Typing on Flat Glass

Examining Ten-Finger Expert Typing Patterns on Touch Surfaces

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dub design: use: build: university of washington

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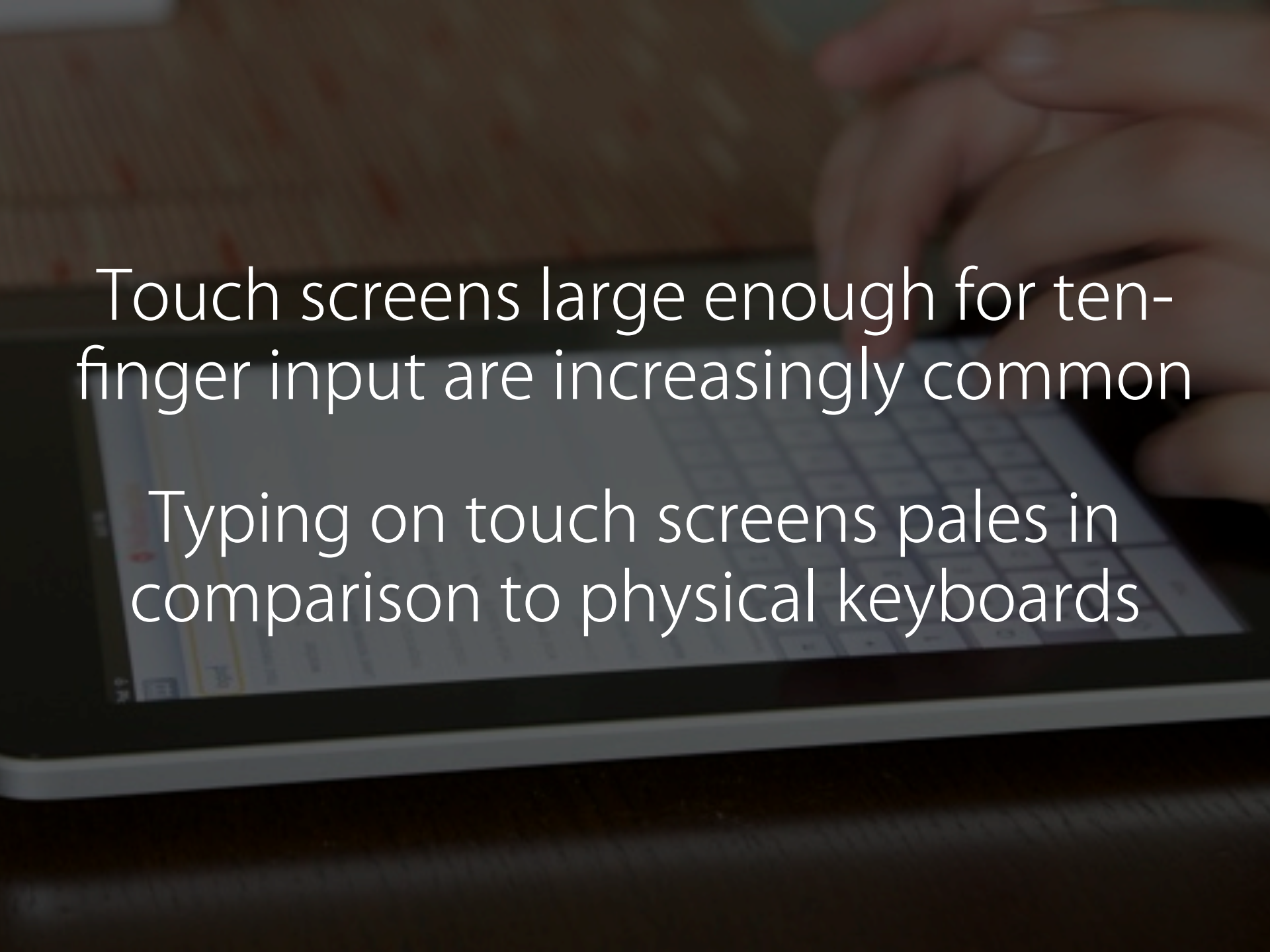
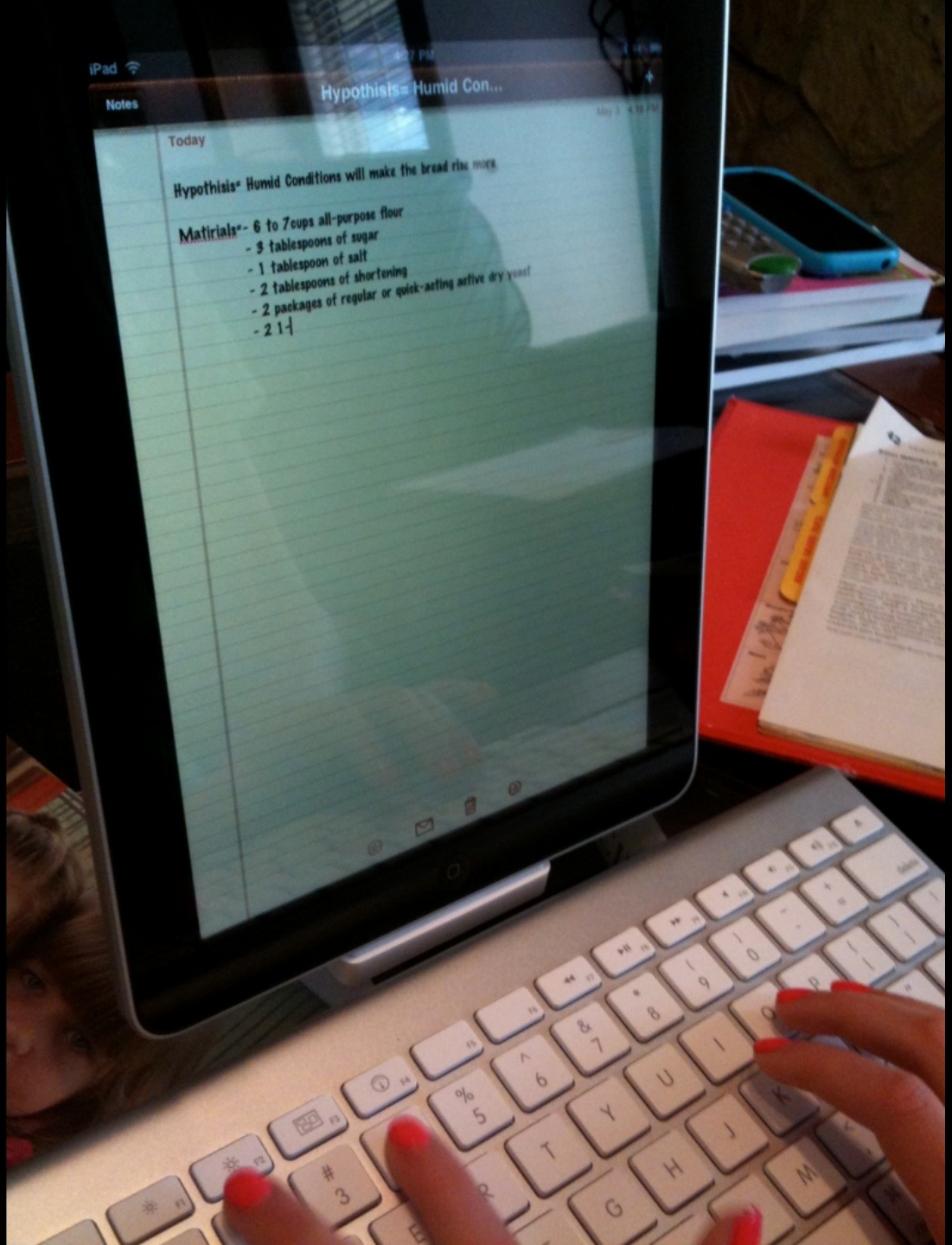
AIM research group
accessibility · interaction · mobility


Touch screens large enough for ten-finger input are increasingly common
Typing on touch screens pales in comparison to physical keyboards


iPad
Notes
Hypothisis= Humid Con...
Today
Hypothisis= Humid Conditions will make the bread rise more
Matirials:- 6 to 7cups all-purpose flour
- 3 tablespoons of sugar
- 1 tablespoon of salt
- 2 tablespoons of shortening
- 2 packages of regular or quick-acting active dry yeast
- 2 1-

Rich potential for adaptation


Microsoft

Rich potential for adaptation

How?

Study with Expert Typists

GOALS

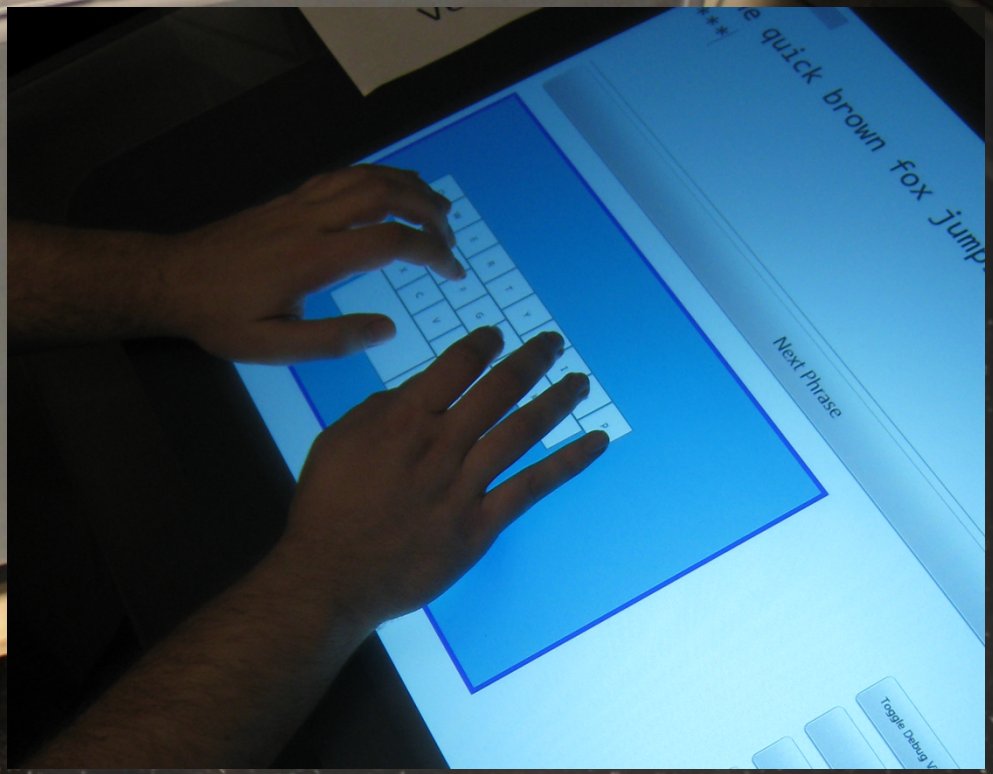
Improve design of touch screen keyboards

Explore if **eyes-free typing** is possible for touch screens

APPROACH

Examine typing patterns that **emerge** when **expert typists** type on a touch screen with **no visible keyboard**

Physical keyboard: 85 WPM (*SD*=19.4)


quick brown fox jump
Next Phrase

20 participants

Task: Series of phrases

3 conditions (within-subjects)

1. **no visible keyboard** and **no feedback** } **least constrained**
2. **visible keyboard** and **asterisk feedback**
3. **no visible keyboard** and **asterisk feedback**

1 No Keyboard and No Feedback

pack my box with five dozen liquor jugs

phrase prompt

Next Phrase

thumb placement
(configured per user)

input area

pack my box with five dozen liquor jugs

Next Phrase

Toggle Debug Visuals (currently OFF)

Activate Keyboard

Reset Trial

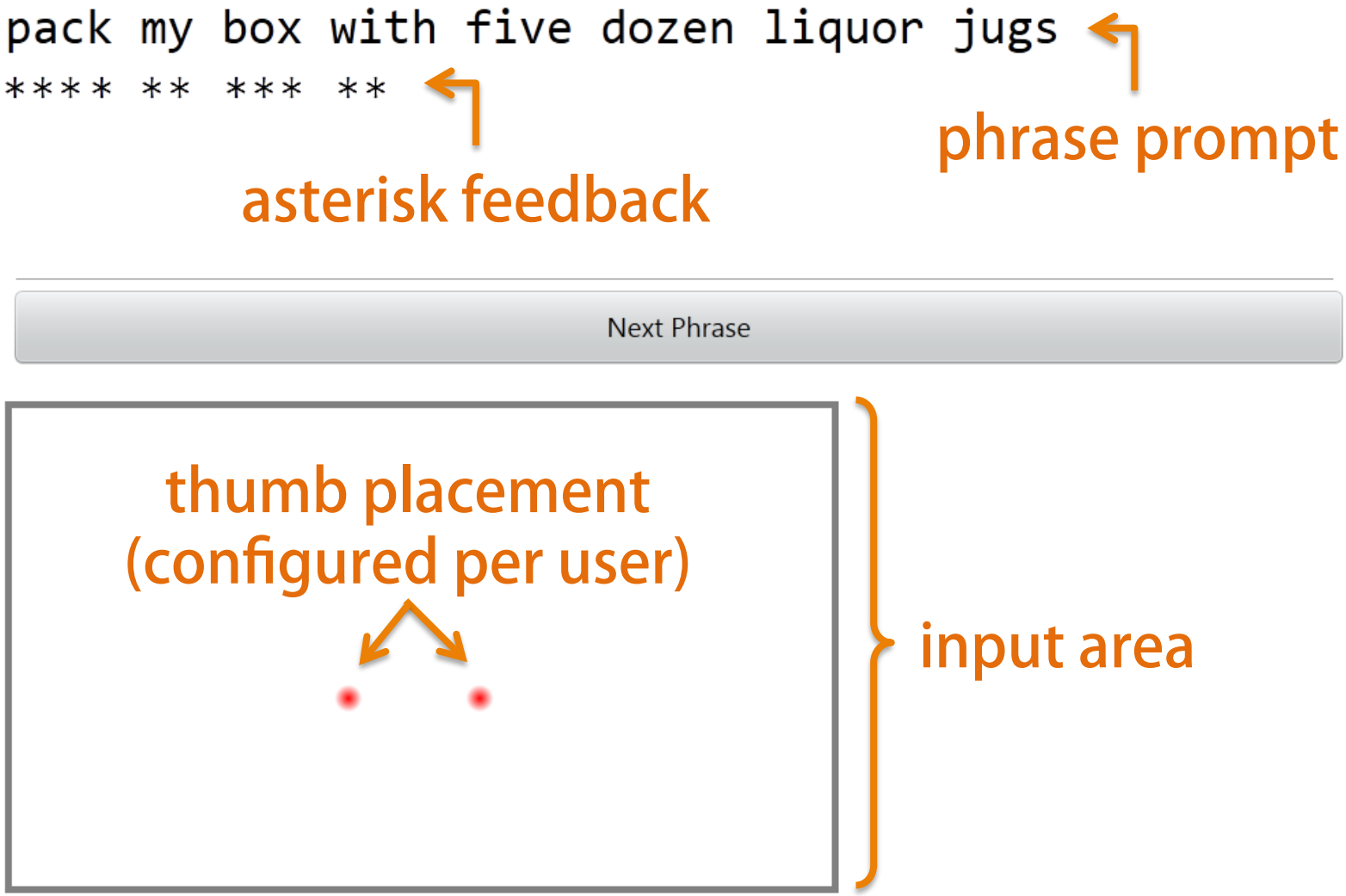
Configuration Complete

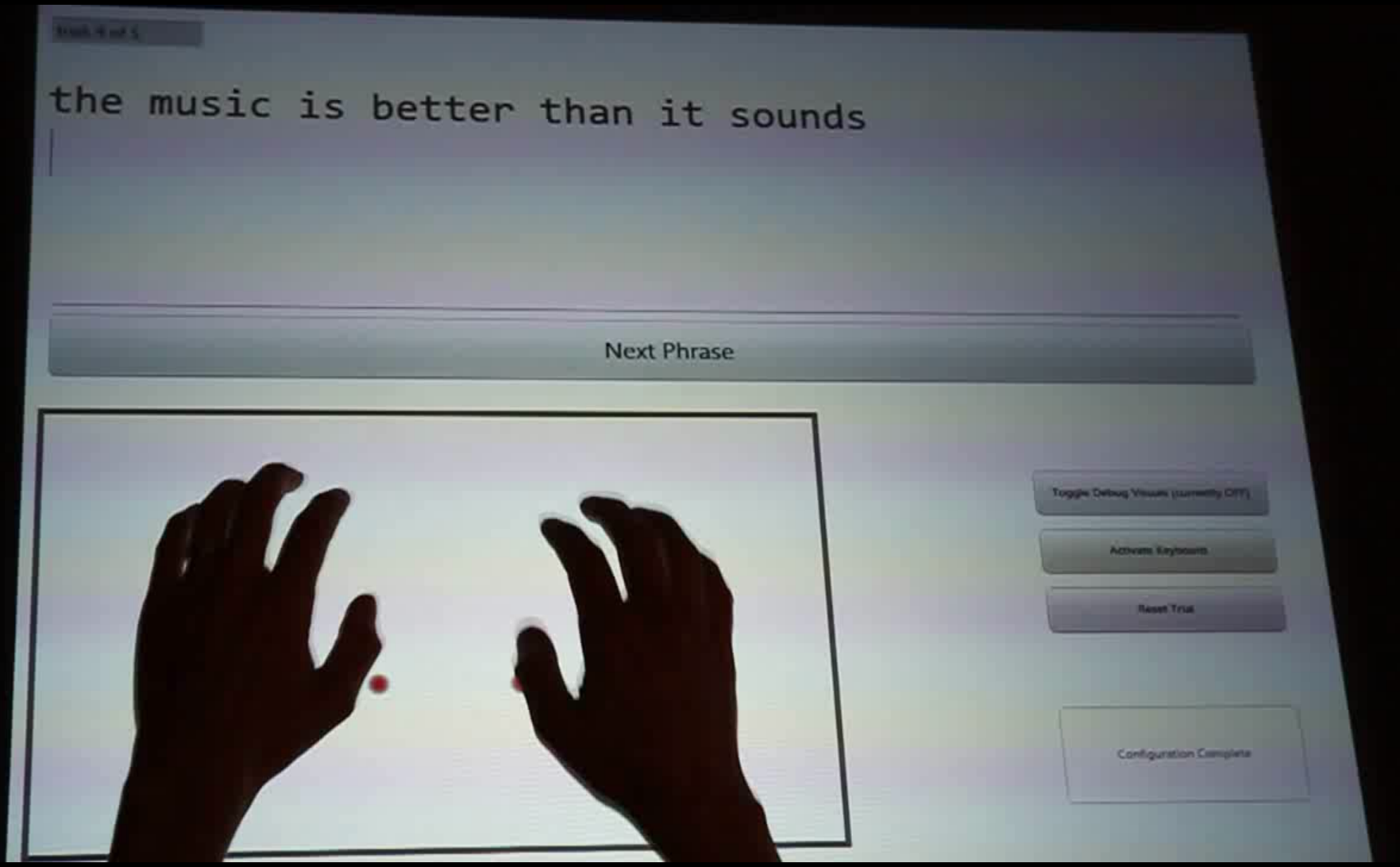
1 No Keyboard and No Feedback

pack my box with five dozen liquor jugs

Next Phrase

2 No Keyboard, Asterisk Feedback




the music is better than it sounds
Next Phrase
Toggle Debug Visuals (currently OFF)
Activate Keyboard
Reset Trial
Configuration Complete

2 No Keyboard, Asterisk Feedback

pack my box with five dozen liquor jugs

**** ** *** **

Next Phrase

3 Visible Keyboard, Asterisk Feedback

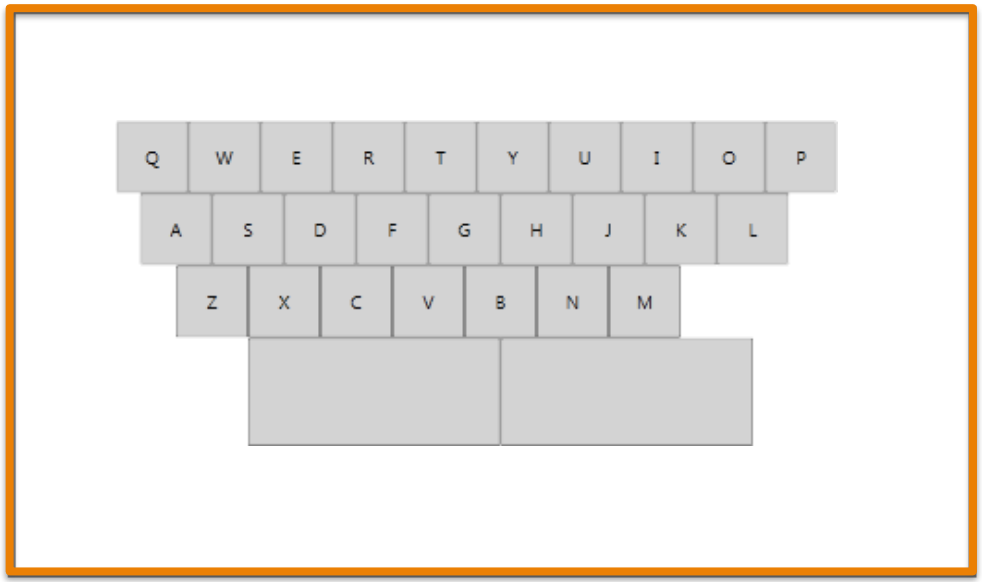
pack my box with five dozen liquor jugs

**** ** *** **

phrase prompt

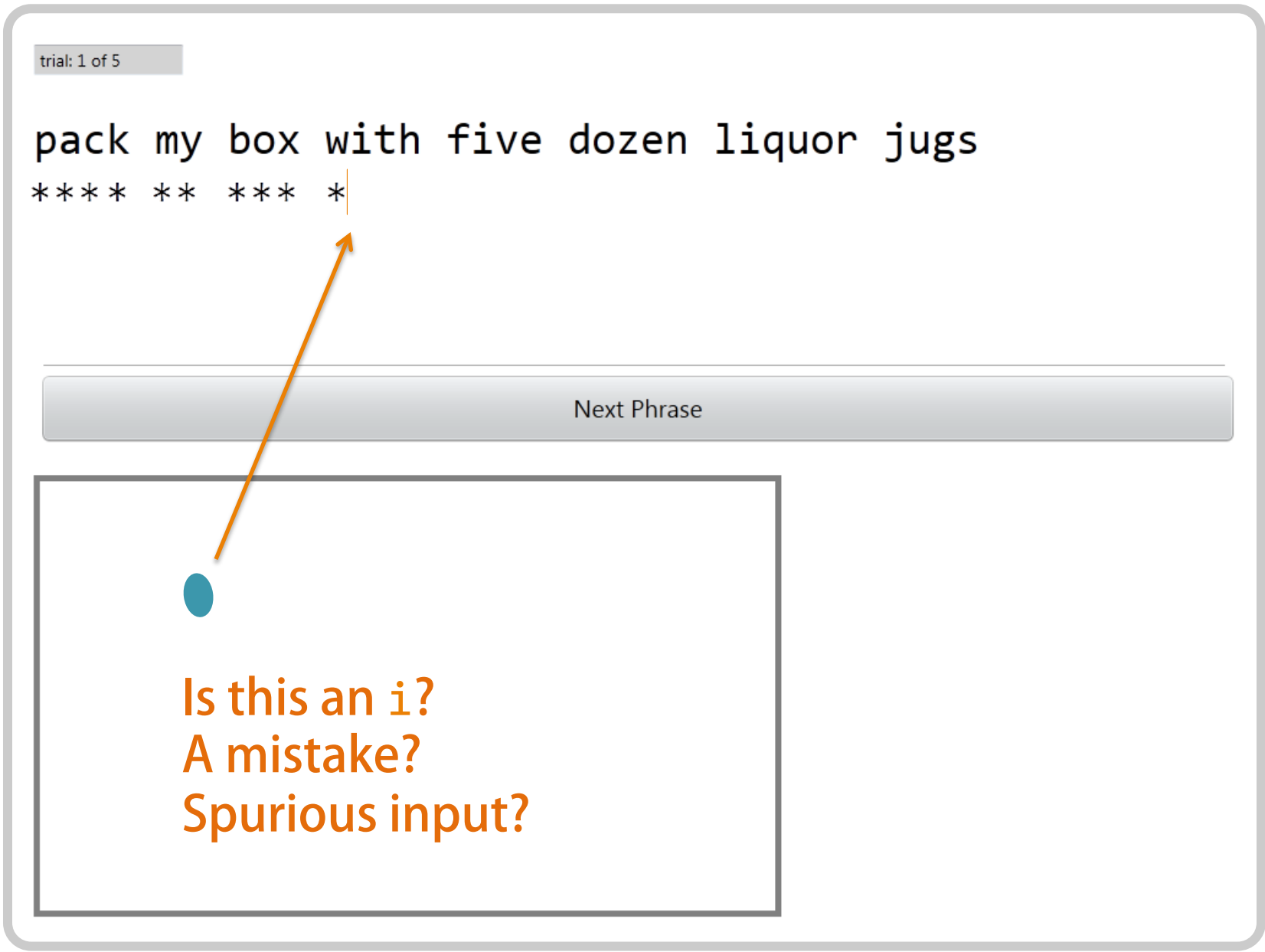
asterisk feedback

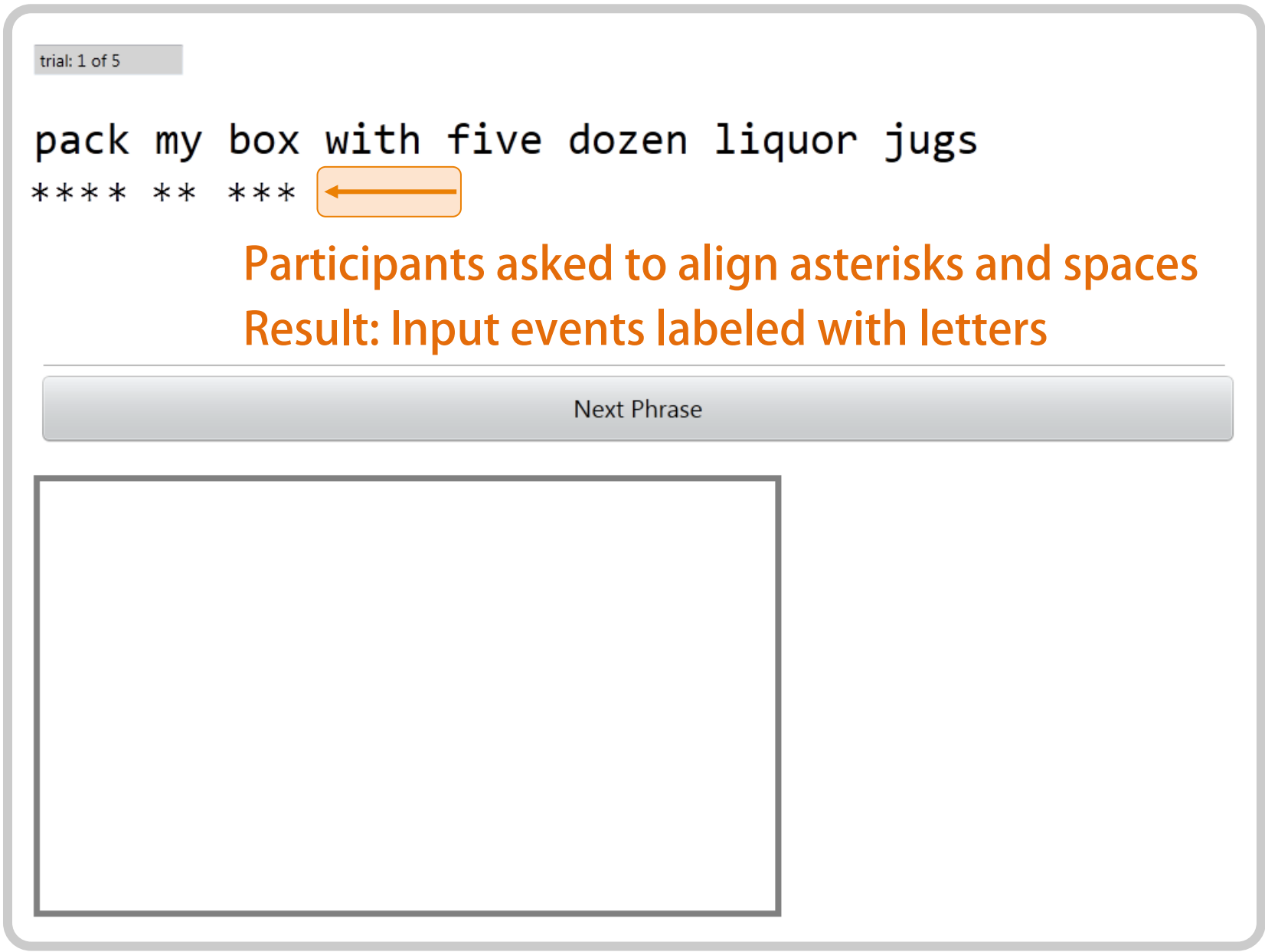
Next Phrase



input area

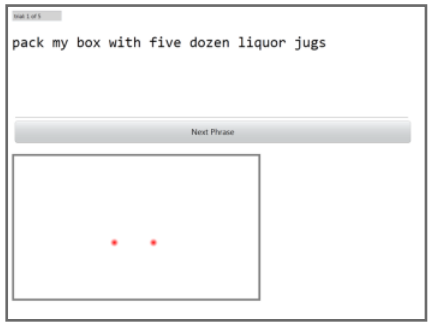
Why asterisk feedback?


trial: 1 of 5
pack my box with five dozen liquor jugs
**** ** *** *
Next Phrase
Is this an i?
A mistake?
Spurious input?


trial: 1 of 5
pack my box with five dozen liquor jugs
**** ** ***
Participants asked to align asterisks and spaces
Result: Input events labeled with letters
Next Phrase

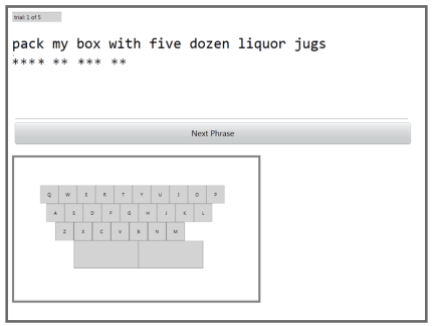
Procedure

1



No keyboard, no feedback condition

2



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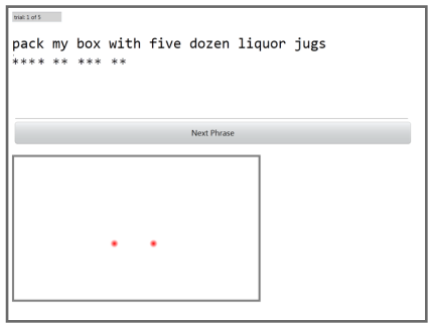


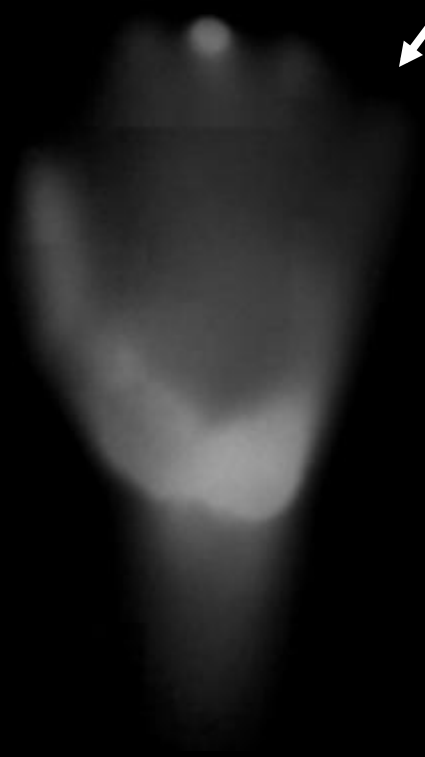
Counterbalanced:
Asterisk feedback conditions

Data Collected

All fingers down

e

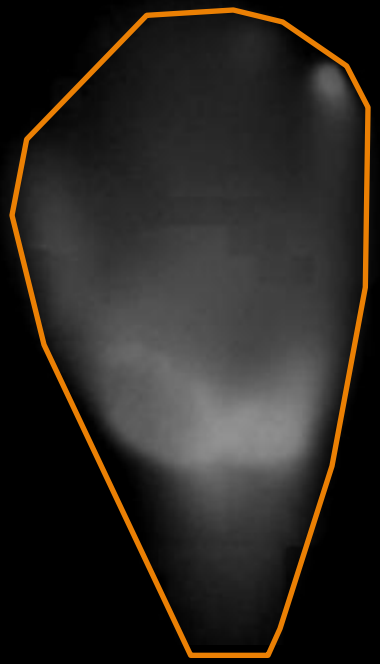
a

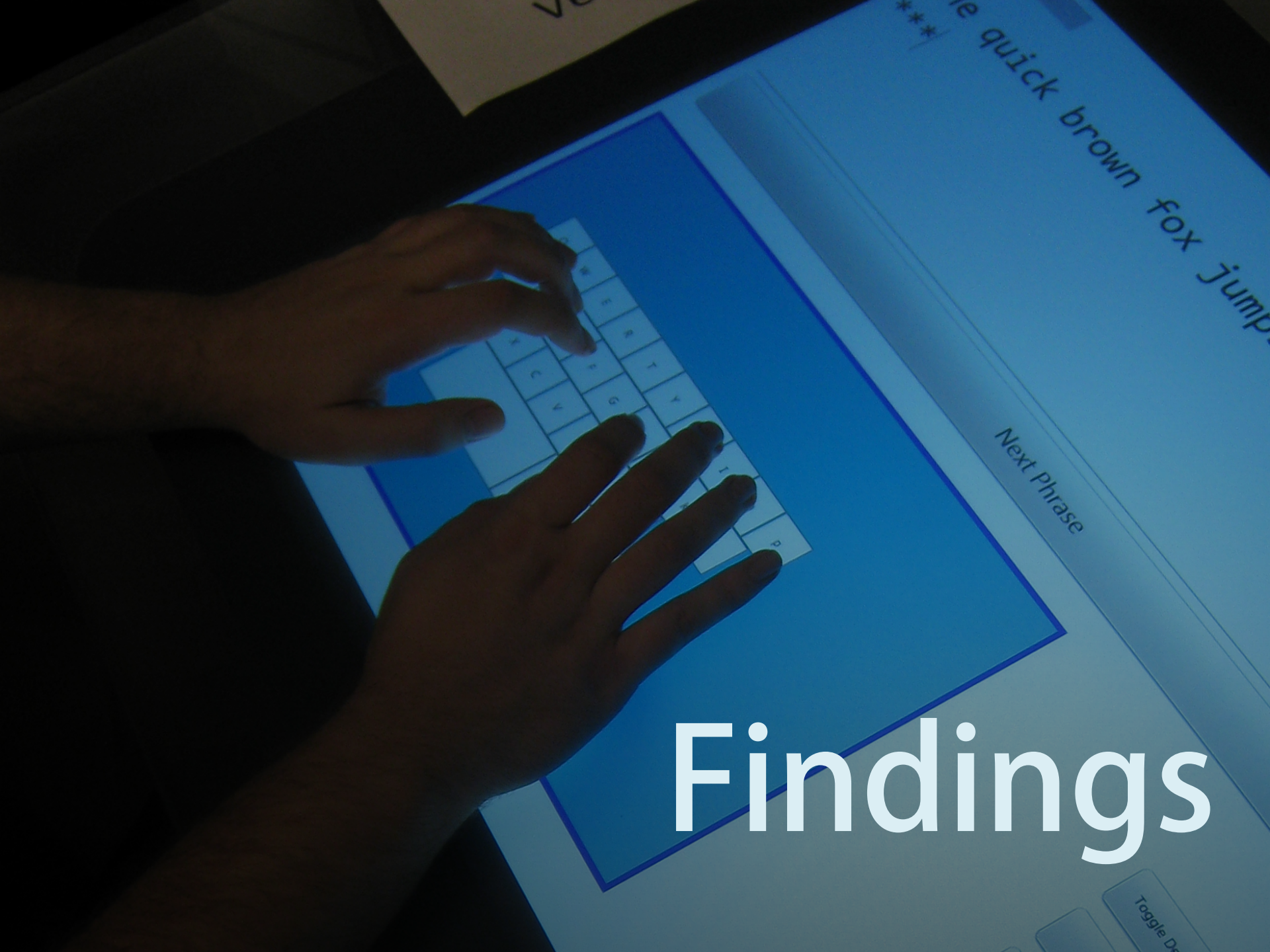


Data Collected

Touch down
and up events

OpenCV & custom
vision algorithms

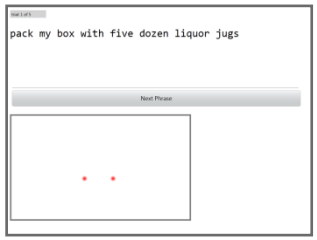




Findings

No Visual Keyboard, No Feedback

All key presses (N = 20)



Finger touches

Hand / arm touches

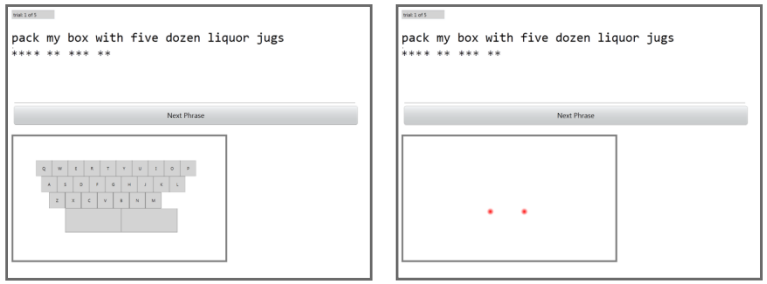
Typing speed: **58.5 WPM** (31% slower than the physical keyboard)

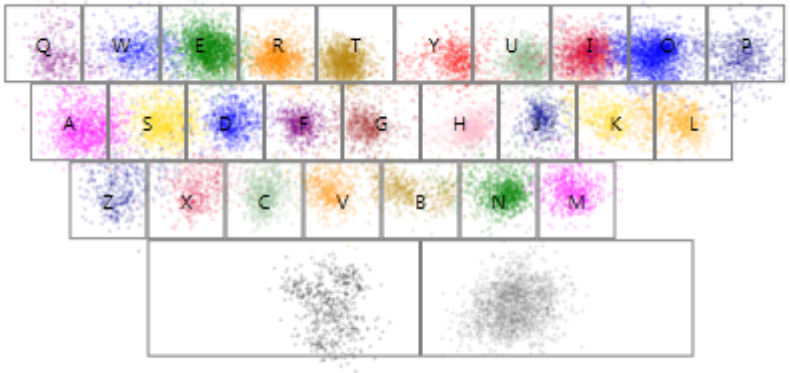
***Ideal* novice user speed**

Heavier use of right thumb

Asterisk Feedback

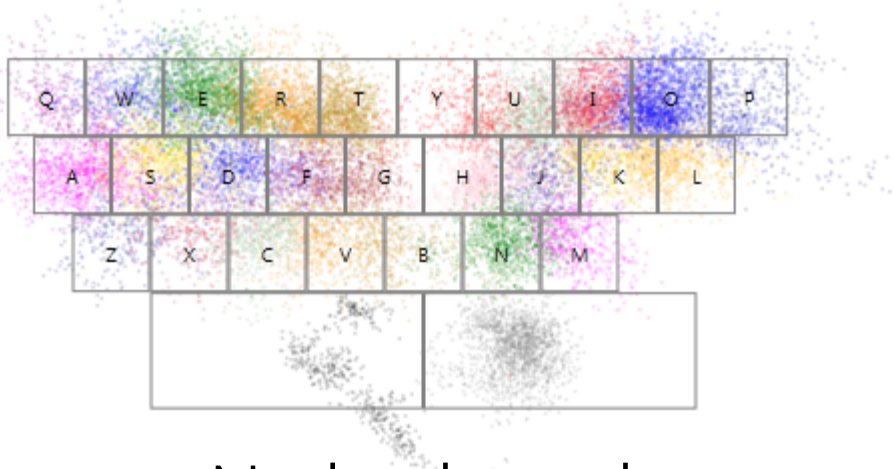
All key presses (N = 20)





Visible keyboard

27.5 WPM



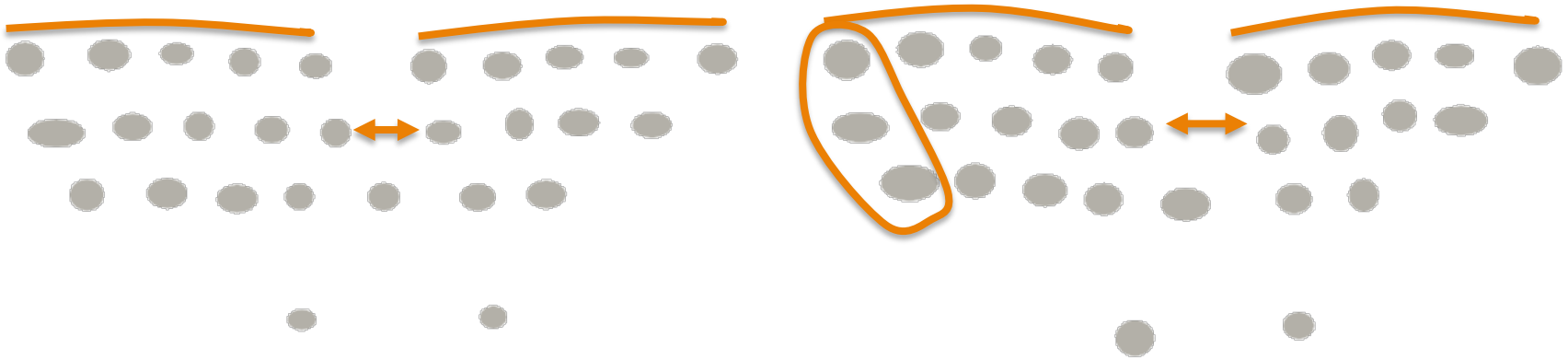
No keyboard
(overlay for illustration only)

28.1 WPM

(not significantly different)

Asterisk Feedback

One Standard Deviation Contour Ellipses (N = 20)



Visible keyboard

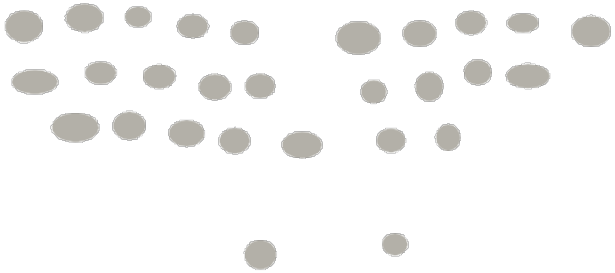
No keyboard

NO KEYBOARD:
($p \leq .001$)

More arched

Greater space between hands

Larger key press spread
(especially bottom and outer keys)



Implications for touch screen keyboard design

More arched

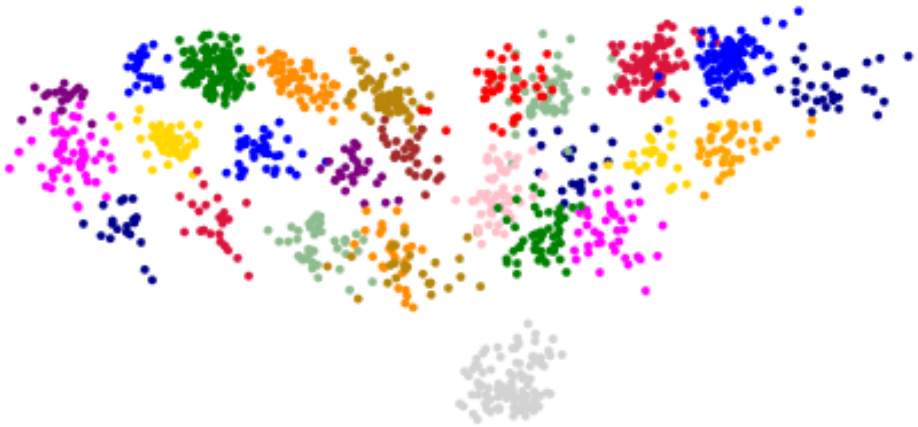
Greater space between hands

Larger key press spread
(especially bottom and outer keys)

Can we support eyes-free typing on flat surfaces?

Key Press Classification: How consistent is finger placement for each key?

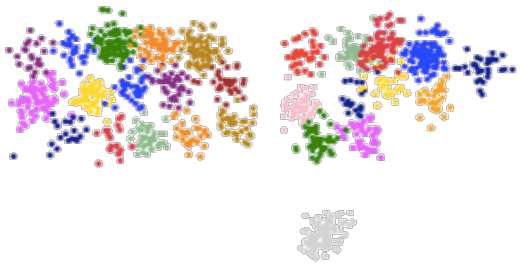
Key centroid distance model
+
10-fold cross validation



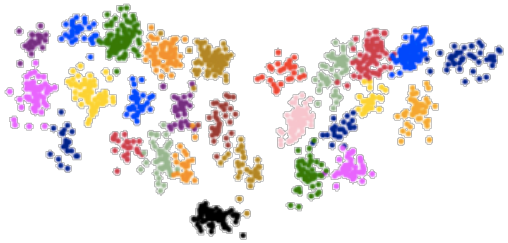
Classification Results (N=20)

	Visible Keyboard	No Keyboard
User-independent	93.1%	70.5%

User-dependent (personalized)



P12



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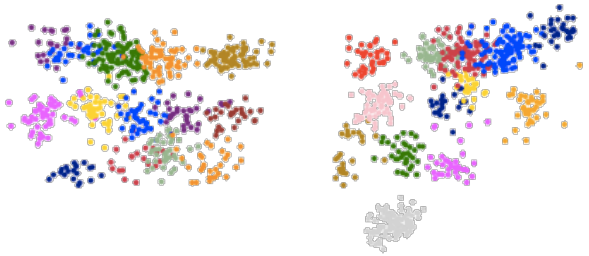
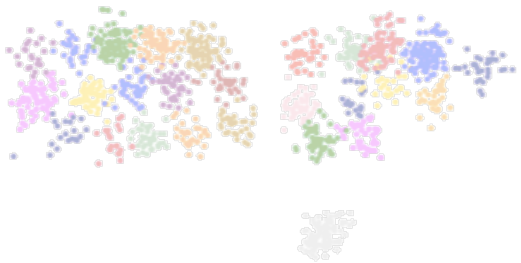


P9

Classification Results (N=20)

	Visible Keyboard	No Keyboard
User-independent	93.1%	70.5%
User-dependent (personalized)	96.7%	90.0%

Eyes-free typing



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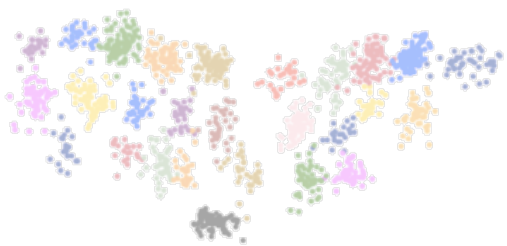

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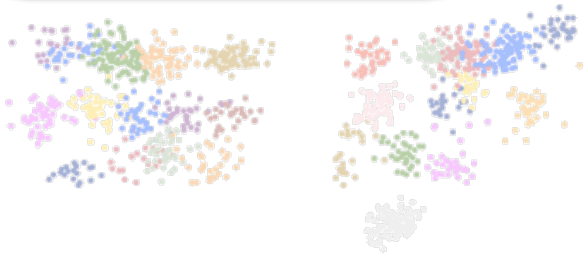


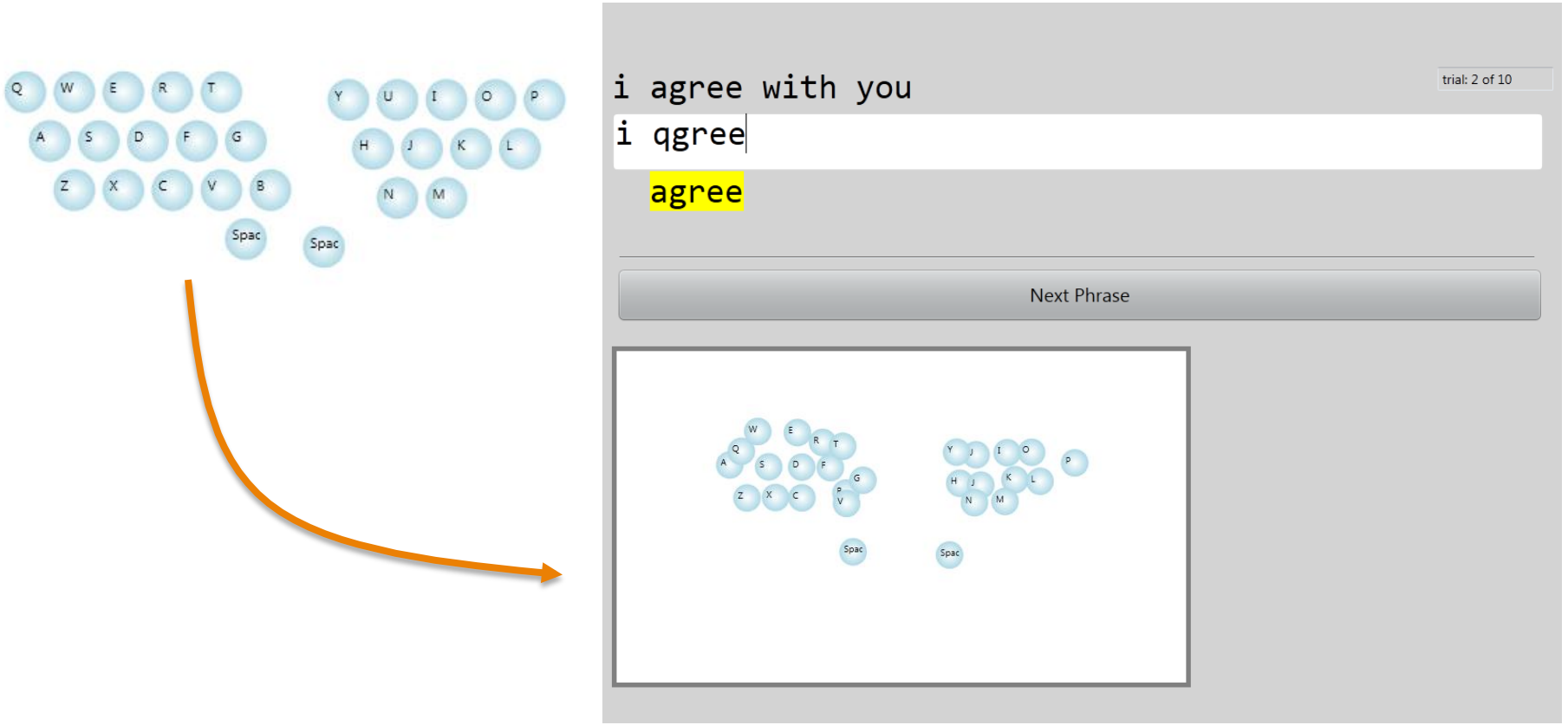
P9

Is **90%** classification accuracy good enough?

+ visible keyboard and practice
+ more sophisticated model
+ language model

Expert typists exhibit **spatially consistent** key press distributions within an individual

Eyes-free typing may be possible on touch surfaces and **personalization** will play a role in such a solution



Eyes-free typing

Support for motor-impaired users

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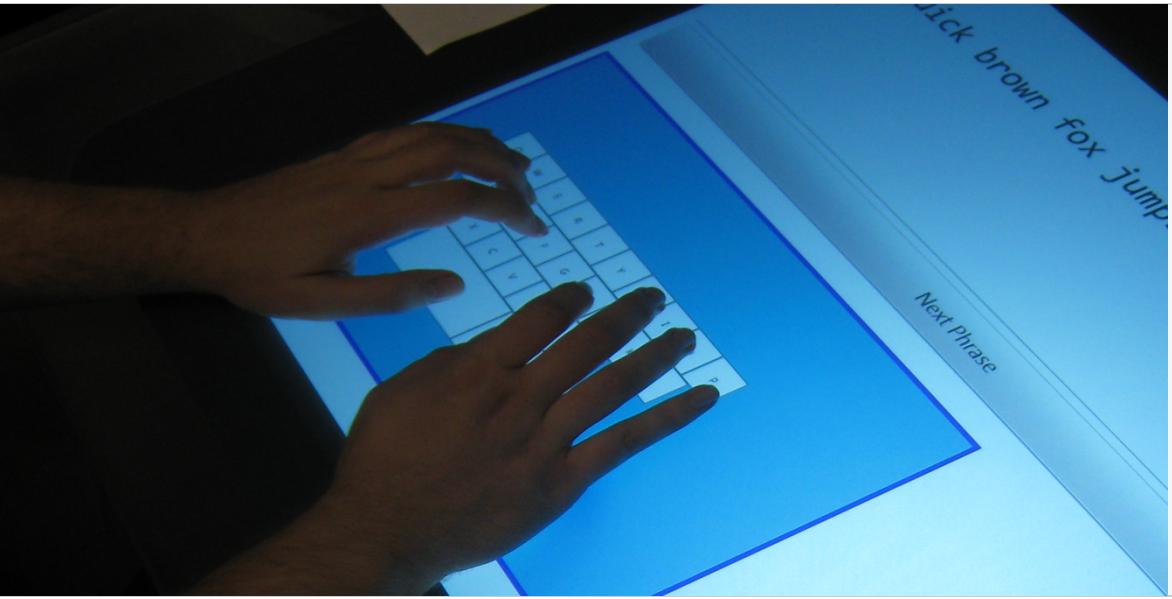

FUNDING

NSERC

NSF

Intel Labs

Microsoft Surface

PHOTOS COURTESY OF FLICKR USERS

Two hands: 21173961

iPad on table: biberfan

iPad physical keyboard: wfryer

Apple keyboard: doobybrain

dub design: use: build: university of washington

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