SYDE 543 COURSE NOTES
COGNITIVE ERGONOMICS

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1 WHY COGNITIVE ERGONOMICS?

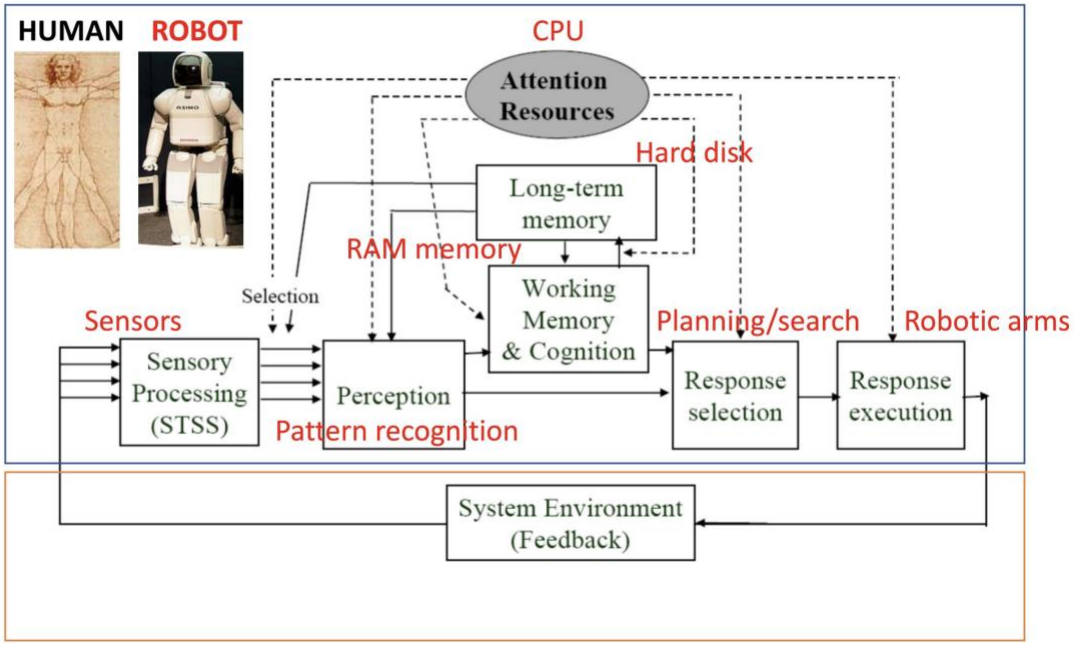
1.1 What is Cognitive Ergonomics?

- Cognitive ergonomics is the field of study that focuses on how well the use of a product matches the cognitive capabilities of users
- Mainly focuses on work activities which have an emphasized cognitive component, are in safety-critical environments, and are in a complex, changeable environment
- Domain: Environment where the system operates, presents constraints and opportunities
- Operates with two underlying theories: a theory about domain and about human cognition

1.2 The Descriptive Model of Human Information Processing

- Short Term Sensory Store (STSS): Events first processed by sight, sound, touch, etc.
- Perception: Determining meaning of events, long term memory of events
- Response Selection: A decision made based on either perception or working memory

A Robot/Computer/Automation/AI Analogy



1.3 Kind vs. Wicked Learning Environment

- Kind learning environments have next steps and goals that are clear, have rules that are clear and never change, get feedback that is quick and accurate (golf, chess, etc.)
- Wicked learning environments have next steps and goals that may not be clear, have rules that may change, may or may not get feedback
- The work world is a wicked environment, where hyper specialization can backfire
- In a wicked world, we need people who generalize first then specialize later on
- We need both frogs and birds, frogs to see the details up close, and birds to integrate the knowledge together, to succeed in a wicked world

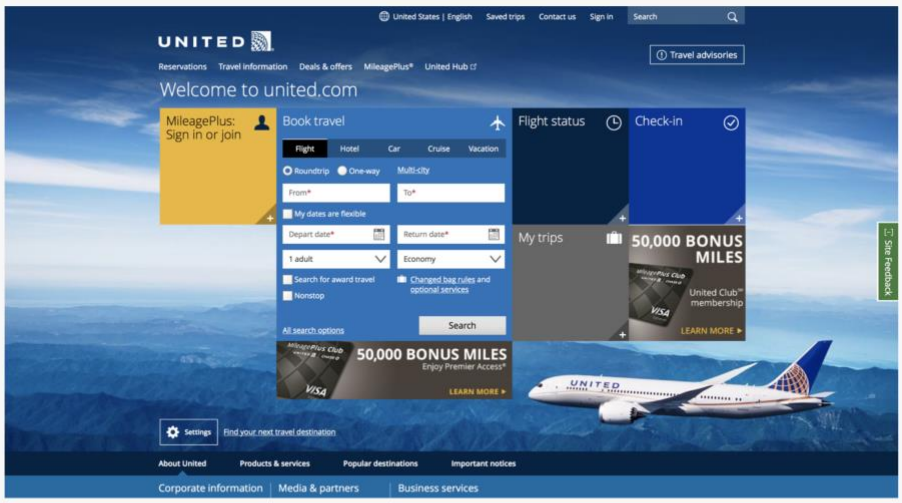
2 SIGNAL DETECTION THEORY AND UI/UX (PART 1)

2.1 Signal-to-Noise Ratio

2.1.1 Definitions

- Signal: Information that is relevant and useful to us
- Noise: Information that is irrelevant to our current need
- Signal-to-Noise Ratio: Ratio of relevant to irrelevant information in an interface

2.1.2 Example



United Airlines' homepage has several elements that might be signal in some situations, but noise in others.

- If booking a flight, “Book Travel” is a signal, but everything else is noise
- UI elements may serve functions other than simple communication or task efficiency
- Aim for a reasonable signal-to-noise ratio rather than excluding all “irrelevant” parts

2.1.3 Increasing Signal-to-Noise Ratio

- Pay attention to your content and have a strong visual hierarchy
- Start with a clear content strategy to help prioritize the information to convey
- Examples: Ensure every piece of text has some importance, avoid redundancy, separate paragraphs, bold keywords, use bullet points, etc.

2.1.4 Visual Hierarchy

- Reflects the relative importance of different elements on the interface (highly relevant, high visual weight)
- Examples: Making font large and bold, changing colour on action, adding an icon, etc.

2.1.5 Dynamic Noise

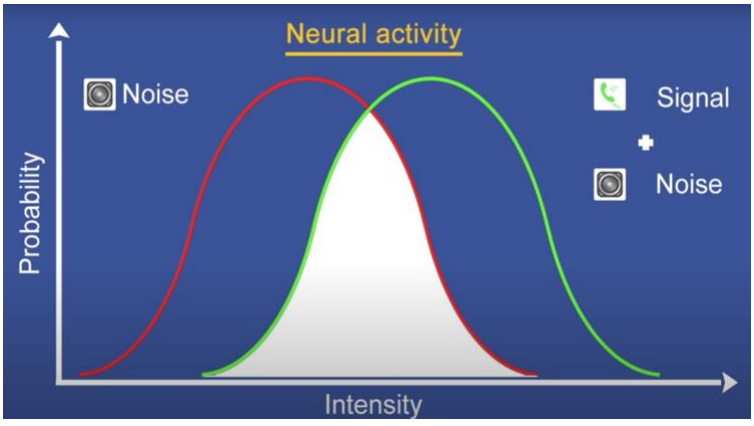
- What counts as noise can change from moment to moment, as the user’s task changes
- Example: Navigation on a website, where the navigation UI is noise while the user is focused on the page content, but becomes the signal once the user is done

2.1.6 Heuristics

- Aesthetic and minimalist design (remove unnecessary elements from the user interface)

2.2 Signal Detection Theory (SDT)

2.2.1 Neural Activity



2.2.2 Hit, Miss, False Alarm, Correct Rejection

- Hit: Positive response when there is a signal
- Miss: Negative response when there is a signal
- False Alarm: Positive response when there is no signal
- Correct Rejection: Negative response when there is no signal

	Signal + noise	Noise
Thinks phone ringing	Hit	False alarm
Thinks phone not ringing	Miss	Correct rejection

2.2.3 Perceptual Sensitivity (d')

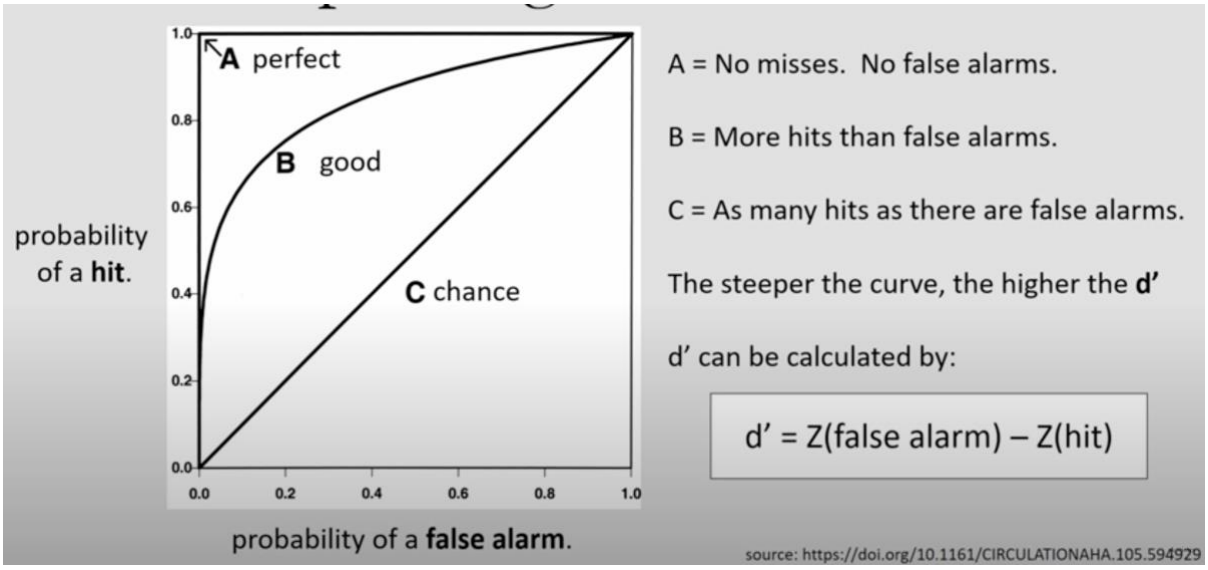
- How different the signal is from the noise
- Larger d': Signal more distinguishable from noise, more hits and correct rejections
- Smaller d': Signal less distinguishable from noise, more misses and false alarms

2.2.4 Decision Criteria (β)

- The degree at which the perceiver is biased to detect or not detect
- Conservative (large) β: Minimal detection, more misses and correct rejections
- Liberal (small) β: Maximal detection, more hits and false alarms

2.3 Receiver Operating Characteristic (ROC) Curve

2.3.1 ROC Curve



2.3.2 Relationship Between ROC Curve and d'

- The steeper the curve, the higher the d'
- $d' = Z(false\ alarm) - Z(hit)$

2.3.3 ROC Curve Axes

- $x - axis$: $probability\ of\ a\ false\ alarm$
- $y - axis$: probability of a hit