

CSCI 1377

Tools for Thought

Multimedia I

Communicating in Space

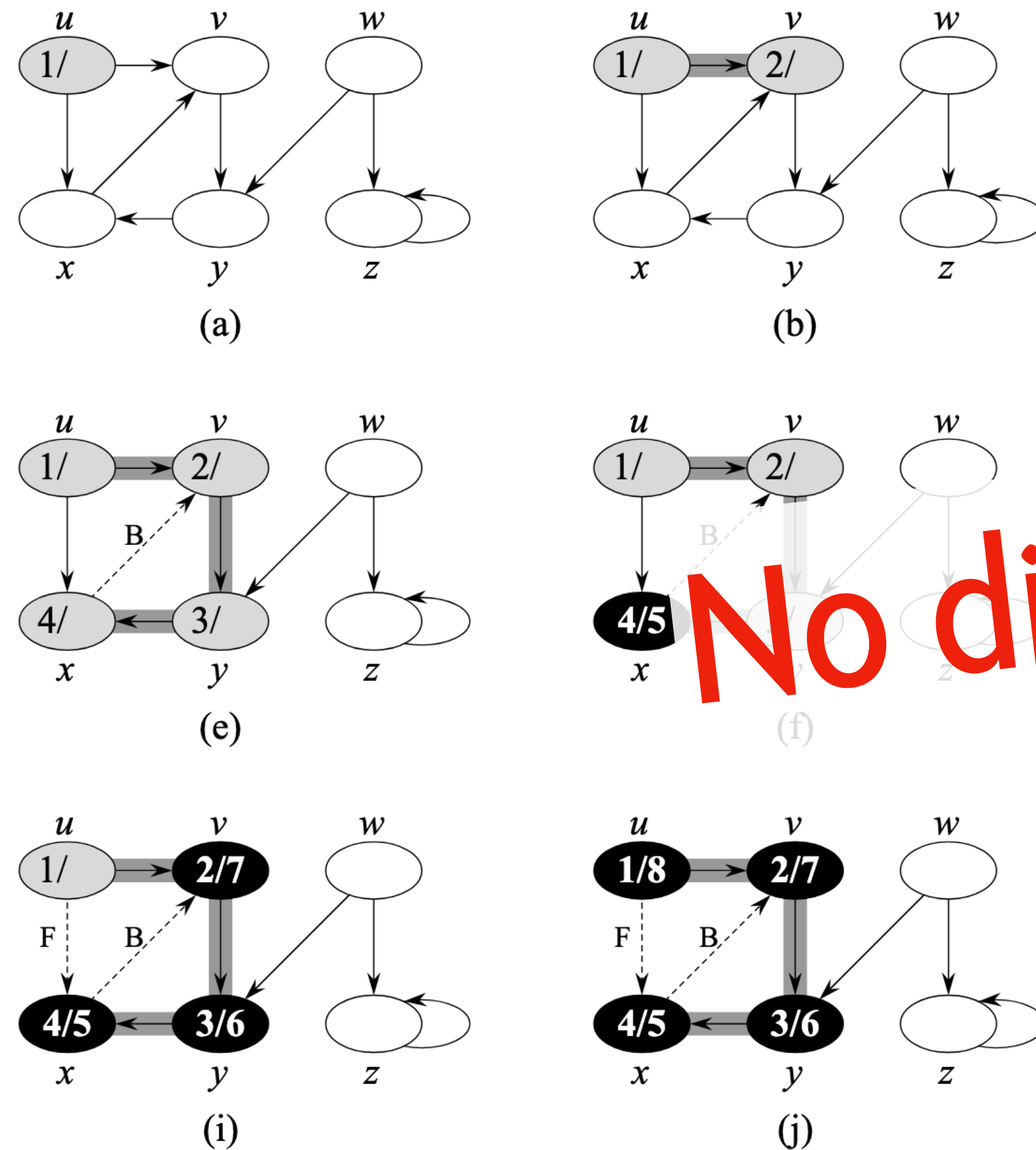


— Scott McCloud, *Understanding Comics* (1993)

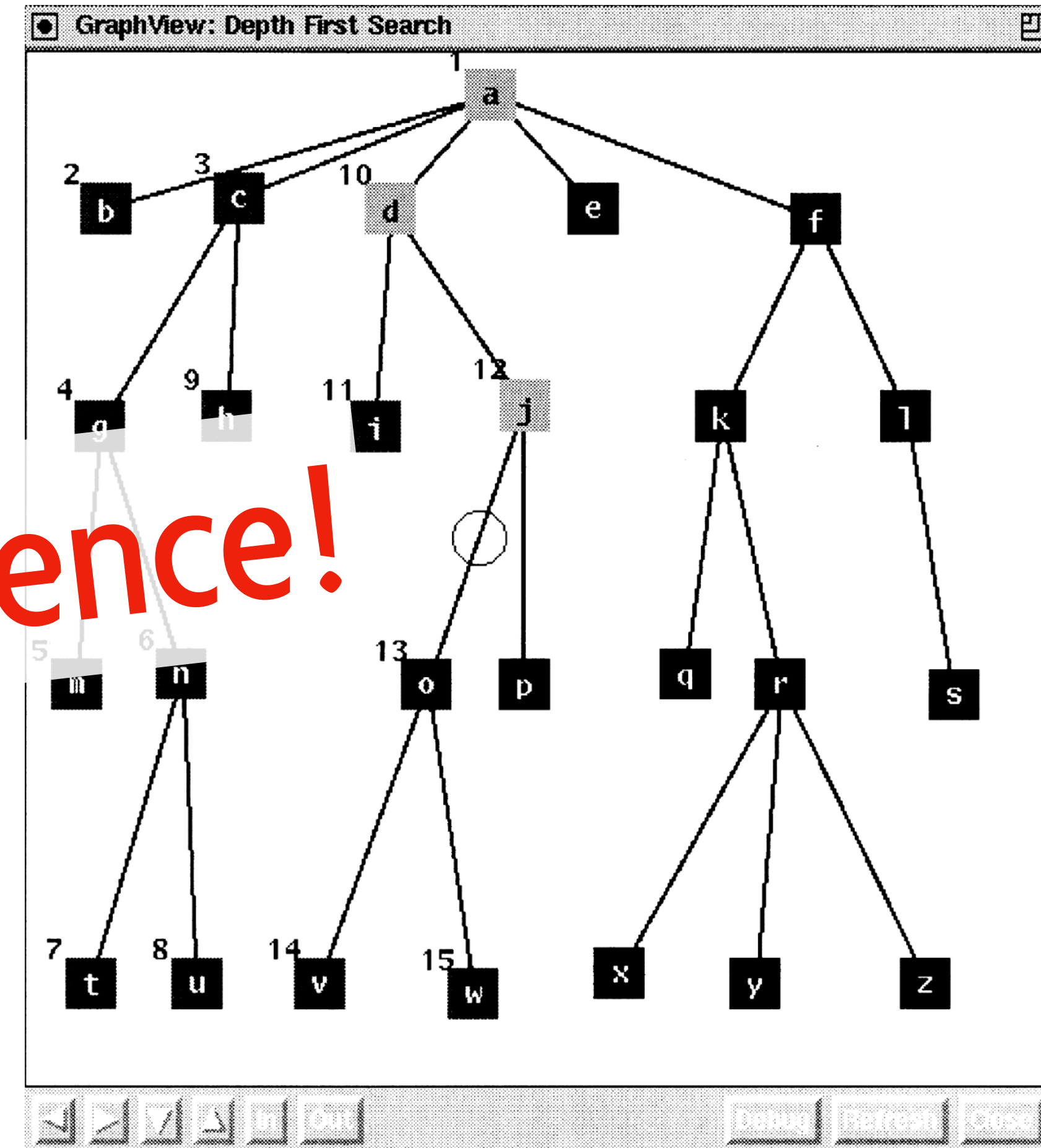
“Perhaps the greatest advantage of electronic documents over paper ones is their ability to handle many more graphic elements. By combining a variety of media, electronic books can provide not only static images, but also dynamics (e.g., computer animations and computer-controlled video sequences), interactivity (e.g., ability to move objects, change and edit objects, and change states), and sound (e.g., computer-generated or audio disk recordings). These features all help in creating better *audiovisualization*.”

— Nicole Yankelovich, Norm Meyrowitz, and Andy van Dam.
“Reading and Writing the Electronic Book” (1985)

But when does multimedia actually help?



from CLRS



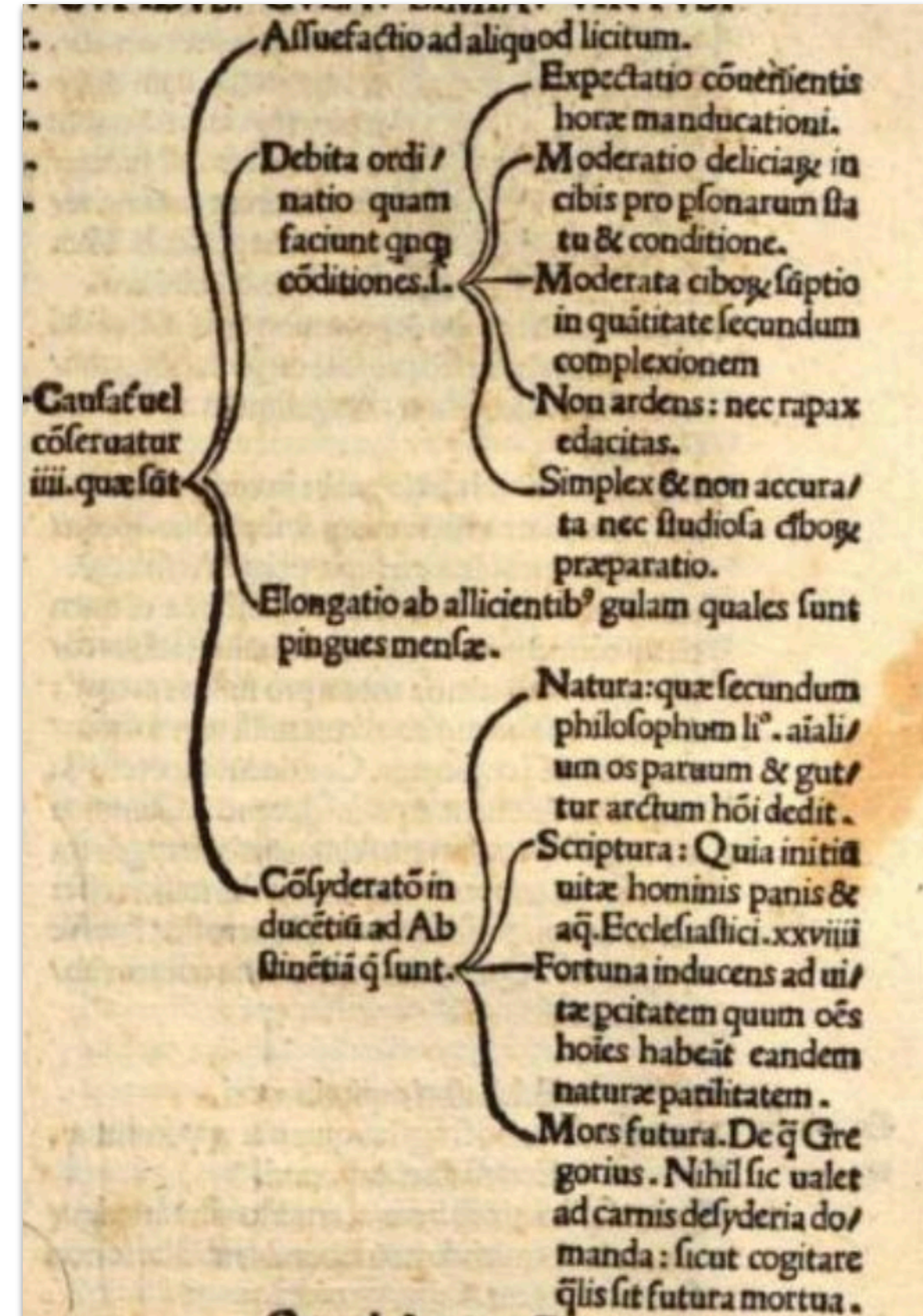
“While static visualizations can provide people with the essence of how something looks, is laid out, or is constituted, animation appears better able to explain a dynamic, evolving process.”

**[https://www.youtube.com/
shorts/scZSaFlX67o](https://www.youtube.com/shorts/scZSaFlX67o)**

Diagrams have existed for thousands of years



Directions to a brothel in Ephesus, Greece (1st c. CE)



Domenico Nani Mirabelli, *Polyanthea* (1503)

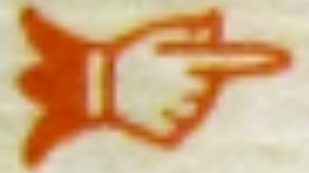
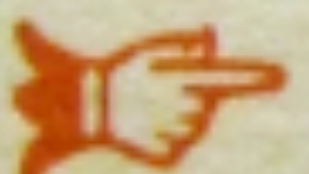
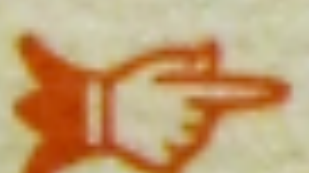
**How far could you go back and have
someone recognize an arrow?**



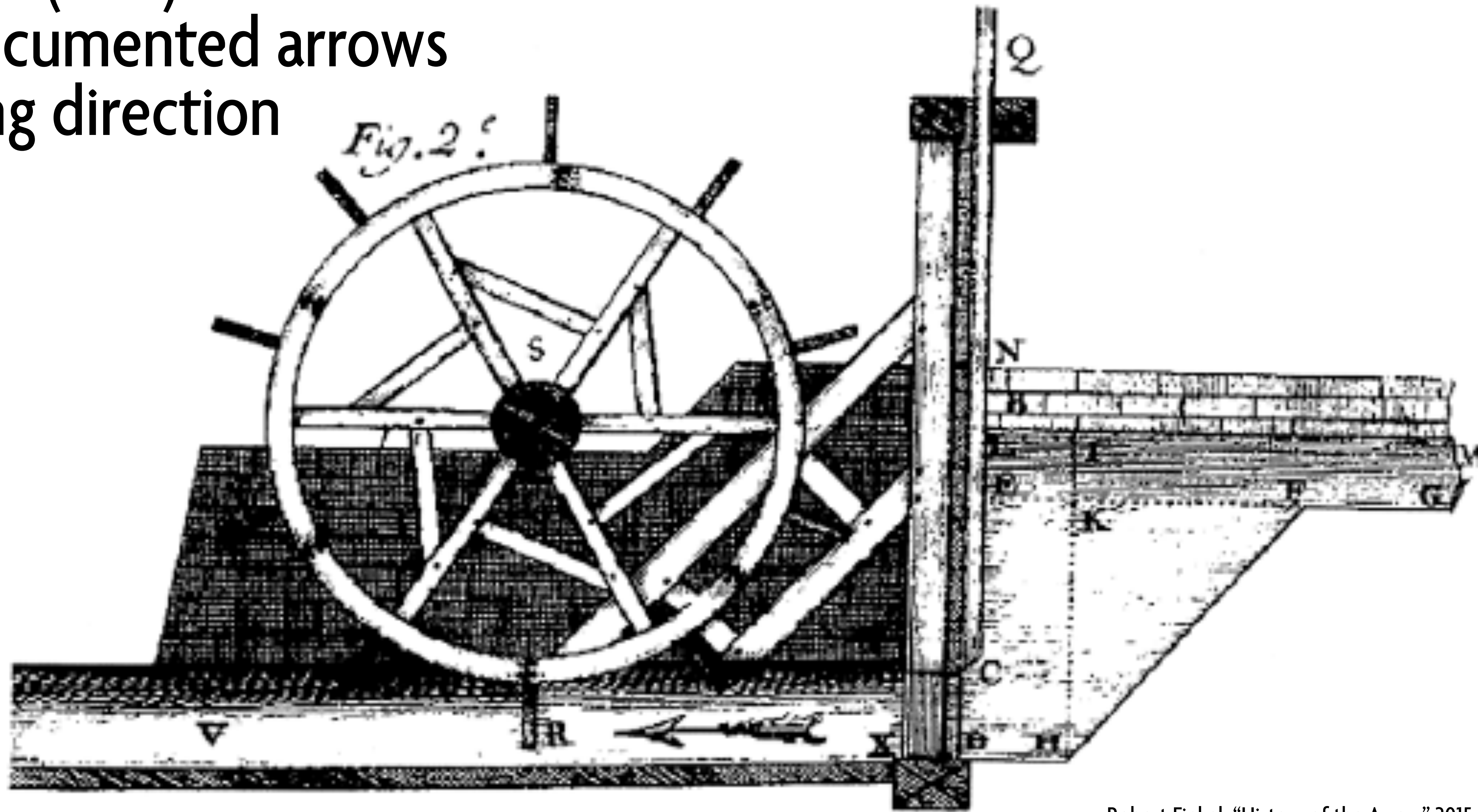
Pointing
was often
done with...
fingers

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Bernard deBélidor's *Hydraulic Architecture* (1737) contains one of the first documented arrows representing direction



The arrow-as-pointer is a recent invention

- Arrows didn't lose their fletchings until the late 1800s
- Arrows were introduced to mathematics by David Hilbert in 1922 to denote implication

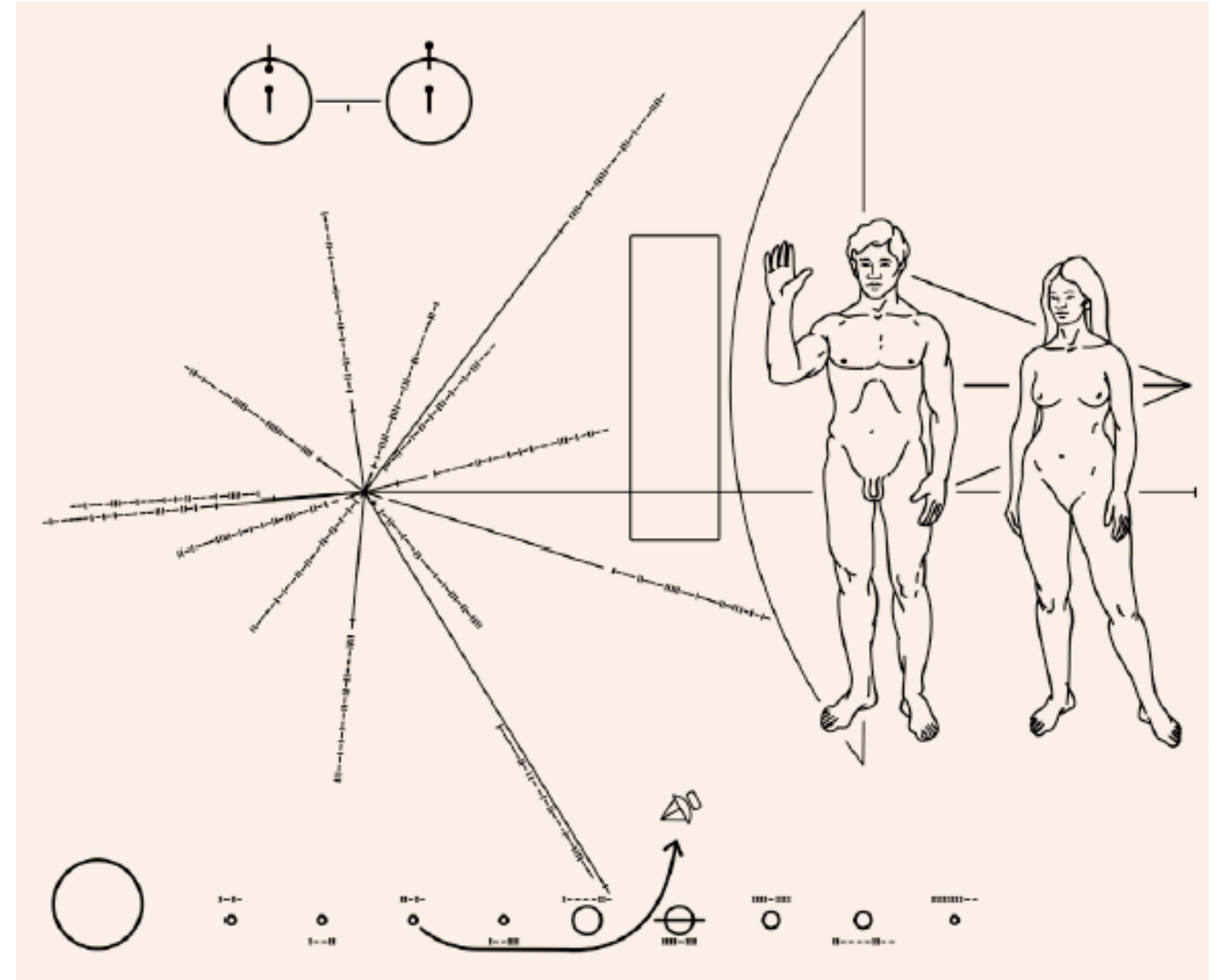


Image sent with the Pioneer 10 probe, 1976

Diagrams in scientific literature

Summary



People return to their baseline weight within 1.7 years on average after stopping treatment with any weight management medication, and just 1.5 years after using semaglutide or tirzepatide

Study design



Systematic review and meta-analysis | Trials (randomised, non-randomised, single arm) and cohort studies (prospective or retrospective)

Data sources



37 studies | 9341 participants ≥ 18 years old with overweight or obesity

Comparison

Intervention

Pharmacological interventions currently or previously licensed for weight loss

6322

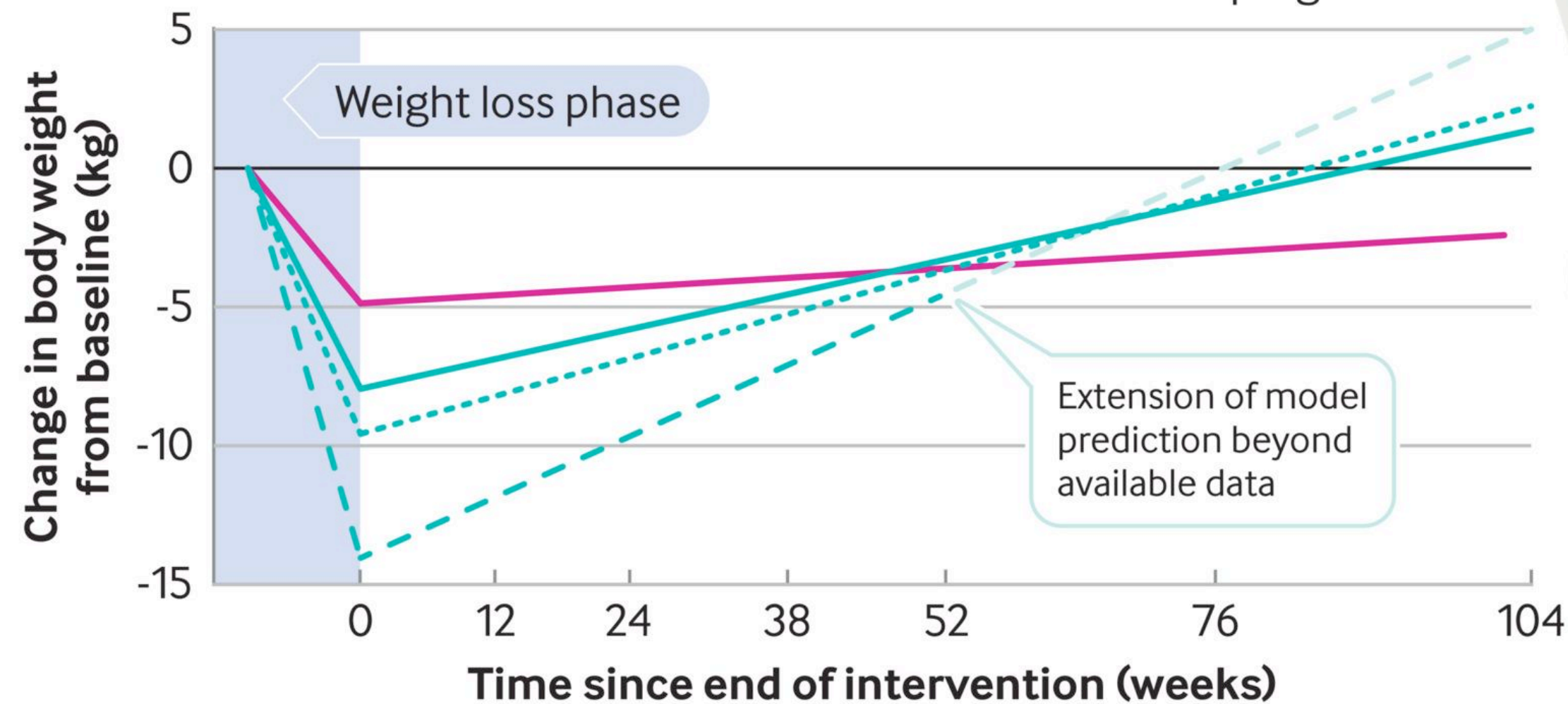
Control

Non-pharmacological weight loss interventions or placebos

3019

Outcomes

— All medication — Newer incretin mimetics
- - - All incretin mimetics — Behavioural programmes



To help our readers to get a quick overview of research we publish, we started making visual abstracts...

— BMJ

Visual Abstracts are eye-catching, graphical summaries of your research. Because they combine image and text, they are easy to read and very effective at engaging your audience, especially on social media channels. Think of a Visual Abstract as the business card for your research!

— Springer Nature

Summary



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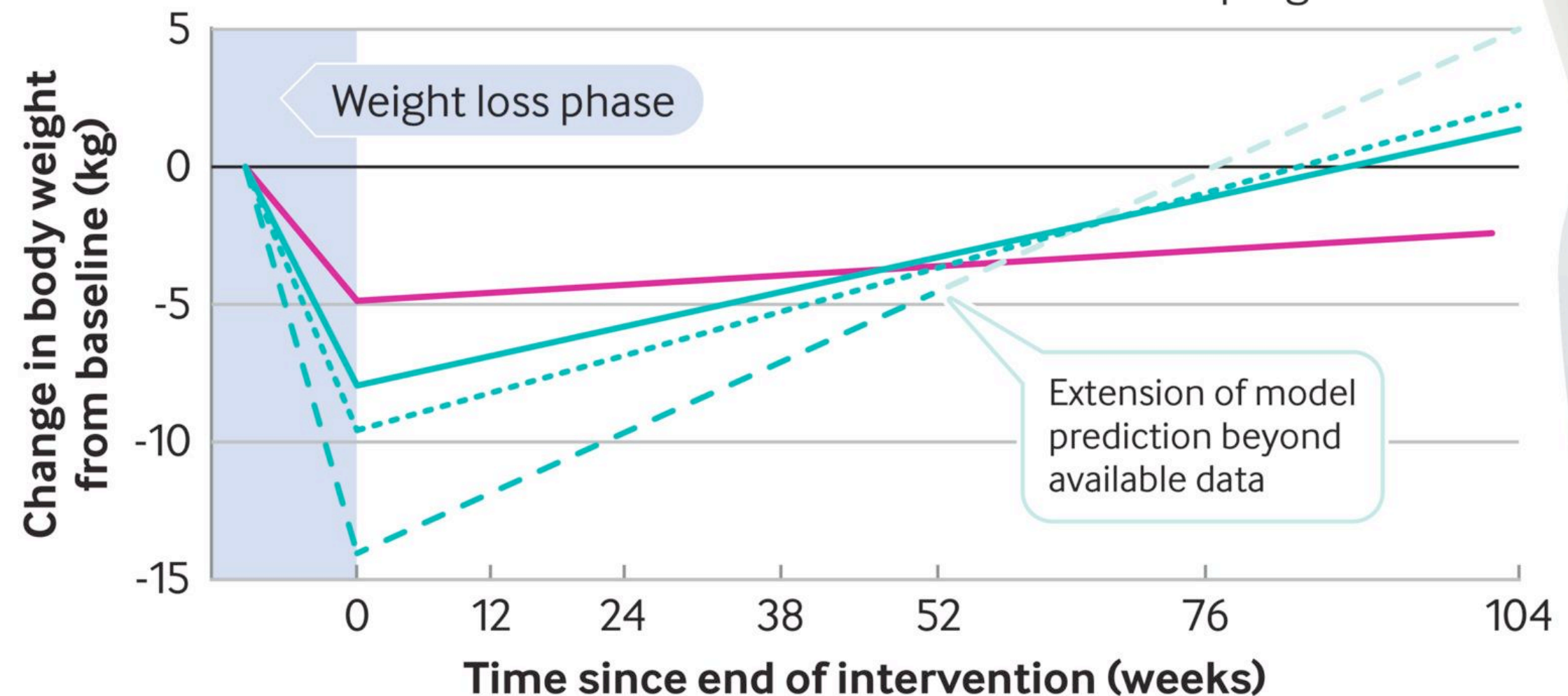
Control

Non-pharmacological weight loss interventions or placebos

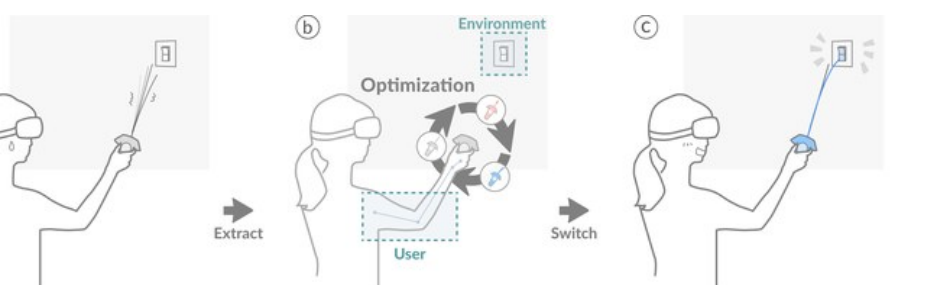
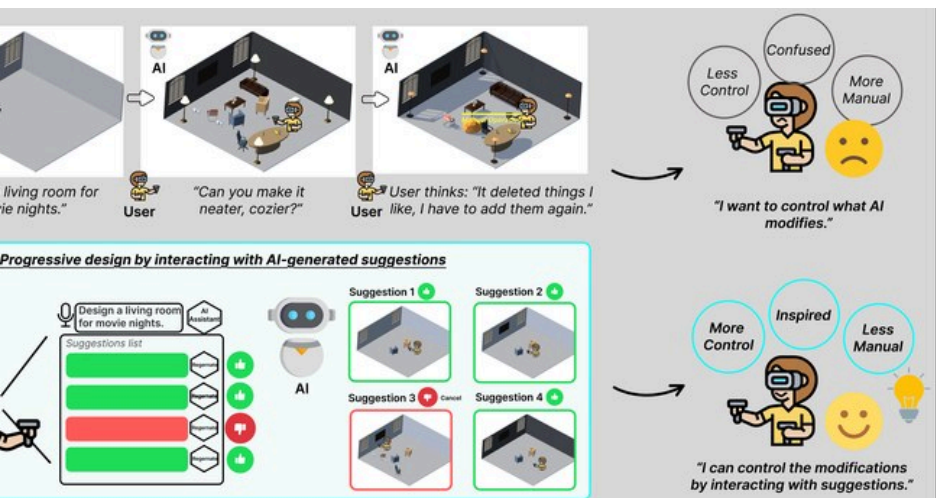
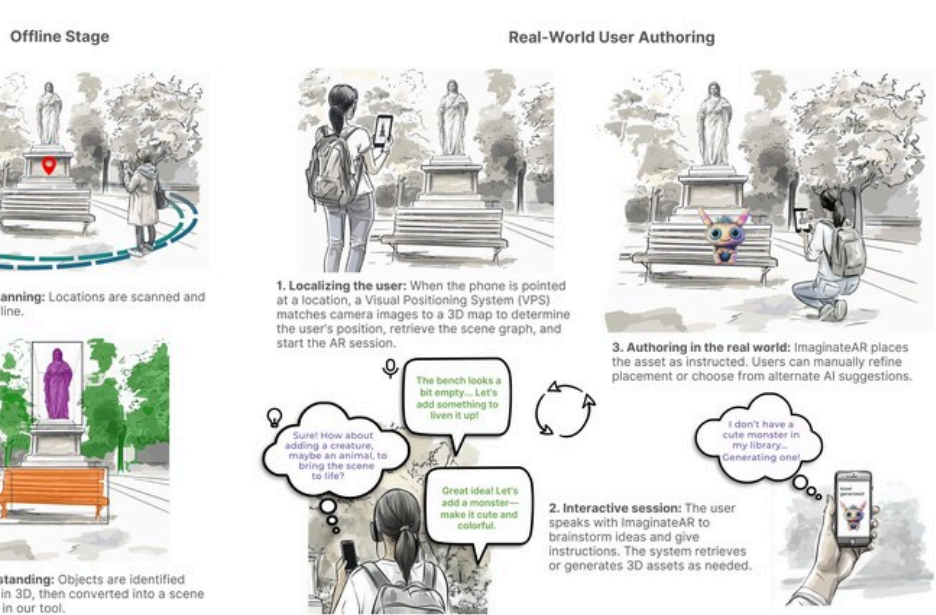
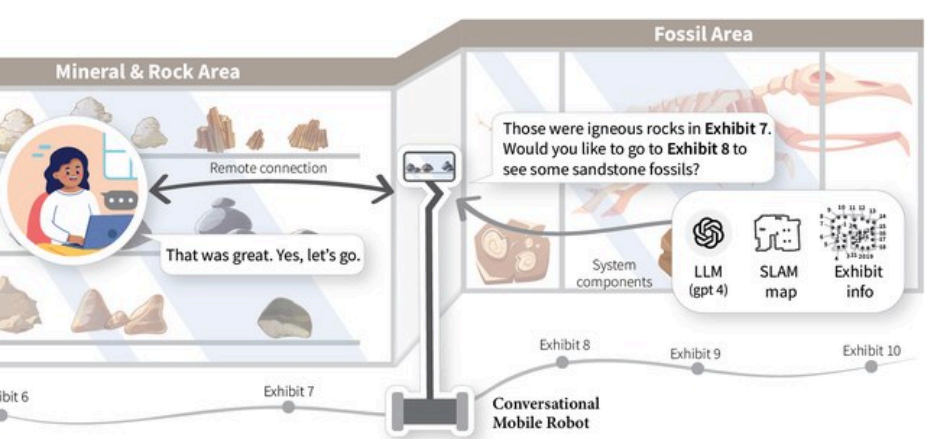
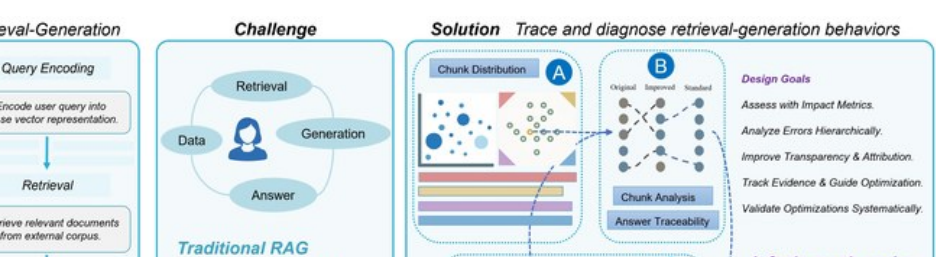
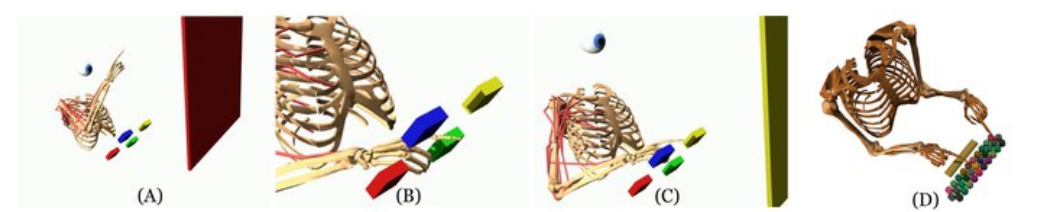
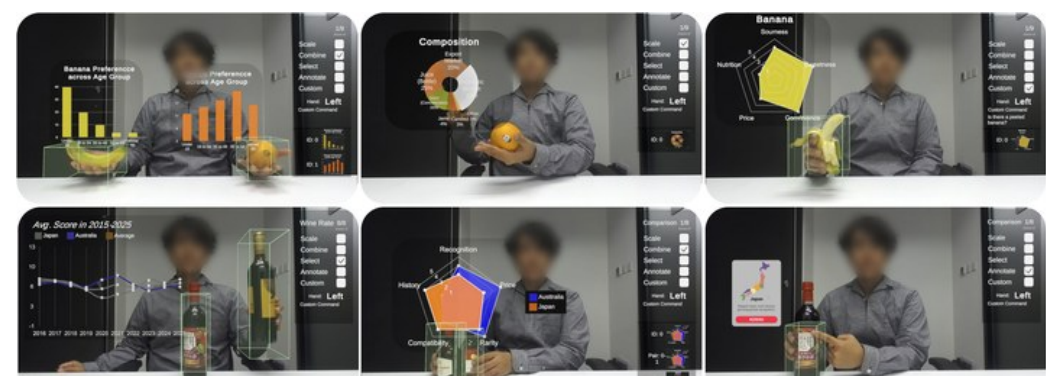
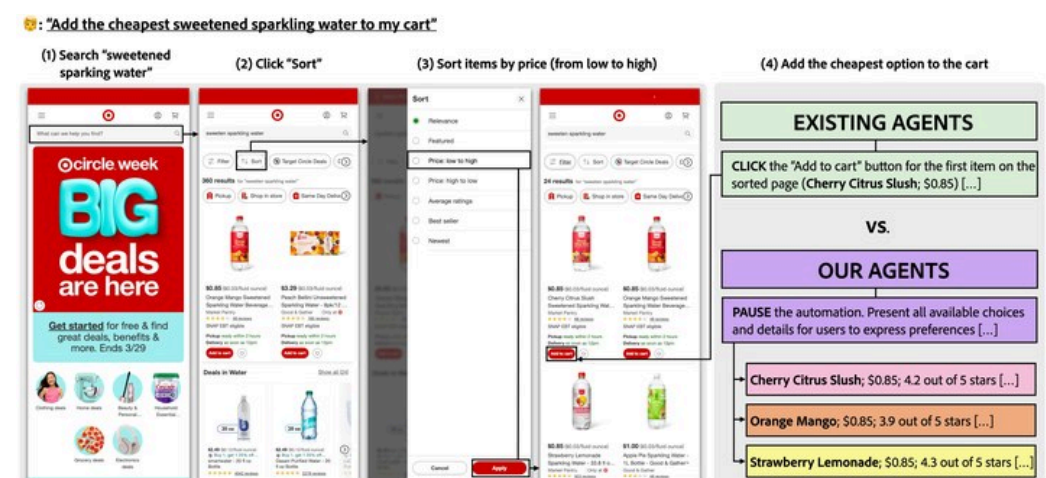
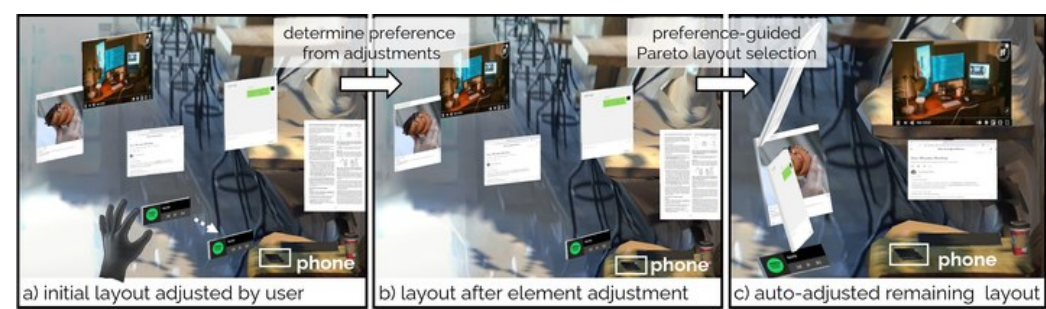
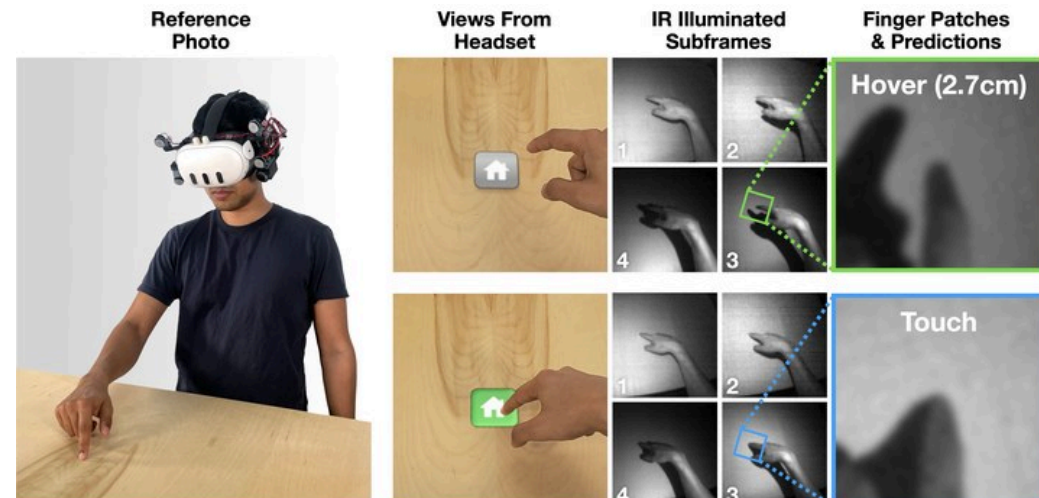
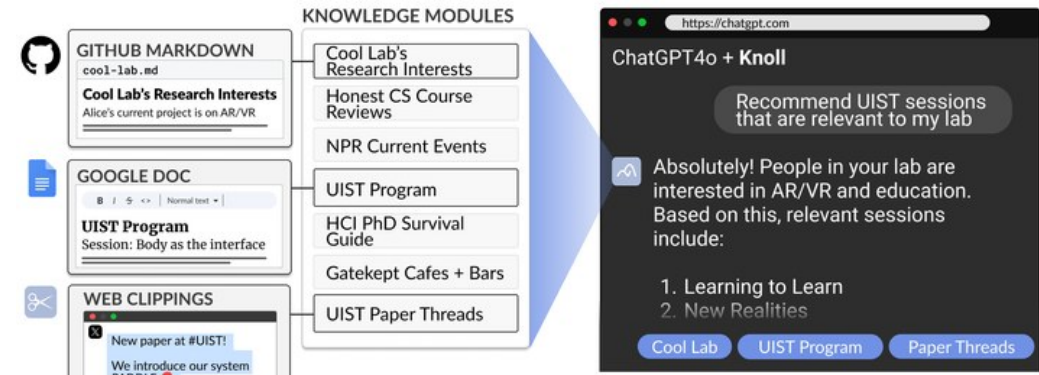
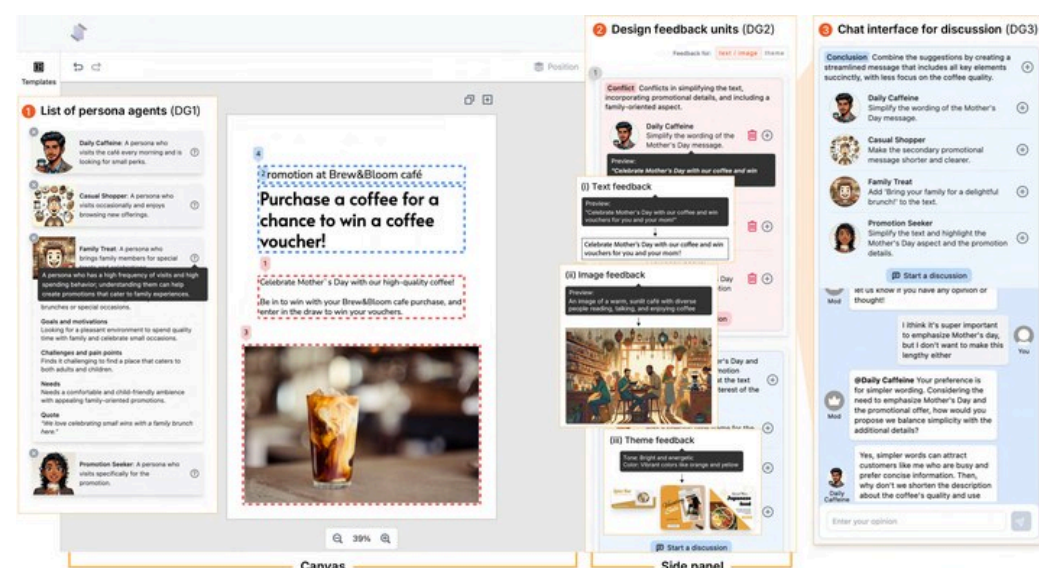
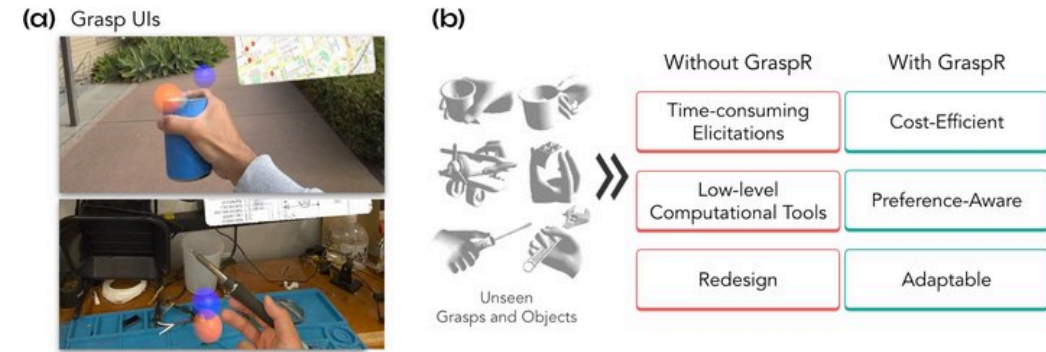
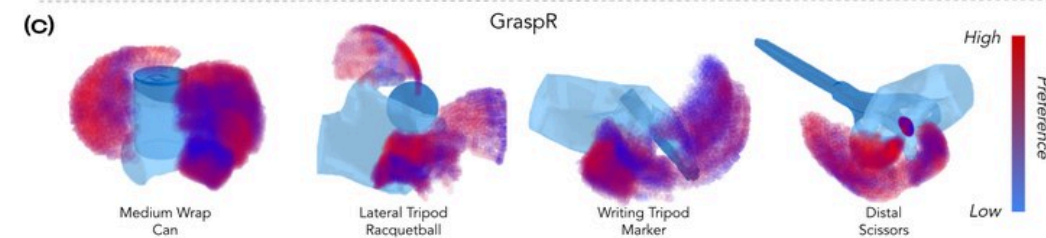
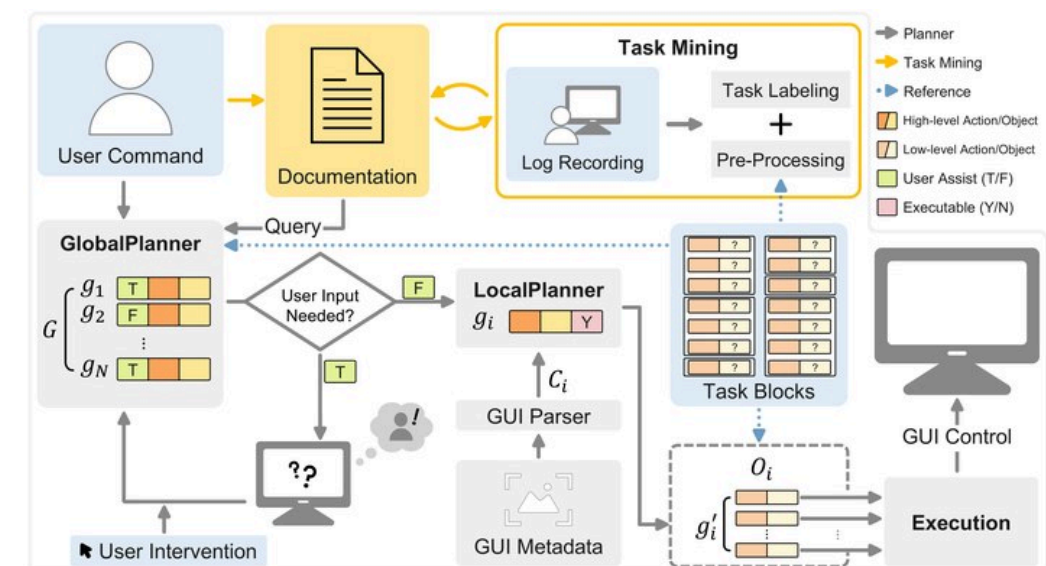
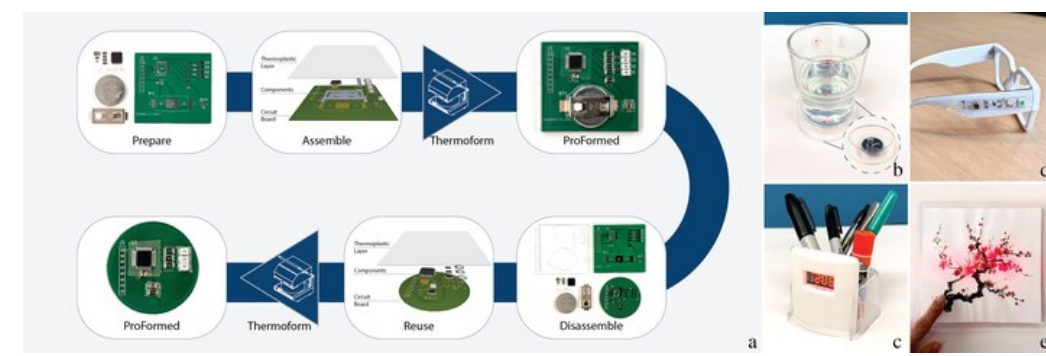
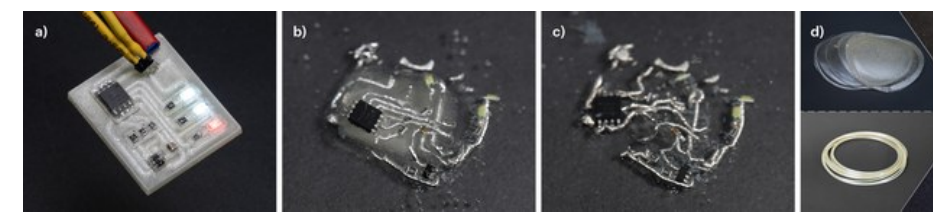
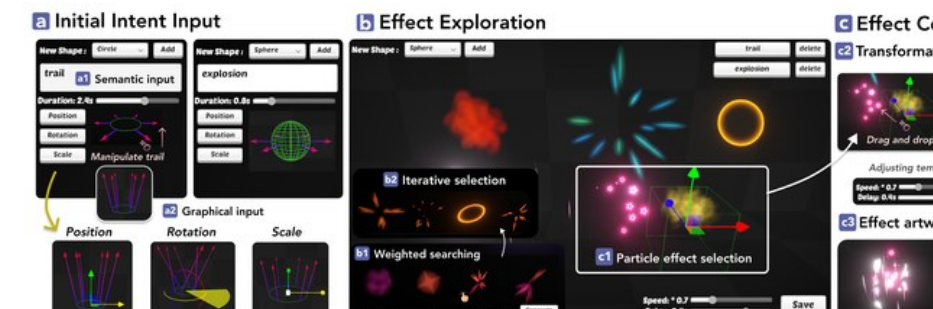
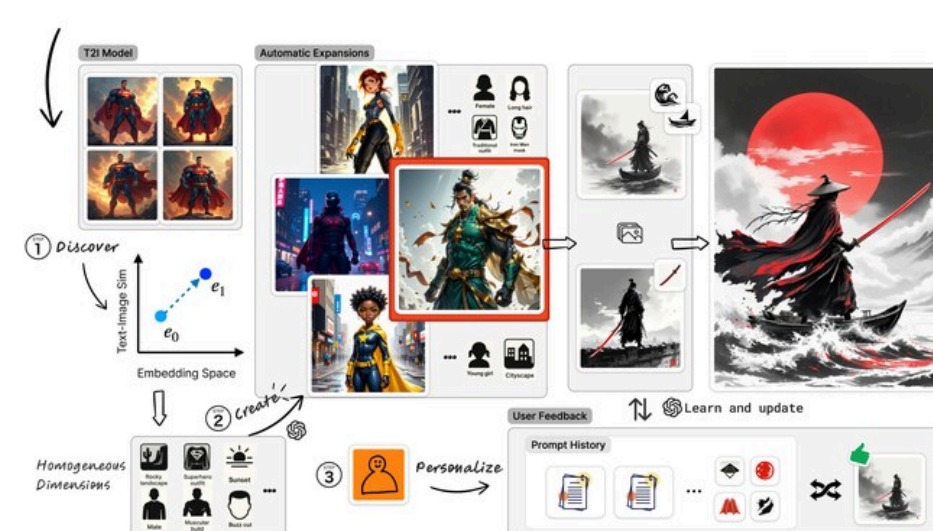
3019

Outcomes

— All medication — Newer incretin mimetics
- - - All incretin mimetics — Behavioural programmes



The modern diagram takes many forms!



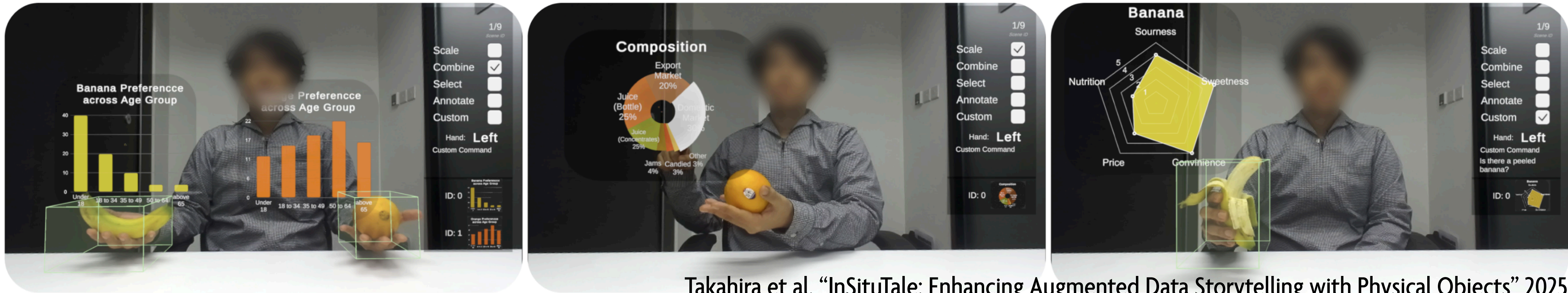
Exercise: build a theory of HCI diagrams

- Goal: analyze the common structure of these diagrams
 - Clusters: which charts are related in form or function?
 - Components: what are common elements across the charts?
 - Efficacy: pick one chart you think is especially effective, and one ineffective
- Format: 5 min on your own, 5 min in small groups, 5 min discussion



[https://cel.cs.brown.edu
/csci-1377-f26
/slides
/12_Multimedia_I_Exercise.pdf](https://cel.cs.brown.edu/csci-1377-f26/slides/12_Multimedia_I_Exercise.pdf)

Example gallery



Takahira et al. “InSituTale: Enhancing Augmented Data Storytelling with Physical Objects” 2025

▼ Flat Text Layout

```
const abs = (x) =>
  x < 0 ? -x
        : x;
```

▼ BOXES Layout

```
const abs = (x) =>
  x < 0 ? -x
        : x;
```

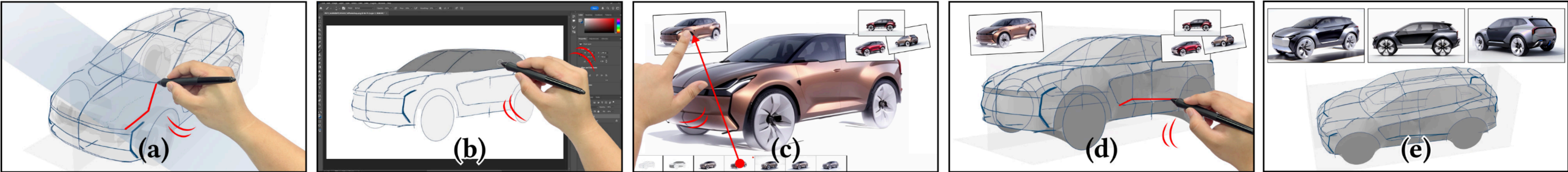
▼ Rocks Layout

```
const abs = (x) =>
  x < 0 ? -x
        : x;
```

▼ Rocks Layout, Simplified

```
const abs = (x) =>
  x < 0 ? -x
        : x;
```

Cohen and Chugh. “Ragged Blocks: Rendering Structured Text with Style” 2025



Lee et al. “3D Sketching + 2D Generative AI for Car Exterior Design” 2025

Annotated screenshots

Exact Match Filter:

Aspects

Pre-Defined Aspects

Problem Domain

Gaps in Prior Work

Methodology/Contribution

Results/Findings

Discussion/Conclusion

User-Defined

Cross-Sentence Relationships

Bookmarked Sentences

Methodology

Goal/Focus

Participants

Contribution

System Characteristics

Context/Status Quo

Enumeration

Highlight All

Switch to Global view

left-justify

Contribution

System Characteristics

(347 sentences)

We propose CreativeConnect, a system with generative AI pipelines that helps users discover u:

We present ChainForge, an open-source visual toolkit for prompt engineering and on-deman

Abstracts

Show full abstract only

#1 Seam Work and Simulacra of Societal Impact in Networking Research: A Critical Technical Practice Approach

807 Choi et al.

672 Arawjo et al.

324 Kim et al.

452 Kazemita. et al

628 Yan et al.

82 Kuo et al.

459 Hou et al.

267 Salvi et al.

638 Hong et al.

169 Zong et al.

1007 Son et al.

54 Duan et al.

150 Yildirim et al.

838 Gu et al.

424 Tan et al.

909 Frost et al.

90 O'Leary et al.

464 Lipkowitz et al

Query Decomposition

Task Specifications

task

Evaluate the effects of remote work on quality of life through various periods of the pandemic

Suggestions to Refine your Search Query:

Assess remote work's impact on life satisfaction during the pandemic

Assess remote work's influence on employment quality during the pandemic

Assess the impact of remote work preferences on post-pandemic quality of life

Filters (1)

column group include hours

Search using your own Column Concept

Enter column name...

Smart Filter by Column Concept:

recession

satisfaction

employment

remote

quality

Remaining datasets: 8

apply filters

Top Granularity Filters

Country (5)

Day (2)

Year (2)

apply filters

Top Dataset Results

Showing 1 to 8 of 8 datasets.

1. Global Remote Work & Wellbeing Dataset.

10 cols · 10000 rows · 133.3 kB · 179

2. Remote Work USA (COVID-19)

24 cols · 3147 rows · 2.0 MB · 81

3. Remote Work Productivity

5 cols · 1000 rows · 6.7 kB · 3.3k

4. COVID-19 on Working Professionals

15 cols · 10000 rows · 255.2 kB · 2.2k

5. Impact of COVID-19 on Working Professionals

15 cols · 10000 rows · 239.5 kB · 3.1k

6. World time use, work hours and GDP

7 cols · 329 rows · 207.6 kB · 734

7. Impact of Covid-19 on Employment - ILOSTAT

9 cols · 283 rows · 11.1 kB · 2.6k

8. Annual Working Hours Dataset (1870-1970)

4 cols · 3470 rows · 27.1 kB · 476

Global Remote Work & Wellbeing Dataset.

global_remote_work_wellbeing.csv

Usability score: 100% 10 cols 10000 rows 133.3 kB 179 global business jobs and career employment Day-Level Granularity

Why is this dataset relevant for your task?

Utility: The dataset includes relevant attributes such as Daily_Working_Hours, Stress_Level, Sleep_Duration, and Work_Life_Balance_Satisfaction, which can help in evaluating the effects of remote work on quality of life.

Limitation: The dataset does not specify a time period or geographical location, as it is described as a comprehensive dataset without temporal or spatial constraints.

Description

The Global Remote Work & Wellbeing Dataset is a comprehensive synthetic dataset designed to capture the multifaceted impacts of remote work on employee productivity, mental health, and work-life balance. It includes anonymized data from various sources to provide insights into daily work experiences and lifestyle patterns in remote work environments.

Dataset Preview

Employee_ID	Daily_Working_Hours	Screen_Time	Meetings_Attended	Emails_Sent	Productivity_Score	Stress_Level	Physical_Activity_Steps	Sleep_Duration	Work_Life_Balance_Satisfaction
---	---	---	---	---	---	---	---	---	---
E00001	7.0	5.6	5	30	3	5	11501	5.8	4
E00002	11.6	5.3	1	30	5	6	5742	8.7	2
E00003	9.9	4.2	3	21	8	4	4852	4.7	1
E00004	8.8	7.3	4	99	1	9	11928	4.3	2
E00005	5.2	6.3	4	87	2	3	7665	7.9	7
E00006	5.2	9.1	6	48	7	2	10325	6.0	2
E00007	4.5	3.2	7	88	1	3	14744	6.3	4
E00008	10.9	7.5	2	27	5	5	2502	8.7	5
E00009	8.8	8.3	5	29	10	1	13911	6.9	3
E00010	9.7	8.3	0	96	8	10	2636	7.3	4

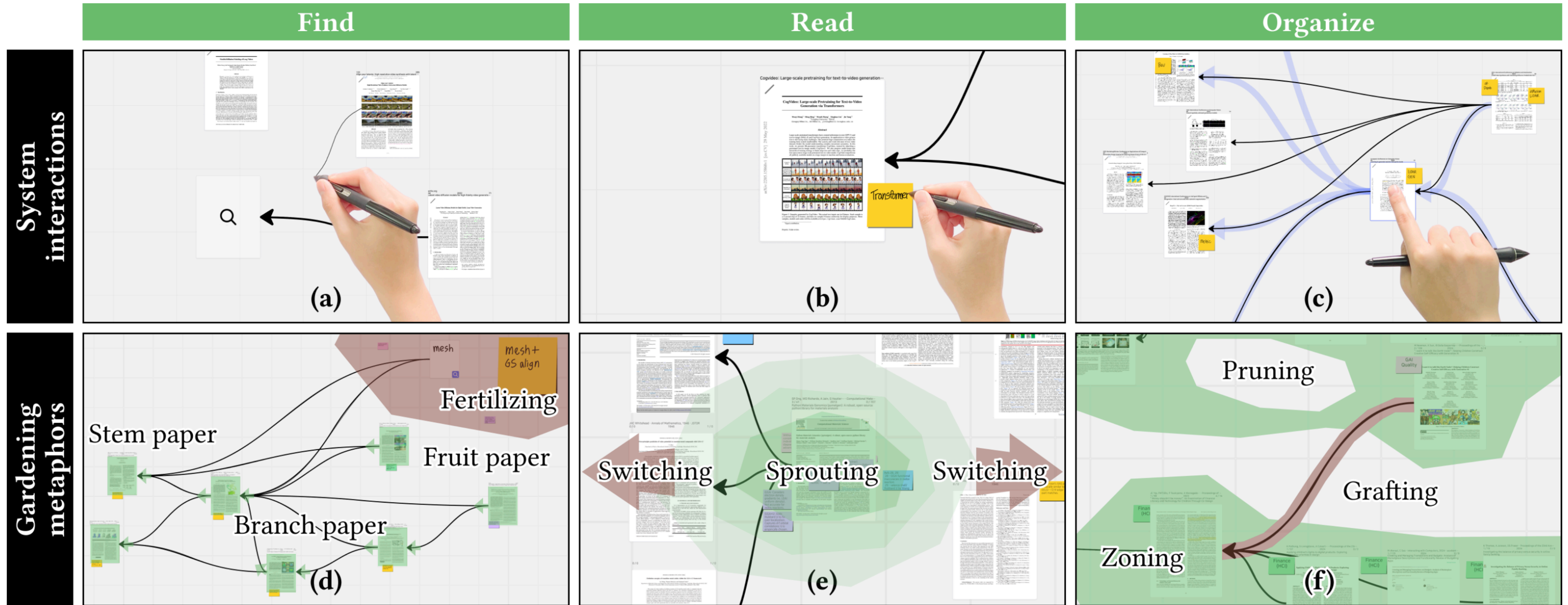
Data Source & Collection Method

The data has been aggregated from a variety of sources, including productivity tracking tools, wearable health devices, and employee self-report surveys.

Gu et al. “AbstractExplorer: Leveraging Structure-Mapping Theory to Enhance Comparative Close Reading at Scale” 2025

Lin et al. “Rethinking Dataset Discovery with DataScout” 2025

Structured + annotated example gallery

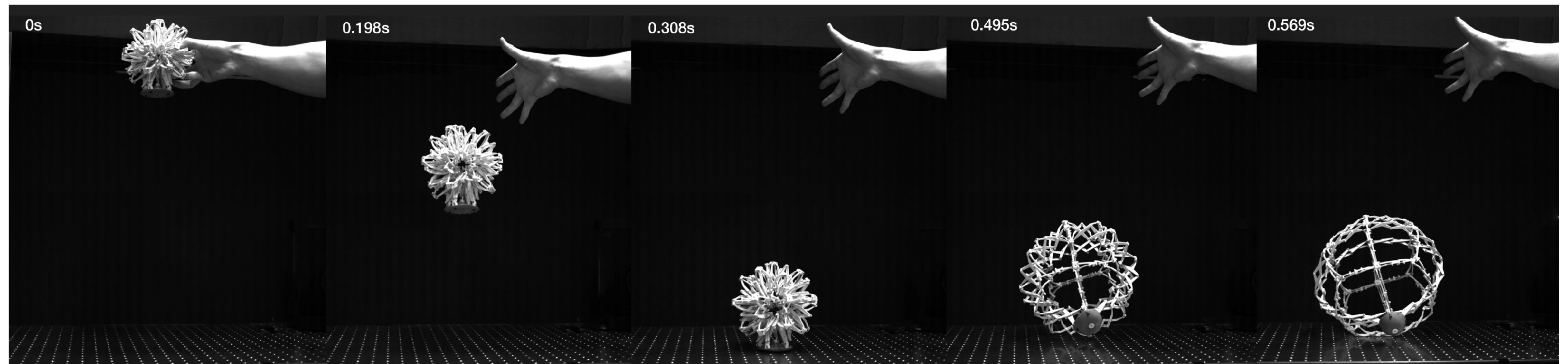


Ma et al. "Garden of Papers: Finding, Reading, and Organizing Research Papers in a Visual, Integrated, and Flexible Workspace" 2025

Video comics



Zhang et al. "BaroPoser: Real-time Human Motion Tracking from IMUs and Barometers in Everyday Devices" 2025



Fu et al. "DropPop: Designing Drop-to-Deploy Mechanisms with Bistable Scissors Structures" 2025

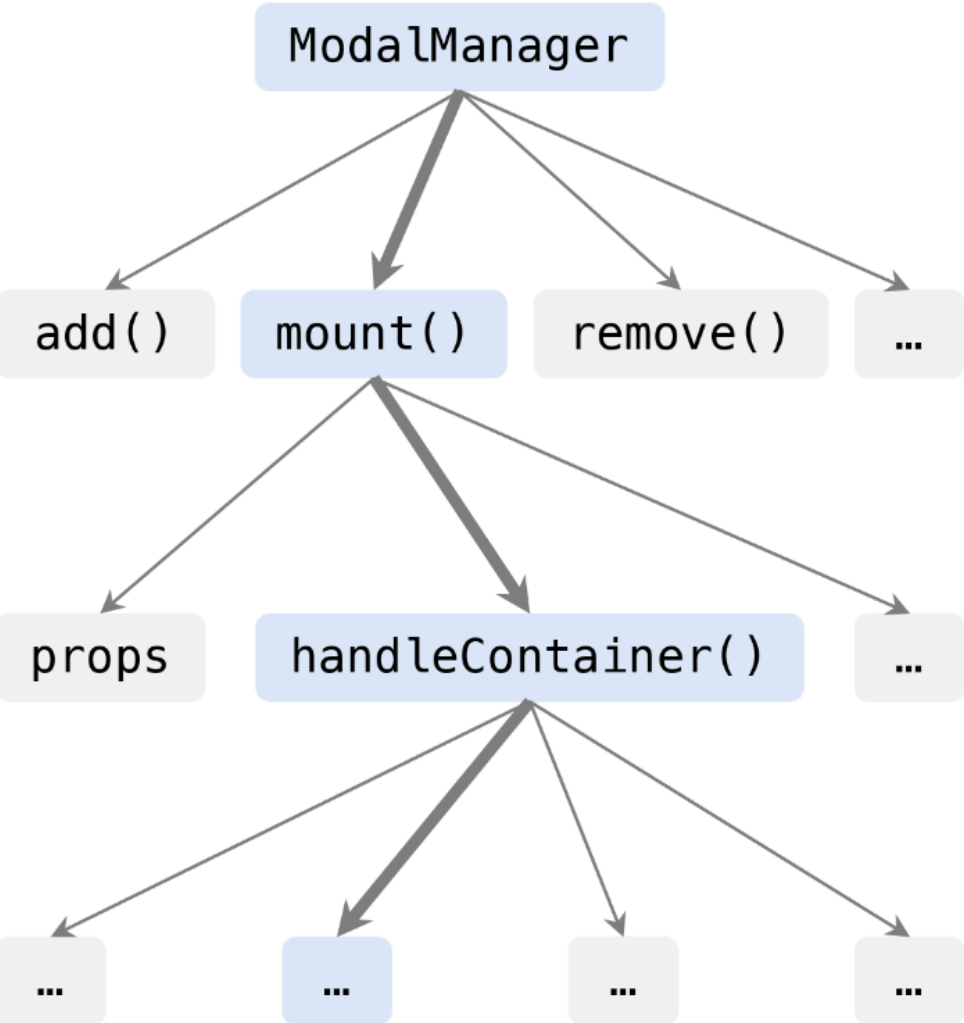
Conceptual comics

1 Developer asks a reachability question

Q: How does the *ModalManager* prevent scrolling?

```
TS ModalManager.ts
206 export class ModalManager {
249   mount(modal: Modal, props:
251     const containerInfo = this.
       containers[containerIndex];
252
253   if (!containerInfo.restore) {
254     containerInfo.restore =
       handleContainer(containerInfo,
         props);
255   }
256 }
```

2 AI agent explores code



3 Agent answers questions with traces

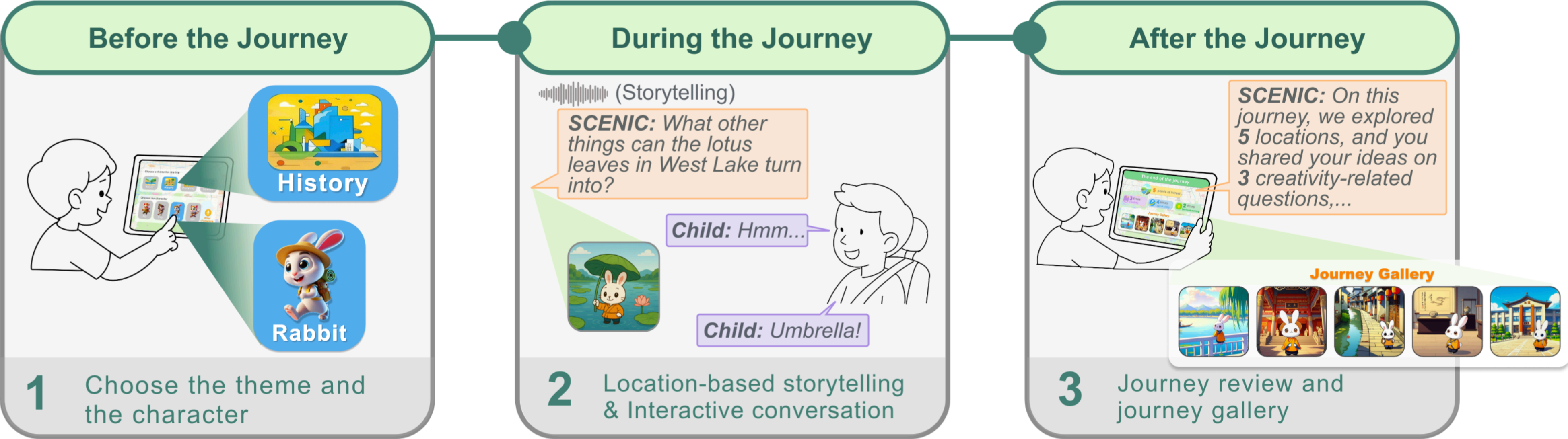
Answer
It prevents scrolling by using the `handleContainer` ...

Descriptive tour of code
The code sets `scrollContainer.style.overflow` to `hidden` to lock scrolling ... walk me here

Replayable Walkthrough
I started here ...
 I decided to look for more info about `mount`
 I decided to look for more info about ...

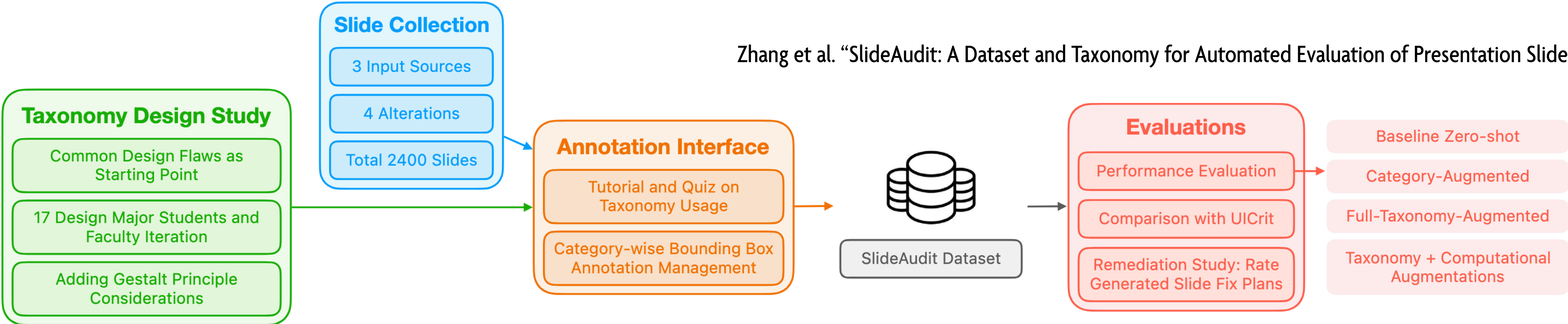
Yan et al. “Answering Developer Questions with Annotated Agent-Discovered Program Traces” 2025

Chen et al. “SCENIC: A Location-based System to Foster Cognitive Development in Children During Car Rides” 2025

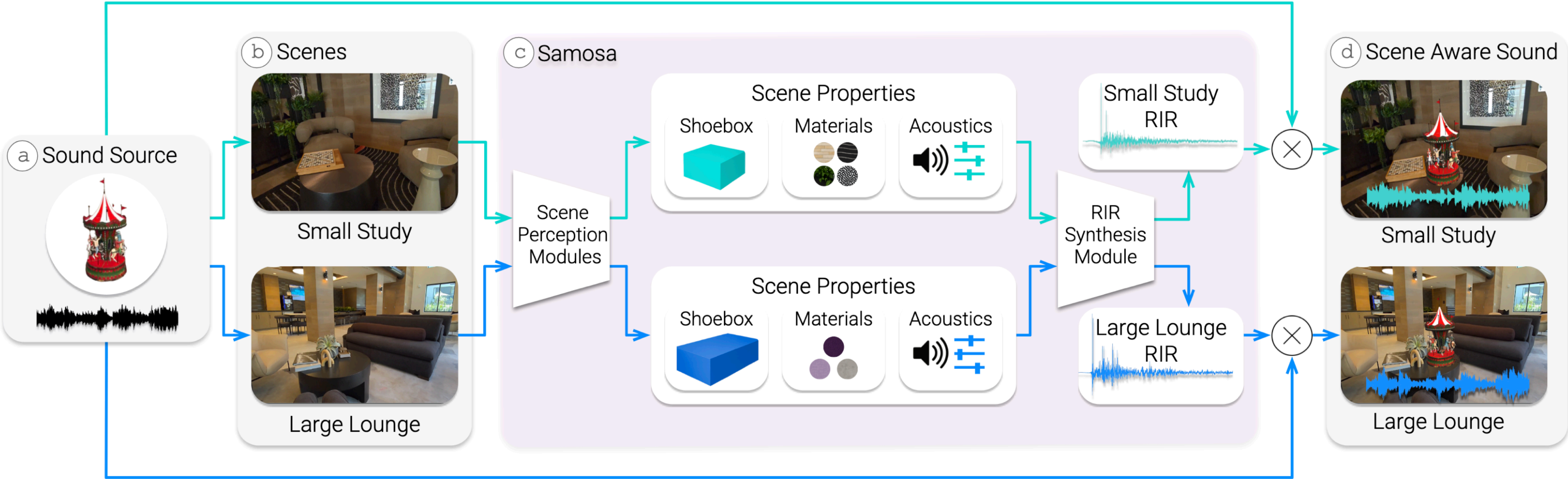


System architecture

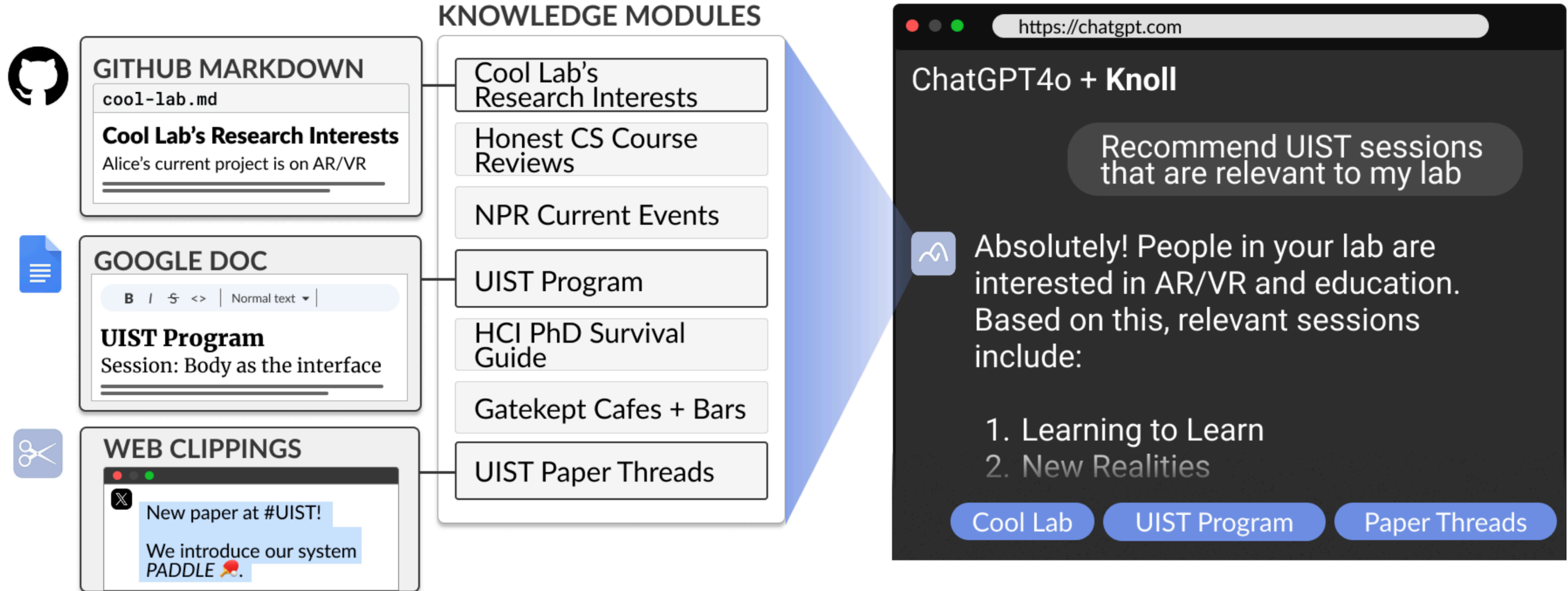
Zhang et al. "SlideAudit: A Dataset and Taxonomy for Automated Evaluation of Presentation Slides" 2025



Xu et al. "Enhancing XR Auditory Realism via Multimodal Scene-Aware Acoustic Rendering" 2025

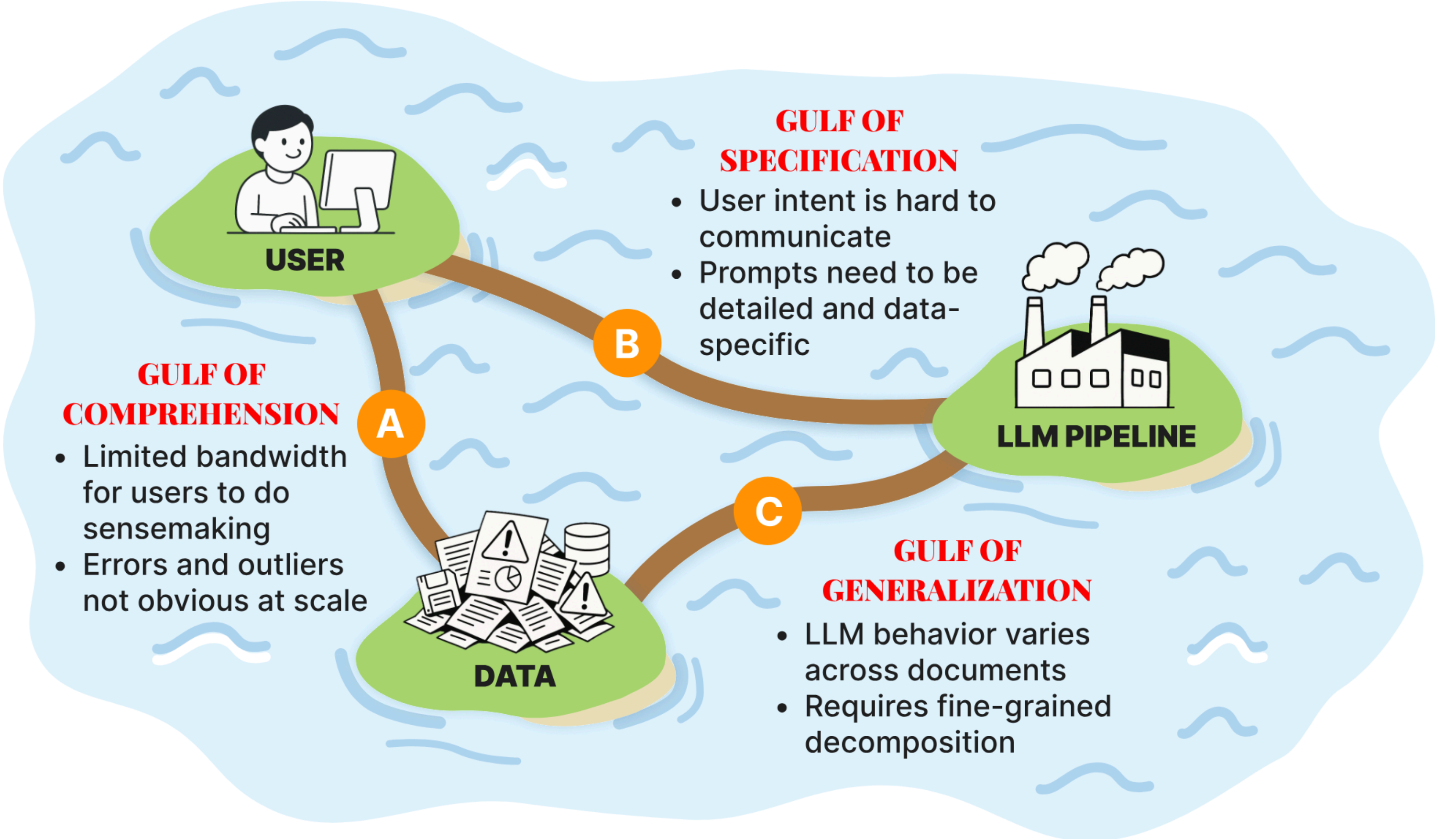


System architecture?



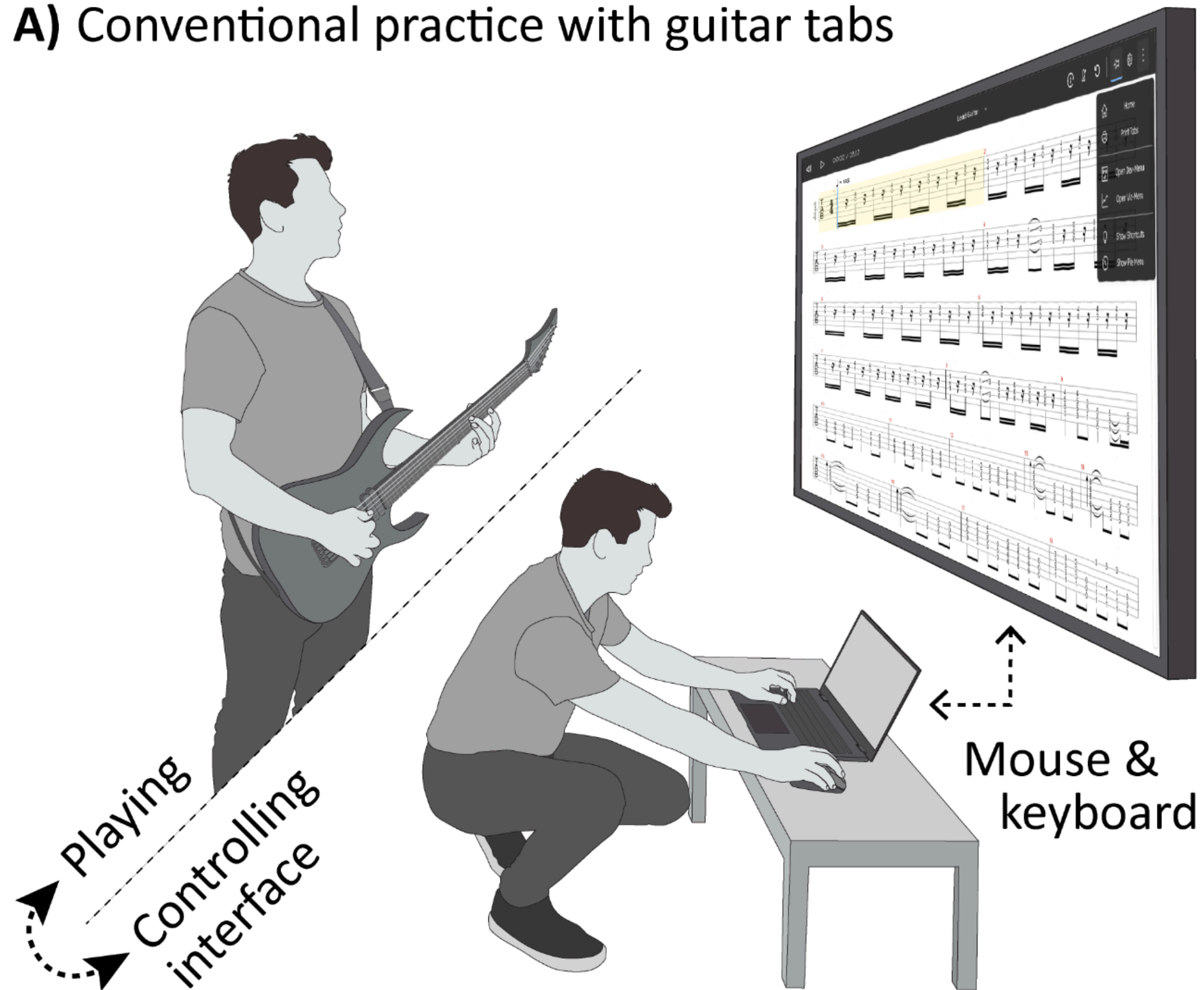
Zhao et al. "Knoll: Creating a Knowledge Ecosystem for Large Language Models" 2025

Visual metaphor

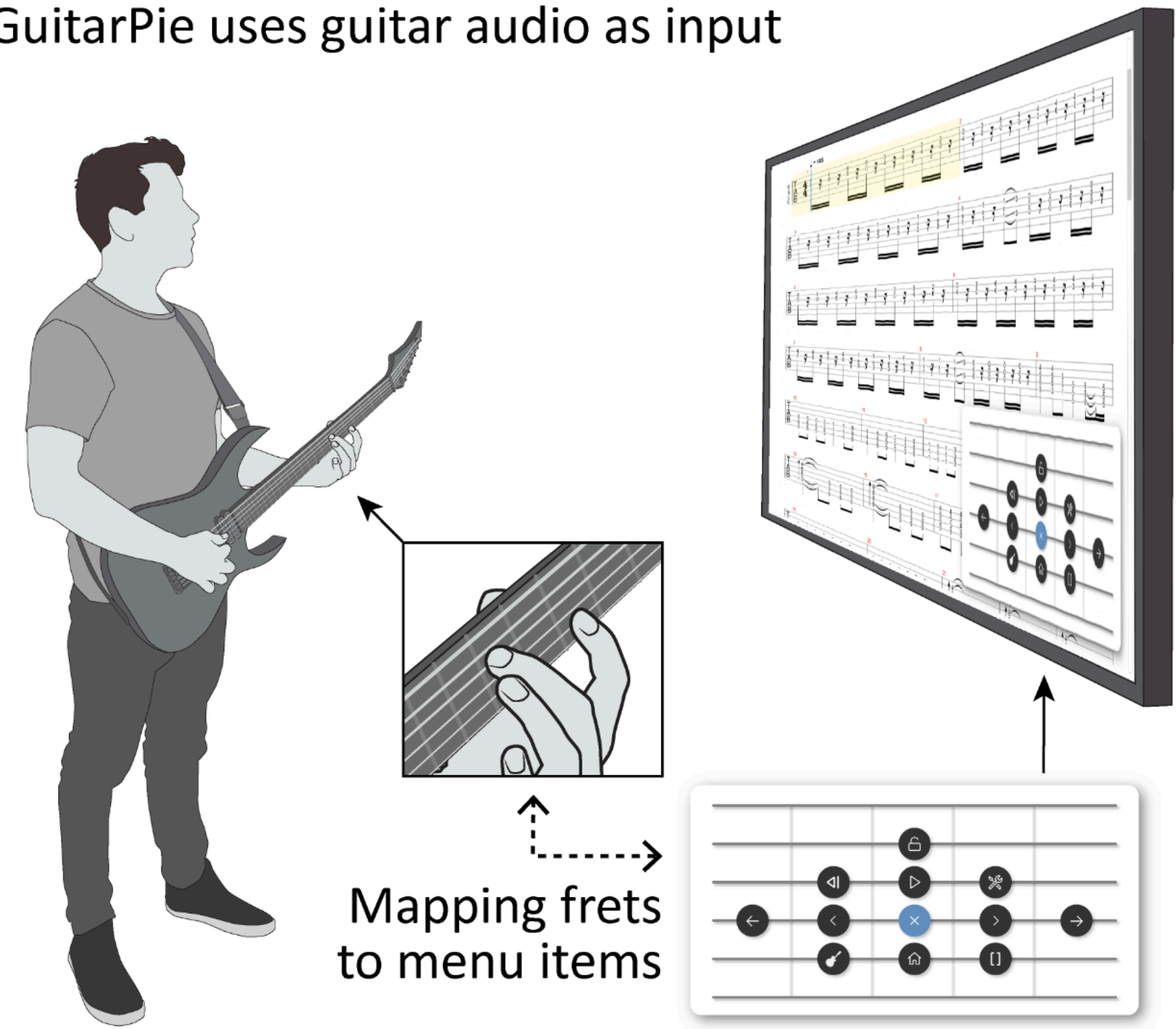


Visual abstraction & zoom

A) Conventional practice with guitar tabs



B) GuitarPie uses guitar audio as input

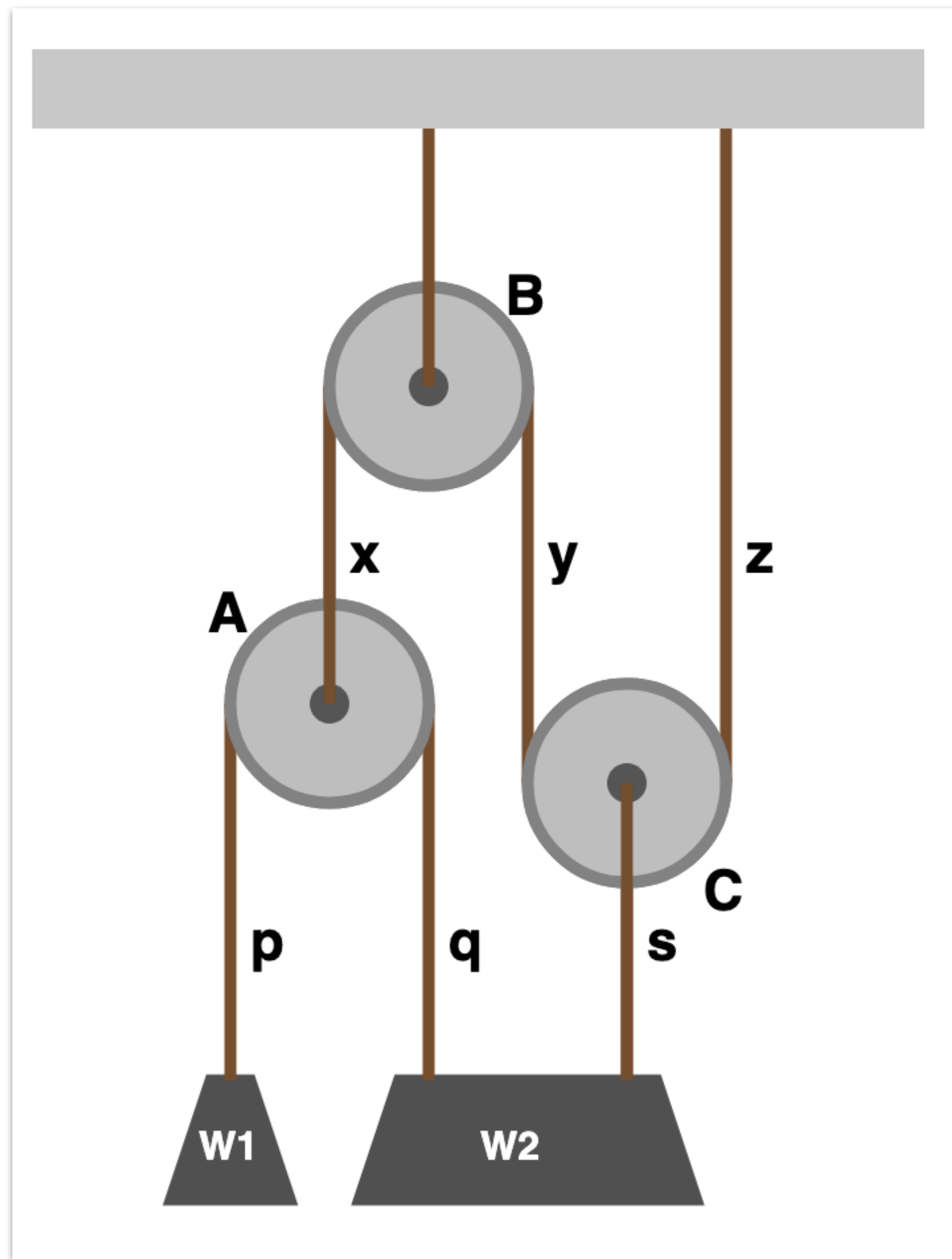


**Diagrams are about the effective
use of space**

1. The first weight is suspended from the left end of a rope over Pulley A.
2. The right end of this rope is attached to, and partially supports, the second weight.
3. Pulley A is suspended from the left end of a rope that runs over Pulley B, and under Pulley C.
4. Pulley B is suspended from the ceiling.
5. The right end of the rope that runs under Pulley C is attached to the ceiling.
6. Pulley C is attached to the second weight, supporting it jointly with the right end of the first rope.

- Set $W1 = 1$
- What is affected by $W1$?
- [S1] Left end of rope over PA
- What is PA attached to?
- [S1 $\rightarrow$ S2] “this rope” = PA, so $W2$
- [S2 $\rightarrow$ S3] PA suspended over PB under PC
- What is PC attached to?
- [S3 $\rightarrow$ S4] irrelevant
- [S4 $\rightarrow$ S5] PC supported by ceiling
- What is PA attached to again?

Find the ratio of the second to the first weight, if the system is in equilibrium.



- Set $W1 = 1$
- What is affected by $W1$?
- $[W1 \rightarrow PA]$ $W1$ goes over PA
- $[PA \rightarrow W1]$ to $W2$
- $[PA \rightarrow B]$ and connected to B
- ...

Find the ratio of the second to the first weight, if the system is in equilibrium.

Diagrams can efficiently encode relational information in space

- Sentential representation requires linear search to discover facts
 - “A points to B”, “B points to C”, “A points to C” what does A point to?
- Diagrammatic representation supports efficient lookups keyed to one element of a relation
 - “Everything that points to A” or “everything A points to” are simple perceptual tasks of following lines

**Diagrams are about visual
abstraction**

FOR EXAMPLE, WHILE *MOST* CHARACTERS WERE DESIGNED *SIMPLY*, TO ASSIST IN *READER-IDENTIFICATION*--



--*OTHER* CHARACTERS WERE DRAWN MORE *REALISTICALLY* IN ORDER TO *OBJECTIFY* THEM, EMPHASIZING THEIR "*OTHERNESS*" FROM THE READER.



A PROP LIKE THIS *SWORD* MIGHT BE VERY *CARTOONY* IN *ONE* SEQUENCE--



--DUE TO THE "*LIFE*" IT POSSESSES AS AN EXTENSION OF MY CARTOON IDENTITY,!

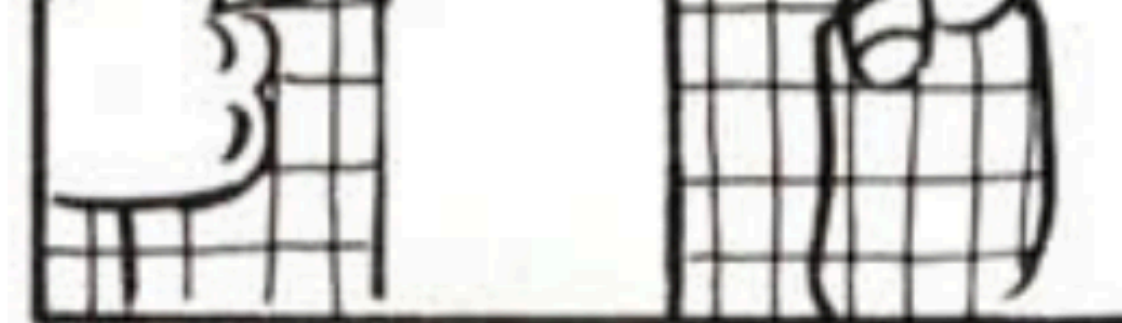


Scott McCloud. *Understanding Comics*. 1993

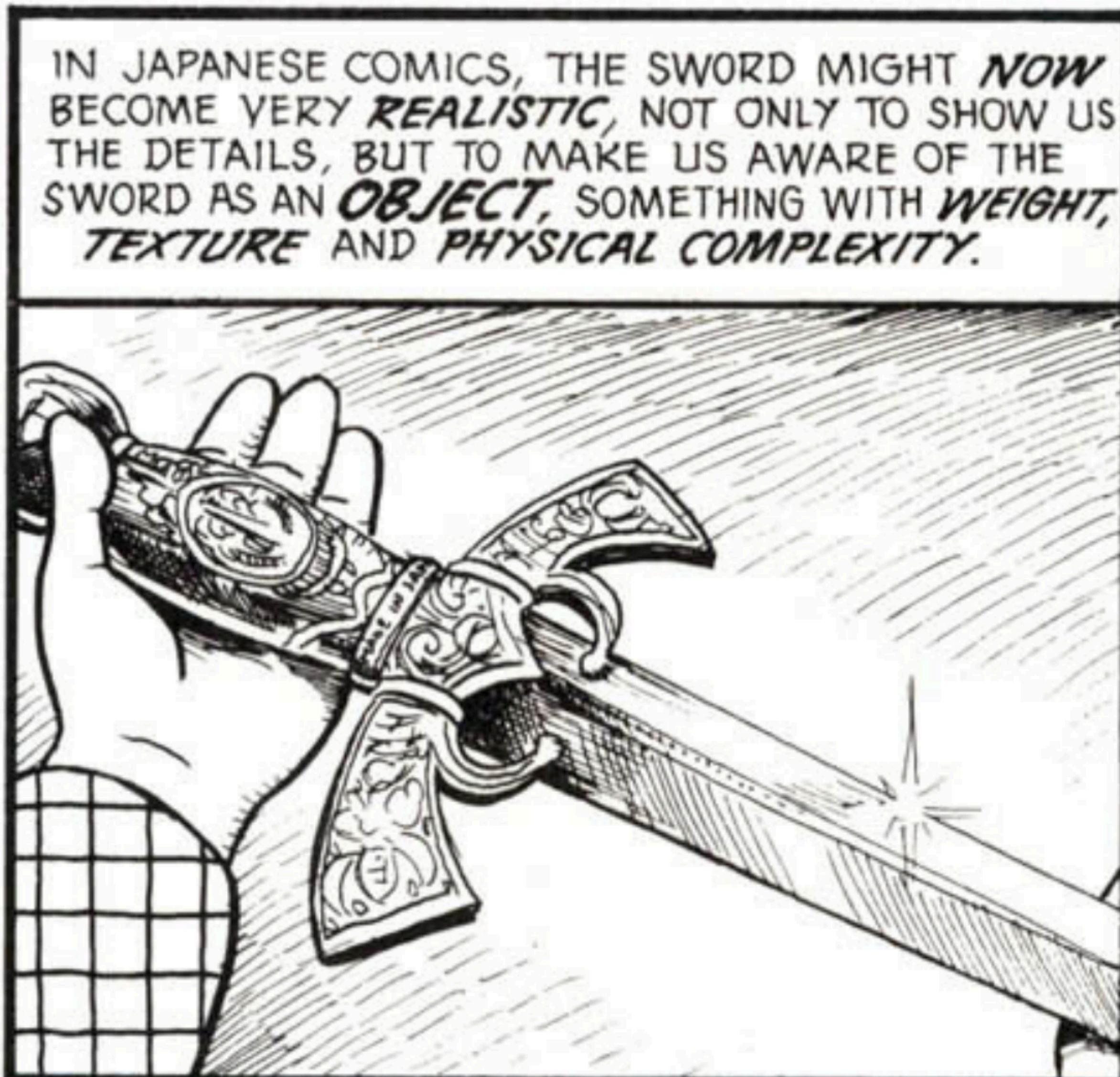
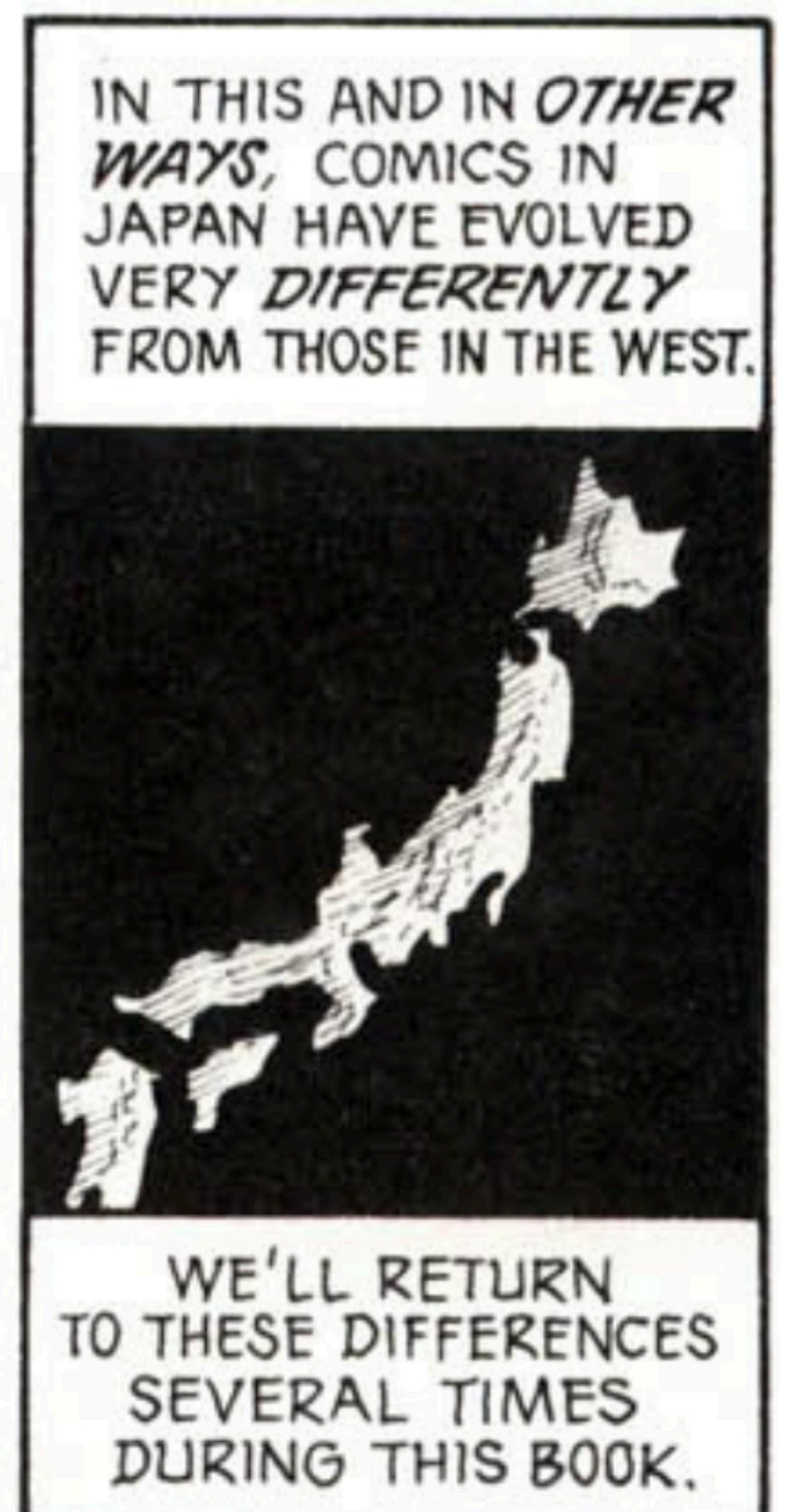
BUT

IN JAPANESE COMICS, THE SWORD MIGHT *NOW* BECOME VERY *REALISTIC*, NOT ONLY TO SHOW US

IN THIS AND IN *OTHER WAYS*, COMICS IN

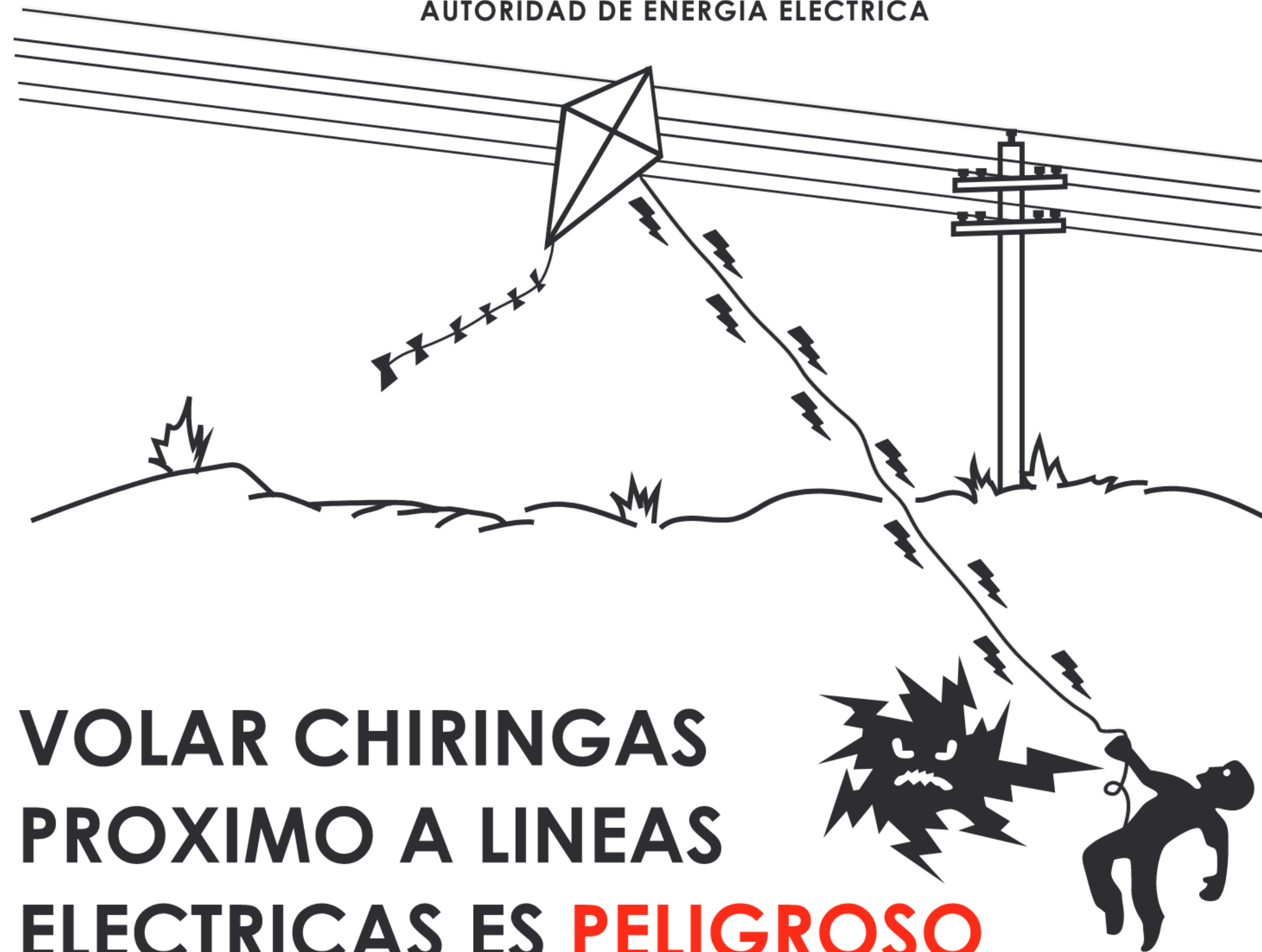


Scott McCloud. *Understanding Comics*. 1993



 WARNING - ADVERTENCIA

AUTORIDAD DE ENERGIA ELECTRICA



**VOLAR CHIRINGAS
PROXIMO A LINEAS
ELECTRICAS ES PELIGROSO**

Realism risks incorrect interpretation of details

 **WARNING - ADVERTENCIA**

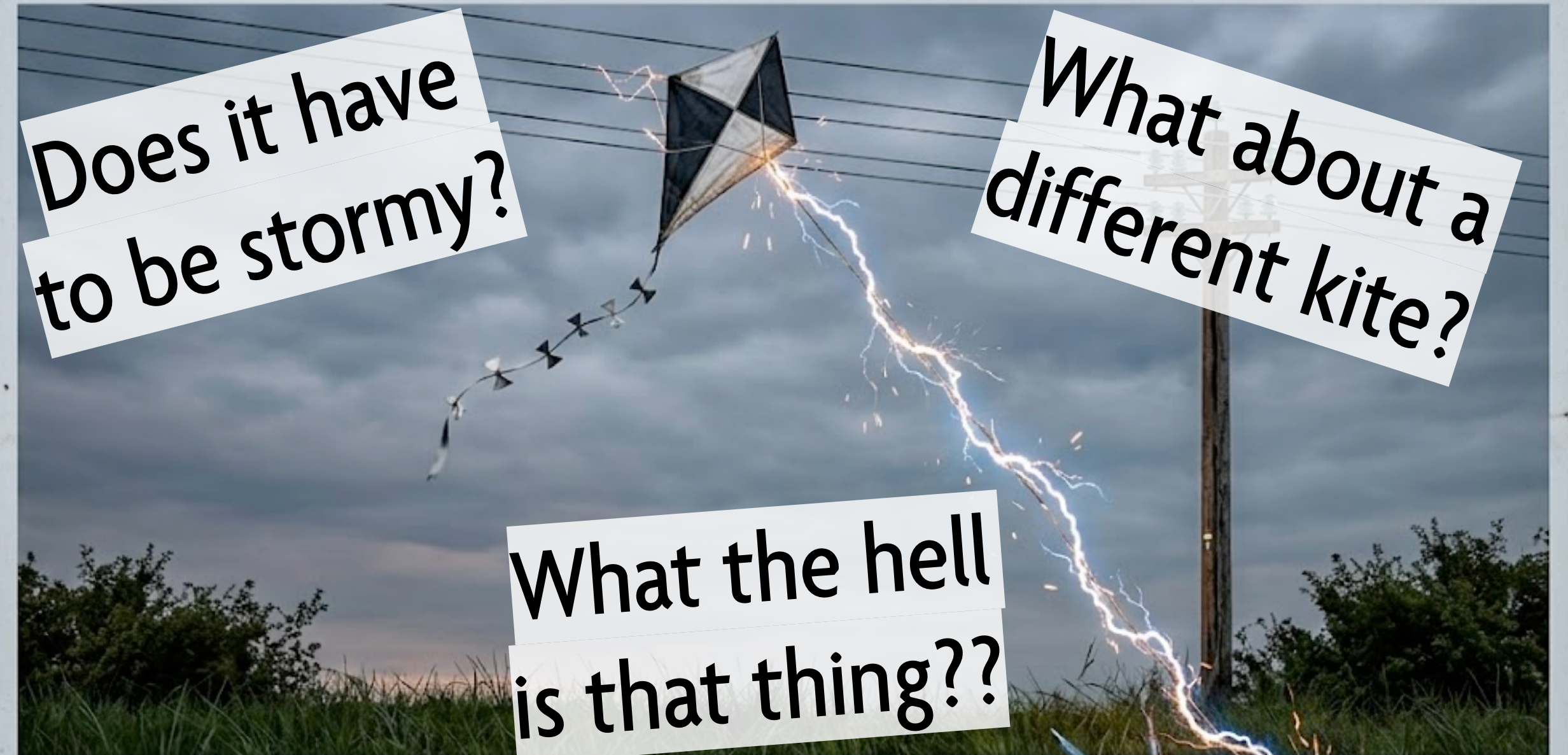
AUTORIDAD DE ENERGIA ELECTRICA



**VOLAR CHIRINGAS
PROXIMO A LINEAS
ELECTRICAS ES PELIGROSO**

 **WARNING - ADVERTENCIA**

AUTORIDAD DE ENERGIA ELECTRICA

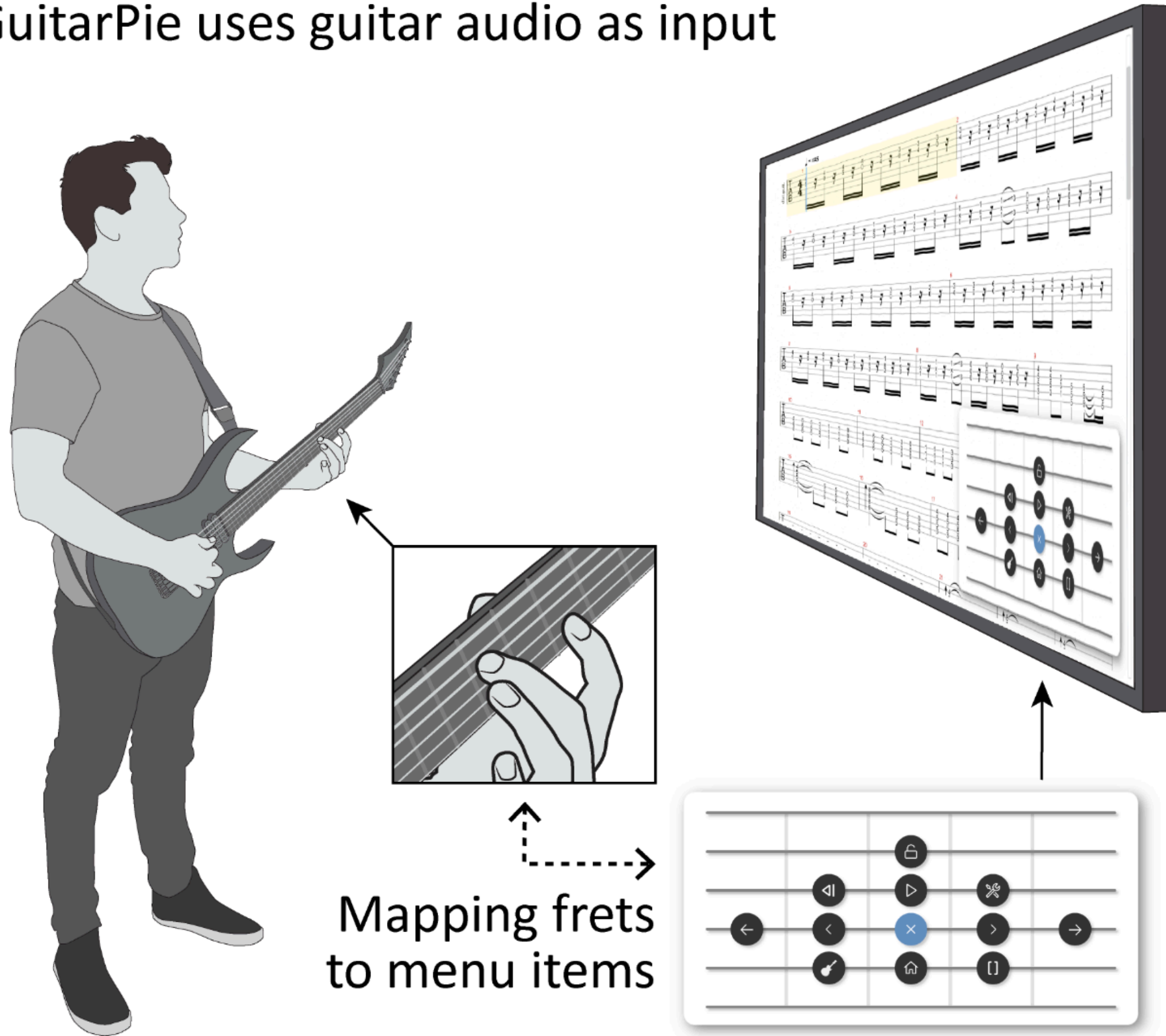


**VOLAR CHIRINGAS
PROXIMO A LINEAS
ELECTRICAS ES PELIGROSO**

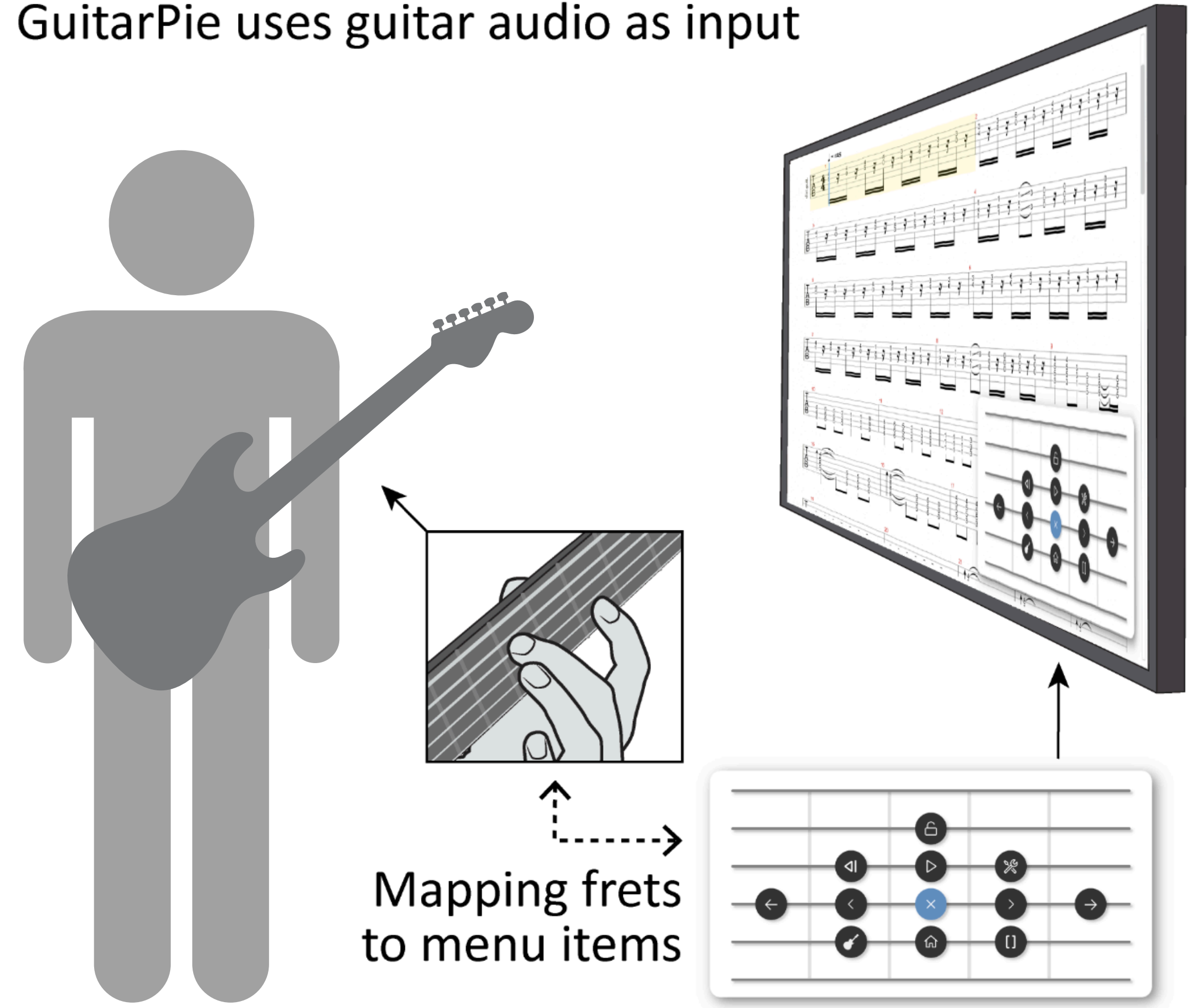


Appropriate level of abstraction depends on context

B) GuitarPie uses guitar audio as input

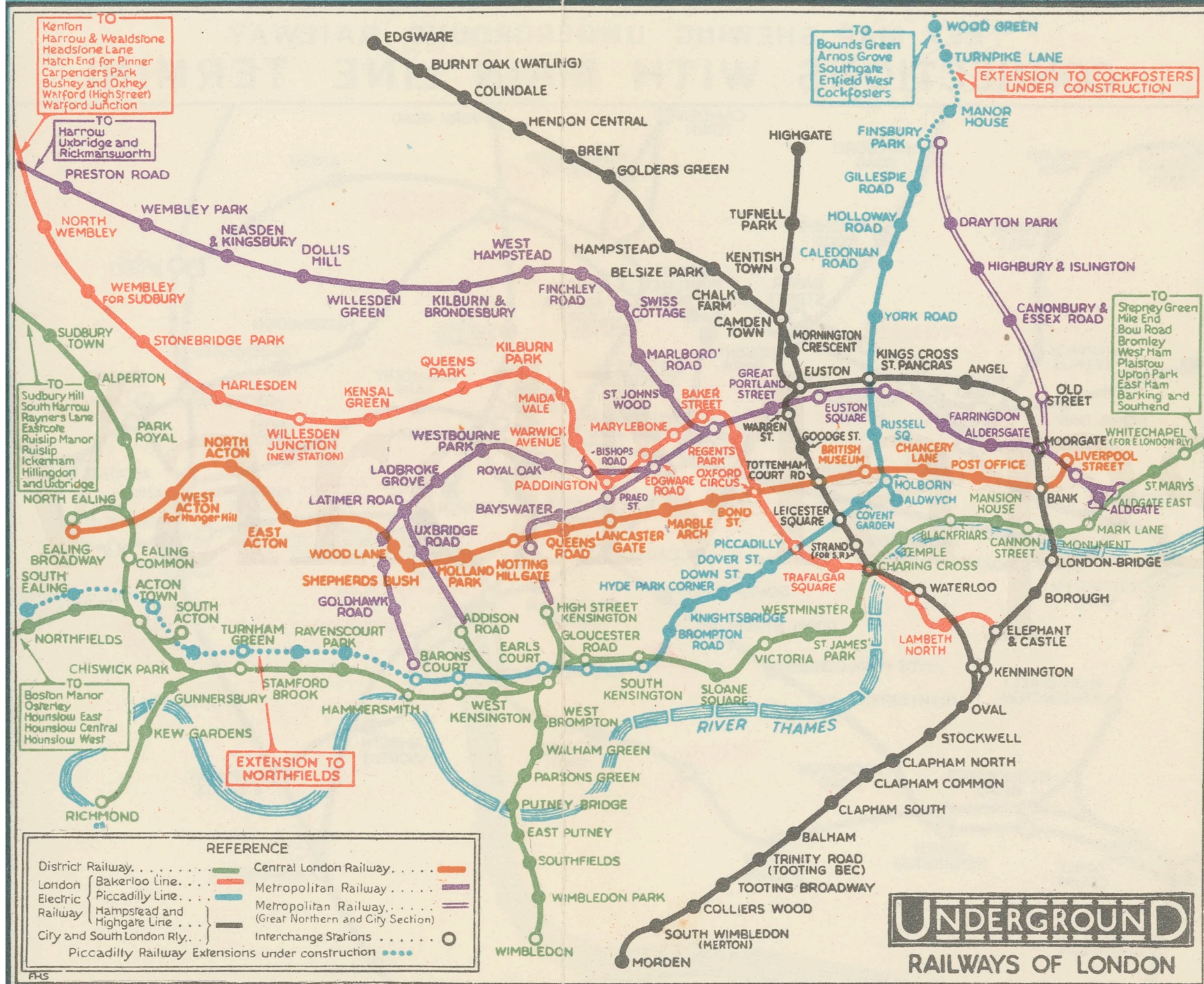


B) GuitarPie uses guitar audio as input



**Diagrams are about functional
distortion**

Map of the London Underground, 1931

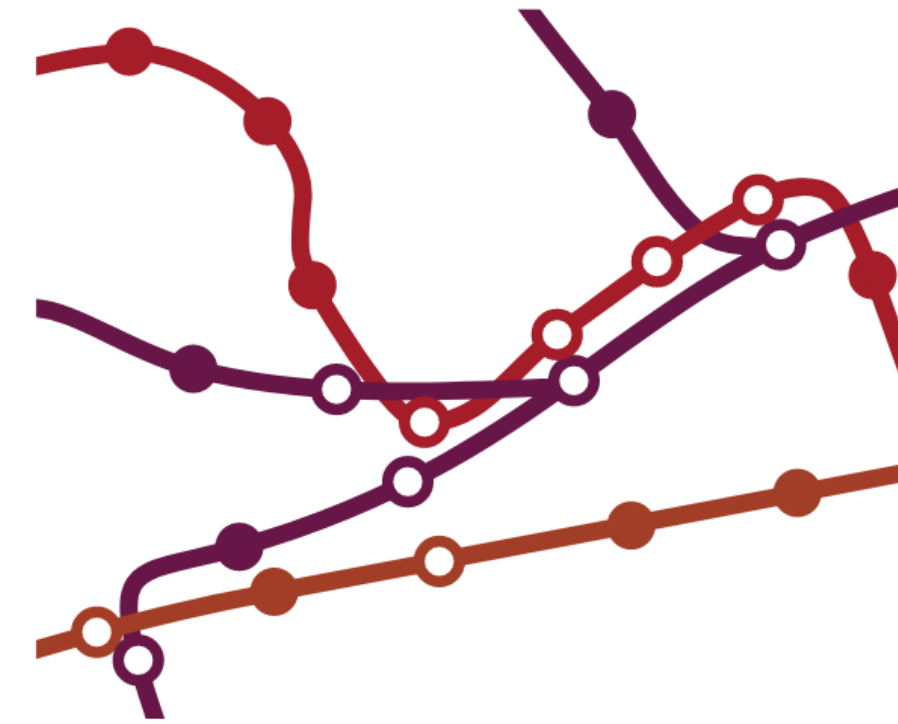


Harry Beck's “octolinear” map, 1933

“If you’re going underground,
why do you need to bother
about geography? It’s not so
important. Connections are
the thing.”



Roberts' principles for effective schematic maps



1: geographical reality



2: Henry Beck's 1933 configuration

Simplicity:

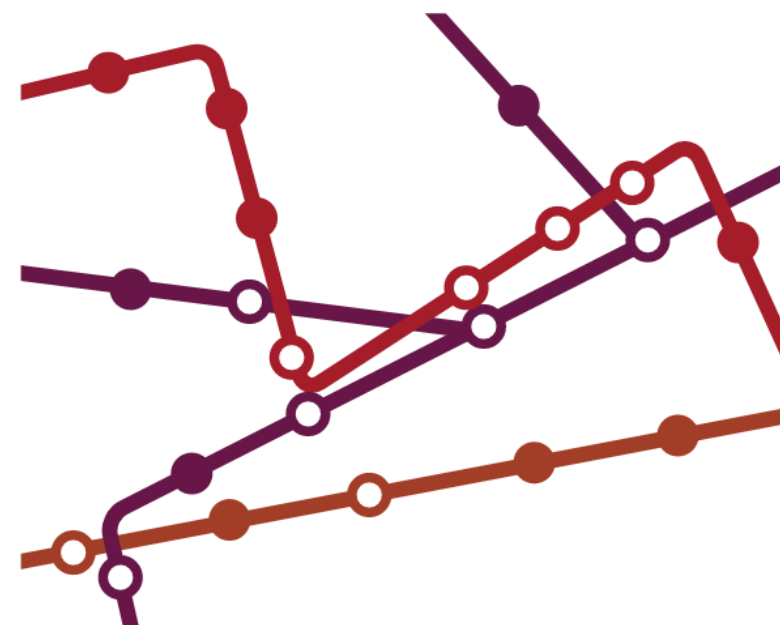
Individual trajectories are easy to follow



3: poor simplicity

Coherence:

Map consists of regular, identifiable shapes



4: poor coherence

Harmony:

Map is aesthetically pleasing to the eye



5: poor harmony

Balance:

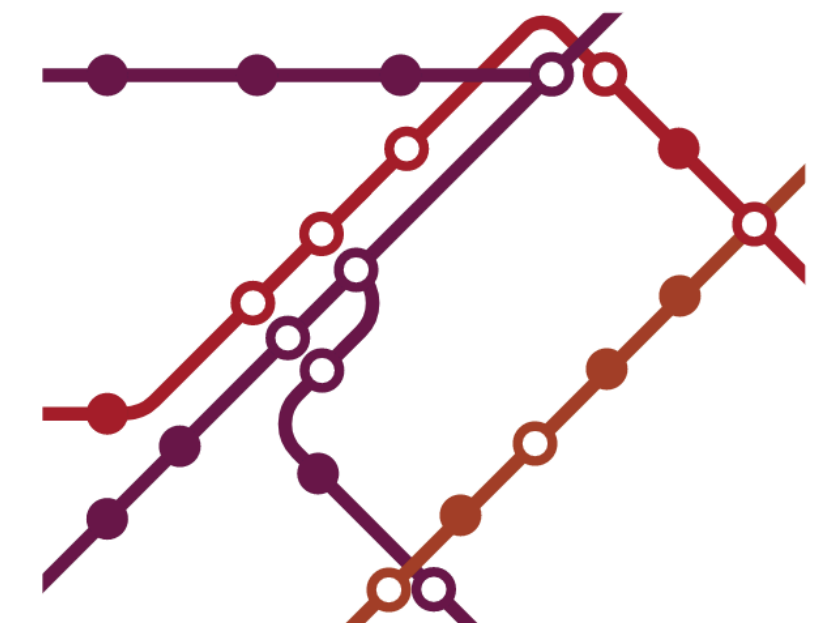
Stations are even across the map



6: poor balance

Topographicity:

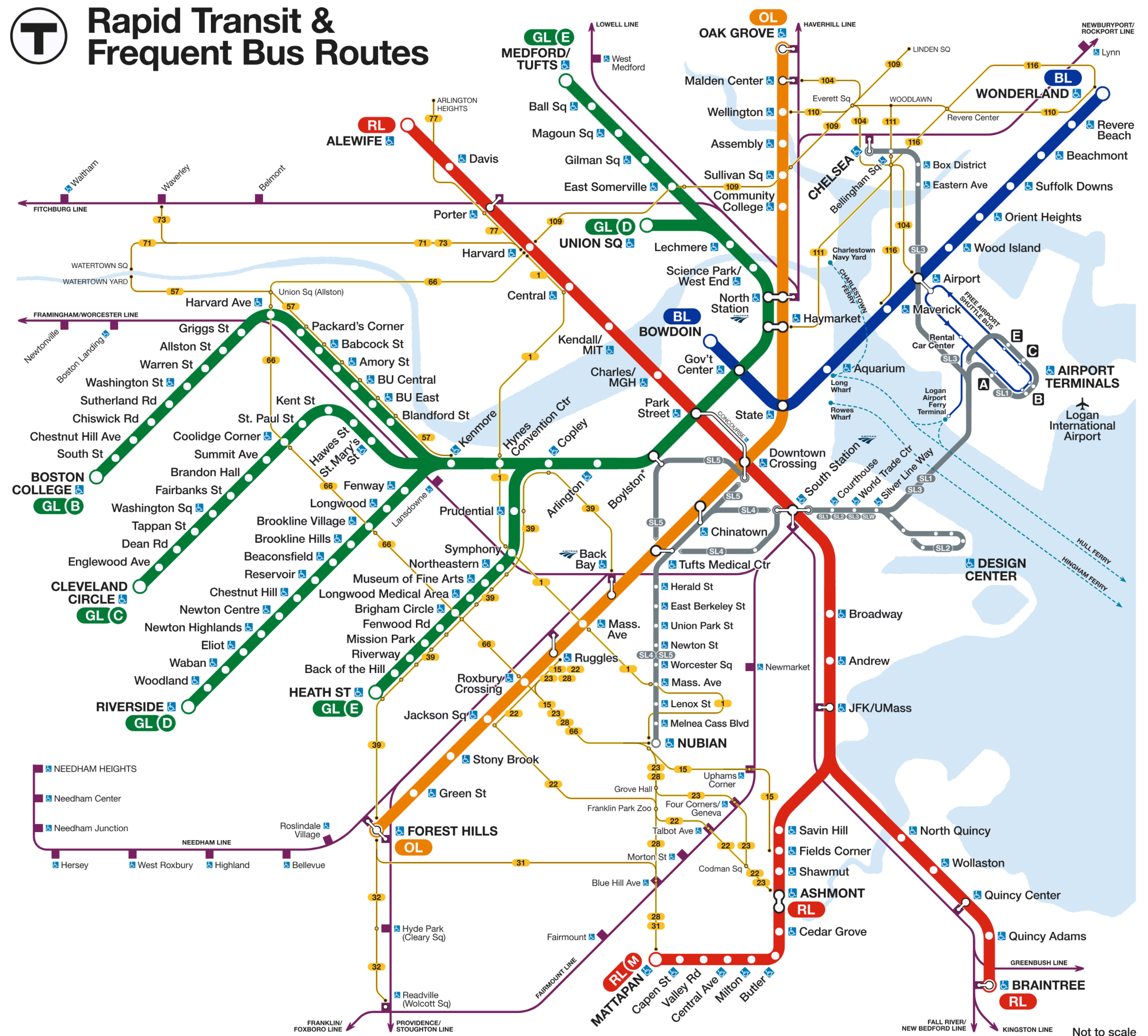
Map is not too heavily distorted wrt geography

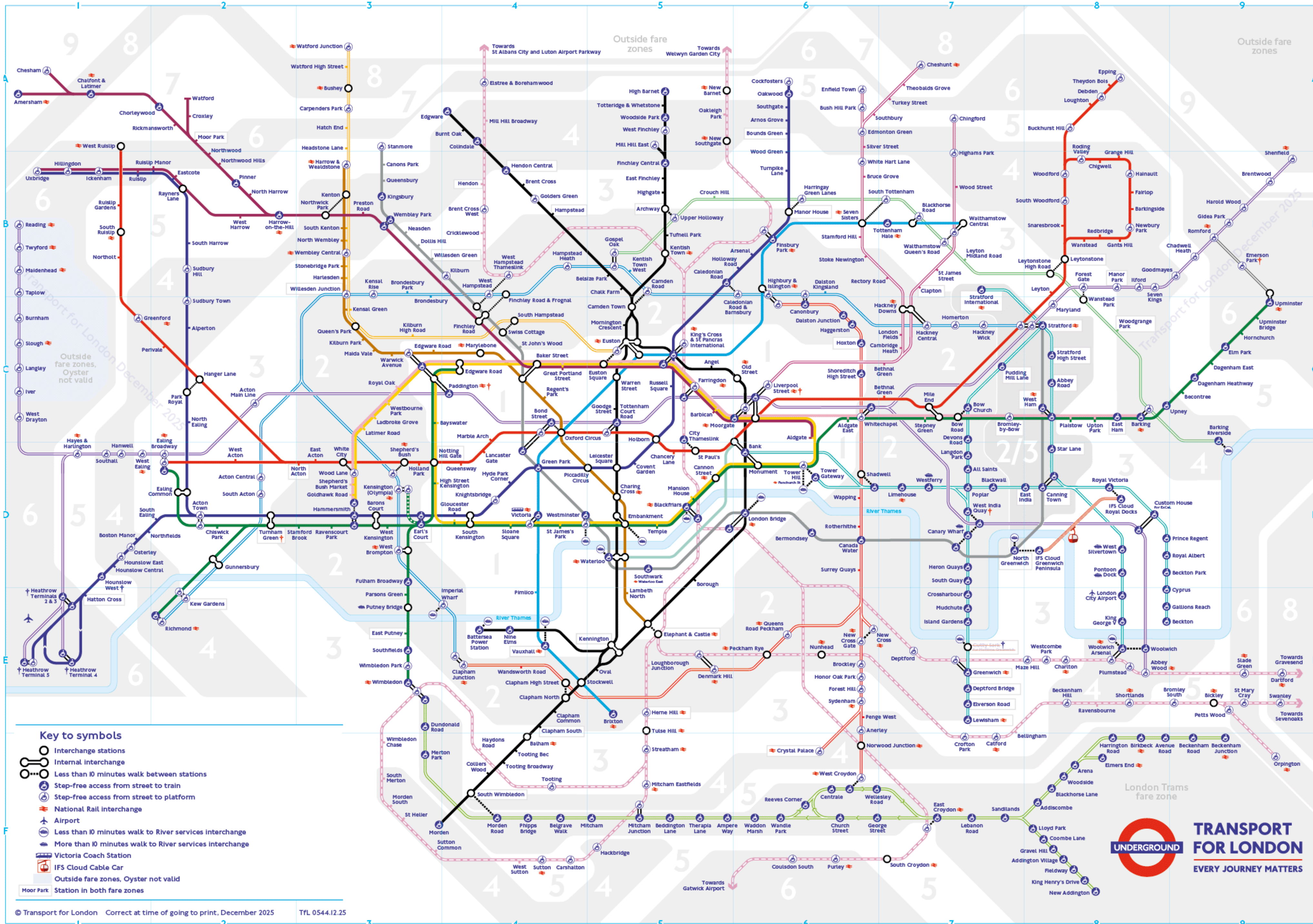


7: poor topographicity

The octolinear
transit map is
everywhere!

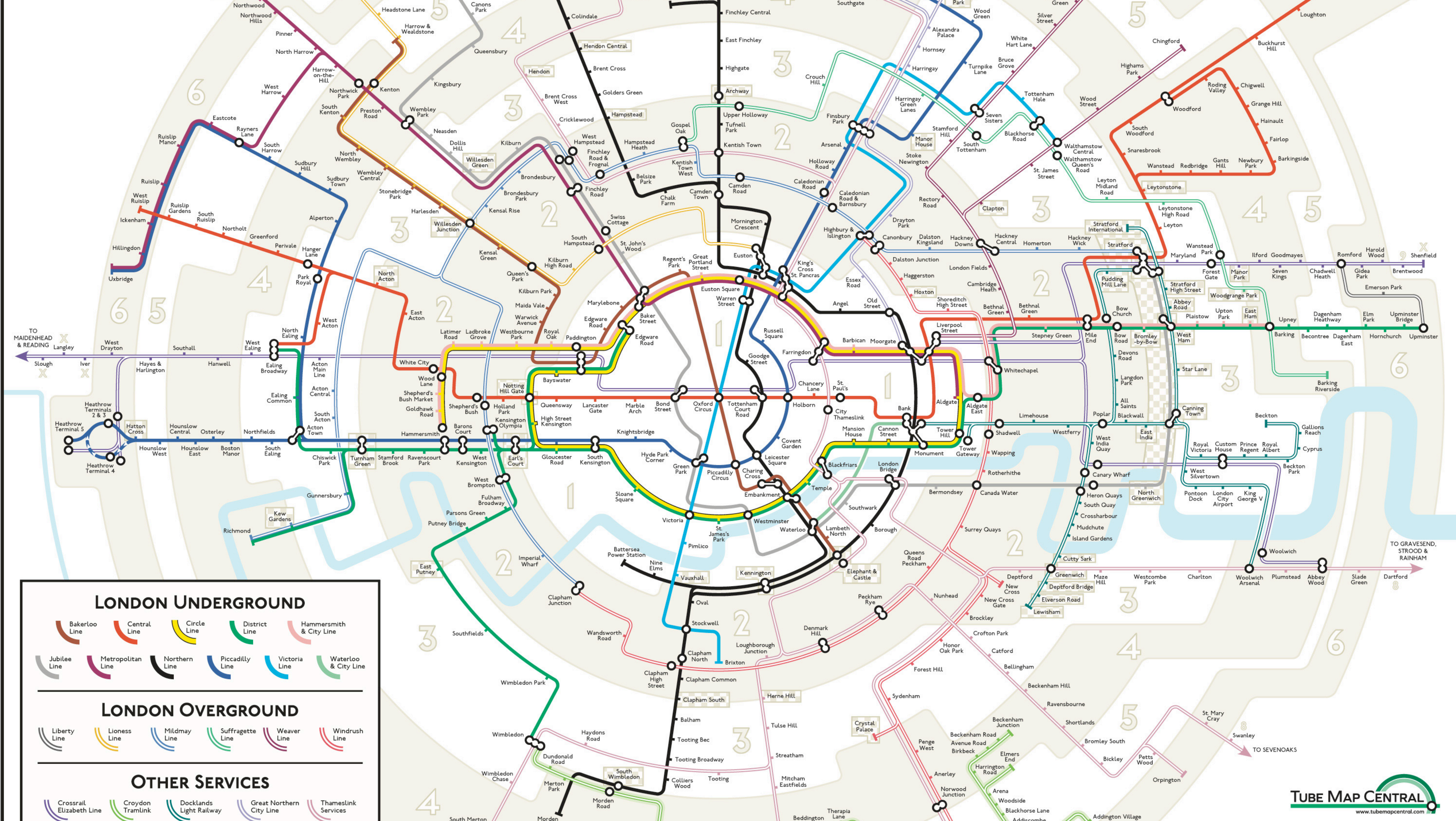
Boston MBTA
map, 2026



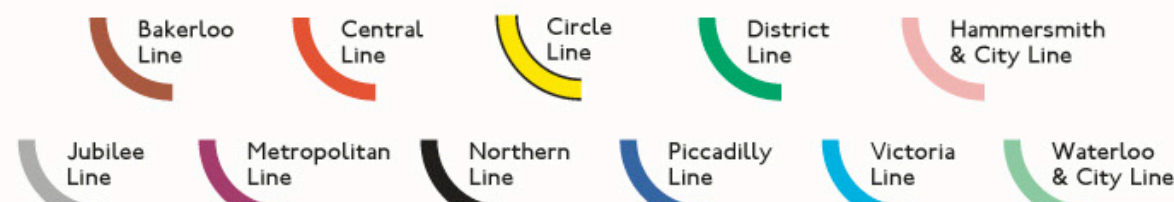


But does
it scale?

London
Underground
map, 2026



LONDON UNDERGROUND



LONDON OVERGROUND

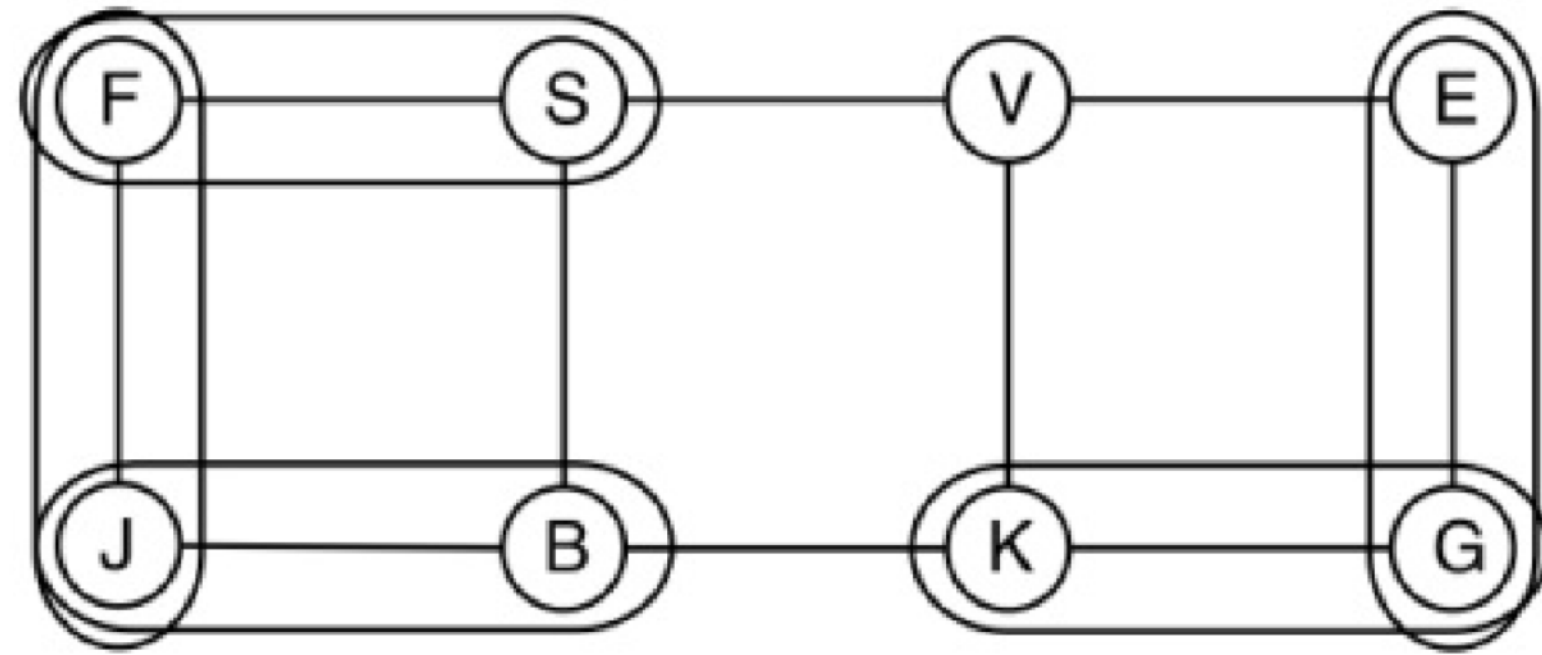


OTHER SERVICES

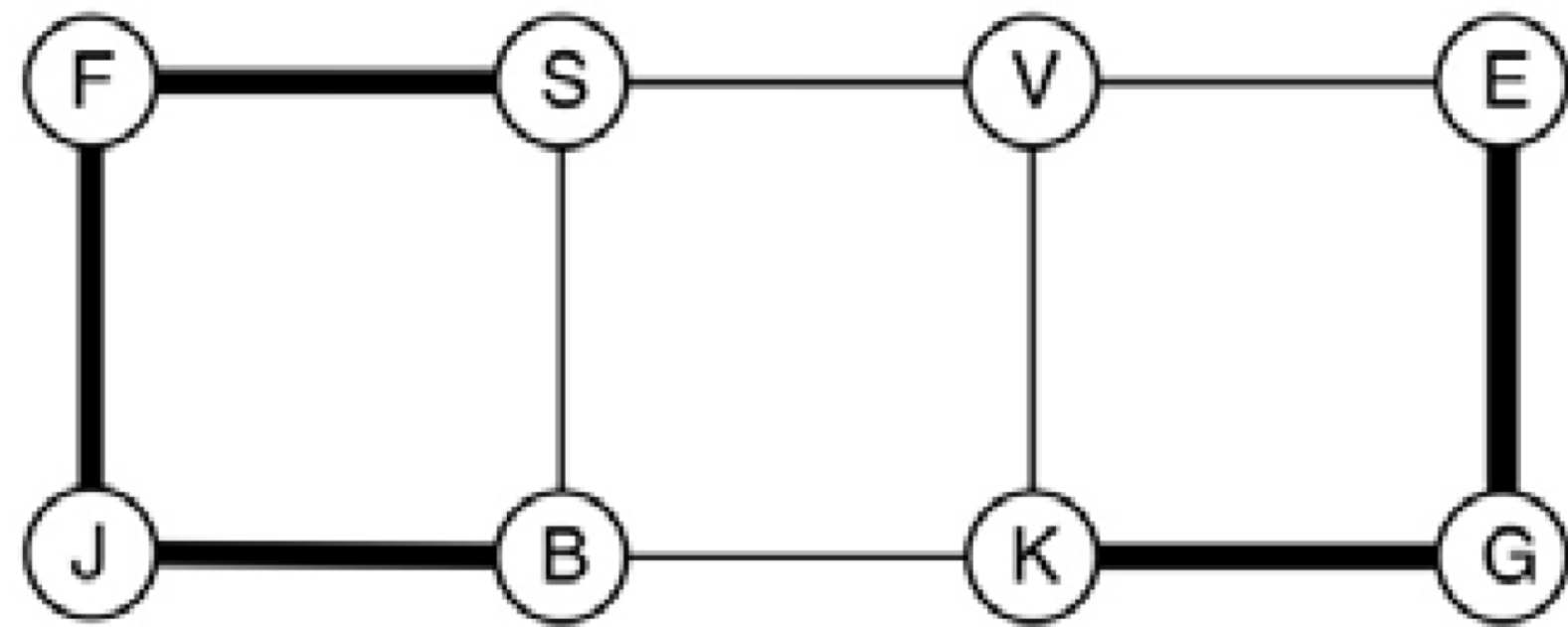


**Diagrams are about finding the
right visual metaphor**

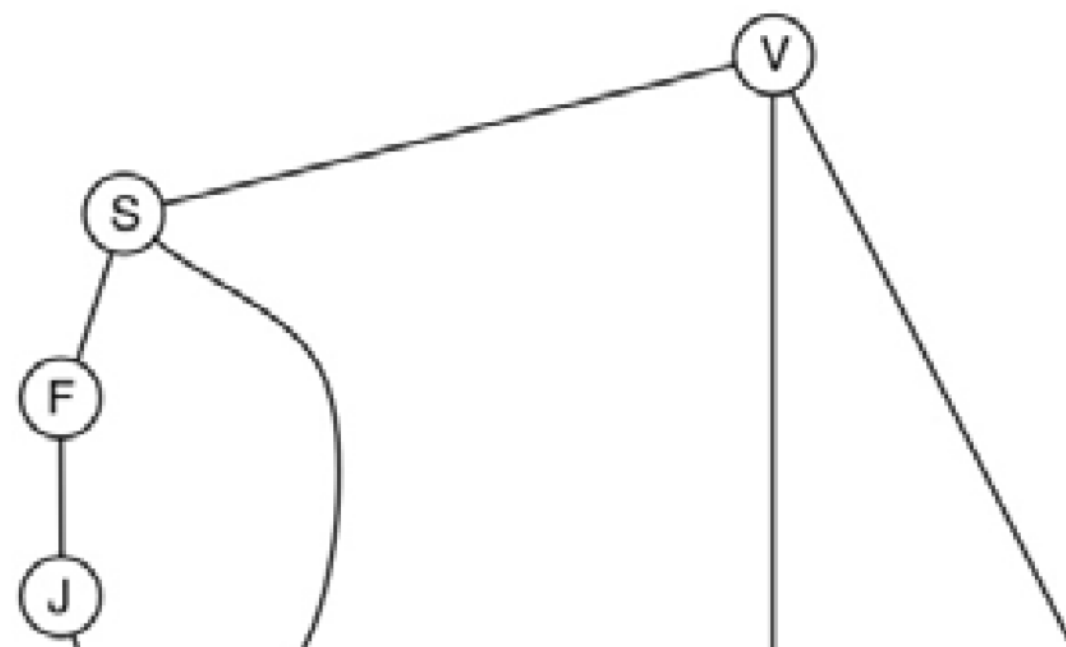
Containment



Thickness



Distance

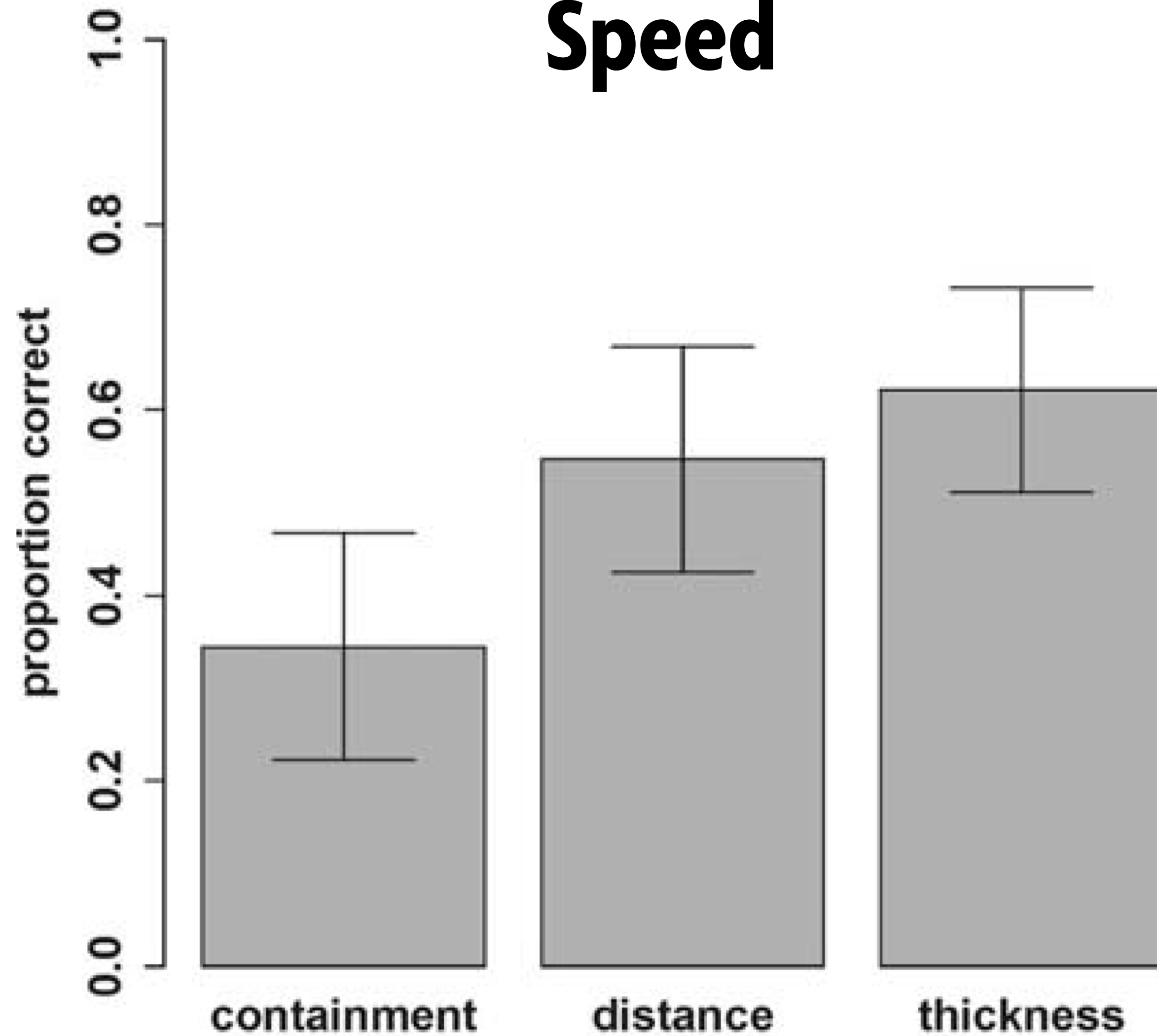


S needs to transmit to E.

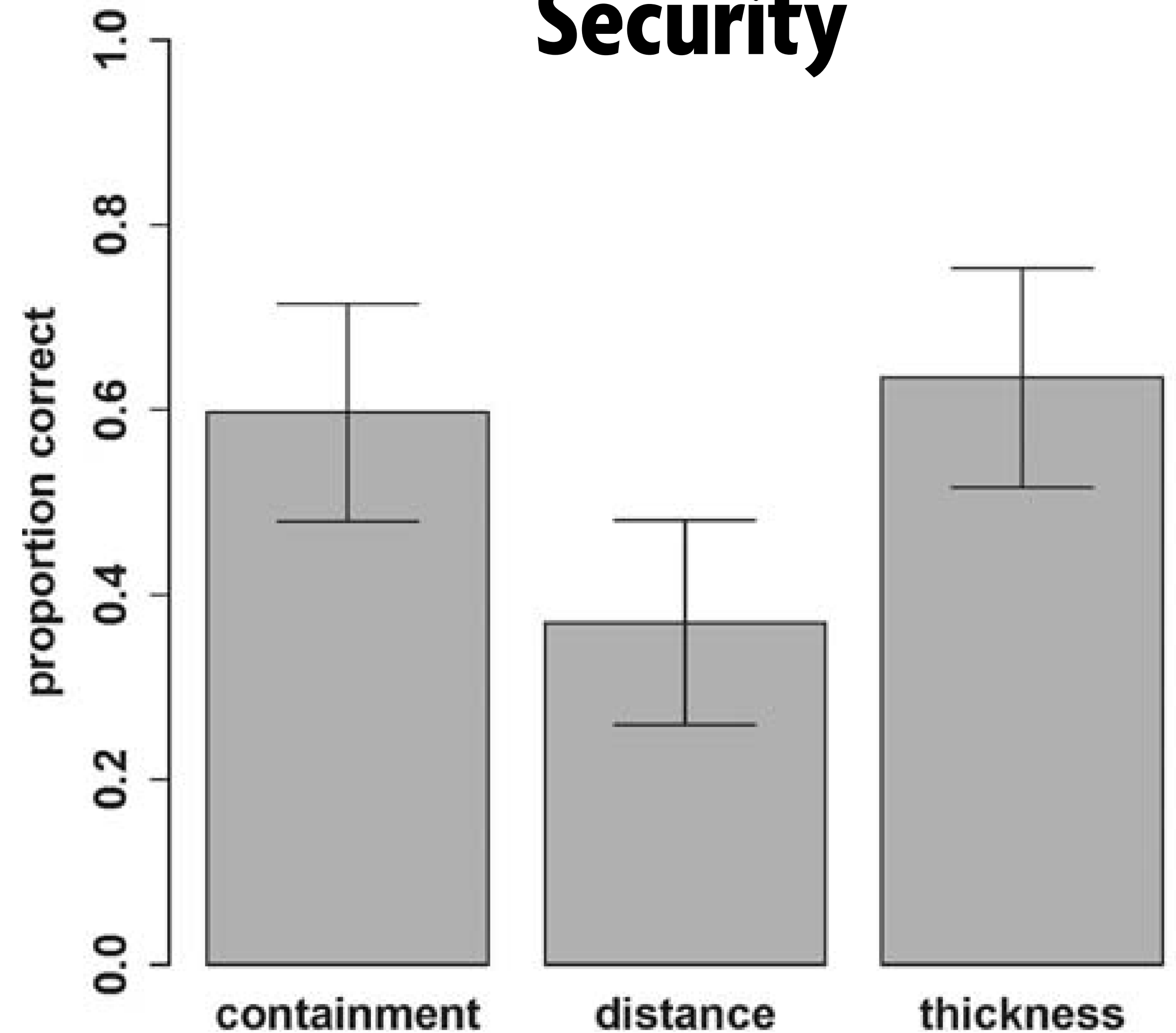
1. S and F communicate with each other six times a second. [...] Along which pathway will the message arrive first?
2. S and F are part of the same system, and six times as secure. [...] Which pathway is the most secure?

Best representation depends on problem format

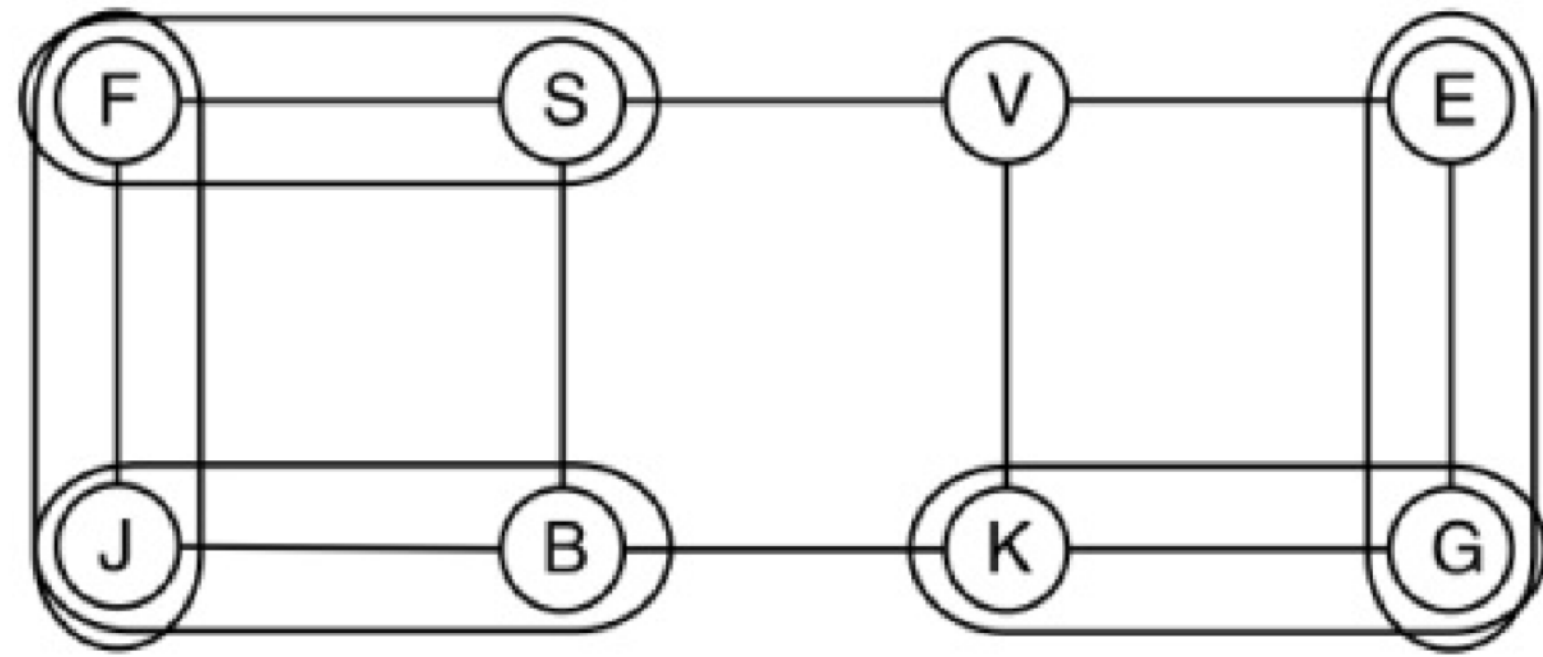
Speed



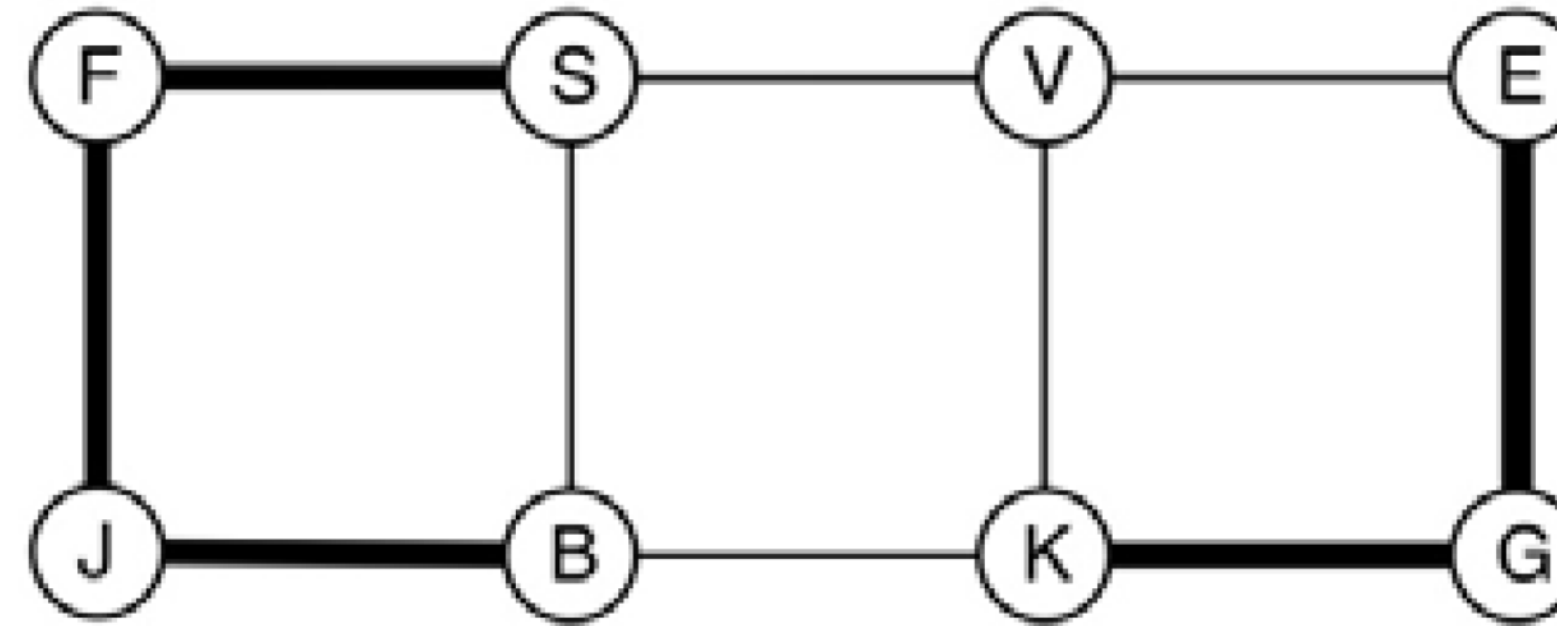
Security



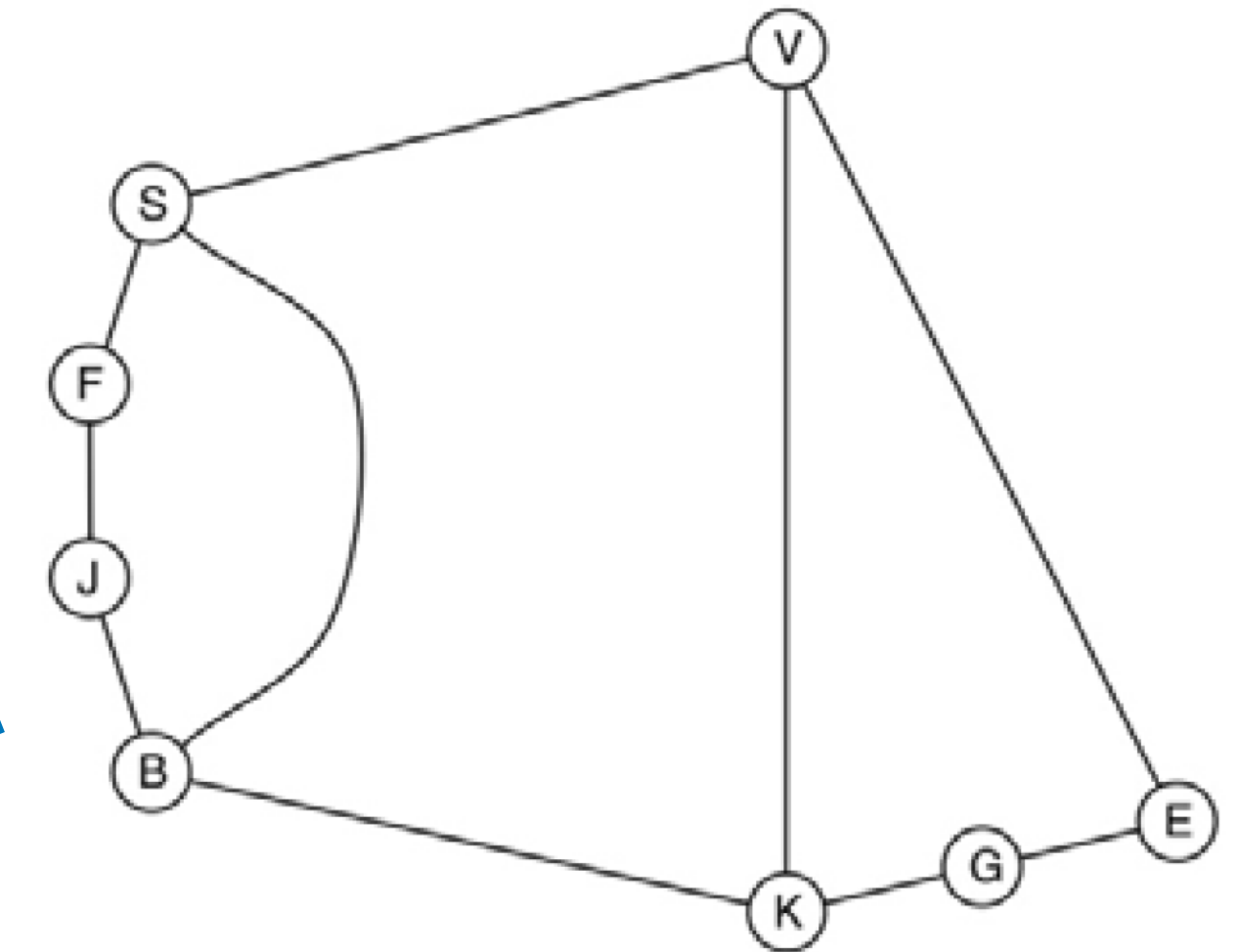
Containment



Thickness



Distance



“communicate
more often”

“part of the
same system”

Congruence: “The structure and content of the external representation should correspond to the desired structure and content of the internal representation.”