MODELS OF INTERACTION

Norman's model of interaction is perhaps the most influential in Human–Computer Interaction, possibly because of its closeness to our intuitive understanding of the interaction between human user and computer. The user formulates a **plan of action, which is then executed at the computer interface**. When the **plan, or part of the plan, has been executed, the user observes the computer interface to evaluate the result of the executed plan**, and **to determine further actions**. The interactive cycle **can be divided into two major phases: execution and evaluation**. These can then be **subdivided into further stages, seven in all**.

1. Establishing the goal.
2. Forming the intention.
3. Specifying the action sequence.
4. Executing the action.
5. Perceiving the system state.
6. Interpreting the system state.
7. Evaluating the system state with respect to the goals and intentions.

Tasks are **operations to manipulate the concepts of a domain**. A goal **is the desired output from a performed task**. For example, one task within the graphic design domain is the construction of a specific geometric shape with particular attributes on the drawing surface. A related **goal would be to produce a solid red triangle centered on the canvas**. An **intention is a specific action required to meet the goal**.

Norman uses this model of interaction to demonstrate why some interfaces cause problems to their users. He describes these in terms of the **gulfs of execution and the gulfs of evaluation**. As we noted earlier, the **user and the system do not use the same terms to describe the domain and goals** – remember that we called the **language of the system the core language and the language of the user the task language**. The gulf of execution is the **difference between the user's formulation of the actions to reach the goal and the actions allowed by the system.** If the **actions allowed by the system correspond to those intended by the user, the interaction will be effective**.

The Gulf of Execution. The gulf of execution **is the degree to which the interaction possibilities** of an artifact, a computer system or likewise **correspond to the intentions of the person and what that person perceives is possible to do with** the artifact/application/etc

Human error – slips and mistakes

Human errors are often classified into *slips* and *mistakes*. We can distinguish these using Norman's gulf of execution.

If you understand a system well you may know exactly what to do to satisfy your goals – you have formulated the correct action. However, perhaps you mistype or you accidentally press the mouse button at the wrong time. These are called *slips*; you have formulated the right action, but fail to execute that action correctly.

However, if you don't know the system well you may not even formulate the right goal. For example, you may think that the magnifying glass icon is the 'find' function, but in fact it is to magnify the text. This is called a *mistake*.

If we discover that an interface is leading to errors it is important to understand whether they are slips or mistakes. Slips may be corrected by, for instance, better screen design, perhaps putting more space between buttons. However, mistakes need users to have a better understanding of the systems, so will require far more radical redesign or improved training, perhaps a totally different metaphor for use.

The interaction framework

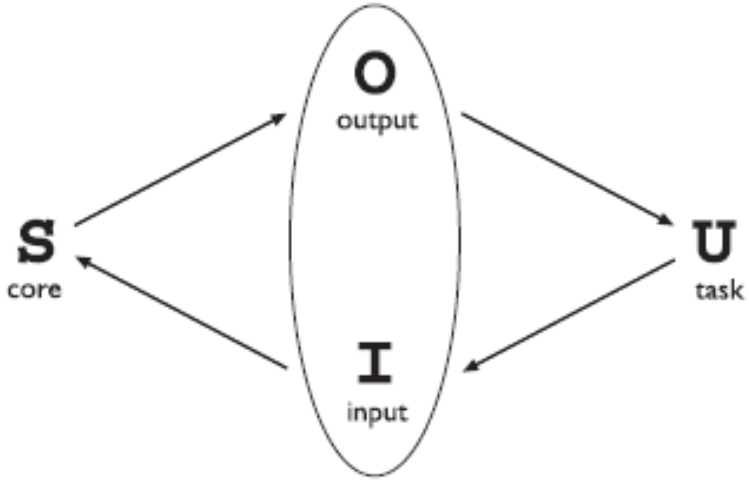


Figure 3.1 The general interaction framework

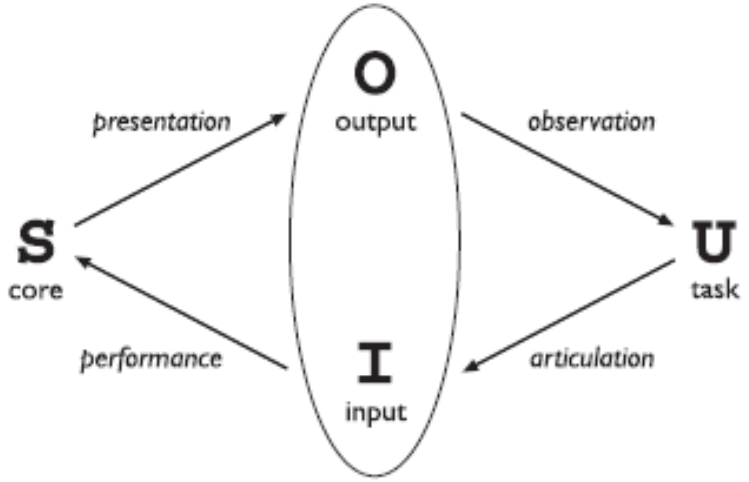


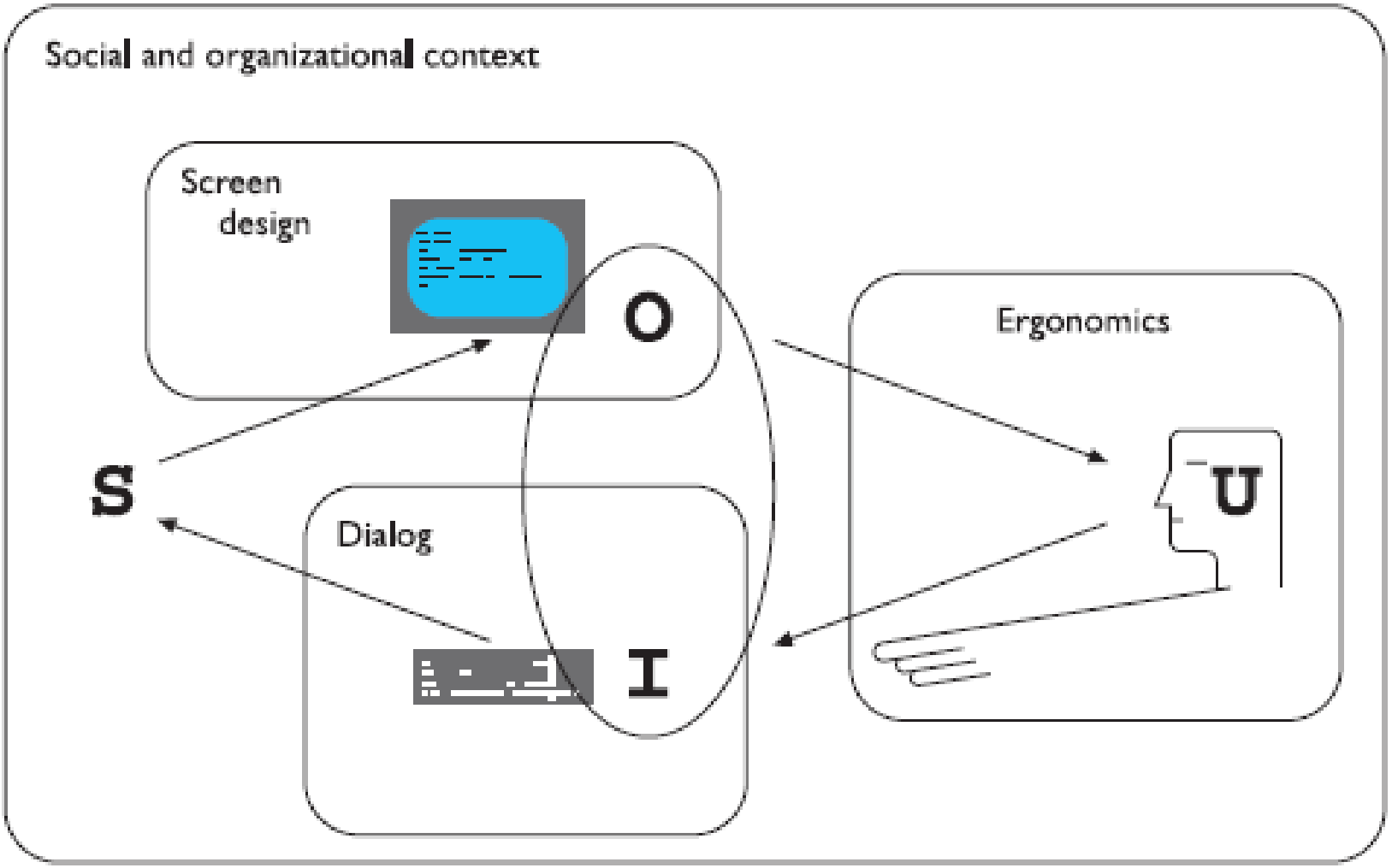
Figure 3.2 Translations between components

Design Focus

Video recorder

A simple example of programming a VCR from a remote control shows that all four translations in the interaction cycle can affect the overall interaction. Ineffective interaction is indicated by the user not being sure the VCR is set to record properly. This could be because the user has pressed the keys on the remote control unit in the wrong order; this can be classified as an articulatory problem. Or maybe the VCR is able to record on any channel but the remote control lacks the ability to select channels, indicating a coverage problem for the performance translation. It may be the case that the VCR display panel does not indicate that the program has been set, a presentation problem. Or maybe the user does not interpret the feedback properly, an observational error. Any one or more of these deficiencies would give rise to ineffective interaction.

FRAMEWORKS AND HCI


Social and organizational context
Screen design
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ERGONOMICS

Ergonomics (or human factors) is traditionally the study of the **physical characteristics of the interaction**: **how the controls are designed, the physical environment in which the interaction takes place, and the layout and physical qualities of the screen**. A primary focus is **on user performance and how the interface enhances or detracts from this**. In seeking to evaluate these aspects of the interaction, ergonomics will certainly also touch upon human psychology and system constraints.

Arrangement of controls and displays

functional controls and displays are organized so that those that are **functionally related are placed together**;
sequential controls and displays are organized to reflect the **order of their use in a typical interaction** (this may be especially appropriate in domains where a particular task sequence is enforced, such as aviation);

frequency controls and displays are organized according to **how frequently they are used, with the most commonly used controls being the most easily accessible.**

In addition to the organization of the controls and displays in relation **to each other, the entire system interface must be arranged appropriately** in relation to the user's position. So, for example, the user **should be able to reach all controls necessary and view all displays without excessive body movement**. **Critical displays should be at eye level**. Lighting **should be arranged to avoid glare and reflection distorting displays**. Controls **should be spaced to provide adequate room for the user to manoeuvre**.

Health issues

Perhaps **we do not immediately think of computer use as a hazardous activity but we should bear in mind possible consequences of our designs on the health and safety of users**. Leaving aside the obvious safety risks of poorly designed safety-critical systems (aircraft crashing, nuclear plant leaks and worse), there are a number of factors that may affect the use of more general computers. **Again these are factors in the physical environment that directly affect the quality of the interaction and the user's performance:**

Physical position As we noted in the previous section, users should be able to reach all controls comfortably and see all displays. Users should not be expected to stand for long periods and, if sitting, should be provided with back support. If a particular position for a part of the body is to be adopted for long periods (for example, in typing) support should be provided to allow rest.

Temperature Although most users can adapt to slight changes in temperature without adverse effect, extremes of hot or cold will affect performance and, in excessive cases, health. Experimental studies show that performance deteriorates at high or low temperatures, with users being unable to concentrate efficiently.

Lighting The lighting level will again depend on the work environment. However, adequate lighting should be provided to allow users to see the computer screen without discomfort or eyestrain. The light source should also be positioned to avoid glare affecting the display.

Noise Excessive noise can be harmful to health, causing the user pain, and in acute cases, loss of hearing. Noise levels should be maintained at a comfortable level in the work environment. This does not necessarily mean no noise at all. Noise can be a stimulus to users and can provide needed confirmation of system activity.

Time The time users spend using the system should also be controlled. As we saw in the previous chapter, it has been suggested that excessive use of CRT displays can be harmful to users, particularly pregnant women.

The use of color

Colors used in the **display should be as distinct as possible and the distinction should not be affected by changes in contrast**. Blue should not be used to display critical information. If color is used as an indicator it should not be the only cue: additional coding information should be included.

The **colors used should also correspond to common conventions and user expectations. Red, green and yellow are colors frequently associated with stop, go and standby respectively**. Therefore, **red may be used to indicate emergency and alarms; green, normal activity; and yellow, standby and auxiliary function**. These conventions should not be **violated without very good cause.**

However, we should remember that **color conventions are culturally determined**. For example, **red is associated with danger and warnings in most western cultures, but in China it symbolizes happiness and good fortune.** The **color of mourning is black in some cultures and white in others**. Awareness of the cultural associations of color is particularly important in designing systems and **websites for a global market**.

INTERACTION STYLES

Interaction **can be seen as a dialog between the computer and the user.** The choice of interface style can have a **profound effect on the nature of this dialog**. Here we introduce the **most common interface styles and note the different effects these have on the interaction**. There are a number of common interface styles including

- **command line interface**
- **menus**
- **natural language**
- **question/answer and query dialog**
- **form-fills and spreadsheets**
- **WIMP**
- **point and click**
- **three-dimensional interfaces**.