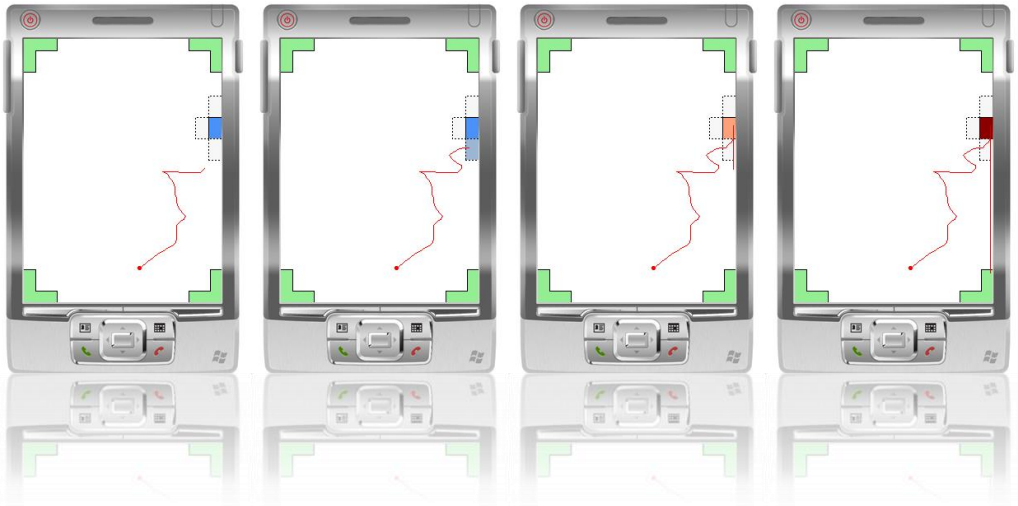
barrierpointing



Using Physical Edges to Assist Target Acquisition on Mobile Device Touch Screens

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[1]Computer Science and Engineering

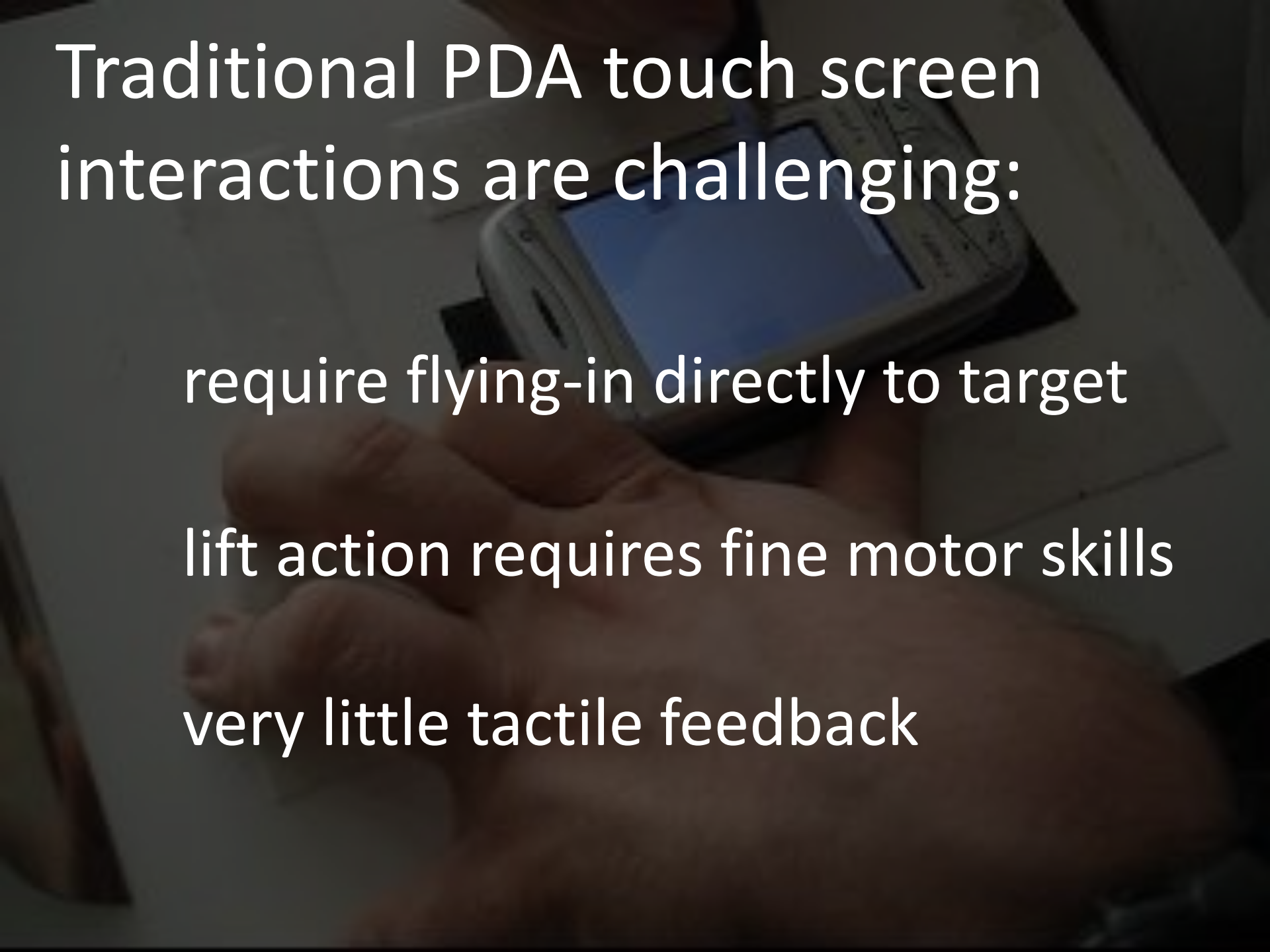
[2]The Information School

dub design: use: build:

university of washington

Ninth International ACM SIGACCESS Conference on Computers and Accessibility

October 15th, 2007



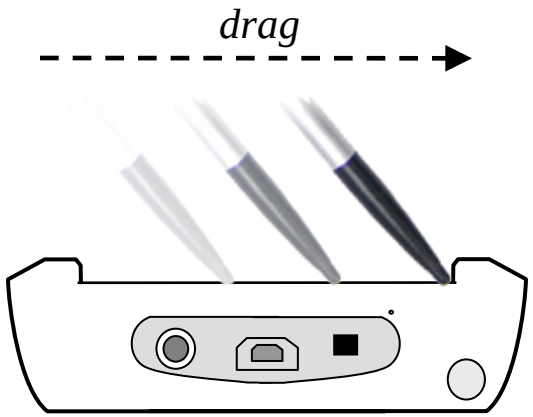
Traditional PDA touch screen interactions are challenging:

require flying-in directly to target

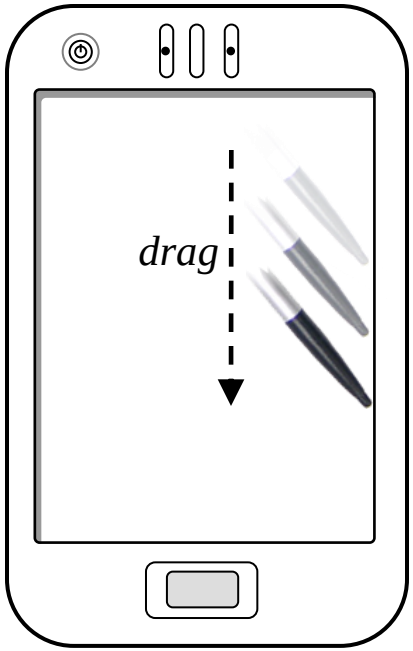
lift action requires fine motor skills

very little tactile feedback

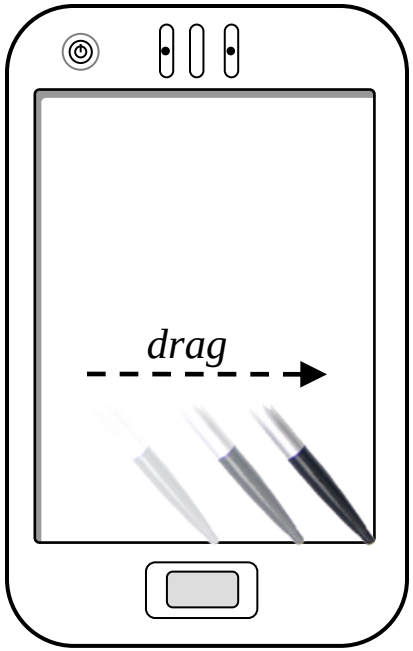
Utilize Screen, Edge & Corners



Allow user to rely on screen surface to assist movement.

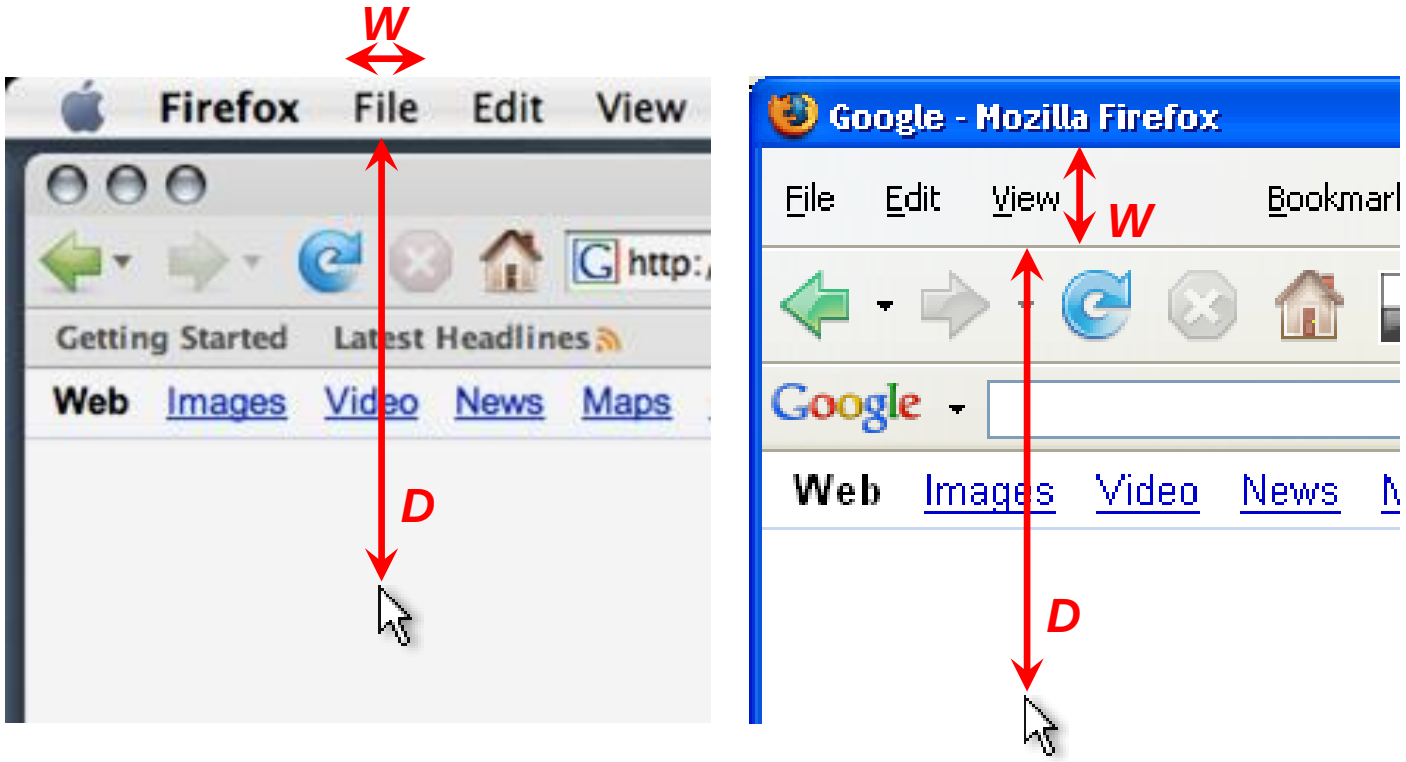


Use screen edge to guide movement.



Use screen corner to trap movement.

Virtual Edges



Walker, N. and Smelcer, J. B. *CHI '90*

Physical Edges

Wobbrock, J., Myers, B. A., and Kembel, J. A. *UIST '03*

Barrier Targets

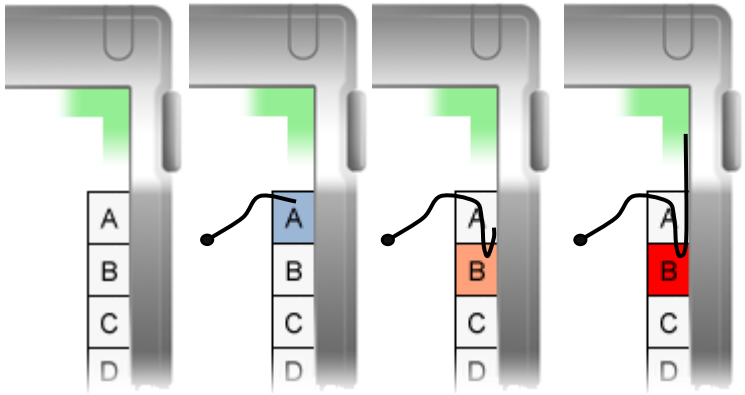
Existing Interface

Realigned Barrier Target Interface

- Targets placed around screen perimeter
- Targets are stroked into rather than tapped

Edge Stroke with Lift Confirmation

Velocity Stroke with Corner Confirmation



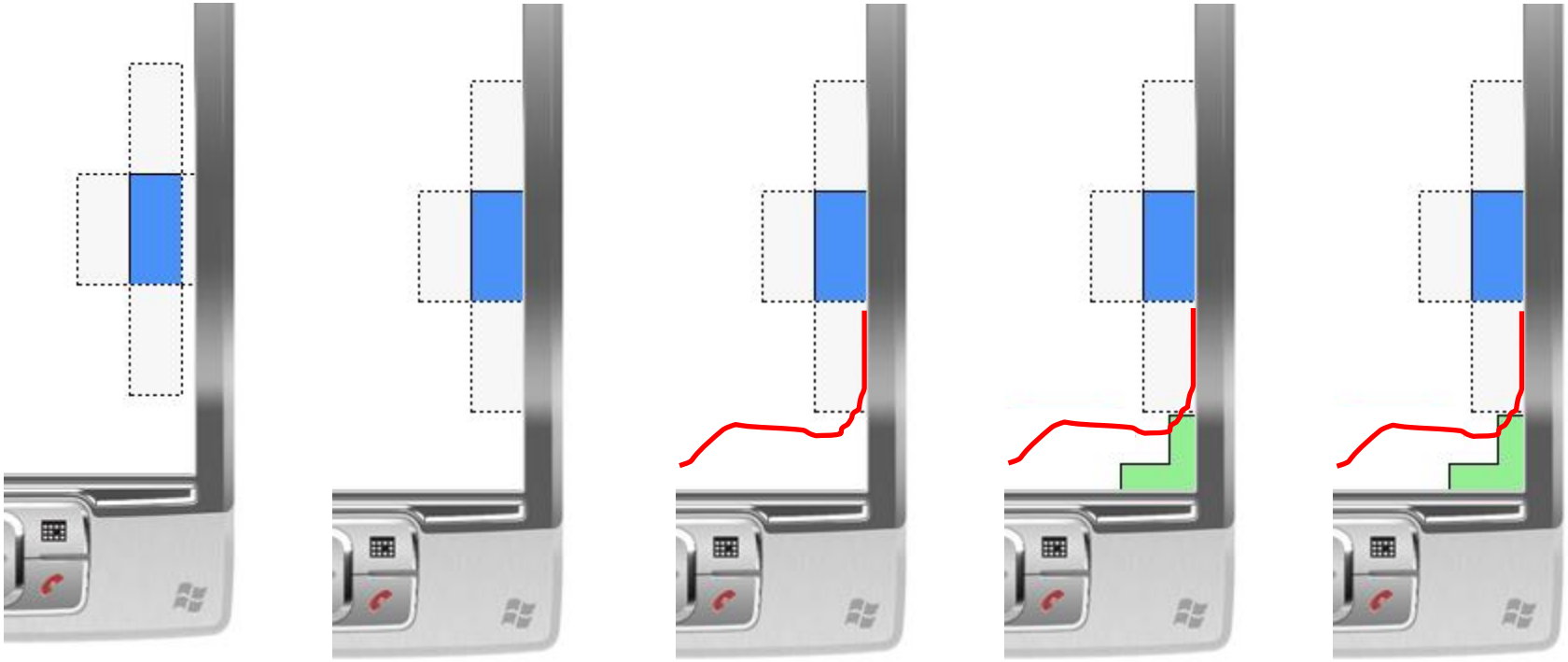
Reverse Stroke with Corner Confirmation

Initial Study

18 Subjects (9 Able Bodied / 9 Motor Impaired)

- Recruited subjects from Seattle area using Craigslist, listservs and word-of-mouth
- Broad Range of Motor Impairments
  - Parkinson's disease, low strength, tetraplegia, cerebral palsy

Five Conditions



1. Fly-in and Tap

2. Edge Fly-in and Tap

Baseline Conditions

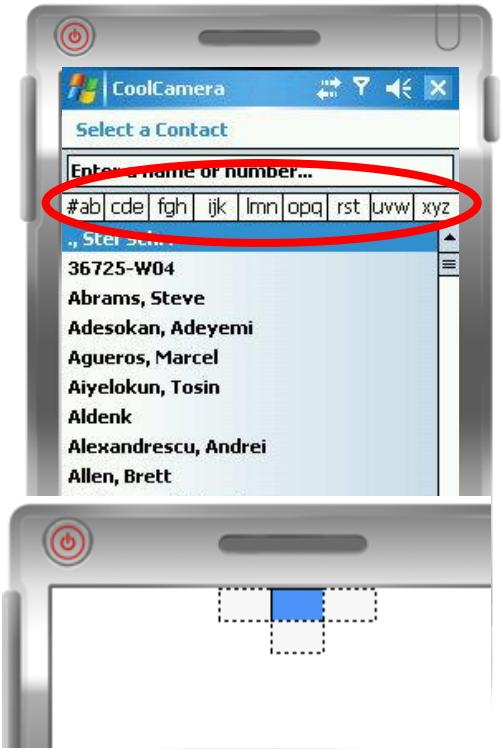
3. Edge Stroke w/Lift Confirm

4. Velocity Stroke w/Corner Confirm

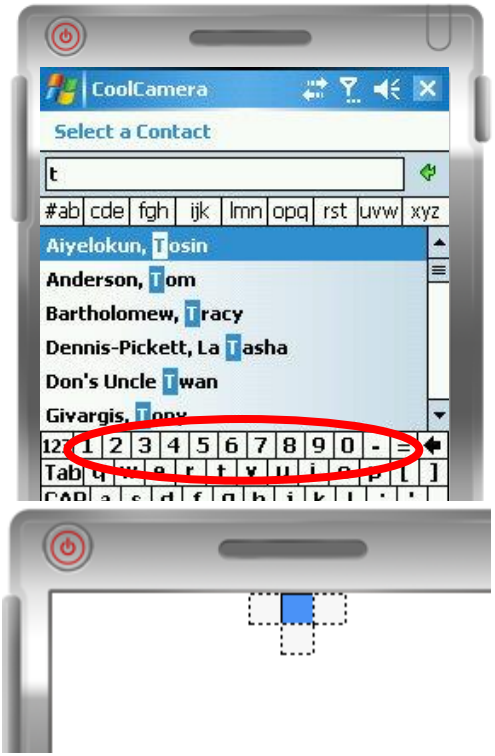
5. Reverse Stroke w/Corner Confirm

Target Sizes

Large: 59x28 pxls



Medium: 26x16 pxls



Small: 15x16 pxls

cingular
Click Here to Begin

Results

Overall target acquisition times were not statistically different for barrier pointing vs. traditional “fly-in and tap”

However…

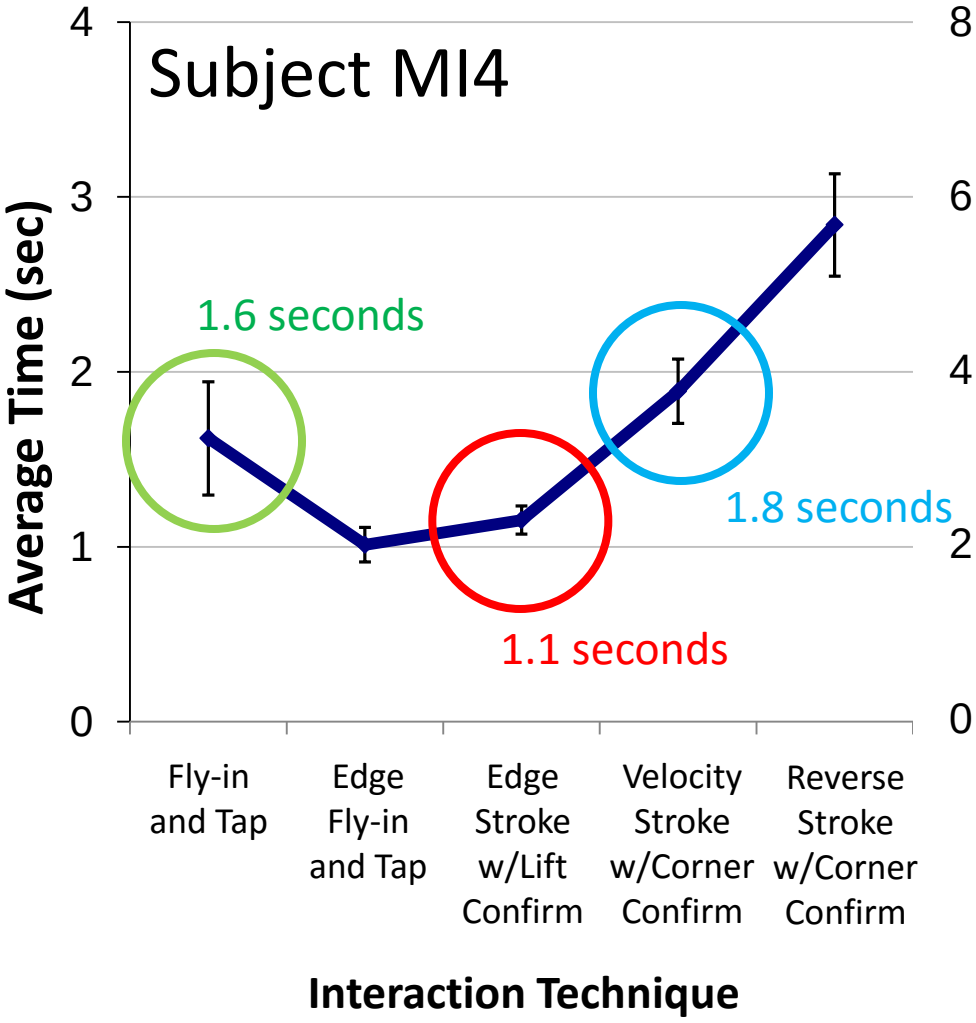
Two of the most severely impaired subjects benefited greatly from the Barrier Pointing techniques

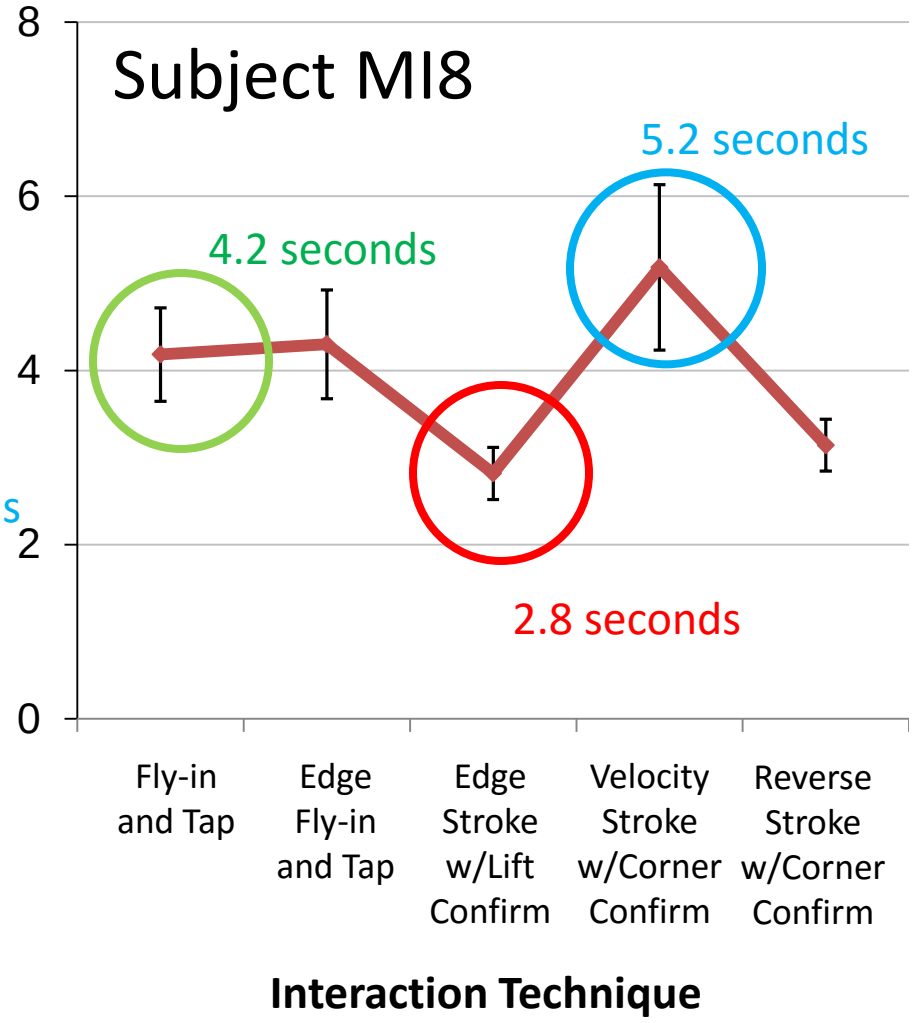
Case Studies

Subject: MI4
Condition:
Tetraplegia (SCI C5). No use of triceps, pectorals, hands. Limited shoulder movement.

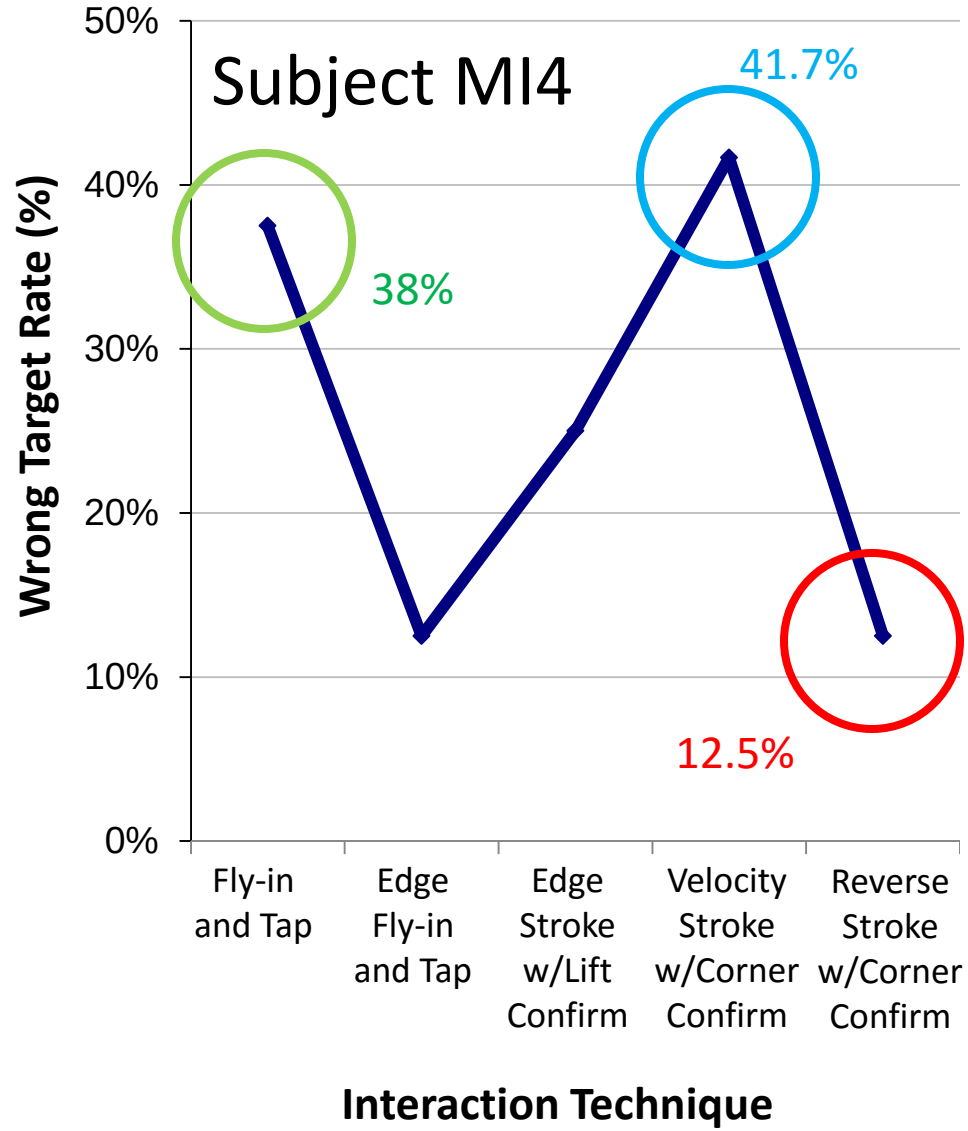
Subject: MI8
Condition:
Spastic Cerebal Palsy. Lack of fine motor skills. Spastic, uncontrollable movements.

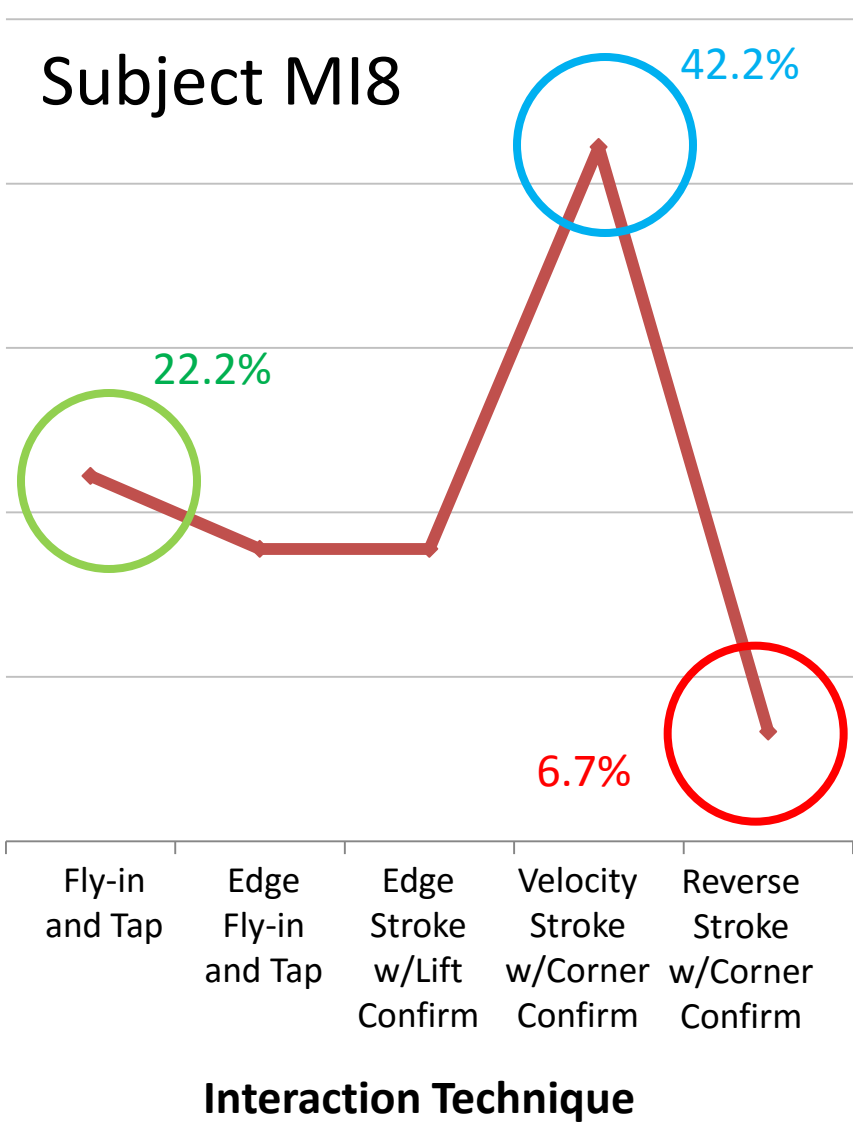
Average Target Acquisition Times



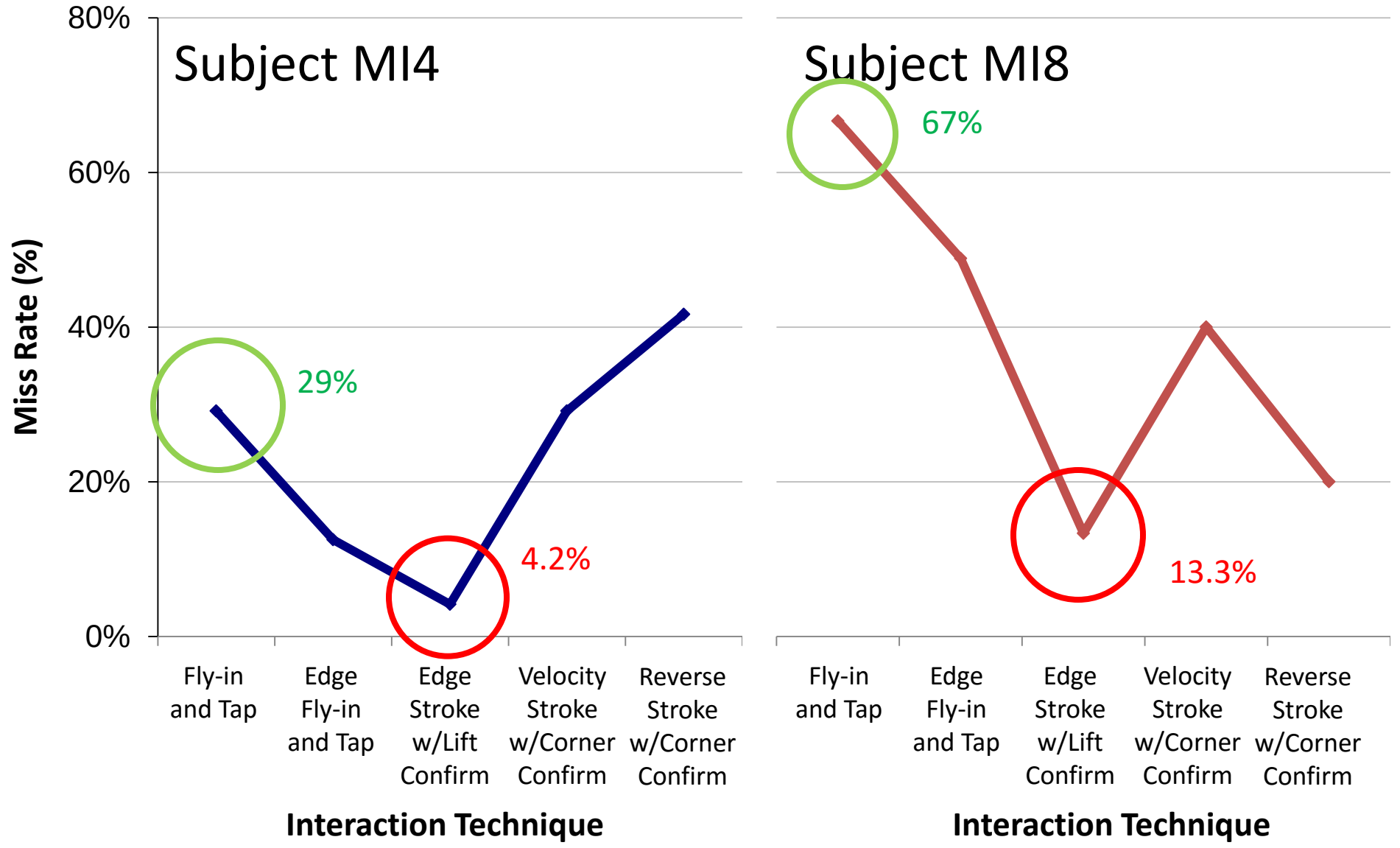


Error Rates

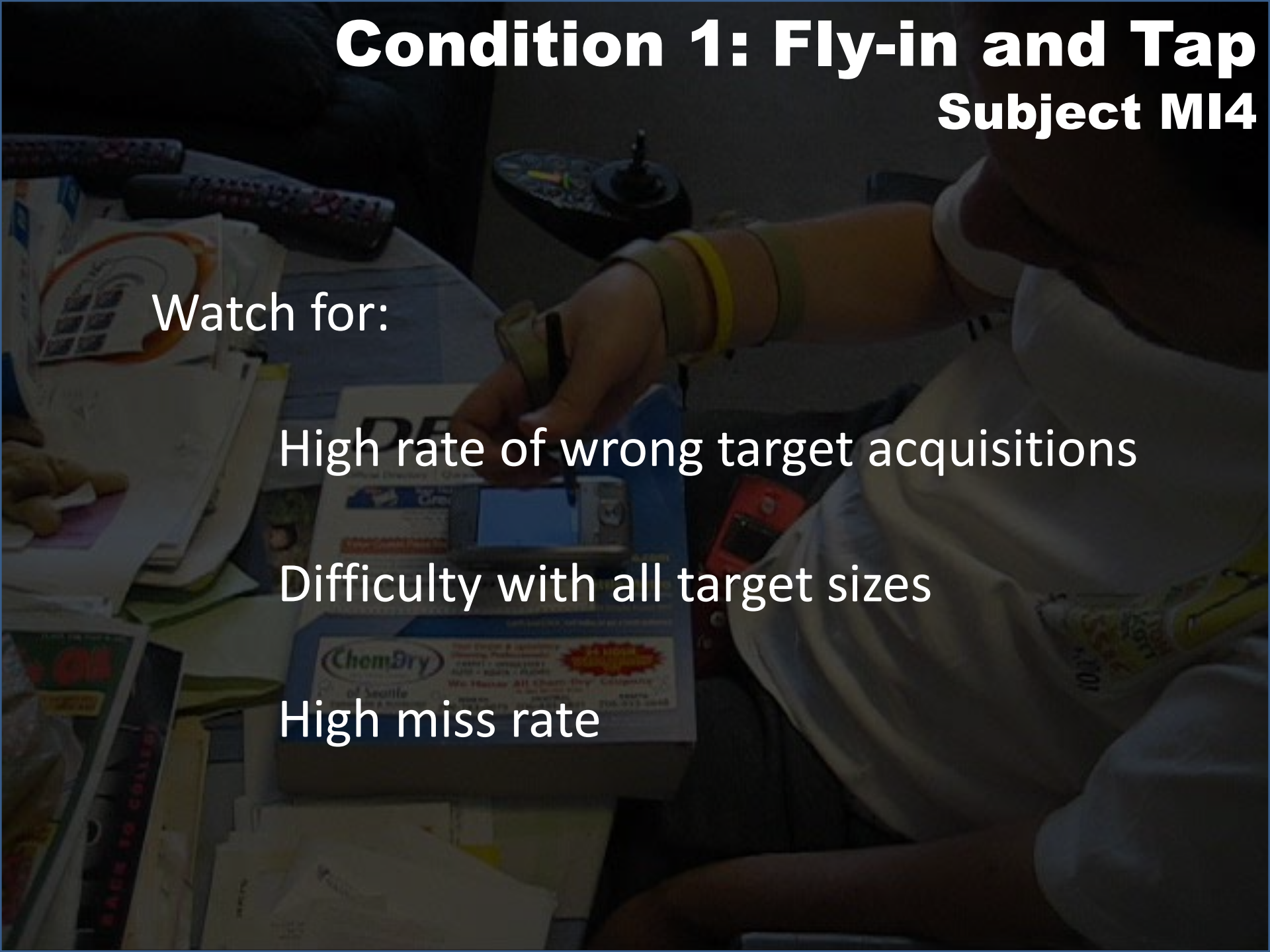

Subject MI4
41.7%
38%
12.5%
50%
40%
30%
20%
10%
0%
Wrong Target Rate (%)
Fly-in and Tap
Edge Fly-in and Tap
Edge Stroke w/Lift Confirm
Velocity Stroke w/Corner Confirm
Reverse Stroke w/Corner Confirm
Interaction Technique


Subject MI8
42.2%
22.2%
6.7%
Fly-in and Tap
Edge Fly-in and Tap
Edge Stroke w/Lift Confirm
Velocity Stroke w/Corner Confirm
Reverse Stroke w/Corner Confirm
Interaction Technique

Miss Rates


Subject MI4
80%
60%
40%
20%
0%
Miss Rate (%)
29%
4.2%
Fly-in and Tap
Edge Fly-in and Tap
Edge Stroke w/Lift Confirm
Velocity Stroke w/Corner Confirm
Reverse Stroke w/Corner Confirm
Interaction Technique
Subject MI8
67%
13.3%
Fly-in and Tap
Edge Fly-in and Tap
Edge Stroke w/Lift Confirm
Velocity Stroke w/Corner Confirm
Reverse Stroke w/Corner Confirm
Interaction Technique

Condition 1: Fly-in and Tap
Subject MI4



Watch for:

- High rate of wrong target acquisitions
- Difficulty with all target sizes
- High miss rate

Chem-Dry
of Seattle

Condition 1: Fly-in and Tap
Subject MI8

Watch for:

- Difficulty with fly-in motion
- Large number of accidental taps
- High rate of slippage

Condition 3: Edge Stroke w/Lift Confirmation

Subject MI4

Watch for:

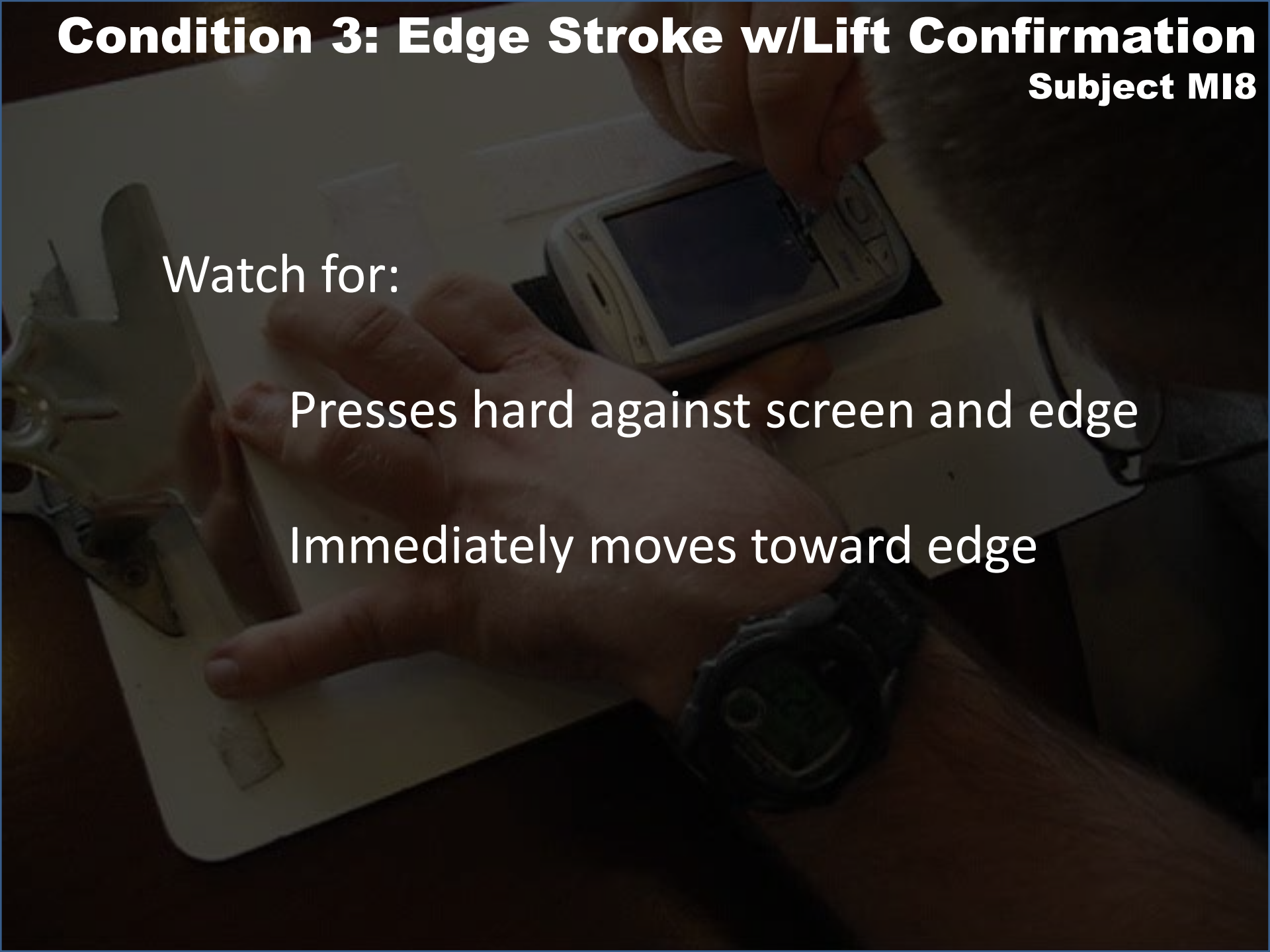
The edge results in smoother motion

The lift causes jerkiness

Returning to screen after lift is difficult

Condition 3: Edge Stroke w/Lift Confirmation

Subject MI8



Watch for:

- Presses hard against screen and edge
- Immediately moves toward edge

Condition 5: Reverse Stroke w/Corner Confirmation

Subject MI4

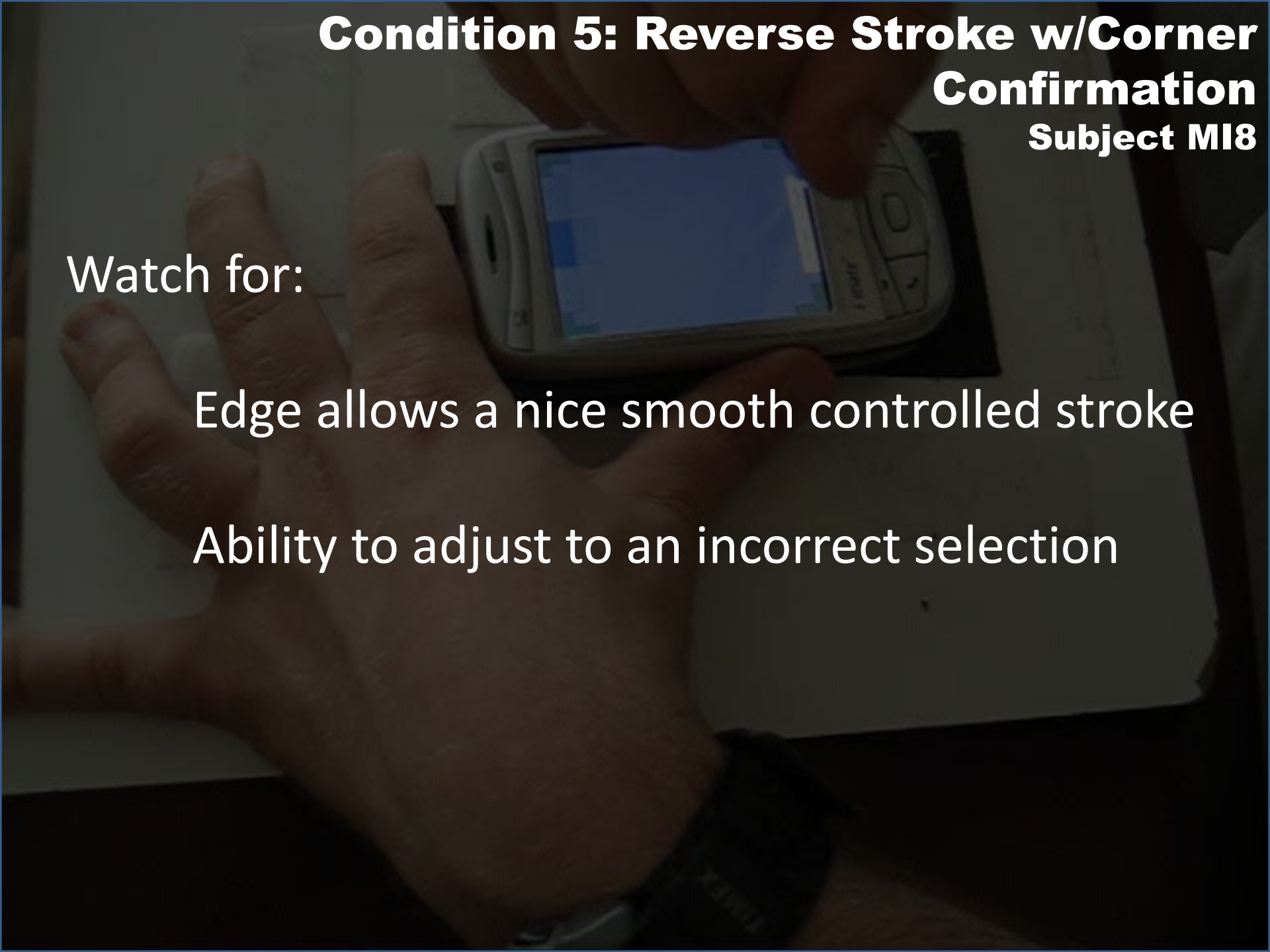
Watch for:

A nice smooth controlled stroke

Requires most movement (fatigue?)

Condition 5: Reverse Stroke w/Corner Confirmation

Subject MI8



Watch for:

Edge allows a nice smooth controlled stroke

Ability to adjust to an incorrect selection

Table of Results

(lower is better)	Time	
	MI4	MI8
Condition 1 “Fly-in and Tap”	1.6 sec	4.2 sec
Condition 2 “Edge Fly-in and Tap”	1.1 sec	4.3 sec
Condition 3 “Edge Stroke w/Lift Confirm”	1.1 sec	2.8 sec
Condition 4 “Velocity Stroke w/Corner Confirm”	1.9 sec	5.1 sec
Condition 5 “Reverse Stroke w/Corner Confirm”	2.8 sec	3.1 sec

Table of Results

(lower is better)	Time		Error Rate	
	MI4	MI8	MI4	MI8
Condition 1 “Fly-in and Tap”	1.6 sec	4.2 sec	37.5%	22.2%
Condition 2 “Edge Fly-in and Tap”	1.1 sec	4.3 sec	12.5%	17.8%
Condition 3 “Edge Stroke w/Lift Confirm”	1.1 sec	2.8 sec	25%	17.8%
Condition 4 “Velocity Stroke w/Corner Confirm”	1.9 sec	5.1 sec	41.7%	42.2%
Condition 5 “Reverse Stroke w/Corner Confirm”	2.8 sec	3.1 sec	12.5%	6.7%

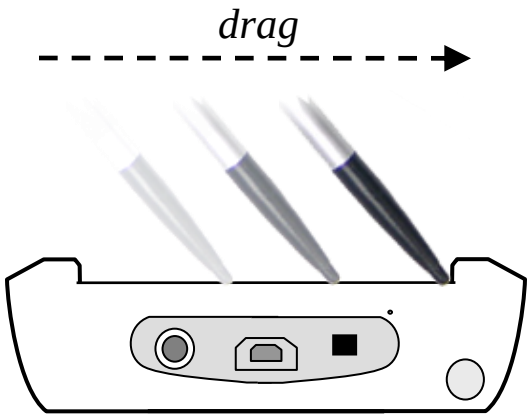
Table of Results

(lower is better)	Time		Error Rate		Miss Rate	
	MI4	MI8	MI4	MI8	MI4	MI8
Condition 1 “Fly-in and Tap”	1.6 sec	4.2 sec	37.5%	22.2%	29.2%	66.7%
Condition 2 “Edge Fly-in and Tap”	1.1 sec	4.3 sec	12.5%	17.8%	12.5%	49%
Condition 3 “Edge Stroke w/Lift Confirm”	1.1 sec	2.8 sec	25%	17.8%	4.2%	13.3%
Condition 4 “Velocity Stroke w/Corner Confirm”	1.9 sec	5.1 sec	41.7%	42.2%	29.2%	40%
Condition 5 “Reverse Stroke w/Corner Confirm”	2.8 sec	3.1 sec	12.5%	6.7%	41.7%	20%

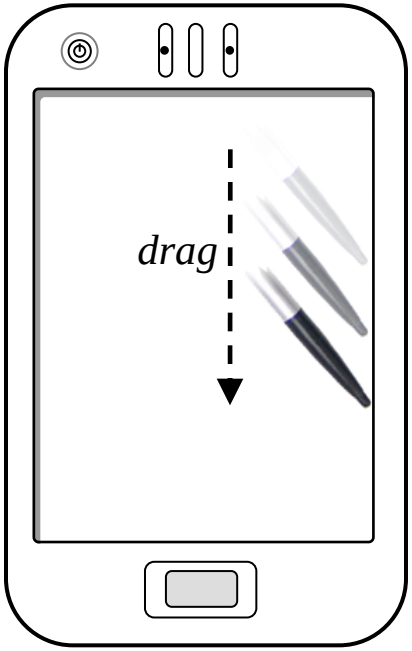
Future Work

- Explore multiple target acquisitions per trial
- Apply barrier pointing to finger/thumb based interaction
- Begin creating barrier pointing widgets and interfaces

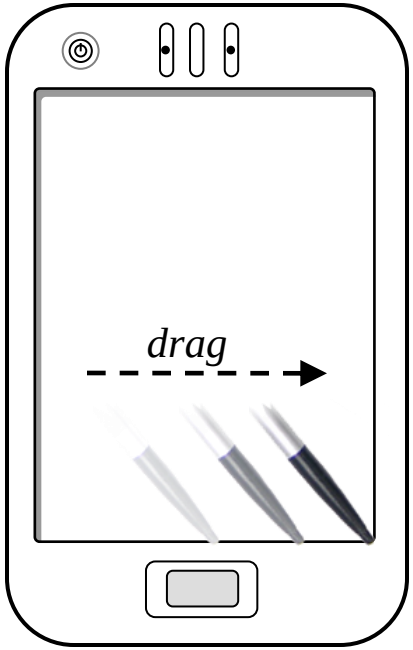
Conclusion



Screen



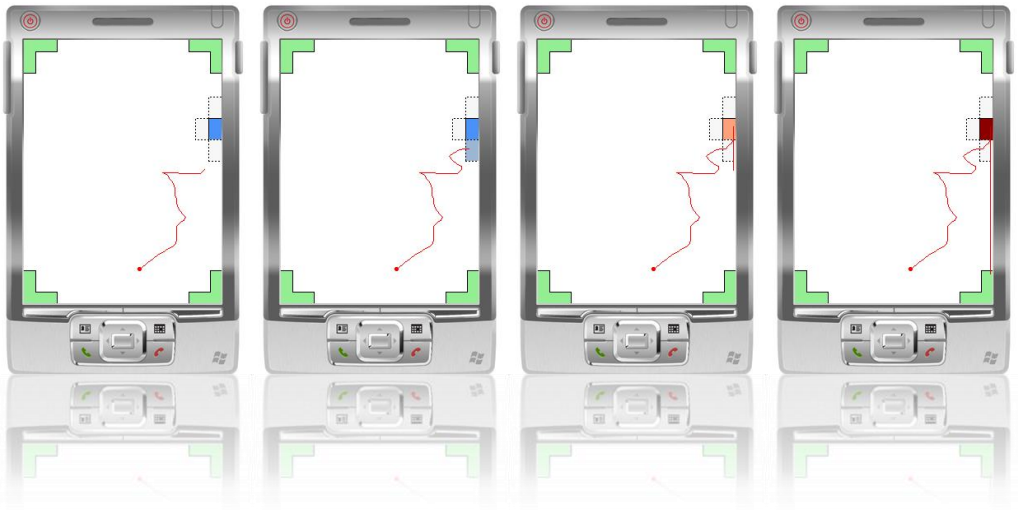
Edge



Corner

Jon Froehlich
jonfroehlich@gmail.com

thankyou!



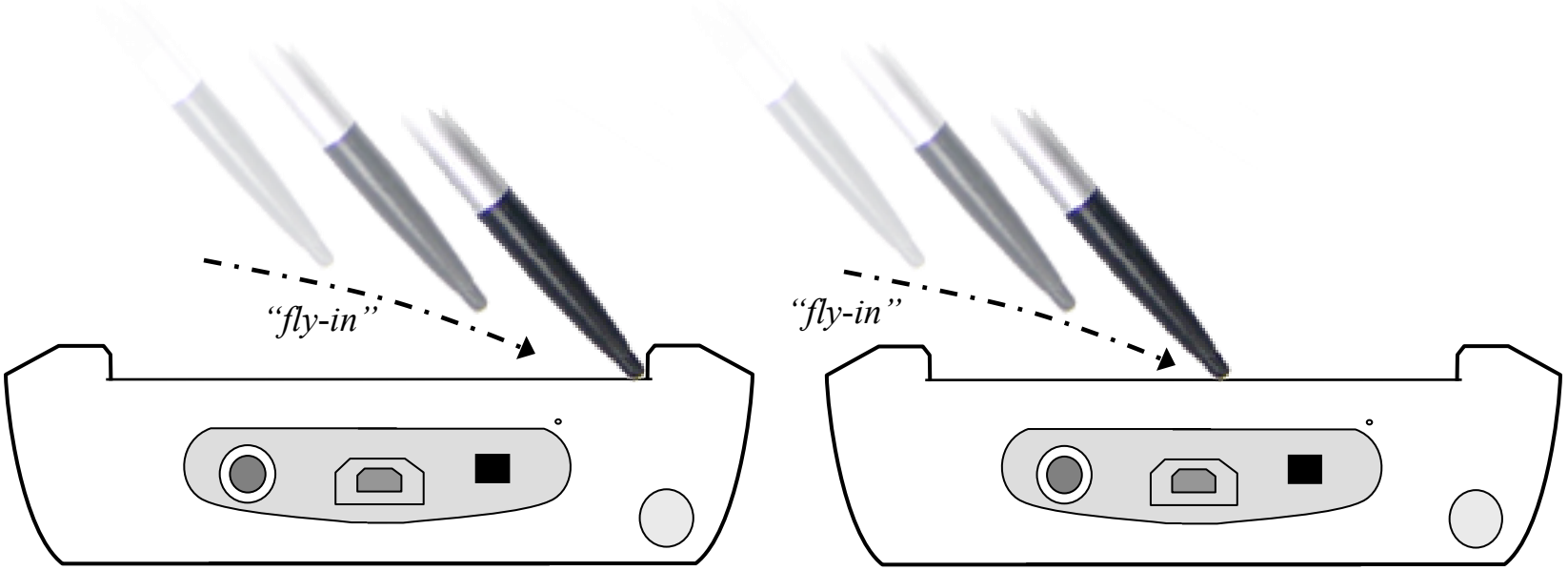
Acknowledgements

I'd like to acknowledge my co-authors Jacob O. Wobbrock and Shaun Kane for a wonderful collaboration, UW Rehabilitative Medicine, the study participants, and Susumu Harada and Anna Talman for their helpful edits/comments on the paper.

dub **design: use: build:**
university of washington

OLD / BACKUP SLIDES

Our Approach

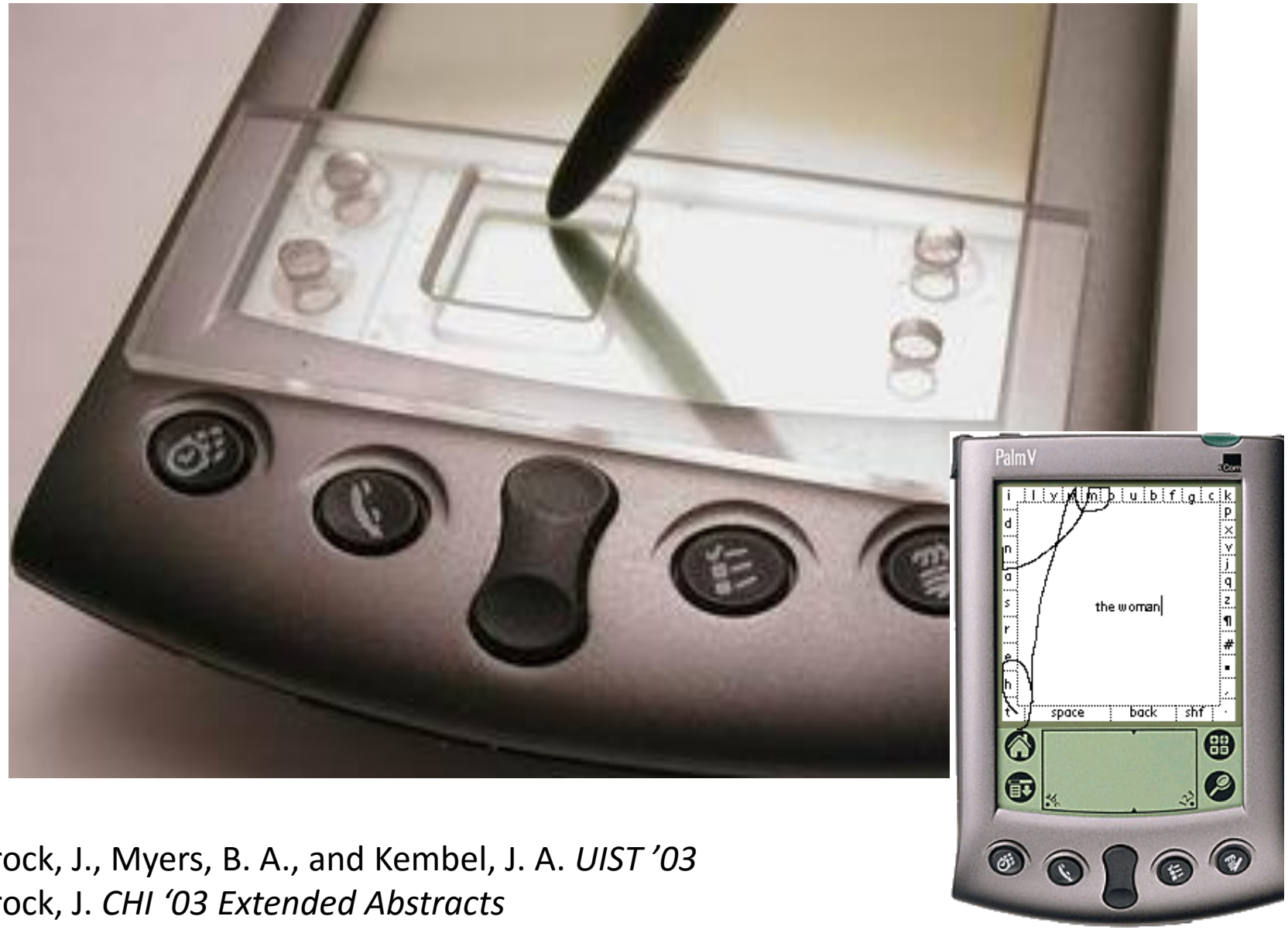


Can we utilize the device's raised edge along the screen perimeter to assist the fly-in movement?

Edge Provides Tactile Feedback

Touchpad's often utilize edge to shortcut access to functions such as scroll, maximize, etc.

Physical Edges



Wobbrock, J., Myers, B. A., and Kembel, J. A. *UIST '03*
Wobbrock, J. *CHI '03 Extended Abstracts*