# THE BRAIN AND TECHNOLOGY

Brain science in interface design

# FEEDBACK

Brian Whitworth, BA (Psych), BSc (Maths), MA (Psych), PhD (IS), Major (Retd.) With illustrations by Jasmin Whitworth

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# FEEDBACK



Knock, and the door will open.



### PART 1. FEEDBACK LOOPS

Feedback loop (shown in red) The Brain causes Behavior that alters Stimuli that alter the brain, in a loop that goes round and round For animals:

- Environment **stimuli** produce sensory input
- The brain **processes** the input
- Then directs muscles to act
- Altering the **stimuli** coming in, etc....

The **feedback loop** is **open** because there are **other causes** 

- It is not obvious what causes what
  - How to make dogs stop barking
- Superstitious behaviors: Are self-sustaining
  - Must sacrifice a bull at mid-winter for summer to come

Today, technology has replaced the world in our FB loops.

Computer games have replaced cards and Mah Jong

Mithra kills the bull to make summer come?





### **STIMULUS-RESPONSE THEORY**

#### Stimulus-response (S-R) theory or Behaviourism:

• Aim to **predict & control, u**sing **input stimuli** only, without mental models or purposes.

Stimuli cause responses so animals should be:

- Passive to input
  - Without stimuli, they should do nothing.
- **Controlled** by environmental stimuli
  - Environment **contingencies** (S) control people's **behavior** (R).
- **Computers** may be like this, but animals aren't.

Online commerce assumes S-R theory when it asks:

- How can we **make** people buy online?
- How can we **control** customer behavior?

Push vs. Pull: The story of the wind vs. the sun

• All the research on how to manipulate people online is based on the premise that people are **input driven**.



Wind vs. Sun is push vs. pull

#### **INPUT DRIVEN**

Input-Processing-Output or IPO models look like this

Input

Process

Output

Flour = wheat + milling

**Behavior = input + process?** 

In fact, people

- Get **bored** without sensory input.
- Hallucinate in sensory-deprivation studies.
- Anticipate: Use feedforward.
- Actively **explore** or seek out stimuli.
- Have **purposes** and **goals**.

The brain, a massively parallel, multi-level, continuously active and highly connected processor, can create its own input, e.g. dreams



Is the brain a machine?

### THE GREAT PSYCHOLOGY WAR

#### **Constructivism vs. Behaviorism:**

- **B. F. Skinner:** Objective stimuli from the world control behavior.
- Noam Chomsky: The brain constructs a subjective world and acts accordingly.

Studies then confirmed:

- 1. **Overload**: There are more stimuli than it is possible to calculate.
- 2. **Productivity**: There are more responses than are learnable.
- 3. Anticipation: Response times can be less than processing times.
- 4. **Modelling:** Learning can occur without rewards.

5. **Masochism**: Some people like pain! This is NOT a stimulus-response world.



Behaviourism vs Constructivism is an argument about where the human feedback loop starts?

### **OUTPUT DRIVEN**

Actions alter input:

- In bacteria, motility evolved before sensing.
- In embryos, motor neurons develop before sensory ones.
- Embryos **move** before sensory cells start working.
  - A bull in a china shop, a boy with a hammer

Output can create input.

- What one sees depends on:
  - The direction body faces -
  - How head is turned
  - Where eye is directed
  - Focal length of the lens

Biology implies R-S rather than S-R loop!

Actions affect retinal stimuli.

For bacteria, movement gives feedback.

Output

Input



Processing

#### INVOLVEMENT

Does your app/web site:

- **1. Dominate** the interaction?
  - Modal questions
  - Flashing ads
  - Pop-up windows
  - Unwanted audio/video
- **2. Invite contributions**?
  - Comments: Can say something
  - Votes: Can express an opinion
  - Links: Can add a link
  - Pictures: Can post a picture
  - Videos: Can post a video

Successful software lets people add value!



In human-centered computing the software is the feedback environment

### PART 2: DRIVING THE FEEDBACK LOOP

A feedback loop **circle** can start anywhere!

- IPO: Input-Processing-Output, so data directs the loop?
  - Mechanistic view that input causes output
  - Sit-in-office spreadsheet managers
  - Software that **spies** on what people do
- **OPI**: *Output-Input-Processing*, so actions direct the loop?
  - Do things and see what happens
  - Walk around managers "How's it going?"
  - Software that **asks** people to help

In between S and R is **processing**, giving:

- **POI**: *Processing-Output-Input*, so the person alters output to get a desired input.
  - **Purposes** and goals drive the feedback loop.





Recycling is a feedback loop

### **BIOLOGICAL FB LOOPS**

**Homeostasis**: System maintains a constant internal state.

- Rats search for food until full.
- **Robots** search for a power point until recharged.
- Webbots search for information until satisfied.
- Flying drone bots recharge by sitting on power lines.
- Life is about maintaining temperature, glucose ...

<u>Autopoiesis</u> (Humberto Maturana): A system creates itself by:

- Self-regulation (homeostasis)
- Self-direction (autonomy)





Cell Mitosis is life creating itself.

The brain controls our glucose level

#### **MANAGEMENT FB LOOPS**

S-R theory: Workers, like donkeys, must be forced or bribed.

• **Theory X**: **Drive** workers with reward/punishment. **Human centered**: Workers, like **children**, are a good risk.

• Theory Y: Enable workers to innovate and create. A combination: Workers need incentive and investment.

• Theory Z: Incentivize and enable workers?

Why do people change jobs?

- Physical reasons: Health, sleep, risk ...
- Information reasons: More money, less costs ... ...
- Personal reasons: Learning, recognition ...
- Social reasons: Family, friends ...

Why do people change software? The same!

 Social systems are people communicating (Niklas Luhmann), so social and personal factors count more when people use them.



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#### **CYBERNETIC FB LOOPS**

Simple causality doesn't work for feedback loops.

• Input causes output, output causes input!

**Cybernetics** a new type of causality:

- "... controlling the system by reinserting into it the results of its past performance" (Wiener)
- Problem: Steam engines generate enough power to explode.
- Watts governor: Power output governs steam input via a set value.

The system **cause** is the **loop control parameter**, i.e., the processing.





### THE BRAIN IS PROCESS DRIVEN

Feedback loop is **initiated** by 3 types of processing:

- Sensory processing (fore-brain)
  - Based on sense data and symbolic processing
  - Can't speak or think without it
- State processing (mid-brain)
  - Based on processing of inner states
  - Can't understand others without it
- Motor processing (hind-brain)
  - Based on generating feedback
  - Can't walk without it, or click a mouse
- Each FB loop center has its own
  - Input channels
    - Cerebellum receives location information.
  - Output channels
    - Mid-brain can create hormonal states.

Plus each center has its own intelligence, knowledge and memory



### PART 3. PURPOSE

Drive: A desired inner state

• We call the state we want happiness.

Goal: A desired outer result

• Say, a big house and pretty wife

Purpose: A drive linked to a goal is the pursuit of happiness

- Only purposes explain human behavior:
  - **To entertain** can be offering food, singing, making a joke ... nothing in common but the purpose

**Purposes cause actions** 

- Is going to a restaurant to eat food the future causing the past? No!
  - A thermostat set to a **future** temperature alters heat **now**.
  - A desire to eat **now** makes me eat in the **future**.
- Purposes as **FB loop parameters** define us.



Our purposes define us.



#### **PURPOSE UNVEILED**

**Drives** as desired inner states can be:

- Genetic or hard-wired: e.g., hunger, sex, curiosity
- Learned or acquired at run time: e.g., money, happiness
- Cultural or from a common library: e.g., racism, sexism Goals as desired outcomes can be:
  - **Defined**: One knows if they are achieved: e.g., to marry.
  - **Undefined**: The goal posts can move: e.g. to find love
  - Impossible: To find a unicorn, to change others
  - Nested: Get a degree to get a job to get wife to have sex.

**Purposes** as goals to satisfy drives can be:

- **Conflicting:** To nurture my son and dominate him
- **False:** To feel 100% safe but what if a meteor ...?
- **Redefined:** Happiness isn't a goal one can pursue but a state of mind that arises.



# Happiness is a state of mind.

#### HAPPINESS

Happiness: A feedback loop parameter:

- The ultimate purpose (Socrates): Happiness is what every person wants.
- Absence of pain: Happiness is having no pain.
- **Hedonism:** Happiness is experiencing pleasure, but pleasure is like a knife that dulls with use.
- Struggle: A job well done is its own reward.
- **Meaning** (Victor Frankl): Happiness is choosing a purpose meaningful to me
  - What is life's purpose? Life asked you first!
- **Know the self** (Buddhism, Hinduism): Who is turning the feedback wheel?
  - "Happiness is the absence of striving for happiness" (Chuangtze).

The Internet is full of people looking for happiness.

• Can a web site change an inner state? Absolutely!



The Internet is changing humanity one inner state at a time



### WHAT PEOPLE WANT

People can use software to:

- Get information (wikipedia)
- Feel good (music)
- Keep up to date (news)
- Be sexually aroused (pornography)
- Discuss ideas (chat rooms, boards)
- Follow social trends (Twitter)
- Learn or teach (Moodle)
- Relate to friends/family (Social networks)
- Make business connections (Linkedin)
- Forage for stuff (Amazon, Ebay)
- Make money (NASDAQ.com)
- Nurture others (tamagotchi digital pet)
- Look at others (lurkers, voyeurs)

What human drives is your software about?





Tamagotchi appeals to our desire to nurture



#### MAINTENANCE OF THE AIM

The first rule of war is: Maintenance of the aim

If you don't know where you're going, you probably won't get there.

Define the product purpose **before** you begin design.

To make money alone is a primitive purpose.

Need a higher purpose stated up front

- Health: Wellbeing
- Education: Understanding
- Business: Synergy
- Politics: Service





#### SOFTWARE SHOULD PUT PURPOSE FIRST

What do people want?

- Gain: What outcomes or states do they want?
- Loss: What don't they want to lose? Identity, peace
- Maintain: What do they want to keep? Privacy, safety

How can technology mediate that?

- To maximize only **my** profit isn't **sustainable**.
- A higher **purpose c**an be shown to staff and customers!
  - **BMW**: To help people experience the joy of driving
  - The Container Store: Get organized, be happy.
  - **Google**: Make the world's information accessible to all.
  - Apple: To make technology people love
  - **Uber**: To connect drivers and passengers
  - Can hire people with a common purpose

Purposes motivate people in a way that nothing else does.



### SOCIAL SYSTEMS

**Social system:** A set of people interacting according to common beliefs including laws, norms, rights and roles

# Social purpose: A purpose of a social system Sustainable social purposes:

- **Justice**: An act's consequences should accrue to its actor.
- **Openness**: Knowledge is shared freely (science).
- **Transparency**: Of community governance
- **Tolerance**: No personal attacks on minorities.
- Synergy: Maximize the gain for all.

**Socio-technical systems** are technical systems that succeed by mediating a social system.



#### What is your social system?



#### **SOCIAL DEFENCES**

**Social systems** need social defences just as physical systems need physical defences

**Social defences** protect against defections that destroy trust

**Defections** like lying, cheating, stealing etc. collapse social systems, online or offline.

Socio-technology needs defences against trolls, cheats and predators.

Synergy	Examples	Defection
Communicate	Email, Chat, ListServ, IM	Spam. Spammers (spam filters)
Learn	Moodle, Blackboard	Plagiarism. Students copy (turnitin)
Know	Wikipedia, Tiddlywiki	Trolls. Wikipedia monitors "trolls"
Friend	Facebook, Myspace, Bebo	Predation: Banish predators
Trends	Digg, Del.icio.us	Advocates: Mark their own web sites
Play	2 <sup>nd</sup> Life, The Sims, MP games	Bullies/Thieves: Rob newbies ("safe" areas)
Trade	E-Bay, Craig's List, Amazon	Scams. Reputation systems cut scams
Work	Monster	Faking. Padded CVs, fake job offers
Download	Webdonkey, Bit-Torrent	Piracy. Society's copyright laws
Publish	Flickr, YouTube	Offensive: Editors remove items that offend.
Advice	Help boards, AnandTech	<b>Confusers</b> . Put old questions in new threads.
Discuss	Slashdot, Boing-Boing	Caviling: Karma systems deselect negativity.
Follow	Twitter	Identity theft. A persona is hijacked.

### **DECLARATION OF ONLINE RIGHTS**

**Privacy**: The inalienable right to control personal data.

- **Choosing** to appear in public or publish in public
- Expect fair use: e.g., CCTV video is only used for security by the state, not for profit ...

**Accountability**: All digital rights must be allocated to people.

• "The computer did it." is never an excuse.

**Freedom**: An active online persona should not be a slave, cf. your online persona sending messages itself is a zombie slave.

**Ownership:** Who creates a thing immediately gets all the rights over it.

- Who creates a photo or video and posts it online **initially** owns it
- I may then choose to **re-allocate the rights**
- A creation space (Facebook, Youtube ...) may have creation conditions agreed in advance

See our papers on developing universal online rights that can be implemented by a common **access control module** 



How human rights are drafted

#### **DIGITAL WILLS**

What happens to all your online stuff when you die?

A **digital will** lets you pass rights to someone else

- Google's Inactive Account manager
- Facebook's legacy contact

#### About Inactive Account Manager

Inactive Account Manager is a way for users to share parts of their account data or notify someone if they've been inactive for a certain period of time. To set up Inactive Account Manager, go to www.google.com/settings/account/inactive and click Setup.

#### How do we detect activity?

We look at several signals to understand whether you are still using your Google Account. These include your last sign-ins, your History page, usage of Gmail (e.g., the Gmail app on your phone) and Android check-ins.



### **PART 4. FEEDBACK ELEMENTS**

Feedback (FB) loop elements:

- Environment: That changes: e.g., the weather
- Sensor(s): Register the environment: e.g., eyes
- Control: By sensor data + knowledge directs effectors
- Effector(s): Change environment: e.g., hands, feet Heating system:
  - Sensor: The thermostat
  - **Control**: Records a desired temperature
  - Effector: The heating system itself
  - Thermostat senses the temperature; the control stops or starts heating based on the desired temperature.

Human feedback loop:

- Sensors: The senses
- Control: The brain
- Effectors: The muscles



Heating Control is a feedback loop parameter

### SEARCH EXAMPLE

Search loop elements:

- Effector: Typing search text
- Environment: The world wide web
- Sensor: The result list
- Control: Search purpose
- **Output driven**: Act first then get a result. How search is evolving:
  - More senses: Image, video and sound results
  - Easier effects: Autocomplete, did you mean?
  - More effects : Search for pictures such as this
  - Feedforward: Weather, news or sport default
  - Rerun the loop: Search within a search
  - Remember: Advise me of new results by email.
  - Extelligence: People who searched for xxx also sought
  - Learning: Thanks button option vs. rate result demand



A world in which every single human being can freely share in the sum of all knowledge.

Free access to information – and disinformation!

#### **A COMPARISON**

#### Heating system:

- **One** input (temperature)
- **One** output (heating)
- **One** desired state (temperature)
- Controller knowledge is
  - Pre-set: Default values
  - Acquired: Owner specifies
  - **Social**: Community can alter it?
- One controller
- Passive to its environment
- Can't guess (feedforward)
- Can't alter itself (learn)

#### **Biological system:**

- Many inputs (senses)
- Many outputs (muscles)
- Many desired states
- Controller knowledge is
  - Genetic: Built into our genes
  - Acquired: As we are taught
  - **Social**: The current culture
- Three controllers (Intellect, emotions, will)
- Active to its environment
- Predicts (feedforward)
- Alters itself (learns)

### **GIVE FEEDBACK**

Without feedback, people try again.

- Load-up splash screen avoids multiple starts.
- My wife downloaded an update over ten times.

Without feedback, people exit the loop.

- Restarting during a software installation can be fatal.
- If nothing happens, how do I know the system hasn't hung?

Feedback includes:

- A real progress bar (that changes)
- A report of progress milestones
- Entertainment or information during the event
- Offer to run in the background
- Give partial results: A one-second search that gives a thousand hits plus a **More** option is better than a 10-minute search that gives a million hits.

Give feedback or lose the interaction!

Warning to not turn off!



#### Flash screen stops double starts



### **DYNAMICAL SYSTEMS**

**Dynamical system**: One whose parts autonomously act or interact over time—e.g., the weather, a forest **Snowball effect**: Small initiator has a big result in time

- Tornadoes begin as small swirls of air.
- Tiny seeds become great oaks.

Amplification: Each cycle increases the effect.

- **Seeding**: A speck of dust crystallizes a saturated liquid.
- Broken windows: Small crimes create bigger ones.
- Vicious cycle: Negativity creates more negativity.
- Virtuous cycle: Pass-it-forward; give back to life.

Socio-technical systems are dynamical.

- One video, tweet or song can go viral.
- One negative comment can cause an uproar.
- One person tells 3-10 others who tell ....



How systems grow like snowballs

#### **FEEDBACK HELIX**

Add a **time** dimension to a feedback loop, and it becomes a **feedback helix**.

- Life is feedback over time.
- Computer games are feedback over time. Students who:
  - Struggle to input a textbook for an hour a night;
  - Can build a virtual civilization or shoot zombies for 4+ hours/night!
  - Why?? Responsive software vs. passive book.
- Each loop compares actual input to the intended goal.
  - Reach for an object, see the object-hand discrepancy, then adjust.
  - Is your website/app "just a pretty face?"



## **GAMES AS FEEDBACK LOOPS**

Turning a feedback (FB) loop is **what we do.** 

• Chat is an FB loop.

Games as FB loops vary by:

- **Purpose**: Combat, build, nurture, explore, acquire, relate
- Cycle control: Real-time vs. turn-based
- **Result variability**: Random events? Luck
- Result time: Strategy vs. action
- **Community**: Single player vs. group, MMO
- Identification: Role-playing avatar
- **Motor skill**: First-person shooter, click speed
- Intellectual skill: Puzzles, patterns
- Just one more click

**E-sports** 



#### AN EXAMPLE

**Civilization Beyond Earth** is a popular turn-based strategy game built by a very competent team

- Contrast problems
  - Miasma hard to see
  - Roads hard to see
- Feedback loop problem
  - Automatic jump to next unit makes the feedback cycle easier
  - A player gathers units around a city to attack (purpose).
  - The game next jumps to units all over the map!
  - Nearest unit cycle would fix this.
  - Programmers don't recognize that people work in a feedback loop



#### Can you see the roads?

### **TIPPING POINT**

Catastrophe theory: Dynamical systems are non-linear.

- A straw breaks the camel's back; a rock causes an avalanche.
- Little causes can have big effects.

**Tipping point theory**: Change is invisible until it "tips".

- One speck causes a saturated liquid to crystallize.
- Social discontent, like saturation, builds up slowly unseen until a small event triggers a major change.
- Killing Archduke Franz Ferdinand caused World War
   I?
- One person triggered the Arab Spring revolution?

Law of the few: 20% of people cause 80% of change

- Connectors: People who introduce people
- Mavens: Experts who share knowledge
- Salesmen: Persuaders who convince people
- Lurkers: People who just look are the vast majority (90%).

He started the Arab spring





### PART 5. LOCUS OF CONTROL

Locus of control: The initiation of a feedback (FB) loop

- **Determinism**: The environment initiates
- Humanism: The person initiates

Not everyone wants full control

- Children don't expect control.
- Gamblers imagine control.
- Adults like to be in control.

Control isn't always good, e.g. Joseph V. Brady's executive monkey experiment:

- Two monkeys were given electric shocks unless they pressed a lever.
- However, only one monkey's lever worked.
- The monkey in control (the executive) got ulcers.
  - In a negative environment, control hurts.
  - In a positive environment, control helps.

The **Wellness Syndrome:** Unrealistic expectations of control over our bodies create guilt, worry and anxiety.



Are you in control?



Is this monkey?

### WHO CONTROLS ONLINE SOCIAL INTERACTIONS?

People **share control** in social interactions, e.g. a conversation should be mutual, so people online **don't like**:

- Being forced: To update, to register ...
- Being **nagged**: To update, to register ...
- Polite Computing: Software that respects people
  - Asks if it can do things
  - Remembers what you did last
  - Selfish software runs itself at every chance.

Who controls the HCI interaction?

- Directed: The system can require a response
  - For non-experts or in a security case: e.g., banking
- Guided: The system suggests a response
  - For adults who can live with their choices: e.g., travel
- Responsive: System does as it is told
  - For people who know what they want: e.g., browsers



Polite acts repair the social fabric that criminal acts rip apart.

## WHEN SOFTWARE TAKES CHARGE

When software **initiates** tabs, windows or apps, we say **Whoa!** 

- I own this computer; I paid for it to do what it wants?
- Civilization is based on the idea that just because you can doesn't mean you should , i.e. might is not right
- Software doing whatever it can is anti-civilization.
- Fortunately, technology gives as well as takes:
  - Browsers defend us against unruly web sites.
  - Back button is a browser undo.
  - Task manager (ctrl/alt/del) makes apps listen.
  - MSConfig controls unruly startups.

People want choice over products they buy.

- Netflix: TV when I want
- Smart TVs:
  - If they can observe my hand wave, hear my speech and upload any of that data without asking, then there may be a foreigner in my living room! "Trust us" is not good enough.



#### Whose in charge here?

←



#### INSOLENCE

Insolence: Showing disrespect to another's choices

- Challenging another's decisions for no reason
- I don't value your choices means I don't value you.
- Software that unnecessarily questions decisions is **insolent**.
  - Are you sure you want to leave this web page?
  - Do you really want to log out?
  - Do you really want to move this file to the recycle bin?

Software should only confirm a choice when it is:

- Irreversible: Clear trash? Overwrite file?
- Serious: Reformat disk?
  - State if irreversible.
    - WARNING: Formatting will permanently erase all data on this disk!
  - Use color, capitals or sound to indicate serious.
  - Give details in a "More" button.



Why do you always question me?

#### **SOCIAL TERMS**

#### Affordance: An invitation to use

- Buttons invite pressing.
- Handles invite holding.
- Babies invite affection.
- Accommodation: People adapt to technology:
  - We get used to **stupid** TV controls?
    - You get used to hanging if they leave you long enough.
  - Given choice, the strong migrate.

#### Appropriation: An unintended use

- TV control: Can mute the ads, channel surf
- Mobile phone: A shopping mall wife-finder
- Photo receipts for online tax return
- Flash protests: Firechat Off-grid system via local Wi-Fi.
- Unintended consequences: If the US appropriates the Internet, others will build their own, killing the WWW.
- China appropriated Western technology give us a factory to see.



This cup invites use



This technology doesnt

### PART 6. THE FEEDBACK PROBLEM

#### Stimulus-driven systems are always after the fact.

- The heating system turns on after it gets cold.
- It turns off after it gets hot.

**In evolution**, it pays not to **wait** for negative states to occur!

- Start the feedback loop with a **prediction**!
  - Find the enemy before they find you.
- Skilled actions use anticipatory schema.
  - It is better to do something than nothing.

#### **Designers:**

- Should you wait for complaints or request them?
- Those who do something may lose but those who do nothing always lose.
- Past businesses that ignored **opportunities**:
  - Word Perfect, Visicalc, Friendster, Myspace
  - Yahoo turned down the purchase of both Facebook and Google

#### Failure happens for two reasons:

- **1.** Doing without thinking.
- 2. Thinking without doing.



#### FEEDFORWARD

Feedback: React to stimuli after the event. Feedforward: Act before things occur.

- The system acts first then adjusts.
- Restarts if the first response isn't in the ballpark.
- In this way, people can get a reaction time of zero!



# Feedforward is how goalies save penalties



### **ACTING VS. REACTING**

Feedback reacts; feedforward acts.

- Reacting
  - Pull back from an attack.
  - Avoid all pain with painkillers.
  - Kill all bugs with antibiotics.
  - Deny any criticism.
  - Avoid all negative feedback.
- Acting
  - Move into attacks (Aikido).
  - Pain is your body's **advice**.
  - Bacteria **strengthen** us (our biome).
  - Criticism (review) improves thought (science).
  - ALL feedback is useful.
- Weightless astronauts become too weak to walk.





#### Pain is not always bad.



Use enemy attacks.

#### HANDLING NO RESPONSE

#### No response is a response!

- In my Access database class
  - The young clicked and got a database lock.
  - A mature lady just looked and read for 40 mins
    - she needed my attention.
- In triage, the quiet ones need help.
- The response that hung my interactive system was a person doing nothing for 20 minutes
- Software responses to inaction:
  - Ask: Are you still there?
  - Offer: Do you need help?
  - Suggest: Here are some options.
  - Encourage: Don't worry, you can't break me.
  - Security: Banks log off or exit you.
  - **Comments**: No one wants to be first (seeding).
  - Personalize: Seeing a known face increases the likelihood that an email, say, will be replied to.



#### LURKERS?

Lurkers: The software community calls people who look but don't contribute "lurkers"!

• Most people learn from life that they are ordinary, so they doubt, distrust, lack confidence, worry, etc. for a reason.

**Spectators**: **Like to watch** what they cannot or dare not do.

- Are spectators at a football game lurkers?
- Are people watching TV lurkers?
- These are wrong expectations.

Spectators **contribute** by:

- Looking: Viewing is an act (number of views)
- Applauding: Clapping (number of likes)
- Recommending: Telling friends (adding links)

Most spectators like:

- Anonymity: Lest they be ridiculed, disparaged or attacked
- **Recognition:** As part of the group



Many people like to watch others play video games on YouTube?

#### **SPECTATORS AREN'T LURKERS!**

Calling **spectators lurkers** illustrates how damaging a technology centered approach is.

Imagine if sports organizers routinely called the people who attended their events lurkers!

Or movie producers, or teachers, or actors ....?



Are all these people "lurkers"?

### STATE FEEDBACK

#### What does this mean?

**Inner states**: Define purposes and goals.

- Kinesthetic state: Muscle feedback
  - Lets us shower in the dark or do a back flip (fast motor loop)
- Emotional state: Learned hormone reaction
  - Fear predicts danger.

Technology inner state is equally critical

- **Hardware**: Drive light, Router light, Temperature, ...
- Software: CPU use, RAM use, HD write. Modem use
  - **Speccy**: Reveals my system's inner state
    - Don't restart a computer that is writing to disk!
- Systems that predict failure can be repaired beforehand!
  - Computers with state feedback cost less to maintain.
  - Always show the current state!
  - Technology that is **understood by people** always works better that that which hides its state from people.



### PART 7. NAVIGATION

#### Successful navigation requires:

- Destination: Where you want to go
- Current location: Where you are now
- A map: That describes the space
  - A web site is a space
  - A document is a space

Without a:

- **Destination**: We have nowhere to go.
- Current location: We are lost.
- Map: We don't know the way.

People wander about websites to:

- Find a **destination** they want.
- Build up a mental **map** of the space.
  - Sunday drivers, Internet wanderers and foragers like to explore
  - In **No Man's Sky**, you can name a new planet you find.



#### This navigation doesnt

🚺 Organisieren 👻 🔢 Ansiel	nen 🖌				
Ordner	~	Name	Änderungsdatum	Тур	
Volume (D:) downloads Film programme SecondLife temp virtualpc xampplite apache		apache cgi-bin htdocs install licenses mysql perl php phpMyAdmin	security sendmail tmp webalizer webdav apache_start.bat apache_stop.bat makecert.bat msvcr71.dll	mysql_start.bat mysql_stop.bat readme_de.txt readme_en.txt service.exe setup_xampp.bat xampp_restart.exe xampp_start.exe xampp_stop.exe	

This navigation works

## **GETTING LOST**

Lost: Not knowing where yourself or something else is

- People can lose:
  - The cursor
    - Move mouse randomly to restart feedback loop.
  - The current directory
    - Don't see the **open folder** context
  - The focus window
    - A hidden modal error window (Alt/Tab)
  - A download that goes somewhere
    - Download it again unless the Browser **remembers**.
  - An email attachment doesn't tell me where it went.
    - Saved to the default (huh?) directory
  - Last edits: I loaded and updated an earlier version instead.
  - An email: It went into my spam folder!

#### Losing yourself



Losing a file

### **SPACES**

A Space: That which contains an object Can have dimensions:

- **1D**: List, drop-down box, sequence
- 2D: Clickable graphic, menu hierarchy
- 3D: Virtual space, second life

Allows movement:

- 1D: Forward-back, up-down, left-right
- 2D: Two of above, allows rotation, area, path
- 3D: Three of above, allows levels, volume, helix Location:
  - URL: Text based meaning for a web location
  - Breadcrumbs: Is also meaningful
  - Map dot location: Plus direction facing?

Extelligence: Social space knowledge

• Tag clouds – Follow established community paths



A tag cloud

### MODES

Mode change: When the feedback loop is changed

- My mouse doesn't work!
  - Explorer: You are in edit mode press Esc twice to restore the file name and return to browser mode.
- I can't edit my Moodle files.
  - You aren't in **edit mode,** ...
- Photoshop
  - Every cursor is a mode (different FB loop rules).

Technology with many modes is hard to learn.

- Minimize modes
  - Easier to use
  - Easier to learn
- **Tell me** when the mode changes! e.g. background change
- Always show the current mode.







#### Am I in record mode?

### PART 8. SCREEN CONTROLS

#### Controls allow acts.

- To stop WW2 fighter pilots crashing expensive planes, studies recommended:
  - 1. Put controls by the controlled.
  - 2. Make controls **cue** actions.
  - 3. Make action effects intuitive.
  - 4. Provide continuous feedback.
  - 5. Reduce feedback modes.
  - 6. Allow for **play**.
- The crash rate dropped significantly.

The same rules apply to screen controls including:

 Push-button, drop-down box, popup menu, tabs, sliders, handle, checkbox, edit box, list, radio-buttons



**Pilot controls** 



Software controls!

# **1. PUT CONTROLS BY THE CONTROLLED**

All controls in one place isn't easier for people!

- What causes what is unclear.
- Press each one to see? No!
  - Could exit the field
  - Could change mode
- Contextual tools must be constantly redrawn. **On-demand** (right-click) context menu is better.
  - Select screen object then act on it.
    - Sound controls by the sound icon.
  - Select a graphic object.
    - Intuitive size/rotate handles appear.

Keyboard design

- The Capslock key isn't near the Capslock light.
- Insert mode key next to navigation keys!
  - Overwrite mode: Typing overwrites vs. inserts



#### **Contextual controls**



**Keyboard controls** 



**Graphic controls** 

#### **Toolbar confusion**

## 2. CONTROLS CUE ACTIONS

- Cursor cues (affordance)
  - Pointer cursor cues to press or activate.
  - Hand cursor cues to select, grasp or move.
  - Text entry cursor invites typing.
- Buttons cue to press.
  - Must project up in 3D
  - We don't press flat pictures.
  - We don't press backgrounds.
  - Underlined blue text cue to press for a link.
- Objects laid out cue to:
  - Touch (select with pointer cursor)
  - Drag and drop (hand cursor)
  - To receptacles—e.g., trash can
- Apps cue to double-click to start
  - What file is the app that starts things?
- Incompleteness cues to cursor offscreen for the rest.
- Microphone moving forward cues to speak/record.







#### What file starts the app?

REC	
+	

#### Am I being recorded?

## **3. INTUITIVE ACTION EFFECTS**

Action/result link should be obvious.

- **Joystick**: push = down, pull = up
- Switch: In Europe Down is on. In US: Up is on!
- Button: Press down to turn on.
- Color: Green is Go; red is Stop.
  - My TV indicates On with six red lights!

Some conventions:

- Select: Click to highlight. I touch.
- Activate: Double click to open, edit. I use.
- Menu: Right-Click Click-Hold, Smart-Left gives choices. I look.
- Go back: Esc key, Alt/F4, Rt-Click-Hold, Smart-Right. I leave.
- Home: Windows key, Apple key, Smart main. I return.

Making a control **unintuitive** 

- Ipad: Four finger pull task manager
- **PC:** Ctrl-Alt-Delete! cf Esc-Esc (Exit-Exit)
- Is next window Alt-Tab because it is dangerous?

Denying human control is the real danger.





## 4. ONGOING FEEDBACK

Ongoing feedback lets people catch errors:

- Confirm print format in advance
- If I drag and drop a directory instead of a file, the copy feedback lets me stop the error.
- Cancel-stop lets me halt it in progress.
- Cancel-Undo lets me reverse it.
- In Word, the Edit menu displays the reverse act to be clear, while Ctrl/Z just does it.

Use background for analogue feedback.

- Screen gets redder as computer heats up.
- Smartphone whistles if a message arrives.
- Screen dims if you don't pedal for a while.
- Gyms already use exercise for energy. Feedback matters: http://www.uxmatters.com



#### **Powerpoint Print function feedback**



### **5. REDUCE MODES**

#### Many modes problem

- A WW2 altimeter dial had three needle modes:
  - Small hand is thousands of feet; larger hand is hundreds, and long, thin hand is tens of thousands of feet.
- Cf a watch's hour/minute/second hands
  - Second hand is very thin; hour hand is short and fat.
- To indicate multi-mode values:

• Use a slider plus chevrons (^), pips (\*), or bars(|) Complex software for CAD, sound, video and pictures was used only by an **elite** until **HCI innovations** introduced it to the public:

- Audacity and Garageband for sound
- Moviemaker for videos
- GIMP for Photoshop?
- Easy to use CAD?



This altimeter is reading 10,180 feet.

#### General Fire Department Rank Insignia



## 6. ALLOW PLAY

Under stress, dominant behaviors assert.

• Play is action without stress.

Reducing fear allows new alternatives.

- To relax when falling (drunks and babies survive crashes) Software functions that support play
  - Undo (Ctrl/Z) to fix smart errors.
    - For j = 1 and I = 1 let i = i + 1 ...
    - Word table, graphics and renumber errors
  - Safe areas
    - Game experts looting **newbies** kills participation.
    - Sandbox area for newbies to learn in
  - Buddy/mentor systems
    - FAQ to answer common worries
  - Moderate negativity
    - Stop trolls killing discussions.
  - Confirmations
    - A post only goes public with my consent (YouTube).





#### PART 9. DESIGNER NOTES: FEEDBACK

**Purpose first** 

• Why did you build this system? Why do people come to it? **Invite a response.** 

Invite people to turn the feedback wheel – or lose them.

Respond to no response.

• Encourage, note, list options, offer help, log off.

Be polite.

• Side flags, not modal nags or interrupts, remember. **Support navigation** 

• Give current location, a map and a destination choice. **State feedback** 

• Current state, goal progress, help feedback spirals **Deny defectors** 

• Rules, laws, norms, procedures against cheating, lying, stealing, bullying, libel and other anti-social shortcuts

#### Social feedback

• Game tutorial vs. text manual, FAQ vs. instructions

At the center of every feedback loop is a purpose.

#### **PURPOSE FIRST**

**Product-driven** businesses assumed a profit purpose, and **profit-driven** businesses have to keep that purpose secret.

**Airbnb**: To let people belong anywhere – this is a goal everyone can get behind.

Such systems need the **trust** that only **social systems** create.

Changing your purpose is changing your feedback control parameter!



Explore the world

See where people are travelling, all around the world.



#### PURPOSE

• Selling a human purpose



• Selling a product



### **INVITE A RESPONSE**

- 2011 screen
  - Colors convey fun.
  - Pictures convey action.
  - Headers to links
  - What do I DO?
- 2016 screen
  - More obvious what to do!
  - Tap to eliminate?

#### Moms' and Kids' Playground



Math

ndrain 📃 🍂

playground

000000

Reading

TUN

tickellin | PrimerilPolic

Playgrou

THE MOMS' & KIDS'

### **INVITE A RESPONSE**

Put choices up front, not demands to buy.



#### Nz\$19.00 No Extra Costs Affordable Rental Cars – Car Rental Auckland **Choose Vehicle Class** Affordable Rental Cars Ltd is located in Auckland, New CONOMY Zealand. Since our humble beginnings 23 years ago our mission (as our name tells you), is offering our customers per day All inclusive affordable, reliable rental cars throughout New Zealand! But we don't only offer you cars; we also offer trucks, trailers TOURING and van rentals. er day If you want to rent a car you can choose between nine PREMIER FOTT NZ33 vehicle types (to suit all budgets and requirements): per day All inclusive Economy Car Rental - From \$19 a day all inclusive Touring Car Rental - With a little bit more comfort Premier Car Rental - Affordable luxury Station Wagon Rental - For that extra luggage space All inclusive 4x4 Car Rental - If you're going on a true New Zealand 4x4 HIRE adventure and need some extra power under the hood Family Vehicle Rental - People movers for the big All lockuster family or large group of friends please click here to check Minivan Rental - 11/12 seater minivans great for EOPLE OVER car hire rates and sporting teams or group outings 0.0 availability. Van Rental - Hire a van for some extra storage space per day All inclusive Truck Hire - Furniture truck or flat-deck truck rental at VAN HIRE great prices (TOTAL DATE OF Der day 2 11 As well as our nine types of vehicle Affordable Rental Cars offer trailer hire starting from just \$20 per day all inclusive: Auckland Trailer Hire 10/11 NZ\$60 car rentals We're a proudly New Zealand owned and operated family business and we're dedicated to meet your needs and Australia make you car rental experience as easy and comfortable IRE NZ\$20 as possible. All Inclusive 16 \* May \* 2015 \* We'll be there for you if you need help with your rental car, New Zealand driving rules or directions to your destination. . 604.0 77 If you're flying to Auckland we also offer a free city pickup or airport pickup service. 1.00 get best deals \$



Apex is New Zealand's largest independent car rental

company and offers a large fleet of new and late model car hire options with both auto and manual transmission.

All advertised rates include GST, insurance and unlimited kilometres 
 premium full size
 po 3

 4wd wagon
 po 3

 4w4 full size
 po 3

 mpv 8 seater
 po 3

## **BE POLITE**

- Microsoft modal nag takes control of the feedback loop and demands centre stage.
- Google non-modal nag sits politely at the side.
- Last century's software vs. this century's software

#### Microsoft's modal nag



### **BE POLITE**

Companies require **opt-out** for choices that should be **opt-in**.

#### If I have to read carefully

- Every installation
- Every update
- Every registration
- Every free offer
- To avoid
- Memory hogs
- Data drains
- Message spam

Then I wont install, update, register ... unless necessary.

I confirm that the email address above is correct

#### 3

From time to time we also send information about products, special offers and promotions. Please use the boxes below to indicate which ones you would be happy to receive by email -

- Information on products that you already have with Westpac
- Information on products that you don't have with Westpac
- Special promotional offers (advance ticket sales for concerts etc)
- Corporate information (Company and investor news, sponsorships & our community involvement)

Invitations to participate in customer feedback (surveys, polls, banking feedback)

Rewards (hotpoints etc)

The above only relate to emails, you may still receive communications by mail.

#### 1

Please choose your preferred email format -

- HTML
- Plain Text

#### 5

Next Step

We value your privacy - view our Privacy statement

The default is that we will bug you!

### **NAVIGATION CONTROLS**

- Text links: Simple, many
- Button bar: Simple, few
- Sitemap: Hierarchical, complete
- Tabs: Simple, few
- Breadcrumbs: Simple, local
- Dropdown menu: Needs context
- Plus combinations!

## FAVORITE POSTS <u>Homeless Experiment</u>





Latest Posts	Latest Comments	Most Popular
Latest Po	sts	



### **NAVIGATION**

e Me

- Tab menu at top
- Dropdown menu
- Search option
- Text links
- Popular links have pictures
- No broken links

FindSomeone Holiday House	es Hotels & Motels Treat Me	Christchurch Quake Suppor	£
trademe Where Kiwis Buy and Sell	Login Register		
Home Browse - Sell	My Trade Me Community	Help	Motors Property Jobs
All items		Search	More options
Buying: Watchlist   Won   Lo	Selling: Ite	ems I'm selling   Sold   Unsold	Cool Auctions View all
Antiques & collectables	Crafts	Movies & TV	Cantab cricket
Art	Electronics & photography	Music & instruments	You vs Crusaders, Black Caps & White Ferns
Baby gear	Flatmates wanted	Pets & animals	
Books	Gaming	Pottery & glass	Advertisement
Building & renovation	Health & beauty	Real estate	Building a
Business, farming & industry	Home & living	Services	
Cars, bikes & boats	Jewellery & watches	Sports	AG
Clothing	Jobs	Toys & models	
Computers	Mobile phones	Travel, events & activities	<u> </u>
			future
Cars, bikes & boats	Real estate	Jobs	* telecom
		Six-figure JODS	smartphonenetwork
Volkswagen Golf GT 2004	4 bedroom house in Franklin	Earn more with a Six- figure job!	
Used cars   Car parts	For sale   To rent	Auckland   Wellington	

#### **STATE FEEDBACK**

Dropbox feedback loop based on state

Measures progress to a goal

Q.	Get started	Brian Whitworth -
<ul> <li>Recents</li> <li>Files</li> <li>Team</li> <li>Paper</li> <li>Photos</li> </ul>	You're 2 steps away from a 48 GB bonus The steps below will teach you how to get the most out of your Dropbox. Finish at least five of them and we'll give you a reward!	
<ul> <li>Sharing</li> <li>Links</li> </ul>	O Take the Dropbox tour	
<ul> <li>Events</li> <li>File requests</li> </ul>	Install Dropbox on your computer	Complete
Get Started 2	O Put files in your Dropbox folder	Complete
Deleted Files	Install Dropbox on other computers you use	
×	Share a folder with friends or colleagues	
	Invite some friends to join Dropbox	
Help Privacy	Install Dropbox on your mobile device	Complete

-

#### SOCIAL FEEDBACK

	From ResearchGate <no-reply@researchgate.net>Cr Subject Congratulations Brian, you achieved top stats last week To bwhitworth@acm.org</no-reply@researchgate.net>	s Reply s Reply All - Forward Archive S Junk S Delete
	To protect your privacy, Thunderbird has blocked remote content in this message.	Qptio
You're in the	Bener	arabCat
opouigni.	Your research is	in the spotlight
Go and look button		
We told your department	With <b>54 new reads</b> , you were from your department last wee	e the most read author ek
friends.	Go to you	ur stats
	Congratulations, Brian. Your achievement is sl and co-authors. Go to your home feed now	shown on the home feeds of your colleagues to see your peers' recent achievements.

#### CONTROL

This **take control** website – like many others like it – has since died.

Tiled **text** is a very bad background!

Repeating text in parallel doesn't increase the effect!



### **GLOBAL MESSAGES**

Games have a global message system for agents to talk to us.

Don't need to use modal windows for every message.

Put messages from the software in a consistent place.

- Games that talk to people do this.
- Why not all software, including Windows?

Put messages in a consistent place

Fairy

