Brugergrænseflader

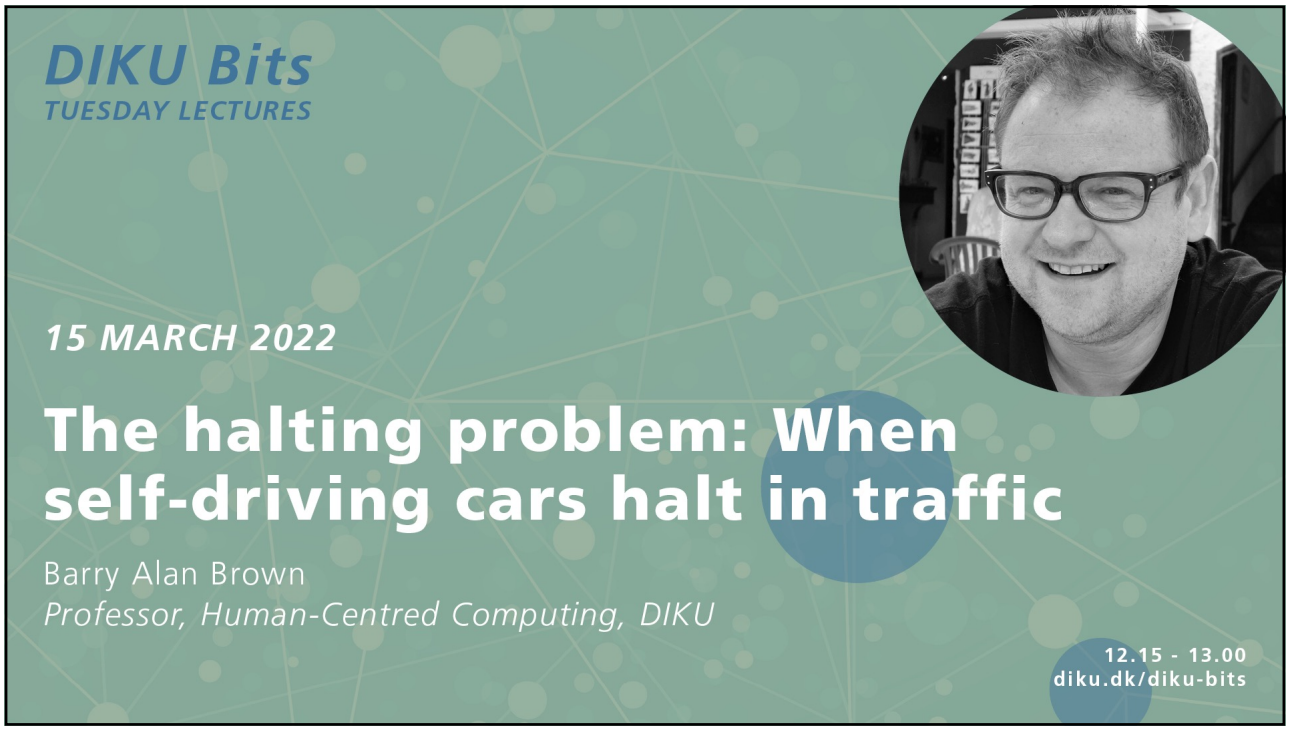
Kasper Hornbæk

1

Praktisk

- Spørgsmål om afleveringsopgave 4?

2



3

Det får I med i dag

1. Lære de basale typer brugergrænseflader
2. Forstå udfordringerne ved direkte manipulation og menuer

4

Hvad er en brugergrænseflade?

- Alle de aspekter af et system som brugeren kommer i kontakt med

- Består af:
  - Enheder, særligt input og output
  - Interaktionsteknikker
  - Repræsentationer
  - Substrat

Grafisk brugergrænseflade:
Mus, skærm
Click-and-drag
Ikoner
Desktop, menu

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Typer af grænseflade

- Grafisk brugergrænseflade (GUI, WIMP)
- Menu- og navigationsgrænseflader
- Kommandolinegrænseflader
- Formular-grænseflader
- Post-WIMP grænseflader

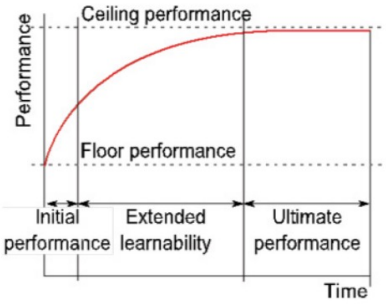
6

Hvordan vælger man en brugergrænseflade?

7

Hvordan vælger man en brugergrænseflade?

- Gode brugergrænseflader afhænger af:
  - Forståelse af brugerne (novice/ekspert, etc.)

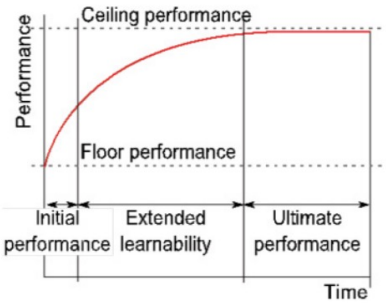


Cockburn et al. (2014)

8

Hvordan vælger man en brugergrænseflade?

- Gode brugergrænseflader afhænger af:
  - Forståelse af brugerne (novice/ekspert, etc.)
  - Forståelse af aktiviteter
  - Forståelse af brugskontekst
  - Design, test og redesign (iterativt design)



Cockburn et al. (2014)

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Gode brugergrænser respekterer mennesker

- Husk at tage hensyn til menneskers psykologi
  - Johnson (2021), fx genkendelse over genkaldelse
  - Norman's *Gulf-of-evaluation* og *Gulf-of-execution*
  - Gestaltlove, CRAP, konsistens
  - Fitt's lov, KLM, GOMS

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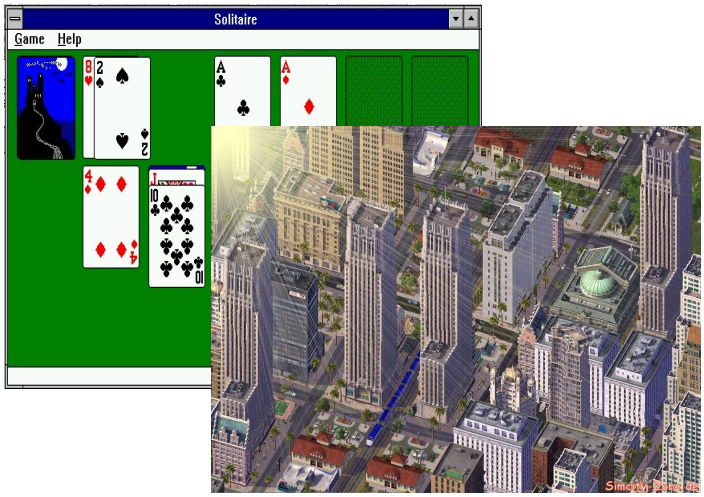
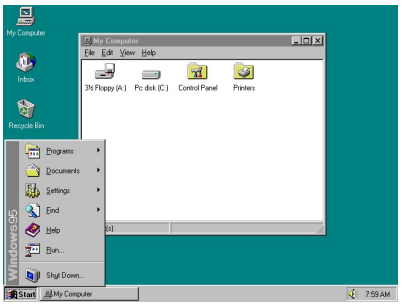
Grafiske brugergrænseflaer





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Direkte manipulation

- Shneiderman (1983)'s definition:
  - Interessante objekter og handlinger synlige
  - Direkte manipulation af objekter i stedet for kompleks syntaks
  - Reversible og trinvise handlinger hvor resultaterne omgående er synlige

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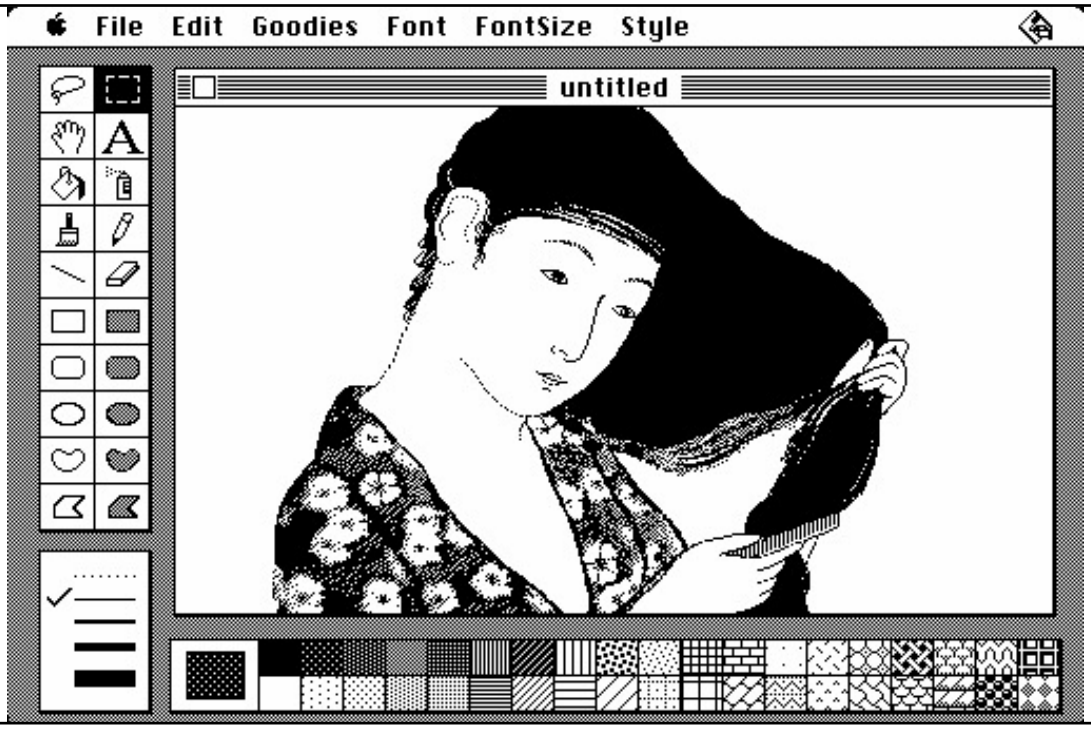

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Fordele ved direkte manipulation

- Objekter og handlinger synligere
  - novicer støttes i at lære basale funktioner
  - kompetente brugere støttes i at huske funktioner
- Direkte manipulation
  - fejlmeddelelser behøves sjældent, fejl undgås
- Reversible handlinger med feedback
  - systemet kan udforskes og handlinger fortrydes, brugere har kontrol

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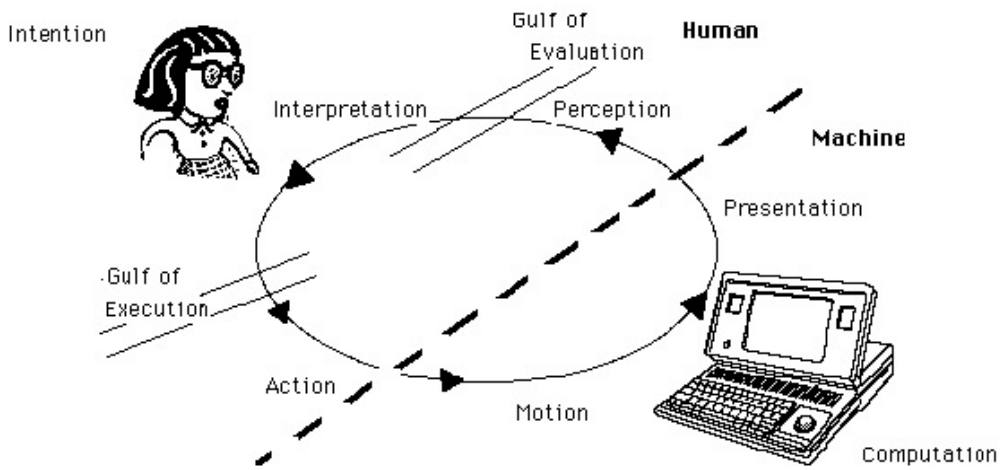
Fordele ved direkte manipulation



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Direkte manipulation på andet?

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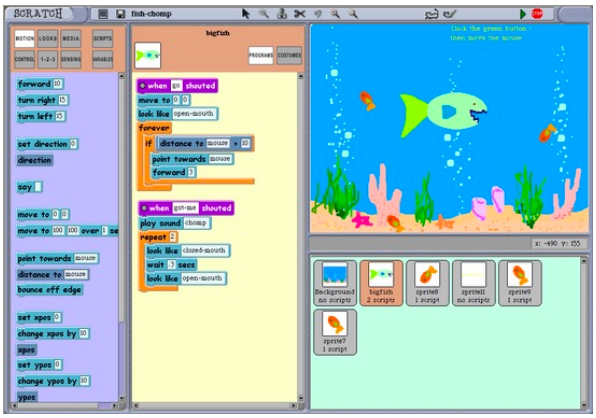
Direkte manipulation på video!

http://dragice.fr/dimp/

18

Ulemper ved direkte manipulation

- Rumlige og visuelle repræsentationer er ikke altid nyttige



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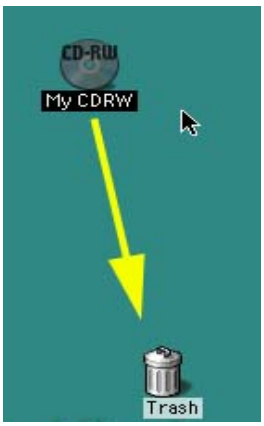
Ulemper ved direkte manipulation

- Rumlige og visuelle repræsentationer er ikke altid nyttige
- Brugeren skal lære betydningen af visuelle metaforer, ikoner, etc.



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Ulemper ved direkte manipulation

- Rumlige og visuelle repræsentationer er ikke altid nyttige
- Brugeren skal lære betydningen af visuelle metaforer, ikoner, etc.
- Makroteknikker og historik er svage
- Uegnet til nogle brugere og brugssituationer
- Svært at implementere (fx <100ms, undo-redo)

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Spørgsmål

Direct Manipulation

Advantages
- Visually presents task concepts
- Allows easy learning
- Allows easy retention
- Allows errors to be avoided
- Encourages exploration
- Affords high subjective satisfaction

Disadvantages
- May be hard to program
- Accessibility requires special attention

Shneiderman et al., p. 237

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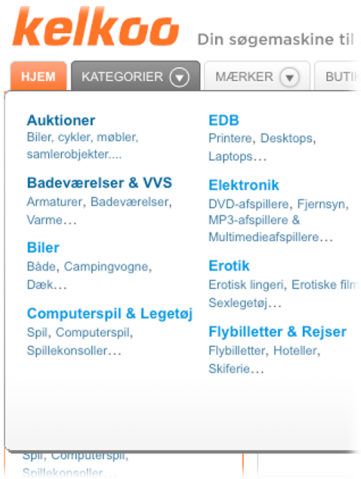
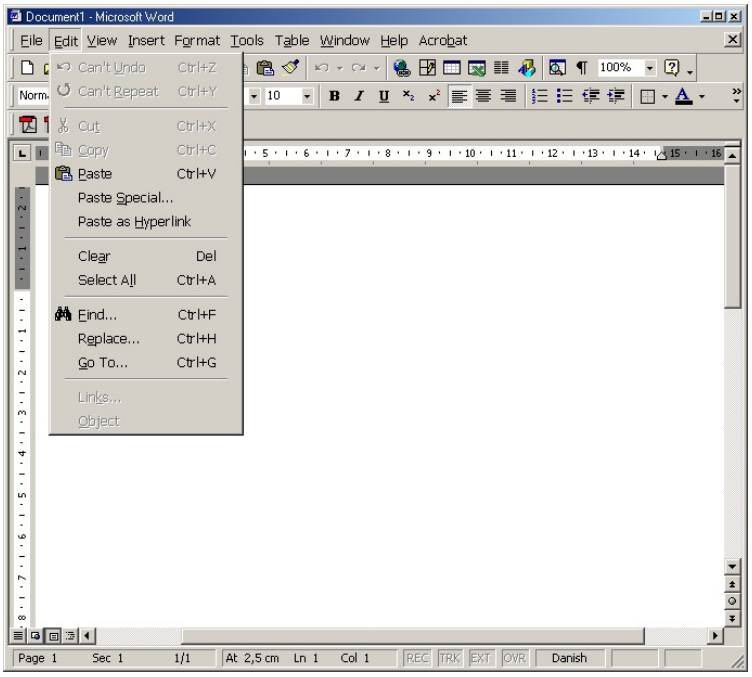
Menu- og navigationsgrænseflader



24

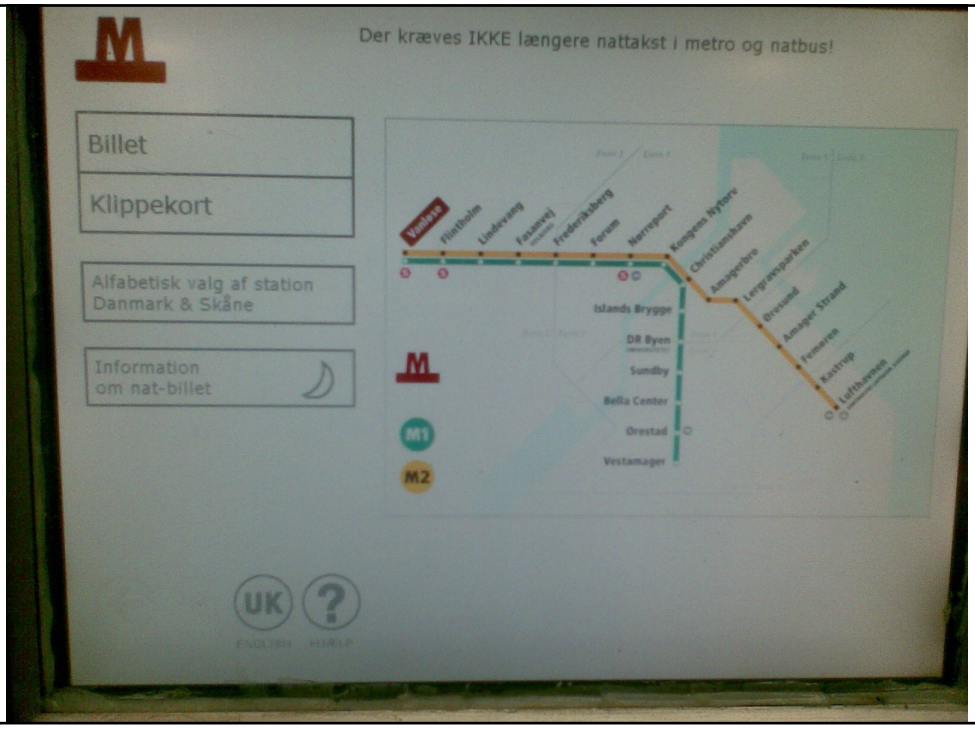

Document1 - Microsoft Word
File Edit View Insert Format Tools Table Window Help Acrobat
Can't Undo Ctrl+Z
Can't Repeat Ctrl+Y
Cut Ctrl+X
Copy Ctrl+C
Paste Ctrl+V
Paste Special...
Paste as Hyperlink
Clear Del
Select All Ctrl+A
Find... Ctrl+F
Replace... Ctrl+H
Go To... Ctrl+G
Links...
Object
Page 1 Sec 1 1/1 At 2,5 cm Ln 1 Col 1 REC TRK EXT OVR Danish

25

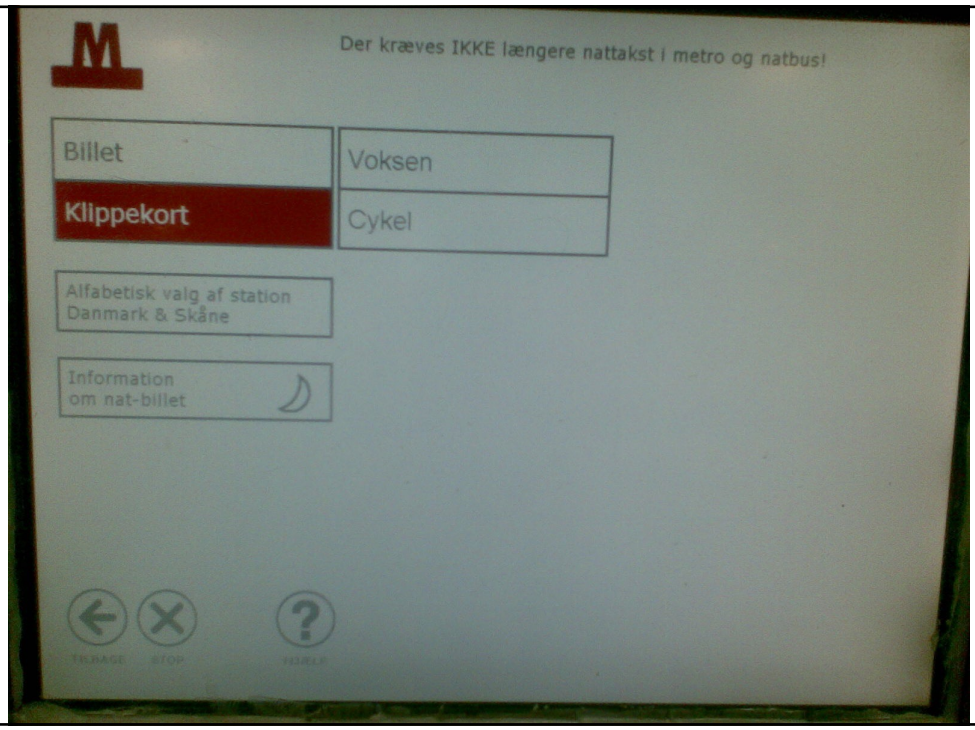
26

Billetter Tickets

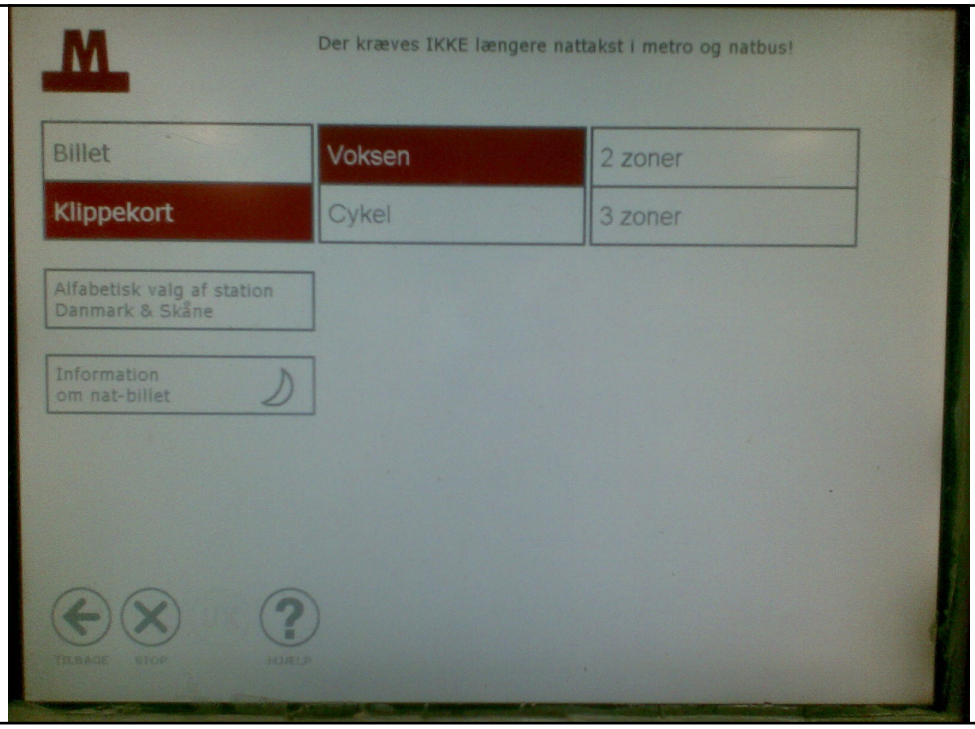
27


Der kræves IKKE længere nattakst i metro og natbus!
Billet
Klippekort
Alfabetisk valg af station
Danmark & Skåne
Information
om nat-billet
Vanløse
Flintholm
Lindevang
Fasanvej
Frederiksberg
Forum
Nørreport
Kongens Nytorv
Christianshavn
Amagerbro
Lergravsparken
Øresund
Amager Strand
Femøren
Kastrup
Lufthavnen
Islands Brygge
DR Byen
Sundby
Bella Center
Orestad
Vestamager
M1
M2
UK

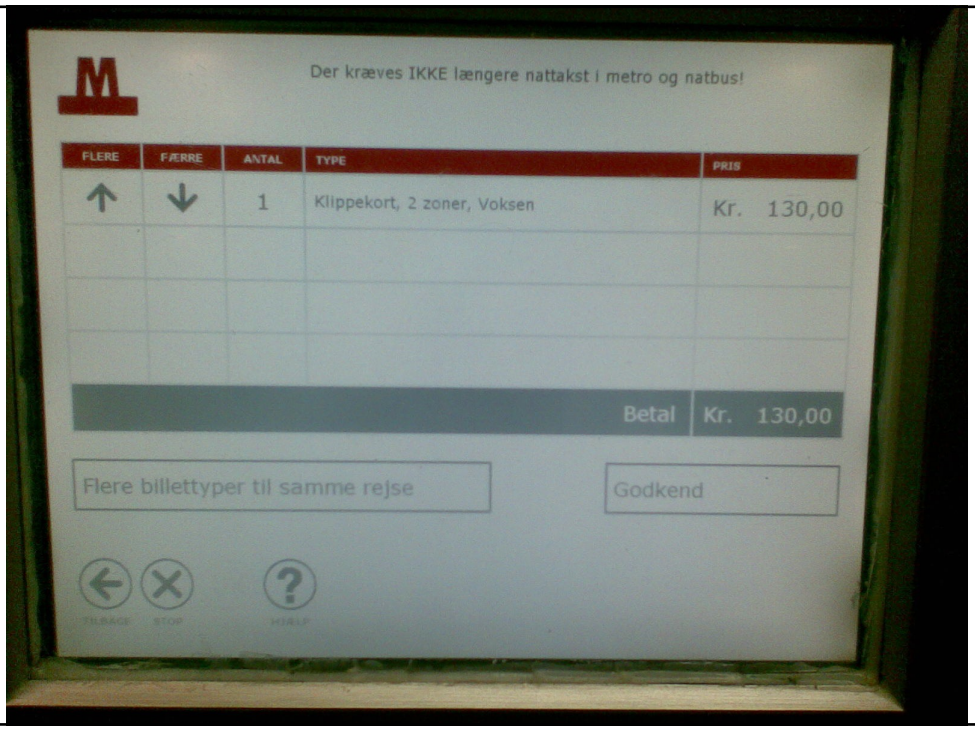
28


Der kræves IKKE længere nattakst i metro og natbus!
Billet
Klippekort
Voksen
Cykel
Alfabetisk valg af station
Danmark & Skåne
Information
om nat-billet

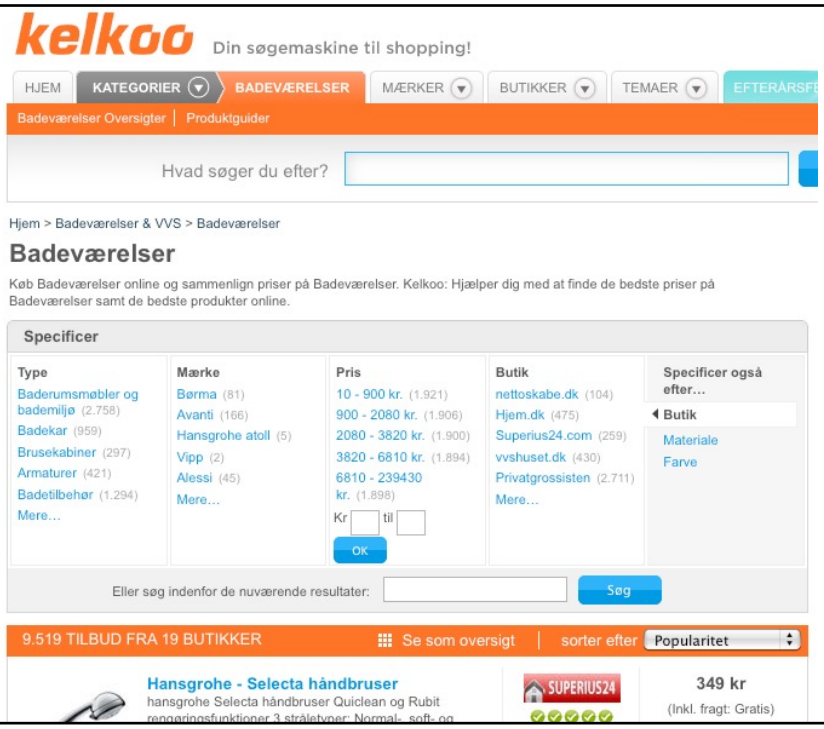
29


Der kræves IKKE længere nattakst i metro og natbus!
Billet
Klippekort
Voksen
Cykel
2 zoner
3 zoner
Alfabetisk valg af station
Danmark & Skåne
Information
om nat-billet

30


Der kræves IKKE længere nattakst i metro og natbus!
FLERE
FÆRRE
ANTAL
TYPE
PRIS
1
Klippekort, 2 zoner, Voksen
Kr. 130,00
Betal
Kr. 130,00
Flere billettyper til samme rejse
Godkend

31


kelkoo
Din søgemaskine til shopping!
HJEM
KATEGORIER
BADEVÆRELSER
MÆRKER
BUTIKKER
TEMAER
Badeværelser Oversigter | Produktguider
Hvad søger du efter?
Hjem > Badeværelser & VVS > Badeværelser
Badeværelser
Køb Badeværelser online og sammenlign priser på Badeværelser. Kelkoo: Hjælper dig med at finde de bedste priser på Badeværelser samt de bedste produkter online.
Specificer
Type
Baderumsmøbler og bademiljø (2.758)
Badekar (959)
Brusekabiner (297)
Armaturer (421)
Badetilbehør (1.294)
Mere...
Mærke
Børma (81)
Avanti (166)
Hansgrohe atoll (5)
Vipp (2)
Alessi (45)
Mere...
Pris
10 - 900 kr. (1.921)
900 - 2080 kr. (1.906)
2080 - 3820 kr. (1.900)
3820 - 6810 kr. (1.894)
6810 - 239430 kr. (1.898)
Kr til
OK
Butik
nettoskabe.dk (104)
Hjem.dk (475)
Superius24.com (259)
vvshuset.dk (430)
Privatgrossisten (2.711)
Mere...
Specificer også efter...
Butik
Materiale
Farve
Eller søg indenfor de nuværende resultater:
Søg
9.519 TILBUD FRA 19 BUTIKKER
Se som oversigt
sorter efter
Popularitet
Hansgrohe - Selecta håndbruser
hansgrohe Selecta håndbruser Quiclean og Rubit
SUPERIUS24
349 kr
(Inkl. fragt: Gratis)

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Design spørgsmål (I)

- Hvordan vælges organisering af menu-grænseflade?
  - Relateret til opgaven
  - Dybde versus bredde
  - Klare, distinkte menudele

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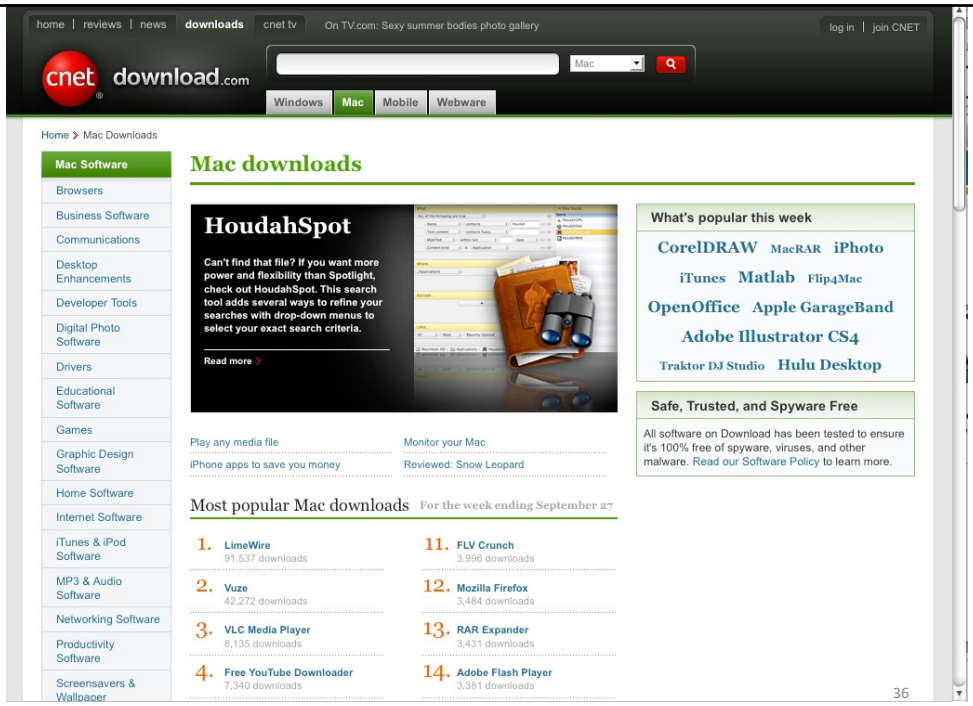
Design spørgsmål (II)

- Hvordan præsenteres inden for en menu?
  - Gruppering
  - Ordning, fx alfabetisk, numerisk, hyppigst brugt, eller vigtigste
- Navngivning af menupunkter

35



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Fordele ved menu-grænseflader

- Genkendelse snare end genkaldelse
- Godt til novicer og brugere som sjældent benytter systemet
- Kan støtte beslutningstagning

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Ulemper ved menu-grænseflader

- Ikke altid effektivt for eksperter
- Ikke egnet til alle opgaver
- Svært at præsentere mange valgmuligheder på begrænset plads

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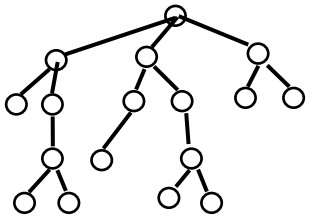
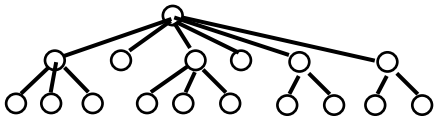
Dybde versus bredde



deep menu hierarchy



broad menu hierarchy

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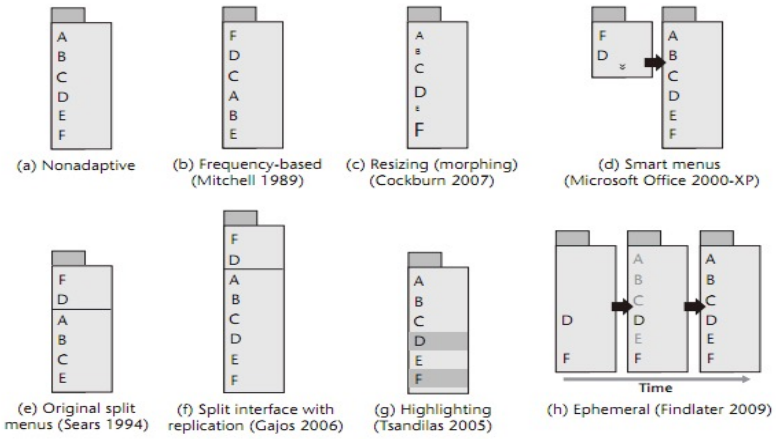
Flashback: Hicks-Hyman Lov

- Kan anvendes for beslutninger mellem lige sandsynlige alternativer
- Beslutningstiden er givet som
  - $T = a + b \log2(n + 1)$
- Raskin (2000) siger at ” a = 50 and b =150 are sufficient place holders for “back-of-the-envelope” approximations”

40

Menu varianter



Leah Findlater and Krzysztof Z. Gajos, "Design Space and Evaluation Challenges of Adaptive Graphical User Interface"

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Shortcuts

The user wants to open a new tab but is not sure of the hotkey. He visually locates the button in the toolbar (boxed on left), then presses the Command key (Ctrl) to activate ExposeHK, which overlays toolbar items with available hotkeys (right). He completes the command by pressing Ctrl T

Malacria et al. (2013)

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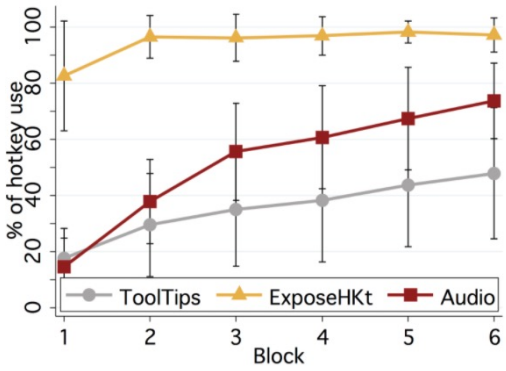
Shortcuts, cont'd



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Similar idea for Overleaf

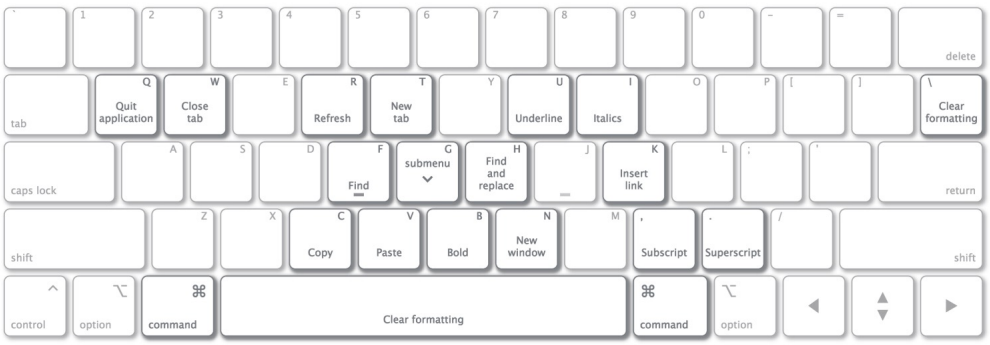

Figure 2. Example KeyMap interface shown while the Command modifier is held down, each shortcut key associated with Command is rendered with the name of the corresponding application command.

Lewis et al. (2020)

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Webnavigation som menugrænseflade

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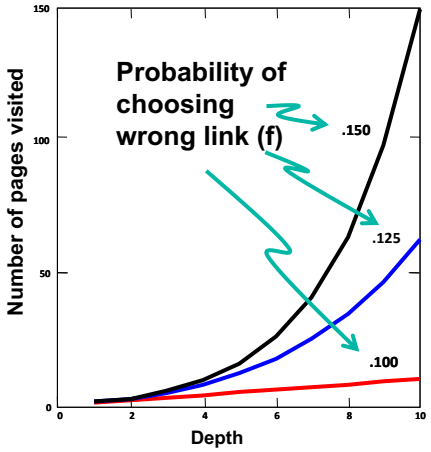
Information scent (Pirolli et al.)



Notes: Average branching factor = 10
Depth = 10

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Metode: kortsortering

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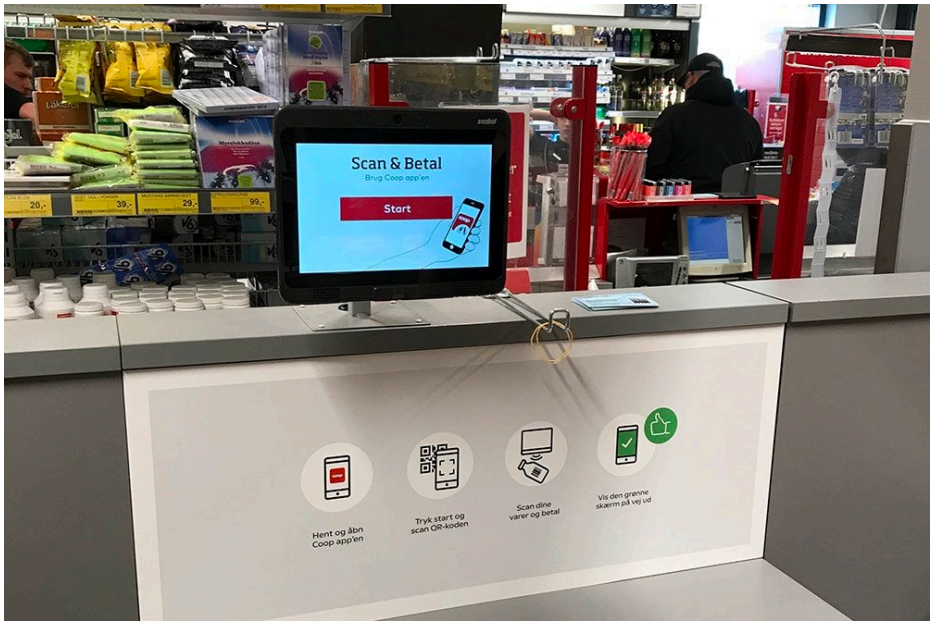

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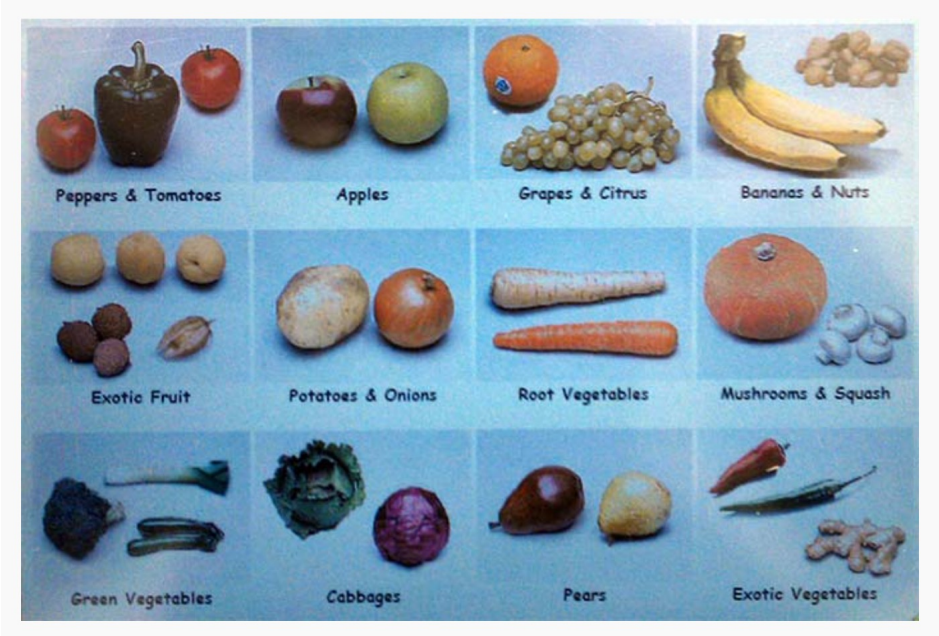

https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/card-sorting

49

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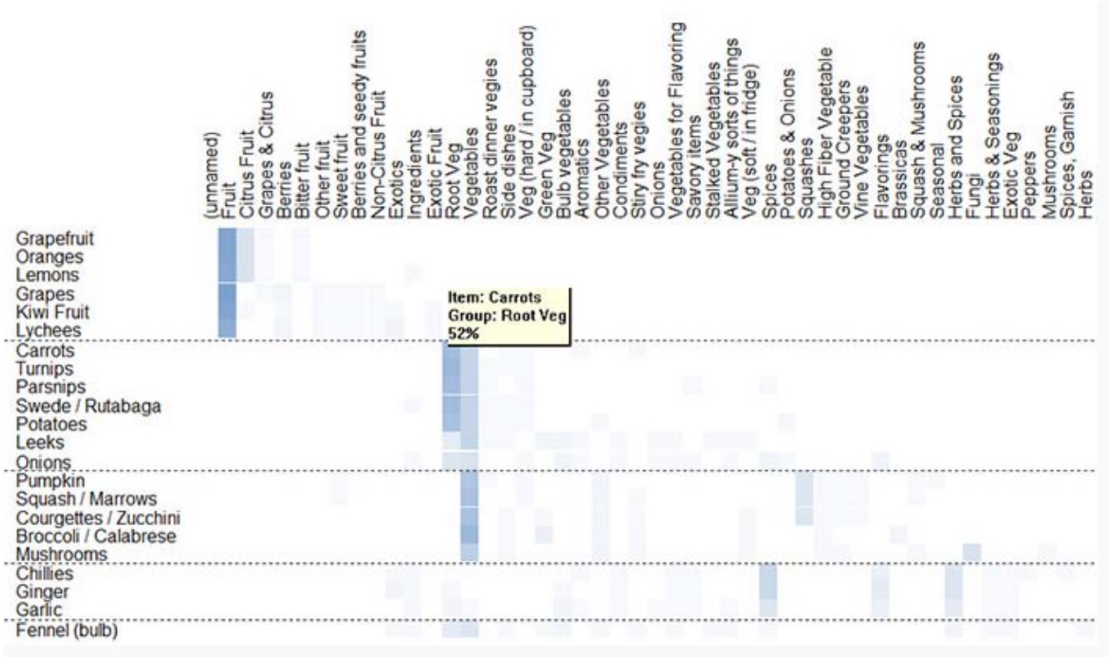

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Spørgsmål

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Kommandolinegrænseflader

- F.eks. SQL
  - Handling: CREATE, ALTER, DROP, …
  - Objekt: TABLE, INDEX, FUNCTION, …

ALTER TABLE table ALTER COLUMN column ADD …
ALTER TABLE table ALTER COLUMN column DROP …

http://ss64.com/sql/

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Vocabulary problem

- Furnas et al. (1986) fandt at forsøgspersoner beskrev det samme objekt med de samme ord i mindre end 20% af tilfældene; det mest populære ord blev brugt mellem 15% og 35% af tilfældene

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Kommandosprog

- Fordele
  - Effektivt og tilfredsstillende for ekspertbrugere
  - Hurtigt
  - Fleksibelt
- Ulemper
  - Læring
  - Genkaldelse, svært at fastholde
  - Høj fejlhyppighed
  - Upræcise fejlbeskeder

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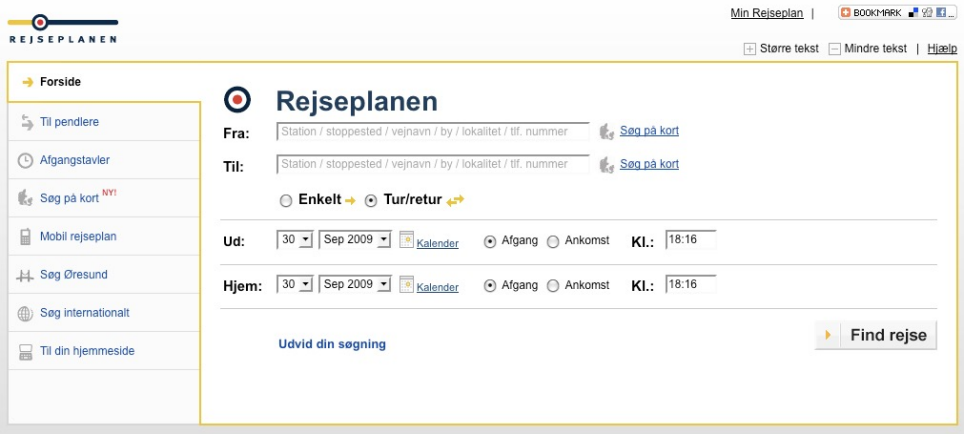
Formular-grænseflader



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1 Policenummer	Policenummer		CPR-nummer
2 Skadelidte	Navn		Stilling
	Adresse		
	Postnummer	By	Telefonnummer
	En eventuel erstatning kan overføres direkte til min konto	Reg. nr.	Kontonr.
3 Skadedato	Dato		Klokkeslæt (0-24)
4 Skadested	Hvor skete uheldet?		I hvilken anledning befandt du dig på skadestedet?
	Ved skader i udlandet bedes land og udrejsedato oplyst		
5 Fritid/arbejde	Er uheldet sket: *- I fritiden?*	☐ *Ja*	☐ *Nej*
	- Under arbejde som lønmodtager?	☐ *Ja*	☐ *Nej*
	- Under arbejde for andre, herunder ulønnet hjælp for andre?	☐ *Ja*	☐ *Nej*
	- På vej til eller fra arbejde?	☐ *Ja*	☐ *Nej*
	- Under arbejde i egen virksomhed?	☐ *Ja*	☐ *Nej*
	- I forbindelse med militærtjeneste	☐ *Ja*	☐ *Nej*
	- I forbindelse med professionel sport?	☐ *Ja*	☐ *Nej*
6 Uheldsbeskrivelse	*1) Beskriv udførligt, hvad der skete*		

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Formular-grænseflader

- Brugeren udfylder felter i en grænseflade som minder om en formular eller blanket
- Eksempler på WWW eller ved registrering af programmer
- Brugsvenligt design blandt andet baseret på principper for menuer og design af papirformularer

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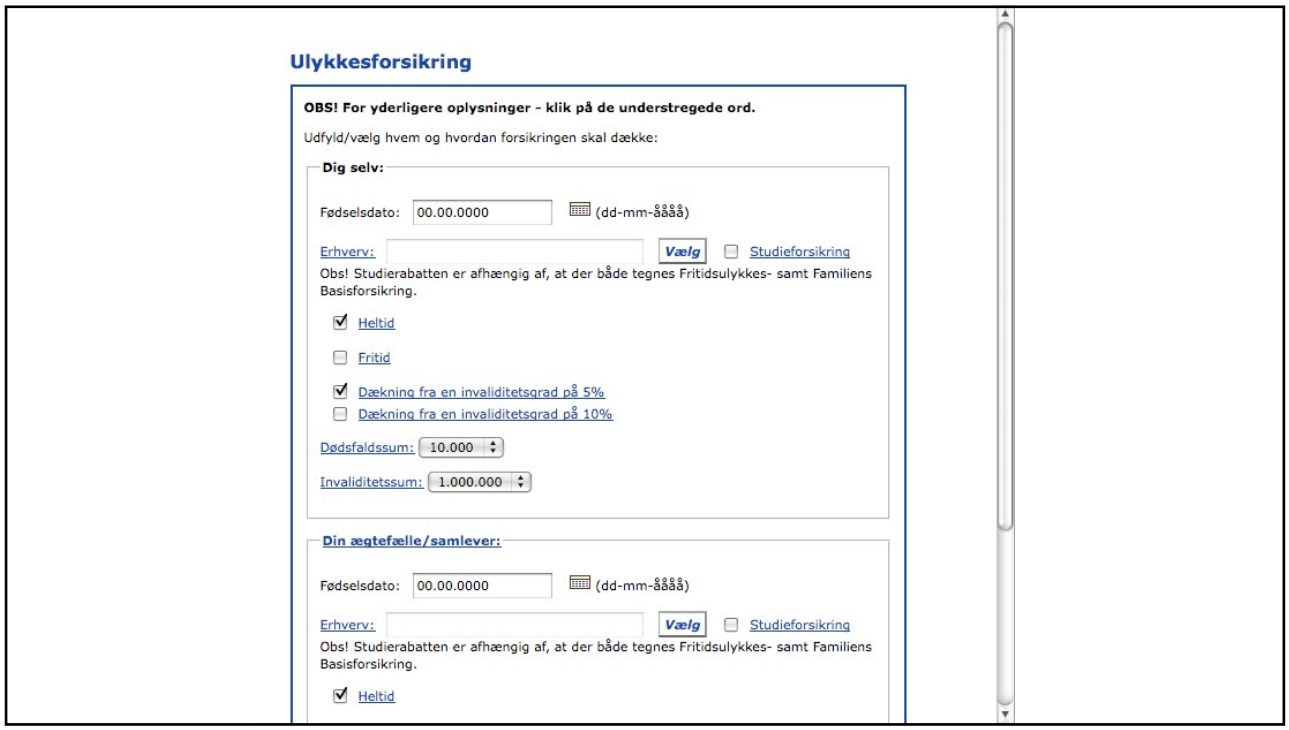

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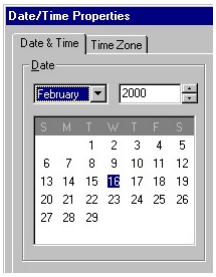
Design af formular-grænseflader

- Logisk og æstetisk organiseret
- Konsistente og forståelige betegnelser
- Nem bevægelse på formularen
- Forebyggelse af fejl, hvor muligt
  - Drop-down menuer
  - Støtte med forslag
  - Vejledende indtastninger



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Spørgsmål?

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Translational distance

- Handler om afstanden mellem menneske og metaphor (p. 233)

- Weak—early video game controllers (Fig. 7.5)
- Medium—touchscreens, multi-touch (Fig. 7.1)
- Strong—data glove, gesturing, manipulating tangible objects (Fig. 7.2)
- Immersive—virtual reality, i.e, oculus rift (Fig. 7.14)

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Touch: natural user interface?

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Touch has its Problems, too

(1) Midas Touch
false inputs problems
removes states that we know from the mouse
examples include: 'hover', 'right click', …

(2) "Fat" Fingers
user interfaces designed for desktops are mostly unusable
they were designed for the mouse (i.e., a single-pixel device)

(3) Occlusion
the mouse does not occlude content on-screen
our fingers and/or hands are constantly in the way

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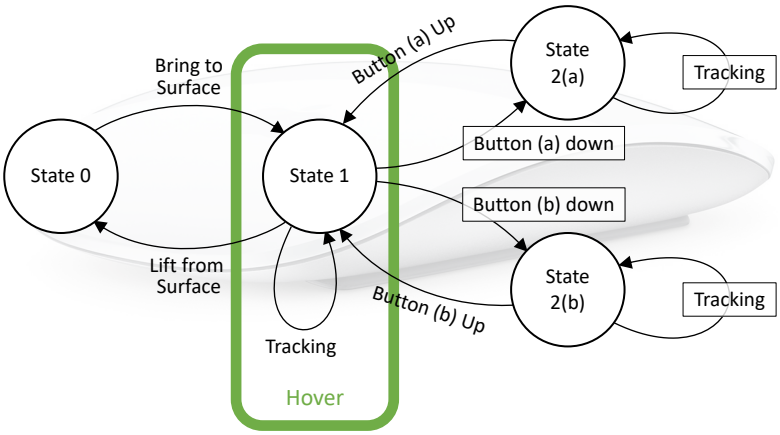
Midas Touch

- MIDAS (GREEK MYTHOLOGY):
- Everything he touched turned into gold – Great, **but** food did so, too!

- TOUCH-ENABLED SURFACES:
- Every touch results in an action! Thus, there's no 'hover' state.

67

State Model of Input: **Mouse**



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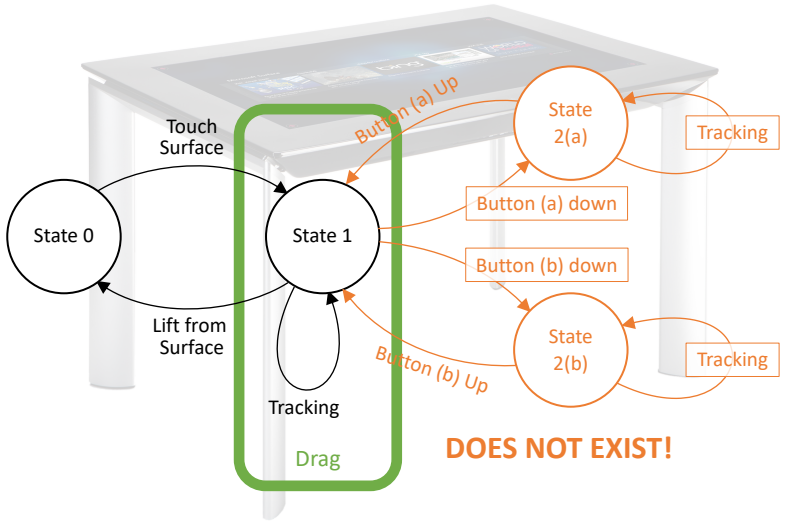
State Model of Input: **Touch**



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Pre-touch sensing

https://dl.acm.org/doi/10.1145/2858036.2858095

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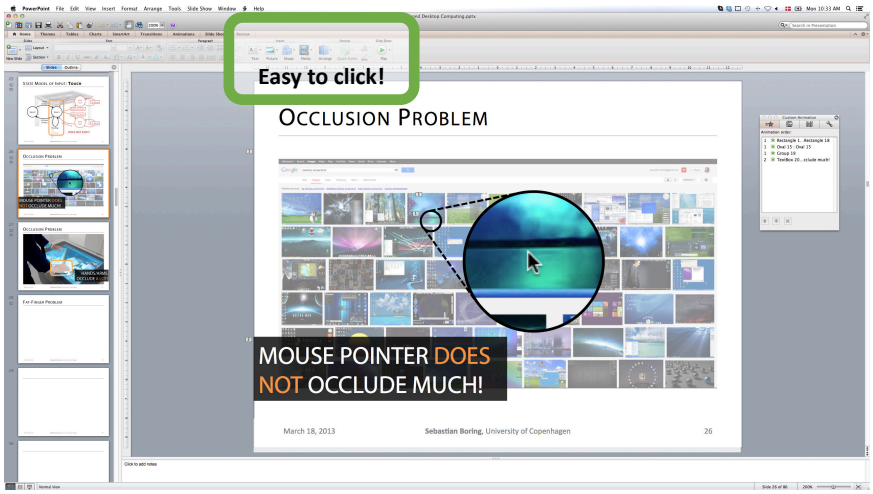
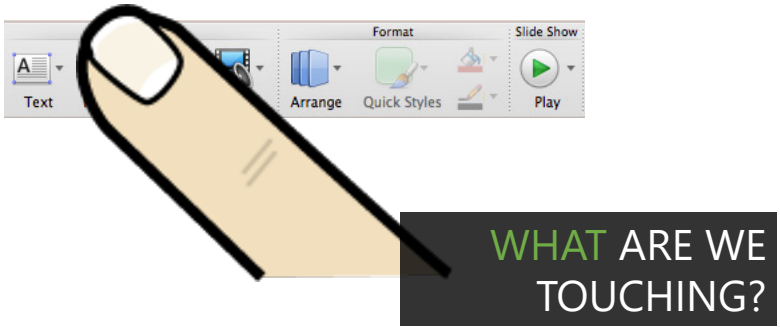
71

Fat-Finger Problem



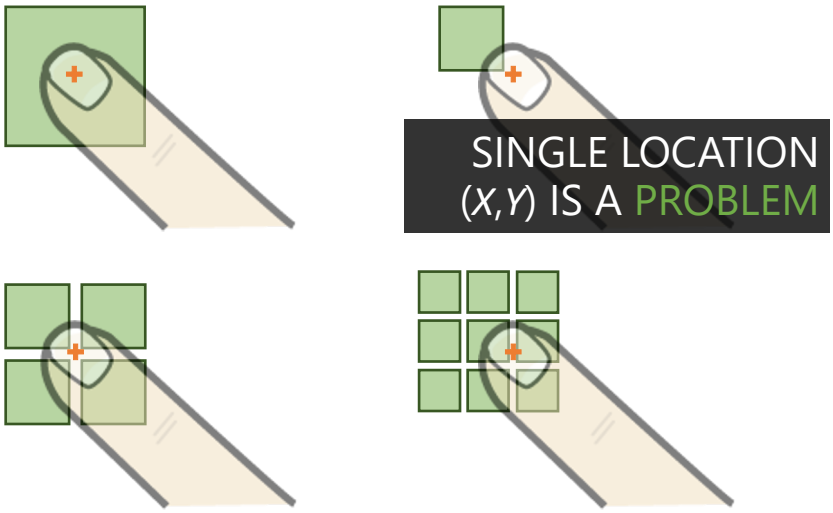
72

Fat-Finger Problem



73

Fat-Finger Problem



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Occlusion Problem

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Occlusion Problem

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What is an experiment?

- "A test under controlled conditions that is made to demonstrate a known truth, examine the validity of a hypothesis, or determine the efficacy of something previously untried", *American Heritage Dictionary*
- Broad use, but usually understood stricter in research methodology

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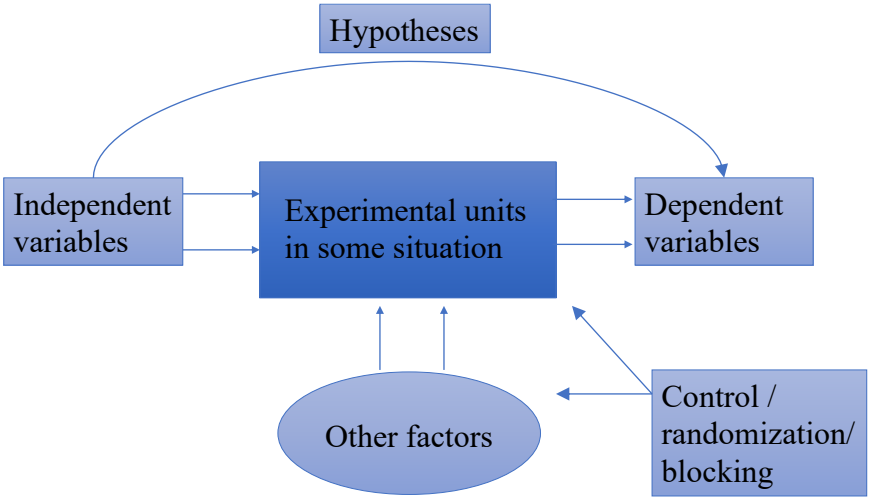
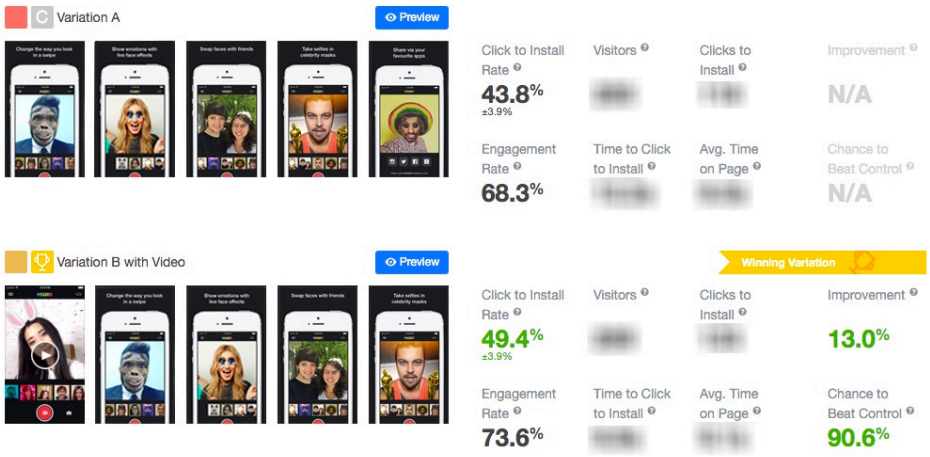
Schematics of experiments



80

A/B experiments



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A/B example

- When you do a Google Search, you have these ads with the links that lead to other websites. Does the colour of the links matter as long as we are getting what we are searching for?
- Google showed 1% of the users a particular blue, another 1% a different blue and so on. Over 40 experiments were ran.
- Look at the click-rate for adds.
- The implication: an additional 200 million dollars in revenue due to this colour change

https://bbharathkumar.medium.com/data-driven-decisions-googles-50-shades-of-blue-experiment-996f01819a97

82

Randomised, controlled trials

- Experiments are well-known in medicine

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How?

84

Formulating hypotheses

- Good hypotheses:
  - Are developed early
  - Define independent and dependent variables
  - May be motivated by theory or literature
  - Are concrete, specific, clear
  - Can be shown wrong
- Hypotheses help think about about one's work

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Selecting independent variables

- Often use control group or baseline technique
- Are they:
  - Similar in all non-essential aspects?
  - Biased? Best possible alternative?
  - Representative?
  - Realistic?
- Use several alternatives

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Selecting dependent variables

- Lots of measures in the literature, use them!
  - Usability (e.g., questionnaires)
  - Psychophysics (e.g., ranking procedures)
  - Graphics/image processing outlets (e.g., *ACM Transactions on Graphics*)
- Objective versus subjective measures

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Validity

- Two major types (see Shadish et al. 2002):
  - Internal validity. Showing that the changes in the independent variable cause the observed values of the dependent variable. Ruling out rival hypotheses.
  - External validity. Are findings repeatable? Do findings generalize across settings and populations?

Shadish, W.R., Thomas D. Cook, and Donald T. Campbell, D.T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston: Houghton-Mifflin

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Dependent variables

Usability objective	*Effectiveness measures*	*Efficiency measures*	*Satisfaction measures*
Overall usability	Percentage of tasks successfully completed Percentage of users successfully completing tasks	Time to complete a task Time spent on non-productive actions	Rating scale for satisfaction Frequency of use if this is voluntary (after system is implemented)
Meets needs of trained or experienced users	Percentage of advanced tasks completed Percentage of relevant functions used	Time taken to complete tasks relative to minimum realistic time	Rating scale for satisfaction with advanced features
Meets needs for walk-up and use	Percentage of tasks completed successfully at first attempt	Time taken on first attempt to complete task Time spent on help functions	Rate of voluntary use (after system is implemented)
Meets needs for infrequent or intermittent use	Percentage of tasks completed successfully after a specified period of non-use	Time spent re-learning functions Number of persistent errors	Frequency of reuse (after system is implemented)
Learnability	Number of functions learned Percentage of users who manage to learn to a pre-specified criterion	Time spent on help functions Time to learn to criterion	Rating scale for ease of learning

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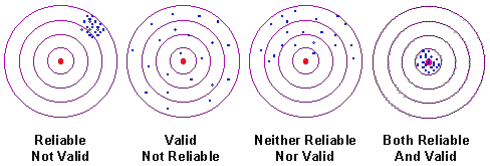
Reliability

- Reliability is the consistency of a measuring instrument or among measurements
- Reliability concerns for instance agreement among observers, similar measures at other times, different ways of measuring



90

Finding a research design

- Experimental units may be people, but could also be images, samples of sound, videos, etc.
  - How to assign experimental units to levels of the independent variable?
  - Main concerns are realism and generalizability
- Dealing with the ”other factors”---when in doubt, randomize, control, or block

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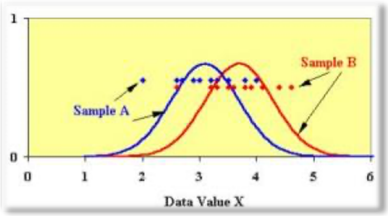
Statistics

- Statistical conclusion validity
- Do t-tests or analysis of variance (e.g., in SAS, SPSS, R)
- There are no such things as:
  - Statistics that take away concerns about validity and reliability
  - Significance tests that show the size of an effect or its practical significance
  - Eyeball statistics
- Variability is your enemy



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Summary of Doing Experiments

- Before doing an experiment:
  - Think about validity and reliability
  - Design so as to rule out alternative hypotheses
  - Consider treatments and measures
- While doing an experiment:
  - Minimize variability
  - Minimize experimenter's influence
- After doing an experiment:
  - Do statistical analysis
  - Discuss ex postfacto validity and sources of error

93

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A worked example

- ”It is generally taken for granted that HDR [high-dynamic range] images look better than LDR ones. We put this to test”

Akyüz, A. et al. (2007) ”Do HDR Displays Support LDR Content? A Psychophysical Evaluation”, *ACM Transactions on Graphics*, 26(3), Article 38.

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A worked example II

- Levels of independent variable:
  - HDR capture, HDR display (hdr)
  - HDR capture, LDR display (bila, hist, phot)
  - LDR capture, LDR display (subj, obj)
- 10 scenes

Figure 1: *The test scenes used in our experiment.*

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A worked example III

- Show 6 images in random order for two seconds each, then presentation of all images in a 2*3 grid
- ”Please indicate which image looks best to you”, no time limit
- Dependent measure is ranking of images
- 22 so-called naïve participants, gender balanced

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A worked example IV

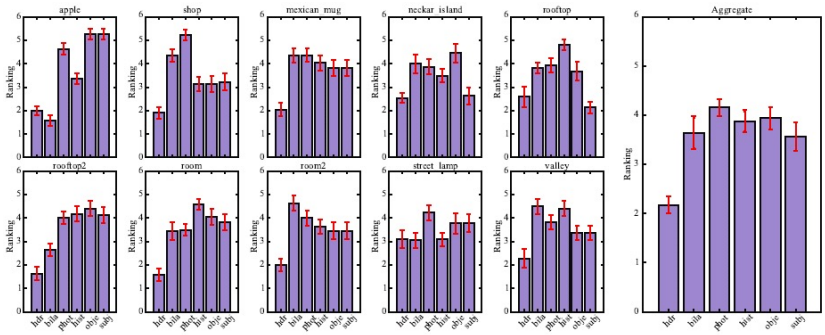

Figure 2: *Mean rankings from Experiment One.* hdr *represents the physically correct HDR image;* bila, phot, hist *represent the bilateral filtering, photographic, and histogram adjustment operators respectively, and* obje *and* subj *represent the objective- and subjective-best images. Left: rankings for the individual scenes. Right: Aggregate result across all scenes. Note that a lower ranking indicates a higher preference. Error bars denote* ± 1 *standard error.*

- Analysis of variance shows $F(5,105) = 20.132$, $p < 0.001$

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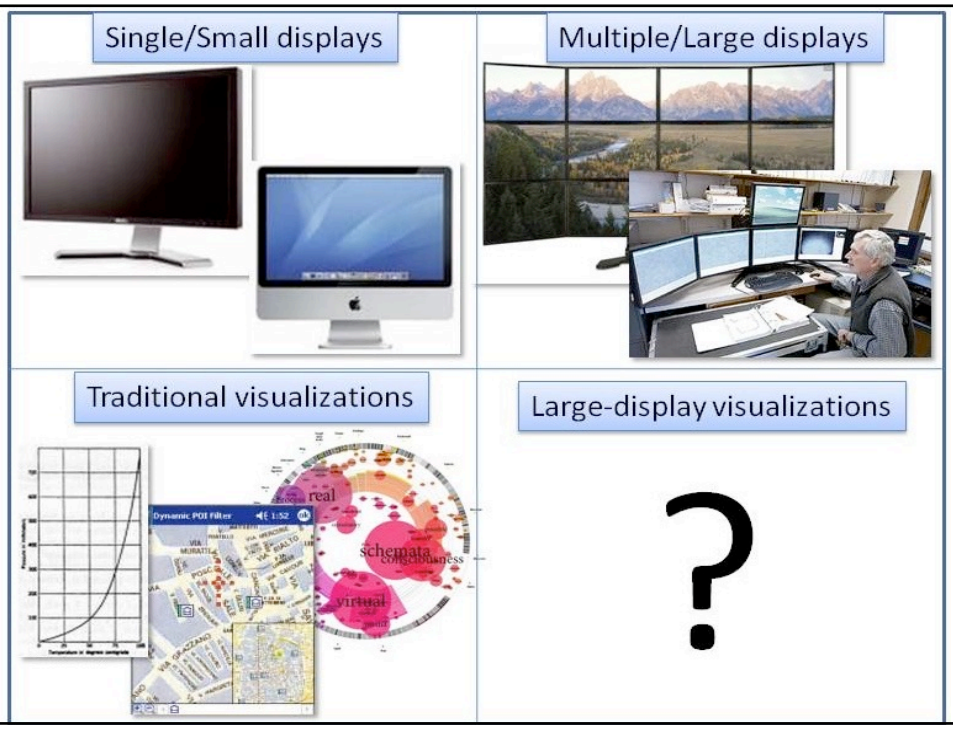
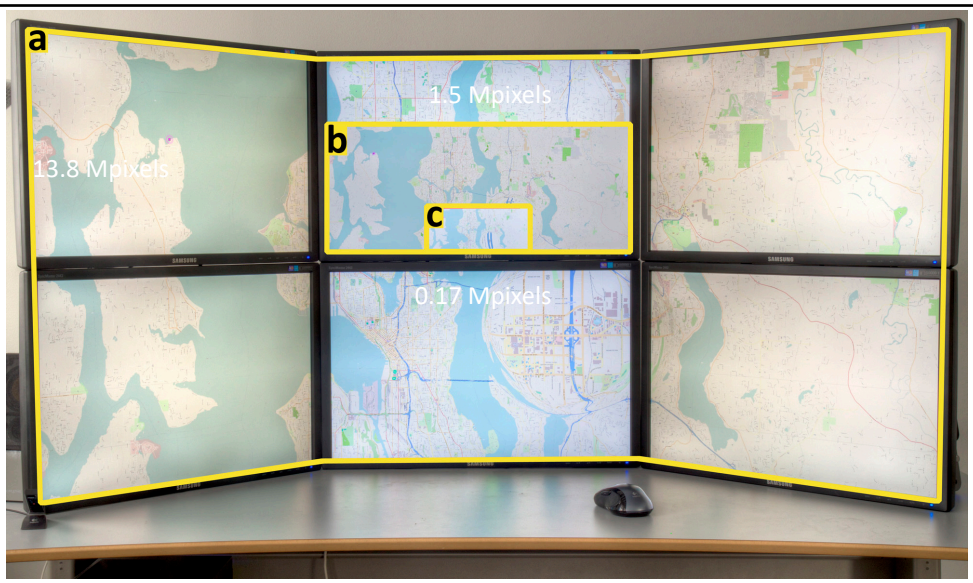
100

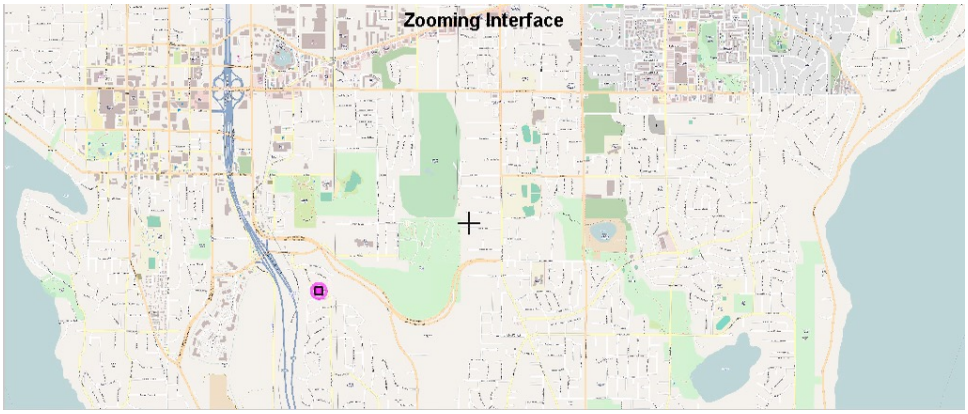


101



Jakobsen & Hornbæk, CHI 2011

102


Zooming Interface

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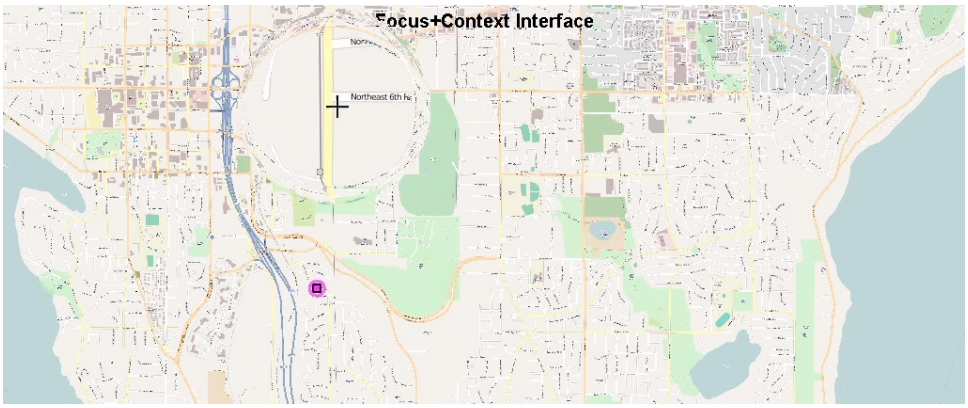
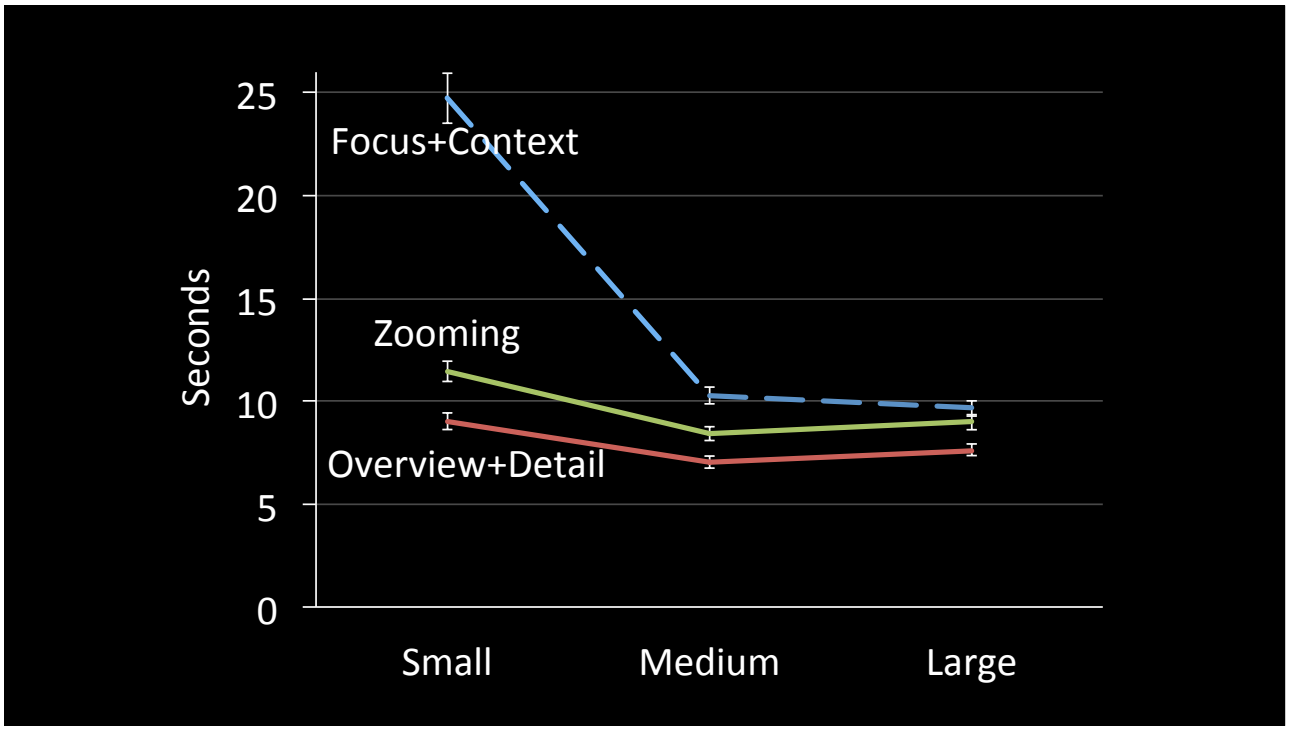
Overview+Detail Interface
Main Street
Southeast 1st Street
Southeast 2nd Street
Southeast 3rd Place
Southeast 5th Street
140th Avenue Southeast
Sammamish High School
Southeast 4th Street
Southeast 6th Street

104

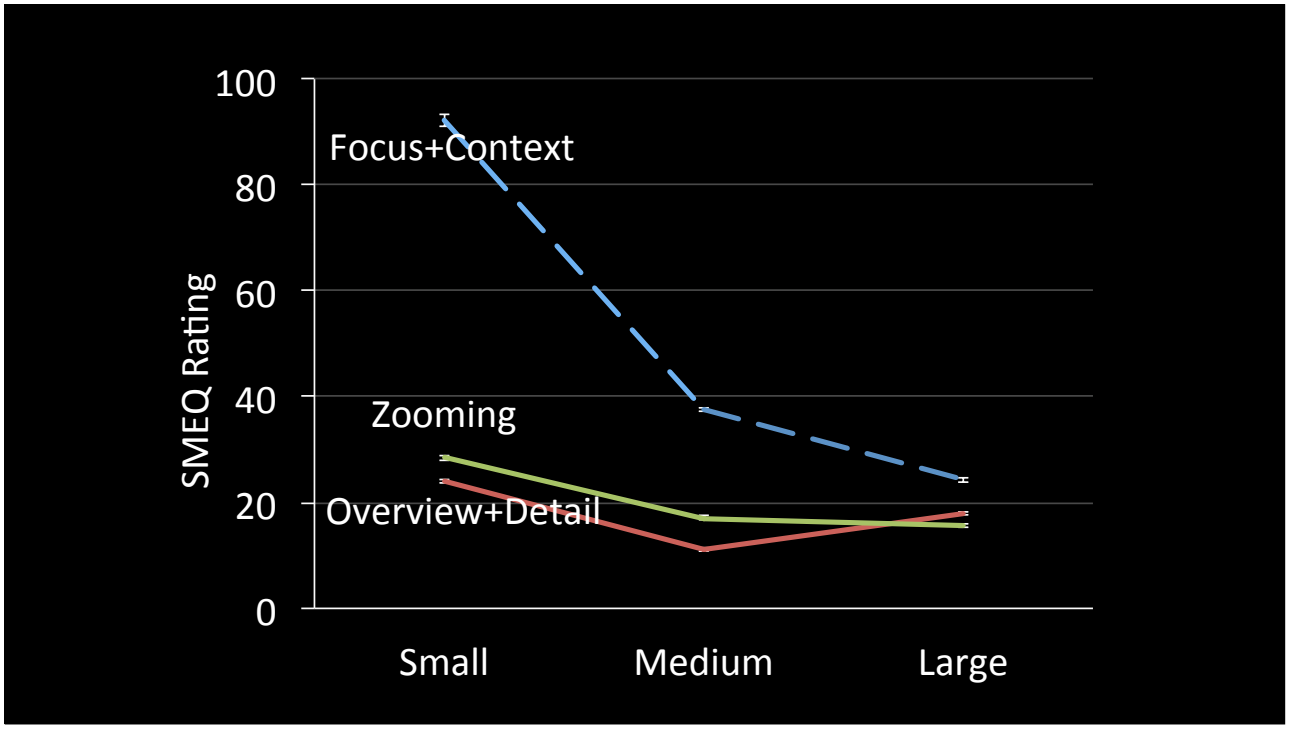


105

106


25
20
15
10
5
0
Seconds
Focus+Context
Zooming
Overview+Detail
Small
Medium
Large

107


100
80
60
40
20
0
SMEQ Rating
Focus+Context
Zooming
Overview+Detail
Small
Medium
Large

108

Spørgsmål?

109

Det har I fået med

- Der er fem slags grænseflader, hver med deres fordele og ulemper
  - GUI, menu, kommandolinie, formular
  - Vi kan gøre noget ved mange af ulemperne
  - Post-wimp kommer på onsdag
- Forstå udfordringerne ved direkte manipulation og menuer

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