cs121 - software development design

alexandre r.j. françois

visiting associate professor of computer science

HARVEY MUDD COLLEGE

sources

general design

- the design of everyday things, don norman [Nor02]
  - see also: www.jnd.org
- bringing design to software, terry winograd Ed. [Win96]

game design

- software engineering for game developers, p. flynt [FS04]
- game design – theory and practice, richard rouse [Rou01]

some material from skip rizzo's introduction to human factors lecture slides (usc)

also:

www.baddesigns.com, www.interaction-design.org

outline

- what is design?
- designing for people
    - seven stages of action
    - knowledge in the head and knowledge in the world
    - designing for error
    - the design challenge
- seven principles for transforming difficult tasks into simple ones
- game design

what is design?

“whenever objects are created for people to use, design is pervasive” [Win96]

“more an activity than a thing”

design...

- is conscious, keeps human concerns in the center, is a conversation with materials, is creative (criteria are unconstrained), is communication, has social consequences, is a social activity...

design entails

- intention
- purpose
- target

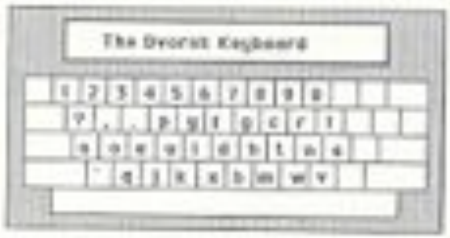
let's talk about keyboards...

A

6.1 Typewriter Keyboards.

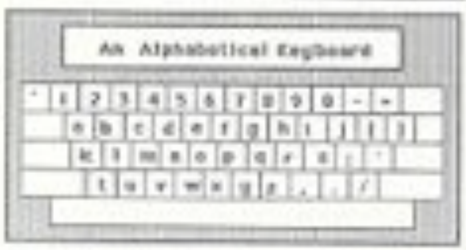
The standard American layout of keys—the Sholes or qwerty keyboard.

B



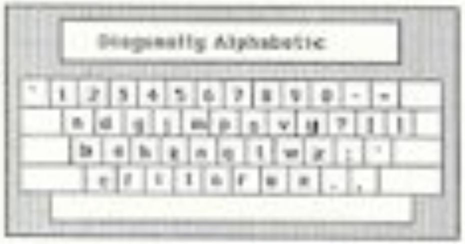
The American Simplified Keyboard (often called ASK), a simplified version of the original Dvorak keyboard; on the original, the numerals and punctuation keys are arranged differently.

C



Most alphabetically organized keyboards arrange the alphabet along horizontal rows, as shown (and in the keyboards of figure 6.5).

D



This alphabetical arrangement is superior, however: with its diagonal arrangement, letters increase systematically up the alphabet from left to right without major breaks.

E

The keyboard at left has randomly arranged letters.

Beginners succeed about the same on all these keyboards: alphabetical works barely better than random. For experts, ASK is best, followed by qwerty: alphabetical keyboards are quite inferior. Moral: Don't bother with alphabetical keyboards.

"A Man's Busy Day."
Circa 1910


Victor
Type writer


CORONA


FORD
SPACE BAR


The Franklin

history of the typewriter

1870's Charles Latham Sholes "Qwerty" keyboard…
  became the Remington typewriter.

other designs

- circular, piano style (with b&w keys)
- gave way to rectangular board.

no Shift Key, double board

why "qwerty"?

touch typing – Frank McGurrin 1877

many variations in key placement

Dvorak (founder of Industrial Engineering Discipline)
  developed a layout based on painstaking analysis

A

6.2 Typewriter Keyboards

The standard American layout of keys —the Sholes or qwerty keyboard.

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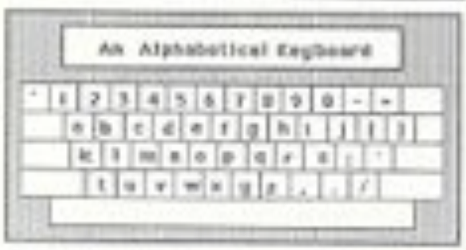

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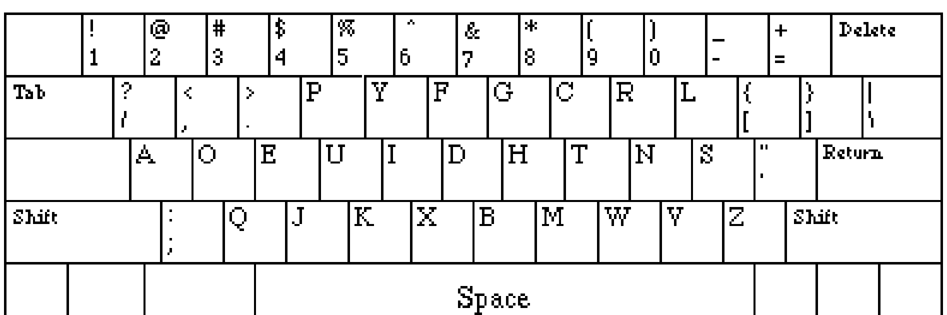
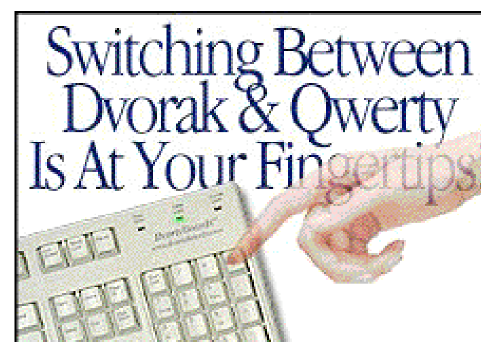
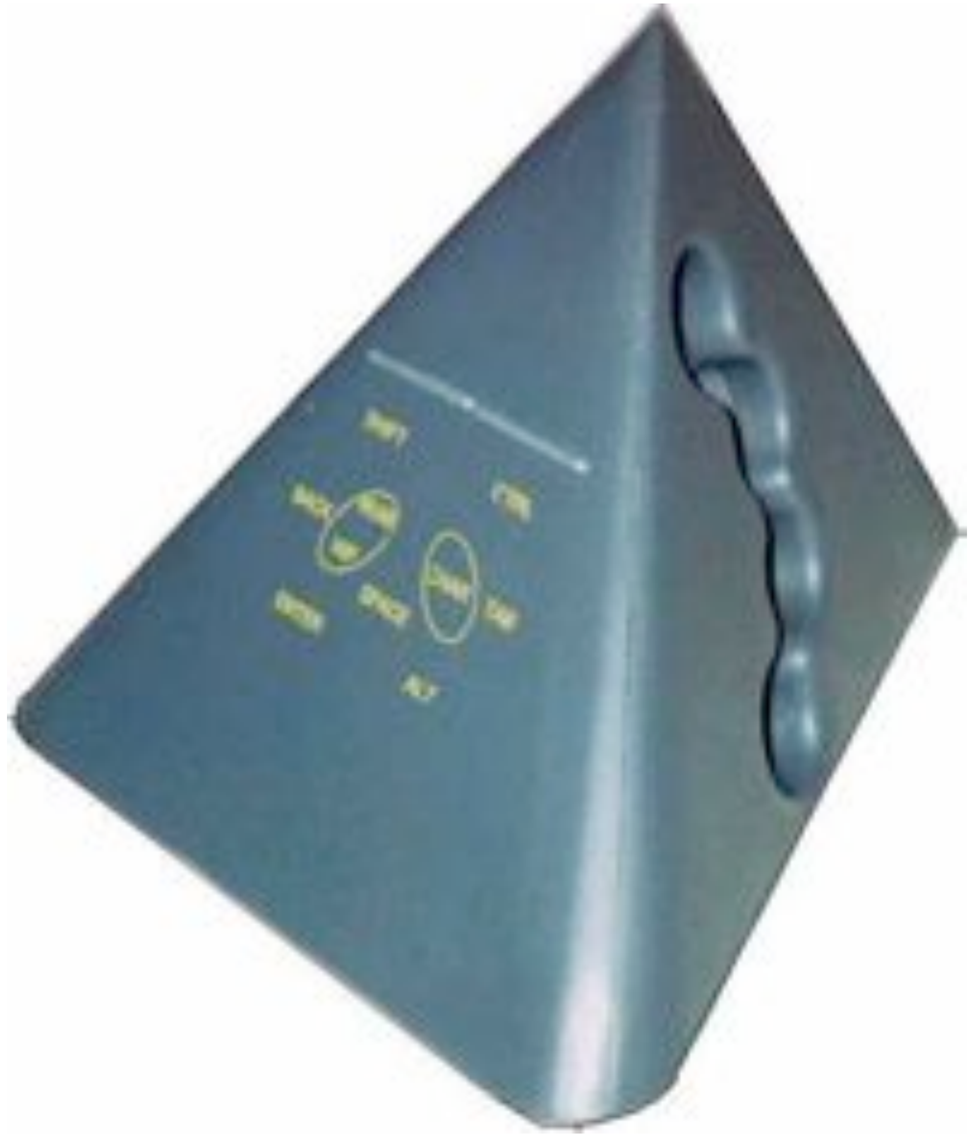
In 1936, August Dvorak, a professor of statistics at University of Washington, proposed rearranging the keyboards alphabetic keys in a layout that is more equitable to the fingers. His design improved efficiency by placing common letters on the home row and also making the stronger fingers do most of the work. The Dvorak layout has been accepted by the American National Standards Institute (ANSI) and has its advocates. However, it has not received wide-spread acceptance because of the many typists trained to use QWERTY keyboards and the costs related to switching over to a new keyboard design.





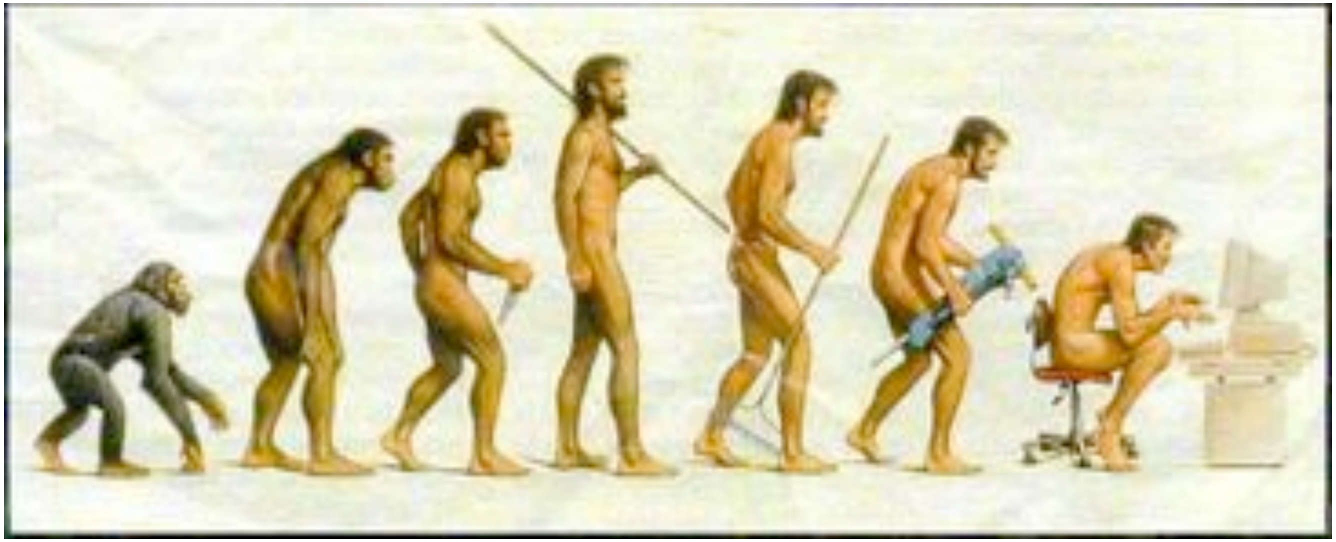

twiddler2



software design

Software design sits at the crossroads of all the computer disciplines: hardware and software engineering, programming, human factors research, ergonomics. ***It is the study of the intersection of human, machine, and the various interfaces–physical, sensory, psychological–that connect them.***

(definition from the Association for Software Design)



software design facets

software engineering

the discipline concerned with the construction of software that is efficient, reliable, robust and easy to maintain

interface design

the possibilities of software are both created and constrained by the physical interfaces

human-computer interaction

whenever someone designs software that interacts with people, the effects of the design extend beyond the software itself to include the experiences that people will have in encountering and using the software

software design facets

art

- because computing evolved initially for use in the laboratory and the office, non cognitive aspects have been largely ignored, except by creators of computer games
- yet, whenever people experience a piece of software, they have natural human responses: they experience beauty, satisfaction and fun, or the corresponding opposites

designing for people

Many scientists who study artificial intelligence use the mathematics of formal logics – the predicate calculus – as their major tool to simulate thought. But human thought–and its close relatives, problem solving and planning–seem more rooted in past experience than in logical deduction. Mental life is not neat and orderly. It does not proceed smoothly and gracefully in neat, logical form. Instead it hops, skips and jumps its way from idea to idea, tying together things that have no business being put together; forming new creative leaps, new insights and concepts. Human thought is not like logic; it is fundamentally different in kind and in spirit. The difference is neither worse nor better. But it is the difference that leads to creative discovery and to great robustness of behavior.

[Nor02] p.115

principles of design for usability and understandability

conceptual model

make it easy to determine what actions are possible at any moment – make use of constraints

visibility

make things visible, including the conceptual model of the system, the alternative actions, and the result of actions

mapping

follow natural mappings between intentions and the required actions; between actions and the resulting effects; and between the information that is visible and the interpretation of the system state

feedback

make it easy to evaluate the current state of the system, give each action an immediate and obvious effect

seven stages of action

action = goal (1) + execution (3) + evaluation (3)

Forming the goal

Forming the intention
Specifying an action
Executing the action

Perceiving the state of the world
Interpreting the state of the world
Evaluating the outcome

design challenges

gulf of execution

- difference between intentions and allowable actions (affordances)
- example: movie projector vs. VCR – cartridge hides the threading complexity

gulf of evaluation

- amount of effort that the person must exert to interpret the state of the system and to determine how well the expectations and intentions have been met
- example: movie projector vs. VCR – trap door hides state

the seven stages as design aid

Visibility

- by looking, the user can tell the state of the device and the alternatives for action

Good conceptual model

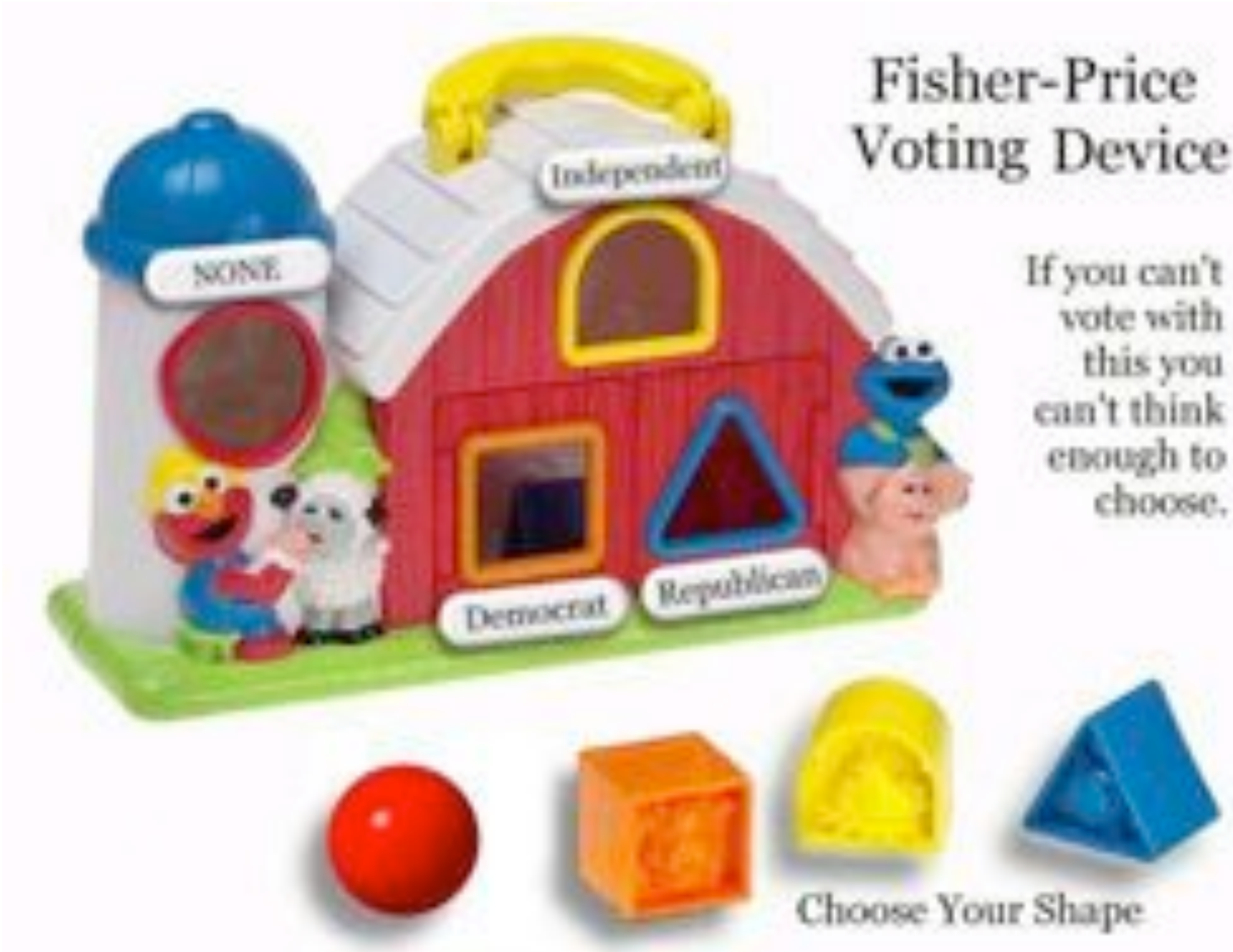
- consistency in the presentation and results
- coherent system image

Good mappings

- possible determine the relationships between actions and results, between the controls and their effects, and between the system state and what is visible

Feedback

- user receives full and continuous feedback about the results of actions.


Fisher-Price
Voting Device
If you can't
vote with
this you
can't think
enough to
choose.
Independent
NONE
Democrat
Republican
Choose Your Shape


COOL • OFF • HEAT
6
7
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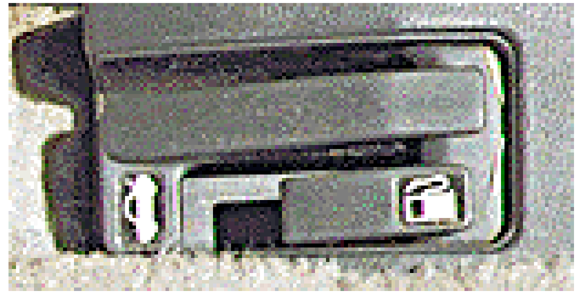
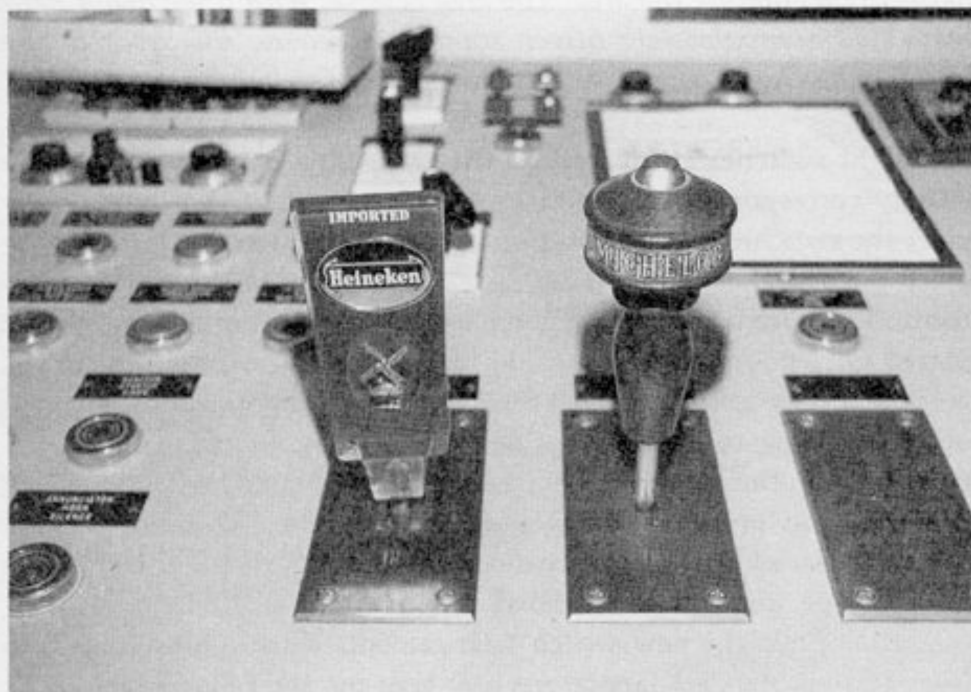
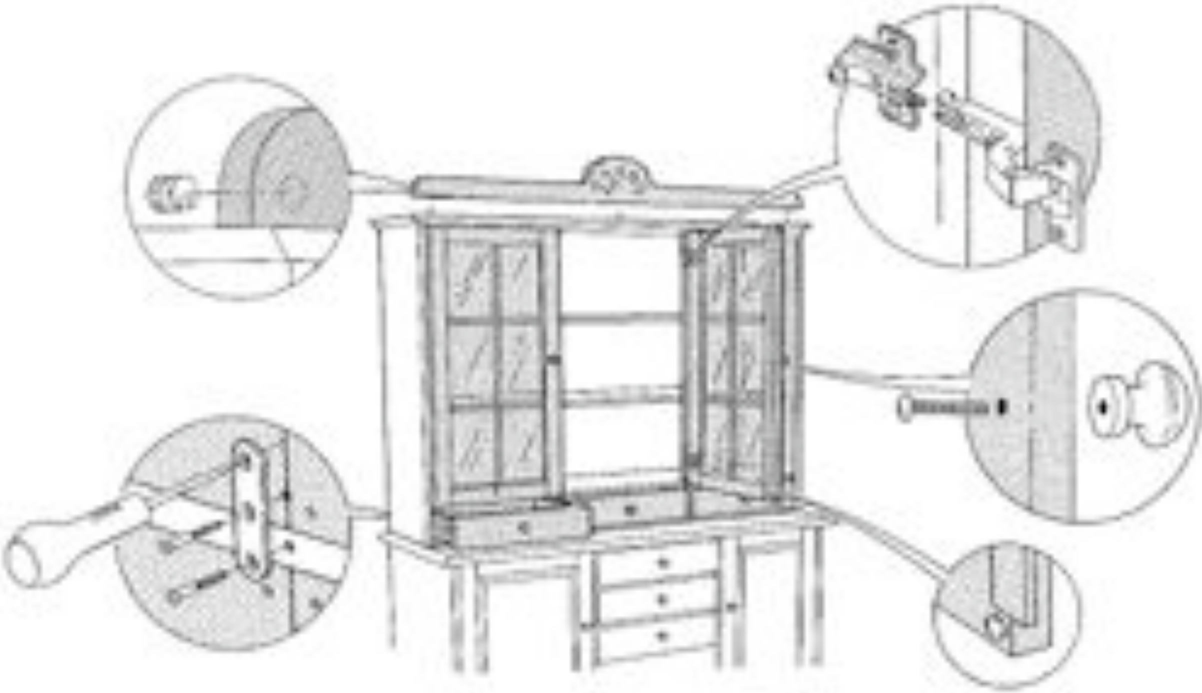
50 60 70 80
50 60 70 80



4.6 **Make the Controls Look and Feel Different.** The control-room operators in a nuclear power plant tried to overcome the problem of similar-looking knobs by placing beer-keg handles over them. This is good design, even if after the fact; the operators should be rewarded. (From Seminara, Gonzales, & Parsons, 1977. Photograph courtesy of Joseph L. Seminara.)





knowledge in the head and in the world

precise behavior can emerge from imprecise knowledge
for 4 reasons:

information is in the world

great precision is not required

natural constraints are present

cultural constraints are present

behavior is determined by the combination of internal knowledge and external information and constraints

trade-off between knowledge in the world and the head

memory as knowledge in the head

- memorizing
  - arbitrary things
  - meaningful relationships
  - memory through explanation
- short term memory (stm)
  - a person should not be required to remember more than 5 or so unrelated items at once
- long term memory (ltm)
  - information is better and more easily acquired if it makes sense, if it can be integrated into some conceptual framework
  - retrieval from ltm is apt to be slow and contain errors

memory as knowledge in the world

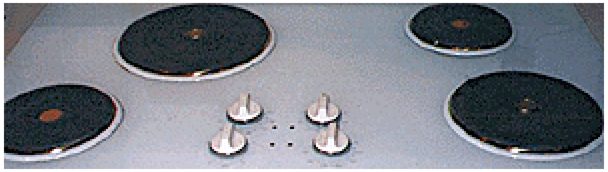
requires physical situation

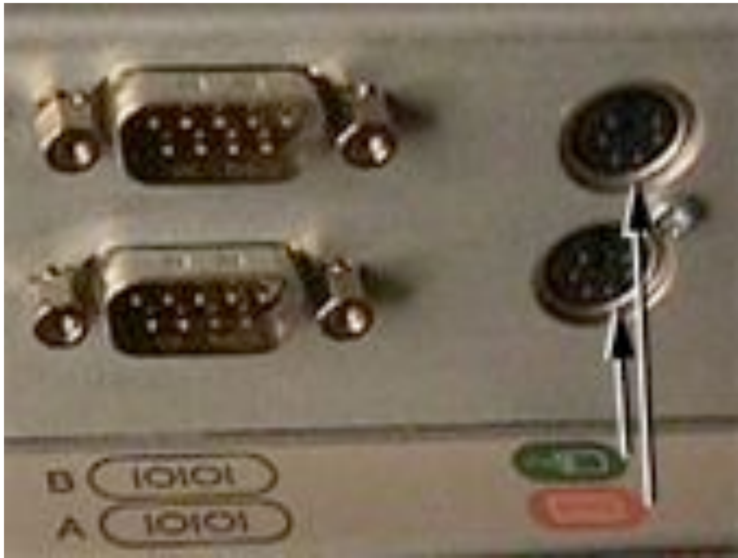
reminding

examples: calendar, knotted handkerchief

natural mappings

example: stove controls layout





designing for error

to err is human!

understand the causes of error and design to minimize those causes

make it possible to reverse actions (undo) or make it harder to do what cannot be reversed

make it easier to discover the errors that do occur, and make them easier to correct

change the attitude towards errors: don't think of the users as making errors, think of the actions as approximations of what is desired

to err is human

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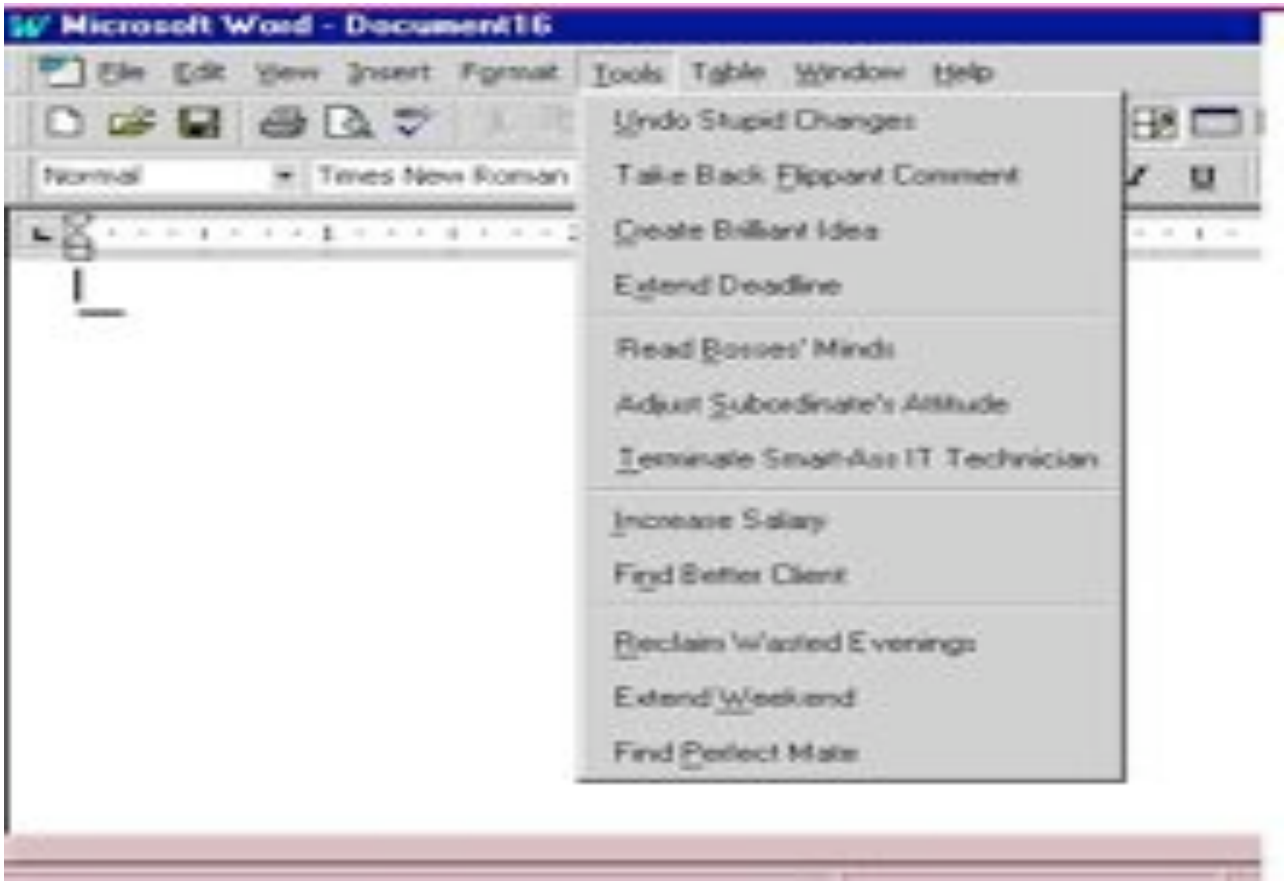

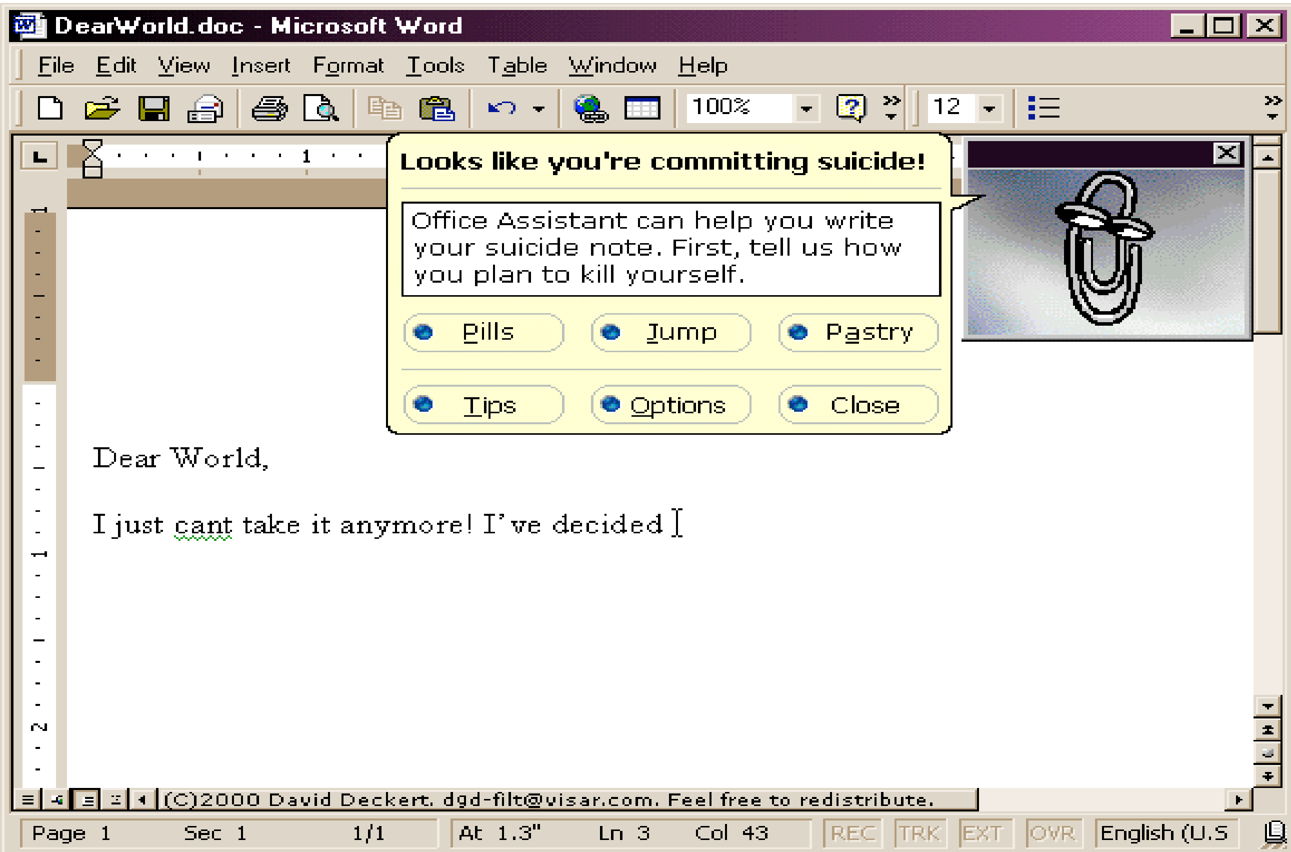
DearWorld.doc - Microsoft Word
File Edit View Insert Format Tools Table Window Help
100%
12
Looks like you're committing suicide!
Office Assistant can help you write your suicide note. First, tell us how you plan to kill yourself.
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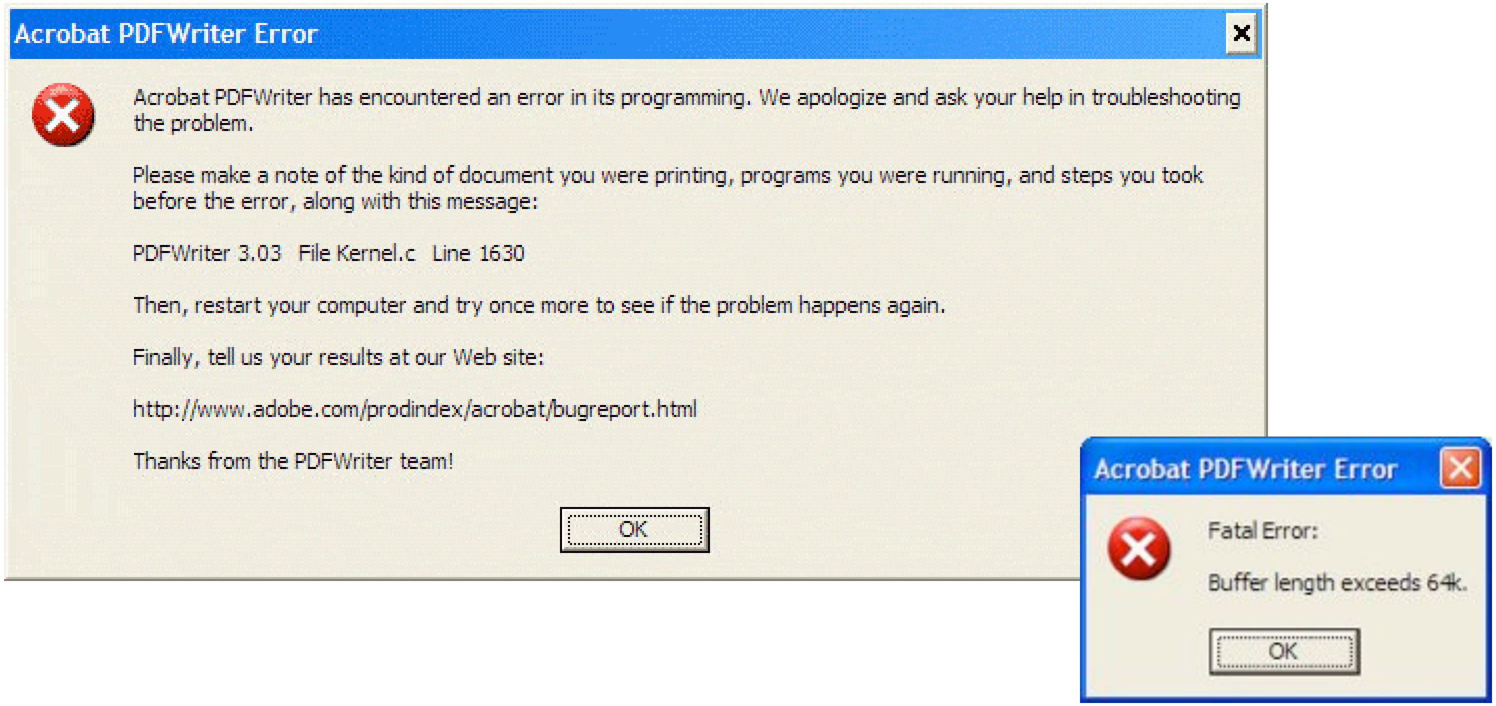


http://www.interaction-design.org/misdesigns

the design challenge

Design is an evolutionary, dynamic, iterative process

- non linear

Design must balance aesthetics, usability, cost, schedule, client requirements, etc.

Some reasons why designs might fail:

- Putting aesthetics first (“award winning” designs)
- Designers are not typical users
- The designer’s clients may not be users

Notice parallel with software...

seven principles for transforming difficult tasks in simple ones

1. use both knowledge in the world and knowledge in the head
2. simplify the structure of tasks
3. make things visible: bridge gulfs of execution and evaluation
4. get the mapping right
5. exploit the power of constraints, both natural and artificial
6. design for errors
7. when all else fails, standardize

[Nor02] p.188

1. use both knowledge in the world and in the head

3 conceptual models:

- design model: what the designer has in mind
- user's model: what the user develops to explain the operations of the system
- system image: physical appearance, operation, way it responds, manual and instructions

ideally, design model ≡ user's model

user and designer communicate only through system

- system image is critical

documentation often not given proper attention

- (1) poor material provided
- (2) people don't read it anyways (human nature...)

2. simplify the structure of tasks

take into account psychology, stm and ltm limitations

provide mental aids
- keep tasks the same

use technology to make visible what would be invisible
- provide feedback and ability to keep control

automate
- but keep task the same
- don't take away control

change the nature of the task
- e.g. hook-and-loop fastener

3. make things visible

bridge the gulfs of execution and evaluation

- execution: user knows what is possible and how
- evaluation: user can tell the effect of their actions

system should provide actions that match intentions

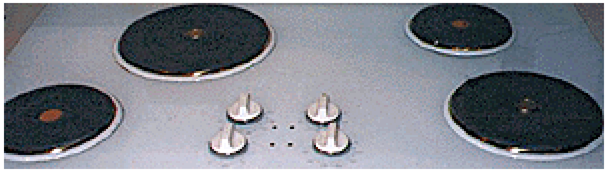
system should provide indications of system state that are readily perceivable and interpretable, and that match intentions and expectations

4. get the mapping right

exploit natural mappings

make sure the user can determine the relationships:

- between intentions and possible actions
- between actions and their effect on the system
- between actual system state and what is perceivable by sight, sound or feel
- between the perceived system state and the needs, intentions and expectations of the user



5. exploit the power of constraints

use constraints so that the user feels there is only one thing to do (the right thing!)

6. design for errors

assume any “error” that can be made will be made

7. when all else fails, standardize

sometimes, an arbitrary choice is necessary

- make one and stick with it

game design

"the game design is what determines the gameplay ... in short, the game design determines every detail of how the game is played" [Rou01] p.xxi

game (creative) design: analogous to a production plan for a film; provides the artistic vision behind the game; implies that software will be developed

game software design: moves forward from the mandate that the production plan offers; reduces the features of the game to a set software requirements and says how the requirements will be implemented

[FS04] p.13

know your customers

players want...

a challenge, to socialize, a dynamic solitary experience, bragging rights, an emotional experience, to explore, to fantasize, to interact

players expect...

a consistent world, to understand the game's bounds, reasonable solutions to work, direction, to accomplish tasks incrementally, to be immersed, some setbacks, a fair chance, not to need to repeat themselves, not to get hopelessly stuck, to do – not to watch

players don't know what they want, but they know when its missing

[Rou01] ch.1

game design document
(sample sections)

Introduction/overview or executive summary

Game mechanics

- what players are allowed to do, how the game is played

Artificial Intelligence

Game elements: characters, items and objects/mechanisms

Story overview

Game progression

- events players experience

System menus

[Rou01] ch.19

avoid

the waffer-thin or ellipsis special document

- lack of useful content – be specific

the back-story tome

- 100s pages of story – should be about the gameplay

the overkill document

- too much detail is waste – be thorough and consistent
- keep to design (avoid requirements or s/w specifications)

the pie-in-the-sky document

- keep feet on ground

the fossilized document

- keep document up-to-date!