Interaction Design

Chapter 5 (May 13th, 2014, 9am–12pm):
Laws of Interaction Design

Why laws? What for?

- There are 3 good reasons for laws in ID:

- **describe**: understand what is going on
- **predict** what will happen if…
- **generate** new alternatives

- We will learn laws about:

- **computers**
- **human motor skills**
- **human cognition**

Laws of Interaction Design

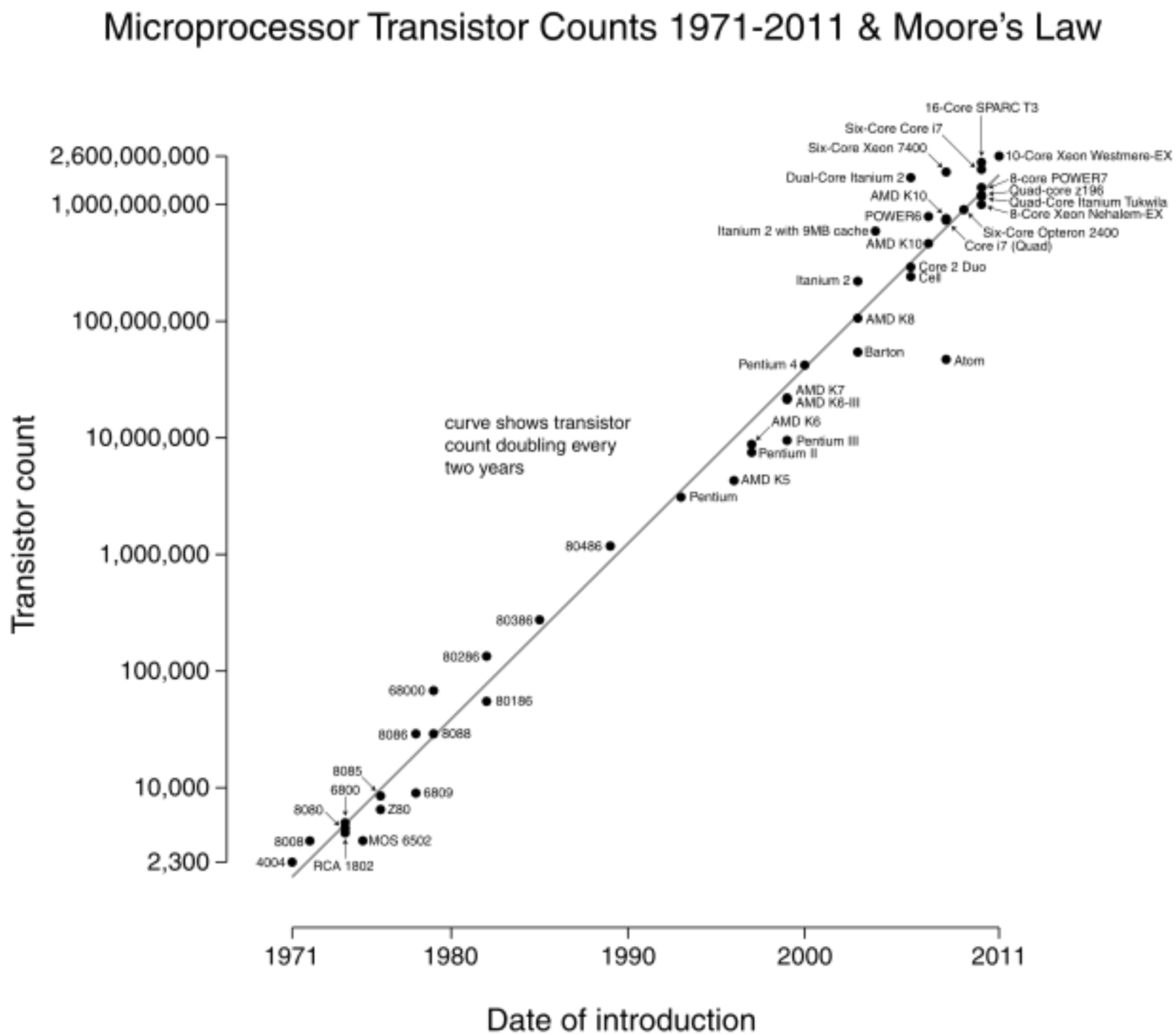
- Moore's law
- Buxton's law
- Fitts' law
- Steering law
- Guiard's Kinematic chain model
- Hick's law
- Law of practice
- Murphy's law

Moore's law

"The complexity for minimum component costs has increased at a rate of roughly a **factor of two per year**…Certainly over the short term this rate can be expected to continue, if not to increase. Over the longer term, the rate of increase is a bit more uncertain, although there is no reason to believe it will not remain nearly constant for at least 10 years. That means by 1975, the number of components per integrated circuit for minimum cost will be 65,000. I believe that such a large circuit can be built on a single wafer."

[Moore, Gordon E. "Cramming more components onto integrated circuits". Electronics, Volume 38, Number 8, April 19, **1965**.]

Moore’s law illustration



Moore's law implications

Don't worry too much about:

- computing power
- storage capacity
- screen resolution
- device size
- weight
- battery life (?)

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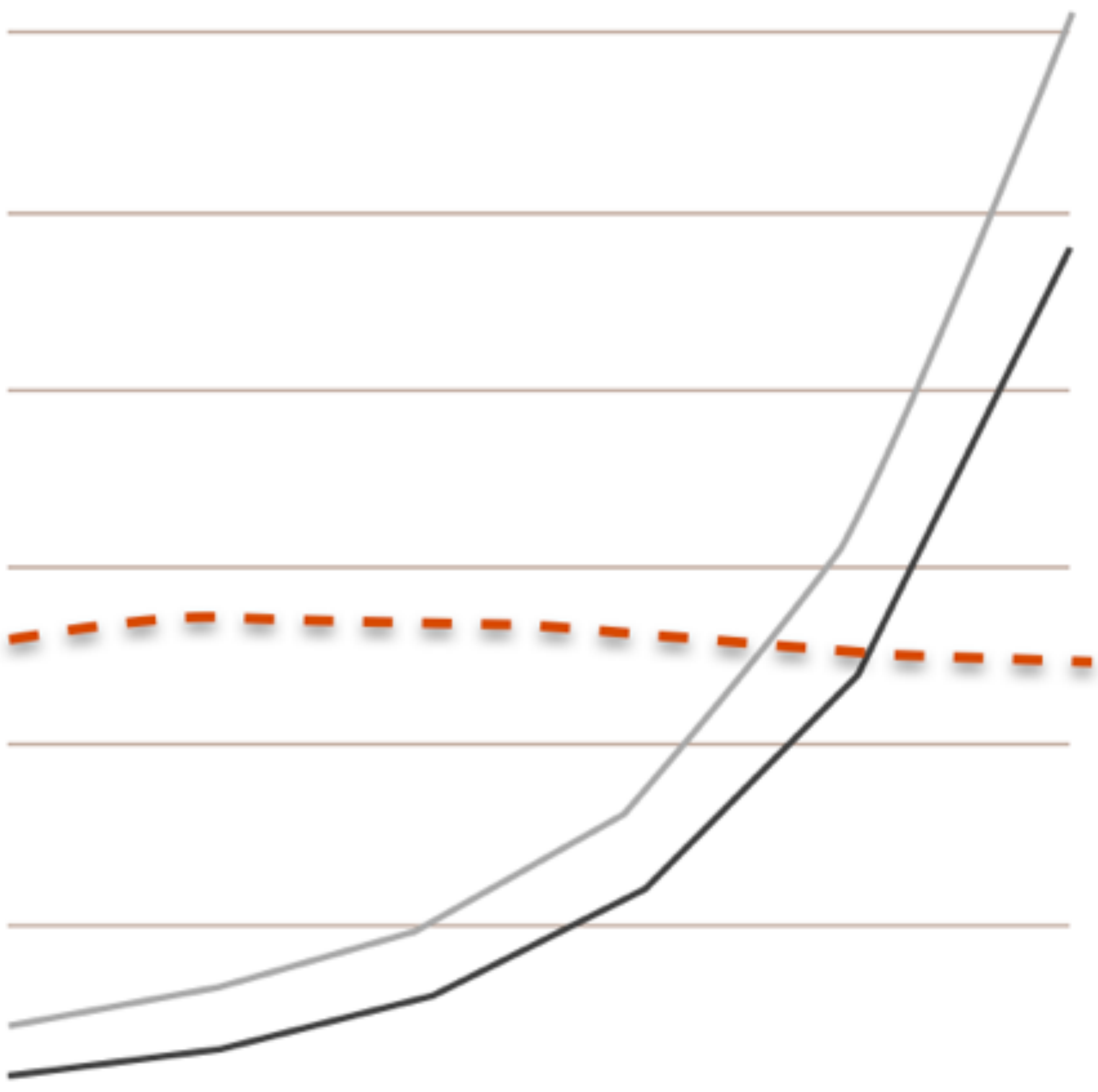
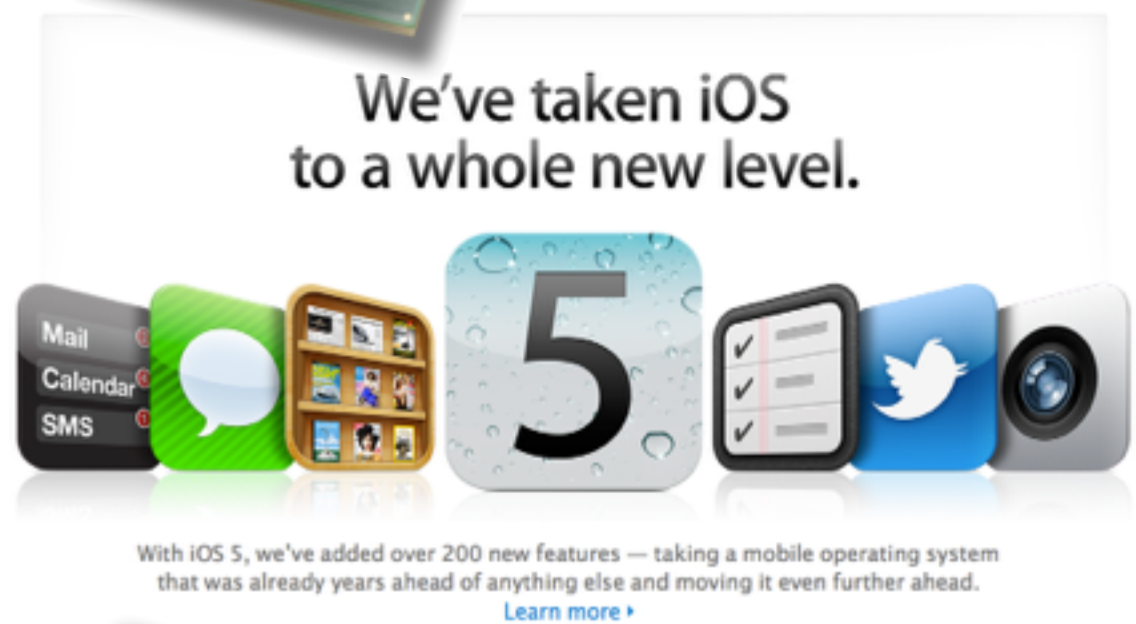
Buxton's law

Moore's law





Buxton's law

God's law

http://www.billbuxton.com/LessIsMore.pdf

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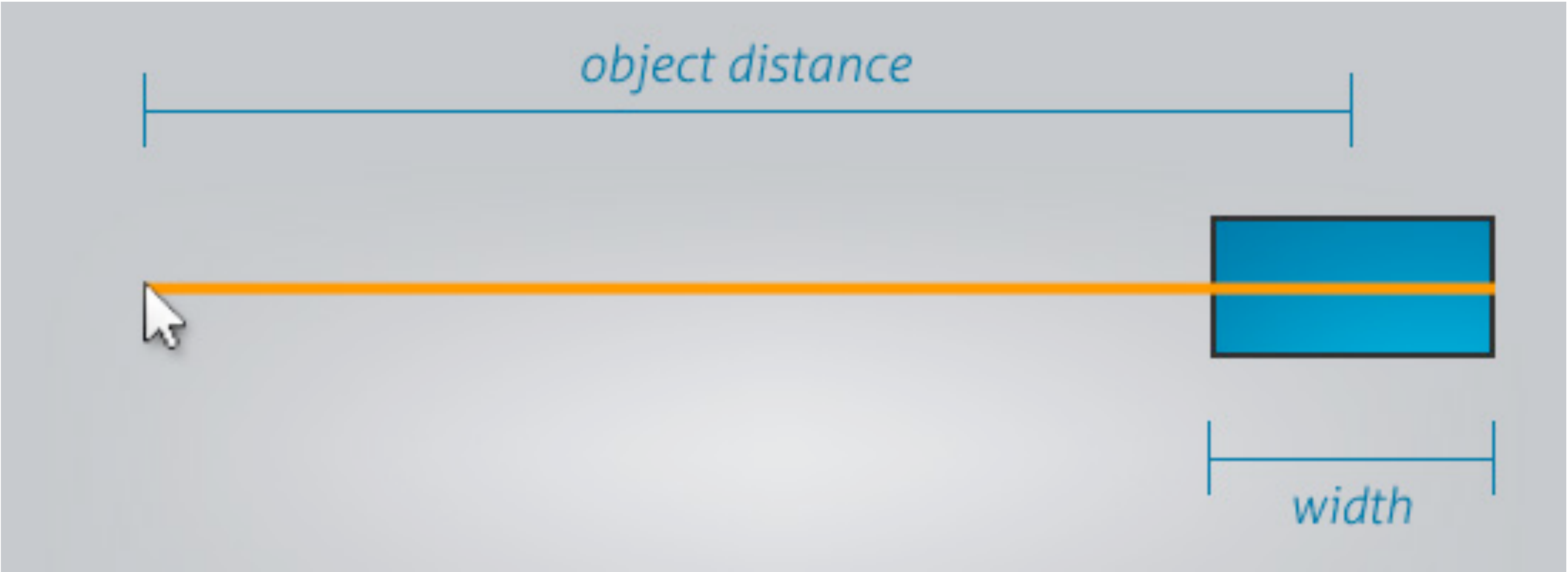
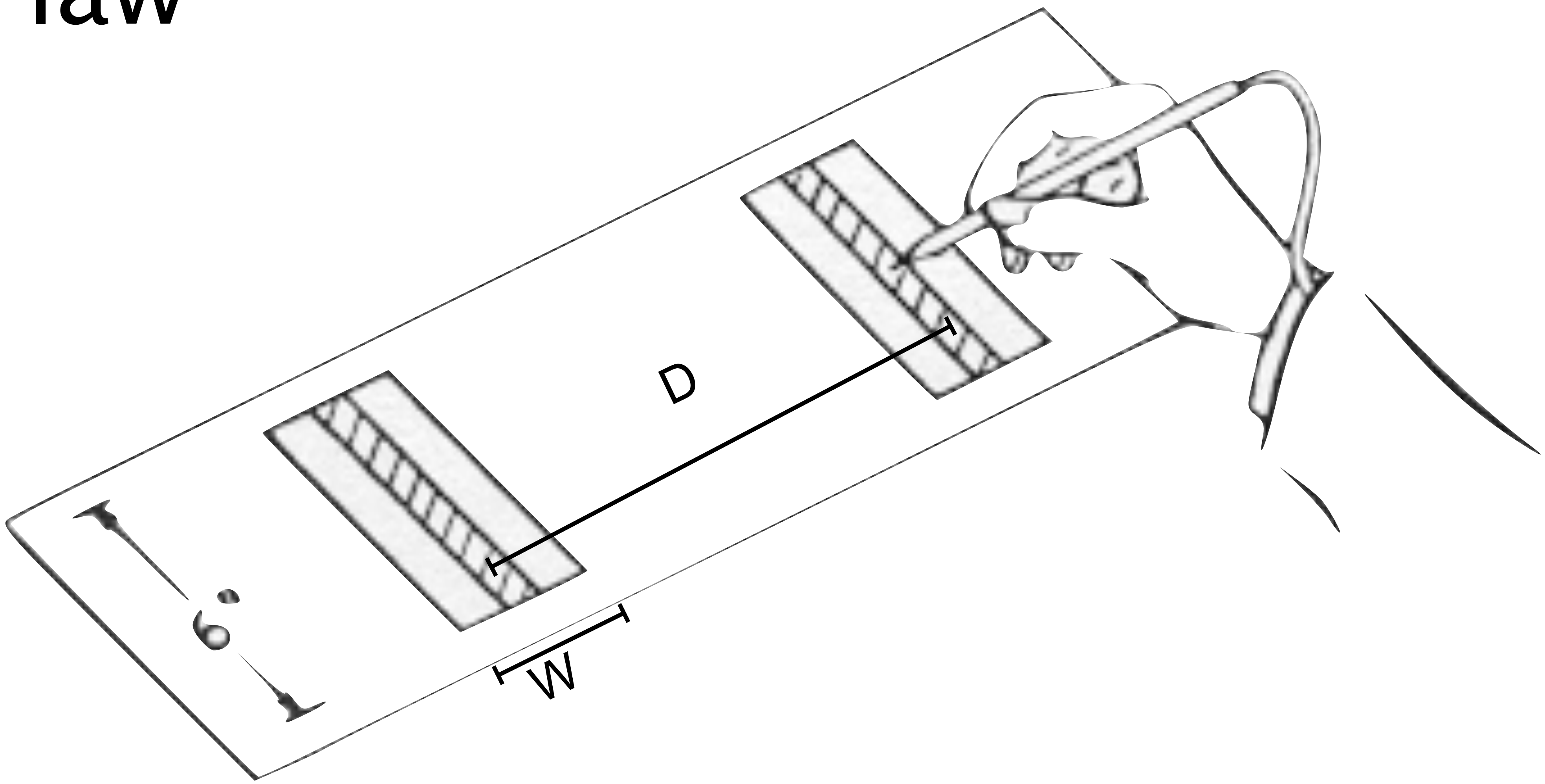
Fitts' law

The time to acquire a target is a function of the distance to and width of the target.



Fitts' law



Distance

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

Movement Time

Coefficients
a: Intercept
b: Slope

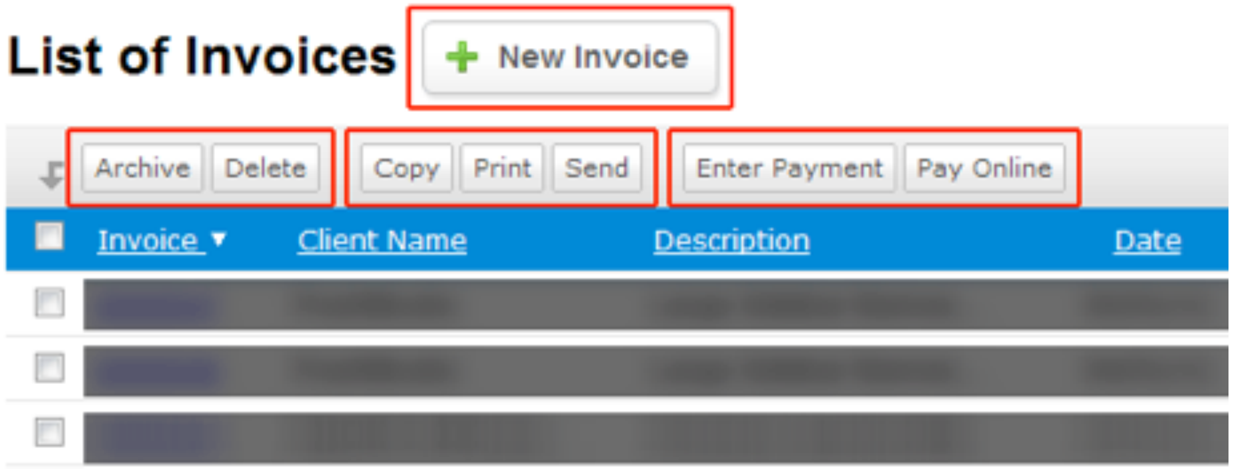
Width

Speed-accuracy tradeoff:

http://www.youtube.com/watch?v=kIy2QA1bFc8

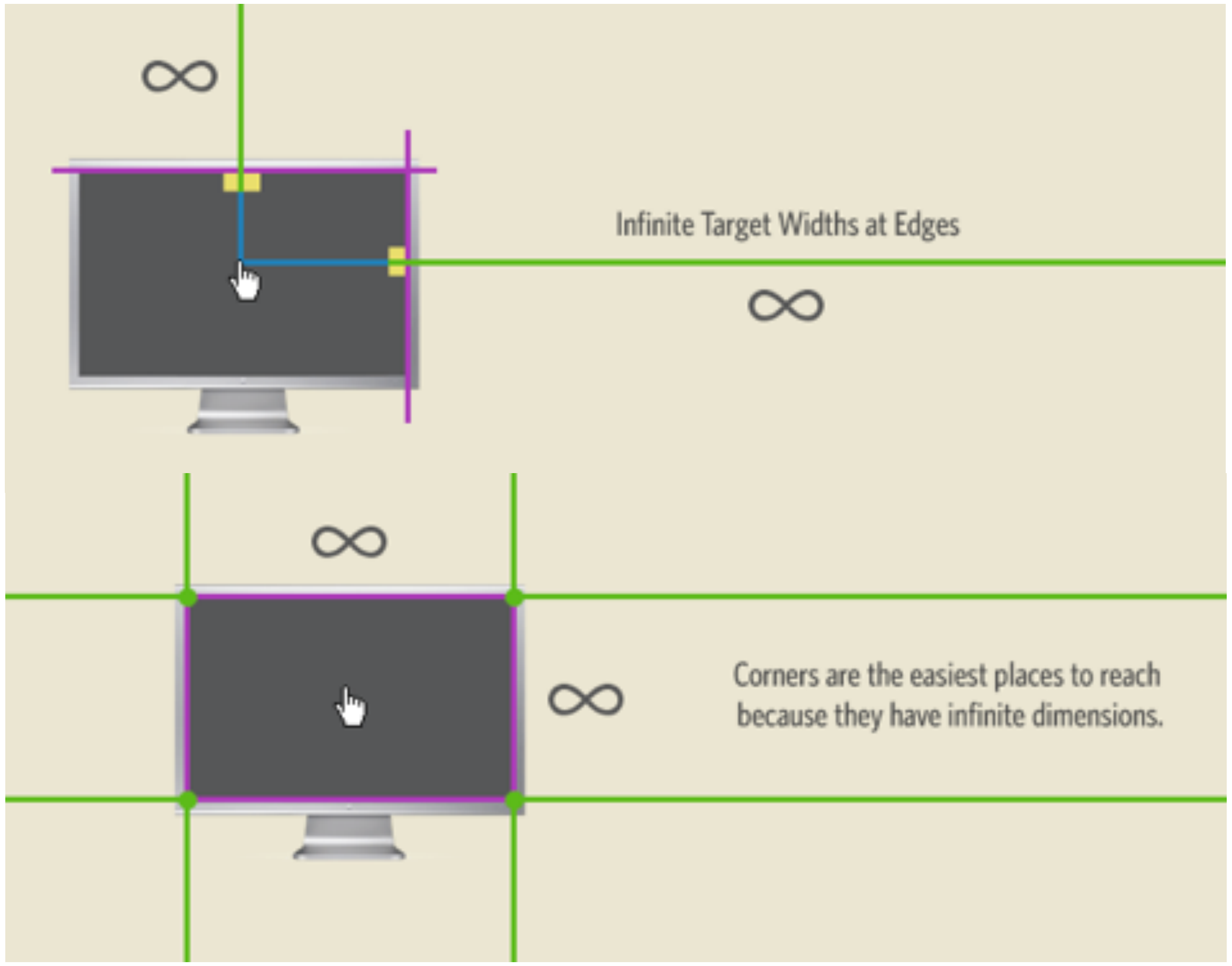
Implications of Fitts' law

Larger targets are easier to hit
-> maximize button size



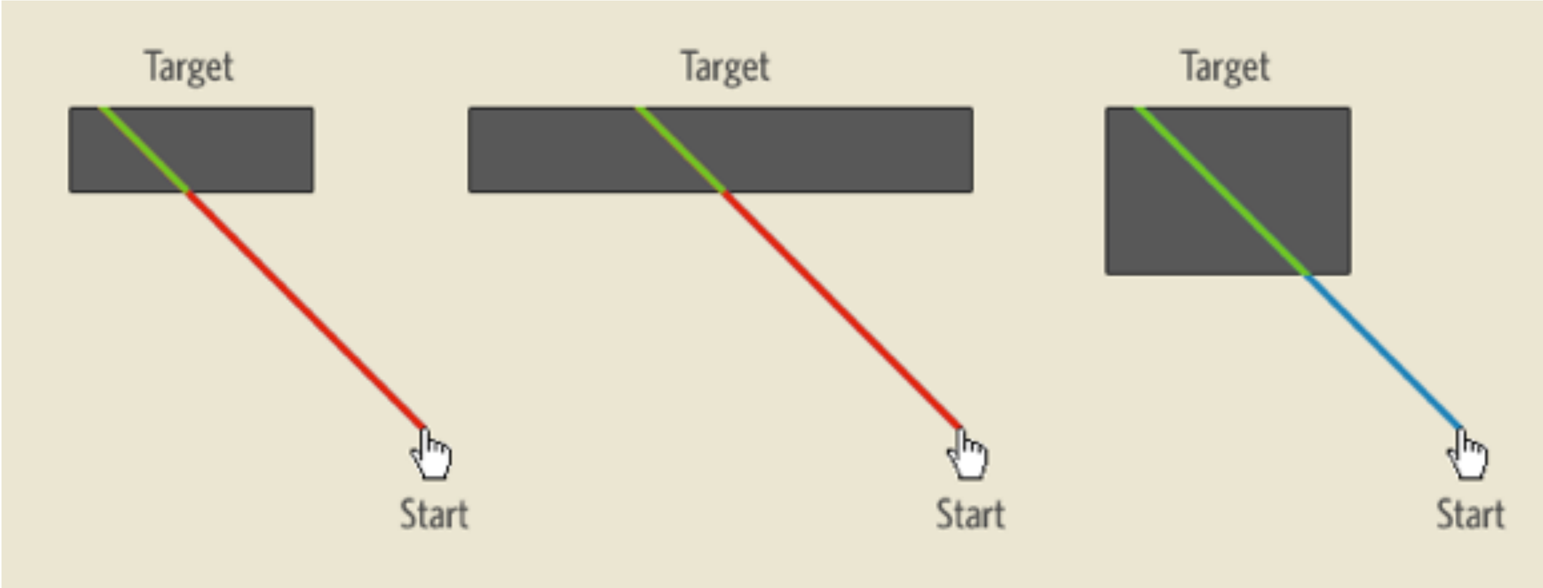
Movement time increases (logarithmically) with distance
-> minimize distances
-> no movement is even better!

Infinite targets:
-> leverage screen borders
-> leverage corners

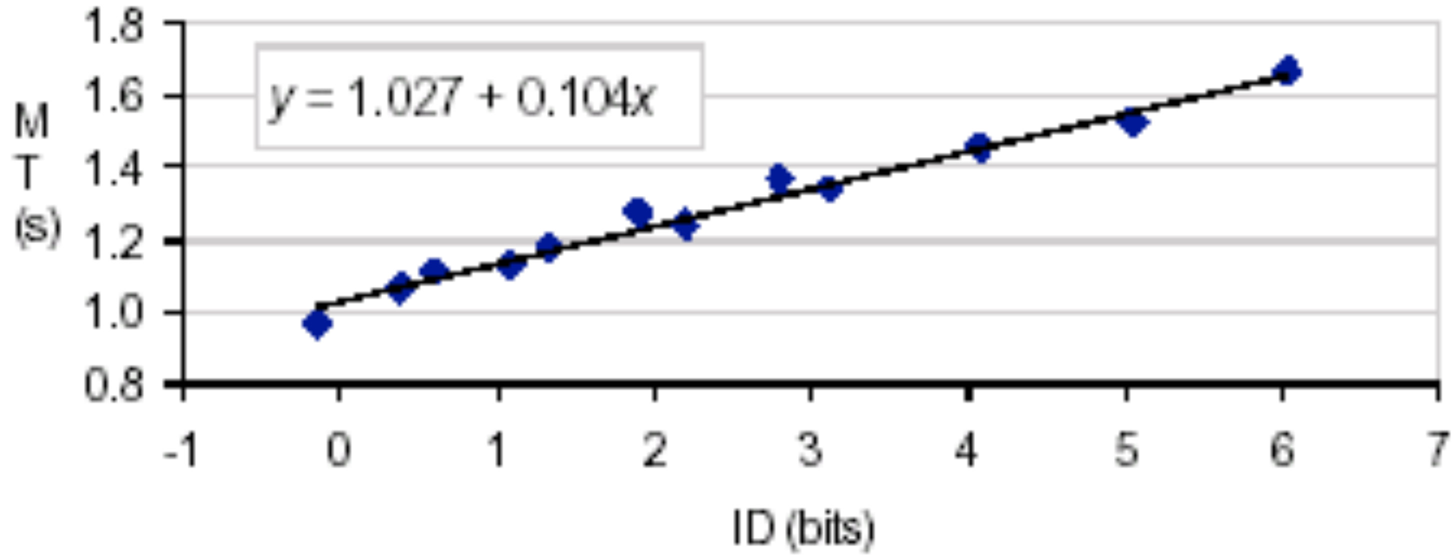


Bigger Is Not Always Better

Movement direction to target



Logarithmic improvements with size



MacKenzies reevaluation of Card's Fitts' Experiment for text selection

Stu Card

A Supporting Science

Interview March 2002

The Mouse and the Desktop   Chapter 1

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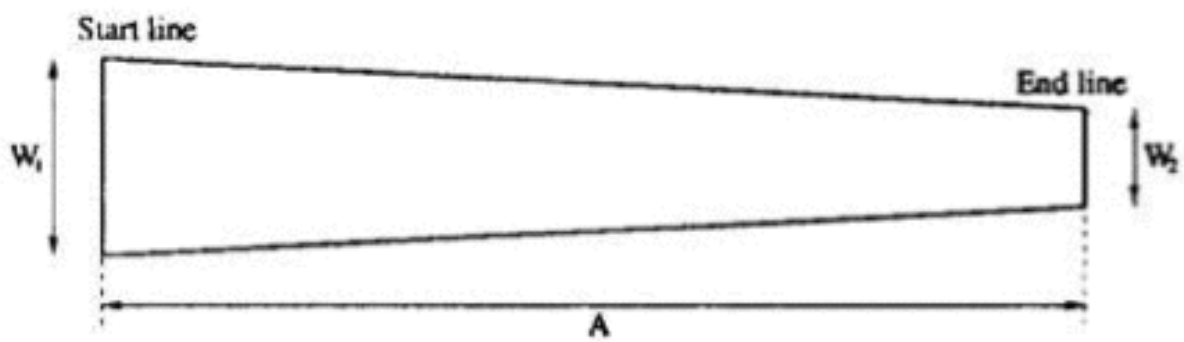
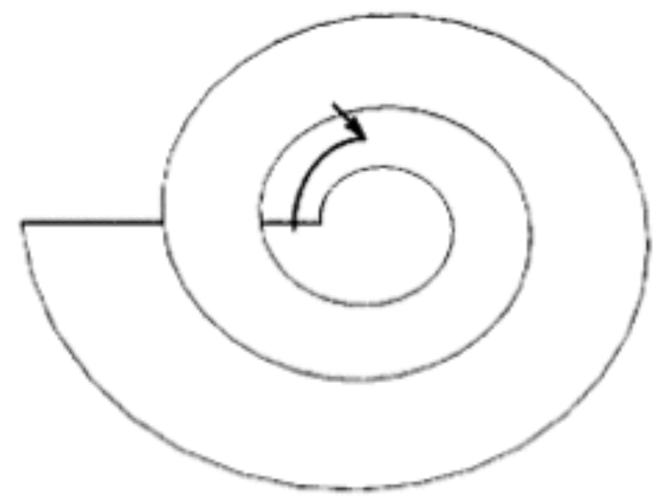
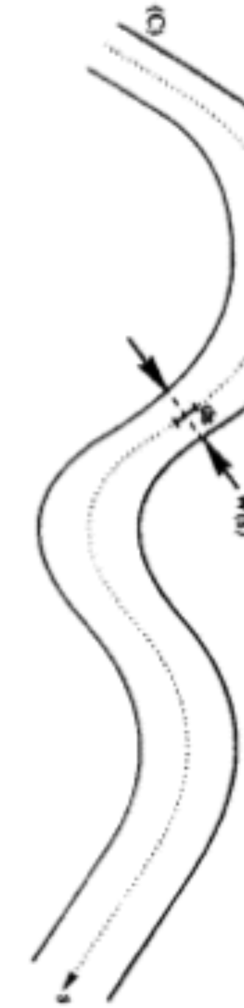
Why is it called Steering Law??

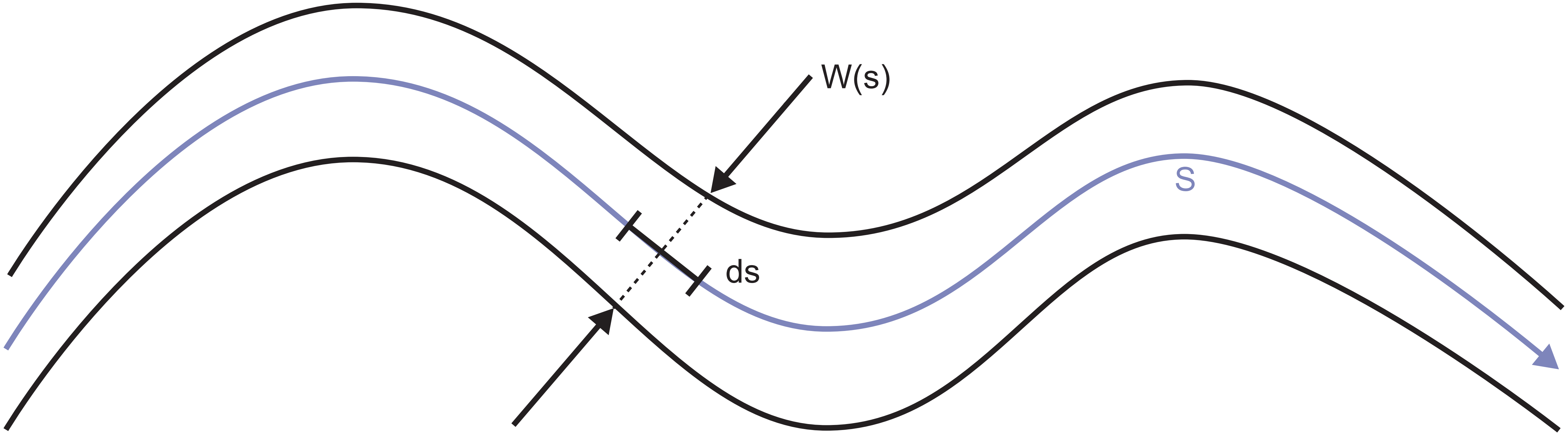
- Early work focused on car driving scenarios and models with straight tunnels
- Various example tunnel shapes have been explored







Steering law on curved paths



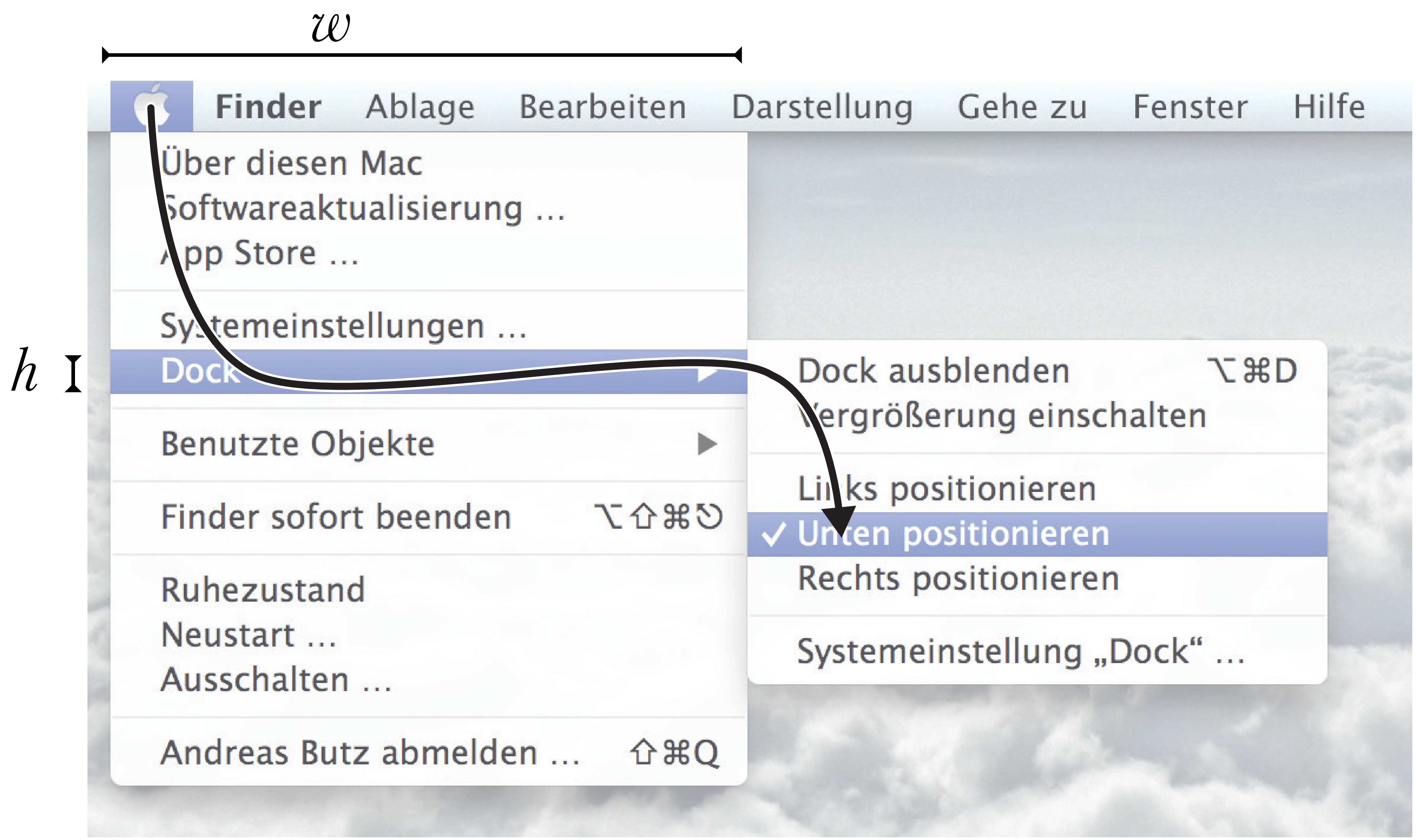
average time to navigate through the path

$$T = a + b * \int_S \frac{1}{W(s)} \mathrm{d}s$$

experimentally fitted constants

width of the path at s

Example application of the steering law



$$T = a_1 + b_1 * \log_2\left(\frac{nh}{h} + 1\right) + a_2 + b_2 * \frac{w}{h} + \ldots$$

vertical: Fitts' law — horizontal: steering law

Mini-discussion

How can we use fitts’ law and steering law to make a computer game more challenging?

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A human capability

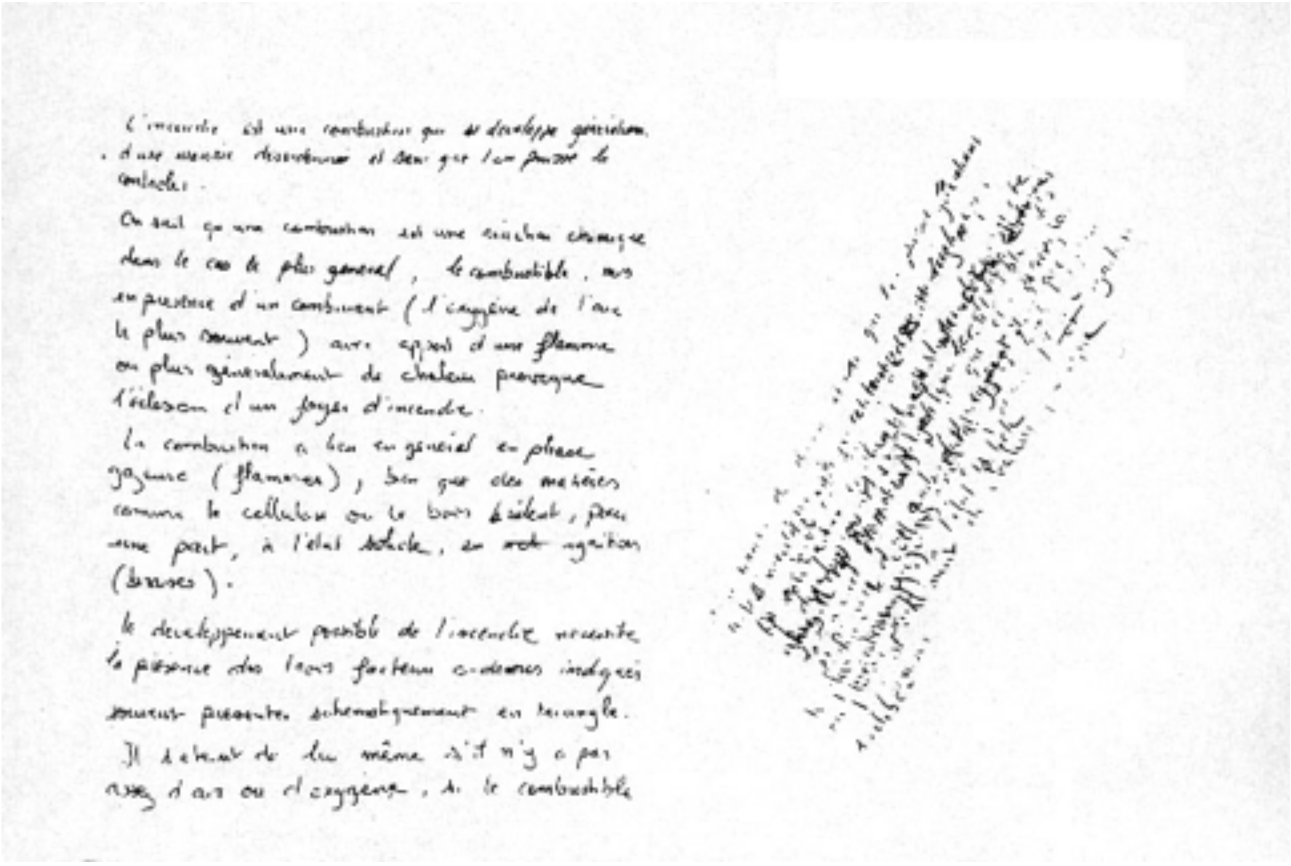
From The Two-Handed Desktop Interface: Are We There Yet? [MacKenzie & Guiard, 2001]

Guiard’s Kinematic Chain

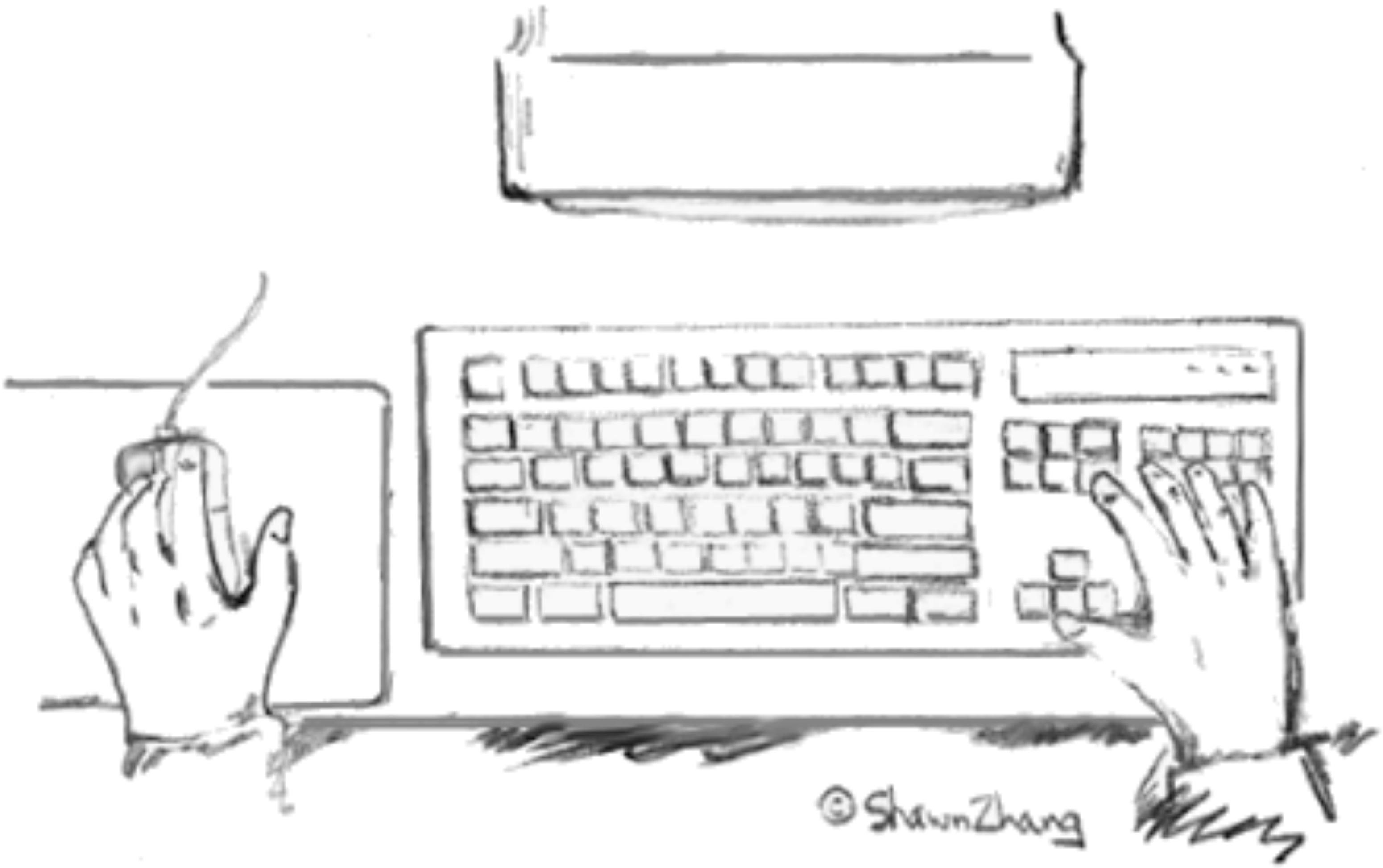
“Under standard conditions, the spontaneous writing speed of adults is **reduced** by some **20%** when instructions **prevent the non-preferred hand** from manipulating the page”

Non-dominant hand provides a frame of reference for the dominant hand

- Non-dominant hand operates at a coarse temporal and spatial scale;
- Dominant hand operates at a fine temporal and spatial scale



Two handed-interaction at the desktop



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Mini-brainstorming

Which tasks in daily life follow a similar distribution of roles between the hands?

Which ones don’t ???

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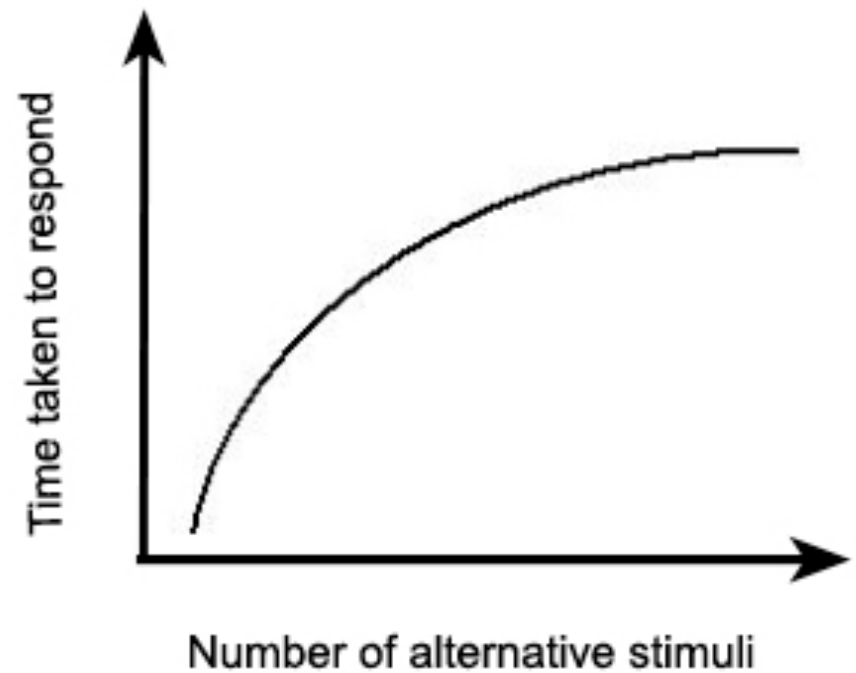
Hick's law

Given **n** known and **equally probable** choices, the average reaction **time** T required **to choose among them** is:



binary search strategy

Time → $T = b \cdot log_2 (n + 1)$

Coefficient (↑ b)

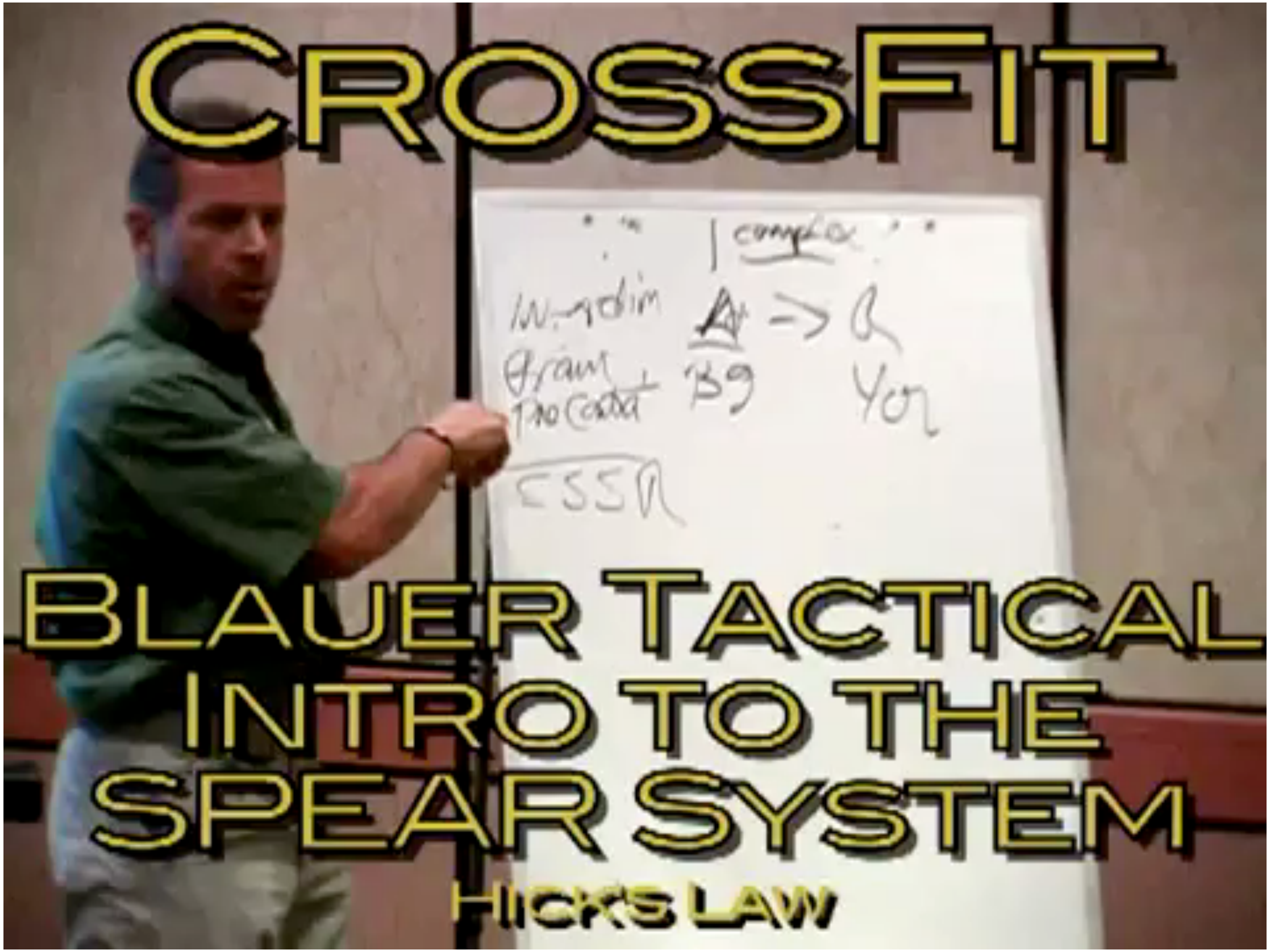
Choices (↑ n)

Hick's Law Examples (really? let's discuss!)

http://www.hier-luebeck.de/wp-content/uploads/2010/09/StartMenueWindows7.jpg

http://www.photosophic.com/iphone_screen

In another context, and slightly wrong ;-)...



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The Power Law of Practice

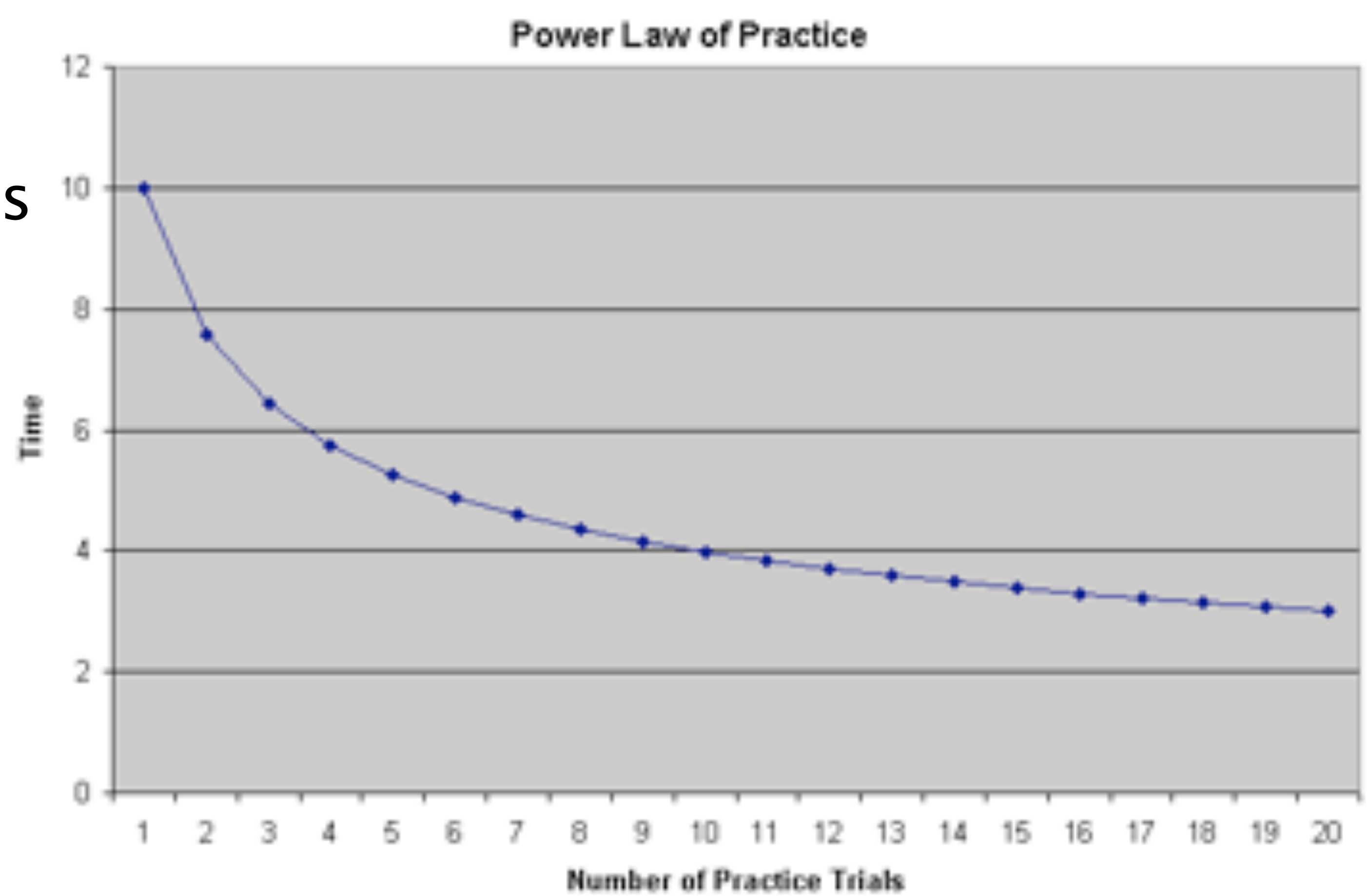
- When performing a task based on practice trials, people improve in speed at a decaying exponential rate.
- The time needed for a particular task decreases in proportion to the number of practice trials taken raised to a power of about a = –0.4
- The logarithm of the time needed for a particular task decreases linearly with the logarithm of the number of practice trials taken (this formulation is for the math geeks… ;-)

Completion time for trial n

Constants

$$T(n) = T(1)\, n^{a} + c$$

Completion time for trial 1



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Murphy’s law

“Whatever can go wrong, will go wrong.“

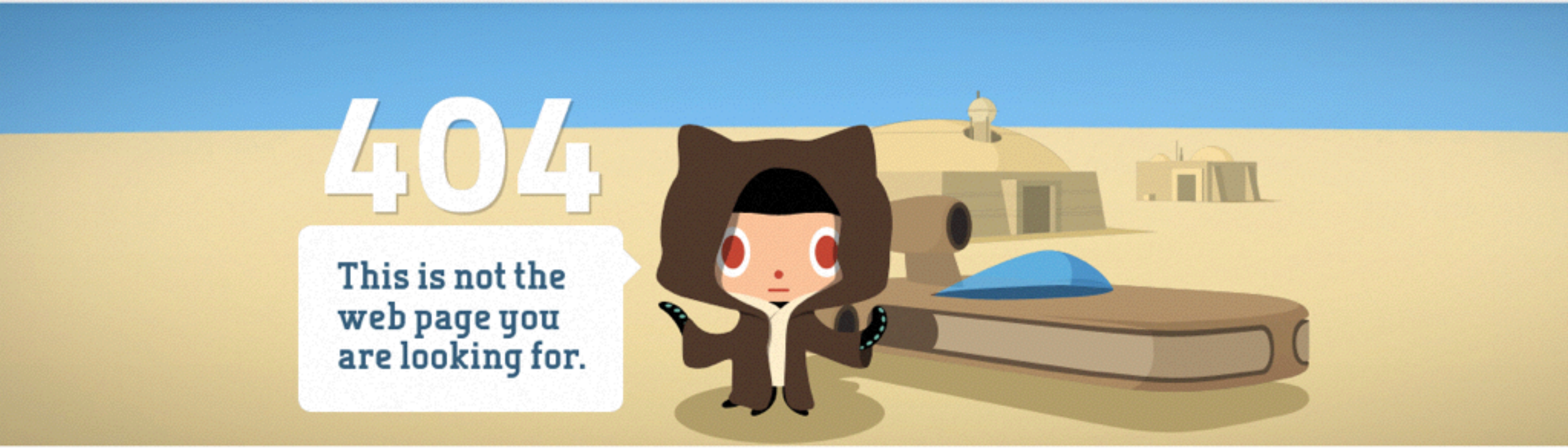
[Edward Aloysius Murphy Jr., 1949]

“If there's more than one possible outcome of a job or task, and one of those outcomes will result in disaster or an undesirable consequence, then somebody will do it that way.“

Implications of Murphy's law

- Prepare for human errors, wrong input etc.
  - do sanity checks in dialogs
  - provide useful defaults
  - make serious mistakes hard

- When building stuff, provide extra time for:
  - mistakes in manufacturing
  - non-functioning tools
  - faulty material
  - misunderstandings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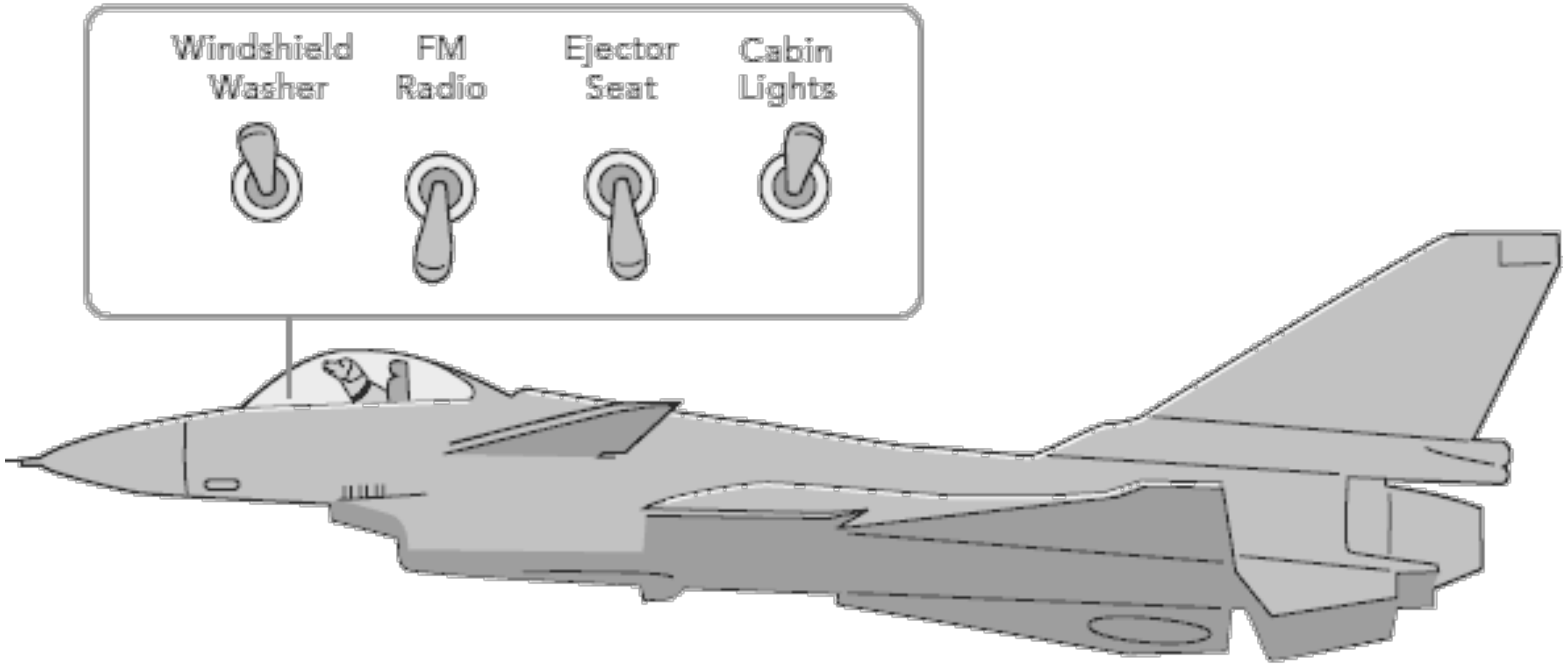
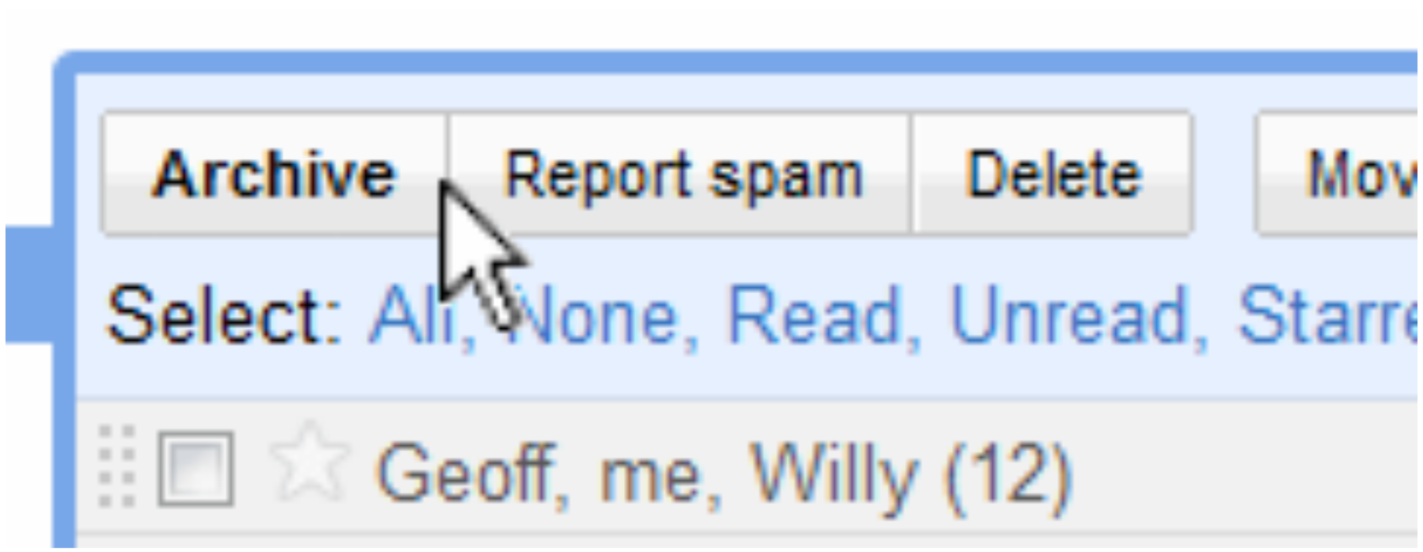
Anti Fitts law





What have we learned today?

about computers:

Moore's law

Buxton's law

about human motor skills:

Fitts' law

Steering law

Guiard's Kinematic chain model

about human cognition:

Hick's law

Law of practice

Murphy's law

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