Touchscreen Smartphone User Interfaces for Older Adults

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Why should we care?

✓   Rapid growth of older population

✓   An increasing and large number of smartphone users, including older adults

✓   Current smartphone user interfaces are not optimized for all types of users,

    including older adults

Outline

1. Introduction

2. Get to know older users

3. An experimental study of an Android launcher for older adults

4. Summary and Conclusion

Define Key Terms

✓ Older adult — people 65 years and older

✓ User interface (UI) — space where humans and software applications/hardware devices interact ("User interface", Wikipedia)

Growth of Older Population

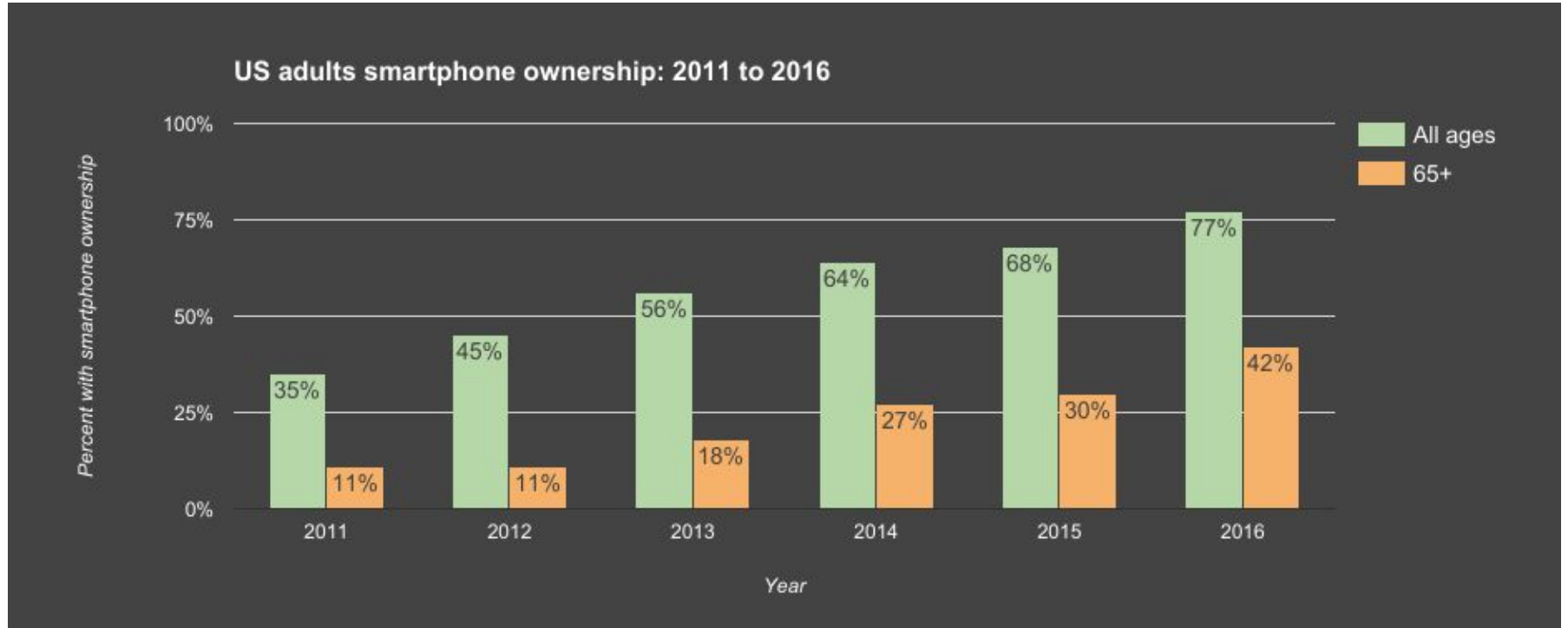Growing older population in US: 2012 to 2050
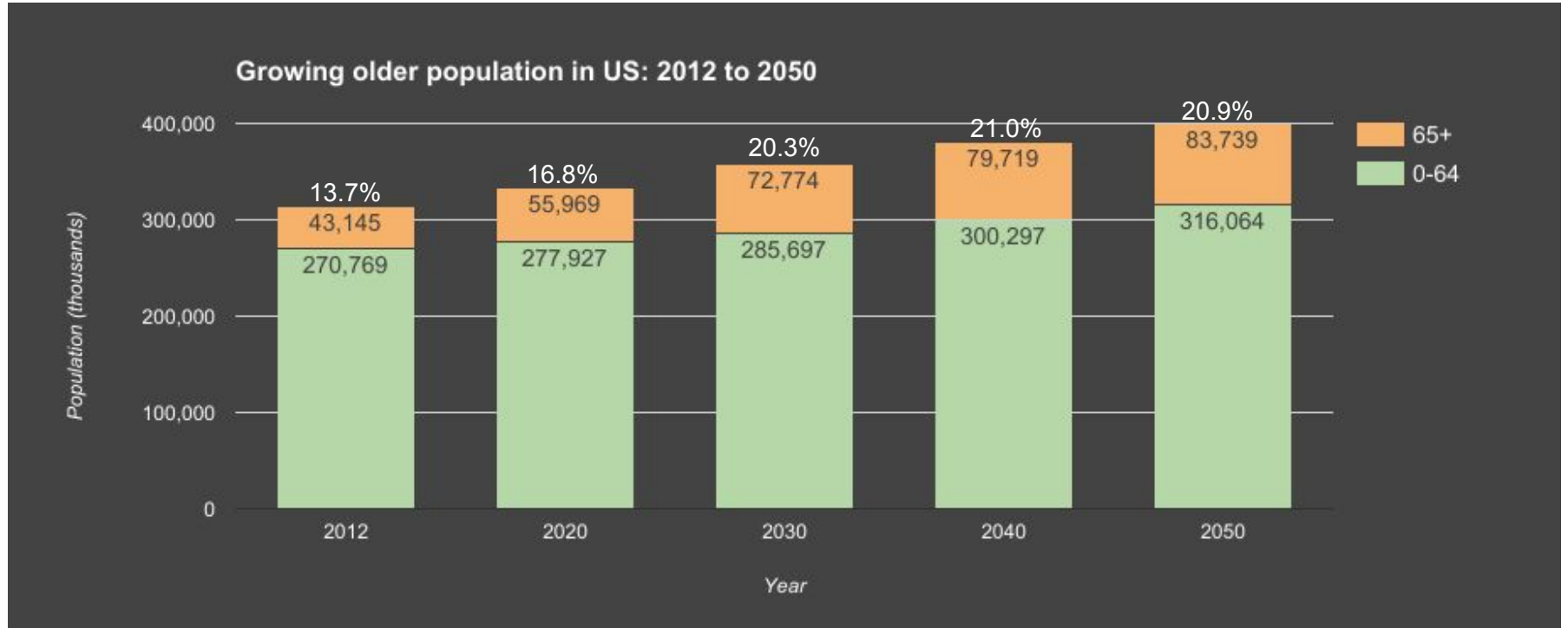
[Ortman and Velkoff, 2014]

Increasing Mobile Phone Users

US adults mobile phone ownership: 2004 to 2016
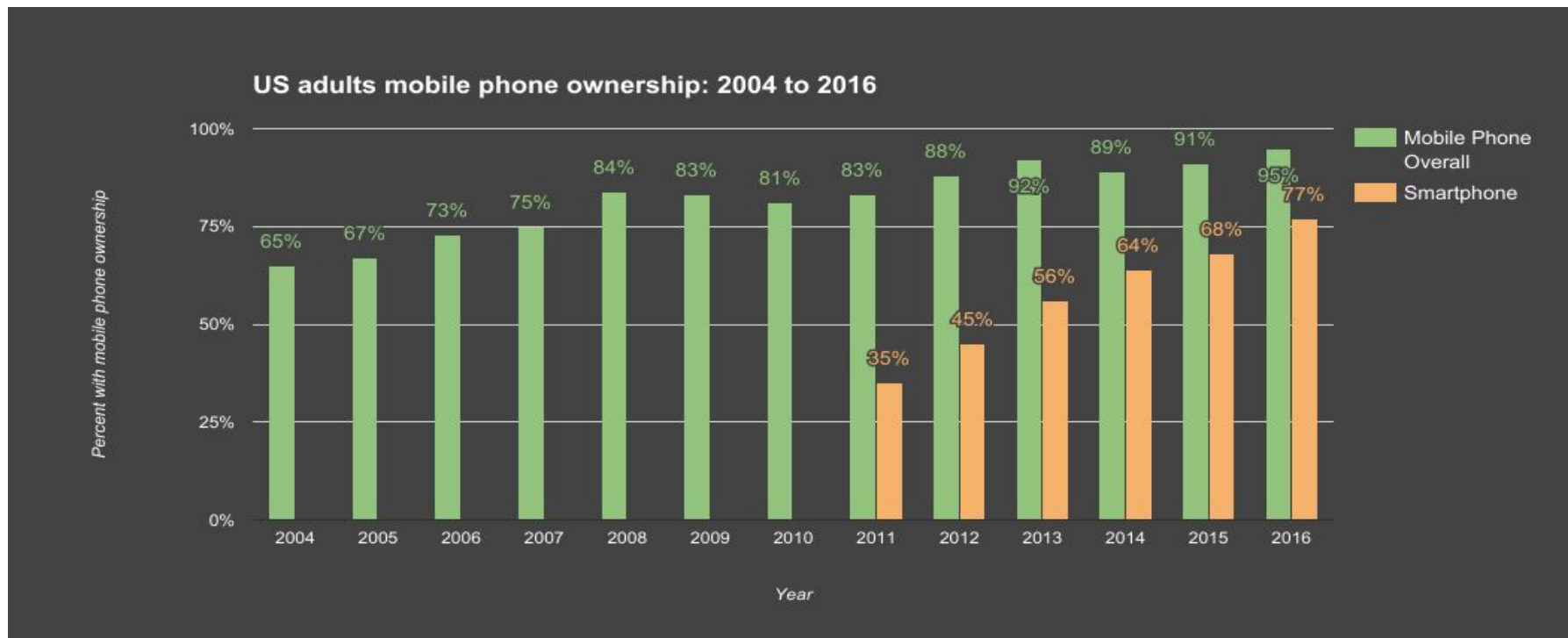
[Anderson, 2015; Fox and Duggan, 2012; Pew Research Center, 2017; Smith 2011, 2013, 2015]

Increasing Smartphone Users

US adults smartphone ownership: 2011 to 2016

[Anderson, 2015; Fox and Duggan, 2012; Pew Research Center, 2017; Smith 2011, 2013, 2015]

Age-related Changes

✓ Vision

✓ Motor control

✓ Hearing

✓ Cognition

Great variety among individuals:

- When the changes start

- How fast the changes happen

- How far the changes go

Age-related physical and cognitive changes affect how well we can interact with digital devices such as smartphones.
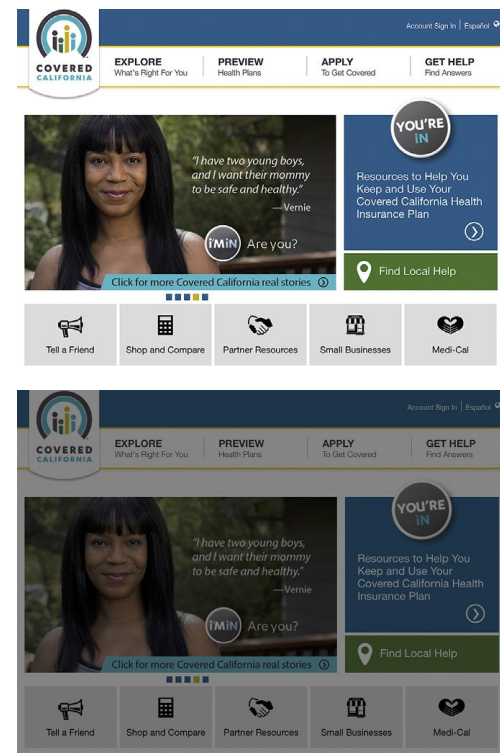
Source: Johnson and Finn, 2017

Age-related Changes (continued)

VISION: PART I

✓ Diminished light perception

  ➡ Take in and register less amount of light

    ○ Everything looks darker as if you were wearing sunglasses

    ○ Need brighter light to see and read well

      ○ Average 60-year-old needs 3 times more amount of light than a 20-year-old to perceive the same subjective brightness

Source: Johnson and Finn, 2017

[Johnson and Finn, 2017]

Age-related Changes (continued)

VISION: PART II

✓ Decreased contrast sensitivity

  ➡ Difficult to see subtle differences in shades of color

    ○ Begins after about 50 years old

    ○ Becomes severe by age 80

      ➡ Hard to see information that poorly contrasts with its background

      ➡ Hard to distinguish similar colors — also affected by diminished sensitivity to light

Source: Johnson and Finn, 2017

Gray background

White, Gray, Blue texts

[Johnson and Finn, 2017]

Age-related Changes (continued)

MOTOR CONTROL

✓ Reduced manual dexterity

➡ Difficult to move your arm, hand, and fingers precisely

○ Begins after about 50 years old

➡ Hard time with grasping and manipulating small objects

○ E.g., small letter keys on smartphones

➡ Hard time with performing multi-finger gestures

○ E.g., pinch and spread on smartphones

Source: Johnson and Finn, 2017

Older User's Needs for Mobile Phones

What do older users need for mobile phones?

- ✓ Simple and easy-to-use UIs
- ✓ Large buttons (physical and/or virtual)
- ✓ Large keyboards (physical and/or virtual)
- ✓ Large displays
- ✓ Advanced features — e.g., camera, alarm clock, calendar, flashlight

Source: Balata, Mikovec, and Slavicek, 2014

Older User's Needs for Mobile Phones (continued)

What mobile phone options are there for older users?

- ✓ Feature phones
- ✓ Smartphones
- ✓ Smartphones but with a launcher

Older User's Needs for Mobile Phones (continued)

What is a launcher?

✓   Android application

✓   Could be pre-installed into the phone or downloaded from the Android Market

Source: Mitroff, 2014

Older User's Needs for Mobile Phones (continued)

What does a launcher do?

- ✓ Modifies Android operating systems' features without making any permanent changes

- ✓ Allows users to customize their device's UIs in order to personalize the home screen and/or application drawer to perform various tasks (e.g., making phone calls, launching other applications) through the UIs

Source: Mitroff, 2014

Older User's Needs for Mobile Phones (continued)

Which option is more desirable for older users?

	Feature phones	Regular smartphones	Using launchers
Simple UIs	√	X	√
Large buttons	X	X	√
Large keyboards	X	X	√
Large displays	X	√	√
Advanced features	X	√	√

KoalaPhone Launcher — Overview

✓ Balata, Mikovec, and Slavicek (2014) at Czech Technical University in Prague, Czech Republic

✓ Developed an Android launcher called "KoalaPhone"

✓ To address the issues of current Android launchers designed for older users

- Limited functionality (i.e., lack of advanced features) — only voice call, SMS, and occasionally taking photos
- Lack of functionality — requires users to launch some applications externally
- Small keyboards
- Small and confusing notifications

KoalaPhone Launcher — UI Designs (continued)

Functions available through the launcher

✓ Basic functions — voice call, SMS

✓ Advanced functions — camera, photo gallery, alarm clock, flashlight, etc.

➡ ***Many older users appreciate these additional features***

✓ SOS button for making emergency calls

➡ ***Many older users appreciate one button call for help or family***

Source: Balata et al., 2014

KoalaPhone Launcher — UI Designs (continued)

Overall design features

✓ All elements of the UIs are enlarged

✓ Keypad with small inactive margins on the sides

➡ ***Prevents users from pressing buttons unintentionally***

✓ All "buttons" with vibration and sound feedbacks

➡ ***Confirms a user's actions on the phone***

Source: Balata et al., 2014

KoalaPhone Launcher — UI Designs (continued)

Home screen

✓ Similar appearance to feature phones

- Clock with the battery and reception signal indicators at the top

- Numeric keypad at the bottom

  ➡ *More familiar layout to older users*

Source: Balata et al., 2014

Looks like a feature phone

Menu button

SOS button
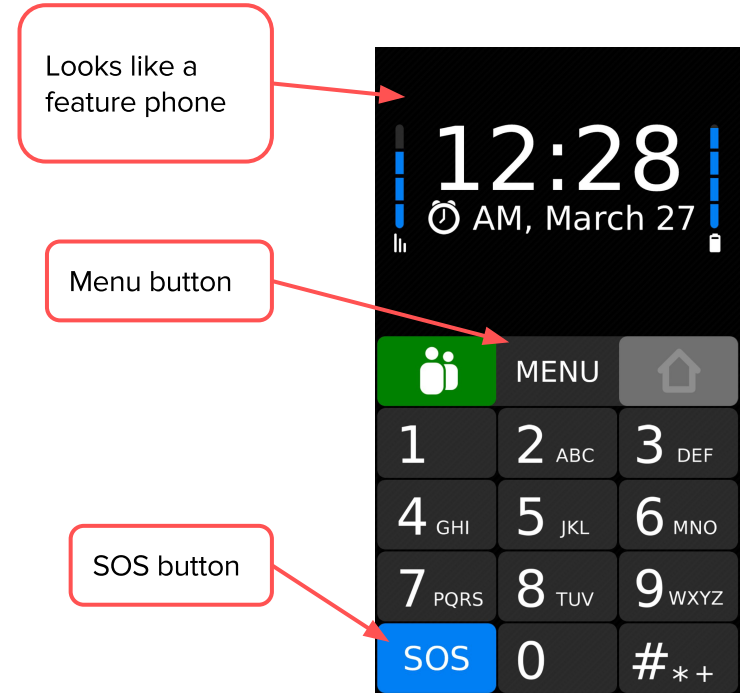
KoalaPhone Launcher — UI Designs (continued)
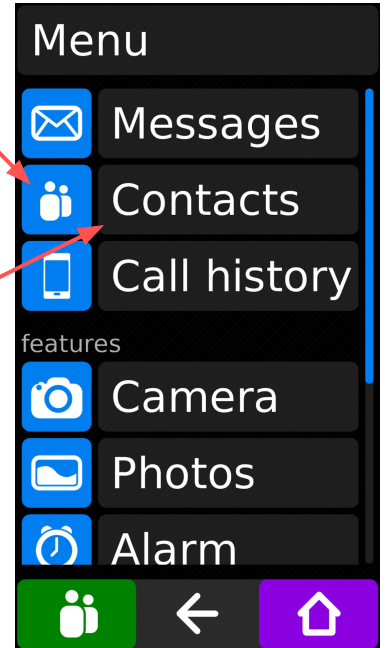
Menu screen

✓ Easy-to-recognize icons with meaningful descriptions

➡ *More familiar symbols and vocabulary to older users*

Easy-to-recognize icons

Meaningful description

Source: Balata et al., 2014

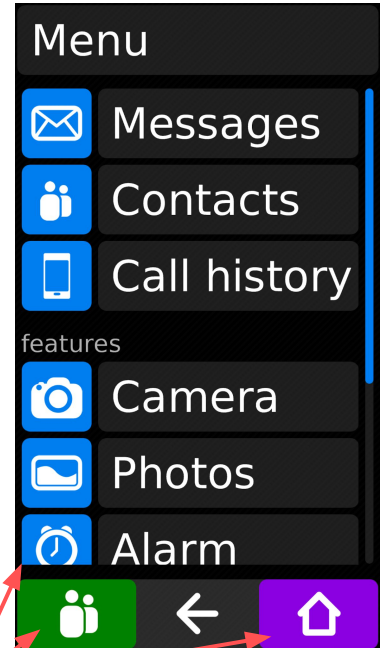# KoalaPhone Launcher — UI Designs (continued)

Application screen

✓ A label at the top of the screen — "Alarm", "Contacts", etc.

✓ A brief but informative description of what to do with the application

➡ *Informs users where they are and what they can do with the application*

Label at the top

Brief description of what to do
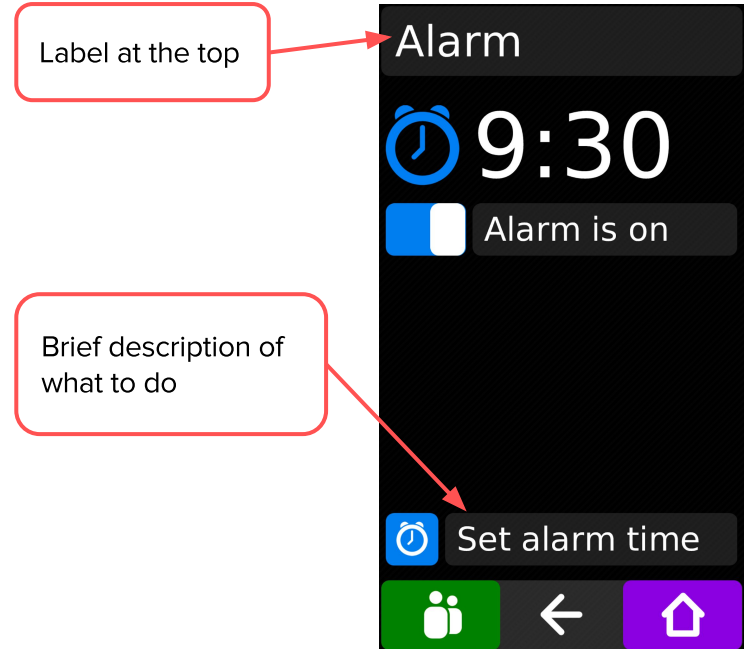
KoalaPhone Launcher — UI Designs (continued)

Color scheme

✓ Black background with white text labels

✓ Bright color buttons with white icons

➡ *Provide sufficient contrast*

➡ *Avoid glaring with the display illumination*

Source: Balata et al., 2014

Bright color buttons with white icons

KoalaPhone Launcher — UI Designs (continued)

Navigation

✓ 3 navigation buttons on every page

- ○ Left button — navigates to contacts, saves a user's input, and sends an SMS

- ○ Middle button — navigates to the previous screen and backspace

- ○ Right button — returns to the home screen

  ➡ *Maintains consistency*

Source: Balata et al., 2014

3 navigation buttons on every page
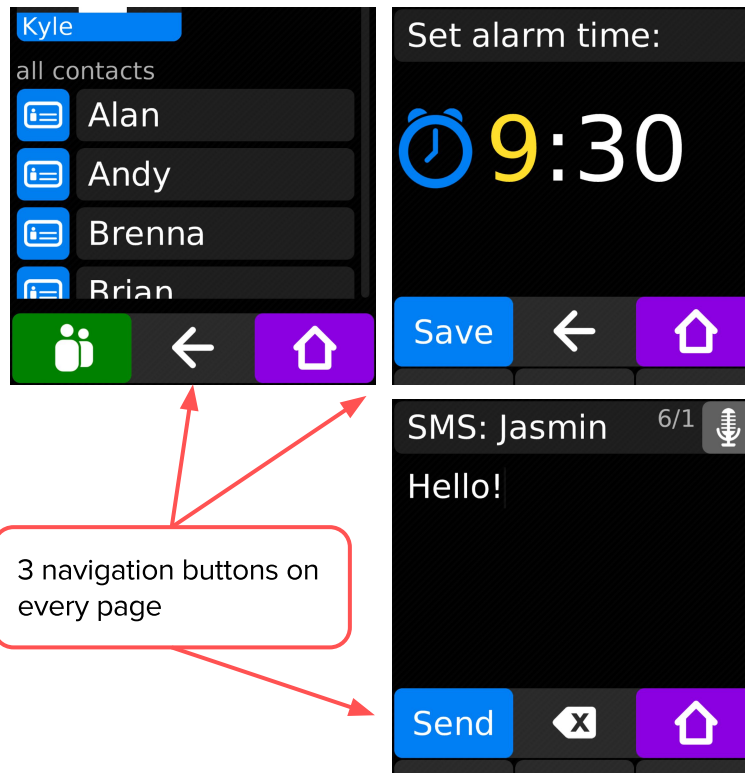
KoalaPhone Launcher - Evaluation

✓ Goal — measure completion rate and error rate of selected tasks

    ○ KoalaPhone vs. Android 4.4 UIs (large text feature on)

✓ Participants — 15 older adults

    ○ Mean age = 69.6 years old

    ○ Non-users of smartphones

✓ Device — LG Nexus 5, a touchscreen phone with 4.95 inch display

Source: Balata et al., 2014

KoalaPhone Launcher - Evaluation (continued)

Six tasks to perform on each UI (i.e., KoalaPhone, Android 4.4)

1. Add a new phone number for a specified contact

2. Send an SMS "Hello" to a specified contact

3. Set the alarm clock to 14:37

4. Take a photo of an arbitrary scene

5. Find a picture of a castle and send it by email

6. Open a map application

Source: Balata et al., 2014

KoalaPhone Launcher - Evaluation (continued)

Additional note about assigned tasks

✓ No time limit to complete each task

✓ Okay to give up on completing tasks

Source: Balata et al., 2014

# KoalaPhone Launcher - Evaluation (continued)

Experimental design

- ✓ 2 x 6 within-subject design
  - ○ Independent variable 1: 2 UIs (i.e., KoalaPhone, Android 4.4)
  - ○ Independent variable 2: 6 tasks
- ✓ Total number of tasks to be used in the evaluation — 180 tasks
  - ○ 15 participants x 2 UIs x 6 tasks = 180 tasks
- ✓ Three things to measure
  - ○ Completion rate of each task by participant for given UI
  - ○ Completion rate of all six tasks by participant for given UI
  - ○ Error rate — the portion of uncompleted tasks to all six tasks by participant for given UI

Source: Balata et al., 2014

KoalaPhone Launcher — Results

Completion rate by task

✓ Task 2 (send an SMS "Hello")
  ○ KoalaPhone — 87%
  ○ Android 4.4 — 60%
  ○ 96.88% chance KoalaPhone has a higher completion rate

✓ Task 5 (send a picture by email)
  ○ KoalaPhone — 93%
  ○ Android 4.4 — 20%
 ○ 99.98% chance KoalaPhone has a higher completion rate

Source: Balata et al., 2014

Completion rate by task: KoalaPhone vs. Android 4.4
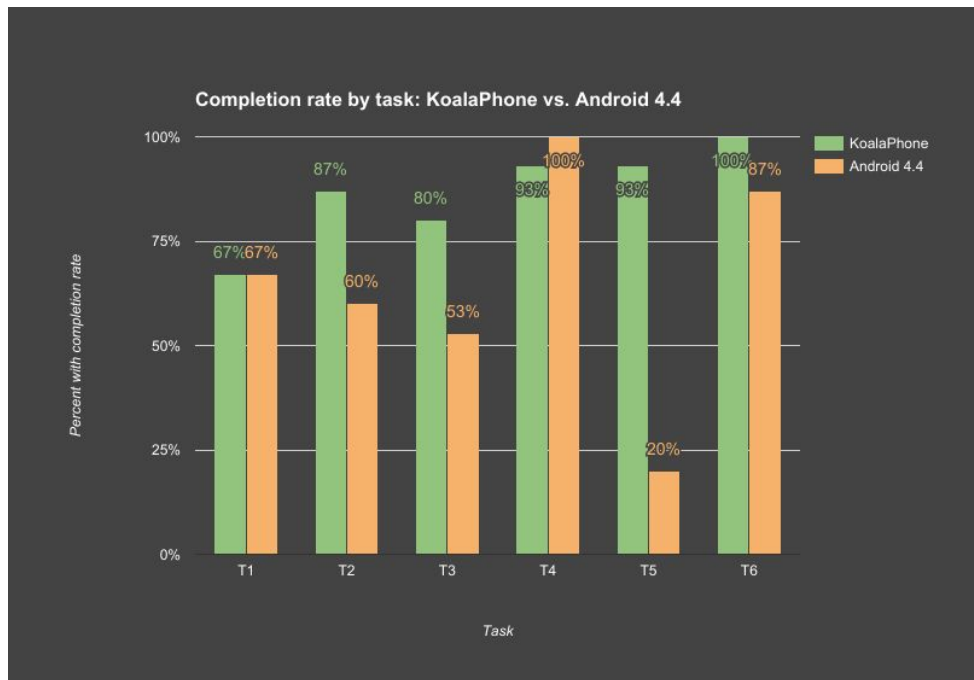
[Balata et al., 2014]

KoalaPhone Launcher — Results

✓ Completion rate of all six tasks

    ○ KoalaPhone — 40%

    ○ Android 4.4 — 6.67%

    ○ 98.44% chance KoalaPhone has a higher completion rate

✓ Error rate (average)

    ○ KoalaPhone — 14%

    ○ Android 4.4 — 33%

       ➡ Difference was statistically significant

Source: Balata et al., 2014

Completion rate of all tasks: KoalaPhone vs. Android 4.4

[Balata et al., 2014]
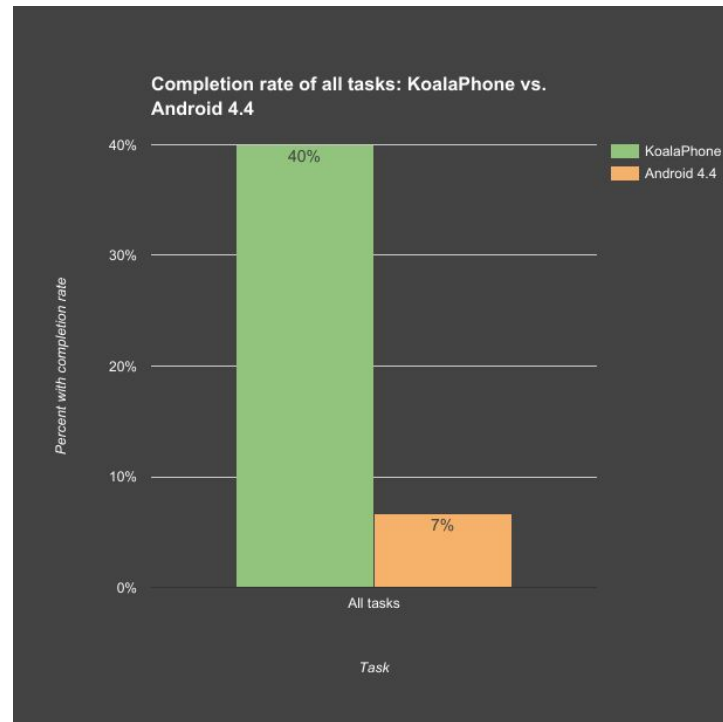
Summary and Conclusion

✓ Older population is growing; so is the number of smartphone users.

✓ When growing old, we experience physical and cognitive changes. Because of these changes, older users have special needs for digital devices such as smartphones.

✓ Launchers that consider older user's needs could improve UIs and help the users interact with smartphones more easily and effectively.

✓ Older users could get more attention when UIs are designed for smartphones; so that this population could use mobile devices with better usability and accessibility in the near future.

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Thank you very much.