# 7b. Interactivity

The baby's motto: *Suck it and see*



## Three processing sub-systems

- Three sub-systems *manage* the human feedback loop:
  - A. ***Sensory analysis*** (cognitions)
  - B. ***Motor analysis*** (skills)
  - C. ***State analysis*** (emotions)
- Psychologists talk of:
  - Cognitive
  - Psychomotor
  - Affective
- People talk of:
  - Intellect (Head)
  - Will (Backbone)
  - Emotions (Heart)
- These sub-systems interact to give human behavior



## Shared control

- *Intellectual control* - understands causes/theory by conceptual knowledge
  - **Disadvantage**: Don't know what is wanted or how to get it
- *Motor control* - knows what gets results by tacit knowledge
  - **Disadvantage**: Doesn't know what is wanted or why
- *Emotional control* - knows what is wanted by experiential knowledge
  - **Disadvantage**: Don't know what satisfies a desire or how to get it
- Only *balance* combines all three



## A. Managing sensory input

- Given *millions* of ways to analyze sense data, to form abstract percepts and concepts
- What is the best way, the right abstractions to "see" the world by?
- Answer: *Those relevant to desired end states*
- The visual system abstracts sense information into *objects* and *actions* that relate to our internal state needs (e.g. hunger), which evolve into emotions



## Beyond perceptions - concepts

- Increasing sense data abstraction creates a cognitive realm of *concepts* and conceptual *schema* (Piaget)
- Each schema is part of a *conceptual mental model* that can predict future sensory input before it happens
- See Learning lesson for more details



## B. Managing motor output

- Given *millions* of potential muscle response combination sequences, what are the best ones to use?
- Answer: Those that *give desired end states*
- Again motor centers "remember" abstract skills that are *not merely sets of muscle memories*:
  - We can write our signature with either hand - using entirely different sets of muscles
  - Lashley's rats: one animal had to roll over entirely to make each turn, yet made no errors in maze traversal.

Gregory: Schema

## Motor Schema

- Skilled behavior involves many muscles in complex sequenced combinations (e.g. bike riding)
- Use *high level motor definitions* independent of muscle level details - action schema
- *Action schema* = a abstract unit of skill
  - As the abstract "square" percept can be triggered by many retinal combinations
  - So an abstract *action schema* can direct many varying muscles to the same effect
    - e.g. We can sign our name with a 10' pole using two hands!



Link: Automatism

## Automatism

- Automatism is performing a sequence of low level motor actions without attention, e.g. riding a bicycle
- Skilled performers automate highly complex actions, to free attention for strategic concerns
- cf in *perceptual abstraction we only see the final results*
- Reduce attention overload by delegating routine processing to automated sub-systems
- The high level motor information to be managed is reduced, e.g. piano playing



Link: Skill,human

## Example - skilled performers

- An unskilled performer, with many "details" to manage, rushes from one to the next
- A skilled performer seems to have "all the time in the world" because
  - Action details are "pre-processed", by training, into schema "packets" freeing up higher levels
  - E.g. Car driving
- But skilled performers may not make the best teachers (if unaware of their automatisms)



Link: Feedback

## Feedback & motor control

- *Motor control* needs direct *sensory feedback*
  (cf. sensory/intellectual analysis of patterns)
- To compare intended vs actual result
  - e.g. reach for an object, see the *object-hand discrepancy,* then adjust
- Motor control also needs *kinesthetic feedback,* sensations from muscles, to work:
  - Can you shower in the dark?



## The feedback problem

- A stimulus driven system is always *after the fact*
  - If a heating system turns off when temperature is above 70° it then goes over 70° (overheats)
  - If it turns on when it drops below 70°, it is already too cold before it gets going
- So why *wait* for negative states to occur?
- Why not *predict* them to avoid them? e.g. program a heating system to counteract temperature *trends* (an abstraction)

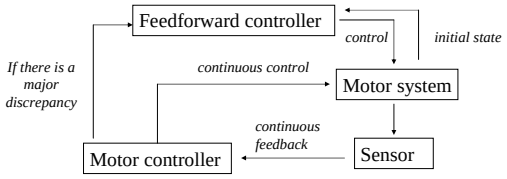


## Feedforward and anticipation

- A feedback loop predicts by *feedforward anticipation,* done before feedback is available
  - Skilled actions, like piano playing, use sequences of *anticipatory schema (*not S-R schema)
  - In feedforward, the system acts first then adjusts
  - If initial response is not "in the right ballpark", then restart (e.g. go behind your back for an object in front of you)
  - If it is, you are in position for a feedback adjustment

## Feedforward and feedback

- Feedforward operates at the *feedback loop start* (or gives *a major performance discrepancy)*






## An example - Navigation

- To *move* to a *destination*, we need:
  - A mental model map of the web site or document space
  - A desired destination
  - Information on our *current location*
- Without a map or our current location we are "lost"
- We decide where to move by compare the two
- Lost people "wander" about until:
  - They form a mental model (map) of the space
  - They locate themselves within a known mental model, i.e. "know where they are"



## Where am I?

- Getting "lost" is a common interaction problem
  - *Losing the cursor* - move mouse randomly until the current position feedback loop is re-established
  - *Losing the current directory* - scan for the little "open folder" cue
  - *Losing the active focus*: if a hidden modal error window wants a response the computer seems to hang - press Alt/Tab to relocate the error window and close it
- *Basic problem*: A user isn't where they think they are



## Application: Navigation principles

- Site structure should continuously support the user's mental model (map) of the space:
  - A text list or hierarchy (LHS menu)
  - Tabs for a purely linear structure
  - A clickable graphic image or text + graphics (i.e. a map)
  - Complex web sites may show only current level details but link to a parent
- Must continuously update user's current position
- A *breadcrumbs* line also allows navigation back to where one has "drilled down" from



## The "mode" problem

- When the feedback loop changes without the user realizing
  - My mouse doesn't work in Explorer!
  - Ah, you created a blank file name in *edit mode*, which is not allowed - press Esc twice to restore the file name (and *browse mode)*
  - I didn't know that I was in "edit mode"!
- Systems must give clear cues if they *change the rules of the interaction* (i.e. change "modes")



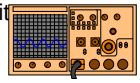
Link: Ergonomics

## Handling controls

- WW2 studies on cockpit controls in fighter planes gave valuable lessons for the design of computer controls:
  - Put the control by the thing controlled
  - Control should "cue" the required action
  - Make the action/result link intuitive
  - Provide continuous feedback
  - Minimize the feedback channels
  - Let the user "play" in a simulator

## Put controls by object controlled

- Microsoft put all controls on a taskbar
  - Confuses as *what causes what* is unclear (e.g. new users press each in turn to see what it does!)
  - Have
- Contextual commands are better:
  - Right mouse popup menu for selected graphic object
  - Select a graphic object to get "handles" to rotate it





## Cueing for actions

- User need *action cues* to respond, e.g.
  - 3D buttons project out so *cue for pressing*
  - Users may not press flat areas (even if they work like a button) as *flatness does not cue pressing*
  - Users will press *objects* in a flat picture, if the objects are look like 3D objects
  - They will not so often press backgrounds
- A microphone image pushed forward might cue for a speech recording



## Intuitive effects

- Action/result link should be intuitive e.g.
  - For a plane, joystick forward is down and back is up
  - For a switch, "Up" is high "down" is low
    - In US up switches lights on
    - In Europe down is on!
  - Green is "go" and red is "stop"
  - For a button, down is on and up is off
  - Whatever the user expects/finds "natural"

*"Intuitive" controls fit what people expect*



## Confirmation messages

- Always *confirm* non-reversible actions
  - Do you really want to reformat your hard drive?
  - Make the consequence clear, e.g. explain what "reformat" means
  - Don't give ALL details but a "More" button so a user can *choose* more details
  - Use perceptions (colors, capitals, fontsize, sound, graphics) to indicate *serious* consequences
  - Warn if it is reversible or not



## Feedback and errors

- Trying to drag and drop a file, I instead copy a whole directory:
  - Feedback makes me *aware* of the error
  - Cancel button lets me to stop it *in progress*
  - Undo button lets me to *reverse* the copying error (the copy program should know the files it copied)
- Systems with undo let users experiment without penalty (*play* maximizes *learning*)



## 3. Managing internal states

- Discrepancy from a desired state increases system activity i.e. increased *drive or need*
- Increasing emotional drive causes more:
  - Motor system actions (actions/tension)
  - Sensory/cognitive analysis (attention/awareness)
- Supports "dominant" acts not new or complex ones, i.e. if emotional, people revert to tried and true, and can't learn new things

## Emotions

- *Emotions* link to body *states*:
  - *Emotion* of *Fear* ~ *Sensation* of *Pain*
  - *Laziness* ~ Sleep
  - *Greed* ~ hunger
  - *Lust* ~ sex
- The *emotional neural system*
  - is independent of body *chemical state,* based on chemical messengers (hormones)
  - but has *learned* to connect to it



Link: Emotions

## Emotions are state memories

- Emotional systems in the brain developed to:
  - *remember* and *represent* past body states (emotional not intellectual memories)
- Emotions *remember* a body state by *re-creating it*:
  - Emotional system can activate parts of the body via autonomic nervous system and chemical messengers
  - Emotions can cause state changes (e.g. blushing, heart rate etc)
  - By our emotional centre, we can *feel* body states.



## The value of emotions

- Emotions *represent* states to allow emotional learning, as concepts allow intellectual learning (i.e. EQ *and* IQ)
  - if a dog bites us causing pain
  - a dog again causes fear (plus state changes)
  - Allows *one trial learning* essential to survival e.g. touch a hot stove only once
- Body state changes are *slow* (via chemicals), emotional system allows *faster* responses
- Emotions *motivate* us to action (emotional events are remembered) and define *likes, dislikes* and *purposes*



## Application - emotional tone

- Every web site evokes an *emotional tone* - its overall impact on the emotions
- Emotional tone uses *past emotional associations* of images, sounds, colors or textures
- Can set in place quickly and "color" everything else (e.g. fear evokes sensitivity to danger signs)
- Certain text words may have *bad associations* for certain people *(red flag words)*



## Application - assessing user purpose

- In evaluating a web site ask:
  - *Who* are the likely users?
  - *What* is/are their likely purpose(s)?
    - To gain information and/or understanding (e.g. wikipedia)
    - To experience or satisfy emotional states (e.g. a video site)
    - To learn a skill or get a useful tool (e.g. download sites)
  - Does the web site match the purpose(s) of its likely users?



## Overall summary

- A feedback loop can evolve in three ways:
  - *Intellectually.* A system to represent and manipulate useful abstract concepts (intellect)
  - *Emotionally.* A system to represent and manipulate desired body states or needs (emotions)
  - *Physically.* A system to represent and manipulate effective motor schema (psychomotor)

## Example

- A web navigation feedback loop uses:
  - Intellectual understanding of a conceptual map
  - Emotional desire for a destination
  - Motor skills to change current location
- A good computer systems is one we:
  - Understand conceptually
  - Like emotionally, and
  - Can use effectively
- Consider a web site ***from all three aspects***



## Other applications

- Users may *understand* a new concept from others - FAQ section lets users view previous learning
- A positive emotional association with one site can transfer to others in a "ring" if each *recommends* or links to them - trust is transferred by recommendations
- People *find* sites by feedforward *predictions* put into a search engine as words. Your site can give the right words to search engine via meta-tags
- Use the web to find what people are searching for, and target that



## Review: Web design "Do's"

- Do combine words and images (Mozilla vs Word buttons) because two channels are better than one
- Do present information in screen size chunks
- Do structure a screen into 2-6 sections
- Do simplify and omit inessential information
- Do use fonts, colors and shapes consistently
- Do distinguish background and foreground
- Do make everything as clear as possible, e.g. type
- Do use established mental models (e.g. space, faces)



## Review: Web design "Don'ts"

- Don't overload/overfill web pages
  People wont read detail and wont scroll - they click-on only if happy with this screen
- Don't add many options or links (add text support)
- Don't have many fonts, symbols and colors
- Don't use tiny type - hard to read is more effort per result
- DON'T SET TEXT IN ALL CAPS – its shouting
- Don't have long videos or large graphics - *the best online delay is no delay*



## Homework – To Read

- The following are the key readings for this lesson:
  - *Feedback*: how motor systems use it
  - *Cybernetics*: applying feedback to machines
  - *Homeostasis*: Keeping constant states
  - *Spatial coordination*: The spatial mental model
  - *Schema*: Abstract motor actions (cf sensory perceptions)
  - *Skills, memory for*: different types of memory
  - *Skills, human*: how people can exceed the apparent limitations of a feedback loop



## OTHER LINKS

- http://psychology.jrank.org/pages/1098/ergonomics.html
- http://www.answers.com/topic/automatism

## Next:

- Learning - how a processing system changes its processing?