Chapter - 3

What are the differences between the Gulf of Execution and Gulf of Evaluation?

Explanation:

- **Gulf of Execution** is the gap between what a user wants to do and how to do it using the system.
- **Gulf of Evaluation** is the gap between the system's response and the user's ability to understand if their action was successful.

Example: If a user wants to delete an email, the Gulf of Execution would be finding the delete button, while the Gulf of Evaluation is seeing confirmation that the email was deleted.

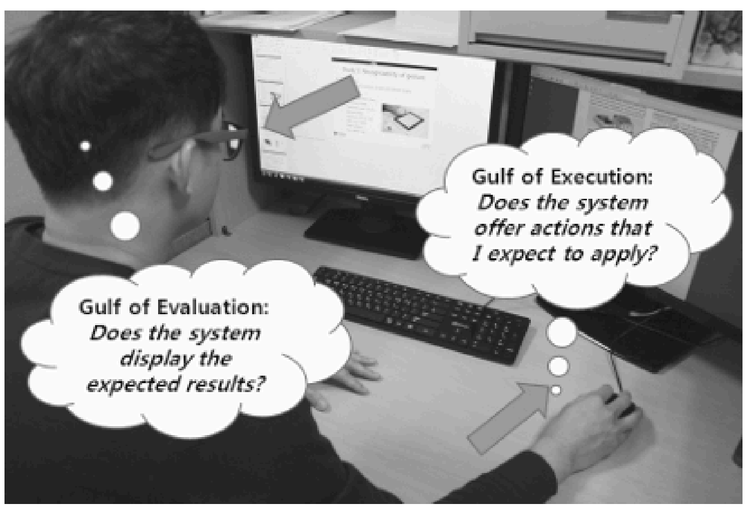

Figure 3.3 Gulf of execution and evaluation: the gap between the expected and actual.

List three types of cognitive process. Explain how they (any one of them) can result in human error when using a computer system.

1. Memory

- Errors Caused By: Limited short-term memory.
- Examples: Difficulty remembering passwords, steps in a task, or previous actions.
- Result: Forgetting important details can lead to errors in data entry or navigation.

2. Attention

- Errors Caused By: Divided or distracted focus.
- Examples: Overlooked warning messages or critical fields due to interface overload or multitasking.
- Result: Missing information or not following necessary steps.

3. Decision-Making

- Errors Caused By: Time pressure, unclear instructions, or confusing options.
- Examples: Choosing the wrong function or button due to similar-looking options.
- Result: Hasty or incorrect choices can lead to unintended actions or data loss.

What is Cognitive Science?

CS explains the human's capability and model of conscious processing of high-level information and investigates the ways in which humans solve problems.

How does a human solve a problem? Explain with model

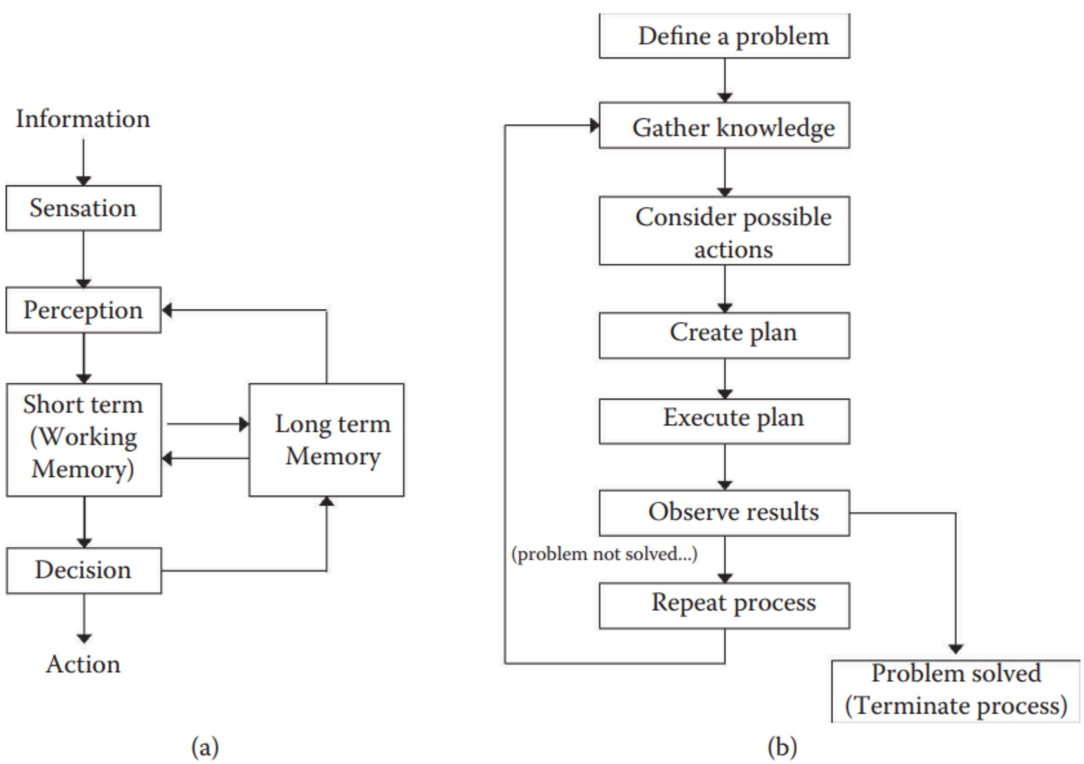

Figure 3.1 (a) The overall human problem-solving model and process and (b) a more detailed view of the "decision maker/executor."

What is GOMS?

GOMS, an acronym for **Goals, Operators, Methods, and Selection rules**, is a cognitive modeling approach used to analyze the user interactions with a system or interface. It helps to understand how users accomplish tasks and to predict the efficiency of different design choices. GOMS is valuable in evaluating and improving the usability of interfaces by providing a structured way to analyze task completion time, ease of learning, and potential bottlenecks

Here's a breakdown of each component in GOMS:

1. **Goals**: These represent what the user intends to achieve, such as "send an email" or "save a document." Goals can be high-level (e.g., completing a report) or more granular (e.g., printing a specific document).
2. **Operators**: These are the basic actions that a user can perform to accomplish a goal, such as pressing keys, clicking buttons, or reading information on the screen. Operators are defined based on the specific system and user actions.
3. **Methods**: Methods are sequences of operators and sub-goals that define how a user accomplishes a goal. For example, to achieve the goal "open an email," the method might involve operators like moving the cursor, clicking the email application, and selecting a message.
4. **Selection Rules**: These define how a user chooses among different methods to achieve a goal when multiple options are available. For instance, a user may decide to use a keyboard shortcut instead of a menu option if they're familiar with the shortcut.

Explain four modalities of sensation and Perception of Information

1. Visual
    a. Field of View (FOV)
    b. Viewing Distance
    c. Pixel
    d. Display Resolution
    e. Visual Acuity / Power of Sight
2. Aural
    a. Intensity
    b. Sound
    c. Phase
3. Tactile
    a. Tactile Resolution
    b. Vibration Frequency
    c. Pressure Threshold
4. Haptic
    a. The Degrees of Freedom
    b. Force Range
    c. Interaction Range
    d. Stability

What is Multimodal Interaction and why should system designers consider implementing it?

Multimodal Interaction refers to systems and interfaces that allow users to interact using multiple sensory channels or "modalities"—such as visual, auditory, tactile, and even voice inputs—rather than relying solely on a single mode like visual or text-based interactions. Multimodal interactions provide a richer, more flexible way to interact with systems, adapting to different user needs, contexts, and preferences, which improves usability and accessibility.

Why System Designers Should Consider Implementing Multimodal Interaction

1. **Enhanced User Experience**: By combining different types of feedback (like sound, visuals, and vibration), users receive more engaging and helpful interactions. For instance, when a message arrives on a smartphone, the device might vibrate (tactile), display a notification icon (visual), and even play a sound (auditory). This combination of modes ensures that the user doesn't miss the notification, regardless of their current focus or environment.
2. **Increased Accessibility**: Multimodal interaction makes systems accessible to people with varying abilities. For example, visually impaired users might rely on auditory feedback (e.g., a screen reader), while those with hearing impairments could benefit from visual cues and haptic feedback. Multimodal systems create a more inclusive user experience, enabling more people to use the technology effectively.

3. **Adaptability and Flexibility**: Different contexts demand different interaction modes. In noisy environments, users might prefer visual or tactile feedback over sound. Similarly, when hands-free interaction is needed (e.g., while driving), voice commands are more convenient. By providing alternatives, designers can create systems that adapt to diverse real-world scenarios.

4) Multimodal Interaction: Using more than one way of interacting with a device can make it work better.

How?

1) Complementary: phone ring (sound) → someone is calling

screen shows (visual) → who's calling

2) Redundant: phone ring → sound + vibrate

3) Altenative: make a call → either press a button

→ or speak someone's name

Key Types of Multimodal Interaction

1. **Complementary Interaction**:
   - Different modalities take on different roles to accomplish an objective.
   - **Example**: In a smart home setup, a doorbell might activate a sound to alert people in the house and display a notification on a phone showing a live video feed. This way, users can both hear the doorbell and see who is at the door.

2. **Redundant Interaction**:
    - Multiple modalities are used to reinforce the same message or action, enhancing reliability and accessibility.
    - **Example**: A smartphone call notification can be accompanied by both sound and vibration, which helps users notice the call even if they don't hear the ringtone, increasing the chance they respond.
3. **Alternative Interaction**:
    - The system allows the user to choose different modes based on preference or context, offering more flexibility and control.
    - **Example**: A smart assistant might let users control it by either pressing a button, using voice commands, or interacting through a touchscreen. This flexibility accommodates different user situations, like hands-free control when cooking or manual interaction when in a quiet environment.

Why It Matters in HCI

By implementing multimodal interactions, designers can create systems that are adaptable, intuitive, and accessible. This makes technology more usable and appealing, especially in a world where users increasingly expect personalized and adaptable interfaces.

"The human eye has a number of limitations" - Give three examples of them. Describe how any one of them should be taken into account in the design of a visual interface.

The human eye indeed has several limitations that impact how we perceive and interpret visual information. Here are three key limitations:

1. **Limited Resolution in Peripheral Vision**:
   - The human eye has sharp focus (high resolution) only at the center of the visual field, while peripheral vision is much less detailed. This means we cannot see details clearly outside the center without moving our eyes.
2. **Sensitivity to Certain Colors and Brightness**:
   - The eye is more sensitive to some colors (like green) and less sensitive to others (like blue), especially in low light. Brightness perception also varies, with very bright or very dark colors making details harder to distinguish.
3. **Difficulty in Tracking Rapid Movements**:
   - The human eye struggles to keep up with fast-moving objects, which can make it hard to perceive changes or actions that occur quickly. This is why, for example, high frame rates are used in animations and videos to ensure smoothness.

Example: Designing with Limited Resolution in Peripheral Vision

When designing a **visual interface**, it's essential to recognize that users will only see high-detail information at the center of their gaze. To account for this:

- Place critical information (like buttons or key indicators) toward the center of the screen or where users are most likely to look directly.
- Avoid placing essential details in the periphery, as users might miss them.
- Use contrasting colors, sizes, or highlighting to draw attention to important elements, ensuring users notice them even if they're not looking directly.

Example in Action: In a dashboard interface for a financial app, the "important alert" icon could be designed with a bright color and positioned centrally so users don't overlook it. Less critical information, like background statistics, can be arranged around the periphery where users will notice them only if they're looking directly. This layout prioritizes what users need to see first and makes navigation more intuitive.

What is Fitt's Law?

Fitts's law is a model of human movement that predicts the time required to rapidly move to a target area as a function of the distance to and the size of the target

$$MT = a + b * ID \text{ and } ID = \log(A/W + 1)$$

Movement of Time (MT) = Actual Prediction value for a particular task

Index of Difficulty (ID) = An abstract notion of difficulty of the task

A, B = Coefficients of specific to a given task