

THESE ARE TEARABLE PUNS.

A DYSLEXIC POET
WRITES INVERSE
I BREAK INTO SONG
IF I CAN'T FIND THE KEY
YOUR CALENDARS DAYS
ARE NUMBERED
BAKERS TRADE RECIPES
ON A KNEAD TO KNOW BASIS
JUMPING OFF A PARIS BRIDGE
MAKES YOU IN SEINE
ACUPUNCTURE IS
A LAB WELL DONE
SANTA'S HELPERS
ARE SUBORDINATE CLAUSES
ONCE YOU'VE SEEN ONE SHOPPING CENTER
YOU'VE SEEN THE MALL
IF A CLOCK GETS HUNGRY
IT GOES BACK FOUR SECONDS
THE BRIDE GOT A NEW NAME
AND A DRESS
A BIKE CAN'T STAND ALONE
BECAUSE IT'S TWO-TIRED

CSE 440: Introduction to HCI

User Interface Design, Prototyping, and Evaluation

Lecture 12:
Inspection-Based Methods

Lauren Milne



Tuesday/Thursday
11 to 12
MOR 230

Today

In-Class

Inspection-Based Methods

Heuristic Evaluation of Paper Prototypes

Revise Prototypes

Usability Testing Check-In for Friday

Changes from Inspection

Changes from First Usability Test

Inspection-Based Methods

We have cut prototyping to its minimum

Sketches, storyboards, paper prototypes

Rapid exploration of potential ideas

But we need evaluation to guide improvement

Evaluation can become relatively slow and expensive

Study participants can be scarce

May waste participants on fairly obvious problems

Inspection-Based Methods

Simulate study participants

Instead of actual study participants, use inspection to quickly and cheaply identify likely problems

Inspection methods are rational, not empirical

Today we cover two complementary methods

Heuristic Evaluation

Cognitive Walkthrough

Heuristic Evaluation

Developed by Jakob Nielsen

Helps find usability problems in a design

Small set of evaluators examine interface

- three to five evaluators

- independently check compliance with principles

- different evaluators will find different problems

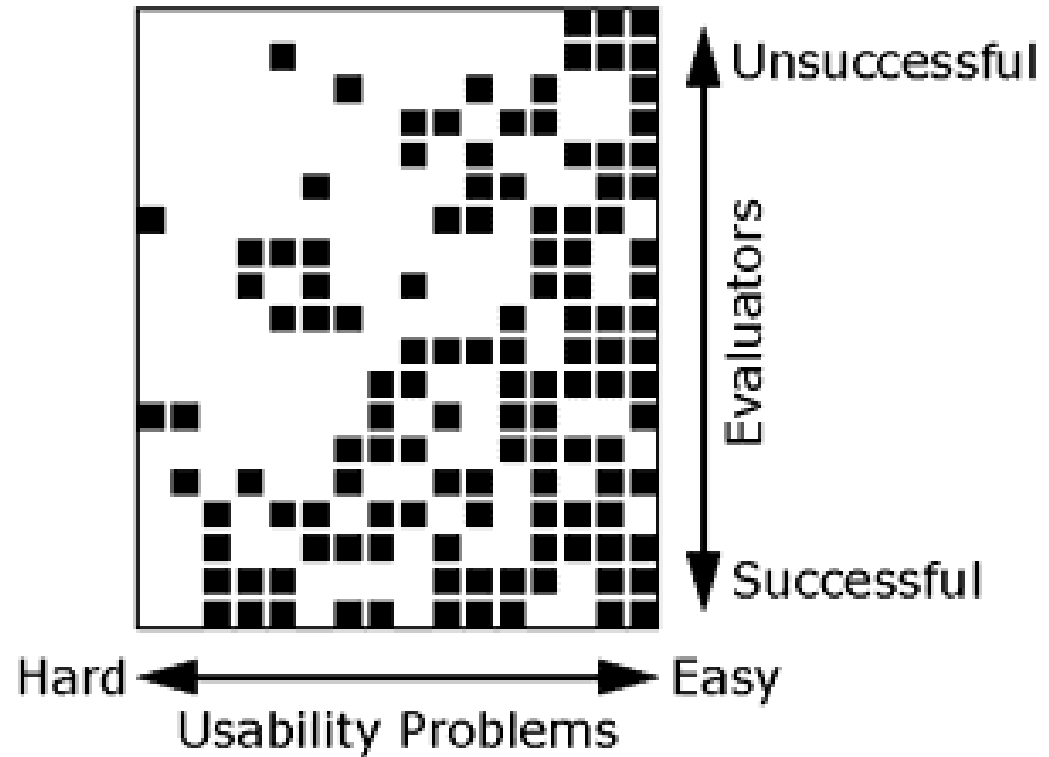
- evaluators only communicate afterwards

Can perform on working interfaces or sketches

Why Multiple Evaluators?

Every evaluator
doesn't find every
problem

Good evaluators
find both easy &
hard ones



Results of Using HE

Discount: benefit-cost ratio of 48

cost was \$10,500 for benefit of \$500,000

how might we calculate this value?

in-house → productivity; open market → sales

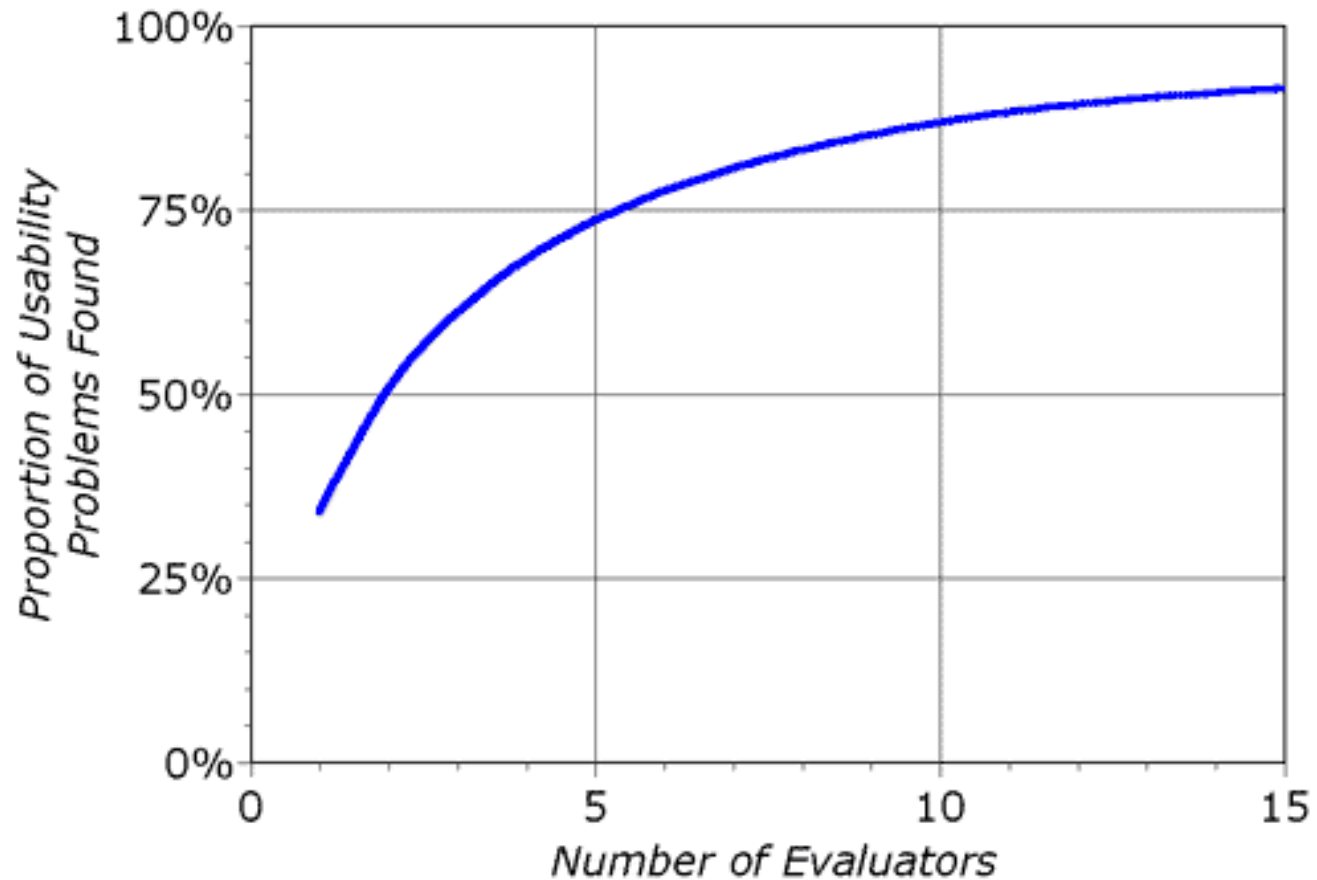
Single evaluator achieves poor results

only finds 35% of usability problems

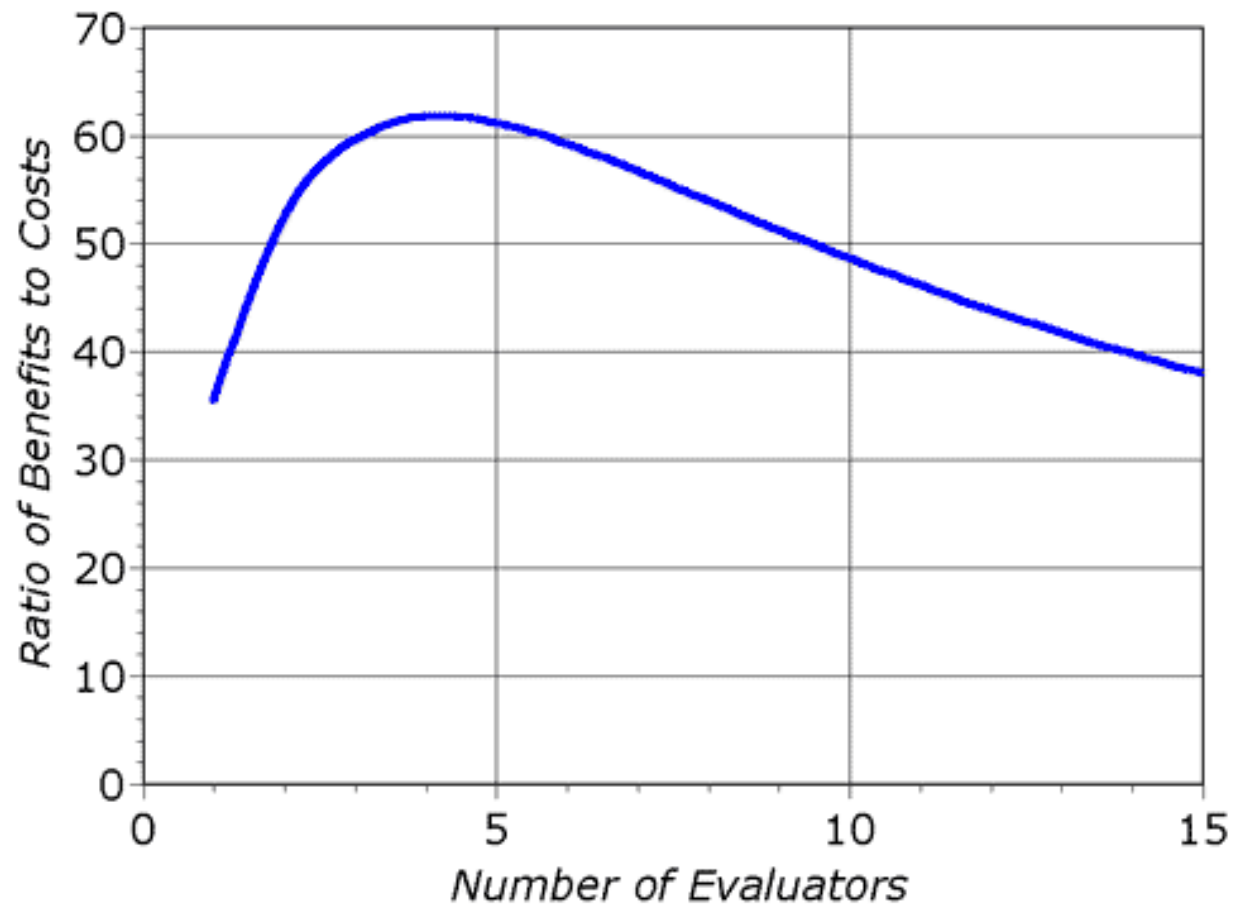
5 evaluators find ~ 75% of usability problems

why not more evaluators?

Number of Evaluators?



Decreasing Returns



Nielsen's 10 Heuristics

Too few unhelpful, too many overwhelming

“Be Good” versus thousands of detailed rules

Nielsen seeks to create a small set

Collects 249 usability problems

Collects 101 usability heuristics

Rates how well each heuristics explains each problem

Factor analysis to identify key heuristics

Nielsen's 10 Heuristics

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help recognize, diagnose, and recover from errors
10. Help and documentation

1. Visibility

Visibility of system status

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

1. Visibility

Visibility of system status

The system should always **keep users informed** about what is going on, through appropriate **feedback** within reasonable time.

Refers to both visibility of system status and use of feedback

Anytime wondering what state the system is in, or the result of some action, this is a visibility violation.

Heuristics



Heuristics

Time Left: 00:00:19



46%

Heuristics

Time Left: 00:00:19 searching database for matches



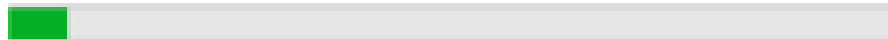
46%


Heuristics



Windows Defender is scanning your PC

This might take some time, depending on the type of scan selected.



 Cancel scan

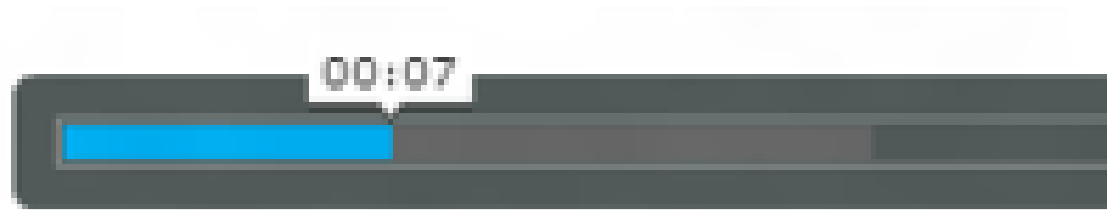
Scan type: Quick scan

Start time: 5:11 PM

Time elapsed: 00:00:06

Items scanned: 2532

Heuristics



Visibility of system status

pay attention to response time

0.1 sec: no special indicators needed

1.0 sec: user tends to lose track of data

10 sec: maximum duration if user to stay focused on action

longer delays absolutely require percent-done progress bars

2. Real World Match

Match between system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

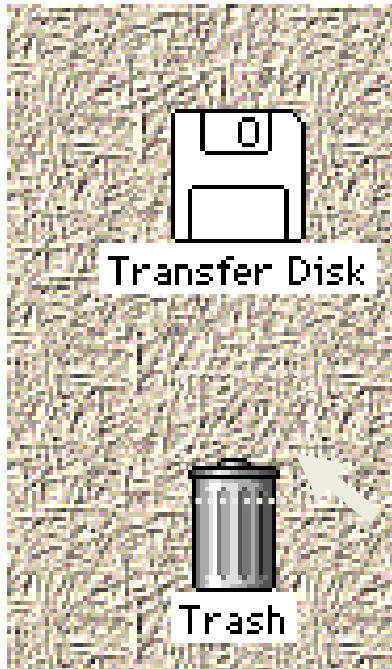
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Match between system and the real world

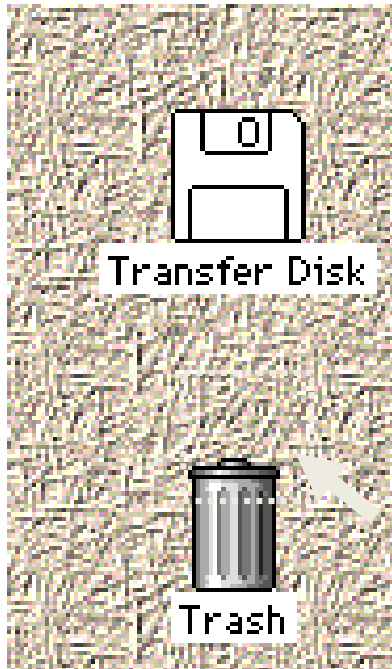
The system should **speak the users' language**, with words, phrases and concepts **familiar to the user**, rather than **system-oriented terms**. Follow real-world conventions, making information appear in a **natural and logical order**.

Refers to word and language choice, mental model, metaphor, mapping, and sequencing

Heuristics



Heuristics



Mac desktop

Dragging disk to trash
should delete, not eject it

Match system to real world

Speak the user's language
Follow conventions

Heuristics



Heuristics



“Mailto”, “protocol”?

Match system to real world

Speak the user's language

3. User in Control

User control and freedom

Users often choose system functions by mistake and will need a clearly marked “emergency exit” to leave the unwanted state without having to go through an extended dialogue.

Support undo and redo.

3. User in Control

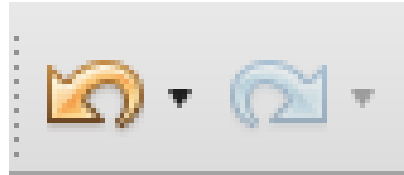
User control and freedom

Users often choose system functions by mistake and will need a clearly marked “emergency exit” to **leave the unwanted state** without having to go through an extended dialogue.

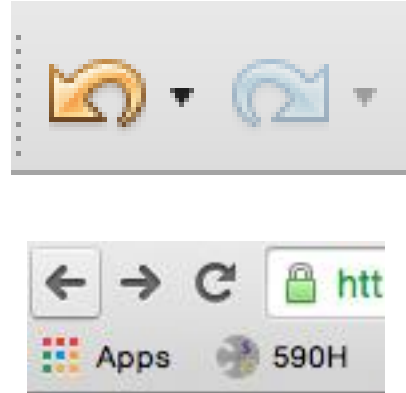
Support undo and redo.

Not just for navigation exits,
but for getting out of any situation or state.

Heuristics



Heuristics



User control & freedom

provide “exits” for mistaken choices, undo, redo
don’t force down fixed paths

Heuristics



Heuristics



User control & freedom

provide “exits” for mistaken choices, undo, redo
don’t force down fixed paths

Wizards

must respond to question before going to next
good for beginners, infrequent tasks
not for common tasks

4. Consistency

Consistency and standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

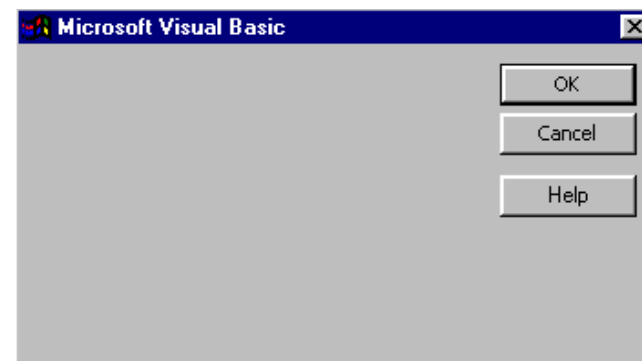
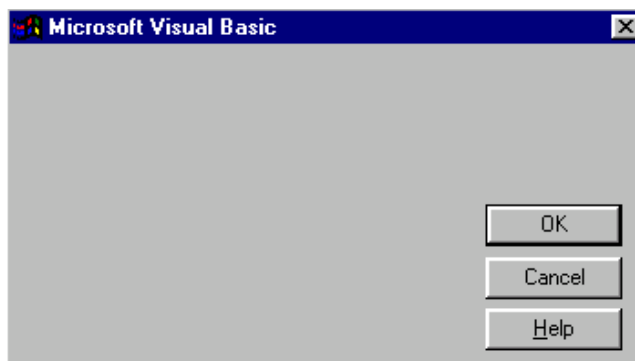
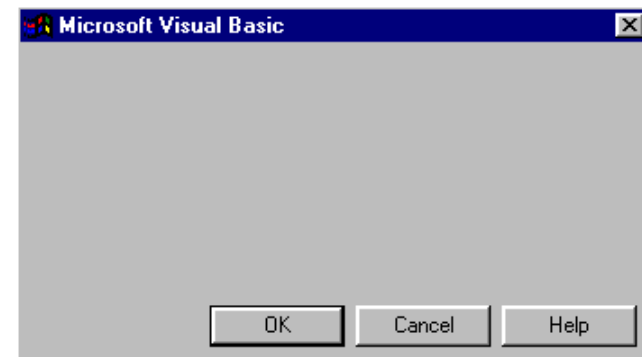
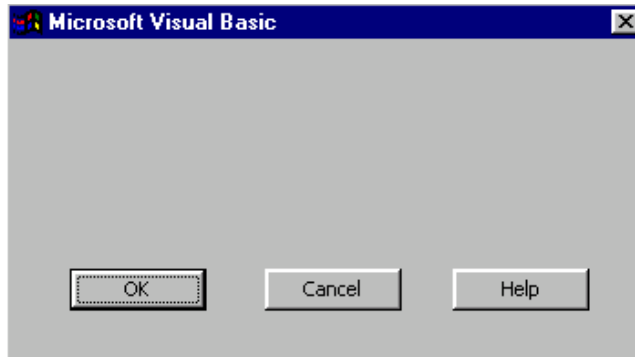
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Consistency and standards

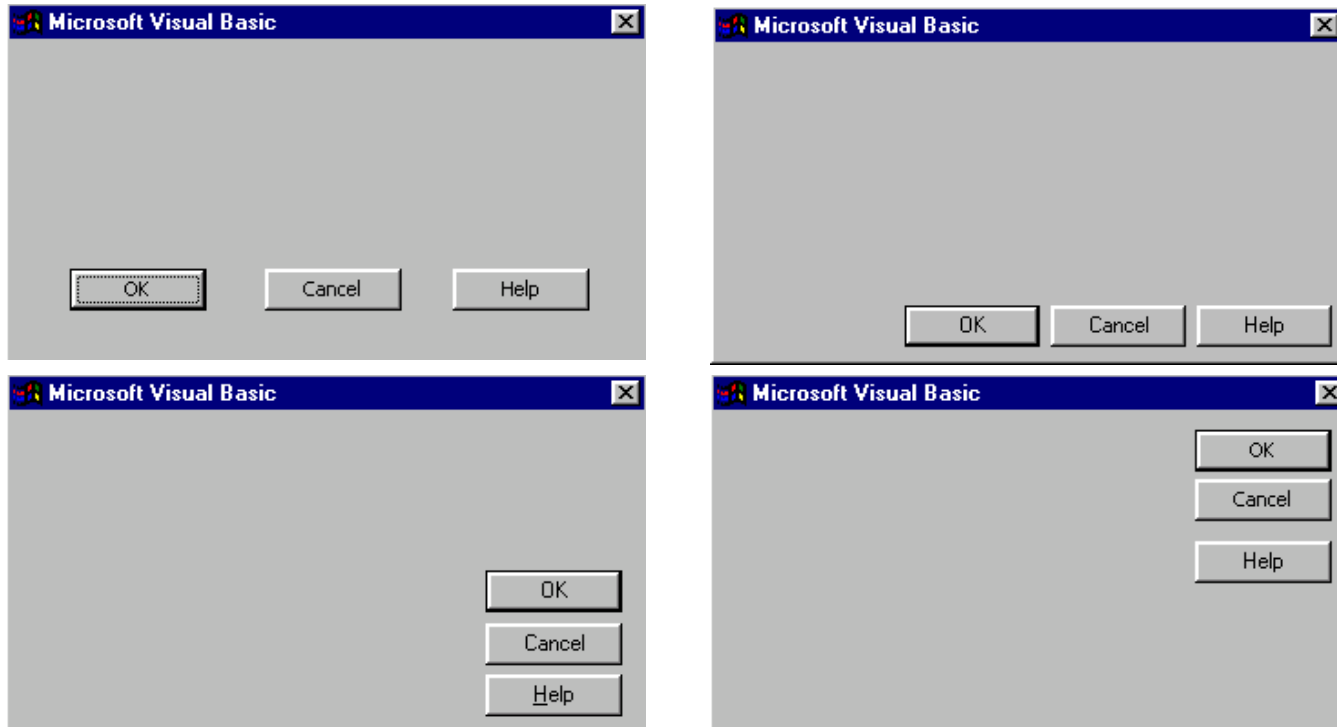
Users should not have to wonder whether different words, situations, or actions **mean the same thing.**
Follow platform conventions.

Internal consistency is consistency throughout the same product. External consistency is consistency with other products in its class.

Heuristics



Heuristics



Consistency & Standards

5. Error Prevention

Error prevention

Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

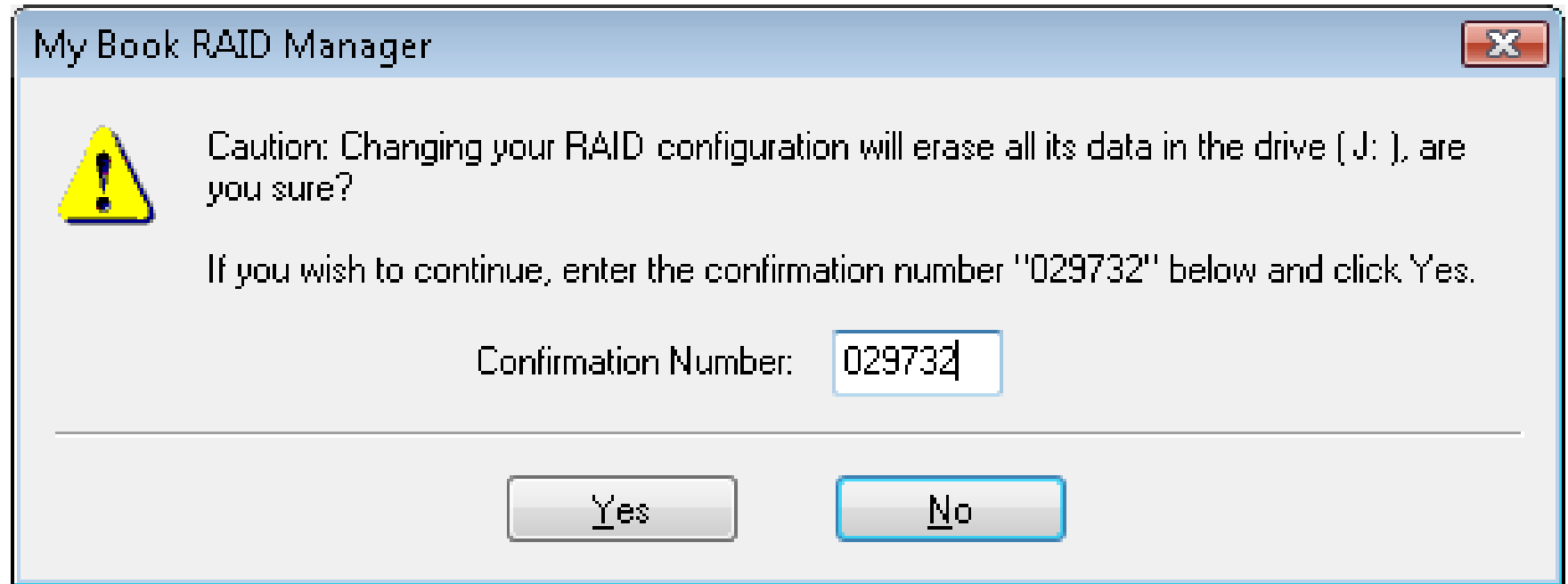
5. Error Prevention

Error prevention

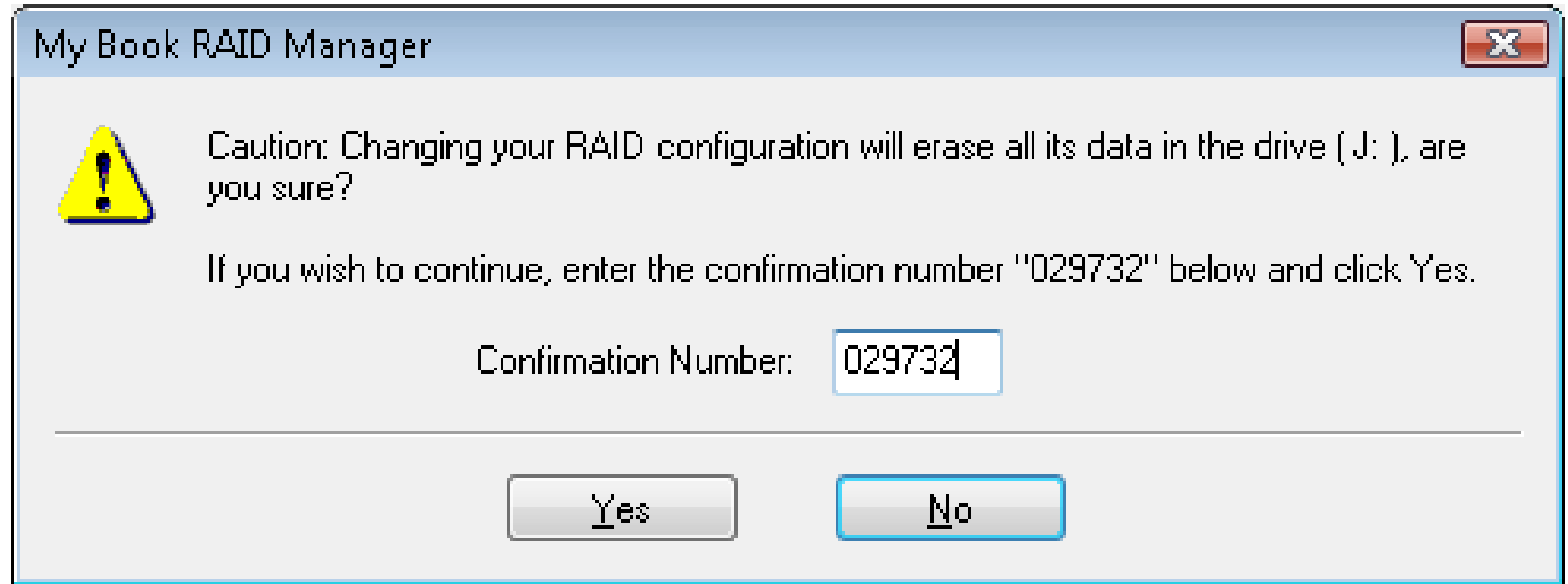
Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either **eliminate error-prone conditions** or check for them and **present users with a confirmation option** before they commit to the action.

Try to commit errors and see how they are handled. Could they have been prevented?

Heuristics



Heuristics



Prevent Errors

Heuristics

The Radiation Dosimetry Program

Please Enter Desired Dose (in Rems)	0.0001
Enter Substance	Polonium
Isotope Number	211

Heuristics

The Radiation Dosimetry Program

Please Enter Desired Dose (in Rems)	0.0001
Enter Substance	Polonium
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Prevent Errors

6. Recognition not Recall

Recognition rather than recall

Minimize the user's memory load by making objects, actions, and options visible.

The user should not have to remember information from one part of the dialogue to another.

Instructions for use of the system should be visible or easily retrievable whenever appropriate.

6. Recognition not Recall

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making objects, actions, and options visible.

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from one part of the dialogue to another.

Instructions for use of the system should be visible or
easily retrievable whenever appropriate.

People should never carry a memory load

6. Recognition not Recall

Addresses visibility of features & information

where to find things

Visibility addresses system status & feedback

what is going on

6. Recognition not Recall

Problems with affordances may go here

hidden affordance: remember where to act

false affordance: remember it is a fake



Heuristics

% rm cse440*

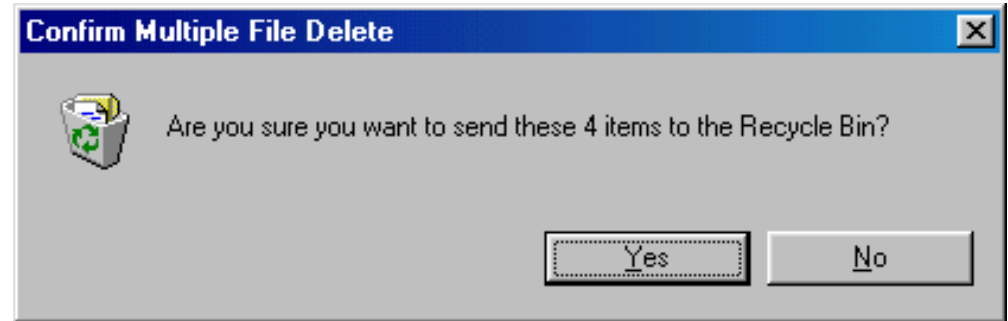
%



Heuristics

% rm cse440*

%



Error prevention

Recognition rather than recall

Visibility

7. Flexibility and Efficiency

Flexibility and efficiency of use

Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

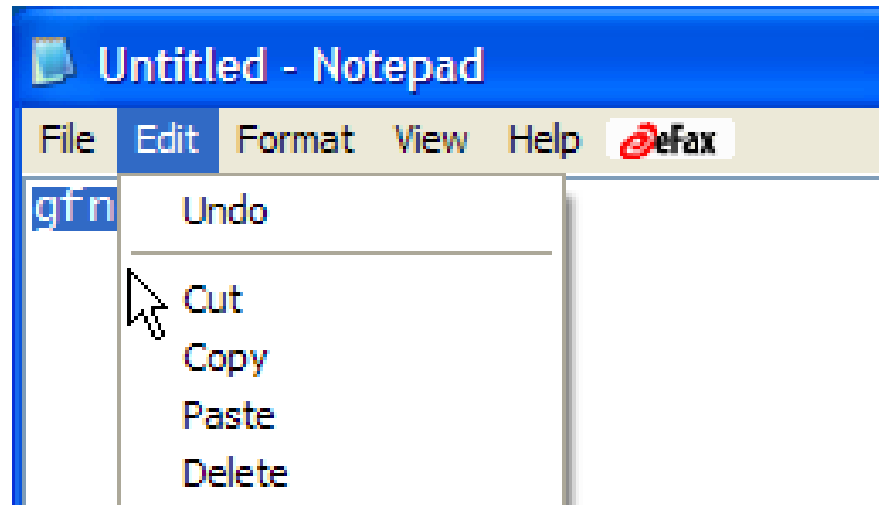
7. Flexibility and Efficiency

Flexibility and efficiency of use

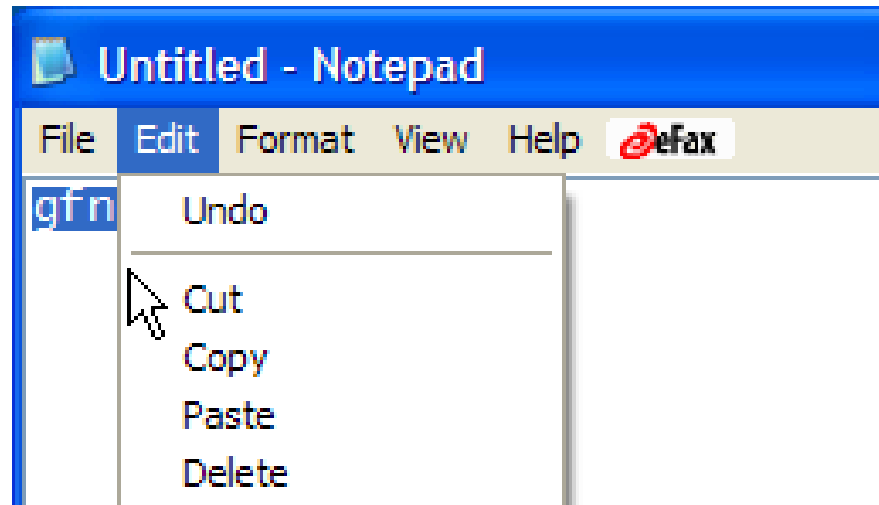
Accelerators -- unseen by the novice user -- may often **speed up the interaction** for the expert user such that the system can cater to both inexperienced and experienced users.
Allow users to tailor frequent actions.

Concerns anywhere users have repetitive actions that must be done manually. Also concerns allowing multiple ways to do things.

Heuristics



Heuristics



Flexibility and Efficiency of Use

accelerators for experts (e.g., keyboard shortcuts)
allow tailoring of frequent actions (e.g., macros)

8. Aesthetic Design

Aesthetic and minimalist design

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

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Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Not just about “ugliness”.

About clutter, overload of visual field, visual noise, distracting animations, and so on.

Heuristics

Fac Order# 93004234 New Report Selection OCB SSF View Dupe Load View Routing Print Call Canceled

Mode From SC To SC Find CAGR 100670861 Charges: 761.50

U Air ADT ADT Stop Ref CA-V 0% Discount: 0%

T Tariff CAVRS-00-01 Service 20 0194 SubTotal: 761.50

From YYV A/J POE Accessorial: 40.00

To YYZ A/E GBL Num Billing Ref Balance: 839.58

Deliver By 06-12-02 17:00 Clock Stop MasterID: 0 Addend: 0

MAWB 0 Closed: 0

MasterID: 0 Print: 0

Hold P/L: 0

Non-Freight: 0

MasterID: 0

Print: 0

Rate: 0

SAVED

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

Units Type H Description Stated ADWT Dimensions GtW Rate Charge

1	CRATE	CRATE	91	94	97	252500	97	50.00	48.50
1	2MAN	2 MAN P/LD						40.00	40.00
2	CRATE	CRATE	500		1,426	104800	1,426	50.00	713.00
0								0.00	0.00

3 Accs: \$40.00 DV: 0 \$0.00 581 949 1523 1,523 761.50

Heuristics

The screenshot displays a complex shipping software interface. At the top, there's a header bar with various function buttons like 'New', 'Report Selection', 'OCB', 'SSF View', 'Dupes Load', 'View Invoic', 'Routing Sheet', 'Print Bill', 'Call Log', and 'Cancelled'. Below this, the interface is divided into several panes. The left pane contains customer and contact information for 'Hi Fo Holdings, Ltd.' and 'CANADIAN HARDWARE & H'. The middle pane shows shipping details, including 'Tariff Service', 'From', 'To', 'Deliver By', and 'Clock Stop'. The right pane displays a summary of charges, including 'Charges', 'Discount', 'Sub Total', 'Accessorial', 'FSC', 'Total', and 'Balance'. At the bottom, there's a table with columns for 'Units', 'Type', 'H Description', 'Stated', 'ADWT', 'Dimensions', 'CWT', 'Rate', and 'Charge'. The table lists three items: '1 CRATE', '1 2MAN', and '2 CRATE'. The bottom status bar shows summary statistics like '3 Accs', '\$40.80', 'DV', '0', '\$0.00', '581', '349', '1523', '1,523', and '761.50'.

Units	Type	H Description	Stated	ADWT	Dimensions	CWT	Rate	Charge
1	CRATE	CRATE	91	94	97	50.00	40.50	
1	2MAN	2 MAN PLO				40.00	40.00	
2	CRATE	CRATE	500		1,426	50.00	713.00	
6						0.00	0.00	

Aesthetic & Minimalist design

no irrelevant information in dialogues

Heuristics



Aesthetic & Minimalist design

no irrelevant information in dialogues

9. Error Recovery

Help users recognize, diagnose, and recover from errors

Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

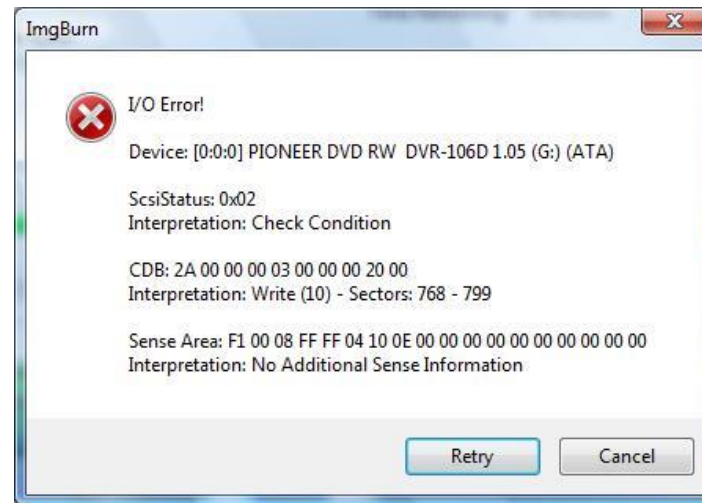
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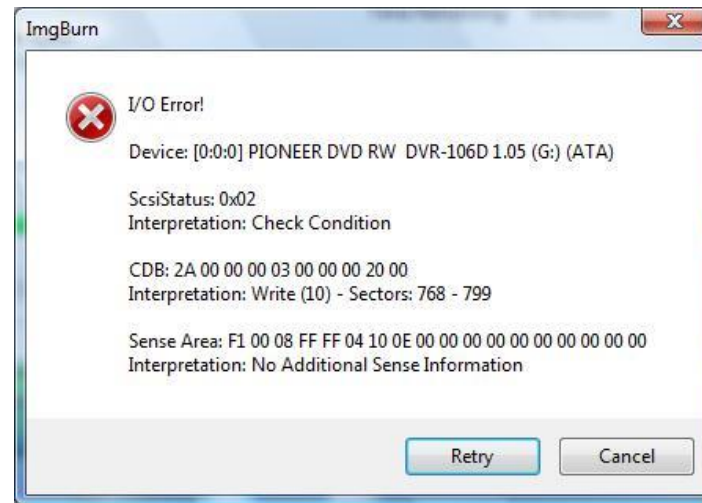
Error messages should be expressed in **plain language (no codes),**
precisely indicate the problem,
and constructively suggest a solution.

Error prevention is about preventing errors before they occur. This is about after they occur.

Heuristics



Heuristics



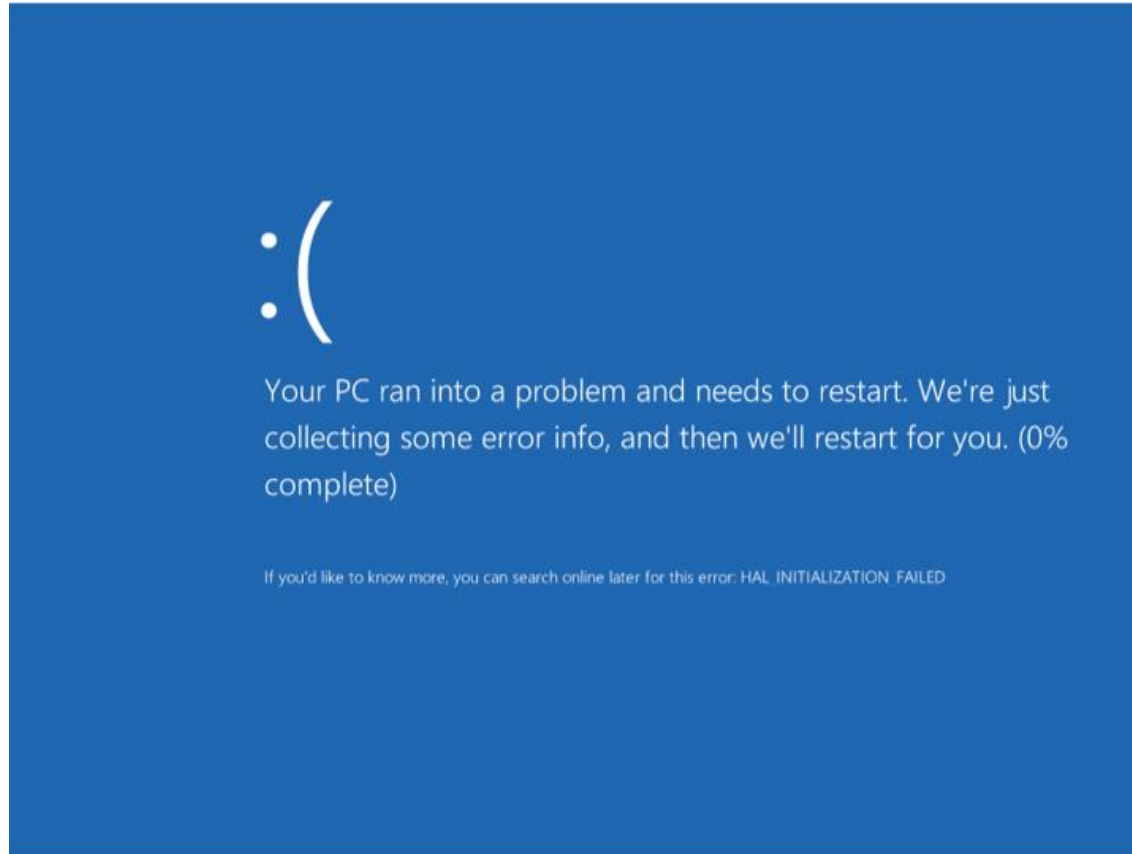
Help recognize, diagnose, & recover from errors

error messages in plain language

precisely indicate the problem

constructively suggest a solution

Heuristics



Help recognize, diagnose, & recover from errors

10. Help

Help and documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

10. Help

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Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be **easy to search**, **focused on the user's task**, **list concrete steps to be carried out**, and not be too large.

This does not mean that the user must be able to ask for help on every single item.

Heuristic Evaluation Process

Evaluators go through interface several times

- inspect various dialogue elements

- compare with list of usability principles

Usability principles

- Nielsen's "heuristics"

- supplementary list of category-specific heuristics
(competitive analysis or testing existing products)

Use violations to redesign/fix problems

Examples

Can't copy info from one window to another

violates “Minimize memory load” (H6)

fix: allow copying

Typography uses different fonts in 3 dialog boxes

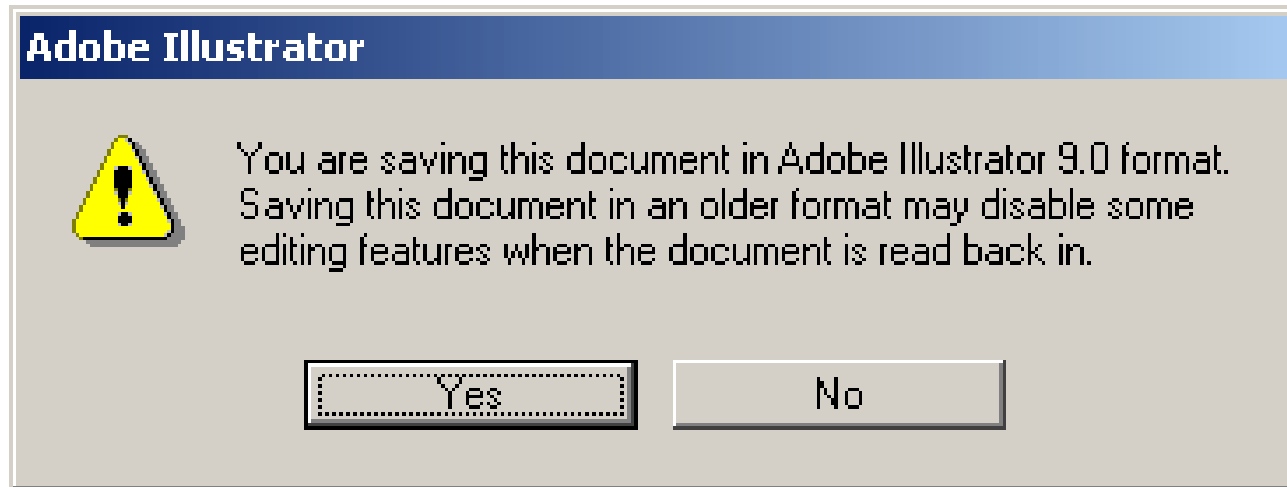
violates “Consistency and standards” (H4)

slows users down

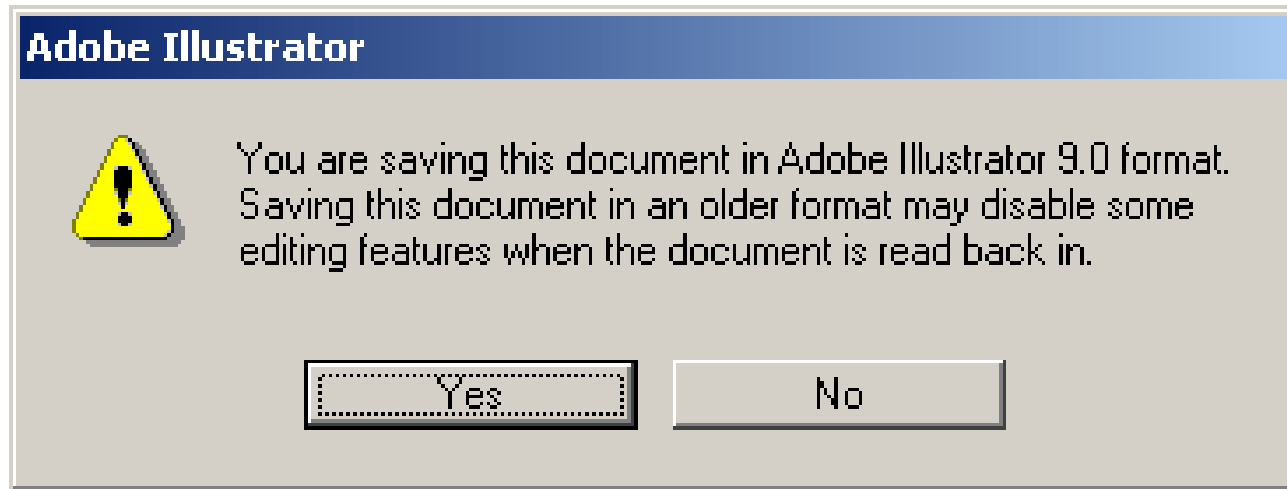
probably wouldn't be found by usability testing

fix: pick a single format for entire interface

Heuristics



Heuristics



What happens if you press No?

violates “User control and Freedom” (H4) “Prevent Errors” (H5)

fix: replace with “Ok” and “Cancel”

Phases of Heuristic Evaluation

1) Pre-evaluation training

give expert evaluators needed
domain knowledge & information on the scenario

2) Evaluation

individuals evaluate interface & make lists of problems

3) Severity rating

determine how severe each problem is

4) Aggregation

group meets & aggregates problems (w/ ratings)

5) Debriefing

discuss the outcome with design team

How to Perform Evaluation

At least two passes for each evaluator

- first to get feel for flow and scope of system

- second to focus on specific elements

If system is walk-up-and-use or evaluators are domain experts, no assistance needed

- otherwise might supply evaluators with scenarios

Each evaluator produces list of problems

- explain why with reference to heuristic

- be specific & list each problem separately

Example Heuristic Violation

1. [H4 Consistency]

The interface used the string "Save" on the first screen for saving the user's file, but used the string "Write file" on the second screen. Users may be confused by this different terminology for the same function.

How to Perform Heuristic Evaluation

Why separate listings for each violation?

- risk of repeating problematic aspect
- may not be possible to fix all problems

Where problems may be found

- single location in interface
- two or more locations that need to be compared
- problem with overall structure of interface
- something that is missing

- common problem with paper prototypes
(sometimes features are implied by design documents
and just haven't been "implemented" – relax on those)

Severity Rating

Used to allocate resources to fix problems

Estimates of need for more usability efforts

Combination of

frequency

impact

persistence (one time or repeating)

Should be calculated after all evaluations are in

Should be done independently by all judges

Severity Rating

- 0 - Do not agree this is a problem.
- 1 - Usability blemish. Mild annoyance or cosmetic problem. Easily avoidable.
- 2 - Minor usability problem. Annoying, misleading, unclear, confusing. Can be avoided or easily learned. May occur only once.
- 3 - Major usability problem. Prevents users from completing tasks. Highly confusing or unclear. Difficult to avoid. Likely to occur more than once.
- 4 - Critical usability problem. Users will not be able to accomplish their goals. Users may quit using system all together.

Example Heuristic Violation

1. [H4 Consistency] [Severity 3]

The interface used the string "Save" on the first screen for saving the user's file, but used the string "Write file" on the second screen. Users may be confused by this different terminology for the same function.

Debriefing

Conduct with evaluators, observers, and development team members

Discuss general characteristics of interface

Suggest potential improvements to address major usability problems

Development team rates how hard to fix

Make it a brainstorming session

Fixability Scores

- 1 - Nearly impossible to fix. Requires massive re-engineering or use of new technology. Solution not known or understood at all.
- 2 - Difficult to fix. Redesign and re-engineering required. Significant code changes. Solution identifiable but details not fully understood.
- 3 - Easy to fix. Minimal redesign and straightforward code changes. Solution known and understood.
- 4 - Trivial to fix. Textual changes and cosmetic changes. Minor code tweaking.

Example Heuristic Violation

1. [H4 Consistency] [Severity 3] [Fix 4]

The interface used the string "Save" on the first screen for saving the user's file, but used the string "Write file" on the second screen. Users may be confused by this different terminology for the same function.

Fix: Change second screen to "Save".

Alternative Inspection-Based Methods

Cognitive Walkthrough

Helps surface different types of usability problems

Consider this as a complement to heuristic evaluation

Action Analysis

Low-level modeling of expert performance

Be aware of GOMS, but you may never encounter it

Cognitive Walkthrough

Evaluation method based on:

A person works through an interface in an exploratory manner

A person has goals

The person is applying means-ends reasoning to work out how to accomplish these goals

Evaluation by an expert, who goes through a task while simulating this cognitive process

Preparation: Need Four Things

- 1) User description, including level of experience
any assumptions made by the designer
- 2) System description (e.g., paper prototype)
- 3) Task description, specifying the task the expert
has to carry out, from a user's point of view
- 4) Action sequence describing the system display
and the user actions needed to complete the
given task. One system display and one user
action together are one step.

Cognitive Walkthrough Process

Expert reads the user, system, task descriptions and carries out the task by following the action list

At each step in action list, asks four questions

Record problems similar to heuristic evaluation

Believability

- 1) Will the user be trying to produce whatever effect the action has?
- 2) Will the user be able to notice that the correct action is available?
- 3) Once the user finds the correct action at the interface, will they know that it is the right one for the effect they are trying to produce?
- 4) After the action is taken, will the user understand the feedback given?

Action Analysis / Cognitive Modeling

GOMS: Goals, Operators, Methods, Selection

Developed by Card, Moran and Newell

Walk through sequence of steps

Assign each an approximate time duration

Sum to estimate overall performance time

1. Select sentence		
Reach for mouse	H	0.40
Point to first word	P	1.10
Click button down	K	0.60
Drag to last word	P	1.20
Release	K	0.60
		3.90 secs

Inspection vs. Usability Testing

Inspection is

- Is much faster

- Does not require interpreting user actions

- May miss problems or find false positives

Usability testing is

- More accurate, by definition

- Account for actual users and tasks

One approach is to alternate between them

- Find different problems, conserve participants

Class exercise

Heuristic evaluation of paper prototypes

Phases of Heuristic Evaluation

1) Pre-evaluation training

give expert evaluators needed
domain knowledge & information on the scenario

2) Evaluation

individuals evaluate interface & make lists of problems

3) Severity rating

determine how severe each problem is

4) Aggregation

group meets & aggregates problems (w/ ratings)

5) Debriefing

discuss the outcome with design team