Analytical evaluation

Lecture 12
Human Computer Interaction design
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Aims:

- Describe the key concepts associated with inspection methods.
- Explain how to do heuristic evaluation and walkthroughs.
- Explain the role of analytics in evaluation.
- Describe how to perform two types of predictive methods, GOMS and Fitts' Law.

Inspections

- Several kinds.
- Experts use their knowledge of users & technology to review software usability.
- Expert critiques (crits) can be formal or informal reports.
- Heuristic evaluation is a review guided by a set of heuristics.
- Walkthroughs involve stepping through a pre-planned scenario noting potential problems.

Heuristic evaluation

- Developed Jacob Nielsen in the early 1990s.
- Based on heuristics distilled from an empirical analysis of 249 usability problems.
- These heuristics have been revised for current technology.
- Heuristics being developed for mobile devices, wearables, virtual worlds, etc.
- Design guidelines form a basis for developing heuristics.

Nielsen's original heuristics

- Visibility of system status.
- Match between system and real world.
- User control and freedom.
- Consistency and standards.
- Error prevention.
- Recognition rather than recall.
- Flexibility and efficiency of use.
- Aesthetic and minimalist design.
- Help users recognize, diagnose, recover from errors.
- Help and documentation.

http://www.stcsig.org/usability/topics/articles/he-checklist.html

Gerhardt-Powals heuristics

1. Automate unwanted workload
   - Free cognitive resources for high-level tasks
   - Eliminate mental calculations, estimations, comparisons, and unnecessary thinking
2. Reduce uncertainty
   - Display data in a manner that is clear and obvious
3. Fuse data
   - Reduce cognitive load by bringing together lower level data into a higher level summation

Gerhardt-Powals heuristics

4. Present new information with meaningful aids to interpretation
   - Use a familiar framework, making it easier to absorb
   - Use everyday terms, metaphors, etc
5. Use names that are conceptually related to function
   - Context-dependent
   - Attempt to improve recall and recognition
6. Group data in consistently meaningful ways to decrease search time

Gerhardt-Powals heuristics

7. Limit data-driven tasks
   - Reduce the time spent assimilating raw data.
   - Make appropriate use of color and graphics
8. Include in the displays only that information needed by the user at a given time
   - Allow users to remain focused on critical data
   - Exclude extraneous information that is not relevant to current tasks
9. Provide multiple coding of data when appropriate
10. Practice judicious redundancy (to resolve the possible conflict between heuristics 6 and 8)

E-notes.com

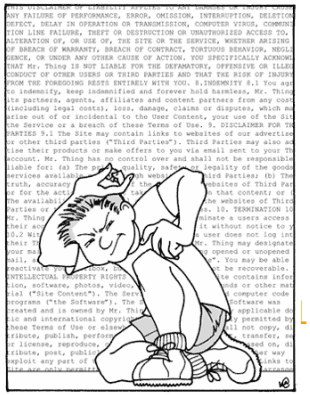
Weinschenk and Barker heuristics for speech systems

1. User Control.
2. Human Limitations
3. Modal Integrity
4. Accommodation
5. Linguistic Clarity
6. Aesthetic Integrity
7. Simplicity
8. Predictability
9. Interpretation
10. Accuracy
11. Technical clarity
12. Flexibility
13. Fulfillment
14. Cultural Propriety
15. Suitable Tempo
16. Consistency
17. User support
18. Precision
19. Forgiveness
20. Responsiveness

Nielsen, 1994

Nielsen's heuristics for Web

1. Bad search
2. PDF Files for Online Reading
3. Not Changing the Color of Visited Links
4. Non-Scannable Text
5. Fixed Font Size
6. Page Titles With Low Search Engine Visibility
7. Anything That Looks Like an Advertisement
8. Violating Design Conventions
9. Opening New Browser Windows
10. Not Answering Users' Questions



Budd, 2007

Website heuristics

1. Design for User Expectations

- Choose features that will help users achieve their goals
- Use common web conventions
- Make online processes work in a similar way to their offline equivalents
- Don’t use misleading labels or buttons

2. Clarity

- Write clear, concise copy
- Only use technical language for a technical audience
- Write clear and meaningful labels
- Use meaningful icons

Budd, 2007

Website heuristics

3. Minimize Unnecessary Complexity and Cognitive Load

- Remove unnecessary functionality, process steps and visual clutter
- Use progressive disclosure to hide advanced features
- Break down complicated processes into multiple steps
- Prioritise using size, shape, colour, alignment and proximity

4. Efficiency and Task Completion

- Provide quick links to common features/functions
- Provide advanced features like the ability to delete multiple messages
- Pre-check common options, like opt-out of marketing emails
- Allow defaults to be changed, cancelled or overridden.
- Remove unnecessary steps

Budd, 2007

Website heuristics

5. Provide Users with Context

- Provide a clear site name and purpose
- Highlight the current section in the navigation
- Provide a breadcrumb trail
- Appropriate feedback messages
- Show number of steps in a process
- Reduce perception of latency by providing visual cues (e.g. progress indicator) or by allowing users to complete other tasks while waiting.

6. Consistency and Standards

- Use common naming conventions such as “log in”?
- Place items in standard locations like search boxes at the top right of the screen
- Use the right interface element or form widget for the job
- Create a system that behaves in a predictable way
- Use standard processes and web patterns

Budd, 2007

Website heuristics

7. **Prevent Errors**
   - Disable irrelevant options
   - Accept both local and international dialling codes
   - Provide examples and contextual help
   - Check if a username is already being used before the user registers
8. **Help users notice, understand and recover from errors**
   - Visually highlight errors
   - Provide feedback close to where the error occurred
   - Use clear messages and avoid technical jargon
9. **Promote a pleasurable and positive user experience**
   - Create a pleasurable and attractive design
   - Provide easily attainable goals
   - Provide rewards for usage and progression

Cogdill, 1999

Heuristics for websites

- Internal consistency
  - The user should not have to speculate whether different phrases or actions carry the same meaning.?
- Simple dialog
  - Terms should be familiar and not be system-oriented.
- Shortcuts
- Minimizing the user's memory load
- Preventing errors
- Feedback
- Internal locus of control

  "Emergency exits"

Turning Design Guidelines into Heuristics

Preece, 2001

Heuristics for social network websites

- Dialog & social interaction support
  - The prompts and feedback that support interaction, the ease with which commands can be executed, the ease with which avatars can be moved, spatial relationships in the environment, etc.
- Information design
  - How easy to read, understandable and aesthetically pleasing information associated with the community is, etc.
- Navigation
  - The ease with user can move around and find what they want in the community and associated website. Many online community users have suffered from the inconsistencies of data transfer and differences in interaction style between imported software modules and the website housing the community.
- Access
  - Requirements to download and run online community software must be clear.

Heuristics for web-based communities

Sociability

- Why should I join?
- What are the rules?
- Is the community safe?
- Can I express myself as I wish?
- Do people reciprocate?
- Why should I come back?

Usability

- How do you join?
- How do I get, read, and send messages?
- Can I do what I want to do easlity?

Preece (2000)

Heuristics for virtual worlds

1. Visibility of state
   - Do the interface elements names are clear?
   - Is the selected object distinguished from the context?

Euristikos virtualiesiems pasauliams

1. Visibility of state
   - Does functionality is visible?

Mankoff et al. (2003)

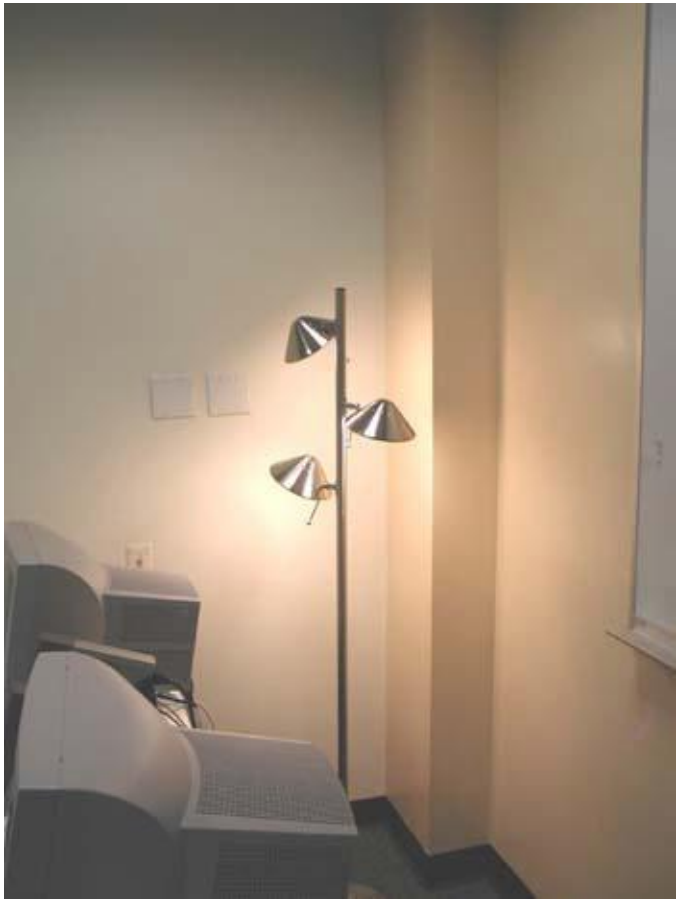
Ambient display heuristics

- Useful and relevant information
- Peripherality of display
- Match between design of ambient display and environments
- Sufficient information design
- Consistent and intuitive mapping
- Easy transition to more in-depth information
- Visibility of state
- Aesthetic and Pleasing Design

Mankoff ir kiti (2003)

Ambient display heuristics

BusMobile.



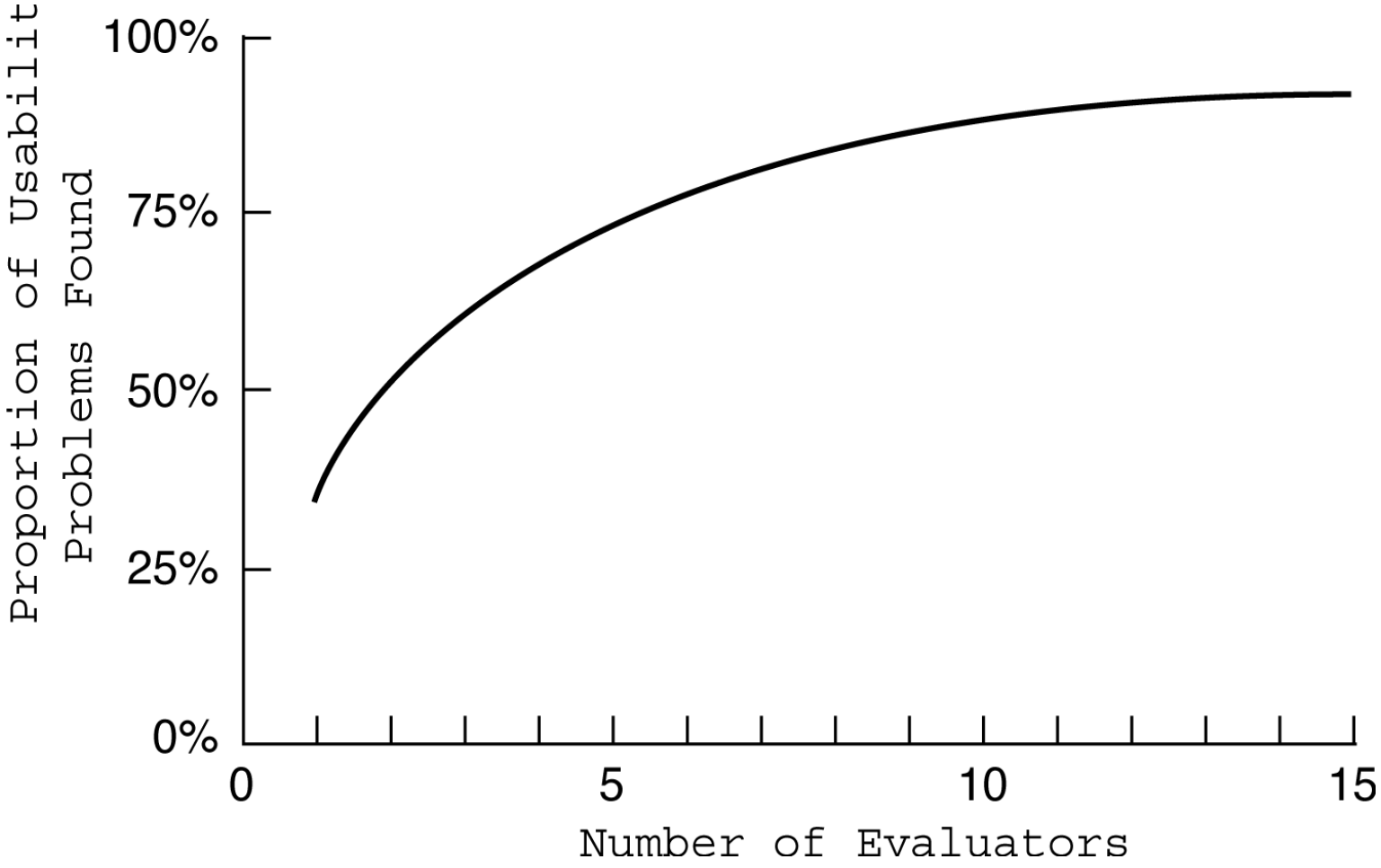
Daylight display

Discount evaluation

- Heuristic evaluation is referred to as discount evaluation when 5 evaluators are used.

- Empirical evidence suggests that on average 5 evaluators identify 75-80% of usability problems.

No. of evaluators & problems



3 stages for doing heuristic evaluation

- Briefing session to tell experts what to do.
- Evaluation period of 1-2 hours in which:
  - Each expert works separately;
  - Take one pass to get a feel for the product;
  - Take a second pass to focus on specific features.
- Debriefing session in which experts work together to prioritize problems.

Advantages and problems

- Few ethical & practical issues to consider because users not involved.
- Can be difficult & expensive to find experts.
- Best experts have knowledge of application domain & users.
- Biggest problems:
  - Important problems may get missed;
  - Many trivial problems are often identified;
  - Experts have biases.

Cognitive walkthroughs

- Focus on ease of learning.
- Designer presents an aspect of the design & usage scenarios.
- Expert is told the assumptions about user population, context of use, task details.
- One or more experts walk through the design prototype with the scenario.
- Experts are guided by 3 questions.

The 3 questions

- Will the correct action be sufficiently evident to the user?
- Will the user notice that the correct action is available?
- Will the user associate and interpret the response from the action correctly?

As the experts work through the scenario they note problems.

Spencer 2000

Streamlined CW

1. Define inputs to walkthrough
2. Convene the walkthrough
   - 2 questions:
     - Will the user know what to do at this step?
     - If the user does the right thing, will they know that they did the right thing, and are making progress towards their goal?
3. Walkthrough the action sequences for each task
4. Record critical information

Pluralistic walkthrough

- Variation on the cognitive walkthrough theme.
- Performed by a carefully managed team.
- The panel of experts begins by working separately.
- Then there is managed discussion that leads to agreed decisions.
- The approach lends itself well to participatory design.

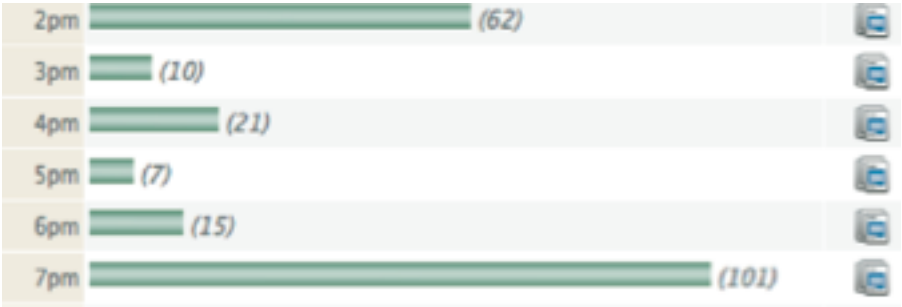
A project for you …

http://www.id-book.com/catherb/

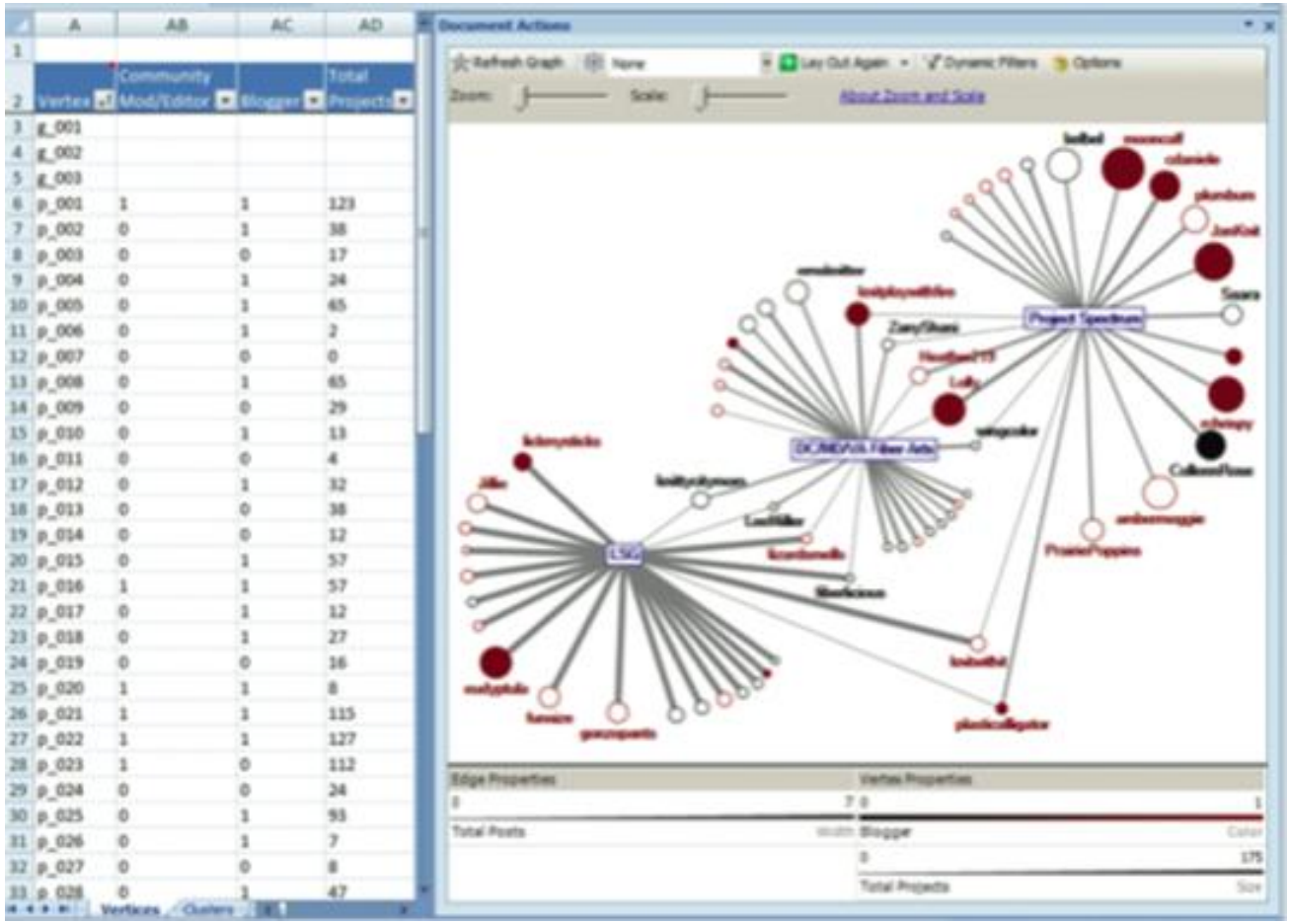
- provides heuristics and a template so that you can evaluate different kinds of systems.
- More information about this is provided in the interactivities section of the id-book.com website.

Analytics

- A method for evaluating user traffic through a system or part of a system
- Many examples including Google Analytics, Visistat (shown below)
- Times of day & visitor IP addresses



Social action analysis
(Perer & Shneiderman, 2008)



	A	AB	AC	AD
1				
2	Vertex	Community Mod/Editor	Blogger	Total Projects
3	g_001			
4	g_002			
5	g_003			
6	p_001	1	1	123
7	p_002	0	1	38
8	p_003	0	0	17
9	p_004	0	1	24
10	p_005	0	1	65
11	p_006	0	1	2
12	p_007	0	0	0
13	p_008	0	1	65
14	p_009	0	0	29
15	p_010	0	1	13
16	p_011	0	0	4
17	p_012	0	1	32
18	p_013	0	0	38
19	p_014	0	0	12
20	p_015	0	1	57
21	p_016	1	1	57
22	p_017	0	1	12
23	p_018	0	1	27
24	p_019	0	0	16
25	p_020	1	1	8
26	p_021	1	1	115
27	p_022	1	1	127
28	p_023	1	0	112
29	p_024	0	0	24
30	p_025	0	1	93
31	p_026	0	1	7
32	p_027	0	0	8
33	p_028	0	1	47

Predictive models

- Provide a way of evaluating products or designs without directly involving users.
- Less expensive than user testing.
- Usefulness limited to systems with predictable tasks - e.g., telephone answering systems, mobiles, cell phones, etc.
- Based on expert error-free behavior.

GOMS

- Goals – what the user wants to achieve eg. find a website.
- Operators - the cognitive processes & physical actions needed to attain goals, eg. decide which search engine to use.
- Methods - the procedures to accomplish the goals, eg. drag mouse over field, type in keywords, press the go button.
- Selection rules - decide which method to select when there is more than one.

Keystroke level model

- GOMS has also been developed to provide a quantitative model - the keystroke level model.
- The keystroke model allows predictions to be made about how long it takes an expert user to perform a task.

Response times for keystroke level operators (Card et al., 1983)

Operator	Description	Time (sec)
K	Pressing a single key or button Average skilled typist (55 wpm) Average non-skilled typist (40 wpm) Pressing shift or control key Typist unfamiliar with the keyboard	 0.22 0.28 0.08 1.20
P P1	Pointing with a mouse or other device on a display to select an object. This value is derived from Fitts' Law which is discussed below. Clicking the mouse or similar device	0.40 0.20
H	Bring 'home' hands on the keyboard or other device	0.40
M	Mentally prepare/respond	1.35
R(t)	The response time is counted only if it causes the user to wait.	t

Summing together

$$T_{\text{execute}} = T_{\text{K}} + T_{\text{P}} + T_{\text{H}} + T_{\text{D}} + T_{\text{M}} + T_{\text{R}}$$

Using KLM to calculate time to change gaze (Holleis et al., 2007)

Attention shift (*SMacro) between the mobile phone and* objects in the real world.

Fitts' Law (Fitts, 1954)

- Fitts' Law predicts that the time to point at an object using a device is a function of the distance from the target object & the object's size.
- The further away & the smaller the object, the longer the time to locate it & point to it.
- Fitts' Law is useful for evaluating systems for which the time to locate an object is important, e.g., a cell phone, a handheld devices.

Fitts' Law evaluations

Input Technique	Mouse	Stylus	Eye with Manual Click	Eye with Dwell Time Click
Movement time *(s.e.)*	*.66* *(.03)*	*.63* *(.03)*	*.57* *(.04)*	*.45* *(.02)*

Table 1. Mean movement times (s) and standard error per input technique.

Vertegaal (2008)

Input Technique	Mouse	Stylus	Eye with Manual Click	Eye with Dwell Time Click
Error rate *(s.e.)*	*4.6%* *(1.3%)*	*6.2%* *(1.5%)*	*11.7%* *(3.5%)*	*42.9%* *(3.7%)*

Table 2. Mean error rates and standard error per input technique.

A project for you …

- Use the web & other resources to research claims that heuristic evaluation often identifies problems that are not serious & may not even be problems.
- Decide whether you agree or disagree.
- Write a brief statement arguing your position.
- Provide practical evidence & evidence from the literature to support your position.

A Project for you …Fitts' Law

Visit Tog's website and do Tog's quiz, designed to give you fitts!

http://www.asktog.com/columns/022DesignedToGiveFitts.html

Key points

- Inspections can be used to evaluate requirements, mockups, functional prototypes, or systems.
- User testing & heuristic evaluation may reveal different usability problems.
- Walkthroughs are focused so are suitable for evaluating small parts of a product.
- Analytics involves collecting data about users activity on a website or product
- The GOMS and KLM models and Fitts' Law can be used to predict expert, error-free performance for certain kinds of tasks.

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