebecca Kaarina Saari
Guest: Professor Alex (Sandy) Pentland
# Session 11: Agenda

- Welcome and Overview of class 11 (5 min.)
- Dialogue with Professor Pentland (55 min)
- Break (10 min.)
- Discussion of other papers (30 -40 min)
- Theme and topic integration (Magee)
  - Further discussion of readings; Heuristics and Gis
  - The role of social sciences in Engineering Systems
  - Importance of specific social science disciplines in ES
  - Human Cognition research overview

- Next Steps -preparation for week 12: (5 min.)
Heuristics (and biases)- two possible views

1. Humans use them because of our flawed, limited reasoning capacity

2. From wikipedia With Amos Tversky and others, Kahneman established a cognitive basis for common human errors using heuristics and biases (Kahneman & Tversky, 1973; Kahneman, Slovic & Tversky, 1982; Tversky & Kahneman, 1974).
3. Humans use highly evolved (by experience and/or evolutionary history) heuristics because of their superior accuracy resulting from their “ecological adaption”.

4. From Gigerenzer “reply to K & T” At issue is the imposition of unnecessarily narrow norms of sound reasoning that are used to diagnose so-called cognitive illusions and the continuing reliance on vague heuristics that explain everything and nothing.
Which view do you think better reflects reality?

- Does it depend on how one defines the term heuristic?
- Specific examples:
- Does your preferred viewpoint lead to actions (management or policy)? What are they?
- Where is the sought after “toolbox of heuristics”? 
Do experts use or eschew heuristics?

☐ Are heuristics a form of abstraction and/or gist?

☐ Is transferability of abstractions from domain to domain likely to be easy?

☐ Are metaphors and analogies a mechanism for such transfer?

☐ Perhaps the “missing toolboxes” are domain specific and the highest level experts in fact have highly honed toolsets....
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Where do we stand relative to Social Sciences and ES?

Chuck Vest from the Preface to *Engineering Systems: Meeting Human Needs in a Complex Technological World*: “It is one thing to invert the order of the two words *systems* and *engineering*, but it is quite another to establish a workable framework for integrating social science writ large with engineering. Indeed it is such a hard task that this book really is a guide to the beginning of a journey. But it is a journey that the authors, together with a number of like-minded colleagues around the world, have already begun.”
Social Sciences & ES- an exploration

- How might we gain a deeper appreciation of “Social Sciences in ES”?
- Is the analogy with Biology entering into engineering useful? Is the further integration of physics and chemistry into engineering (so-called “engineering science” movement) a useful analogy?
- Four perspectives approach S/S, F, S, T
Function of SS in ES

- What is the purpose or high level reason for wanting to include SS in ES?
- Lots of specific problems
- To better anticipate the impact of technological choices on humans/society?
- To better anticipate the impact of society on technological choice?
Scale/Scope/Structure of SS in ES

- What boundaries might we want to think about?
- Do we want to emphasize research agenda or practice/education agenda?
- What aspects of each discipline?
- P/R = deep qualitative conceptual understanding; R = also quantitative theory where emerging
- What SS disciplines and how deeply in each?
Temporality wrto SS in ES

☐ SS in engineering education broadly-now or later? Is this the right time?

☐ Taught by SS or by engineers who know SS quite well?

☐ Analogies suggest: Start with graduate students and then they undertake teaching UGs when they move to faculty positions

☐ One SS at a time or work through several simultaneously?
Choice among social sciences

Which do you think are most important for ES?

The social sciences are a group of academic disciplines that study human aspects of the world. They diverge from the arts and humanities in that the social sciences tend to emphasize the use of the scientific method in the study of humanity, including quantitative and qualitative methods.
List of social sciences- adapted from Wikipedia

- The main **social sciences** include:
  - Anthropology
  - Economics
  - History
  - Linguistics
  - Philosophy
  - Political science
  - Psychology and social psychology
  - Sociology

- **Others**
  - Communication
  - Criminology
  - Cultural Studies
  - Education
  - Law
  - Social Work
  - Developmental studies
Which to pursue first?

- My favorites for deepest understanding for both practice and research are economics and psychology
- Why?
- Economics is dominant in policy advising and research on policy (MW)
- Psychology is the Bridge between engineering and the social sciences
- Many others are potentially of interest..
Two Overviews of Cognitive Science

- Levels- cells/neurons, axons, brain structure and plasticity, individual and social behavior and decisions
- Experimental approaches:
- Theories and Models:

- Decision making-
  - behavioral economics
  - Game theory and rational choice theory
- Biology based
  - Brain
  - mind
- Social science and culture based
Human Cognition Overview Topics

- Evolutionary psychology, cultural influences
- Brain plasticity
- Emotions and cognition
- Creativity, metaphors and analogies
- Group problem solving
- Memory
- Brain science, neuroscience, etc.
- Decision-making
- AI and modeling, EPIC and HCI
- Brain structure, modules etc.
Cultural and evolutionary influences


- Evolutionary psychology
  - Steven Pinker: The Language Instinct, How the Mind Works, The Blank Slate, The Stuff of Thought
Brain Plasticity

- Societal effects
  - Nicholas Carr, *The Shallows: How the Internet is changing the way we think*,
  - Doidge, *The Brain that Changes Itself* (2007)
  - McLuhan, *Understanding Media: The extension of man* (The medium is the message) (1964)
  - Saenger, *Space between Words*
  - Landes, *Revolution in Time*

- Personal scale Effects
  - Ramachandran, V. S. Perception of phantom limbs

- Micro level effects
Emotions and Cognition

- Emotions also have been considered harmful to thinking but new work has gone deeper and shown value of emotions
  - Damasio, *Descartes Error; the Feeling of what happens*
  - LeDoux *The Emotional Brain*
Creativity

- Robert J. Weber and David Perkins, *Inventive Minds: Creativity in Technology*
- Csikszentmihalyi, M. *Creativity: Flow and the psychology of discovery and invention*
- Amabile, Teresa *Creativity in Context: Update to the Social Psychology of Creativity*
Analogies and Metaphors

- Donald Schon, *The Reflective Practitioner* 1983 ("Generative Metaphors")
- James Geary, *I is an Other: The Secret Life of Metaphor and how it shapes the way we see the World*, 2011
- Speer, N. K. "Reading Stories Activates Neural Representations of Visual and Motor Experiences", *Psychological Science* 2009
- Engineering Design (lots and some in 2 weeks)
Group Problem Solving


- James Surowiecki, The Wisdom of Crowds, 2004 (anecdotes and interesting speculation why averages for crowds of independent estimates can be superior);

- Scott Page, The Difference, 2007 (models showing benefit of diversity etc.)
Memory

- Baddeley, A. D. *Working Memory* (1986)
- *Memory and Cognition* (A Journal)
Brain science- pathways and learning from pathologies

- Oliver Sachs: *The Man who mistook his wife for a Hat; Seeing Voices: A Journey into the World of the Deaf; An Anthropologist on Mars; The Mind’s Eye.*
Further Readings in Decision-Making

- Ken Binmore, *Rational Decisions*
- Gerd Gigerenzer, *Rationality for Mortals*
- Daniel Gilbert, *Stumbling on Happiness*
- T. Sagara, *Collective Choice? Public Planning and Arrow’s Theorem*
- Barry Schwartz, *The Paradox of Choice*
Other areas

☐ Visualization:
  ■ see “A Historical Review of visualization in Human Cognition” by L. P. Rieber

☐ IQ and its change over time
  ■ James Flynn, *What is Intelligence?* 2009
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