Usability Engineering
SENG 42222

Cognitive Models

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What is a cognitive model?

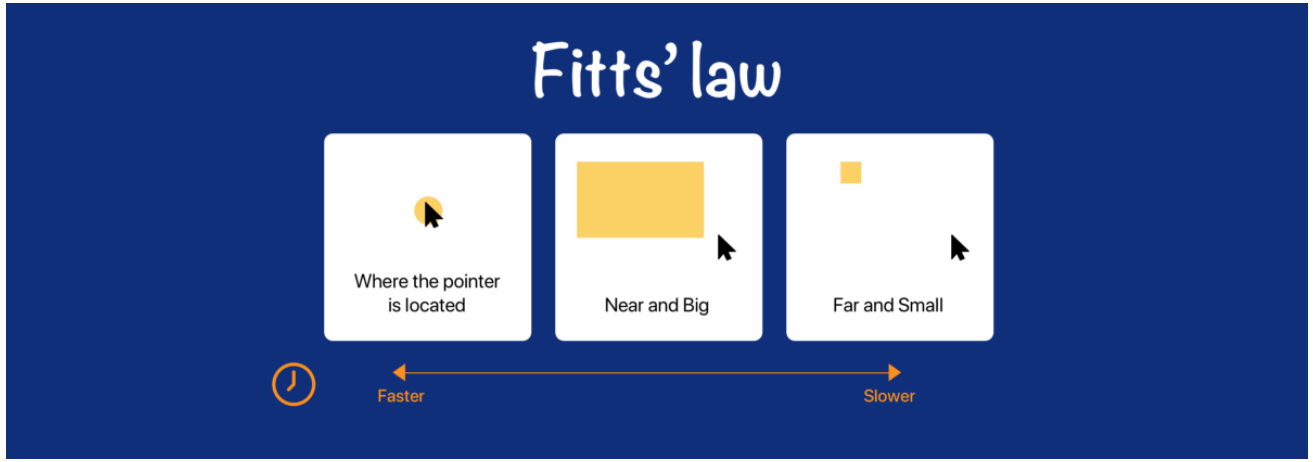
Cognitive models are ways of describing or predicting user performance through a generalized representation of the way a type of user would interact with a system.

- The model,
  - allows a designer to consider the implications of design decisions (and frame possible approaches to design) prior to getting direct user feedback on a design.
  - should be informed by previous analysis of users, to have some confidence in the model's ability to represent the way a user might think or interact.

Commonly known models

1. Fitts' Law

- The further away a target is, and the smaller its size, the longer it will take for a user to reach it.
- The time required to move from a starting point to within the confines of a target area is dependent on a logarithmic relationship between the distance from the point to the target area and the size of the target.



Commonly known models

2. Hick's law (Hick-Hyman law)

- The time it takes to make a decision increases proportionally to the number and complexity of choices. Hick's law is the appropriate model in choosing an alternative from a menu or navigation bar for decision times, rather than Miller's "magic number" of 7 plus or minus 2.
- 7 plus or minus 2
  - The number of items that can be held in short-term memory or that can be the focus of attention.
  - The number applies only to retention and recall of information, and not to recognition.
  - "The Magic Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information" (The Psychological Review, 1956, vol. 63, pp. 81-97)

Commonly known models

3. GOMS

- GOMS is a family of predictive models of human performance that can be used to improve the efficiency of human-machine interaction by identifying and eliminating unnecessary user actions.
- GOMS stands for (Goals, Operators, Methods, and Selection).
- GOMS variants
  - KLM-GOMS (Keystroke-Level Model)
  - CMN-GOMS
  - NGOMSL
  - CPM-GOMS

Require extensive training and familiarity with HCI principles to perform an analysis

Commonly known models

3. GOMS

Definitions for these terms are listed below.

- A **Goal** is defined as the successful end state for the task. For example, "Update my mailing address.“
- An **Operator** is an action performed on the machine. On a computer, this essentially breaks down into keystrokes and mouse clicks needed to achieve the goal of "Update my mailing address.“
- A **Method** is a series of Operators chained together to form a single unit. A single method might be "Click on the OK button," which contains the Operators (move the hand to the mouse, point the mouse to the OK button, click the mouse, release the mouse , move the hand back to keyboard)
- A **Selection** is a decision made, and this is required when a task flow has parallel actions. For example, the user might "Click on the OK button" using the chain of Operators above, or might simply press the ENTER key. The ENTER key is obviously much more efficient, but users may or may not be aware that this path through the task flow exists, hence a selection is needed.

Commonly known models

3.1 KLM-GOMS

Part of the GOMS family of predictive models, the Keystroke-Level Model GOMS (KLM-GOMS) is a quantitative modeling tool for predicting how long it will take expert users to complete a specific task with no errors.

- KLM-GOMS predicts task times based on a simple set of physical and mental operators including keystrokes, button clicks, pointer movement, keyboard to mouse movement, and thinking time.
- Each KLM operator is assigned a time based on empirical research. To obtain the predicted time for a task, you add the times for individual operators.

Commonly known models

3.1 KLM-GOMS

- With a KLM-GOMS analysis, a given flow through a user interface (a task) is broken down into atomic pieces (keystrokes, mouse clicks, moving hands back and forth between the keyboard and mouse, etc.)
- A lookup table is then used to retrieve the interaction time for each atomic action, and then total task time is calculated by adding all the actions together.

Some sample action times (Kieras, 2001)

- **Keystroke (key press and release):** 0.08 - 1.2 seconds (.28 recommended for most users)
- **Point mouse to target:** 1.10 seconds (The exact value can be calculated with Fitt's law)
- **Click or release the mouse:** 0.10 seconds
- **Move hand to keyboard from mouse:** 0.40 seconds
- **Move hand to mouse from keyboard:** 0.40 seconds
- **User Wait for system to respond:** W seconds (depends on the system).

Commonly known models

3.1 KLM-GOMS

The KLM-GOMS technique can be used to compare predicted performance across different variations on a user interface. The method does not require users or a working prototype - only a description of the path through which the software is needed.

KLM can also predict task times for different approaches to the same task.

- For example, you could use KLM to compare the time it takes to change attributes using keyboard shortcuts versus mouse and toolbar options.

Commonly known models

3.1 KLM-GOMS

The quality of the KLM analysis depends highly on the assumptions of the modeler. Some assumptions that might be considered in the creation of a KLM are:

1. The user is an expert in the domain and system being analyzed.
2. The user will start with her hands on the keyboard.
3. The user is not interrupted during the tasks.
4. The user is familiar with the hardware.
5. The user's system has essentially instantaneous response time (or you will include a "Wait" operator).
6. The user is a good typist (and thus will take 0.12 seconds to press a key).

Q & A