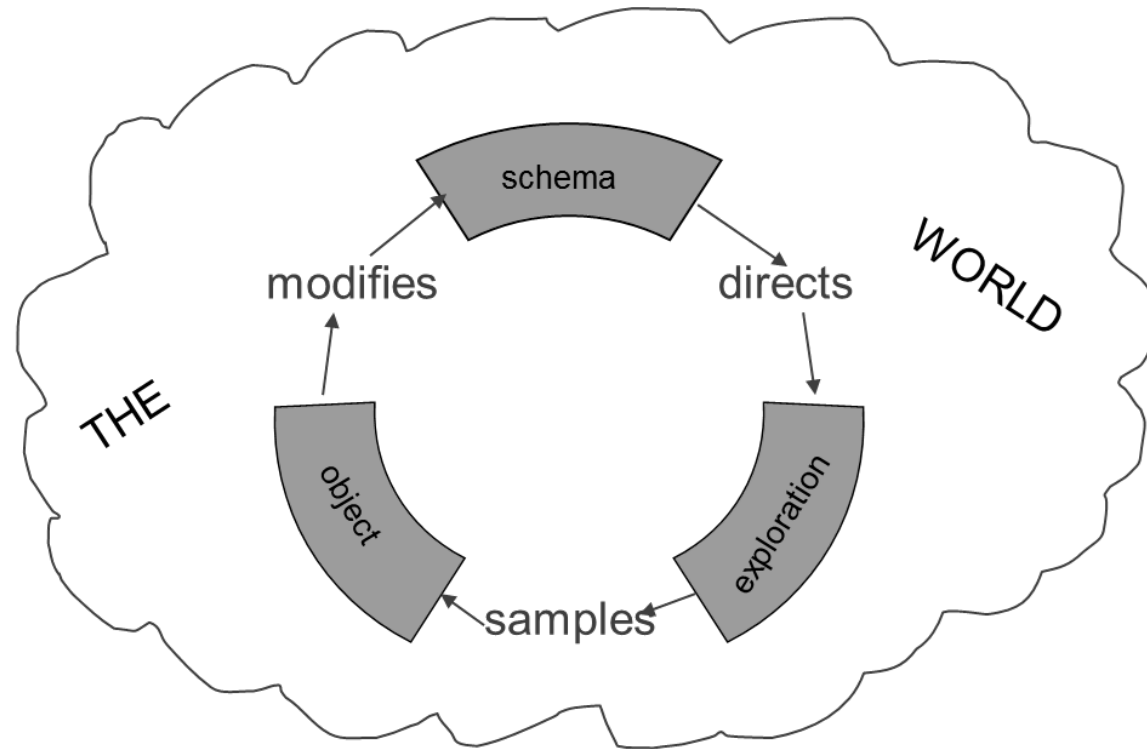# Cognition

Prof. Joseph Giacomin

The Perception-Action Cycle

American neurophysiologist Roger Sperry proposed that the perception–action cycle is the fundamental logic of the nervous system. The brain is considered to be the evolutionary response to the need to transform sensory patterns into patterns of motor coordination.

Affordance

Objects can have characteristics which seem to be facilitating or even inviting a specific course of action.

The "affordance" can be physical, as with a rocker type switch, or it can be learned from past interaction, play or watching of others.

Schema

A mental structure of pre-conceived ideas, a framework representing some aspect of the world or a system for perceiving and organising new items of information.

The "schema" can be innate as with certain linguistic structures, or it can be learned from past interaction, play or watching of others.

Mental Models

First hypothesised by the Scottish psychologist Kenneth Craik in 1943.

A psychological representation of real, hypothetical or imaginary situations.

A set of relationships held in memory which enable people to anticipate and predict the causal behaviour of the world.
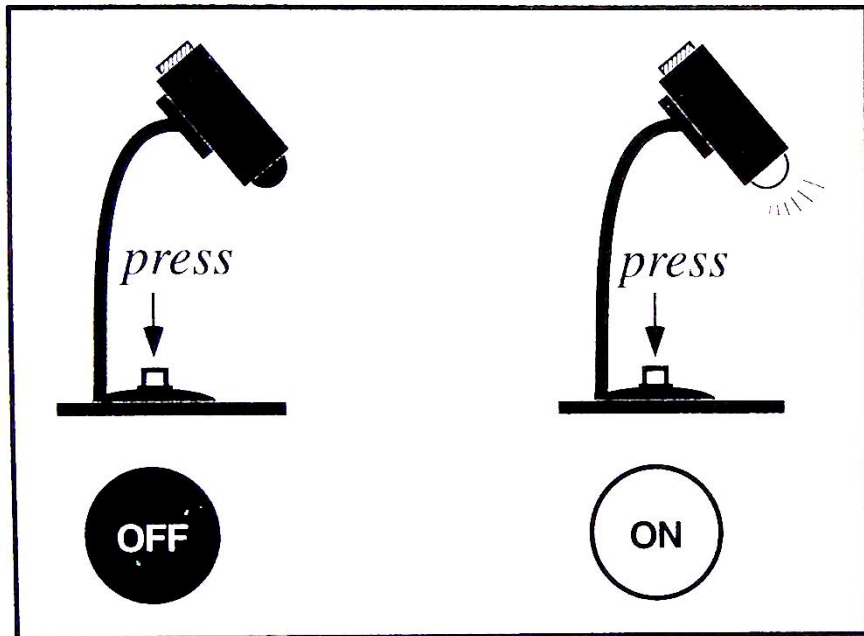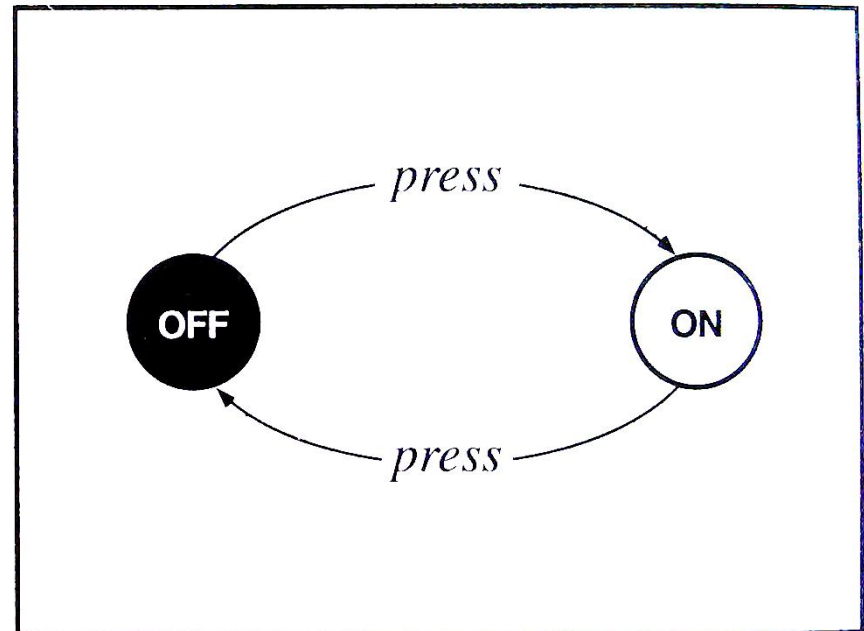
Mental Models

Figure 1.2 (a). Two states.

Figure 1.2 (b). And a transition.

The mental model of a desk lamp with a simple on-off switch involves two operating states and two possible transitions.
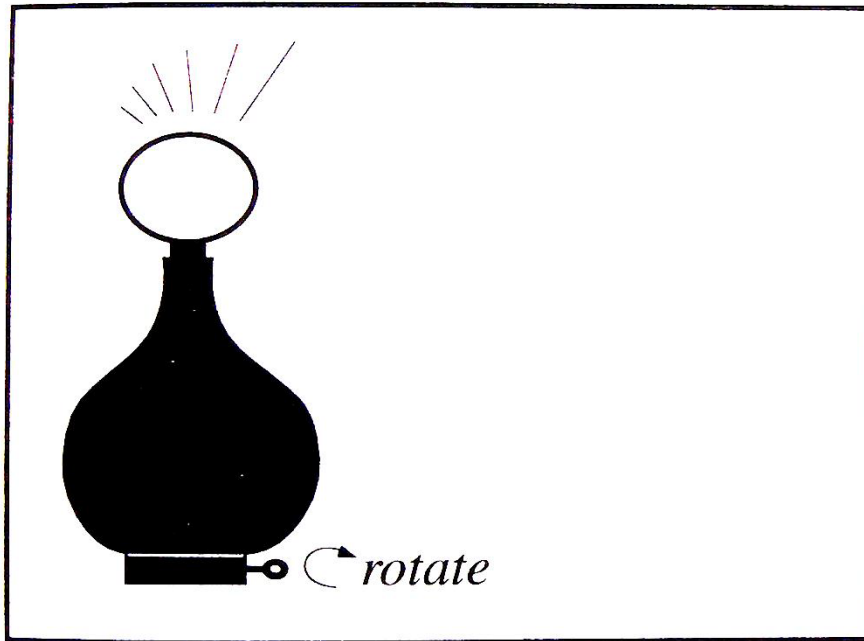
Mental Models
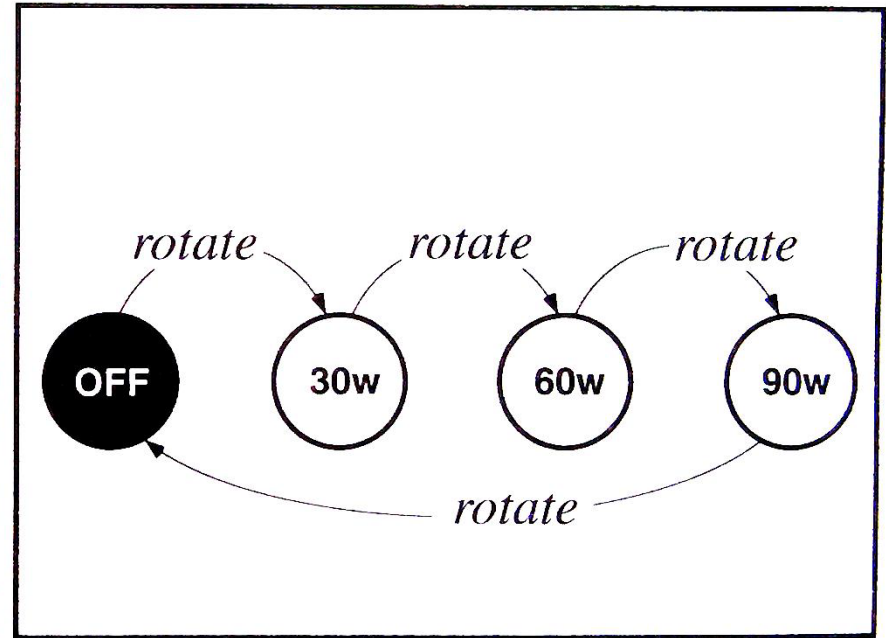

Figure 1.3 (a). Three-way lamp fixture.

Figure 1.3 (b). And its behavior.

The mental model of a desk lamp with a four-position rotary switch involves four operating states and four possible transitions.

Mental Models

Even with such a simple device two problems occur:

- **Unless specific labelling is provided the user will not be certain of the available choices (number of operating states) when he or she interacts with the lamp for the first time. Without activating several times it cannot be noted that multiple illumination levels are available.**

- **The exact illumination setting (30w, 60w or 90w) which is currently on is not immediately obvious. The user will have to cycle around the switch to observe the illumination in order to understand which setting has been selected.**

rotate
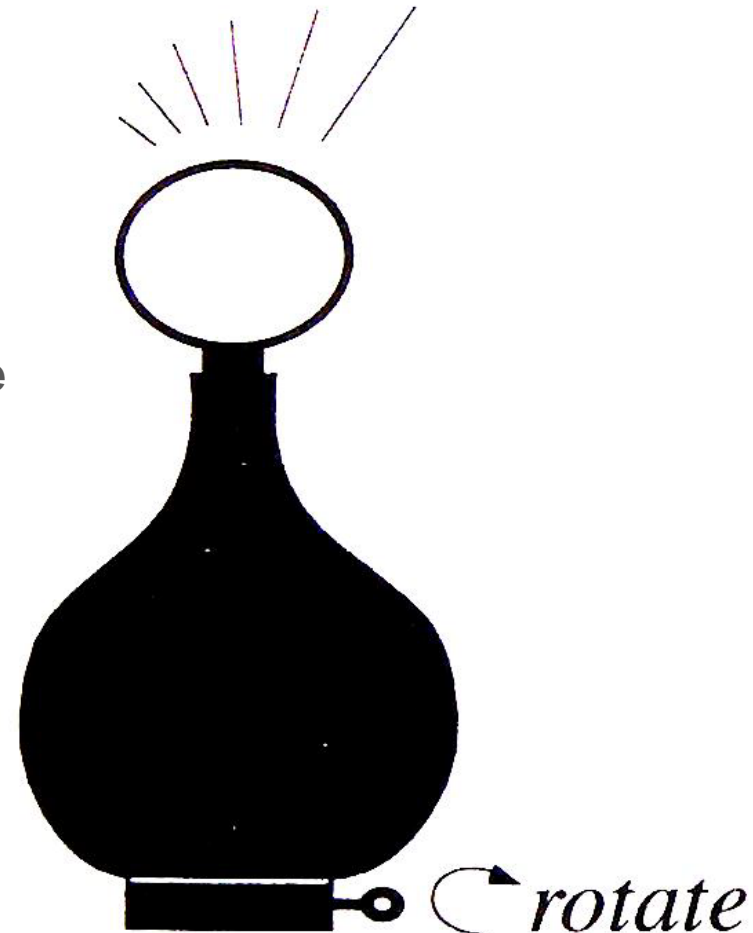
Mental Models

As the device which is being designed becomes more complex it is relatively easy to end up with situations in which there is a mismatch between the device's transitions and the mental model of the person who uses it.

For example several brands of remote control have layouts similar to the one shown, in which the "mode" buttons at the top are used to switch between completely distinct systems which operate individually.
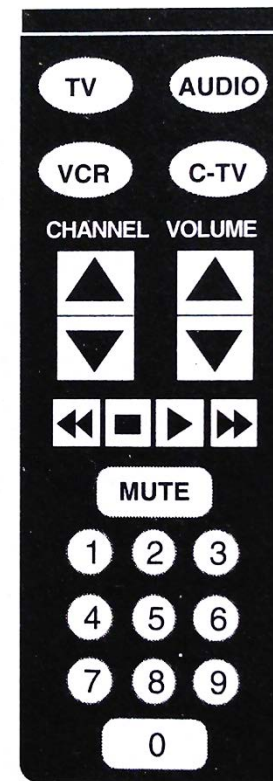
Mental Models
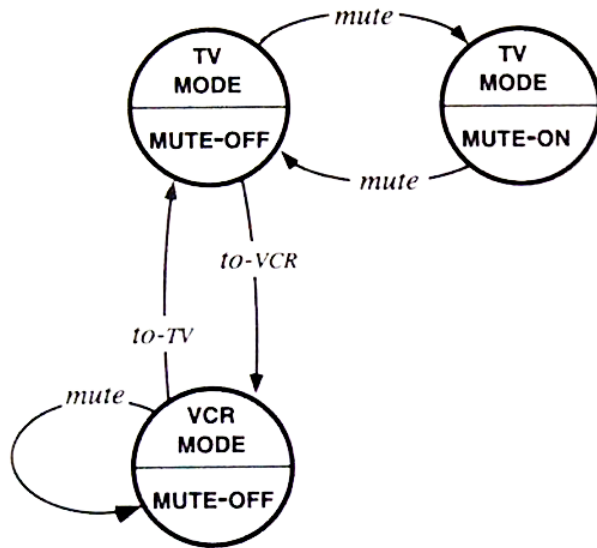
Device Model
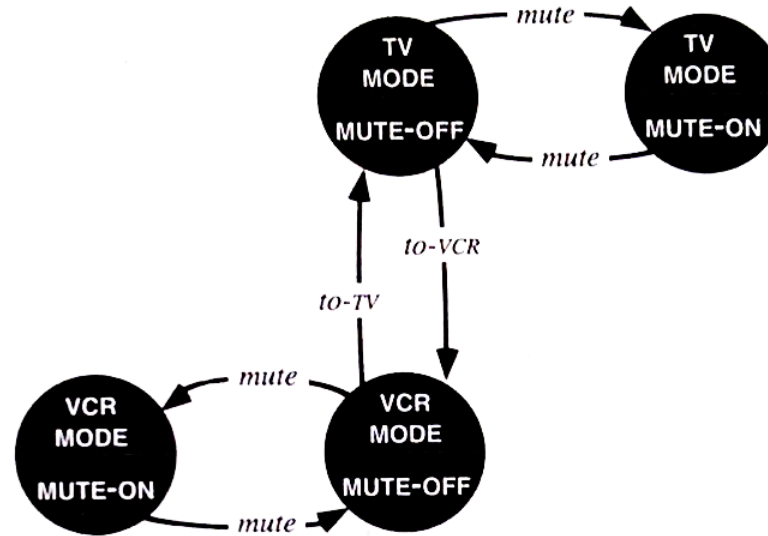
User Mental Model

Since the "mute" mutton works only in "TV Mode" then pressing it when instead using the VCR, CHANNEL TV or AUDIO leads to no muting of the sound. Such a gap between the device model and the most obvious user model can lead to errors and frustration.

Mental Models

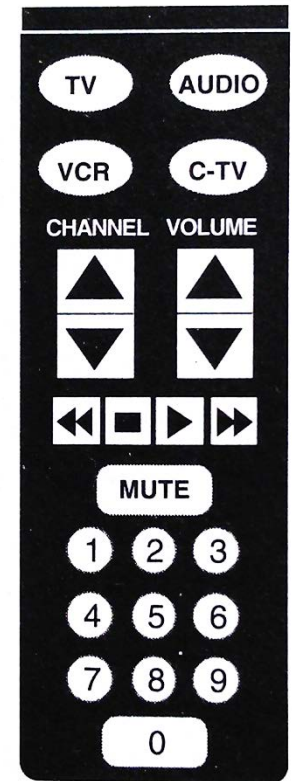To help people form the correct mental model of the system the underlying structure, logic and affordances should be made obvious.

The mental model should be consistent at every level, i.e. all menus and sub-menus should involve similar logic, structure, affordances and metaphors.

Cultural stereotypes should be considered during design of the product, system or service.

With most products, systems and services there are points where the same human action can lead to different results depending on the current operating state. Feedback is therefore needed to confirm the current operating state.

Time delays in response to human action must be minimised to avoid confusion.

Metaphor (noun)

an expression that describes a person or object by referring to something that is considered to have similar characteristics to that person or object: 'the mind is an ocean' and 'the city is a jungle' are both metaphors.

Metaphor

The essence of metaphor is understanding one thing in terms of another.

Usually a more simple and well know thing is used to help explain a more complicated or less familiar thing.

Most human thought processes are metaphorical.

Metaphors are not arbitrary, they are based on physical and cultural experience.

Orientational Metaphors

Happy Is Up - Sad is Down
>*I am in high spirits. I'm feeling down. I fell into depression.*

Conscious is Up – Unconscious is Down
>*Get up. Wake up. He fell asleep. He dropped off to sleep.*

Health and Life Are Up – Sickness and Death are Down
>*He is at the peak of health. Lazarus rose from the dead. He fell ill. He dropped dead.*

Having Control or Force is Up – Being Subject to Control or Force is Down
>*He has control over me. I am on top of the situation. He fell from power.*

More is Up – Less is Down
>*Income rose last year. I'm topping up my oystercard. He's underage. Stocks are down.*

Good is Up – Bad is Down
>*Things are looking up. Its been downhill ever since. We have hit an all time low.*

Rational is Up – Emotional is Down
>*It was a high-level discussion. He could not rise above his emotions.*

Ontological Metaphors

Entity and Substance

We need to combat inflation. *It will take a lot of patience to finish this course. He went to New York to seek fame and fortune. He broke down.*

Containers

I was in the forest. There is a lot of land in Kansas. There is nothing in sight. Are you in the race on Sunday ? He is in love.

Personification

Life cheated him. Cancer finally caught up with him. That fact argues against the standard theory. She's sailing out of harbour tomorrow.

Workload

The amount of work or of working time assigned.

The amount of work performed or capable of being performed, usually within a specific amount of time.

First known use in 1943.

Source: Merriam Webster Dictionary

Mental Workload

(Curry, Jex et al. 1979) "… the mental effort that the human operator devotes to control or supervision relative to his capacity to expend mental effort … workload is never greater than unity."

(Kramer, Sirevaag et al. 1987) "... the cost of performing a task in terms of a reduction in the capacity to perform additional tasks that use the same processing resource."

(Eggemeier, Wilson et al. 1991) "Mental workload refers to the portion of operator information processing capacity or resources that is actually required to meet system demands."

Mental Workload

Tasks which lead to high levels of mental workload tend to be characterised by one or more of the following:

- Stimulus driven not self paced

- Large fluctuations in demand

- Multiple simultaneous tasks

- High stress/High consequence

Mental Workload
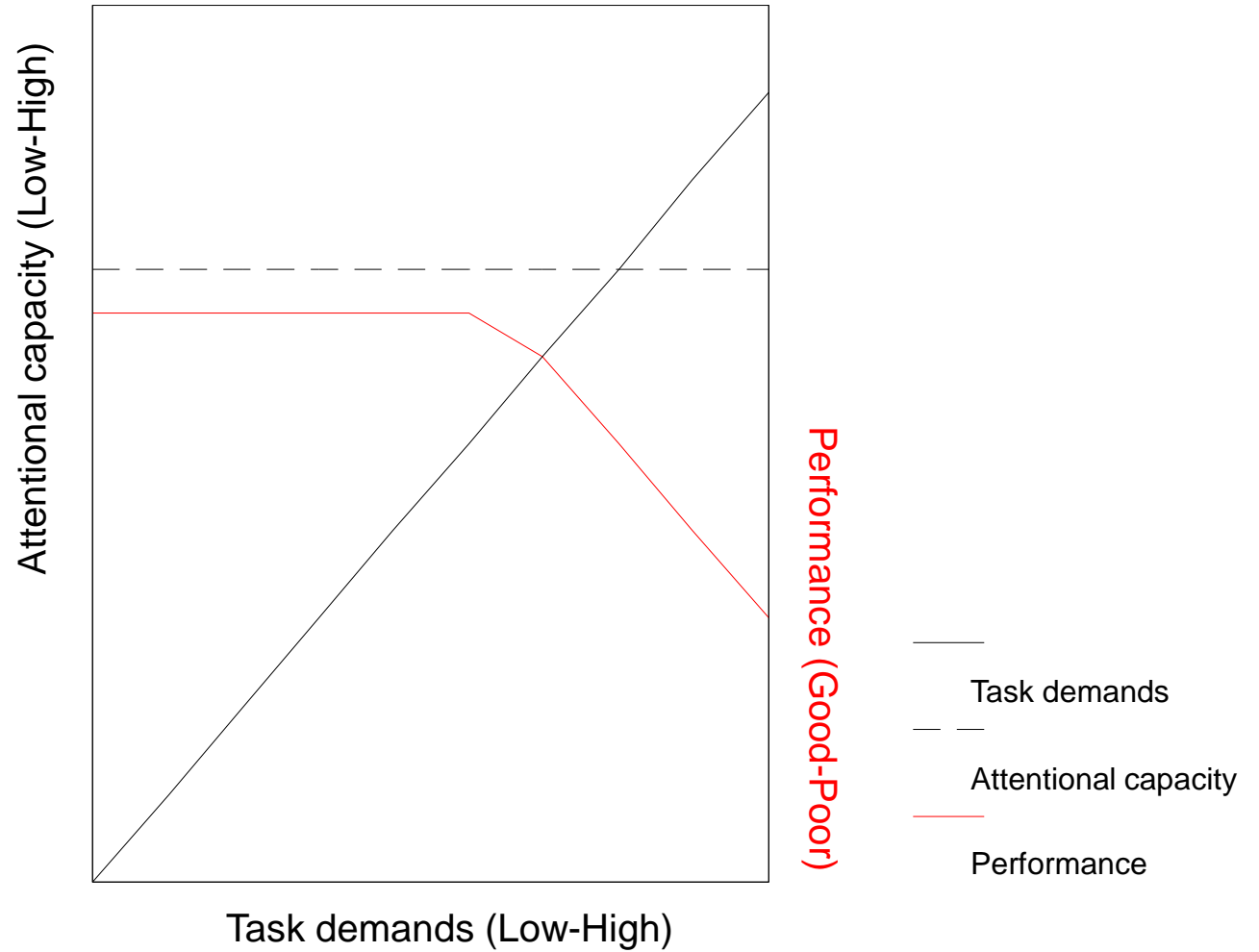
Mental Workload

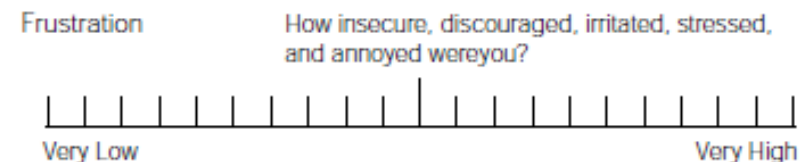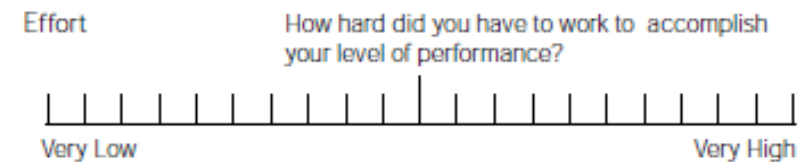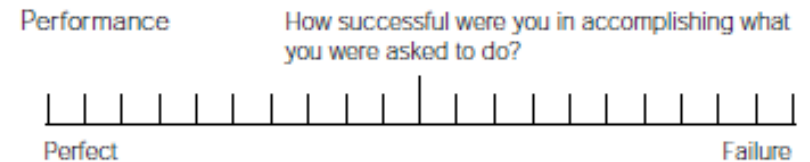One of the most frequently used methods for measuring mental workload is the NASA Task Load Index (NASA-TLX).
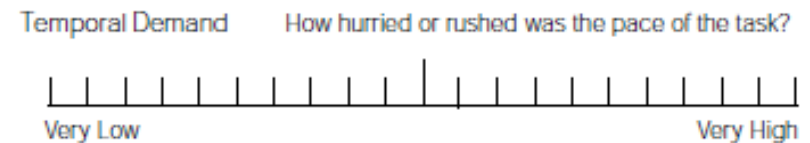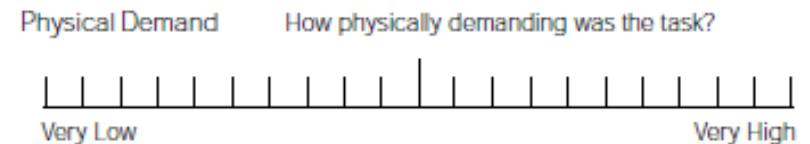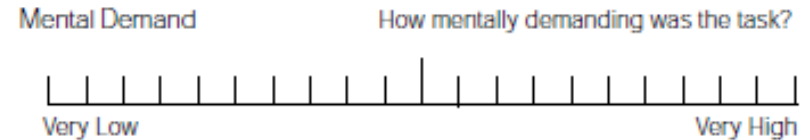
NASA-TLX has been cited in more than 550 studies and a search for "NASA-TLX" on Google Scholar identified more than 3,660 articles.

NASA-TLX is a subjective multidimensional assessment tool that rates perceived mental workload using six different subscales: Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration.

NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date

Mental Demand — How mentally demanding was the task?

Very Low ———————————————— Very High

Physical Demand — How physically demanding was the task?

Very Low ———————————————— Very High

Temporal Demand — How hurried or rushed was the pace of the task?

Very Low ———————————————— Very High

Performance — How successful were you in accomplishing what you were asked to do?

Perfect ———————————————— Failure

Effort — How hard did you have to work to accomplish your level of performance?

Very Low ———————————————— Very High

Frustration — How insecure, discouraged, irritated, stressed, and annoyed were you?

Very Low ———————————————— Very High

Design Classic: Nokia 1100 Series

The Nokia 1100 was designed at the Nokia Design Center in California by Miki Mehandjiysky.

It offered simple and error-free functionality for voice calls, SMS text messages, alarm clock and other basic features. It was targeted at developing countries and users who did not require complex capabilities.

250 million have been sold since the launch in 2003 making it the world's best selling mobile phone and, at one point in time, the best selling consumer electronics device in the world.

Design Classic: TomTom Navigator

Introduced in 1996 the TomTom navigator is an example of a technology which operates in a transparent manner, which builds trust and which helps people to achieve efficient wayfinding.

TomTom navigation products have won iF Product Design Awards in 2005, 2009, 2010 and 2011.

Thank you.