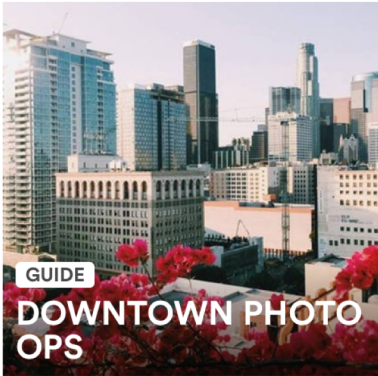# Nonvisual Interaction Techniques at the Keyboard Surface

Rushil Khurana, Duncan McIsaac, Elliot Lockerman
Carnegie Mellon University
rushil@cmu.edu

Jennifer Mankoff
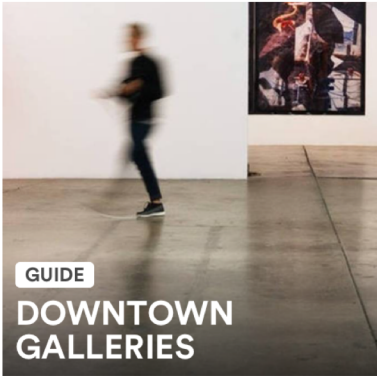University of Washington
jmankoff@acm.org

Categories ⌄

Los Angeles

GUIDE
DOWNTOWN PHOTO OPS

By Grant Legan   Fashion photographer

GUIDE
DOWNTOWN GALLERIES

By Donna Chu   Art advisor

GUIDE
HIKES WITH VIEWS

By Nichelle Hines   Spin instructor

GUIDE
DOG-FRIENDLY RESTAURANTS

By Tamar Geller   Dog trainer

GUIDE
EASY BIKE RIDES
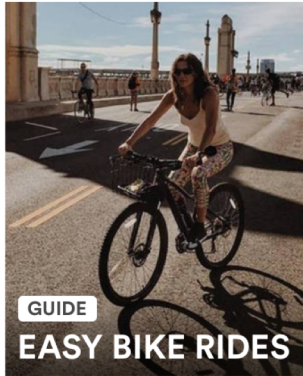
By Gloria Hwang   Bike entrepreneur

Havana

2

Related work

auditory interfaces
[Mynatt et al.]

Braille Displays
[Mynatt et al., Weber 95,
Volkel et al, 2008]

Figure 1. Access overlays allow a blind user to accurately locate items on a 2-D touch screen map.

Fabricated overlays
[Kane et al. 2011]

Related work

auditory interfaces
[Mynatt et al.]

Braille Displays
[Mynatt et al., Weber 95,
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generalizable: ✔

spatial: ✘

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auditory interfaces
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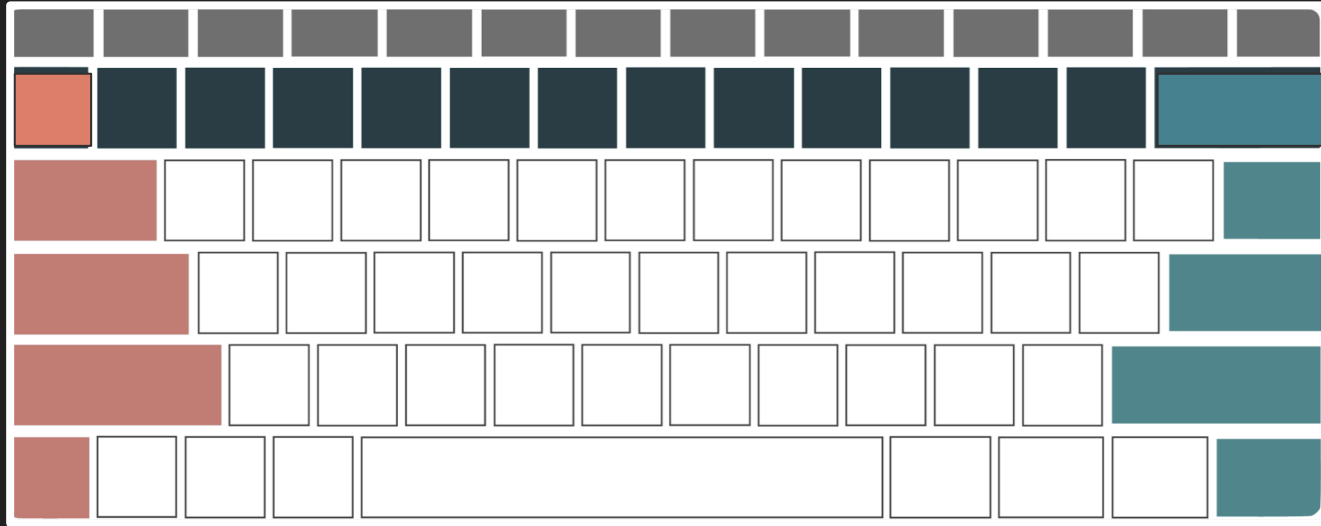Fabricated overlays
[Kane et al. 2011]

generalizable:

spatial:

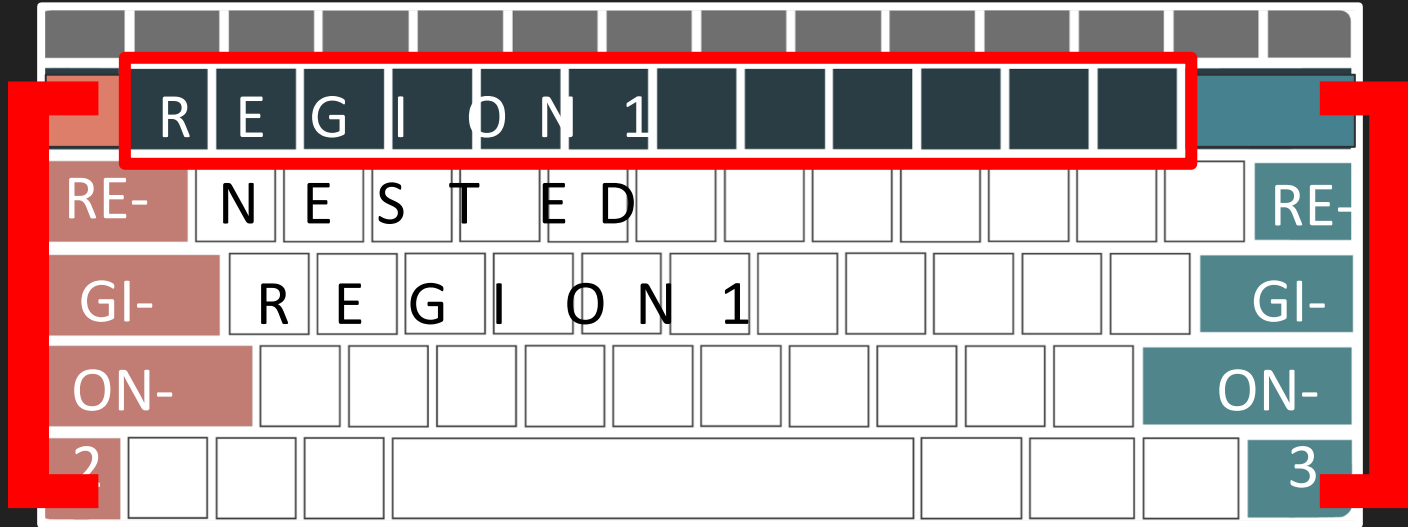# Spatial Region Interaction Techniques (SPRITEs)

Keyboard Surface Interactions
Menus & Lists

Spatial Region Interaction Techniques (SPRITEs)

horizontal movement / grouped items like lists menus etc.

vertical movement for 2D widgets such as tables

reserved for scrolling

Spatial Region Interaction Techniques (SPRITEs)
Overview of our techniques

Exploration

Searching

Scrollbar

Menus

Tables

List of Search Results

Table Search

Map Search
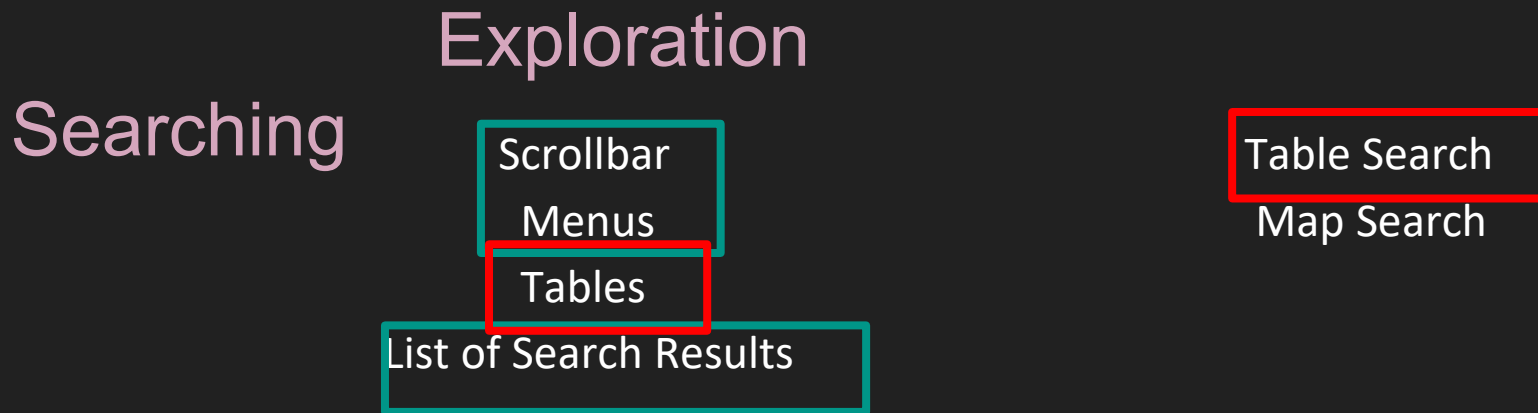
Exploration: Tables

Employee ID	First Name	Last Name
0067	Jill	Smith
0072	Eve	Doe
0081	John	Jackson
0090	Magda	Robinson

black: currently
pressed key

`1,1 employee ID`

Employee ID	First Name	Last Name
0067	Jill	Smith
0072	Eve	Doe
0081	John	Jackson
0090	Magda	Robinson

black: currently pressed key

`1,2 first name`

gray: last selection in horizontal direction

black: currently pressed key

Employee ID	First Name	Last Name
0067	Jill	Smith
0072	Eve	Doe
0081	John	Jackson
0090	Magda	Robinson

2,2 Jill

Searching: Tables

Query: Jill

Employee ID	First Name	Last Name
0067	Jill	Smith
0072	Eve	Doe
0081	Jill	Jackson
0090	Magda	Robinson

black: currently
pressed key
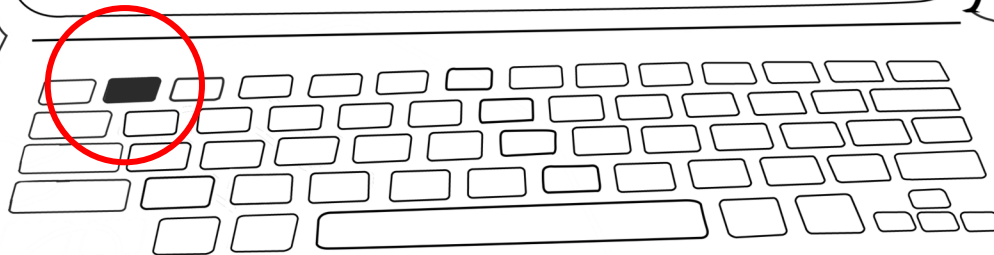
`0 occurences in this column`

Query: Jill

Employee ID	First Name	Last Name
0067	Jill	Smith
0072	Eve	Doe
0081	Jill	Jackson
0090	Magda	Robinson

black: currently
pressed key

2 occurences in this column

Query: Jill

Employee ID	First Name	Last Name
0067	Jill	Smith
0072	Eve	Doe
0081	Jill	Jackson
0090	Magda	Robinson

gray: last selection in horizontal direction

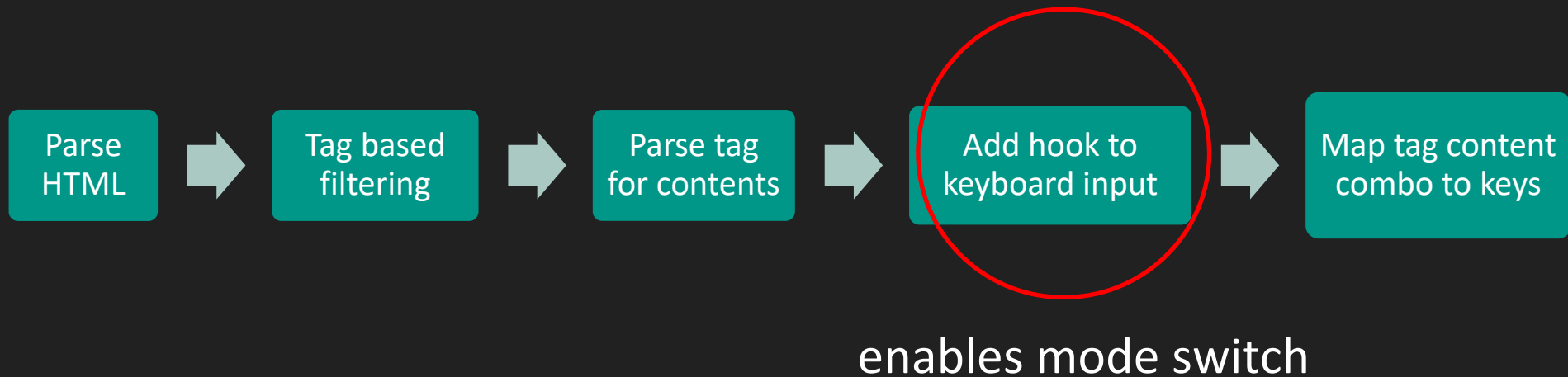black: currently pressed key
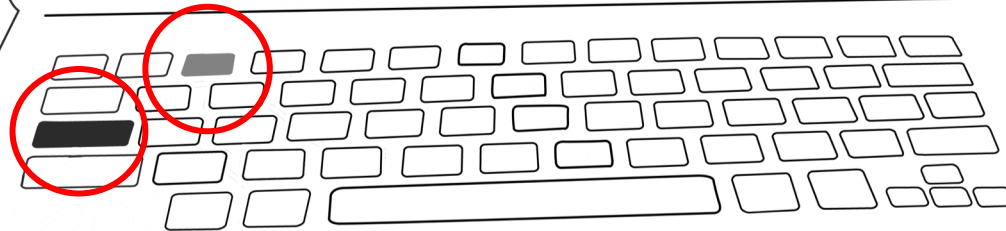
2,2 Jill found. no other occurences in this row

19

Spatial Region Interaction Techniques (SPRITEs)

Parse HTML → Tag based filtering → Parse tag for contents → Add hook to keyboard input → Map tag content combo to keys

enables mode switch

User Study

User Study goals

1. Primary: Compare the performance and usability of Sprites to each participant's own accessibility tool.

1. Secondary: explore how the interaction techniques impacted participants' understanding of the page organization and spatial layout

User Study Overview

10 subjects
5M, 5F; age 24-73 (mean =44.2, S.D. = 17.36)
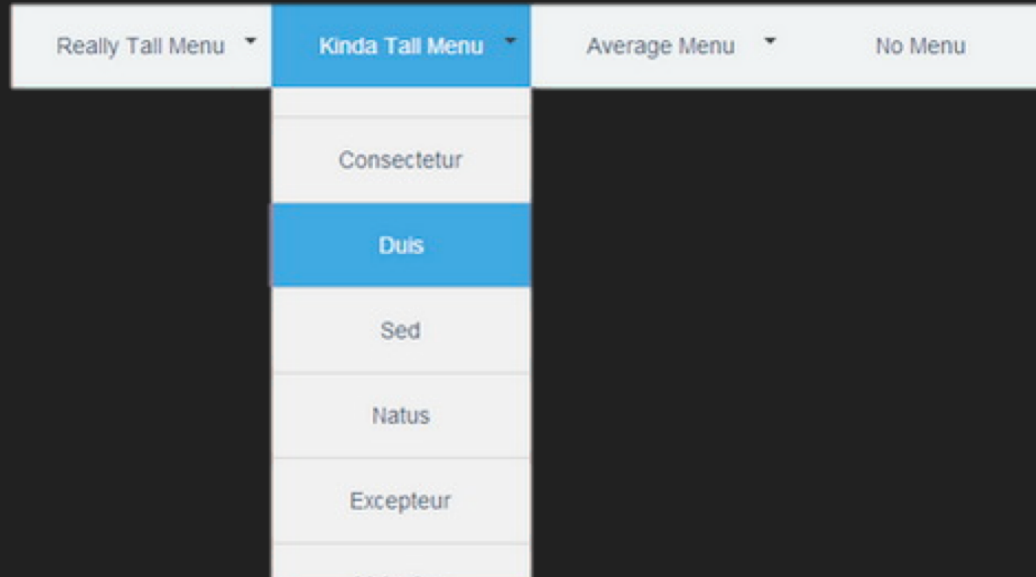9 blind, 1 low vision

8 tasks
(page layout, menus, tables, maps)
both screen reader and Sprites
counterbalanced

Results: Menu

Task:
(a) find all the elements within a menu
(b) list all the elements that have a sub-menu.

Really Tall Menu ▾	Kinda Tall Menu ▾	Average Menu ▾	No Menu
	Consectetur		
	Duis		
	Sed		
	Natus		
	Excepteur		

Results: Menu
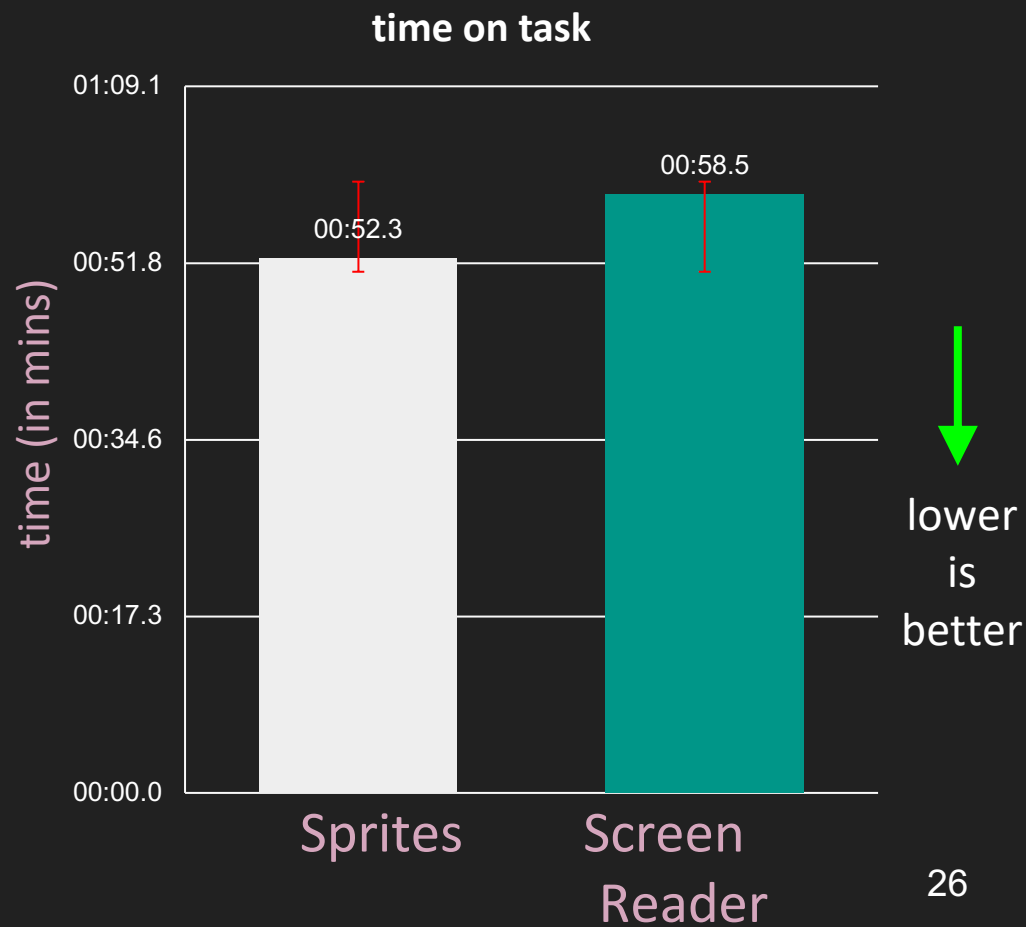
Task:

(a) find all the elements within a menu

(b) list all the elements that have a sub-menu.

Task Completion Rate

Sprites	Screen Reader
10 / 10	3 / 10

Results: Menu

time on task

Chart: time on task (time in mins). Sprites: 00:52.3. Screen Reader: 00:58.5. Y-axis values: 00:00.0, 00:17.3, 00:34.6, 00:51.8, 01:09.1.

lower is better

Results: Table Lookup

Task:

Lookup the answer to a question in the table.

First Name	Last Name	Username
Mark	Otto	@mdo
Larry	the Bird	@twitter

Results: Table Lookup

Task:

Lookup the answer to a question in a table.

Task Completion Rate

Sprites	Screen Reader
9 / 10	3/ 10

Results: Table Lookup

time on task

time (in mins)

01:26.4	
01:17.8	
01:09.1	01:10.5
01:00.5	
00:51.8	
00:43.2	
00:34.6	
00:25.9	00:22.7
00:17.3	
00:08.6	
00:00.0	

Sprites   Screen Reader

lower is better
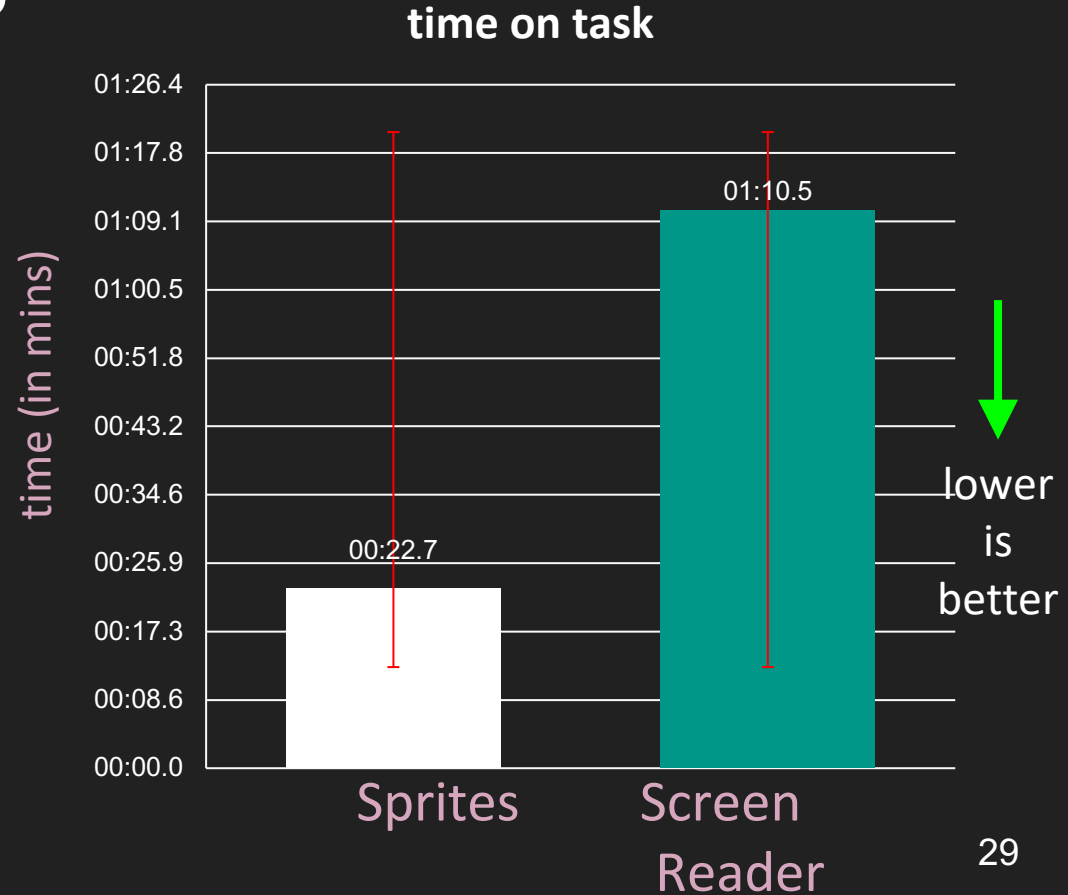
Results: Table Search

Task:

Find number of occurrences of a query in a column/row.

First Name	Last Name	Username
Mark	Otto	@mdo
Larry	the Bird	@twitter
Larry	the Bird	@twitter

Results: Table Search

Task:

Find number of occurrences of a query in a column/row.

Task Completion Rate

Sprites	Screen Reader
10 / 10	3 / 10

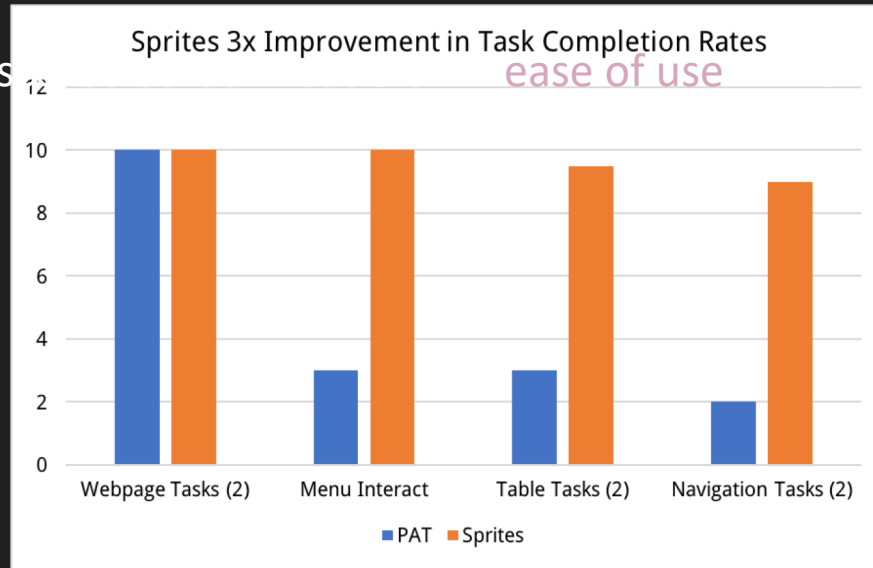# Results: Table Search

time on task

lower is better
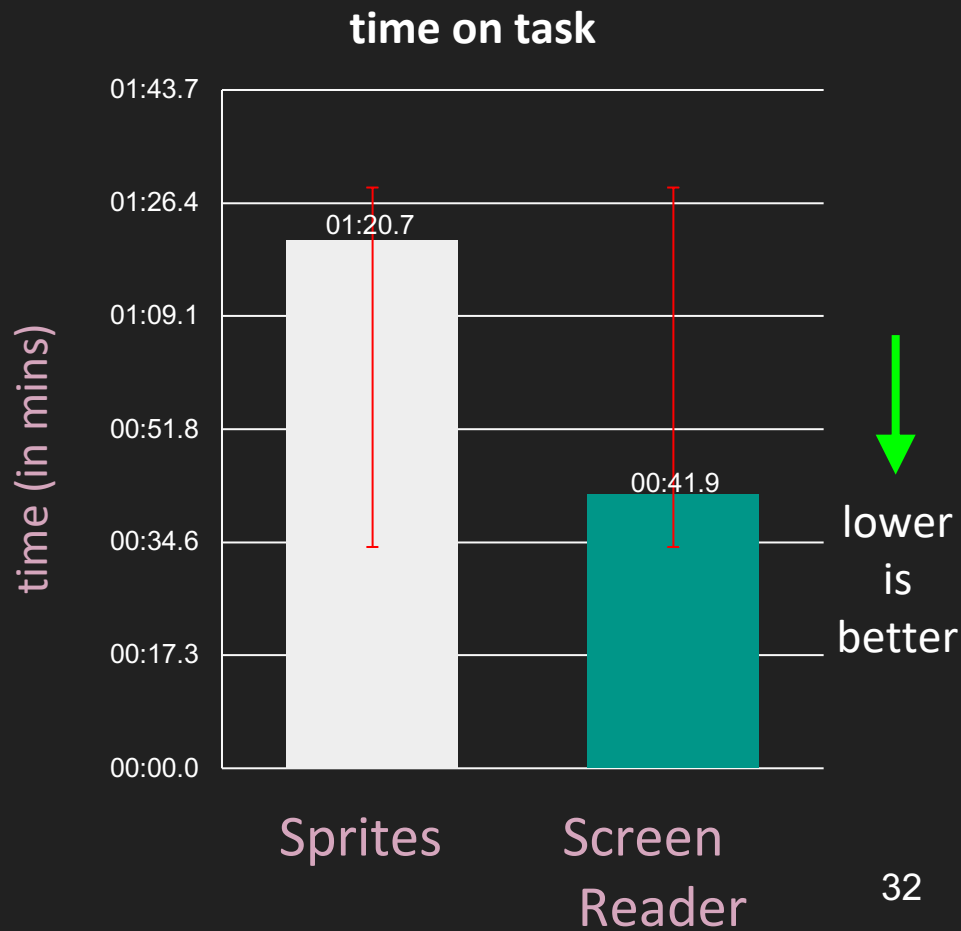
"It's easy to remember when you use keys like this. When you gotta use shortcut with 2 or 3 keys, it just like…do I use ctrl something, do I use shift something, alt something, windows something…you know that makes it a little more complicated"

"…table is not nicely laid out. You are counting in your head, its as if somebody took a table out and put it in lines underneath it which is horrible for locating something in a particular column. But I like yours, I was able to understand the table."

Summary of Results

1. Sprites outperformed screen readers in completion rate, albeit not in completion time. Only 3 / 10 participants were able to complete the tasks using a screen reader.

2. Sprites also outs̶ ~~ease of use~~ rated by participants.

Sprites 3x Improvement in Task Completion Rates

	Webpage Tasks (2)	Menu Interact	Table Tasks (2)	Navigation Tasks (2)
PAT	10	3	3	2
Sprites	10	10	9.5	9

■ PAT ■ Sprites

Summary of Results

1. Sprites was less advantages for text-based tasks, Sprites worked better for web widgets.

2. Shortcuts add cognitive load, and even after years of use, most users did not remember all available shortcut keys.

3. Compliance with accessibility guidelines is not the end goal: usability is.
   a. use natural landmarks on keyboard to guide users.

Future Work

Nonvisual Interaction Techniques at the Keyboard Surface

Rushil Khurana, Duncan McIsaac, Elliot Lockerman
Carnegie Mellon University
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