

# Heuristics

And Model Human Processor



# Human Computer Interaction

COMS21301

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**bad vs. good  
designs**



how do you **turn off the light?**



what?  
such a **bad** affordance!

**www.ARNGREN.net** (Fm 01.11.2004) 1936722

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 Avium  
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 Bilbane  
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 Luft-Jekk  
 Lykt (oppladbar)  
 Mobil-telefon-T. 2  
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 Oversetter (44 språk)

**Trådløs Kamera m/ Alarm & GSM 1999,-**

**Trådløs Kamera 499,-**  
 60cm lang

**Tau & Brann-Båt. kr. 598,-**  
 Spruter-Vann

**El-bil til Posten 79.998,-**

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**Elbil; Arngren-Comarth 2WD/4WD. 2 eller 3 seter kr. 79.998,-**

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**44 Språk-Talende Oversetter m/Horsk fra kr. 398,-**

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 ● er på Lager  
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**RC Produkter**  
 120cm langt. Computer-styrt

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**RC Produkter**

fame or shame?





fame or shame?



Source: Interface Hall of Shame

<30 sec brainstorming>



Source: Interface Hall of Shame

why long text, why ragged left, why "OKAY"? 1<sup>st</sup> clue that there is a problem





Source: Interface Hall of Shame

wrong affordance: scroll bar for discrete content



Source: Interface Hall of Shame

inconsistence: horizontal scroll bar for scrolling content of a document



Source: Interface Hall of Shame

no shortcut for frequent users



how can we redesign it?

<30 sec brainstorming>





## Click and Print



Certificate:

Certificate of (blank)  
Certificate of Achievement  
Create Your Own Award  
**Customer Service Award**  
Distinguished Service  
Employee of the Month  
Leadership Award  
Outstanding Performance  
Safety Award  
Sales Award  
Team Player Award

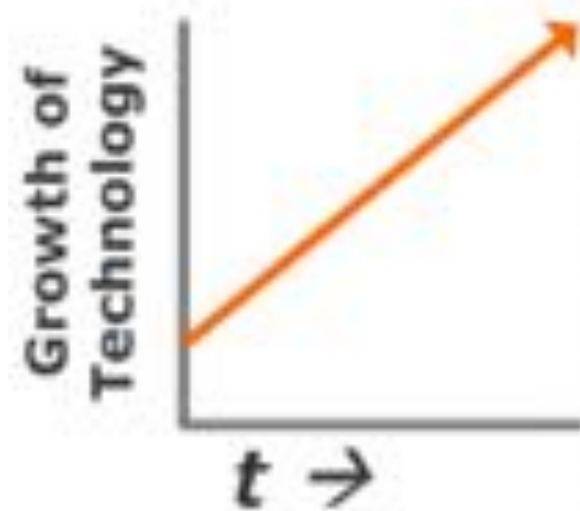
Preview:



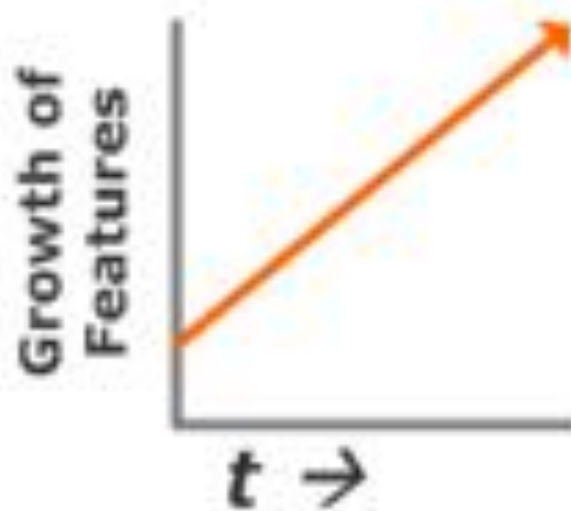
OK

Cancel

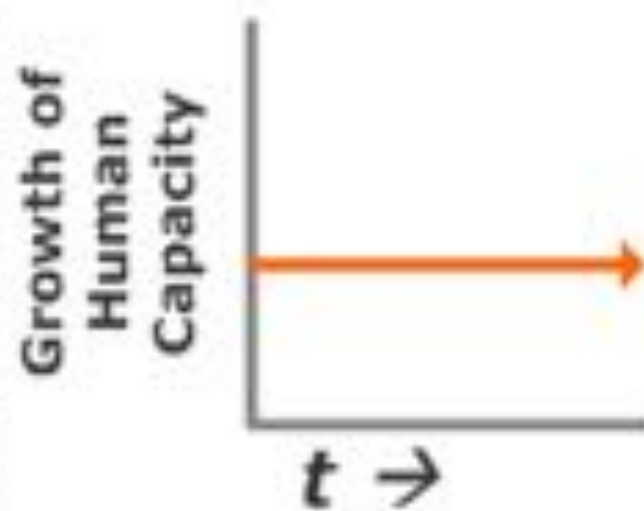
**Moore's Law**



**Buxton's Law**



**God's Law**





bad user interface design cost times ... can also cost lives (Therac-25)



**Harold Thimbleby <http://www.cs.swan.ac.uk/~csharold/>**



unfortunately, user interfaces are not easy to design!

# Heuristics::

(or usability guidelines) are rules that distill out the principles of effective user interfaces

during design to help choices / during evaluation to detect problems

plenty of sets of guidelines to choose from

# Nielsen heuristics

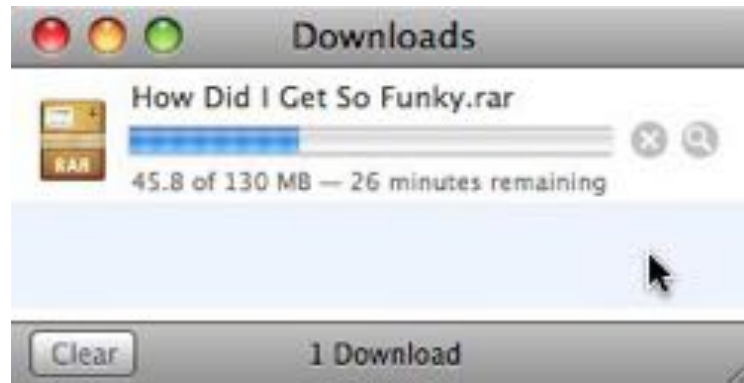
# Nielsen (revised)

- H2-1: visibility of system status
- H2-2: match between system & real world (speak the users' language)
- H2-3: user control and freedom
- H2-4: consistency and standards
- H2-5: error prevention (minimize users' memory load)
- H2-6: recognition rather than recall
- H2-7: flexibility and efficiency of use (shortcuts)
- H2-8: aesthetic & minimalist design
- H2-9: help recognize, diagnose, & recover from errors
- H2-10: help and documentation



# visibility of system status

system should always keep users informed about what is going on, through appropriate feedback within reasonable time



0.1 sec: no special indicators needed (< human processing)

1.0 sec: user tends to lose track of data

10 sec: max. duration if user to stay focused on action

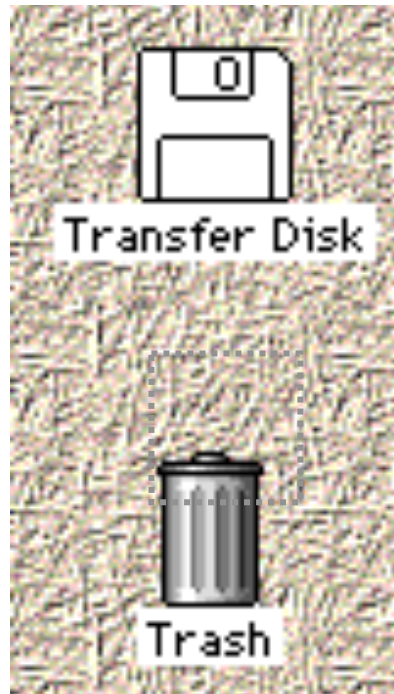
for longer delays, use percent-done progress bars

# match between system & real world

System speak the users' language, with words, concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order

H2.

bad



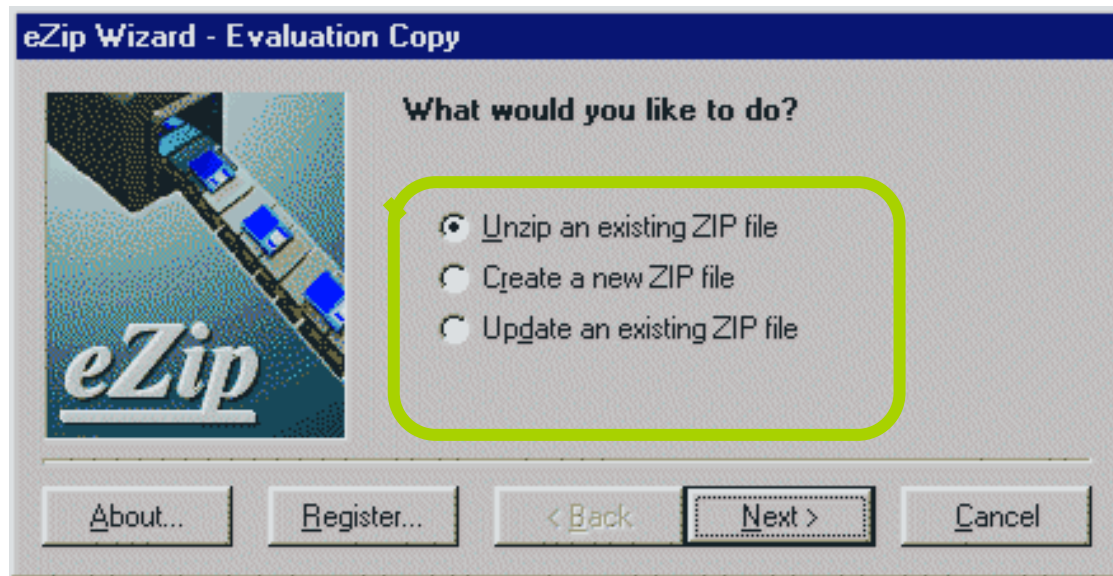
speak the users' language  
follow real world conventions

**example of violation:**

dragging disk to Mac trash **should delete it**, not eject it

# user control & freedom

users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.



good

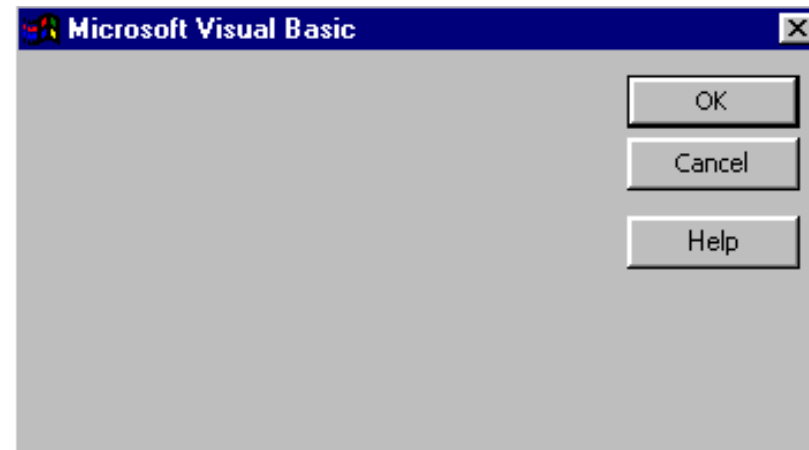
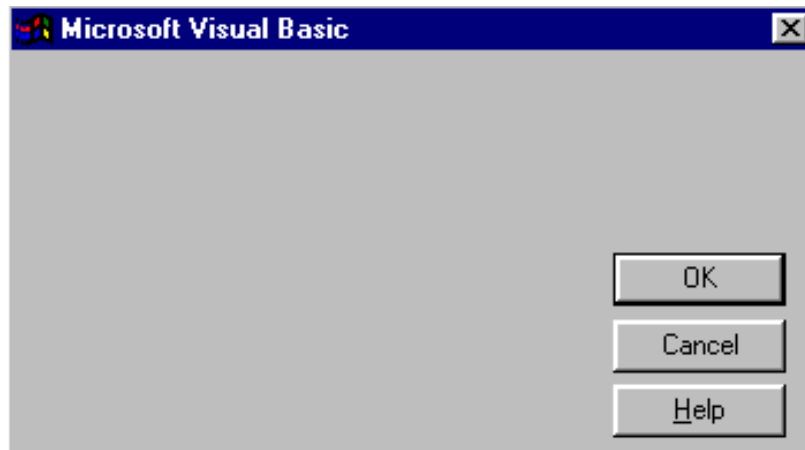
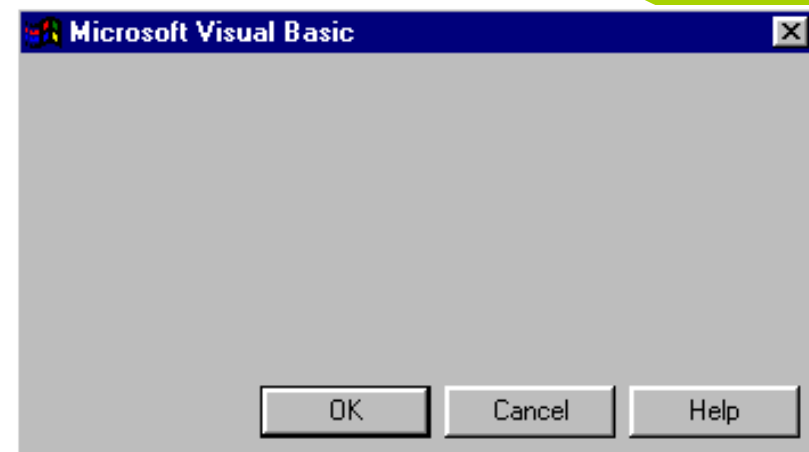
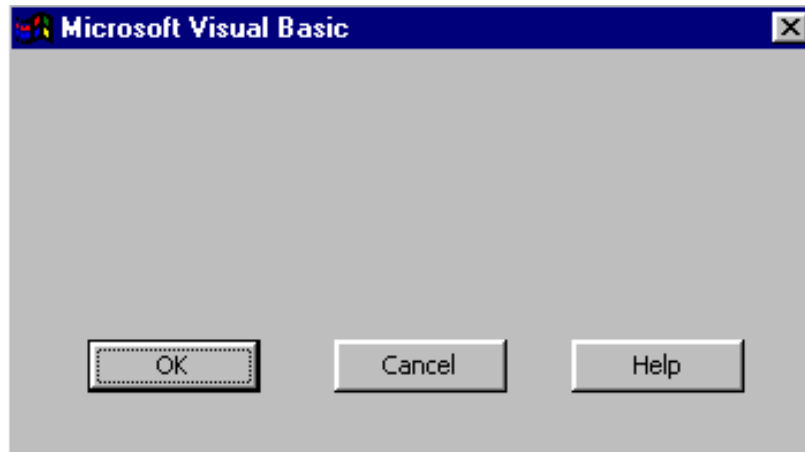
**wizards:** must respond to question before going to next  
good for infrequent tasks (e.g., modem config.) and beginners  
not for common tasks and experts → **have 2 versions (WinZip)**

# consistency & standards

users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.



bad



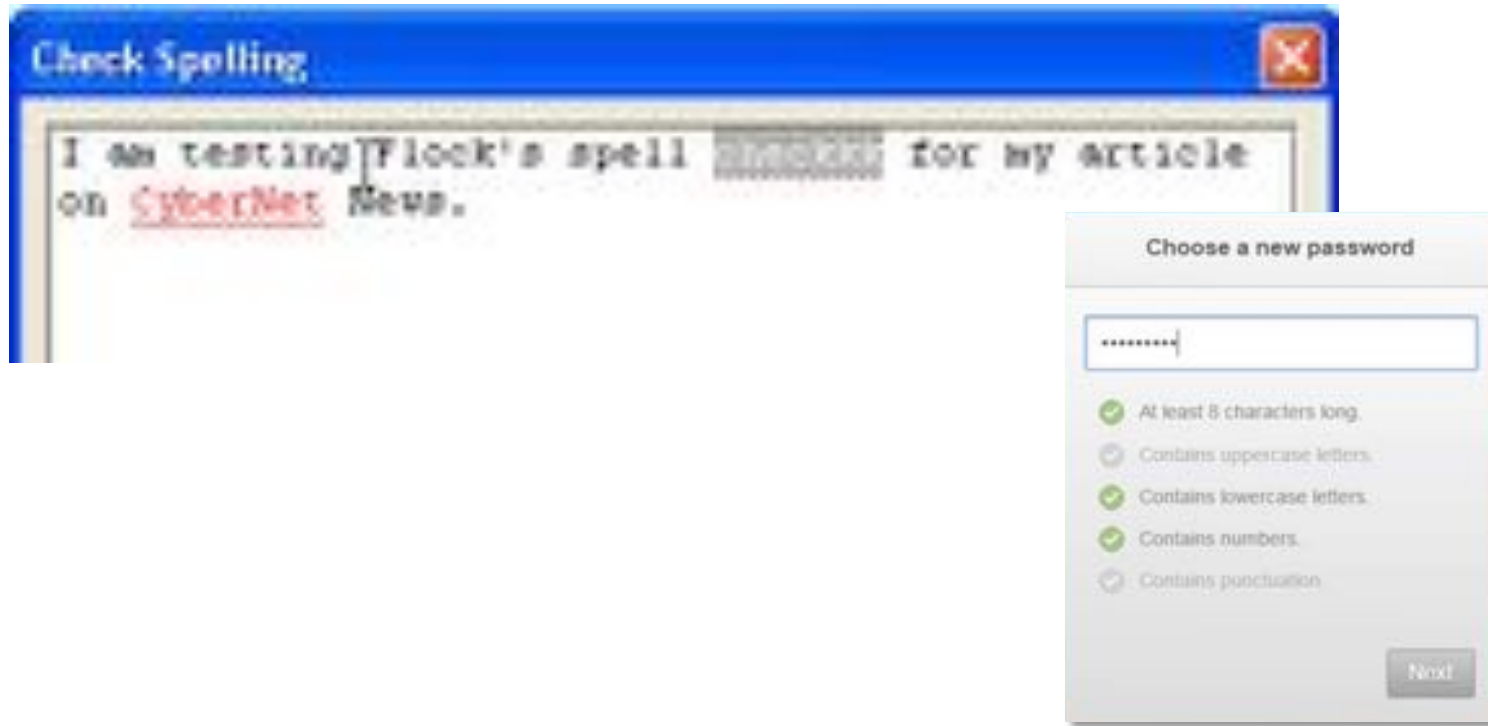


# error prevention

even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.



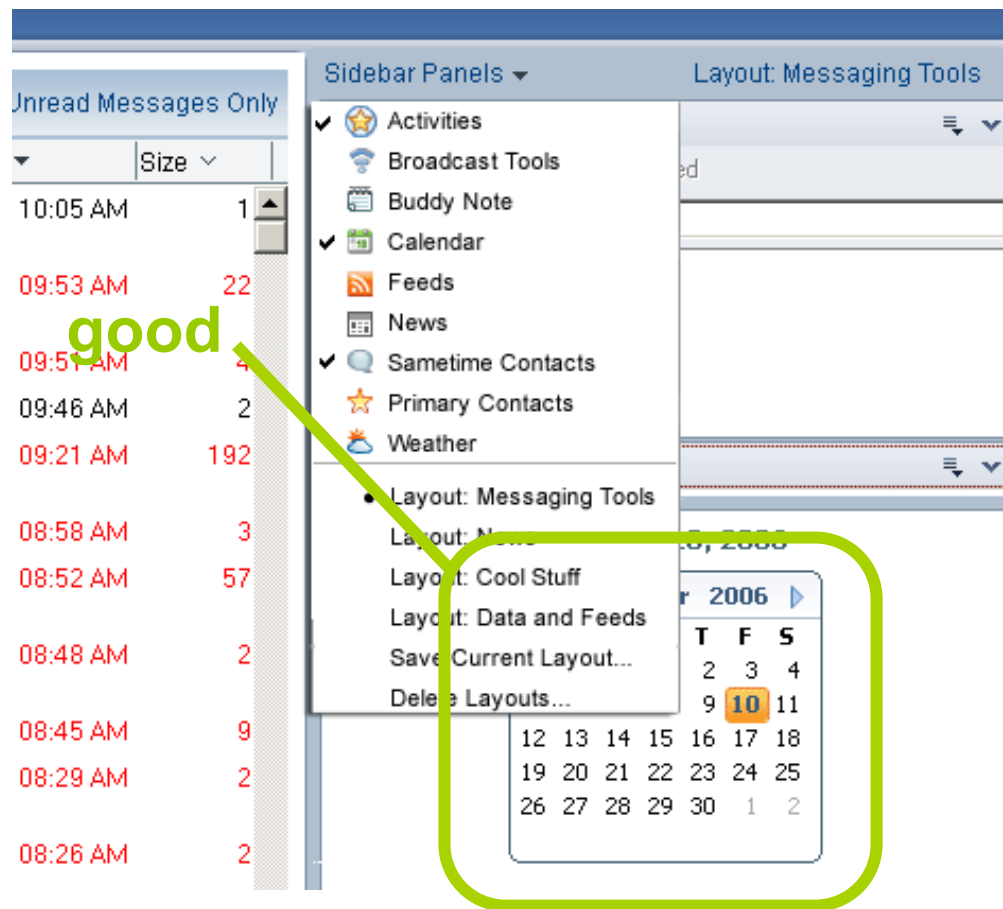
good





# recognition, not recall

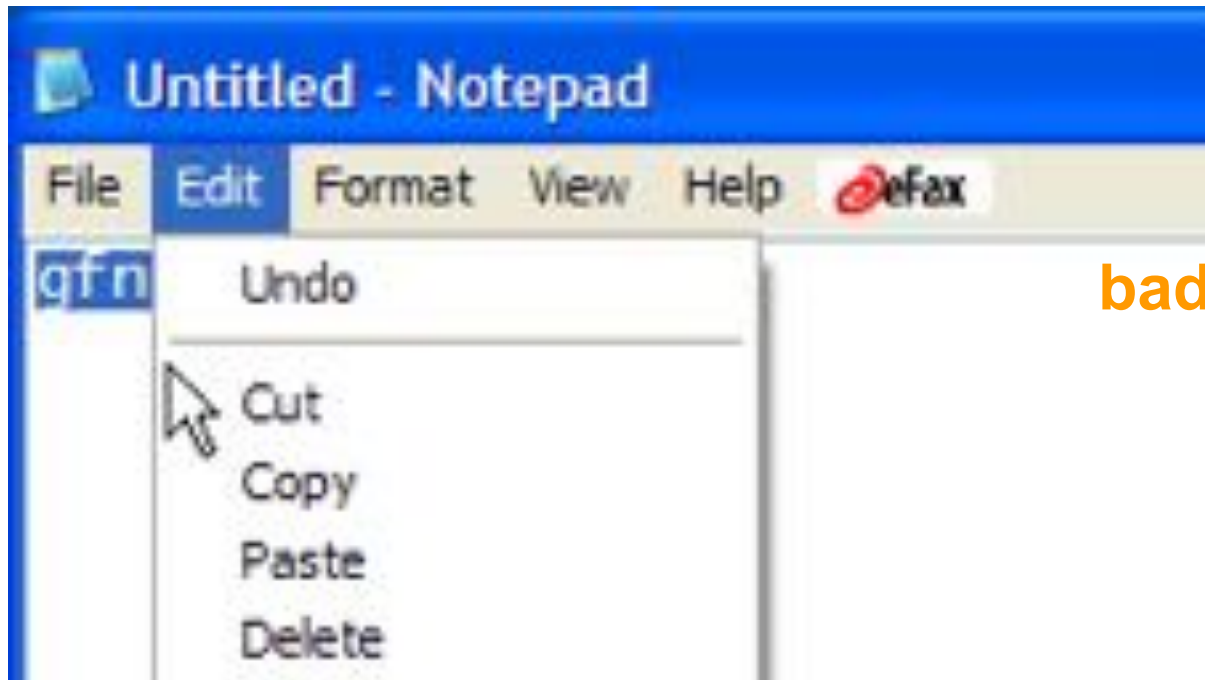
minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.



# flexibility and efficiency of use

accelerators - unseen by the novice – may speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

## H2.



# aesthetic & minimal design

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.



bad

A screenshot of a web form titled "Q&D Software Development Order Desk". The form is divided into several sections. The first section contains a "Form Title" field with the text "Q&D Software Development Order Desk" and a "Background Color" dropdown set to "FFF8F0". The second section contains a "Form Heading" field with the text "Q&D Software Development Order Desk" and a "Text Color" dropdown set to "000080". The third section contains an "E-Mail responses to" field with the text "dversch@q-d.com" and an "Alternate" field. The fourth section contains a "Text to appear in Submit button" field with the text "Send Order" and a "Text to appear in Reset button" field with the text "Clear Form". The fifth section contains a "Background Graphic" dropdown set to "Mailto" and a "Scrolling Status Bar Message" field with the text "WebMania 1.5b with Image Map Wizard is here!!". The form is styled with a light yellow background and a grey border. The text is in a serif font. The form is labeled as "bad" in the context of the slide.

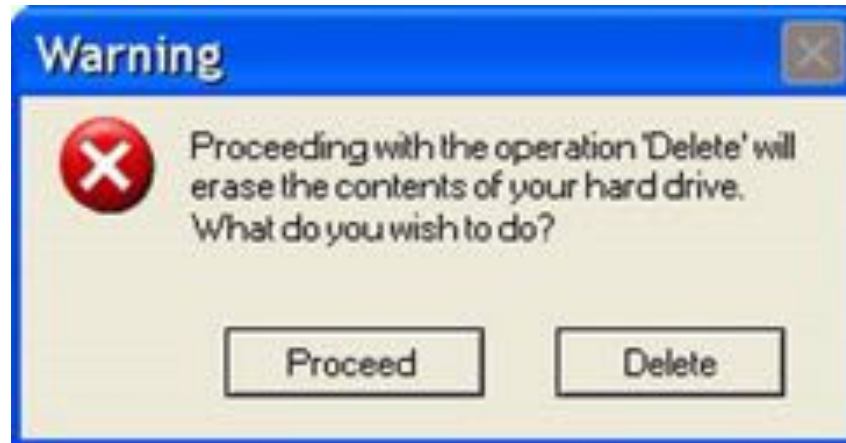


# help recognize, diagnose, & recover from errors

error messages should be expressed in plain language (no codes),  
precisely indicate the problem, and constructively suggest a solution.

H2.

bad



# help & documentation

even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.





other  
heuristics

# Tog

**Anticipation** Try to anticipate the user's wants and needs. Give user all information and tools needed for each step.

**Autonomy:** The computer, the interface, and the task environment all "belong" to the user. Give user control by keeping her informed.

**Color Blindness:** use clear, secondary cues.

**Consistency:** The most important consistency is consistency with user expectations. The importance of strict consistency varies. It is just important to be visually inconsistent when things must act differently as it is to be visually consistent when things act the same.

**Defaults:** Defaults should be easy to "blow away." They should be "intelligent" and responsive.

**Efficiency of the User:** Consider user's productivity, not the computer's. Keep the user occupied. Maximize everyone's efficiency. Great efficiency breakthroughs are in system architecture.

**Explorable Interfaces:** Give user roads & landmarks, but allow exploration. Give user stable cues for a sense of "home." Allow undo Allow a way out.

**Fitts's Law:** time to acquire a target is a function of the distance to and size of the target.

**Human Interface Objects:** User's interface objects appear within the user's environment. They can be seen, heard, touched, etc. They have a standard way of interacting with standard resulting behaviors. They should be understandable, self-consistent and stable.

**Latency Reduction:** Reduce the user's experience of latency.

Push latency into the background.

**Learnability:** All applications and services have a learning curve.

Limit trade-offs between usability and learnability.

**Metaphors, Use of:** Choose metaphors well to enable the user to grasp the conceptual model. Bring metaphors alive by appeal to kinesthesia.

**Protect Users' Work:** Ensure that users never lose work, unless completely unavoidable.

**Readability:** Text that must be read should have high contrast. Use font sizes large enough. Don't forget those with special needs.

**Track State:** Keep track of state. Store it for later use.

**Visible Navigation:** Avoid invisible navigation. Do not prevail upon user to build elaborate mental maps.

<http://asktog.com/atc/principles-of-interaction-design/>

# Schneiderman

**Strive for consistency:** Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus, and help screens; and consistent commands should be employed throughout.

**Enable frequent users to use shortcuts:** As the frequency of use increases, so do the user's desires to reduce the number of interactions and to increase the pace of interaction. Abbreviations, function keys, hidden commands, and macro facilities are very helpful to an expert user.

**Offer informative feedback:** For every operator action, there should be some system feedback. For frequent and minor actions, the response can be modest, while for infrequent and major actions, the response should be more substantial.

**Design dialog to yield closure:** Sequences of actions should be organized into groups with a beginning, middle, and end. The informative feedback at the completion of a group of actions gives the operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds, and an indication that the way is clear to prepare for the next group of actions.

**Offer simple error handling:** As much as possible, design the system so the user cannot make a serious error. If an error is made, the system should be able to detect the error and offer simple, comprehensible mechanisms for handling the error.

**Permit easy reversal of actions:** This feature relieves anxiety, since the user knows that errors can be undone; it thus encourages exploration of unfamiliar options. The units of reversibility may be a single action, a data entry, or a complete group of actions.

**Support internal locus of control.** Experienced operators strongly desire the sense that they are in charge of the system and that the system responds to their actions. Design the system to make users the initiators of actions rather than the responders.

**Reduce short-term memory load.** The limitation of human information processing in short-term memory requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced, and sufficient training time be allotted for codes, mnemonics, and sequences of actions.

# Norman

affordance

natural mapping

visibility

feedback



“what is my function?”



“don’t know but I’d probably  
place my thumb like that”



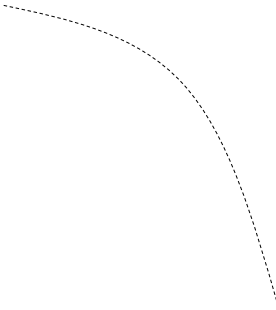
“what is my function?”



“thumb stone: place your thumb and play”



Norman, Gibson



affordance::

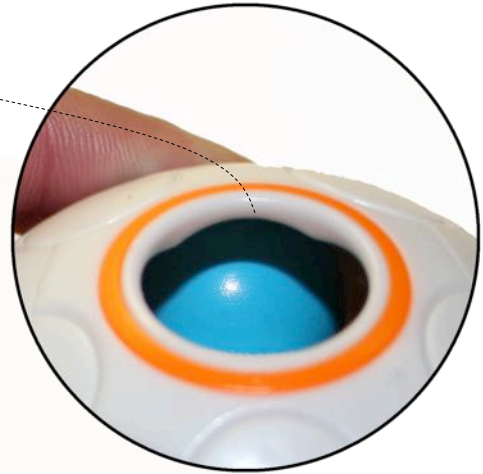
the quality of an object to tell us **how it wants  
to be used** and to **help us using it**

“thumb stone: place your thumb and play”



**perceived affordance:** see and guess how to use it

“the ball slides here”



**physical affordance:** guides/prevent you to use

affordance is everywhere

“push me”

“pull me”





“throw me away”



“sit”





“... here you are, just in place to press this”

“roll that thing...”



“pull and peel”



“share”



and also ...



difficult wine glass



eternal loop watering can



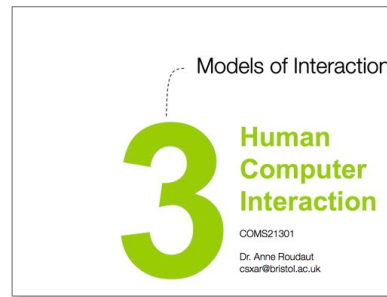
mmm pouring pot?





impossible soup pot

where do  
heuristics come  
from?



(implement & conduct  
experiment  
= compare to nature

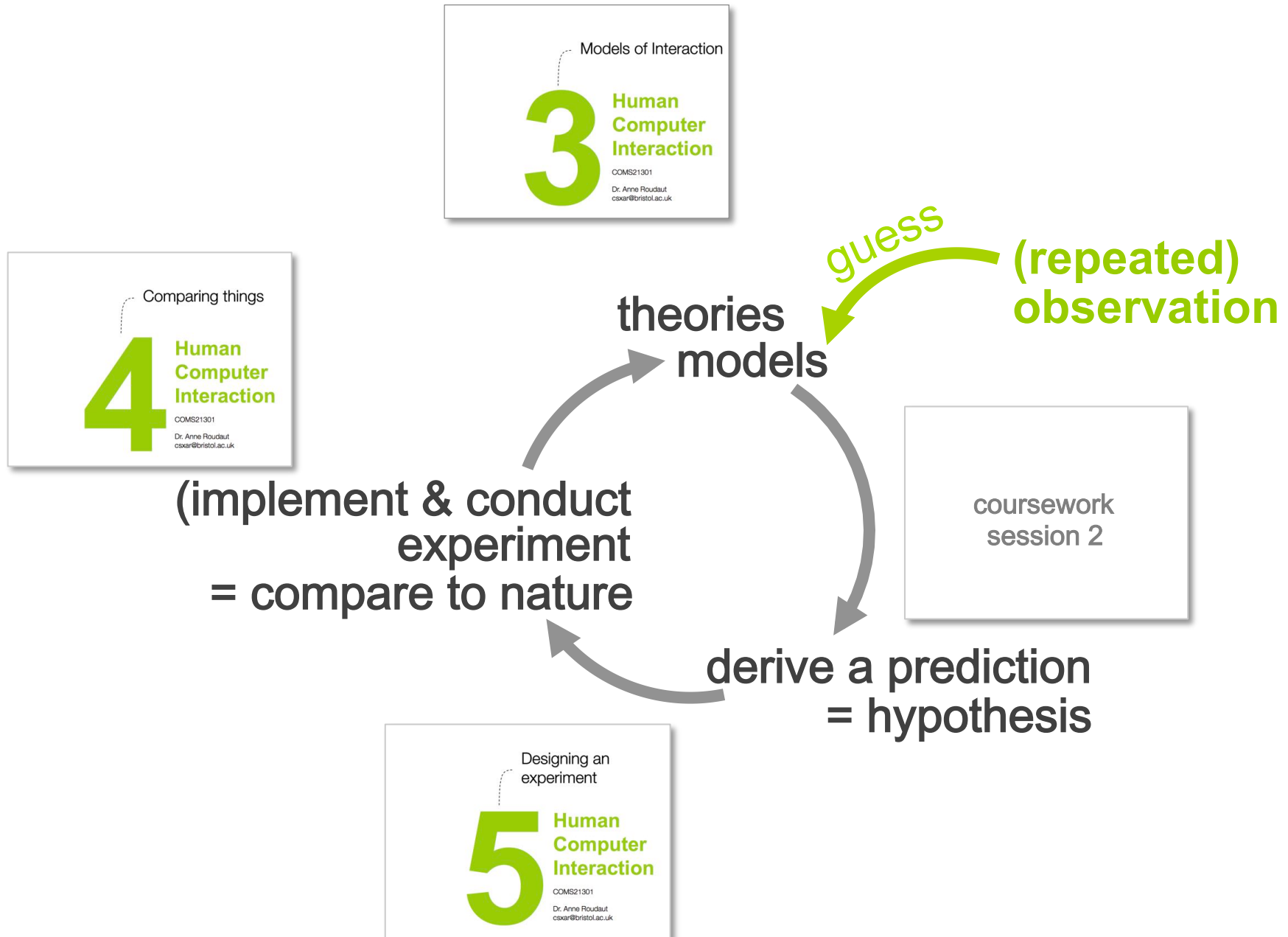


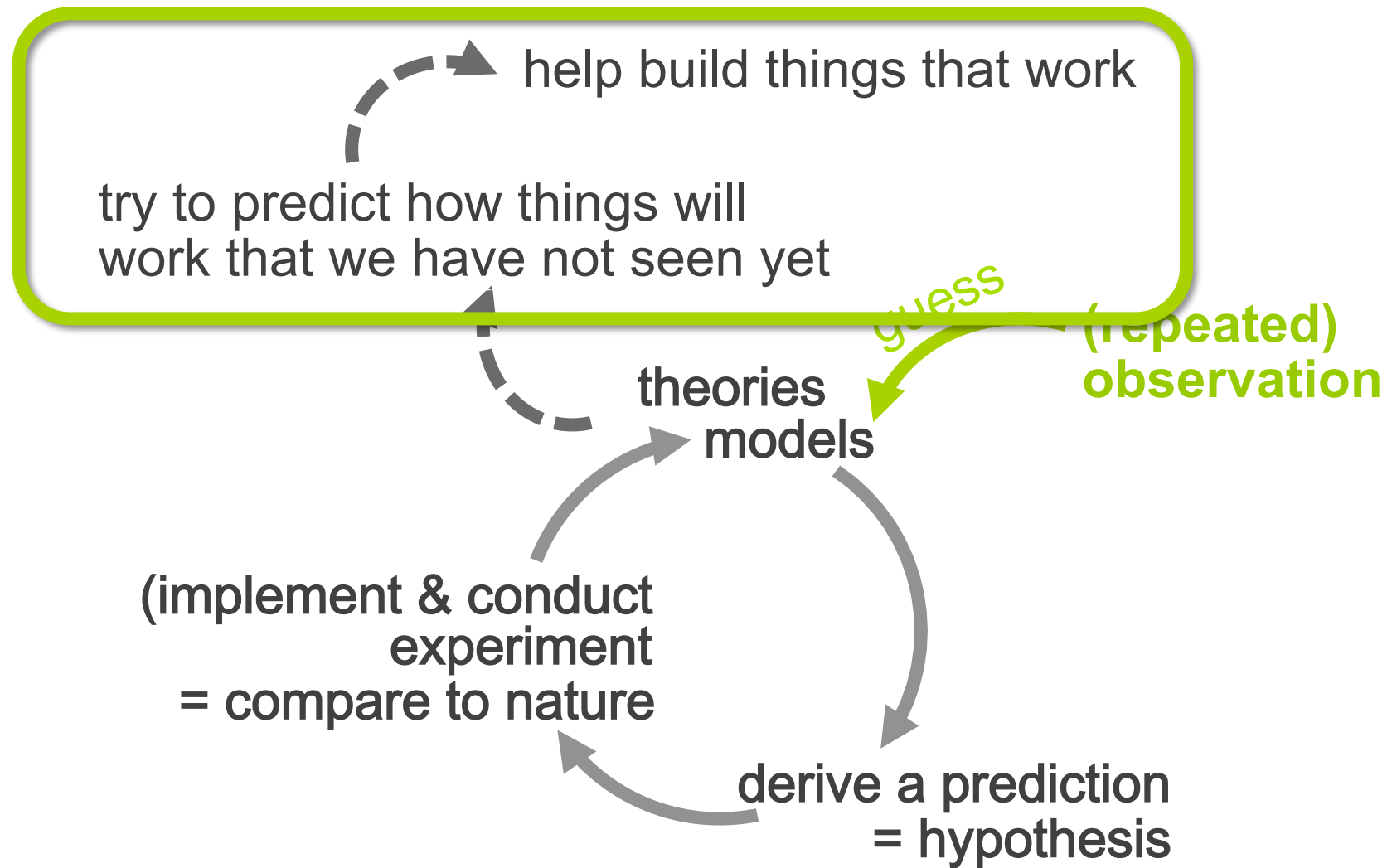
theories  
models

guess  
(repeated)  
observation

coursework  
session 2

derive a prediction  
= hypothesis







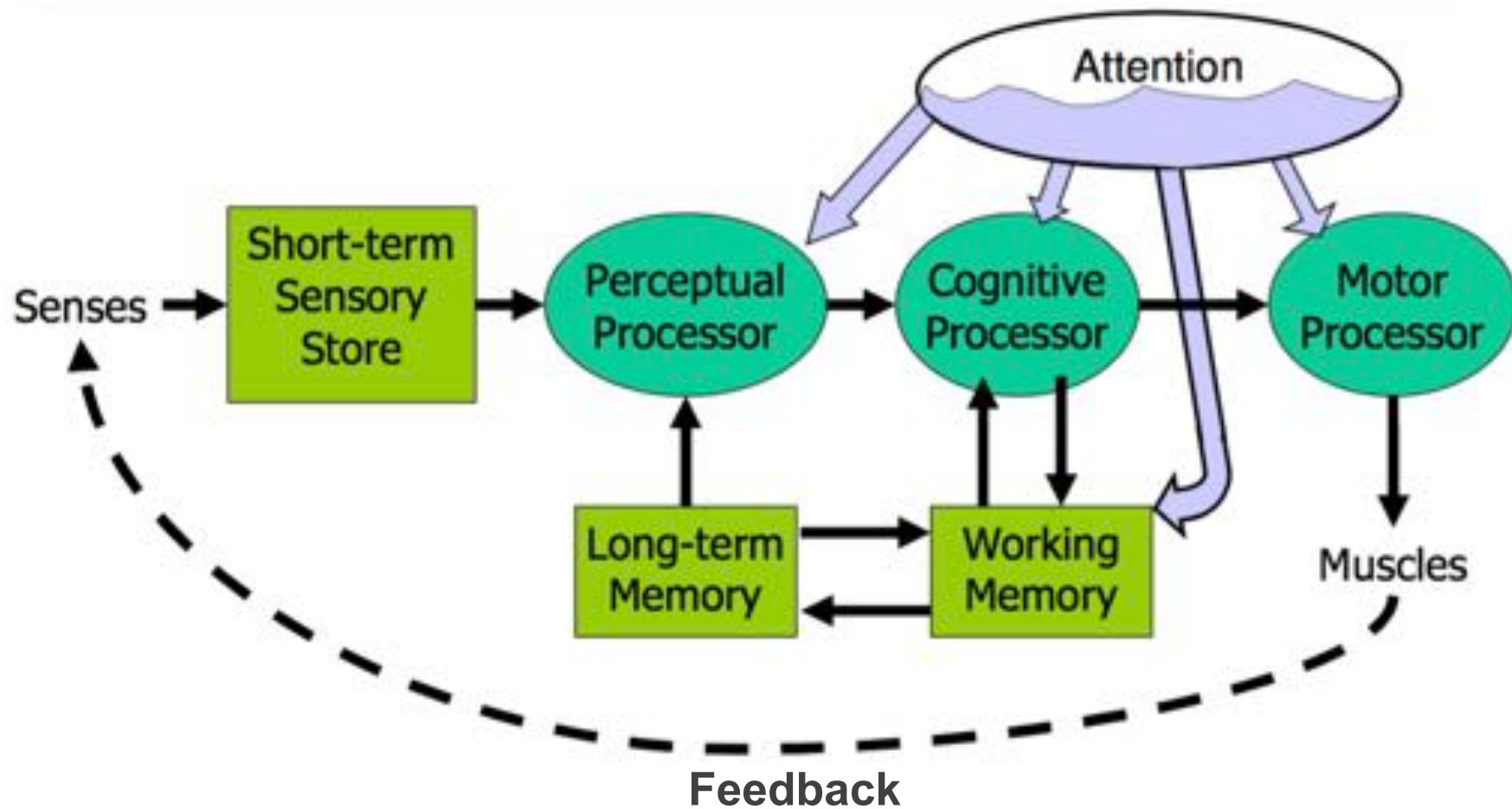
# fitts' law ::

the time required to **acquire a target** of size  $w$  at distance  $d$  can be described as  $t = a + b \log (1 + d/w)$

# Model Human Processor ::

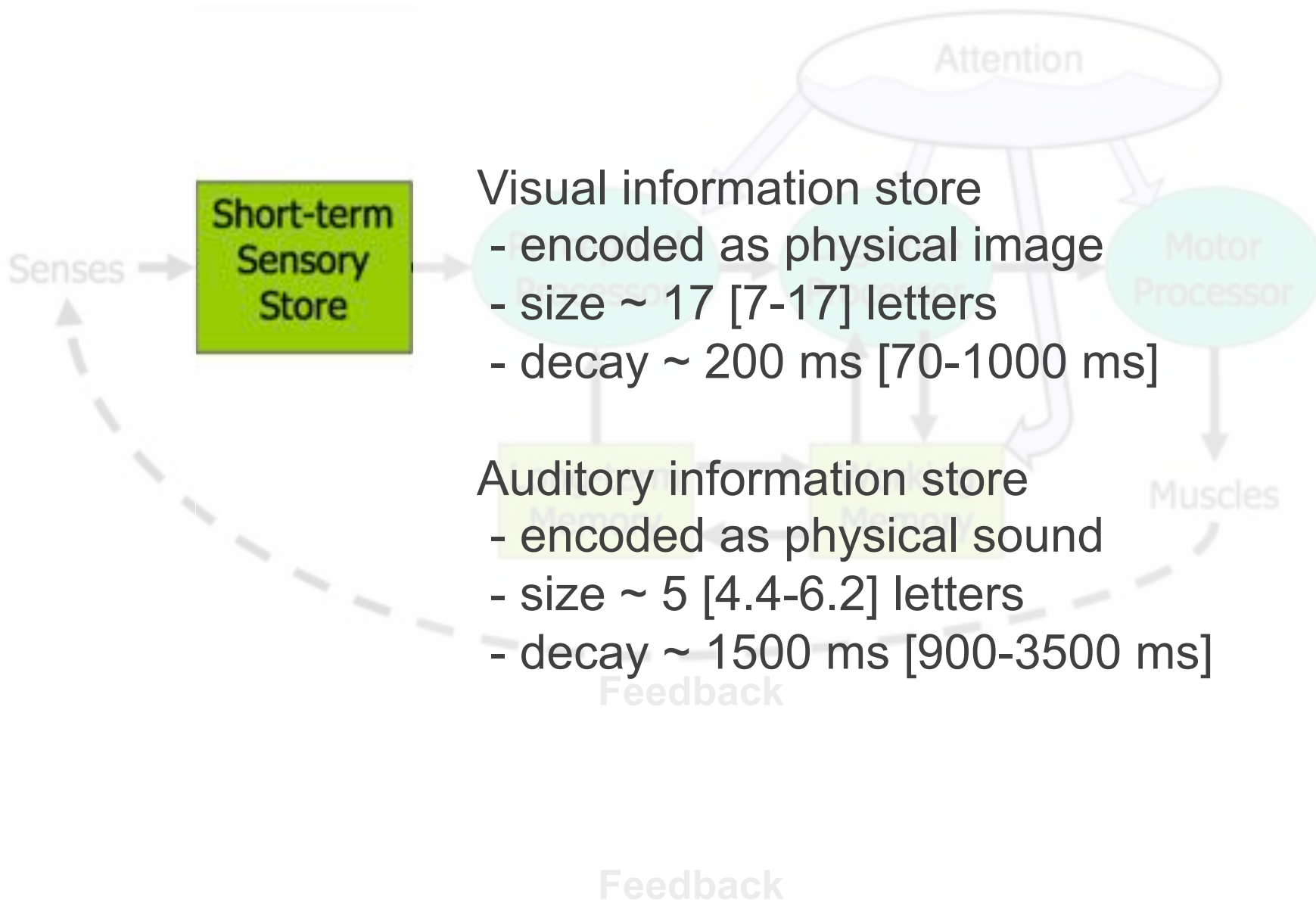
a cognitive modeling method used to calculate how long it takes to perform a certain task

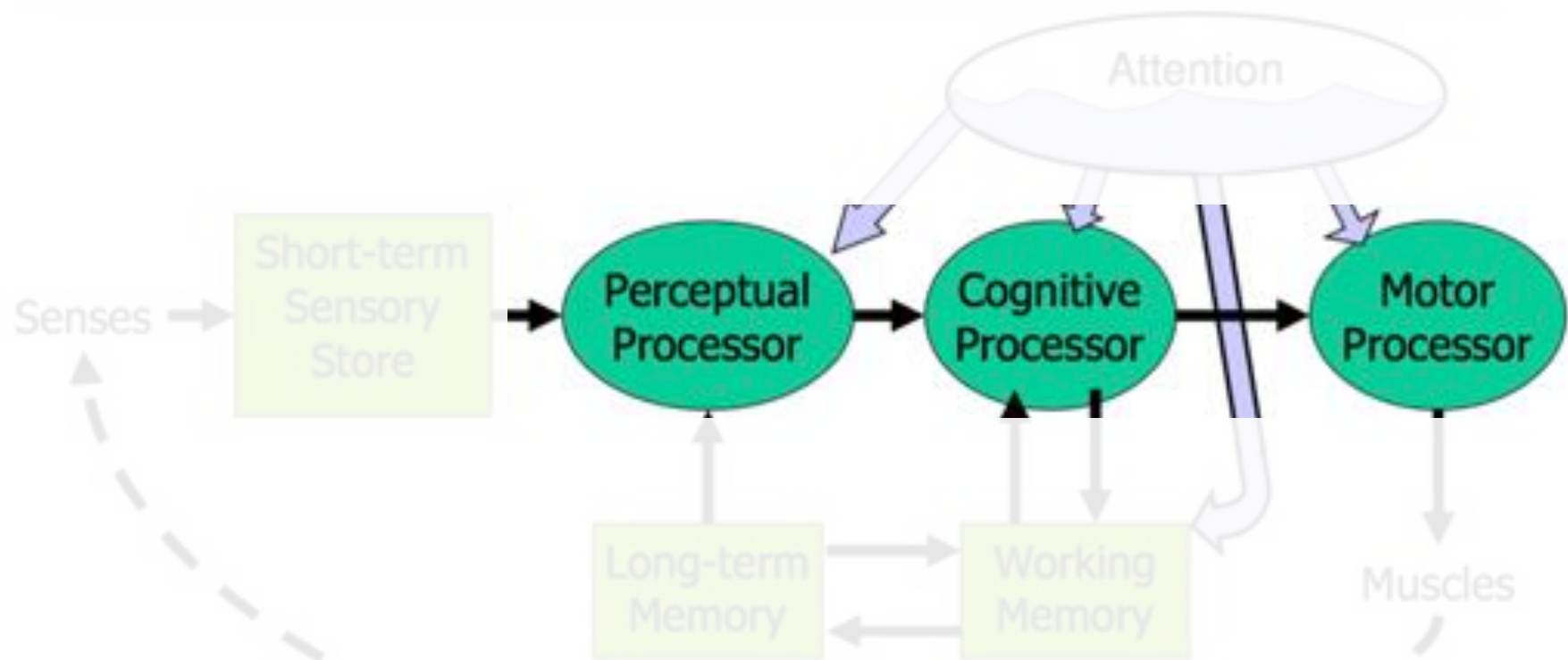
... let's look at this one now



summarize decades of psychology research in **an engineering model**

modification from Card, Moran, Newell (1983) + Wickens (1984)





Processors have a cycle time

$T_p \sim 100\text{ms}$  [50-200 ms]

$T_c \sim 70\text{ms}$  [30-100 ms]

$T_m \sim 70\text{ms}$  [25-170 ms]

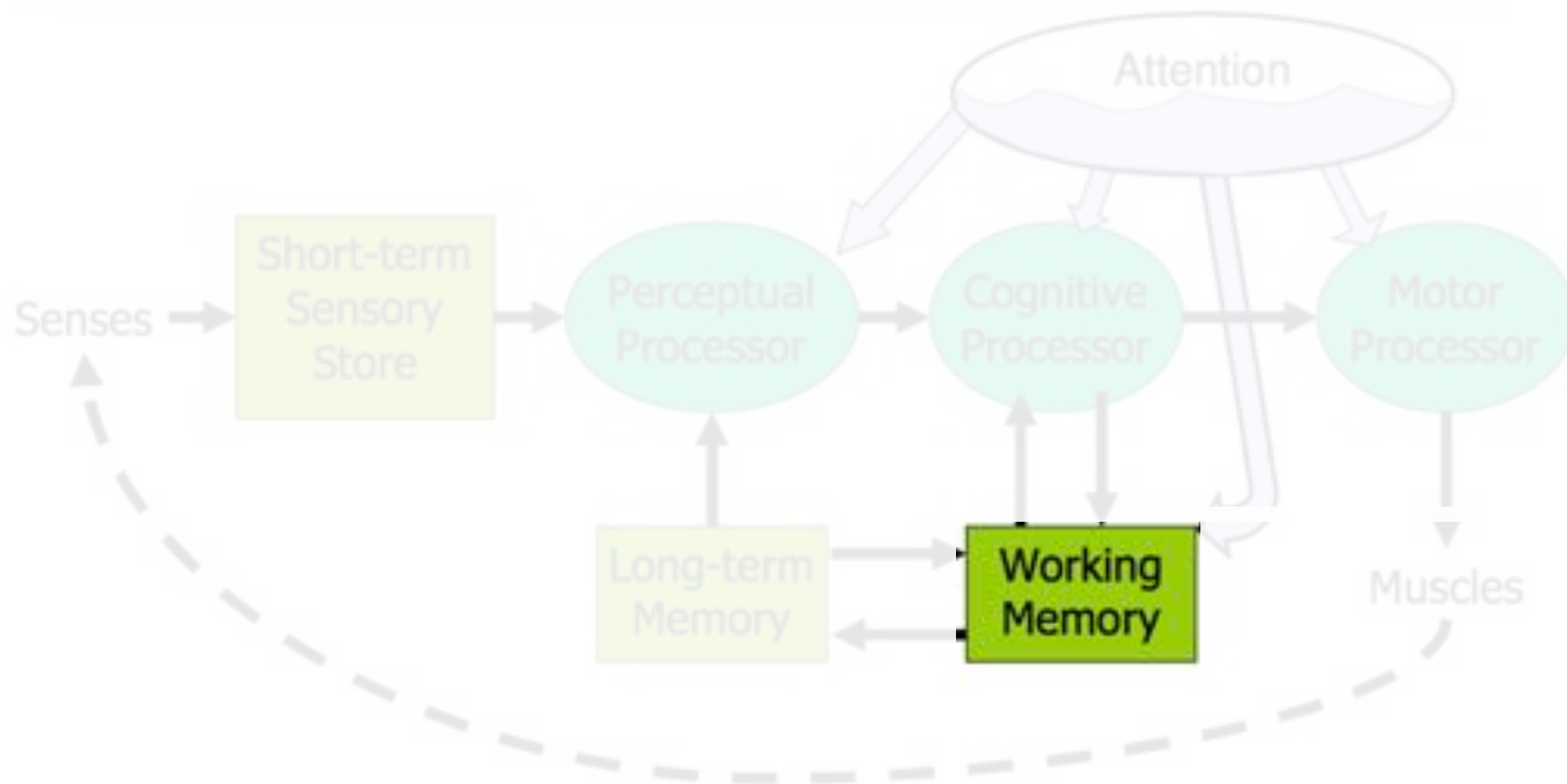
Fastman may be 10x faster than Slowman

A hand is holding a flipbook, which is a series of drawings of a stick figure in various poses, creating an illusion of motion. The background is a blurred image of the flipbook's pages.

## Consequences

- $1/T_p$  frames/sec is enough to perceive a moving picture (10 fps OK, 20 fps smooth)
- Computer response  $< T_p$  feels instantaneous
- Causality is strongly influenced by fusion

two stimuli within the same PP cycle  
( $T_p \sim 100\text{ms}$ ) appear **fused**



Chunk: unit of perception or memory

Capacity:  $7 \pm 2$  +chunks

Chunking depends on presentation and we know





how many chunk?

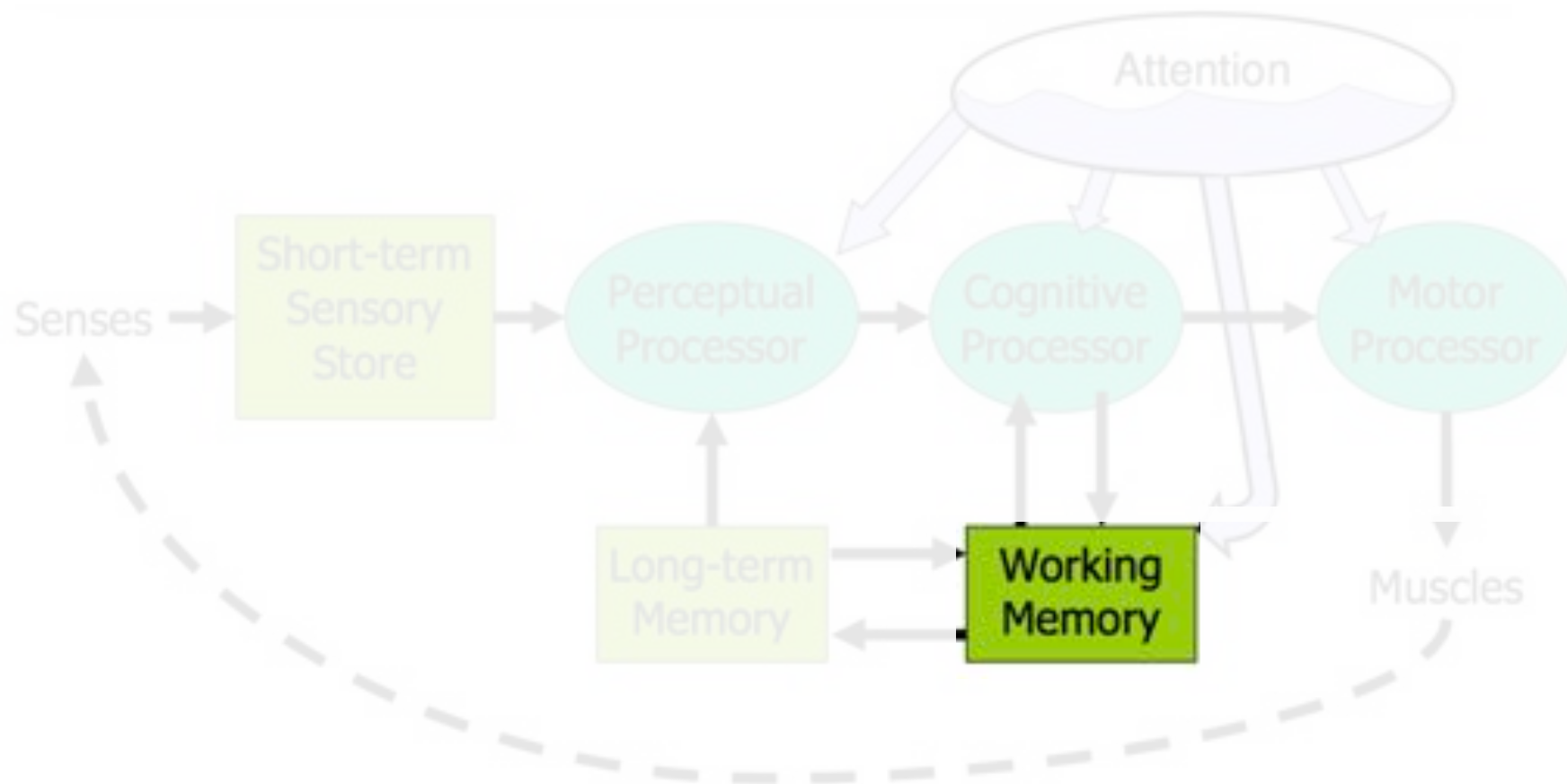
SNCFEDFMDRFNAC

SNCF EDF MDR FNAC

BMWRCAAOLIBMFBFI

BMW RCA AOL IBM FBI



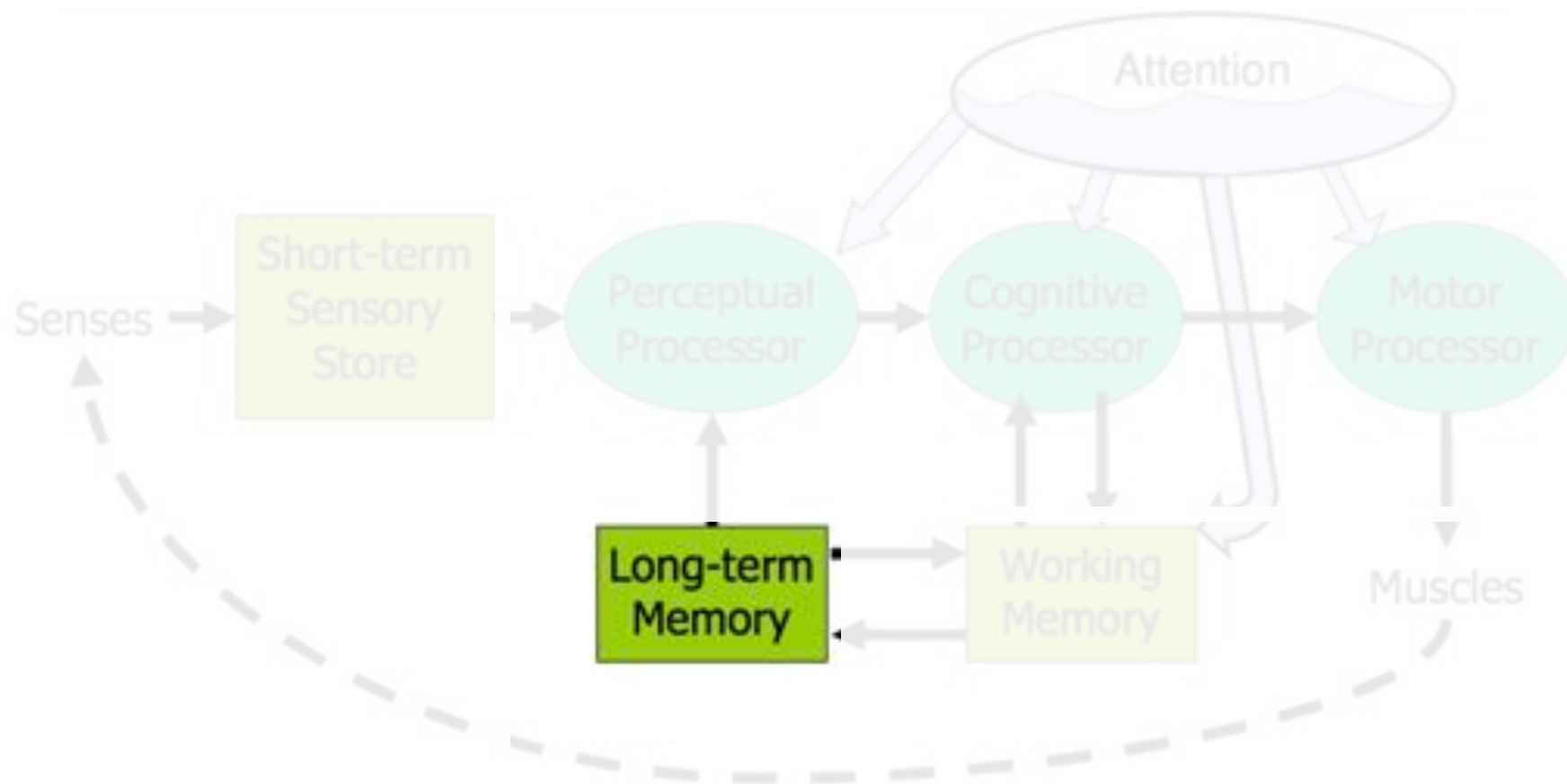


Chunk: unit of perception or memory

Capacity:  $7 \pm 2$  +chunks

Chunking depends on presentation and we know

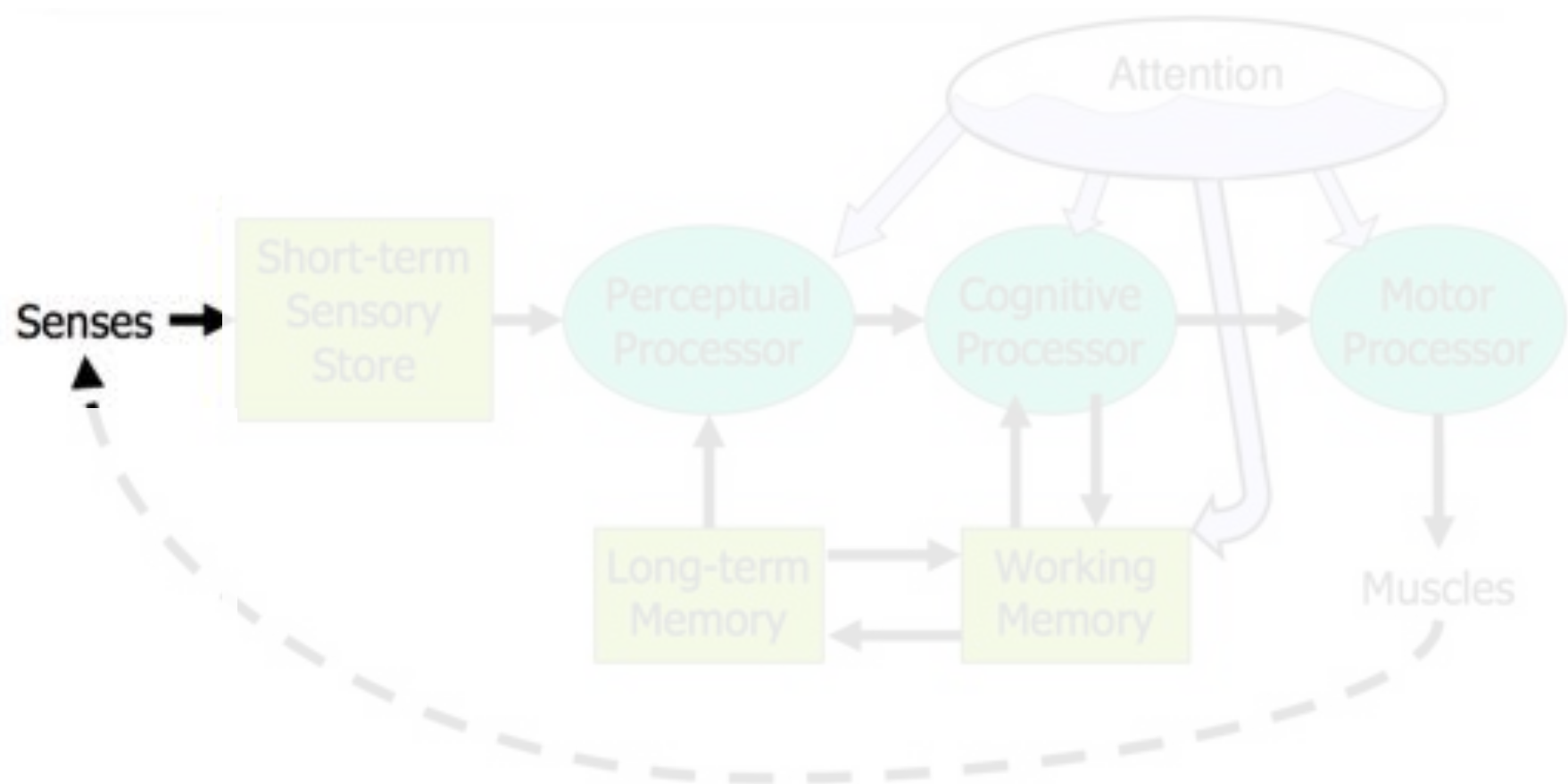
**Maintenance rehearsal (repetition)**

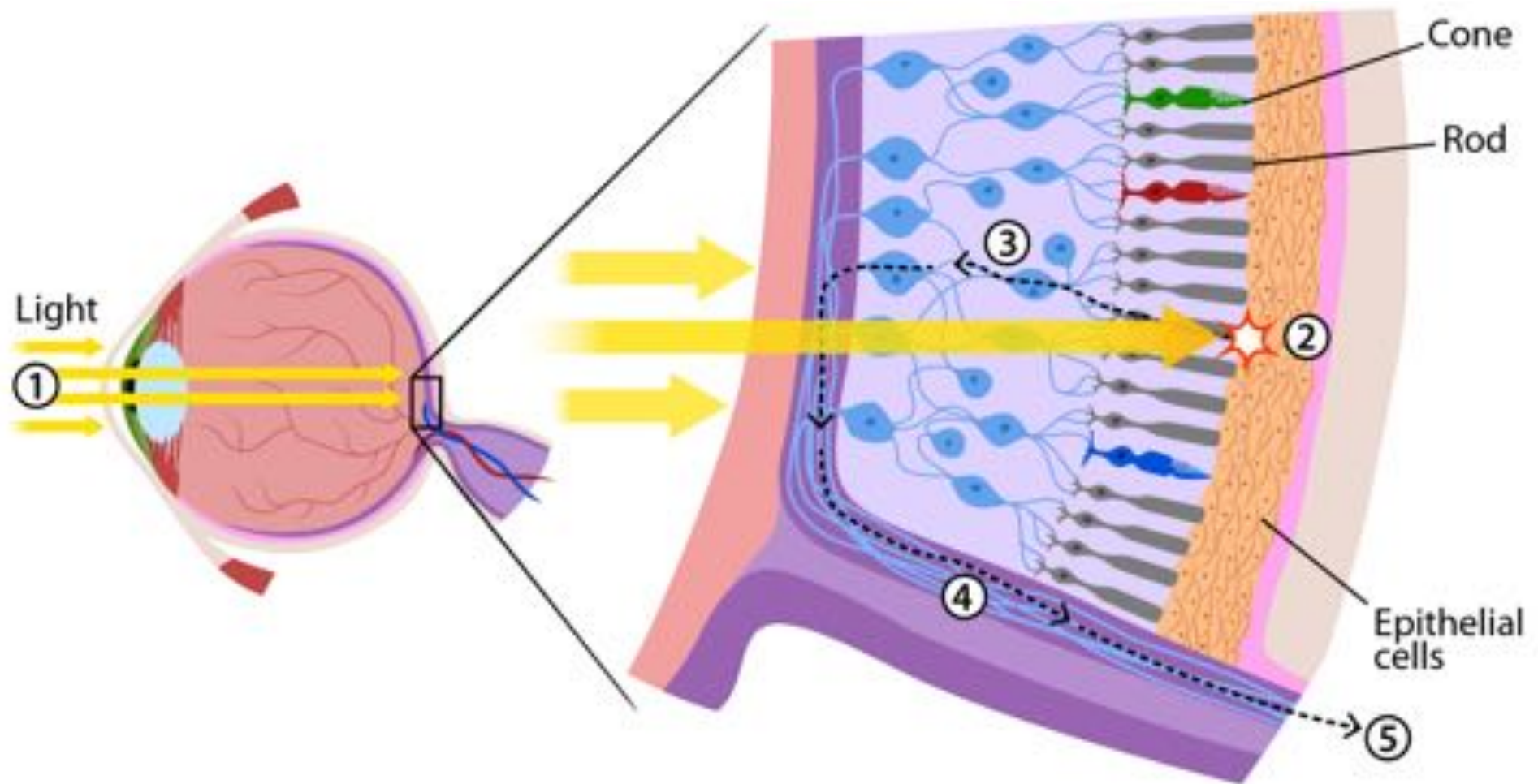


Huge capacity

Little decay

**Elaborative rehearsal** moves chunks from WM to LTM by making connections with other chunks





Rods: sensitive to low light, one kind  
Cones: brighter light, three kinds short (blue), medium (green), long (yellow but called red)

Brightness  $M + L + \text{rods}$

Red-green difference  $L - M$

Blue-yellow difference weighted sum of  $S, M, L$

rods and cones do not send signals directly to visual cortex; instead, signals recombined into three channels.



drive theory opponent colors: e.g. red-green  
good contrasting colors as drive red-green  
channel to opposite extremes.



*You could pick almost any shade of  
blue from a light one like #6666ff*

*to a really dark one like #000099  
often used in political designs*

*or even a medium one like #333399  
but all blue on red combos look terrible*

this model also explains why this hurts!

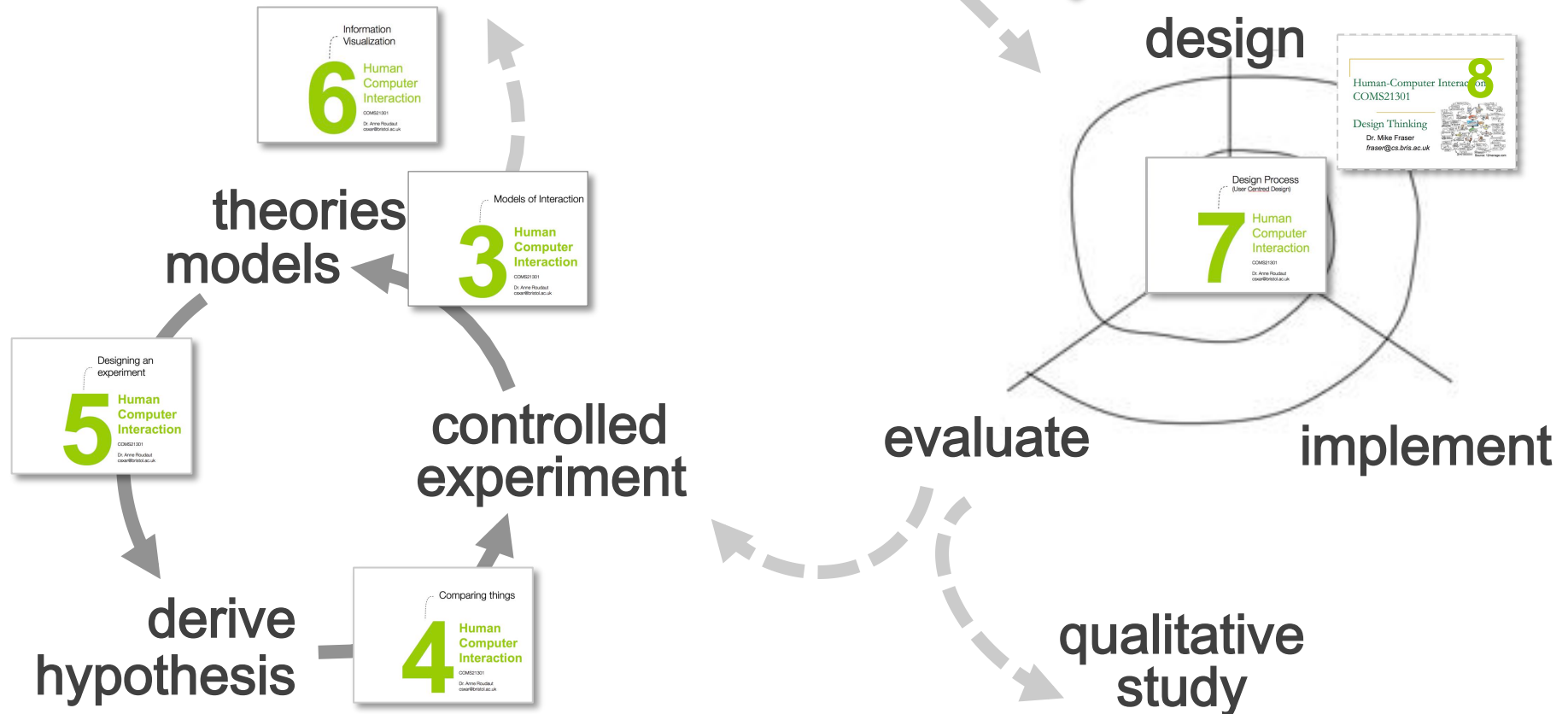
Highly separated wavelengths (red & blue) cant be focused simultaneously as a result, it looks a little fuzzy.

So blue-on-red or red-on-blue text is painful to read, and **should be avoided at all costs.**

# HCI unit overview

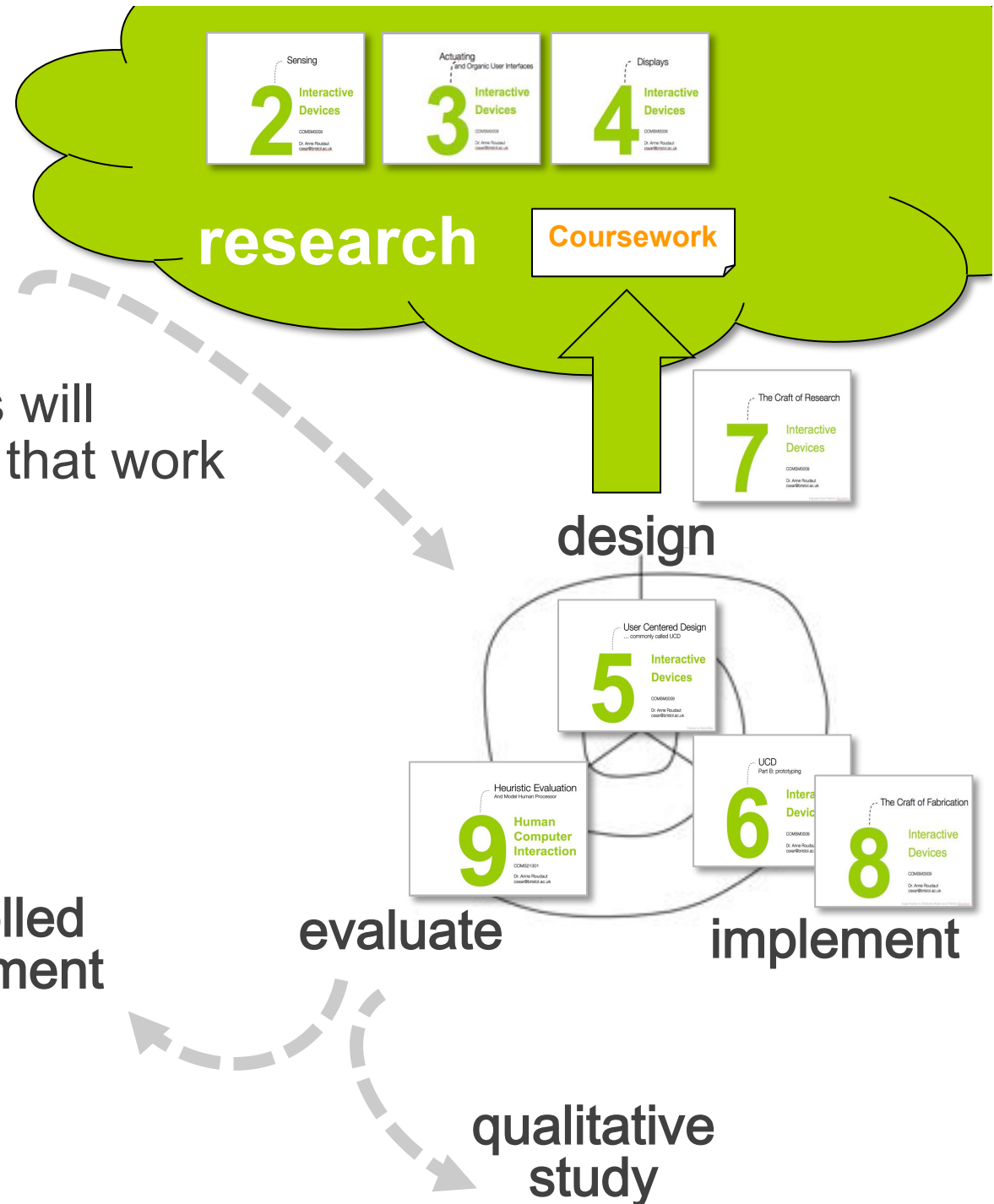
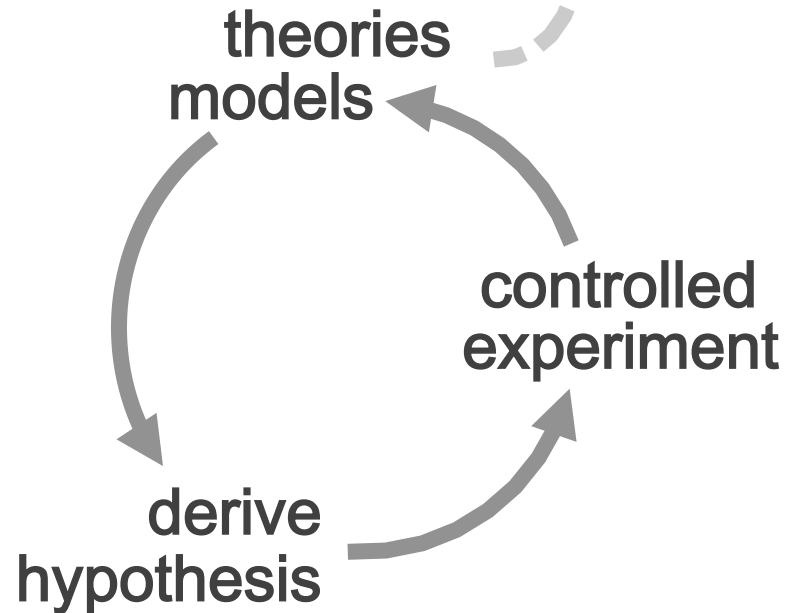
# HCI

predict how things will  
work / help build things that work



# Interactive Devices

predict how things will work / help build things that work



end