Design of Interactive Systems (DIS)

Lecture 13: Foundations of designing interactive systems– Cognition and action

Dr. Kalpana Shankhwar, *kalpana@iiitd.ac.in*

Assistant Professor

Department of Human Centered Design,
IIIT Delhi

Part IV **Foundations of designing interactive systems**

- **Chapter 21**: Memory and attention
- **Chapter 22**: Affect
- **Chapter 23**: Cognition and action
- **Chapter 24**: Social interaction
- **Chapter 25:** Perception and navigation

Introduction

- There is no single theory about how people **think** and **reason** **(cognition)** and what relationships there are between **thought** and **actions**

- **Embodied cognition** recognizes that we have physical bodies which have evolved and are adapted to a range of activities that take place in the world

- **Distributed cognition** argues that thinking is spread across **brains**, **artefacts** and **devices** and is not simply processed in the brain

- **Situated action** points to the importance of context in deciding what we do

- **Activity theory** focuses on action in pursuit of objectives.

Aims

- Cognitive psychology and in particular the idea of humans as **information processors**

- The importance of **context** in the design of interactive systems and as a major part of determining the range and type of **actions** we take

- The importance of the **body** to thinking and taking action

- Two more views of cognition and action - **distributed cognition** and **activity theory**.

Human information processing

- There is a psychology-based book that discusses how humans interact with computers. The core expression of the books is "A **scientific psychology** should help us in arranging the interface so it is **easy**, **efficient** and **error free** - even enjoyable".

- The human information processing paradigm characterizes or simplifies people's abilities into three 'blocks' or subsystems: (a) **a sensory input subsystem**, (b) **a central information processing subsystem** and (c) **a motor output subsystem**.

- In this view of HCI, humans and computers are functionally **similar** and form a **closed loop**.
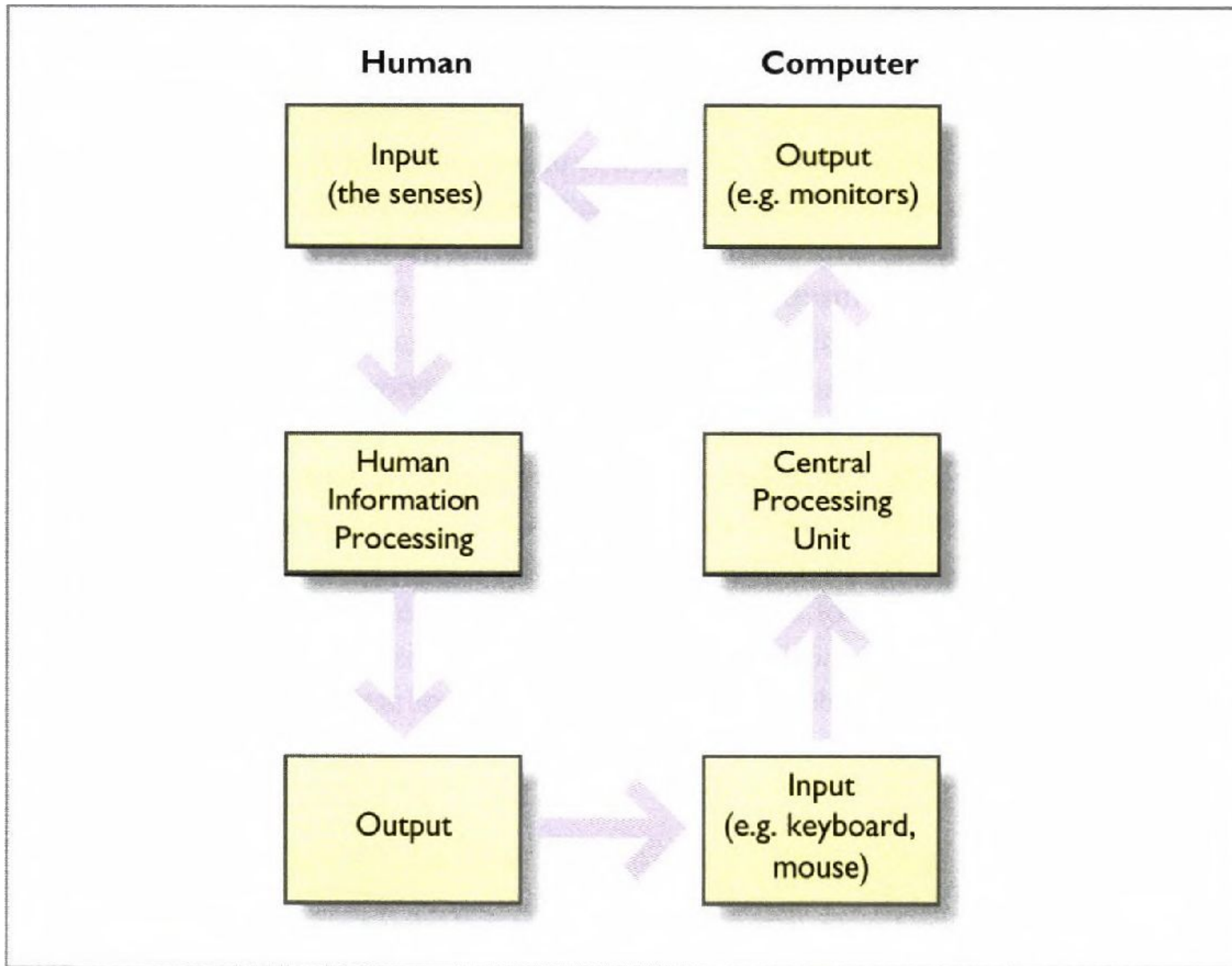
Figure 23.1 The information processing paradigm (in its simplest form)

A seven-stage model of activity

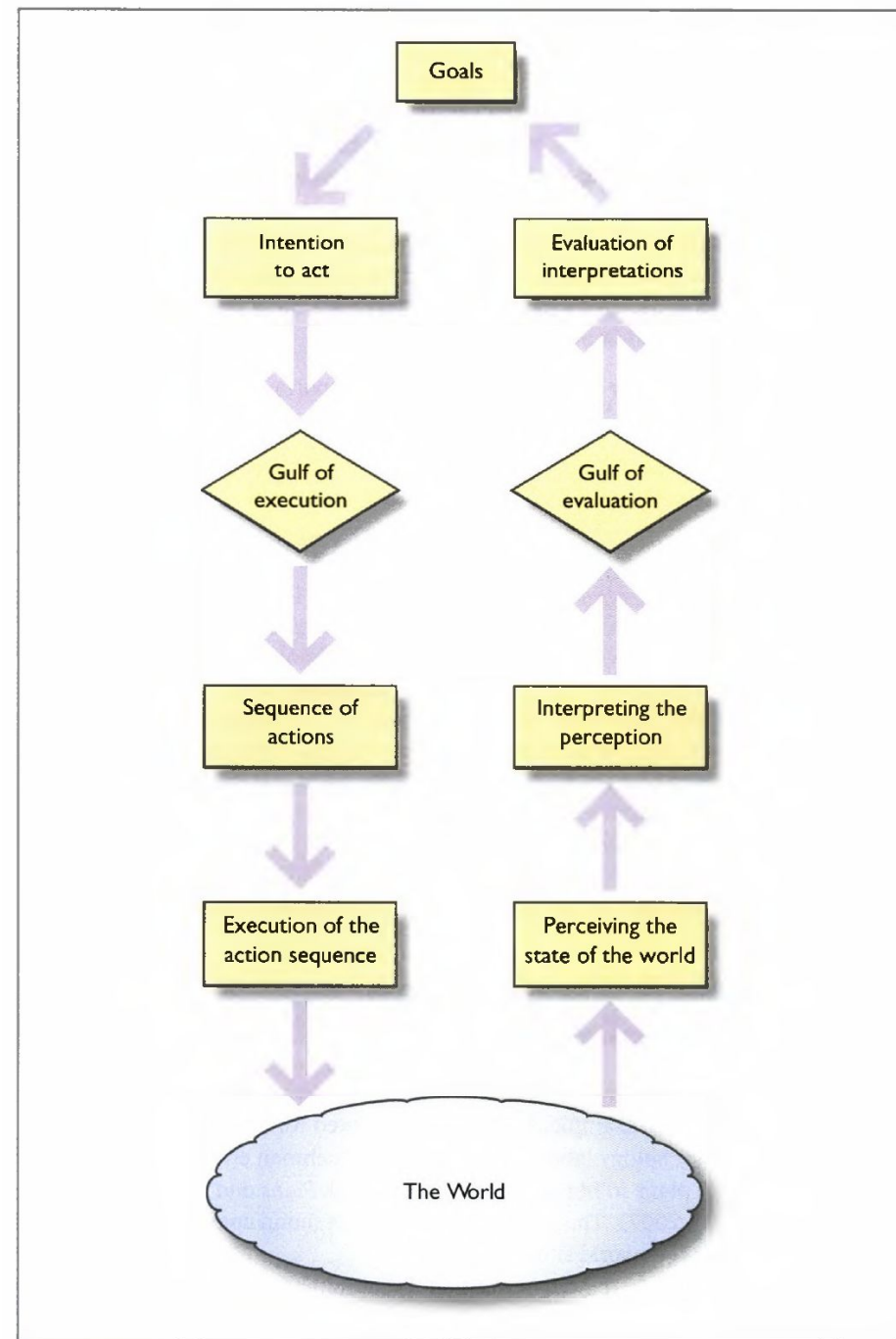Figure 23.2 is a representation of Norman's seven-stage model of how an individual completes an activity

Figure 23.2 Norman's seven-stage model of activity

A seven-stage model of activity

- We begin with a **goal,** e.g. checking sports results on the Web

- Our next step is to form a set of **intentions** to achieve this goal, e.g. finding a computer with a browser,

- This is translated into a **sequence of actions** to be executed, e.g. go to a computer lab or Internet cafe, then log on to a PC, double-click on a Web browser, type in the URL, hit return, read sports results.

- At each step on the way we perceive the **new state** of the world, **interpret** what we see, and **compare** it against what we intended to change.

- We may have to **repeat** these actions if our goals were not met.

A seven-stage model of activity

- The **gulf of execution** refers to the problem of how an individual translates intentions into action.

- The **gulf of evaluation** refers to how an individual understands, or evaluates, the effects of actions and knows when his or her goals are satisfied.

Why HIP is not enough

- The popularity of HIP has diminished dramatically in recent years, for the following reasons:

- **It is too *simple*.** We are much more complex and cannot be represented meaningfully as a series of boxes, clouds and arrows.

- ***HIP arose from laboratory studies.*** The physical and social contexts of people are many and varied and conspicuous by their absence from these diagrams.

- ***HIP models assume that we are alone in the world***. Human behaviour is primarily social and hardly ever solitary. Work is social, travel is usually social. Where are these people represented in the block and arrow models of cognition?

Creativity and cognition

- Emotion, social interaction, intention and volition (will power) all have a part to play in creativity

- Convergent thinking is directed at finding the best solution to a problem

- Divergent thinking is concerned with bringing diverse ideas together and exploring many unusual ideas and possibilities. (brainstorming)

Situated action

- People respond constructively and perhaps unpredictably to real-world situations.

- In 1991 Bannon published a paper entitled 'From human factors to human actors'

- The aim was to understand the people using collaborative systems as empowered, problem-solving, cooperative individuals rather than mere subjects in an applied psychology experiment.

- Treating people as merely a set of cognitive systems and subsystems (which is implied by the term *human factors)*

- Respecting people as autonomous participants, actors, with the capacity to govern their own behaviour.

- Bannon argues that it involves moving from narrow experimental studies of individual people working on a computer system to the social setting of the workplace.

'Going for a curry' script

- A group of students going to an Indian restaurant to have dinner on Saturday night.

- Scripts are credible means by which we organize our knowledge of the world and a means of directing our behaviour (i.e. planning).

- The advantage of scripts is that they can be adapted to other situations.

- The Indian restaurant script is readily adapted for use in a Thai, Chinese or Italian restaurant (i.e. find restaurant, get table, read menu, order food, eat food, pay for meal)

- easily adapted to, for example, hamburger restaurants (the order of get table and order food is simply reversed).

Distributed cognition

- On 20 July 1969, astronauts Neil Armstrong and Buzz Aldrin landed on the Moon

- At Mission Control, Charlie Duke followed the process closely

- Transcript of the last few seconds of the landing

  Aldrin: *'4 forward. 4 forward. Drifting to the right a little. 20 feet, down a half* Duke: *'30 seconds.'*

  Aldrin: *'Drifting forward just a little bit; that's good.'*

  Aldrin: *'Contact Light.'*

  Armstrong: *'Shutdown.'*

  Aldrin: *'Okay. Engine Stop.'*

  Aldrin: *'ACA out of detent'*

  Armstrong: *'Out of detent. Auto.'*

  Duke: *'We copy you down, Eagle.'*

  Armstrong: *'Engine arm is off. Houston, Tranquillity Base here. The Eagle has landed.'*

  Duke: *Roger, Tranquillity. We copy you on the ground. You got a bunch of guys about to turn blue. We're breathing again. Thanks a lot.'*

Distributed cognition

- Ed Hutchins has developed the theory of **distributed cognition** to describe such situations.

- The theory argues that both the cognitive process itself and the knowledge used and generated are often distributed across **multiple people**, **tools** and **representations**.

- Everyday examples would include:
  - A driver and passenger navigating a foreign city using maps and road signs
  - The homely task of shopping with the aid of a list and the reminders presented by the supermarket shelves
  - Colleagues rationalizing a project budget using an Excel spreadsheet and some unintelligible printouts from Finance.

Internal and external representation

- In distributed cognition, resources include the **internal representation** of knowledge (human memory, sometimes called knowledge in the head) and **external representations** (knowledge in the world).

- Anything that supports the cognitive activity, but instances would include gestures, the physical layout of objects, notes, diagrams, computer readings and so forth.

- Team-working situations, such as Pacific islanders wayfinding between far distant islands, the navigation of US naval ships, aircraft cockpits

Different ways in which processes might be distributed

- Three different kinds of distribution emerge:
  - Cognitive processes may be distributed across the members of a social group
  - Cognitive processes may involve coordination between internal and external structures
  - Processes may be distributed through time in such a way that the products of earlier events can transform the nature of later events

Embodied cognition

- An **affordance** is a resource or support that the environment offers an animal; the animal in turn must possess the capabilities to perceive it and to use it.

- Examples of affordances include, objects that can be manipulated, substances that can be eaten.

- If we were able to design interactive systems which immediately presented their affordances, usability Issues would be banished

- An affordance thus exists, whether it is perceived or used or not. It may be detected and used without explicit awareness of doing so

- Affordances are both in the world and in the mind of the observer.

Figure 23.4 An affordance in the world

Embodied cognition

- Norman elaborated the concept of affordance: people are said to perceive the intended behaviour of the interface widgets such as the knobs and dials of a range of software applications.
- These intended and perceived behaviours are usually very simple, including sliding, pressing and rotating.

Embodied cognition

- "real affordances are not nearly as important as perceived affordances: it is perceived affordances that tell the user what actions can be performed on an object and, to some extent, how to do them. [Perceived affordances are] often more about conventions than about reality".
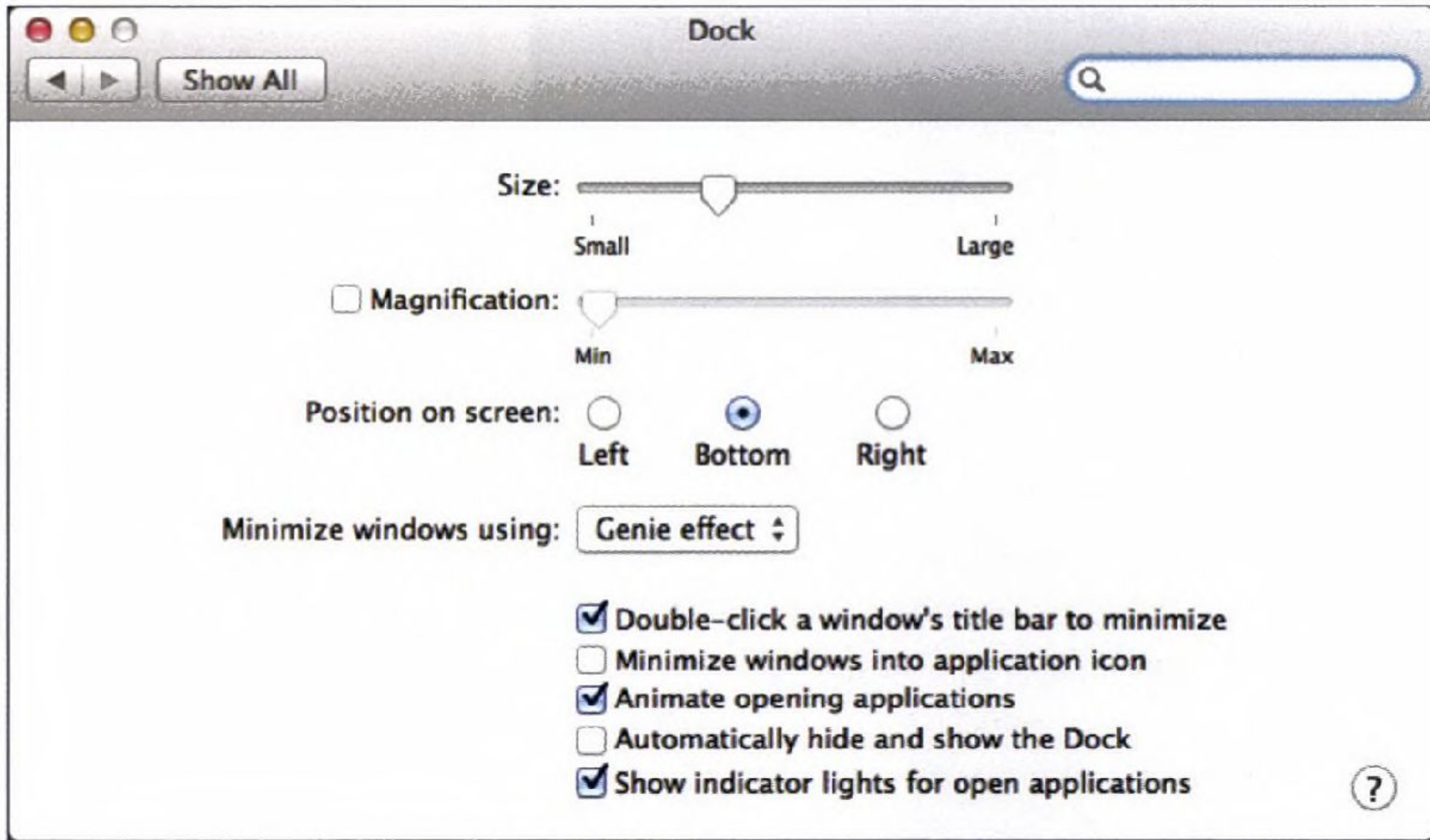
Figure 23.5 A perceived affordance at the user interface

Enactive interaction

- In every-day life people interact with their surroundings in a direct manner.

- Whenever we handle an object, we get an intuitive feeling of its properties and its affordances.

- Likewise, the object is influenced directly by our actions: when an object is picked up by a person, this object moves according to the energy created and forces exerted by this person.

- In fact, a loop can be identified between the person and the object, more precisely between the gestures (actions) and the haptic feedback.

- This implies that the consequences of one's action have an immediate feedback. This forms the basis for enactive knowledge.

Enactive interaction

- An example of the use of enactive knowledge is playing a musical instrument, such as a guitar.

- When playing a guitar, a musician exerts energy, which makes the strings vibrate and produces sound waves.

- The musician gets feedback by feeling which strings are being touched and in what place

Embodied interaction

- Embodied interaction is concerned with two main features: meaning and coupling.

- Meaning may be about **ontology**, **inter-subjectivity** or **intentionality**.

- **Ontology** is concerned with how we describe the world, with the entities and relationships with which we interact.

- **Inter-subjectivity** is about how meaning can be shared with others. This involves both the communication of meaning from designers to other people, so that the system can reveal its purpose, and the communication between people through the system.

- The third aspect of meaning is **intentionality**. This is to do with the directedness of meaning and how it relates one thing to another.

Embodied interaction

- **Coupling** is concerned with making the relationship between **actions** and **meaning** effective.

- Dourish uses the familiar example of a hammer to illustrate coupling.

- When you use a hammer it becomes an extension to your arm (it is coupled) and you act through the hammer onto the nail. You are engaged in the activity of hammering.

- From this theory of embodied interaction - 'not just how we act *on* technology, but how we act *through* it'

Class activity

Find some more affordances in everyday objects. How is the affordance 'presented'? Also, try to identify apparent affordances that are misleading.