Mental Model

People understand and interact with systems and environments based on mental representations developed from experience.

Mental models are representations of systems and environments derived from experience. People understand and interact with systems and environments by comparing the outcomes of their mental models with the real-world systems and environments. When the outcomes correspond, a mental model is accurate and complete. When the outcomes do not correspond, the mental model is inaccurate or incomplete. With regards to design, there are two basic types of mental models: mental models of how systems work (*system models*) and mental models of how people interact with systems (*interaction models*).[1]

Designers generally have very complete and accurate system models, but often have weak interaction models—i.e., they know much about how a system works, but little about how people will interact with the system. Conversely, users of a design tend to have sparse and inaccurate system models, but through use and experience commonly attain interaction models that are more complete and accurate than those of designers. Optimal design results only when designers have an accurate and complete system model, attain an accurate and complete interaction model, and then design a system interface that reflects an efficient merging of both models.[2]

Designers can obtain accurate and complete interaction models through personal use of the system, laboratory testing (e.g., focus groups and usability testing), and direct observation of people interacting with the system, or similar systems. Use of the system by the designer will reveal obvious design problems, but will fail to reveal the problems of interaction that emerge when people are unfamiliar with the system. Laboratory testing is useful for evaluating designs in a controlled environment, but must be conducted with care, as the artificial context and expectation effects can compromise the validity of the results. Direct observation in the target environment is the preferred method for acquiring accurate information about how people interact with systems, but is costly and impractical for designs that are not yet publicly available.

Design with people's interaction models in mind. If there is a standard mental model for how something works, try to design leveraging that model. When this is not possible, (e.g., the system is new and novel), create an interaction experience that draws from common mental models as much as possible, such as the desktop metaphor for computers. However, do not contrive design just to leverage a familiar model—it is better to have people learn a new model that is clear and consistent, than to use a familiar model that does not fit. Use the systems that you design, and employ laboratory testing and field observation in order to develop accurate and complete interaction models. Above all, watch people use the design and take note of how they use it.

See also Affordance, Expectation Effects, Mapping, and Mimicry.

[1] The seminal works on mental models are *The Nature of Explanation* by Kenneth Craik, Cambridge University Press, 1943; and *Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness* by Philip N. Johnson-Laird, Cambridge University Press, 1983. For a design perspective, see "Surrogates and Mappings: Two Kinds of Conceptual Models for Interactive Devices" by Richard M. Young, and "Some Observations on Mental Models" by Donald Norman, both in *Mental Models* by D. Gentner and A. Stevens (Eds.), Lawrence Erlbaum Associates, 1983.

[2] Note that an *efficient* merging does not simply mean revealing the system model. It may mean concealing the system model from users, revealing the system model to users, or a combination therein.

Despite the measurable safety benefits of antilock brakes in controlled tests with trained drivers, research by the Highway Loss Data Institute indicates that antilock brakes have not reduced the frequency or cost of accidents in real-world driving situations.

The likely cause is that people are not using antilock brakes properly—or rather; antilock brakes are not designed properly. The interaction model for antilock brakes differs radically from the interaction model for conventional brakes.

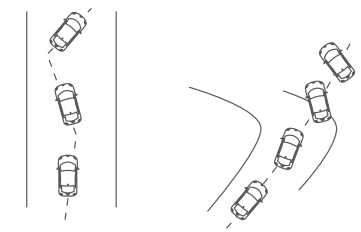
This suggests that designers gave little consideration to the interaction models of the target audience in the design process.

Interaction Model for Conventional Brakes

On slick surfaces...

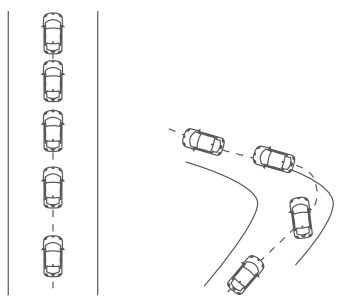
- depress the brake pedal smoothly
- pump brakes to prevent brakes from locking up
- do not steer while braking, except to counter-steer
- noise and vibration are signs that something is wrong

INCORRECT INTERACTION
slamming brakes/steering while braking
Car will take a longer time to stop and will not make the turn



wet, slick surface wet, slick surface

CORRECT INTERACTION
pumping brakes
Car will take a shorter time to stop and may make the turn



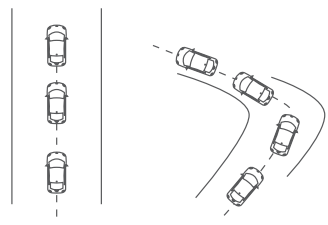
wet, slick surface wet, slick surface

Interaction Model for ABS Brakes

On slick surfaces...

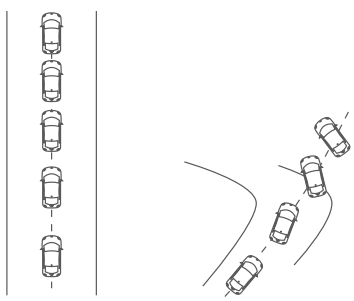
- depress the brake pedal fast and hard
- do not pump brakes
- steer while braking
- noise and vibration are signs that the system is operating properly

CORRECT INTERACTION
slamming brakes/steering while braking
Car will properly stop and make the turn



wet, slick surface wet, slick surface

INCORRECT INTERACTION
pumping brakes
Car will take a longer time to stop and will not make the turn



wet, slick surface wet, slick surface