Lecture 16 – Data Objects

Today's Learning Objectives:

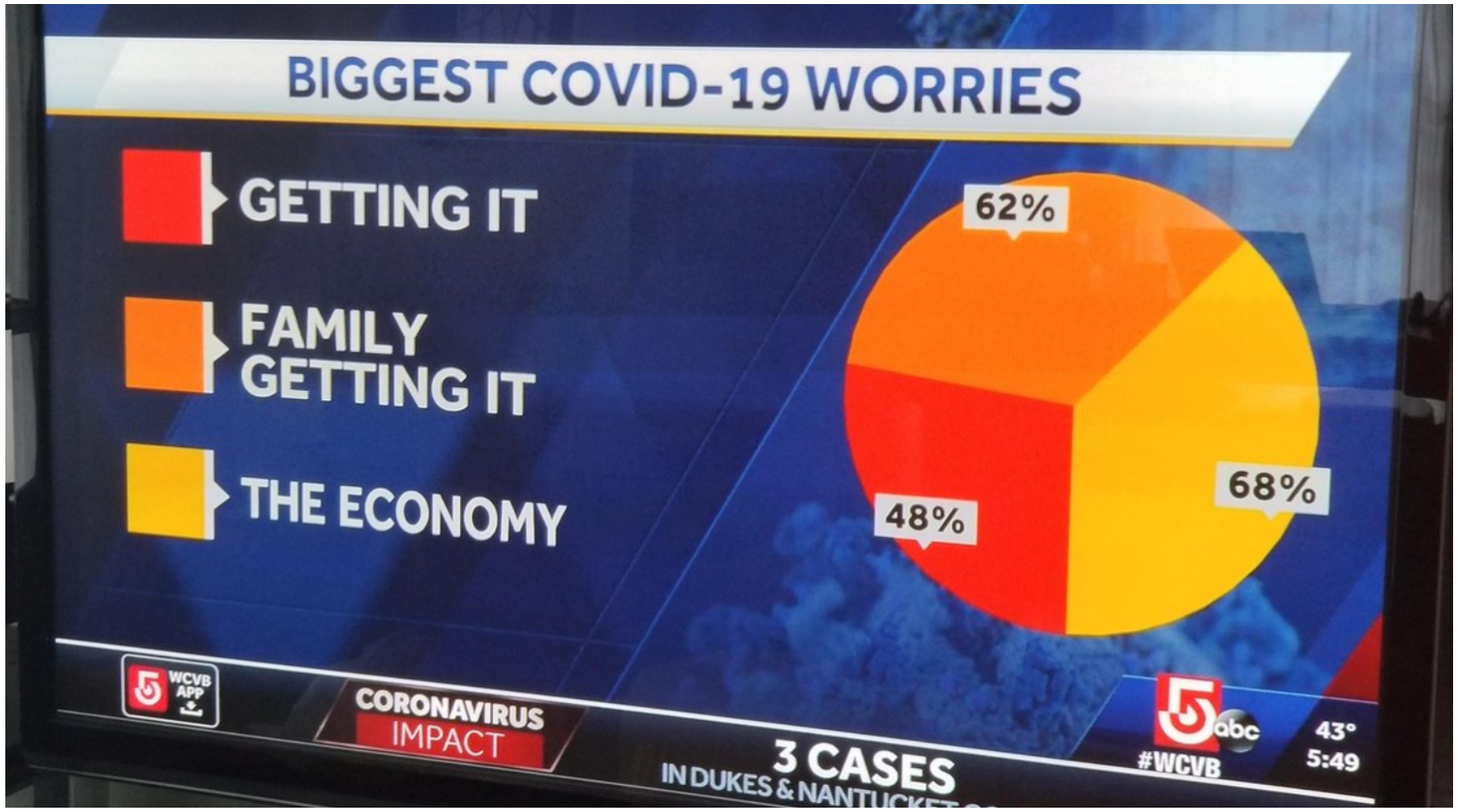
1. Describe the two main theories behind object recognition.

2. Discuss how priming can work to speed searching and object recognition.

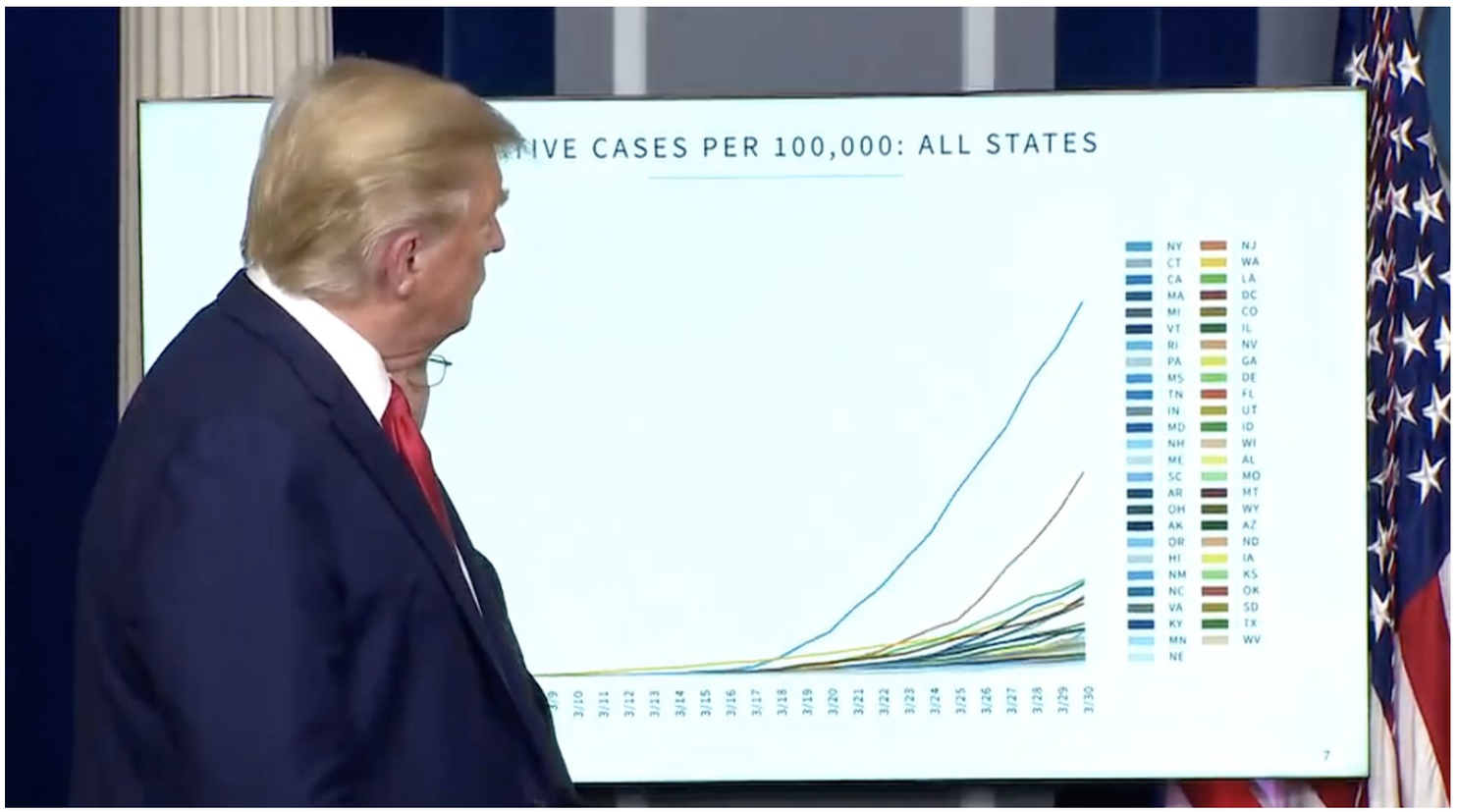
3. Describe geon theory of recognition.

COVID-19 Visualization Wins and Losses

Wrong



Bad



COVID-19 Visualization Wins and Losses

Brilliant

This is how you do Data Viz, folks.

"All the News That's Fit to Print"

The New York Times

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JOB LOSSES SOAR; U.S. VIRUS CASES TOP WORLD

Since the coronavirus descended on Brooklyn Hospital Center three weeks ago, the staff has handled over 800 potential cases.

New Data Shows Staggering Toll of Outbreak

This article is by **Ben Casselman, Patricia Cohen** and **Tiffany Hsu**.

More than three million people filed for unemployment benefits last week, sending a collective shudder throughout the economy that is unlike anything Americans have experienced.

The alarming numbers, in a report released by the Labor Department on Thursday, provide some of the first hard data on the economic toll of the coronavirus pandemic, which has shut down whole swaths of American life faster than government statistics can keep track.

Just three weeks ago, barely 200,000 people applied for jobless benefits, a historically low number. In the half-century that the government has tracked applications, the worst week ever, with 695,000 so-called initial claims, had been in 1982.

Thursday's figure of nearly 3.3 million set a grim record. "A large part of the economy just collapsed," said Ben Herzon, executive director of IHS Markit, a business data and analytics firm.

The numbers provided only the first hint of the economic cataclysm in progress. Even comparatively optimistic forecasters expect millions more lost jobs, and with them foreclosures, evictions and bankruptcies. Thousands of businesses have closed in response to the pandemic, and many will never reopen. Some economists say the decline in gross domestic product this year could rival the worst years of the Great Depression.

And there was fresh evidence on Thursday of the relentless course of the virus itself. Cases in the United States now exceed 80,000, the most of any nation, even China and Italy, according to a New York Times database. More than 1,000 deaths across the country have been linked to the virus.

At least 160 million people na-

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Labeling Regions by Risk

President Trump told governors he planned to classify counties according to the danger of coronavirus infection. Page A11.

Nearly 3.3 million unemployment claims were filed last week, a record number.

3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0

Unfilled Posts Force Scramble By Washington

By JENNIFER STEINHAUER and ZOLAN KANNO-YOUNGS

WASHINGTON — Of the 75 senior positions at the Department of Homeland Security, 26 are either vacant or filled by acting officials, including Chad F. Wolf, the acting secretary who recently was unable to tell a Senate committee how many respirators and protective face masks were available in the United States.

The National Park Service, which like many federal agencies is full of vacancies in key posts, tried this week to fill the job of a director for the national capital region after hordes of visitors flocked to see the cherry blossoms near the National Mall, creating a potential public health hazard as the coronavirus continues to spread.

At the Department of Veterans Affairs, workers are scrambling to order medical supplies on Amazon after its leaders, lacking experience in disaster responses, failed to prepare for the onslaught of patients at its medical centers.

Ever since President Trump came into office, a record high turnover and unfilled jobs has emptied offices across wide swathes of the federal bureaucracy. Now, current and former administration officials and disaster experts say the coronavirus has exposed those failings as never be-

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Online Class With No Way To Get There

By NIKITA STEWART

Allia Phillips was excited about picking up an iPad from her school in Harlem last week. She did not want to miss any classes and hoped to land on the fourth-grade honor roll again.

On Monday, the first day that New York City public schools began remote learning, the 10-year-old placed her iPad on a tray she set up over her pillow on a twin bed in a studio that she shares with her mother and grandmother inside a homeless shelter on the Upper West Side.

And then, Allia saw nothing.

"I went downstairs to find out that they don't have any internet," said Kasha Phillips-Lewis, Allia's mother. "You're screwing up my daughter's education. You want to screw me up? Fine. But not my daughter's education."

The Department of Education, which runs the largest school system in the country with more than 1.1 million students, began attempting to teach all students through remote learning this week because schools were closed to slow the spread of the coronavirus.

Shuttering the vast system, which includes 1,600 schools, was a serious challenge for the city, and the large-scale, indefinite school closures are uncharted territory, altering the lives and rou-

Continued on Page A16

Courage at a Brooklyn Hospital, At the Front of an Invisible War

By SHERI FINK

It was not even 9 in the morning and Dr. Sylvie de Souza's green N95 mask, which was supposed to form a seal against her face, was already askew.

In freezing rain on Monday, she trudged in clogs between the emergency department she chairs at the Brooklyn Hospital Center and a tent outside, keeping a sharp eye on the trainee doctors, nurses and other staff members who would screen nearly 100 walk-in patients for the coronavirus that day.

Inside her E.R., more than a dozen people showing signs of infection waited for evaluation in an area used just a few weeks ago for stitches and casts. Another dozen lay on gurneys arranged one in front of the next, like a New York City car park. One man on a ventilator was waiting for space in the intensive care unit.

Minutes before paramedics wheeled in a heart attack patient, Dr. de Souza pointed to beds reserved for serious emergencies, separated by a newly constructed wall from the suspected virus cases. "This is our safe area," she told a reporter. Then she corrected herself: "This is thought to be safe." There was really no way

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With Supplies Waning, Workers Soldier On

No Crowd, but I'll Take You Out to the Ballgame

By DAN BARRY

Professional baseball greeted a new season this afternoon with an Opening Day game for the ages, an extra-inning masterpiece that vividly unfolded on the sun-dappled field of the imagination. The crack of the bat could almost be heard, the blur of whirs almost seen, the communal joy nearly felt.

From the moment the first batter tipped his helmet — and a bird flew out — to the walk-off home run by a slathering peach-hater, this 11-inning affair redefined what constitutes a perfect game. No one cared about the outcome; the distraction was reward enough.

Don't misunderstand: This game between the New York Gothams and the Cincinnati Greens mattered, but in ineffable ways beyond the columns of wins and losers. It mattered so much that complaints about baseball's slow pace yielded to the universal wish that this game would last forever.

"I could've played into the night," said the redeemed Gothams left fielder Kammy Iona, who missed part of last season after sneezing so hard that he strained a ligament in his back. "I didn't

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A Fan Writes a Fantasy for Opening Day

Weekly unemployment claims

2008 RECESSION

PREVIOUS AVERAGE, 345,000

'00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14 '15 '16 '17 '18 '19 '20

Note: Official figures are seasonally adjusted. Source: Department of Labor

Model of Visual Perception

Stage 1: Parallel

- First pass processing
- Parallel
- Transitory
- Rapid
- Extraction of features
- Bottom-up, data-driven
- Understand visual salience

Stage 2: Patterns

- Visual field is divided up, used for pattern finding
- Top-down attention
- Flexible
- Slower
- Serial
- Where/ what split

Stage 3: Visual Working Memory

- Small no. patterns (<4) passed to VWM
- Objects held in VWM by active attention
- Limited number of WM “slots” available

below awareness

within awareness

Object Recognition

Stage 1: Parallel

- First pass processing
- Parallel
- Transitory
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within awareness

below awareness

- We don’t really know how the brain recognizes objects.
  - Two theories:
    - **image-based**
    - **structure-based**

Image-based Recognition

- Our visual systems are really, really good at recognizing pictorial image representations.

    - *Recognition* is different (and faster) than *recall*. (Recall takes longer and we're less good at it.)

    - In rapid serial visual presentation, subjects can identify specific objects in pictures presented 5 times a second reliably!

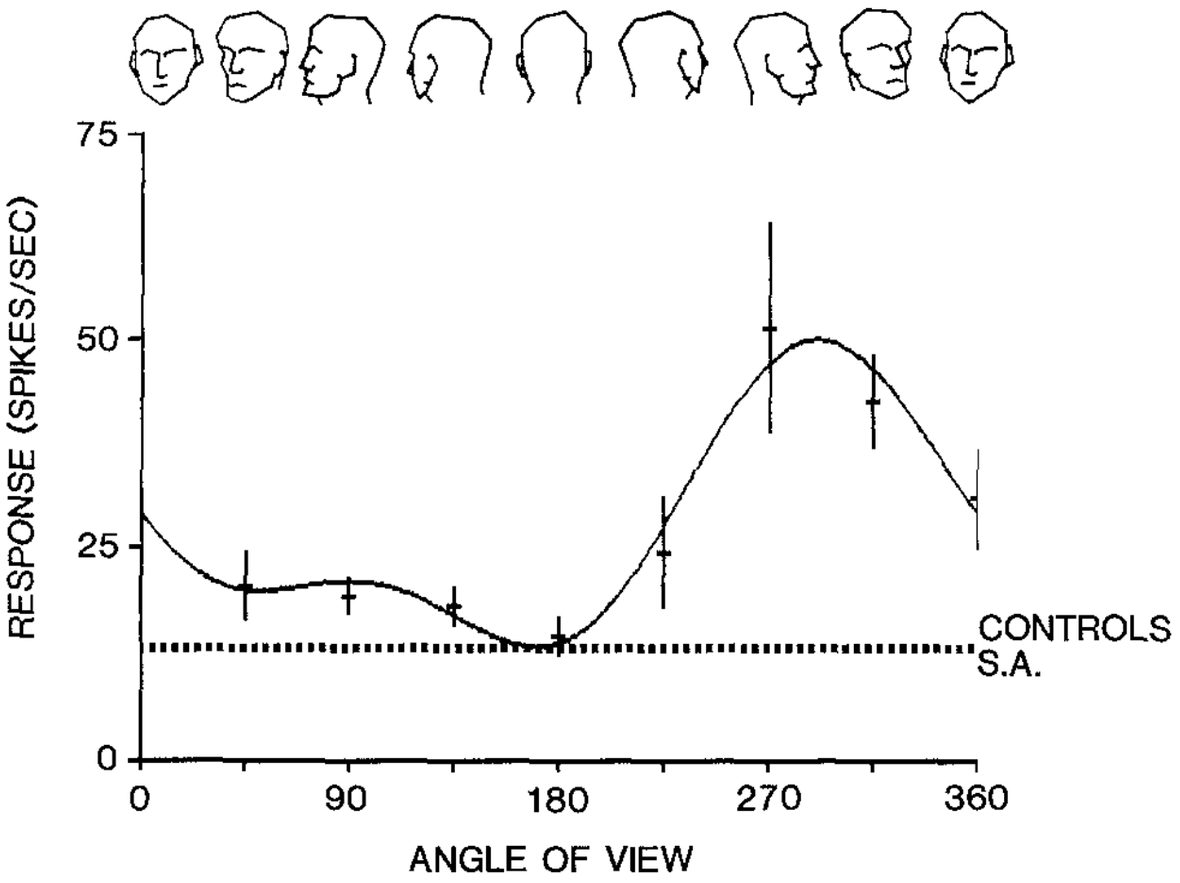
    - *Attention blink*: if another object of the same type follows within 350 ms of the first, the second is not noticed.

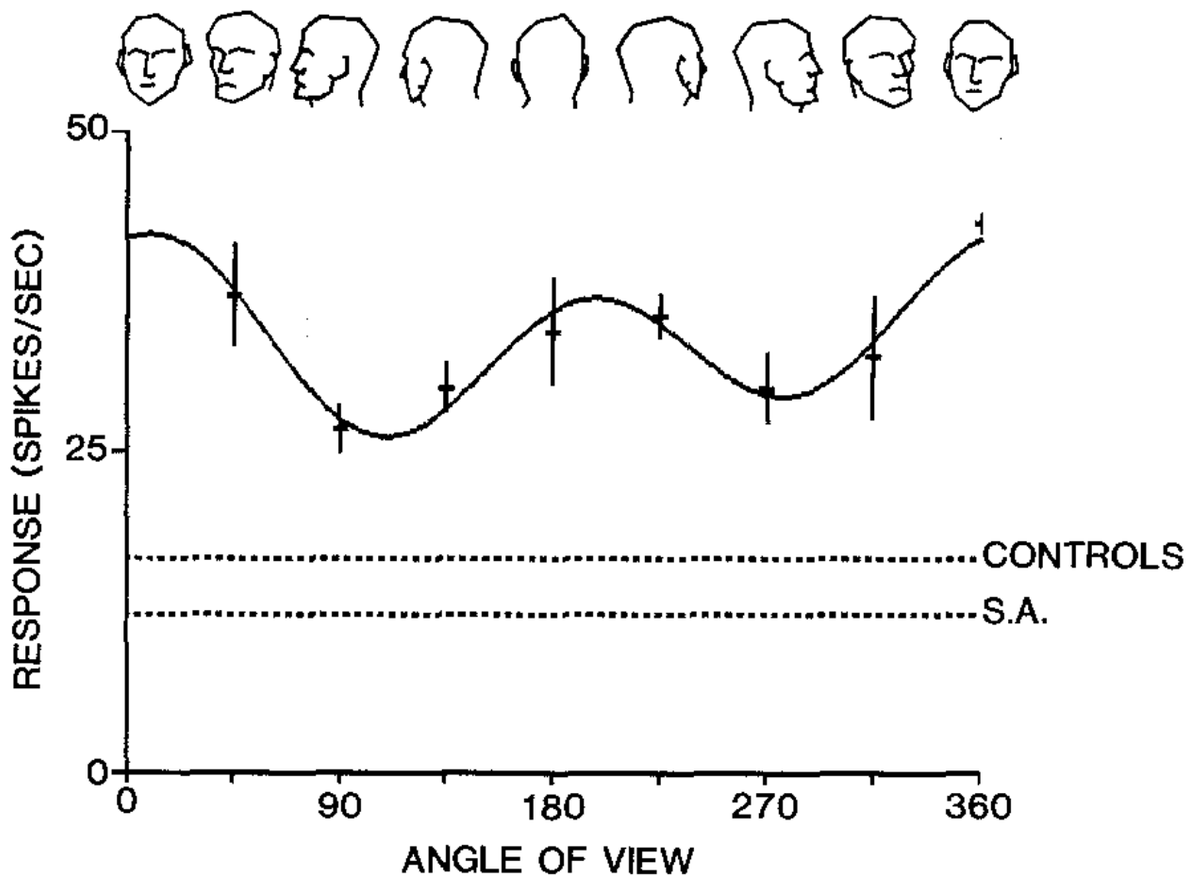
    - Subjects do the best if a 3D object is presented in the same orientation as they are initially seen.

    - *Objects are recognized by scanning a known picture database.*

Image-based Recognition

- Experimental evidence for image-based recognition





Perrett et al. 1991

- Specific neurons in monkeys will respond to specific orientations of faces.

- Supports multiple-view, image-based theory of recognition

Image-based Recognition: Viewing size

- Viewing size affects recognition

Image-based Recognition: Viewing size

- Viewing size affects recognition

  - For optimal identification, make important patterns and complex objects so they have a size of 4-6° of visual angle.

Image-based Recognition: Priming

#FindThatLizard by @Afro_Herper on twitter

Image-based Recognition: Priming

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Image-based Recognition: Priming

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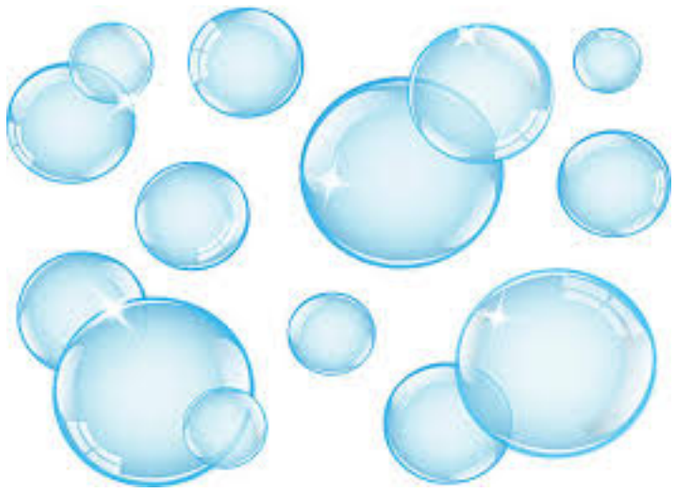
Image-based Recognition: Priming



So_p

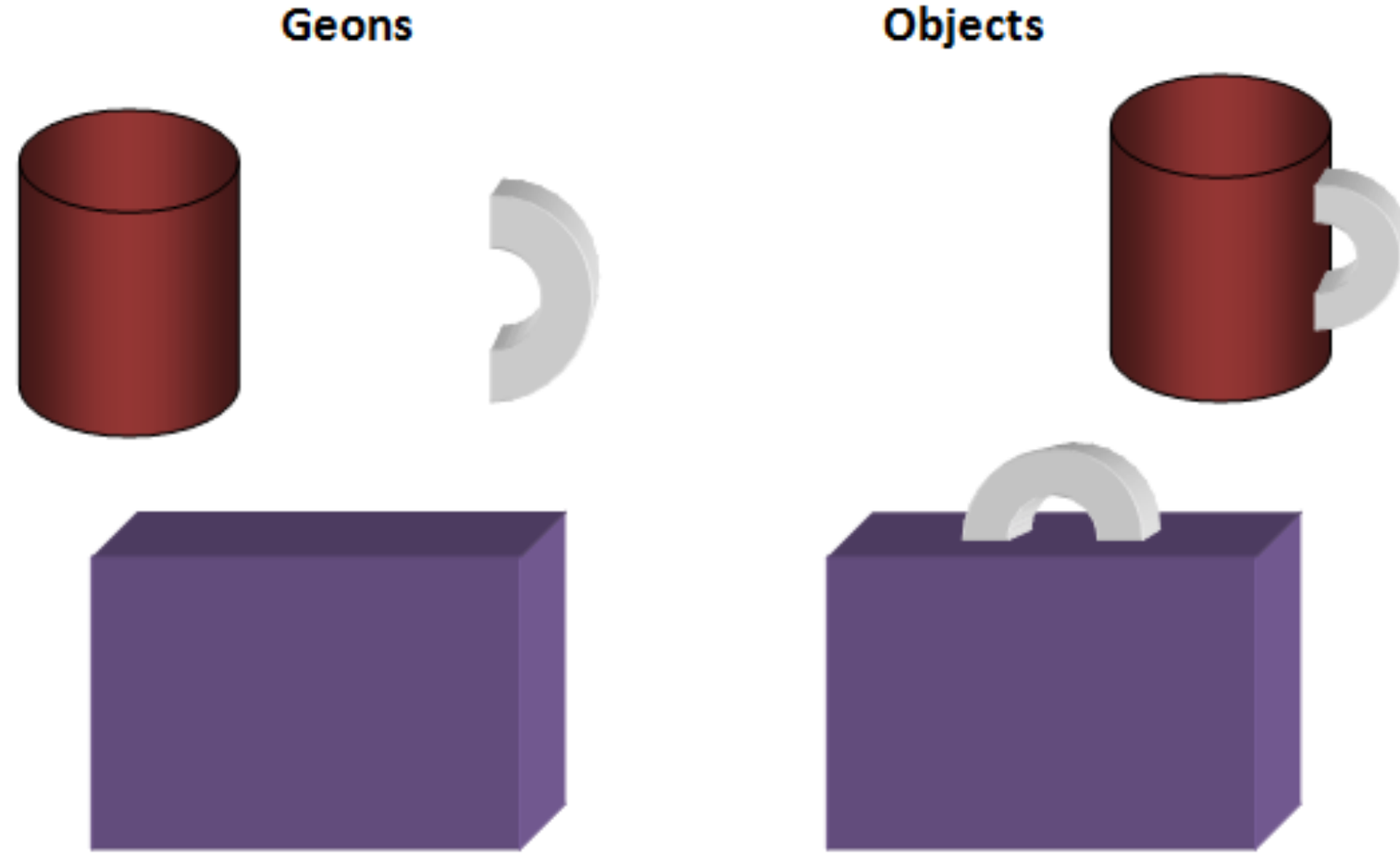
Image-based Recognition: Priming

So_p

Structure-based Recognition

- **Geon theory:** Objects are constructed of geometric objects we already understand.

    - Brain recognizes geons and then constructs them to recognize more complicated objects.



Wikipedia, *UserLdaisy*

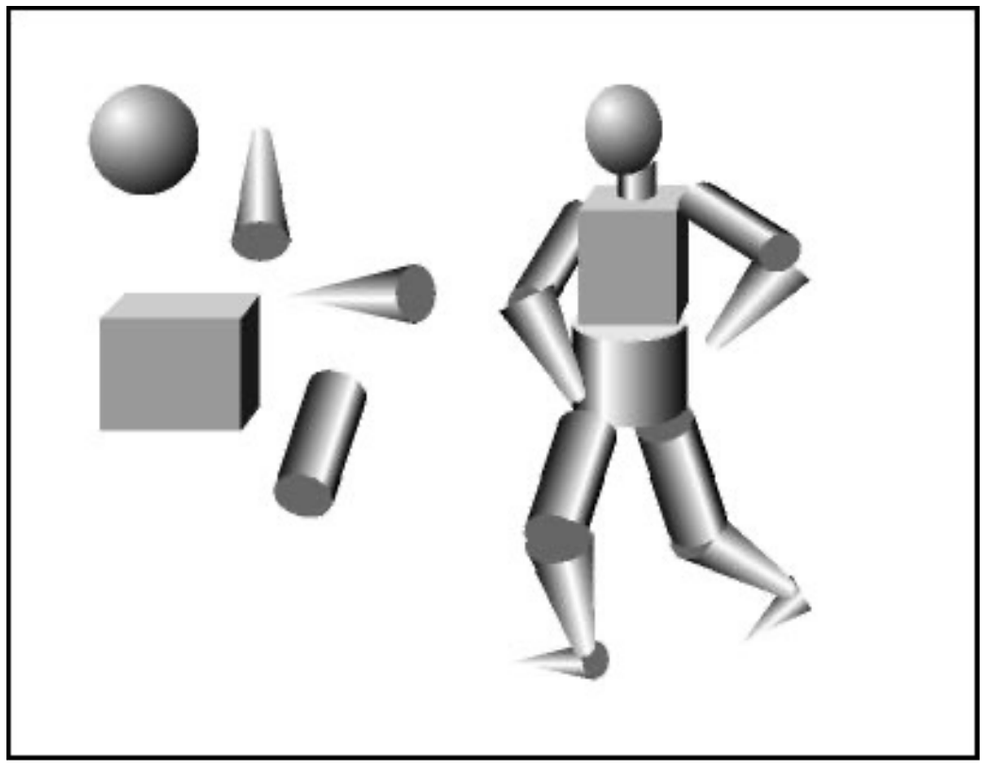


Fig. 8.5 Primitive geons constructing a more complicated human form.

Structure-based Recognition

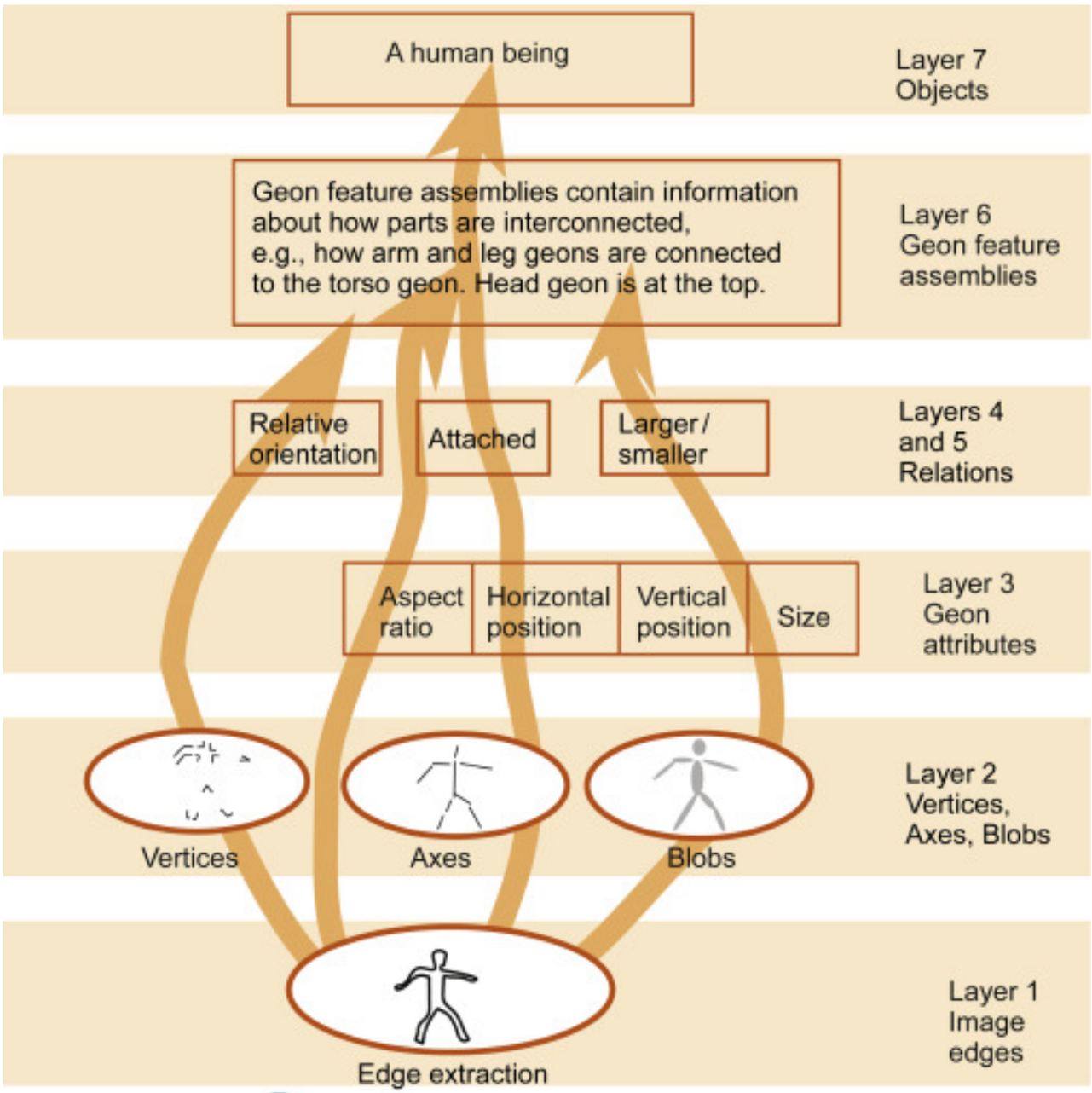
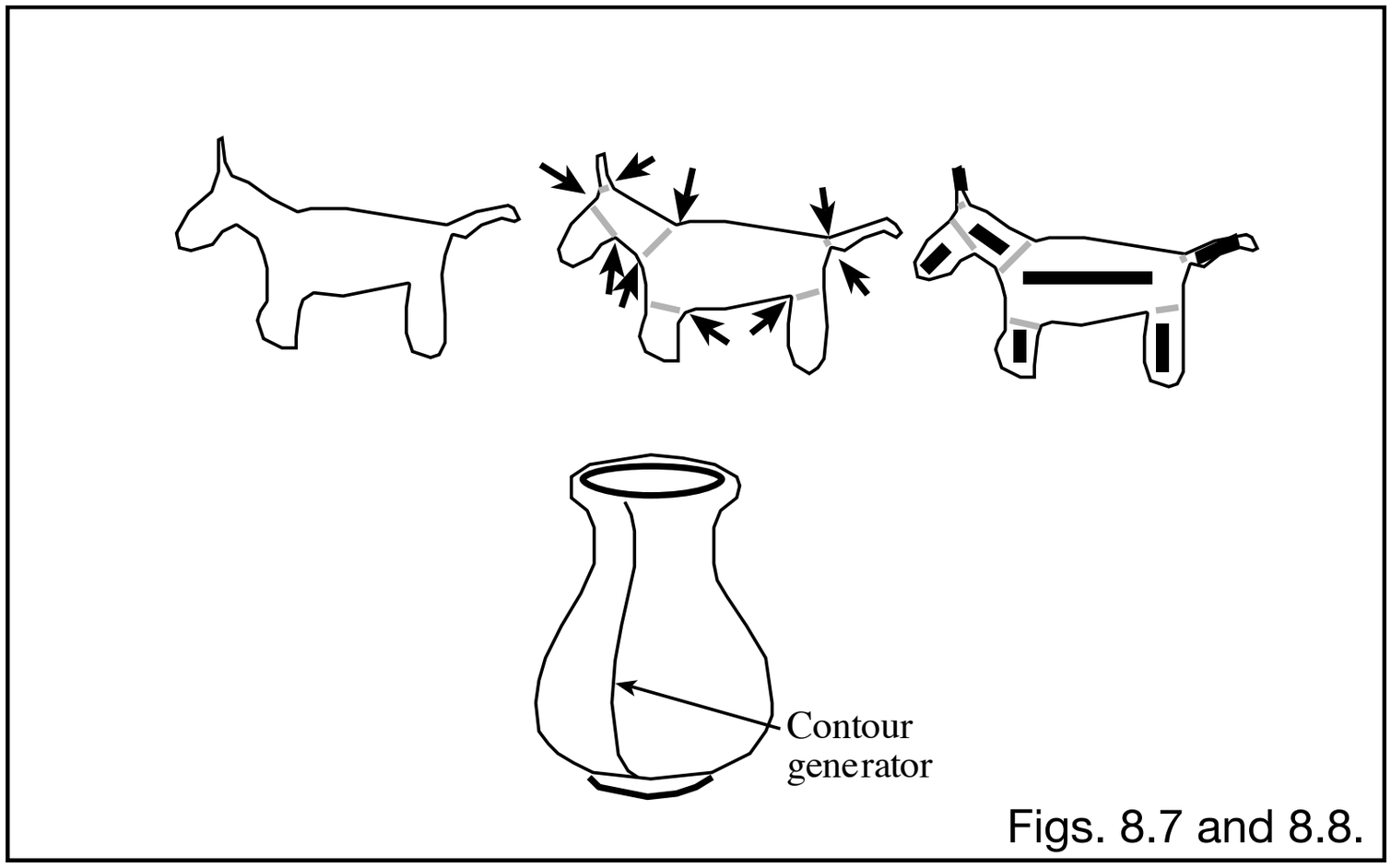


Fig. 8.4 A simplified view of Hummel and Biederman's (1992) neural network model of form perception.

Structure-based Recognition

- Brain finds geons by extrapolating shapes and contours from 3D cues.



Figs. 8.7 and 8.8.

Structure-based Recognition

- Silhouettes: important for determining objects and their structures.

    - Brain recognizes line drawings much faster than photographs of similar objects.

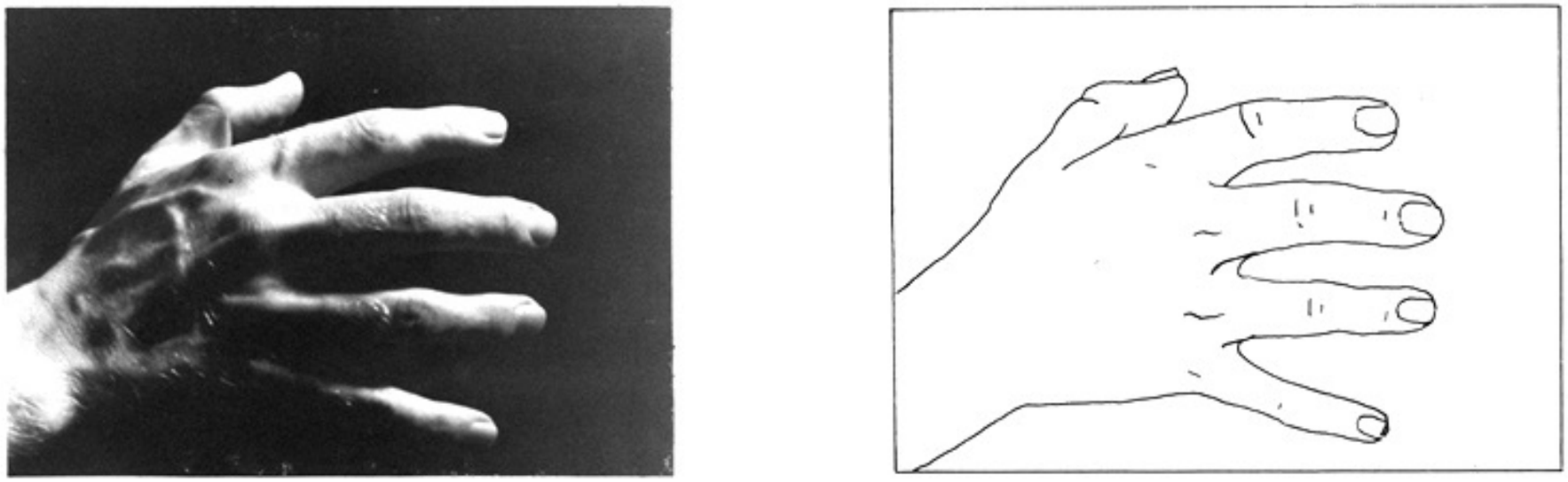
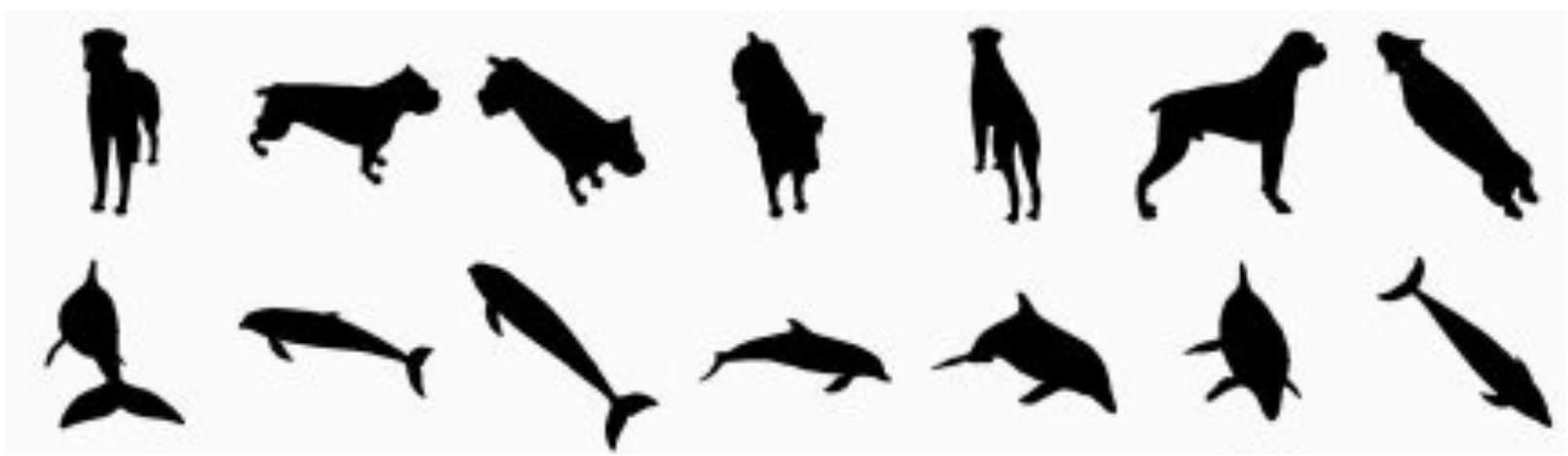


Fig. 8.9 A photograph and a simplified line drawing of a hand.

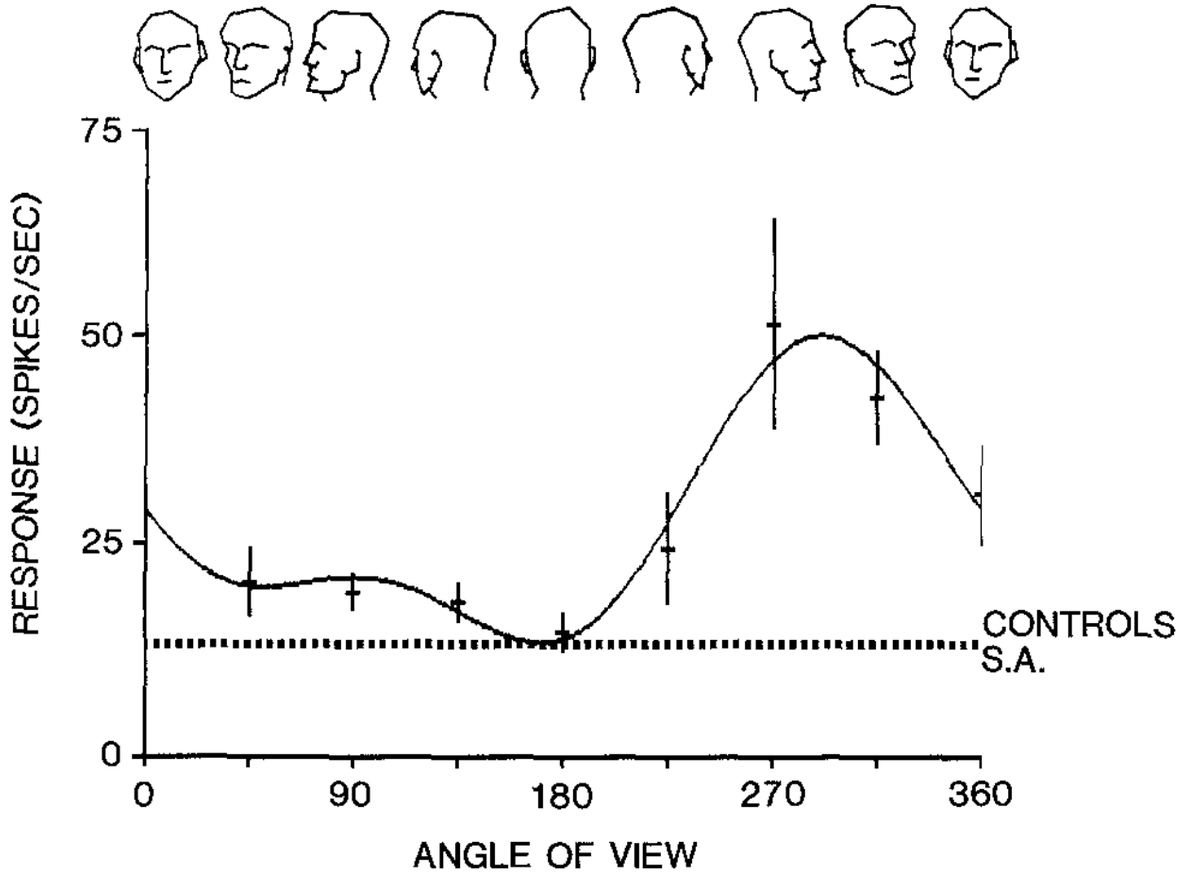
- Many shapes have canonical silhouettes defined viewpoints that are most easily recognized.

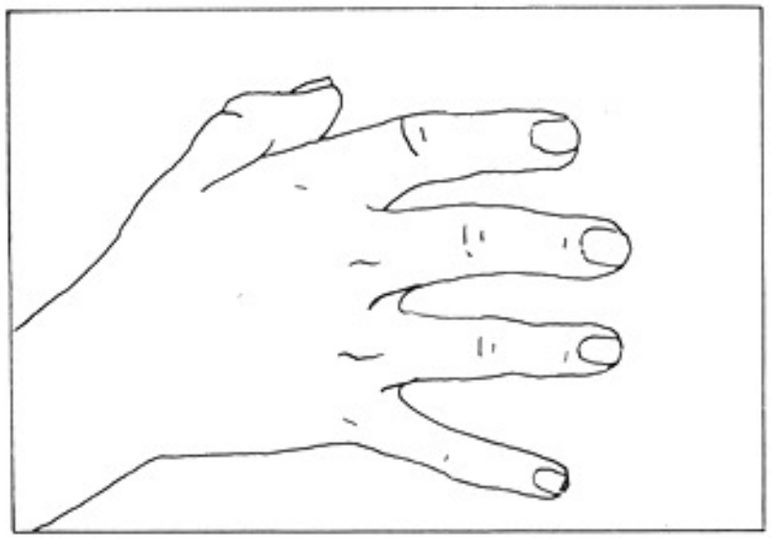


Macrinin et al. 2002

Object Recognition: how does it happen?

- Although some aspects of image-based and structure-based recognition theories are mutually exclusive, it's likely that **both types of cues** are important for object recognition.



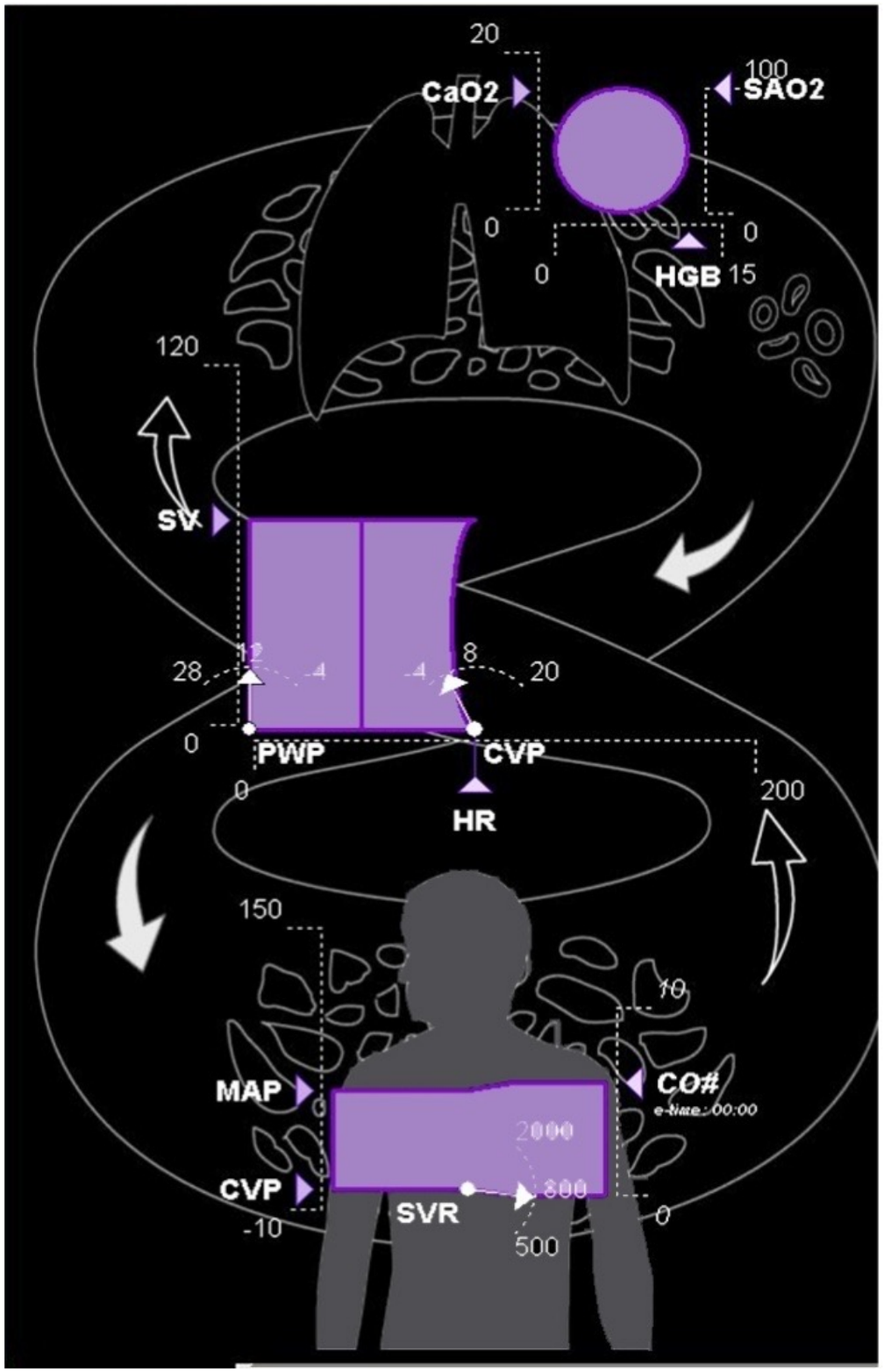


Building Object-based Diagrams

- Object displays and diagrams are a **powerful way** to communicate data **very quickly and accurately**.
    - “single contoured object” to integrate several separate variables
    - variable data will be processed together in parallel
    - far faster than separate, serial processing
    - uses fewer working memory spots
    - makes it possible to rapidly integrate several information sources
    - reduces visual clutter in display
- Object displays and diagrams are most effective when components of objects have natural or metaphorical relationship.

Building Object Displays: Example

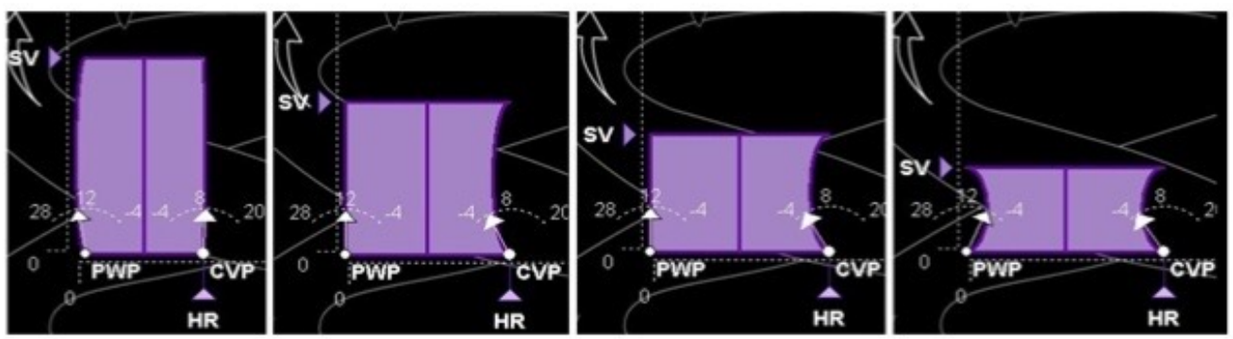
- Example: George Blike's anesthesia instrument readout.



- **Center** represents heart, size and shape of glyph represents four measurements:
  - *height*: volume pumped by single heart beat
  - *width*: heart rate
  - *size*: emergent property showing heart throughput.
  - *bowing*: pulmonary wedge pressure and central venous pressure, representing right and left pressures of the heart.

Reduced errors by 66%!

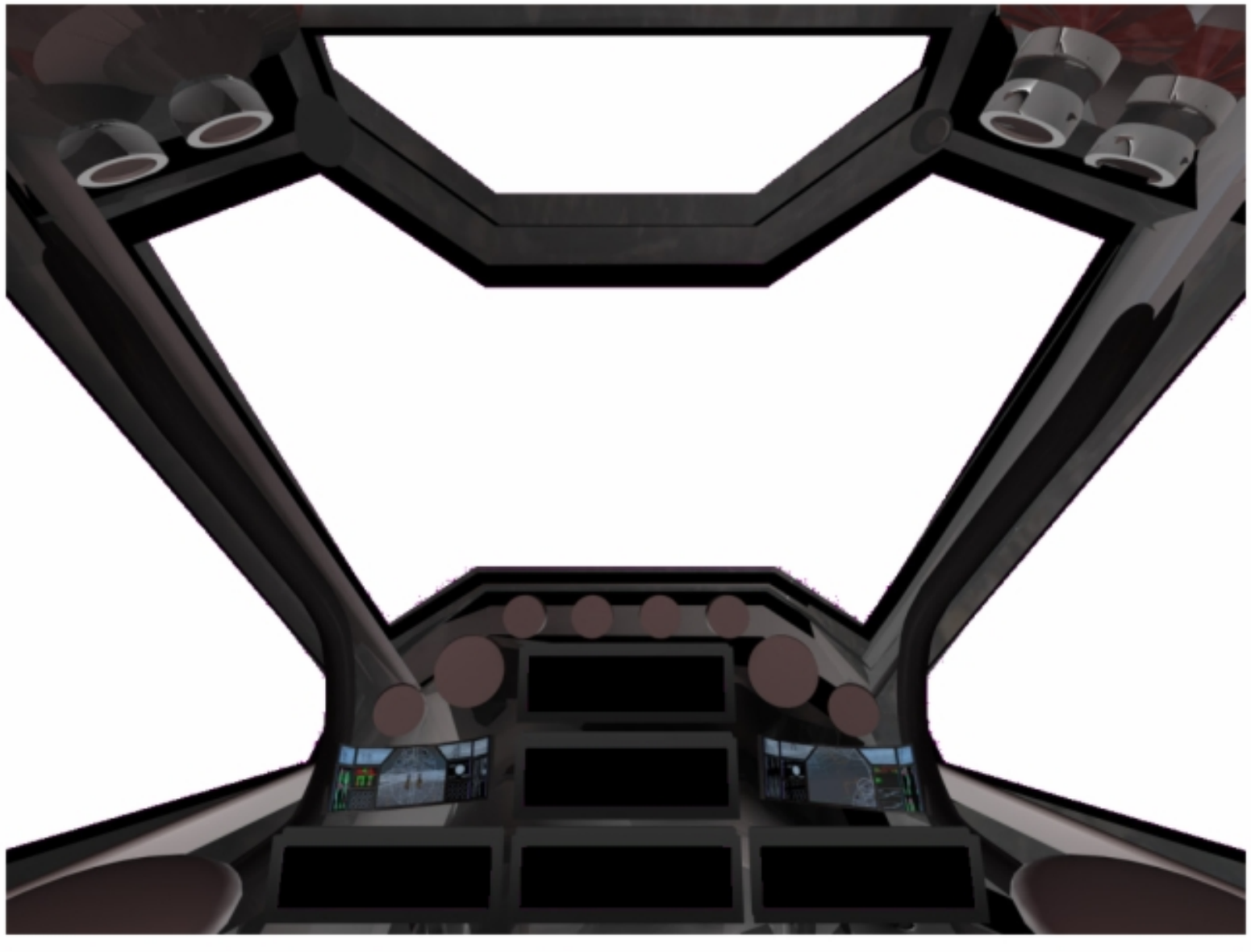
A hemorrhage in progress



Assignment:

You are developing a video game of a spaceship fighter in which the user will have a cockpit view. Similar to plane dog-fights, the user will have to quickly navigate the ship so it can shoot down its opponent and avoid being shot down.

Design a cockpit visual display that will be projected into the screen that gives the user relevant information. Speed is key here, you can assume that the user will undergo training in order to read your display.



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