Study of Handheld Computer Stylus Skills in Older Adults

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Older Adults as Census Enumerators

2000 Census

- 35% of enumerators aged 50 or over
  - 17% 50-59
  - 12% 60-69
  - 6% 70+
- More likely to have free time
- Know their neighborhood

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Handheld Computers for 2010 Census

- Census Bureau considering using handheld computers for 2010 Census
- Can 200,000 older adults use them accurately and efficiently?

Potential Issues

- Handhelds targeted at younger users
- Not many users over 55 years old
  - Pastore 2001; MBA Online 2004
- Cognitive and sensory issues
  - Memory, vision, hearing, information processing speed
    - Gregor et al. 2002; Hanson 2001
- Older adults had more difficulty completing tasks during usability testing of handheld computer software

Research Questions

- Can older adults complete simple tasks with a stylus accurately and efficiently?
- What icon sizes work best for them?
- What techniques work best for selecting options?

Participants

- 20 aged 18-22 years old
  - mean 19.6, 13 female, 7 male
  - 1 used HHC on a regular basis
- 20 aged 50-64 years old
  - mean 57.4, 16 female, 4 male
  - none used HHC on a regular basis
- 20 aged 65+
  - mean 71.6, 12 female, 8 male
 - 1 used HHC on a regular basis

Hardware Materials

- Compaq iPAQ 3950
- PocketPC 2002
- 64MB, Intel PXA250 processor
- 240 x 320 pixel resolution
- 0.2391 mm pixel size
- Connected to computer through USB cable

Software Materials

- Application logged all user actions
- No action required by researcher
- Sound feedback for success failure
- Four types of tasks
  - Tapping circles
  - Touching circles
 - Straight steering
  - Circular steering

Tap and Touch Tasks

- Two techniques to select icons/checkboxes/radio buttons
- Tap on large start circle, then tap or touch target circle
- Tasks not repeated if unsuccessful
- 3 circle sizes (16, 24, 32 pixels)
- 3 distances each (3x, 4x, 5x circle size)
- 8 angles

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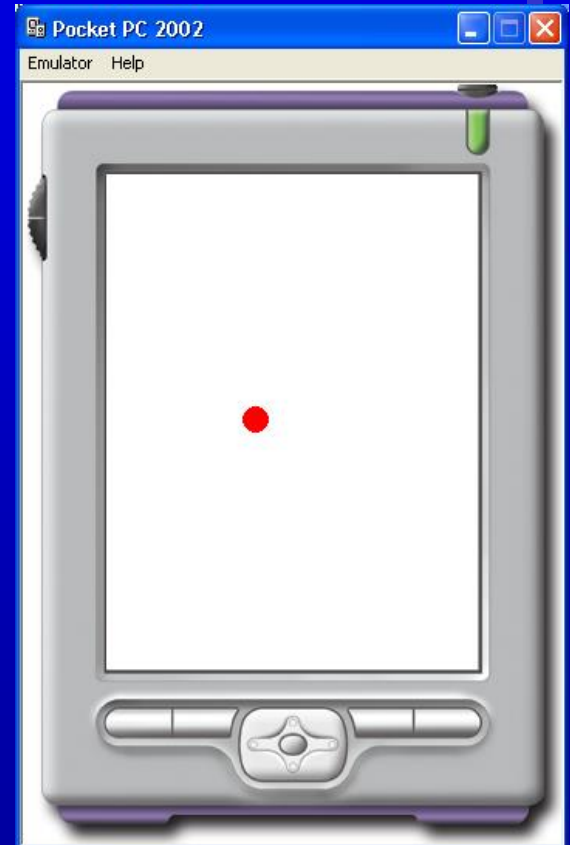
Straight Steering Tasks

- Steer stylus between parallel lines
- Simulating multiple selections in a grid
- Put stylus on large start circle, then steer stylus between parallel lines
- Tasks repeated if unsuccessful
- 3 widths (16, 24, 32 pixels)
- 3 distances (3x, 4x, 5x width)
- 8 angles

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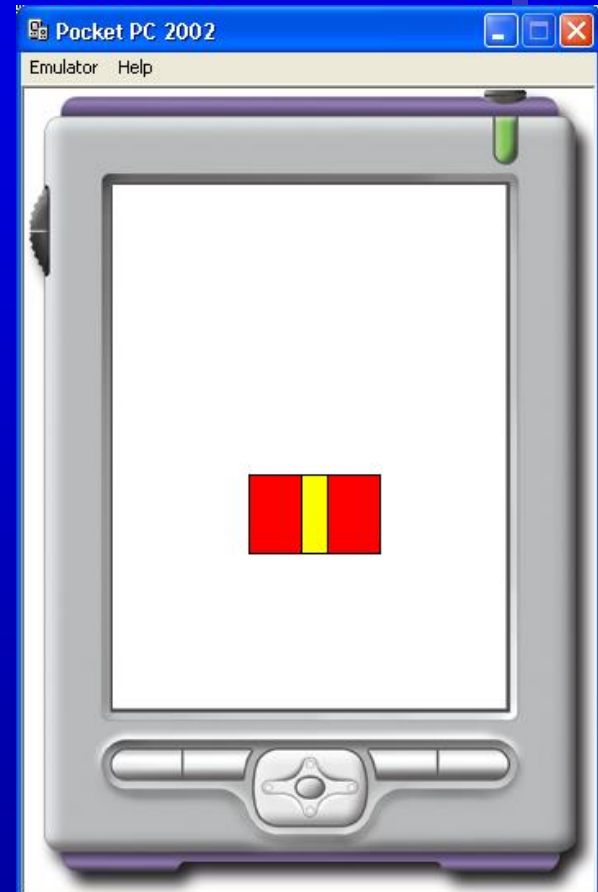
Circular Steering Tasks

- Steer stylus between circumferences of two concentric circles
- Simulating another technique for multiple selections in a grid
- Put stylus on large start circle, then steer stylus around inner circle staying within outer circle
- Tasks repeated if unsuccessful
- 3 widths (16, 24, 32 pixels)
- 4 distances (6x, 8x, 10x, 12x width)
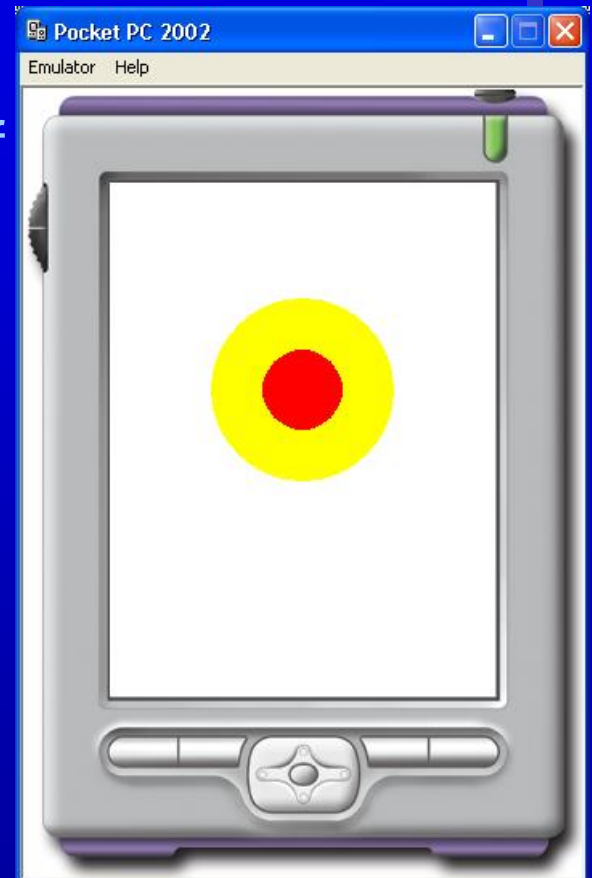
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Procedure

- Locations:
  - Census Bureau Usability Lab, Suitland, MD
  - Rockville Senior Center, Rockville, MD
- Instructed to be quick and accurate
- Personal information requested before start of study
  - age, gender, computer experience

Procedure

- Task order (50% of participants each)
  - Tap, touch, straight, circular
  - Touch, tap, straight, circular
- Tapping, touching and straight steering
  - 16 practice tasks
  - 2 blocks of 72 tasks each
- Circular steering
  - 8 practice tasks
  - 4 blocks of 12 tasks each

Design

- Independent variables
    - Age level
    - Target or width size
    - Distance
    - Angle (except for circular steering)
    - Block number
    - Study order (tap vs. touch)
- Dependent variables
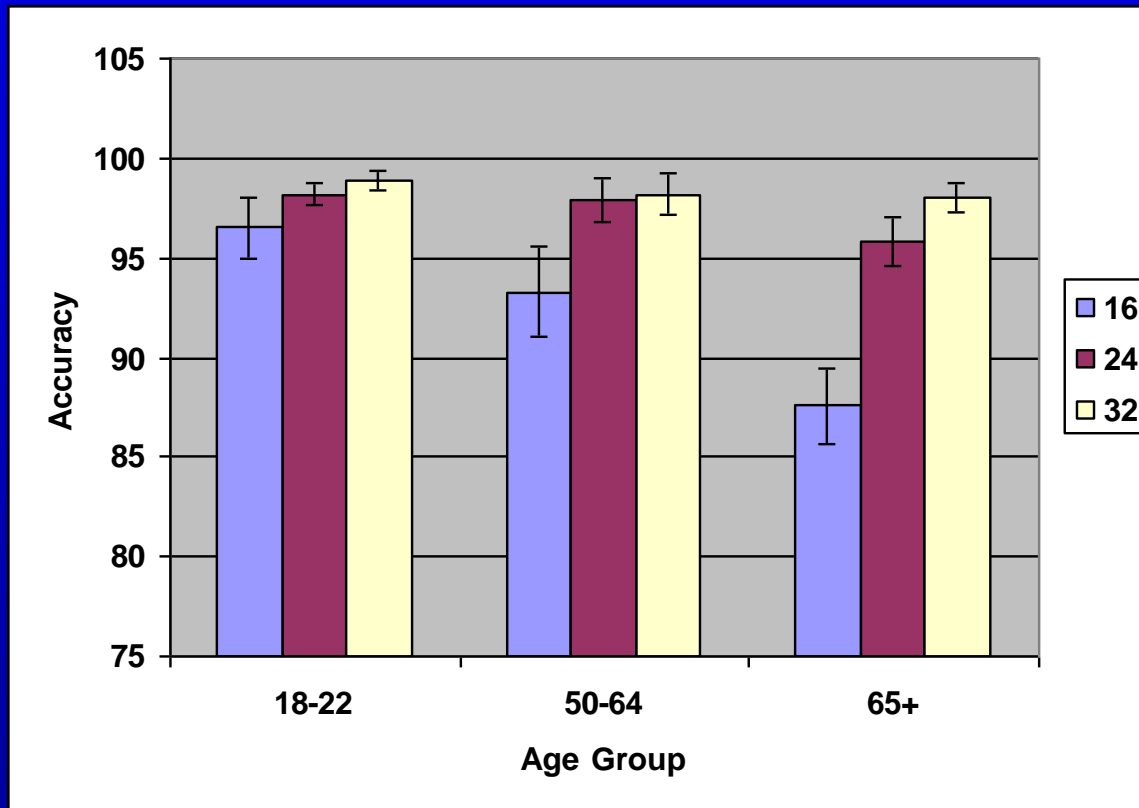   - Accuracy
    - Time

Data Analysis

- XML log files imported into Microsoft Access

- Relevant data exported to SPSS 12.0 for Windows

- Repeated measures analyses
  - Between subjects ANOVA
  - MANOVA Wilks' Lambda (for within subjects)

- Pairwise comparisons using Bonferroni's correction

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Results: Tapping

- Size had significant effect on accuracy only for 65+ age group
- Other age groups had no significant accuracy advantage with larger targets
- 65+ age group significantly less accurate than other age groups
- Size, age group and distance had significant effect on time, but all averages < 1 second
- Mid-range distances provided best times

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Results: Tapping (accuracy)

Results: Touching

- Size had significant effect on accuracy for all age groups
- No significant differences between age groups
- Size, distance, and angle had significant effect on time
- 45, 90 degrees faster than 0, 315 degrees
- All time averages < 1 second

# Results: Touching (accuracy)

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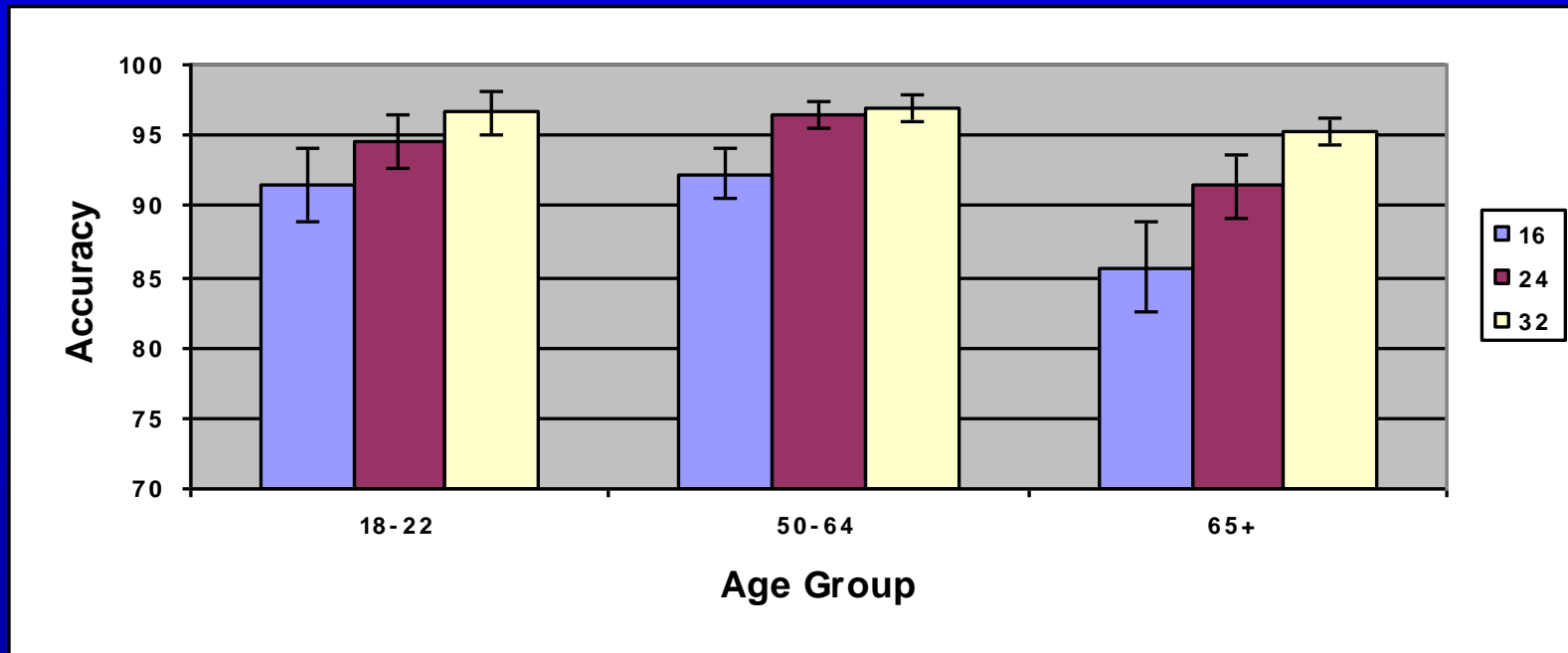
Results: Tap vs. Touch

- Tapping significantly better in accuracy ($p = 0.017$) and time ($p = 0.004$)
  - Accuracy: applies only to 16 pixel targets for 18-22 age group
  - Time: applies to 18-22 age group for all target sizes, and 50-64 age group for 32 pixel targets

Results: Tap vs. Touch

Only slightly above half had higher accuracy when tapping

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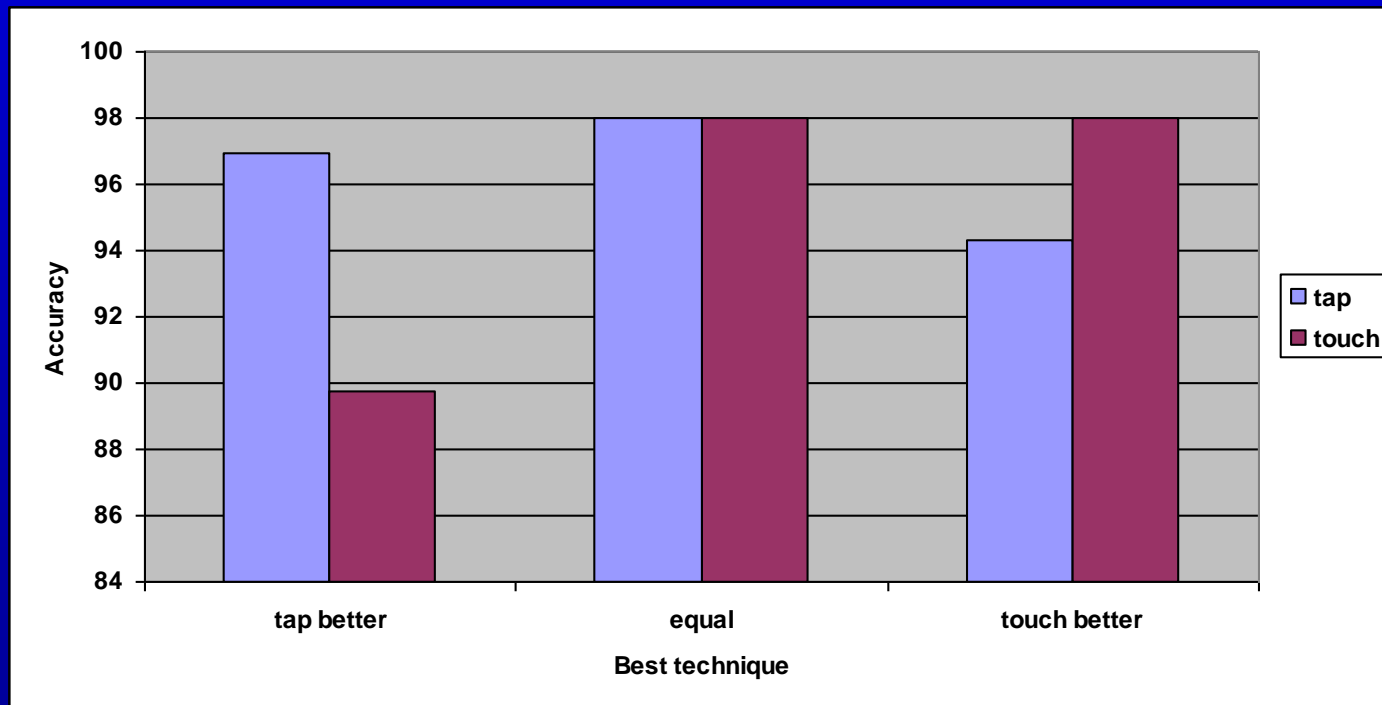
Results: Straight Steering

- Size and distance had a significant effect on accuracy

- Size, block, distance, and angle had a significant effect on time

- Age group had no significant effects

- Very high accuracy rates (> 94% on average)

- High speed (longest average = 640 ms)

- 45 and 90 degrees fastest

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Results: Circular Steering

- Most difficult type of task
- Size, distance had significant effect on accuracy, time
- 16 pixel widths caused accuracy to dip below 90%
- Age group had no significant effects

Results: Circular Steering (accuracy)

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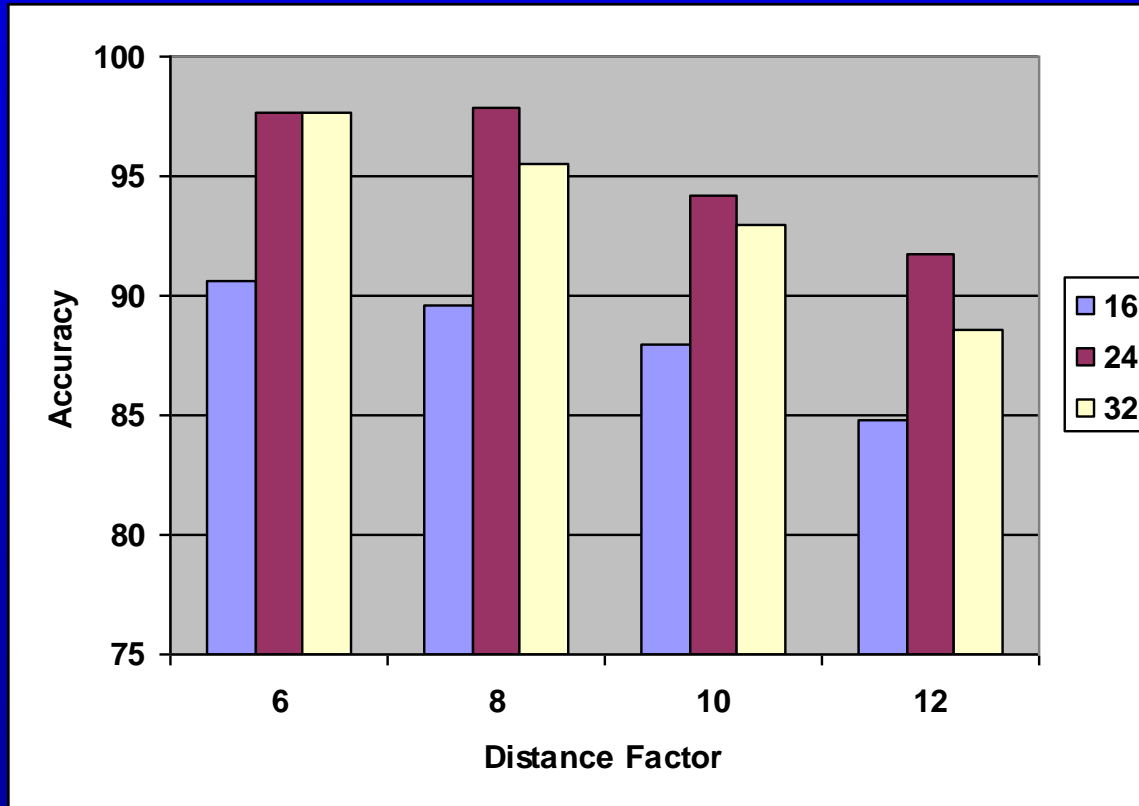
Observations

- Older adults sometimes inadvertently touched screen with finger

- Older adults tap harder, with experience they start tapping lighter, sometimes too light

- Streaky performance

Implications

- Older adults can complete simple stylus tasks with handheld computers accurately and efficiently

- Tapping seems to provide advantages over touching

- Straight steering very easy

- Circular steering difficult for all

Future Work

- Study technique differences between accurate and inaccurate touching of circles
- Study other reasons for older adult difficulty with handheld computer software
  - User interface complexity
  - Memory issues

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Questions?

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