Designing For Users

User-centered design

- UCD is an approach to user interface design and development that involves users throughout the design and development process.
- User-centered design not only focuses on understanding the users of a computer system under development but also requires an understanding of the tasks that users will perform with the system and of the environment (organizational, social, and physical) in which they will use the system

- Four main principles of human-centered design

1. The active involvement of users
2. An appropriate allocation of function between user and system
3. The iteration of design solutions
4. Multidisciplinary design teams

- The four essential human-centered design activities are

1. Understand and specify the context of use
2. Specify the user and organizational requirements
3. Produce design solutions (prototypes)
4. Evaluate designs with users against requirements

User Interface Design Process

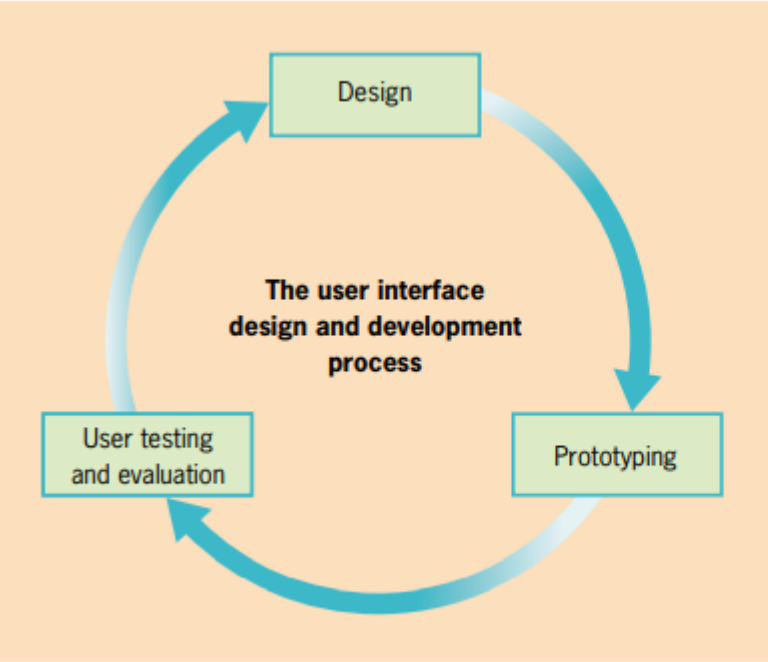


Figure 1.9 The iterative user interface design and evaluation process. (From Greenberg, 1996.)

- The essential difference between the classic life cycle and user-centered interface design is that user interface design and development is based on the premise that **users should be involved throughout the design life cycle.**
- Additionally, the process should be highly iterative, so that the design can be tested (or evaluated) with users to make sure it meets the users' requirements
- Unlike this iterative design process, the waterfall life cycle generally leaves evaluation to the end.

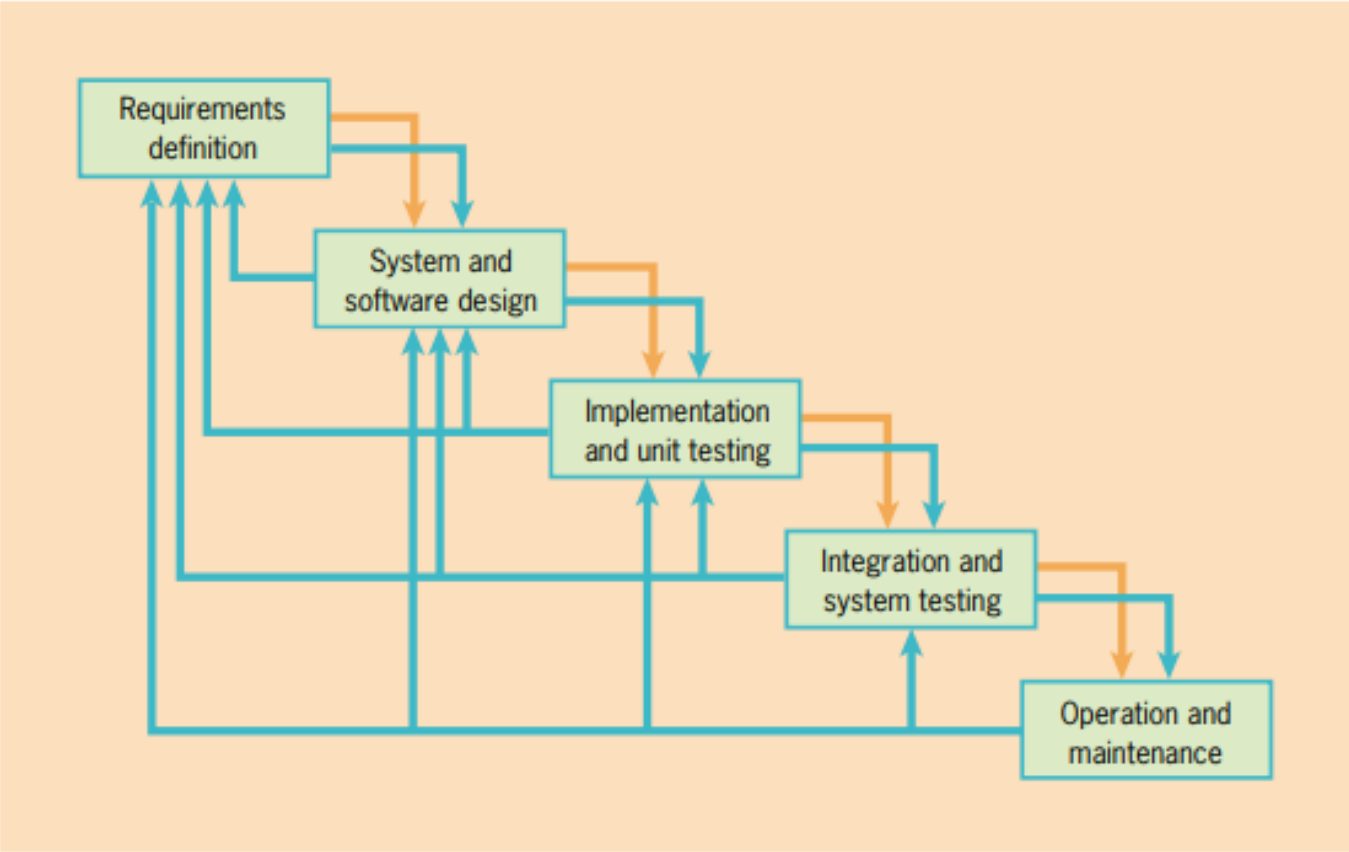


Figure 1.8 The classic life cycle. (From Sommerville, 1995.)

Involving Users

- The way to be user-centered is to **involve users and to pay attention to their views**.
- This can include
  - simply observing users' working practices as part of collecting system requirements
  - using psychologically based user-modeling techniques
  - including user representatives on the design team
  - users should be involved in the testing and evaluation of the system during its design and development

Who are the users?

- Customers, who pay for and perhaps specify the computer system under development
- Other people within the users' organizations who have an interest in the development of the system
- Users or end users — the people who actually use the system directly to undertake tasks and achieve goal

When and How to Involve Users

- **Early in the design process** when the requirements are being specified. Users could help in **defining the requirements** for the system by contributing a specification or by testing early mockups. Users can get involved by allowing themselves to be observed and **giving feedback about the problems of the current system**.
- **During prototyping**, to test designs and options. Users could test versions of the interface to provide feedback and make suggestions to the designers.

When and How to Involve Users

- **Just before delivery of the product**. Users again could test the product by using it or completing surveys about the various features. At this point, however, only minimal changes would be allowable.
- **During training/after delivery of the system**. Again, users would use the product and give their opinions and detail any problems. Revisions at this stage would be included in the next version.

Making the Design Process Iterative

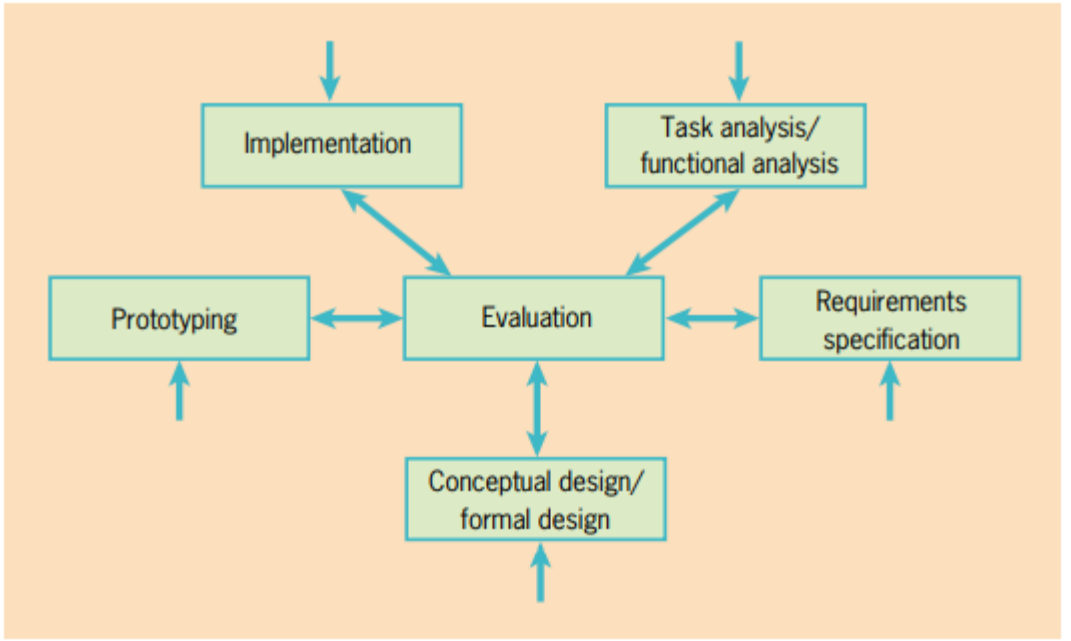


Figure 1.10 The star life cycle. (From Hix and Hartson, 1993.)

- The star life cycle encourages iteration.
- Firstly, **the central point of the star is evaluation**, which is viewed as being relevant at all stages in the life cycle and not just at the end of product development as the classic life cycle tends to suggest.
- Evaluation is concerned with gathering data about the usability of a design or product by a specified group of users for a particular activity within a specified environment or work context.
- These include interviews with users and others, observing users in their workplace, and getting users' opinions from questionnaires or other types of surveys.
- Second, the star life cycle is "intended to be **equally supportive of both top-down and bottom-up development, plus inside-out and outside-in development**" Thus, a design can start with any process in the star life cycle.

The Two Types of Knowledge Needed for UI Design

- Information-gathering activities and analyses that form part of the user interface design and development process
- User interface design knowledge — for example, design principles and design rules.

When and How Do You Evaluate?

- Evaluation is a way of finding out whether your systems work, and it is an ongoing activity throughout the life cycle.
- You can look for as many problems as possible (diagnostic evaluation) or you can try to measure the performance of the system (measurement evaluation).
- The role of the evaluation is always to inform the design and to improve it at all stages.
- Measurement evaluation frequently contributes to subsequent versions of a product.
- Different kinds of evaluation may be carried out at different design stages and for different reason

- **Evaluation Early in the Life Cycle**
- It is undertaken to validate the users' requirements, predict the usability of the product or the usability of an aspect of the product, and to assess how well the interface meets the users' needs.
- The earliest user evaluations may be best done using paper-based prototypes and mockups.
- These are very low cost but can yield a great amount of information and feedback about a design.
- Findings from early evaluations can be taken on board and fed back into the design process before the design is set.

- **Evaluation Later in the Life Cycle**
- It is also undertaken to assess how well the user interface meets the users' needs.
- It is carried out to check the usability of the nearly completed system and to ensure that the system meets the specified usability requirements.
- At this point, findings are unlikely to be fed into the UI design and development process, as generally by this point the system is more or less ready.
- These findings might be used for the next version or release of a system rather than for changing the near-finished product

How do you evaluate?

- **Observing the organization and how people work.**
- observation or monitoring of the way in which users interact with a product or prototype.
- The observation may take place informally in the field or in a laboratory as part of more formal usability testing.
- **Interviewing, talking, and asking questions**. As well as examining users' performance, it is important to find out what they think about using the technology. No matter how good users' performance scores are when using technology, if for some reason they do not like using it, then it will not be used. Surveys using questionnaires and interviews provide ways of collecting users' attitudes to the system.

How do you evaluate?

- **Making predictions**.
- The aim of this kind of evaluation is to predict the types of problems that users will encounter without actually testing the system with them.

How to gather requirements: some techniques to use

- Observing Your Users
- Interviewing Your Users
- Questionnaire and surveys

Observing Your Users

- Direct and Indirect Observation

Direct observation

- It is a straightforward activity and will rapidly provide you with an insight into the users, their tasks, and the environment for a computer system.
- Direct observation can be undertaken in many ways, but generally direct observation studies are classified as either field studies or controlled studies.
- Field studies directly observe users in their usual work or home environment, doing their normal work or home tasks, with the observer making notes about interesting behaviors.
- Controlled studies directly observe users in a place other than their normal environment (for example, in a usability laboratory), performing specially devised tasks, with the observer recording their performance in some way, such as by timing tasks or particular sequences of actions.

Direct observation - Limitations

- it is an easy activity to undertake and always yields interesting data, but it does have some limitations.
- it only allows a single pass at the information gathering (or data collection), and although the observer may take notes, it is hard to get a full record of user activity in one observation session.
- The observer has to make decisions about what is important to record, and there is no opportunity to review that decision and look at alternative data later on.
- It is considered to be obtrusive and can alter a user's behavior and performance

Direct observation

- Direct observation is useful early in the life cycle as part of gathering the requirements for a computer system.
- If you want a permanent record of your observations, then some sort of recording equipment (such as video, audio, or interaction logging) should be used

Indirect Observation: Video Recording

- Video recording on its own is an alternative to direct observation as it provides a permanent record of the observation session.
- Sometimes video recording may be used with software that automatically logs users' keystrokes or interactions.
- Although collecting several kinds of information can be beneficial, it means that there is more data to analyze, which can be time consuming.
- Because indirect observation creates more distance between observers and users, it is considered to be more objective than direct observation

Points to Consider in Relation to Observation

- If you record data using video or logging software, then you can go back and look at it later
- However, you may end up with an overwhelming amount of data to analyze, which can be a problem unless you have a clear idea of what you are looking for and what you want to find out
- It takes many times longer to fully analyze video than it does to film it in the first place.
- If you record those things of interest by hand, however, your recording will probably be incomplete because you will miss things. You will thus have a less complete picture to review later.

- Direct observation is the cheapest and most straightforward way of recording observations.
- Automatic indirect recording provides a permanent record that you can return to later and as often as necessary.
- The two techniques are not mutually exclusive, since you may use direct observation to initially plan your automatic recording

Interviewing Users

- Interviewing involves talking to or questioning users.
- It enables the gathering of information in a fast and friendly way.
- You will need to plan interviews carefully, deciding in advance who to interview, what questions to ask to gather the relevant information, and how long the interviews should be.
- There are two main kinds of interview: structured and unstructured (flexible).
- A structured interview has predetermined questions that are asked in a set way; there is little, if any, scope for exploring additional topics that might arise during the interview.
- a flexible interview generally has some set topics for discussion and exploration, but no set sequence: the interviewer is free to follow up the interviewees' replies, and to find out more about anything that is said

Questionnaires and Surveys

- Questionnaires and surveys take a different approach to interviews for the purpose of gathering information.
- The focus shifts from the flexible and friendly approach provided by interviewing to the preparation of unambiguous questions and statements for the gathering of more precise information

Types of Question Structure

- there are two question structures for questionnaires: closed questions and open question
- **Closed Questions**
- A closed question asks the respondent to select an answer from a choice of alternative replies. C
- losed questions may require just “yes” or “no” responses, or they may have some form of rating scale associated with them
- More complex rating scales increase the number of points (or responses) to produce a multipoint rating scale called a **semantic differential**
- A Likert scale is a selection of statements, each similar to a semantic differential, that when analyzed together portray a user’s attitude

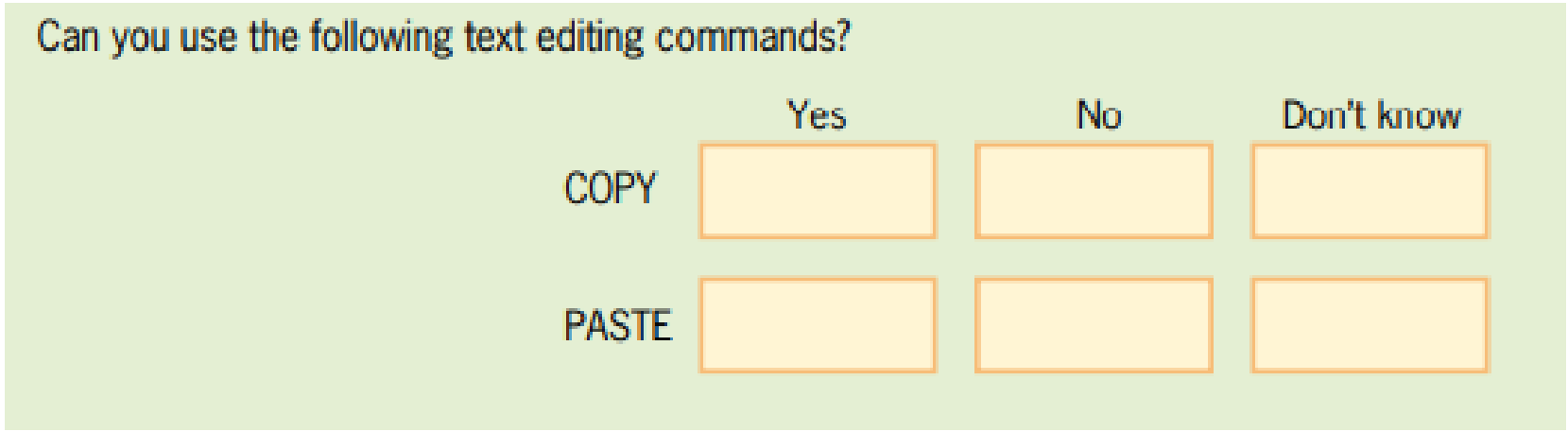


Figure 2.2 An example of a simple checklist.

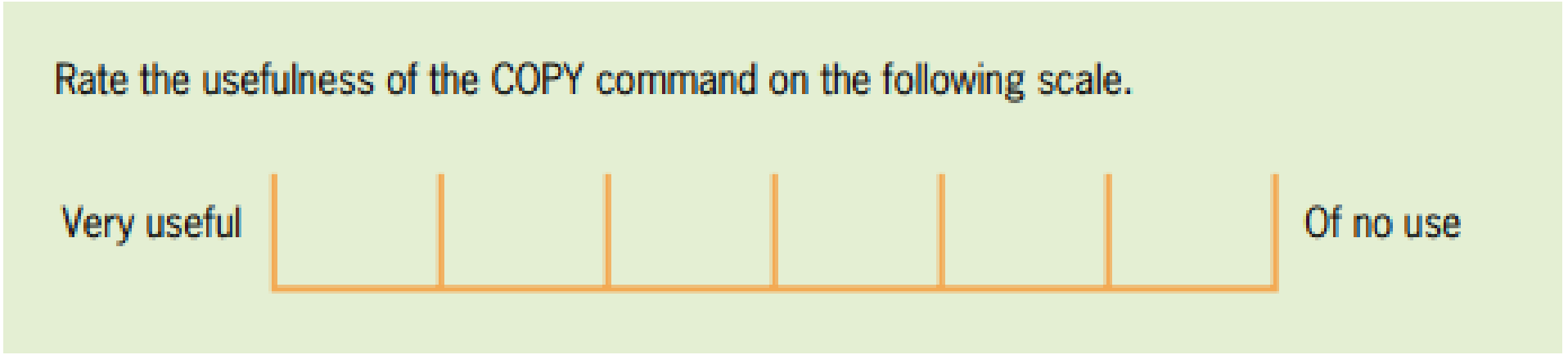


Figure 2.3 An example of a semantic differential.

- **Open Questions**
- An open question allows respondents to say whatever they like in response, and they are used where there are no predetermined answers.
- Open questions typically start with phrases such as “What do you . . . ,” “How do you . . . ,” or “What ways . . . .”
- Limiting the amount of space on the form for the answer can encourage respondents to prioritize their points
- Open questions provide richer data than do closed questions, although the responses will be more time consuming to analyze as you need to read each one and decide on some way of grouping and classifying them.

Points to Consider When Designing Questionnaires

- Make the process easy for the person who is answering by keeping the **questions simple, and ask as few questions as possible**; unless absolutely necessary, aim for no more than two sides of letter paper or A4 paper
- Make sure the questions are **clear and unambiguous**, as you will not be there to address any difficulties that the people completing the questionnaire may have.
- Make sure the questions will **gather the information you need**.
- **Provide opportunities for your respondents to offer information** that you may not have thought about; for example, you might include some open questions or an “any other comments” box

Finding out about the users and the domain

- Users: Finding Out Who They Are
- Users' Needs: Finding Out What Users Want
- The Domain: What Expert Knowledge Is Relevant to the Application?

Table 3.1 Areas of Investigation and Information Gathered for UI Design

Focus of investigation	Information gathered
The domain	Wider specialist knowledge Specific knowledge for a computer system
The users	Who they are; focuses on the *real* (primary) users, but also considers other stakeholders (secondary users)
Characteristics of the users	Age, sex, culture, physical abilities and physical disabilities, educational background, computer/IT experience, motivation, attitude, enjoyment, satisfaction
Characteristics of the tasks	Are the tasks easy, complex, novel, variable, repetitive, frequent or infrequent, single tasks or multitasking, time critical, requiring individual or collaborative working? Are there safety issues in relation to the work?
Physical environment	Noise, stress, comfort, dirt, dust, heating, lighting, ventilation, furniture, working space, individual offices, open-plan areas, equipment layout, hazards in the workplace
Social environment	Pressure of work, individual or collaborative working, individual offices or open-plan areas

Organizational environment	Organizational mission and aims, organizational attitude to IT, organizational policies, job design, and roles
User support environment	Availability of training, availability of colleagues/experts, availability of manuals or online help
Qualitative usability aspects	General, often unquantifiable goals, such as easy to learn, UI intuitiveness
Quantitative usability goals	Measurable goals, such as usability metrics
Constraints	Costs, timescales, budgets, technology hardware and software
Trade-offs	Conflicting/contradictory requirements

Users: Finding Out Who They Are

- In UI design it is imperative to know who the application is being designed for and what the users believe they want from an application.
- People or groups of people in an organization who use the application directly are referred to as the **primary users.**
- **Secondary users** are people or groups of people who are not primary users but who are affected or influenced in some way by the computer system or who affect or influence its development.
- Together the primary users and secondary users are known as stakeholders

Describing the Users: Users Have “Characteristics” That Are Relevant to UI Design

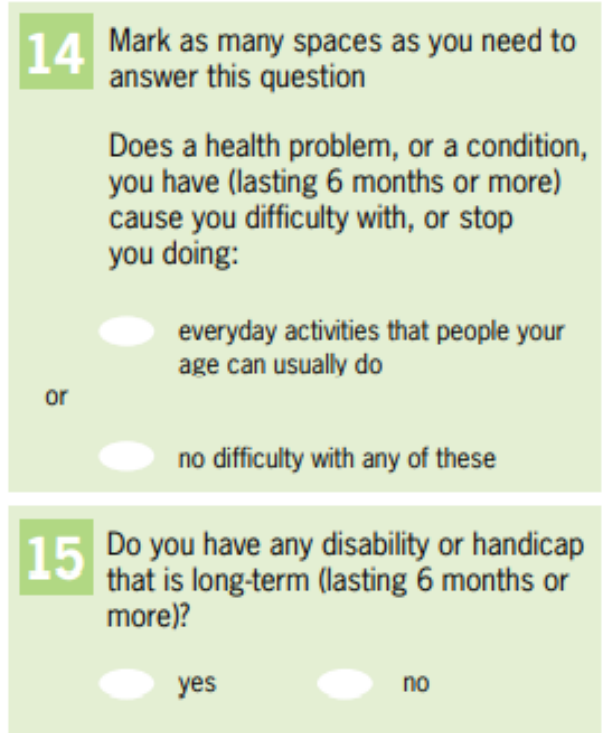
- a profile of the real users of the application is created that describes the users in terms of their particular attributes, such as age, sex, and physical abilities and disabilities
- In addition to physical characteristics, it is also necessary to know about the educational background of the users and how much IT experience they possess.
- Users’ psychological characteristics are also important.

Table 3.2 User Characteristics Relevant to UI Design

Age
Sex
Culture
Physical abilities and disabilities
Educational background
Computer/IT experience
Motivation
Attitude

Designing for Physical Limitations

- blind or visually impaired
- color blindness
- Deuteranopia, where red/green are difficult to distinguish
- Protanopia, another type that affects the ability to distinguish red/green
- Tritanopia, a rare problem that affects the ability to distinguish blue/yellow



14 Mark as many spaces as you need to answer this question

Does a health problem, or a condition, you have (lasting 6 months or more) cause you difficulty with, or stop you doing:

- everyday activities that people your age can usually do

or

- no difficulty with any of these

15 Do you have any disability or handicap that is long-term (lasting 6 months or more)?

- yes
- no

Figure 3.1 Questions on illness and disability from the New Zealand 1996 census. (Taken from www.stats.govt.nz, visted July 9, 2004.)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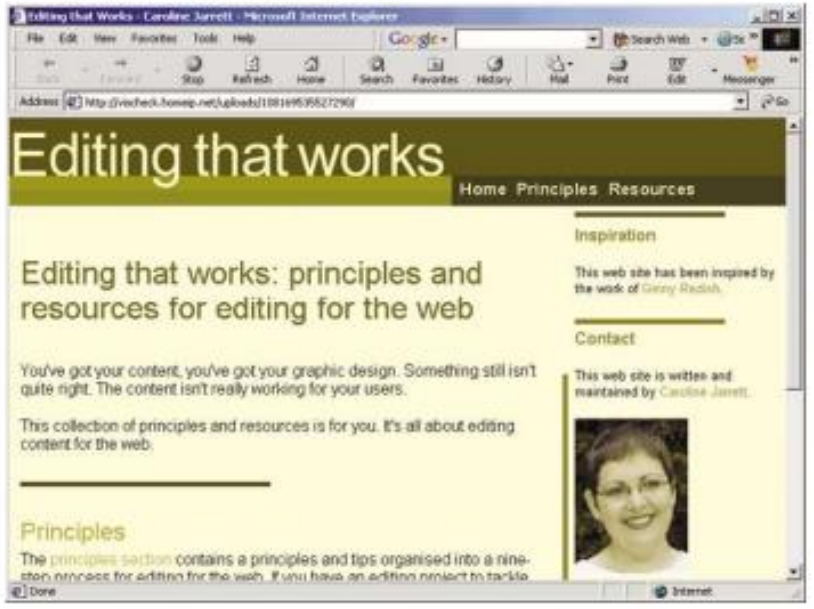
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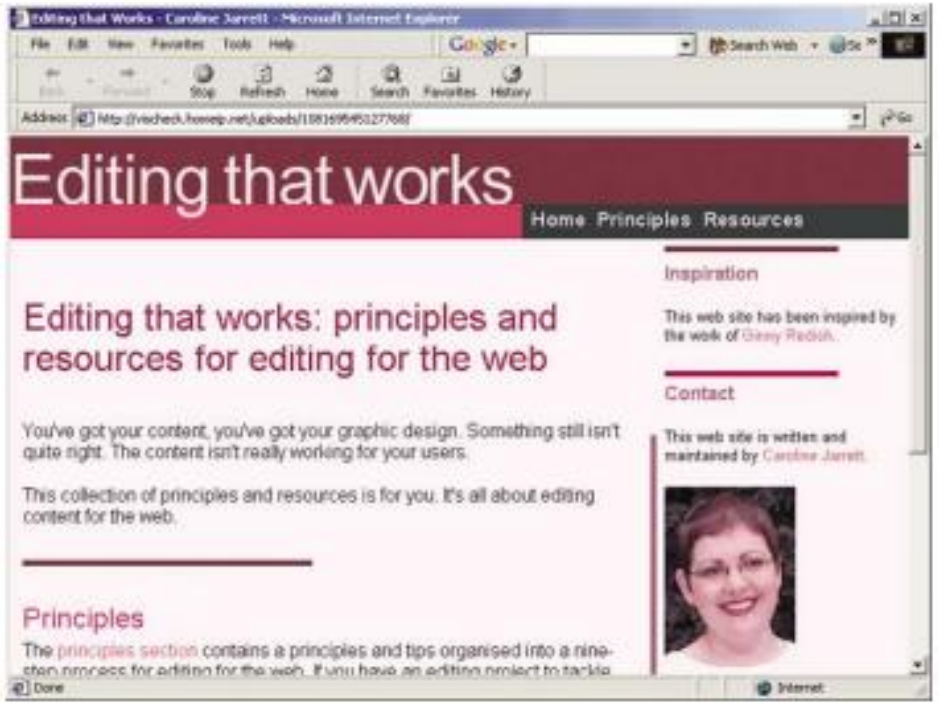

Figure 3.2 The same web site as seen by (top) a person with no problems, (middle) a deuteranope, (bottom) a tritanope. Simulation by www.vischeck.com.

User Profiling: Describing Your Users and Their Characteristics

- There are two main ways to find out about your users so that you can create a user profile.
- First, if you know who your real users are (that is, if you know who will actually be using the interface), then you can ask them to complete a questionnaire.
- Second, if you are unsure about who your real users are, then you will need to talk to or interview knowledgeable people in the organization — domain experts, managers, work supervisors, personnel managers, and product development managers — to find out about the users

Table 3.3 User Profile of ATM Customers (from Chapanis, 1996)

User characteristics	ATM customer characteristics
Age	Will range in age from about 12 to 80+
Sex	Both male and female
Physical limitations	May be fully able-bodied or may have some physical limitations in relation to hearing, sight, mobility, use of hands, or wheelchair use Will be of varying heights
Educational background	May have only minimal education qualifications and possess limited literacy and numeracy skills
Computer/IT use	May have little or no prior experience of computer or IT use
Motivation	May be very motivated to use the ATM, particularly if they can do their banking quickly and avoid waiting in long lines at the bank
Attitude	Attitudes to use may vary, depending on the services the ATM offers, the reliability of the technology itself, and the attitude of users toward computers

Smaller User Groups Are Easier to Design For

- Personas: Another Way to Describe Your Users
- A persona is a precise description of a user and what he or she wishes to do when using a system

Table 3.4 ATM User Groups (adapted from Stone, 2001)

User characteristic	ATM customer characteristics, by group		
	Teens/young adults	Young adults to middle age	Middle age to senior citizens
Age	12 to 25.	25 to 50.	50 to 80+.
Sex	Both male and female.	Both male and female.	Both male and female.
Physical limitations	May be fully able-bodied or may have some physical limitations in relation to, for example, hearing or sight. Will be of varying heights.	May be fully able-bodied or may have some physical limitations in relation to, for example, hearing or sight. Will be of varying heights.	May be fully able-bodied or may have some physical limitations in relation to, for example, hearing or sight, mobility, or use of hands. Will be of varying heights.
Educational background	May have minimal or no educational qualifications.	May have only minimal educational qualifications.	May have only minimal educational qualifications.

Computer/IT use	Probably have some prior experience of computer or IT use.	May have little or no prior experience of computer or IT use.	May have little or no prior experience of computer or IT use.
Motivation	Probably very motivated to use the ATM, especially in relation to their banking habits.	Could be very motivated to use the ATM, especially if they can do their banking quickly and avoid standing in line at the bank.	Could be very motivated to use the ATM, but would probably prefer to stand in a line in the bank.
Attitude	Attitudes to use may vary, depending on the services the ATM offers and the reliability of the technology itself.	Attitudes to use may vary, depending on the services the ATM offers and the reliability of the technology itself.	Attitudes to use may vary, depending on the services the ATM offers and the reliability of the technology itself.

Table 3.5 Translating User Characteristics into UI Design Requirements (middle age to senior citizen group)

User characteristics	ATM UI requirements
Age range from 12 to 80+	ATM screen height needs to accommodate users of varying height.
May be fully able-bodied or may have some physical limitations	ATM screen height needs to accommodate able-bodied users as well as users with walking sticks or those who use wheelchairs. Arthritis of the hands could be a problem, so any controls used should accommodate this.
May have some physical limitations in relation to hearing	All user inputs should have both visual and auditory feedback.

May have some physical limitations in relation to sight	Screen text should be of a reasonably large font, in order to be read by both the visually impaired and unimpaired.
May have some physical limitations in relation to use of hands	Touchscreens, if used, should have target areas that are large enough to locate with limited manual dexterity. Touchscreens, if used, should be sensitive enough to respond to users with decreased strength in fingers or hands.
Little or no experience of computer/IT use	The application should be easy to use (i.e., the tasks users want to undertake should be simple to perform). The application should be easy to learn (i.e., the user should be able to use the system without help, training, or instruction).

Users' Needs: Finding Out What Users Want

- two types of need: felt needs and expressed needs.
- Felt needs, in many cases, are hidden or slow in being identified, as users may not know or understand what a system may be able to offer them or how it could make the accomplishment of their goals easier; so they do not realize that they have a need in the first place.
- You might identify felt needs by questioning individuals or, on a wider basis, by using surveys.

- Expressed needs, on the other hand, are what people say they want.
- For example, users may have grumbled for years about the lack of a particular feature in a computer system without ever doing anything about it; yet when they are consulted, this missing feature may be one of the first things they identify as an essential requirement.

The Domain: What Expert Knowledge Is Relevant to the Application?

- In UI design, the term domain refers to the area of expertise and specialist knowledge
- for example, financial applications or process control systems — for which an application may be developed.
- A domain may be described using particular concepts that highlight important aspects
- For example, the domain specific concepts for a financial application would include credits, debits, accounts, and interest rates.
- Also included in the description of a domain is any specialized knowledge needed to perform tasks and accomplish goals.
- For example, if you want to accomplish the goal of paying a bill by credit card, you will need to have a general idea about how credit cards operate.

Understanding the domain

- The activity of gathering information about a domain is known as domain analysis.
- This involves talking to, observing, and interviewing domain experts, people who are knowledgeable and skilled in the domain area you are investigating

Representing the Domain

- The outputs you arrive at upon completion of a domain analysis are domain models
- domain models describe the domain information and concepts relevant to the particular system under development.
- These domain models contain a subset of the total expert knowledge of the whole domain

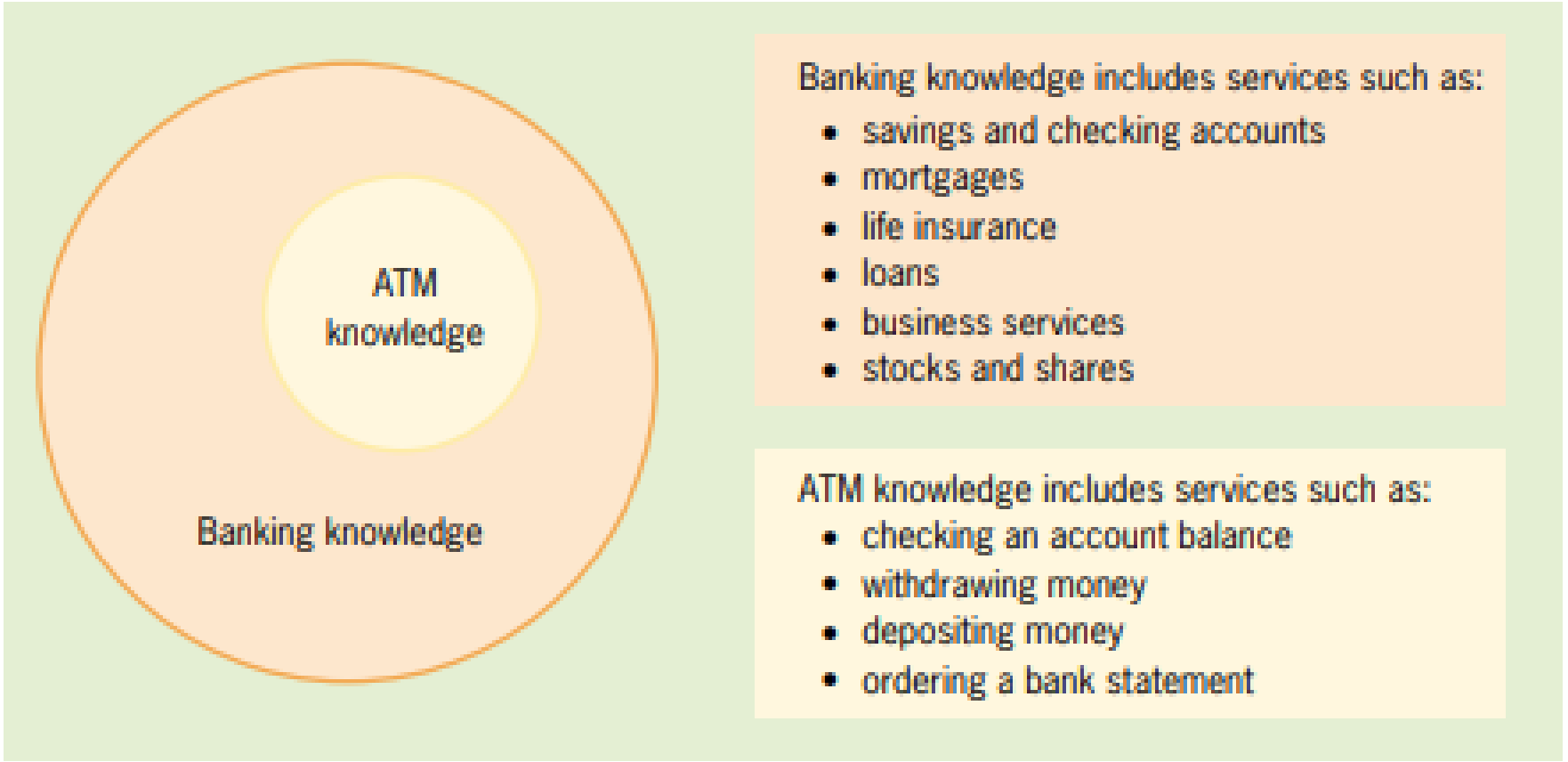

Figure 3.3 ATM Domain Knowledge Is a Subset of Total Banking Domain Knowledge. (From Stone, 2001.)

Representing the Domain

- Domain models can simply be textual descriptions of the relevant domain information, but often graphical notations from systems analysis are used to model the domain.
- These include, the dataflow diagram, the entity–relationship diagram, and the state transition diagram.
- Once created, your domain models — whether textual or graphical — will form part of the requirements specification document

The Two Types of Knowledge Needed for User Interface Design

- for effective user interface design, the designer needs to know about the intended users of a system and must design iteratively.
- In addition, you need to know about and take other information into account comes from two sources:

1. Information-gathering activities and analyses that form part of the user interface design and development process.
2. User interface design knowledge, which comes partly from theory, such as the field of cognitive psychology, and partly from experience, such as studying designs that are currently working well for users

Four Psychological Principles

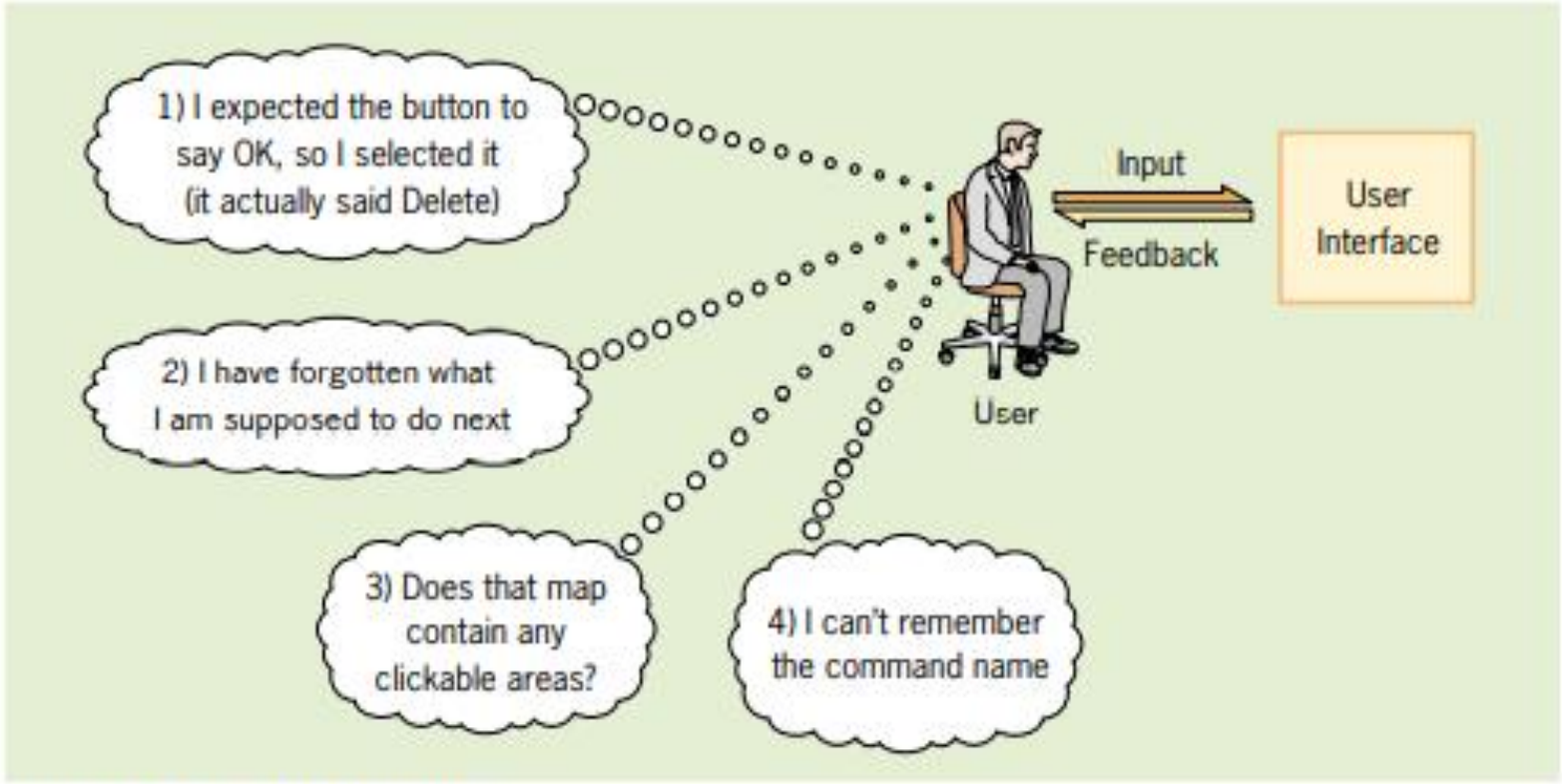

Figure 5.1 Confusing the user.

Four Psychological Principles

1. **Users see what they expect to see.** If the OK button is usually on the left of the Delete button and a new screen swaps these around, users may think they see the OK button on the left and erroneously press the Delete button.
2. **Users have difficulty focusing on more than one activity at a time**. A user who is working in a busy environment may be distracted, so the UI should remind the user what he or she needs to do next.
3. **It is easier to perceive a structured layout**. It is difficult to perceive a button if the screen does not give you any clues, such as lines or shadow encompassing a clickable area.
4. **It is easier to recognize something than to recall it**. Some UIs expect the user to recall esoteric information such as command names. This can be difficult, particularly for a novice user. It is often better to make the information visible in the form of a menu or a button

1 Users See What They Expect to See

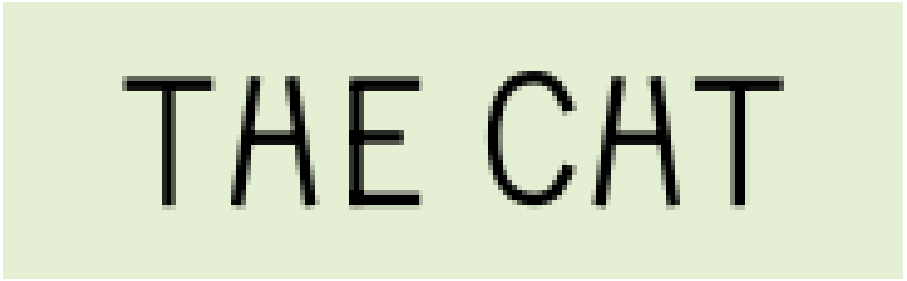

Figure 5.2 The effect of context. (From Selfridge 1955, ©1955 IEEE.)

- The context of the other characters, together with our prior knowledge, enables us to interpret the middle letter as two different characters.
- prior knowledge of the world helps us to make sense of it and we see what we expect to see
- we are not very good at handling unexpected situations

- **The principle of consistency**. As users find it difficult to handle the unexpected, it is important to be consistent throughout the UI. For example, you should use colors in a consistent manner. If you use red to indicate danger, then always use red, rather than red sometimes and green at other times. The same applies to screen layout, such as the positioning of buttons, and to all aspects of UI design.
- **The principle of exploiting prior knowledge**. As users perceive the screen using their prior knowledge, this provides the opportunity to draw on their experience. A screen metaphor, such as the calculator that comes with the Microsoft Windows operating system, does this by presenting users with a familiar image that allows them to apply their prior knowledge and experience of a physical calculator to the Windows version.

2 Users Have Difficulty Focusing on More Than One Activity at a Time

- Thus, to focus attention you should adhere to the following principles:
- **The principle of perceptual organization**. If you group things together that go together, it is easier for the user to pay attention to the appropriate group. For example, the screens in Figure 5.3 both represent the same information. However, part (a) has been grouped into categories and part (b) has not. The lack of structure in part (b) makes it difficult to find information.

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Dublin	664	FR	1035	1135	£149	£100
Toulouse	8064	AF	1110	1410	£307	£182
Frankfurt	4618	LH	1115	1355	£222	£152
Amsterdam	2045	UK	1130	1335	£222	£152
Copenhagen	8363	BA	1145	1445	£315	£187
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Dest: Copenhagen (BA8363) Dep: 1145; Arr: 1445
(B/S: £315/187)
Dest: Paris-CDG (BA1803) Dep: 1150; Arr: 1400
(B/S: £248/165)
Dest: Exeter (JY446) Dep: 1205; Arr: 1305
(B/S: £155/102)
Dest: Glasgow (BA1903) Dep: 1210; Arr: 1310
(B/S: £155/102)
Dest: Munich (LH4526) Dep: 1225; Arr: 1525
(B/S: £301/179)
Dest: Geneva (BA8413) Dep: 1235; Arr: 1420
(B/S: £222/152)
Dest: Aberdeen (BA4172) Dep: 1245; Arr: 1345
(B/S: £155/102)

(b)

Figure 5.3 The structuring of text. (From Tullis, 1988.)

2 Users Have Difficulty Focusing on More Than One Activity at a Time

- **The principle of importance**. If something is important for the user, it should be placed in a prominent position. For example, alarm and warning messages are often placed in the center of the screen, blocking the work that the user is carrying out.

3 It Is Easier to Perceive a Structured Layout

- it is easier to perceive that things go together if they are arranged so that they look like they go together.
- According to Gestalt psychology, a number of laws determine the way in which we perceive the world

- *The law of proximity.* Elements that are close together appear as groups rather than as random elements.
- *The law of similarity*. Elements of the same shape or color appear to belong together.
- *The law of closure*. Where possible, we see an incomplete element as complete — we fill in the gap.
- *The law of continuity*. We see this figure as two lines of dots crossing each other, rather than as a random set of dots.
- *The law of symmetry*. We tend to perceive regions bounded by symmetrical borders as coherent figures.

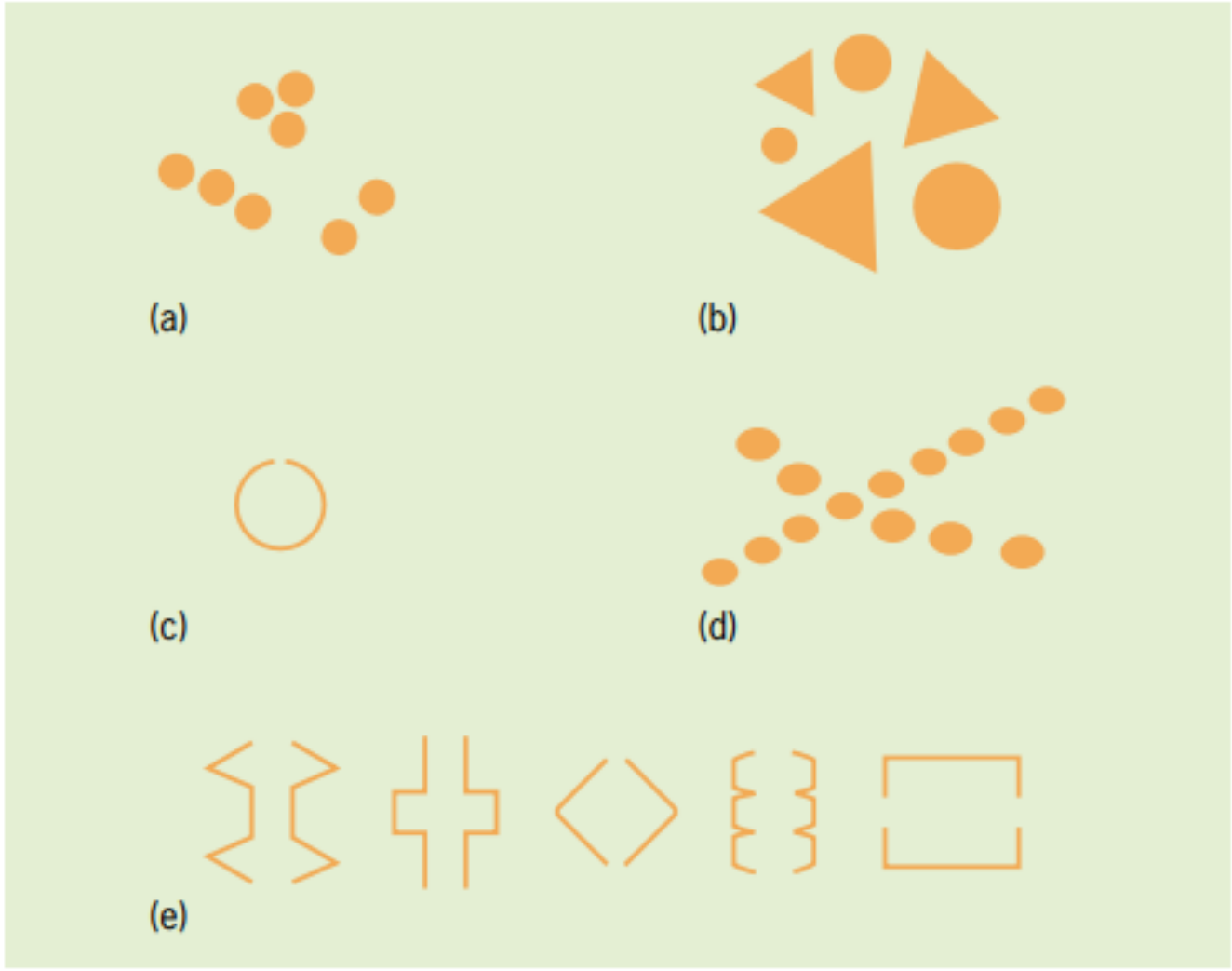

Figure 5.4 The Gestalt principles of perceptual organization: (a) proximity, (b) similarity, (c) closure, (d) continuity, and (e) symmetry.

4 It Is Easier to Recognize Something Than to Recall It

- One of the findings in memory research is that it is easier to recognize information than to recall it.
- Thus, it is easier to take a shopping list with you to the supermarket than to try to recall everything you want to buy.
- knowledge in the head and knowledge in the world.
- The basic idea is that when we carry out everyday tasks, we combine information that is stored in memory with information we locate in the world
- principle of recognition: where possible, allow users to recognize what they want rather than making them recall it.

Three Principles from Experience: Visibility, Affordance, and Feedback

- The principle of visibility: It should be obvious what a control is used for.
- The principle of affordance: It should be obvious how a control is used.
- The principle of feedback: It should be obvious when a control has been used.

Figure 5.7 Door handles. The one on the left affords pulling. The one on the right affords levering. What about the one in the middle?

Design Principles and Design Rules: Knowledge for User Interface Design

- design principles are abstract and at a high level, they are not always easy to apply directly as they must first be interpreted
- design rules that describe how the principle will be interpreted and applied in specific circumstances
- Design rules are low-level, highly specific instructions that can be followed with minimum interpretation or translation by the designer