Lecture 13. Mid-Term Review

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Human Computer Interaction

- What is Human Computer Interaction (HCI)?

A discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

ACM SIGCHI Curricula for Human-Computer Interaction
by Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong and Verplank
http://old.sigchi.org/cdg/cdg2.html (access 2018)

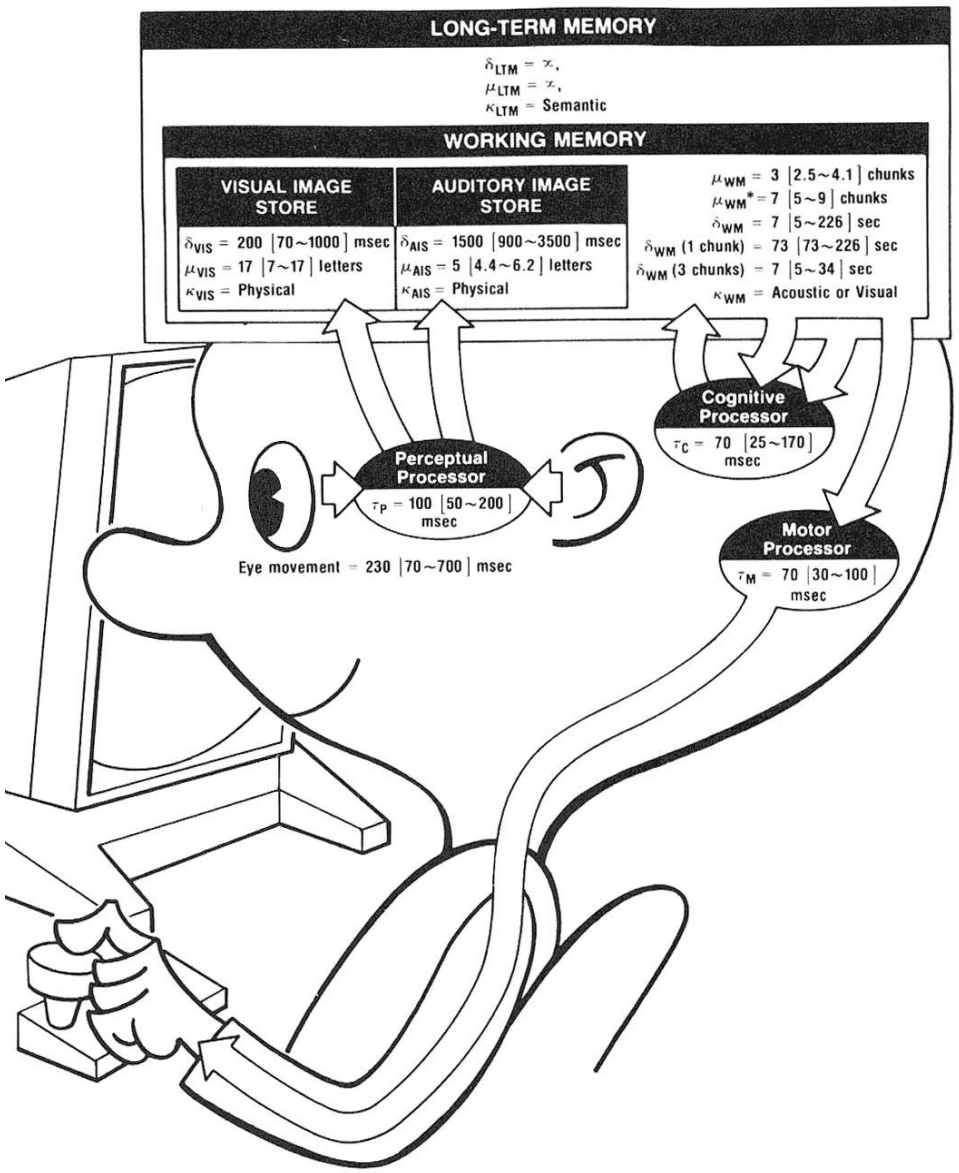
What have we learned?

- **Theoretical Foundations**
  - Human Performance Modeling
  - Evaluation Methodologies
  - Behavioral Science in HCI
  - Design Principles, Affordances

- **Practical Topics**
  - Text Entry Technologies
  - Tangible Interfaces
  - Multi-Modal Interfaces
  - Natural User Interfaces (NUI)
  - Human Computation
  - Intelligent User Interfaces (IUI)

Human Performance Modeling

Summary



3 subsystems

- Perceptual
- Cognitive
- Motor

- Each subsystem has its own memories and processors.

- Memory
  μ, storage capacity in items
  δ, decay time of an item
  κ, main code type (physical, acoustic, visual, semantic)

- Processor
  τ, cycle time

- Three subsystems can work in parallel.

Human Performance

- Three Types of Models

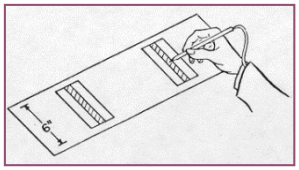
  Best Performance (Fastman)

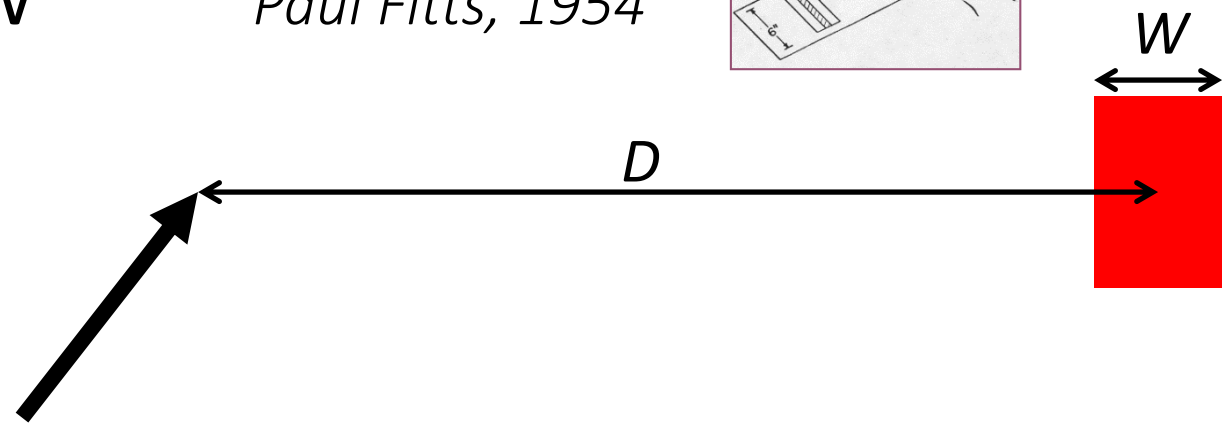
  Worst Performance (Slowman)

  Nominal Performance (Middleman)

Fitts' Law

Paul Fitts, 1954





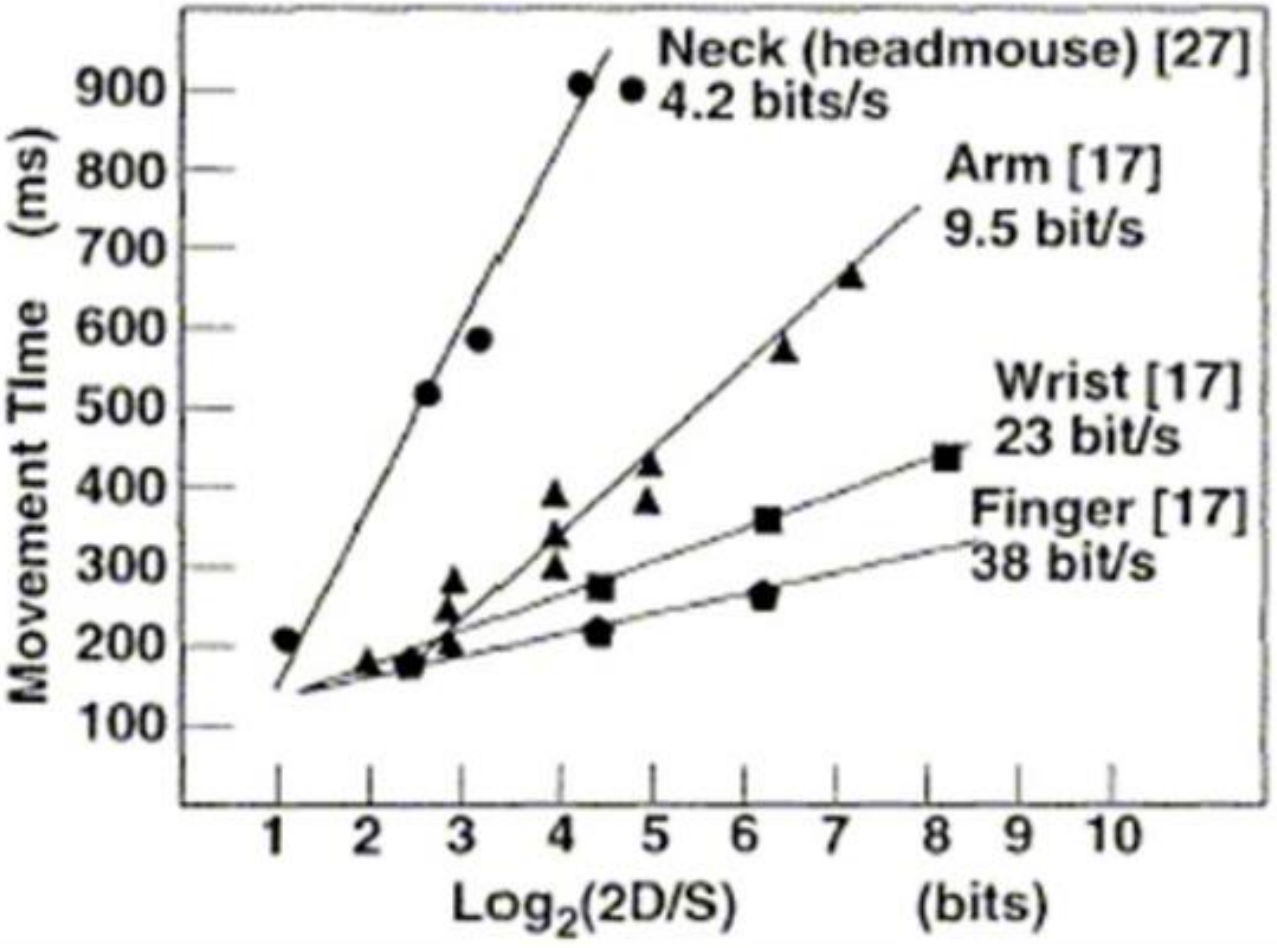
$$MT = a + b \log_2 \left(\frac{D}{W} + 1 \right)$$

Movement Time

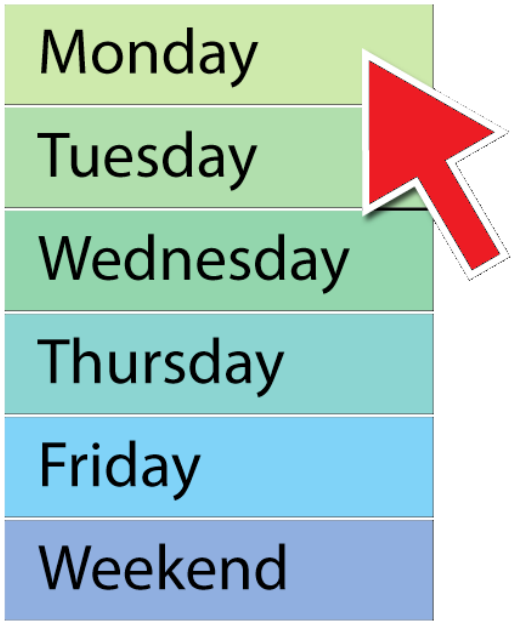
Index of Difficulty

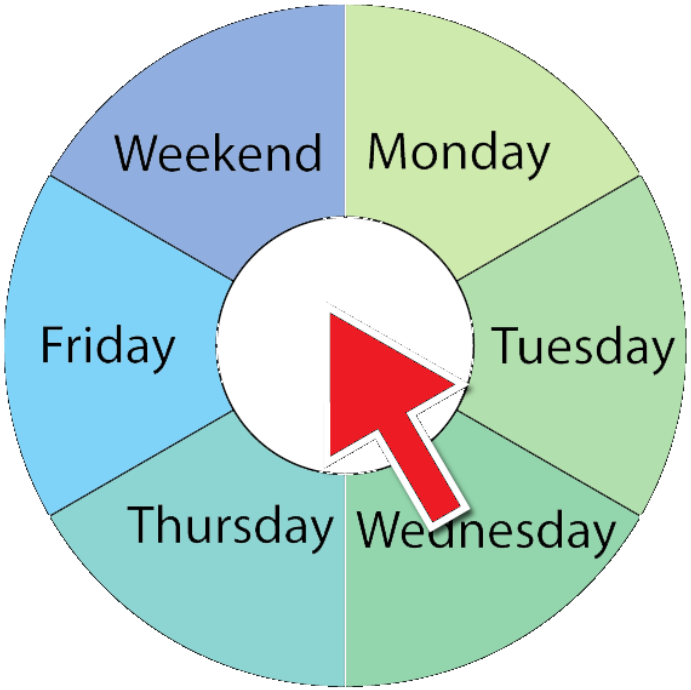
Bandwidth (IP) of Human Muscle Groups

IP = 1/b



Fitts' Law Example





Which will be faster on average?

pie menu (bigger targets & less distance)

Power Law of Practice

- Task time on the nth trial follows a power law

$$T_n = T_1 n^{-a} + c$$

where a = .4 [.2 ~ .6], c = limiting constant

  - You get faster the more times you do it!

Applies to skilled behavior (sensory & motor)

Does not apply to

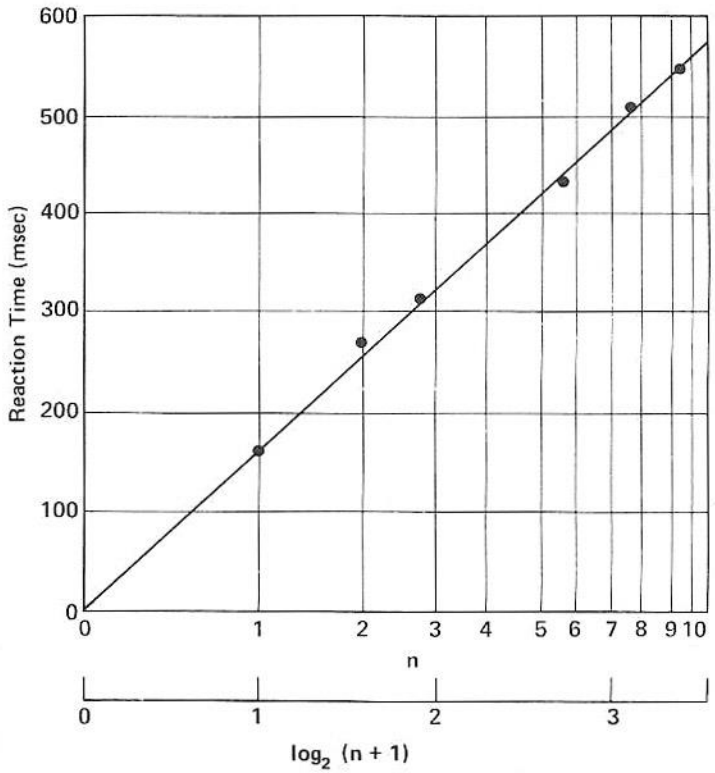
- Knowledge acquisition
- Improving quality

Hick's Law

The time it takes for a person to make a decision as a result of the possible choices he or she has: increasing the number of choices will increase the decision time logarithmically.

$$T = b \cdot \log_2(n+1)$$

At the onset of one of *n* lights, arranged in a row, the subject is to press the key located Below the light (After Welford, 1968, p62)



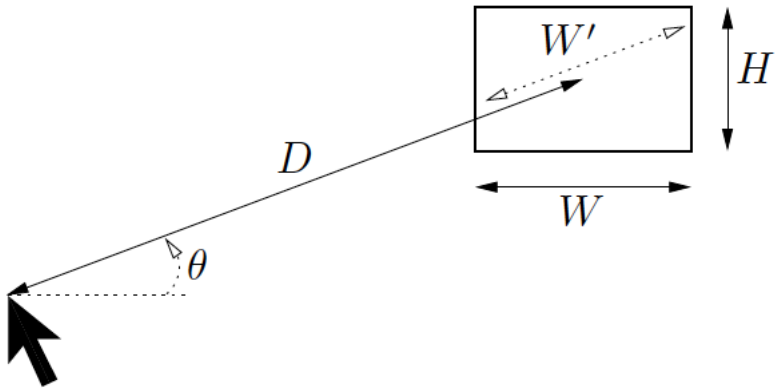
Extending Fitts' law to Two-Dimensional Tasks

- 5 model proposed
  - "STATUS QUO" model
  - "SMALLER OF" model
  - Apparent width W' model
  - Substitute W with W*H
  - Substitute W with W+H

$$MT = a + b\log_2\left(\frac{D}{W} + 1\right)$$

$$ID_{\min(W,H)} = \log_2\left(\frac{D}{\min(W,H)} + 1\right)$$

$$ID_{W'} = \log_2\left(\frac{D}{W'} + 1\right)$$

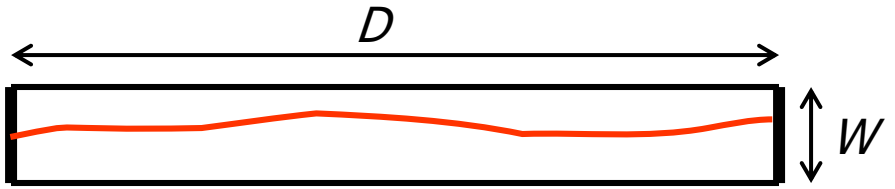


Steering Law *(Accot and Zhai, 1997)*

"Beyond Fitts' Law: Models for trajectory based HCI tasks."
Proceedings of ACM CHI 1997 Conference

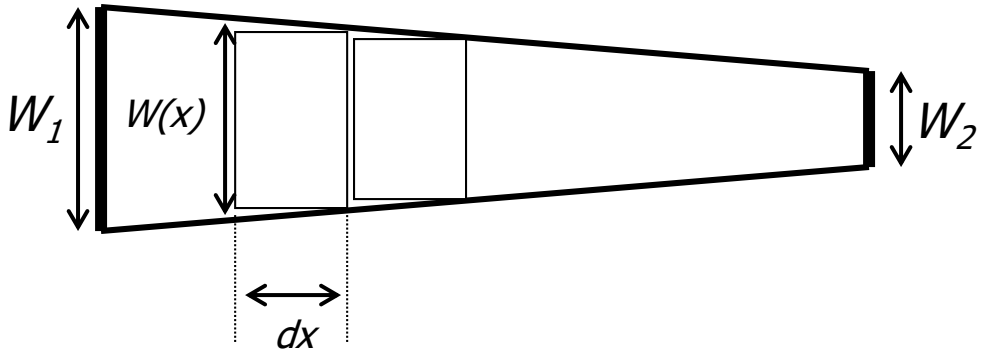
fixed width tunnel:

$$ID = \frac{D}{W}, \quad MT = a + b\frac{D}{W}$$



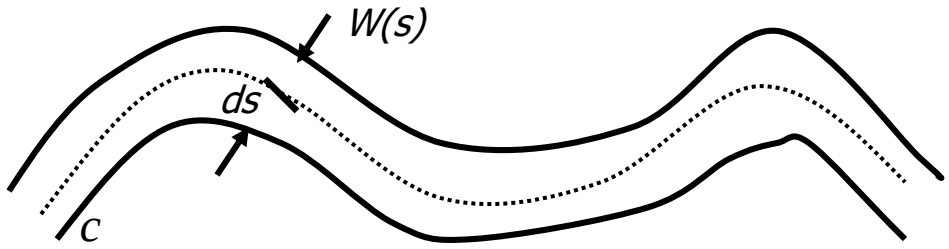
narrowing tunnel:

$$ID = \int_0^D \frac{dx}{W(x)}$$



general Steering Law:

$$ID = \int_c \frac{ds}{W(s)}$$



What is GOMS?

- A family of user interface modeling techniques

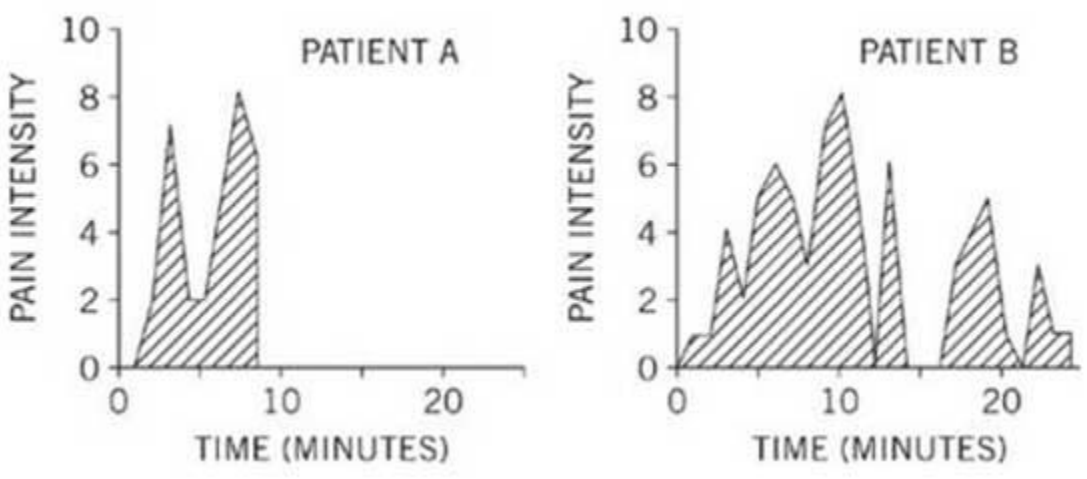
- Goals, Operators, Methods, and Selection rules
  - Input: detailed description of UI and task(s)
  - Output: various qualitative and quantitative measures

Behavioral Science in HCI

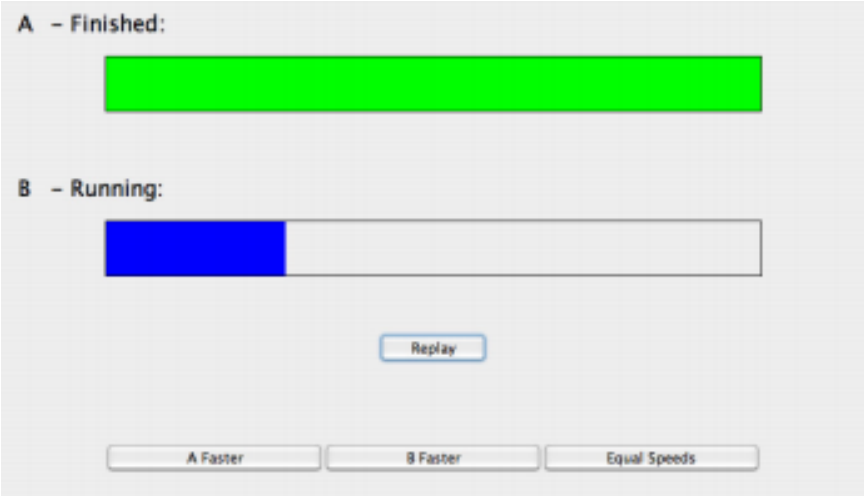
Peak-End Effect

- **Peak-End Rule**
  - The most intensive (peak) and ending moments play a dominant role

- **Judgments of unpleasantness are unaffected by their timespan**
  Experiment . Patients undergoing colonoscopy examination



App #1. Progress Bar Designs

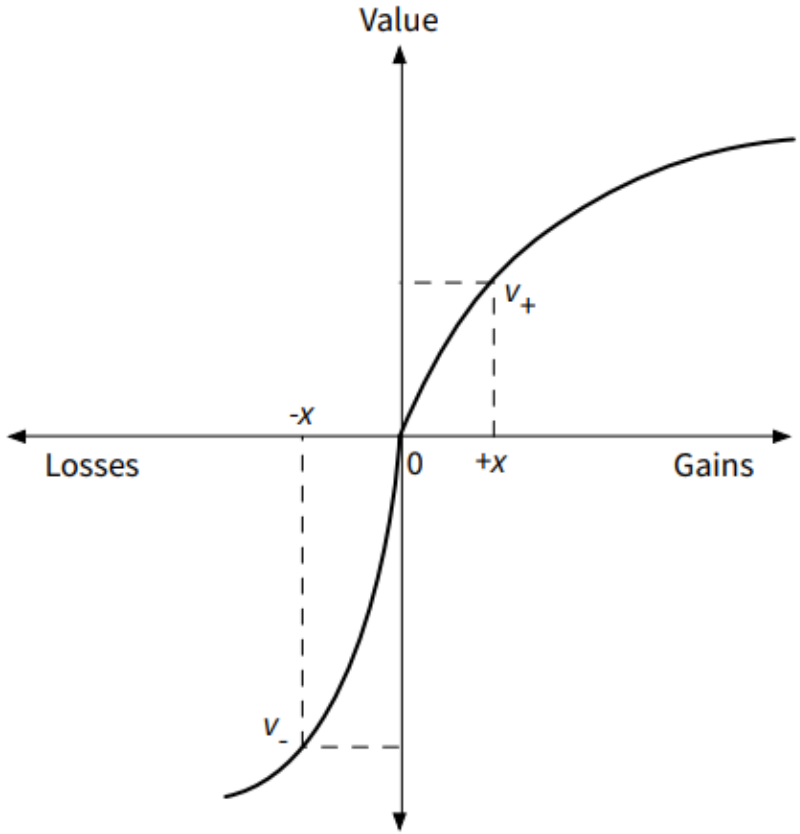


- Each progress bar took 5.5 seconds
- Progress behaviors varied, including
  linear, early pause, late pause, slow wavy, fast wavy
  poser, inverse power, fast power, inverse fast power

Chris Harrison, Brian Amento, Stacey Kuznetsov, and Robert Bell. 2007. Rethinking the progress bar. UIST '07, 115-118.

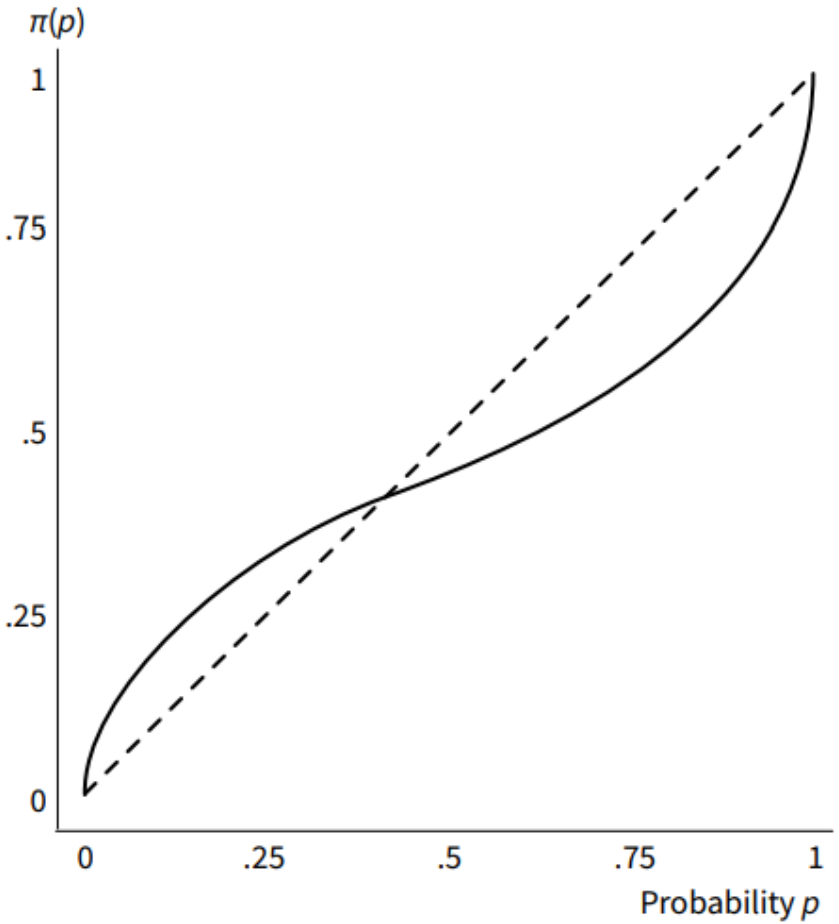
Prospect Theory

- Value function

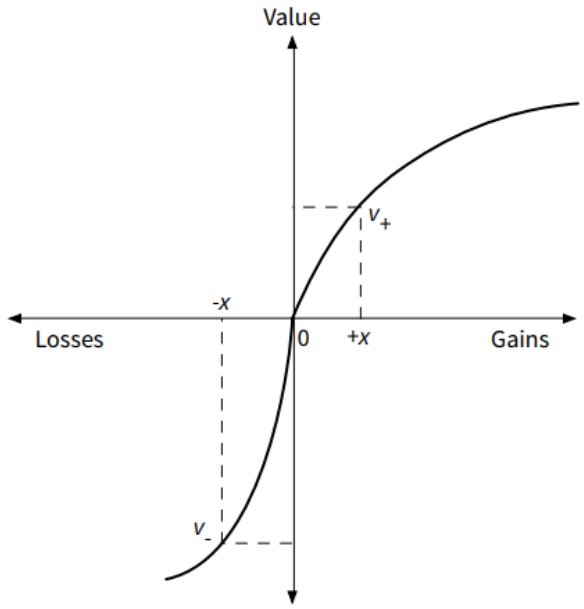


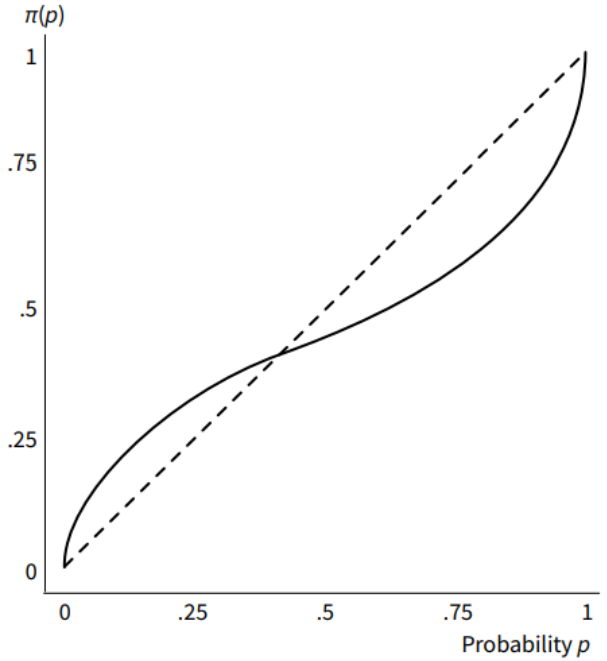
Prospect Theory

- Decision Weighting Function



Prospect Theory





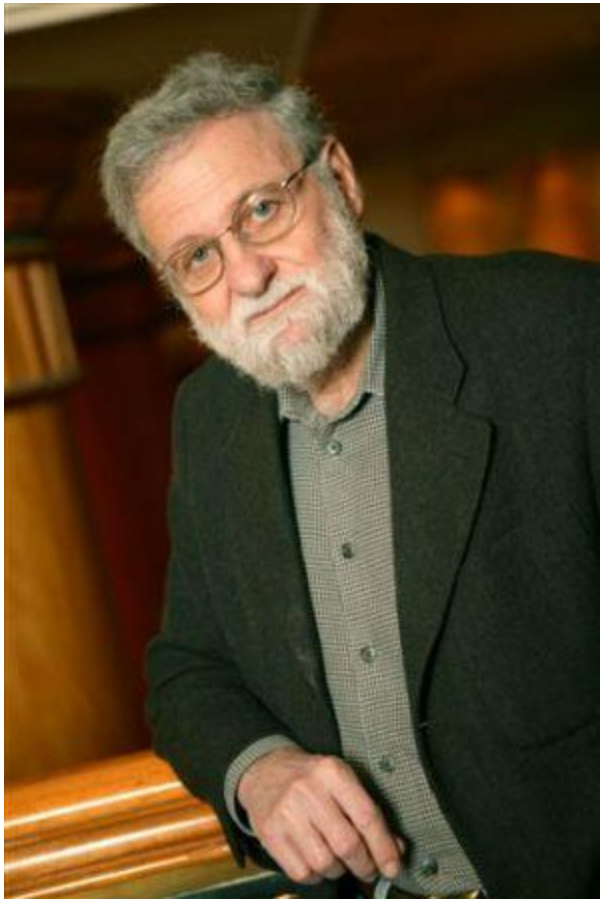
$$V(X,P) = \sum_{i=1}^{n} \pi(p_i)v(x_i).$$

Enhanced Active Choice

- Opt-in: Place a check in the box if you want a reminder to get a Flu Shot.
- Opt-out: Place a check in the box if you DO NOT want a reminder to get a flu shot.
- Active Choice:
  - I don’t want a reminder to get a flu shot.
  - I want a reminder to get a flu shot.
- Enhanced Active Choice:
  - I want a reminder to get a flu shot
  - I want to remind myself to get a flu shot

Affordances

"… the term **affordance** refers to the *perceived* and *actual* properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.



Some affordances obvious

- Knobs afford turning
- Buttons afford pushing
- Glass can be seen through

Some affordances learned

- Glass breaks easily
- Floppy disk
  - Rectangular – can't insert sideways

What have we learned?

- **Theoretical Foundations**
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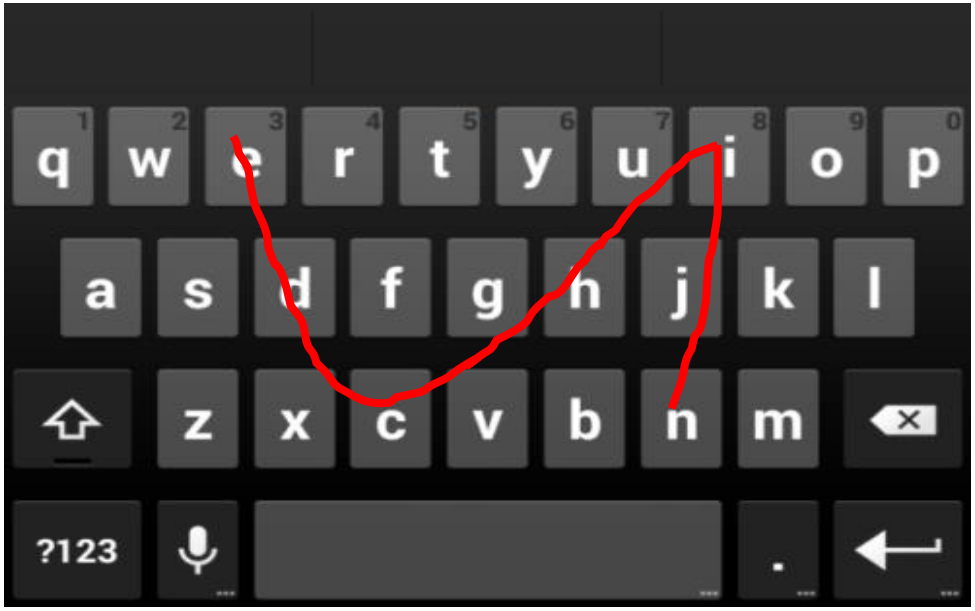
Text Entry Technique

Smart Touch Keyboard

Gesture Keyboard

Entering *nice*



Sample Questions

Problem 1.4: Please choose a model that can be used to model high level tasks such as text editing:

A. The Fitts' Law
B. Model Human Processor
C. GOMS
D. The Hick's Law

Your Answer: __

Problem 2b [2pts]: The Qwerty layout is an optimal layout for one-finger typing on smartphone

True / False
Explain: