Building User Interfaces
Mobile Computing
IAT351

Week 9 Lecture 1

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Lyn Bartram

lyn@sfu.ca

SFU

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

In 1954 Harold S. Osborne, the recently retired chief engineer for AT&T, made the following prediction (quoted in Conly 1954, p. 88):

> *Lets say that in the ultimate, whenever a baby is born anywhere in the world he [sic] is given at birth a number that will be his telephone number for life. As soon as he can talk, he is given a watchlike device with 10 little buttons on one side and a screen on the other [see Figure 8.1]. Thus equipped, at any time when he wishes to talk with anyone in the world, he will pull out the device and punch on the keys the number of his friend. Then, turning the device over, he will hear the voice of his friend and see his face on the screen, in color and in three dimensions. If he does not see him and hear him, he will know that the friend is dead.*

Sony Walkman

Car phone

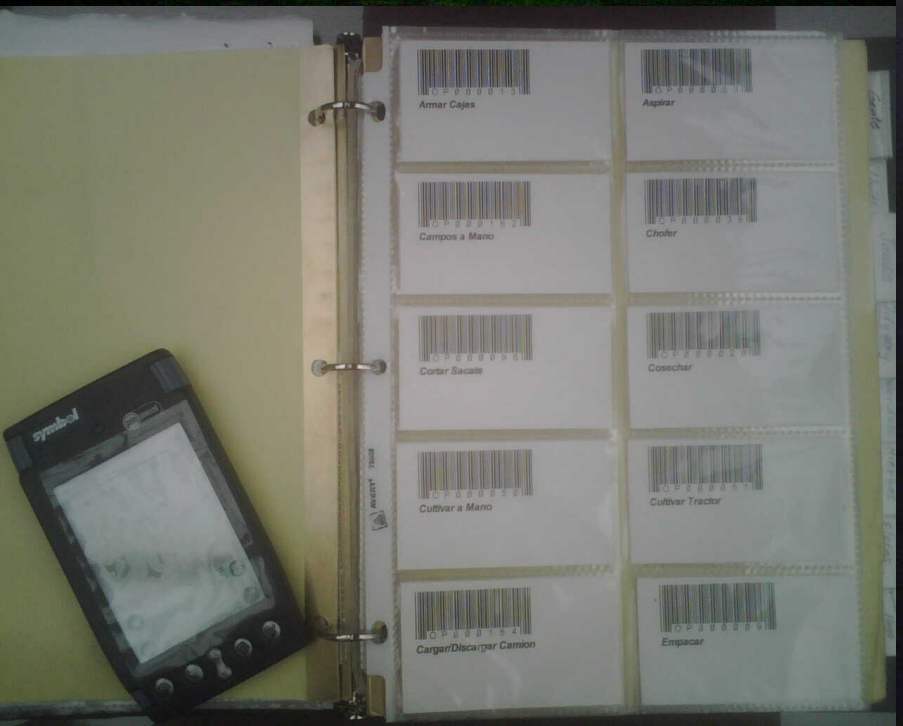

cartel
BLUE CARPHONE
VOICE DIAL
PVT
STORE
EDIT
SEND
PAD
END
cartel

Mobile connectivity

- 75% of the world population have access to mobile phones
- 2000 – 1 billion mobile subscriptions
- 2012 – 6 billion
  - 5 billion in developing countries
- 2011 - > 30 billion apps downloaded
- Most people use a few apps most of the time

- What should we be making and how?


Like we have been doing
for 40 years?



What about the new capabilities of multimedia and communication?

Malaysia
Integrated Compass. Why?

The Very Nature of Information Has Changed

Information was…

- Scarce
- Expensive
- Shaped and controlled by elites
- Designed for one-way, mass consumption
- Slow moving
- External to our worlds

Information is…

- All around us
- Cheap or free
- Shaped and controlled by consumers and networks
- Designed for sharing, participation and feedback
- Immediate
- Embedded in our worlds

Information is Woven Into Our Lives

Mobile is the needle, Social Networks are the thread

Mobile…

Moves information with us

Makes information accessible ANYTIME and ANYWHERE

Puts information at our fingertips

Magnifies the demand for timely information

Makes information location-sensitive

Social Networks…

Surround us with information through our many connections

Bring us information from multiple, varied sources

Provide instant feedback, meaning and context

Allow us to shape and create information ourselves and amplify others' messages

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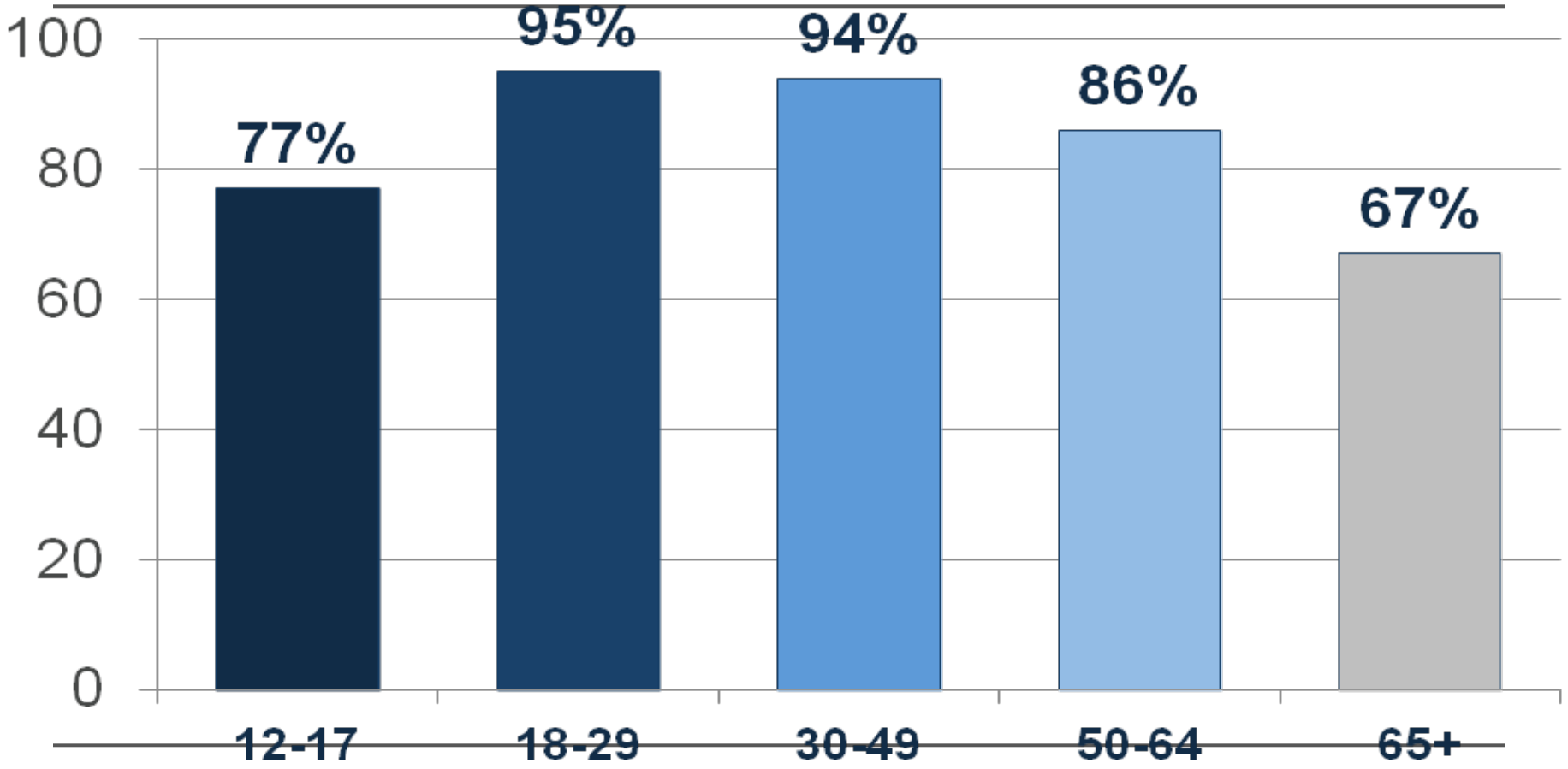
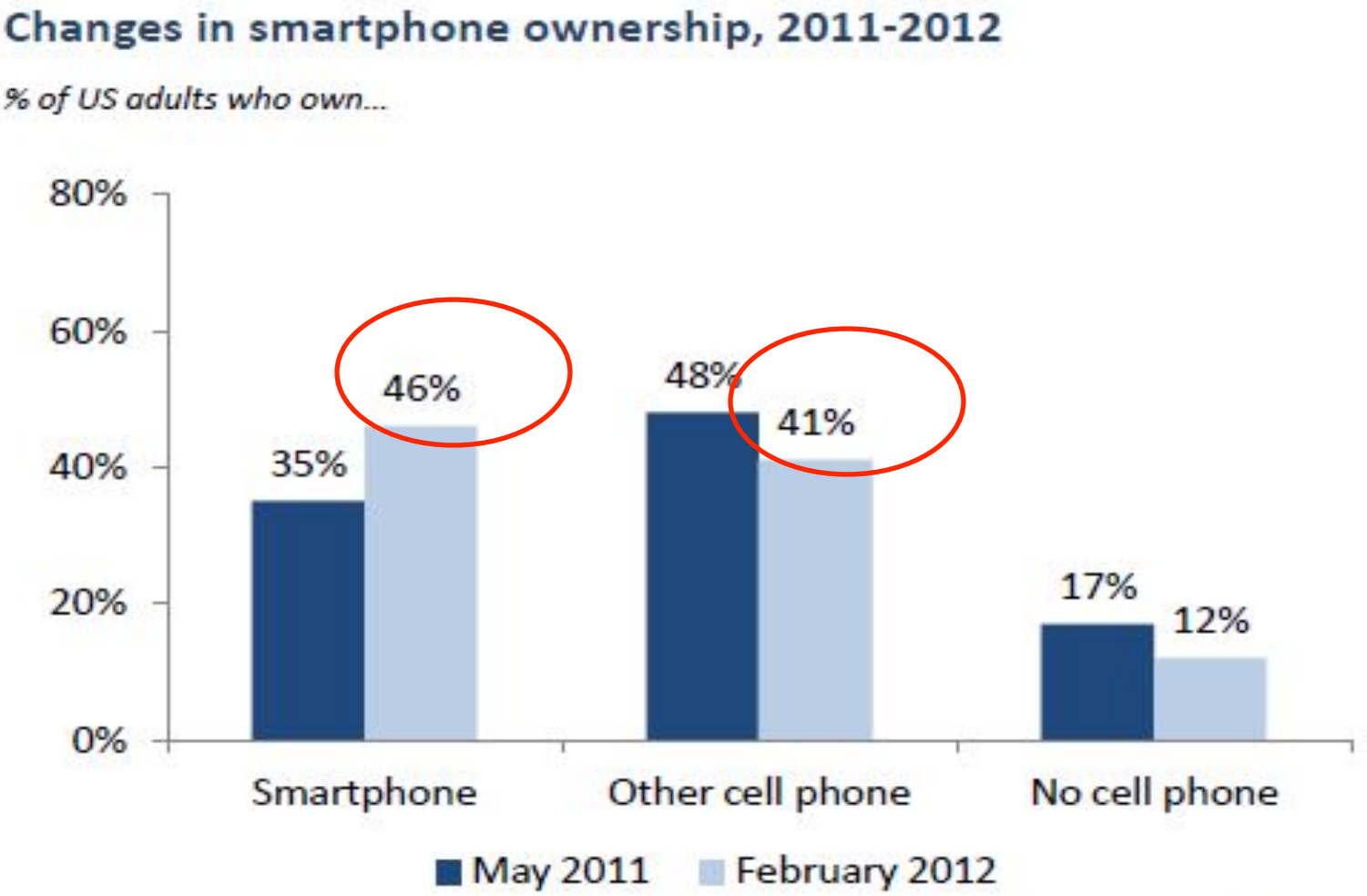
Mobile is the Needle: 88% of US Adults Have a Cell Phone

% in each age group who have a cell phone



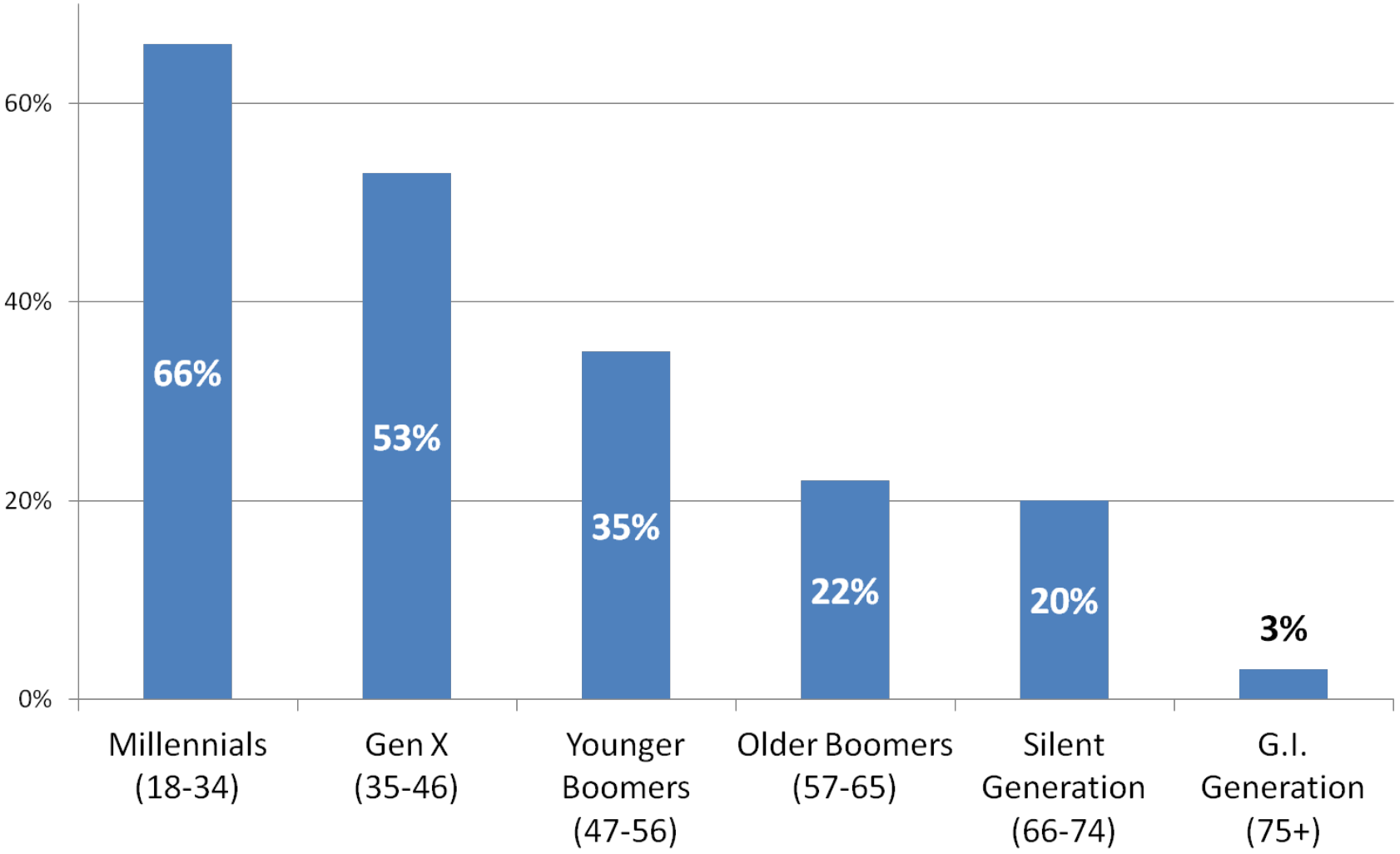
Teen data July 2011 Adult data Feb 2012

Smartphone tipping point -- 46%

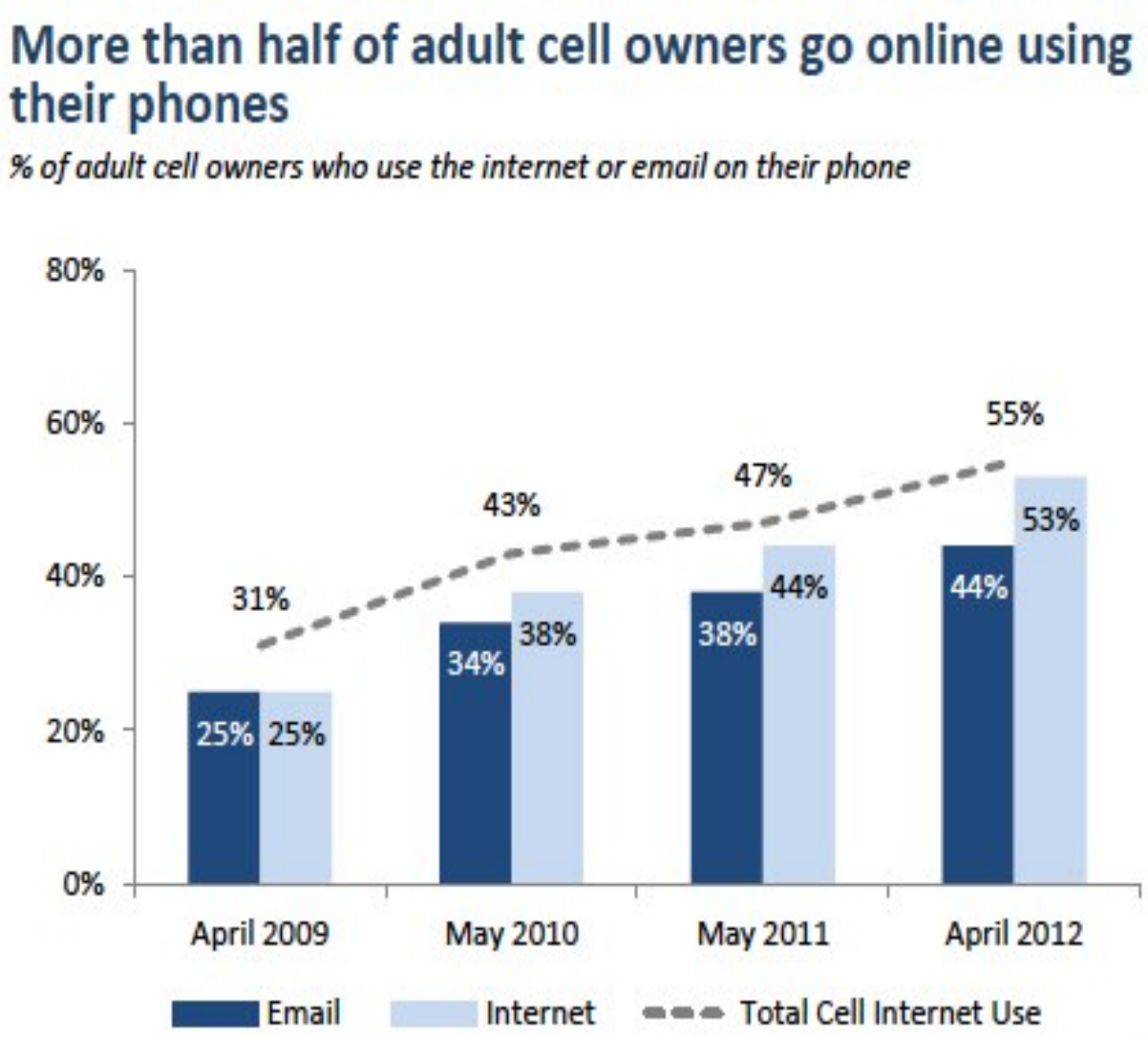


Source: Pew Research Center's Internet & American Life Project April 26-May 22, 2011 and January 20-February 19, 2012 tracking surveys. For 2011 data, n=2,277 adults ages 18 and older, including 755 interviews conducted on respondent's cell phone. For 2012 data, n=2,253 adults and survey includes 901 cell phone interviews. Both 2011 and 2012 data include Spanish-language interviews.

Smartphones – 46%



An internet device

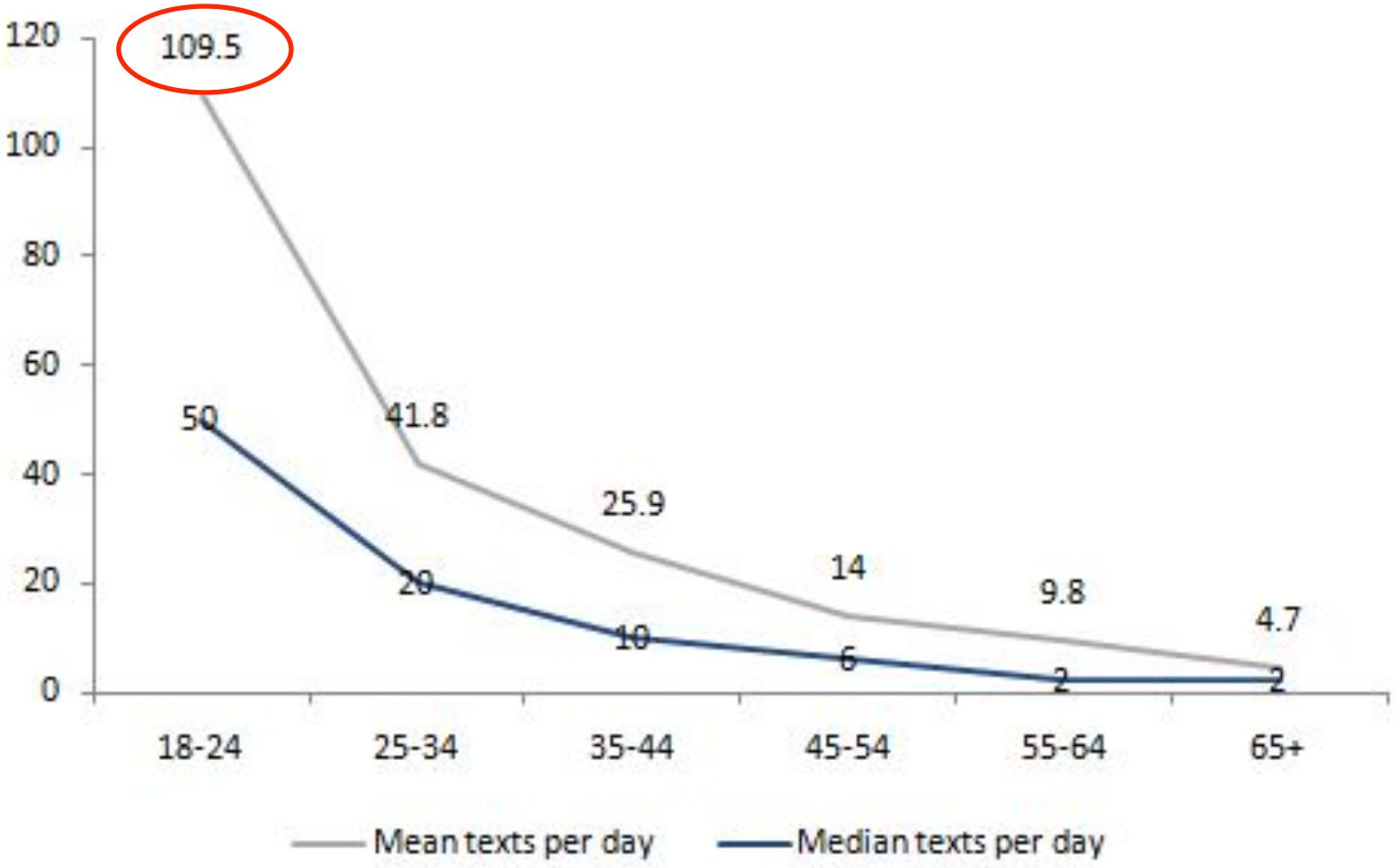


17% use mobile as primary or exclusive online connection device

- 45% of those ages 18-29
- 51% of blacks
- 42% of Latinos
- 38% of those in HH earning less than $50K

Number of texts sent/received per day, by age group

Based on adults who use text messaging on their cell phones



Source: The Pew Research Center's Internet & American Life Project, April 26 – May 22, 2011 Spring Tracking Survey. n=2,277 adult internet users ages 18 and older, including 755 cell phone interviews. Interviews were conducted in English and Spanish.

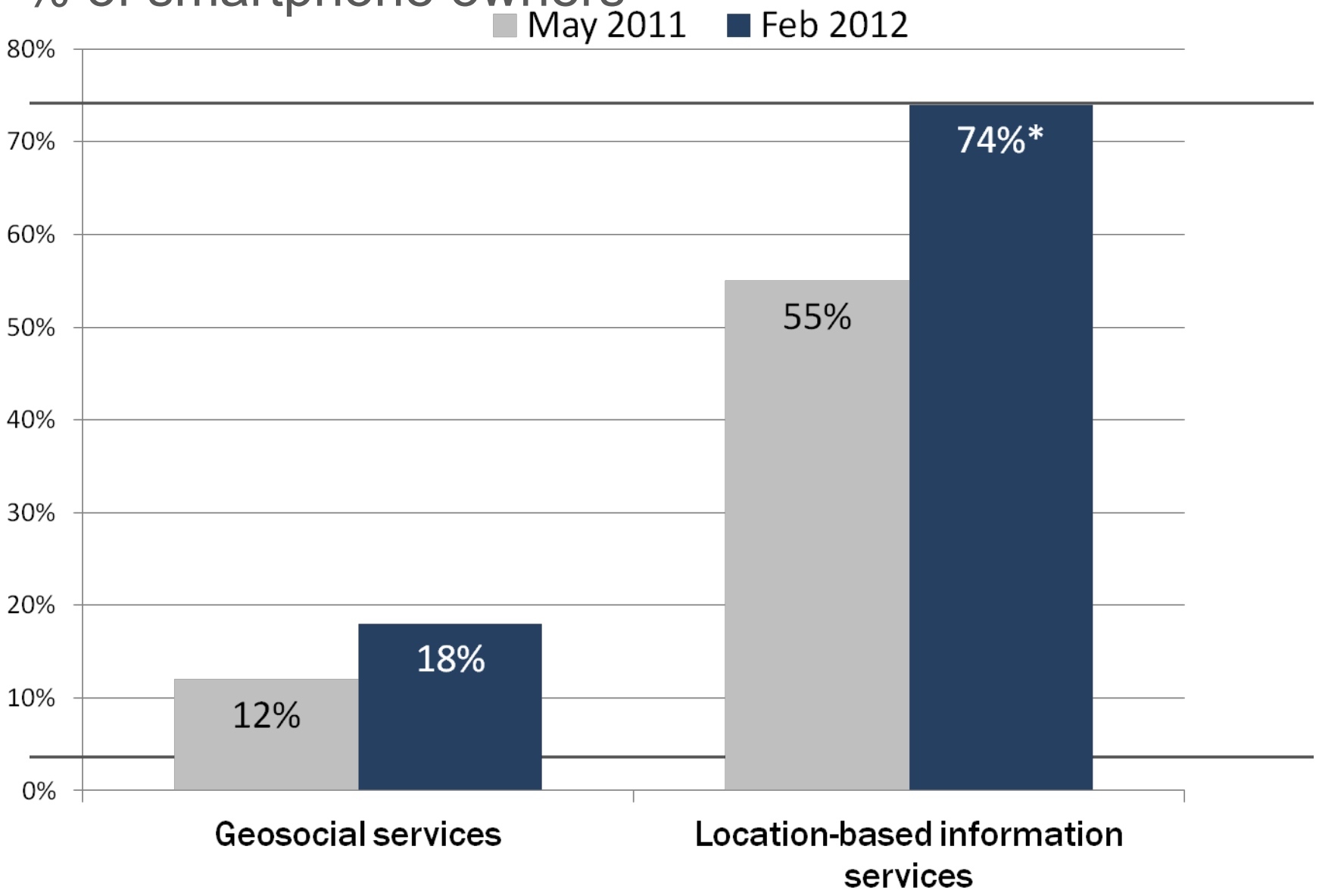
Cell phones as connecting tools

% of cell owners

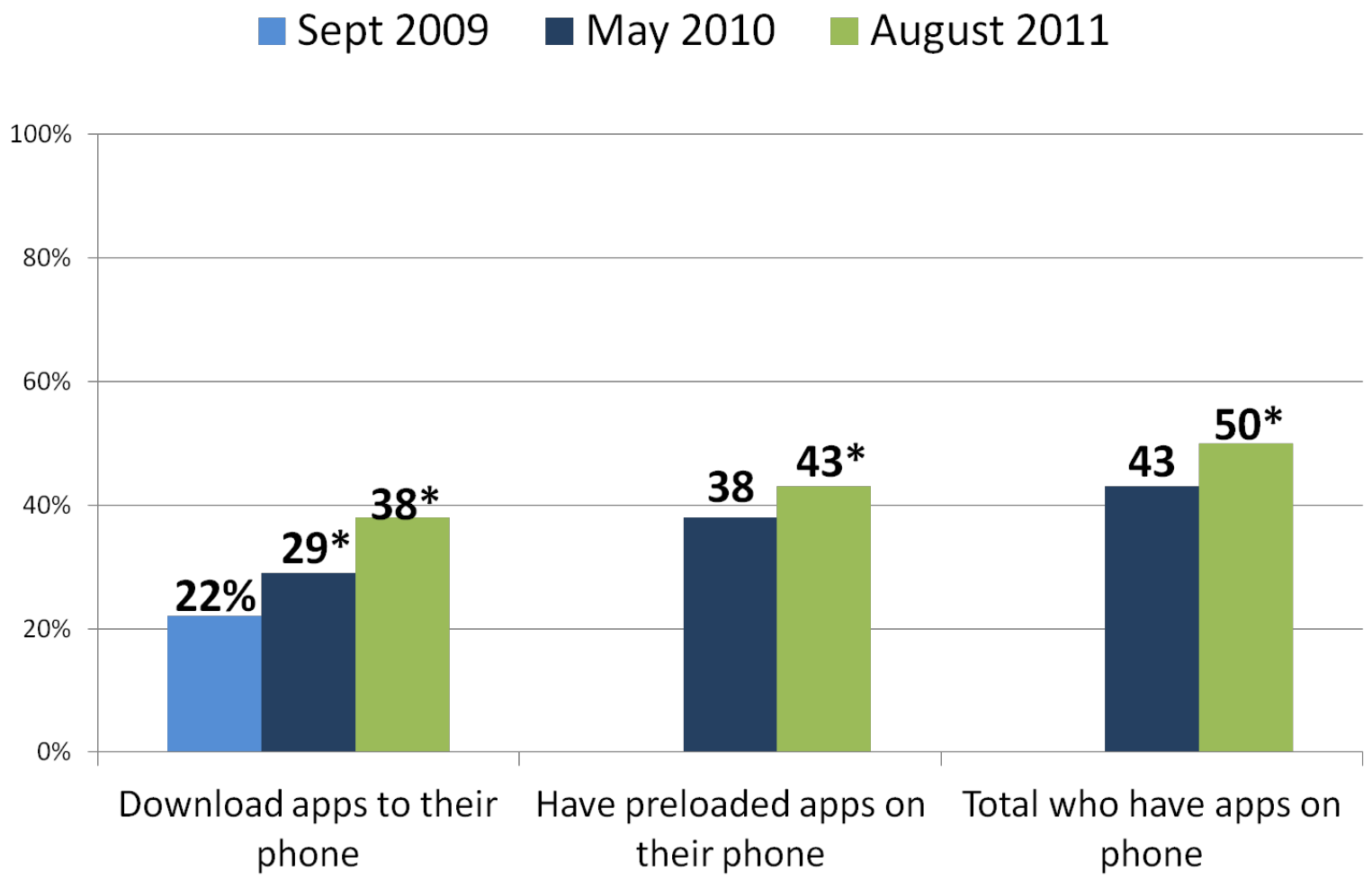
- 64% send photo or video
  - Post video 25%
- 55% access social net. site
- 30% watch a video
- 11% have purchased a product
- 11% charitable donation by text
- 60% (of Twitter users) access Twitter

Location services

% of smartphone owners

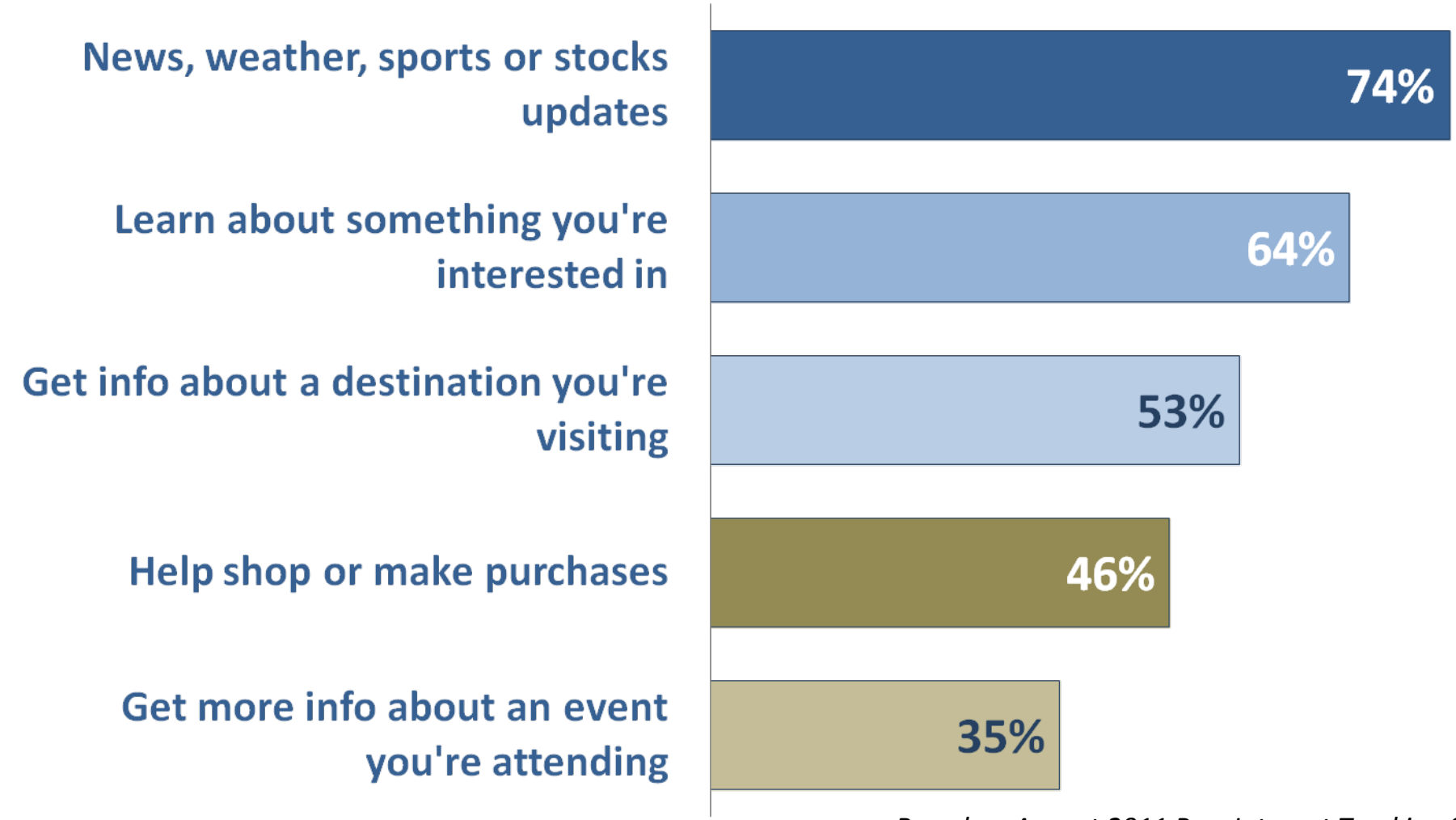


Apps – 50% of adults



Apps: From Superhighway to Bypass

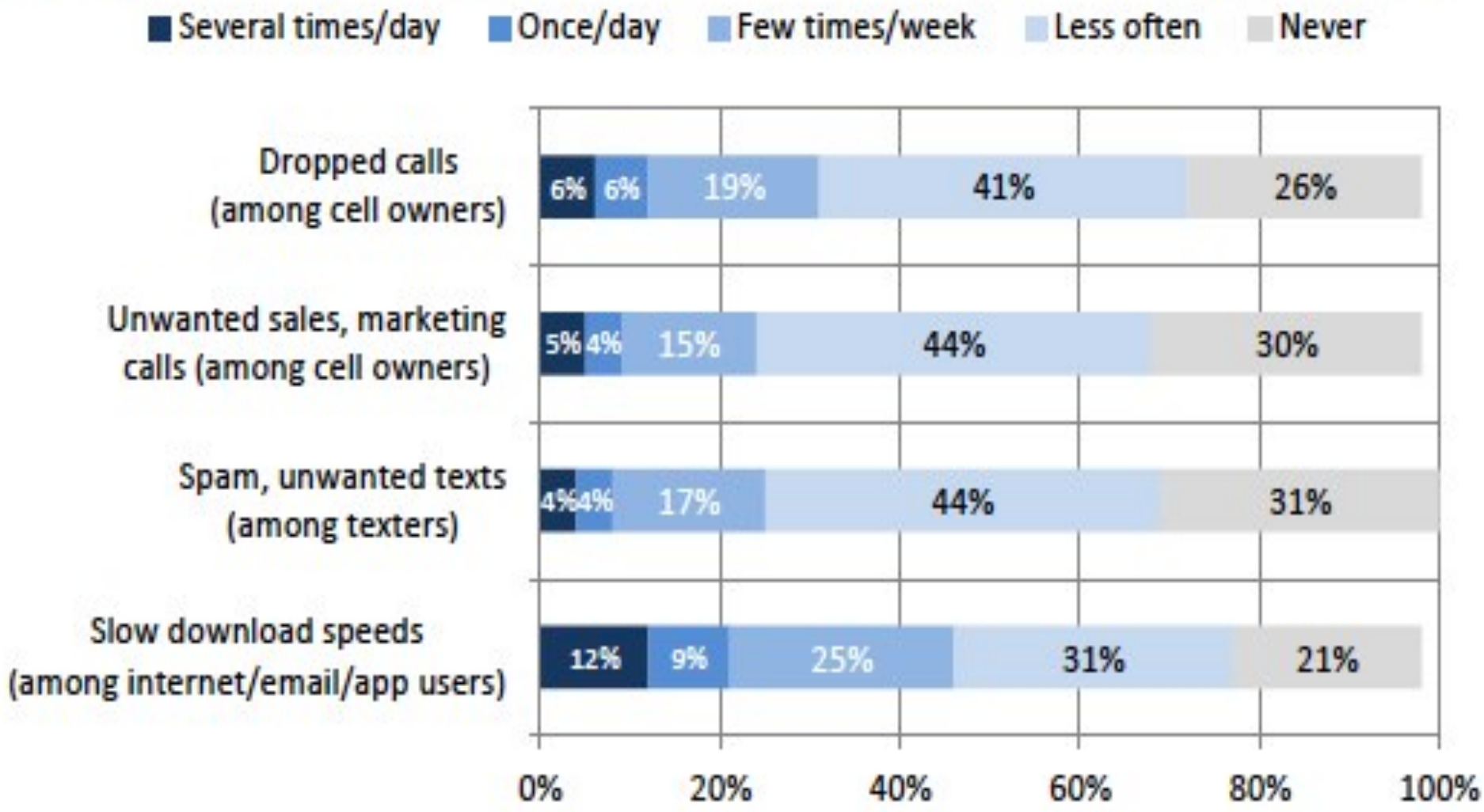
Apps provide direct connections to information



Based on August 2011 Pew Internet Tracking Survey

How often cell users experience problems with their phones

Among Americans ages 18+ who are cell owners, texters or cell internet/email/app users respectively



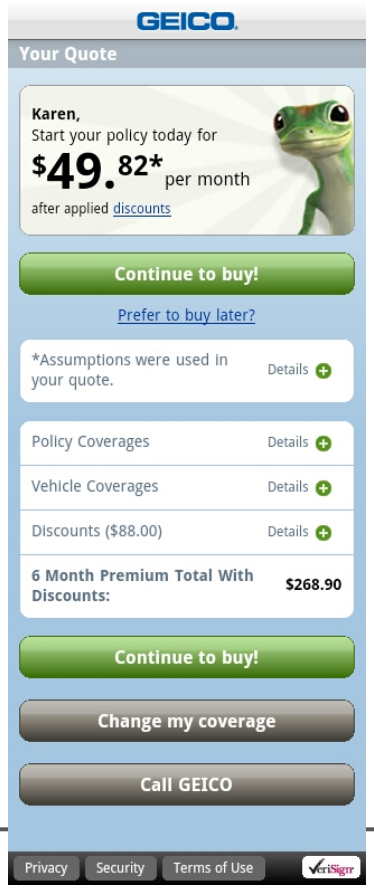
Cell phone uses

% of cell users have done these things in past 30 days

- Coordinate a meeting or get-together – 41%
- Solve an unexpected problem that they or someone else had encountered – 35%
- Decide whether to visit a business, such as a restaurant – 30%
- Find information to help settle an argument they were having – 27%
- Look up a score of a sporting event – 23%
- Get up-to-the-minute traffic or public transit information to find the fastest way to get somewhere – 20%
- Get help in an emergency situation – 19%

UX

User interface considerations on mobile are radically different than on the desktop.



Hall of Fame or Hall of Shame?

- Windows Mobile home screen
- What will I use this phone for other than as a phone?

Hall of Shame!

- Too many clicks to do anything
- Calendar
  - Start
  - Scroll through icons to find the one I want
  - Maybe less if used it recently (then at top, but still several clicks)

A brief story

Use case: Lyn is driving to a new place for a job interview (SFU Surrey). She doesn't know Surrey …

BUT

She has a new voice-activated GPS that will help!

- "Voice command" -> "Find place" -> "Simon Fraser University Surrey"
  - Location found, "*Would you like to begin route?*" "yes"
  - I want to save it to Favorites. No favorites that I can see.
- "voice command" -> "recently found"->selected by touch (driving)
- "*would you like to begin route or add to current route*"?

NO.

  - "back". "back". "exit". ….
- Pull over and stab screen wildly


3.7 km
Old Yale Rd
99A
128 St
Arrive In
4.6 km
Arrival
13:47
Elevation
0 m
Speed
0 km/h
GARMIN

connectivity

We are not stationary when we use mobile.

So why are we designing from the inside of our quiet well-connected offices with fully charged batteries?

Adapted from Mobile Testing, Karen Johnson, 2012

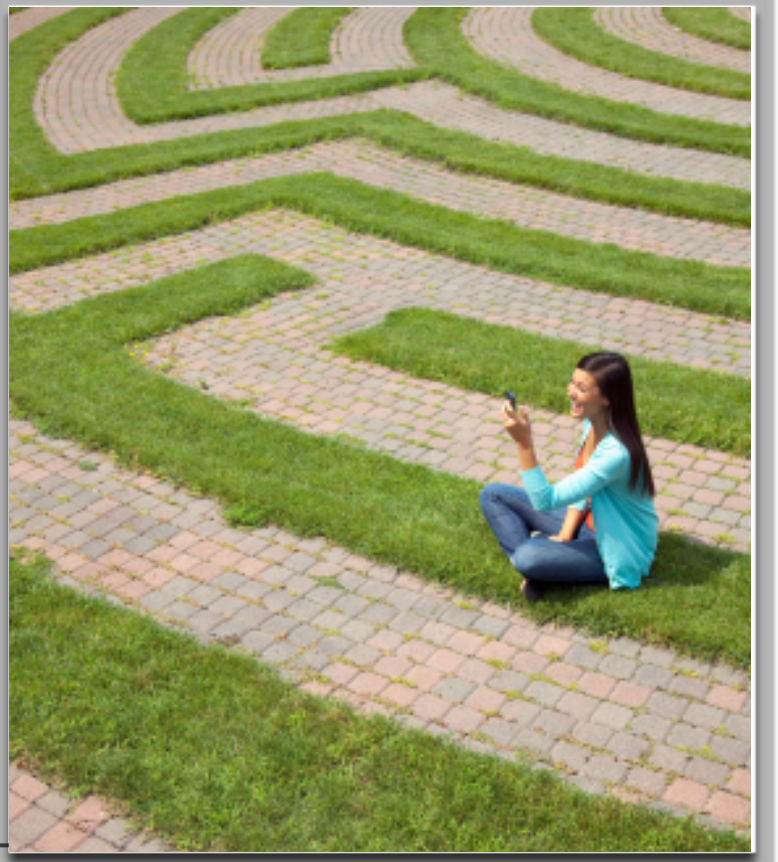
Quick and busy

- We are not engaged in a long, purposeful task when we are mobile
- The app is not the main thing we are doing

- Why are we building user interfaces that assumed focused, prolonged attention?

How we get there

The navigational path users take on mobile is not the same as on a desktop.



Mobile Testing, Karen Johnson, 2012

Navigation

We are still navigating sites and apps but rarely do we have a visual cookie crumb trail.

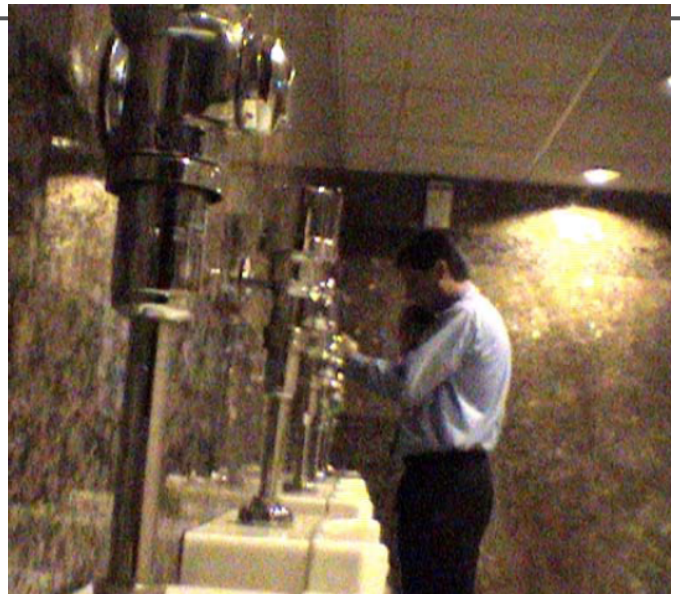
- Rotate
- Pinch/zoom
- Accelerometer
- Vertical/horizontal
- Paging forward & back

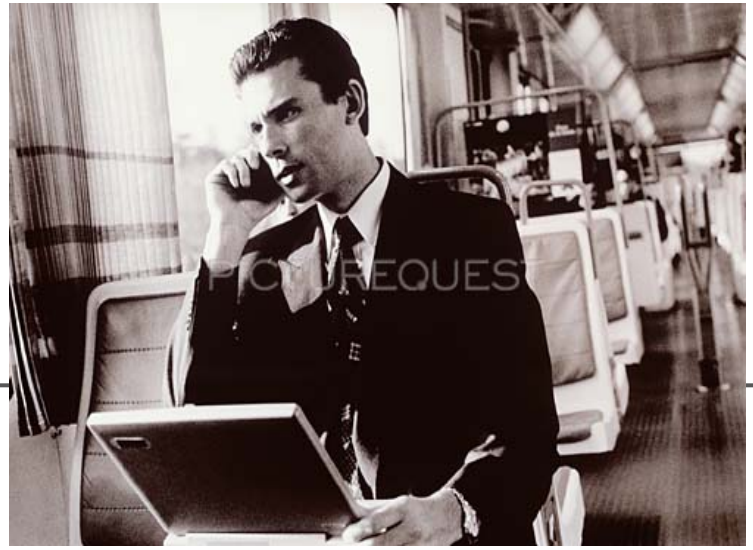
Mobile Testing, Karen Johnson, 2012

Key Challenges in Making Mobile Applications

- Limited Physical Resources
  - CPU, Memory, Screen Size, Input Devices, Battery Life etc
- Diversified Context of Use
- Different Activities
- Limited Attention

Diversified Context of Use





Different Activities

- People use small-screen devices for different activities than desktops; don't assume you understand these activities already

Limited Attention

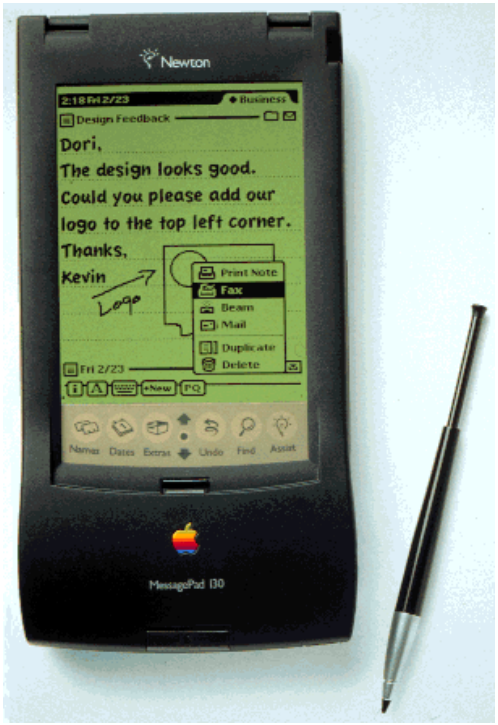
- Don't assume your applications have people's full attention; they're doing something else while using your device or app.

One Sentence Summary

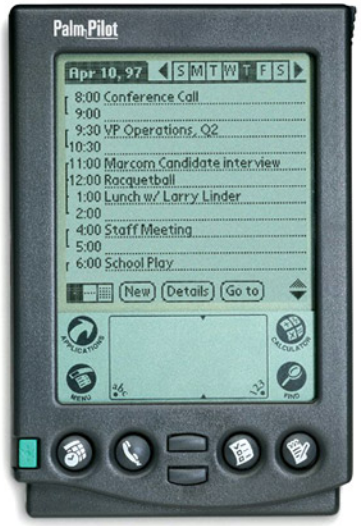
- **There is no silver bullet in designing mobile applications, but there is one sentence you should remember -**

Mobilize, Don't Miniaturize !

Mobile design evolving rapidly!



Newton



Palm Pilot

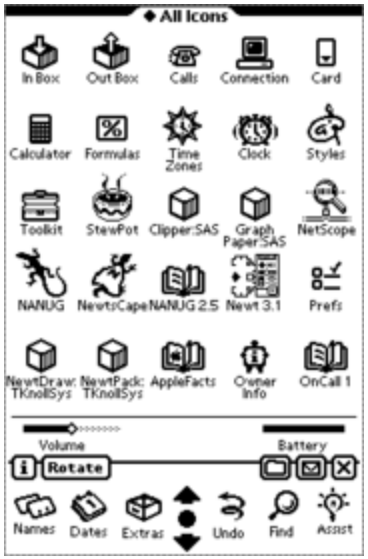
iPhone

1/20/2009

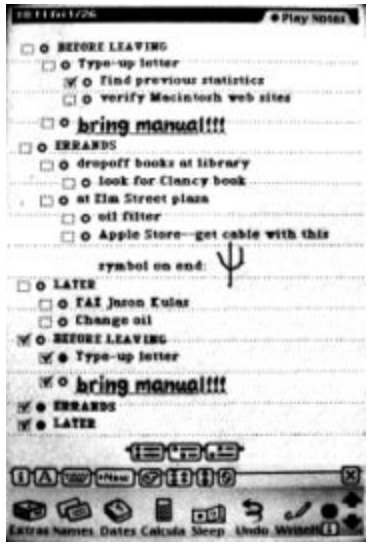
Source: Apple, Palm

There was the Newton ...

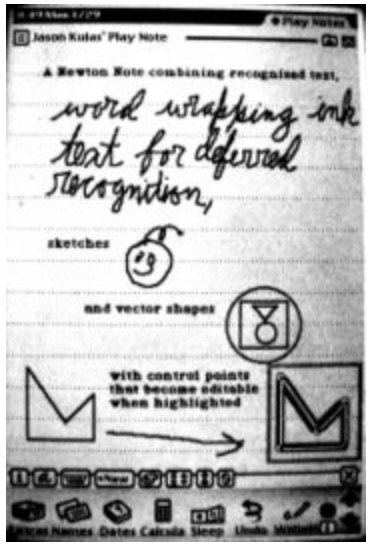
Apple Newton MessagePad



The Newton OS GUI



Photograph of screen displaying Checklist, some bullet points checked and/or "collapsed"



Newton screen displaying a Note with text, "ink text", a sketch, & vectorized shapes

Source: The Simpsons, Wikipedia

The Newton had problems

Design Issues

- Recognition
  - relied on it too much, didn't work well enough
- Physical size
  - too big
- Connectivity
  - not much

"Hey, Take a memo on your Newton"

"Beat Up Martin"

"Baahh!"

The Original Apple Newton's handwriting recognition was made light of in The Simpsons episode *Lisa on Ice*

Source: The Simpsons, Wikipedia

The Palm Pilot Improved...

Design Wins

- Recognition: simple graffiti
- Physical size: fits in the front pocket
- Connectivity: easy sync

Jeff Hawkins, Palm

Pocket size

Graffiti

HotSync

Palm OS

Rob Haitani, Palm OS

[Designs] what should be most prominent based on frequency of use, and makes most often used interactions accessible in a single step.

Source: Palm 1000 Retrospective, Palm V, Rob Haitani in Moggridge, Designing Interactions. Ch. 3. From the Desk to the Palm. http://www.designinginteractions.com/interviews/RobHaitani

Prototyping the Palm
hardware, form factor, software

What makes mobile design exciting?

Many Design Choices

- Think different from GUI/Web
- Swiss army vs. dedicated
- Pen/speech/gesture modalities
- Integrate with other tasks
- Social apps

Always in your pocket

Mobile Usage Context

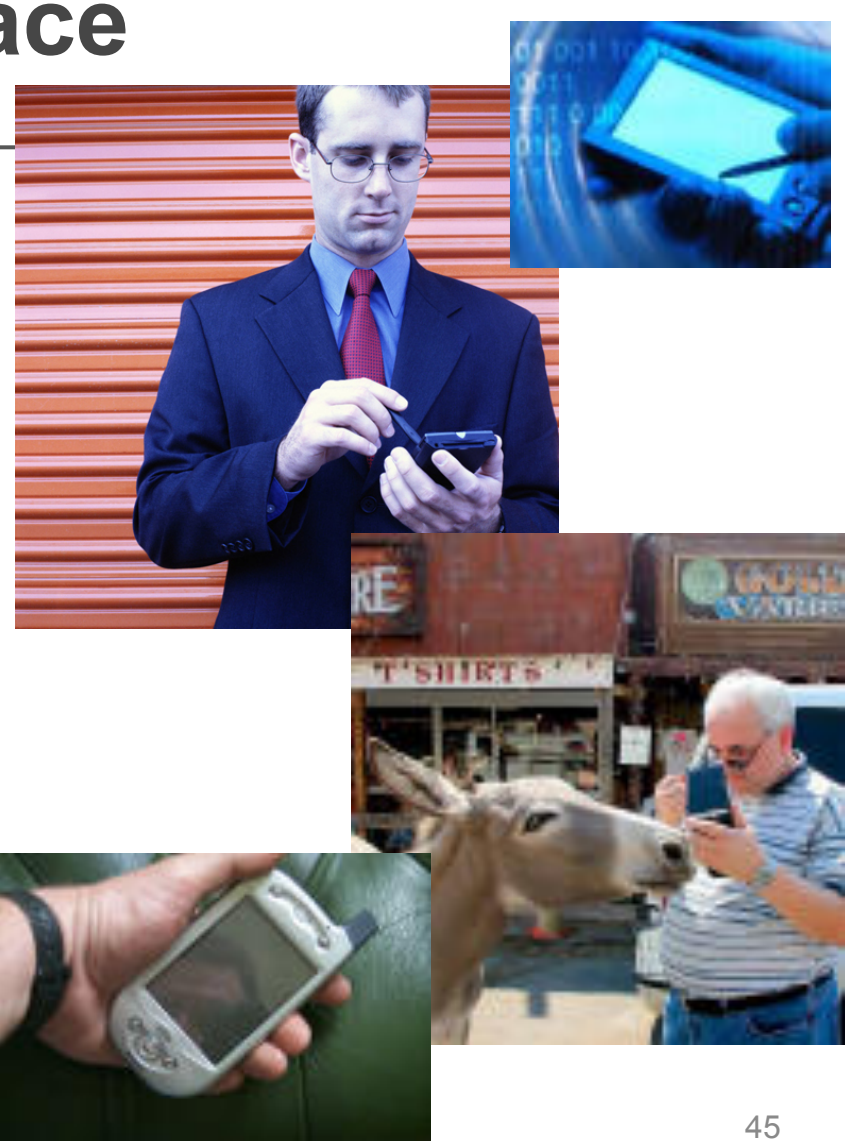
- Mobile device always with user & on
- Use gives clues to context…
  - Calendar
  - Job order…
- Location gives many contextual cues
  - ..
- Simple activity inference gives context
  - Driving? Adapt how?

Limited Attention & Input Interaction

- Minimize keystrokes
- Provide overview + detail
- Understandable interface at a glance
- Design with tasklets
- Minimum set of functions

Problem: screen space

- How to display information on small screens so that it can be understood in its context?



User Context Factors

- Distractions
- Movement
- Lighting
- Reduced screen space
- Bandwidth and memory restrictions
- Input constraints
- Two hands or one hand or no hand

Trade-offs

- Content vs context
  - space needed to include contextual information reduces amount of content
- Full set vs full content
  - Remove images or some data items
- Completeness vs readable
  - Reduce font size so that everything is there but cannot be read
- Replication vs representative
  - Exact information or summary

Design Decision Factors

Tasks

- Browsing
- Reading
- Finding
- Re-finding
- Comparison

Input

- Input data and/or manipulate data

Usability Factors

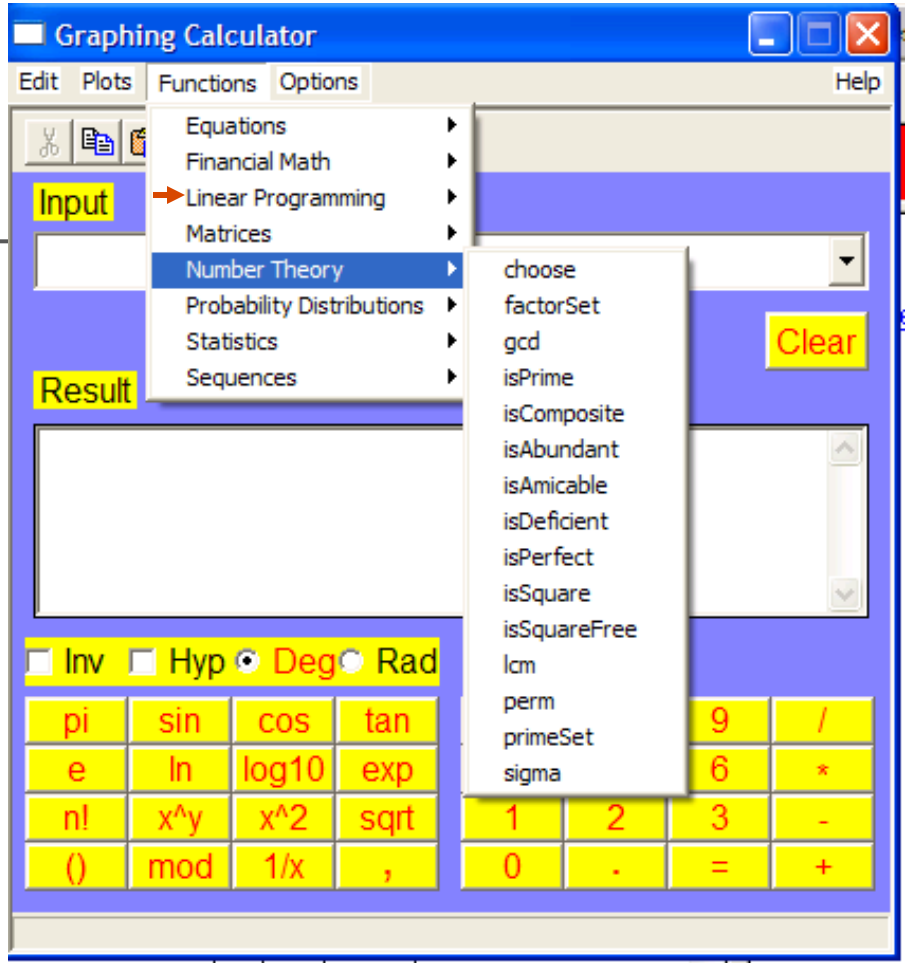
- Scrolling
  - Vertical scrolling
    - Skimming/scanning
  - Horizontal scrolling
    - Reading/comparison problems
- Size and Reading
  - speed
  - comprehension
- Target Size and accuracy (Fitt's law)
- Error rates for input
  - Mistakes
  - Slips
  - Feedback

Design Decisions

- Menus
- Text
- Lists
- Images
- Forms
- Option Layout
- Tables
- Input

Menus

- Shallow hierarchy for performance
- Length
- Ellipses for long items
- Personalization
- Feedback



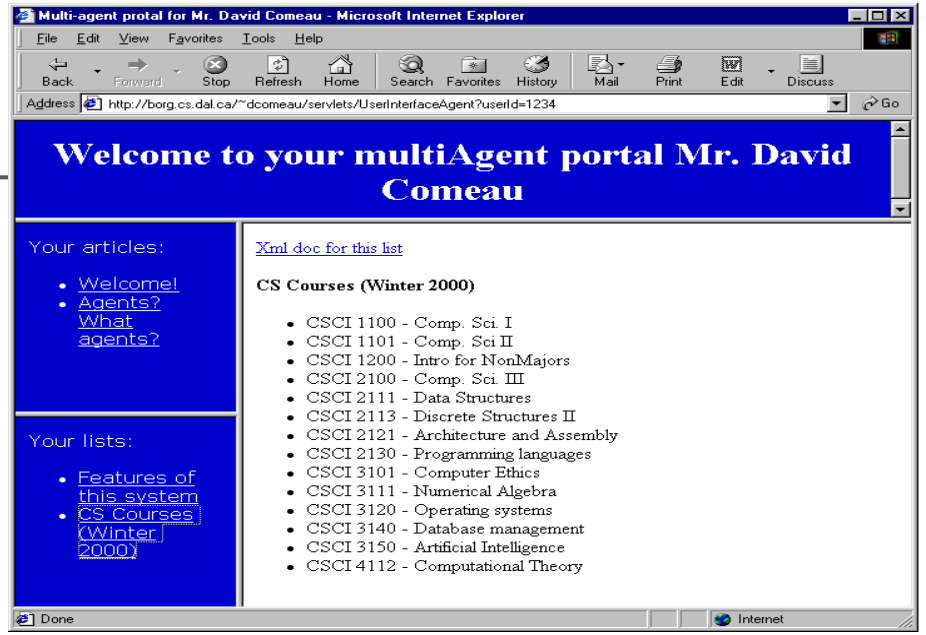
Text

- Page vs scroll
- Keep clear context
- Reading
  - Chunk text to logical units
  - Eliminate sideways scroll
- Finding
  - Add search
  - Columns
- Font size

Lists

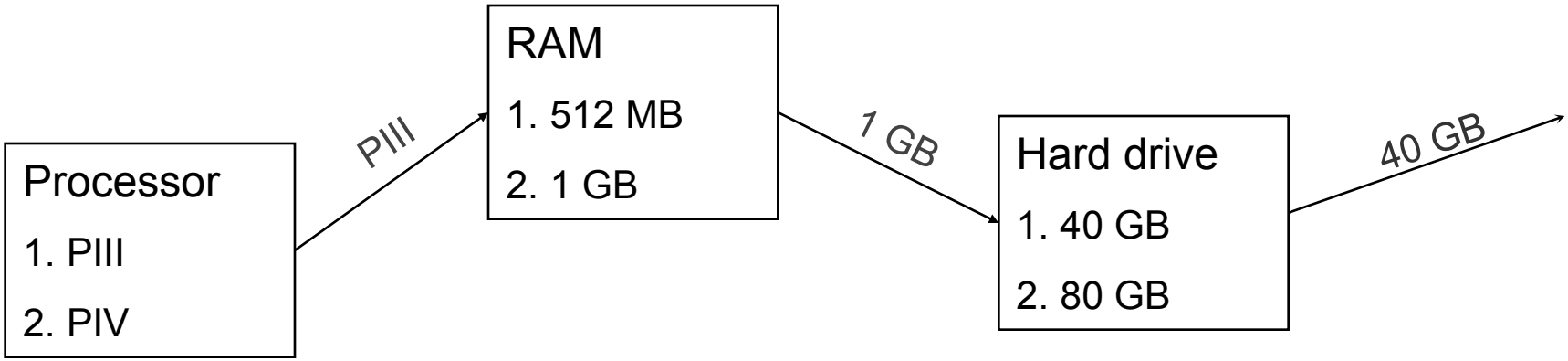
- Breaking up the list
  - No effect on performance (Reseil & Shneiderman, 87)
  - Perform is affected (Duchnicky & Kolers, 83)
- Search option useful

  (Jones et al, 1999)
- Ellipsis …
- Keep context



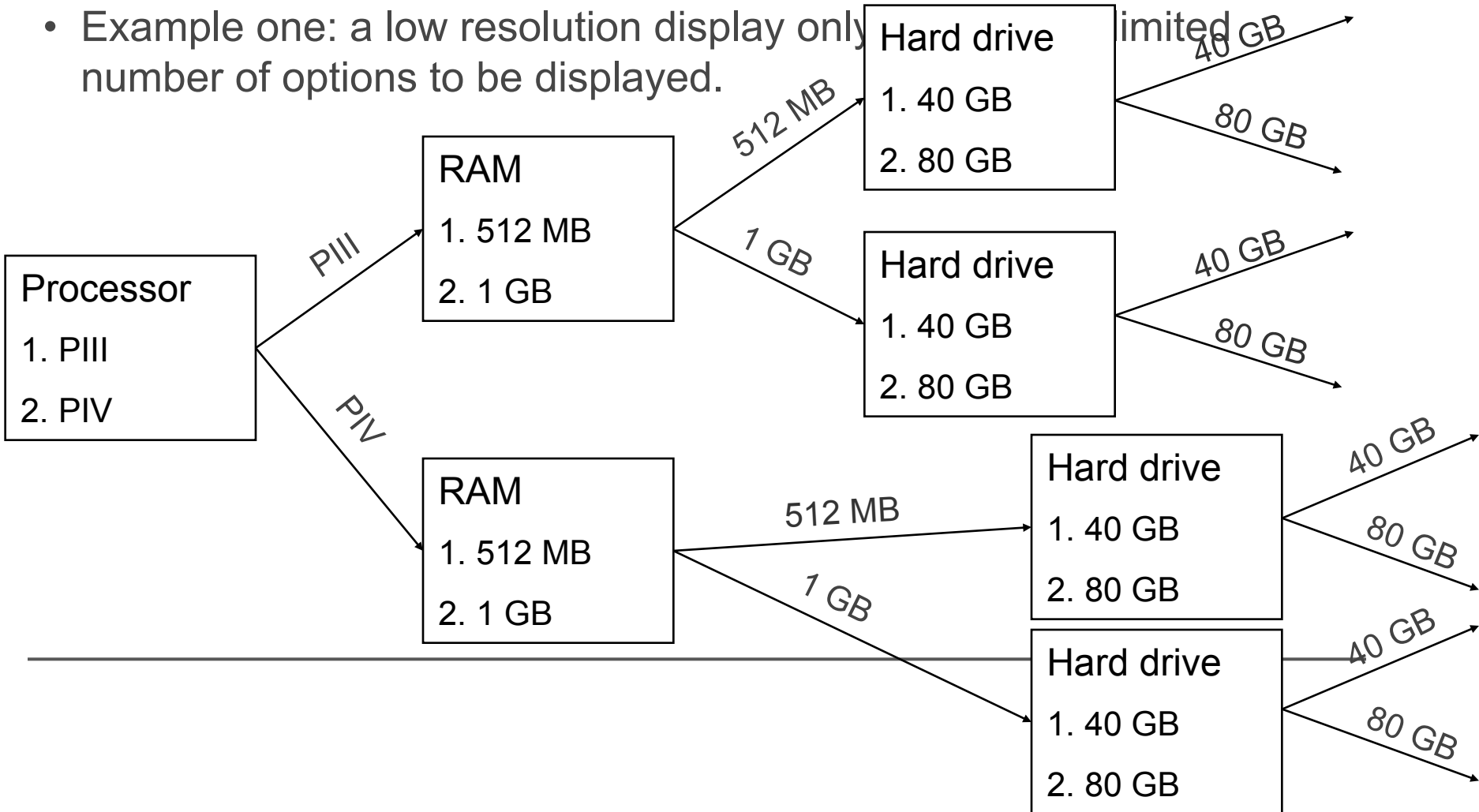
The Smaller The Screen The More Temporal Is The Design

- Example one: a low resolution display only allows for a limited number of options to be displayed.



The Smaller The Screen The More Temporal Is The Design

- Example one: a low resolution display only [illegible] limited number of options to be displayed.

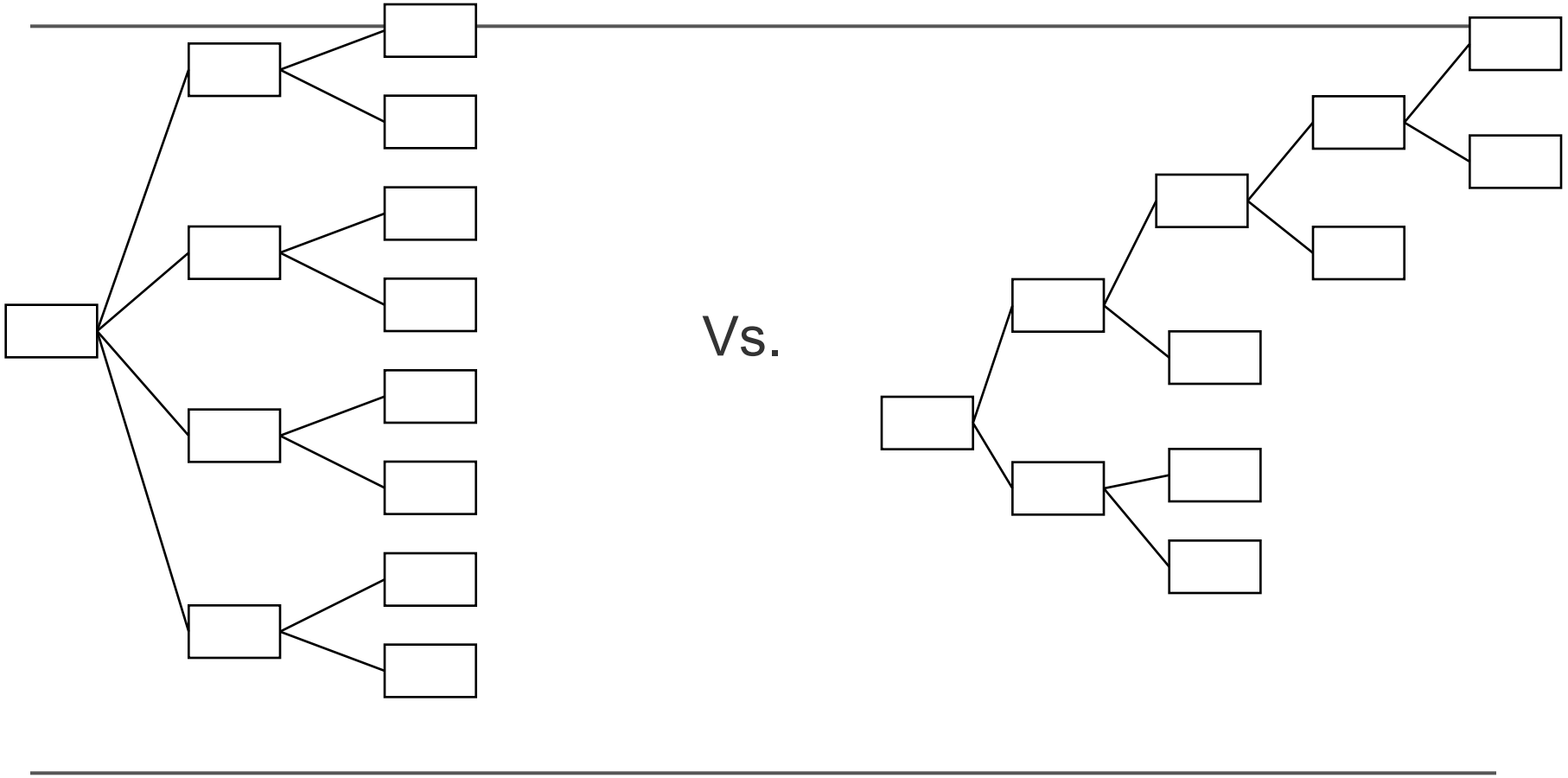


The Smaller The Screen The More Temporal Is The Design (2)

- Example two: a higher resolution display with a larger number options available reduces the need to remember previous menu selections.

Options
1. PIII, 512 MB, 40 GB
2. PIII, 512 MB, 80 GB
3. PIII, 1 GB, 40 GB
4. PIII, 1 GB, 80 GB
5. PIV, 512 MB, 40 GB
6. PIV, 512 MB, 80 GB
7. PIV, 1 GB, 40 GB
8. PIV, 1 GB, 80 GB

To Avoid Overly Temporal Designs, Consider Broader Rather Than Deeper Hierarchies



Create shortcuts

- Redesign lists
- Partition forms
- Implement navigational shortcuts

- Optimise input with data entry shortcuts

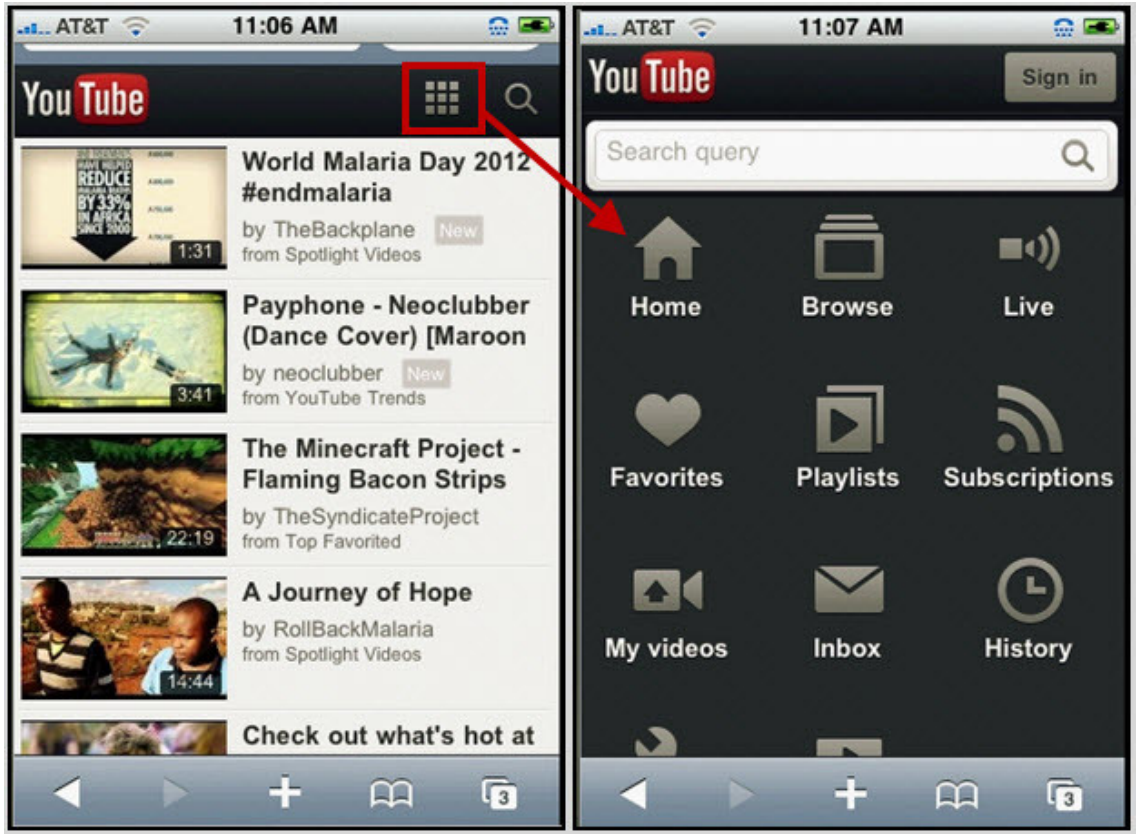
Designing Lists Of Functions

- Order lists by frequency over an alphabetical ordering : Can be implemented if a small number of features are invoked the majority of the time.
- Changing the default list that is displayed depending upon the context or reorder lists according to the context

Appointments
(N)ew
(E)dit
(R)emove

Contacts
(F)ind
(E)dit
(N)ew
(R)emove

Compress navigation with shortcuts



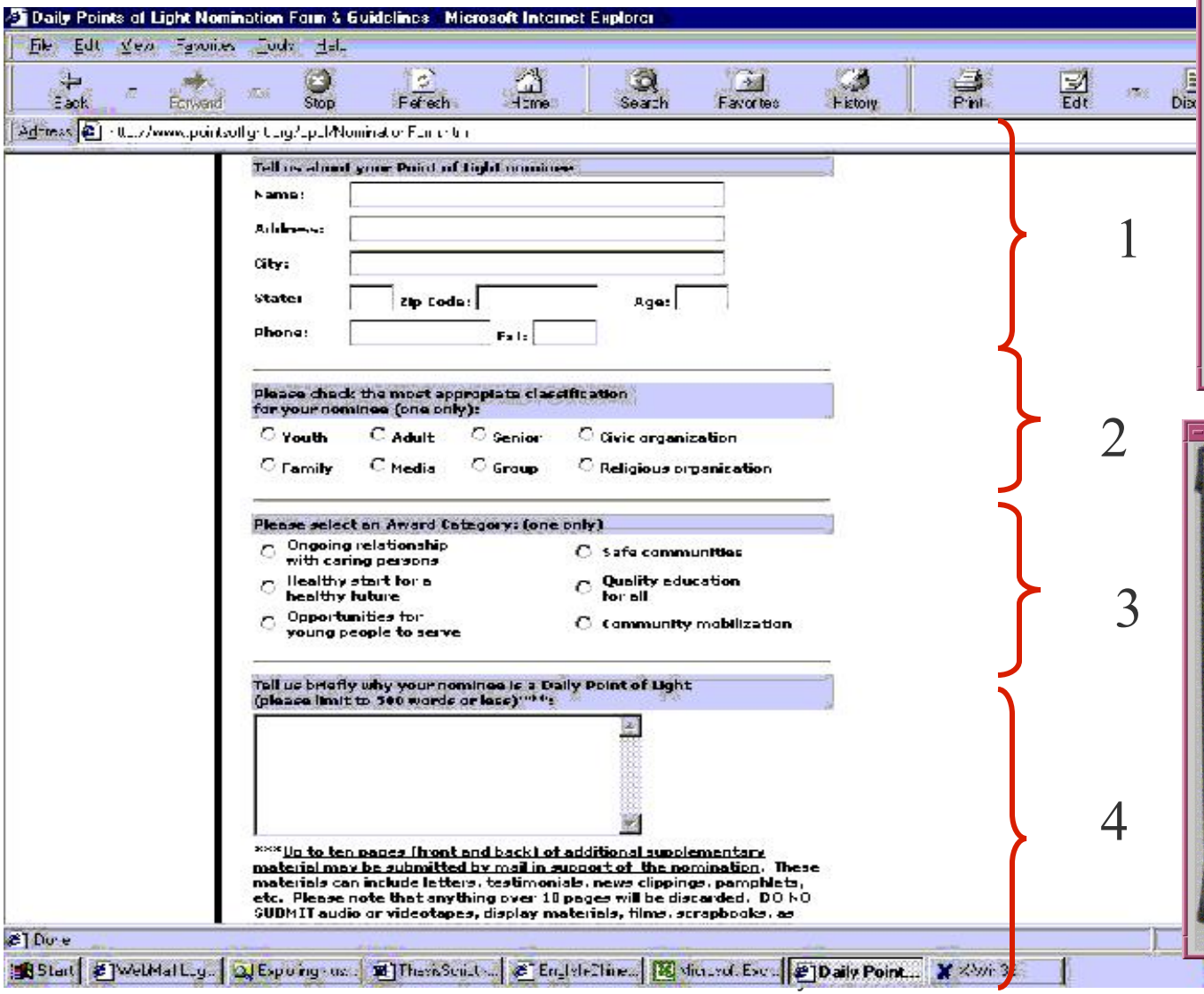
Prioritise options with context

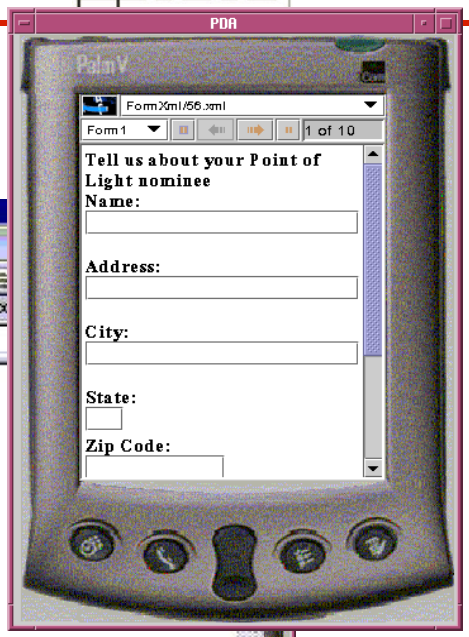
Mobile site for University of Michigan gives priority to bus routes and maps

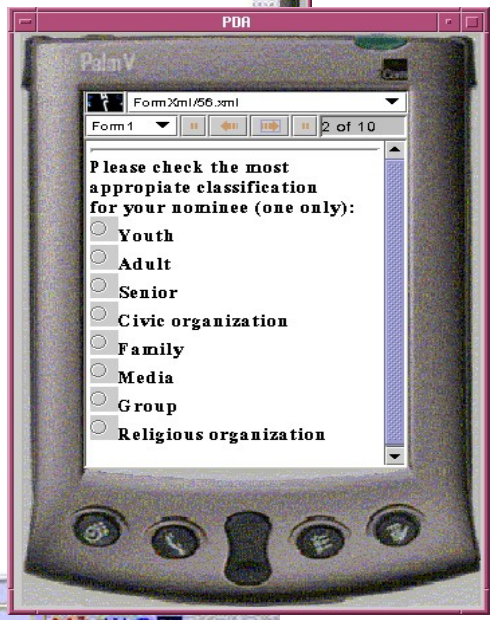
Forms on Small Screens

- Logic units
- Reconnect sections at server
- Avoid text boxes
- Avoid horizontal scroll

Forms → Partitions





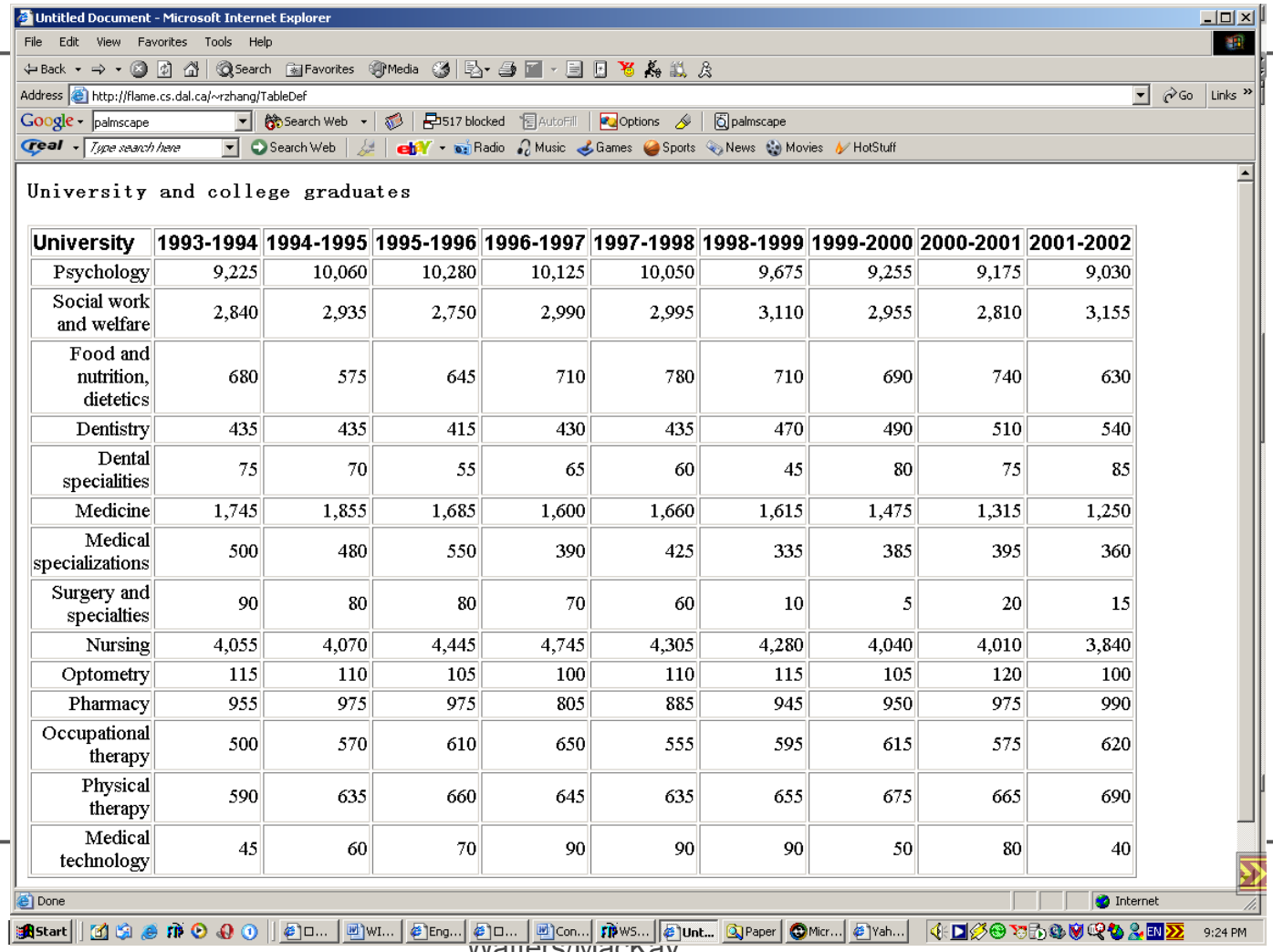


90% effective over 100 random sites with forms

Results (Christie,Klein,Watters/03)

- screen size significantly influences performance in finding targets
- Consistently more efficient at finding targets using the grid layout
  - increasing from 16 to 25 items had no effect on performance **once learned.**
- users did not always prefer grid even when performance was better
- For performance, this suggests that grids work when
  - interface is static
  - buttons are large enough to read and use.
  - the number of potential options can fit on the screen (or device, if hard wired)

Tables of Data



University and college graduates

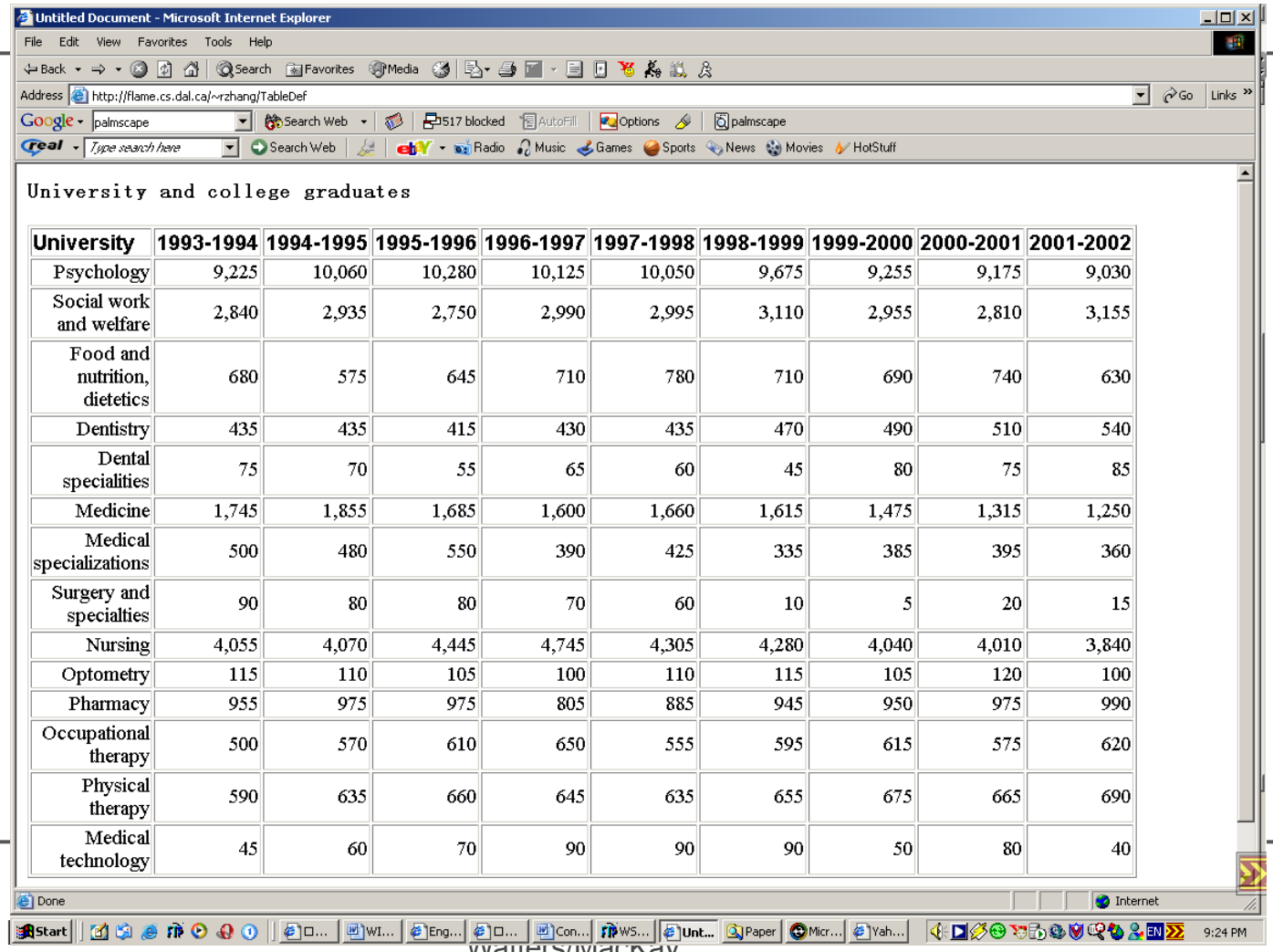
University	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002
Psychology	9,225	10,060	10,280	10,125	10,050	9,675	9,255	9,175	9,030
Social work and welfare	2,840	2,935	2,750	2,990	2,995	3,110	2,955	2,810	3,155
Food and nutrition, dietetics	680	575	645	710	780	710	690	740	630
Dentistry	435	435	415	430	435	470	490	510	540
Dental specialities	75	70	55	65	60	45	80	75	85
Medicine	1,745	1,855	1,685	1,600	1,660	1,615	1,475	1,315	1,250
Medical specializations	500	480	550	390	425	335	385	395	360
Surgery and specialties	90	80	80	70	60	10	5	20	15
Nursing	4,055	4,070	4,445	4,745	4,305	4,280	4,040	4,010	3,840
Optometry	115	110	105	100	110	115	105	120	100
Pharmacy	955	975	975	805	885	945	950	975	990
Occupational therapy	500	570	610	650	555	595	615	575	620
Physical therapy	590	635	660	645	635	655	675	665	690
Medical technology	45	60	70	90	90	90	50	80	40

Tables on Small Screens

- Using large tables on small devices

- Does it help to:
  - Use screen space for headings and context
  - Use screen space for a search function
  - Change the navigation model
- For:
  - Simple look up tasks
  - More complicated tasks

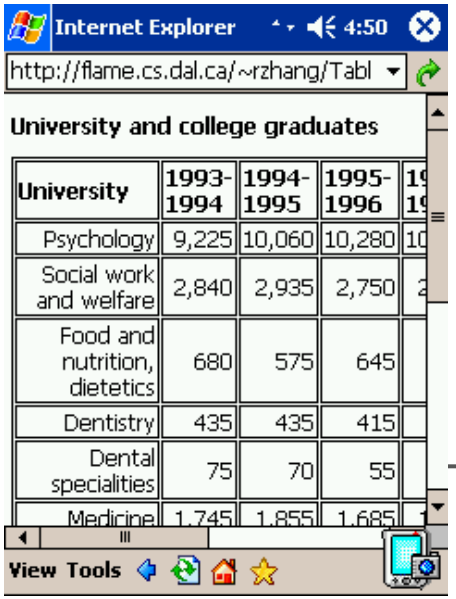
Changing the TABLE model

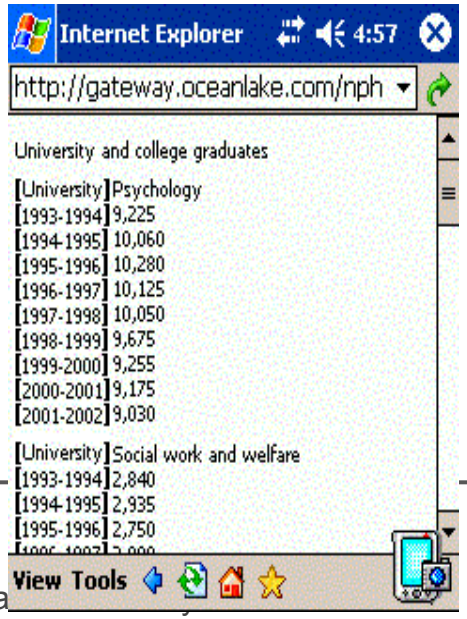


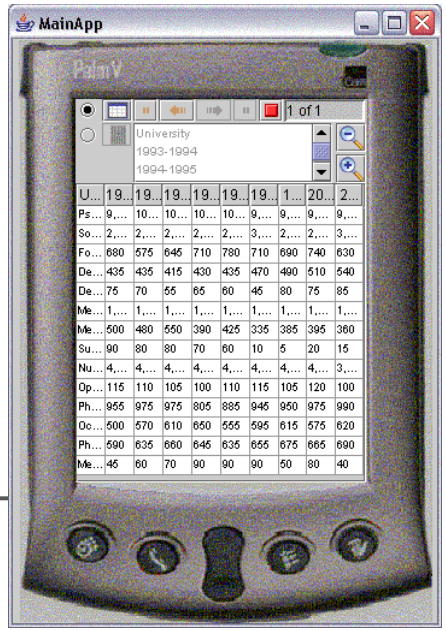
University	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002
Psychology	9,225	10,060	10,280	10,125	10,050	9,675	9,255	9,175	9,030
Social work and welfare	2,840	2,935	2,750	2,990	2,995	3,110	2,955	2,810	3,155
Food and nutrition, dietetics	680	575	645	710	780	710	690	740	630
Dentistry	435	435	415	430	435	470	490	510	540
Dental specialities	75	70	55	65	60	45	80	75	85
Medicine	1,745	1,855	1,685	1,600	1,660	1,615	1,475	1,315	1,250
Medical specializations	500	480	550	390	425	335	385	395	360
Surgery and specialties	90	80	80	70	60	10	5	20	15
Nursing	4,055	4,070	4,445	4,745	4,305	4,280	4,040	4,010	3,840
Optometry	115	110	105	100	110	115	105	120	100
Pharmacy	955	975	975	805	885	945	950	975	990
Occupational therapy	500	570	610	650	555	595	615	575	620
Physical therapy	590	635	660	645	635	655	675	665	690
Medical technology	45	60	70	90	90	90	50	80	40

Alternate Views

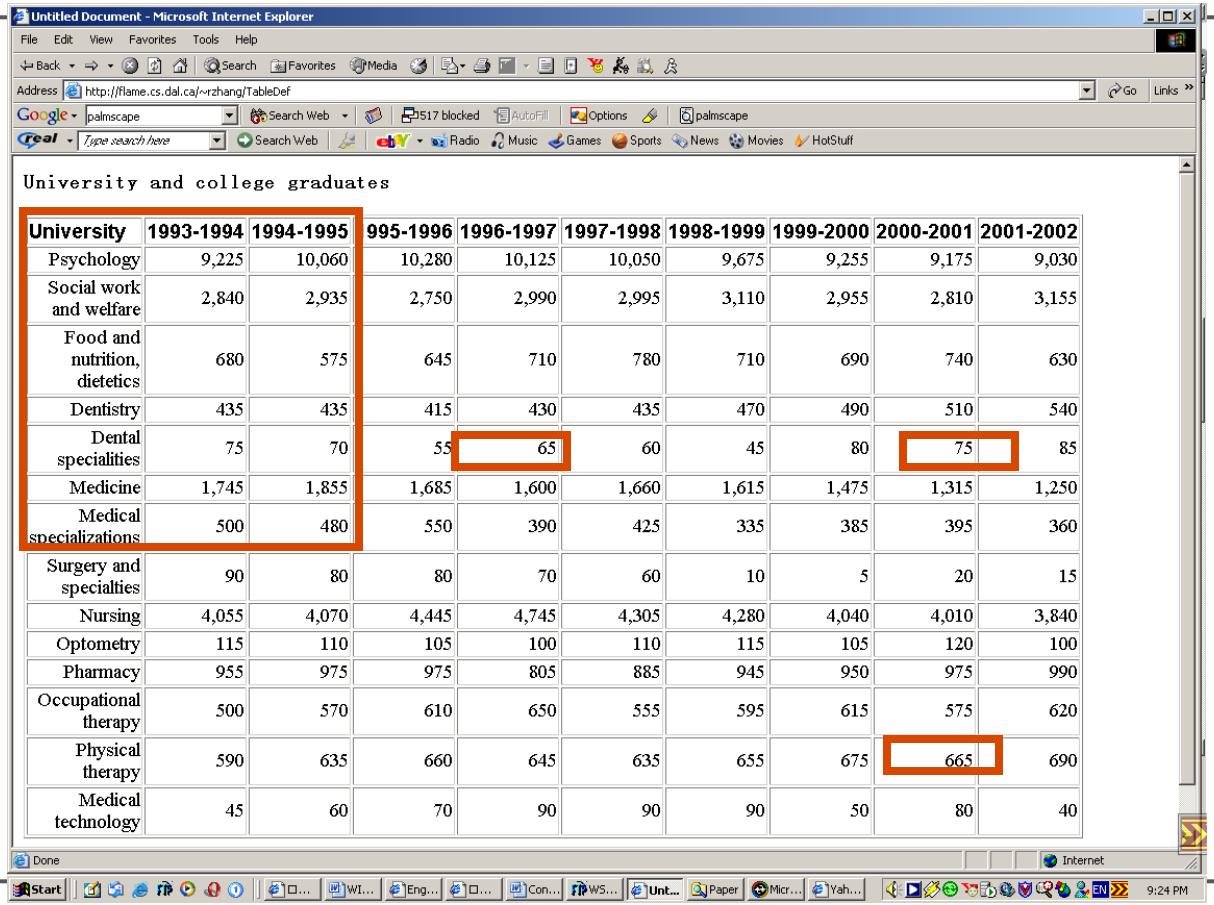
- ***Default View*** (NetFront v3.0 and ThunderHawk)
- ***Linear View*** (OceanLake's mScope and AvantGo)
- ***Overview***







Task Complexity



University and college graduates

University	1993-1994	1994-1995	995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002
Psychology	9,225	10,060	10,280	10,125	10,050	9,675	9,255	9,175	9,030
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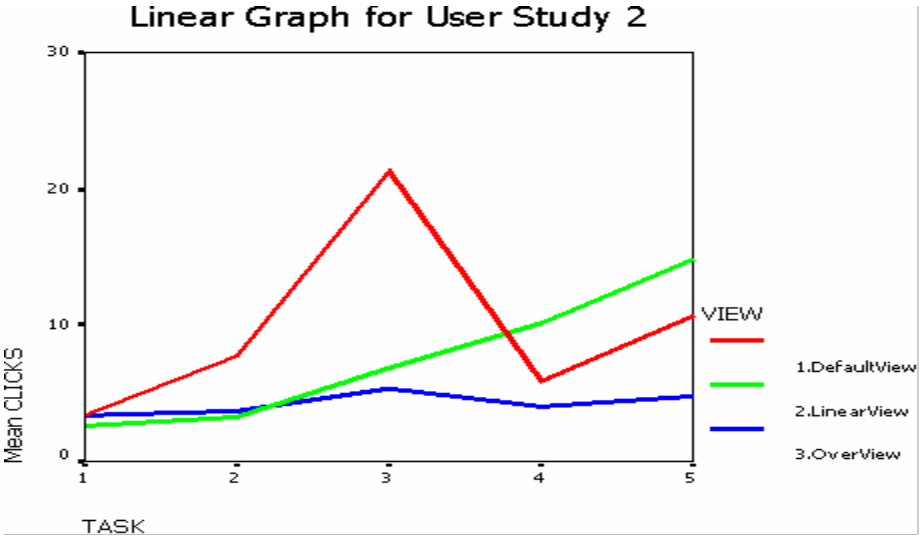
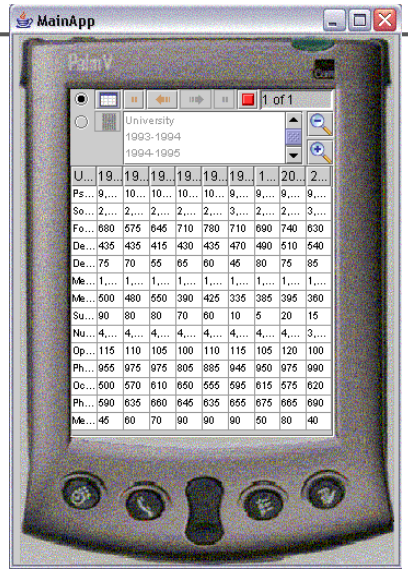
Physical therapy	590	635	660	645	635	655	675	665	690
Medical technology	45	60	70	90	90	90	50	80	40

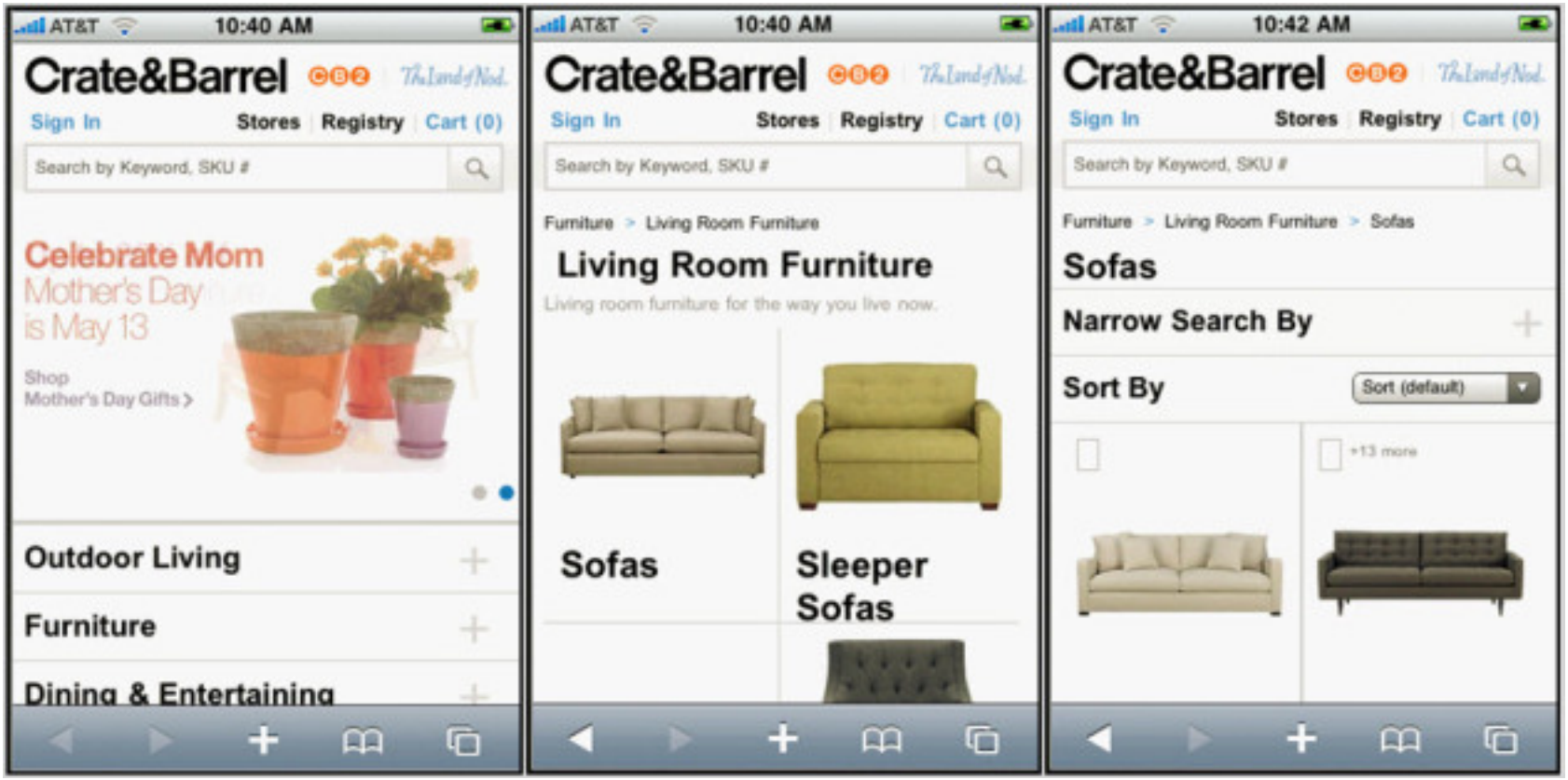
User Study (9 participants)





Overview is significantly more stable as task complexity increases

Design for fat fingers



Input Choices

- Reducing Input Errors
  - Spell ahead
  - Big Targets
  - Feedback
  - Take-backs
- Reduce direct input
  - Menus/dropdowns
- One handed options?
  - Voice
  - RFID
  - Gesture/tilt
  - Thumb buttons/touch

Example approach: Nokia Navi-

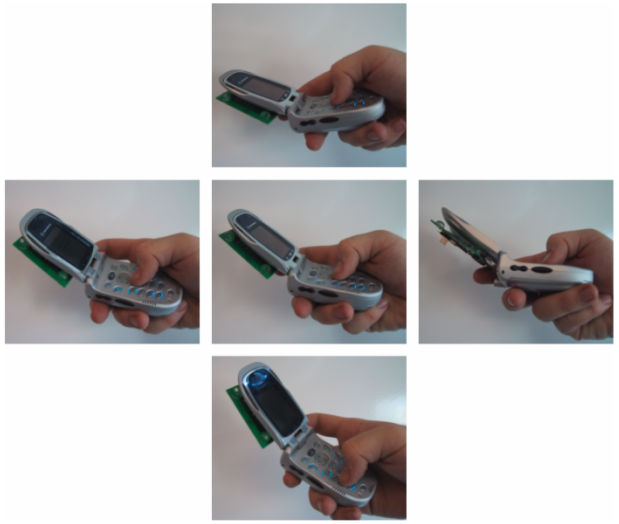
FIGURE 2-1. Nokia's constant push for Simplicity in handset design.

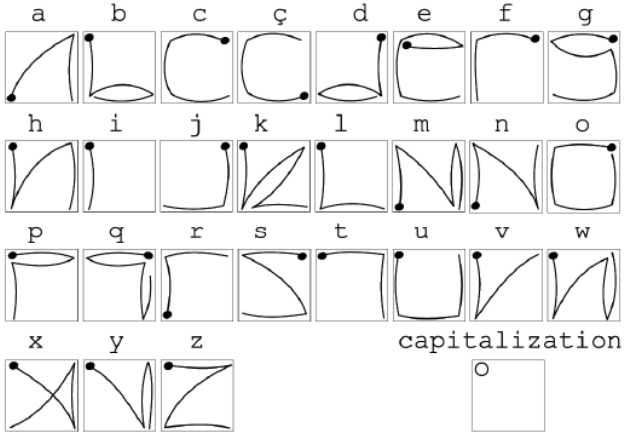
Reducing number of buttons

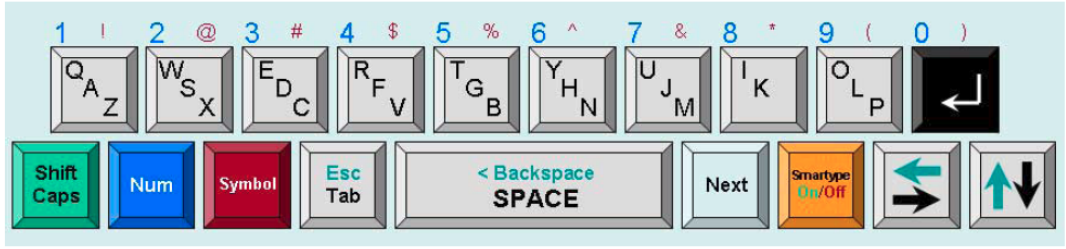
The motivation of this Simplicity was the understanding that only two tasks were used the majority of the time: answering the phone and dialing from the phone book. Nokia came up with an extremely simple and elegant design to do this. Answer the phone? Press the big button. Hang up the phone? Press the big button. Call someone? Use the arrow keys to get to the right person and press the big button. By restricting

Source: Scott Jenson, The Simplicity Shift. Cambridge University Press, 2002.

Mobile Input: Lots of Research

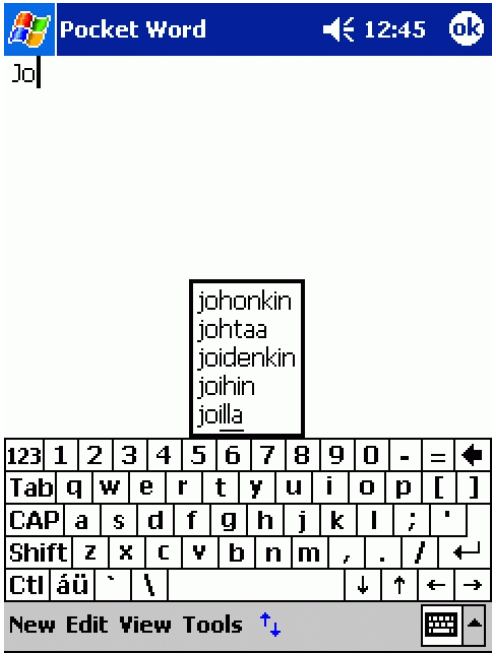






Disambiguation w/ Dictionary

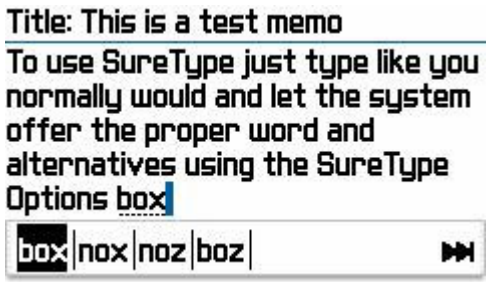
- Dictionary based (such as T9, Pocket PC)
  - e.g., 2-2-5-3
  - able 2-2-5-3-0
  - cake 2-2-5-3-N-0
  - bald 2-2-5-3-N-N-0
  - calf 2-2-5-3-N-N-N-0
- Lots of “N” = Next



Source: Microsoft, MacKenzie, I. S., Kober, H., Smith, D., Jones, T., Skepner, E. (2001). LetterWise: Prefix-based disambiguation for mobile text input. Proceedings of the A
Symposium on User Interface Software and Technology - UIST 2001, pp. 111-120. New York: ACM.

Disambiguation w/ Predictive

- Predictive (such as Letterwise)
  - e.g., t-h-
  - e A%
  - i B%
  - o C%
  - u D%
  - …



Source: Microsoft, MacKenzie, I. S., Kober, H., Smith, D., Jones, T., Skepner, E. (2001). LetterWise: Prefix-based disambiguation for mobile text input. Proceedings of the A Symposium on User Interface Software and Technology - UIST 2001, pp. 111-120. New York: ACM.

Dictionary vs. Predictive

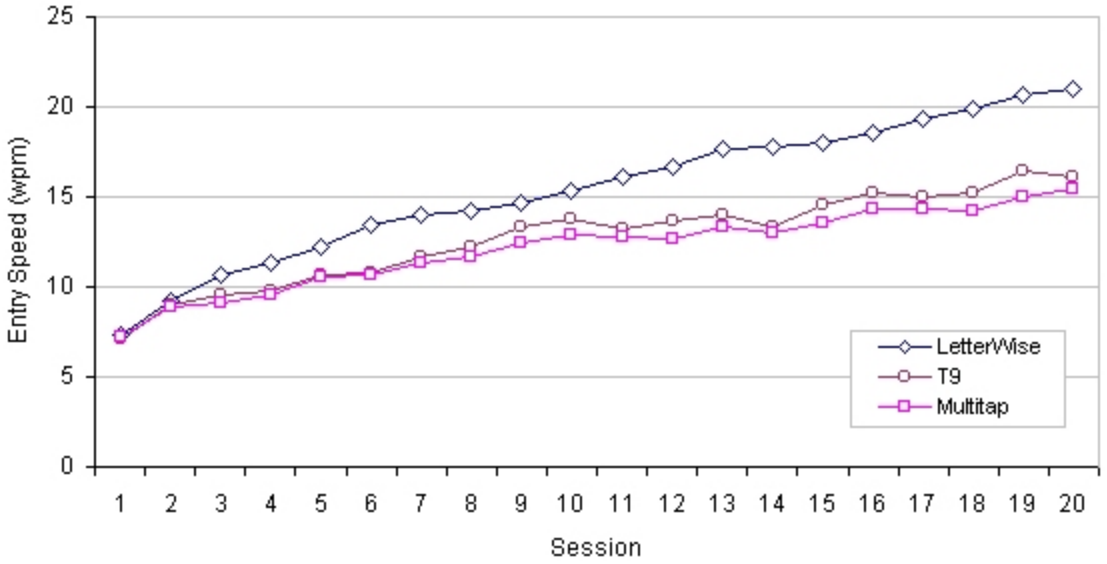


Figure 11. Comparison of entry rates (wpm) with practice for *LetterWise*, *T9*, and *Multitap*. (Note: *LetterWise* and *Multitap* figure are from Figure 6. Simulated *T9* figures are from Figure 10 with 0.85 frequency of words in dictionary)

Source: MacKenzie, I. S., Kober, H., Smith, D., Jones, T., Skepner, E. (2001). LetterWise: Prefix-based disambiguation for mobile text input. Proceedings of the ACM Symposium on User Interface Software and Technology - UIST 2001, pp. 111-120. New York: ACM.

Case Study: iPhone Input

Design distinctions

- Multi-touch Input
- Disambiguation of input
- Animations

Internet + Music + Phone

Predictive Touch keyboard

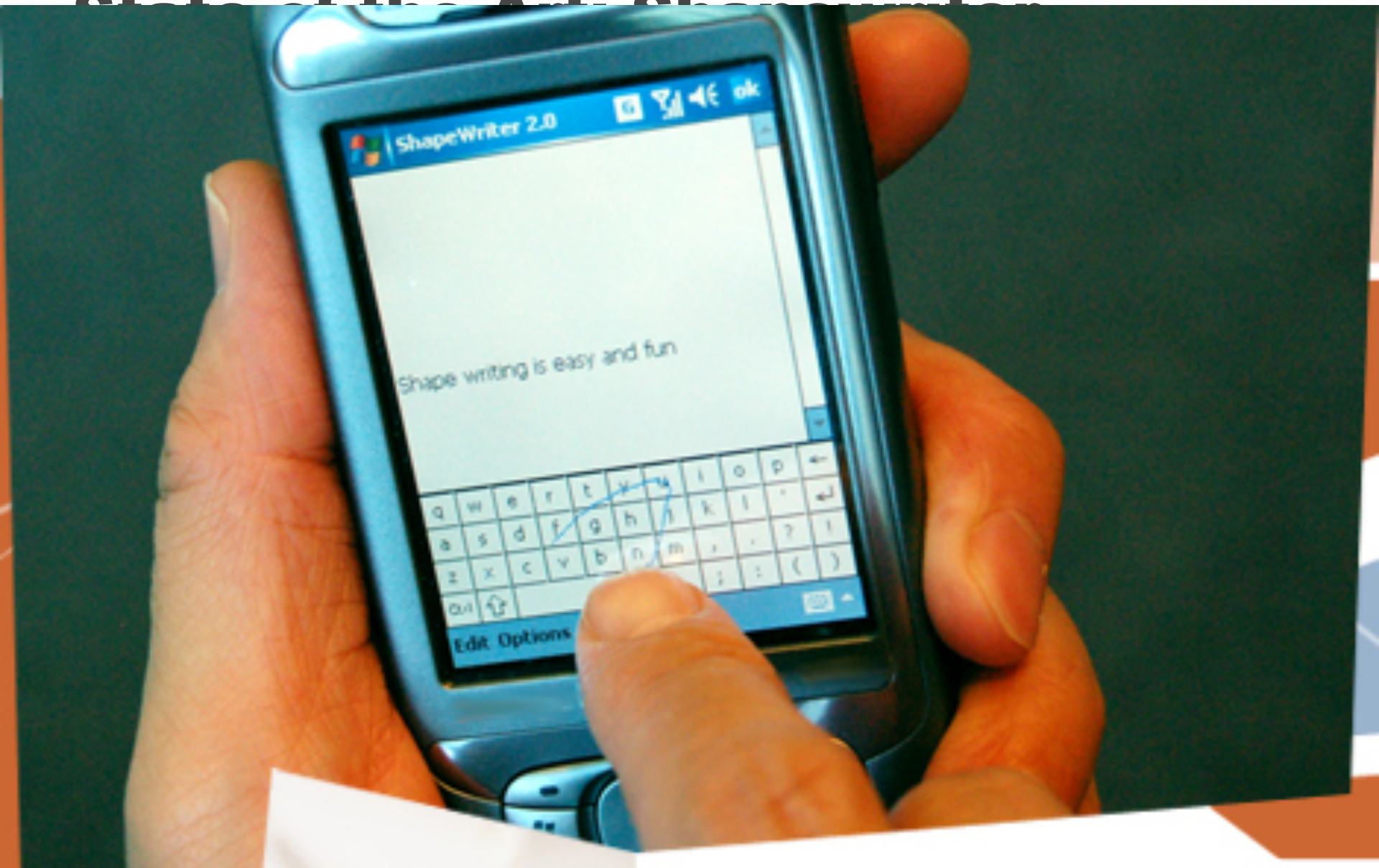
Multi-touch | Mac OS X | Wireless | Accelerometer | Proximity Sensor

Source: Apple

iPhone Typing Algorithm

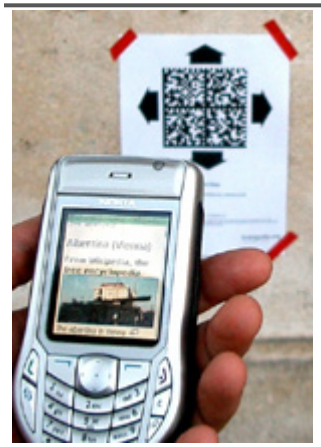
- Model where a user touched on the screen
- Model the layout of keys and what keys surround the touch
- If word not in dictionary (or if an extremely unlikely word), present alternative
- While user types, dynamically adjust (invisible) target sizes of keys
- User can accept by simply tapping ‘Space’

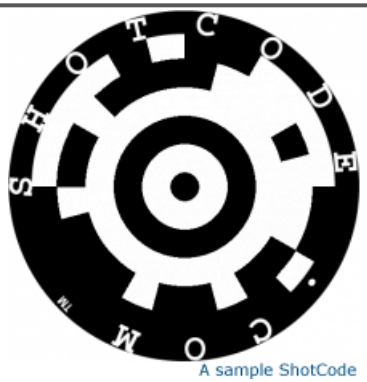
State of the Art: Shapewriter



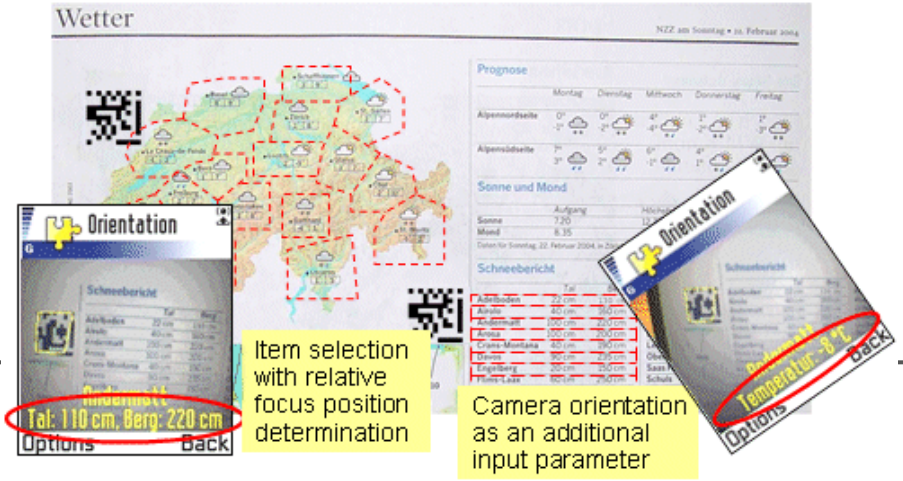
System/Service Design

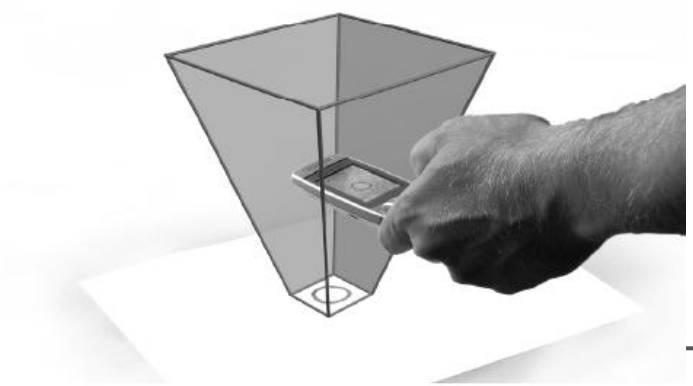
Emerging Marker Based Interactions on Camera Phones





A sample ShotCode





Information Appliances

- Mobile devices with dedicated purpose

Amazon Kindle eBook

Further Reading on Mobile

- Studio 7.5, Designing for Small Screens
- Mizuko Ito, Personal, Portable, Pedestrian
- Rich Ling, the Mobile Connection
- Christian Lindholm, Mobile Usability
- Matt Jones, Mobile Interaction Design