UNIT-II

OBSTACLES AND PITFALLS IN DEVELOPMENT PATH

- No body ever gets it right for the first time
- Development is chock full of surprises.
- Good design requires living in a sea of changes.
- Designers need good tools.
- Performance design goals
- People may make mistakes while using a good system also

COMMON PITFALLS

- No early analysis and understanding the users needs and expectations.
- A focus on using design features or components .
- No usability testing.
- No common design team vision.
- Poor communication

COMMON USABILITY PROBLEMS

- Ambiguous menus and icons.
- Languages that permit only single direction movement through a system.
- Input and direct manipulation limits.
- Complex linkage.
- Inadequate feedback.
- Lack of system anticipation.
- Inadequate error messages.

IRRITATING CHARACTERS

- Visual clutter
- Impaired information readability
- Incomprehensible components
- Annoying distractions.
- Confusing navigation.
- Inefficient operations
- Inefficient page scrolling.
- Information overload

DESIGN TEAM

- Development
- Human factors
- Visual Design
- Usability assesment
- Documentation
- Training

HUMAN INTERACTION WITH COMPUTERS

Understanding How People Interact with Computers Characteristics of computer systems, past and present, that have caused, and are causing, people problems. We will then look at the effect these problems have –

- Why people have trouble with computers
- Responses to poor design
- People and their tasks

Why People Have Trouble with Computers

- Extensive technical knowledge but little behavioral training.
- With its extensive graphical capabilities.
- Poorly designed interfaces.
- What makes a system difficult to use in the eyes of its user?
- Use of jargon
- Non-obvious design
- Fine distinctions
- Disparity in problem-solving strategies
- an "error-preventing" strategy
- Design inconsistency

PSYCHOLOGICAL

Typical psychological responses to poor design are:

- Confusion: Detail overwhelms the perceived structure. Meaningful patterns are difficult to ascertain, and the conceptual model or underlying framework cannot be understood or established.

- Annoyance: Roadblocks that prevent a task being completed, or a need from being satisfied, promptly and efficiently lead to annoyance. Inconsistencies in design, slow computer reaction times, difficulties in quickly finding information, outdated information, and visual screen distractions are a few of the many things that may annoy users.

- Frustration: An overabundance of annoyances, an inability to easily convey one's intentions to the computer, or an inability to finish a task or satisfy a need can cause frustration. Frustration is heightened if an unexpected computer response cannot be undone or if what really took place cannot be determined: Inflexible and unforgiving systems are a major source of frustration.

- Panic or stress: Unexpectedly long delays during times of severe or unusual pressure may introduce panic or stress. Some typical causes are unavailable systems or long response times when the user is operating under a deadline or dealing with an irate customer.

- Boredom: Boredom results from improper computer pacing (slow response times or long download times) or overly simplistic jobs.

- These psychological responses diminish user effectiveness because they are severe blocks to concentration.

  --Thoughts irrelevant to the task at hand are forced to the user's attention, and necessary concentration is impossible.

  --The result, in addition to higher error rates, is poor performance, anxiety, and dissatisfaction Physical.

- Psychological responses frequently lead to, or are accompanied by, the following physical reactions.

- Abandonment of the system: The system is rejected and other information sources are relied upon. These sources must, of course, be available and the user must have the discretion to perform the rejection.

In business systems this is a common reaction of managerial and professional personnel. With the Web, almost all users can exercise this option.

- Partial use of the system: Only a portion of the system's capabilities are used, usually those operations that are easiest to perform or that provide the most benefits. Historically, this has been the most common user reaction to most computer systems. Many aspects of many systems often go unused.

- Indirect use of the system: An intermediary is placed between the would-be user and the computer. Again, since this requires high status and discretion, it is another typical response of managers or others with authority.

- Modification of the task: The task is changed to match the capabilities of the system. This is a prevalent reaction when the tools are rigid and the problem is unstructured, as in scientific problem solving.

- Compensatory activity: Additional actions are performed to compensate for system inadequacies. A common example is the manual reformatting of information to match the structure required by the computer. This is a reaction common to workers whose discretion is limited, such as clerical personnel.

- Misuse of the system: The rules are bent to shortcut operational difficulties. This requires significant knowledge of the system and may affect system integrity.

- Direct programming: The system is reprogrammed by its user to meet specific needs. This is a typical response of the sophisticated worker.

- These physical responses also greatly diminish user efficiency and effectiveness. They force the user to rely upon other information sources, to fail to use a system's complete capabilities, or to perform time-consuming "work-around" actions

IMPORTANT HUMAN CHARACTERISTICS IN DESIGN

• Importance in design are perception, memory, visual acuity, foveal and peripheral vision, sensory storage, information processing, learning, skill, and individual differences.

- Perception
- Proximity
- Similarity
- Matching patterns
- Succinctness
- Closure
- Unity
- Continuity
- Balance
- Expectancies
- Context
- Signals versus noise

- Memory: Memory is not the most stable of human attributes, as anyone who has forgotten why they walked into a room, or forgotten a very important birthday, can attest.
  - -*Short-term*, or working, memory.
    - *Long-term* memory
    - Mighty memory

- Sensory Storage

- Mental Models: As a result of our experiences and culture, we develop mental models of things and people we interact with.

- A mental model is simply an internal representation of a person's current understanding of something. Usually a person cannot describe this mental mode and most often is unaware it even exists.

- Mental models are gradually developed in order to understand something, explain things, make decisions, do something, or interact with another person.

- Mental models also enable a person to predict the actions necessary to do things if the action has been forgotten or has not yet been encountered.

- Movement Control : Once data has been perceived and an appropriate action decided upon, a response must be made.

- In many cases the response is a movement. In computer systems, movements include such activities as pressing keyboard keys, moving the screen pointer by pushing a mouse or rotating a trackball, or clicking a mouse button

THE IMPLICATIONS IN SCREEN DESIGN

- Learning: Learning, as has been said, is the process of encoding inlong-term memory information that is contained in short-term memory.
- It is a complex process requiring some effort on our part. Our ability to learn is important-it clearly differentiates people from machines.
- Given enough time people can improve the performance in almost any task. Too often, however, designers use our learning ability as an excuse to justify complex design.
- A design developed to minimize human learning time can greatly accelerate human performance.
- People prefer to stick with what they know, and they prefer to jump in and get started. Unproductive time spent learning is something frequently avoided.
- Skill: The goal of human performance is to perform skillfully. To do so requires linking inputs and responses into a sequence of action.

- The essence of skill is performance of actions or movements in the correct time sequence with adequate precision. It is characterized by consistency and economy of effort.
- Economy of effort is achieved by establishing a work pace that represents optimum efficiency.
- It is accomplished by increasing mastery of the system through such things as progressive learning of shortcuts, increased speed, and easier access to information or data.
- Skills are hierarchical in nature, and many basic skills may be integrated to form increasingly complex ones. Lower-order skills tend to become routine and may drop out of consciousness.
- System and screen design must permit development of increasingly skillful performance.
- Individual Differences: In reality, there is no average user. A complicating but very advantageous human characteristic is that we all differ-in looks, feelings, motor abilities, intellectual abilities, learning abilities and speed, and so on.
- In a keyboard data entry task, for example, the best typists will probably be twice as fast as the poorest and make 10 times fewer errors.
- Individual differences complicate design because the design must permit people with widely varying characteristics to satisfactorily and comfortably learn the task or job, or use the Web site.
- In the past this has usually resulted in bringing designs down to the level of lowest abilities or selecting people with the minimum skills necessary to perform a job.
- But technology now offers the possibility of tailoring jobs to the specific needs of people with varying and changing learning or skill levels. Multiple versions of a system can easily be created.
- Design must provide for the needs of all potential users

HUMAN CONSIDERATIONS IN DESIGN

- The User's Knowledge and Experience

  The knowledge possessed by a person, and the experiences undergone, shape the design of the interface in many ways. The following kinds of knowledge and experiences should be identified.

- Computer Literacy - Highly technical or experienced, moderate computer experience, or none

- System Experience - High, moderate, or low knowledge of a particular system and its methods of interaction

- Application Experience - High, moderate, or low knowledge of similar systems

HUMAN CONSIDERATIONS IN DESIGN

- Task Experience - Other Level of knowledge of job and job tasks
- Systems Use - Frequent or infrequent use of other systems in doing job
- Education - High school, college, or advanced degree
- Reading Level - Less than 5th grade, 5th-12th, more than 12th grade
- Typing Skill - Expert (135 WPM), skilled (90 WPM), good (55 WPM), average (40 WPM), or "hunt and peck" (10 WPM).
- Native Language or Culture- English, another, or several.

JOB/TASK/NEED

- Type of System Use - Mandatory or discretionary use of the system.
- Frequency of Use - Continual, frequent, occasional, or once-in-a-lifetime use of system
- Task or Need importance - High, moderate, or low importance of the task being performed
- Task Structure - Repetitiveness or predictability of tasks being automated, high, moderate, or low
- Social Interactions - Verbal communication with another person required or not required
- Primary Training - Extensive or formal training, self training through manuals, or no training
- Turnover Rate - High, moderate, or low turnover rate for jobholders
- Job Category - Executive, manager, professional, secretary, clerk
- Lifestyle - For Web e-commerce systems, includes hobbies, recreational pursuits, and economic status

PSYCHOLOCICAL CHARCTERISTICS

- Attitude - Positive, neutral, or negative feeling toward job or system
- Motivation - Low, moderate, or high due to interest or fear
- Patience - Patience or impatience expected in accomplishing goal
- Expectations - Kinds and reasonableness
- Stress Level - High, some, or no stress generally resulting from task performance
- Cognitive Style - Verbal or spatial, analytic or intuitive, concrete or abstract.

PHYSICAL CHARACTRISTICS

- Age Young middle aged or elderly
- Gender Male or Female
- Handness Left, right or ambidextrous
- Disabilities Blind, defective vision, deafness, motor handicap

HUMAN INTERACTION SPEEDS

- The speed at which people can perform using various communication methods has been studied by a number of researchers.

- Reading: The average adult, reading English prose in the United States, has a reading speed in the order of 250-300 words per minute. Proof reading text on paper has been found to occur at about 200 words per minute, on a computer monitor, about 180 words per minute.

- One technique that has dramatically increased reading speeds is called Rapid Serial Visual Presentation, or RSVP. In this technique single words are presented one at a time in the center of a screen. New words continually replace old words at a rate set by the reader. For a sample of people whose paper document reading speed was 342 words per minute. (With a speed range of 143 to 540 words per minute.) Single words were presented on a screen in sets at a speed sequentially varying ranging from 600 to 1,600 words per minute. After each set a comprehension test was administered.

READING

- Prose text - 250-300 words per minute.
- Proof reading text on paper - 200 words per minute.
- Proofreading text on a monitor - 180 words per minute.

LISTENING

- Speaking to a computer: 150-160 words per minute.
- After recognition corrections: 105 words per minute.

KEYING

- Typewriter
  - Fast typist: 150 words per minute and higher
  - Average typist: 60-70 words per minute
- Computer
  - Transcription: 33 words per minute
  - Composition: 19 words per minute
- Two finger typists
  - Memorized text: 37 words per minute

  Copying text: 27 words per minute
- Hand printing
  - Memorized text: 31 words per minute.
  - Copying text: 22 words per minute.

UNDERSTAND THE BUSINESS FUNCTION

- Business definition and requirements analysis

  --Direct methods -

  -Indirect methods

  --Requirements collection guidelines
- Determining basic business functions

  --Developing conceptual modes

  --Understanding mental models -

  -Users new mental model
- Design standards or style guides

  --Value of standards and
  guidelines --Document design

  --Design support and implementation
- System training and documentation

  -- Training

  --Documentation

DIRECT METHODS

- Individual Face-to-Face Interview
- Telephone Interview or Survey
- Traditional Focus Group
- Facilitated Team Workshop
- Observational Field Study
- User-Interface Prototyping
- Usability Laboratory Testing
- Card Sorting for Web Sites
- A technique to establish groupings of information for Web sites

INDIRECT METHODS

- MIS Intermediary
- Paper Surveyor Questionnaire
- Electronic Surveyor Questionnaire
- Electronic Focus Group
- Marketing and Sales
- Support Line
- E-Mail or Bulletin Board
- User Group
- Competitor Analyses
- Trade Show
- Other Media Analysis
- System Testing

DETERMINING BASIC BUSINESS FUNCTIONS

• Major system functions are listed and described, including critical system inputs and outputs.

A flowchart of major functions is developed. The process the developer will use is summarized as follows:

Gain a complete understanding of the user's mental model based upon:

- The user's needs and the user's profile.
- A user task analysis.
- Develop a conceptual model of the system based upon the user's mental model. This includes:
- Defining objects.
- Developing metaphors.

UNDERSTANDING THE USER'S MENTAL MODEL

- The next phase in interface design is to thoroughly describe the expected system user or users and their current tasks.
- The former will be derived from the kinds of information collected in Step 1 "Understand the User or Client," and the requirements analysis techniques described above.
- A goal of task analysis, and a goal of understanding the user, is to gain a picture of the user's mental model.
- A mental model is an internal representation of a person's current conceptualization and understanding of something.
- Mental models are gradually developed in order to understand, explain, and do something.
- Mental models enable a person to predict the actions necessary to do things if the actions have been forgotten or have not yet been encountered.

PERFORMING A TASK ANALYSIS

- User activities are precisely.
- Task analysis involves breaking down the user's activities to the individual task level.
- Knowing why establishes the major work goals;
- Complete description of all user tasks and interactions.
- Work activities are studied using the techniques just reviewed;
- Direct observation, interviews, questionnaires, or obtaining measurements of actual current system usage.
- Listing of the user's current tasks.
- Another result is a list of objects the users see as important to what they do

DEVELOPING CONCEPTUAL MODELS

- The output of the task analysis is the creation, by the designer, of a conceptual model for the user interface.
- A conceptual model is the general conceptual framework through which the system's functions are presented.

- Such a model describes how the interface will present objects, the relationships between objects, the properties of objects, and the actions that will be performed.

- A conceptual model is based on the user's mental model. Since the term mental model refers to a person's current level of knowledge about something, people will always have them

DEVELOPING CONCEPTUAL MODELS

- Since mental models are influenced by a person's experiences, and people have different experiences, no two user mental models are likely to be exactly the same.

- Each person looks at the interface from a slightly different perspective. The goal of the designer is to facilitate for the user the development of useful *mental model of the system.*

- This is accomplished by presenting to the user a *meaningful conceptual model of the system* .

- When the user then encounters the system, his or her *existing mental model* will, hopefully, mesh well with the system's conceptual model.

- As a person works with a system, he or she then develops a *mental model of the system.*

- The system mental model the user derives is based upon system's behavior, including factors such as the system inputs, actions, outputs (including screens and messages), and its feedback and guidance characteristics, all of which are components of the conceptual model.

- Documentation and training also playa formative role. Mental models will be developed regardless of the particular design of a system, and then they will be Modified with experience.

- What must be avoided in design is creating for the user a conceptual model that leads to the creation of a false mental model of the system, or that inhibits the user from creating a meaningful or efficient mental model.

Guidelines for Designing Conceptual Models

- Reflect the user's mental model, not the designer's.
- Draw physical analogies or present metaphors.
- Comply with expectancies, habits, routines, and stereotypes.
- Provide action-response compatibility.

- Make invisible parts and process of a system visible.
- Provide proper and correct feedback.
- Avoid anything unnecessary or irrelevant.
- Provide design consistency.
- Provide documentation and a help system that will reinforce the conceptual model.
- Promote the development of both novice and expert mental models.

Defining Objects

• Determine all objects that have to be manipulated to get work done.

Describe:

- The objects used in tasks.
- Object behavior and characteristics that differentiate each kind of object.
- The relationship of objects to each other and the people using them.
- The actions performed.
- The objects to which actions apply.
- State information or attributes that each object in the task must preserve, display,or allow to be edited.

• Identify the objects and actions that appear most often in the workflow.

• Make the several most important objects very obvious and easy to manipulate

Developing Metaphors

- Choose the analogy that works best for each object and its actions.
- Use real-world metaphors.
- Use simple metaphors.
- Use common metaphors.
- Multiple metaphors may coexist.
- Use major metaphors, even if you can't exactly replicate them visually.
- Test the selected metaphors.

SCREEN DESIGNING

How to distract the screen user

- Unclear captions
- Improper type and graphic emphasis
- Misleading headings
- Irrelevant and unnecessary headings
- Inefficient results
- Clustered and cramped layout
- Poor quality of presentation
- Legibility
- Appearance
- arrangement
- Visual inconsistency
- Lack of design features
- Over use of 3D presentations
- Overuse of too many bright colors
- Bad typography

Variety of distractions

- Numerous audio and visual interruptions
- Extensive visual clutter
- Poor information readability
- In comprehensible screen components
- Confusing and inefficient navigation
- Inefficient operations
- Excessive or inefficient page scrolling
- Information overload
- Design in consistency
- Outdated information

What screen users want

- an orderly clean clutter free appearance
- An obvious indication of what is being shown and what should be done with it.
- Expected information located where it should be.
- A clear indication of what relates to what.
- Plain and simple english
- A clear indication of when an action can make a permanent change in data

What screen users do

- Identifies a task to be performed or need to be fulfilled.
- Decides how the task will be completed or need fulfilled.
- Manipulates the computers controls.
- Gathers necessary data.
- Forms judgments resulting in decisions relevant to task.

Design goals

- Reduce visual work
- Reduce intellectual work
- Reduce memory work
- Reduce mentor work
- Eliminate burdens or instructions.

SCREEN MEANING AND PURPOSE

Each screen element

- Every control
- All text
- Screen organization
- All emphasis
- Each color
- Every graphic
- All screen animation
- All forms of feedback

Must

- Have meaning to screen users
- Serve a purpose in performing task organizing screen elements

Consistency

- Provide real world consistency
- Provide internal consistency
- Operational and navigational procedures
- Visual identity or theme
- Component
- Organization
- Presentation
- Usage
- Locations
- Follow the same conventions
- Deviate only when there is clear benefit to user

ORDERING OF SCREEN DATA & CONTENT

- Divide information into units that are logical, meaningful and sensible.
- Organize by interrelationships between data or information.
- Provide an ordering of screen units of elements depending on priority.
- Possible ordering schemes include

- Conventional
- Sequence of use
- Frequency of use
- Function
- Importance
- General to specific**.**

- Form groups that cover all possibilities.
- Ensure that information is visible.
- Ensure that only information relative to task is presented on screen.
- Organizational scheme is to minimize number of information variables.
- Upper left starting point
- Provide an obvious starting point in the screen's upper left Corner.

SCREEN NAVIGATION AND FLOW

• Provide an ordering of screen information and elements that:

- ➢ is rhythmic guiding a person's eye through display
- ➢ encourages natural movement sequences.
- ➢ minimizes pointer and eye movement distances.

➢

• Locate the most important and most frequently used elements or controls at top left.
• Maintain top to bottom , left to right flow.
• Assist in navigation through a screen by

- ➢ Aligning elements
- ➢ Grouping elements
- ➢ Use of line borders
- ➢

• Through focus and emphasis, sequentially, direct attention to items that are

- ➢ Critical
- ➢ Important
- ➢ Secondary
- ➢ Peripheral
- ➢

- Tab through window in logical order of displayed information.
- locate command button at the end of the tabbing order sequence,
- When groups of related information must be broken and displayed on separate screens, provide breaks at logical or natural points in the information flow.
- In establishing eye movement through a screen, also consider that the eye trends to move sequentially , for example –
    - ➢ From dark areas to light areas
    - ➢ From big objects to little objects
    - ➢ From unusual shapes to common shapes.

- From highly saturated colors to unsaturated colors.

• These techniques can be initially used o focus a person's attention.

• Maintain top to bottom, left to right through the screen. This top to bottom orientation is Recommended for information entry for the following reasons –

- Eye movements between items will be shorter.
- Control movements between items will be shorter.
- Groupings are more obvious perceptually.
- When one's eyes moves away from the screen and then back, it returns to about same place it left, even if it is seeking next item in sequence.
-

• Most product style guides recommend a left to right orientation.
• Our earliest display screens reflected this left to right entry orientation.
• Top to bottom orientation is also recommended for presenting displays of read only information that must be scanned.

VISUALLY PLEASING COMPOSITION

• Provide visually pleasing composition with the following qualities –

- balance
- Symmetry
- Regularity
- Predictability
- Sequentiality
- Economy
- Unity
- Proportion
- Simplicity
- Groupings.

Balance

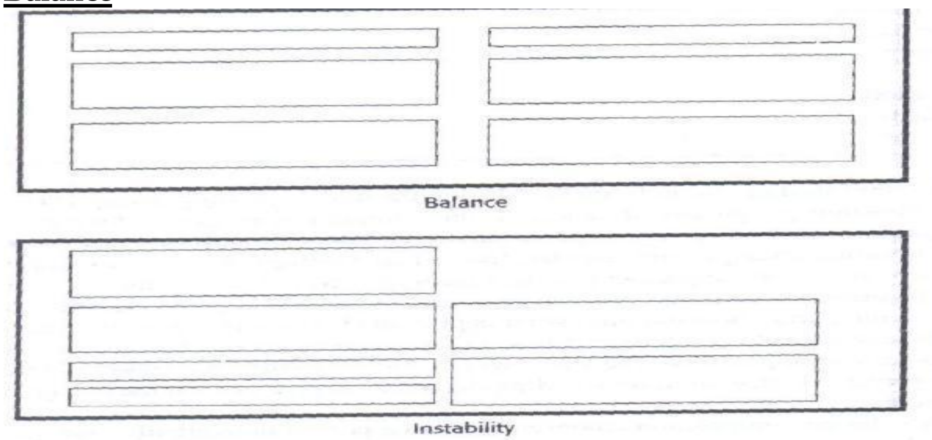


Figure 3.1 Balance (versus instability).

Symmetry

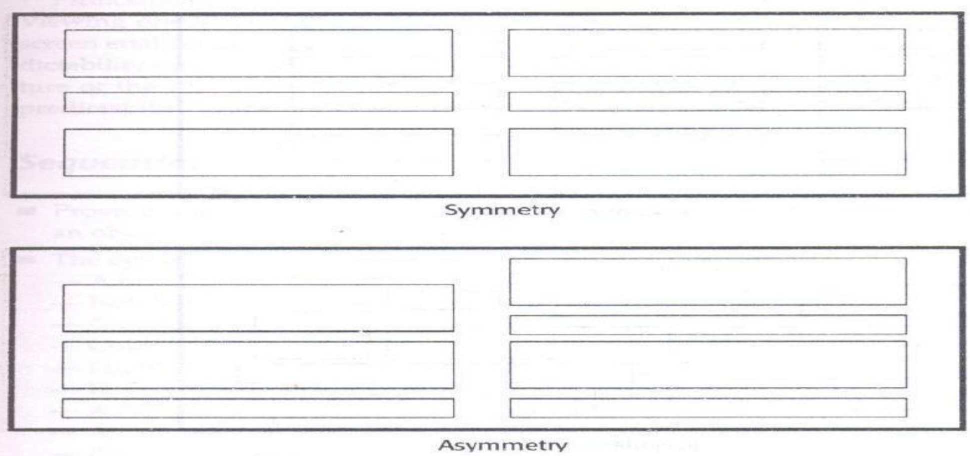


Figure 3.2 Symmetry (versus asymmetry).

Regularity

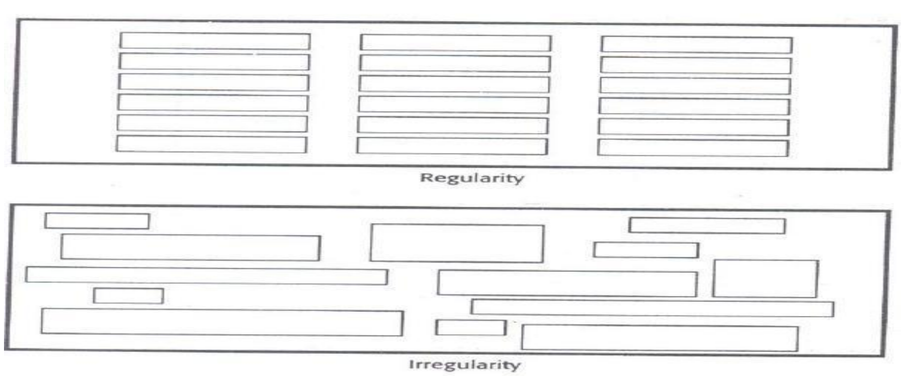


Figure 3.3 Regularity (versus irregularity).

Predictability

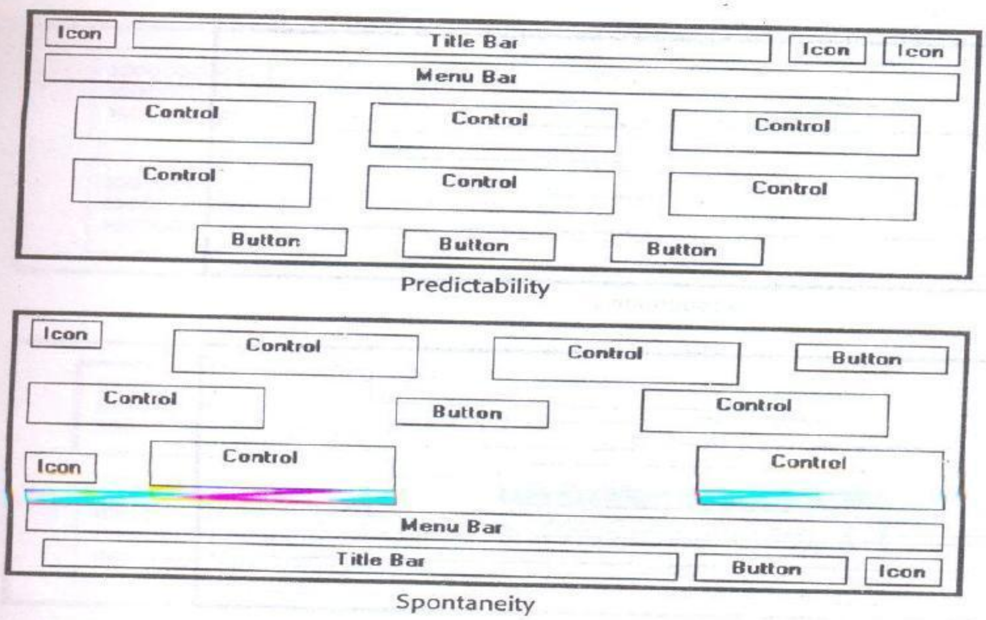


Figure 3.4 Predictability (versus spontaneity).

sequentially

- The eye trends to be attracted to :
- A brighter element before one less bright
- Isolated elements before elements in a group
- Graphics before text
- Color before black and white
- Highly saturated colors before those less saturated.
- Dark areas before light areas
- A big element before a small one
- An unusual shape before a usual one
- Big objects before little objects

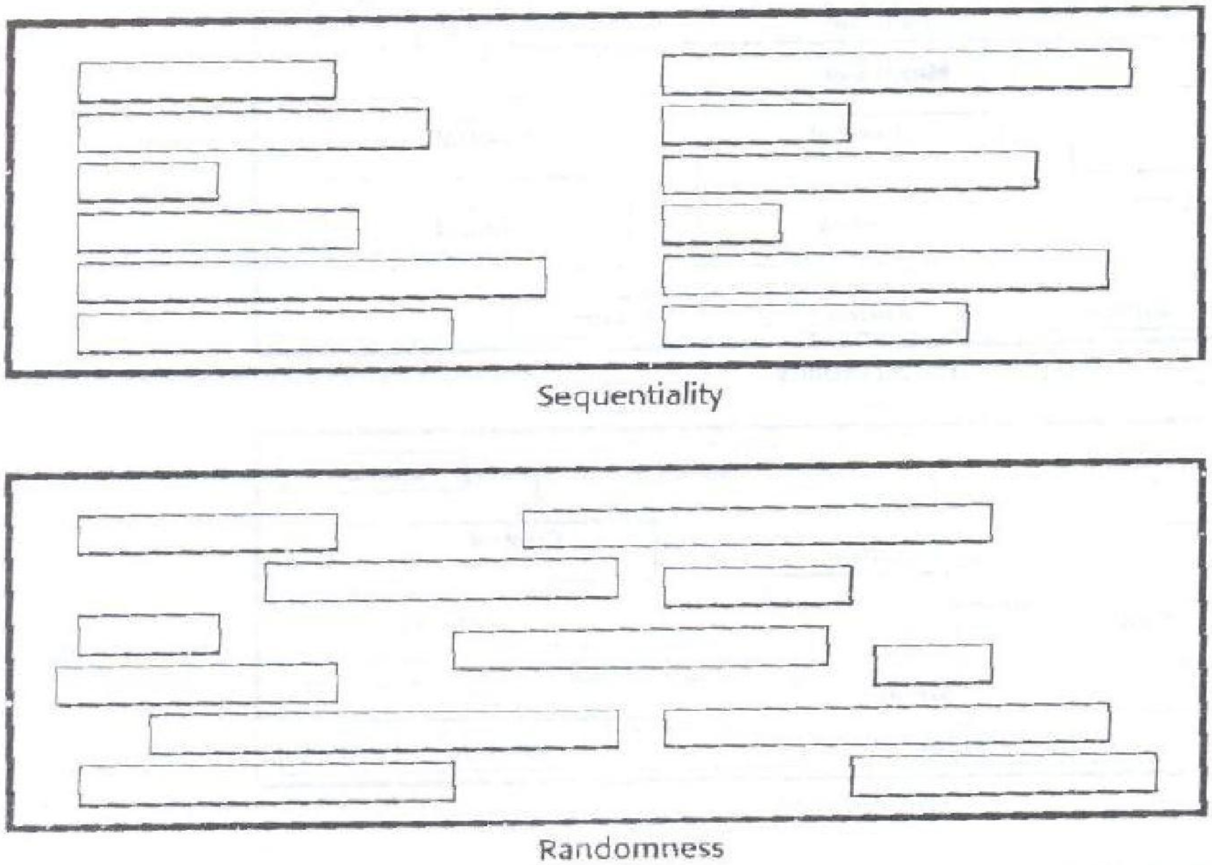


Figure 3.5 Sequentiality (versus randomness).

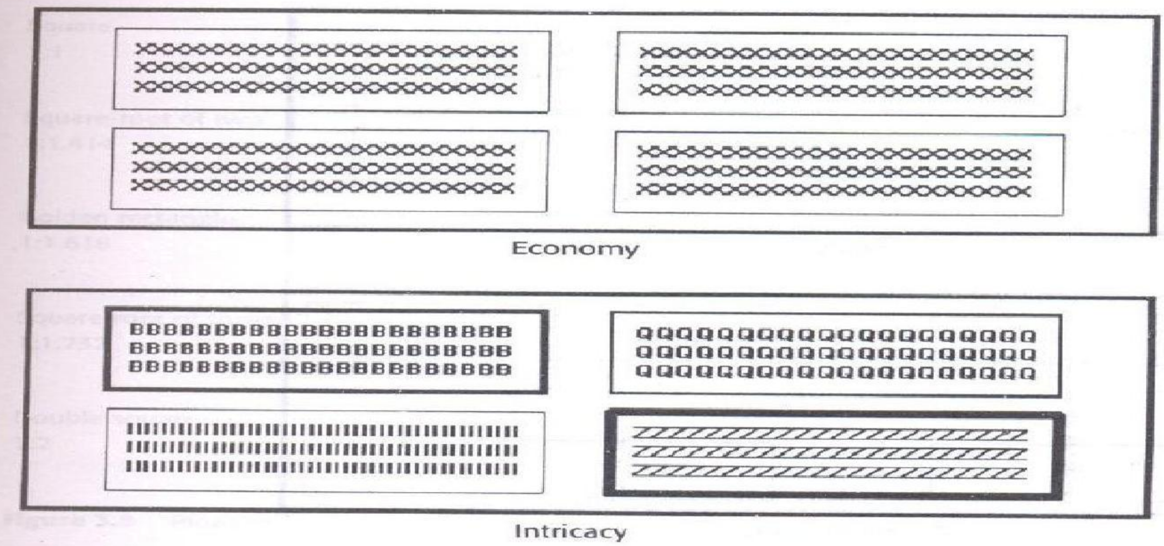


Figure 3.6 Economy (versus intricacy).

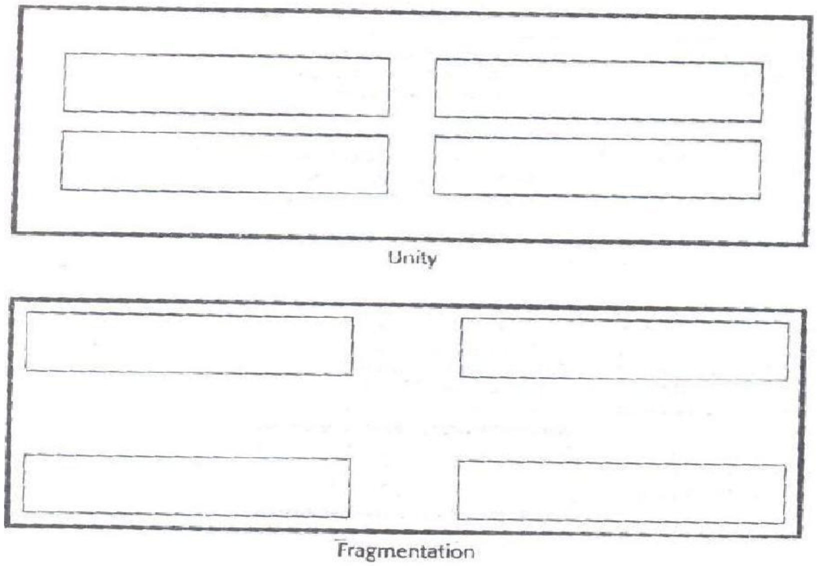


Figure 3.7 Unity (versus fragmentation).

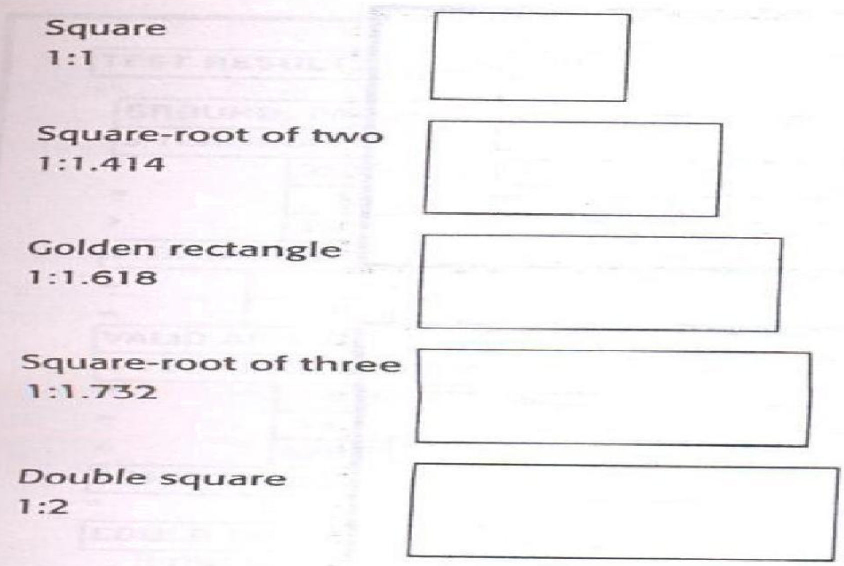


Figure 3.8 Pleasing proportions.

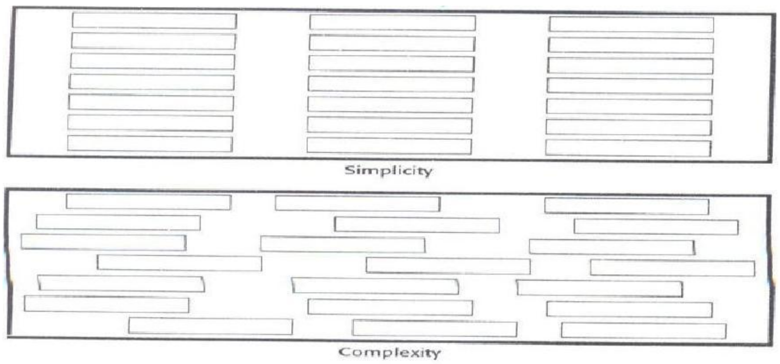


Figure 3.9 Simplicity (versus complexity).

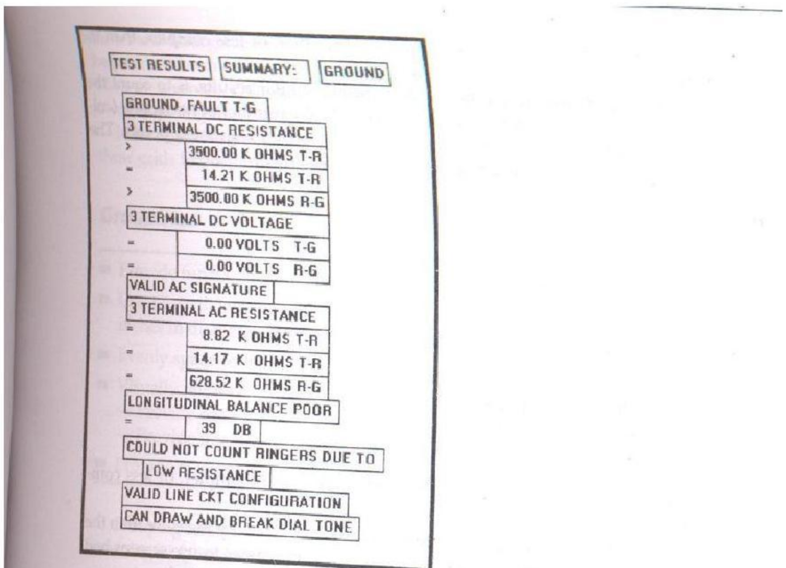
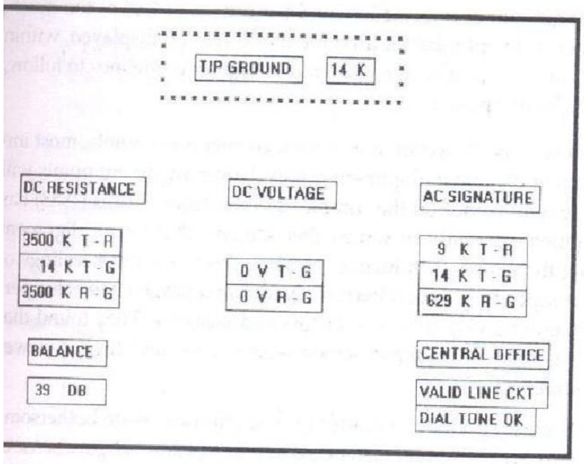


Figure 3.10 Original screen, from Tullis (1981), with title, captions, and data inscribed by rectangles.

- Figure 3.11 (redesigned):

  18 fields with 7 horizontal (column) alignment points = 43 bits.
  18 fields with 8 vertical (row) alignment points = 53 bits.
  Overall complexity = 96 bits.



gure 3.11 Redesigned screen, from Tullis (1981), with title, captions, and data inscribed by rectangles.

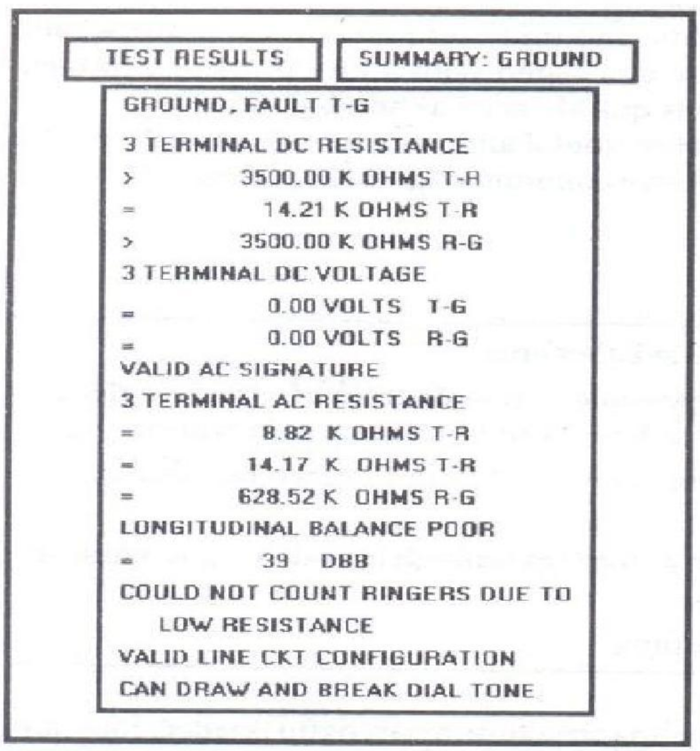


Figure 3.12 Original screen, from Tullis (1981), with grouping indicated by bold boxes.

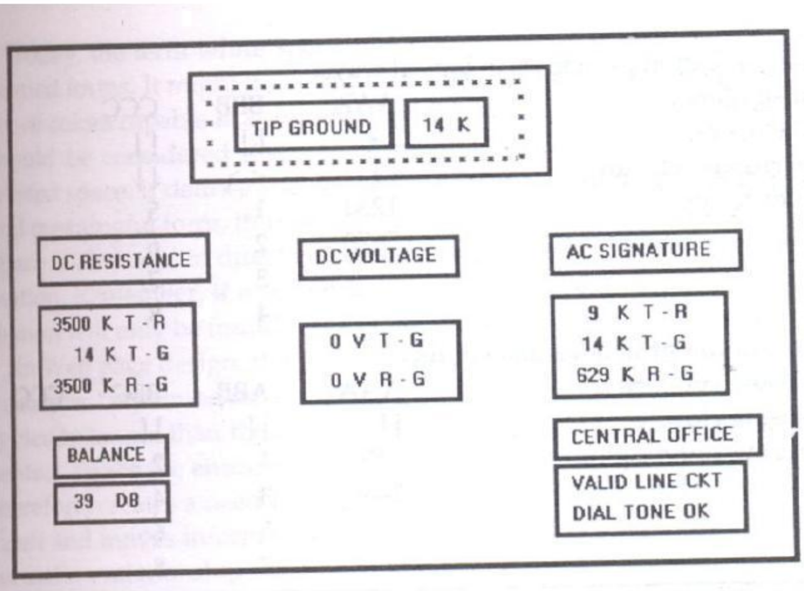


Figure 3.13 Redesigned screen, from Tullis (1981), with grouping indicated by bold boxes.

<u>GROUPING USING BORDERS</u>

- Provide functional groupings
- Create spatial groupings
- Provide meaningful titles for each grouping
- Incorporate line borders
- Do not exceed three line thick ness
- Create lines consistent in height and length
- For adjacent groupings with borders where ever possible
- Use rules and borders sparingly

FOCUS AND EMPHASIS

- Visually emphasize the
- Most prominent element
- Most important elements
- Central idea or focal point
- De emphasize less important elements
- To ensure that
- Too many screen elements are emphasized.
- Screen clutter
- Using too many emphasize techniques

- To provide emphasis use techniques such as :
- Higher brightness
- Reverse polarity

- Larger and distinctive font
- Underlining
- Blinking
- Line rulings
- Contrasting colors
- Larger size
- Positioning
- Isolation
- Distinctiveness
- White space

INFORMATION RETRIEVAL ON WEB

- The most sought after web commodity is content.
- Behavior is often goal driven.
- Reading is no longer a linear activity.
- Impatience.
- Frequent switching of purpose.
- Web users access site for different reasons: a focused search for a piece of information or an answer less focused for browsing or surf.
- High tech capabilities , fancy graphics do not compensable for inefficient or poor content.
- Initial focus on attention
- Page perusal
- Scanning guidelines
- Browsing
- Browisng guidelines
- Searching
- Problems with search facilities
- Search facility guidelines
- Express the search
- Progressive search refinement
- Launch the search
- Present meaningful results

SCANNING GUIDELINES

- Organization
  - Minimize eye movement
  - Provide groupings of information
  - Organize content in a logical and obvious way.

- Writing
  - Provide meaningful headings and subheadings.
  - Provide meaningful titles

- Concisely write the text.
- Use bullets/ numbers
- Array information in tables

• Presentation
  – Key information in words or phrases
  – Important concepts

BROWSING GUIDELINES

• Facilitate scanning
• Provide multiple layers of structure
• Make navigation easy
• Respect users desire to leave
• Upon returning help users reorient themselves.
• Users can browse deeply or simply move on.
• Provide guidance to help reorientation
• Understand terms to minimize to need for users to switch context.

PROBLEMS WITH SEARCHING

- Not understanding the user.
- Difficulties in formulating the search.
- Difficulties in presenting meaningful results.
- Identify the level of expertise of user.

KNOW THE SEARCH USER

- Plan for user's switchig purposes during search process.
- Plan for flexibility in the search process.
- Anticipate
- Nature of every possible query
- Kind of information desired
- How much information will result the search.

STATISTICAL GRAPHICS

• A statistical graphic is data presented in a graphical format.
• A well designed statistical graphic also refered to as chart or graph.
• Use of statistical graphics
- reserve for material that is rich, complex or difficult.
• Data Presentation
• emphasize the data
• Minimize non data elements
• Minimize redundant data
• Fill the graph's available area with data.
• Show data variation

• Provide proper context for data interpretation.
• Scales and shading
    - place ticks to marks scales on the outside edge of each axis.
    - employ a linear scale.
    - mark scales at standard or customary intervals
    - Start a numeric scale at zero.
    - display only a single scale on axis.
    - provide aids for scale interpretation.
    - clearly label each axis.
    - Provide scaling consistency
    - consider duplicate axis for large scale data.
    - Proportion
    - Lines
    - Labeling
    - Title
    - Interpretation of numbers

TECHNOLOGICAL CONSIDERATION -INTERFACE DESIGN

Graphical systems

- Screen design must be compatible with the capabilities of the system –
    - system power
    - Screen size
    - Screen resolution
    - Display colors
    - Other display features
- Screen design must be compatible with the capabilities of the
    - Platform compatibility
    - development and implementation
    - Platform style guide
- Browser
    - compatibility
    - monitor size and resolution
    - fonts
    - Color
    - Bandwidth
    - Version
- Other considerations
    - Downloading
    - Currency
    - Page printing
    - Maintainability