

Monday, December 12, 2022



*Ph.D. thesis proposal*

# Tool Support for Knowledge Foraging, Structuring, & Transfer During Online Sensemaking

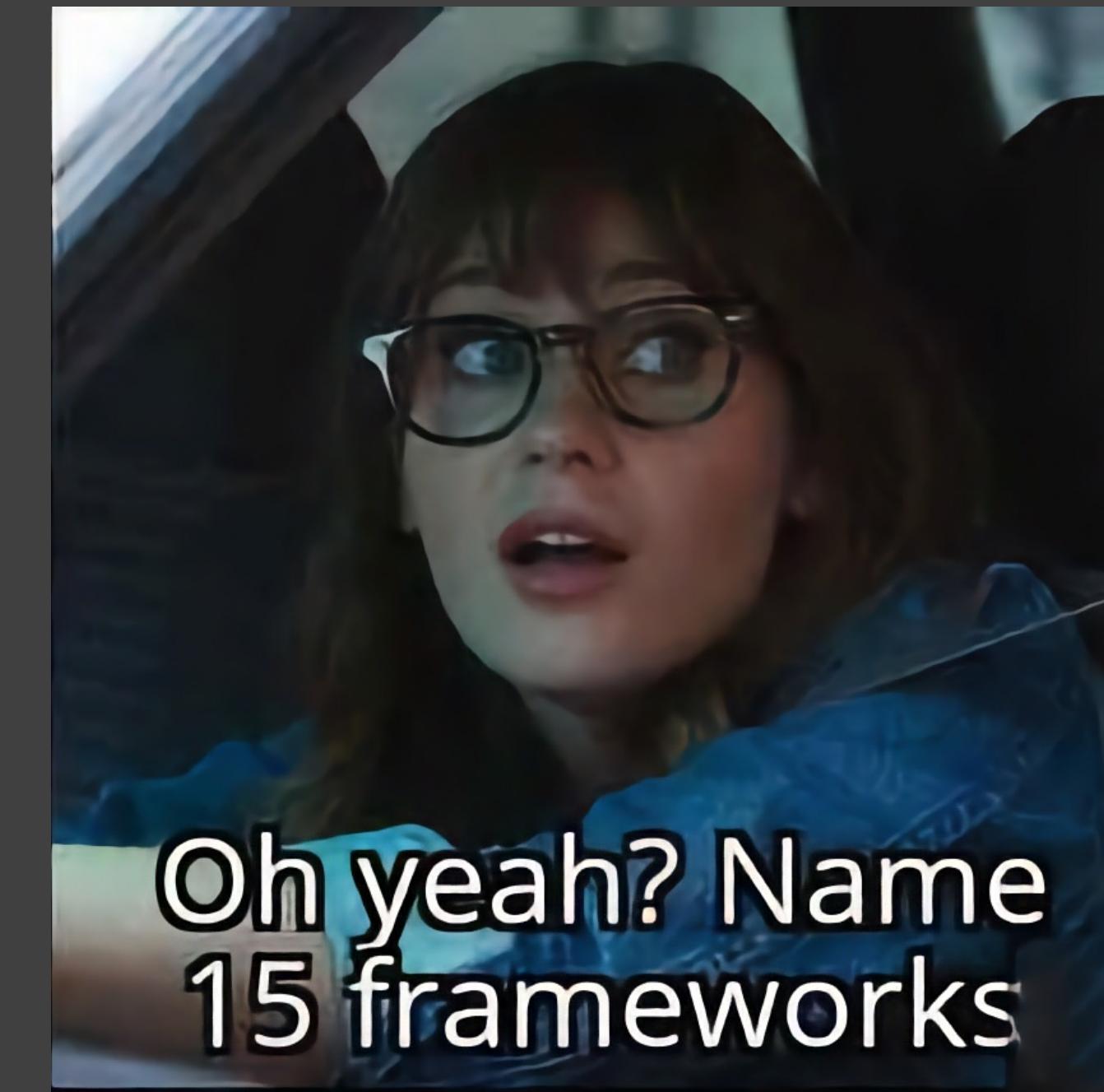
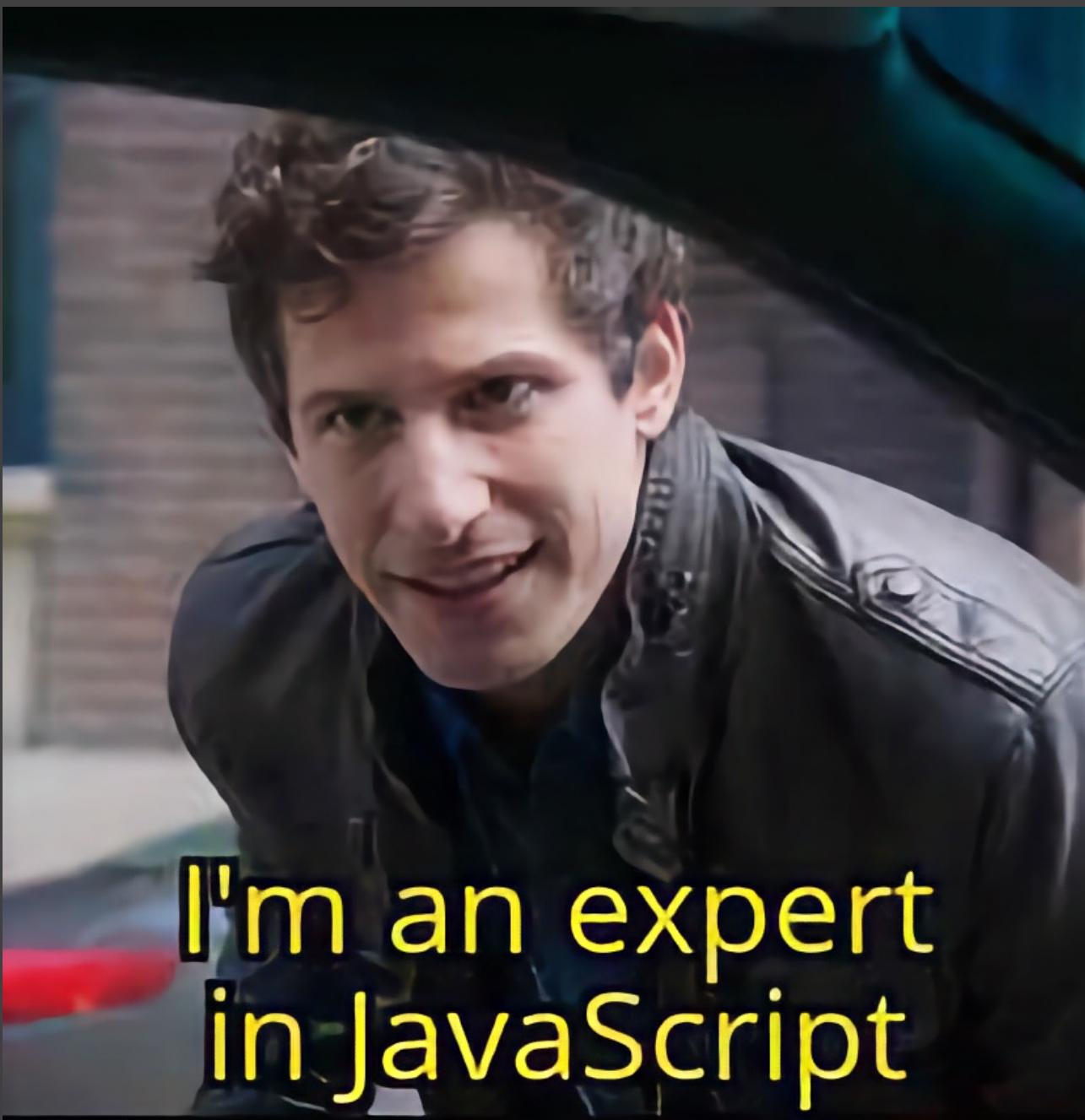
**Michael Xieyang Liu**

@lxieyang(@hci.social) / xieyangl@cs.cmu.edu

**CMU HCII**

Committee  
Brad A. Myers  
Aniket Kittur  
Kenneth Holstein  
Daniel M. Russell (Google)

# Example: choosing a JavaScript framework



# Foraging information

## Vue.js Is Good, But Is It Better Than Angular Or React?

by Mantra Malhotra / May 19, 2021 / 16 Comments / 106302 Views

Simform → Blog → Web App Development →

### Best Frontend Frameworks of 2021 for Web Development

If you are looking for the best frontend frameworks in 2021, then this article will help you choose the right one.

Hiren Dhaduk January 5, 2021

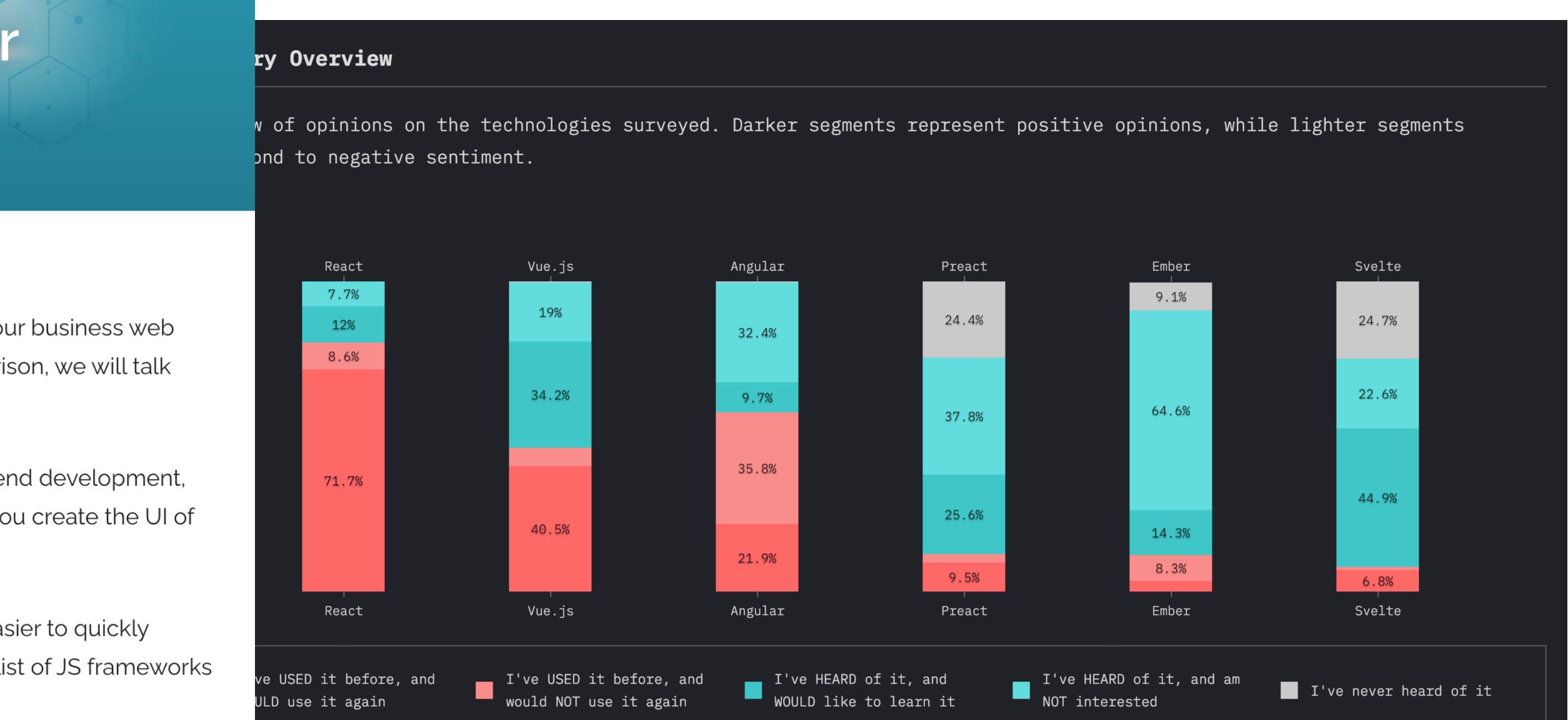
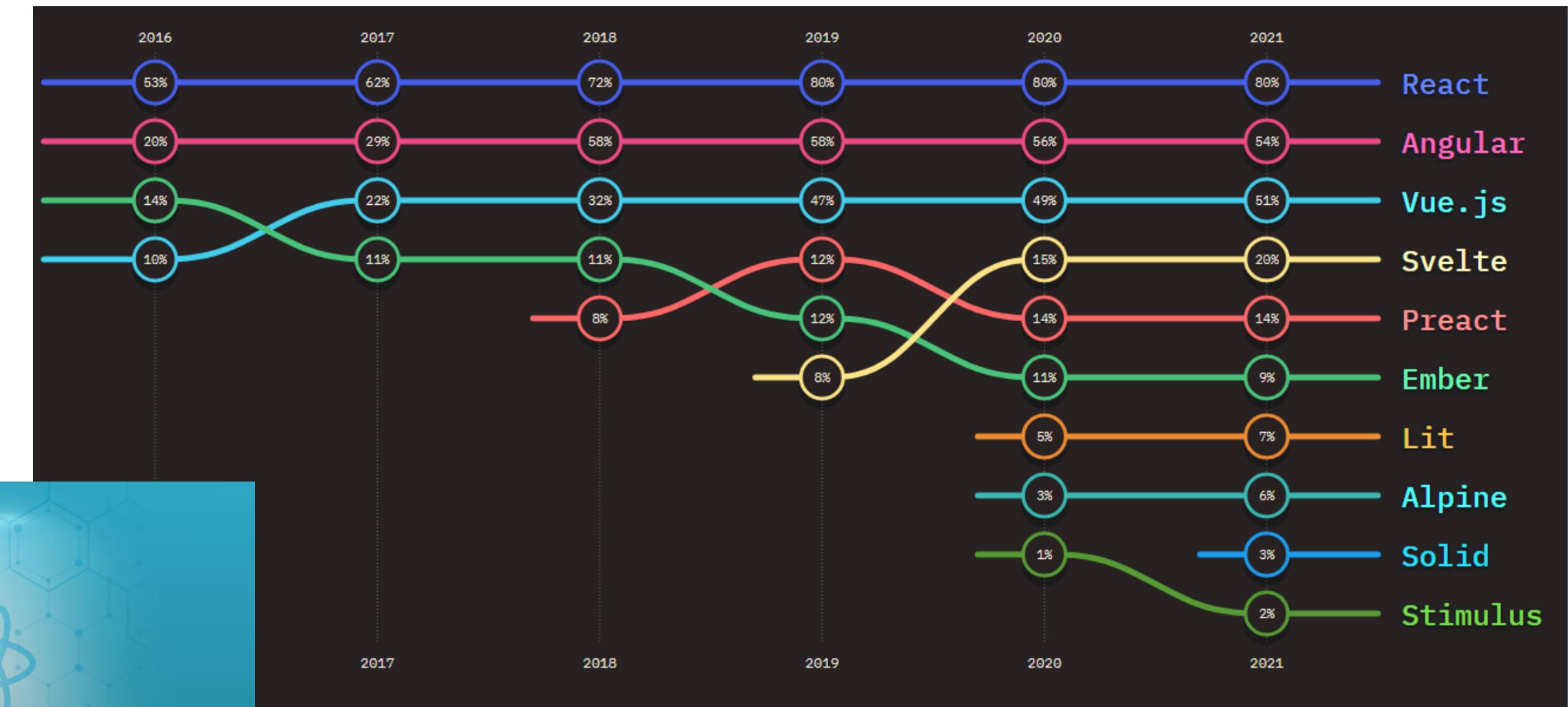
## React vs Angular vs Vue 2021: Which to Choose for Your Web App?

By Praveen Mishra May 6, 2021 □ 1

A few years ago, there was a lot of debate mainly arguing that React is the best framework for web development. However, now there are many other frameworks like Angular, Vue.js, etc., which are also popular and have their own strengths and weaknesses. In this article, we will compare React, Angular, and Vue.js and help you choose the right one for your web app.

**According to the survey, Vue.js has the highest user satisfaction rating among the three frameworks.**

User experience is becoming more important in the market today. As a developer, you should always keep up with the latest trends and features. No matter what kind of application you are building, user experience is key. That is the principle behind the success of companies like Netflix, Facebook, and Google.



# Evidence scattered across webpages...

## React Developer Tools

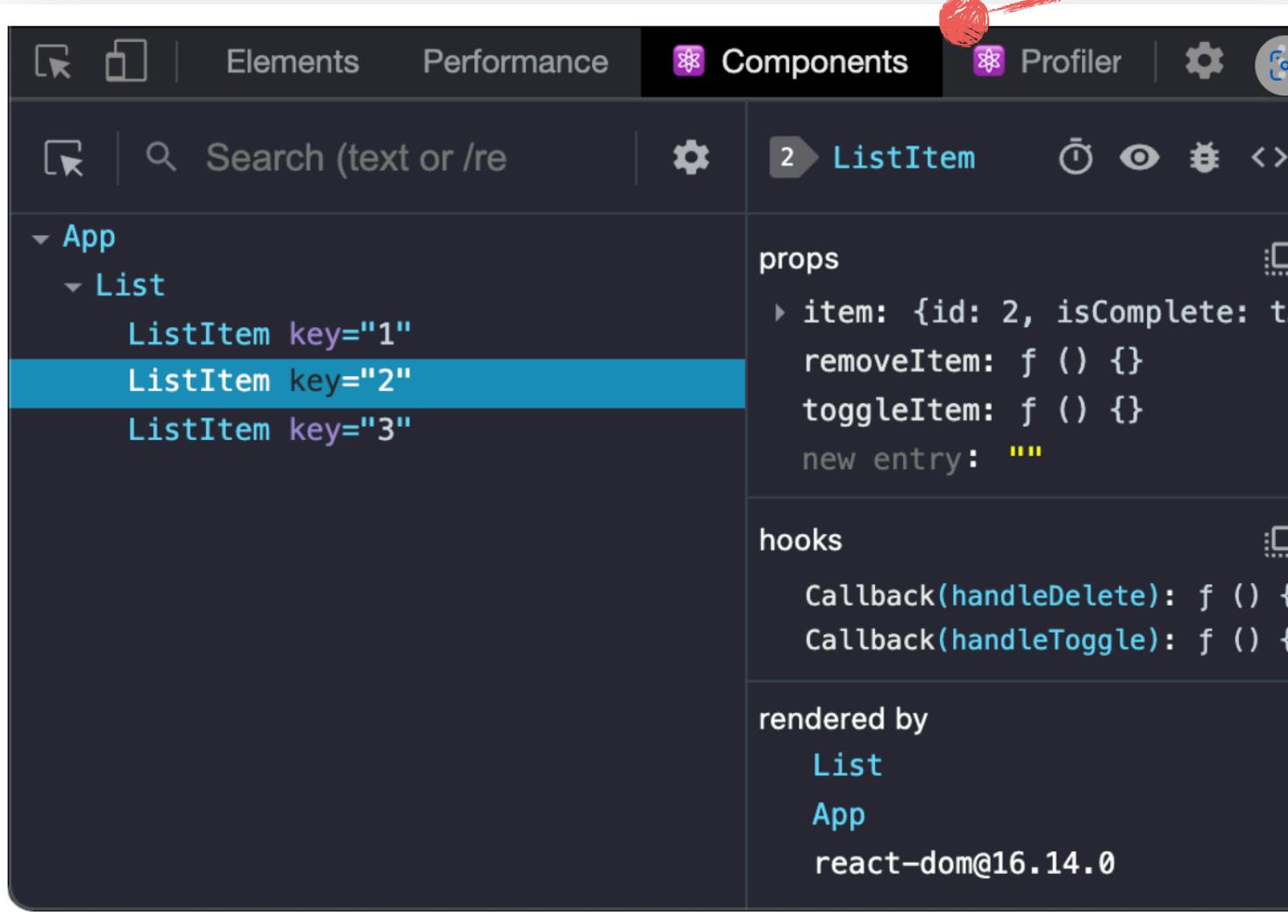
Use React Developer Tools to inspect React components, edit props and state, and identify performance problems.

You will learn

- How to install React Developer Tools

### Browser extension

The easiest way to debug websites built with React is to install the React Developer Tools browser extension. It is available for several popular browsers:



Safari and other browsers

For other browsers (for example, Safari), install the [react-devtools](#) npm package:

```
# Yarn  
yarn global add react-devtools  
  
# Npm  
npm install -g react-devtools
```

Next open the developer tools from the terminal:

## Top Front-end Frameworks for 2022

Let's take a closer look at the front-end frameworks dominating the landscape. We know who the big players are, but what about newcomers? Alpine, Lit, and Solid are all showing promising usage percentages... And we definitely want to know more about Svelte.

# #1 – React



React continues to dominate the front-end space. The framework stands out with its own virtual DOM, ensuring persistent app performance at scale. Likewise, the component-based structure means that development is more accessible across teams.

While the learning curve for React is moderately forgiving, the accessibility of tooling makes the process manageable. Namely, [create-react-app](#) automates the build process for an application boilerplate. And then there are [React DevTools](#), providing an accessible debugging experience from the browser.

Thanks to the mass adoption of React, front-end developers can enjoy getting their hands on

React.js Pros	React.js Cons
Easy to get started with thanks to troves of online tutorials, courses, etc.	Documentation can feel a bit lacking for beginners. E.g. JSX
Component structure makes it easy to define an element and then reuse it as needed.	Only used for UI development.
SEO-friendly for static and dynamic projects.	Not the best choice for small projects.
Version Control provides notices on outdated code structure.	Unopinionated – your call on deciding the structure and style guide.

## #2 – Angular

## Turing

**Svelte vs React**  
Which JavaScript Framework Should You Choose?



## Bundle Size

Svelte's .gzip version has a size of 1.6 kilobytes. React.gzip, when combined with ReactDOM, has a total size of 42.2 kilobytes. The smaller bundle size of Svelte ensures faster loading speeds, better responsiveness, and lower bandwidth costs.

Svelte is a free and open-source front-end compiler based on JavaScript language. React is a front-end JavaScript library that uses multiple third-party components to design UI elements. The article explains the differences between Svelte vs React in detail.

Developers use [JavaScript frameworks](#) like Svelte and React to create, design, and code functional websites. Knowing the difference between Svelte and React would help [web developers](#) decide which frameworks to use.

### Svelte vs React: What is Svelte?

Developed by Rich Harris in 2016, Svelte is a free, open-source front-end compiler. Svelte compiles HTML templates to create unique code that manipulates the Document Object Model directly. Unlike traditional JavaScript frameworks like React, Svelte avoids overheads associated with the virtual DOM.

One way Svelte operates reduces the transferred file size and offers better client performance. The compiler processes the application code inserts calls to automatically update the data, and re-renders UI elements based on that data. Svelte is written in the TypeScript language, a superset of JavaScript.

### When should you use Svelte?

Svelte is known for simplicity, as its code closely resembles Vanilla JavaScript. Svelte allows developers to complete their objectives with fewer lines of code. Developers should use Svelte if they are targeting a very small package size for their website.

Programs written in Svelte are useful for application in low-capacity or low-power devices. Svelte tools and frameworks provide better control over state management, routing, and creating customized infrastructure. Svelte is useful for DOM manipulation, reactive frameworks, and emerging markets.

### Which companies use Svelte?

# Foraging → Structuring Information

Vue.js Is Good, But Is It Better Than Angular  
Or React?

by Mantra Malhotra / May 19, 2021 / 16 Comments / 106302 Views

**SIMFORM** Simform → Blog → Web App Development → **Menu**

## Best Frontend Frameworks of 2021 for Web Development

If you are looking for the best frontend frameworks in 2021, then this article is for you. We will compare three popular frameworks: React, Angular, and Vue.js.

**Hiren Dhadialla** January 5, 2021

### React vs Angular vs Vue 2021: Which to Choose for Your Web App?

By Praveen Mishra May 6, 2021 1 Reading Time: 8 minutes

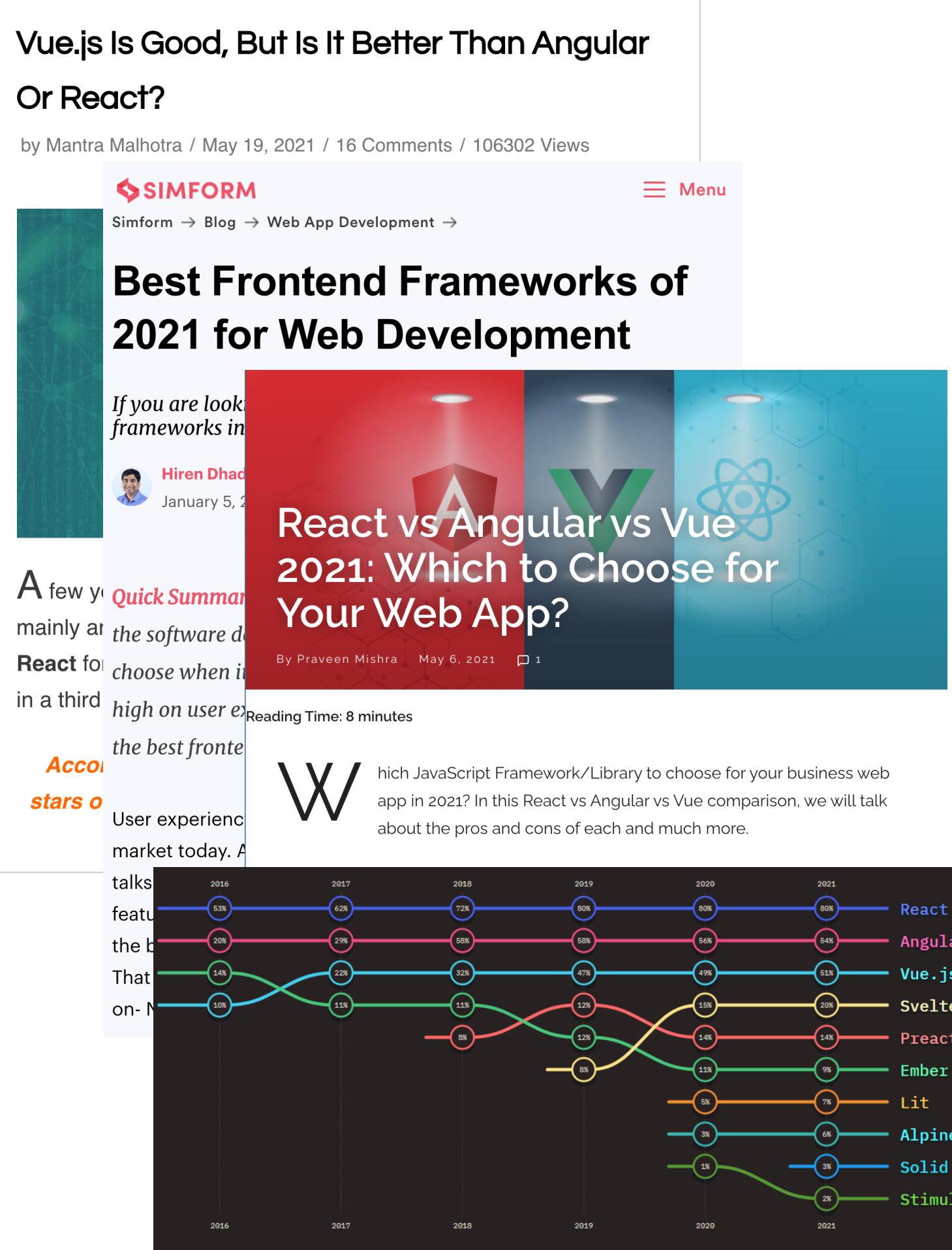
A few years ago, React was the most popular framework for building web applications. However, in recent years, Angular and Vue.js have gained significant popularity. In this article, we will compare the three frameworks and help you decide which one is the best for your web application.

Accomplished by Hiren Dhadialla on May 6, 2021

User experience is the most important factor in today's market. A

W hich JavaScript Framework/Library to choose for your business web app in 2021? In this React vs Angular vs Vue comparison, we will talk about the pros and cons of each and much more.

talks 2016 2017 2018 2019 2020 2021 React 53% 62% 72% 80% 80% 80% Angular 20% 29% 58% 68% 56% 54% Vue.js 14% 22% 32% 47% 49% 51% Svelte 8% 11% 11% 12% 13% 20% Preact 10% 11% 12% 14% 14% 14% Ember 11% 11% 9% Lit 7% 7% Alpine 3% 3% Solid 2% Stimulus 1%



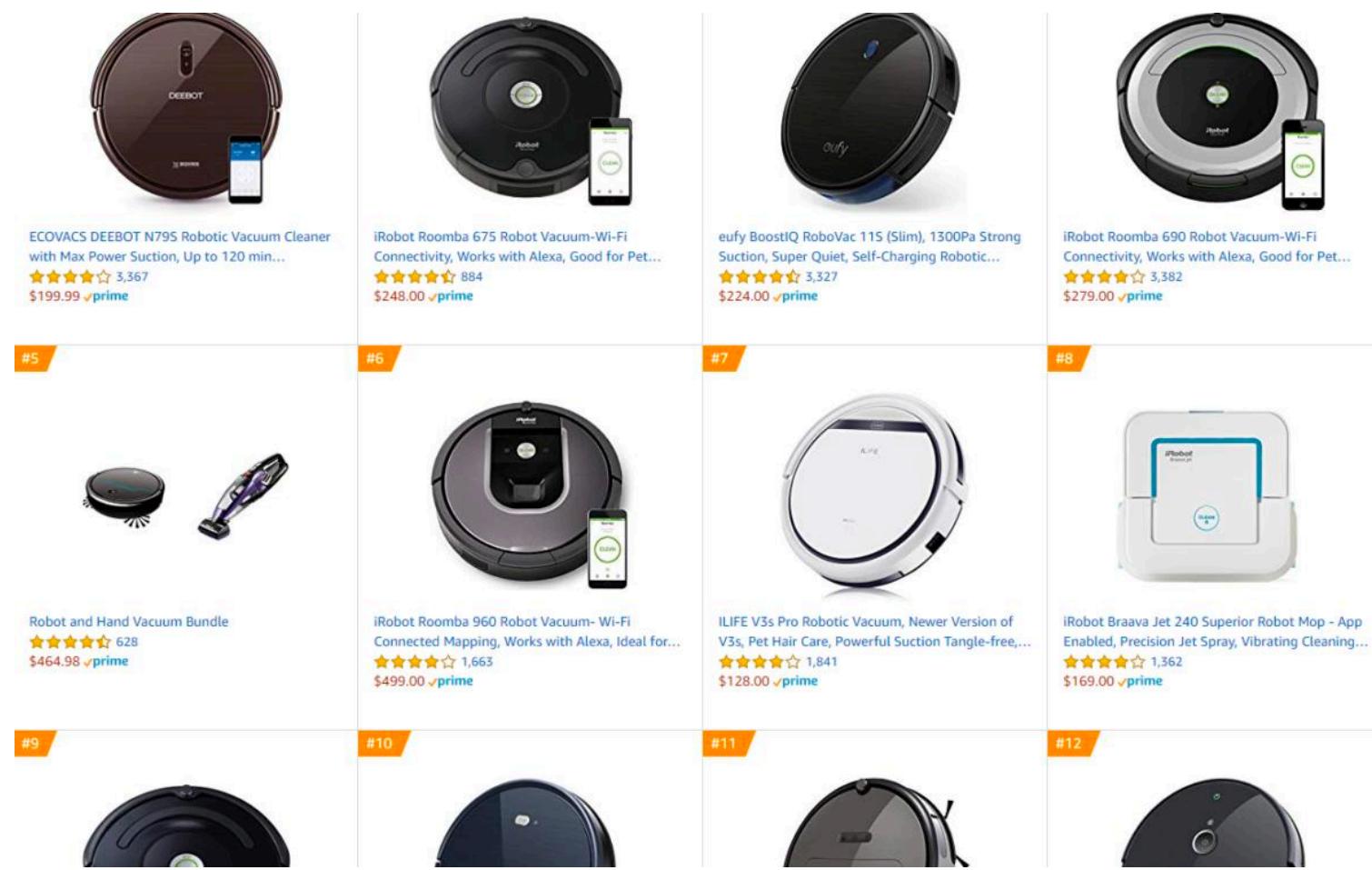
↑ This is hard!

	Fast?	dev community	documentation	supported by
React	yes	Really large	<a href="https://reactjs.org/">https://reactjs.org/</a>	facebook
Angular	?	Also large	Not so easy to understand <a href="https://angular.io/docs">https://angular.io/docs</a>	google
Vue	yes	?	Very detailed, Very easy to understand <a href="https://vuejs.org/v2/guide/">https://vuejs.org/v2/guide/</a>	Community, started by Evan You

Aspirational compassion table summarized  
from various sources that would help with  
decision-making



Programming



Buying a robot vacuum



Planning a vacation



Understanding  
medical diagnosis & treatments

# Prior research – finding information

The screenshot shows the Mica search interface. At the top, there's a search bar with "Java full screen" and a dropdown menu set to "Java". Below the search bar, the text "Search Completed" is displayed. The results list includes:

- Full-Screen Exclusive Mode API**  
Do you want to use high-performance graphics in the **Java** development environment?  
setFullScreenWindow  
getDefaultScreenDevice  
GraphicsDevice  
GraphicsEnvironment  
isFullScreenSupported  
BufferCapabilities  
getDefaultConfiguration  
BufferStrategy
- Full-Screen Exclusive Mode**  
Full-screen exclusive mode is handled through a `java.awt.GraphicsDevice` object.  
For a list of all available **screen** graphics devices (in single or ...)  
[java.sun.com/docs/books/tutorial/extras/fullscreen/exclusivemode.html](http://java.sun.com/docs/books/tutorial/extras/fullscreen/exclusivemode.html) - 8k  
- Cached

## Finding APIs

Stylos et al. 2006

The screenshot shows a Flex 3 tutorial page titled "Flex 3 - Using the URLLoader class". It includes the following code example:

```
<?xml version="1.0" encoding="utf-8"?>
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml">
<mx:Script>
    urlLoader

```

Below the code, there is a snippet of ActionScript:

```
var loader:URLLoader = new URLLoader();
loader.addEventListener(function(e:Event){
    trace("loaded");
});
loader.load(new URLRequest("example.com"));
```

## Finding example code

Brandt et al. 2010

The screenshot shows a developer's browser window with several tabs open:

- fourier transform properties - Google Search**  
**Properties of Fourier Transform**  
[fourier.eng.hmc.edu/e101/.../node2.html](http://fourier.eng.hmc.edu/e101/.../node2.html) [flag|delete]
- MINIM FFT - Google Search**  
**The Fast Fourier Transform**  
[www.dspguide.com/ch12.htm](http://www.dspguide.com/ch12.htm) [flag|delete]

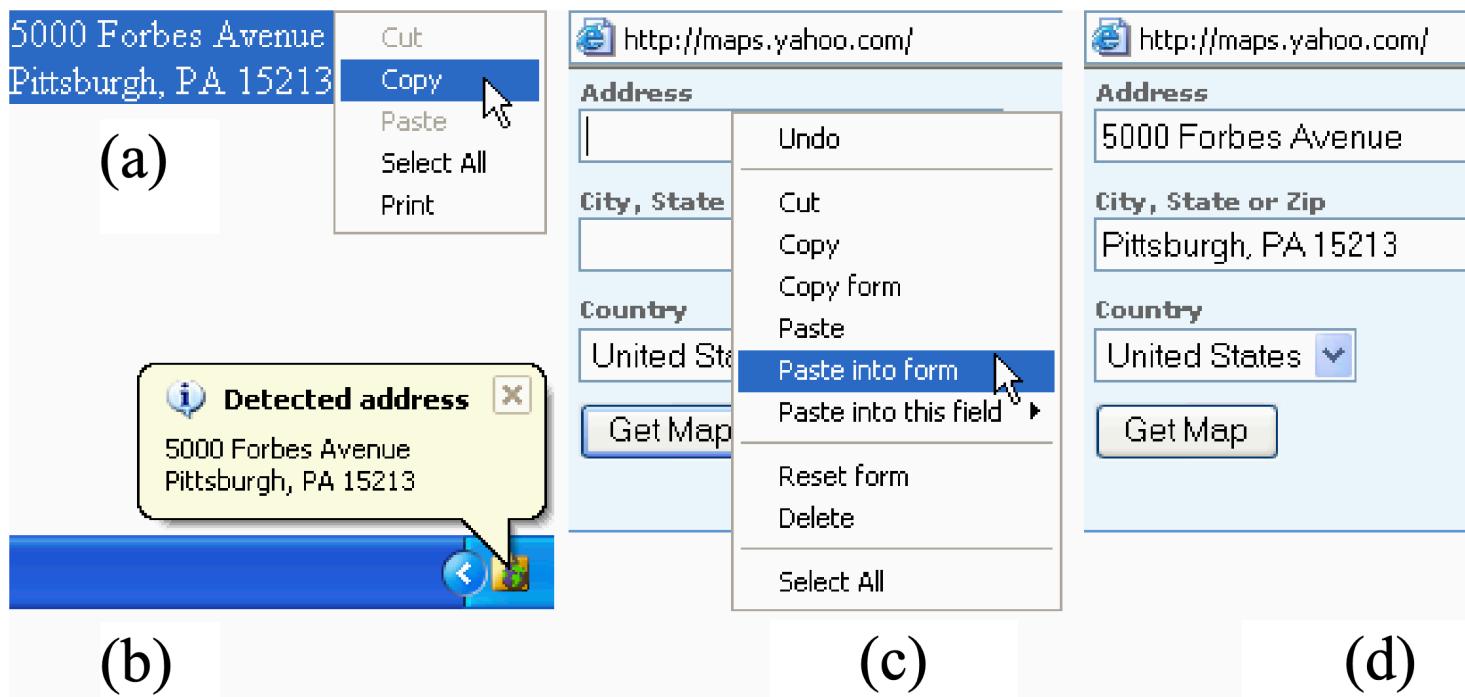
On the right side of the browser, there is a code editor window titled "AnalyzeSound §" containing the following code:

```
background(0);
stroke(255);
// perform a forward FFT on the sa
fft.forward(jingle.mix);
for(int i = 0; i < fft.specSize();
{
    // draw the line for frequency b
    line(i, height, i, height - fft.
    fill(255,63);
}
```

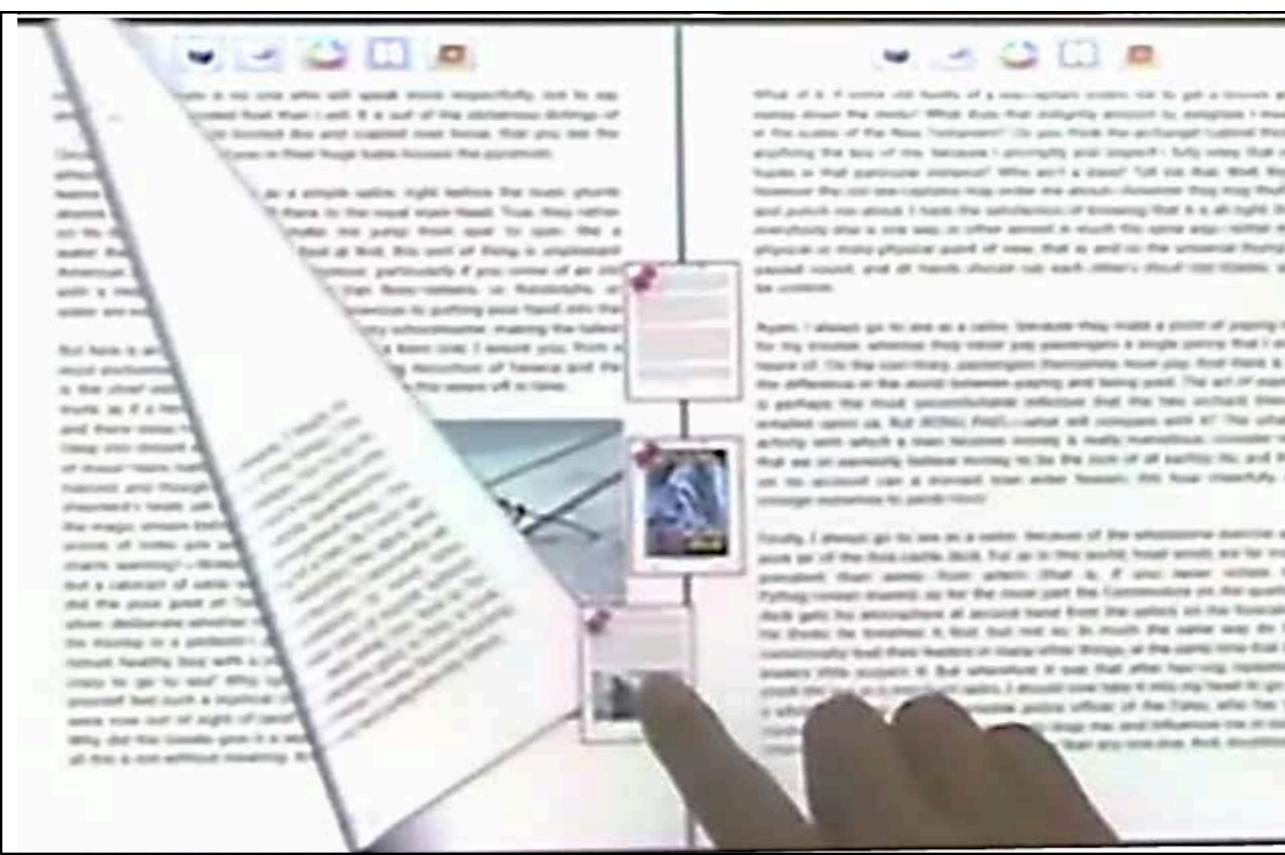
## Keeping track of information source

Hartmann et al. 2011

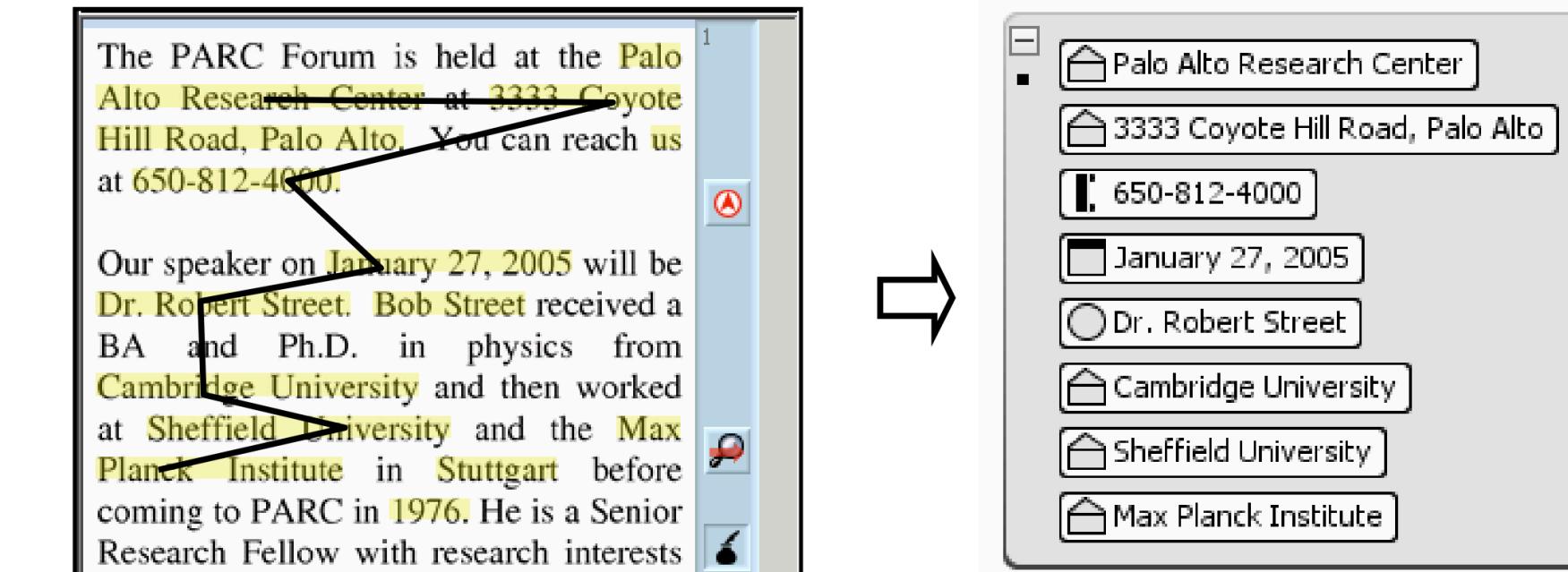
# Prior research – saving information



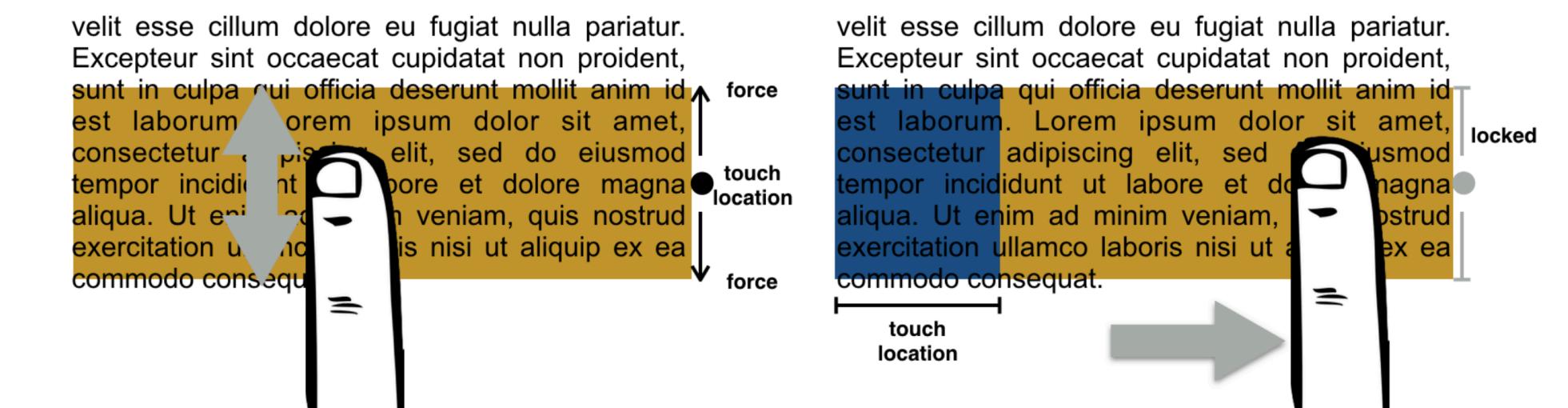
Citrine: providing intelligent copy-and-paste  
Stylos et al. (UIST 2004)



GatherReader: gathering information while active reading  
Hinckley et al. (CHI 2012)

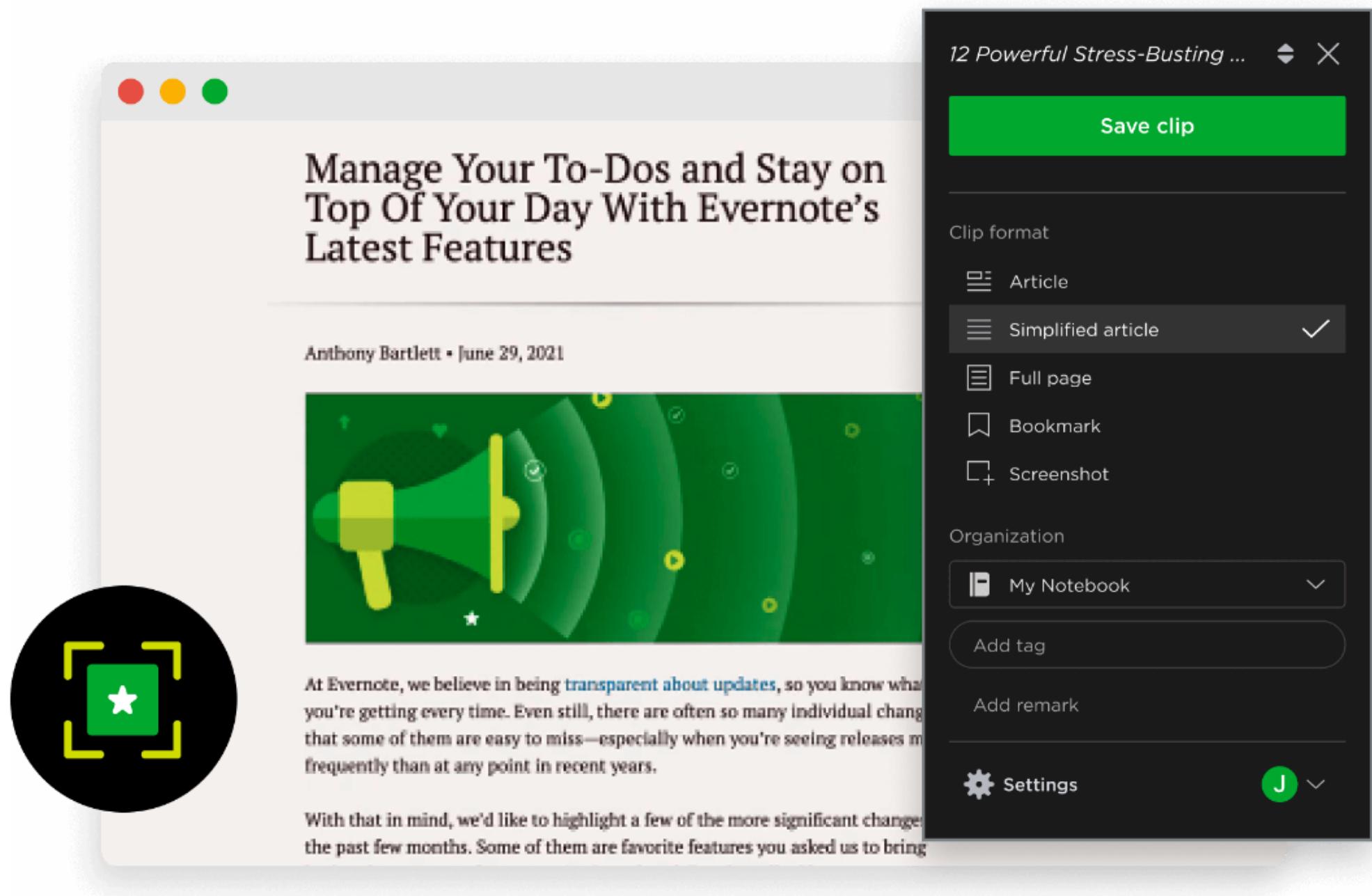


Entity quick click: rapid text copying based on automatic entity extraction  
Bier et al. (CHI 2006)



Supporting Mobile Sensemaking Through Intentionally Uncertain Highlighting Changes al. (UIST 2016)

# Commercial tools



Web clippers for  
saving content from browsers



Notes/spreadsheet apps for  
personal information management (PIM)

# Challenges

- It is **cognitive and physically demanding** for people to **collect and organize** information into structures, especially without proper tool support.

# Reusing decisions?

Not that easy!

The screenshot shows a blog post titled "Vue.js Is Good, But Is It Better Than Angular Or React?" by Mantra Malhotra. The post discusses the best frontend frameworks for 2021. It includes a section on "React vs Angular vs Vue 2021: Which to Choose for Your Web App?" and a chart showing the growth of various frameworks from 2016 to 2021.

**Best Frontend Frameworks of 2021 for Web Development**

If you are looking for the best frontend framework for web development in 2021, then this article is for you. We will compare three popular frameworks: React, Angular, and Vue.js. We will discuss their pros and cons, and help you decide which one to choose for your next project.

**React vs Angular vs Vue 2021: Which to Choose for Your Web App?**

A few years ago, React was the most popular framework for web development. However, in recent years, Angular and Vue.js have gained significant popularity. In this article, we will compare the three frameworks and help you decide which one to choose for your next project.

**W**hich JavaScript Framework/Library to choose for your business web app in 2021? In this React vs Angular vs Vue comparison, we will talk about the pros and cons of each and much more.

**Vue.js** is a progressive JavaScript framework for building user interfaces. It follows the MVVM pattern and is known for its simplicity and reusability. Vue.js has a large and active community, and it is supported by a number of companies, including Netflix and LinkedIn.

**Angular** is a full-fledged framework for building complex web applications. It follows the MVC pattern and is known for its robustness and scalability. Angular has a large and active community, and it is supported by a number of companies, including Google and Microsoft.

**React** is a library for building user interfaces. It follows the unidirectional data flow pattern and is known for its performance and reusability. React has a large and active community, and it is supported by a number of companies, including Facebook and Airbnb.

**Svelte** is a new framework for building user interfaces. It follows the component-based architecture and is known for its performance and reusability. Svelte has a small but growing community, and it is supported by a number of companies, including Netflix and LinkedIn.

**Preact** is a lightweight alternative to React. It follows the component-based architecture and is known for its performance and reusability. Preact has a small but growing community, and it is supported by a number of companies, including Netflix and LinkedIn.

**Ember** is a full-fledged framework for building complex web applications. It follows the MVC pattern and is known for its robustness and scalability. Ember has a small but growing community, and it is supported by a number of companies, including Netflix and LinkedIn.

**Lit** is a new framework for building user interfaces. It follows the component-based architecture and is known for its performance and reusability. Lit has a small but growing community, and it is supported by a number of companies, including Netflix and LinkedIn.

**Alpine** is a new framework for building user interfaces. It follows the component-based architecture and is known for its performance and reusability. Alpine has a small but growing community, and it is supported by a number of companies, including Netflix and LinkedIn.

**Solid** is a new framework for building user interfaces. It follows the component-based architecture and is known for its performance and reusability. Solid has a small but growing community, and it is supported by a number of companies, including Netflix and LinkedIn.

**Stimulus** is a new framework for building user interfaces. It follows the component-based architecture and is known for its performance and reusability. Stimulus has a small but growing community, and it is supported by a number of companies, including Netflix and LinkedIn.

	Fast?	dev community	documentation	supported by
React	yes	Really large	<a href="https://reactjs.org/">https://reactjs.org/</a>	facebook
Angular	?	Also large	<b>Not so easy to understand</b> <a href="https://angular.io/docs">https://angular.io/docs</a>	google
Vue	yes	?	<b>Very detailed,</b> <b>Very easy to understand</b> <a href="https://vuejs.org/v2/guide/">https://vuejs.org/v2/guide/</a>	Community, started by Evan You

# Appropriate to reuse?

- People intuitively focus on **correctness**, however, it's often subjective depending on the specific situation.
- There are other facets that are equally important, such as **context relevance** or the **completeness** of research.
- When unsure about these factors, people would rather carry out research by themselves than reuse.

# Challenges

- It is **cognitive and physically demanding** for people to **collect and organize** information into structures, especially without proper tool support.



Initial person

# Challenges

- It is **cognitive and physically demanding** for people to **collect and organize** information into structures, especially without proper tool support. Initial person
- It is difficult for subsequent people to judge whether it is **appropriate to reuse** learning outcomes and decisions made by an initial person. Subsequent people

# Challenges

- It is **cognitive and physically demanding** for people to **collect and organize** information into structures, especially without proper tool support. Initial person
- It is difficult for subsequent people to judge whether it is **appropriate to reuse** learning outcomes and decisions made by an initial person. Subsequent people

I study people's sensemaking and decision-making processes, and

I build **user interfaces, interactions, and**

**computational scaffolds** that enable

people to collect and organize

knowledge to make and justify decisions,

while keeping track of that knowledge and

making it useful for subsequent people

with similar needs.



Initial person



Subsequent people

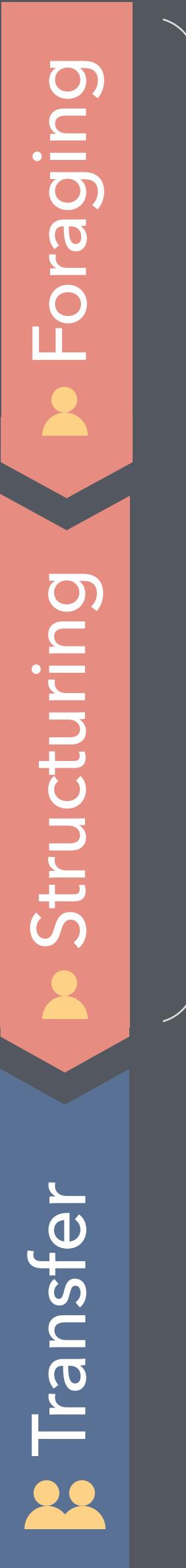
I build **user interfaces, interactions, and computational scaffolds** that enable people to collect and organize knowledge to make and justify decisions, while keeping track of that knowledge and making it useful for subsequent people with similar needs.

• Foraging

• Structuring

• Transfer

I build **user interfaces, interactions, and computational scaffolds** that enable people to collect and organize knowledge to make and justify decisions, while keeping track of that knowledge and making it useful for subsequent people with similar needs.

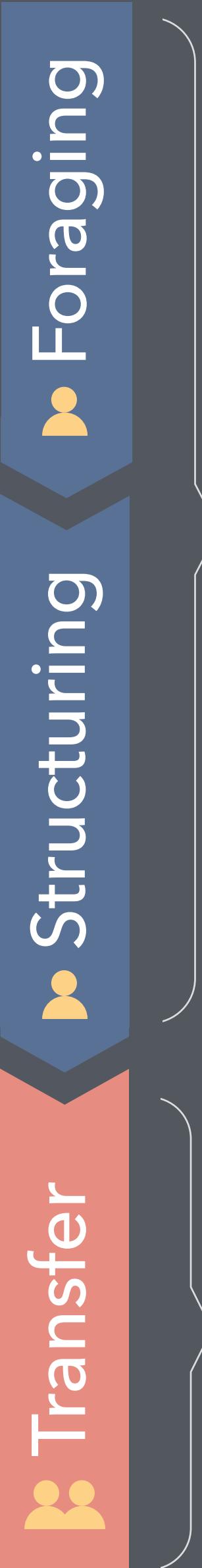


Unakite (UIST 2019)  
Honorable Mention (top-6)

Crystalline (CHI 2022)

Wigglite (UIST 2022)

I build **user interfaces, interactions, and computational scaffolds** that enable people to collect and organize knowledge to make and justify decisions, while keeping track of that knowledge and making it useful for subsequent people with similar needs.



Unakite (UIST 2019)  
🥇 Honorable Mention (top-6)

Crystalline (CHI 2022)

Wigglite (UIST 2022)

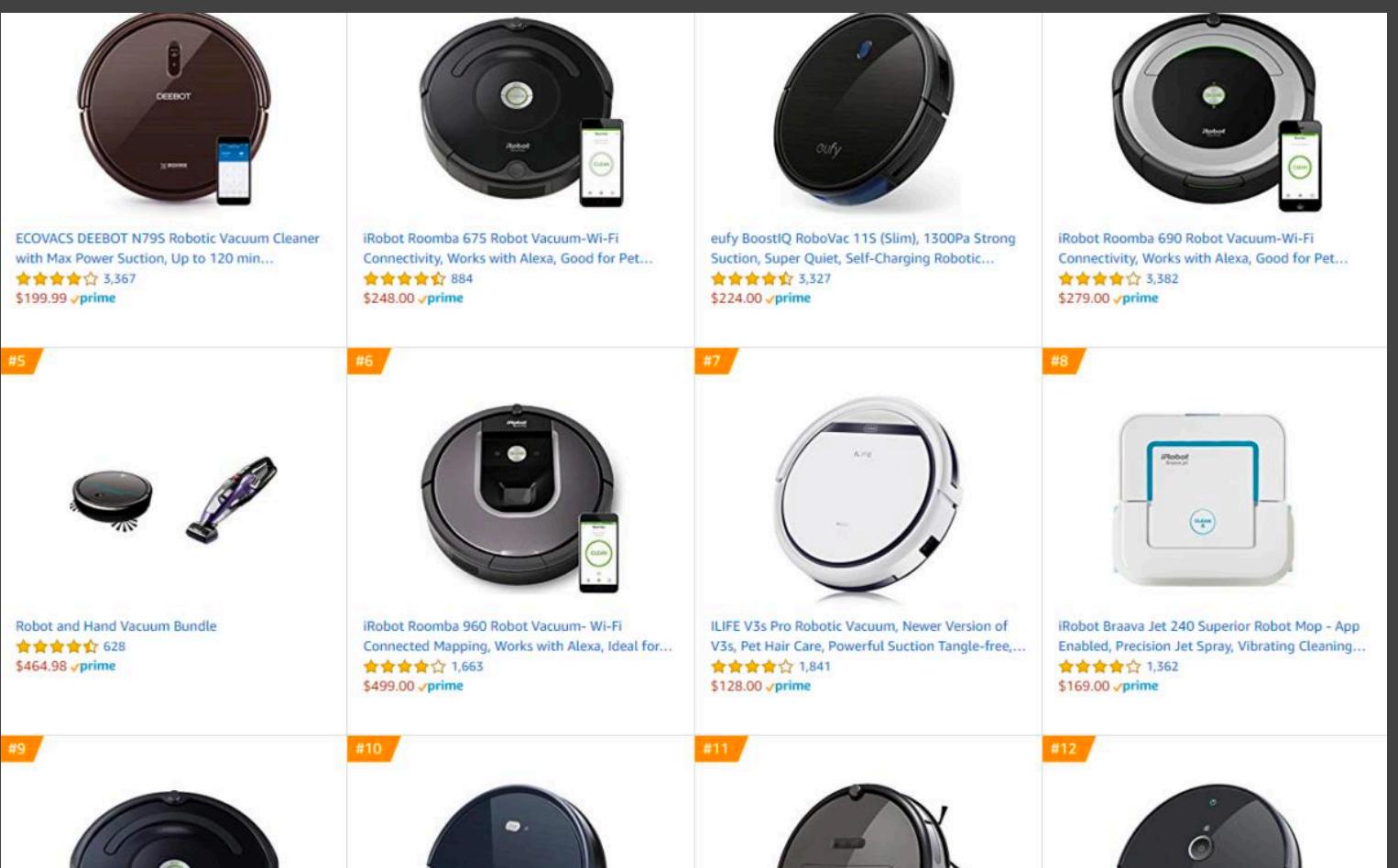
Strata (CSCW 2021)  
🏆 Best paper (top 1%)

I build **user interfaces, interactions, and computational scaffolds** that enable people to collect and organize knowledge to make and justify decisions, while keeping track of that knowledge and making it useful for subsequent people with similar needs.





Programming



Consumer purchasing



Unakite (UIST 2019)  
ribbon Honorable Mention (top-6)

Crystalline (CHI 2022)

Wigglite (UIST 2022)

*Proposed Work (2023)*

Strata (CSCW 2021)  
trophy Best paper (top 1%)

# Unakite: Scaffolding Developers' Decision-Making Using the Web



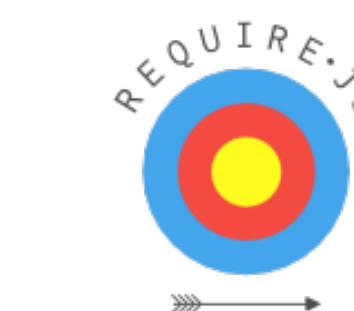
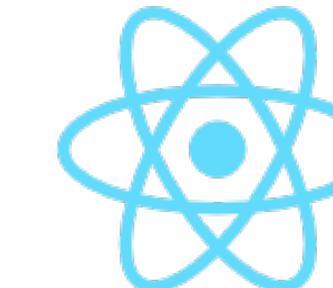
Honorable Mention (top-6)

Michael Xieyang Liu, Jane Hsieh, Nathan Hahn,  
Angelina Zhou, Emily Deng, Shaun Burley,  
Cynthia Taylor, Aniket Kittur, Brad A. Myers

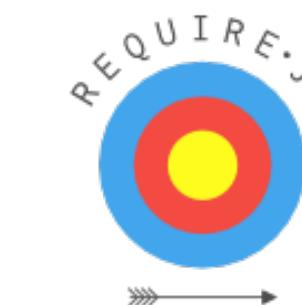
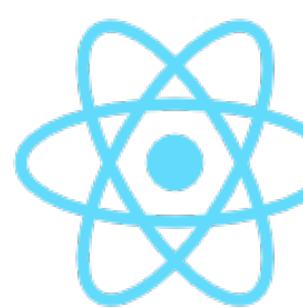
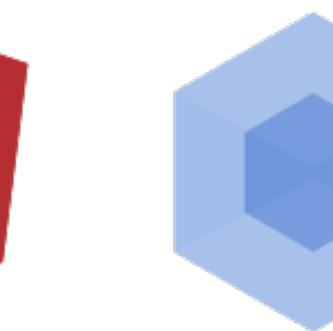


**U**sers **n**eed **a**ccelerators for **k**nowledge for **i**mplementations in **t**echnology **e**nvironments

# Trade-offs



*BABEL*



# Formative Study 1: Developer Interviews

15 developers (5 professionals, 10 students)

**Goal:** understand how developers currently collect and manage information about trade-offs

# Finding 1: Making decisions is frequent and difficult in programming.

13 developers reported being frequently swamped in difficult decision making tasks (N=15).

*trade-offs among optimization methods when training neural nets (e.g., “stochastic gradient descent”, “augmented Lagrangian”, etc.)*

- P9

*balance between cost and performance when picking cryptographic algorithms to protect users’ sensitive information*

- P13

# Finding 2: Developers need **tool support** for making decisions

8 participants used existing tools to organize information (N=15). However, there are difficulties in:

- **Collecting content**
- **Maintaining provenance**
- **Synthesizing the new with existing content**
- **Tedious context switches**

*“... copy-pasting is just too much work, and I lose all the styling” - P7*

*“...whenever I save something, I always forget to also save the URL [of the source]” - P15*

*“Evernote dumps everything I clip into a list of notes. There’s no way for me to organize them” - P9*

*“I always find myself constantly switching back and forth between the notes tab and the other tabs” - P13*

# Finding 3: While making decisions, developers curate **mental tables** comparing different **options** with respect to different **criteria**

	Fast?	dev community	documentation	supported by
React	yes	Really large	<a href="https://reactjs.org/">https://reactjs.org/</a>	facebook
Angular	?	Also large	Not so easy to understand <a href="https://angular.io/docs">https://angular.io/docs</a>	google
Vue	yes	?	Very detailed, Very easy to understand <a href="https://vuejs.org/v2/guide/">https://vuejs.org/v2/guide/</a>	Community, started by Evan You

P13's notes in a Google Doc on picking a JavaScript library

# Unakite



A chrome extension that helps developer  
**collect** and **organize** information while  
searching and browsing



# Design Goals (based on formative studies + prior work)

**[D1] Scaffolding:** helping developers form systematic models when approaching decision making problems with tradeoffs.

**[D2] Lightweight interactions:** reducing the cost of collecting and organizing content so that the entry barriers to use the tool are low.

**[D3] Summarization:** helping developers synthesize and summarize different pieces of content together and manage them.

**[D4] Contextualization:** enabling developers to recreate the context from which information snippets were collected and copied.

# [D1] Scaffolding

The “Option-Criterion-Evidence” framework

		Criteria			
		having a convenient notation for matrix multiplication	having built-in support for inverse and other matrix operations	Support arbitrary dimensional array	having long-term support
Options	numpy array				
	numpy matrix				

Criteria

Evidence

# [D2] Lightweight interactions

The screenshot shows the Unakite application interface. At the top, there is a search bar with the text "how to represent matrices in python". To the right of the search bar is a user profile for "Michael". Below the search bar, there is a section titled "Table (Created 0...)" which contains a comparison table. The table has three columns: "convenient notation for matrix multiplication", "have long term support", and "support N-dimensions". There are three rows: "Numpy matrices" (marked with a blue plus sign), "python list", and "numpy ndarrays". The "Numpy matrices" row has a green thumbs-up icon in the first column, a red thumbs-down icon in the second, and a red thumbs-down and yellow info icon in the third. The "python list" row has a red thumbs-down icon in the first column, a red thumbs-down icon in the second, and a red thumbs-down and yellow info icon in the third. The "numpy ndarrays" row has a green thumbs-up icon in the third column. Below the table, there is a navigation bar with tabs: Uncategorized, Options, Criteria, Snippets (which is highlighted in blue), All, and Trashed. The main area below the navigation bar displays a list of snippets. The first snippet is "no!!!", the second is "Matrix objects are a subclass of ndarray, so they inherit all...", and the third is "Numpy matrices are strictly 2-dimensional, while numpy arrays (ndarrays) are...". Each snippet has a purple bookmark icon, a comment icon, a trash icon, and a timestamp indicating it was created "a month ago".

	convenient notation for matrix multiplication	have long term support	support N-dimensions
Numpy matrices	👍	👎	👎 ⓘ
python list	👎	👎	👎 ⓘ
numpy ndarrays			👍

Comparison table

Snippet repository

# [D3] Summarization

**Comparison Table:** a high-level summary of the decision-making space

	having a convenient notation for matrix multiplication	having built-in support for inverse and other matrix operations	Support arbitrary dimensional array	having long-term support
numpy array				
numpy matrix				

# [D3] Summarization

## Ratings as evidence

	having a convenient notation for matrix multiplication	having built-in support for inverse and other matrix operations	Support arbitrary dimensional array	having long-term support
numpy array				
numpy matrix				



positive



negative



informational

# Evidence

	having a convenient notation for matrix multiplication	having built-in support for inverse and other matrix operations	Support arbitrary dimensional array	having long-term support
numpy array				
numpy matrix	 I can basically do a*b			

Uncategorized Options Criteria Snippets All Trashed

Python 3.5 NumPy supports infix (@) operator for matrix multiplication

1

stackoverflow.com 7 months ago

I tried the infix operator and it worked like a charm!

matrix will be deprecated in the future

docs.scipy.org 7 months ago

I thought numpy matrix can't do high dimensional vector manipulations

Created 7 months ago

Clicking on the rating icons in the comparison table reveals its corresponding evidence snippet



The main advantage of numpy matrices is that they provide a convenient notation for...



stackoverflow.com

an hour ago

Showing HTML snapshot



The main advantage of numpy matrices is that they provide a convenient notation for matrix multiplication: if a and b are matrices, then  $a*b$  is their matrix product.

```
import numpy as np  
  
a=np.mat('4 3; 2 1')  
b=np.mat('1 2; 3 4')  
print(a)  
# [[4 3]  
#  [2 1]]  
print(b)  
# [[1 2]  
#  [3 4]]  
print(a*b)  
# [[13 20]  
#  [ 5  8]]
```



Add a comment

# Snippet

- Original HTML with styling
- Easy to recognize

# Snippet Metadata

 The main advantage of numpy matrices is that they provide a convenient notation for...

  stackoverflow.com 2 hours ago ^

The main advantage of numpy matrices is that they provide a convenient notation for matrix multiplication: if a and b are matrices, then `a*b` is their matrix product.

Information Source

Collection Time

```
import numpy as np

a=np.mat('4 3; 2 1')
b=np.mat('1 2; 3 4')
print(a)
# [[4 3]
#  [2 1]]
print(b)
# [[1 2]
#  [3 4]]
print(a*b)
```

# Unakite web app

The screenshot shows a web browser window with the title "python - What are the differences?" and the tab "Unakite". The URL is "unakite-v2.firebaseio.com/tasks/67JnWNxIYj2vBObkfPA4?". The main content area displays a task titled "how to represent matrices in python" and a "My Tasks" section.

**Task List:**

- how to represent matrices in python
- Numpy matrices are strictly 2-dimensional, while numpy arrays (ndarrays) are N-dimensional.
- if you want to go to more than 2 dimensions,...
- The main advantage of numpy matrices...

**Snippets:**

- Uncategorized Options Criteria Snippets All Trashed
- Numpy matrices are strictly 2-dimensional, while numpy arrays (ndarrays) are N-dimensional. (stackoverflow.com, 3 hours ago)
- if you want to go to more than 2 dimensions,...
- The main advantage of numpy matrices...

**Showing HTML snapshot** (toggle button)

The main advantage of numpy matrices is that they provide a convenient notation for matrix multiplication: if  $a$  and  $b$  are matrices, then  $a*b$  is their matrix product.

```
import numpy as np

a=np.mat('4 3; 2 1')
b=np.mat('1 2; 3 4')
print(a)
# [[4 3]
# [2 1]]
print(b)
# [[1 2]
# [3 4]]
print(a*b)
```

**Table (Created On September 24, 2019 1:32 PM)**

	Add A Column	Add A Row
support N-dimensions stackoverflow.com 3 hours ago	convenient notation for matrix multiplication stackoverflow.com 3 hours ago	have loi ...
numpy ndarrays stackoverflow.com 3 hours ago		
Numpy matrices stackoverflow.com 3 hours ago		
python list Created 3 hours ago		

**Table (Created on September 24, 2019 1:32 PM)**

**Row 1:**

- support N-dimensions  
stackoverflow.com 3 hours ago
- convenient notation for matrix multiplication  
stackoverflow.com 3 hours ago
- have loi  
...

**Row 2:**

- numpy ndarrays  
stackoverflow.com 3 hours ago
- 
- 

**Row 3:**

- Numpy matrices  
stackoverflow.com 3 hours ago
- 
- 

**Row 4:**

- python list  
Created 3 hours ago
- 
- 

**Details for Numpy matrices row:**

- Numpy matrices are strictly 2-dimensional, while numpy arrays (ndarrays) are N-dimensional.  
stackoverflow.com 3 hours ago
- 
- 

**Comment for Numpy matrices row:**

Michael Updated 19 minutes ago  
if you want to go to more than 2 dimensions, array is the way to go!

**Add a comment:**

# Study 1: Authoring

- Goal: Evaluate the **usability** and **effectiveness** of Unakite.
- Tasks: Collect information from Stack Overflow pages and organize them into comparison tables.
- Between-subjects design: The control group used Google Doc to make tables, while the experimental group used Unakite.

# Study 1: Authoring

- Recruited 20 participants (13 w/ professional experience, 7 students), each completed two tasks in the same condition.
- After the initial two tasks, all participants then used Unakite for a programming task they were trying to solve in real-life.

# Study 1: Results - Unakite is usable!

- All participants are able to use the various Unakite feature.
- On average, participants collected 3 options, 4 criteria, 16 snippets, and made 12 ratings.

	Availability of Learning Resources	Popularity	Ease of Integration (with Other Libraries)	Core Features	Usability
React					
Angular					
Vue					
EmberJS					

Participant P13's comparison table capturing the trade-offs in choosing JavaScript front-end frameworks.

P5 Cloud Computing Service Comparisons

+ Table (Created 0... X)

	Deployment	Downtime	Geographic availability	Database support	Control over scaling	Amount of configuration to do (i.e. PaaS vs not)	Pricing
Heroku	+		+	-	+	+	-
Amazon EC2		+		-	-	-	-
Google Cloud	+	+	+	+		+	+
AWS Beanstalk	-	+	+	-	+	-	-
Azure						+	+

Trade-offs in choosing cloud computing service comparisons. (P5)

P18 Hybrid app development framework

+ Table (Created 0... X)

	Performance	Deployment	customized UI design	dynamic framework	efficiency	Documentation	Programming Language
React Native	-	-	-	+	+	-	Javascript
Flutter	+	+	+	+	-	+	Dart

Trade-offs in choosing hybrid app development framework. (P18)

# Study 1: Results - Unakite is more efficient!

- Overhead cost: the percentage of the time spent on directly using tool features
  - Google Doc: copy-pasting, formatting, maintaining table, etc.
  - Unakite: selecting (snapshot), drag & drop, etc.

Unakite (25%) v.s. Google Doc (44%)  
( $p < 0.01$ )

# Study 2: Understanding

- Goal: Evaluate developers' ability to **understand** the trade-offs and decisions with Unakite
- Tasks: Explain code decisions made by a previous developer
- 16 participants (9 w/ professional experience, 7 students), within-subjects design, each completed one task in each condition

# Study 2: Understanding

A screenshot of a web-based task management application. The title bar says "how to represent matrices in python". The main area shows a table titled "Table (created on September 24, 2019 1:32 PM)". The table has three columns: "Add A Column", "support N-dimensions", and "convenient notation for matrix multiplication". There are four rows: "numpy ndarrays", "Numpy matrices", "python list", and another "Numpy matrices" row. Each row contains a snippet from Stack Overflow and a comment from Michael. The code snippets show how to multiply matrices using np.mat and np.array.

Add A Column	support N-dimensions	convenient notation for matrix multiplication
numpy ndarrays	support N-dimensions	convenient notation for matrix multiplication
Numpy matrices	Numpy matrices	python list
Numpy matrices	Numpy matrices	Numpy matrices

```
import numpy as np
a=np.mat('4 3; 2 1')
b=np.mat('1 2; 3 4')
print(a)
# [[4 3]
# [2 1]]
print(b)
# [[1 2]
# [3 4]]
print(a*b)
# [[13 20]
# [5 8]]
```

Unakite condition:  
explore pre-made comparison table

A screenshot of a web browser displaying a comparison table. The table has three columns: "Add A Column", "support N-dimensions", and "convenient notation for matrix multiplication". There are four rows: "numpy ndarrays", "Numpy matrices", "python list", and another "Numpy matrices" row. Each row contains a snippet from Stack Overflow and a comment from Michael. The code snippets show how to multiply matrices using np.mat and np.array.

Add A Column	support N-dimensions	convenient notation for matrix multiplication
numpy ndarrays	support N-dimensions	convenient notation for matrix multiplication
Numpy matrices	Numpy matrices	python list
Numpy matrices	Numpy matrices	Numpy matrices

```
import numpy as np
a=np.mat('4 3; 2 1')
b=np.mat('1 2; 3 4')
print(a)
# [[4 3]
# [2 1]]
print(b)
# [[1 2]
# [3 4]]
print(a*b)
# [[13 20]
# [5 8]]
```

Control condition:  
read *the same set of web resources*

# Study 2: Result - Understanding decisions with Unakite is faster!

The screenshot shows the Unakite interface with a table titled "Table (Created on September 24, 2019 1:32 PM)". The table contains several rows of code snippets from Stack Overflow, each with a "like" button. The snippets include:

- "Numpy matrices are strictly 2-dimensional, while numpy arrays (ndarrays) are N-dimensional." (3 likes)
- "The main advantage of numpy matrix..." (1 like)
- "numpy ndarrays" (1 like)
- "Numpy matrices" (1 like)
- "python list" (1 like)

On the left, there is a sidebar with a snippet of Python code:

```
import numpy as np
a=np.mat('4 3; 2 1')
b=np.mat('1 2; 3 4')
print(a)
# [[4 3]
# [2 1]]
print(b)
# [[1 2]
# [3 4]]
print(a*b)
# [[13 20]
# [5 8]]
```

115 seconds (about 2 min)

The screenshot shows a Stack Overflow post on the SciPy.org website. The post has 366 upvotes. The text reads:

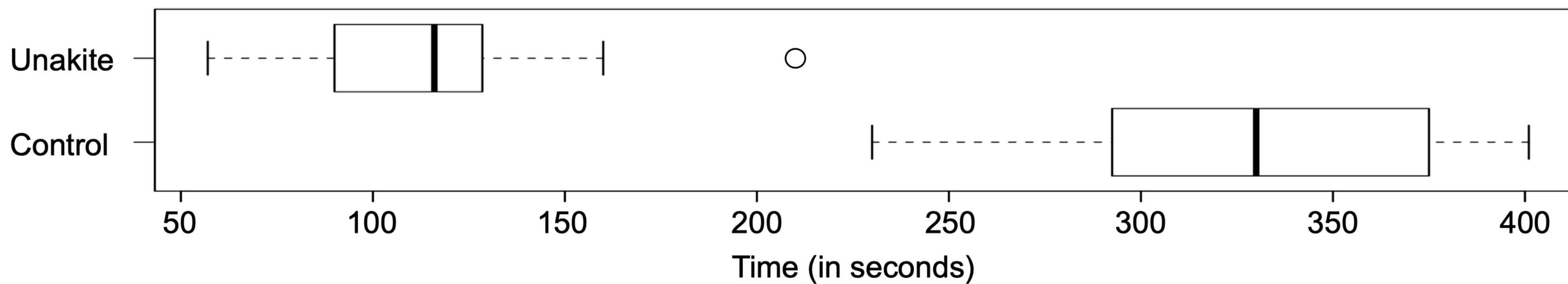
Numpy matrices are strictly 2-dimensional, while numpy arrays (ndarrays) are N-dimensional. Matrix objects are a subclass of ndarray, so they inherit all the attributes and methods of ndarrays.

The main advantage of numpy matrices is that they provide a convenient notation for matrix multiplication: if a and b are matrices, then a\*b is their matrix product.

Below the text is a snippet of Python code:

```
import numpy as np
a=np.mat('4 3; 2 1')
b=np.mat('1 2; 3 4')
print(a)
# [[4 3]
# [2 1]]
print(b)
# [[1 2]
# [3 4]]
print(a*b)
# [[13 20]
# [5 8]]
```

332 seconds (about 5 min 30 sec)



CSCW 2021

# Strata: A Framework and System for Evaluating and Reusing Summarized Knowledge



Best paper (top 1%)

Michael Xieyang Liu, Aniket Kittur, Brad A. Myers



**S**idebar **t**owards **r**euse and to **a**ssess **t**rustworthiness and **a**pplicability

Foraging

Structuring

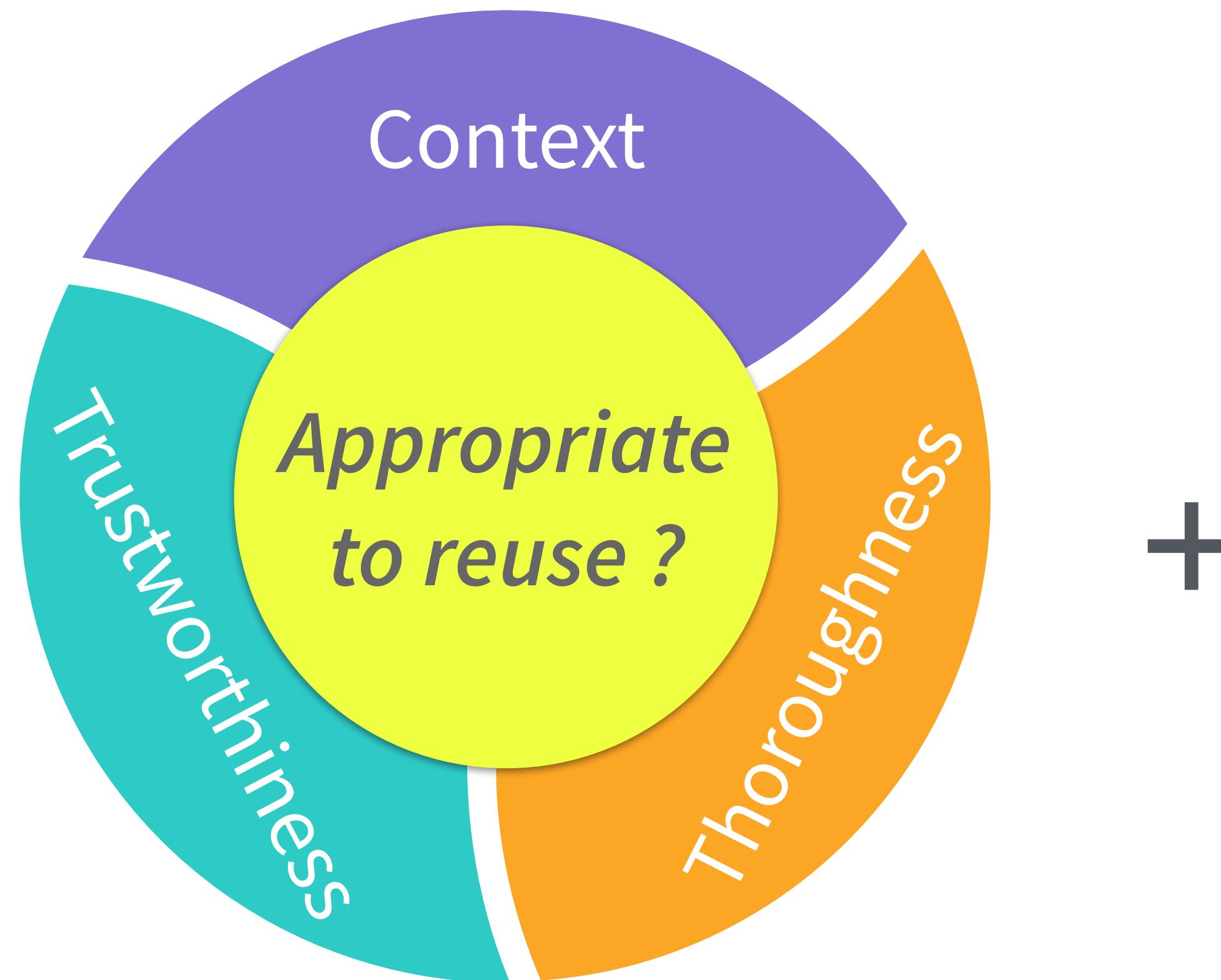
Transfer

# Key challenge: appropriate to reuse?

choosing a python data structure to hold matrix-like data

	more convenient	faster	less memory wastage or shortage
Add A Column			
Add A Row			
Numpy ndarray	 perhaps the main advantage of matrix was that it provided ...	 speed test between matrix and array	 consumes less memory   There is a chance of memory wastage or shortage
numpy matrix	 perhaps the main advantage of matrix was that it provided ...	 arrays are faster than matrix	
List	 convenient to use		 consumes less memory

# Our approach: framework + system



+

choosing a python data structure to hold matrix-like data		
Add A Column	more convenient	faster
Numpy ndarray	perhaps the main advantage of matrix was that it provided ...	speed test between matrix and array
numpy matrix	perhaps the main advantage of matrix was that it provided ...	arrays are faster than matrix
List	convenient to use	consumes less memory

Original Unakite table

Framework

Strata system

# Generating **framework** that guides knowledge reuse

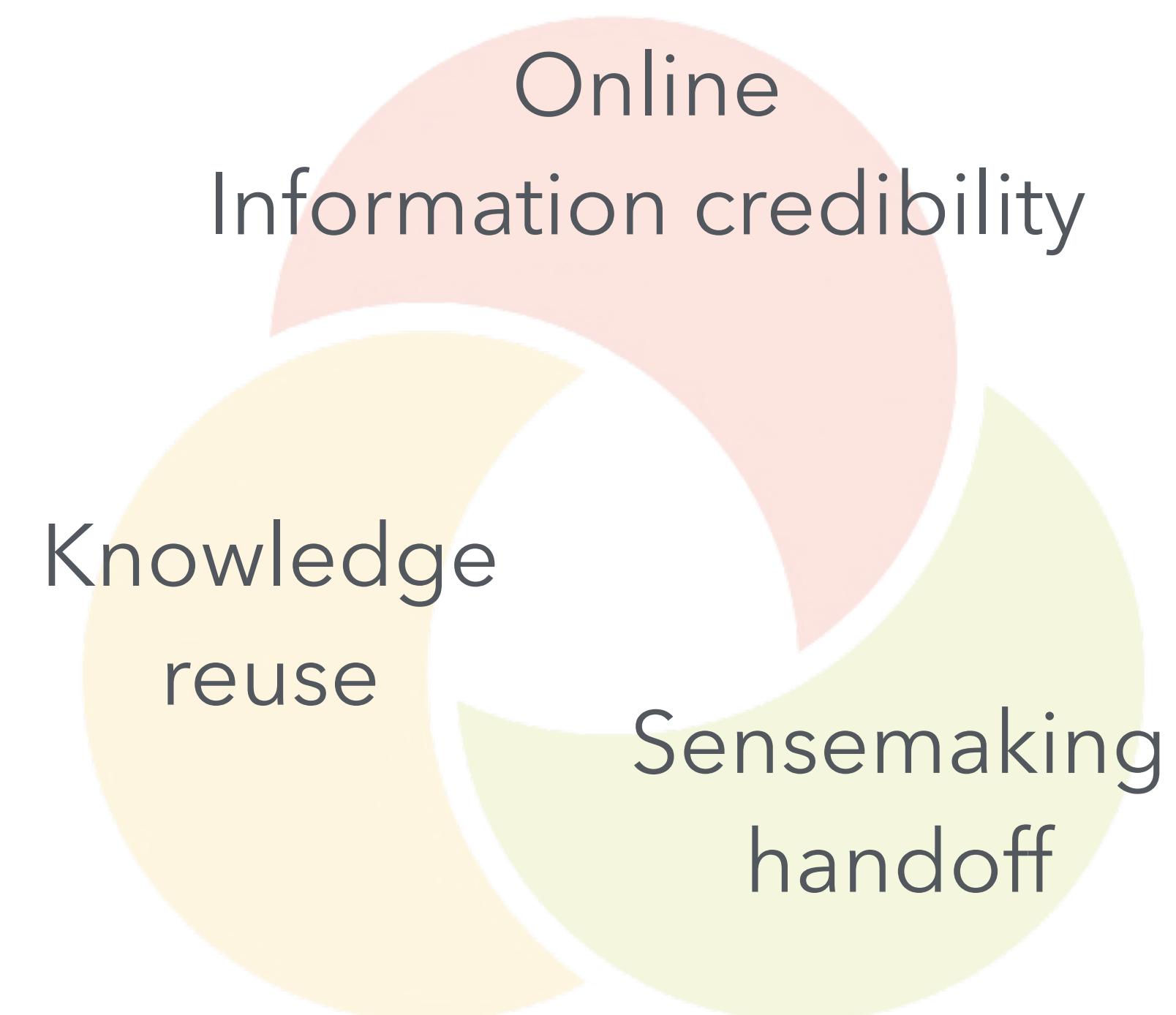
## Exploratory Interviews



N = 15,  
with developers



## Literature Review



# Framework

## Context

Goals of the original decision

Contextualization of information

Situational awareness

## Trustworthiness

Source credibility and diversity

Information up-to-dateness

Information popularity

Information consistency

Author credibility

## Thoroughness

Research process and effort

Alternatives or competitors

Usable artifacts

## Context

Goals of the original decision [23, 92, 100, 101, 111, 126]

Contextualization of information [43, 83, 85, 118]

Situational awareness [17, 33, 92, 93, 100, 109, 111]

## Trustworthiness

*"This looks like it's trying to pick a speech recognition API, but what I want is actually text to speech."*

*"What does this 'very efficient' mean, is it 'memory' or 'time' efficient?"*

*"I'm using Python 2.7 at the moment, which is fairly old, does this example also use this version?"*

## Thoroughness

## Context

## Trustworthiness

## Thoroughness

Source credibility and diversity [35, 39, 43, 87, 108, 118]

Information up-to-dateness [15, 26, 87]

Information popularity [86, 108]

Information consistency [86, 87]

Author credibility [35, 65, 108, 113, 116]

*"If it's from Stack Overflow, I'm usually fine with it. But if it's from some random blog posts written by some random guy, I would think twice."*

*"Is this speed comparison [between React, Angular, and Vue] up-to-date now that Angular 9 was just released?"*

## Context

Research process and effort [100, 101, 109, 131]

Alternatives or competitors [35, 87]

Usable artifacts [27, 97, 102]

## Trustworthiness

*"How much effort was put into making this decision?" | "What did the author focus on?"*

*"I heard anecdotally that Svelte gives you much better performance than all these big (JavaScript) frameworks [React, Angular, and Vue]. I should take a look at that before I decide."*

*"[Are there] any code snippets that I can immediately plug into mine and test?"*

## Thoroughness

## choosing a python data structure to hold matrix-like data

Add A Column	more convenient	faster	less memory wastage or shortage
Add A Row	 Numpy ndarray	 perhaps the main advantage of matrix was that it provided ...	 speed test between matrix and array  There is a chance of memory wastage or shortage
	 numpy matrix	 perhaps the main advantage of matrix was that it provided ...	 arrays are faster than matrix
	 List	 convenient to use	 consumes less memory

# Strata system – extracting signals for reuse

The diagram illustrates the Strata system's process for extracting signals for reuse from a Stack Overflow post. It shows three main components:

- Source domain:** A screenshot of a Stack Overflow question page titled "numpy np.array versus np.matrix (performance)". The page includes navigation links for "About", "Products", and "For Teams".
- # of up-votes:** An arrow points to the up-vote count of 5 on the question page.
- Libraries, languages & versions:** An arrow points to the "Versions used" section, which lists "Numpy: 1.7.1", "IPython: 0.13.2", and "Python: 2.7".
- Timestamps:** An arrow points to the timestamp "Asked 8 years, 4 months ago" and "Active 1 year, 6 months ago".
- Example code:** An arrow points to the code snippets in the answers, specifically the IPython timing output.

Annotations with red boxes highlight specific elements:

- The Stack Overflow logo and the question title are highlighted.
- The up-vote count (5) is highlighted.
- The "Versions used" section is highlighted.
- The timestamp and active status are highlighted.
- The code snippets in the answers are highlighted.
- The "Share", "Improve this answer", and "Follow" buttons at the bottom of the post are highlighted.
- The "Community Bot" and user statistics (24.1k, 20, 95, 149) at the bottom right are highlighted.

Text annotations include:

- "Source domain"
- "# of up-votes"
- "Libraries, languages & versions"
- "Timestamps"
- "Example code"

Code snippets from the post:

```
In [1]: import numpy as np
In [2]: %timeit
...: v = np.matrix([1, 2, 3, 4])
100000 loops, best of 3: 16.9 us per loop

In [3]: %timeit
...: w = np.array([1, 2, 3, 4])
100000 loops, best of 3: 7.54 us per loop
```

# Strata system – augmenting Unakite tables

Strata

Context Trustworthiness Thoroughness

Search Queries

The searches that the author made:

	Sort by: timestamp duration number of snippets
G numpy array vs numpy matrix	5 snippets
G numpy array vs python list	3 snippets
G python matrix data structure advantages and disadvantages	2 snippets
G python matrix data structure	2 snippets
G numpy matrix memory usage	0 snippets
G numpy array and python list	0 snippets

Languages, Frameworks & Platforms

Languages

Python v2.7	Add
-------------	-----

Libraries & Frameworks

Numpy v1.7.1
--------------

Platforms

Not able to detect any platform information from the snippets.

Snippet Surroundings

Check out surroundings of snippets to better understand what they mean.

choosing a python data structure to hold matrix-like data

Add A Column	more convenient	faster	less memory wastage or shortage
<b>Numpy ndarray</b>	perhaps the main advantage of matrix was that it provided ...	speed test between matrix and array	consumes less memory There is a chance of memory wastage or shortage
<b>numpy matrix</b>	perhaps the main advantage of matrix was that it provided ...	arrays are faster than matrix	
<b>List</b>	convenient to use		consumes less memory

# Context panel

Strata

Context	Trustworthiness	Thoroughness
<b>Search Queries</b> The searches that the author made: Sort by: timestamp duration number of snippets		
<ul style="list-style-type: none"><li>⌚ numpy array vs numpy matrix 5 snippets</li><li>⌚ numpy array vs python list 3 snippets</li><li>⌚ python matrix data structure advantages and disadvantages 2 snippets</li><li>⌚ python matrix data structure 2 snippets</li><li>⌚ numpy matrix memory usage 0 snippets</li><li>⌚ numpy array and python list 0 snippets</li></ul>		
<b>Languages, Frameworks &amp; Platforms</b> Languages Python v2.7 Add Libraries & Frameworks Numpy v1.7.1 Platforms <i>Not able to detect any platform information from the snippets.</i>		
<b>Snippet Surroundings</b> Check out surroundings of snippets to better understand what they mean.		

choosing a python data structure to hold matrix-like data

Add A Column	more convenient	faster	less memory wastage or shortage
Add A Row	<b>Numpy ndarray</b>   perhaps the main advantage of matrix was that it provided ...   speed test between matrix and array   There is a chance of memory wastage or shortage		
	<b>numpy matrix</b>   perhaps the main advantage of matrix was that it provided ...   arrays are faster than matrix		
	<b>List</b>   convenient to use  		   consumes less memory

# Context panel

Content

Search

The search

G num

G num

G pyth

G disa

G pyth

G num

G num

Languages

Python

Libraries

Numpy

Platform

Not able to detect any platform information from the snippets.

Snippet Surroundings

Check out surroundings of snippets to better understand what they mean.

## Search Queries

The searches that the author made:

Sort by: timestamp duration number of snippets

<b>G numpy array vs numpy matrix</b>	5 snippets
<b>G numpy array vs python list</b>	3 snippets
<b>G python matrix data structure advantages and disadvantages</b>	2 snippets
<b>G python matrix data structure</b>	2 snippets
<b>G numpy matrix memory usage</b>	0 snippets
<b>G numpy array and python list</b>	0 snippets

ure to hold matrix-like data

convenient	faster	less memory wastage or shortage
the main advantage of matrix was provided ...	speed test between matrix and array	consumes less memory
the main advantage of matrix was provided ...	arrays are faster than matrix	There is a chance of memory wastage or shortage
ent to use		consumes less memory

# Context panel

The screenshot shows the Context panel interface with several sections and cards:

- Context** (selected tab):
  - Search Queries**: A list of search terms like "numpy array vs num", "numpy array vs py", "python matrix data", etc.
  - Languages, Frameworks**: A list of installed languages/frameworks: Python v2.7, Numpy v1.7.1.
  - Snippet Surroundings**: A section about checking surrounding code.
- Search Results (Top Row):**
  - more convenient**: NumPy is more convenient due to free vector and matrix operations.
  - faster**: NumPy is faster than Python matrices, especially for small structures.
  - less memory wastage or shortage**: There is a chance of memory wastage or shortage.
- Search Results (Bottom Row):**
  - Numpy ndarray**:
    - NumPy Arrays:** Example: perhaps the main advantage of matrix was that it provided ...
    - Output:** speed test between matrix and array
  - 4 years ago numpy matrix**:
    - considerably faster than matrix**: when array/matrices are small, but the difference gets smaller for larger data structures.
    - Small (4x4):** arrays are faster than matrix

# Context panel

# Trustworthiness panel

Context **Trustworthiness** 3 Thoroughness

**Domains** 1 issue

**Credibility** - 1 of the domains is not on the trusted whitelist:  
- [www.techgeekbuzz.com](http://www.techgeekbuzz.com) [add as trusted](#)  
[\[whitelist of trusted domains\]](#)

**Diversity** - Information are from 4 different domains, the most-used one being [stackoverflow.com](#), which is where 58% of the snippets are collected from.

List of source domains

<a href="#">stackoverflow.com</a>	7 snippets
<a href="#">www.geeksforgeeks.org</a>	2 snippets
<a href="#">www.quora.com</a>	2 snippets
<a href="#">www.techgeekbuzz.com</a>	1 snippets

**Evidence Snippets** 2 issues

**Evidence popularity** - 3 evidence snippets received at least 5 up-votes on Stack Overflow.

**Up-to-dateness** - The oldest snippet was updated 4 years ago.

**Evidence consistency** - There is 1 cell with conflicting evidence.

**Task Author**

The Octocat octocat [Edit](#)  
The most popular repo [Spoon-Knife](#) has 10232 ★ and uses [HTML](#).  
</> The author uses [Ruby](#), [CSS](#) the most often.  
[GitHub](#)  
<http://www.github.com/blog>

<b>more convenient</b> <a href="#">stackoverflow.com</a> 231 up votes updated 3 years ago	<b>faster</b> <a href="#">stackoverflow.com</a> 5 up votes accepted answer updated 3 months ago	<b>less memory wastage or shortage</b> <a href="#">www.quora.com</a> updated a year ago
<b>Numpy ndarray</b> <a href="#">www.techgeekbuzz.com</a> updated 13 days ago	perhaps the main advantage of matrix was that it provided ... <a href="#">stackoverflow.com</a> 20 up votes updated 4 years ago	speed test between matrix and array <a href="#">stackoverflow.com</a> 5 up votes accepted answer updated 3 months ago
<b>numpy matrix</b> <a href="#">stackoverflow.com</a> 5 up votes accepted answer updated 3 months ago	perhaps the main advantage of matrix was that it provided ... <a href="#">stackoverflow.com</a> 20 up votes updated 4 years ago	arrays are faster than matrix <a href="#">stackoverflow.com</a> 5 up votes updated 3 years ago
<b>List</b> <a href="#">stackoverflow.com</a> 5 up votes updated 5 years ago	convenient to use <a href="#">www.geeksforgeeks.org</a> updated 17 days ago	consumes less memory <a href="#">www.geeksforgeeks.org</a> updated 2 years ago

# Trustworthiness panel

Context    Trustworthiness **3**    Thoroughness

**Domains**    1 issue

Credibility - 1 of the domains is not on the trusted whitelist:  
- [www.techgeekbuzz.com](#)    [add as trusted](#)

[whitelist of trusted domains]

Diversity - Information are from 4 different domains, the most-used one being [stackoverflow.com](#), which is where 58% of the snippets are collected from.

List of source domains

Domain	Snippets
<a href="#">stackoverflow.com</a>	7 snippets
<a href="#">www.geeksforgeeks.org</a>	2 snippets
<a href="#">www.quora.com</a>	2 snippets
<a href="#">www.techgeekbuzz.com</a>	1 snippets

**Evidence Snippets**    2 issues

Evidence popularity - 3 evidence snippets received at least 5 up-votes on Stack Overflow.

Up-to-dateness - The oldest snippet was updated 4 years ago.

Evidence consistency - There is 1 cell with conflicting evidence.

**Task Author**

The Octocat octocat    [Edit](#)  
The most popular repo [Spoon-Knife](#) has 10233 ★ and uses HTML.  
</> The author uses Ruby, CSS the most often.  
[GitHub](#)  
<http://www.github.com/blog>

[GitHub](#)  
<http://www.github.com/blog>

more convenient	faster	less memory wastage or shortage
<a href="#">stackoverflow.com</a>	<a href="#">stackoverflow.com</a>	<a href="#">www.quora.com</a>
<b>Numpy ndarray</b> <a href="#">www.techgeekbuzz.com</a>	perhaps the main advantage of matrix was that it provided ... <a href="#">stackoverflow.com</a>	consumes less memory <a href="#">www.geeksforgeeks.org</a>
<b>numpy matrix</b> <a href="#">stackoverflow.com</a>	speed test between matrix and array <a href="#">stackoverflow.com</a>	There is a chance of memory wastage or shortage <a href="#">www.quora.com</a>
<b>List</b> <a href="#">stackoverflow.com</a>	arrays are faster than matrix <a href="#">stackoverflow.com</a>	
	convenient to use <a href="#">www.geeksforgeeks.org</a>	consumes less memory <a href="#">www.geeksforgeeks.org</a>

# Trustworthiness panel

Context **Trustworthiness** 3 Thoroughness

**Domains** 1 issue

**Credibility** - 1 of the domains is not on the trusted whitelist:  
- [www.techgeekbuzz.com](http://www.techgeekbuzz.com) [add as trusted](#)  
[\[whitelist of trusted domains\]](#)

**Diversity** - Information are from 4 different domains, the most-used one being [stackoverflow.com](#), which is where 58% of the snippets are collected from.

List of source domains

<a href="#">stackoverflow.com</a>	7 snippets
<a href="#">www.geeksforgeeks.org</a>	2 snippets
<a href="#">www.quora.com</a>	2 snippets
<a href="#">www.techgeekbuzz.com</a>	1 snippets

**Evidence Snippets** 2 issues

**Evidence popularity** - 3 evidence snippets received at least 5 up-votes on Stack Overflow.

**Up-to-dateness** - The oldest snippet was updated 4 years ago.

**Evidence consistency** - There is 1 cell with conflicting evidence.

**Task Author**

The Octocat octocat [Edit](#)  
The most popular repo [Spoon-Knife](#) has 10232 ★ and uses [HTML](#).  
</> The author uses [Ruby](#), [CSS](#) the most often.  
[GitHub](#)  
<http://www.github.com/blog>

<b>more convenient</b> <a href="#">stackoverflow.com</a> 231 up votes updated 3 years ago	<b>faster</b> <a href="#">stackoverflow.com</a> 5 up votes accepted answer updated 3 months ago	<b>less memory wastage or shortage</b> <a href="#">www.quora.com</a> updated a year ago
<b>Numpy ndarray</b> <a href="#">www.techgeekbuzz.com</a> updated 13 days ago	perhaps the main advantage of matrix was that it provided ... <a href="#">stackoverflow.com</a> 20 up votes updated 4 years ago	speed test between matrix and array <a href="#">stackoverflow.com</a> 5 up votes accepted answer updated 3 months ago
<b>numpy matrix</b> <a href="#">stackoverflow.com</a> 5 up votes accepted answer updated 3 months ago	perhaps the main advantage of matrix was that it provided ... <a href="#">stackoverflow.com</a> 20 up votes updated 4 years ago	arrays are faster than matrix <a href="#">stackoverflow.com</a> 5 up votes updated 3 years ago
<b>List</b> <a href="#">stackoverflow.com</a> 5 up votes updated 5 years ago	convenient to use <a href="#">www.geeksforgeeks.org</a> updated 17 days ago	consumes less memory <a href="#">www.geeksforgeeks.org</a> updated 2 years ago

# Trustworthiness panel

Context Trustworthiness <sup>3</sup> Thoroughness

**Domains** 1 issue

Credibility - 1 of the domains is not on the trusted whitelist:  
- [www.techgeekbuzz.com](http://www.techgeekbuzz.com) [add as trusted](#)  
[\[whitelist of trusted domains\]](#)

Diversity - Information are from 4 different domains, the most-used one being [stackoverflow.com](http://stackoverflow.com), which is where 58% of the snippets are collected from.

List of source domains

Domain	Snippets
<a href="http://stackoverflow.com">stackoverflow.com</a>	7 snippets
<a href="http://www.geeksforgeeks.org">www.geeksforgeeks.org</a>	2 snippets
<a href="http://www.quora.com">www.quora.com</a>	2 snippets
<a href="http://www.techgeekbuzz.com">www.techgeekbuzz.com</a>	1 snippets

**Evidence Snippets** 2 issues

Evidence popularity - 3 evidence snippets received at least 5 up-votes on Stack Overflow.

Up-to-dateness - The oldest snippet was updated 4 years ago.

Evidence consistency - There is 1 cell with conflicting evidence.

**Task Author**

The Octocat octocat [Edit](#)  
The most popular repo [Spoon-Knife\\_has](#) 10232 ★ and uses HTML.  
</> The author uses Ruby, CSS the most often.  
[GitHub](#)  
<http://www.github.com/blog>

more convenient  
[stackoverflow.com](http://stackoverflow.com)  
231 up votes  
updated 3 years ago

faster  
[stackoverflow.com](http://stackoverflow.com)  
5 up votes  
accepted answer

less memory wastage or shortage  
[www.quora.com](http://www.quora.com)  
updated a year ago

speed test between matrix and array

**stackoverflow.com**

5 up votes  
accepted answer

updated 3 months ago

Numpy ndarray  
[www.techgeekbuzz.com](http://www.techgeekbuzz.com)  
updated 13 days ago

numpy matrix  
[stackoverflow.com](http://stackoverflow.com)  
5 up votes  
accepted answer  
updated 3 months ago

List  
[stackoverflow.com](http://stackoverflow.com)  
5 up votes  
updated 5 years ago

convenient to use  
[www.geeksforgeeks.org](http://www.geeksforgeeks.org)  
updated 17 days ago

consumes less memory  
[www.geeksforgeeks.org](http://www.geeksforgeeks.org)  
updated 2 years ago

# Trustworthiness panel

Context Trustworthiness <sup>3</sup> Thoroughness

**Domains** 1 issue

Credibility - 1 of the domains is not on the trusted whitelist:  
- [www.techgeekbuzz.com](http://www.techgeekbuzz.com) [add as trusted](#)  
[\[whitelist of trusted domains\]](#)

Diversity - Information are from 4 different domains, the most-used one being [stackoverflow.com](http://stackoverflow.com), which is where 50% of the snippets are collected from.

List of sources:  
[stackoverflow.com](http://stackoverflow.com)  
[www.geeksforgeeks.org](http://www.geeksforgeeks.org)  
[www.quora.com](http://www.quora.com)  
[www.techgeekbuzz.com](http://www.techgeekbuzz.com)

**Evidence Snippets** 2 issues

**Evidence popularity** - 3 evidence snippets received at least 5 up-votes on Stack Overflow.

**Up-to-dateness** - The oldest snippet was updated 4 years ago.

**Evidence consistency** - There is 1 cell with conflicting evidence.

**more convenient**  
[stackoverflow.com](http://stackoverflow.com)  
231 up votes  
updated 3 years ago

**faster**  
[stackoverflow.com](http://stackoverflow.com)  
5 up votes  
accepted answer  
updated 3 months ago

**less memory wastage or shortage**  
[www.quora.com](http://www.quora.com)  
updated a year ago

consumes less memory  
[www.geeksforgeeks.org](http://www.geeksforgeeks.org)  
updated 2 years ago

There is a chance of memory wastage or shortage  
[www.quora.com](http://www.quora.com)  
updated a year ago

arrays are faster than matrix  
[stackoverflow.com](http://stackoverflow.com)  
5 up votes  
updated 3 years ago

convenient to use  
[www.geeksforgeeks.org](http://www.geeksforgeeks.org)  
5 up votes  
updated 17 days ago

consumes less memory  
[www.geeksforgeeks.org](http://www.geeksforgeeks.org)  
updated 2 years ago

The Octocat octocat  
The most popular repo [Spoon-Knife\\_has](#) 10232 ★ and uses HTML.  
</> The author uses Ruby, CSS the most often.  
[GitHub](#)  
<http://www.github.com/blog>

# Trustworthiness panel

Context Trustworthiness <sup>3</sup> Thoroughness

**Domains** 1 issue

Credibility - 1 of the domains is not on the trusted whitelist:  
- [www.techgeekbuzz.com](http://www.techgeekbuzz.com) add as trusted  
[\[whitelist of trusted domains\]](#)

Diversity - Information are from 4 different domains, the most-used one being [stackoverflow.com](#), which is where 58% of the snippets are collected from.

List of source domains

<a href="#">stackoverflow.com</a>	7 snippets
<a href="#">www.geeksforgeeks.org</a>	2 snippets

**Task Author**

**The Octocat** octocat

The most popular repo [Spoon-Knife](#) has 10232 ★ and uses [HTML](#).

</> The author uses [Ruby](#), [CSS](#) the most often.

[GitHub](#)

<http://www.github.com/blog>

more convenient

stackoverflow.com  
231 up votes  
updated 3 years ago

faster

stackoverflow.com  
5 up votes  
accepted answer  
updated 3 months ago

less memory wastage or shortage

www.quora.com  
updated a year ago

consumes less memory

www.geeksforgeeks.org  
updated 2 years ago

There is a chance of memory wastage or shortage

www.quora.com  
updated a year ago

speed test between matrix and array

stackoverflow.com  
5 up votes  
accepted answer  
updated 3 months ago

arrays are faster than matrix

stackoverflow.com  
5 up votes  
updated 3 years ago

consumes less memory

www.geeksforgeeks.org  
updated 2 years ago

# Thoroughness panel

**Context**   **Trustworthiness**   **Thoroughness**

**Research Process** [0 issue]

**Time spent** - The author spent a total of about **an hour** on the task. The task was updated **18 days ago**.

**Information collected** - The author went through **10 pages**, and collected **12 snippets**, of which **3** are options, **3** are criteria, and **6** are evidence snippets.

**Timeline**

- python matrix data structure** 5 minutes
  - Python Matrix 2 minutes
    - Numpy ndarray
  - matrix - How to represent matrices in python - Stack Overflow a minute
    - List
  - python - Matrix data structure - Stack Overflow a minute
    - Python Matrix and Introduction to NumPy - Programiz
- python matrix data structure advantages and disadvantages** 9 minutes
  - Q What are the advantages and dis-advantages of array? - Quora 9 minutes
    - There is a chance of memory wastage or shortage
    - less memory wastage or shortage
- numpy array and python list** (0 pages) a few seconds
- numpy array vs python list** 12 minutes
  - Python Lists VS Numpy Arrays - GeeksforGeeks 2 minutes
    - convenient to use
    - consumes less memory
  - What are the advantages of NumPy over regular Python lists ... 10 minutes
    - more convenient
- numpy array vs numpy matrix** 13 minutes
  - python - numpy np.array versus np.matrix (performance) - Stack Overflow a minute
    - Numpy ndarray
    - speed test between matrix and array
    - faster
  - What are the differences between numpy arrays and matrices ... 10 minutes
    - perhaps the main advantage of matrix was that it provided a convenient notation for matrix multiplication
  - python - numpy np.array versus np.matrix (performance) - Stack Overflow 2 minutes
    - arrays are faster than matrix
- numpy matrix memory usage** (0 pages) a few seconds

more convenient	faster	less memory wastage or shortage
stackoverflow.com	stackoverflow.com	www.quora.com
<b>Numpy ndarray</b> www.techgeekbuzz.com	perhaps the main advantage of matrix was that it provided ... stackoverflow.com	consumes less memory www.geeksforgeeks.org
<b>numpy matrix</b> stackoverflow.com	perhaps the main advantage of matrix was that it provided ... stackoverflow.com	arrays are faster than matrix stackoverflow.com
<b>List</b> stackoverflow.com	convenient to use www.geeksforgeeks.org	consumes less memory www.geeksforgeeks.org

**Commonly Searched for Alternatives**

Developers who searched for options that are in the table also searched for these other alternatives:

- Pandas Dataframe
- Set
- Dictionary
- Tuple
- Numpy Array
- String
- Series

**Code Examples**

The author copied and used the following code:

```
In [1]: import numpy as np
In [2]: %timeit
...: v = np.matrix([1, 2, 3, 4])
100000 loops, best of 3: 16.9 us per loop

In [3]: %timeit
...: w = np.array([1, 2, 3, 4])
100000 loops, best of 3: 7.54 us per loop
```

Other code examples from snippets:

```
In [11]: a = [[1,2,3,4],[5,6,7,8]]
In [12]: aa = np.array(a)
In [13]: ma = np.matrix(a)
```

Numpy ndarray	numpy matrix	List
Commonly searched for alternatives: numpy matrix pandas dataframe python list speed test between matrix and array </> contains code examples	Commonly searched for alternatives: pandas dataframe numpy ndarray python lists set tuple arrays are faster than matrix </> contains code examples	</> contains code examples

# Thoroughness panel

**Timeline**

- G python matrix data structure** 5 minutes
  - Python Matrix 2 minutes
  - Numpy ndarray
  - matrix - How to represent matrices in python - Stack Overflow a minute
  - List
  - python - Matrix data structure - Stack Overflow a minute
  - Python Matrix and Introduction to NumPy - Programiz a minute
- G python matrix data structure advantages and disadvantages** 9 minutes
  - What are the advantages and dis-advantages of array? - Quora 9 minutes
    - There is a chance of memory wastage or shortage
    - less memory wastage or shortage
- G numpy array and python list** (0 pages) a few seconds
- G numpy array vs python list** 12 minutes
  - Python Lists VS Numpy Arrays - GeeksforGeeks 2 minutes
    - convenient to use
    - consumes less memory
  - What are the advantages of NumPy over regular Python lists ... 10 minutes
    - more convenient
- G numpy array vs numpy matrix** 13 minutes
  - python - numpy np.array versus np.matrix (performance) - Stack Overflow a minute
    - numpy matrix
    - speed test between matrix and array
    - faster
  - What are the differences between numpy arrays and matrices ... 10 minutes
    - perhaps the main advantage of matrix was that it provided a convenient notation for matrix multiplication
  - python - numpy np.array versus np.matrix (performance) - Stack Overflow 2 minutes
    - arrays are faster than matrix
- G numpy matrix memory usage** (0 pages) a few seconds

**more convenient**

stackoverflow.com	faster	less memory wastage or shortage
perhaps the main advantage of matrix was that it provided ...	speed test between matrix and array	consumes less memory
arrays are faster than matrix	There is a chance of memory wastage or shortage	www.geeksforgeeks.org
convenient to use	consumes less memory	www.geeksforgeeks.org

**Numpy ndarray**

Commonly searched for alternatives: numpy matrix | pandas dataframe | python list

code:

```
]) per loop
) per loop
```

**numpy matrix**

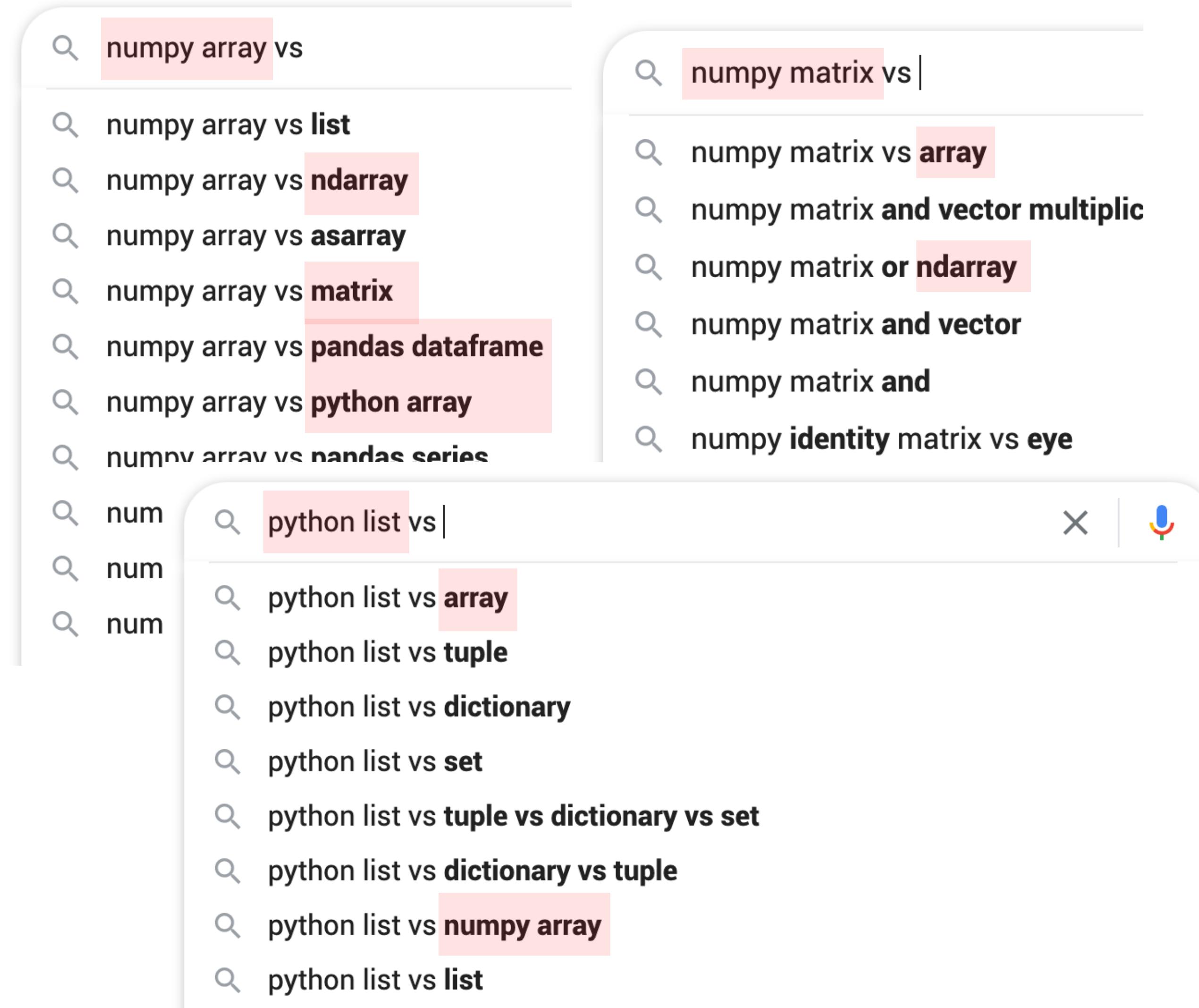
Commonly searched for alternatives: pandas dataframe | numpy ndarray | python lists | set | tuple

**List**

Commonly searched for alternatives: array | set | dictionary | tuple | numpy array | string | series

# Finding alternatives using Google autocomplete

"[option name] vs \_\_\_\_"

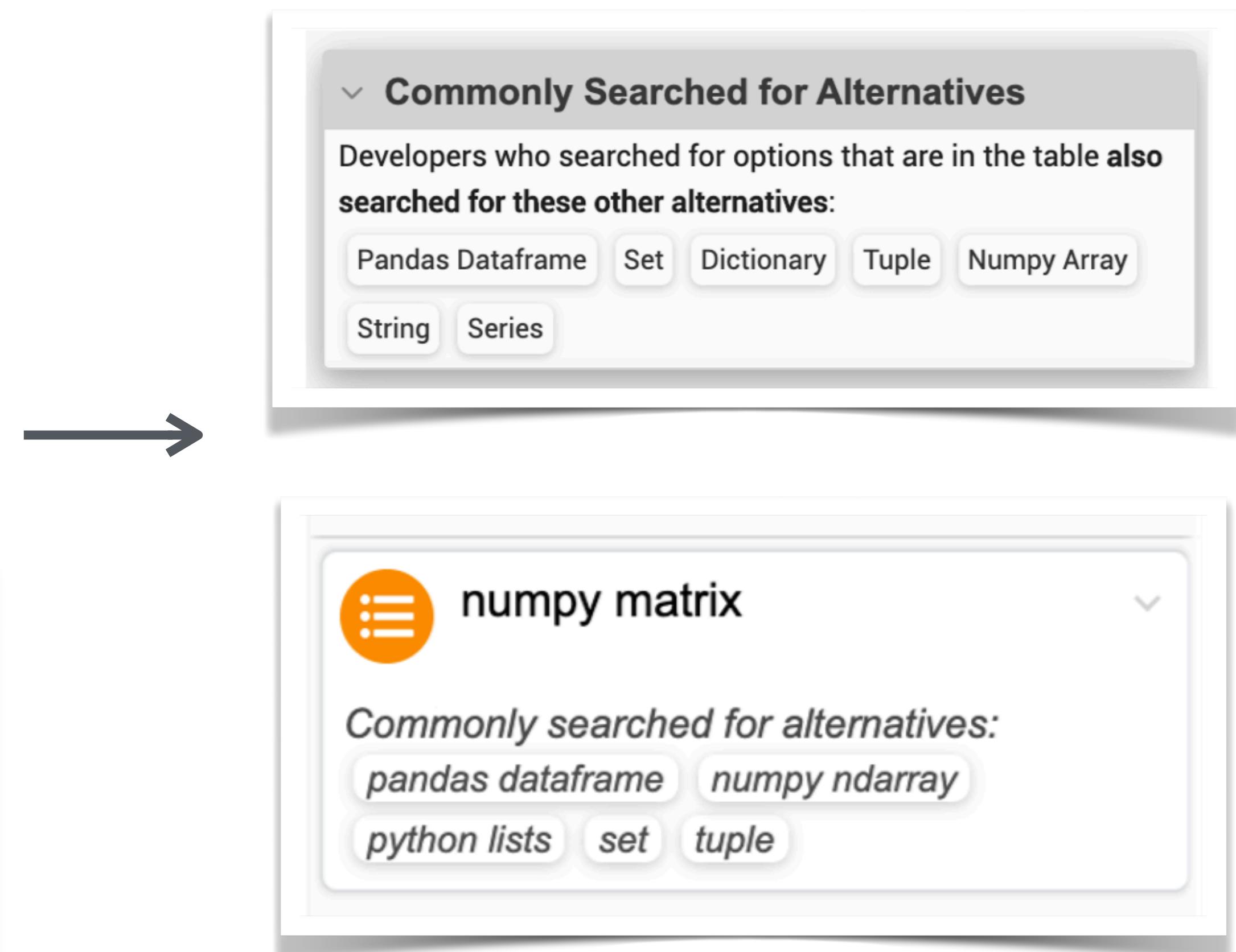


The image shows two Google Autocomplete dropdowns. The first dropdown, for "numpy array vs", has suggestions including "numpy array vs list", "numpy array vs ndarray", "numpy array vs asarray", "numpy array vs matrix", "numpy array vs pandas dataframe", "numpy array vs python array", and "numpy array vs pandas series". The second dropdown, for "python list vs", has suggestions including "python list vs array", "python list vs tuple", "python list vs dictionary", "python list vs set", "python list vs tuple vs dictionary vs set", "python list vs dictionary vs tuple", "python list vs numpy array", and "python list vs list". Both dropdowns have a red box highlighting the first suggestion in each list.

- numpy array vs
- numpy array vs list
- numpy array vs ndarray
- numpy array vs asarray
- numpy array vs matrix
- numpy array vs pandas dataframe
- numpy array vs python array
- numpy array vs pandas series

- python list vs
- python list vs array
- python list vs tuple
- python list vs dictionary
- python list vs set
- python list vs tuple vs dictionary vs set
- python list vs dictionary vs tuple
- python list vs numpy array
- python list vs list



The image shows a Google search results page for "numpy matrix vs". On the right, there is a sidebar titled "Commonly Searched for Alternatives" which lists "Pandas Dataframe", "Set", "Dictionary", "Tuple", "Numpy Array", "String", and "Series". Below the sidebar, there is a detailed result for "numpy matrix" with a description: "Commonly searched for alternatives: pandas dataframe numpy ndarray python lists set tuple".

Commonly Searched for Alternatives

Developers who searched for options that are in the table also searched for these other alternatives:

Pandas Dataframe Set Dictionary Tuple Numpy Array  
String Series

**numpy matrix**

Commonly searched for alternatives:

pandas dataframe numpy ndarray  
python lists set tuple

# Thoroughness panel

Context Trustworthiness Thoroughness

Research Process 0 issue

Time spent - The author spent a total of about an hour on the task. The task was updated 18 days ago.

Information collected - The author went through 10 pages, and collected 12 snippets, of which 3 are options, 3 are criteria, and 6 are evidence snippets.

Timeline

- python matrix data structure
- Python Matrix
  - Numpy ndarray
  - matrix - How to represent matrices in Stack Overflow
  - python - Matrix data structure - Stack Overflow
  - Python Matrix and Introduction to NumPy - Programiz
- python matrix data structure advantages and disadvantages
  - What are the advantages and disadvantages of array? - Quora
  - There is a chance of memory wastage or shortage
  - less memory wastage or shortage
- numpy array and python list
- numpy array vs python list
  - Python Lists VS Numpy Arrays - GeeksforGeeks
  - convenient to use
  - consumes less memory
  - What are the advantages of NumPy over regular Python lists ...
  - more convenient
- numpy array vs numpy matrix
  - python - numpy np.array versus np.matrix (performance) - Stack Overflow
  - numpy matrix
  - speed test between matrix and array
  - faster
  - What are the differences between numpy arrays and matrices ...
  - perhaps the main advantage of matrix was that it provided convenient notation for matrix multiplication
  - python - numpy np.array versus np.matrix (performance) - Stack Overflow
  - arrays are faster than matrix
- numpy matrix memory usage

more convenient stackoverflow.com faster stackoverflow.com less memory wastage or shortage www.quora.com

Numpy ndarray www.techgeekbuzz.com

perhaps the main advantage of matrix was that it provided ... stackoverflow.com

speed test between matrix and array stackoverflow.com

consumes less memory www.geeksforgeeks.org

There is a chance of memory wastage or shortage www.quora.com

consumes less memory www.geeksforgeeks.org

Code Examples

The author copied and used the following code:

```
In [1]: import numpy as np
In [2]: %timeit
...: v = np.matrix([1, 2, 3, 4])
100000 loops, best of 3: 16.9 us per loop

In [3]: %timeit
...: w = np.array([1, 2, 3, 4])
100000 loops, best of 3: 7.54 us per loop
```

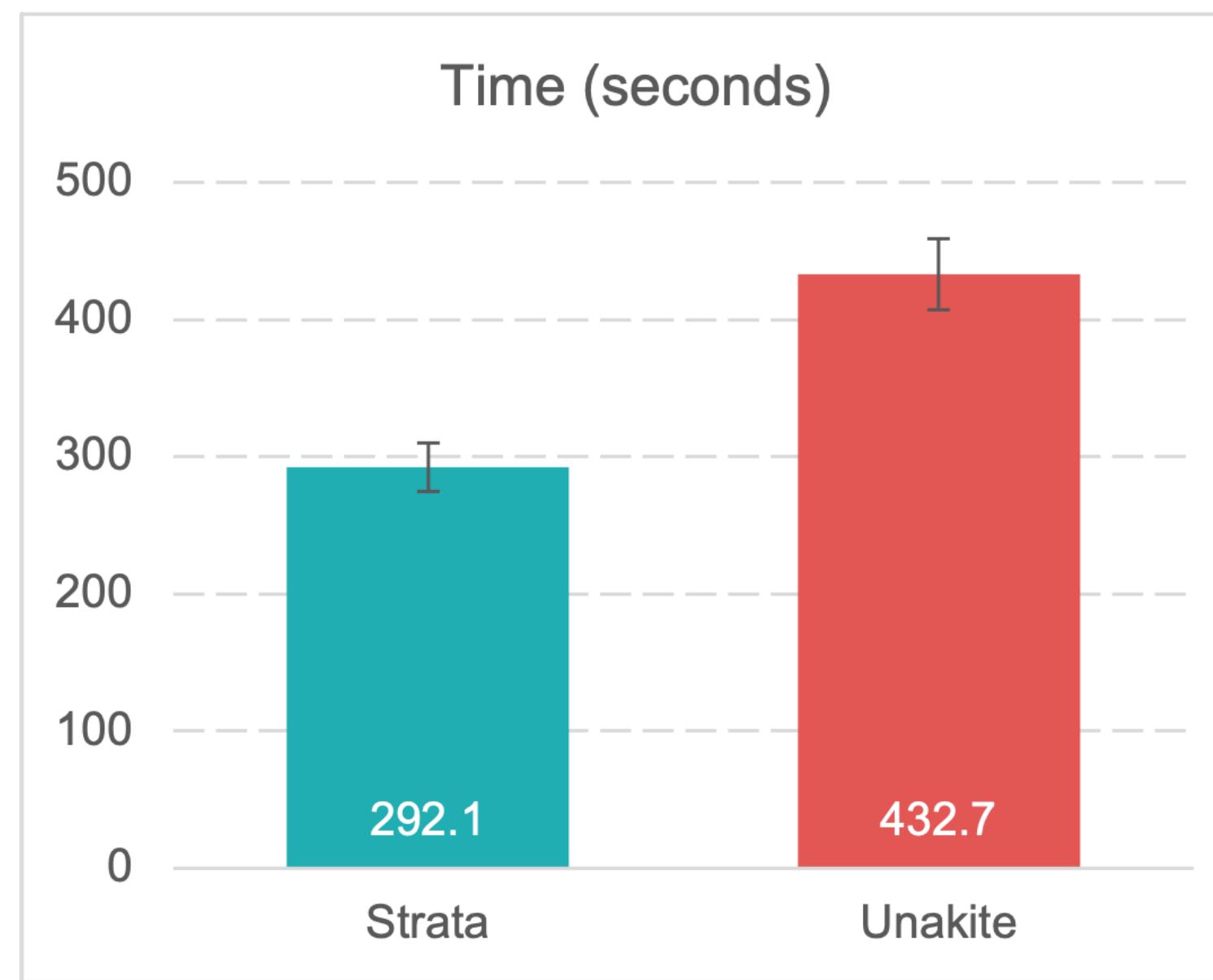
Other code examples from snippets:

```
In [11]: a = [[1,2,3,4],[5,6,7,8]]
In [12]: aa = np.array(a)
In [13]: ma = np.matrix(a)
```

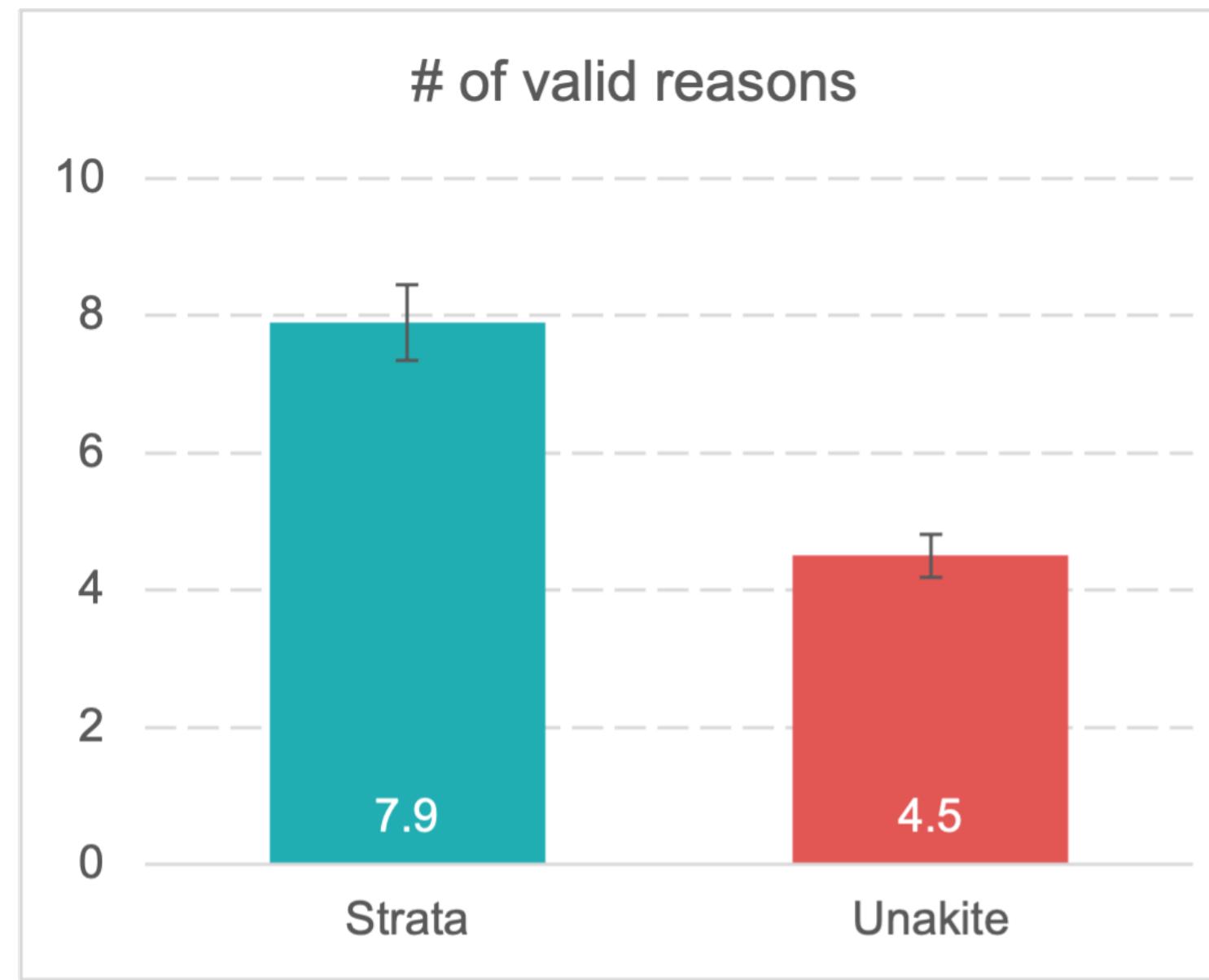
# Lab study – judging whether to reuse decisions

N=20, between-subjects, Unakite as baseline

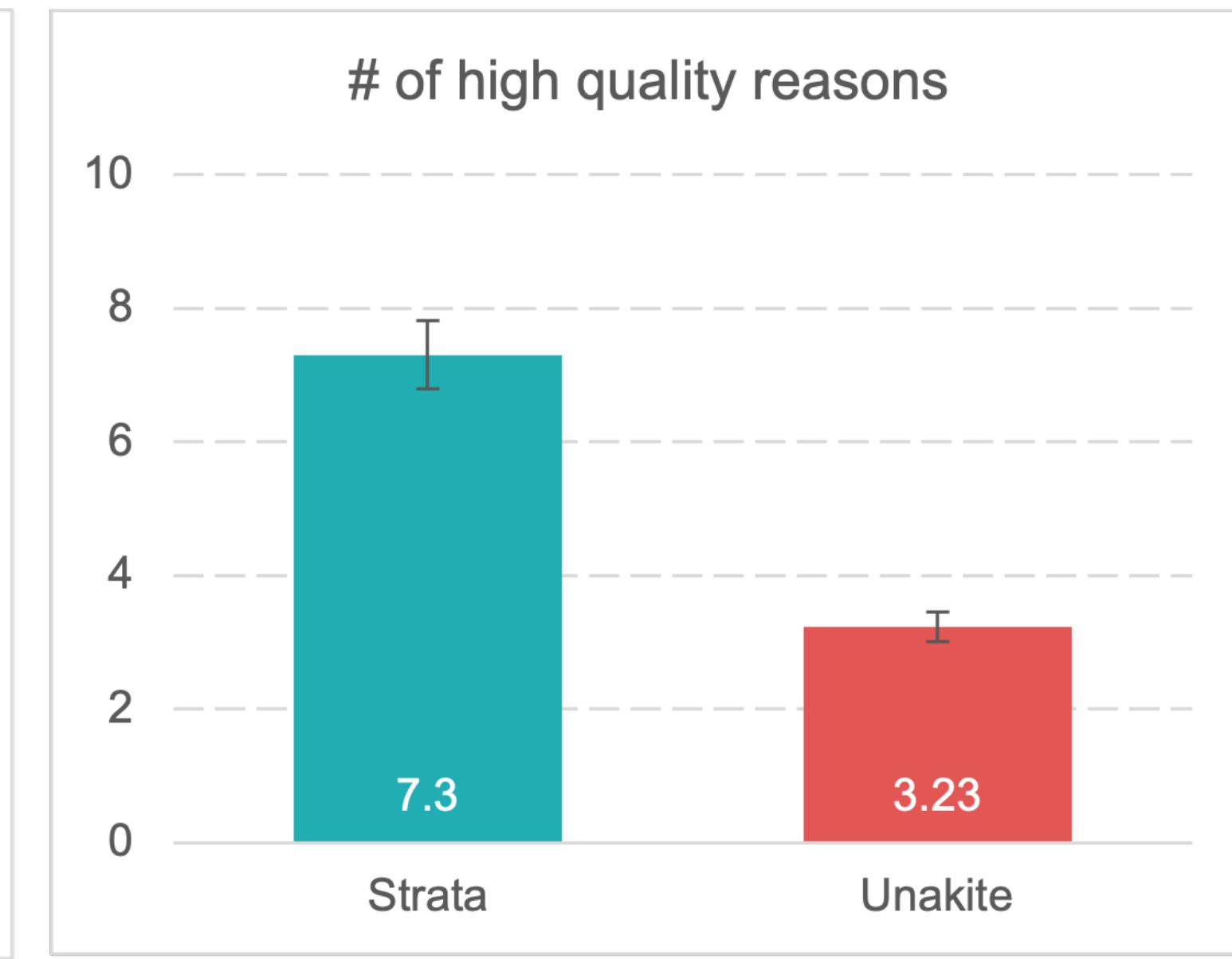
32.5% reduction in time spent



75.6% more valid reasons



126% more high quality reasons



p < 0.05

p < 0.05

p < 0.05

# Lab study – judging whether to reuse decisions

- Framework as guidance

*"serve(d) as a guidance for things that I should pay attention to" -- P8*

- Reminder of appropriateness properties

*"I realize that I'm more of a grab-and-go kinda person and I don't usually remember to check how many up-votes a Stack Overflow answer gets or when it was last updated" -- P17*

# Lab study – judging whether to reuse decisions

- Using Strata when authoring decisions

*"going through the three main aspects is like going through our usual quality checklist, which makes sure that we're not missing anything" -- P6*

*"if my previous browsing sessions are captured by this, then I won't need to make myself available again and again if somebody else suddenly has a question that only I know the answer to, since I made it in the first place--this table thing will almost be self-explanatory" -- P13*

CHI 2022

# Crystalline: Lowering the Cost for Developers to Collect and Organize Information for Decision Making

Michael Xieyang Liu, Aniket Kittur, Brad A. Myers



*Clipping resulting in your structure as tables and lists linked to implicit notetaking easily*

Foraging

Structuring

Transfer

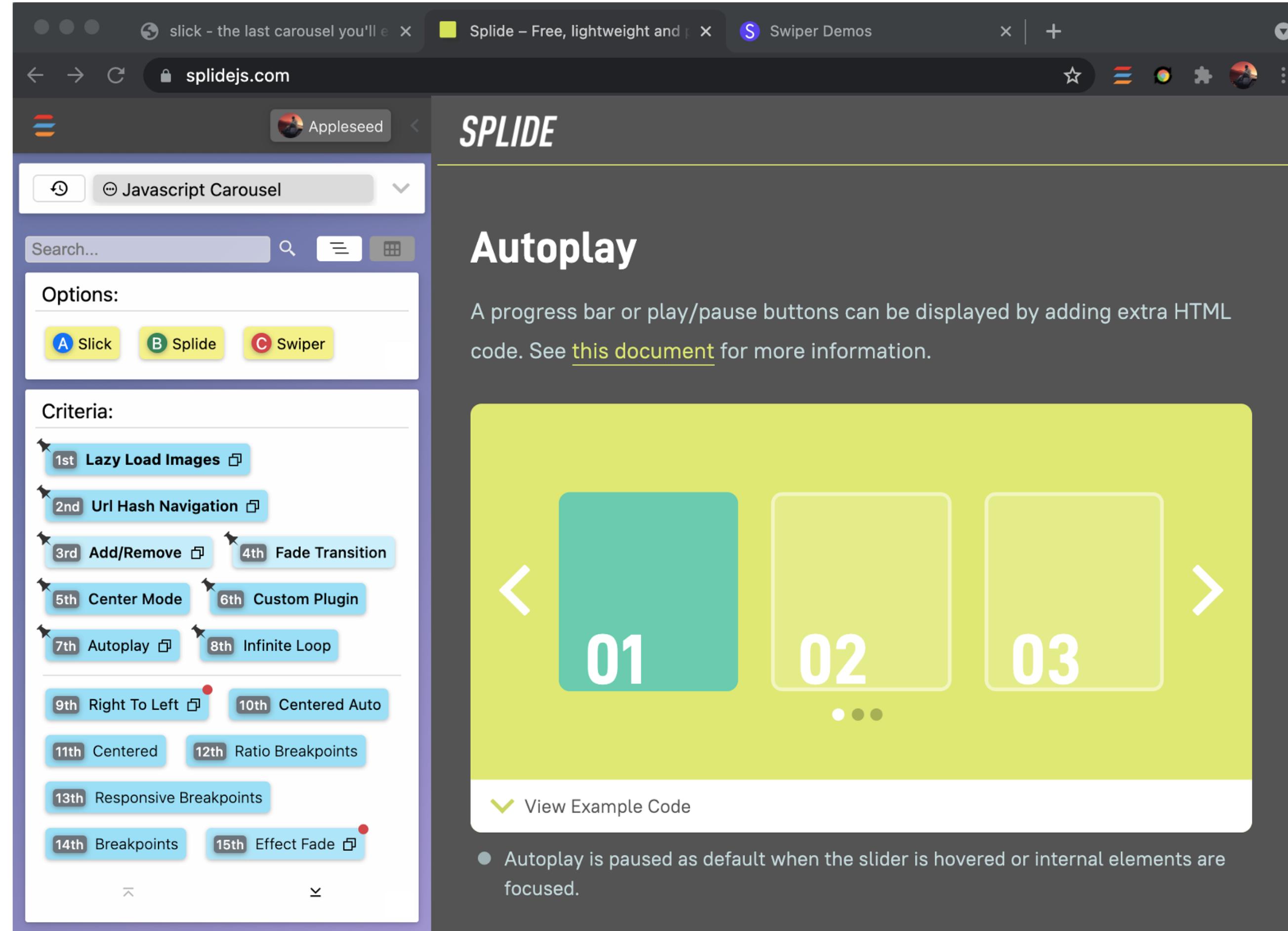
Can we do it **automatically**?

By leveraging:

Machine understanding of  
web content and structure

Implicit signals from  
people's browsing behavior

# Design goals for automatic collection & organization



- Minimize the cost to collect information
- Actively filter, organize, and prioritize information
- Reduce the cost of incorrect automation support

Crystalline



Tribbiani



Home

Documents

日本語



Javascript Carousel

Search...

Options:

Criteria:

History:

javascript carousel

Splide - The lightweight, flexible and accessible slider/carousel

# Splide

Splide is a lightweight, flexible and accessible slider/carousel written in TypeScript. No dependencies, no Lighthouse errors.

[Download](#) [Get Started](#)

[Splide v3 has been released!](#)

## Examples



## User's Guide

[Getting Started](#)

# NLP Heuristics to extract options and criteria

The screenshot shows a browser window with three tabs open:

- react angular vue - Google Search
- Angular vs React vs Vue: Which Framework to Choose in 2022
- Angular vs React vs Vue: Which Framework Is Better? 2022

The main content is from aThemes.com/guides/angular-vs-react-vs-vue/. The page title is "Angular vs React vs Vue 2022". It features a graphic comparing the three frameworks. The left side is red with the Angular logo (A), the right side is dark blue with the Vue.js logo (V), and the middle is white with the React logo (atom symbol). The text below the graphic states: "There are three frameworks for building web applications that every frontend developer has heard about: [React](#), [Vue.js](#), and [Angular](#). React is a UI library, Angular is a fully-fledged front-end framework, while Vue.js is a progressive framework."

**Options:**

- A Vue
- B React
- C Angular

**Criteria:**

- 1st Job Market
- 2nd License
- 3rd Architecture
- 4th Popularity
- 5th Development
- 6th Community
- 7th History
- 8th React In Action
- 9th Advantages Of React

**History:**

- react angular vue
- Angular vs React vs Vue: Which Framework to Choose in 2022
- Angular vs React vs Vue: Which Framework Is Better? 2022
- Vue vs React vs Angular - Best Front-end Javascript Frameworks - Clockwise Software

Words and phrases  
between “vs”

# NLP Heuristics to extract options and criteria

## Part 2: Community and development

Now that you are familiar with the history and recent trends for each of these frameworks, we will look at the community to assess the development of these frameworks. We have already seen that for all of the frameworks, incremental releases have been shipped regularly over the past year, which indicates that development is going on in full swing.

### Size and load times



The sizes of the libraries won't be as big of a factor since caching and minification are pretty standard nowadays. Although there can be a significant difference between the sizes of the frameworks (e.g. Angular is the largest), they are still small as compared to the average webpage size (about 2MB according to the most [recent data](#)). Additionally, if you [use a popular CDN](#) to load these libraries, it is highly probable that a user has the library already loaded in their [local system](#).

...

### Components



Components are integral parts of all three frameworks, no matter if we're talking [Vue](#), [React](#), or [Angular](#). A component generally gets an input, and changes behavior based on it. This behavior change generally manifests as a change in the UI of some part of

	Angular	React	Vue
# Watchers	3.1k	6.7k	6.3k
# Stars	78.4k	180k	218k
# Forks	20.6k	36.5k	35.7k
# Contributors	1,500+	1,500+	400+

Entities in page titles, section headers, and table headers, etc.

javascript carousel - Google Search

Splide - The lightweight, flexible and accessible slider/carousel

slick - the last carousel you'll ever need

Swiper Demos

Crystalline

Tribbiani

Javascript Carousel Javascript

Search...

Options:

A Swiper   B Slick   C Splide

Criteria:

1st Fade Transition   2nd Lazy Load

3rd Multiple Slides   4th Fade

5th Center Mode   6th Autoplay

7th Custom Pagination

8th 1 Slide Per Move   9th Drag Free

10th Slider Progress   11th Vertical Slider

12th Side Padding   13th Default

14th Data Attribute Settings

15th Right To Left

History:

javascript carousel

Splide - The lightweight, flexible and accessible slider/carousel

slick - the last carousel you'll ever need

Swiper Demos

## Side Padding

Code   Preview

## Multiple Slides

Code   Preview

## 1 Slide Per Move

Extension

Transition

Version 3

## Tutorials

Image Slider

Thumbnail Slider

Gallery

Autoplay Toggle

Slider Progress

## Extensions

Auto Scroll

Intersection

Video

Grid

URL Hash Navigation

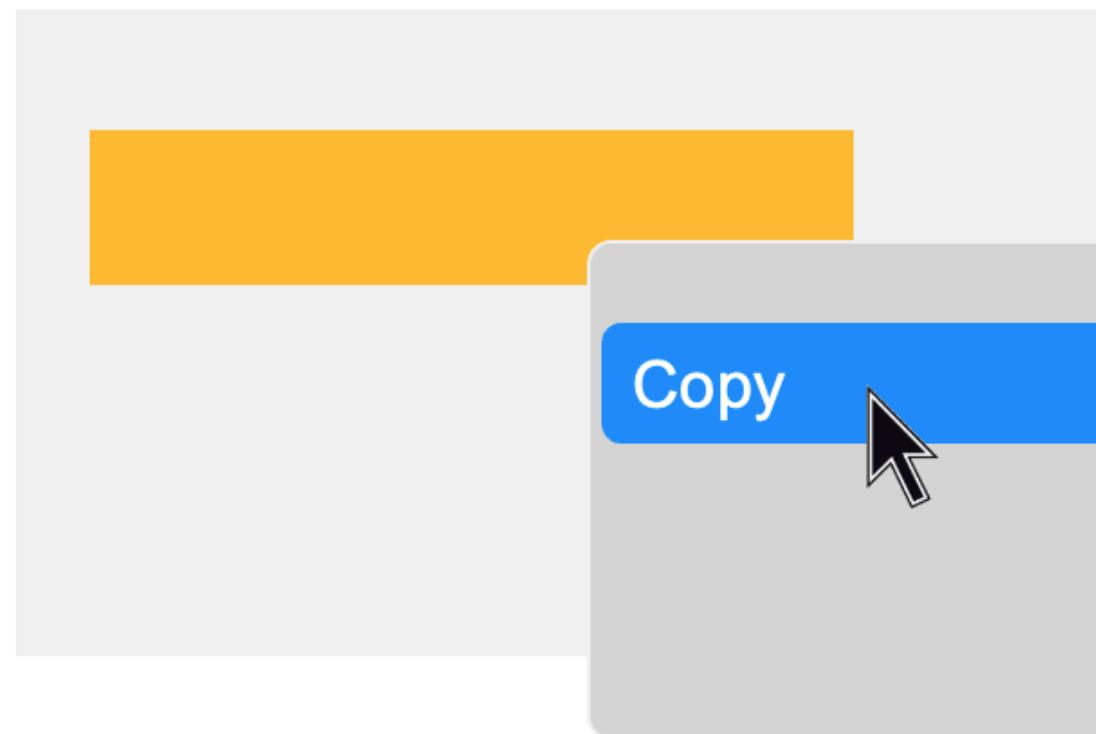
## Integration

React Splide

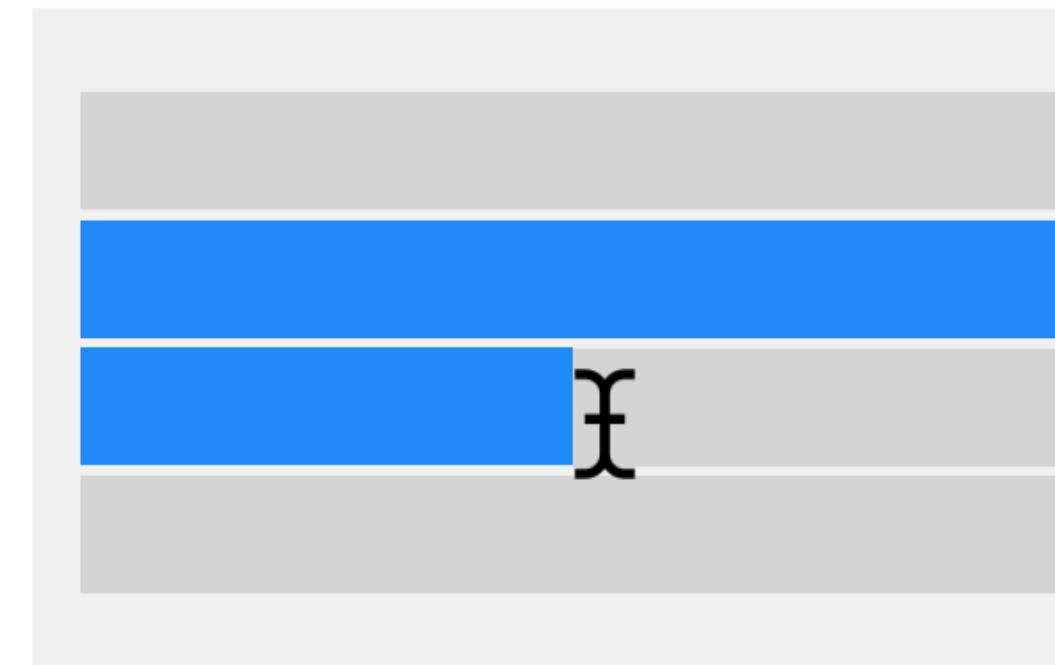
Vue Splide

Svelte Splide

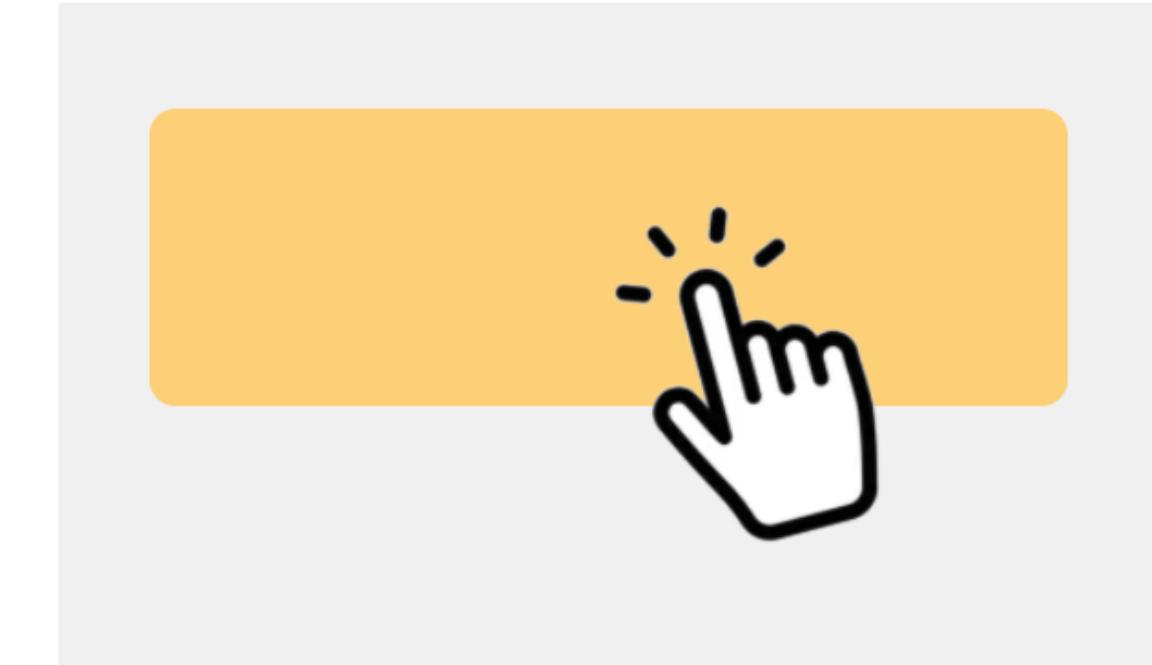
# Implicit behavior signals while browsing



Copying content



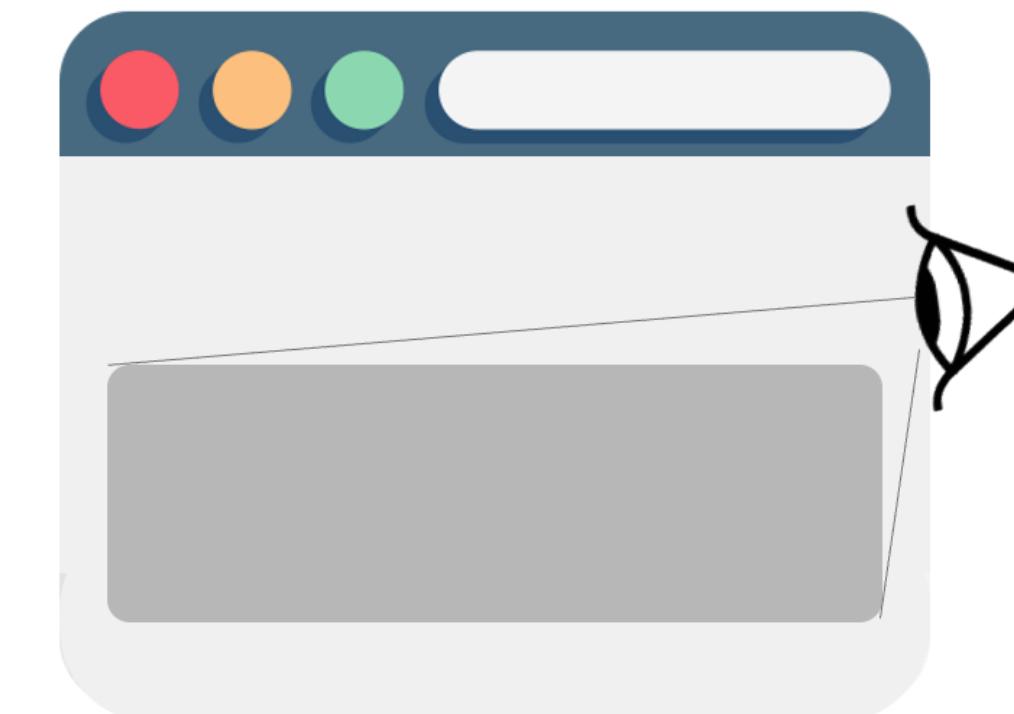
Text highlighting



Clicking



Cursor hovering



Content dwelling

javascript carousel - Google Search | Splide - The lightweight, flexible and accessible slider/carousel | slick - the last carousel you'll ever need | Swiper Demos

swiperjs.com/demos

**Crystalline** Tribbiani

Javascript Carousel Javascript

Search... Options: A Swiper B Slick C Splide

**Criteria:**

- 1st Focus Center
- 2nd Multiple Slides
- 3rd Slides Grid
- 4th Custom Pagination
- 5th Scroll Container
- 6th Centered Auto
- 7th Filtering
- 8th Freemode
- 9th Nested
- 10th Drag Free
- 11th Slides
- 12th Virtual Slides
- 13th Slides Per View
- 14th Watch Slides Visibility
- 15th View Auto

**History:**

- javascript carousel
- Splide - The lightweight, flexible and accessible slider/carousel
- slick - the last carousel you'll ever need
- Swiper Demos

**Sponsors** Become a sponsor

Slide 2

Slide 4

Slide 6

# Nested

Open in new window

Core React Vue Angular Svelte

# Text highlighting

Horizontal Slide 1

Grab cursor

Open in new window

Core React Vue Angular Svelte

Crystalline Tribbiani

Javascript Carousel Javascript

Search...

Options:

A Swiper B Slick C Splide

Criteria:

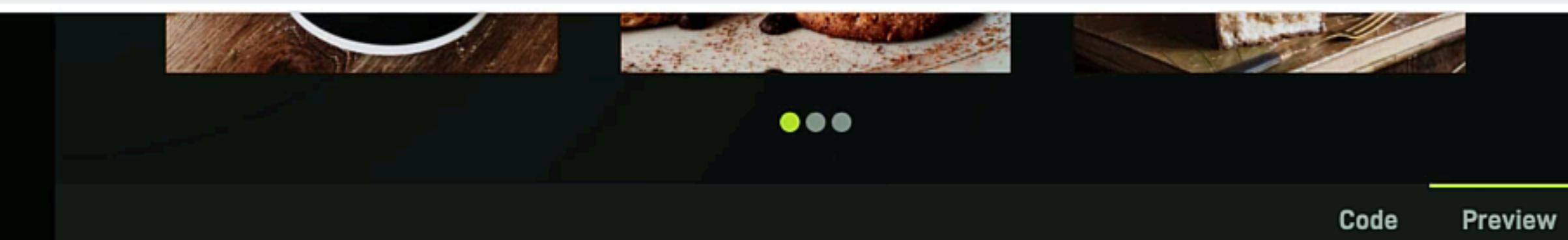
- 1st Grab Cursor
- 2nd Fade Transition
- 3rd Nested
- 4th Add/Remove
- 5th Slides Grid
- 6th Custom Pagination
- 7th Scroll Container
- 8th Thumbnails
- 9th Centered Auto
- 10th Filtering
- 11th Lazy Load
- 12th Freemode
- 13th Drag Free
- 14th Slides
- 15th Virtual Slides



(4)

History:

- javascript carousel
- Splide - The lightweight, flexible and accessible slider/carousel
- slick - the last carousel you'll ever need
- Swiper Demos



Code Preview

## Thumbnails

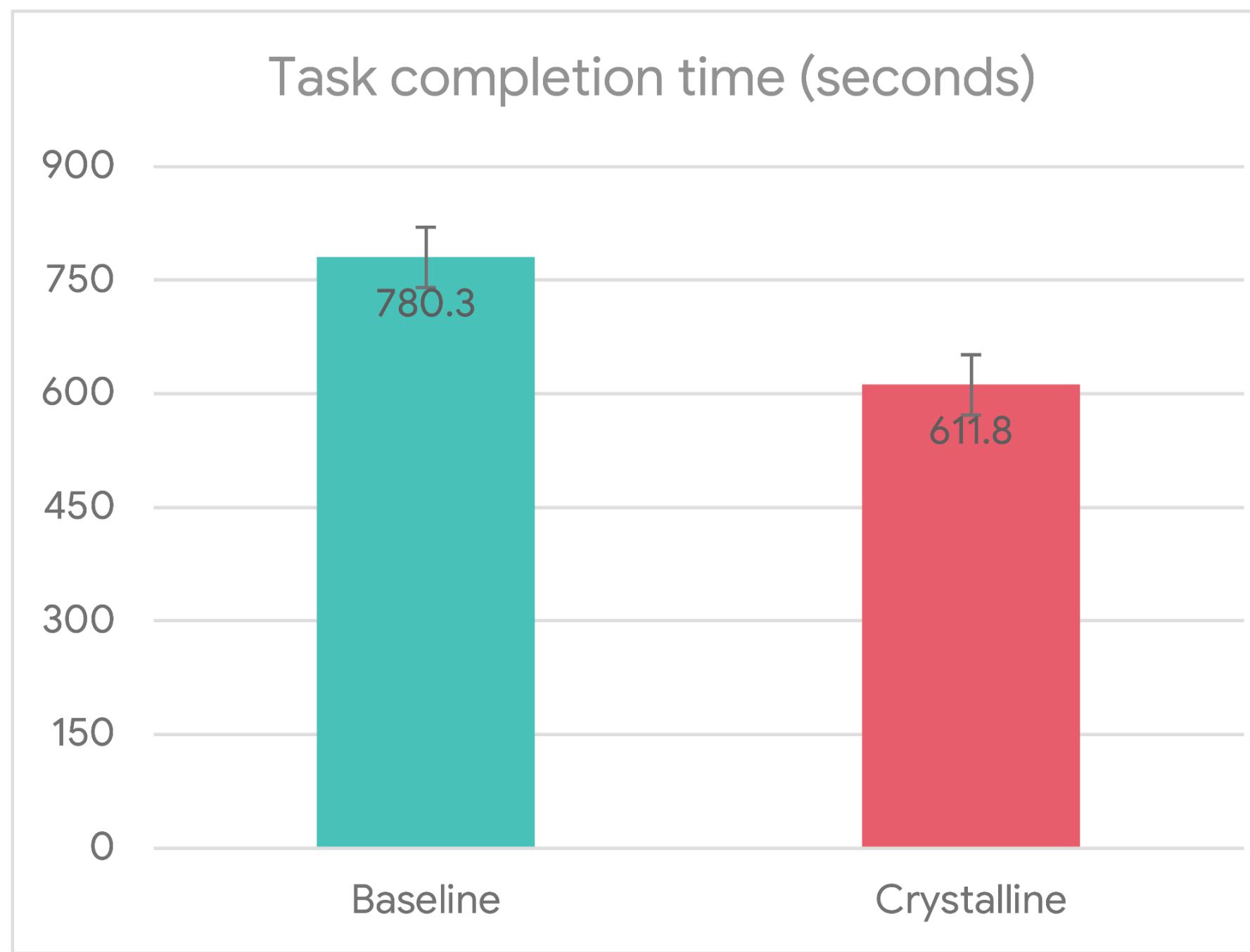
Splide sliders can be synchronized with one another. By utilizing this, you can make a gallery with thumbnails navigation.

The main image shows a close-up of a coffee cup with a latte art heart design on top, sitting on a wooden surface next to a small white container of marshmallows and some greenery. Below the main image is a horizontal row of six smaller thumbnail images, each showing a different food or drink item. On either side of these thumbnails are large, semi-transparent arrows pointing left and right, indicating that clicking on a thumbnail will change the main image.

# Lab study – collecting + organizing information

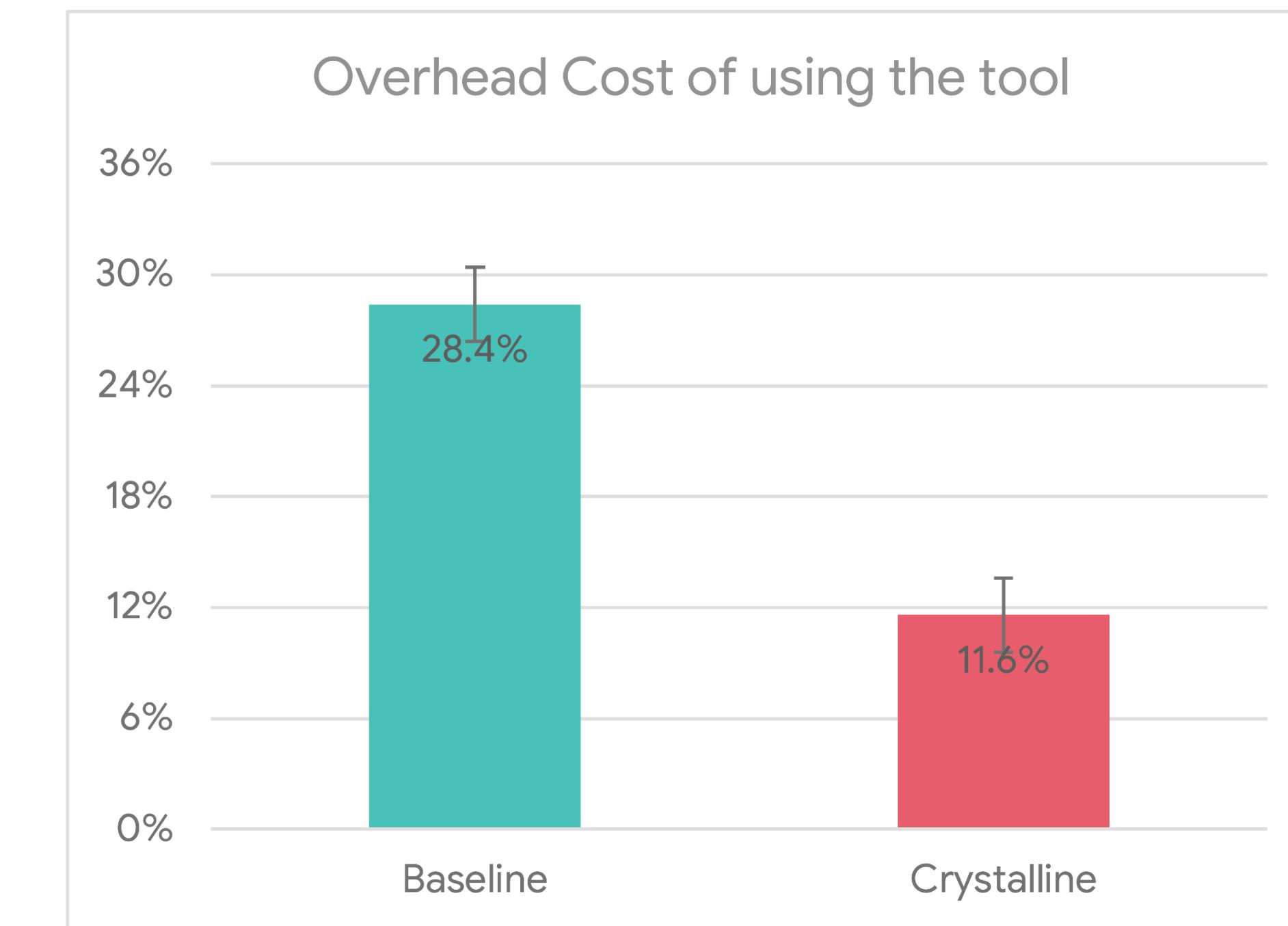
N=12, within-subjects, Unakite as baseline

20% faster



p < 0.05

60% less overhead cost



p < 0.05

# Explanation for lowered overhead cost

	Manually select information and capture	Rename an option / criteria	Delete an option / criteria	Manually put information snippets into the table	Remove a snippet from the table	Merge criteria into groups	Split criteria groups	Pin or reorder criteria	Overall
Task A	27.0 (6.42)	1.67 (1.97)	0.67 (1.03)	16.5 (5.43)	0.50 (0.84)	N/A	N/A	6.00 (2.19)	52.3 (13.7)
Task B	26.2 (5.56)	1.83 (1.60)	1.50 (1.38)	14.5 (5.28)	0.33 (0.82)	N/A	N/A	6.00 (1.79)	50.3 (14.3)
<b>Average</b>	<b>26.6 (5.74)</b>	<b>1.75 (1.71)</b>	<b>1.08 (1.24)</b>	<b>15.5 (5.21)</b>	<b>0.42 (0.79)</b>	<b>N/A</b>	<b>N/A</b>	<b>6.00 (1.91)</b>	<b>51.3 (13.4)</b>
<b>(a) Unakite condition</b>									
	Manually select information and capture	Rename an option / criteria	Delete an option / criteria	Manually put information snippets into the table	Remove a snippet from the table	Merge criteria into groups	Split criteria groups	Pin or reorder criteria	Overall
Task A	0.83 (0.75)	2.17 (1.17)	0.50 (0.84)	0.17 (0.41)	0.33 (0.52)	2.33 (0.82)	0.83 (0.75)	5.33 (1.97)	12.5 (3.02)
Task B	1.00 (1.26)	1.67 (0.82)	0.50 (0.55)	0.33 (0.52)	0.33 (0.52)	1.83 (0.75)	0.67 (0.82)	5.50 (2.74)	11.8 (3.31)
<b>Average</b>	<b>0.92 (1.00)</b>	<b>1.92 (1.00)</b>	<b>0.50 (0.67)</b>	<b>0.25 (0.45)</b>	<b>0.33 (0.49)</b>	<b>2.08 (0.79)</b>	<b>0.75 (0.75)</b>	<b>5.42 (2.27)</b>	<b>12.2 (3.04)</b>
<b>(b) Crystalline condition</b>									

**Table 2: Statistics for the average number of interactions performed by users to perform the tasks in the user study. Standard deviations are included in the parentheses.**

# Explanation for lowered overhead cost

	Manually select information and capture	Rename an option / criteria	Delete an option / criteria	Manually put information snippets into the table	Remove a snippet from the table	Merge criteria into groups	Split criteria groups	Pin or reorder criteria	Overall
Task A	27.0 (6.42)	1.67 (1.97)	0.67 (1.03)	16.5 (5.43)	0.50 (0.84)	N/A	N/A	6.00 (2.19)	52.3 (13.7)
Task B	26.2 (5.56)	1.83 (1.60)	1.50 (1.38)	14.5 (5.28)	0.33 (0.82)	N/A	N/A	6.00 (1.79)	50.3 (14.3)
<b>Average</b>	<b>26.6 (5.74)</b>	<b>1.75 (1.71)</b>	<b>1.08 (1.24)</b>	<b>15.5 (5.21)</b>	<b>0.42 (0.79)</b>	<b>N/A</b>	<b>N/A</b>	<b>6.00 (1.91)</b>	<b>51.3 (13.4)</b>
<b>(a) Unakite condition</b>									
	Manually select information and capture	Rename an option / criteria	Delete an option / criteria	Manually put information snippets into the table	Remove a snippet from the table	Merge criteria into groups	Split criteria groups	Pin or reorder criteria	Overall
Task A	0.83 (0.75)	2.17 (1.17)	0.50 (0.84)	0.17 (0.41)	0.33 (0.52)	2.33 (0.82)	0.83 (0.75)	5.33 (1.97)	12.5 (3.02)
Task B	1.00 (1.26)	1.67 (0.82)	0.50 (0.55)	0.33 (0.52)	0.33 (0.52)	1.83 (0.75)	0.67 (0.82)	5.50 (2.74)	11.8 (3.31)
<b>Average</b>	<b>0.92 (1.00)</b>	<b>1.92 (1.00)</b>	<b>0.50 (0.67)</b>	<b>0.25 (0.45)</b>	<b>0.33 (0.49)</b>	<b>2.08 (0.79)</b>	<b>0.75 (0.75)</b>	<b>5.42 (2.27)</b>	<b>12.2 (3.04)</b>
<b>(b) Crystalline condition</b>									

Table 2: Statistics for the average number of interactions performed by users to perform the tasks in the user study. Standard deviations are included in the parentheses.

Active (manual)  
capturing and organizing → Passive  
monitoring and error-fixing

# Quality of the resulting comparison tables

	Manually select information and capture	Rename an option / criteria	Delete an option / criteria	Manually put information snippets into the table	Remove a snippet from the table	Merge criteria into groups	Split criteria groups	Pin or reorder criteria	Overall
Task A	27.0 (6.42)	1.67 (1.97)	0.67 (1.03)	16.5 (5.43)	0.50 (0.84)	N/A	N/A	6.00 (2.19)	52.3 (13.7)
Task B	26.2 (5.56)	1.83 (1.60)	1.50 (1.38)	14.5 (5.28)	0.33 (0.82)	N/A	N/A	6.00 (1.79)	50.3 (14.3)
<b>Average</b>	<b>26.6 (5.74)</b>	<b>1.75 (1.71)</b>	<b>1.08 (1.24)</b>	<b>15.5 (5.21)</b>	<b>0.42 (0.79)</b>	<b>N/A</b>	<b>N/A</b>	<b>6.00 (1.91)</b>	<b>51.3 (13.4)</b>

(a) Unakite condition

	Manually select information and capture	Rename an option / criteria	Delete an option / criteria	Manually put information snippets into the table	Remove a snippet from the table	Merge criteria into groups	Split criteria groups	Pin or reorder criteria	Overall
Task A	0.83 (0.75)	2.17 (1.17)	0.50 (0.84)	0.17 (0.41)	0.33 (0.52)	2.33 (0.82)	0.83 (0.75)	5.33 (1.97)	12.5 (3.02)
Task B	1.00 (1.26)	1.67 (0.82)	0.50 (0.55)	0.33 (0.52)	0.33 (0.52)	1.83 (0.75)	0.67 (0.82)	5.50 (2.74)	11.8 (3.31)
<b>Average</b>	<b>0.92 (1.00)</b>	<b>1.92 (1.00)</b>	<b>0.50 (0.67)</b>	<b>0.25 (0.45)</b>	<b>0.33 (0.49)</b>	<b>2.08 (0.79)</b>	<b>0.75 (0.75)</b>	<b>5.42 (2.27)</b>	<b>12.2 (3.04)</b>

(b) Crystalline condition

**Table 2: Statistics for the average number of interactions performed by users to perform the tasks in the user study. Standard deviations are included in the parentheses.**

# Qualitative feedback

- Reduced overhead and workload

*"It feels as if I was sitting in the passenger seat and not having to do all the steering and maneuvering." -- P8*

- Working with machine mistakes

*"it felt like a mind reader. I know it's not perfect, but I also don't expect it to be, and would actually prefer occasionally peeking into what it's been doing and fixing whatever that's not correct than just grabbing everything by myself all the time." -- P7*

UIST 2022

# Wigglite: Lightweight Interaction Techniques for Information Collection and Triage

Michael Xieyang Liu, Andrew Kuznetsov, Yongsung Kim,  
Joseph Chee Chang, Aniket Kittur, Brad A. Myers.



**W**iggling for **i**nformation **g**athering and **g**enerating **l**ightweight **i**mpressions for **t**riage and **e**ncoding

Foraging

Structuring

Transfer

## Sony a7 IV Mirrorless Camera

BH #SOA74 • MFR #ILCE-7M4/B | ★★★★★ 378 reviews | 179 Questions, 231 Answers



In Stock

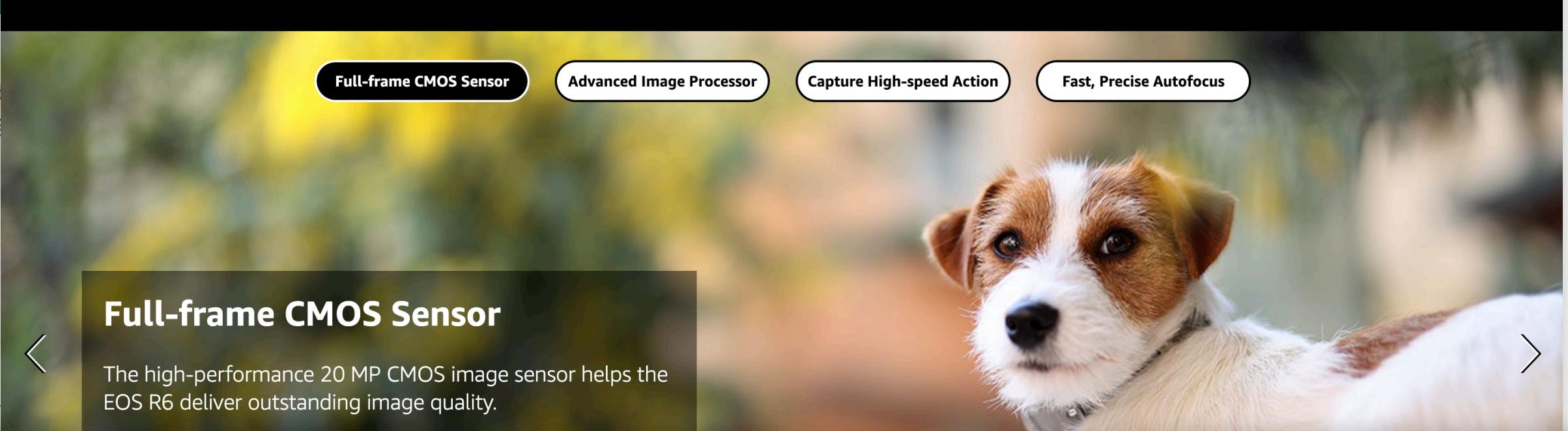
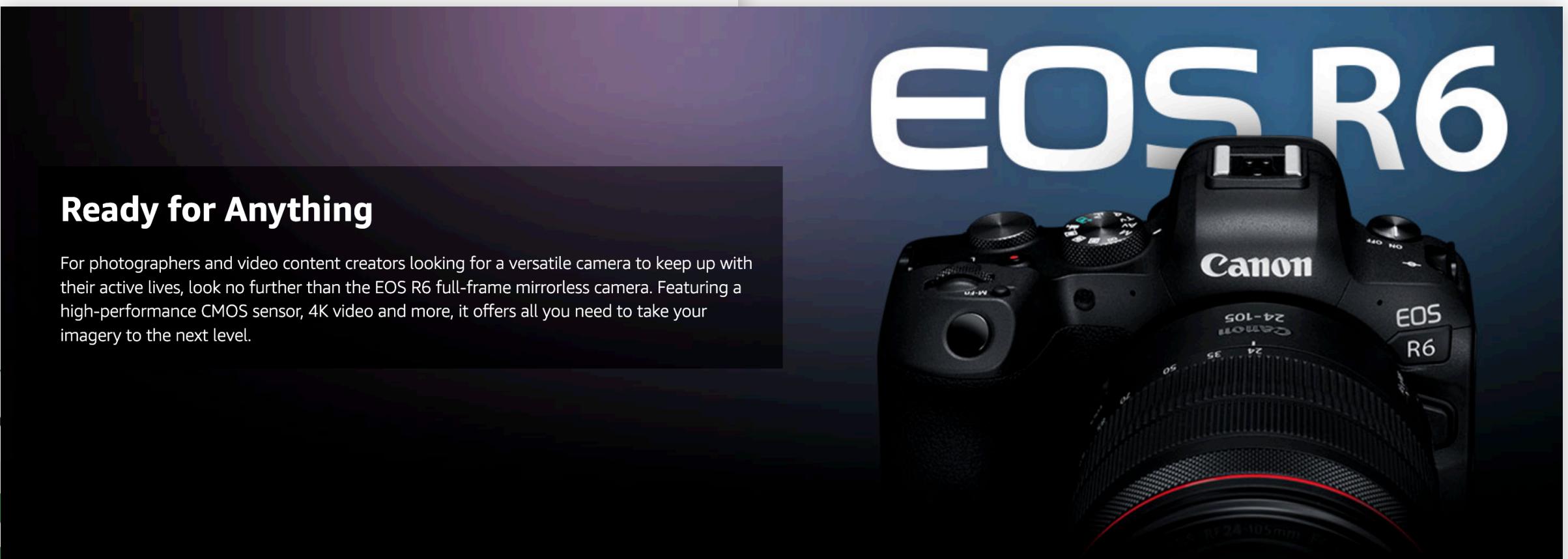
**\$2,498.00**

\$209/mo. suggested payments with the [payboo](#) credit card.<sup>§</sup> [Learn More](#)

or Save the Tax with the [payboo](#)

1  
▼  
▲

Ad



## The 7 Best Mirrorless Cameras - Fall 2022 Reviews

Updated Sep 30, 2022 at 10:34 am  
By Adriana Wiszniewski

Our Gear

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

73

74

75

76

77

78

79

80

81

82

83

84

85

86

87

88

89

90

91

92

93

94

95

96

97

98

99

100

101

102

103

104

105

106

107

108

109

110

111

112

113

114

115

116

117

118

119

120

121

122

123

124

125

126

127

128

129

130

131

132

133

134

135

136

137

138

139

140

141

142

143

144

145

146

147

148

149

150

151

152

153

154

155

156

157

158

159

160

161

162

163

164

165

166

167

168

169

170

171

172

173

174

175

176

177

178

179

180

181

182

183

184

Hello, Sign in  
Select your address

Electronics

Amazon.com

>Returns & Orders

Cart

All Best Sellers Amazon Basics Customer Service New Releases Today's Deals Prime Amazon Home Books Music Registry Fashion Kindle Books Gift Cards Toys & Games Sell Automotive Pet Supplies

Camera & Photo Deals Best Sellers DSLR Cameras Mirrorless Cameras Lenses Point-and-Shoots Sports & Action Cameras Camcorders Photography Drones Security Cameras Accessories

 Sony a7 III (ILCEM3K/B) Full-frame Mirrorless Interchangeable-Lens Camera with 28-70mm Lens with 3-Inch LCD Screen

★★★★★ 1,743  
\$2,198.00 prime

Customers who viewed this item also viewed

Sponsored

  
Canon EOS R5 Full-Frame Mirrorless Camera - 8K Video, 45 Megapixel Full-Frame CMOS Sensor, DIGIC X Image Processor, Up to 12 fps Mechanical Shutter (Body Only)  
★★★★★ 500  
\$3,899.00

  
Canon EF-EOS R Mount Adapter – Compatible with EOS RP, EOS R, EOS R6, and EOS R5 Cameras  
★★★★★ 728  
\$99.00

  
Canon EOS R6 Mirrorless Digital Camera (Body Only) (Renewed)  
★★★★★ 6  
\$2,344.00

Electronics > Camera & Photo > Digital Cameras > Mirrorless Cameras

  
6 VIDEOS  
360°

**Canon EOS R6 Full-Frame Mirrorless Camera with 4K Video, Full-Frame CMOS Sensor, DIGIC X Image Processor, Dual UHS-II SD Memory Card Slots, and Up to 12 fps with Mechanical Shutter, Body Only, Black**

Visit the Canon Store  
★★★★★ 890 ratings | 87 answered questions  
Amazon's Choice in Mirrorless Cameras by Canon

Price: \$2,499.00  
Pay \$138.83/month for 18 months, interest-free upon approval for the Amazon Rewards Visa Card  
Available at a lower price from other sellers that may not offer free Prime shipping.  
Color: Black  
Style: Body Only

**Body Only**  
\$2,499.00

24-105mm IS STM Kit  
\$2,799.00

24-105mm USM Kit  
\$3,599.00

Configuration: Base

Model Name: Canon EOS R6  
Brand: Canon  
Form Factor: Mirrorless  
Skill Level: Professional

Buy new: \$2,499.00  
FREE delivery Thursday, April 14. Details  
Select delivery location  
Only 1 left in stock - order soon.

Add to Cart  
Buy Now  
Secure transaction  
Ships from Dodd Camera  
Sold by Dodd Camera  
Return policy: Eligible for Return, Refund or Replacement within 30 days of receipt  
Add a Protection Plan:  
 3-Year Protection for \$147.99  
 2-Year Protection for \$109.99  
Add an Accessory:

36%

it comes to going mobile, it can be a difficult decision when choosing between a laptop or an iPad. Here's what you should know about the pros and cons of each.

The nice thing about iPads is that they're cheaper than laptops for the most part. They're really fun to play with, but you can't really type as well as you can on a laptop. You can't really use a trackpad for serious work done. You can opt for a hundred dollars for a keyboard and a trackpad, but you can't really type some serious work done.

However, laptop trackpads are not as responsive. You can opt for a hundred dollars for a keyboard and a trackpad, but you can't really type some serious work done.

uptick in detail and comparable low light performance is the most likely thing we can expect, in terms of image quality.

resolution, in fact if you

Despite the higher resolution, the a7 IV can still shoot at 10 frames per second. However, it can only do so in the lossy compressed format if you want to shoot Raw, and drops to 12-bit mode, further reducing dynamic range. The a7 IV has a *lossless* compression option, for when you need maximum processing flexibility, but the burst rate drops to around 6 fps if you use it. Sony says the camera's buffer depth allows over 800 Raw+JPEG images (or over 1000 JPEGs), but this is in the uncompressed Raw format, which again shoots at around 6 fps.

uptick in detail and comparable low light performance is the most likely thing we can expect, in terms of image quality.

Despite the higher resolution, the a7 IV can still shoot at 10 frames per second. However, it can only do so in the lossy compressed format if you want to shoot Raw, and drops to 12-bit mode, further reducing dynamic range. The a7 IV has a *lossless* compression option, for when you need maximum processing flexibility, but the burst rate drops to around 6 fps if you use it. Sony says the camera's buffer depth allows over 800 Raw+JPEG images (or over 1000 JPEGs), but this is in the uncompressed Raw format, which again shoots at around 6 fps.

uptick in detail and comparable low light performance is the most likely thing we can expect, in terms of image quality.

Copy Select All Find Selection >

Despite the higher resolution, the a7 IV can still shoot at 10 frames per second. However, it can only do so in the lossy compressed format if you want to shoot Raw, and drops to 12-bit mode, further reducing dynamic range. The a7 IV has a *lossless* compression option, for when you need maximum processing flexibility, but the burst rate drops to around 6 fps if you use it. Sony says the camera's buffer depth allows over 800 Raw+JPEG images (or over 1000 JPEGs), but this is in the uncompressed Raw format, which again shoots at around 6 fps.

## 1. Initiate selection mode

## 2. Specify selection range

## 3. Copy the selected text

software for Mac or PC. A connection via smartphone is also possible, though audio may

Paste    Select    Select All     HD (720).

- List

software for Mac or PC. A connection via smartphone is also possible, though audio may not be available at resolutions above HD (720).

[+++]

- However, it can only do so in the lossy compressed format if you want to shoot Raw, and drops to 12-bit mode, further reducing dynamic range.

software for Mac or PC. A connection via smartphone is also possible, though audio may not be available at resolutions above HD (720).

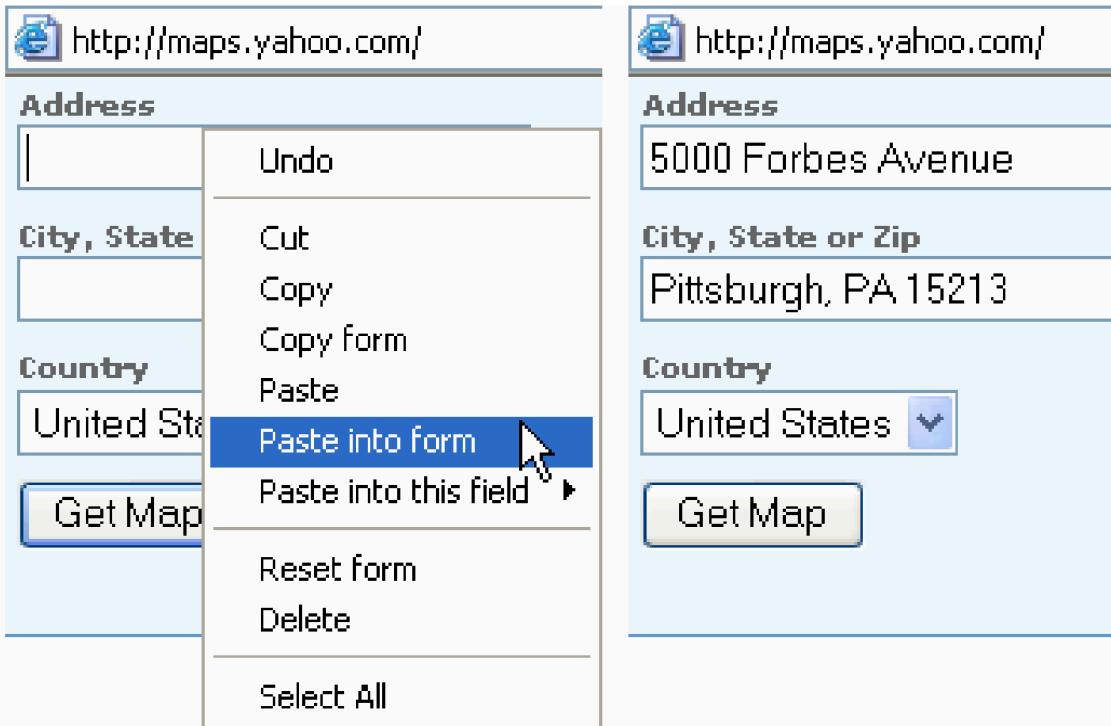
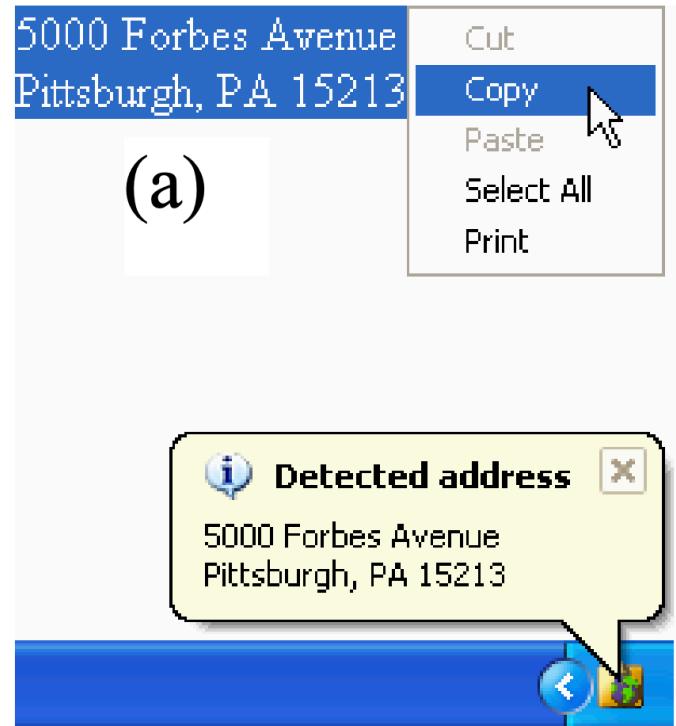
[+++]

- However, it can only do so in the lossy compressed format if you want to shoot Raw, and drops to 12-bit mode, further reducing dynamic range.

## 4. Context switch to the note-taking app

## 5. Paste the information in

## 6. Triage the information with mental judgement

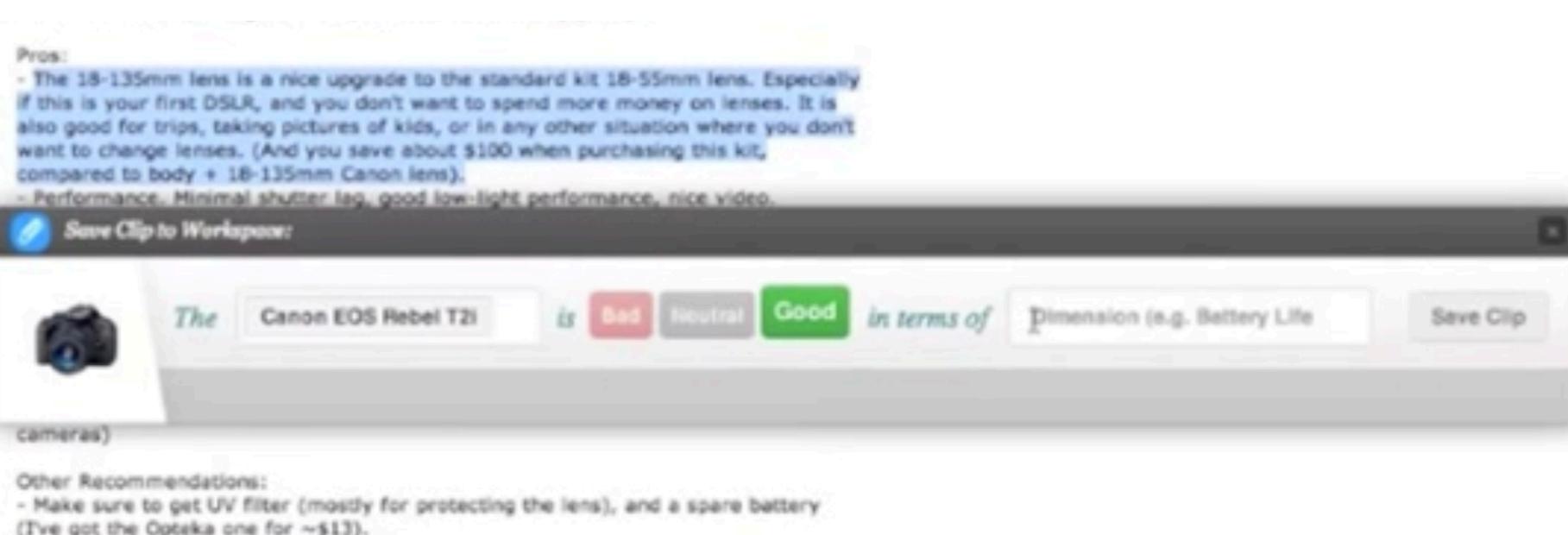


(b)

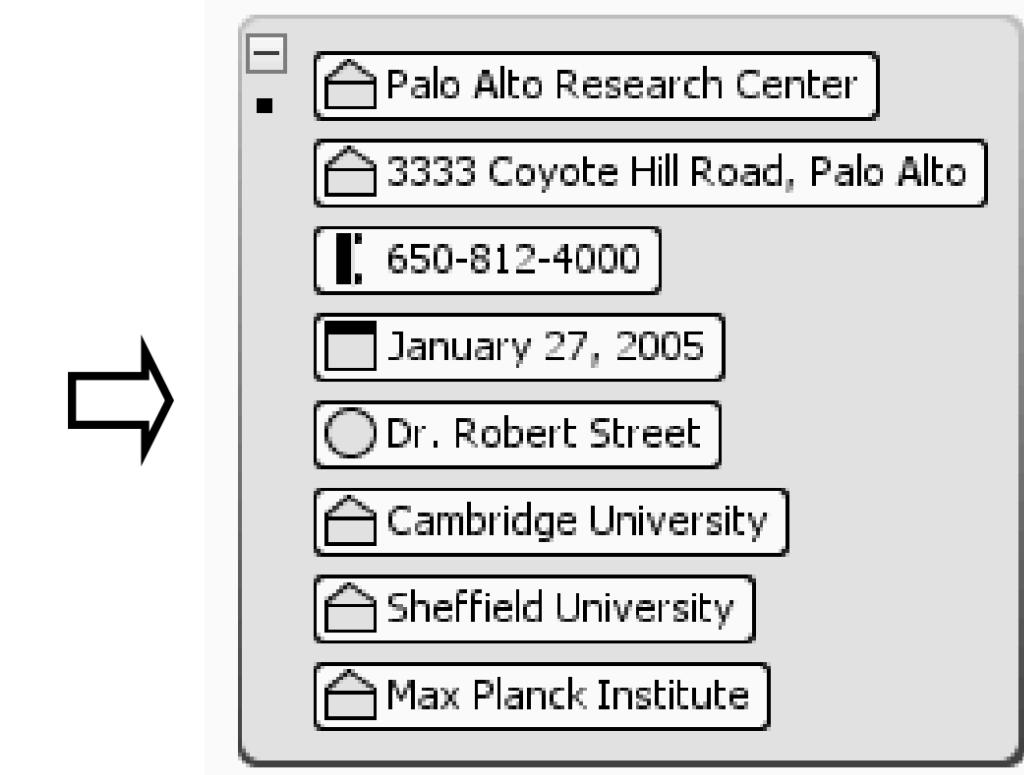
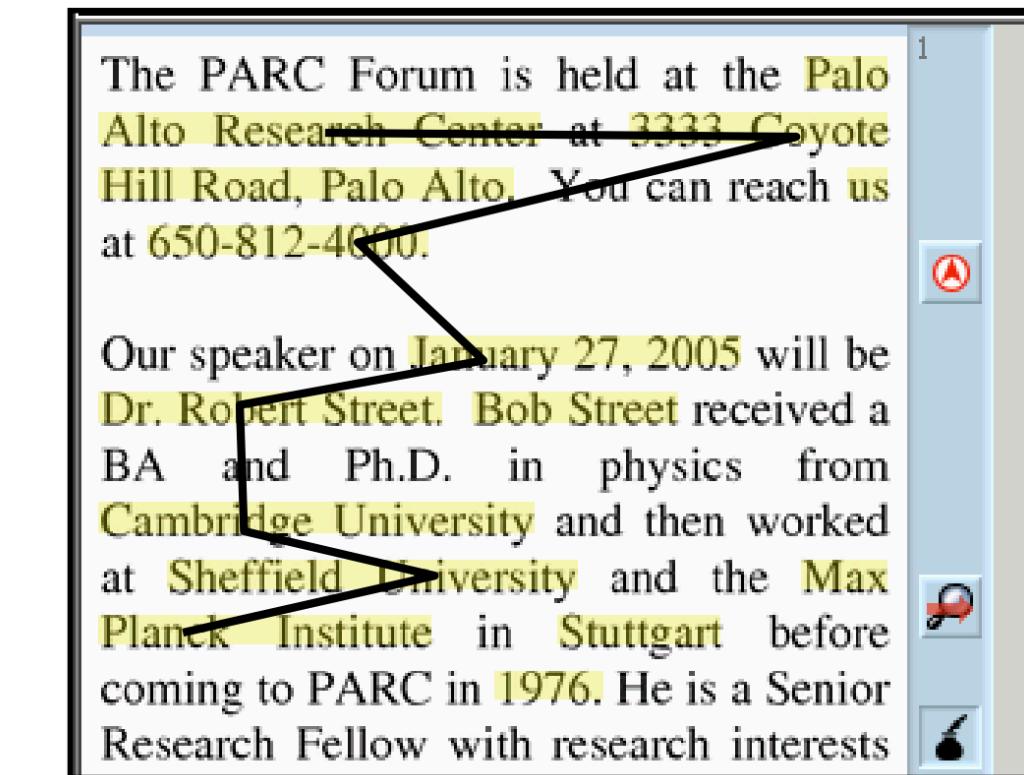
(c)

(d)

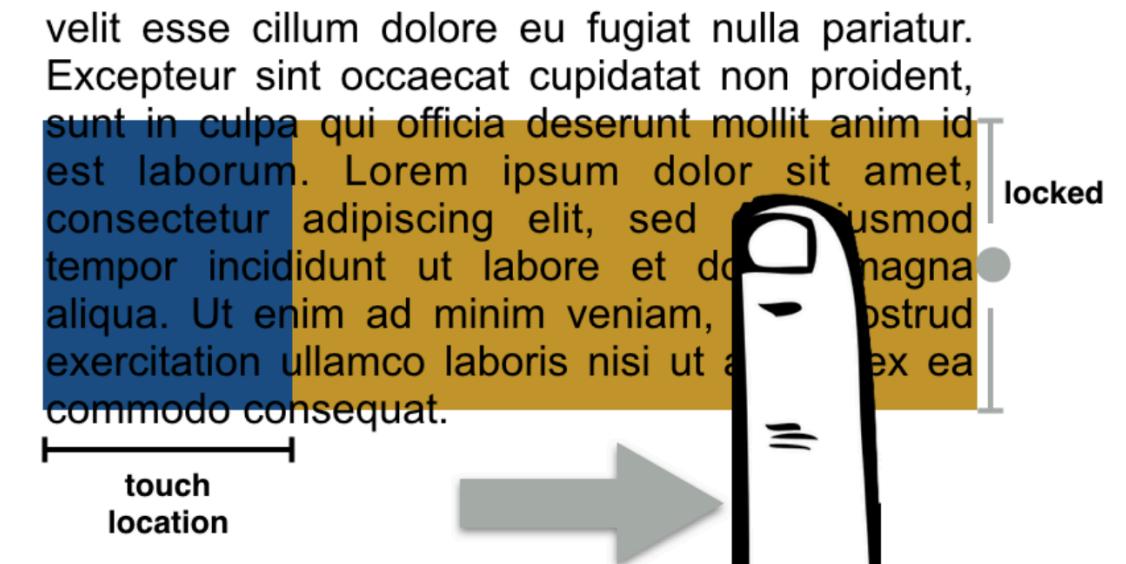
Stylos, J., Myers, B. A., & Faulring, A.  
*Citrine: providing intelligent copy-and-paste*  
UIST 2004



Kittur, A., Peters, A. M., Diriye, A., Telang, T., & Bove, M. R.  
*Costs and benefits of structured information foraging*  
CHI 2013



Bier, E. A., Ishak, E. W., & Chi, E.  
*Entity quick click: rapid text copying based on automatic entity extraction*  
CHI 2006



Chang, J. C., Hahn, N., & Kittur, A.  
*Supporting Mobile Sensemaking Through Intentionally Uncertain Highlighting*  
UIST 2016

or so away from being able to jump between tabs. They're also touch sensitive, so you may not need to click or nudge anything at all.

This layout makes the menus much quicker to navigate, as do sub-section headings within each tab. The arrangement differs from previous Sony cameras but the underlying relationships between settings remain the same, so it shouldn't take too long to familiarize yourself with the new system if you're an existing Sony user.

### Constant smartphone connection

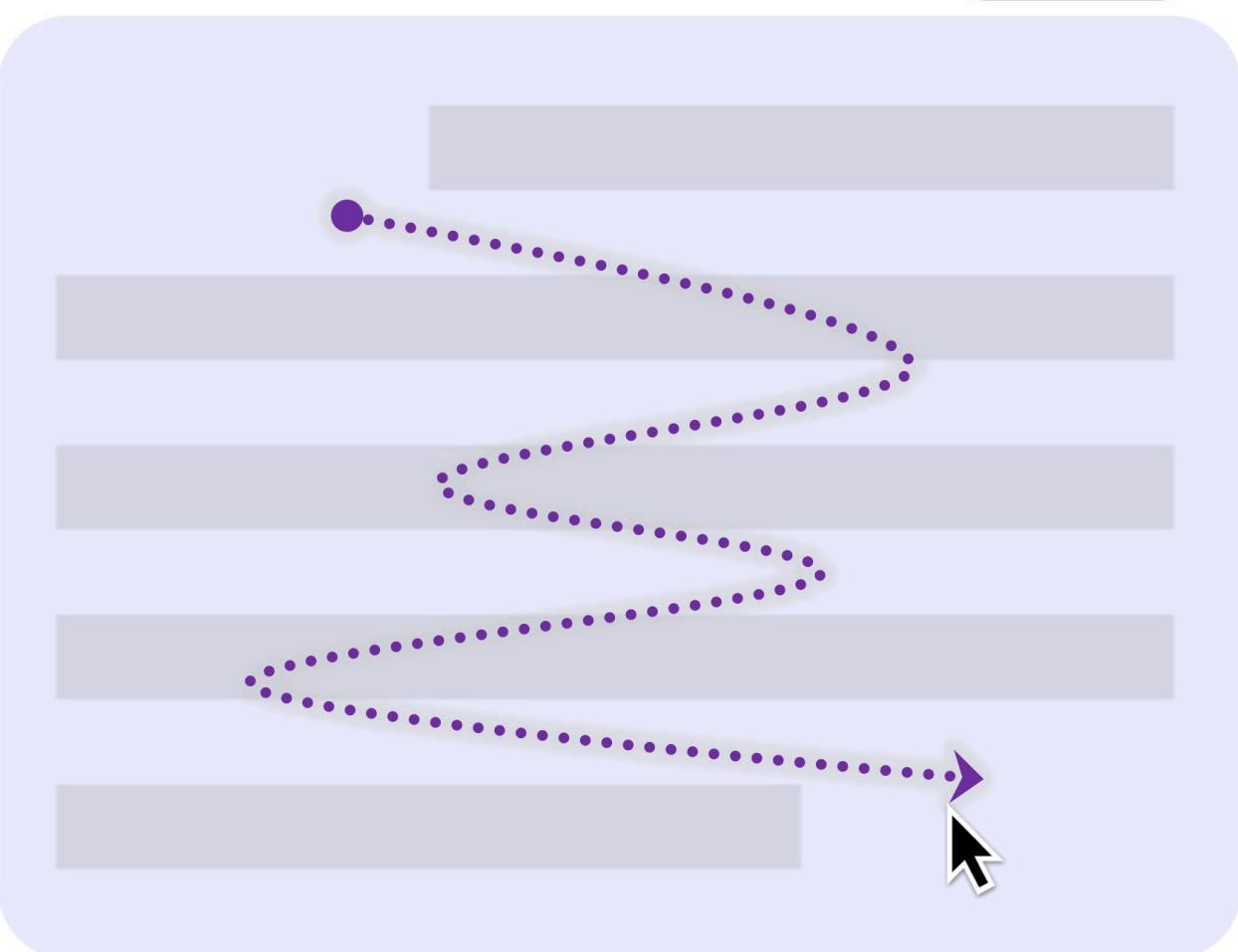
Sony has offered Bluetooth on its cameras for many years but has used it solely for transferring location data from smartphones. The a7 IV adds a constant-connection option of the type offered by most of its rivals. This means you only have to pair the camera with your smartphone once, after which they will automatically re-establish a Bluetooth Low Energy connection, making it much quicker and simpler to transfer images to your phone.

### Closable shutter



The a7 IV gains the ability to close its mechanical shutter when the camera is turned off, helping to prevent dust build-up on the sensor. Shutter blades tend to be very lightweight, which also means they can be pretty fragile, so this should be seen as dust prevention, rather than a physical protection measure.

### Battery



**Wiggle** the cursor back-and-forth over the content of interest to save it.

# Ending with a swipe in different directions to encode mental judgement (e.g., valence)

[Helpful](#) | [Report abuse](#)



Robert

★★★★★ **Autofocus wow.**

Reviewed in the United States on January 23, 2022

Style: Body Only | Configuration: Base | **Verified Purchase**

Upgraded from the A7III. I thought the A7III autofocus was great, but this camera truly blows the A7III autofocus out of the water. I'd say this alone is worth the upgrade. I also really appreciate the improved menu system. It's actually usable now. I hear the video features are greatly improved which I appreciate, but I'm mostly a still photographer. I also appreciate the bump in megapixels, which extends the reach of this camera a bit more when I need to crop. There are many other improvements which you can read about online, but as I said the autofocus improvement alone is worth the upgrade in my opinion. Buy it and enjoy.

10 people found this helpful

[Helpful](#) | [Report abuse](#)



Amazon Customer

★★★★★ **Overheating Issues in Menu**

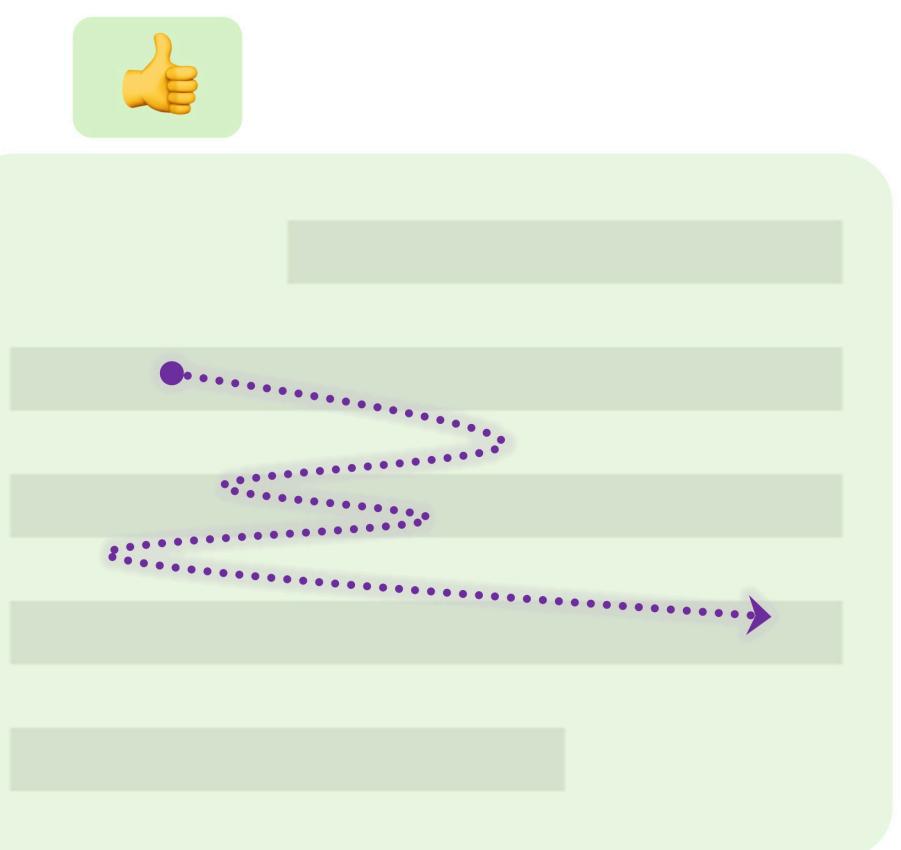
Reviewed in the United States on January 12, 2022

Style: w/ 28-70mm | Configuration: Base | **Verified Purchase**

I've been using this camera for only an hour now. I took a few pictures, and one video. As I operate the menu (customizing buttons and whatnot), the camera is overheating. I've had to turn it off twice now to let it cool down. I've looked it up, and apparently this is a common issue that users are experiencing - overheating, particularly while operating the device menu. It's very disappointing, but as I'm not sure if it will affect the operation of the camera after the settings are completed, I am not yet sure if I will return the device or keep it.

12 people found this helpful

[Helpful](#) | [Report abuse](#)



Positive valence, or "pro"

# Ending with a swipe in different directions to encode mental judgement (e.g., valence)

this camera a bit more when I need to crop. There are many other improvements which you can read about online, but as I said the autofocus improvement alone is worth the upgrade in my opinion. Buy it and enjoy.

10 people found this helpful

[Helpful](#) | [Report abuse](#)



Amazon Customer

**★★★★★ Overheating Issues in Menu**

Reviewed in the United States on January 12, 2022

Style: w/ 28-70mm | Configuration: Base | [Verified Purchase](#)

I've been using this camera for only an hour now. I took a few pictures, and one video. As I operate the menu (customizing buttons and whatnot), the camera is overheating. I've had to turn it off twice now to let it cool down. I've looked it up, and apparently this is a common issue that users are experiencing - overheating, particularly while operating the device menu. It's very disappointing, but as I'm not sure if it will affect the operation of the camera after the settings are completed, I am not yet sure if I will return the device or keep it.

12 people found this helpful

[Helpful](#) | [Report abuse](#)



Hai Le

**★★★★★ Love My New A7 IV!**

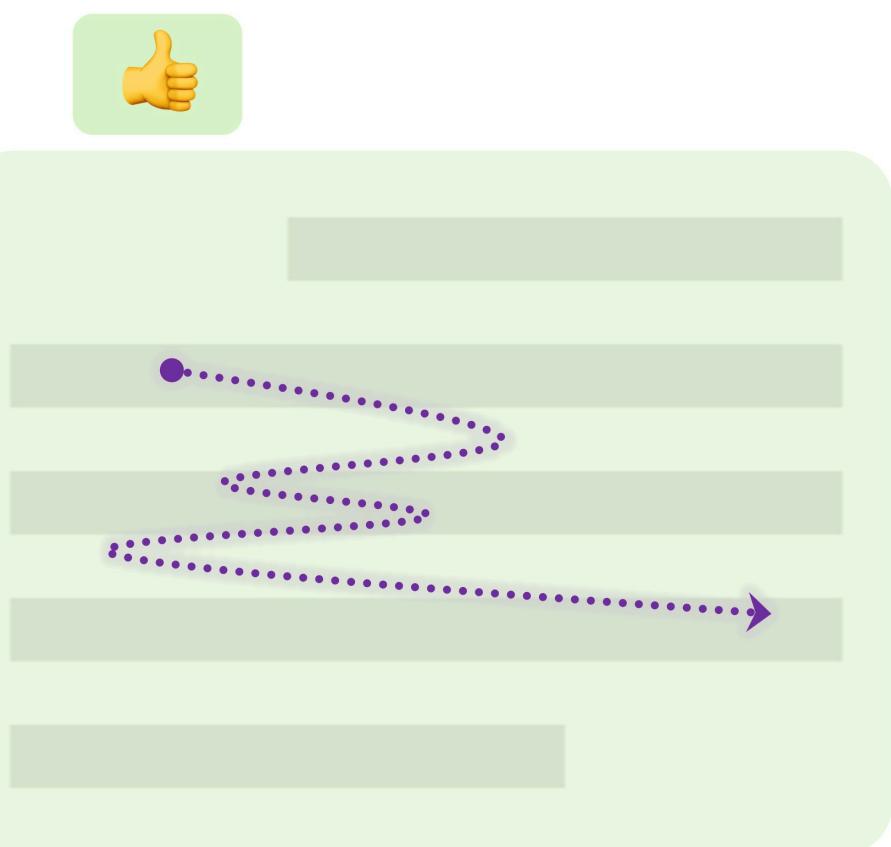
Reviewed in the United States on December 26, 2021

Style: Body Only | Configuration: Base | [Verified Purchase](#)

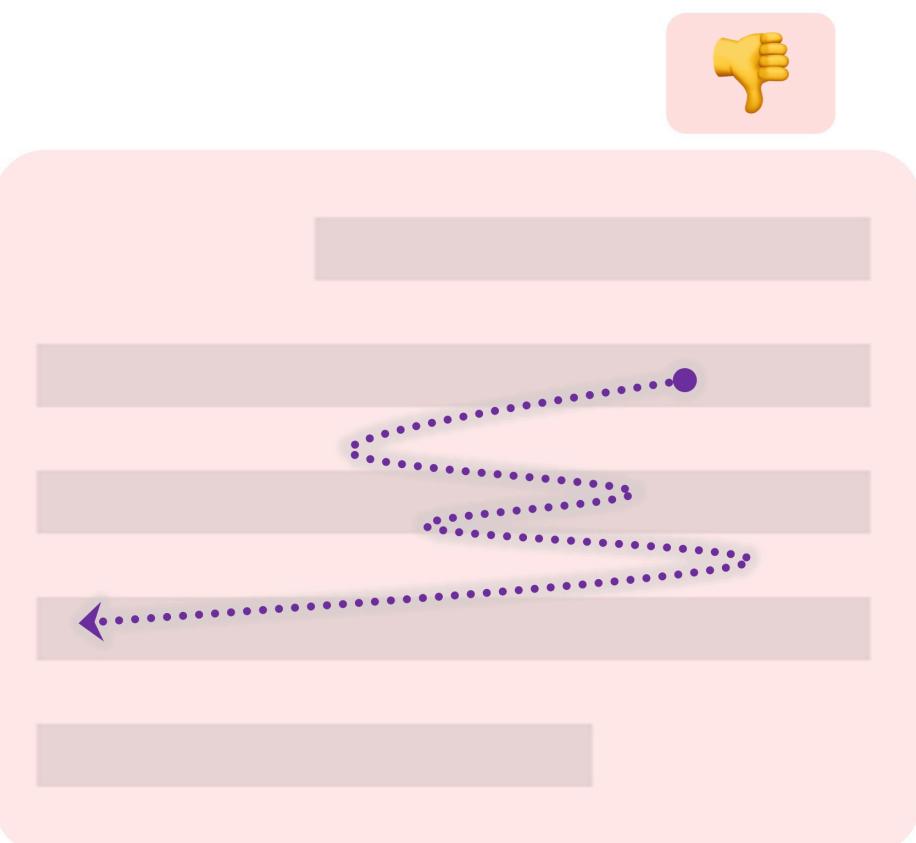
Received the camera early, yeah! A7IV's auto focus was awesome, the color was NICE and the images were sharp! The low light's shooting was unbelievable. Good job Sony!

14 people found this helpful

[Helpful](#) | [Report abuse](#)

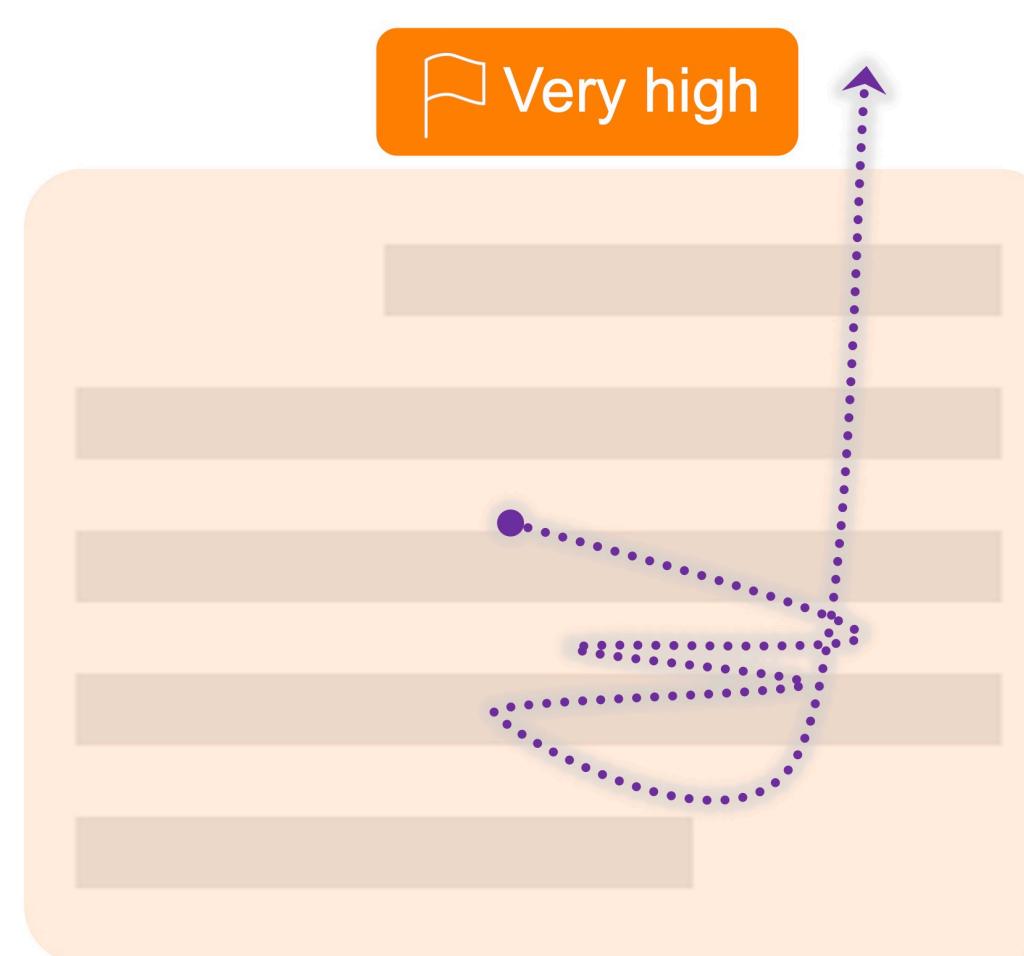
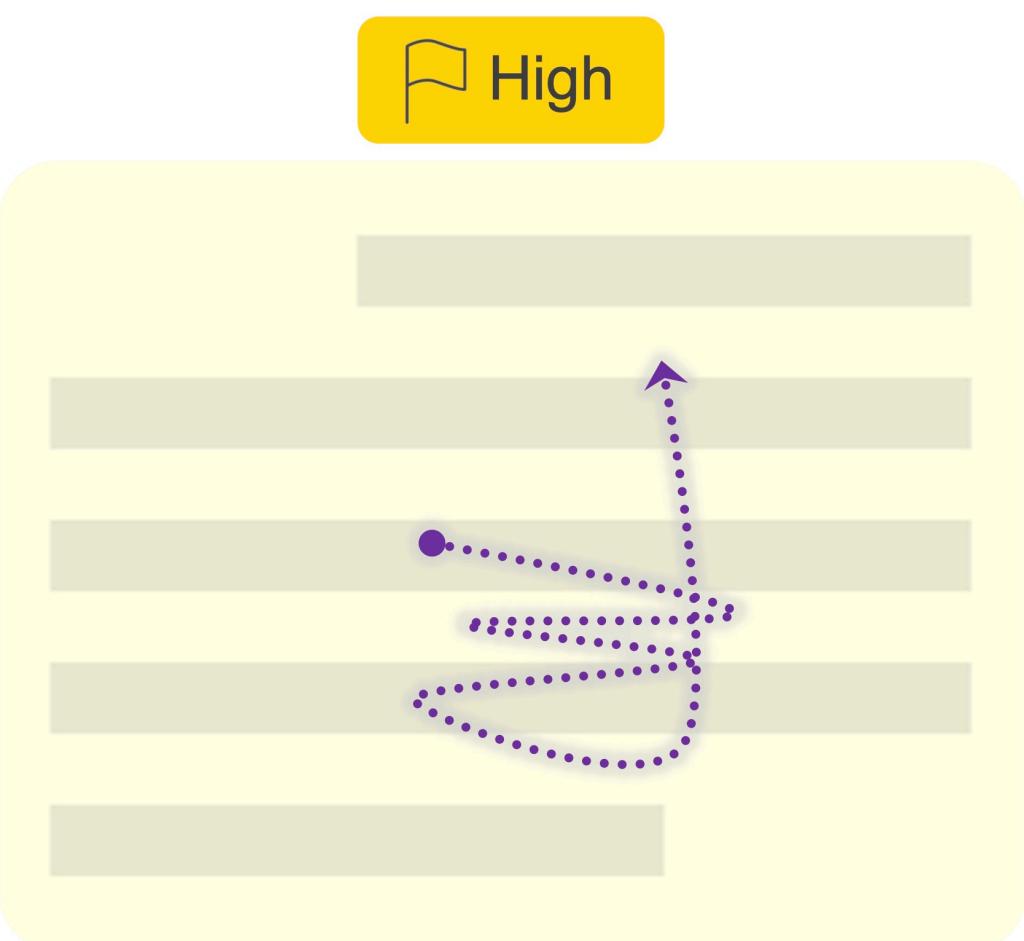
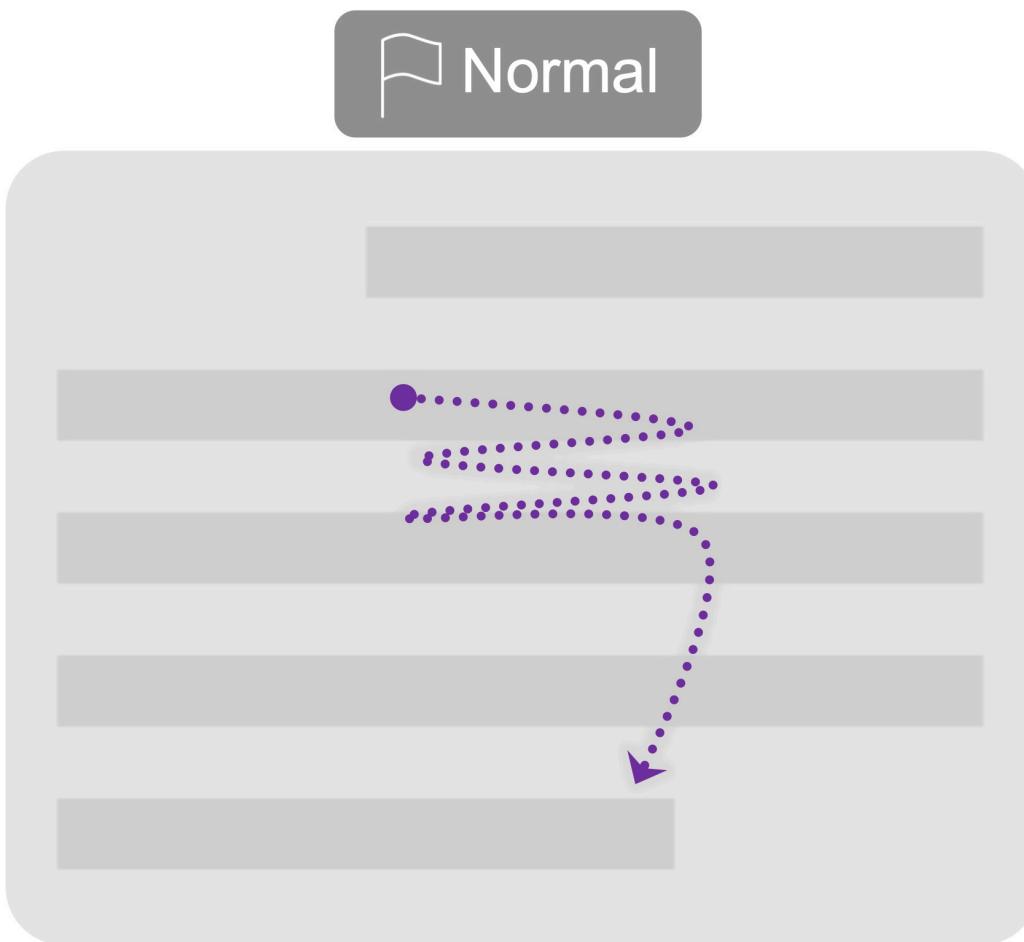


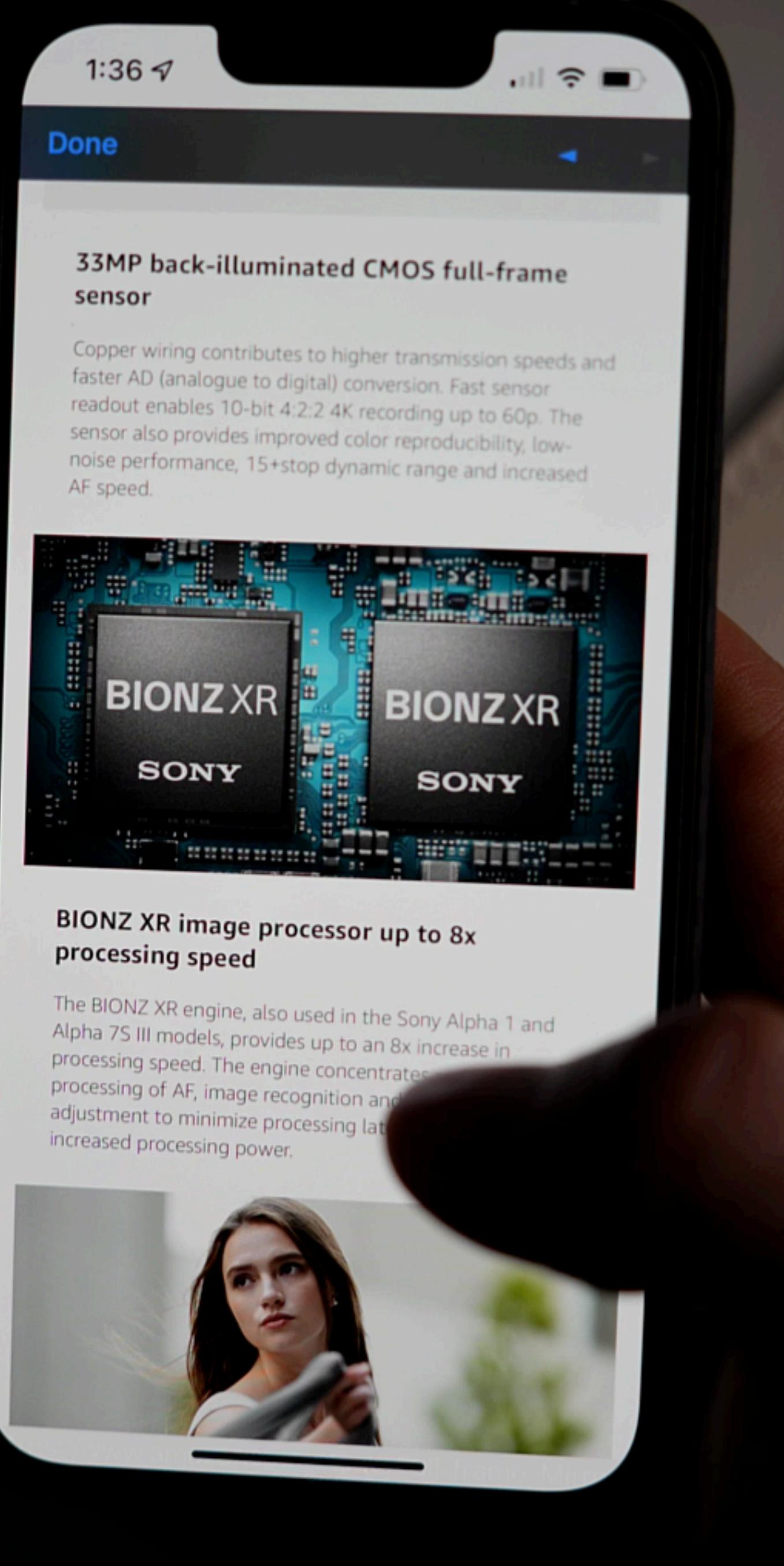
Positive valence, or "pro"



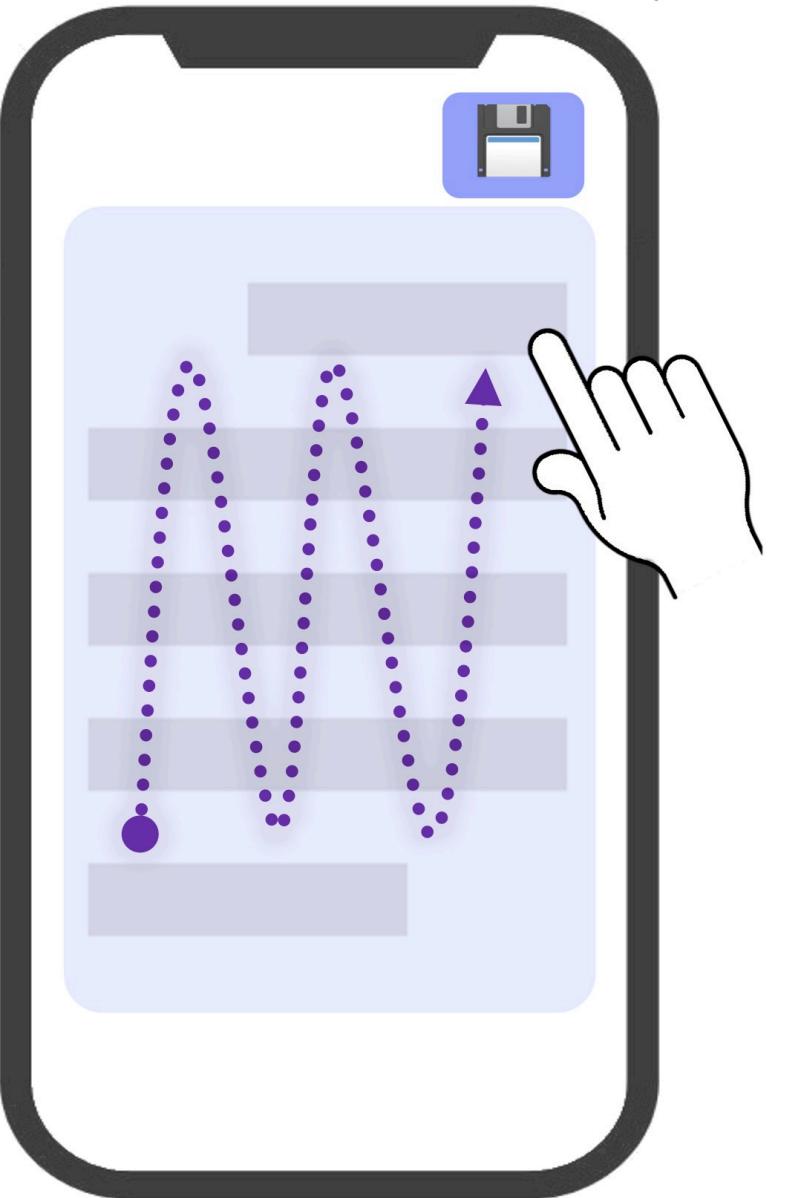
Negative valence, or "con"

Ending with a swipe in different directions to encode mental judgement (e.g., priority)

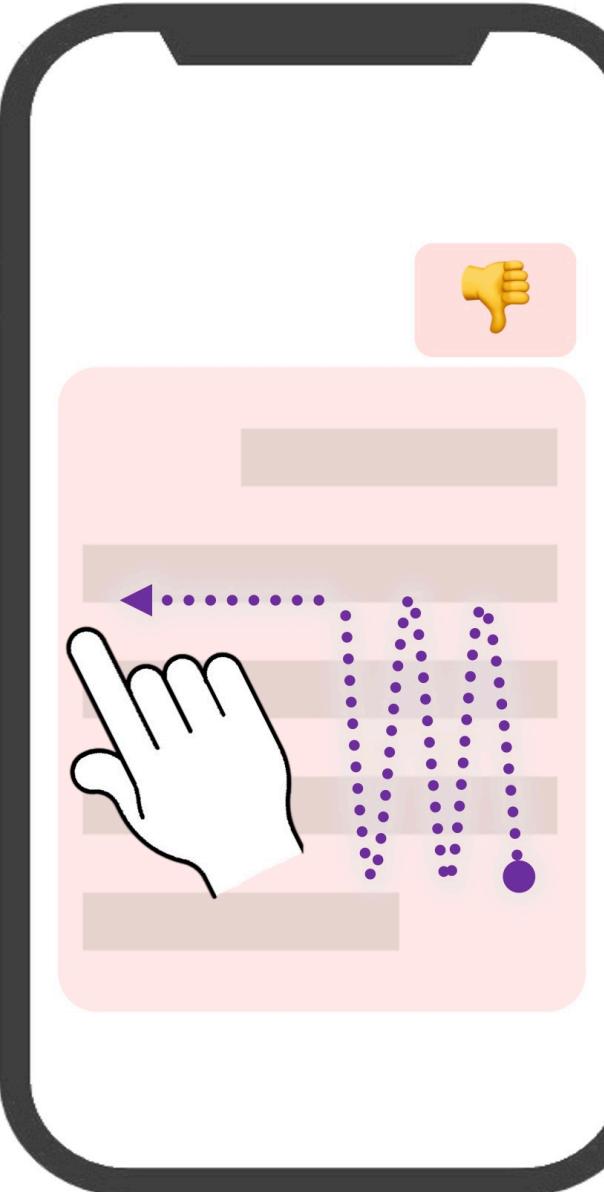




**Wiggle** the finger up-and-down on the content of interest to save it.



Negative valence,  
or “con”



Positive valence,  
or “pro”

# Design goals

## [D1] Accuracy

It needs to be accurate and precise enough to lock onto the content the users intend to collect.

## [D2] Efficiency

It should be quick and low-effort to perform, and minimize interruptions to the main activities that users are performing, such as learning and active reading.

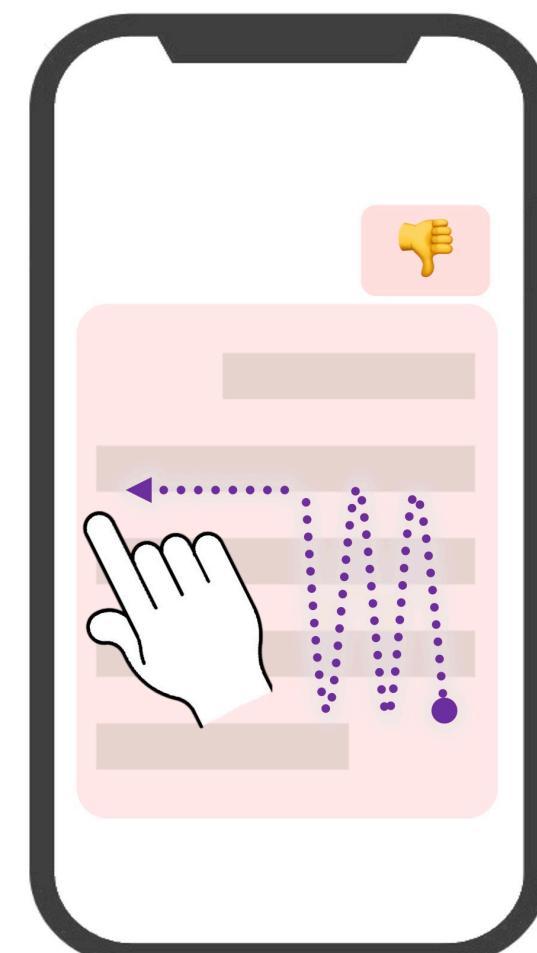
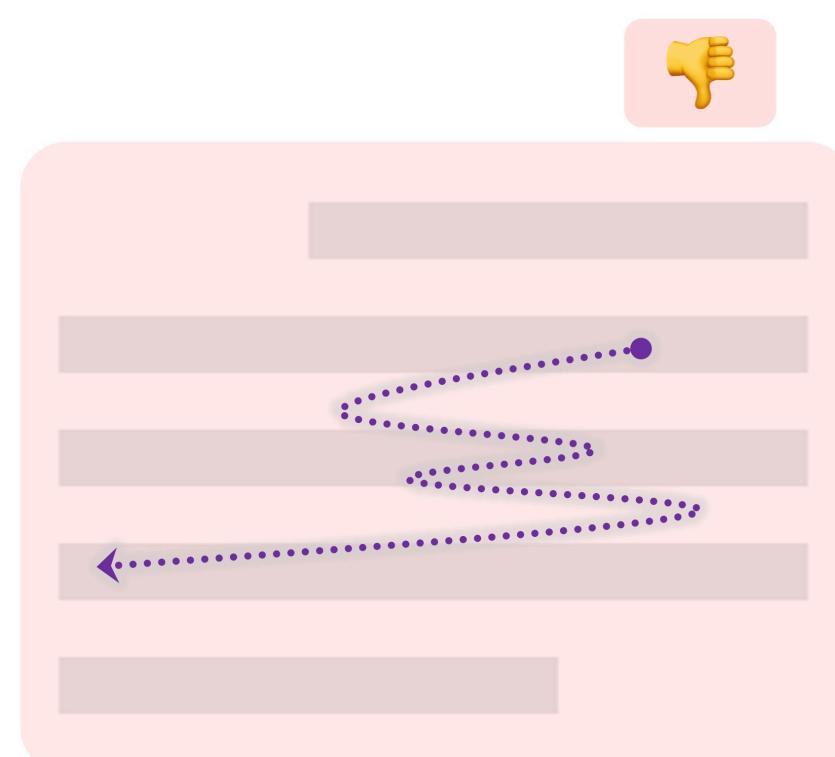
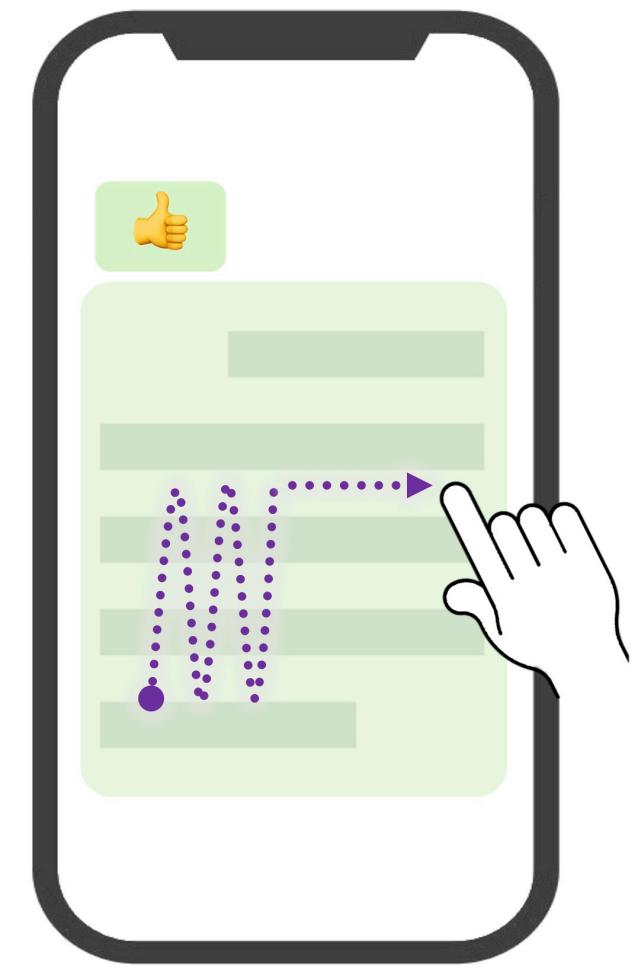
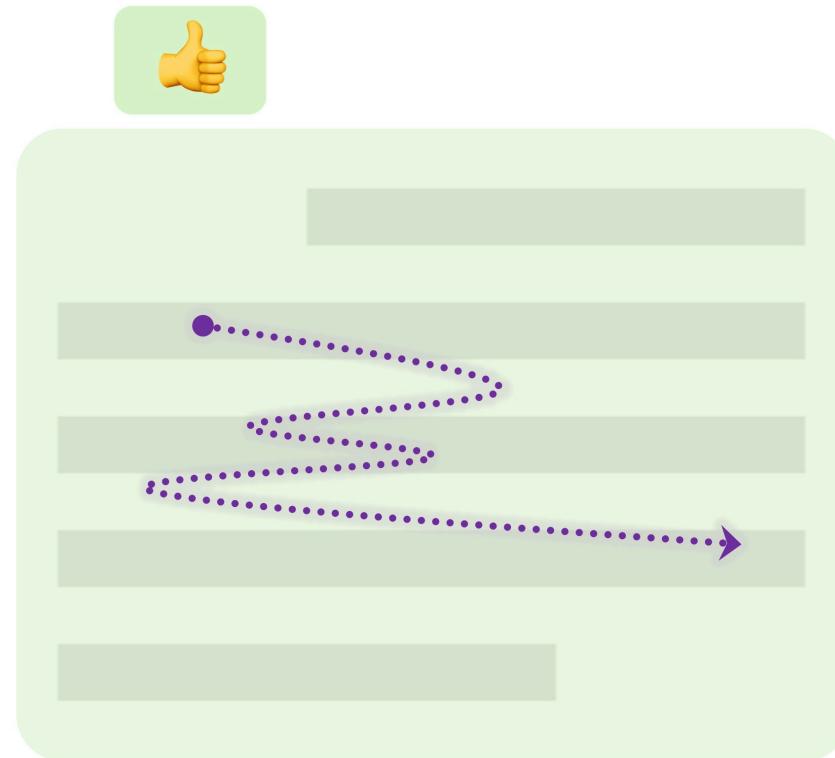
## [D3] Expressiveness

It should be extendable to provide natural and intuitive affordances for users to express aspects of their mental context at the moment, and in the scope of this work, encoding *valence* ratings as well as topic *priorities*.

## [D4] Integration

It should be a complement to and not interfere with the existing interactions that users already use, such as using the pointer to select text and pictures or click on links.

# The case for wiggling



- Mouse pointer is readily available
- No clicking required
- Natural extension to encode extra mental judgement
- Do not interfere with existing interactions
- Robust against false positives

# Topics view

Search Google or type a URL

## Picking a digital camera

+ Add Topic

### Sony Alpha 7 IV Full-frame Mirrorless Interchangeable Lens Camera

Sony Alpha 7 IV Full-frame Mirrorless Interch... 10.0

Upgraded from the A7III. I thought the A7III autofocus was great, but this camera truly blows the A7III autofocus out of the water. I'd say this alone is worth the upgrade. I also really appreciate the improved menu system. It's actually usable

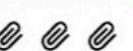
Sony a7 IV review Digital Photography Review

The a7 IV uses the same NP-FZ100 battery as the a7 III and other more recent Sony cameras. It's a usefully hefty unit that, combined with the relatively modest viewfinder res, lets the a7 IV achieve a CIPA battery life rating of 580 shots per

Sony a7 IV review Digital Photography Review

	Compressed Raw (damagingly lossy)	Lossless compressed/ Uncompressed Raw
Max	10 fps (12-bit)	6 fps (14-bit)

Canon EOS R6 Mirrorless Camera



### Nikon Z6 Full Frame Mirrorless Camera Body

Priority Level

Frame Mirrorless Camera Body : ... 5.0



6 combines a 24.5MP Full-Frame BSI sensor with Nikon's advanced EXPEED processor for the sharp, vibrant, high resolution photos and videos that Nikon is renowned for.

Sony Alpha a6000 Mirrorless Digital Camera with 16-50mm Power Zoom ...



My Workspace

MY PROJECTS

+ Add Project

Picking a digital camera

Javascript frontend framework

Coffee Maker

Literature Review

Sprint meetings

Reading List

In app browser solutions

Competitor analysis

Note taking application

Vacuum cleaner

Hybrid App Development

javascript framework

ARCHIVED

Archived

Deleted 0

OTHER

Get Referral Codes

Settings

Help

SIGN OUT

# Holding tank

amazon.com 10 electronics.sony.com 1

Sony Alpha 7 IV Full-frame M... 6 Canon EOS R6 Full-Frame M... 3

Sony a7 IV Mirrorless Cam... 1 Nikon Z6 Full Frame Mirro... 1

Focus on clips with a rating over 5.5

Sony Alpha 7 IV Full-frame Mir... 8.5

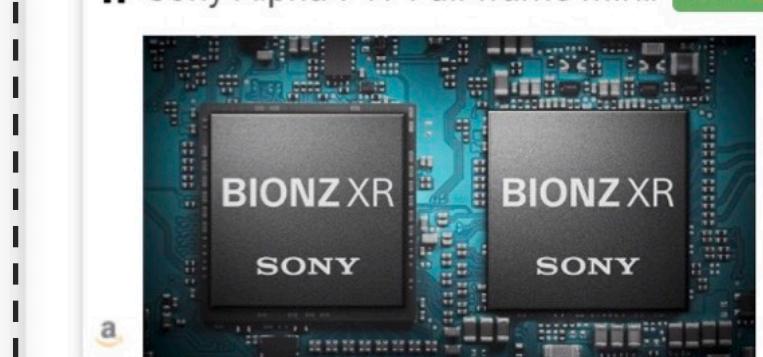
Exposure Aperture Priority, Manual, Control Program, Shutter Priority

Type

33MP full-frame Exmor R back-illuminated CMOS sensor

Sony Alpha 7 IV Full-frame Mir... 7.6

Sony Alpha 7 IV Full-frame Mir... 6.1



Canon EOS R6 Full-Frame Mir... -6.0

The high-performance 20 MP CMOS image sensor helps the EOS R6 deliver outstanding image quality.

Low score clips 4

Canon EOS R6 Full-Frame Mir... 3.1

The EOS R6 features the same base image sensor and image processor as the EOS-1D X Mark III, enabling a native ISO range of 100-102,400. With high-speed continuous shooting of upto 12fps with the Mechanical shutter

Sony Alpha 7 IV Full-frame Mi... -2.4

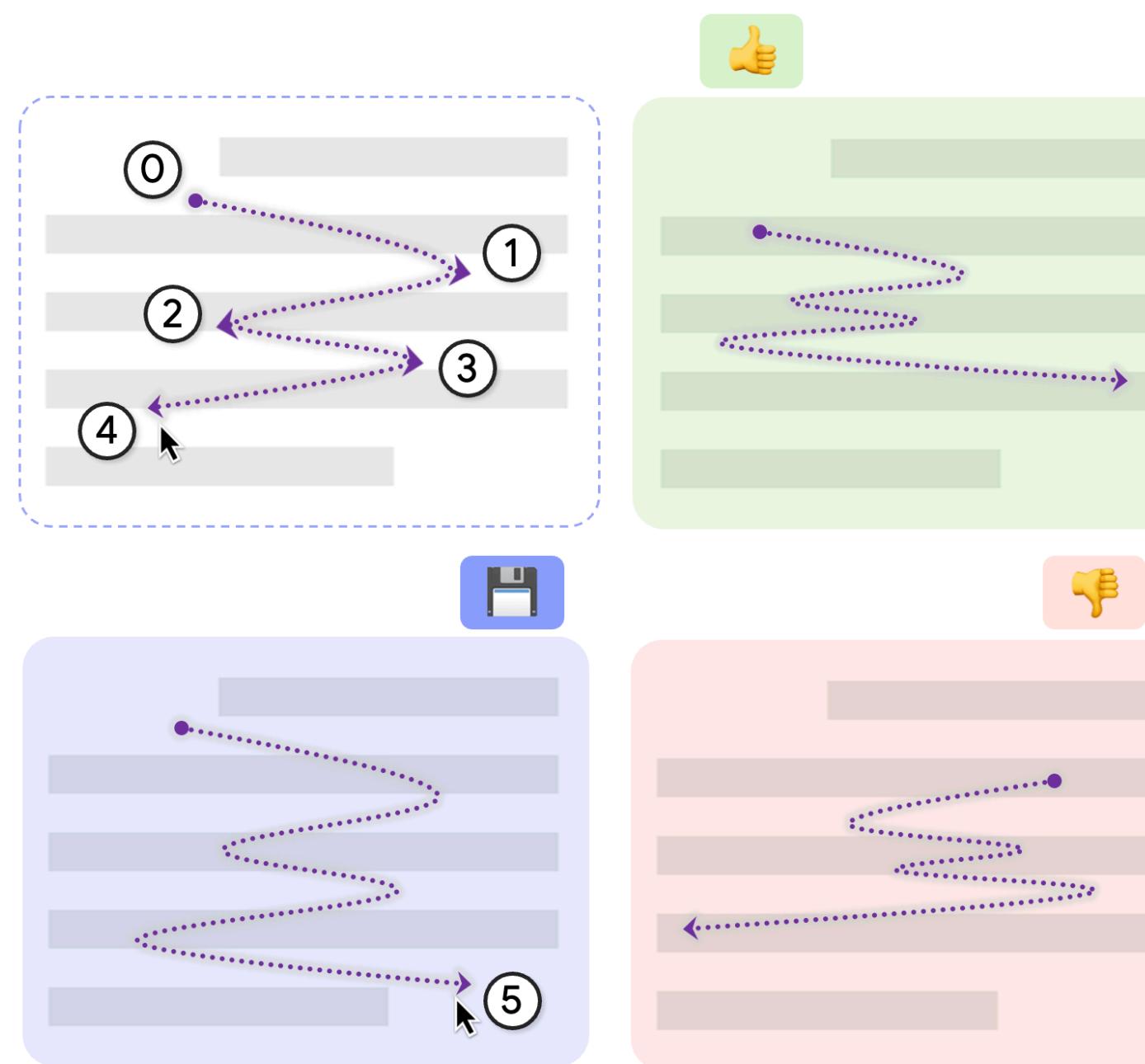
Beautiful color expression made simple with S-Cinetone color profile

Sony Alpha 7 IV Full-frame Mir... 2.0

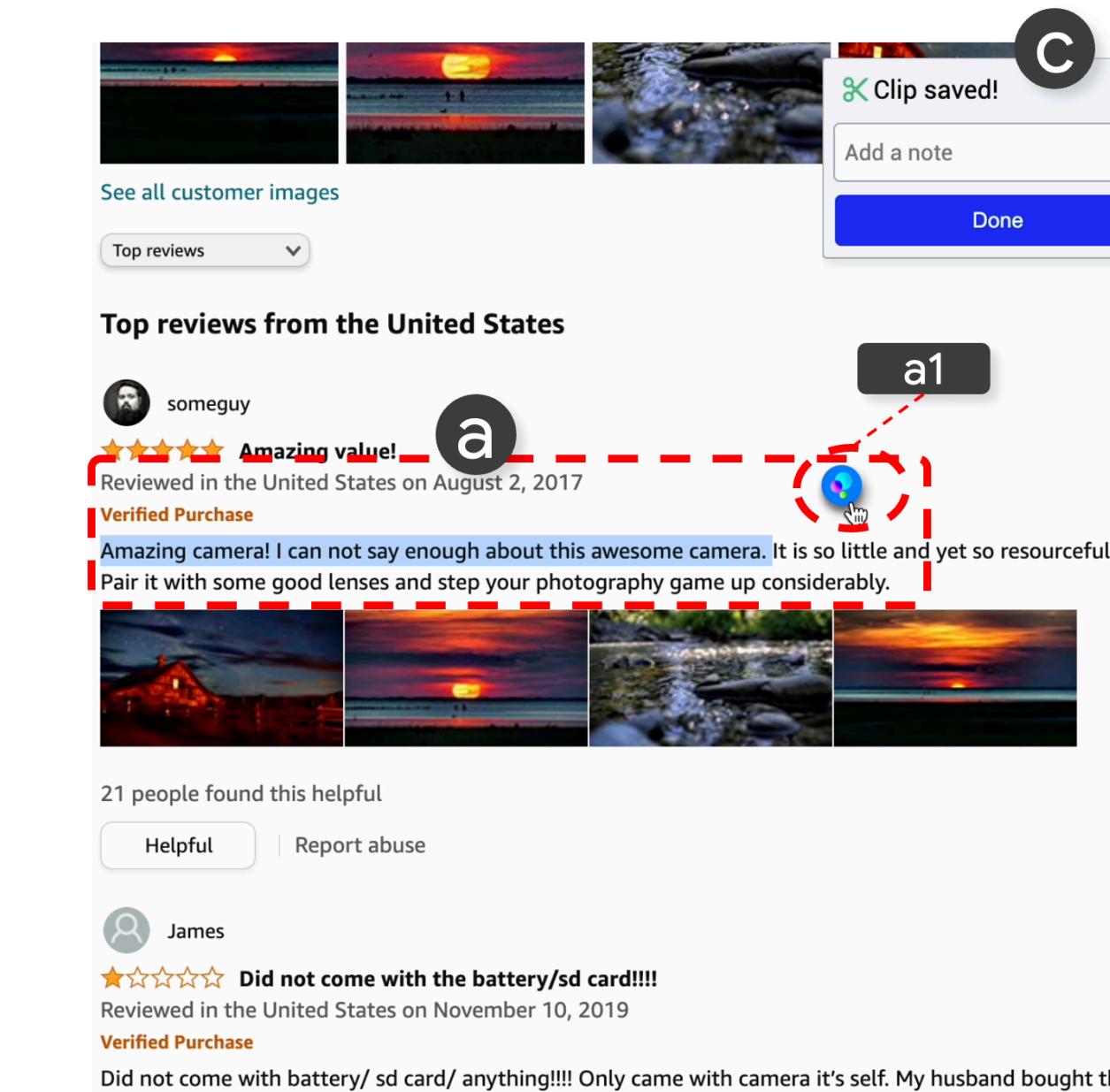
This is a very versatile system, it's really quick with lots of options, it works really well with the Imaging Edge app, overall this is a great tool to have for any hybrid shooter out here

# Lab study – collecting and triaging

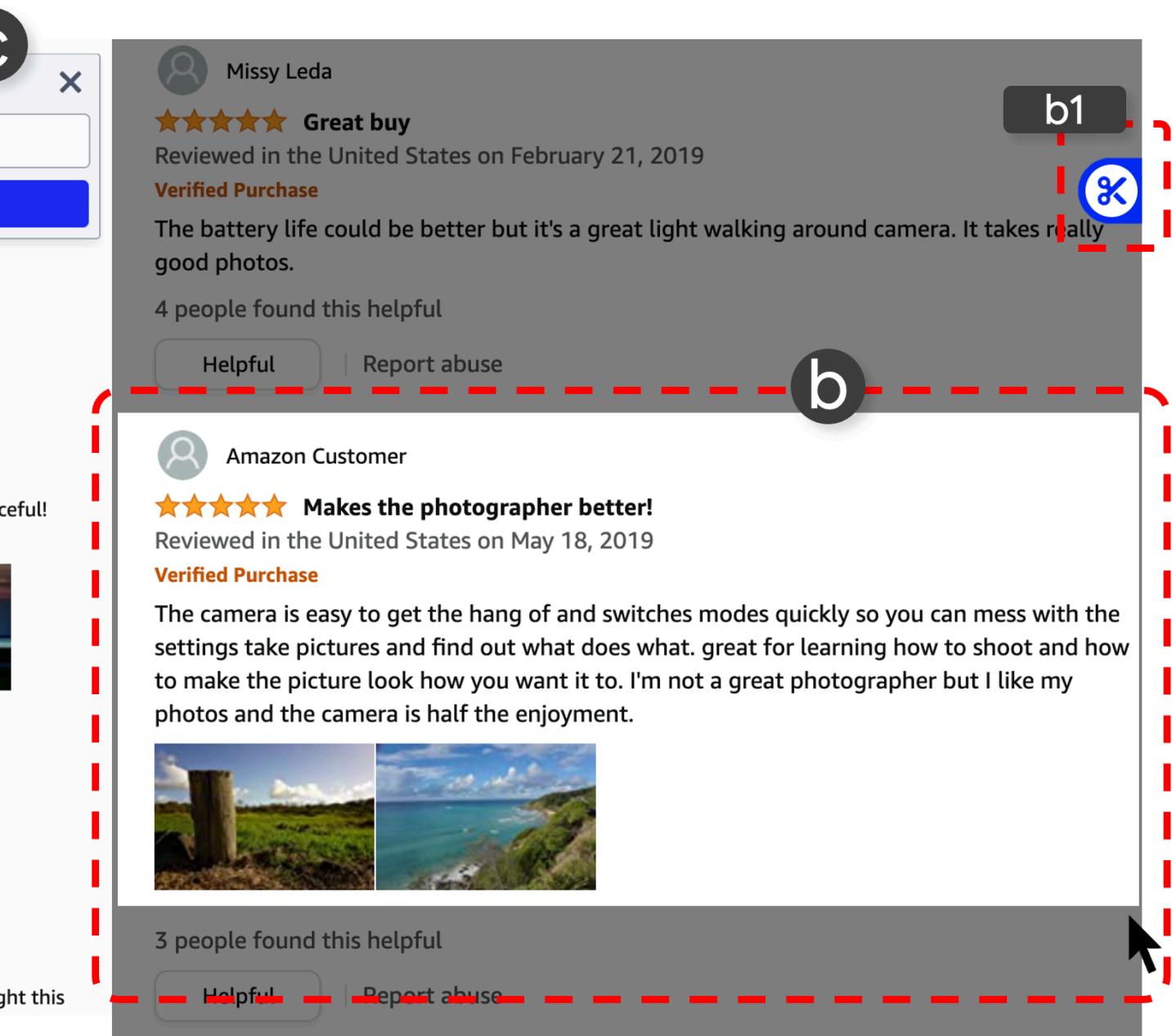
N=12, within-subjects



V.S.



Clipping text



Clipping screenshot

Wiggling

Baseline

## [D1] Accuracy

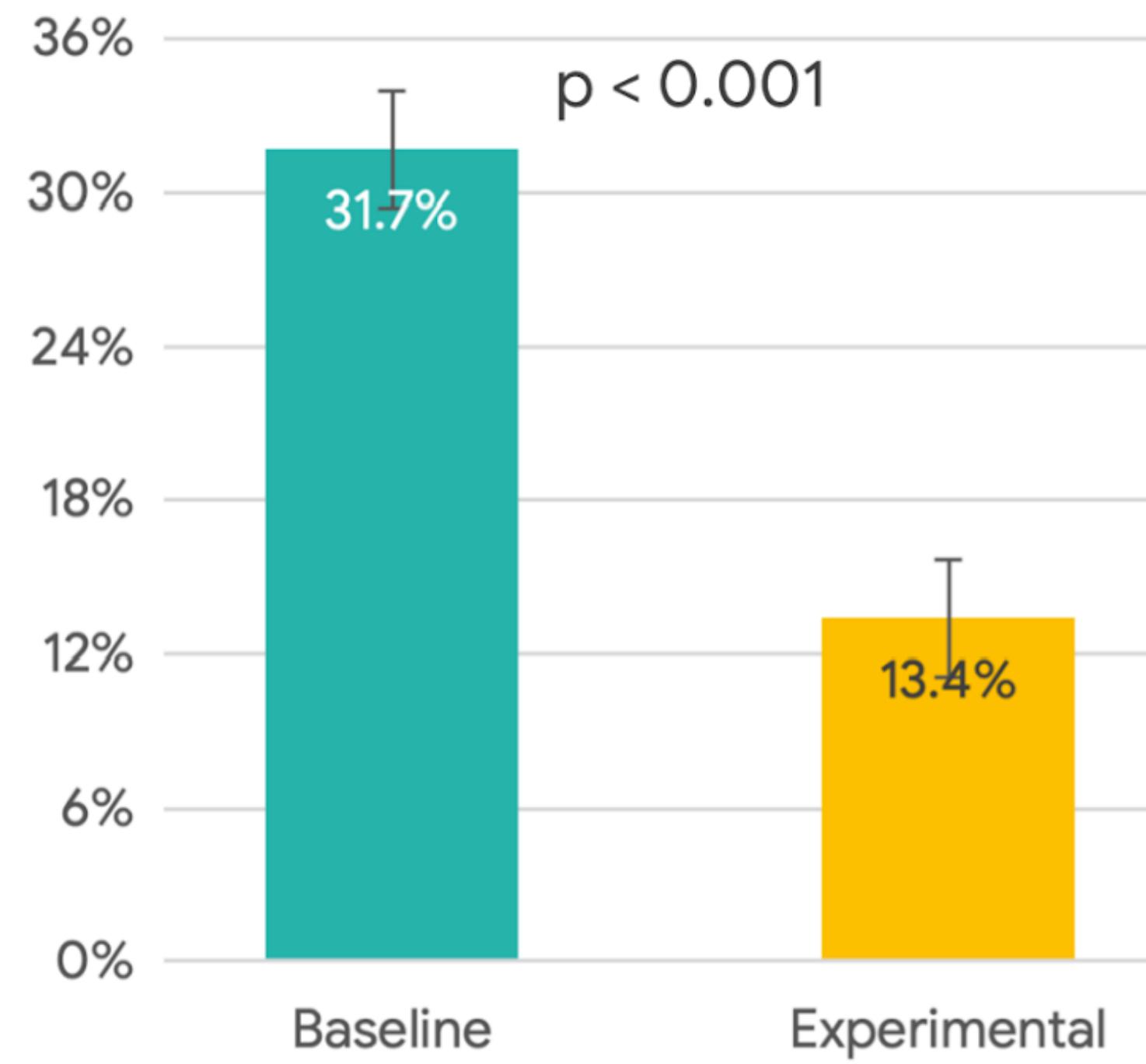
## [D2] Efficiency

## [D3] Expressiveness

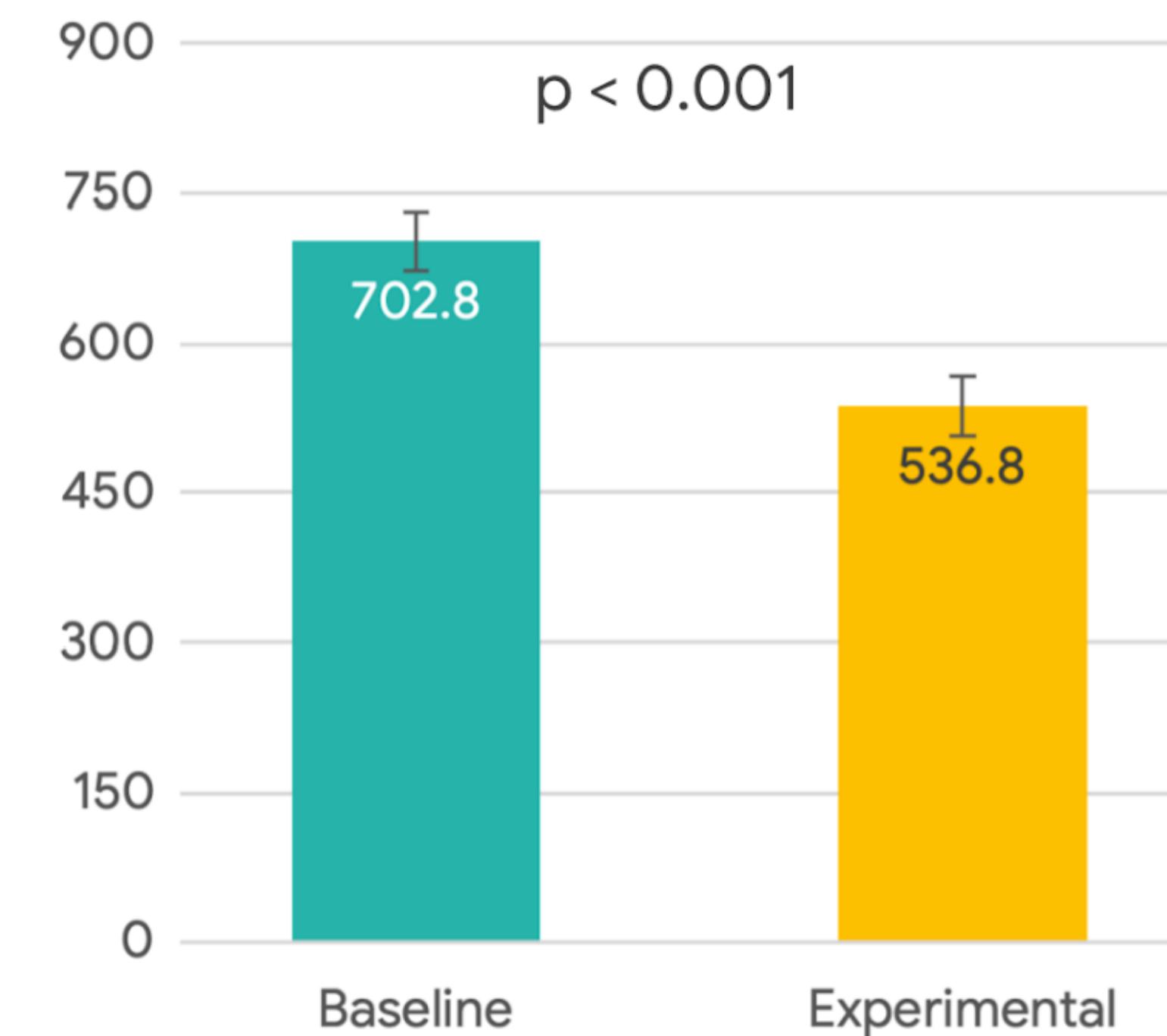
## [D4] Integration



58% less overhead cost



24% faster





- Participants collected almost **twice** as many clips using wiggling (37.8 clips vs 20.3 clips,  $p < 0.01$ )
- **79.6%** encoded with either valence (62.4%) or priority (17.2%)

## [D1] Accuracy



TP

3.53% false negative (FN)

With the current implementation,  
2.01% did not activate, 1.48%  
activated on the wrong content

## [D2] Efficiency



TP

## [D3] Expressiveness



0 false positive (FP)

suggesting normal mouse  
movements would not trigger a  
wiggle activation

TN

## [D4] Integration



## [D1] Accuracy



## [D2] Efficiency



## [D3] Expressiveness



## [D4] Integration



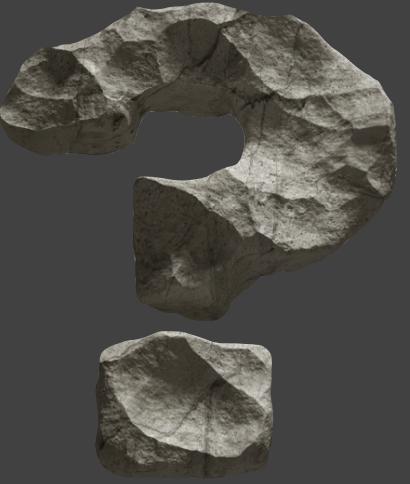
- **Fluid workflow**

*“I just wiggle and move on, in fact, when I am wiggling on something, my eyes are already onto the next paragraph, no more stopping to do the regular clipping thing any more” – P11*

- **Potential customizability**

Participants wondered if they could customize the system, such as by *“writing some sort of plugin, like the one I wrote for Obsidian, to map the different directional swipes to what I want depending on the situations that I’m in”* – P1

# Future work



# What we learned so far

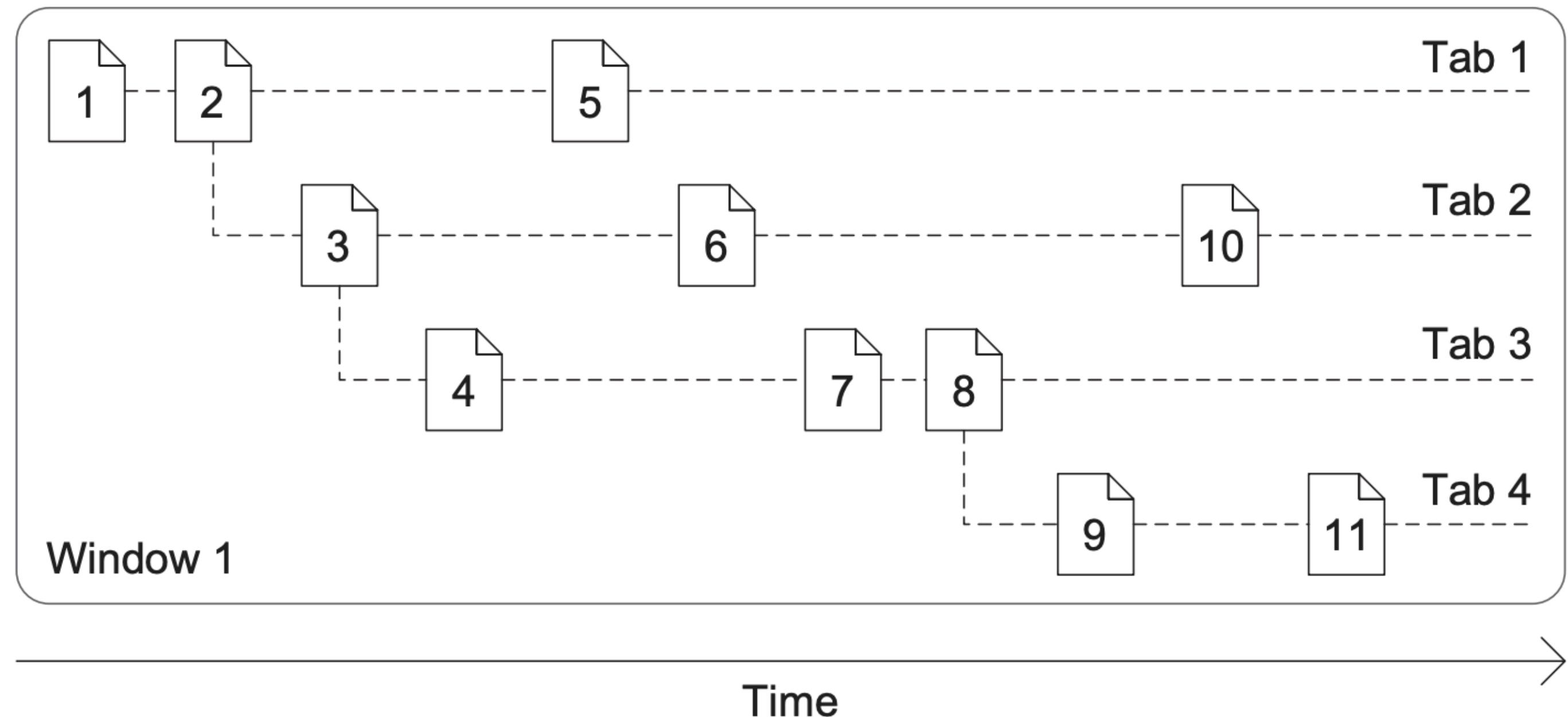
- **Externalizing mental models is beneficial**
  - Reduces mental load & scaffolds decision making
  - Explains/justifies decision making processes and rationale
  - Facilitates reuse of sensemaking resources & results
- **Tools should reduce the cost of externalization**
  - Providing in-situ info. foraging and structuring support
  - Enabling automatic info. foraging and structuring
  - Supporting lightweight interactions

# Limitations of existing work

- **Problems with tabular structure**
  - Doesn't quite match people's mental models during early sensemaking stages.

# Flexible organizational structures

## Organizing with branches



Huang et al. 2012

plate rich text editor <

Snippets Code Pages 1 Notes

draft.js <

Snippets 2 Code Pages 1 Notes

highlighted

The Draft.js model is built with [immutable-js](#), offering an API with functional state updates and aggressively leveraging data persistence for scalable memory usage.

clicked

Immutable Editor State

react rich text editor <

Snippets 5 Code 1 Pages 4 Notes

texts that you copied

- \**Immutable Editor State:* \* The Draft.js model is built with immutable-js, offering an API with functional state updates and aggressively leveraging data persistence for scalable memory usage.

highlighted

- The editor's "schema" was hardcoded and hard to customize. Things like bold and italic were supported out of the box, but what about comments, or embeds, or even more domain-specific needs?

highlighted

- Support for setting font-size and font-family.

clicked

- The repositories were monolithic, not small and reusable. The code bases for many of the editors often didn't expose the internal tooling that could have been re-used by developers, leading to having to reinvent the wheel.

# Flexible organizational structures

## **Other potential ways of organizing knowledge**

e.g., similarity-based grouping and categorizations

I plan to run contextual inquiries and brainstorming sessions with participants.

# Limitations of existing work

- **Problems with tabular structure**
  - Doesn't quite match people's mental models during early sensemaking stages.
- **Disconnect between automation and user input**
  - Limited ways for users to guide system automation

Implicit Behavioral Signal	Selected References in Prior Research	Descriptions	Strength of indication of user attention	Score Function $W$
<b>Copying content</b>	Developers frequently copy sample code from the web to use in their own code [8, 54, 55]	Triggers when the user copies some text from a content block $b$ . This typically happens when a developer copies sample code from web pages to try out in their own code.	Strongest	40 for each triggering
<b>Text highlighting</b>	People tend to highlight text while reading to help focus their attention [105]	Triggers each time when some text in a content block $b$ gets selected. Triggerings where the selected text is shorter than 5 characters are disqualified.	Strong	20 for each triggering
<b>Clicking</b>	Clicking on content, such as widgets and links, is considered to be a decent behavioral indicator for perceived interesting elements on web pages [57]	Triggers when the user clicks on a content block $b$ . This accounts for situations where the developer interacts with content on a page, such as live demo widgets. Clicks that are part of text highlighting are excluded.	Strong	20 for each triggering
<b>Cursor hovering</b>	People tend to use the cursor to guide their attention while reading web pages [18, 52, 57, 65, 103].	Triggers each time when the mouse cursor hovers over a content block $b$ for at least 2 seconds. This accounts for situations where the developer naturally moves the mouse cursor onto the content that is currently being read to guide his or her attention [18, 64, 102, 103]. However, a cursor hover triggering will be disqualified when the system detects an extended period of idling (2 minutes) without any user actions.	Weak	$0.5t$ , where $t$ is the duration (measured in seconds) of the cursor's stay within the bounds of content block $b$ . The maximum score is 10. In our pilot testing, users rarely spend more than 10 seconds reading a text block.
<b>Content dwelling</b>	The longer some content stays visible, the more likely that the user is interested in it [22, 65].	Triggers each time when a content block $b$ gets scrolled into and stays in the visible view port for at least 2 seconds. This indicates that the developer has at least paid attention to $b$ . However, a dwell triggering during idling is disqualified.	Weak	$0.2t$ , where $t$ is the duration (measured in seconds) of content block $b$ 's stay in the visible browser viewport. The maximum score is 4. In our pilot testing, users rarely stay at one location for more than 10 seconds.

# Guiding automation with user input

## **Direction customization of scoring functions**

Allow users to directly adjust the parameters.

## **Learning scoring functions over time**

Train an online learning model that takes into account user input (fixes of incorrect automation results) and improve its performance over time.

- generalizable to all users and scenarios
- allow additional signals

# Limitations of existing work

- **Problems with tabular structure**
  - Doesn't quite match people's mental models during early sensemaking stages.
- **Disconnect between automation and user input**
  - Limited ways for users to guide system automation
- **Limited ecological validity**
  - Few evidence on how people use the systems for real-world tasks.

# Field deployment study

*Research questions:*

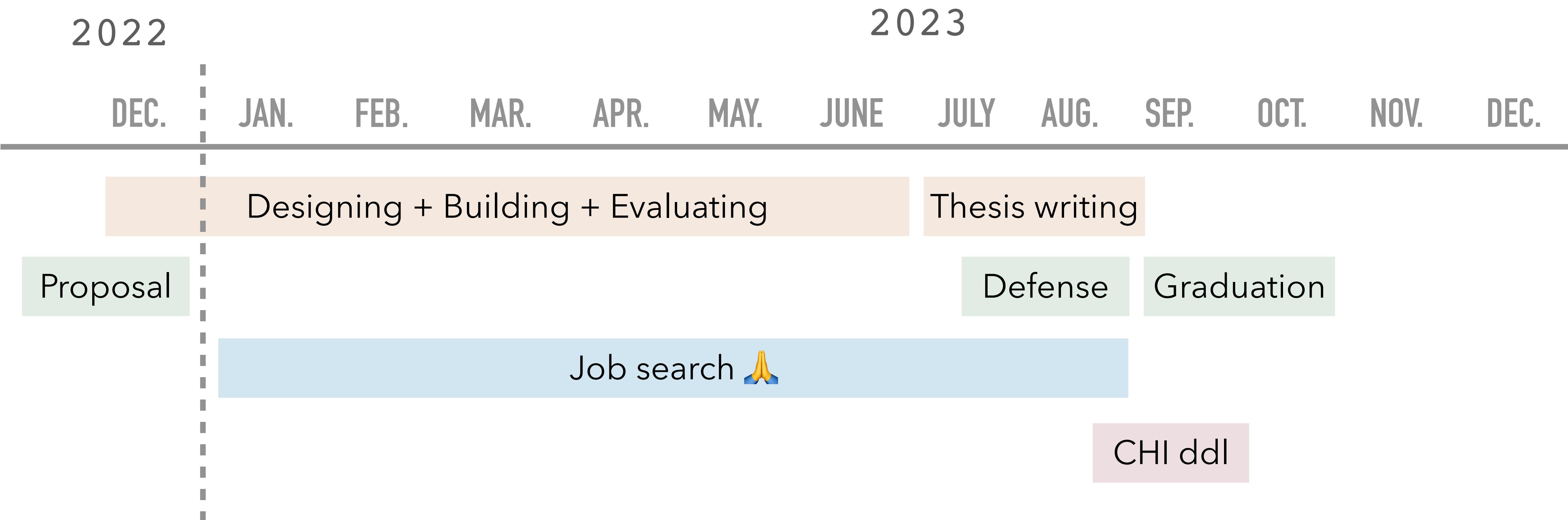
- **[Usability]** Can people use the system to collect and organize information and externalize their thought processes when sensemaking?
- **[Usefulness]** Does the system offer value over what people would normally do when reading through and making sense of web content for decision making?
- **[Effectiveness]** How much effort do people perceive that they have to put into to keep the external structure up-to-date and reflective of their state of thinking at any given point in time?
- **[Characteristics]** What are some potential common characteristics of the structures that people externalize depending on the nature of the tasks?

# Field deployment study

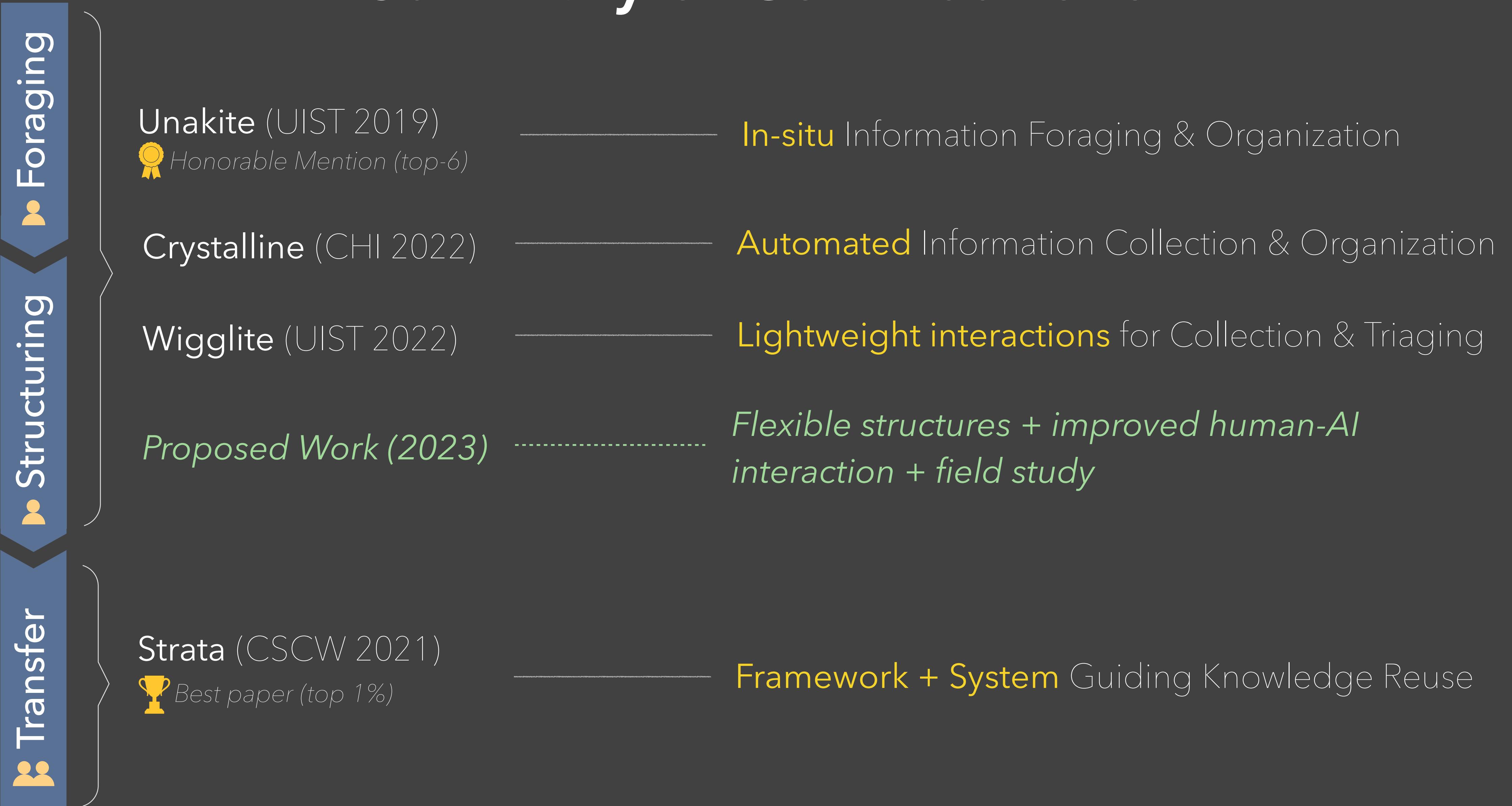
*Planned approach:*

- Integrate existing and the proposed techniques into a new system.
- A small group (20 - 30 users) of participants use the new system for their everyday sensemaking and decision making tasks for an extended period of time (~1 month).
- Use a mix of qualitative (e.g. interviews, surveys, ESM) and quantitative (e.g., log data analysis) methods.
- Present findings and offer design implications for future in-situ sensemaking systems.

# Timeline



# Summary of Contributions





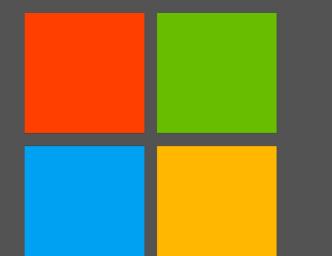
Committee



Thank you ❤️

Collaborators, friends,

R2, participants, & instant noodle



BOSCH

Sponsors

Monday, December 12, 2022



*Ph.D. thesis proposal*

# Tool Support for Knowledge Foraging, Structuring, & Transfer During Online Sensemaking

**Michael Xieyang Liu**

@lxieyang(@hci.social) / xieyangl@cs.cmu.edu

**CMU HCII**

Committee

Brad A. Myers

Aniket Kittur

Kenneth Holstein

Daniel M. Russell (Google)

# Happy Gingerbread House Day!

