# Creating Human-Computer Partnerships

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Computer as **tool** Empower users

Computer as **servant** Delegate tasks



Human-Computer Interaction

Artificial Intelligence

Computer as *medium* Communicate



Mediated Communication

Machine learning perspective: *Human*-in-the-loop Use human input to *improve the algorithm* 

Machine learning perspective: *Human*-in-the-loop Use human input to *improve the algorithm* 

User types Google suggests User chooses

Google	google
000000	google google maps
🔚 Everything	google translate
Images	google earth
Videos	google images
News	About 5,700,000,000 results (0.07 seconds)
<ul> <li>Shopping</li> <li>Realtime</li> <li>More</li> </ul>	Google Q Enables users to search the Web, Usenet, and images. Features include PageRank, caching and translation of results, and an option to find similar pages. Show stock quote for GOOG www.google.com/ - Cached - Similar
San Francisco, CA Change location	Google Images Q Google Images. The most comprehensive image search on the web. www.google.com/imghp - Cached - Similar
Any time Latest Past 24 hours	Google Maps Q. Find local businesses, view maps and get driving directions in Google Maps. maps.google.com/ - Cached - Similar
Past 2 days Past week	News for google
Past month Past year Custom range More search tools	Google Goes Gaming With Search Puzzles 43 minutes ago This week, Google is happy to oblige, introducing a new puzzle called "a Google a Day" that asks users to — what else? — use the search engine to solve the Wall Street Journal (blog) - 7 related articles - Shared by 5+

# But 'human-in-the-loop' is not always best for the user

-071

If *Human*-in-the-loop uses human input to *improve the algorithm* 

If *Human*-in-the-loop uses human input to *improve the algorithm* 

Shouldn't we also have '*Computer*-in-the-loop' to **empower the user**? Human-Computer Partnerships

We already create models of *users* to inform the *system* 

Shouldn't we also create models of the **system** to inform the **user**?

We need to create effective human-computer partnerships What do we mean by 'partnership'?

Take a taxi Driver in control



What do we mean by 'partnership'?

Take a taxi Driver in control

Drive a motorcycle User in control



What do we mean by 'partnership'?

Take a taxi Driver in control

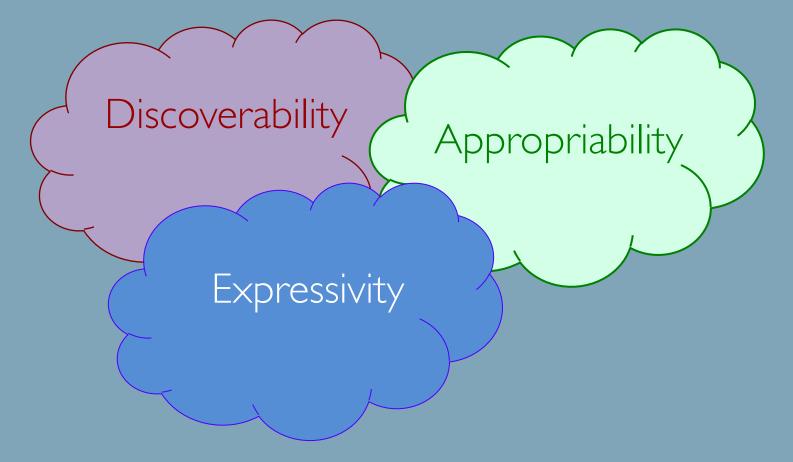
Drive a motorcycle User in control

Ride a horse Shared control



Human-Computer Partnerships

To share control, users need:



# What can we learn from physical tools ?

### We can use physical tools as designed...



# What can we learn from physical tools ?

### But we can also improvise !



Some of us become virtuoso users

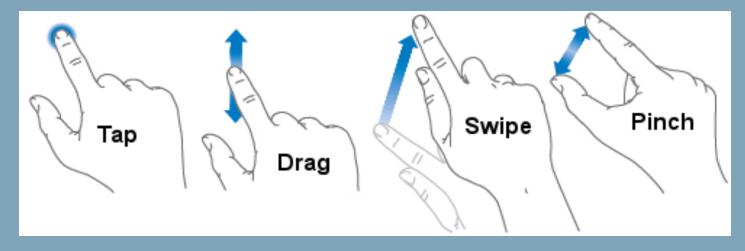
Why can't we learn to 'play' software tools ? without relearning the interface with every software upgrade ?



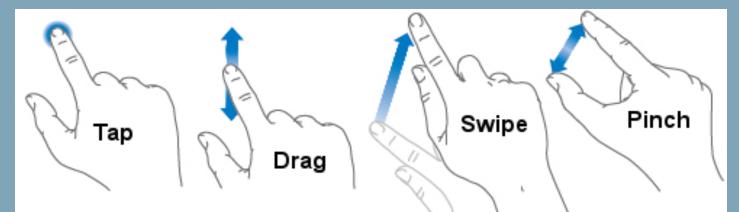
# Take a smartphone ...



# Smartphone interfaces are simple



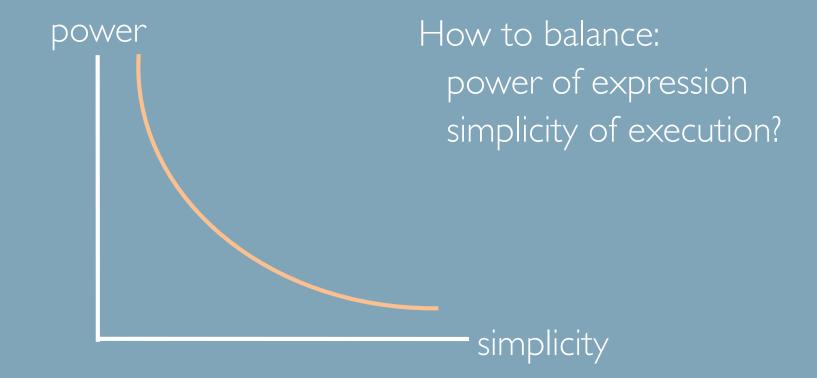
# Smartphone interfaces are simple



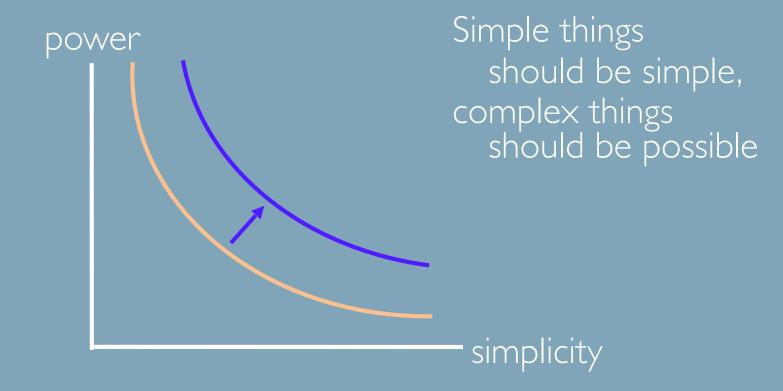
#### Why not powerful, expressive and simple ?



Major design trade-off



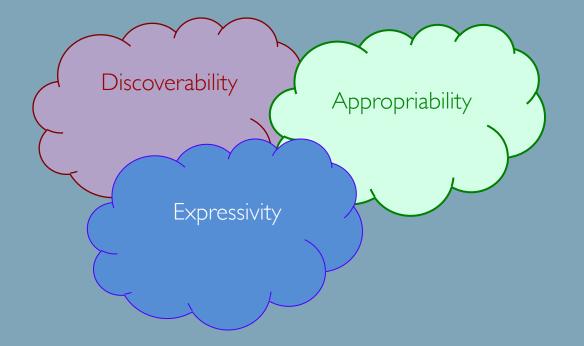
# Solution: Shift the curve



#### Human-computer partnerships

People can *adapt to* technology *adapt* the technology

they learn it they appropriate it



#### Human-computer partnerships

People can adapt to technology adapt the technology

they learn it they appropriate it

Computers can adapt to people adapt people's behavior they teach (CAI)

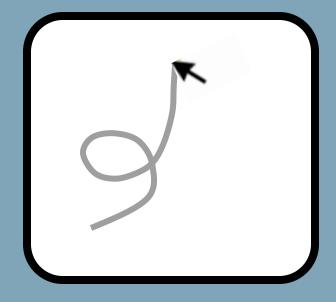
they learn (AI)



# How can I learn which gesture executes which command?



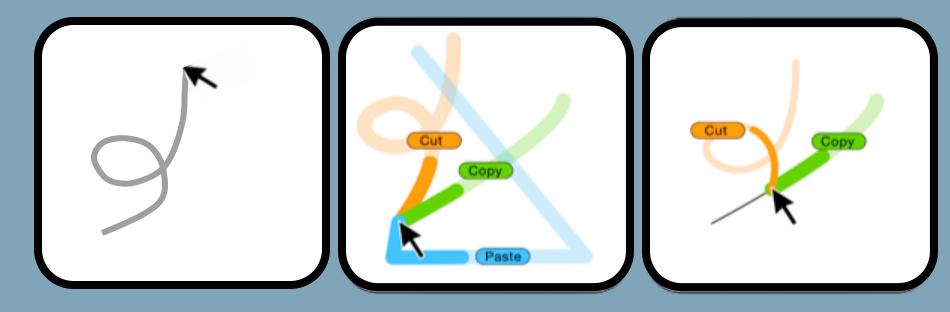
### Experts just perform the gesture



Bau & Mackay, UIST'09



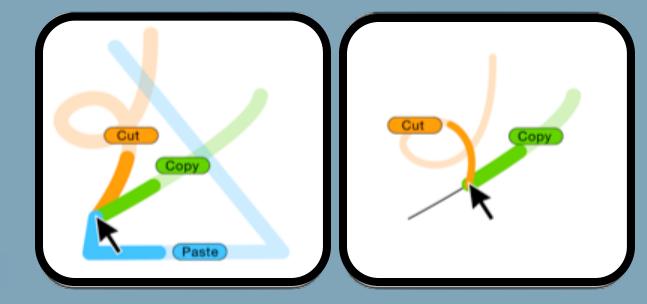
Experts just perform the gesture Novices pause ... and the Octopocus guide appears



Bau & Mackay, UIST'09



Progressive feedforward What gestures are available ? Progressive feedback What did the system recognize ?



Bau & Mackay, UIST'09

#### Inking the 'Help' command

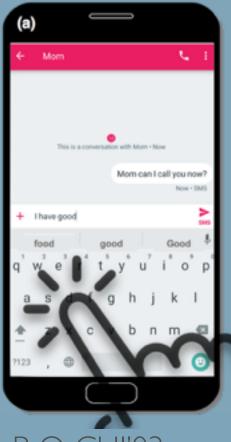


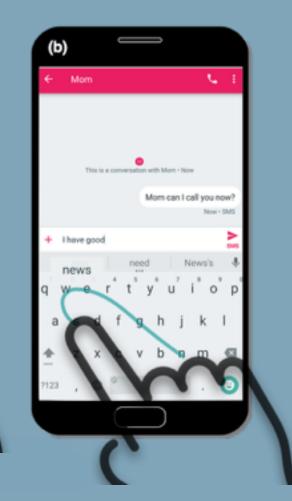
# How can Hearn new gestures that execute commands ?

# Gesture typing: Typing with gestures

### Instead of tapping....

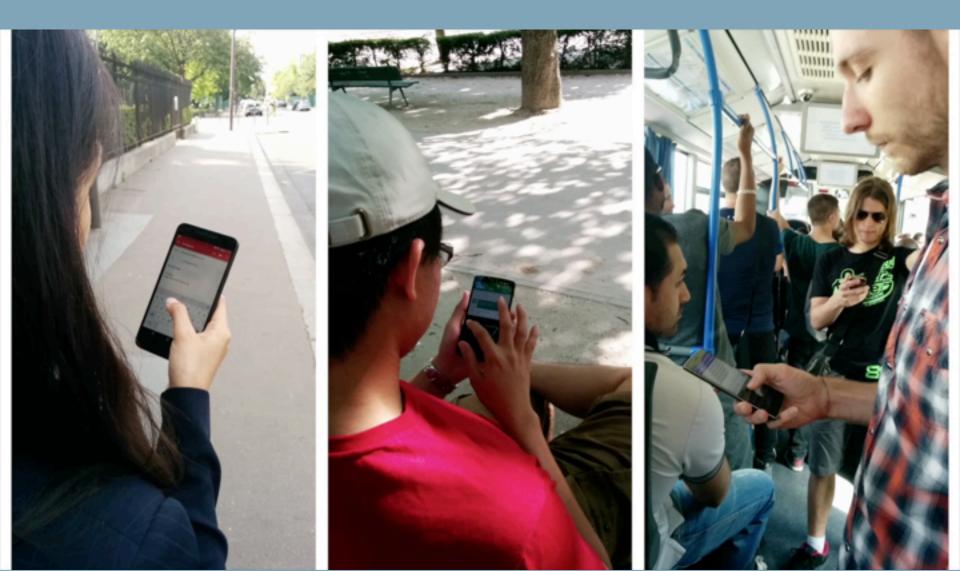
# draw through each letter to type a word



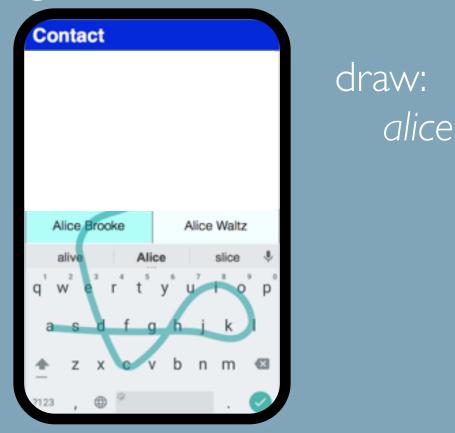


Zhai, S. & Kristensson, P.-O. CHI'03

# Gesture typing



#### Transform gestures into commands ...

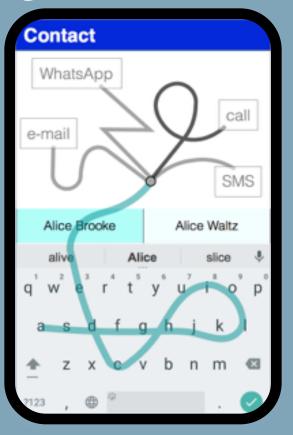


#### Transform gestures into commands ...



draw: *alice* choose contact: *Alice Brooke* 

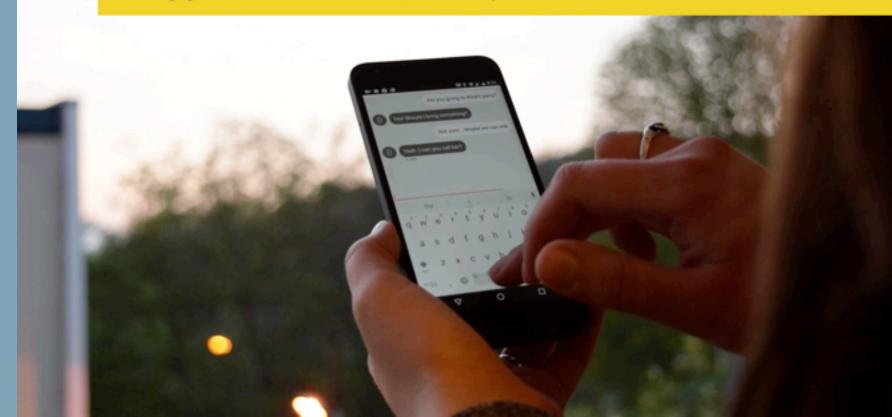
#### Transform gestures into commands ...



write: *alice* choose contact: *Alice Brooke* choose comm app: *Alice Brooke* 

#### Command-line interaction from a soft keyboard

CommandBoard offers a simple, efficient and incrementally learnable technique for issuing gesture commands from a soft keyboard.

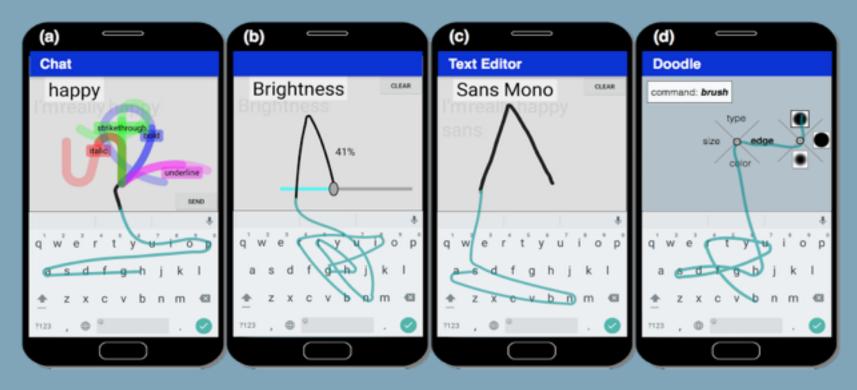


#### Execute any command from a gesture keyboard

Screen Space	Contact	User Action	User Goal
command-gesture input space	WhatsApp e-mail SMS	draw gesture	execute command, add gesture shortcut
command bar	Alice Brooke Alice Waltz	cross command option	choose command option
suggestion bar	alive Alice slice 🌵	tap word	choose word or command
text input space	q <sup>1</sup> w <sup>2</sup> e <sup>3</sup> r <sup>4</sup> t <sup>5</sup> y <sup>6</sup> u <sup>7</sup> t <sup>8</sup> o <sup>9</sup> p <sup>6</sup> a s d f g h j k l	tap key, cross key, dwell on key	enter text/emoticon, change layout, specify command

# CommandBoard

#### Execute any command from a gesture keyboard

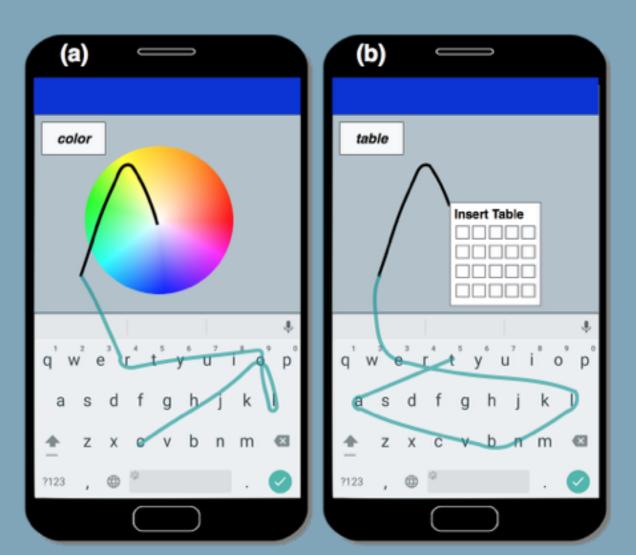


Alvina, Griggio, Bi & Mackay UIST' 17

# CommandBoard

# Draw *color,* then pick from a color wheel

Draw table, then insert a table

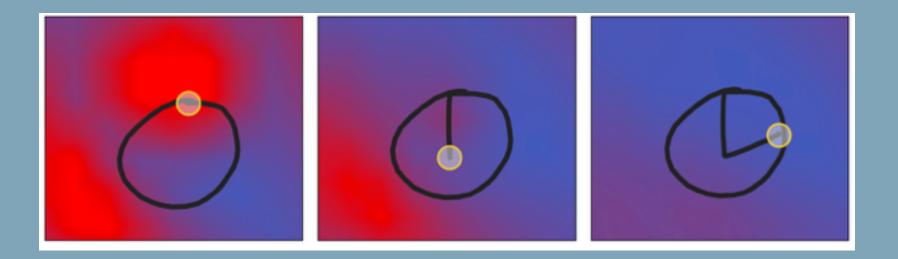




How can I create my own gesture commands?

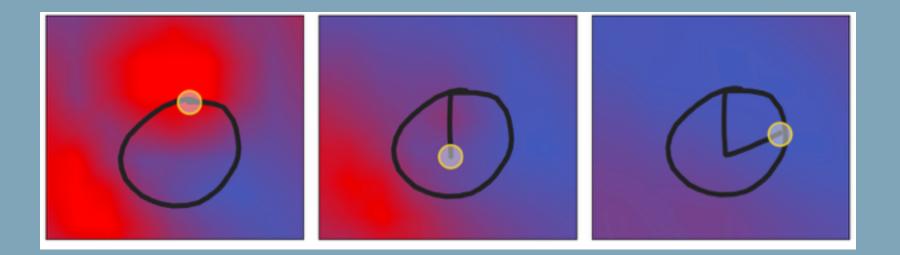
### Fieldward

Create your own gesture commands Must be: easy for you to remember



### Fieldward

Create your own gesture commands Must be: easy for you to remember easy for the system to recognize

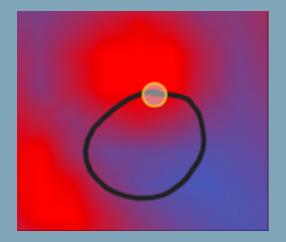


Fieldward

Draw a gesture

If it ends in a red zone the gesture is ambiguous

If it ends in a blue zone you have a new gesture !

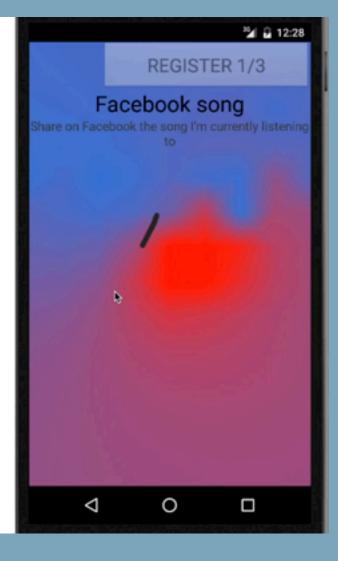




# Fieldward:

# Fieldward

Shows a color gradient indicating optimal directions to make a recognizable gesture





How can I generate expressive text?

#### Human expression

#### Handwriting is expressive

I will be thankful for what I have be thank be thank thankb thank? haut thankful thank ul what I have tor thankful for what have thankful for have what what have tor have nankfulfor w what E have thank tal for will e thankful for will b be thankful for what I Will be thankful for what Will will be thankful for what will be thankful for what what I will be thankful for what I will thankoul for what I 6 be

#### Human expression

#### Handwriting is expressive ... SMS messages -- not so much

.... AT&T 12:58 PM 🕺 77% 🔳 I will be thankful for what Kessages (1) Michel Contact I have 20 minutes door to door. It's crazy. thank thank Thursday 5:03 AM hau have thank hankful have Hi Can you talk? have Give me a minute Thank + have Ton what Ok thantful what tor thankful for Will You can call thankt thankful whatI for be Thursday 8:51 AM what I be thankful will tor Text Message thankoul for what. Send

Human expression vs. Machine classification

Machine learning algorithms: Goal is to classify the correct word Human variation is treated as noise

#### Gesture typing algorithms are great ...









#### Human expression vs. Machine classification

Four ways to input the word "great"









All produce the identical result: great

# Expressive Keyboard vs. Machine classification

Machine learning Guess the correct word (classify) Throw away human variation

Human-centered approach Create expressive output Transform human variation

Alvina, Malloch & Mackay CHI'16

# Expressive Keyboard

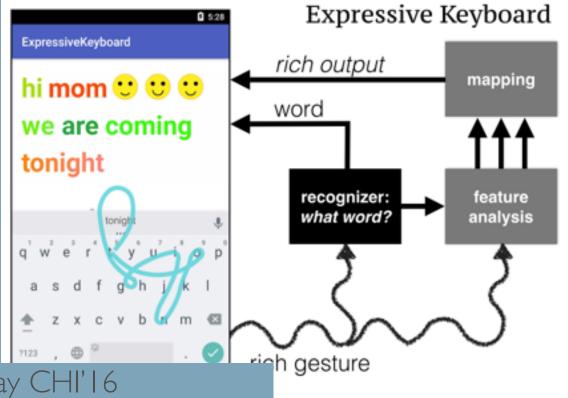


Expressive Keyboards produce accurate words, but let users control the output properties

# Expressive Keyboard

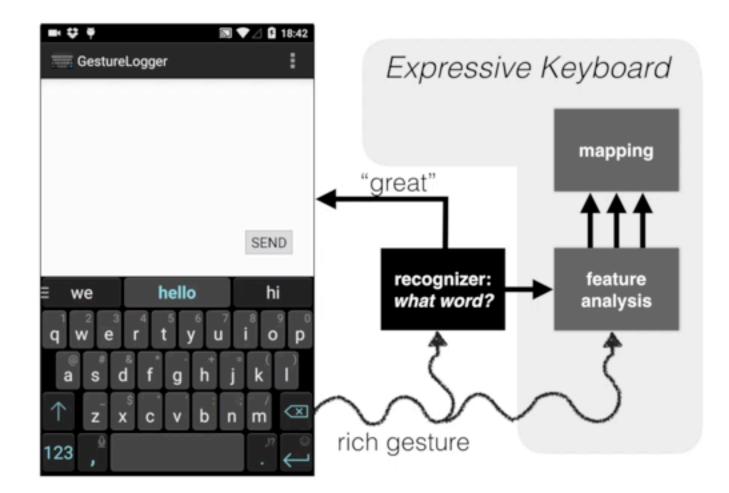
### Map gesture variation to output properties

Users control: text color font style emojis



Alvina, Malloch & Mackay CHI'I 6

# Expressive Keyboard – measure variation



# Expressive Keyboard – Expressive emojis

What else can we do with Expressive Keyboards?

# Next: Expressive Typography

### Current project:

Express how the text appears ... by modifying your gesture typing Expressive Typography project. Contexts for using expressive typography. Ways to control input and output features in different contexts. Demonstration of the prototype and the font variations. Types of dynamic font variations. The quick brown fox jumps over the lazy dog. Sphinx of black quartz, judge my vow. (Plain)

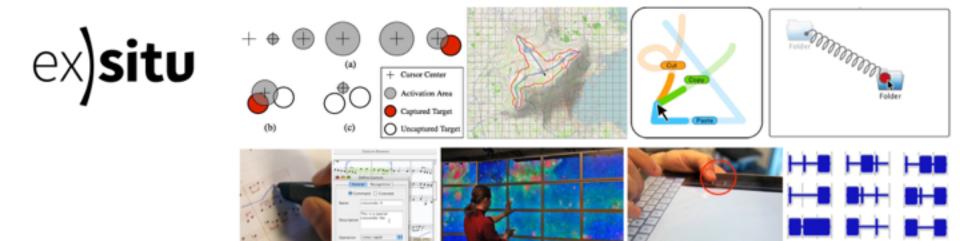
Expressive Typography project. Contexts for using expressive typography. Ways to control input and output features in different contexts. Demonstration of the prototype and the font variations. Types of dynamic font variations. The quick brown fox jumps over the lazy dog. Sphinx of black quartz, judge my vow. (Informal-Totally)

Expressive Typography project. Contexts for using expressive typography. Ways to control input and output features in different contexts. Demonstration of the prototype and the font variations. Types of dynamic font variations. The quick brown fox jumps over the lazy dog. Sphinx of black quartz, judge my vow. (Spread-Totally)

Expressive Typography project. Contexts for using expressive typography. Ways to control input and output features in different contexts. Demonstration of the prototype and the font variations. Types of dynamic font variations. The quick brown fox jumps over the lazy dog. Sphinx of black quartz, judge my vow. (Elegant-Totally). Tomorrow: true humancomputer partnerships

> that empower rather than frustrate (or replace) people





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