# Usability Engineering
## Evaluation Methods

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## Content today

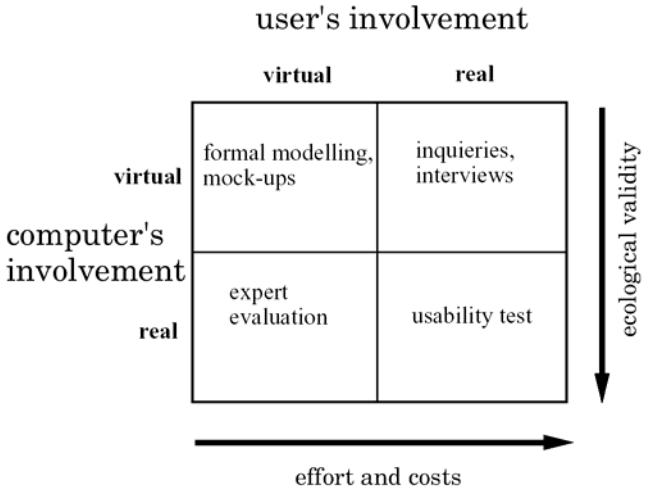
- Analytical or Inspection methods
- Heuristic Evaluation procedure
- Heuristic Evaluation discussion
- Alternative heuristics
- Cognitive Walkthrough (CW) procedure
- CW discussion

# Analytical evaluation methods

- Emphasis:
  predict usability problems!
- Methods differ in
  whether it is based on theory,
  what theory it is based on and
  thus in scope and applicability



# Overview over Evaluation methods



## Inspection methods
(Nielsen and Mack, 1994):

- Evaluators examine usability-related aspects of user interface
- Use of inspection problem reports:
  - Leads to fixes and redesign suggestions
  - Prioritised list of usability problems, based on severity of problems
  - Software cost associated with implementing suggested redesign



## Inspection methods

- Heuristic evaluation
- Guideline review
- Pluralistic walkthrough
- Consistency inspections
- Standards inspections
- Cognitive walkthroughs
- Formal usability inspections

## Differences

- Number and detail of heuristics/guidelines
- Amount of task/ goal focus
  - specific tasks
  - open-ended examination
- Individual versus group inspections
  - multiple views, multiple expertise
- Ease of use and ease of learning



## Validity of inspection results

- How predictive are the results of end-user problems?
- At most predict 30 -50% of problems found with user testing

## Effectiveness of inspection results

- Effectiveness in improving usability of product
- Need for clear problem reports: e.g.
  - What is the problem
  - What is the cause
  - What interface component is involved
  - Severity of problem
  - Ideas for improvements



## Trade-offs

- Global evaluation versus detailed evaluation: heuristics versus many guidelines
- Task-oriented versus open-ended evaluation
- Based on detailed user profiles, or less well defined user profiles
- Consideration of number of design trade-offs

## Heuristic Evaluation (HE)

- Limited set of heuristics
- Scope:
  - Source of heuristics
  - Task oriented approach
  - Professional domain
- (Similar to Shneiderman's 8 golden rules)

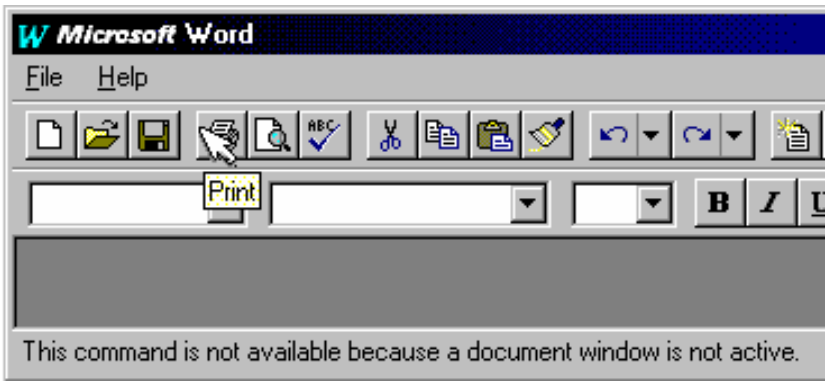


## Heuristic Evaluation (HE)

- Compare design against principles [P-x]
- For example:
  - [P-1] Error prevention
  - [P-2] Flexibility and efficiency of use
  - [P-3] Help users recognize, diagnose, and recover from errors
  - …

## [P-1] Prevent errors

- Disabled functions should appear as such.



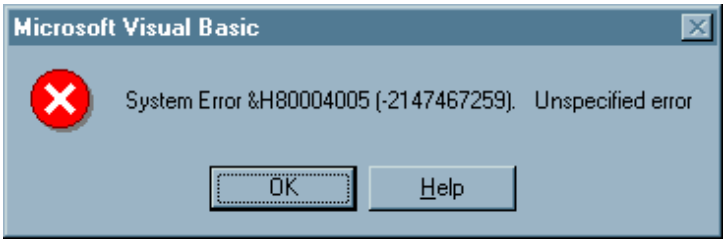



## [P-2] Flexibility and frequency of use

- Accelerators speed up the interaction for the expert user
- Allow users to tailor frequent actions.
- Example: incorrect assumptions

## [P-3] Help users recognize and recover from errors

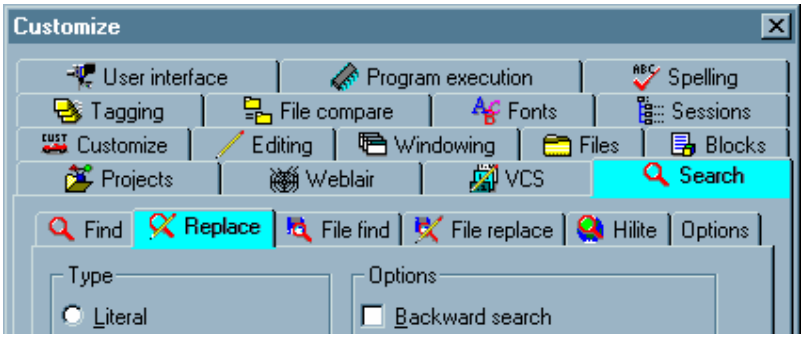
- Error messages should be expressed in plain language



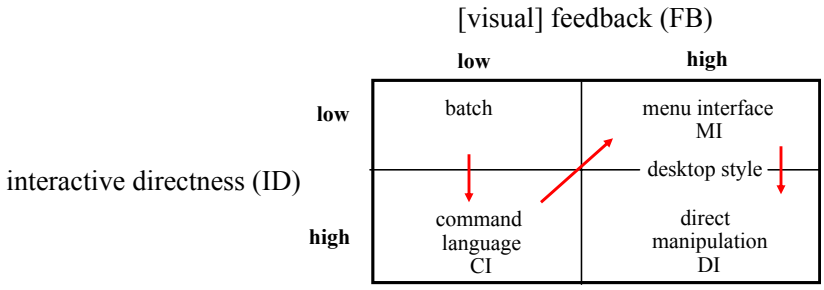



## [P-4] Recognition rather than recall

- Provide only limited number of options



# [P-5] (visual) feedback
# [P-6] interactive directness






# How to measure [P-5] and [P-6]

(functional) feedback

$$fFB = 1/D \sum_{d=1}^{D} (\#PF_d / \#HF_d) * 100\%$$

interactive directness

$$ID = \left\{ 1/P \sum_{p=1}^{P} \ln(PATH_p) \right\}^{-1} * 100\%$$

# Standards and Norms: overview

| DIN 66 234 part 8 (1988) | EC directive 90/270/EEC (1990) | ISO 9241 part 10 (1996) | Ulich (1991) |
|---|---|---|---|
| suitability for the task | suitability (activity adapted) | suitability for the task | task orientation |
| self-descriptiveness | feeback about system states | self-descriptiveness | transparency |
| | appropriate format and pace of information presentation | | feedback |
| conformity with user expectations | | conformitity with user expectations | compatibility |
| | | | consistency |
| | information and instruction of user | suitability for learning | support |
| | ease of use applicable to skill level | suitability for individualization | selection possibilities user definability |
| | hearing and participation of users | | participation |
| controllability | | controllability | flexibility |
| error robustness | | error tolerance | |



# Procedure for finding problems and variants

- Training session of product
- Actual evaluation:
  two passes using a scenario:
  1) get a feel for interface,
  2) focus on heuristics
- Debriefing session for discussion of outcomes
- Severity rating of problems

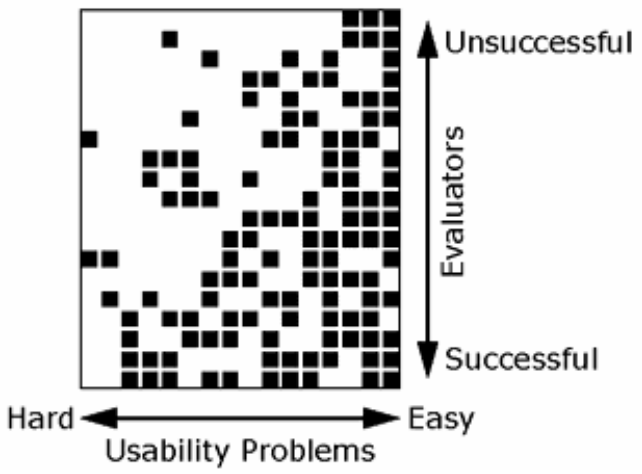
## The evaluator effect with heuristic evaluation

- Validity of method:
  same set of problems, with other methods
- Different evaluators find different problems
- What kind of expertise is required?
  - Usability in general
  - Domain expertise: e.g. data entry tasks

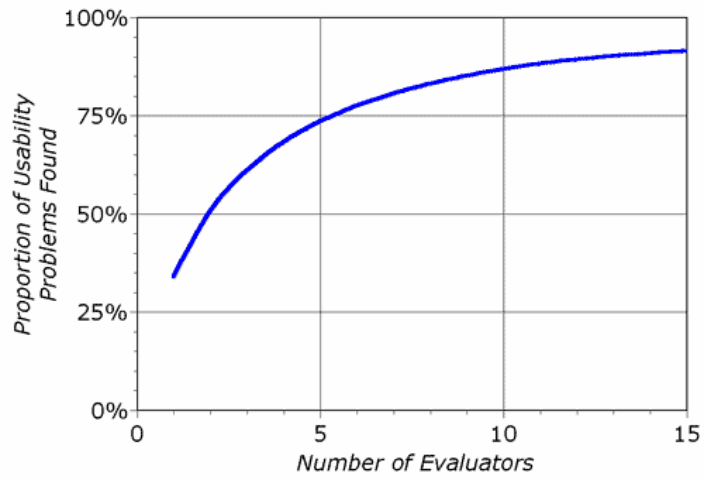
=> advise on optimum number of evaluators



## Which evaluators found which problems?



## How many evaluators found how many problems?






## Heuristic Evaluation: pros and cons

- Good points:
  - useful as a checklist when developing UI
  - useful for 'quick and dirty' evaluation
    (see Nielsen's 'discount usability engineering' approach)
- Not so strong points
  - the rules are a mixed bag (no underlying theory)
  - sometimes they are mutually contradictory
  - ambiguous, hard to interpret

## Severity of a usability problem

- The frequency with which the problem occurs:
  *Is it common or rare?*
- The impact of the problem if it occurs:
  *Will it be easy or difficult for the users to overcome?*
- The persistence of the problem:
  *Is it a one-time or a recurring problem?*



## Severity Rating [0-4]:

0 Don't agree this is a usability problem
1 Cosmetic problem only –
need not be fixed unless time is available
2 Minor usability problem –
fixing this should be given low priority
3 Major usability problem –
important to fix, high priority
4 Usability catastrophe –
imperative to fix

## Alternative Heuristics:
(Malone and Lepper 1987)

- Background: intrinsically motivating educational environments
- Emphasis on better learning, because it is fun!

⇒ different set of heuristics

- Furthermore, see website:
  The interactive heuristic evaluation toolkit (with different sets of heuristics):
  http://www.id-book.com/catherb/Complete_heurs.php



## Malone and Lepper's heuristics

- Developed in the context of Educational Environments and Games
- Emphasis on motivation to learn, because of intrinsic motivation (e.g. fun)
- Assumption:
  - Providing intrinsic motivation, influences what and how people learn (and possibly perceive interaction in general)
    http://www.id-book.com/catherb/index.htm

## Heuristics for Intrinsically Motivating Instructional Environments

- Individual motivations
  - Challenge (appropriate level of difficulty)
  - Curiosity (appropriate level of informational complexity)
  - Control (user should feel in control)
  - Fantasy (fantasy should be appealing)
- Interpersonal motivations
  - Cooperation
  - Competition
  - Recognition



## Example: computer game

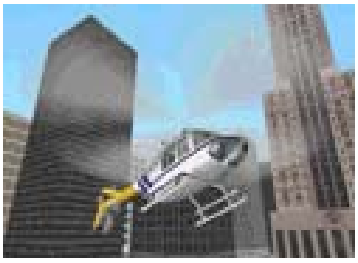
- Flight simulator
- How to interpret:
  - Challenge
  - Fantasy
  - Control

## Challenge: The Mooney IFR panel.



## Fantasy: San Francisco's Golden Gate Bridge at sunrise, as seen from the Cessna 182RG.

## Control: example



This is the Bell 206

The Sopwith flying over mountains.



## Cognitive Walkthrough (CW)

- Predicts usability problems
- Focus on one aspect of usability: ease of learning!
  - Based on theory of learning by exploration
- Evaluates interface in the context of one or more specific tasks.
- Done by individuals or by groups.

## Theoretical background

- Focus on *novice* explorative learning of computer interfaces
- Problem solving theories
- Theoretical model of learning by exploration (CE+ theory from Polson & Lewis 1990)



## Components of CW

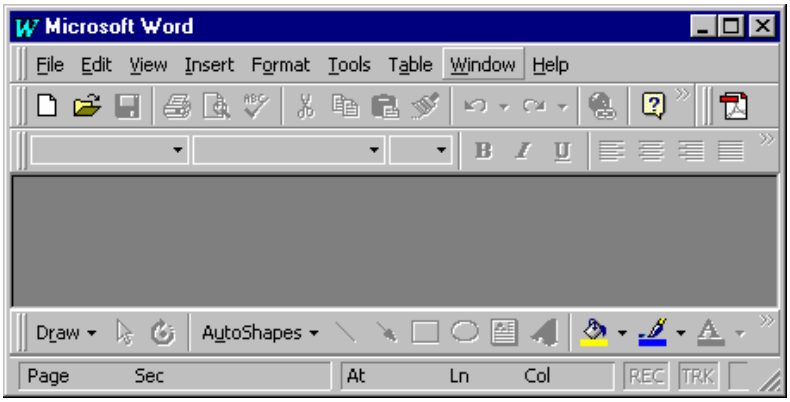
- Problem solving component
  - when faced with a set of untried actions: CE+ chooses action with most overlap with goal
- Learning component
  - evaluates whether feedback contains terms of the user goals, and stores the outcome of the action
- Execution component
  - executes rules and coordinates execution of rules

## Example CW: "Task: open new file"

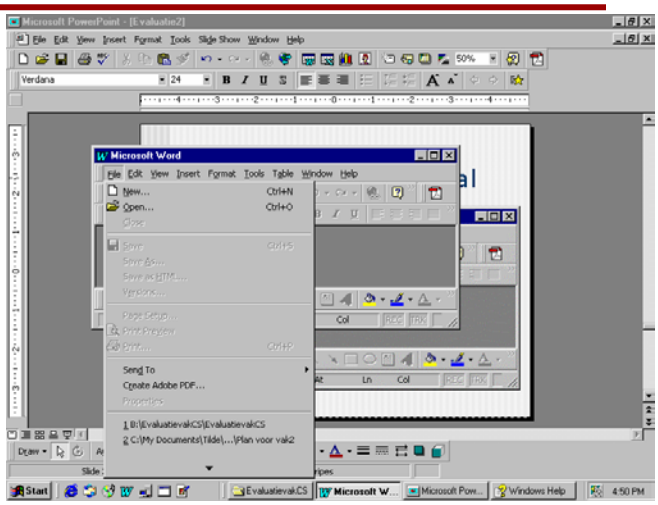
- Problem solving:
  - Check visible menu names for overlapping terms (File)
  - Select menu name with most overlap
- Learning component
  - Assess feedback, store results: "New blank document"
- Execution component
  - Decides whether to do problem solving, or applies knowledge through learning component



## Assess overlap with goal (1)

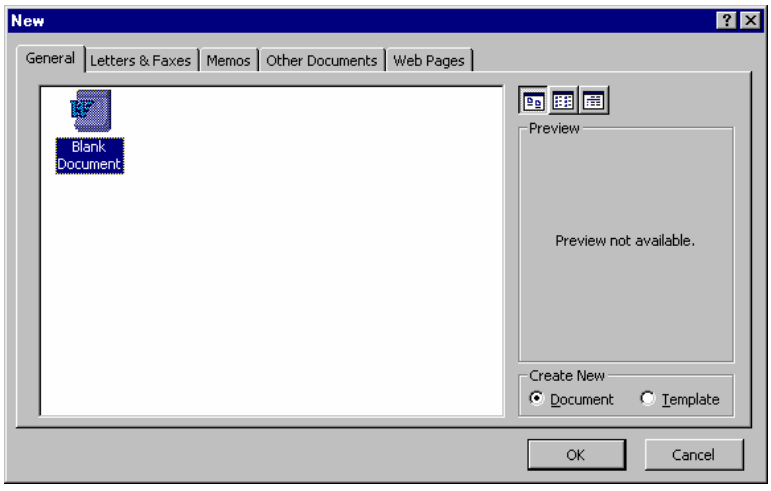


# Assess overlap with goal (2)

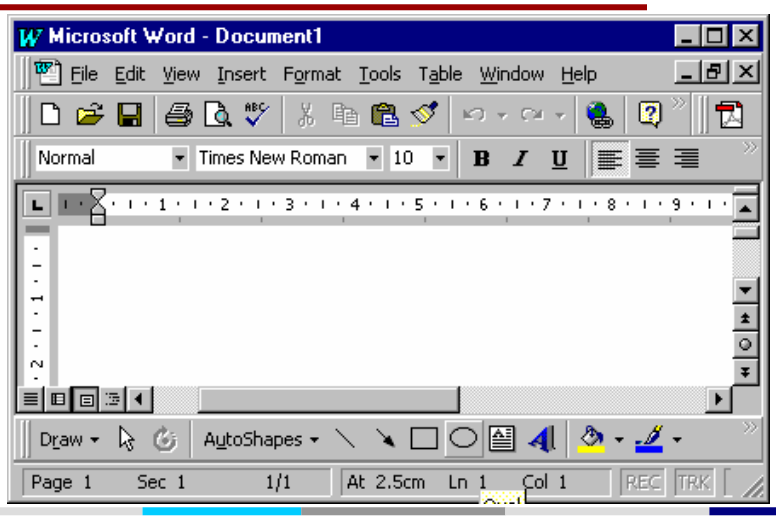





# Assess overlap with goal (3)



# Evaluate results and store






# Usability principles based on CE+

- Make available actions visible
- Use identity cues between actions and goals
- Use identity cues between feedback and goals
- Provide obvious way to undo actions
- Make available actions easy to discriminate
- Offer few alternatives
- Tolerate at most one hard-to-understand action in a repertoire
- Require as few choices as possible

## Input to the CW:

- Interface's detailed design description (paper mock-up or working prototype)
- Task scenario
- Assumptions about the user group
- Context of use
- Sequence of actions, to complete each task



## CW Analyst asks four questions:

- Will the user try to achieve the right effect?
- Will the user notice that the correct action is available?
- Will the user associate the correct action with the effect to be achieved?
- Will the user see that progress has been made?

## Criticisms to CW

- Tedious to use:
  - answers many questions for each action
- Limited scope: ease of learning
  - Misses consistency problems, general problems and recurring problems
- Only finds problems to correct action sequences, not recovery-from-error problems
- Difficult to apply without knowledge about background theory



## The evaluator effect in CW
(Hertzum and Jacobsen 1998)

- Large differences between evaluators in number of problems found
- What is found is influenced:
  - by assumptions about users (how diverse)
  - by anchoring to evaluator's own experience

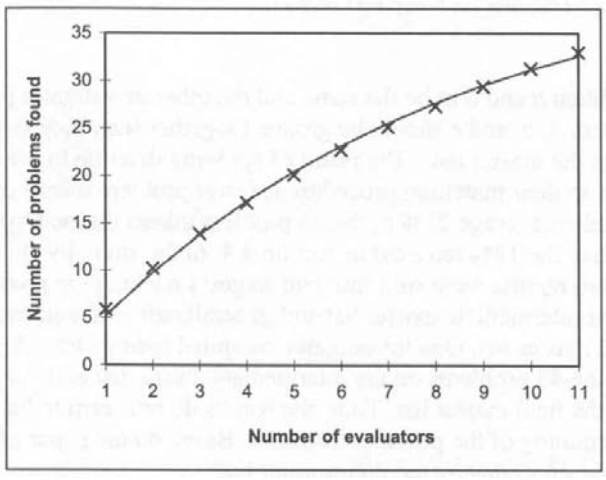
# Evaluator effect in CW
(Hertzum and Jacobsen 1998)


- Who found which problems?

Each row represents an evaluator, each column a problem.



# Evaluator effect in CW
(Hertzum and Jacobsen 1998)



## Literature for next lecture

- Dumas and Redish, 1999, chapters 7, 11, 12, 18
- Boren and Ramey, 2001 Thinking Aloud (thinkaloud[2001].pdf on 0H420 website)



## References


- Hertzum,M. and Jacobsen, N.E. (1998) *Individual differences in evaluator performance during first-time use of the cognitive walkthrough technique.* (see UEM[1999appendix].pdf)
- Malone, T.W., en Lepper, M.R. (1987) Making learning fun: a taxonomy of intrinsic motivations for learning, *In: Snow, R.E., en Farr, M.J. (eds.) Aptitude, learning and interaction III. Conative and affective process analysis*. Hillsdale, N.J.: Erlbaum.
- Nielsen, J, and Mack, R.L. (1994) *Usability Inspection Methods*, John Wiley and Sons.
  - Chapter 1: Executive summary, 1-24.
  - Chapter 5: The cognitive walkthrough method: a practitioner's guide, 105-140.
- Nielsen's website: http://www.useit.com/papers/heuristic/