

## Slipping and Drifting: Using Older Users to Uncover Pen-based Target Acquisition Difficulties

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1

### Pen-based Interaction

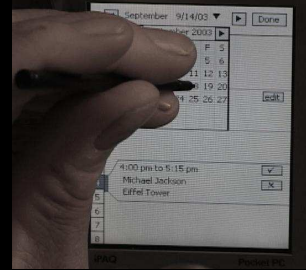
- ▶ Inductive pen technology
- ▶ Input only with a special pen
- ▶ Input both above and on the surface of the screen
  - *Hover region*: space above the screen in which the senses the location of the pen
  - Analogous to normal mouse movement (i.e., no buttons pressed)



2

## Motivation

- ▶ Pen-based input is compelling
  - Direct
  - Takes full advantage of hand-eye coordination
  - Familiar form of interaction
- ▶ Especially Beneficial for older adults [Charness et al. 2004]



But, many still struggle !

3

## Limitations of previous work

- ▶ Lots of work examining target acquisition
  - Hybrid pointing, hover widgets, crossing, circling, space touch, zoom pointing, zlliding, pointing lens, and many, many more.
- ▶ Standard point and tap is still king
- ▶ Three limitations
  1. Narrow focus on young healthy adults.
  2. Focus on designing and evaluating novel techniques.
  3. Focus on a single, typically highly constrained task.

4

## Our Approach

- ▶ To perform a detailed analysis of the *types of difficulties* user encounter,
- ▶ To determine if these difficulties *vary over task situation*, and
- ▶ To determine if these difficulties *vary with age*

5

## Methodology

The methodology diagram illustrates the experimental setup. It features a 'Menu' section with a list of animals: Beaver, Dolphin, Elephant, Giraffe, Iguana, Lion, Mouse, Otter, Squirrel, Tiger, Walrus, and Zebra. A 'Two Tasks' section shows a circular tapping task with a red dot. A 'Three Age Groups' section displays three avatars labeled 'Young', 'Pre-old', and 'Old'. A box on the right lists the design types: 'Within-subjects design' and 'Counterbalanced tasks'.

Animals → Mouse

Menu

Two Tasks

Three Age Groups

Young

Pre-old

Old

Tapping

- ▶ Within-subjects design
- ▶ Counterbalanced tasks

6

## Participants

- ▶ 12 in each of 3 age groups:
  - 18–54 (7 female; mean age 31.7)
  - 55–69 (8 female; mean age 52.1)
  - 70–85 (9 female; mean age 76.3)
- ▶ Based on changes that occur in cognition
- ▶ All were novices to pen input.
- ▶ All were right handed and free of diagnosed impairment to their hand.



Young



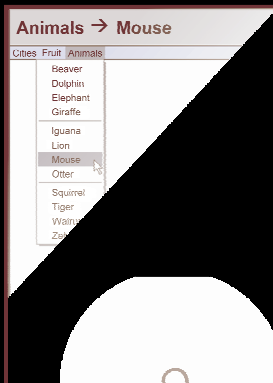
Pre-old



Old

7

## Two Tasks

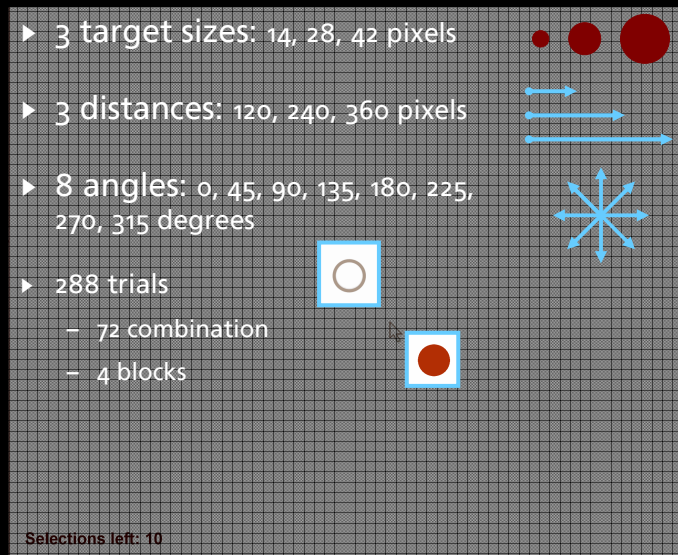


- ▶ Multi-dimensional Tapping
  - Well understood measures of speed and accuracy
- ▶ Menu Selection
  - Greater degree of realism
  - Higher cognitive effort

8

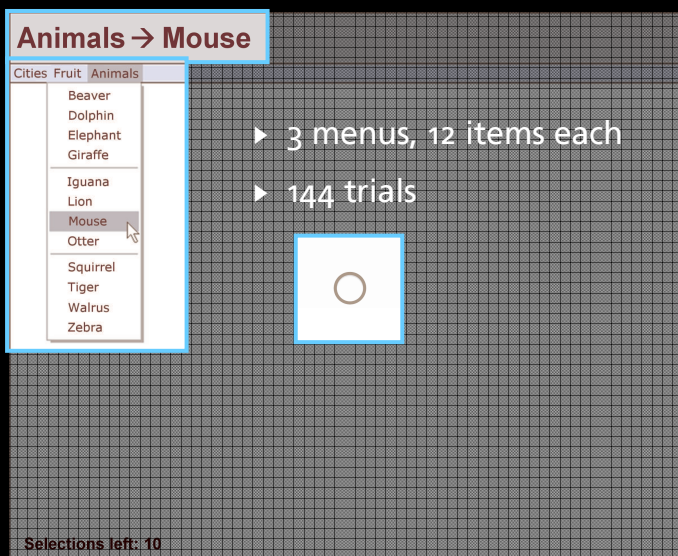
## Tapping Task

- ▶ 3 target sizes: 14, 28, 42 pixels
- ▶ 3 distances: 120, 240, 360 pixels
- ▶ 8 angles: 0, 45, 90, 135, 180, 225, 270, 315 degrees
- ▶ 288 trials
  - 72 combination
  - 4 blocks



9

## Menu Task



10

## Measures

- ▶ Speed
- ▶ Accuracy: Categorized errors
  - Slips
    - ▶ Pen lands on target
    - ▶ Pen moves (slips) off target
    - ▶ Pen lifts off target
  - Misses
    - ▶ Pen lands and lifts off target



11

## Hypotheses

1. Speed and accuracy will decrease as age increases.
2. Age will impact the *types of errors*.
3. Task will impact the *types of errors*.

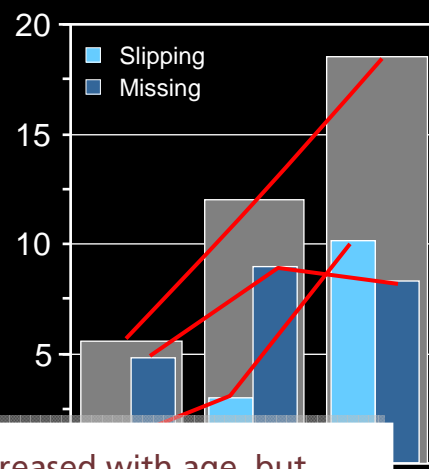
12

## Results

13

### Tapping Task Results: Accuracy

- ▶ Accuracy decreased with age ( $p < 0.05$ )
- ▶ Slips and Misses Individually
  - Missing remained relatively constant ( $p = 0.46$ )
  - Slipping increased with age ( $p < 0.05$ )



Overall accuracy decreased with age, but because of *additional error types*

14

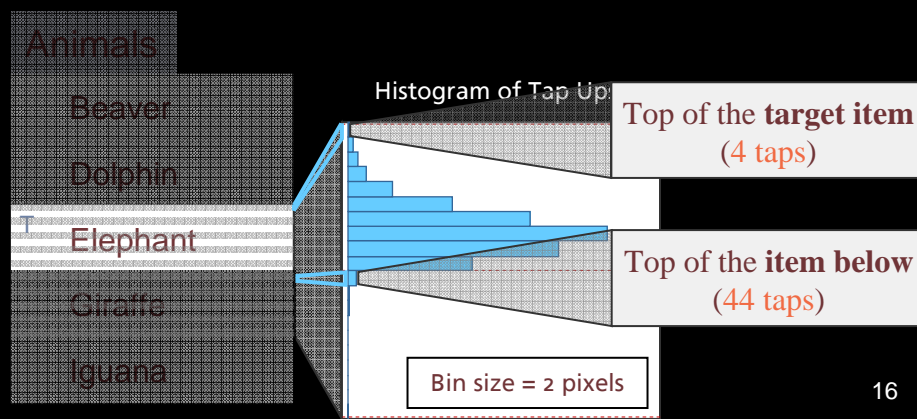
## Menu Task Results: Accuracy

- ▶ Fewer errors observed than expected
- ▶ Overall error rate only 1.4%
- ▶ Looked at general trends in the types observed

15

## Menu Task Results: Missing Just Below

- » 11 times more likely targeted at the item above
- » Accounted for 33% of errors



16



## Menu Task Results: Drifting



- ▶ Dominant pattern observed, involving accidental use of the hover region
- ▶ 35 out of 36 subjects drifted at least once
- ▶ Trials with drift were *slower* than those without ( $p < 0.001$ )
- ▶ Old and pre-old participants *drifted more* ( $p < 0.05$ )
- ▶ Drifting *did not decrease* over time

17

## Hypotheses

1. Speed and accuracy will decrease as age increases. ✓
  - ▶ Both tasks: Speed decreased with age.
  - ▶ Tapping task: Accuracy decreased with age.
  - ▶ Menu task: Drifting increased with age.
2. Age will impact the types of errors made. ✓
  - ▶ Menu Task: too few errors to examine.
  - ▶ Tapping Task: everyone missed, older users also slipped.
3. Task will impact the types of errors revealed. ✓
  - ▶ Tapping task: slipping and missing *and*
  - ▶ Menu task: drifting and missing just below.

18

## Conclusions and Future Work

- ▶ **Summary:** 3 sources of difficulty
- ▶ **Next Steps:** Addressing the difficulties
  - Slipping
    - ▶ Can we adapt *mouse techniques*?
  - Missing just below
    - ▶ Can we *reassign* or *deactivate* those selections?
  - Drifting
    - ▶ Can we *turn off* the functionality? Can we *delay* it?

19

## A Final Word

- ▶ **Drifting and Missing Just Below**
  - Not planned measures
  - Initially observed affecting the older groups
  - Analysis found they affected everyone

Including older adults enabled us to discover difficulties  
common across the adult lifespan

The end.

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20