Exploring User-Defined Back-of-Device Gestures for Mobile Devices

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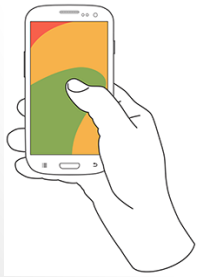
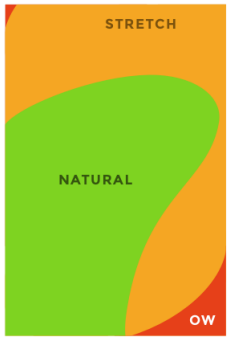
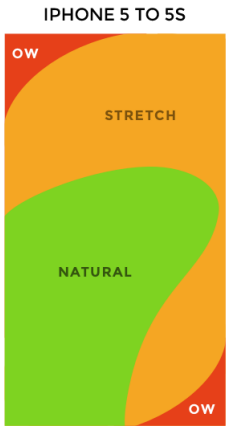
Motivation

- The problem with one-handed interaction
  - Limited thumb reachability:
    - Thumb of phone gripping hand can't reach the entire screen
    - Problem increases with larger screens

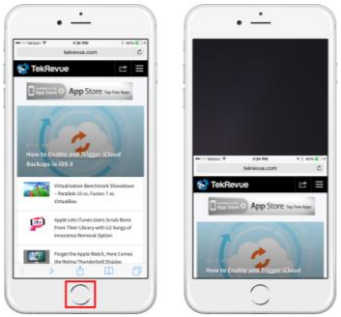






Motivation

- Shifting or shrinking the screen reduces the input space and viewable area
  - Increases fat finger problem
  - Increases occlusion problem



Apple reachability feature for iPhone6

Samsung one-handed operation

- How can we tackle these issues without reducing input space?
  - Utilizing the back of the device

Swipe left back-of-device gesture

Problem and Goal

- Existing research on back-of-device gestures focus on pre-designed gesture sets

- Given a set of common smartphone tasks, what are the back-of-device gestures that users come up with while performing one-handed interaction?

GOAL: Provide guidance to smartphone designers for incorporating back-of-device interaction for different tasks in smartphones.

Method

- Elicitation study with 15 participants
- 23 tasks
- Each task accompanied by visual cues
- Users asked to come up with gestures using “think aloud” protocol

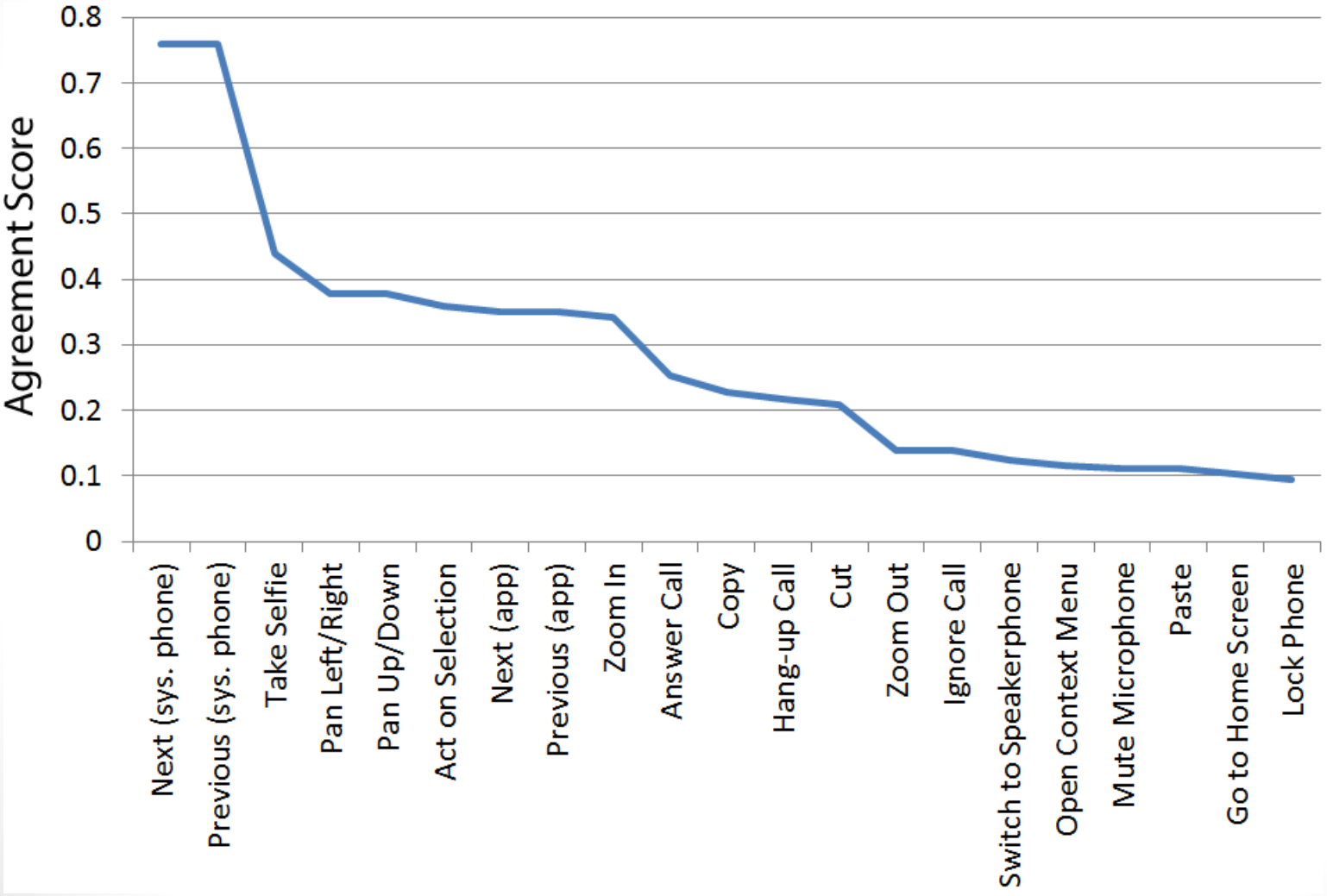
Category	Sub-Category	Tasks
Navigation	System-Phone	Next (Vertical)
		Previous (Vertical)
		Go To Home Screen
	Application	Next (Horizontal)
		Previous (Horizontal)
		Pan Left
		Pan Right
		Pan Up
		Pan Down
		Zoom In
		Zoom Out
Action	System-Phone	Answer Call
		Hang-Up Call
		Ignore Call
		Mute Microphone
		Switch to Speaker
		Lock Phone
		Act on Selection
	Application	Take Selfie
		Copy
		Cut
		Paste
		Open Context Menu

Agreement scores

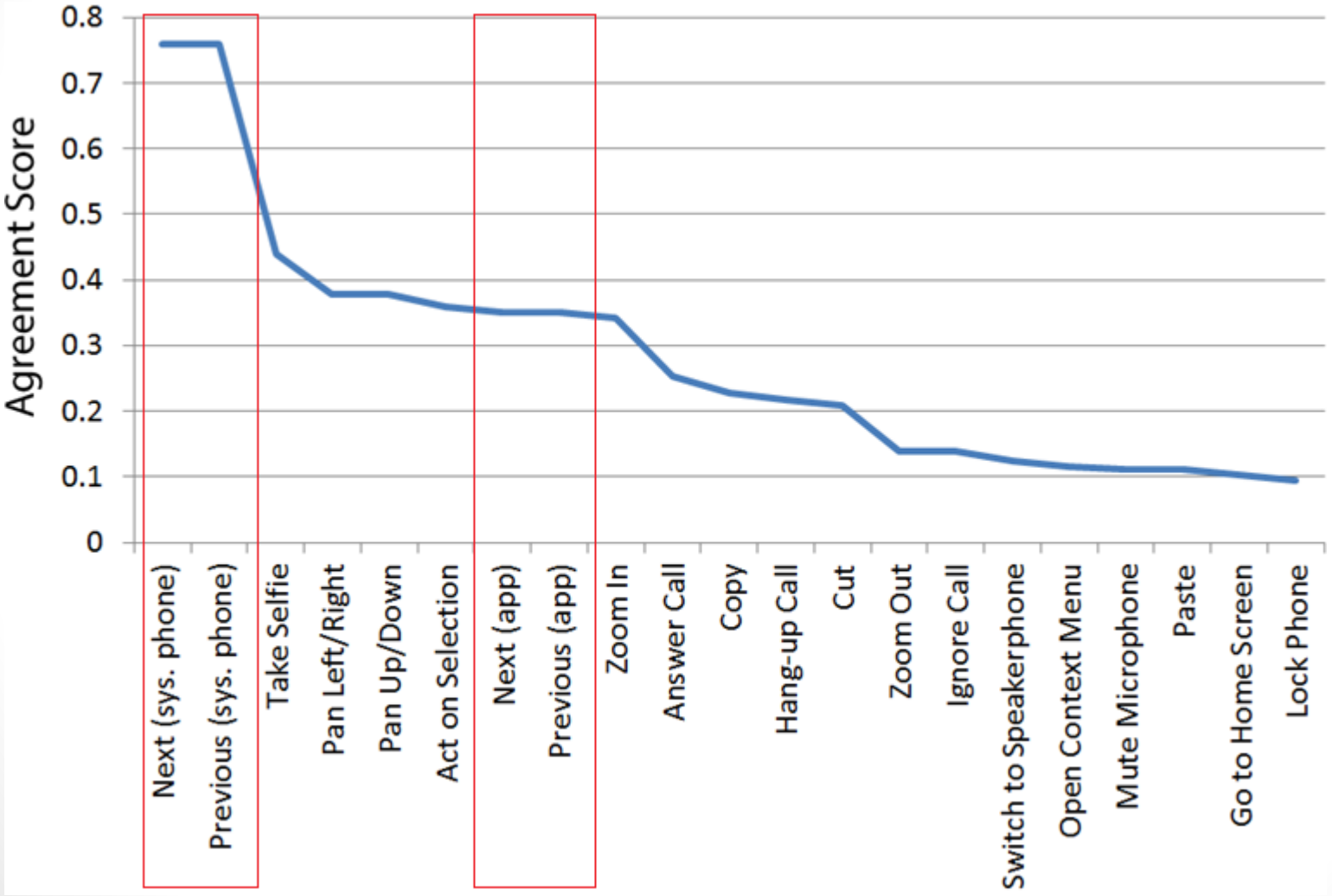
- Agreement scores (Wobbrock et. al) used to extract degree of consensus among participants for each task.

- $A_t = \sum_{P_t} (\frac{P_i}{P_t})^2$
  - t = one task in the set of all tasks T
  - P_t = set of proposed gestures for task t
  - P_i = subset of identical gestures from P_t

Agreement scores



Agreement scores



Common Elicited Gestures

Swipe-Left

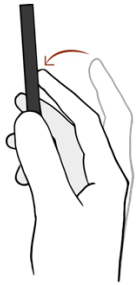
- Next (Horizontal)
- Pan Left (Map)
- Answer Call

Swipe-Right

- Previous (Horizontal)
- Pan Right (Map)
- Hang-up Call
- Ignore Call

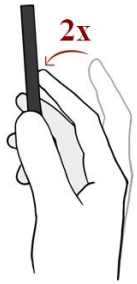
Swipe-Up

- Pan Up (Map)
- Previous (Vertical)



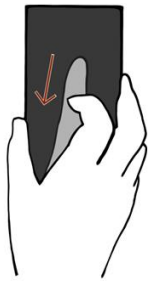
Tap

- Act on Selection



Double Tap

- Use Front Camera
- Zoom In (Map)



Swipe-Down

- Pan Down (Map)
- Next (Vertical)

Discussion

- Legacy bias:
  - Map pan/zoom operation
    - Similar gestures to front of screen
    - “To pan the map down, I’d like to slide my finger from down to up because this is the same gesture when I’m doing map navigation in front screen” [P8]
  - Answering / rejecting / ignoring calls
    - Swiping left/right
  - Copy & Paste:
    - ‘C’ / ‘V’ gestures on back

C Gesture

Discussion

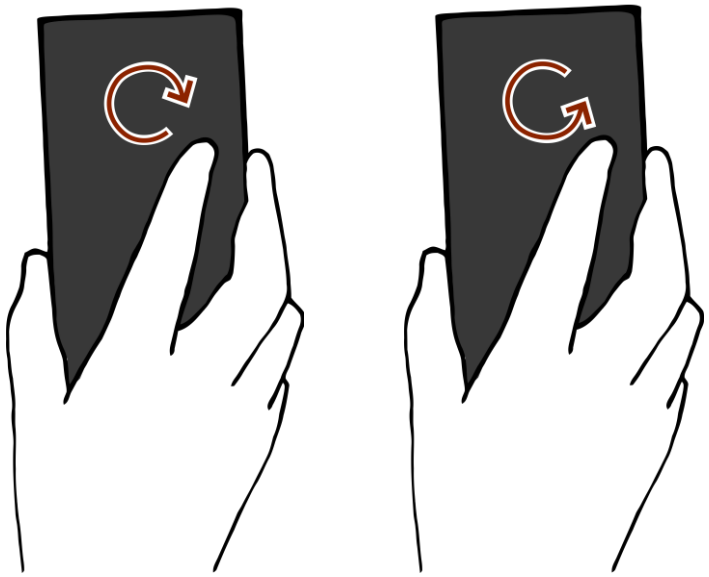
- Low agreement scores
  - Moving content vs. moving viewport
  - Tasks without corresponding front screen gestures
    - Map zoom in/out:
      - No difficulty designing gestures
    - Cut/Copy/Paste:
      - Difficulty designing gestures

- Users were more comfortable designing gestures for tasks with existing prominent front screen gestures

Discussion

- Concern for accidental input:
  - Double Tap/Rhythmic taps on the back of device

- Natural & consistent mapping:
  - Tasks that are opposite but equivalent – gestures in opposite directions or orientations



Clockwise / Counterclockwise Swipe

Discussion

- Location specific gestures :
  - For taking a picture with front camera – tap on middle [P1]
  - Opening an app – Tap on upper left corner [P1]

Upper Left Tap

Middle Tap

Takeaways

GOAL: Provide guidance to smartphone designers for incorporating back-of-device interaction for different tasks in smartphones.

1. Re-use of same gesture based on context
2. Orientation of tasks effect gesture orientation
3. Simple over complex gestures-swiping along axis/tapping
4. Concern for accidental input
   - Delimiter?
5. Natural and consistent mapping of gestures
6. Location specific gestures

Conclusion & Future Work

- ✓ Explored what gestures user can come up with using back-of-device to support one-handed interaction in smartphones.
- ✓ Obtained insight into the mental model of designing back-of-device gestures.
- ❑ Implementation and user-evaluation of back-of-device gesture recognizer
- ❑ Compare and contrast back-of-device gesture to alternate gestural techniques

Questions?

Swipe-Left

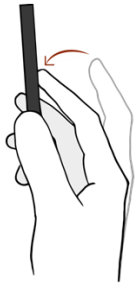
- Next (Horizontal)
- Pan Left (Map)
- Answer Call

Swipe-Right

- Previous (Horizontal)
- Pan Right (Map)
- Hang-up Call
- Ignore Call

Swipe-Up

- Pan Up (Map)
- Previous (Vertical)



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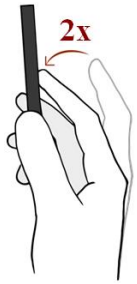
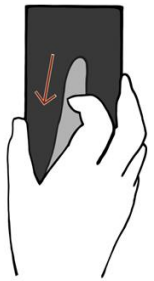


Double Tap

- Use Front Camera
- Zoom In (Map)



Swipe-Down

- Pan Down (Map)
- Next (Vertical)

References

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