

CS 889  
Advanced Topics in Human-  
Computer Interaction  
RepliCHI

# Overview

- Scheduling
- A brief overview of HCI
- Experimental Methods overview
- Goals of this course
- Syllabus and course details

# A note on scheduling

- Course is scheduled in two 2.5 hour slots per week.
- Anticipate teaching between 12 – 14 classes during term, so 5 or 6 weeks equivalent with no classes
- Goal is to front load learning and presenting so that later part of course focuses on data collection and projects

# Human-Computer Interaction

- The discipline concerned with designing products that are useful, usable, and used.
  - Problems with this definition?
- Design systems that are:
  - Learnable, flexible, robust?
  - More Efficient?
  - That people “like better”?
- Contrast “like better” with “usable”
  - Which is more quantitative a metric?

# Two Sides to HCI

- Interactive System Design (CS 449)
  - Understand current work practice of users
  - Identify breakdowns
  - Re-design work
  - Design architecture of system
  - Draw UI sketches
  - Evaluate with users
  - Redesign
  - Implement Prototypes and evaluate
- User interface implementation (CS 349)
  - Graphic output and input
  - Events
  - GUI toolkits, toolkit architectures
  - Undo and Errors
  - Screen design and layout
  - Custom controls
  - Computationally intensive tasks
  - Scripting languages

**BUT ... CS 889 is a research-based course**

# HCI Research

- Areas
  - User interfaces systems and technology
  - Computer supported cooperative work
  - Ubiquitous computing
  - Designing interactive systems/Designing user experiences
  - Mobile interaction
  - Etc.
- Most research has some experimental or evaluation component to them

# Goals of experiments/evaluation

- Understand real world
  - How users use technology
  - Can design be improved, can work be automated, can we help a potential user group?
- Compare things
  - Best/better/worse
- Engineering toward a target
  - Essential features
  - Is design good enough
- Check conformance to a standard
  - Microsoft design guidelines
  - Mac interface guidelines

# Research-Based Evaluation

- Two broad approaches
  - Quantitative methods
    - Positivist/post-positivist
  - Qualitative methods
    - Constructivist
- Combined in mixed methods research
  - Two approaches to mixed methods
    - Sequential
    - Concurrent



# Quantitative Approaches

- Hypothesis driven or model driven
  - Testing a theory
  - Statistics
  - Correlation
- **Post-positivist** => hard to be absolutely sure
  - Causes probably determine effects and outcomes
- Goal is to be able to say that it is unlikely to see effect by chance
  - $P \leq 0.05$
  - $R^2 \sim 1.0$

# Quantitative Metrics

- Need to be measurable
  - Time
  - Error rate
  - User satisfaction
  - Cognitive load (NASA TLX)
  - Learning curve (time/efficiency)
  - Clicks
- All indirect measures of “better” interface
  - All relative measures
- Correlation with model
  - $R^2 \sim 1.0$  (depending on number of data points)

# Qualitative Approaches

- Research starts with data collection
- Collection motivated by questions that are broad and non-leading
  - How do people use smartphones for gaming?
  - Establish meaning from views of participants
- Process
  - Look for patterns
  - Build theory from ground up

# Mixed Methods

- Collect diverse types of data
- Can do sequentially
  - Typically starts broad using qualitative or quantitative data
  - Then focuses using another methodology
- Can do concurrently
  - Use multiple types of data simultaneously to develop a more complete picture
- Triangulates data
  - Uses different sources to develop a full understanding

# RepliCHI

- This course is about replication studies in HCI
  - Given some experiment and data collection that's been published
  - Replicate the study to verify results
- Why replicate?
  - Quantitative
    - $P \leq 0.05$
    - $R^2 \sim 1.0$
  - Qualitative
    - Imagine a study of Nintendo DS multi-player gaming from 2007
    - Imagine a study of digital video consumption from 2006

# Extended Goals of this course

- Doing replication is essentially doing experimental HCI
  - To understand strengths and weaknesses of different experimental method in HCI
  - To develop an appreciation for experimental HCI research
  - To be able to apply these techniques to do HCI research

# Syllabus

- Three components
  - Individual – 35%
    - Research papers
  - Groups of one or two
    - Exercises – 15%
    - Course project – 50%

# Research papers – 35%

- Starting next week, assigned readings
  - Evening before class by 9pm, each student posts a summary of paper of exactly 4 sentences on course wiki
    - Summary of research question of paper
    - Summary of results
    - Some value judgement on paper including one sentence on strengths and one on weaknesses.
  - Typically drawn from CHI 2015
  - Some from older venues or other venues depending on your interest
- Early in the course (~ two weeks), I will present material on and around papers and class will discuss papers
  - Class participation is important
  - It is a good rule of thumb to have added to discussion every class
- Later, students will present once or twice during term
  - Typically three – four papers covered per class



# Exercises – 15%

- Two posted
- Early exercises give some experience with data collection and analysis
  - Data collection and slide deck posted on piazza
  - Students selected at random to present their findings
  - Note that there will be distribution amongst all of you

# Project – 50%

- Goal is to perform a replication study
- Must identify a published research result that you wish to replicate
  - Can also “extend” the result
  - Some flexibility for thesis work

# Course Resources

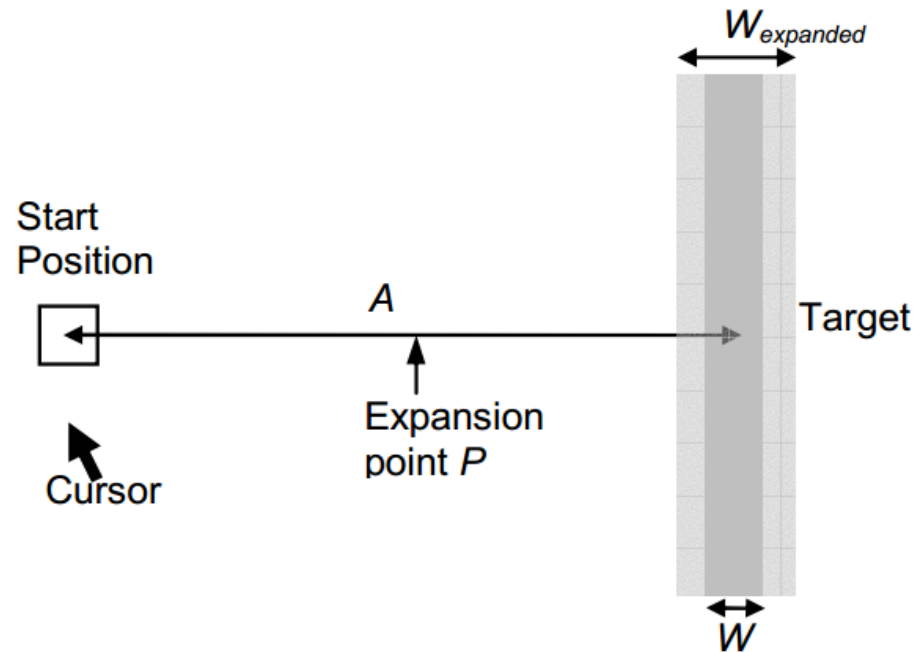
- Website
  - Will include links to readings
  - Readings are typically in ACM DL
  - Must be on-campus or using library's proxy connection to access
- Reserve in library
  - Research Design: Qualitative, Quantitative and Mixed Methods Approaches (Creswell)
- Free eBooks
  - Basics of qualitative research : techniques and procedures for developing grounded theory, Corbin and Strauss
  - Practical Statistics 4 HCI (Wobbrock)

Questions?

# Replication Case Study

# Acquisition of Expanding Targets

- Idea is to enlarge targets to speed clicking



# Components of this paper

- Fitts's Law
  - Log term is called the Index of Difficulty, ID
  - $1/b$  is the Index of Performance, IP
  - $a$  is the start-stop time, i.e. “additive factors”
- Optimized Initial Impulse Model
  - Ballistic impulse followed by iterative corrections

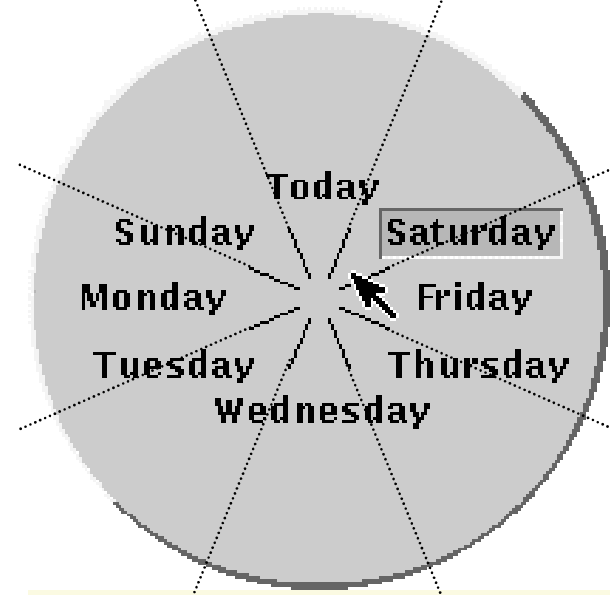
$$MT = a + b \log_2 \left( \frac{A}{W} + 1 \right)$$

# Design Implications – Fitts' Law

Pop-up Linear Menu

Today
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

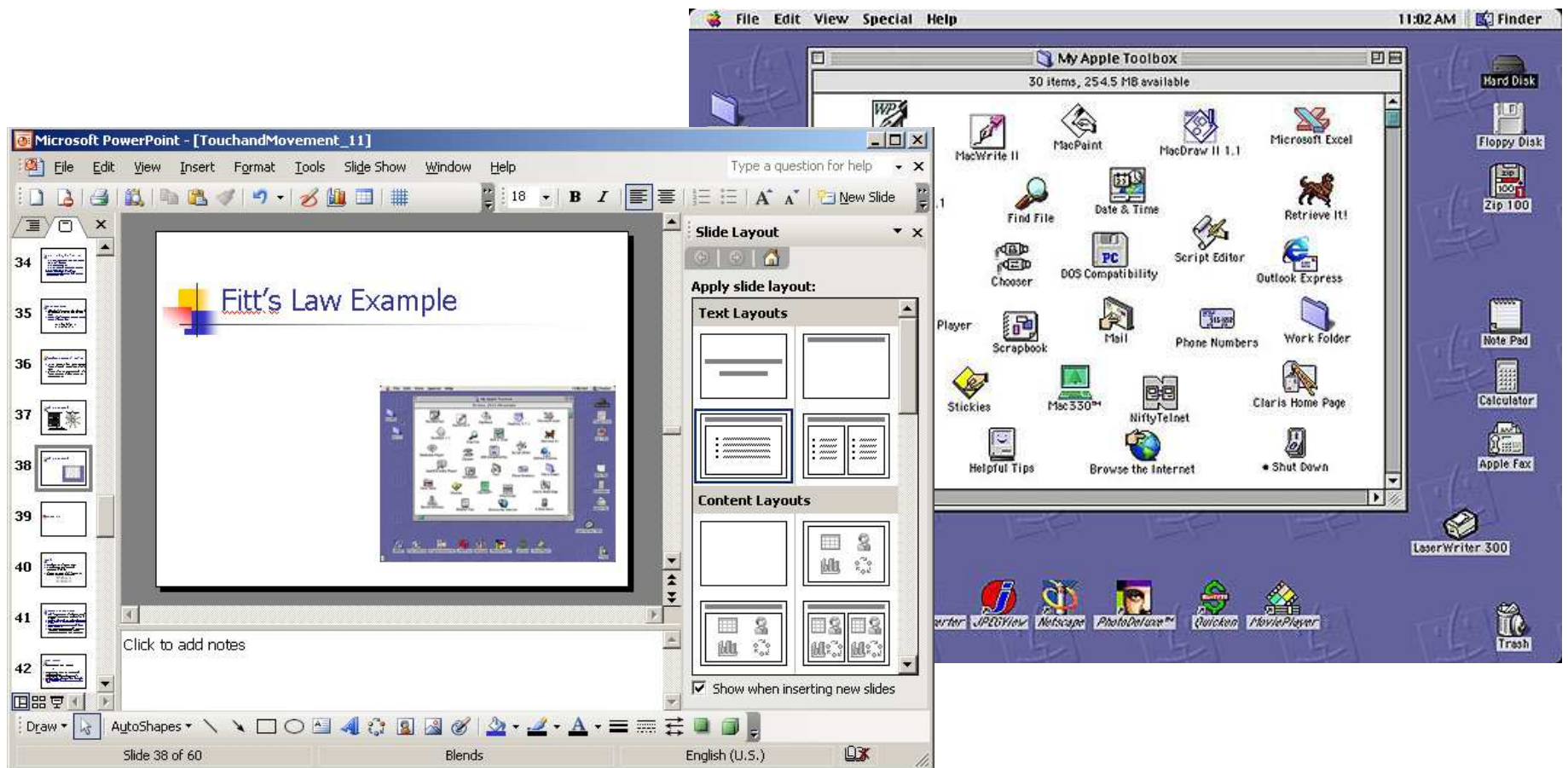
Pop-up Pie Menu



From Landay's HCI slides  
I'm still not sold on Pie menus



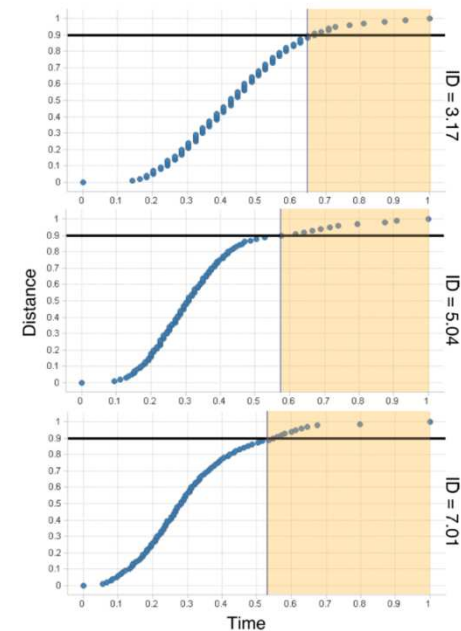
# Design Implications – Fitts' Law



# Components of this paper

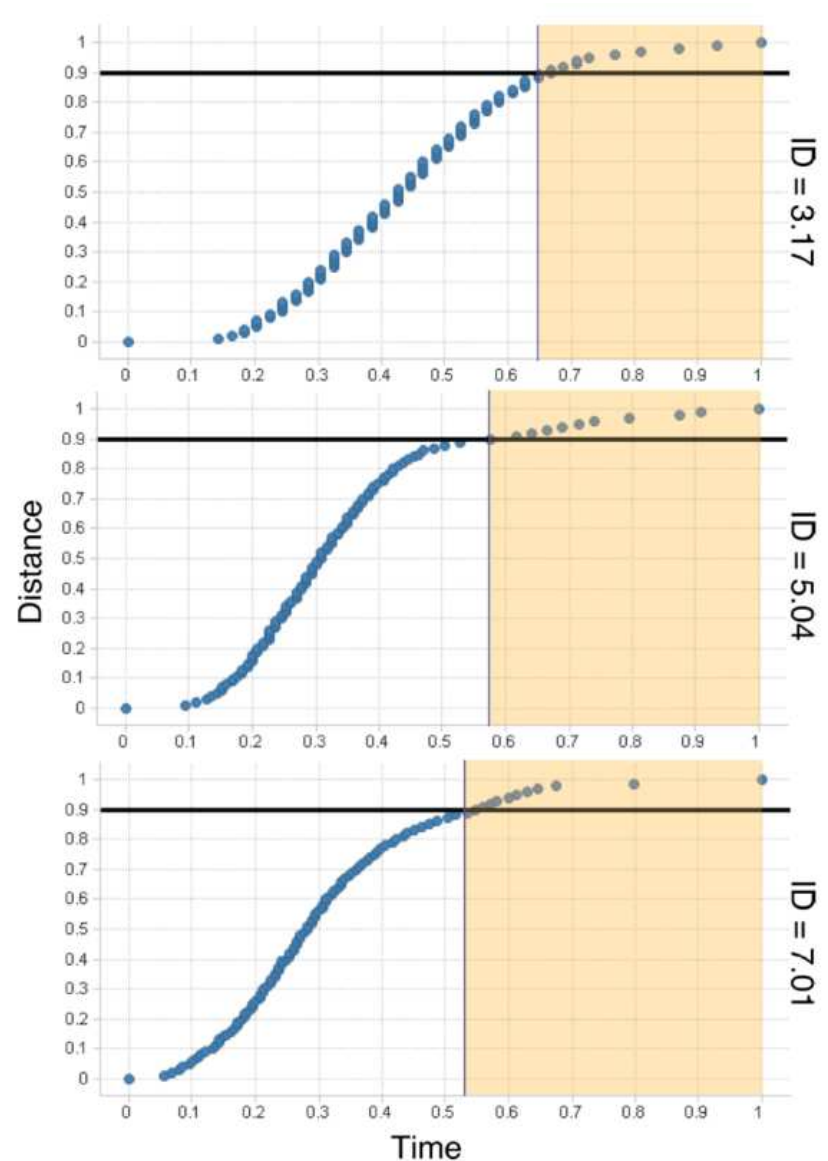
- Fitts's Law
  - Log term is called the Index of Difficulty, ID
  - $b$  is the Index of Performance, IP
  - $a$  is the start-stop time, i.e. “additive factors”
- Optimized Initial Impulse Model
  - Ballistic impulse followed by iterative corrections

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



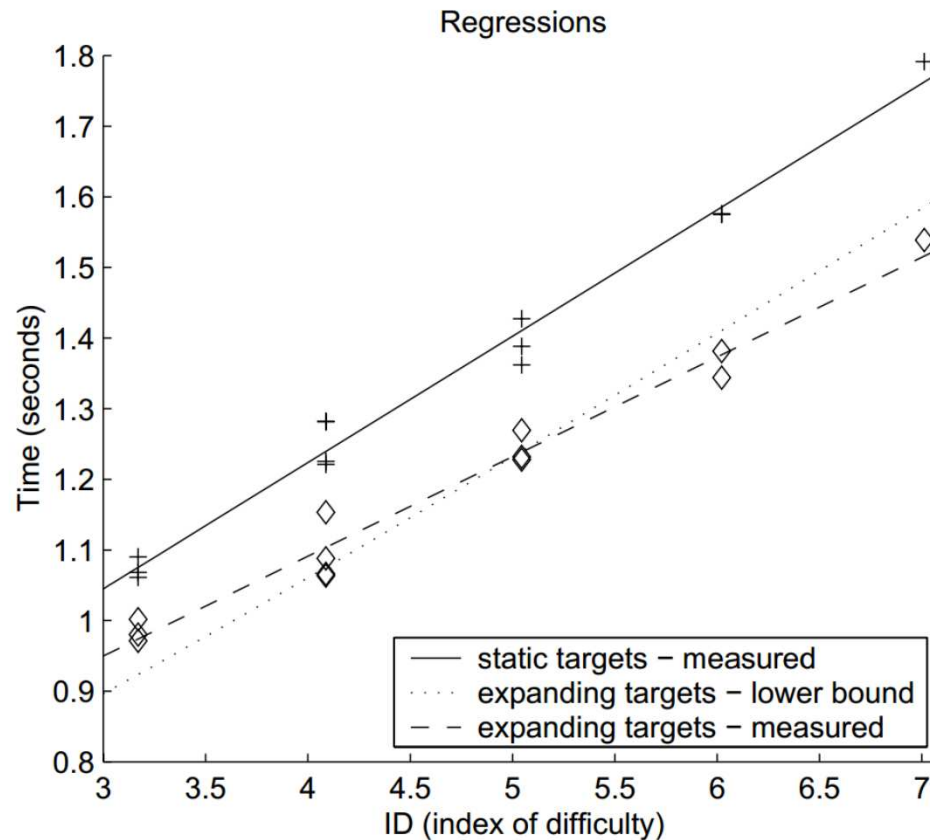
# Findings

- Even if target expansion occurs as late as 90% of movement distance, still get full benefits
  - To understand why
  - ...



# Findings

- Movement time from Fitts's Law is based on final target size, not initial size



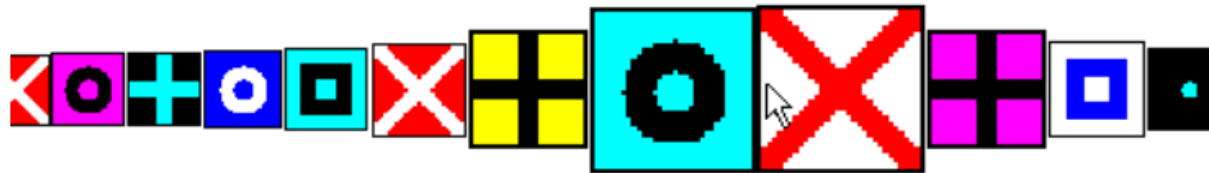
# Design Implications



(a)



(b)

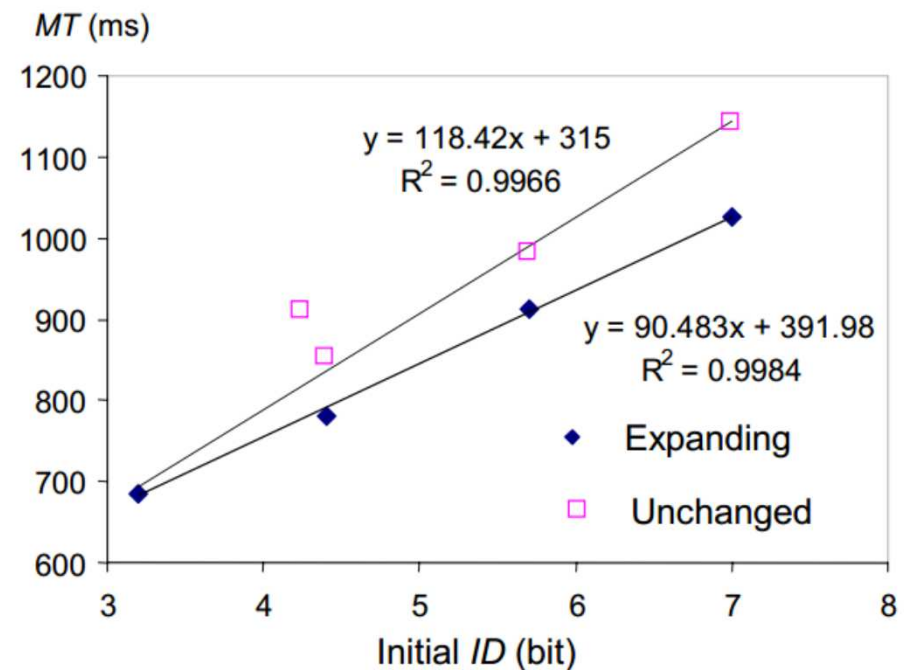


(c)

Problems?

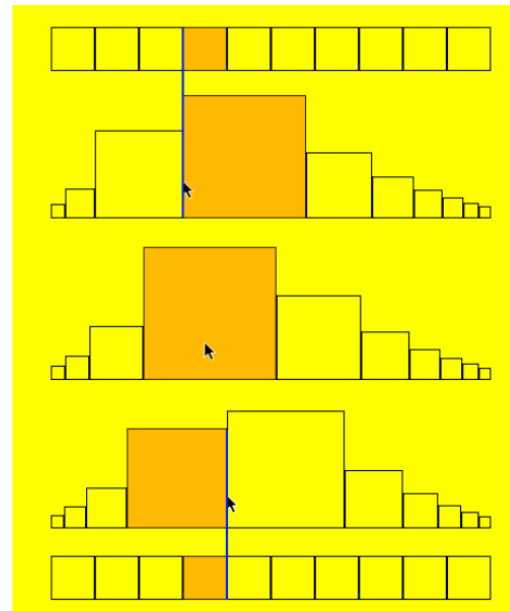
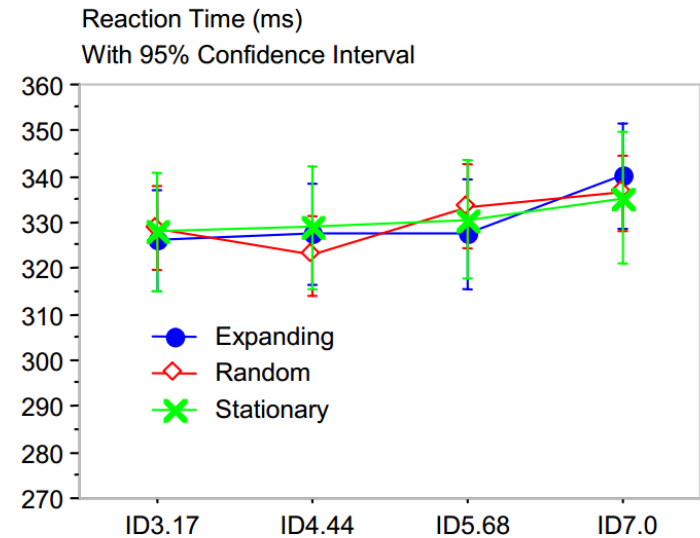
# Zhai et al. Replication

- Did participants start to assume target would expand?
- Looked at randomly expanding, shrinking or leaving target unchanged



# Other findings

- Reaction time varied with ID
  - Explanation?
- Why Mac Dock expansion sucks
  - And what we can do about it ...





# Replications from class

- Ruoti et al. → Atwater and Bocovich (SOUPS 2015)
- Mandryk and Lough → Ruiz (AVI 2014)