

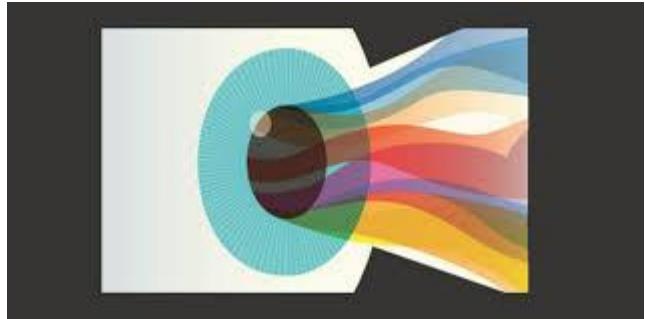
# Fundamental Concepts

# Human Capabilities

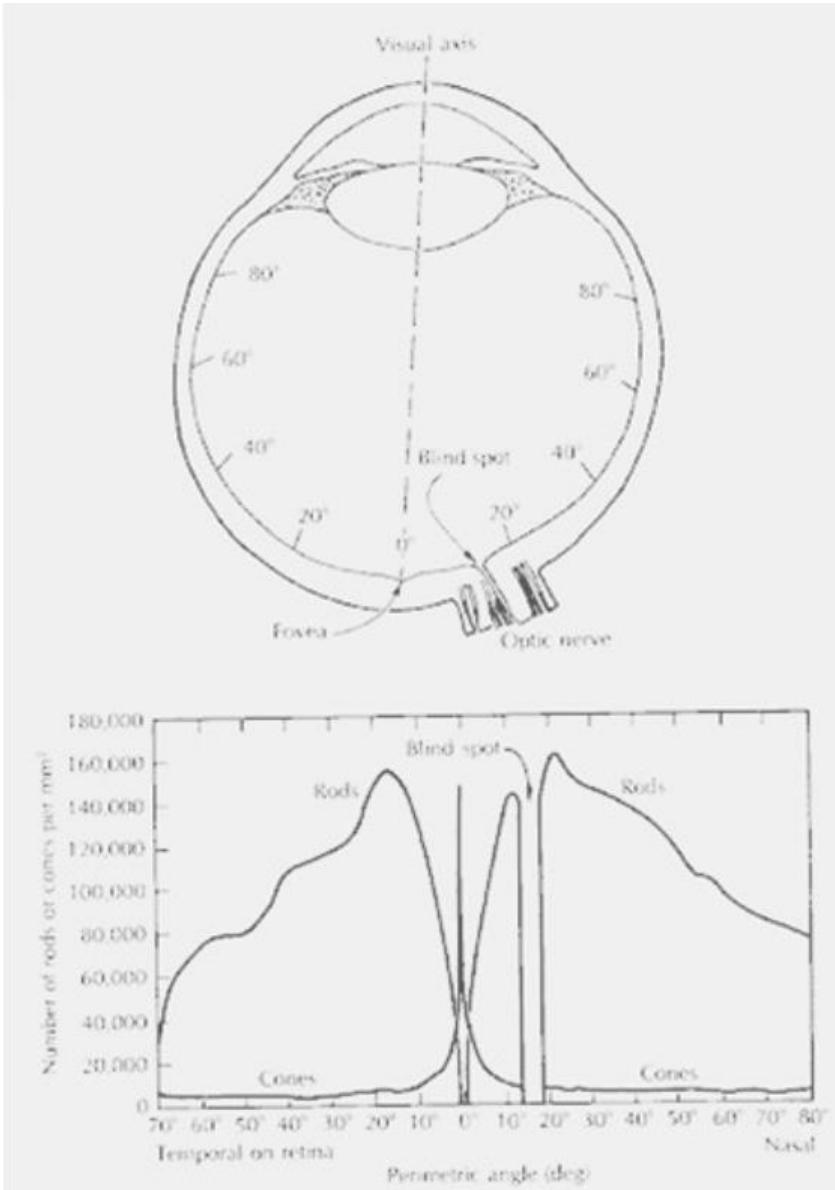
- Our Senses
  - How to sense changes/information
- Our Cognition
  - How we process and interpret input
- Our Motor System
  - How can we react to input and cognition

# Human Senses

- Sight, hearing, touch important for the design of current interfaces
  - Others: smell, tastes, kinesthetic
- Abilities and limitations constrain design space



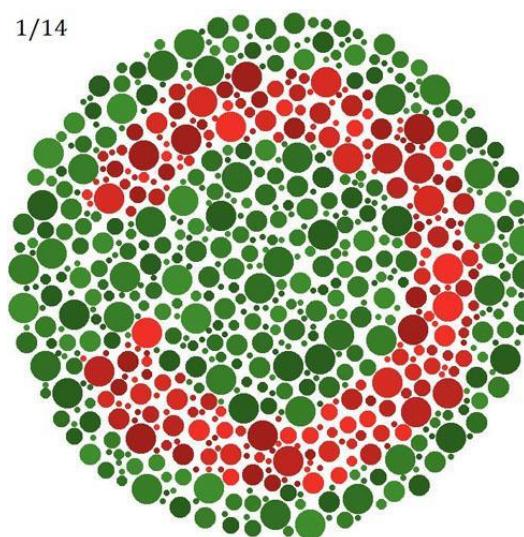
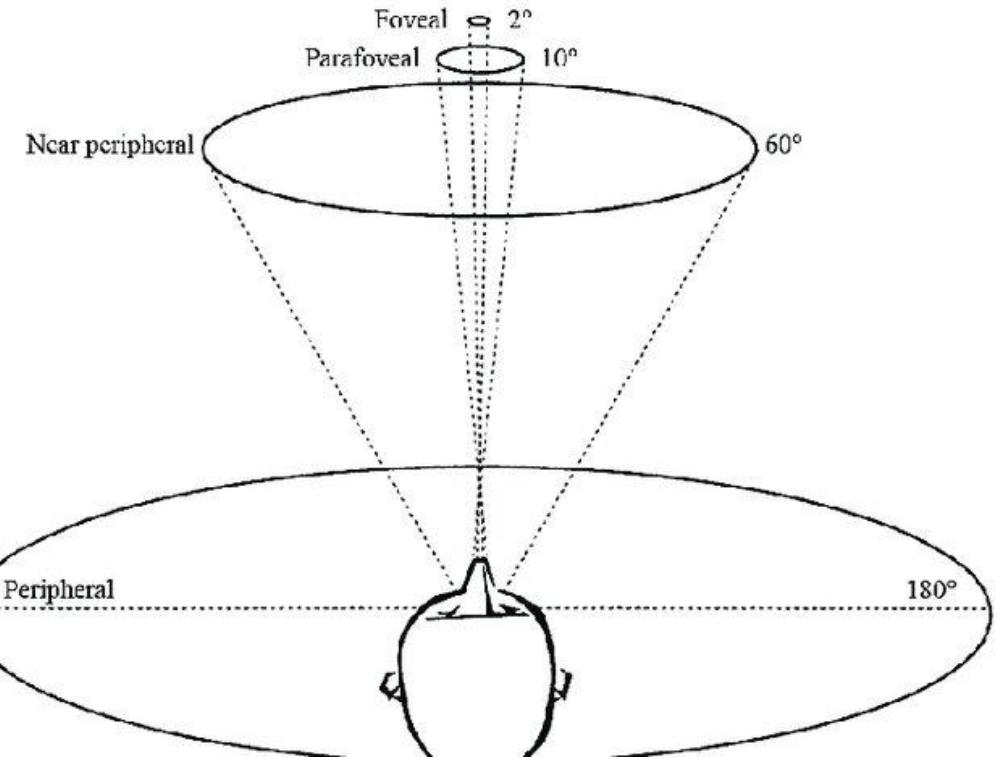
# Sight



- Visual angle
  - Total: 200 degrees
  - High-res: ~15 degrees
- Rods
  - 120 million!
  - B/W
  - 1000x more sensitive than cones
- Cones
  - 6-7 million
  - 64% red
  - 32% green
  - 2% blue

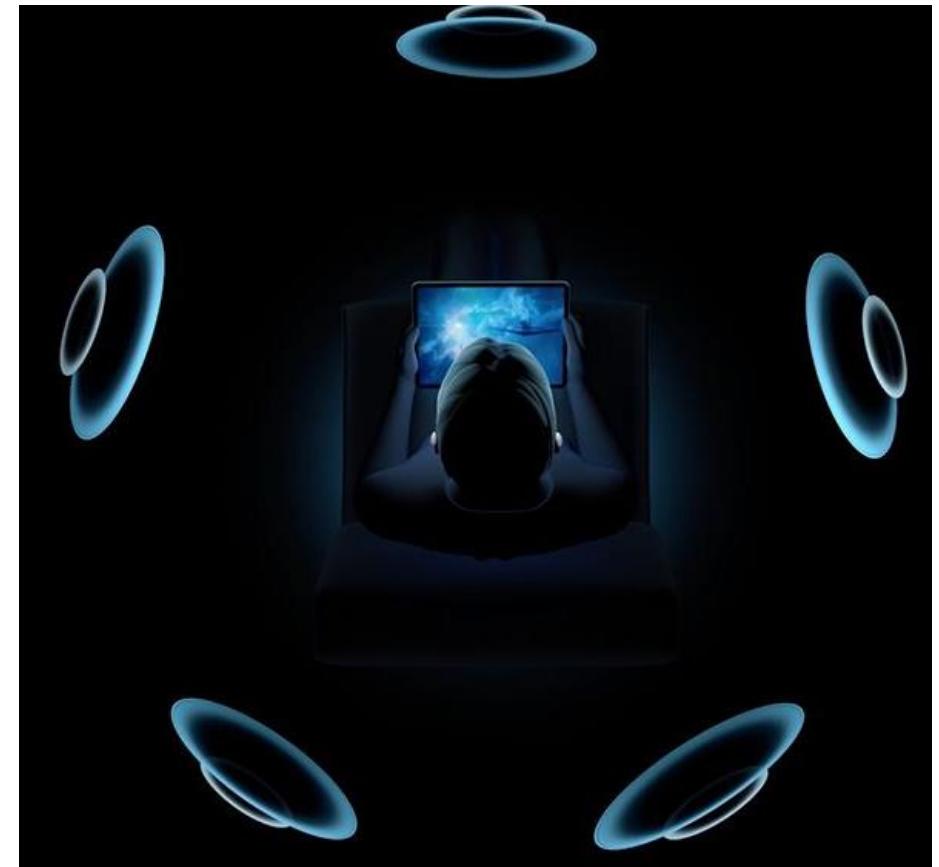
# Sight

- Color Perception
  - 7-8% of males cannot distinguish red from green
  - 0.4% of women
- Peripheral vision
  - Largely movement oriented
- Stereopsis
  - Monocular (color, brightness, shape)
  - Binocular (size, interposition, perspective, parallax)



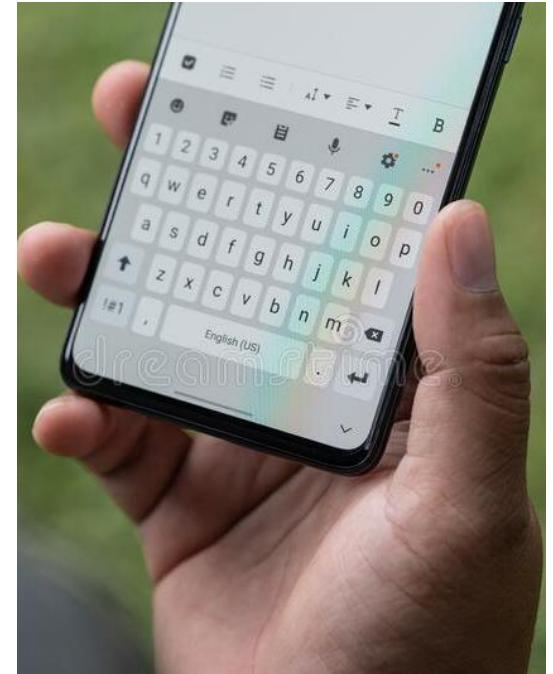
# Audition (Hearing)

- Capabilities:
  - Pitch – frequency (20 – 20,000 Hz)
  - Loudness – amplitude (30 – 100 dB)
  - Location ( $5^\circ$  source & stream separation)
  - Timbre – type of sound (music instruments)



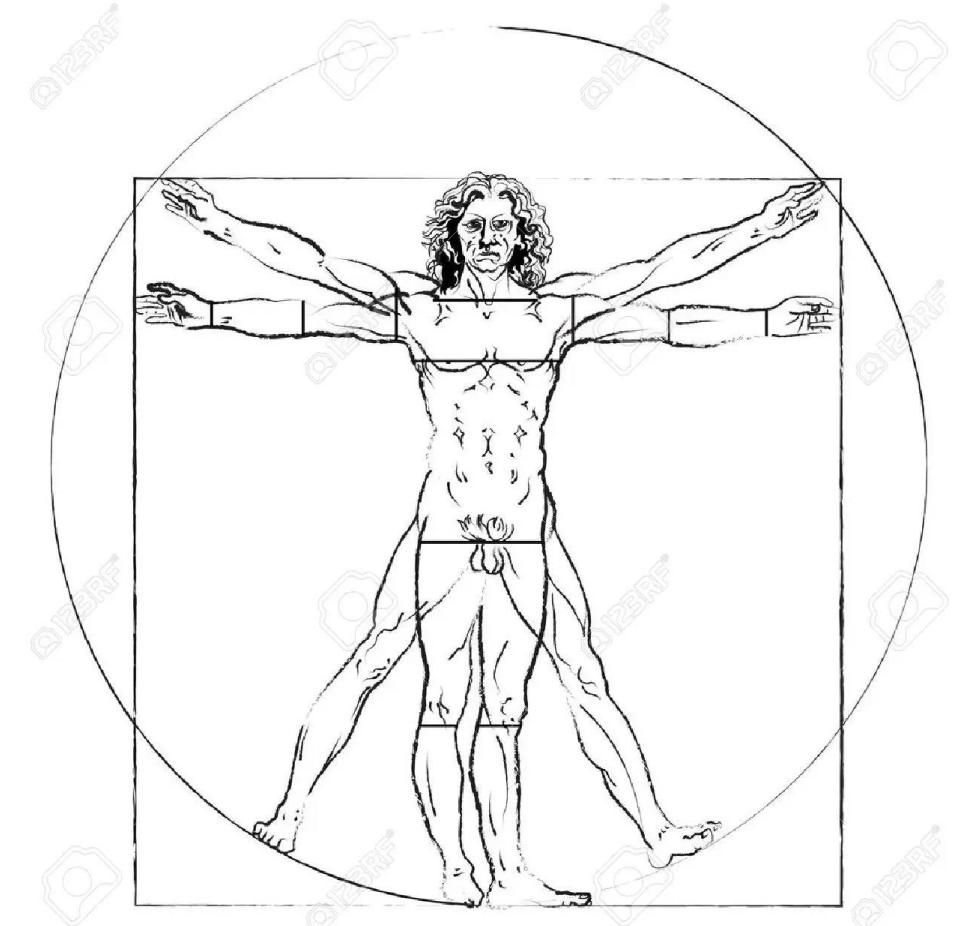
# Touch

- Three main sensations handled by different types of receptors
  - Pressure (normal)
  - Intense pressure (heat/pain)
  - Temperature (hot/cold)
- Sensitivity, Dexterity, Flexibility, Speed
- Where important?
  - Mouse, Keyboards, Buttons, VR, Surgery



# Motor System (Our Output System)

- Capabilities
  - Range of movement, reach, speed, strength, dexterity, accuracy  
⇒Workstation design, device design
- Often cause of errors
  - Wrong button
  - Double-click vs. Single Click
  - Not-detected mid-air gestures
- Principles
  - Feedback is important
  - Minimize eye movement

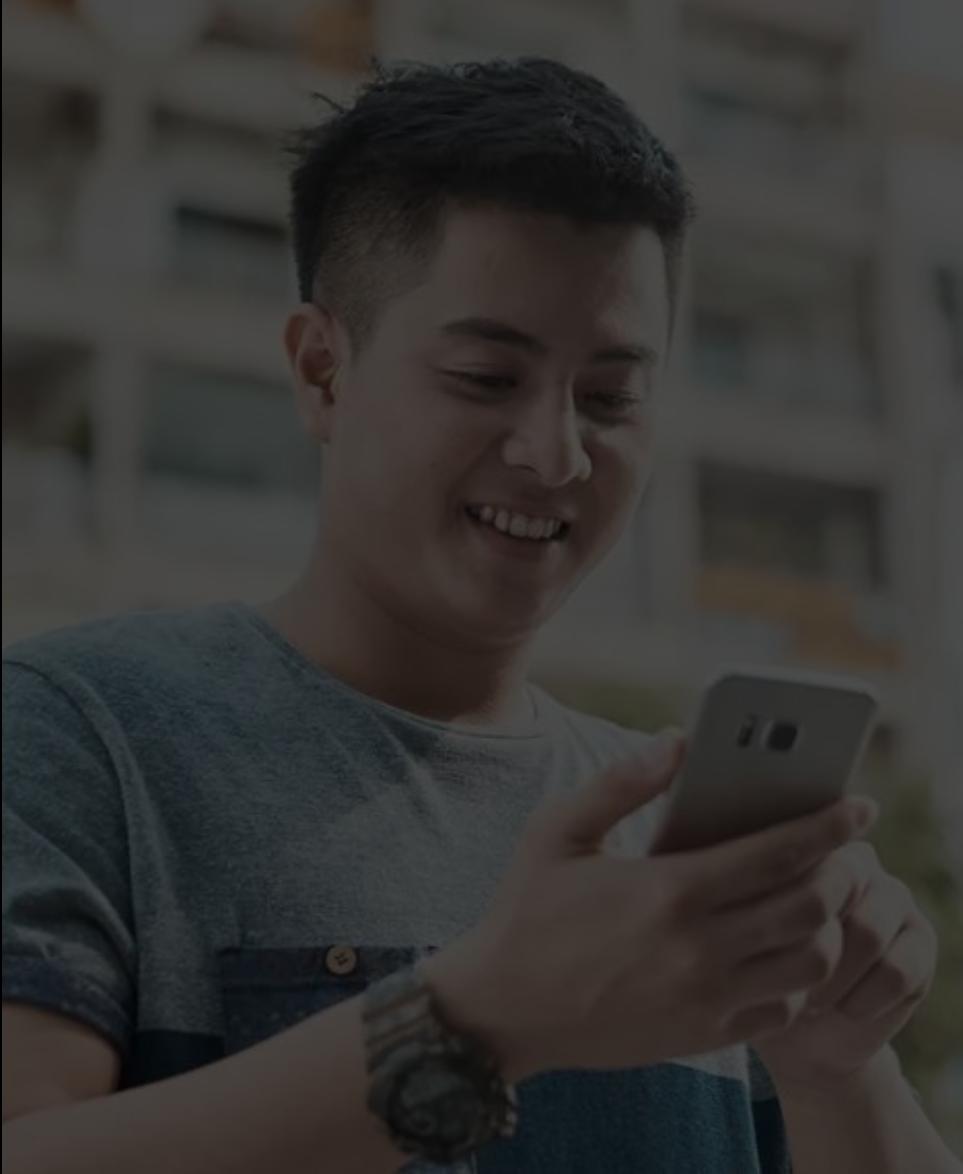


INTRODUCING  
**WATCH**  
SERIES 4

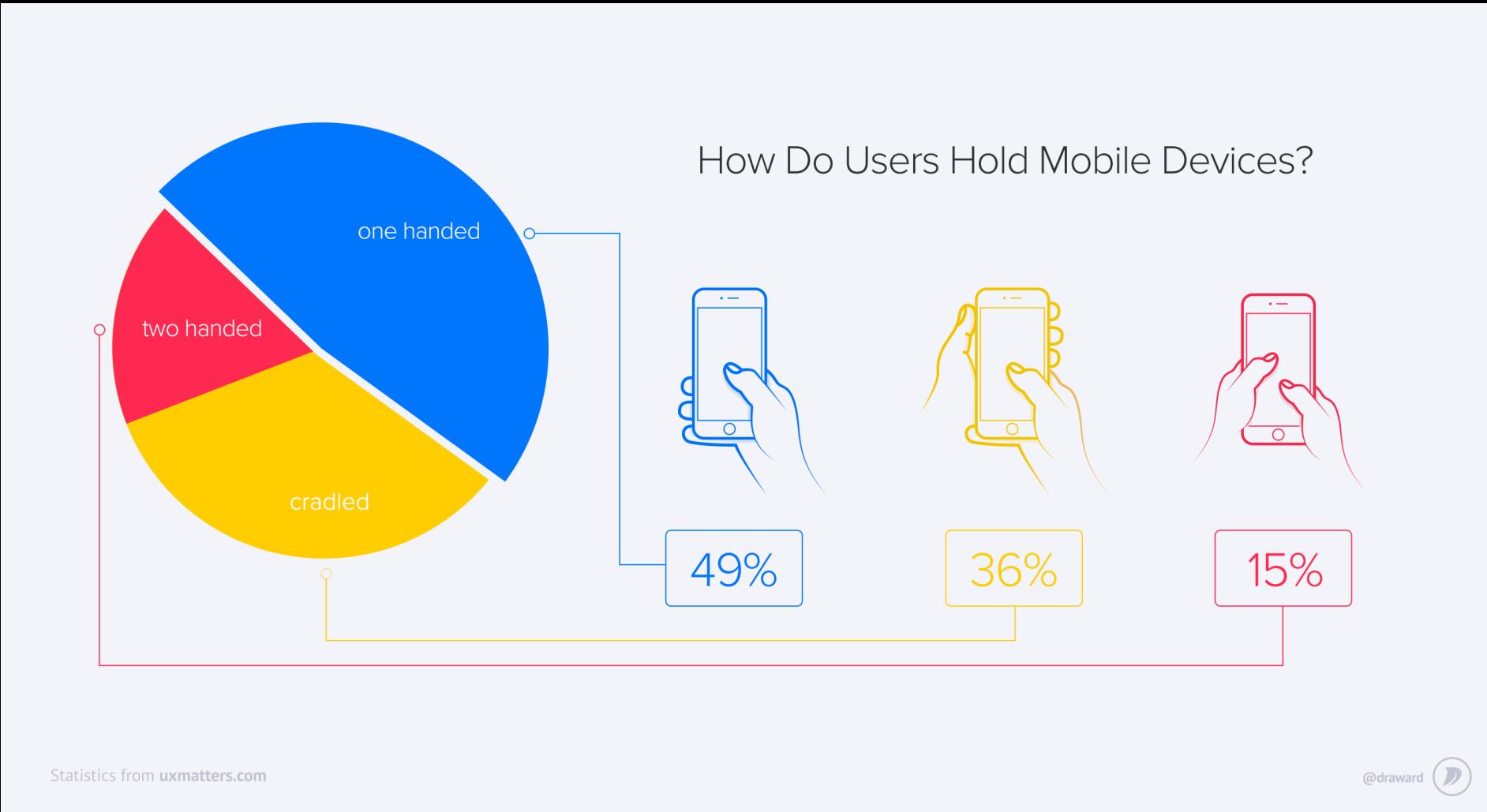




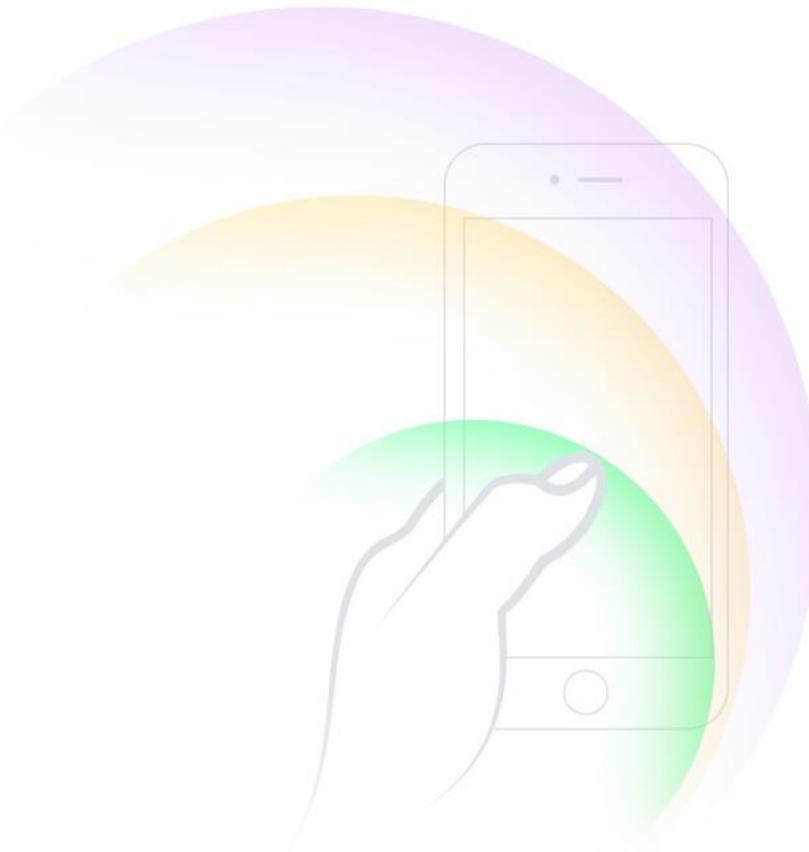
<https://www.youtube.com/watch?v=2YduyTzZews>



# LYFT'S USER INTERACTION INSIGHTS



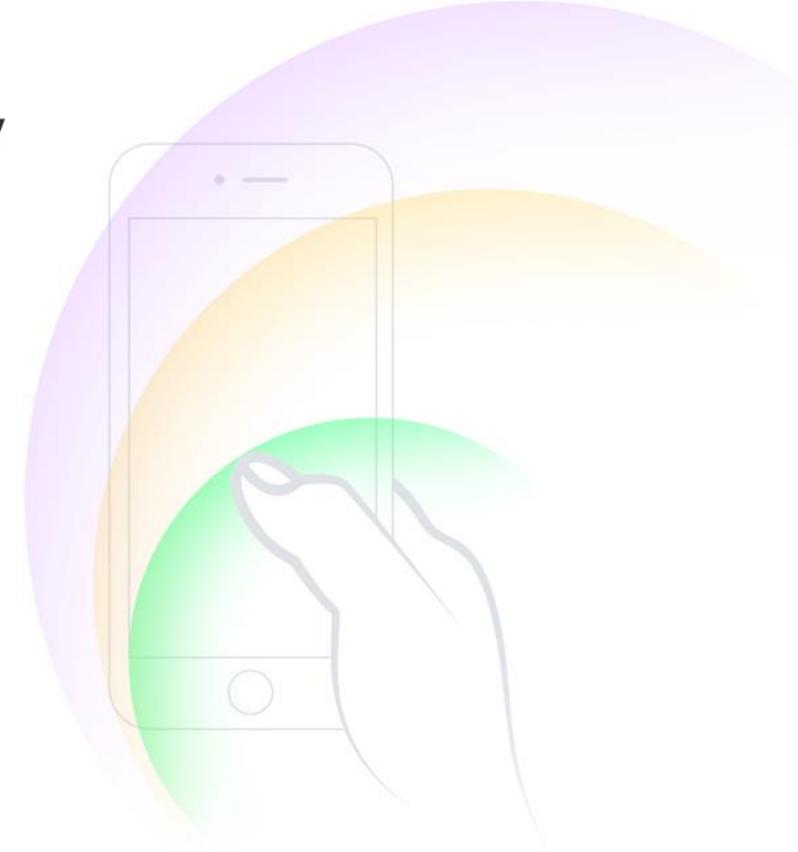
# LYFT'S USER INTERACTION INSIGHTS



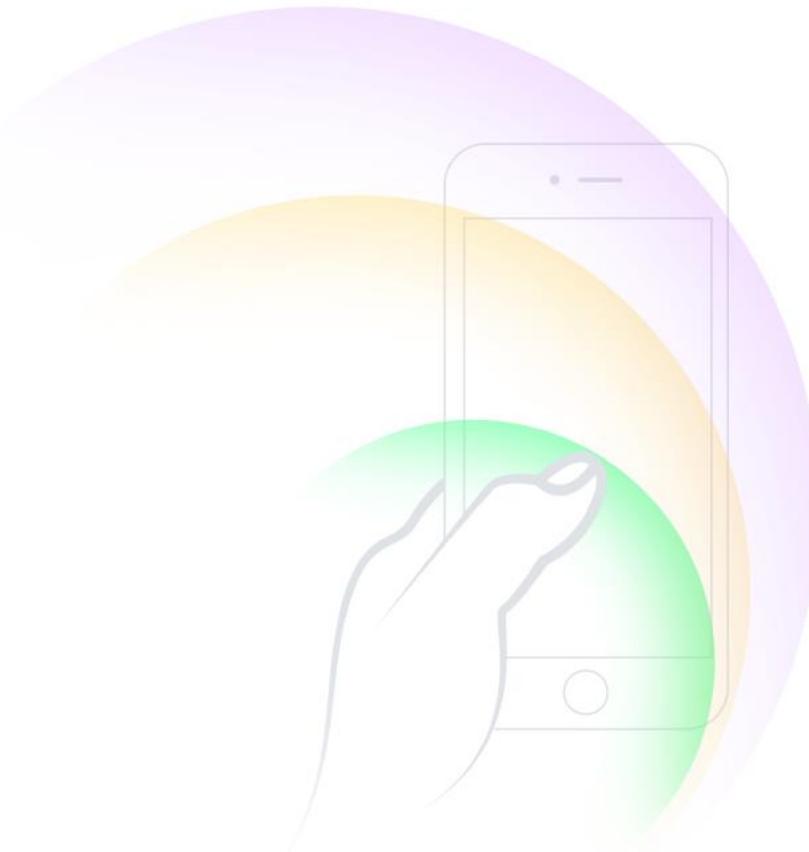
## Reachability

Left-Handed & Right- Handed Example

- — Good
- — Medium
- — Out of Reach (OW)



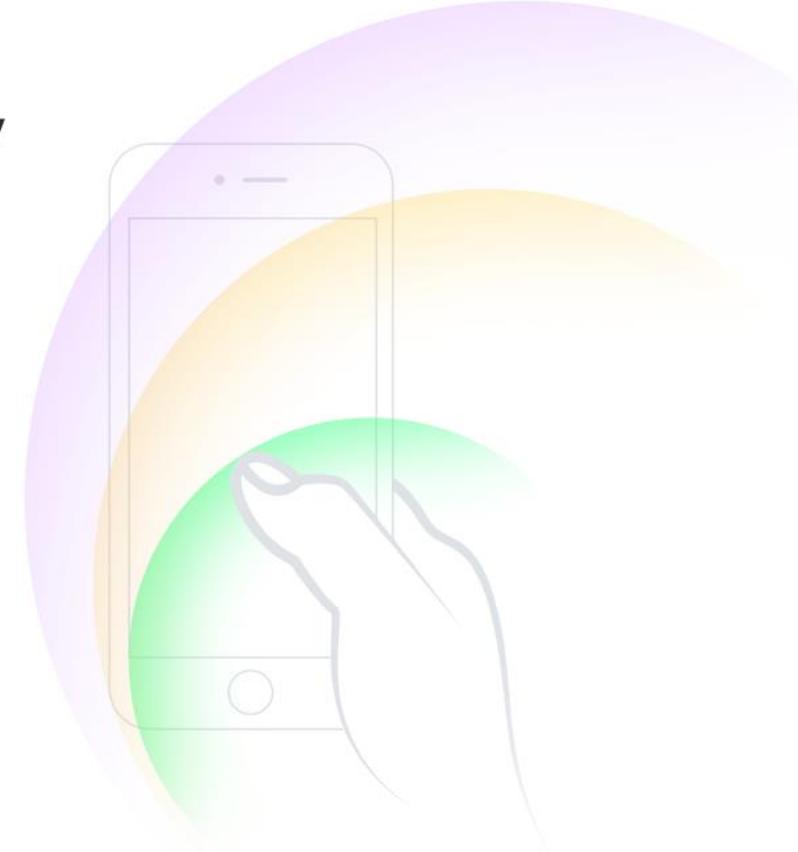
# LYFT'S USER INTERACTION INSIGHTS



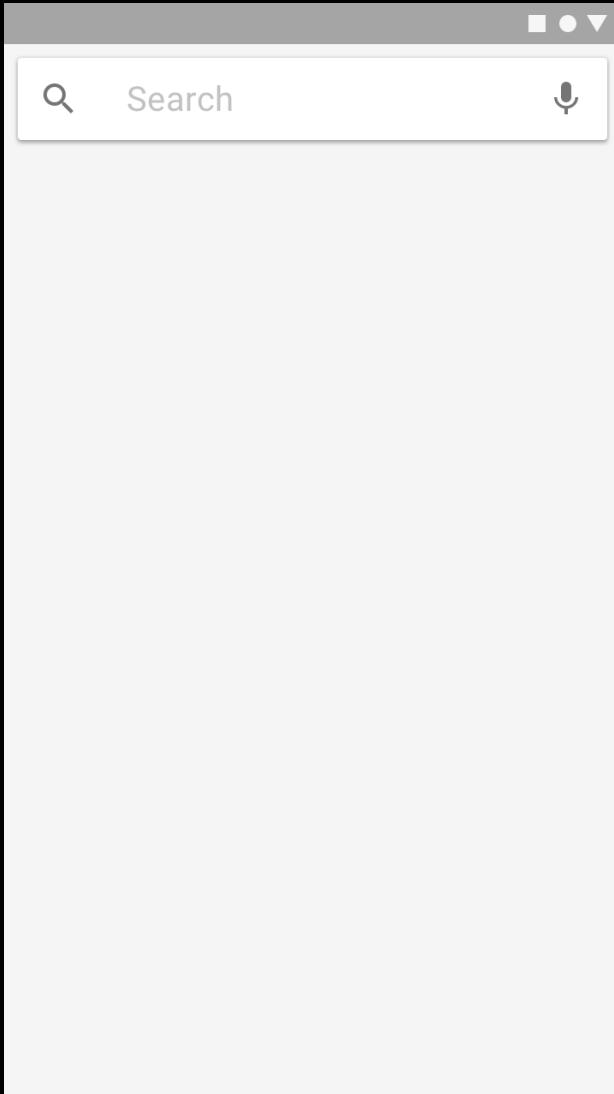
## Reachability

Left-Handed & Right- Handed Example

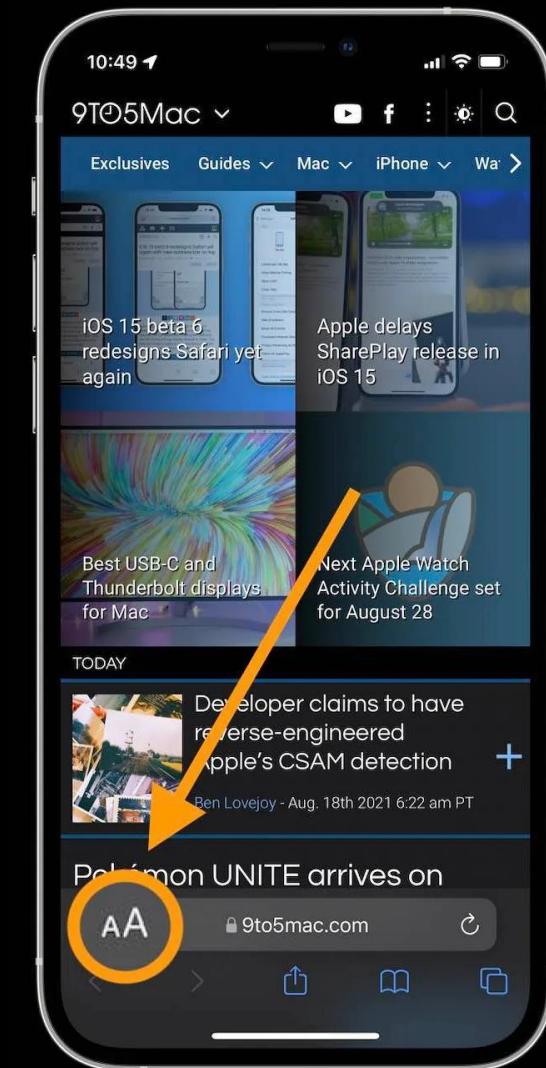
- — Good
- — Medium
- — Out of Reach (OW)



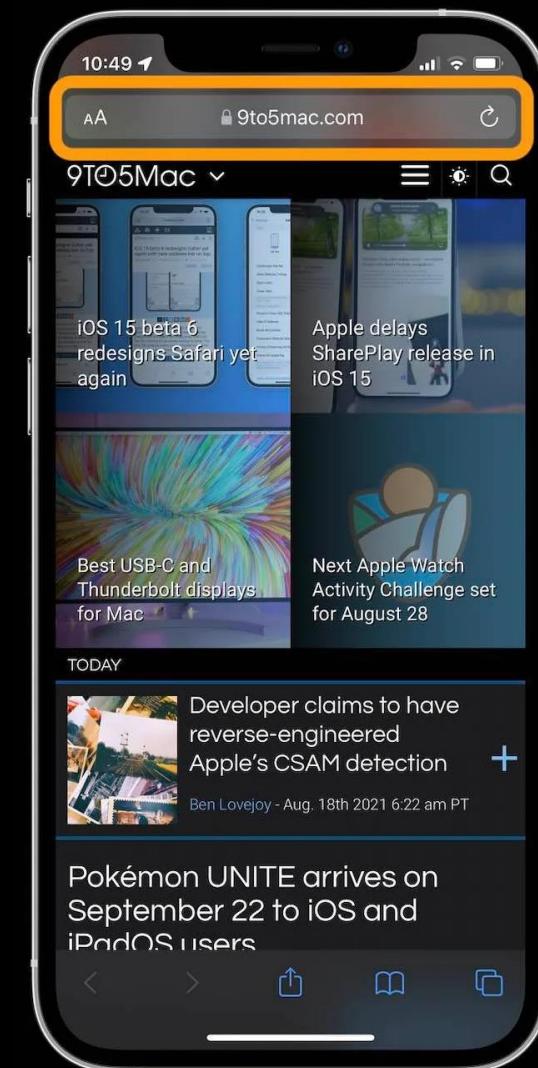
# SEARCH BAR ACCORDING TO POPULAR DESIGN GUIDELINES



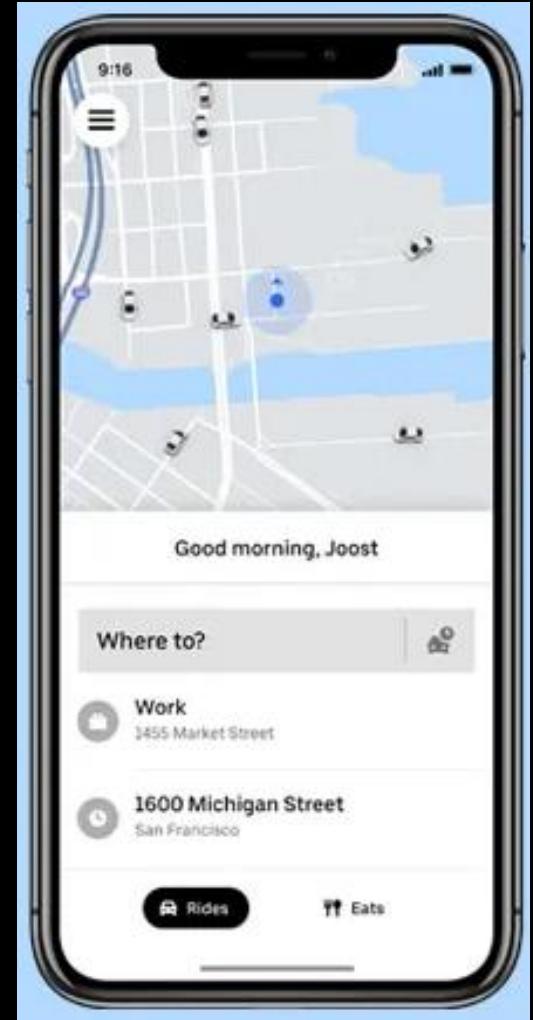
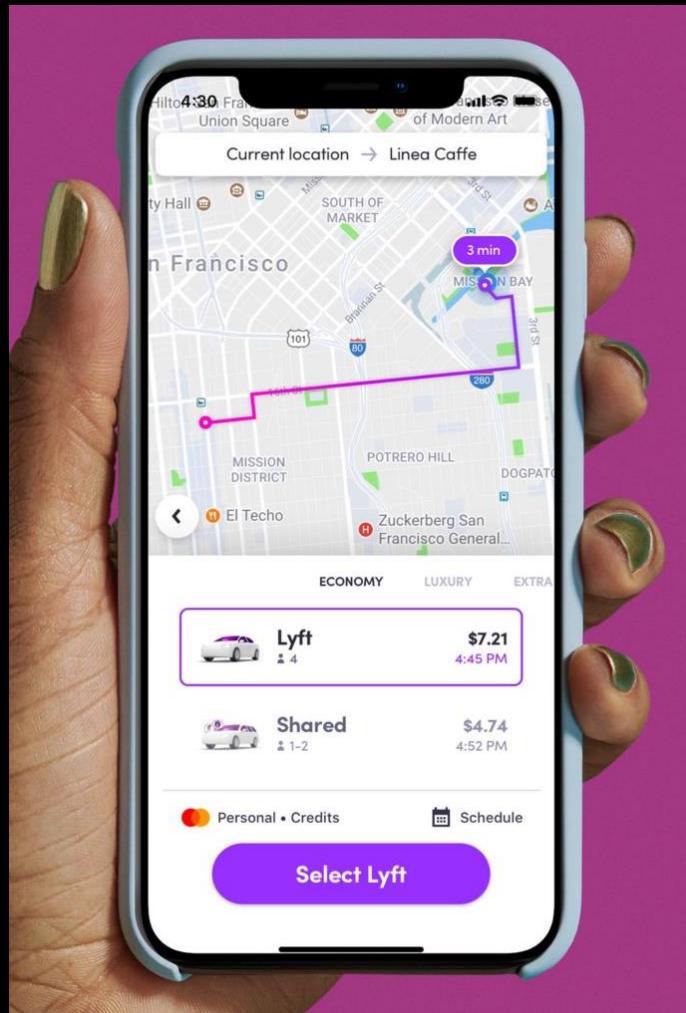
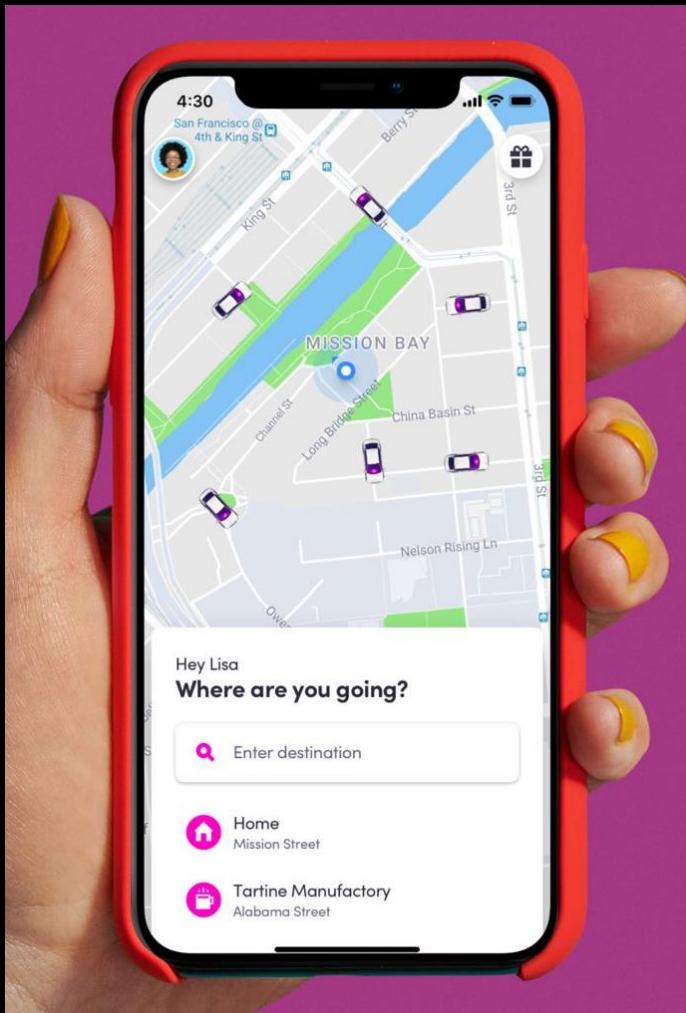
Google Material Design



iOS Material Design



# LYFT'S UNCONVENTIONAL RESEARCH BAR



# Human Cognition

# Attention



# Different types of attention

- Selected attention
- Focused attention
- Divided attention

# Selected attention



# Focused attention



# Divided attention



# Design implications for attention



https://www.facebook.com

\_Project Sweden souvenir shop... DELL Solved: XPS 13 9360, ... Thông báo mời nộp h... HCI Libraries

Create post

Lê Khánh Duy  
Friends

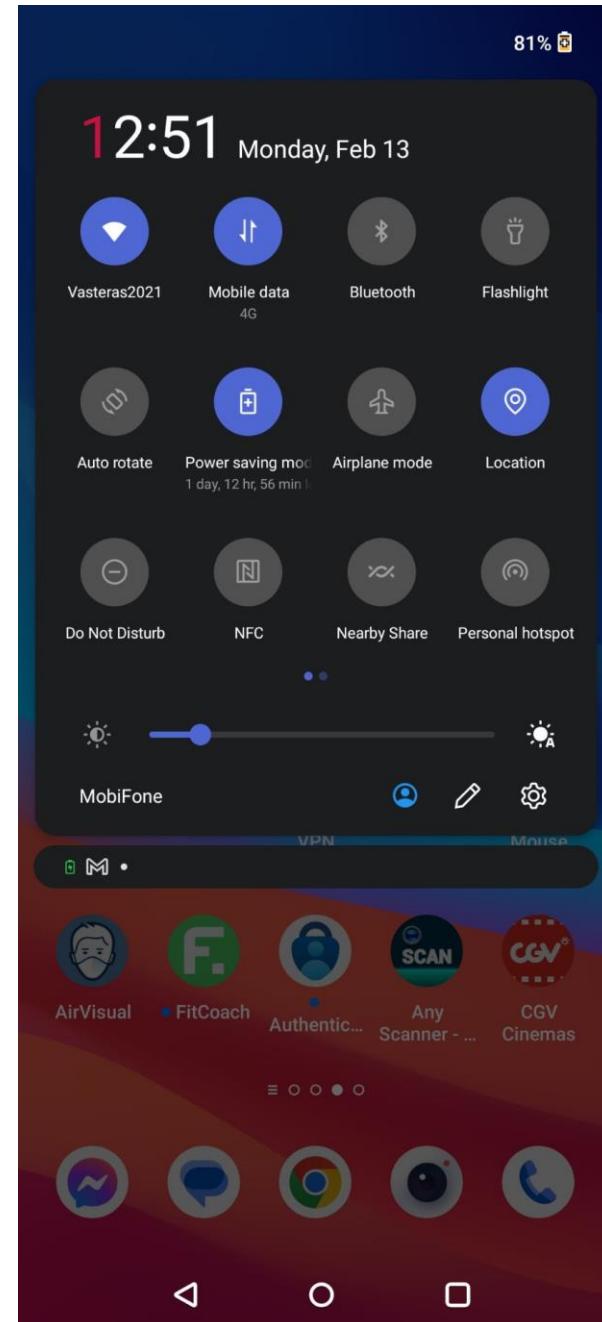
What's on your mind, Duy?

Aa

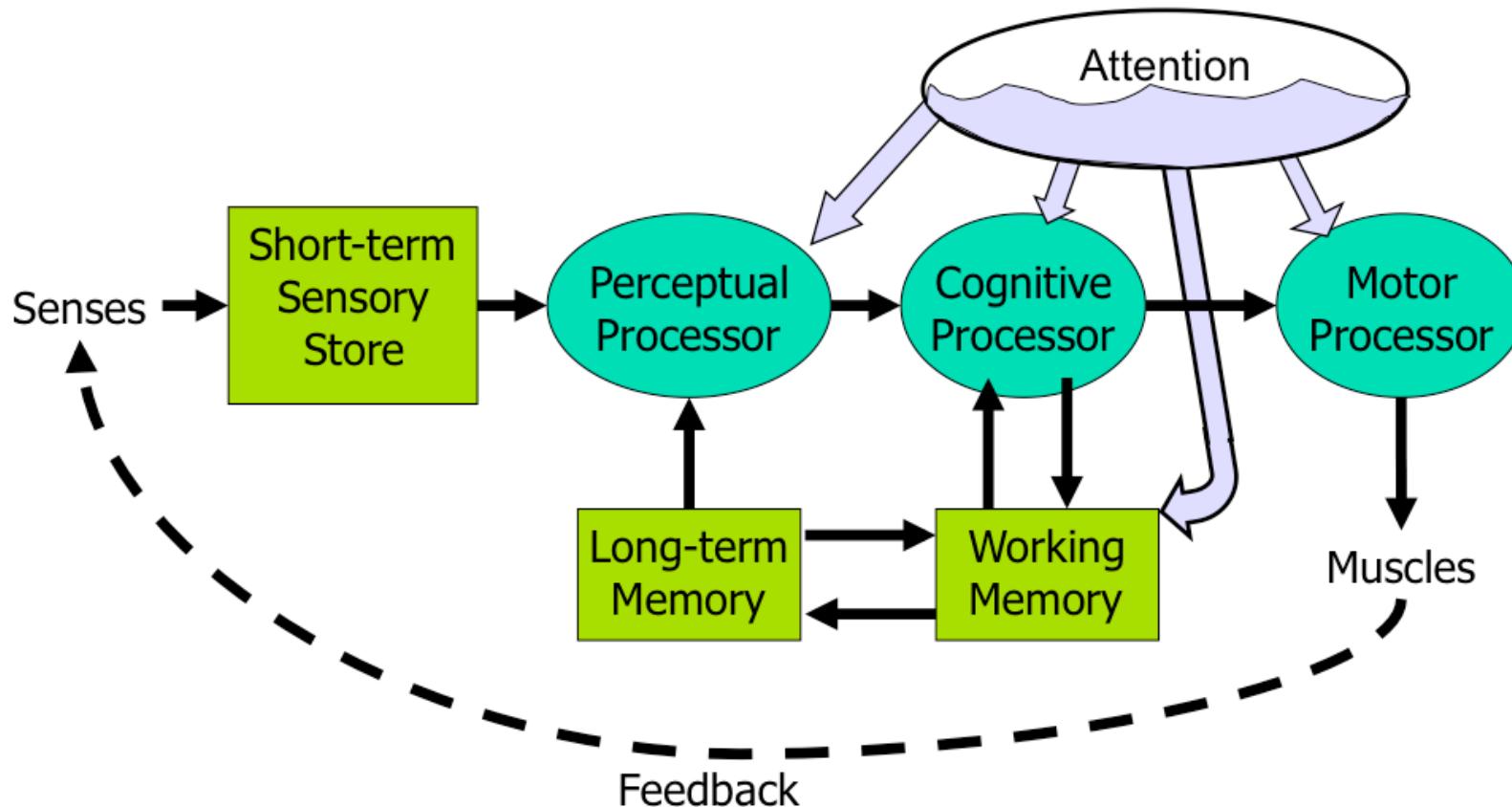
Add to your post

Post

hình dịch trên những ngữ liệu thu thập được, đồng thời xây dựng website hỗ trợ chuyển tự tự động từ chữ Nôm sang chữ Quốc ngữ (đã nộp hồ sơ đăng ký Quyền tác giả).



# Human information processing



(Source: MIT CS Course 6.813/6.831)

# Mini experiment

- Try to remember items below as many as you can

TKGD



CSC13112

Báo chí

Nhà đất

Xe đẹp



ebook

Nóng



Nhân văn

Kỹ sư mù sứ

Phần mềm

Con người

Valentine

Trịnh Công Sơn



Google

U23

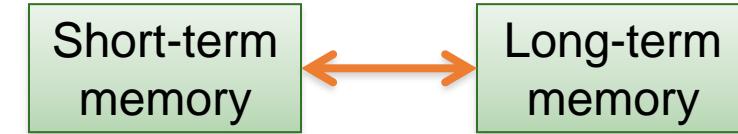
# Mini experiment (cont'd)

- How many items do you remember?
- How could you remember them?
  - familiar?
  - funny?
  - attracting your attention?
  - related?
  - repeating them?

# Memory

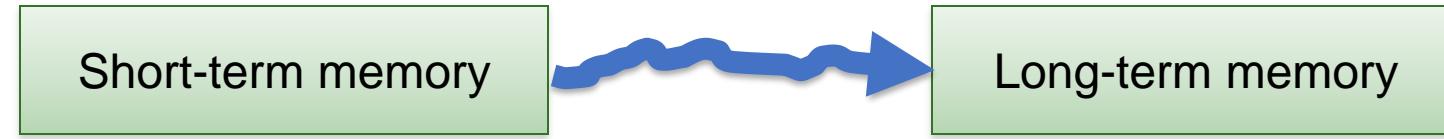


- Short-term memory (working memory)
  - Small: ~ 7 items or “chunks”
  - Short-lived: ~10 seconds
  - Repeating helps retain chunks
    - Distraction does the opposite
- Long-term memory
  - Unlimited size and duration
  - Elaborative rehearsal helps transfer chunks from short-term to long-term memory



# Learning

- A process of transferring and putting information from short-term to long-term memory



- Implications for user interface design?

# Chunking

- Chunk is a unit of memory or perception
  - Depends on how the information is presented

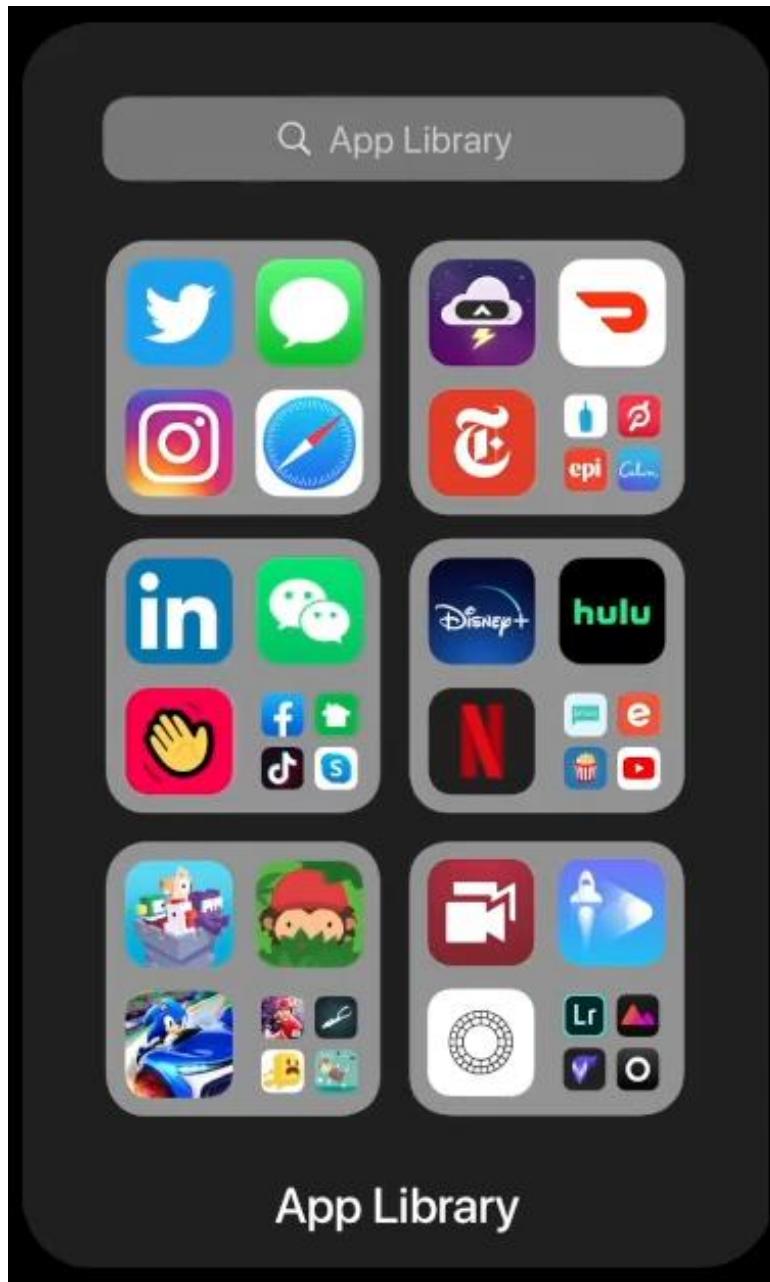
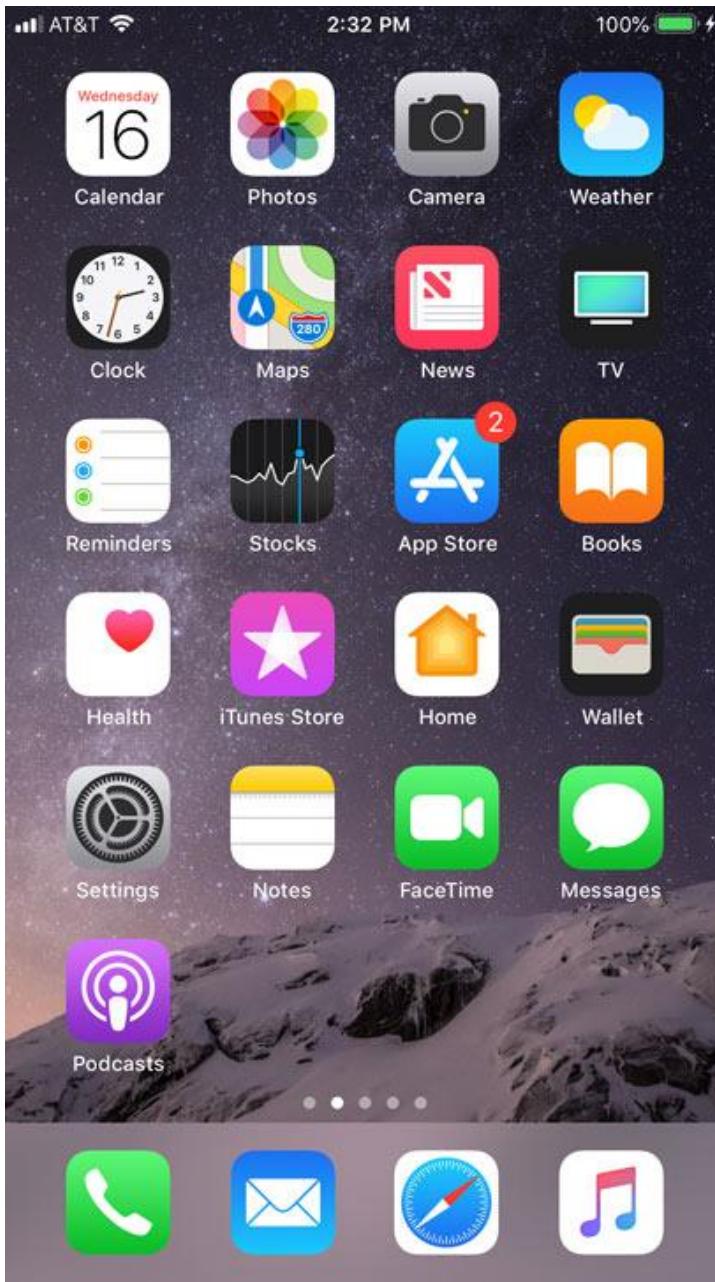
H A P P Y V A L E T I N E ← Hard to remember all

HAPPY VALENTINE ← Easy remember all

- Depends on what you already know
  - Linking with the past experience

0888247247 → 0888.247.247

323-481-1585





## TRA CỨU TRỰC TUYẾN



Tra cứu mã số BHXH



Tra cứu cơ quan BHXH



Tra cứu CSKCB cấp giấy  
nghỉ việc hưởng BHXH



Tra cứu CSKCB ký hợp  
đồng khám, chữa bệnh  
BHYT



Tra cứu đơn vị tham gia  
BHXH



Tra cứu các tổ chức dịch  
vụ thu BHXH, BHYT



ĐL cá nhân



Dịch vụ công



Tra cứu



Trao đổi



## TRA CỨU TRỰC TUYẾN



Tra cứu mã số BHXH



Tra cứu cơ quan BHXH



Tra cứu đơn vị tham gia  
BHXH



Tra cứu các tổ chức dịch  
vụ thu BHXH, BHYT



ĐL cá nhân



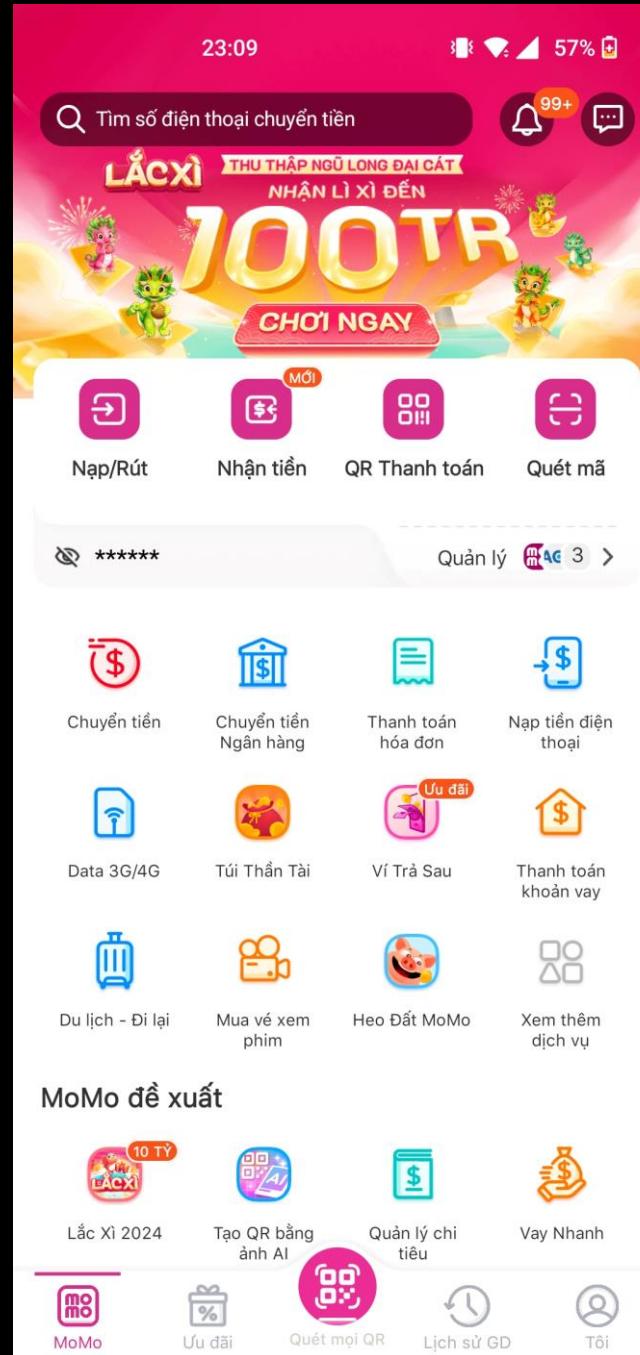
Dịch vụ công

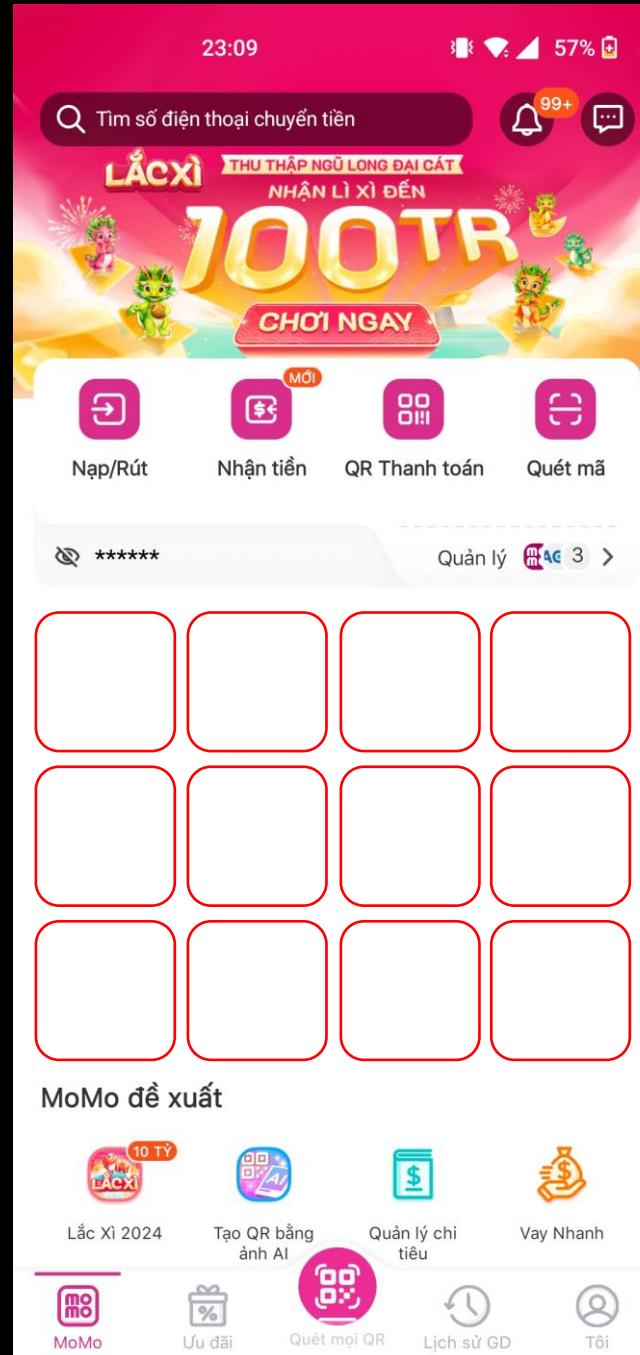


Tra cứu



Trao đổi

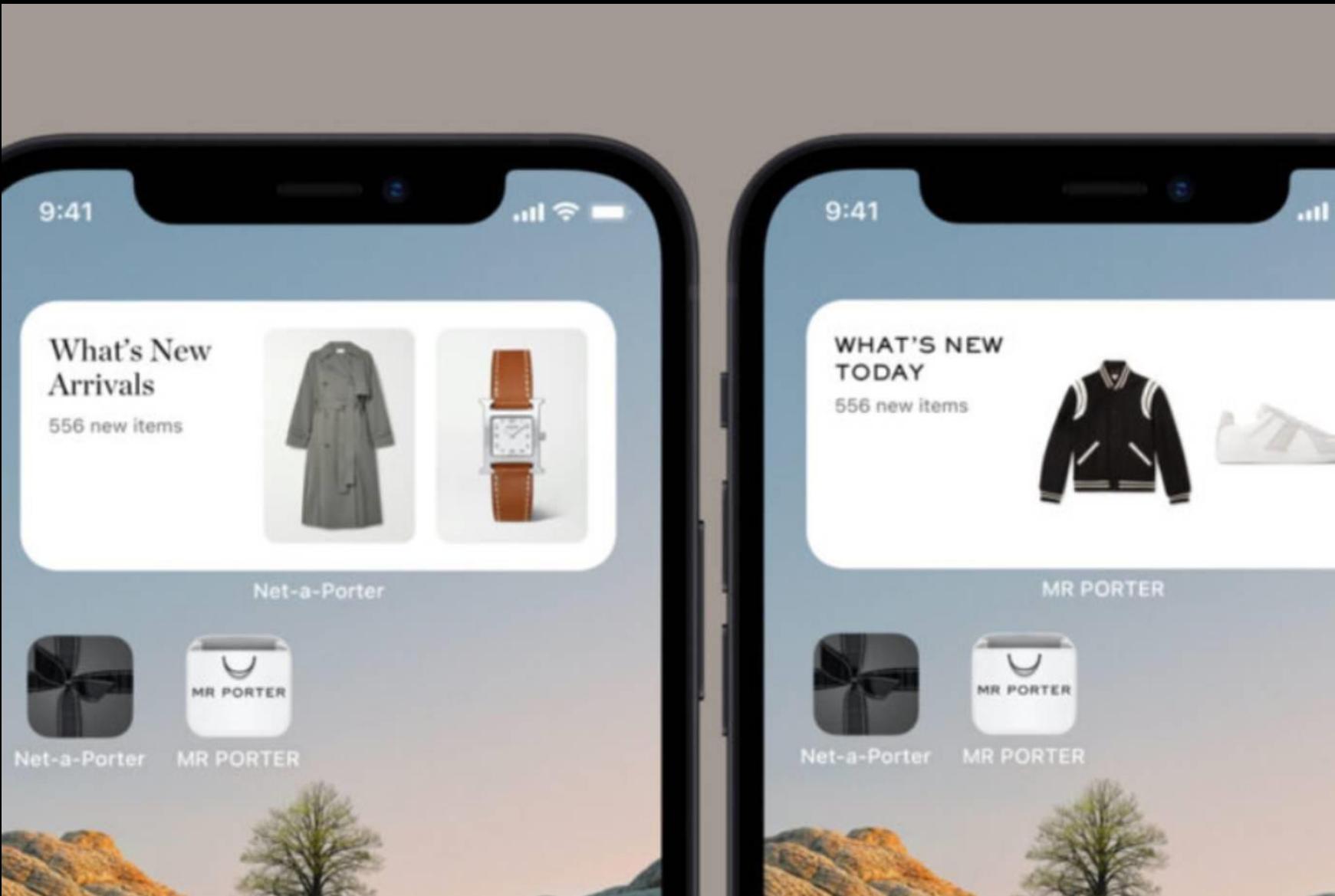




# iOS Shortcut UIs



# Mr.Porter Glanceable UI



# Recognition versus recall



# Recognition and Recall

- Recognition

- Remembering with the help of a visible cue (evidence – bằng chứng)
- e.g., you recognize your friend easily when seeing his/her face, but you may not remember his/her name.

<b>Một giao diện tốt là giao diện *</b>	
<input type="checkbox"/>	Dễ học
<input type="checkbox"/>	Hiệu quả
<input type="checkbox"/>	Dễ nhớ
<input type="checkbox"/>	Có nhiều màu sắc
<input type="checkbox"/>	Tránh và phục hồi lỗi tốt
<input type="checkbox"/>	Mới lạ

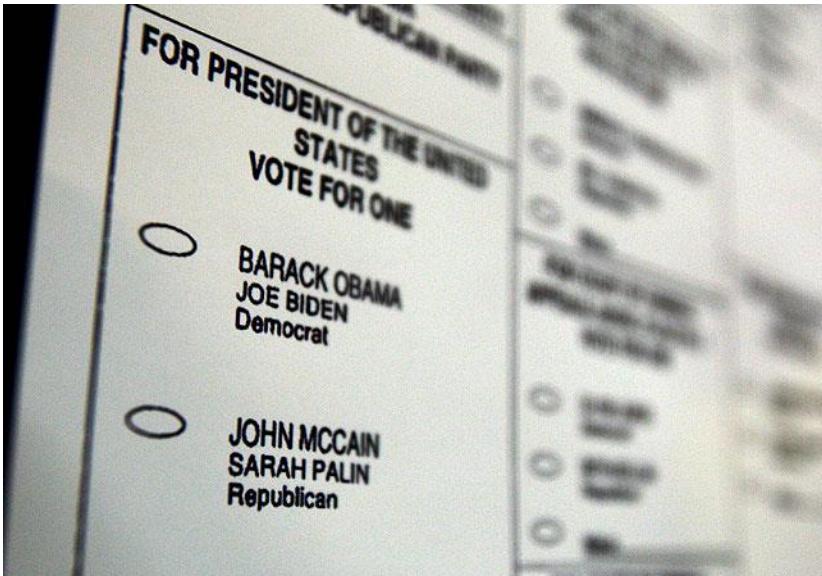
# Recognition and Recall (cont'd)

- Recall
  - Remembering with no help
  - e.g., you remember a person when someone refers to him
  - Do you remember her name?
- It is easier to recognize than recall things
  - You don't remember every items in the File menu of Notepad, do you?
  - But you recognize their functions when you look at them



# Recognition and Recall (cont'd)

- Which one is recall and recognition?



**FOR PRESIDENT OF THE UNITED STATES**

**WRITE NAMES OF THE CANDIDATES TO VOTE FOR**

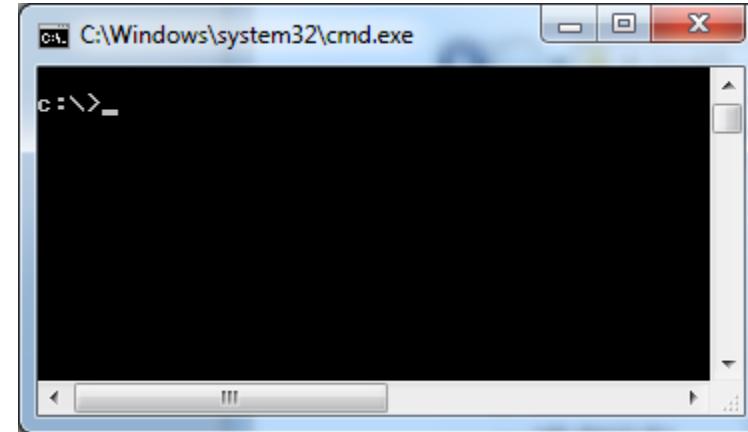
# Recognition and Recall (cont'd)

- Implications
  - Performing operations via visual presentation is more learnable than via command line
  - Direct manipulation is more learnable than other interface styles

Delete a file name keymap.txt

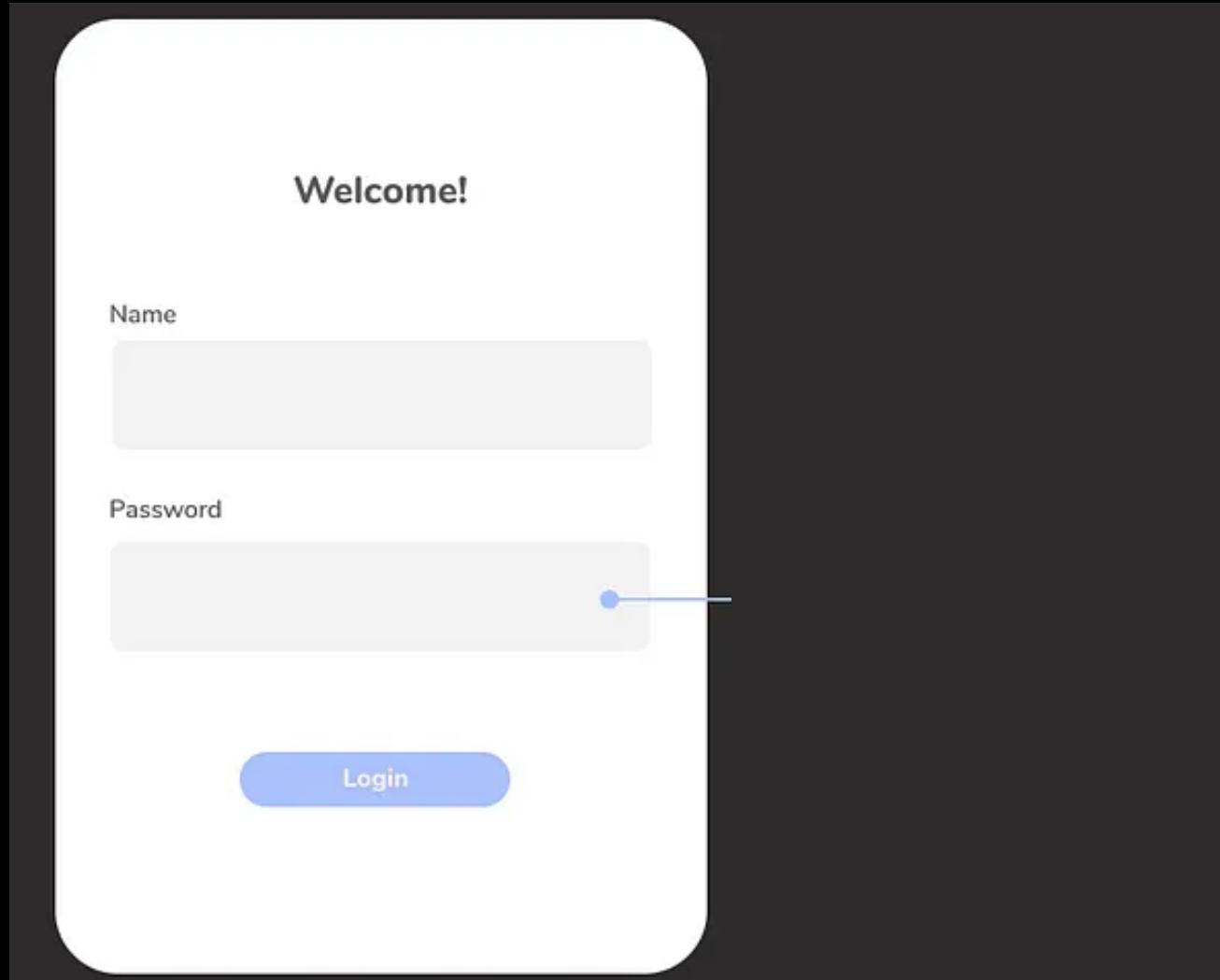


Delete a file name keymap.txt



What do you need to remember to do?

# Recall in UI





by Okta

## Welcome

Log in to Auth0 to continue to Auth0  
Community.

Email address

Continue

OR



Continue with Microsoft Account



Continue with GitHub



Continue with Google

8:40

Cancel



### How to Set Up Face ID

First, position your face in the camera frame. Then move your head in a circle to show all the angles of your face.

Get Started

Accessibility Options

8:40

Cancel



Move your head slowly to complete the circle.

8:40

Cancel

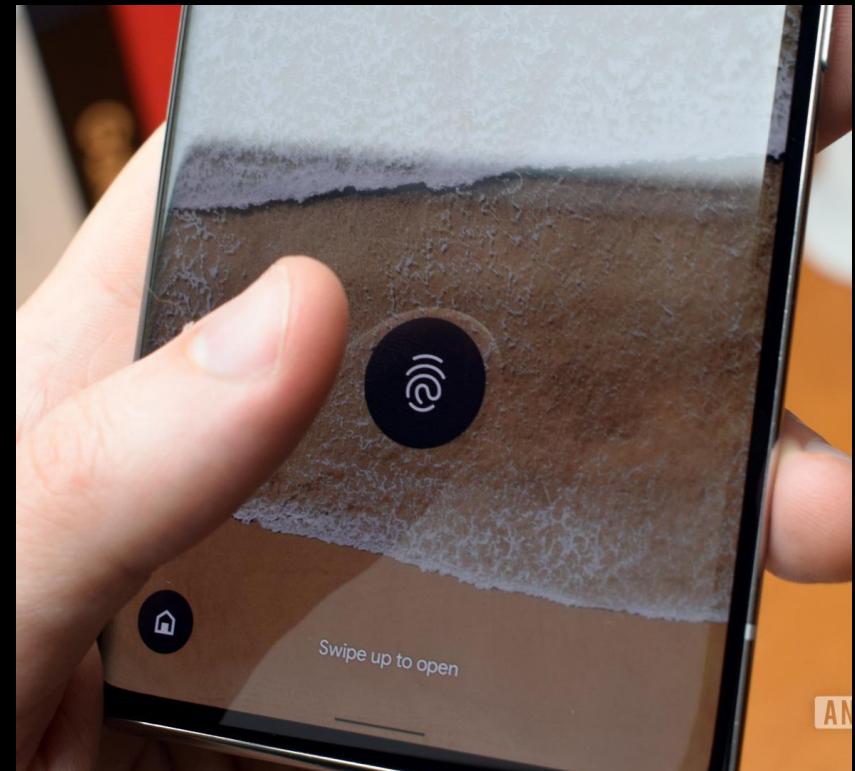


First Face ID scan complete.

Continue

8:40

Cancel



**M SERIES**  
**MONEY HEIST**

▶ Play + My List

**Watch Part 3 Now**

With millions of euros and their lives on the line, nine robbers attempt to pull off the greatest heist of all time.

TV-MA

New Release

NSARIS RIGHT NOW

Emmy Winner • Prison • Gal Pals

ON JUNE 12

WHITNEY CUMMINGS: CAN I TOUCH IT? • COMEDIANS IN CARS GETTING COFFEE • OTHERHOOD • BASKETBALL

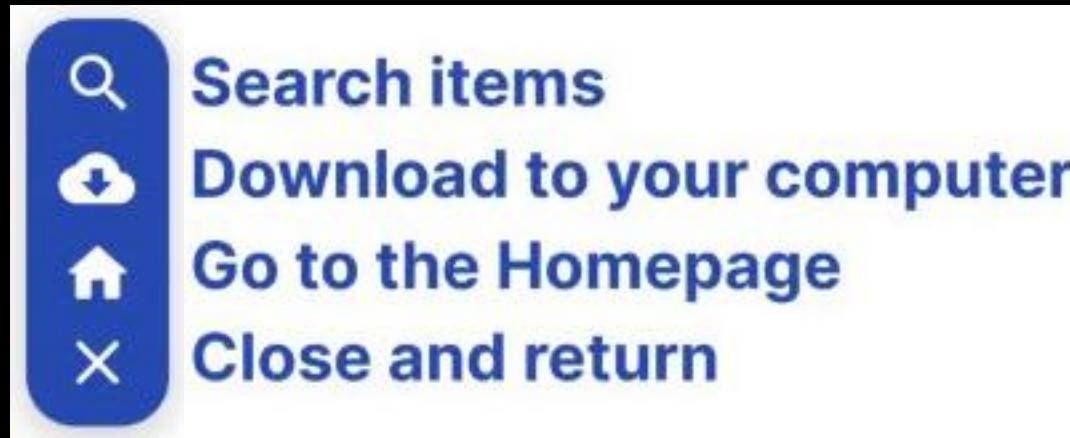
Continue Watch

MONEY HEIST • GREAT HACK • I AM MOTHER • WEIRDO • BLACK HOLE APOCALYPSE • DONALD GLOVER

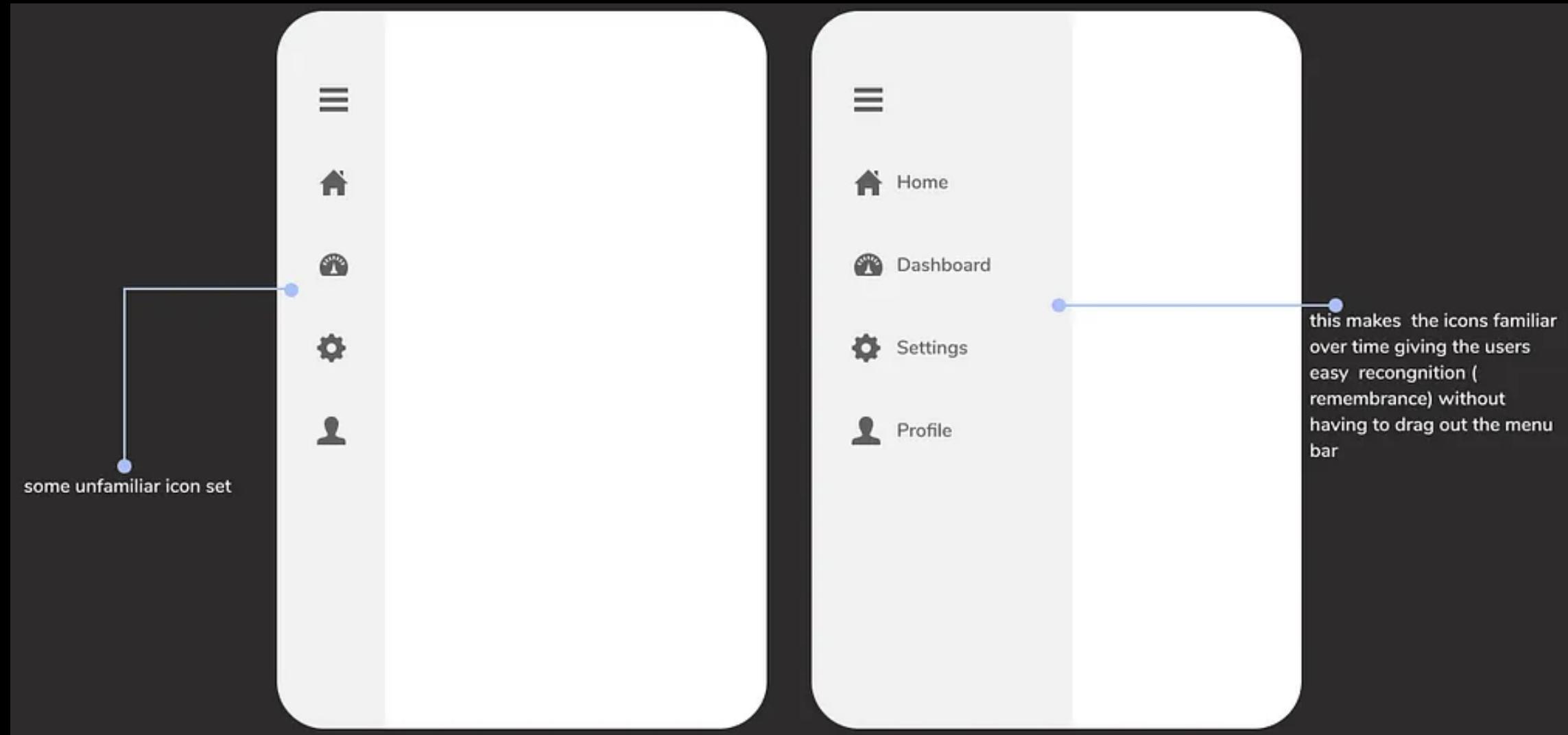
Trending Now

the office • QUEER EYE • FOX

# Recognition in UI



# Support Recognition in UI





MAI

MAI  
MỘT BỘ PHIM CỦA TRẦN THÀNH  
TẾT 2024

OFFICIAL FIRST LOOK TRAILER

MAI  
Lãng Mạn

18+ Phim được phổ biến đến người xem từ đủ 18 tuổi trở lên

Ngày khởi chiếu  
10/02/2024

Thời lượng  
**151 phút**

Ngôn ngữ  
Phụ đề

**★ 9.1 /10**  
(30.5k đánh giá)

9-10 ★   
7-8 ★   
5-6 ★   
3-4 ★   
1-2 ★

Đáng xem (9.6k) Cảm động (6.4k)  
Tuyệt vời (4.5k) Hài lòng (4.2k)

Mua vé

**MAI**

MOT BO PHIM CUA TRAN THANH  
TET 2024

**OFFICIAL FIRST LOOK TRAILER**

**MAI**  
Lãng Mạn

**18+** Phim được phổ biến đến người xem từ đủ 18 tuổi trở lên

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Tuyệt vời (4.5k) Hài lòng (4.2k)

**Mua vé**

**MAI**

momo | LOTTE CINEMA 3/3

H.nay	Thứ 3	Thứ 4	Thứ 5	Thứ 6	Thứ 7	C.N
<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>01</b>	<b>02</b>	<b>03</b>

Tất cả 9:00 - 12:00 12:00 - 15:00 15:00 -

**Rạp đề xuất (5)** TP.HCM

**Lotte Nowzone**  
Bạn ở gần rạp này • 0.2 km

Tầng 5, TTTM Nowzone, 235 Nguyễn Văn... [Tìm đường](#)

**2D Lồng tiếng**

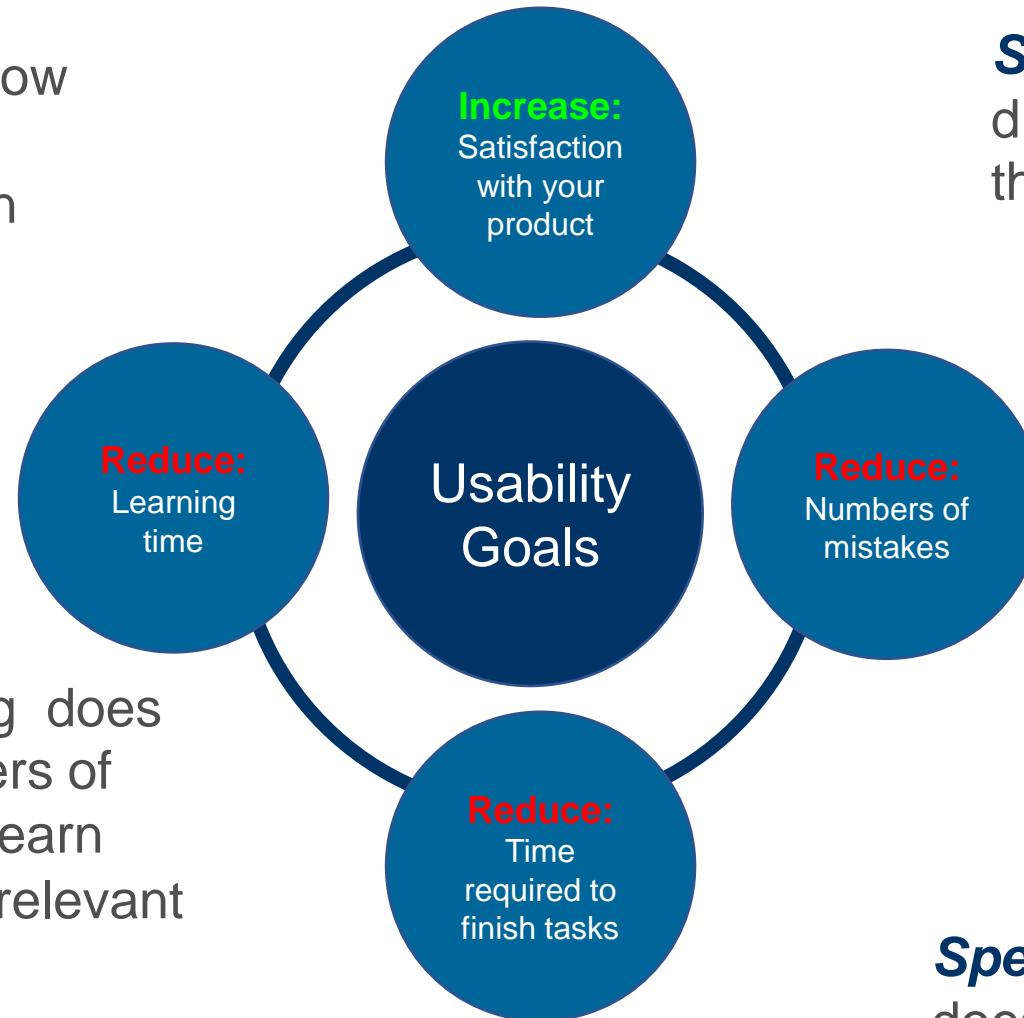
<b>12:15 ~ 14:46</b> 138/138 Ghế	<b>14:00 ~ 16:31</b> 136/138 Ghế	<b>14:45 ~ 17:16</b> 136/138 Ghế
<b>15:30 ~ 18:01</b> 103/103 Ghế	<b>16:30 ~ 19:01</b> 138/138 Ghế	<b>17:15 ~ 19:46</b> 130/138 Ghế
<b>18:00 ~ 20:31</b> 103/103 Ghế	<b>19:00 ~ 21:31</b> 138/138 Ghế	<b>19:45 ~ 22:16</b> 130/138 Ghế

# Usability definition

- Usability
  - How well users can use the system's functionality
- Dimensions
  - Learnability
    - How easy it is to learn and use?
  - Efficiency
    - How quickly users perform tasks using the UI?
  - Memorability
    - How easy it is for users to reestablish proficiency?
  - Errors
    - Are the errors committed by users often? Is it easy to recover from errors?
  - Satisfaction
    - Are users satisfied with the UI?

# USABILITY GOALS AND MEASURES

**Retention over time:** How well do users maintain their knowledge after an hour, a day, or a week?



**Time to learn:** How long does it take for typical numbers of the user community to learn how to use the actions relevant to a set of tasks?

**Subjective satisfaction:** How much did users like using various aspects of the interface?

**Rate of errors by users:** How many and what kinds of errors do people make in carrying out the benchmark tasks?

**Speed of performance:** How long does it take to carry out the benchmark tasks?

# Remember this?

## UX vs. Usability

Evaluation of understandability vs. holistic design

Designing it right vs. the right design

Often, poor usability leads to a bad user experience, but not necessarily

# USABILITY EVALUATIONS

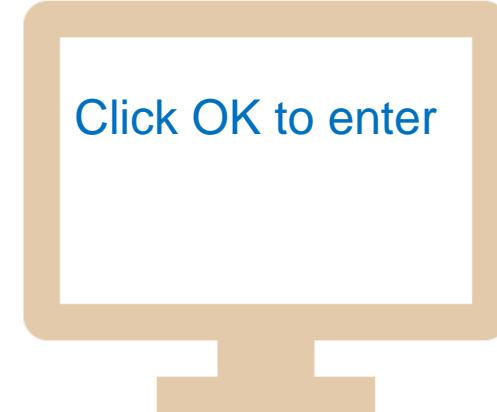


# HOW TO DESIGN FOR A GOOD USABILITY?

- Visibility
- Accessibility
- Consistency
- Affordances

# Visibility

- Operations should be visible to users
  - Unix commands are very invisible vs. Windows' menus
  - Right click menus are not very visible
    - A reason why iOS does not support much right-click
  - Drag-drop is not either
    - But it's a direct manipulation style reflecting real world
- Visibility versus Simplicity
  - More visibility may result in reduced simplicity



# VISIBILITY



# VISIBILITY



# Accessibility

## Why is Accessibility Important?

Types of impairments that affect how people use your digital product



VISUAL



AUDITORY



COGNITIVE



MOBILITY

# Accessibility



# Accessibility



# AFFORDANCES

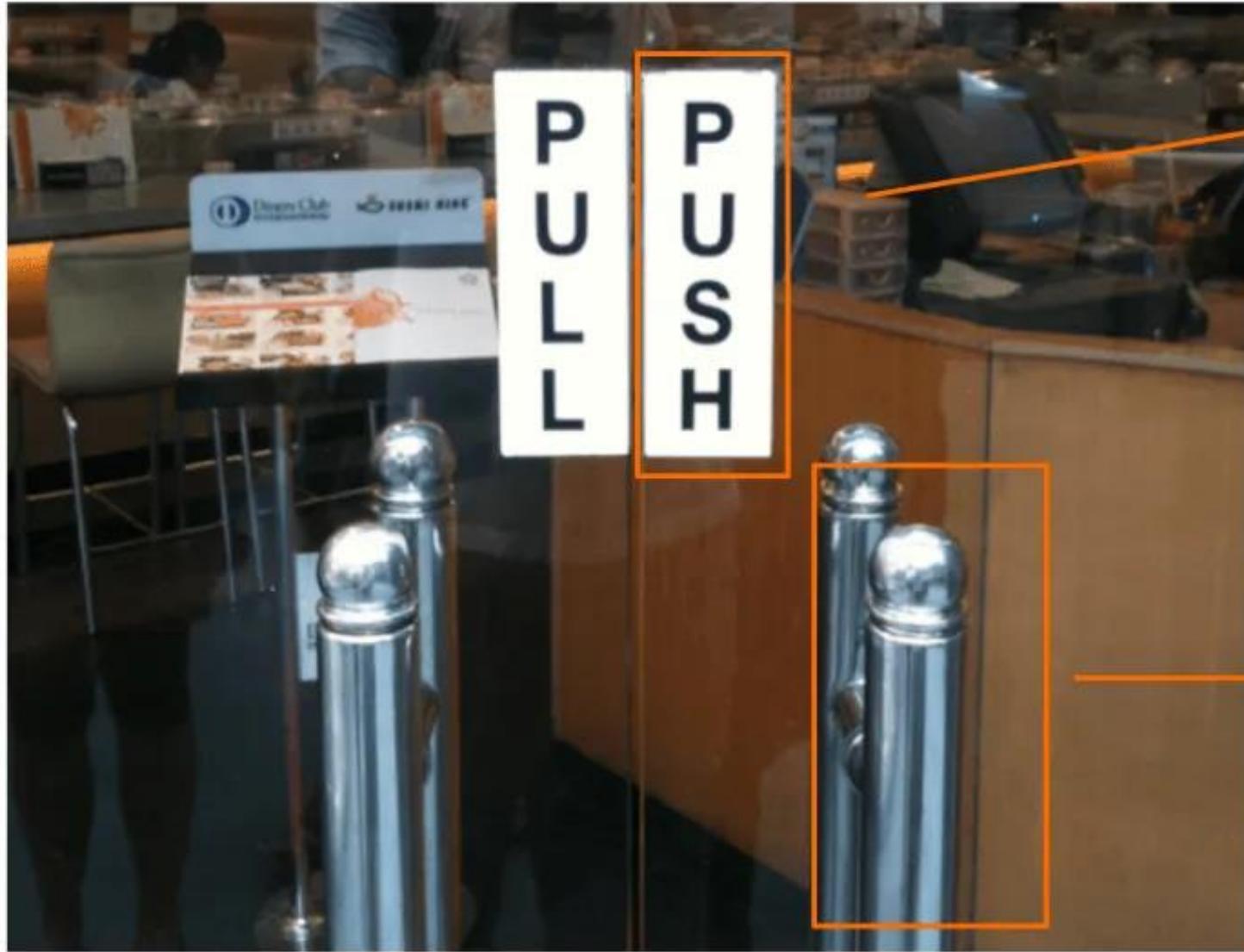
## Affordance

- Perceived and actual properties of an object that give clues to its operation



## Examples of Affordances





## Signifier

- Sign to explain what to do (because the affordances are confusing)

## Affordance

- Handle to physically grasp

*Which one is a button?*



IPSUM

IPSUM



## New Releases

**ON JUNE 12**

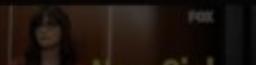
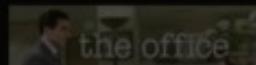
Emmy Winner • Prison • Gal Pals



## Continue Watch



## Trending Now



# Natural mapping

- Physical arrangement of controls matches arrangement of their operations
- It's best to map directly, but not always have to be
  - Light switches
  - Car's turn signals



# Feedback

- Actions should have immediate effects
  - e.g., push buttons, scroll bars, mouse icons
- Feedback types
  - Audio
  - Visual
  - Haptic (giving a feeling, e.g., vibration of a mouse click)

# Consistency

- Similar things should work similarly
  - Fonts, colors, icons, layouts, etc.
- Different things should look different
- Consistency types
  - Internal: within the system
  - External: across different systems
  - Metaphorical: reflecting real-world objects
    - A print icon is a metaphor of the printer

Bad

This is an  
amazing title

Since company's name isn't  
so self-explanatory, landing  
section will have clear title  
of couple words that will...

This is an  
amazing title

Since company's name isn't  
so self-explanatory, landing  
section will have clear title  
of couple words that will...

**This is an  
amazing title**

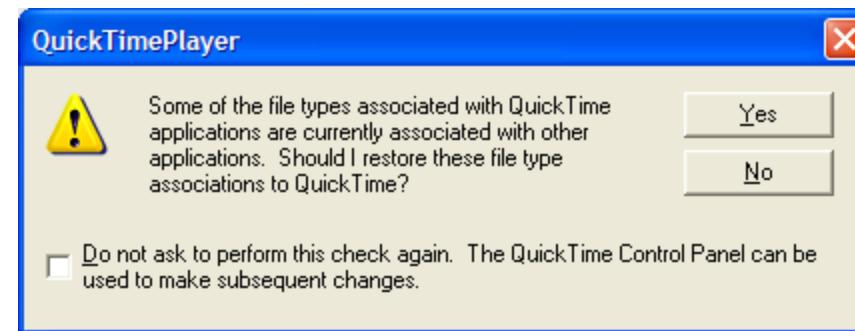
Since company's name isn't  
so self-explanatory, landing  
section will have clear title of  
couple words that will...

**This is an  
amazing title**

Since company's name isn't  
so self-explanatory, landing  
section will have clear title of  
couple words that will...

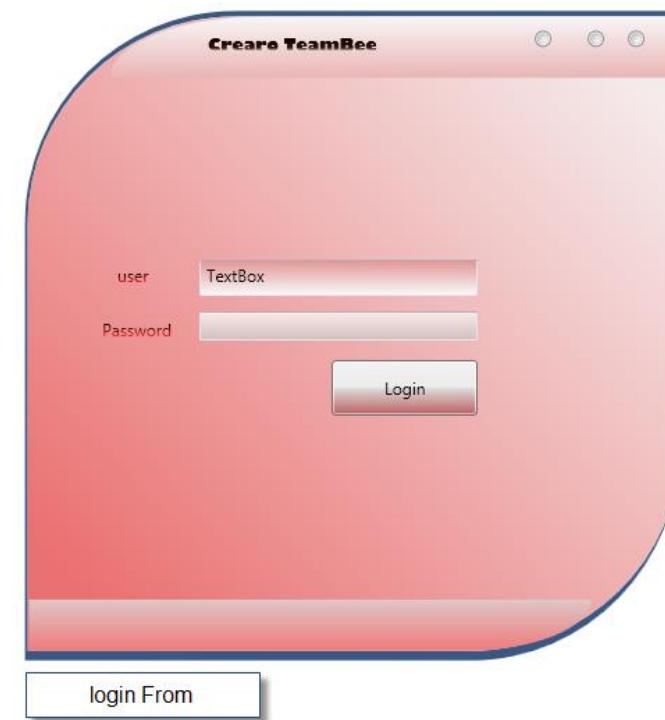
# Consistency (cont'd)

- Speak the user's language
  - Use common words, avoid slangs and jargon
  - But avoid wordy and overly verbose



# Platform standards

- Follow guidelines of platforms
  - MS Windows user interface guidelines
  - Apple user experience guidelines
- Follow frameworks
  - Various frameworks have their own looks and feels guidelines
- Learn from existing applications

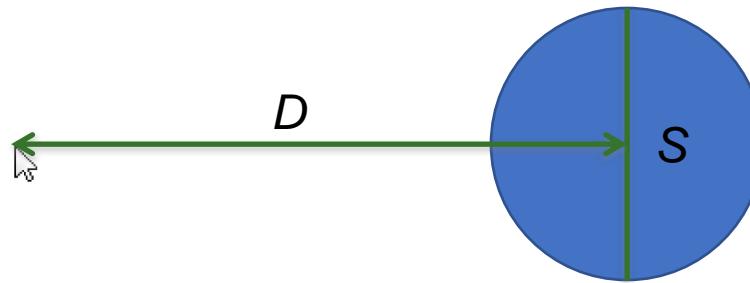


# Efficiency

# Fitts's law

- Time  $T$  to move hand to a target of size  $S$  at distance  $D$  away from the mouse pointer is

$$T = a + b * \log(D/S + 1)$$



- $a$  and  $b$  are constants
- $T$  is dependent only on  $\log(D/S + 1)$
- $\log(D/S + 1)$  is defined as *index of difficulty*

# Implications of Fitts's law

- Similar targets should be grouped
- Targets at screen edge are easy to hit
- Pie menu is faster to use than linear menu
  - It's faster 15-20% according to a study by Callahan, 1994
- Lengthy menus should be avoided

(Callahan et al. 1994, "An empirical comparison of pie vs. linear menus," CHI 1991)

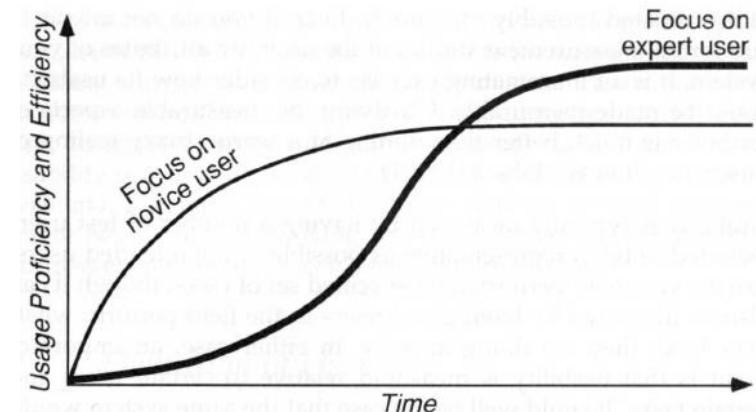
# Power law of practice

- Time  $T_n$  to do a task the  $n$ th time is

$$T_n = T_1 * n^{-a}$$

$a$  is typically from 0.2 to 0.6

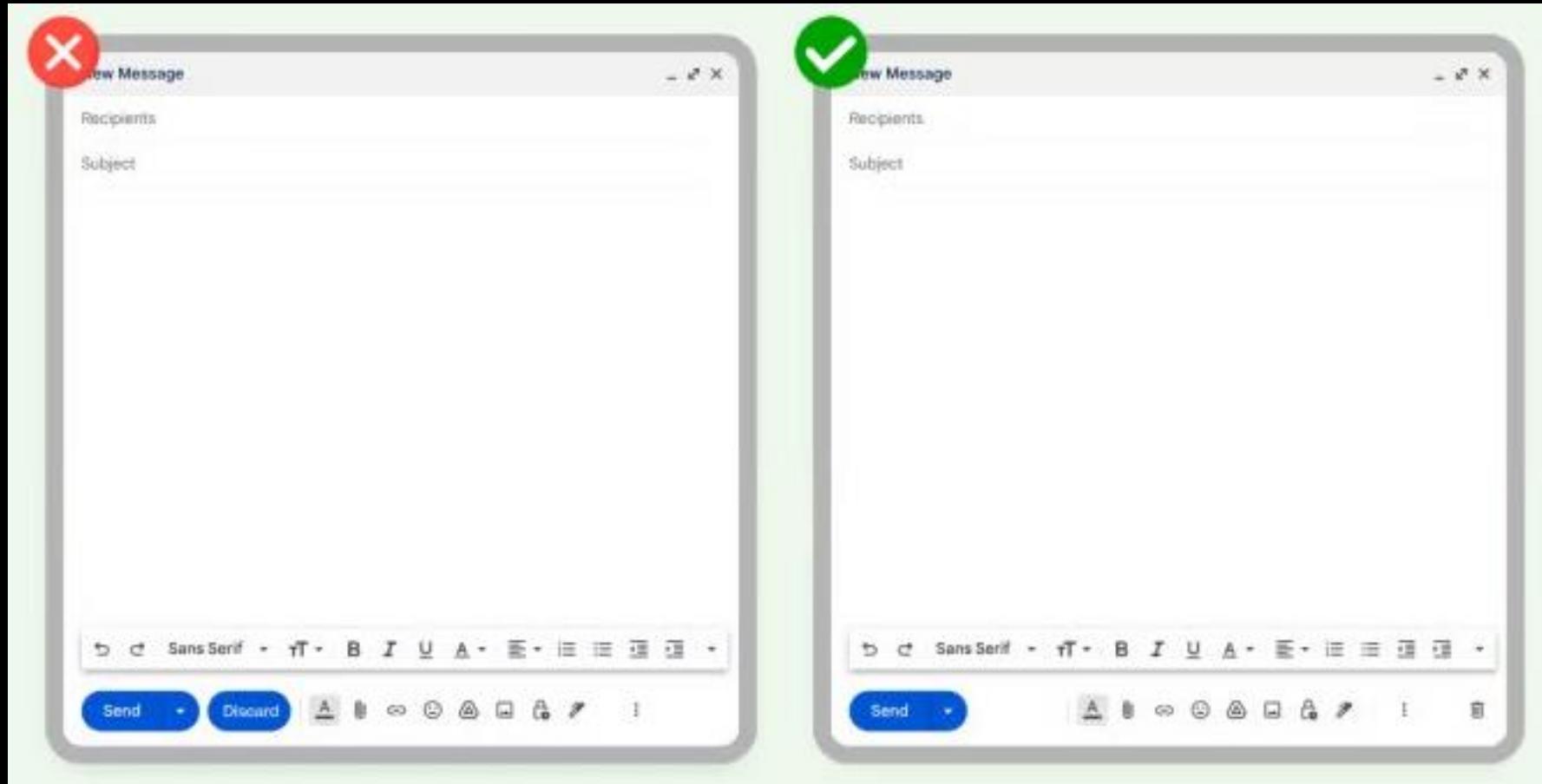
- Implications
  - With practice, novices get better
  - But their performance becomes nearly flat
  - Remember the Nielsen's Learning curve?



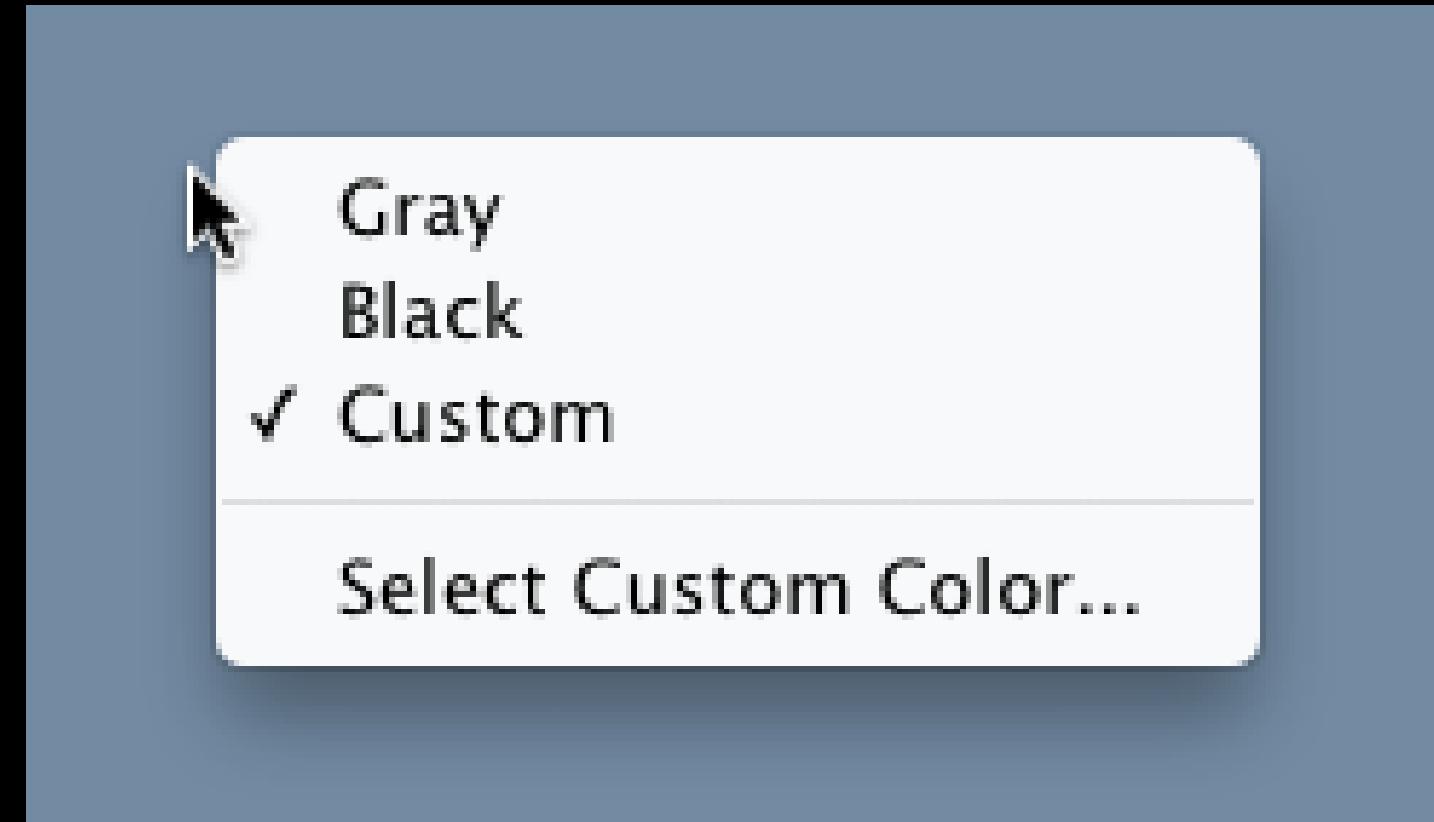
# SCROLL BARS & NAVIGATION ARROWS

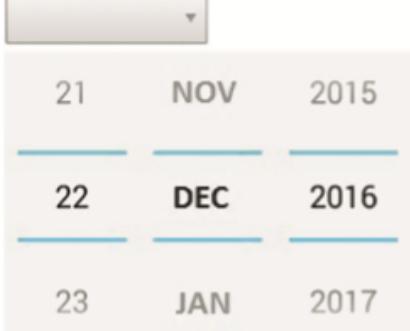


# Gmail Threw Discard Button Away



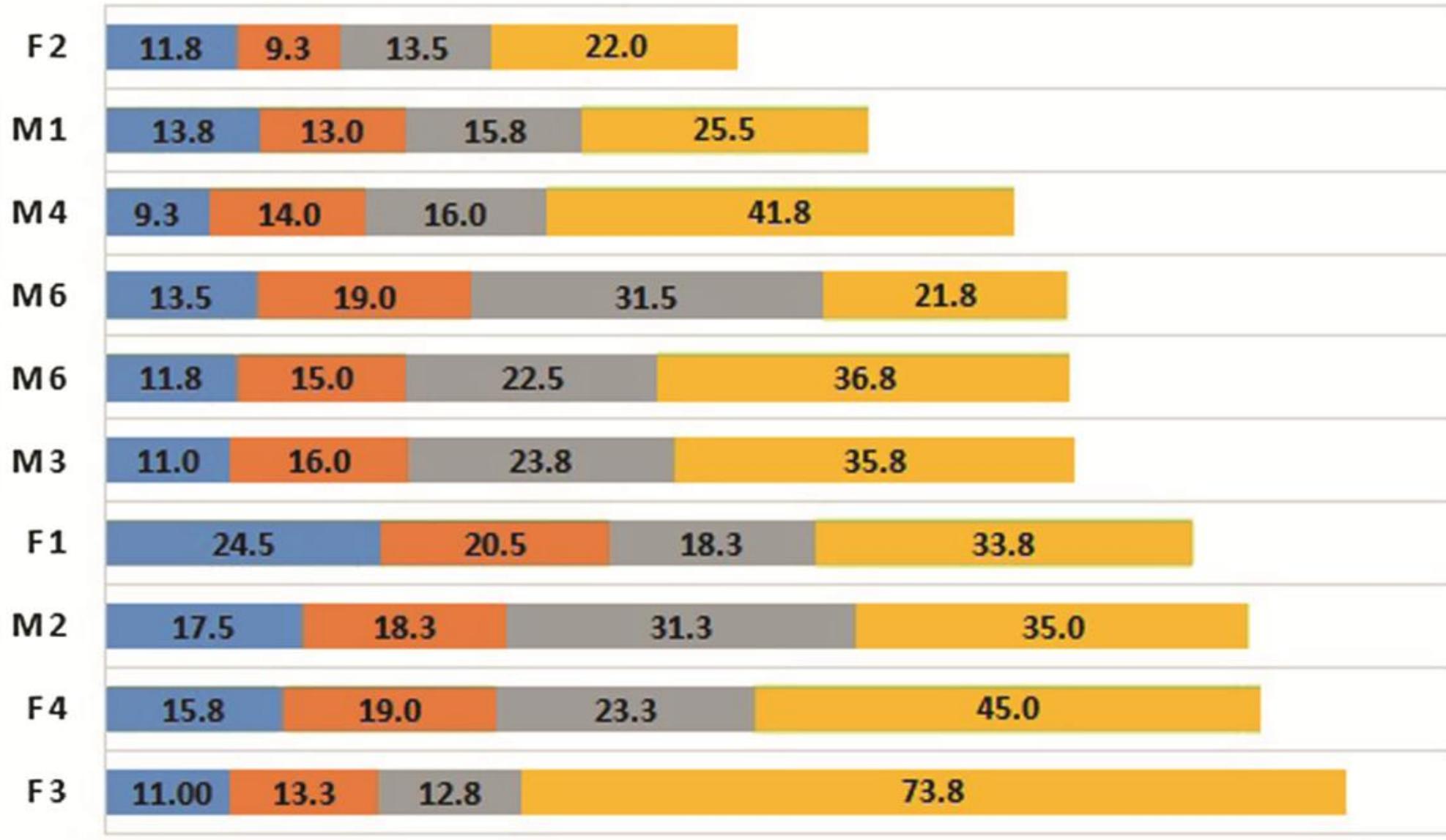
## POP-UP MENUS

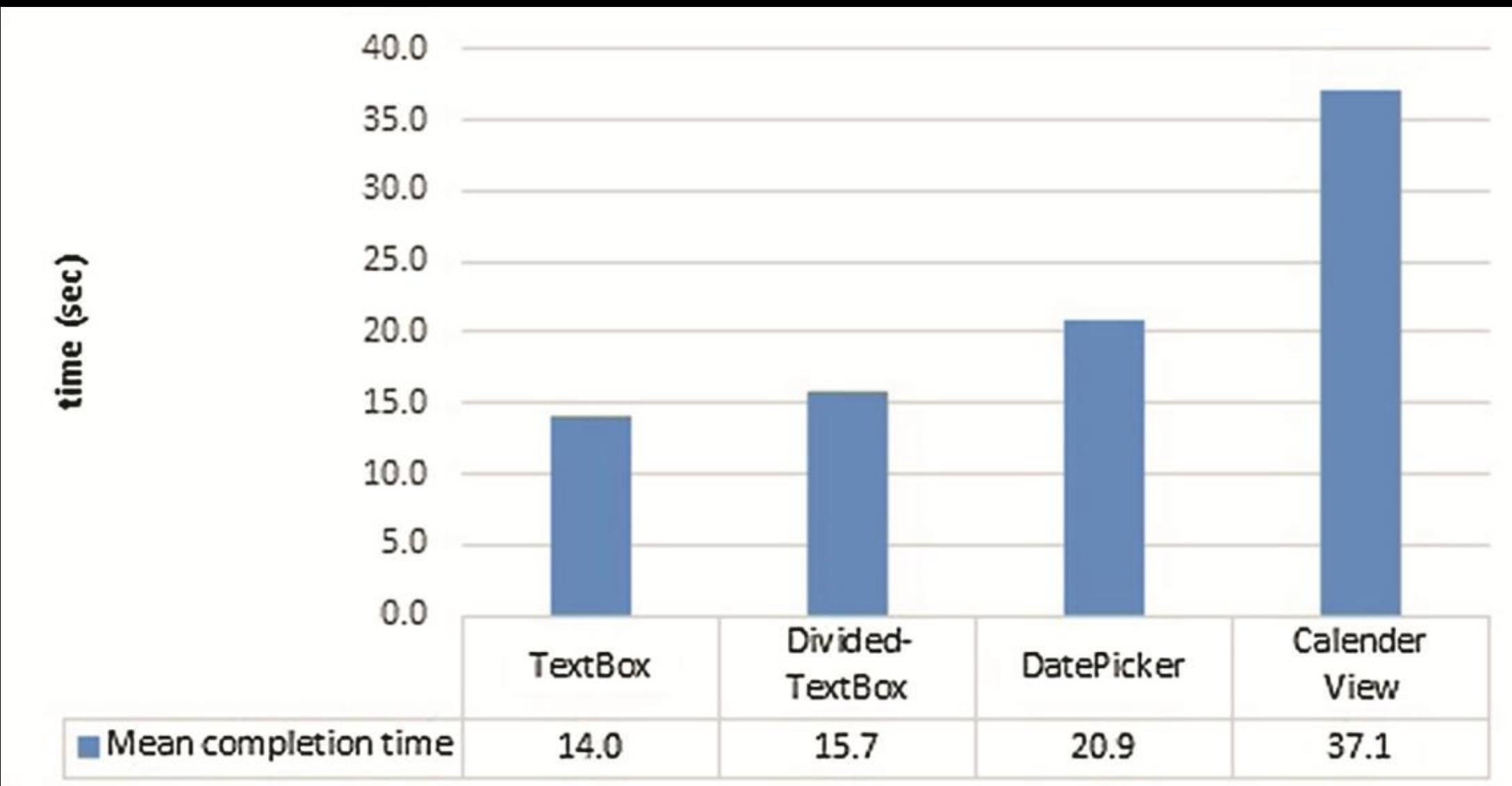


Input method	Design version
Text box	<b>dd/mm/yyyy</b>
Divided text box	<b>dd mm yyyy</b>
Date picker	
Calendar view	

Türkcan, A. Kürşad, and Pınar Onay Durdu. "***Entry and selection methods for specifying dates in mobile context.***" In *Human-Computer Interaction. Interaction Technologies: 20th International Conference, HCI International 2018, Las Vegas, NV, USA, July 15–20, 2018, Proceedings, Part III* 20, pp. 92-100. Springer International Publishing, 2018.

■ TextBox ■ Divided-TextBox ■ DatePicker ■ Calender View





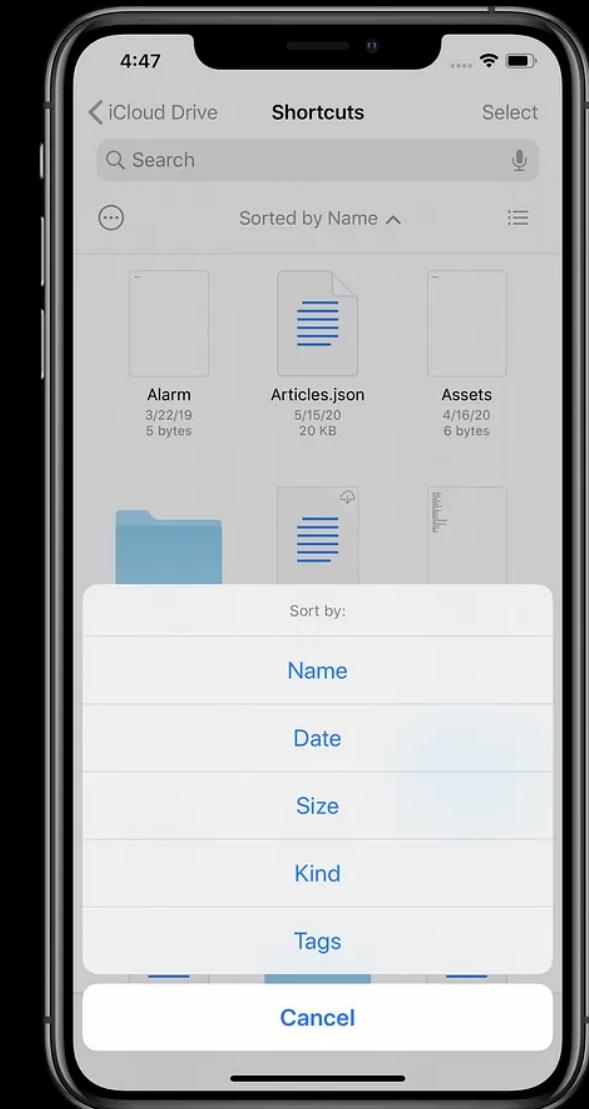
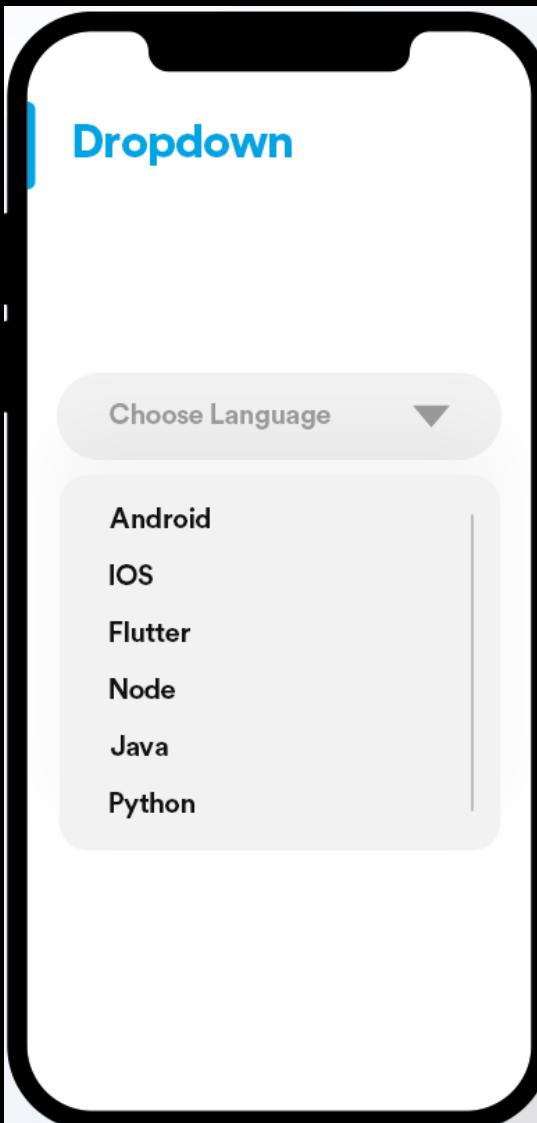
## Participants preferences among the input methods

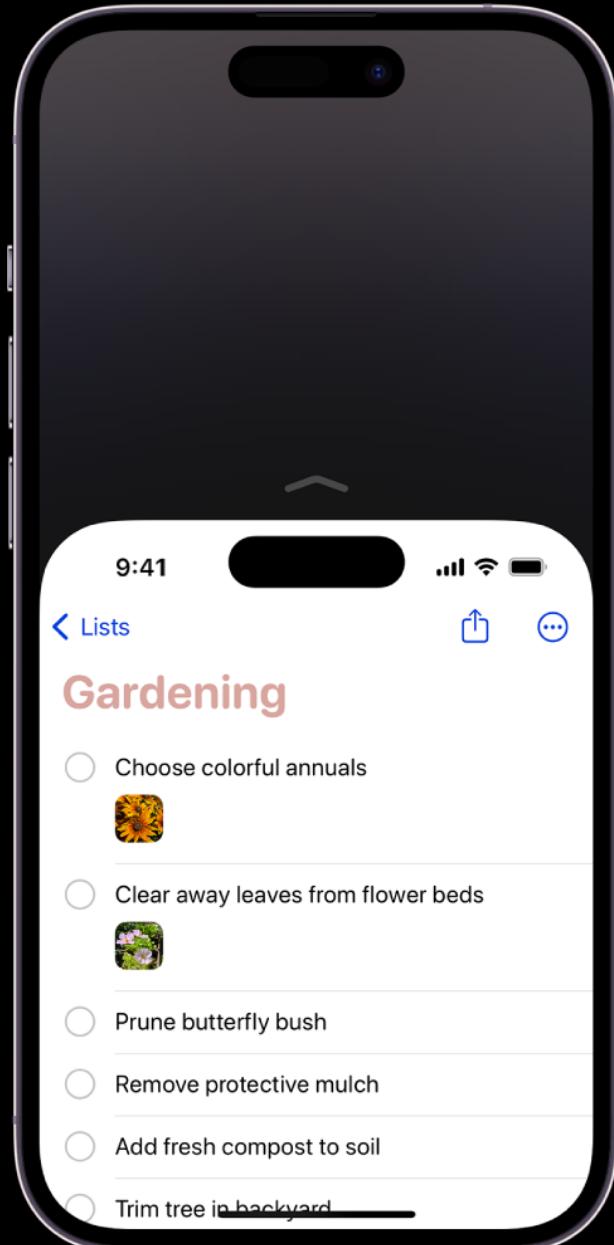
	M	SD
Textbox	2.3	0.8
Divided-textbox	3.7	0.5
Datepicker	2.7	1.1
Calendar view	1.3	0.5

**Table 1.** Demographic and smartphone related information of the participants

Participants	Age	Gender	Mobile OS experience	Occupation
F1	18	F	ANDROID	Undergraduate student
F2	18	F	ANDROID	Undergraduate student
M1	25	M	ANDROID	Teacher
M2	35	M	ANDROID	Teacher
M3	30	M	ANDROID	Computer engineer
M4	41	M	IOS	Teacher
M5	34	M	IOS	Electrical engineer
M6	32	M	IOS	Teacher
F3	18	F	IOS	Undergraduate student
F4	30	F	IOS	Teacher

# HISTORY OF MOBILE DROPODOWN LIST UI





1. Go to Settings ⓘ > Accessibility > Touch, then turn on Reachability.
2. To lower the top half of the screen, do one of the following:
  - *On an iPhone with Face ID:* Swipe down on the bottom edge of the screen.
  - *On an iPhone with a Home button:* Lightly double-tap the Home button.
3. To return to the full screen, tap the upper half of the screen.

<https://support.apple.com/en-vn/guide/iphone/iph145eba8e9/ios>



16:06 11:35 79% 90%

## Delivery Details

University Of Science - Nguyen Van C  
Duy Lê Khánh • 84901811408

Phu My Hung Tower  
[Add recipient details \\*](#)

Add more stops

Pick up now (15 min or less) >  
Drop off by 16:51 • 1-Hour

Bike >

### How'd you like it delivered?

- Instant** 47.000đ  
Instant delivery in 30 minutes/5km
- 2 - Hour** 34.000đ  
Fast delivery, affordable price
- Same Day** From 25.000đ  
4 hours intra-city delivery, flat-fare

Select Delivery Type

Hoa đơn truyền hình

Dịch vụ Internet và Truyền hình SCTV  
Áp dụng toàn quốc

### THÔNG TIN KHÁCH HÀNG

Loại phí thanh toán  
Chọn loại hóa đơn

Mã khách hàng  
Nhập mã khách hàng

### HÓA ĐƠN MẪU

Nhập mã KH được hiển thị tại đây

Hủy Chọn loại hóa đơn

Dịch vụ trả trước

Thanh toán hóa đơn



16:06 79%

< Delivery Details

University Of Science - Nguyen Van C  
Duy Lê Khánh • 84901811408

Phu My Hung Tower  
[Add recipient details \\*](#)

Add more stops

Pick up now (15 min or less)  
Drop off by 16:50 • 1-Hour

Bike

How'd you like it delivered?

- Instant** 47.000đ  
Instant delivery in 30 minutes/5km
- 2 - Hour** 34.000đ  
Fast delivery, affordable price
- Same Day** From 25.000đ  
4 hours intra-city delivery, flat-fare

Select Delivery Type

11:35 90%

< Hóa đơn truyền hình

SCTV

Dịch vụ Internet và Truyền hình SCTV  
Áp dụng toàn quốc

THÔNG TIN KHÁCH HÀNG

Loại phí thanh toán  
Chọn loại hóa đơn

Mã khách hàng  
Nhập mã khách hàng

HÓA ĐƠN MẪU

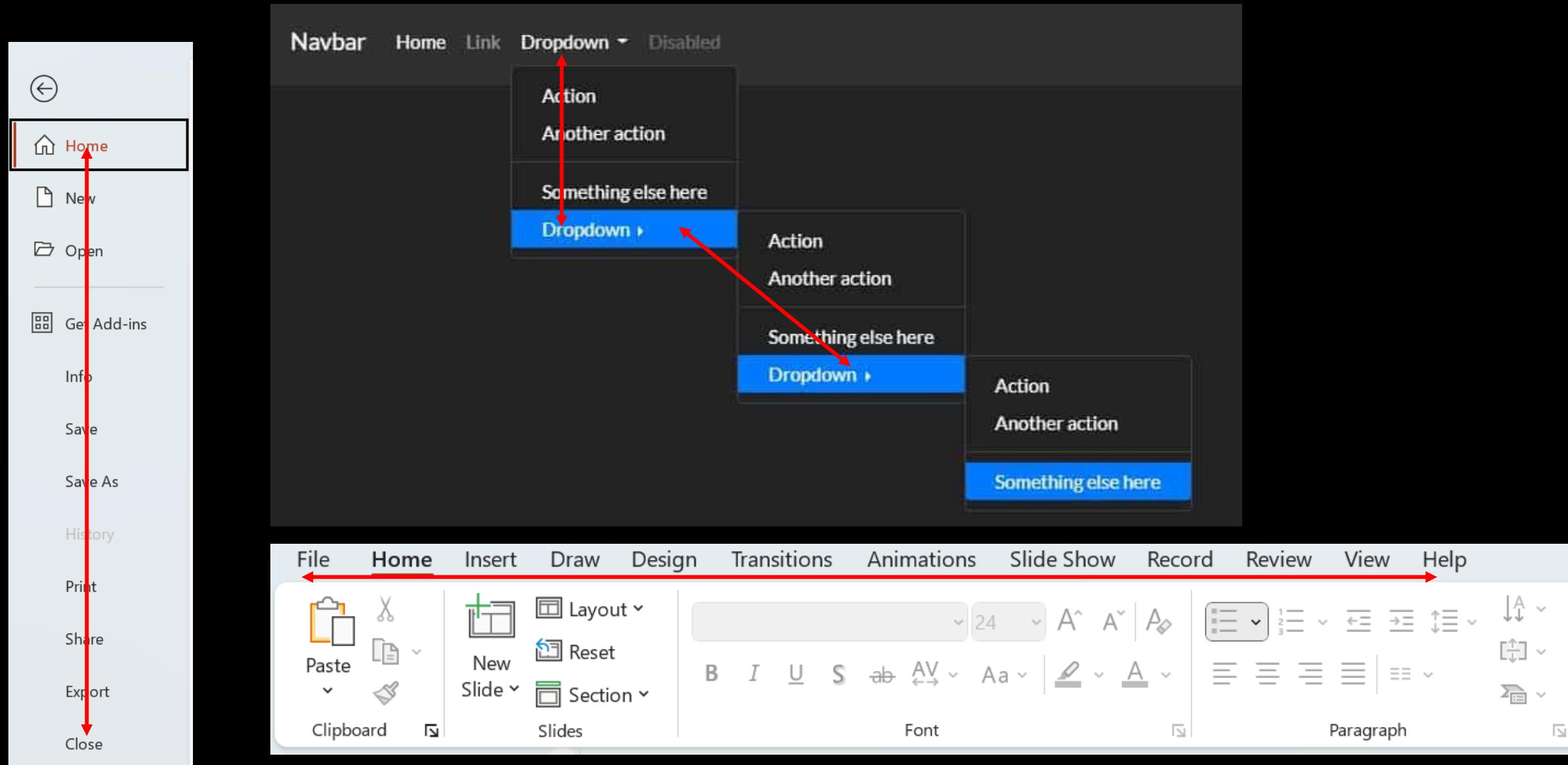
Nhập mã KH được hiển thị tại đây

Hủy Chọn loại hóa đơn

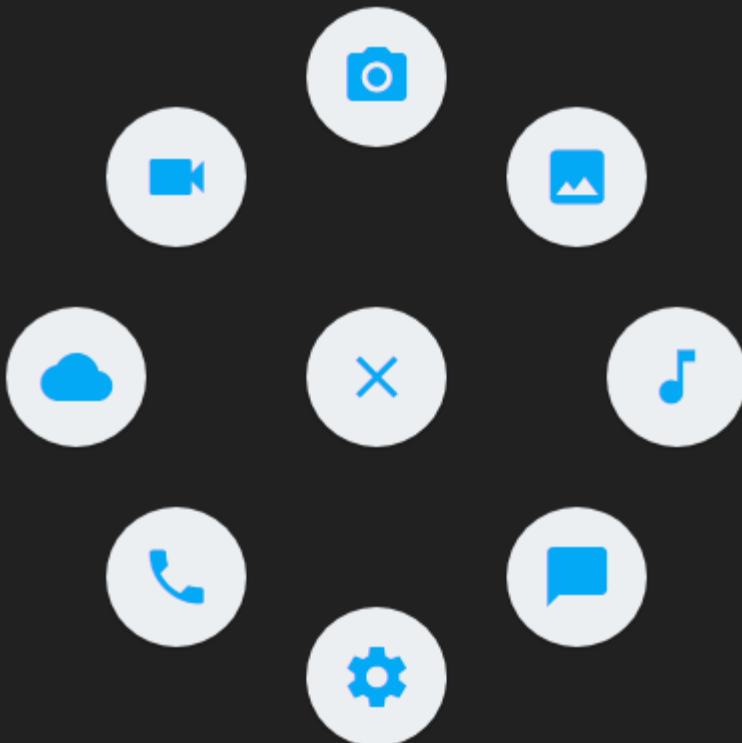
Dịch vụ trả trước

Thanh toán hóa đơn

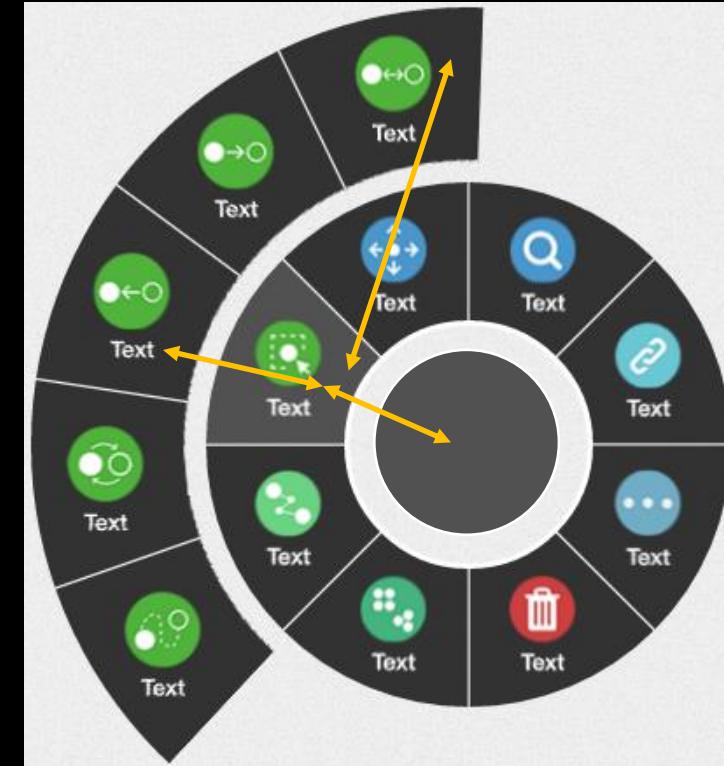
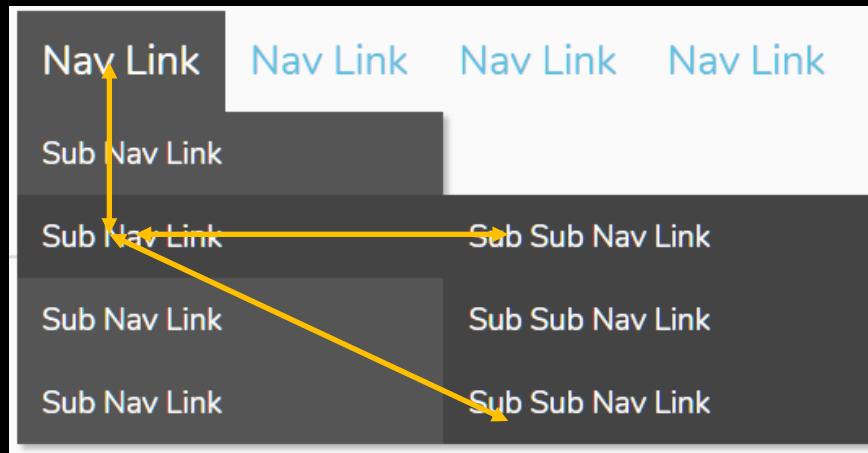
# Problem with list-based menu



# CIRCULAR MENU

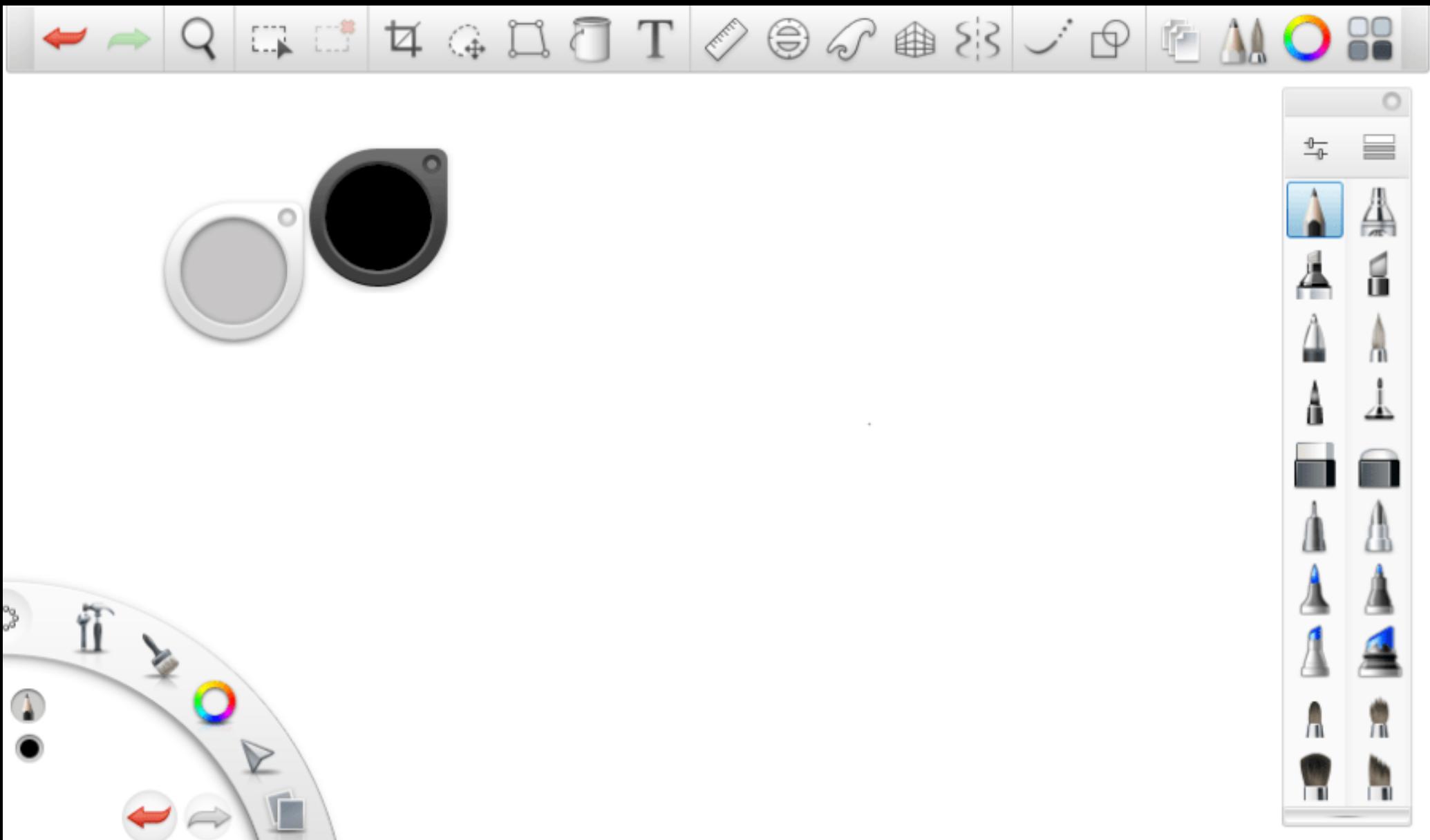


- Shorter average acquisition time
- Support spatial memory



mo  
mo

# AUTODESK SKETCHBOOK



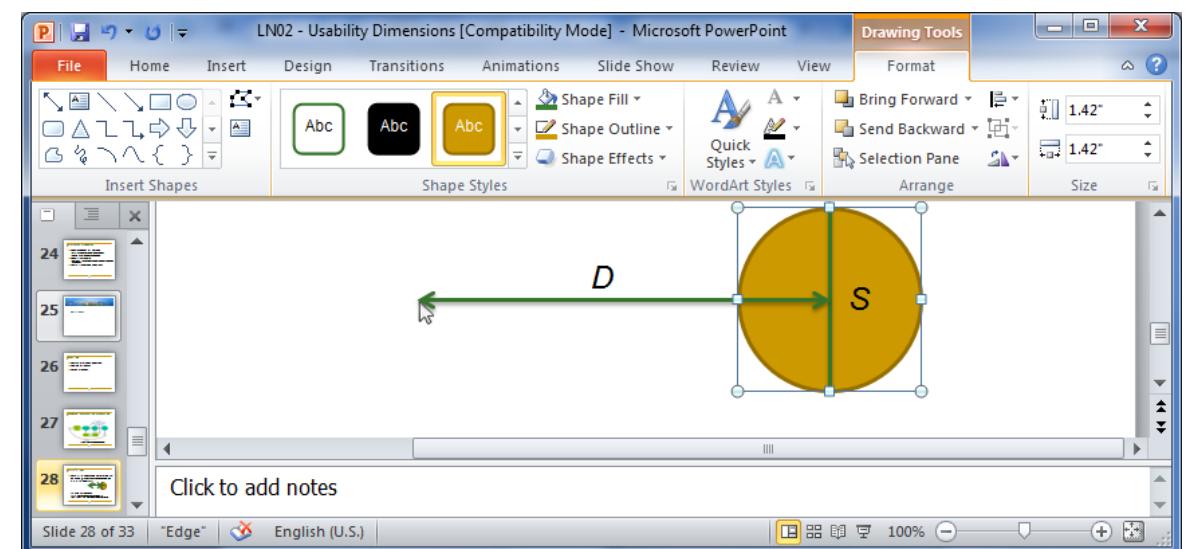
mo  
mo

# NOKIA (LUMIA) CAMERA APP



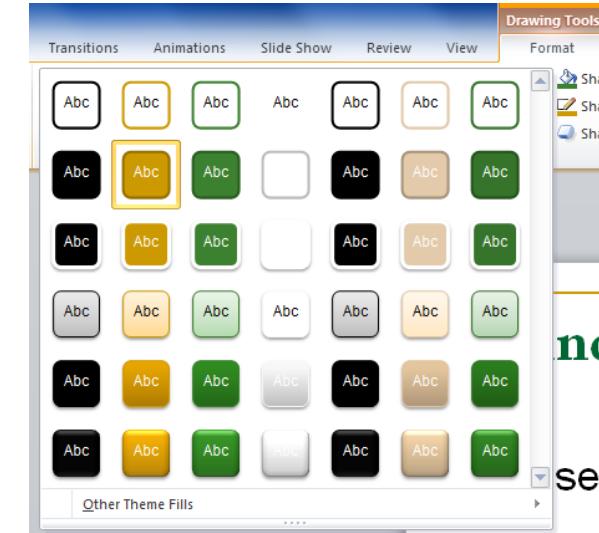
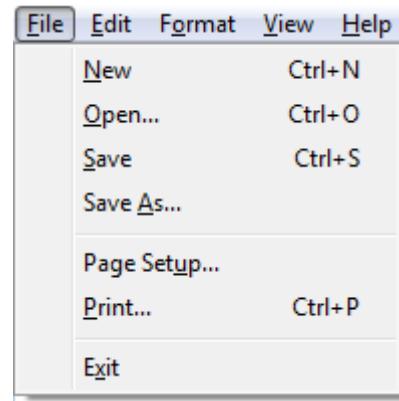
# Principles to improve efficiency

- Make often-used targets big
- Group targets that are used together
  - Grouped toolbar buttons, menu items, etc.
- Place oftenly-used menu items on top of menu
- Use screen corners and edges



# Principles to improve efficiency (cont'd)

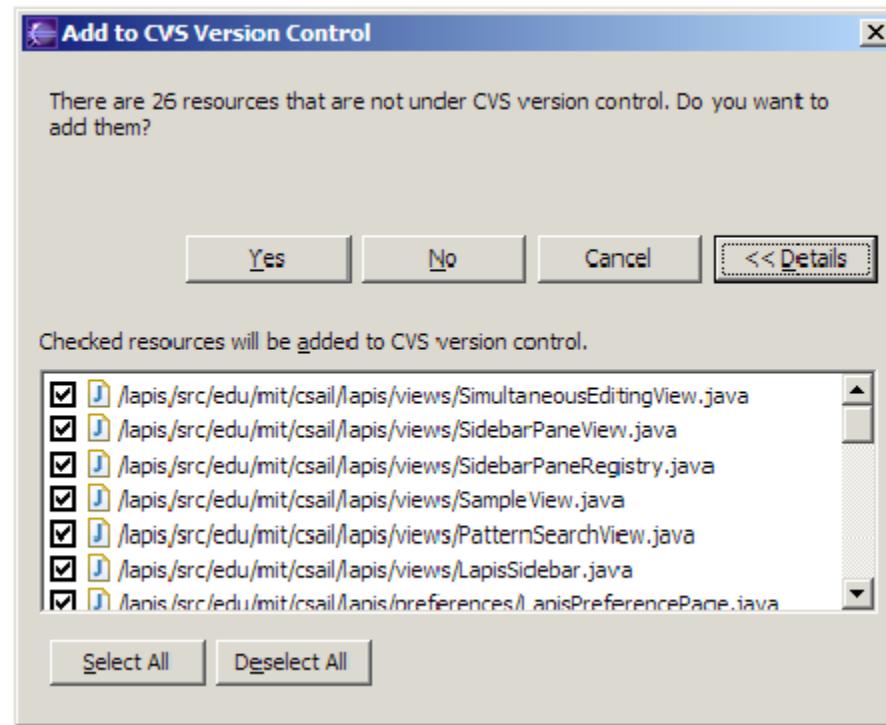
- Use keyboard shortcuts and menu accelerators



- Predefine a group of styles

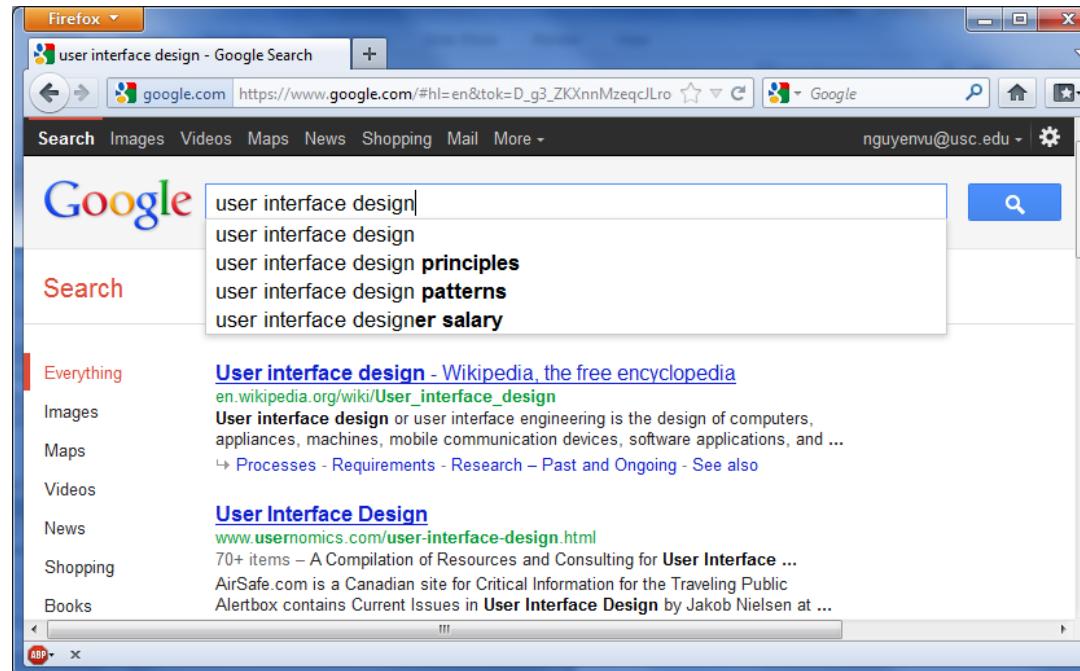
# Principles to improve efficiency (cont'd)

- Aggregating and choose most common selections by default
- Use defaults



# Principles to improve efficiency (cont'd)

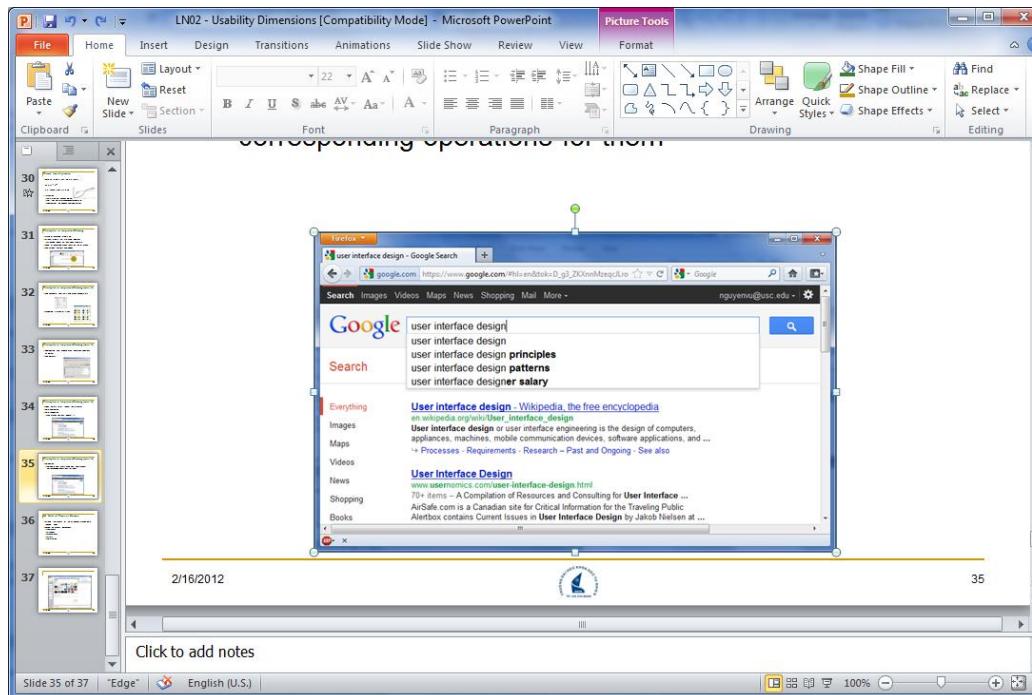
- Keep history (e.g., recent files in Word)
- Auto completion
- Auto suggestion
  - This makes you lazy, doesn't it?



# Principles to improve efficiency (cont'd)

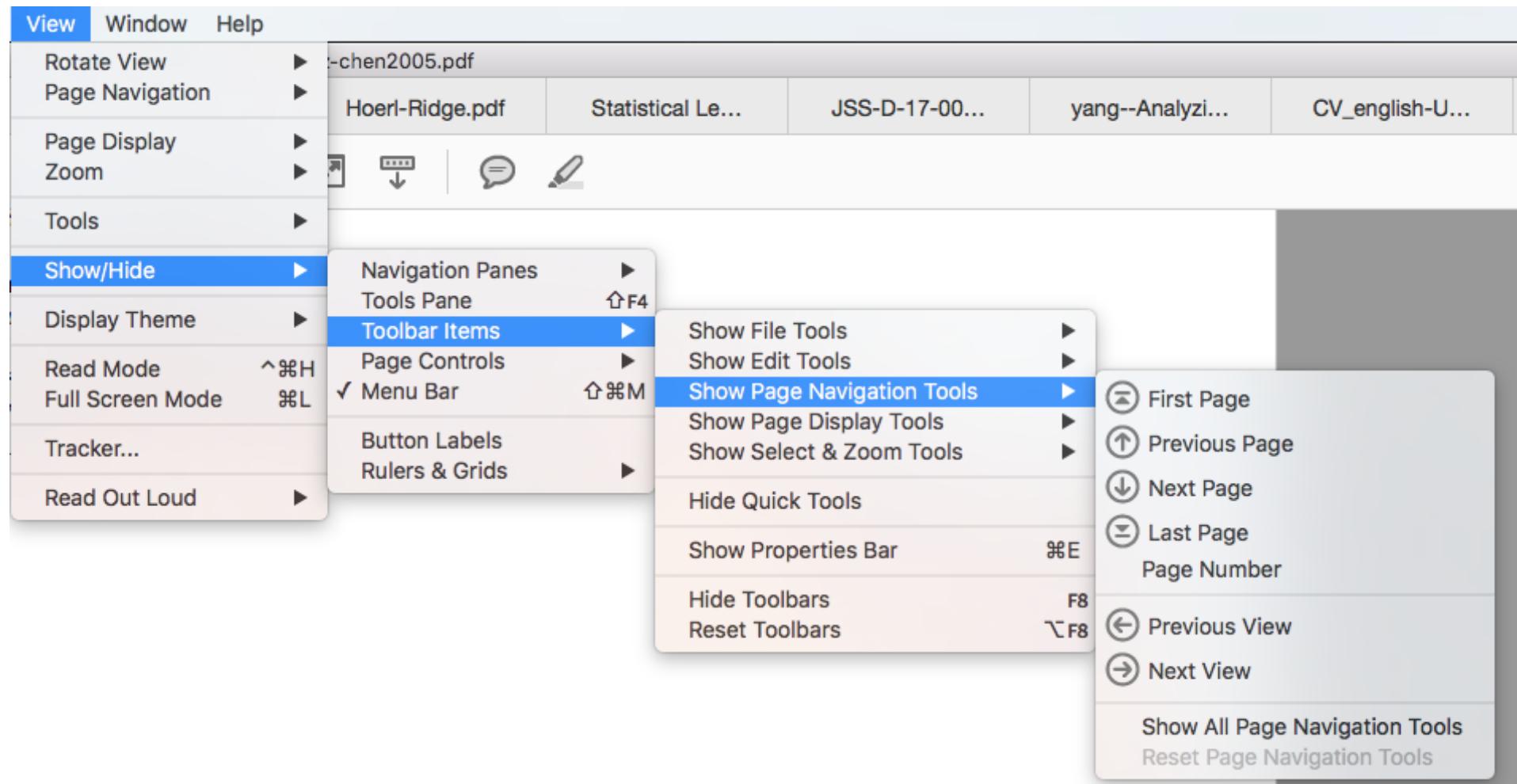
- Anticipation

- Anticipate what users will do next and present corresponding operations for them



# Bad menu for efficiency

- Acrobat Reader for Mac



# Mental models

- Craik (1943) described mental models as:
  - internal constructions of some aspect of the external world enabling predictions to be made
- Involves unconscious and conscious processes
  - images and analogies are activated
- Deep versus shallow models
  - e.g. how to drive a car and how it works

# Mental models

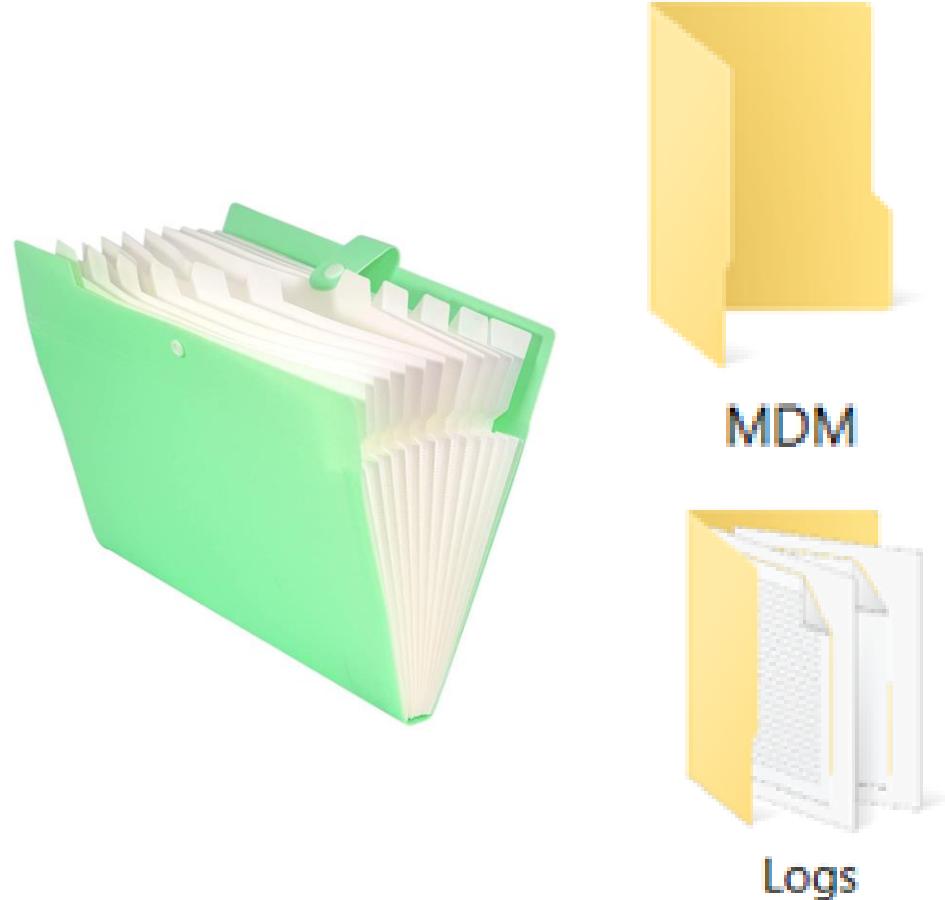
- Users develop an understanding of a system through learning about and using it -- mental model:
  - How to use the system (what to do next)?
  - What to do with unfamiliar systems or unexpected situations (how the system works)
- People make inferences using mental models of how to carry out tasks

Designs should not  
confuse/conflict users'  
mental model



# Interface/Interaction Metaphors

- A set of user interface *visuals, actions* and *procedures* that exploit *specific knowledge* that users *already have of other domains*.
- The purpose is to give the user *instantaneous knowledge* about *how to interact with the user interface*. They are designed to be *similar to physical entities* but also *have their own properties*



# Metaphors

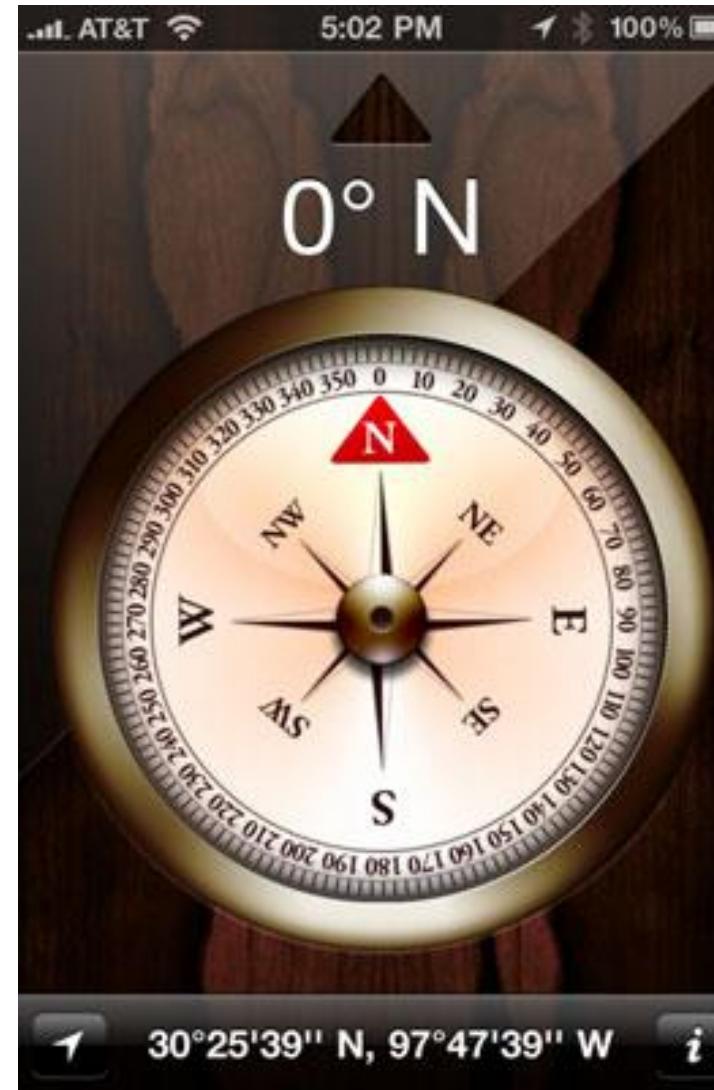
- Metaphor is a presentation of real-world in user interface
- Advantages
  - Highly learnable
  - Connect with user's existing model easily
- Problems
  - Hard to design metaphors that are appropriate
  - Potentially deceptive and misleading
  - May not be used consistently everywhere
  - Culturally dependent (localization issue)



# Interface/Interaction Metaphors



# Interface/Interaction Metaphors



# Interface/Interaction Metaphors



# Digital Finnish Driving License by HiQ

# Interface/Interaction Metaphors



# Shneiderman's Eight Golden Rules

- Strive for consistency
- Cater to universal usability
- Offer informative feedback
- Design dialogs to yield closure
- Prevent errors, rapid recovery
- Permit easy reversal of actions
- Support user control
- Reduce memory load

# Conceptual model

- A conceptual model is the mental model that people carry of how something should be done
- We describe them in terms of
  - Core activities
  - Objects
  - Interface metaphors

# FORMULATING A CONCEPTUAL MODEL

- What will the users be doing when carrying out their tasks?
- How will the system support these?
- What kind of interface metaphor?
- What kinds of interaction modes and styles to use?