Reflections of Memory in the Environment

Jason R. Finley
William F. Brewer
Aaron S. Benjamin
University of Illinois at Urbana-Champaign

SenseCam 2009 Symposium, Chicago, IL
October 17th, 02009

Outline

- A Memory Experiment
- Reflections of Memory in the Environment
  - Improving the use of sensors to predict memorability
- An Overall Framework

Memory Experiment using SenseCam

1. Does end-of-day image review improve memory?
2. Does sensor-triggering yield more memorable pictures than timer-triggering?

SenseCam Trigger Methods

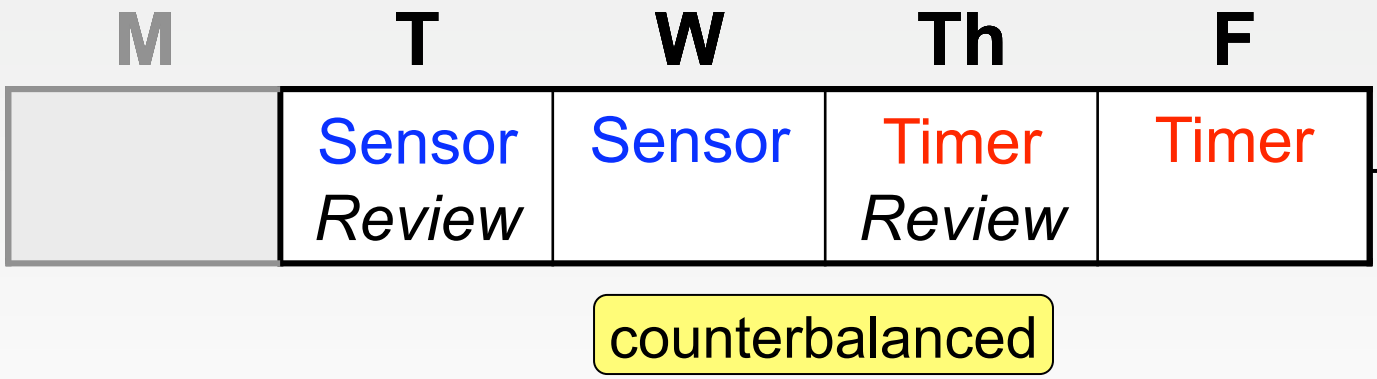
1. ~~Manual~~
2. Sensor algorithm
3. Timer

All 3 enabled by default

Control condition
(de facto randomly sampled)

N=12

Design and Methods



<u>End-of-Day Review</u>

- Randomly selected subset of images
- Chronological order
- 1 fps

<u>Sensor Mode vs. Timer Mode</u>

- Timer: mean 10.56 sec (SD 1.3)

Memory Tests

1, 3, 8 weeks

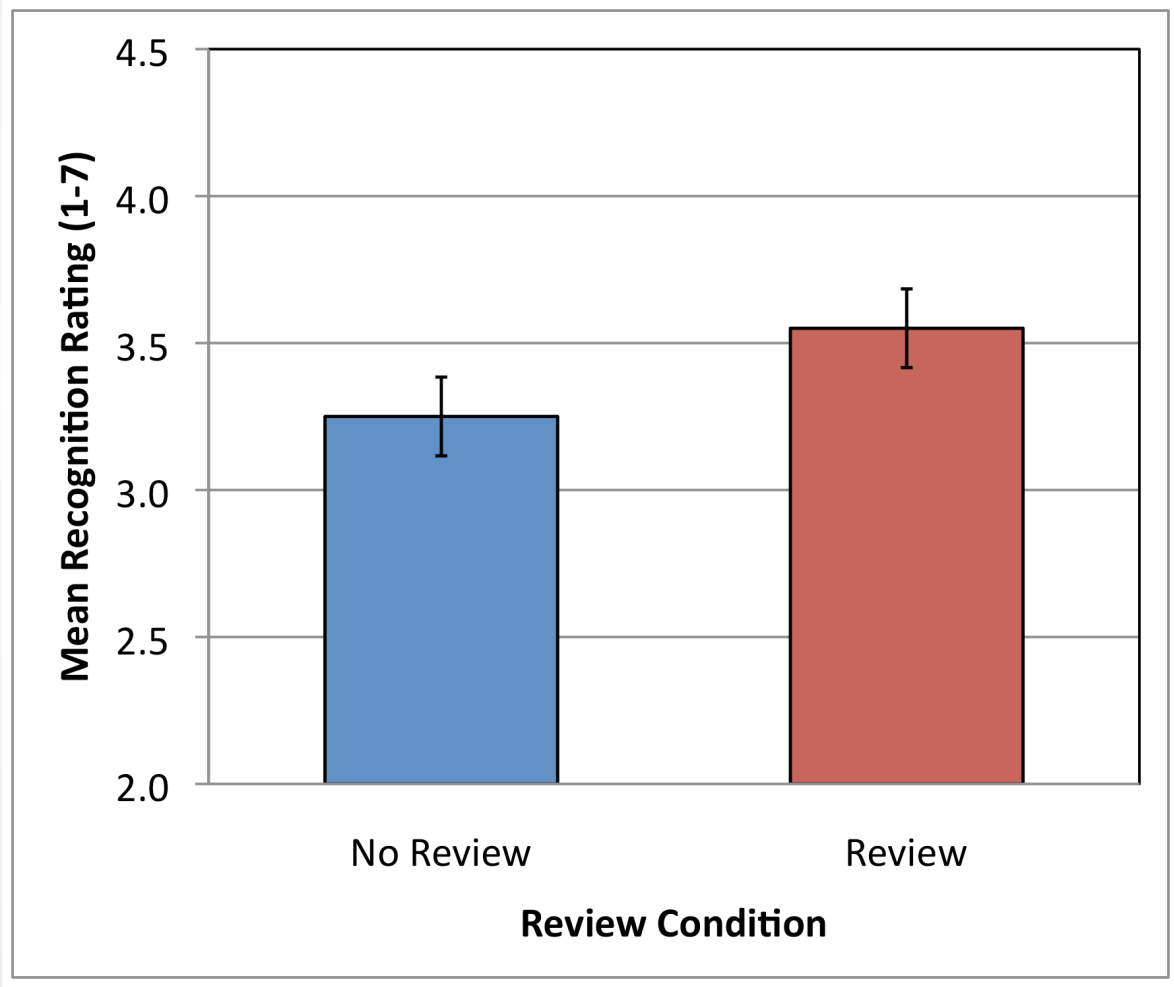
Recognition Rating

Please rate the strength of your memory for the scene(s) and/or event(s) depicted by this picture.

1	2	3	4	5	6	7
no memory						extremely strong memory

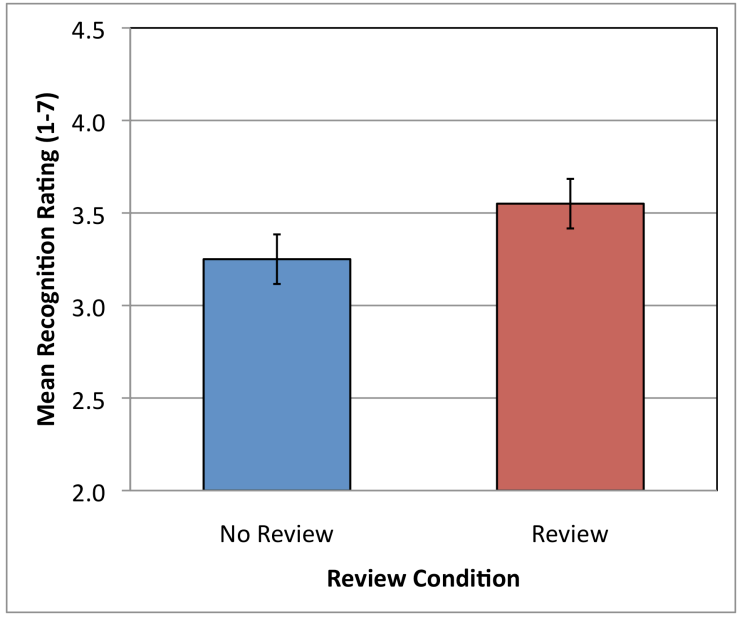
Your rating:

Results: Review Condition

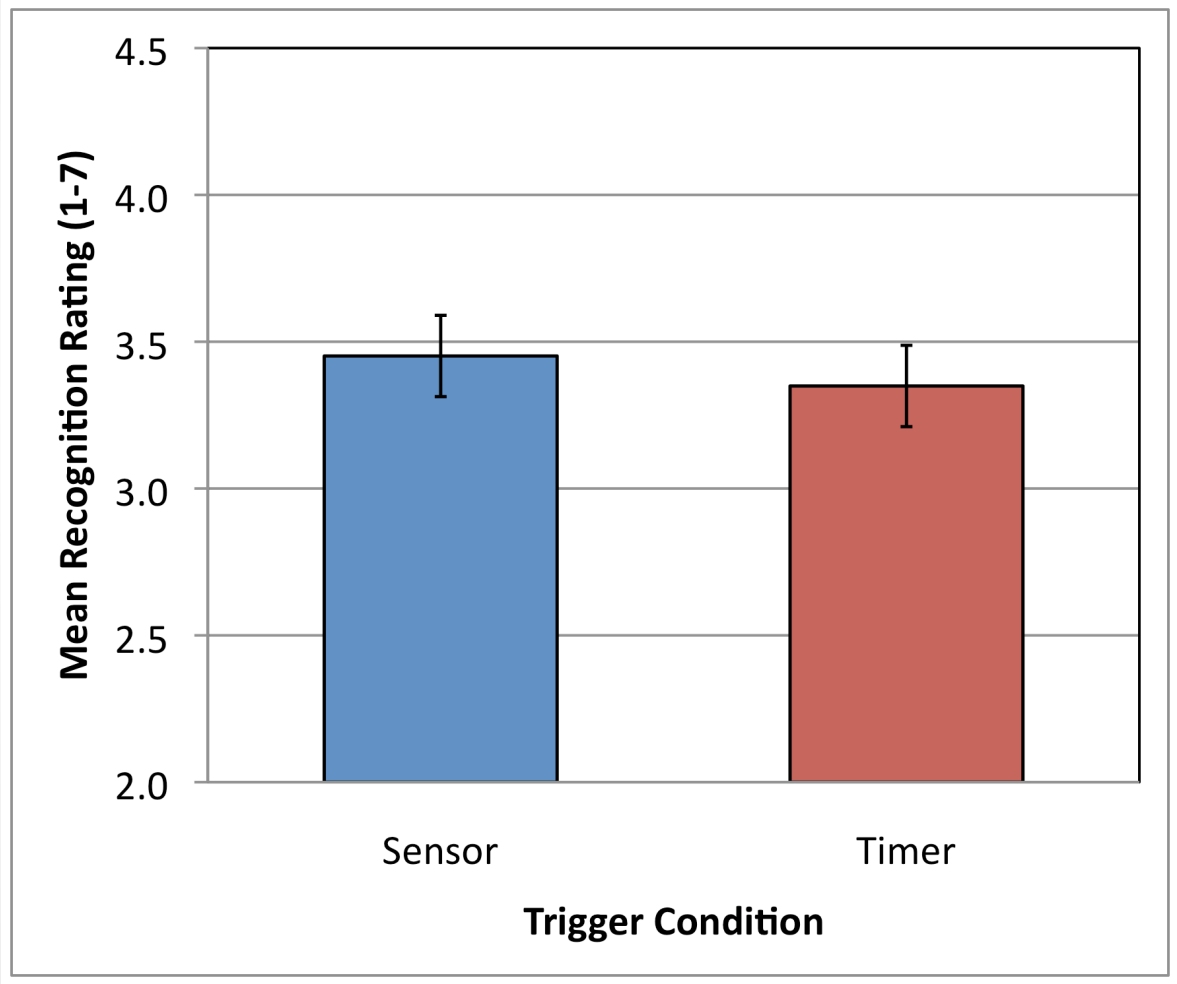


Conclusion 1

- End-of-day review helps memory.

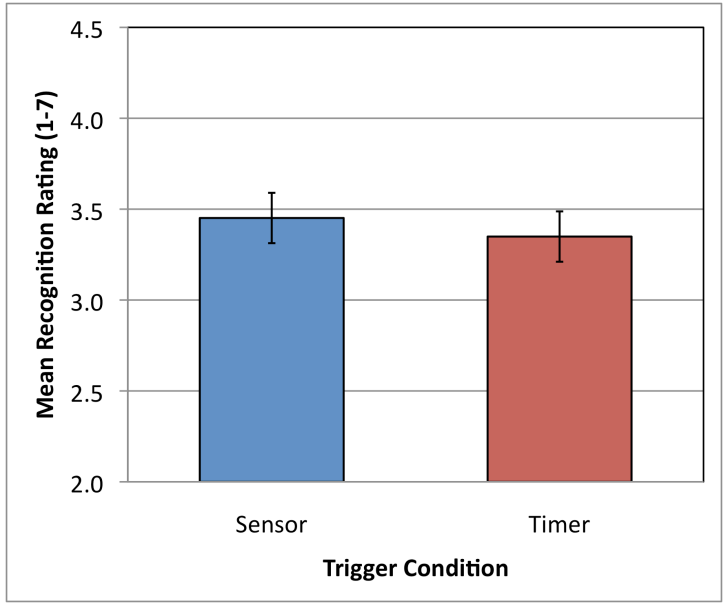


Results: Trigger Condition



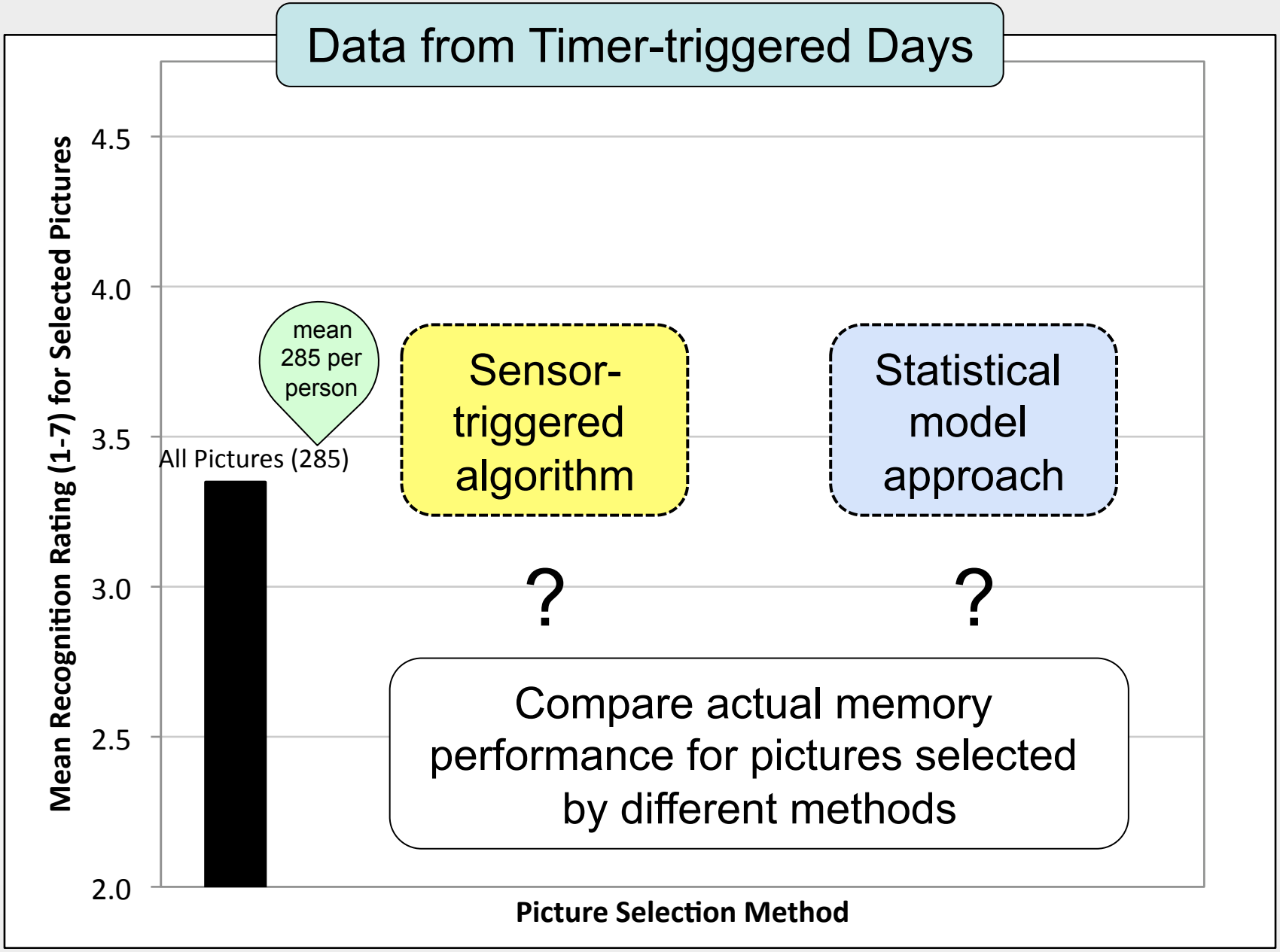
Conclusion 2

- Little to no advantage of sensor triggering over randomly selected timer-triggered images



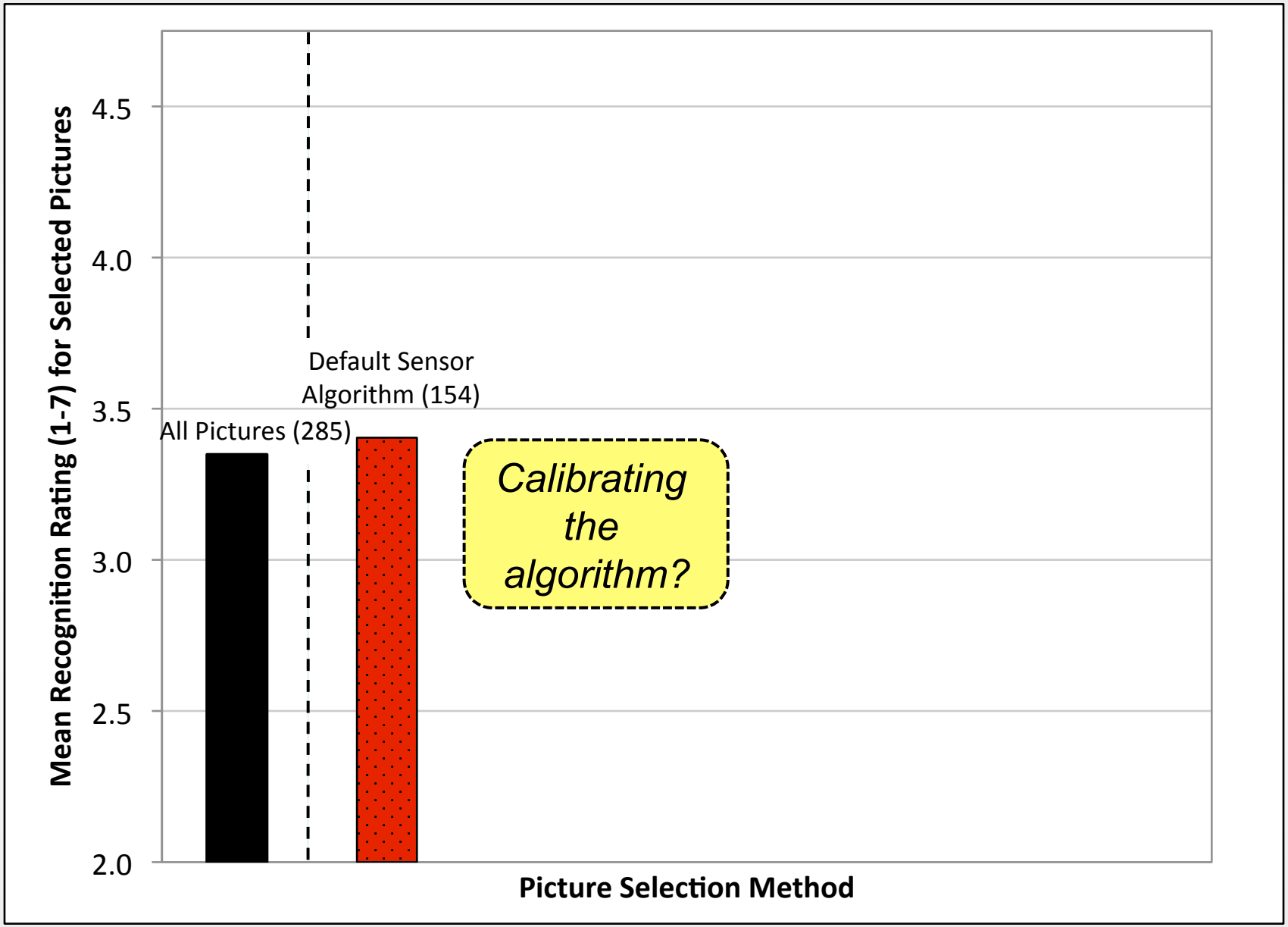
Reflections of memory in the environment?

- To what extent ***is*** memory reflected in the environment?
- Can we *improve* the way we use physical sensor data to better select more memorable images?


Data from Timer-triggered Days
Mean Recognition Rating (1-7) for Selected Pictures
4.5
4.0
3.5
3.0
2.5
2.0
mean 285 per person
All Pictures (285)
Sensor-triggered algorithm
Statistical model approach
?
?
Compare actual memory performance for pictures selected by different methods
Picture Selection Method

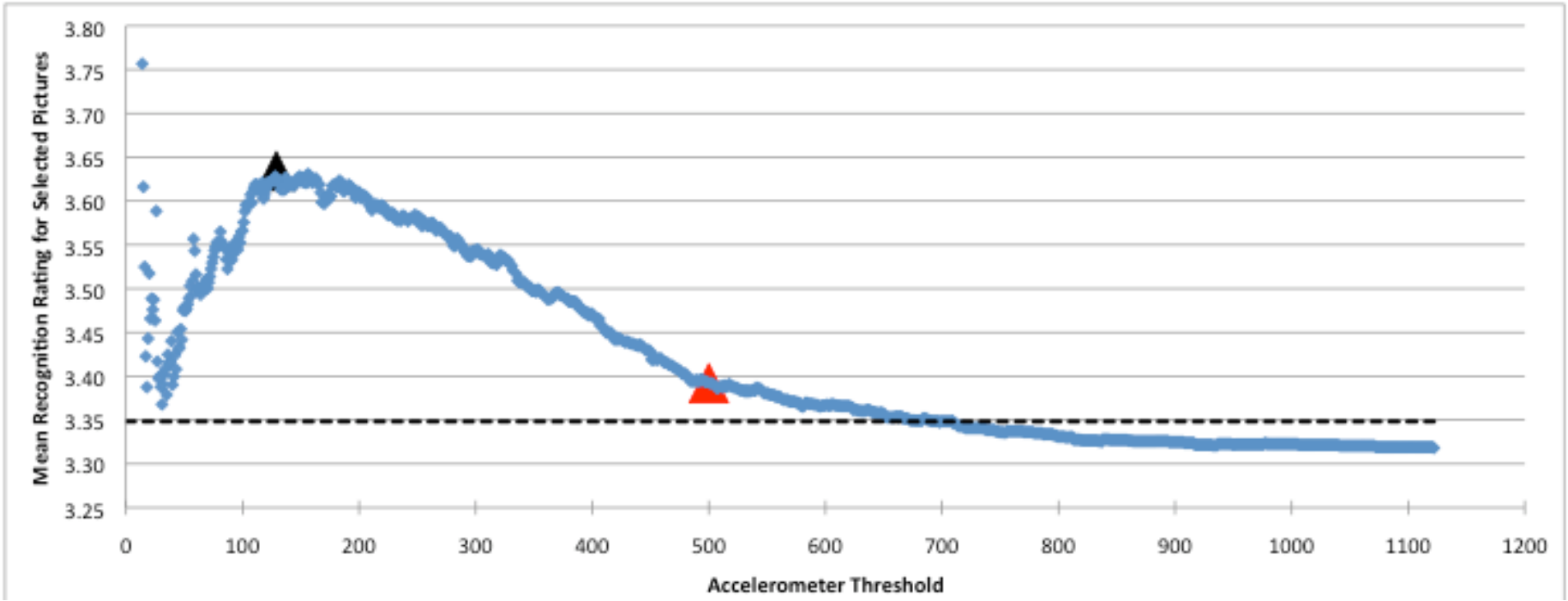
Default sensor-triggering algorithm

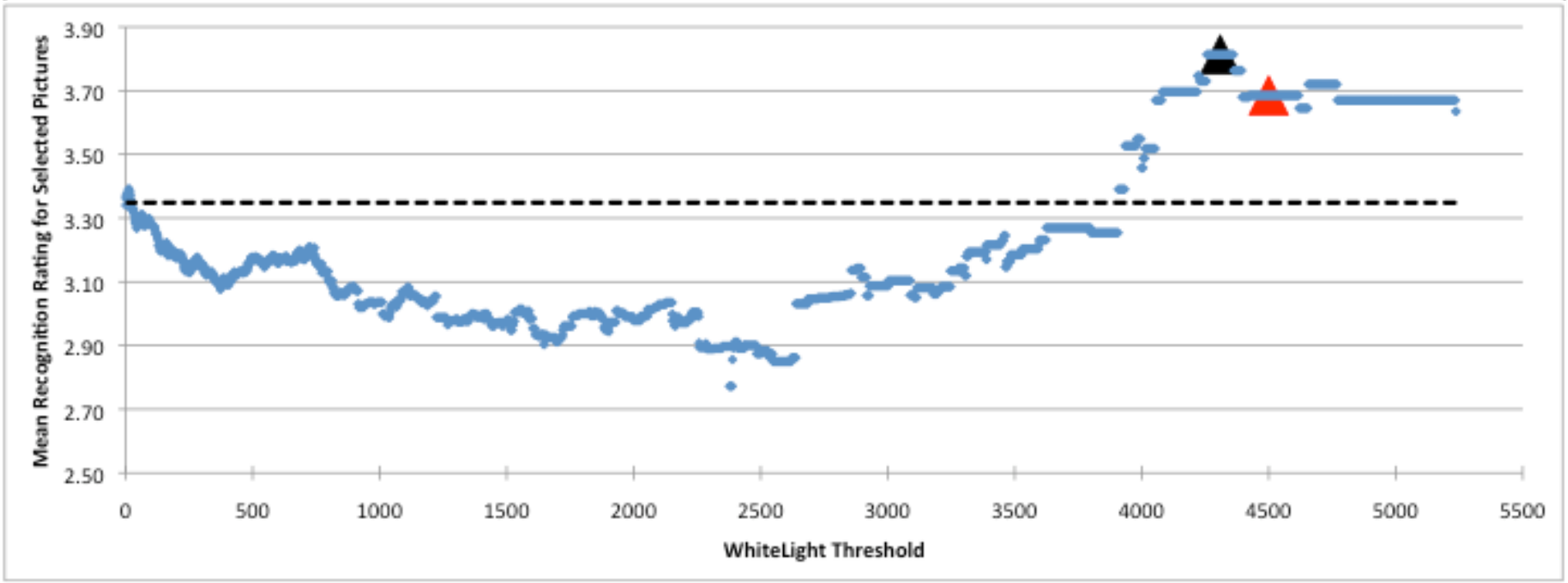
- Captures a picture IF:
  1) White Light has changed >4500, OR
  2) Accelerometer hasn't changed >500 & Passive Infrared =1
- Simulate algorithm on data from timer-triggered days
  - Select subset of pictures it WOULD have taken

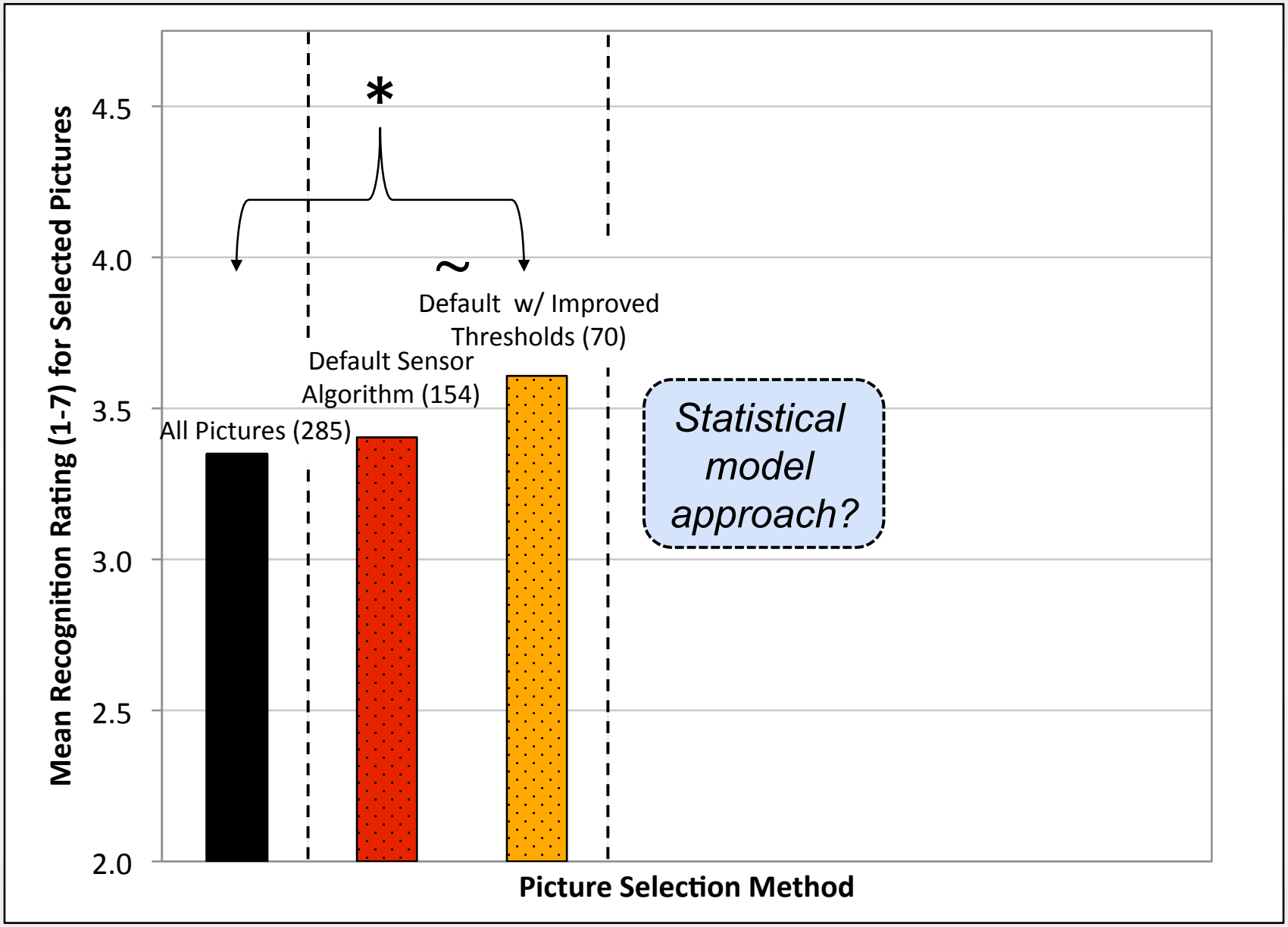

Mean Recognition Rating (1-7) for Selected Pictures
4.5
4.0
3.5
3.0
2.5
2.0
Default Sensor Algorithm (154)
All Pictures (285)
Calibrating the algorithm?
Picture Selection Method

Default sensor-triggering algorithm

- Captures a picture IF:
  1) White Light has changed >**4500**, OR
  2) Accelerometer hasn't changed >**500** & Passive Infrared =1
- Improving the threshold values?


Mean Recognition Rating for Selected Pictures
3.80
3.75
3.70
3.65
3.60
3.55
3.50
3.45
3.40
3.35
3.30
3.25
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Accelerometer Threshold


Mean Recognition Rating for Selected Pictures
3.90
3.70
3.50
3.30
3.10
2.90
2.70
2.50
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
WhiteLight Threshold

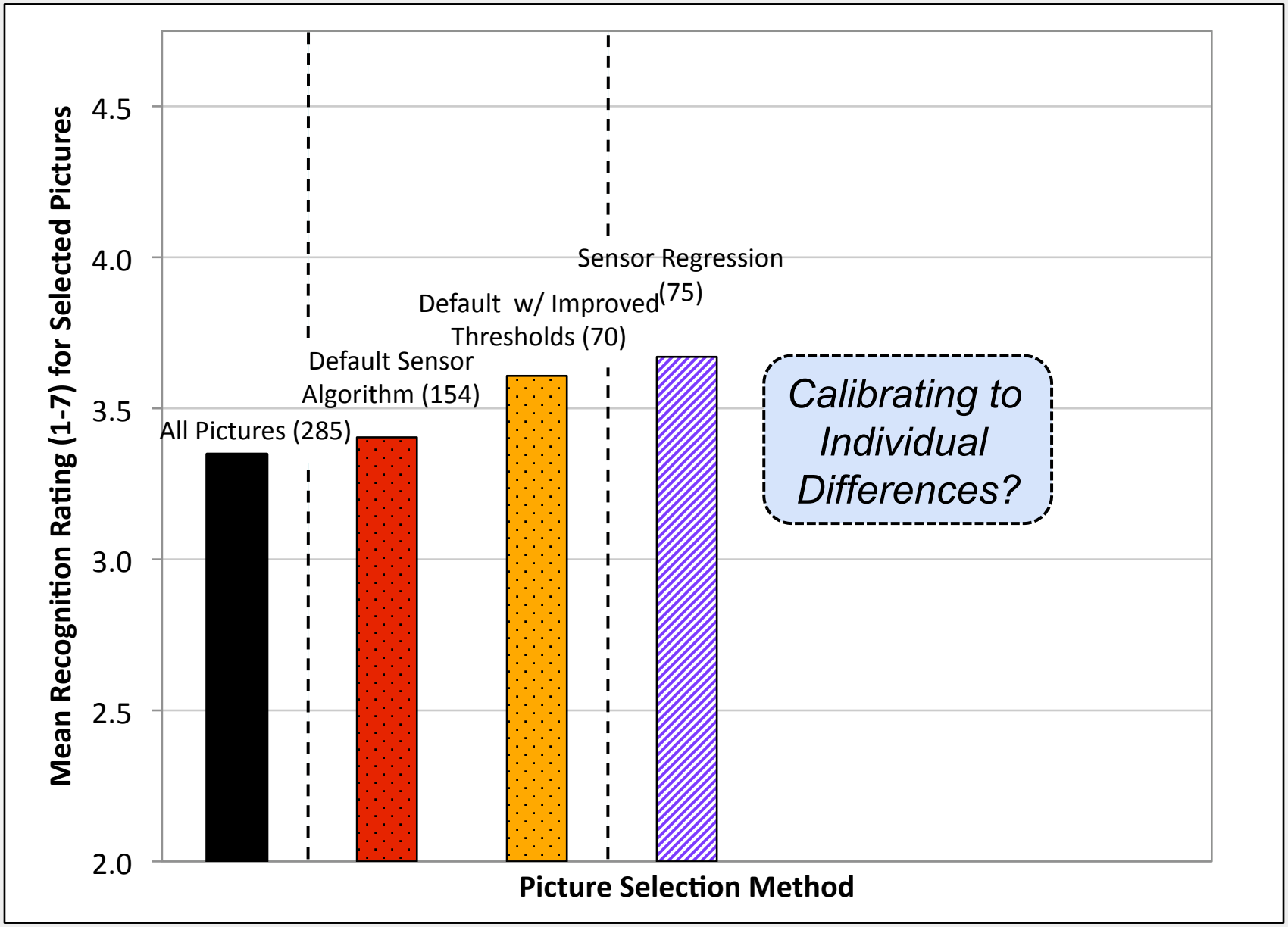

Mean Recognition Rating (1-7) for Selected Pictures
4.5
4.0
3.5
3.0
2.5
2.0
*
~
Default w/ Improved Thresholds (70)
Default Sensor Algorithm (154)
All Pictures (285)
Statistical model approach?
Picture Selection Method

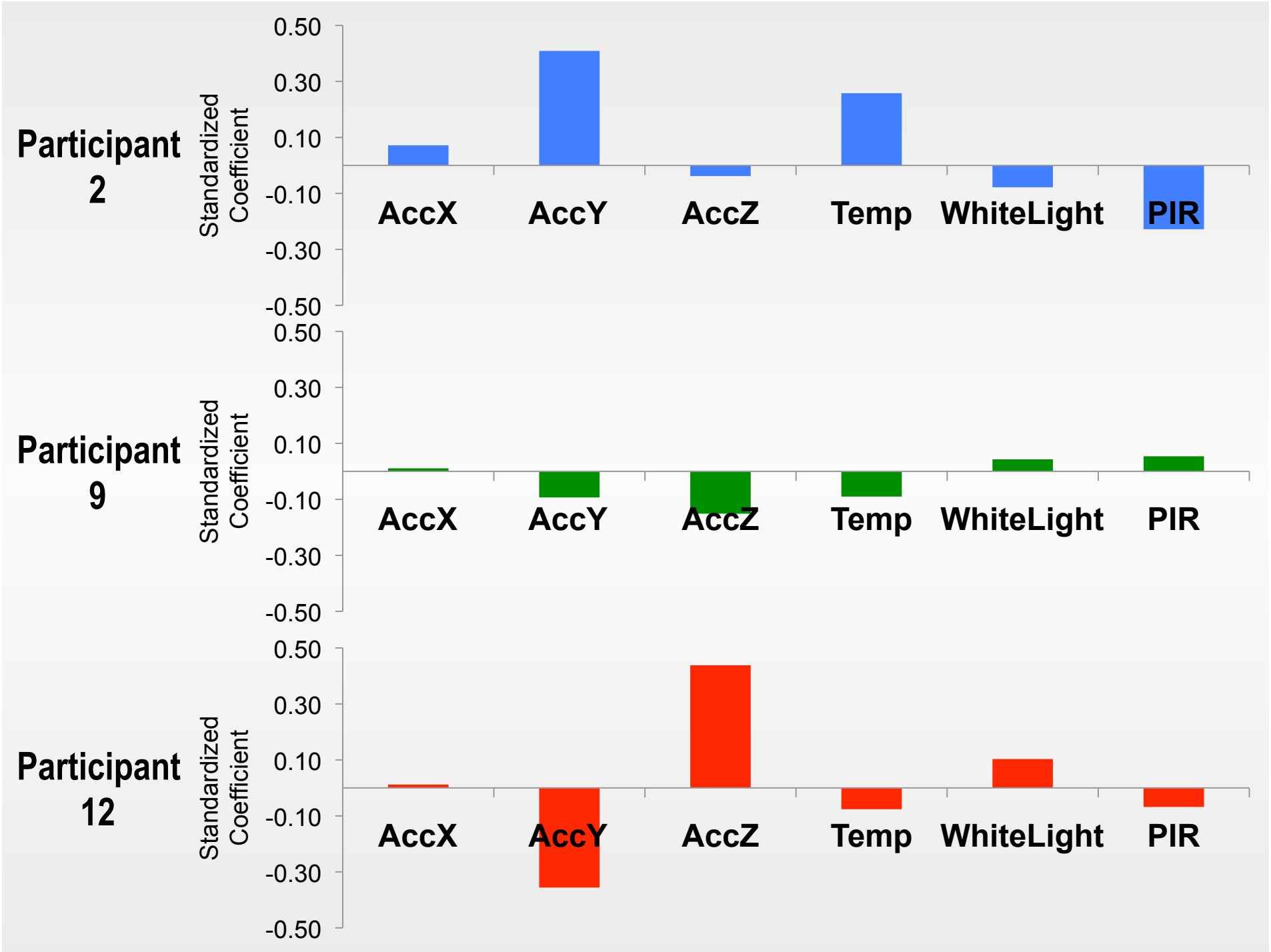
Sensor-based regression selection approach

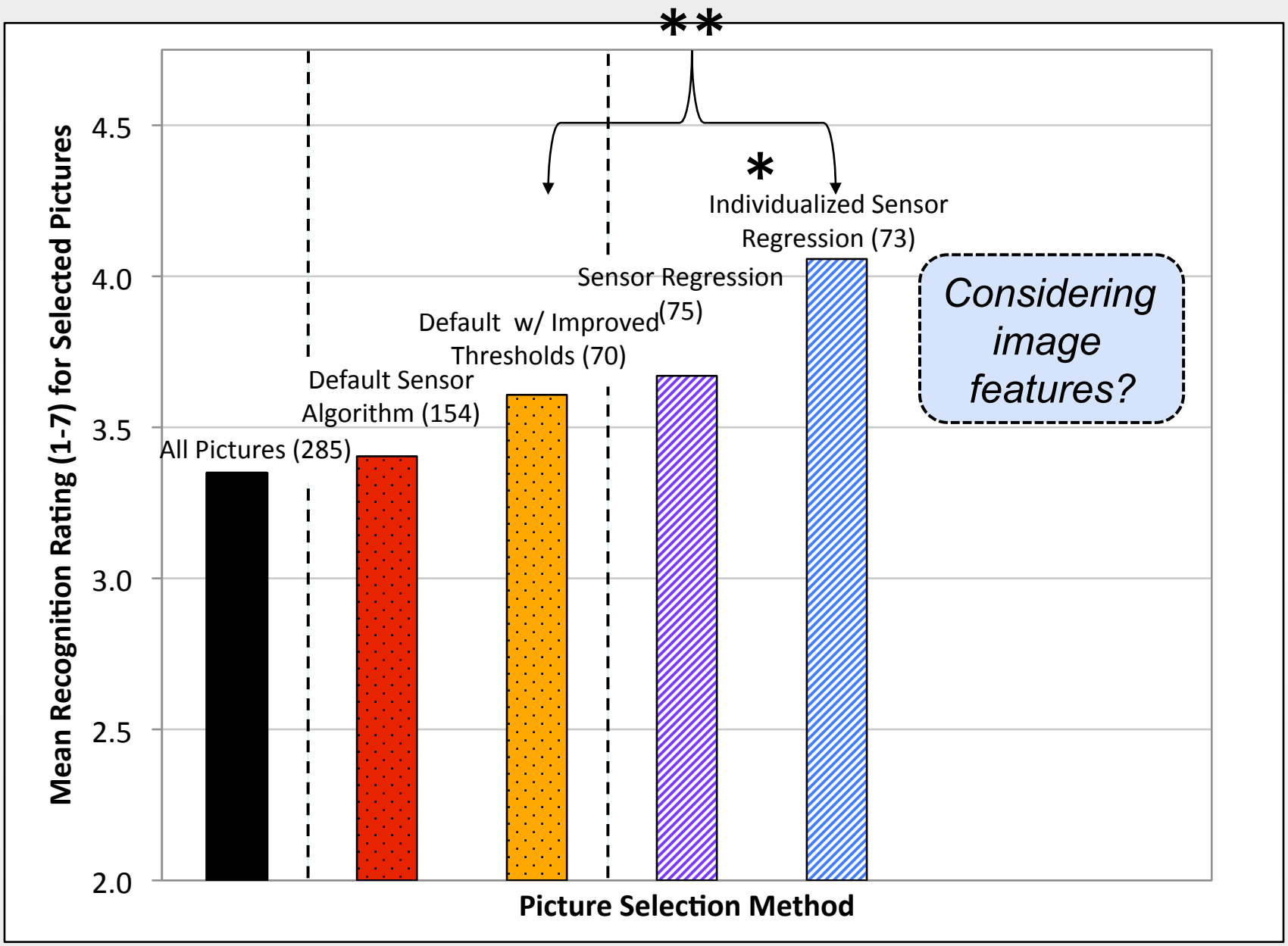
- Default algorithm: implicit psych. theory
- New approach:
  - Use *memory data* to empirically derive memory/sensor relationship
  - Make statistical model (regression) to predict memorability of images
  - Select same size subset of pictures

Sensor-based regression selection approach

- 6 Predictor variables:
  - Accelerometer (X, Y, Z)
  - Temperature
  - White Light
  - Passive Infrared (PIR)
- Response variable:
  - Recognition Rating (1-7)

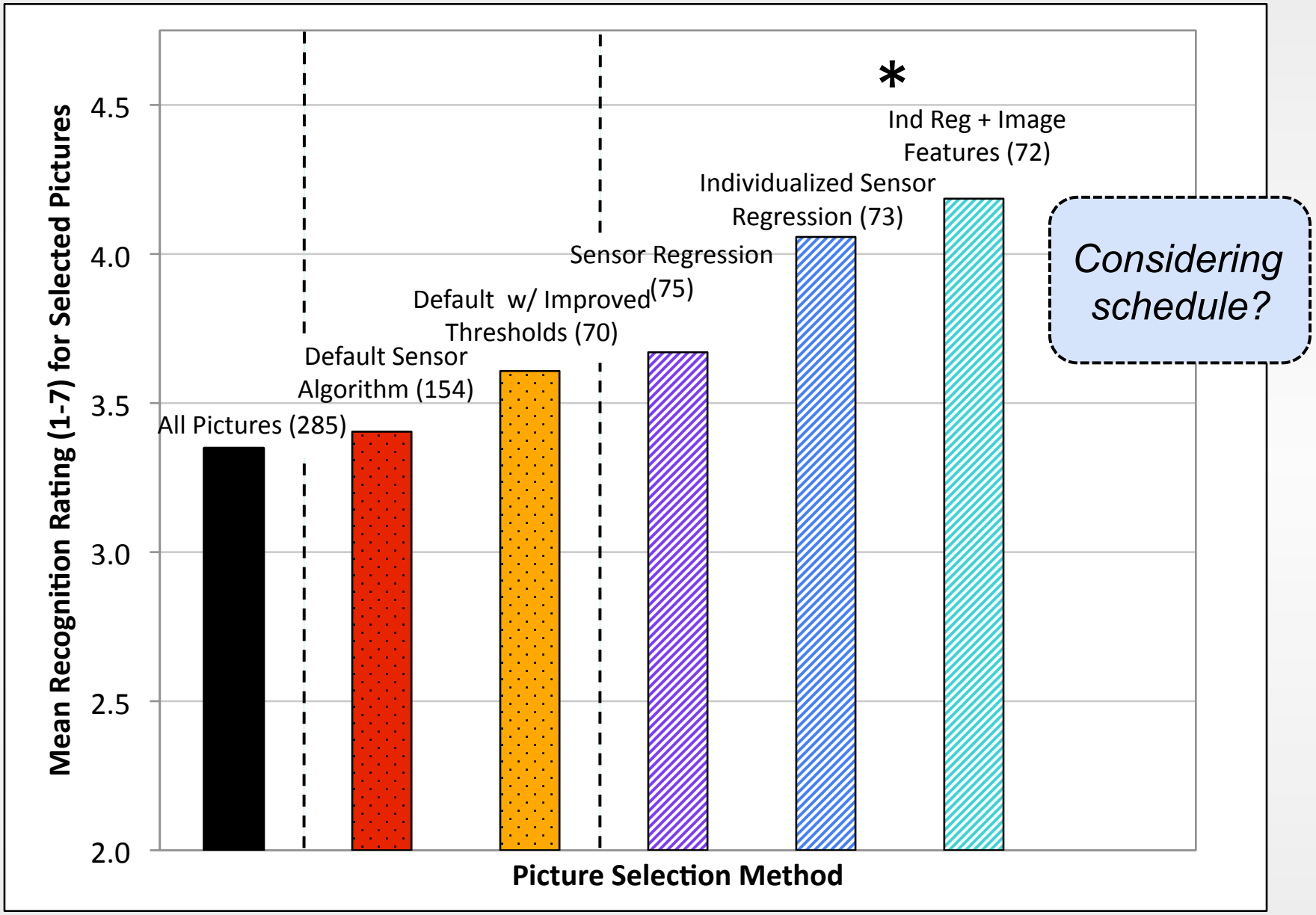

Mean Recognition Rating (1-7) for Selected Pictures
4.5
4.0
3.5
3.0
2.5
2.0
All Pictures (285)
Default Sensor Algorithm (154)
Default w/ Improved Thresholds (70)
Sensor Regression (75)
Calibrating to Individual Differences?
Picture Selection Method


Participant 2
Standardized Coefficient
0.50
0.30
0.10
-0.10
-0.30
-0.50
AccX
AccY
AccZ
Temp
WhiteLight
PIR
Participant 9
Standardized Coefficient
0.50
0.30
0.10
-0.10
-0.30
-0.50
AccX
AccY
AccZ
Temp
WhiteLight
PIR
Participant 12
Standardized Coefficient
0.50
0.30
0.10
-0.10
-0.30
-0.50
AccX
AccY
AccZ
Temp
WhiteLight
PIR


**
*
4.5
4.0
3.5
3.0
2.5
2.0
Mean Recognition Rating (1-7) for Selected Pictures
All Pictures (285)
Default Sensor Algorithm (154)
Default w/ Improved Thresholds (70)
Sensor Regression (75)
Individualized Sensor Regression (73)
Considering image features?
Picture Selection Method

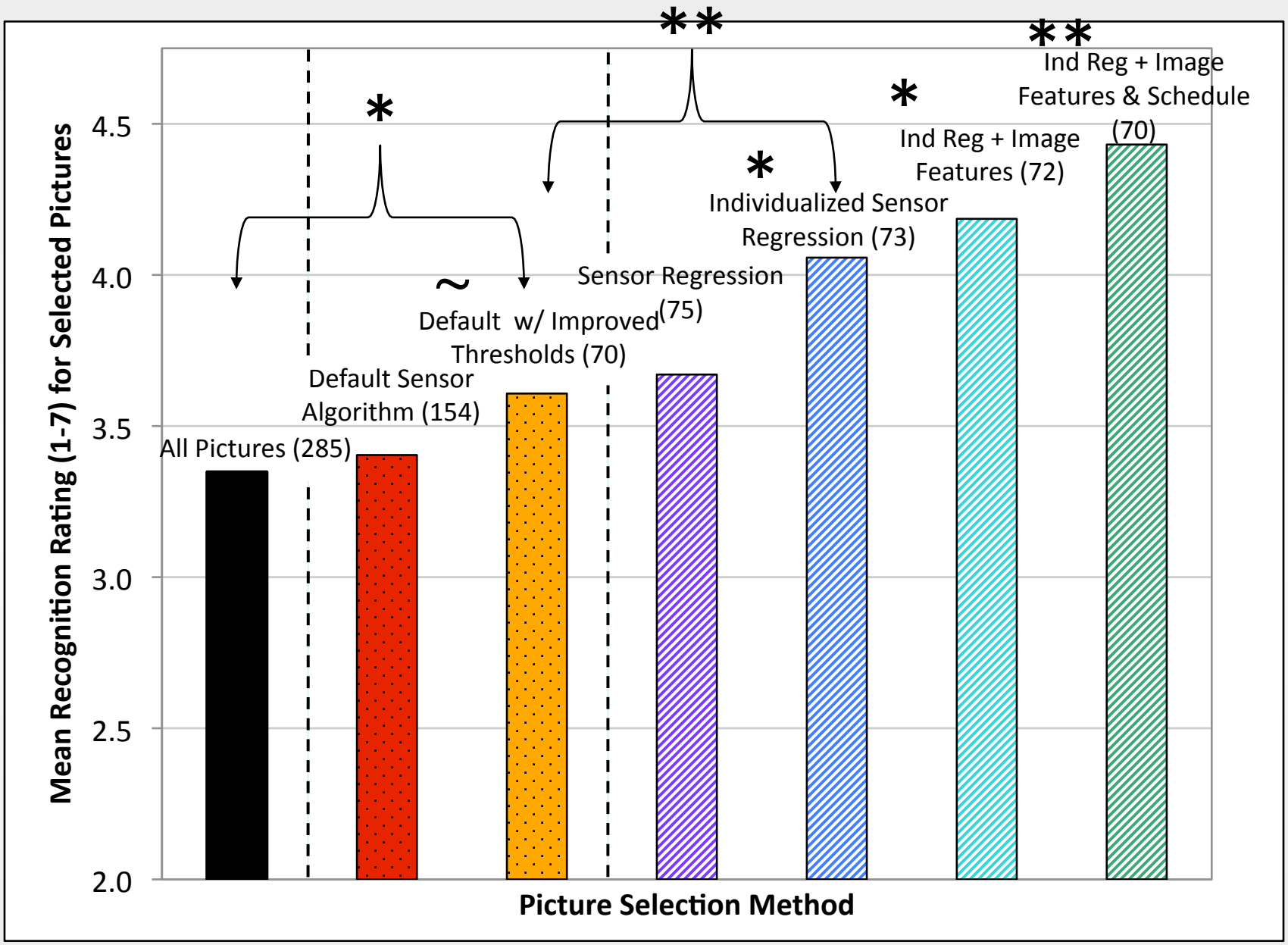
Individually fit predictor variables

1. Sensors
2. Image processing
   - Edge Density, Clutter
   - Face detection


Mean Recognition Rating (1-7) for Selected Pictures
4.5
4.0
3.5
3.0
2.5
2.0
All Pictures (285)
Default Sensor Algorithm (154)
Default w/ Improved Thresholds (70)
Sensor Regression (75)
Individualized Sensor Regression (73)
Ind Reg + Image Features (72)
*
Considering schedule?
Picture Selection Method

Individually fit predictor variables

1. Sensors
2. Image processing
   - Edge Density, Clutter
   - Face detection
3. Structure of day
   - In class or not

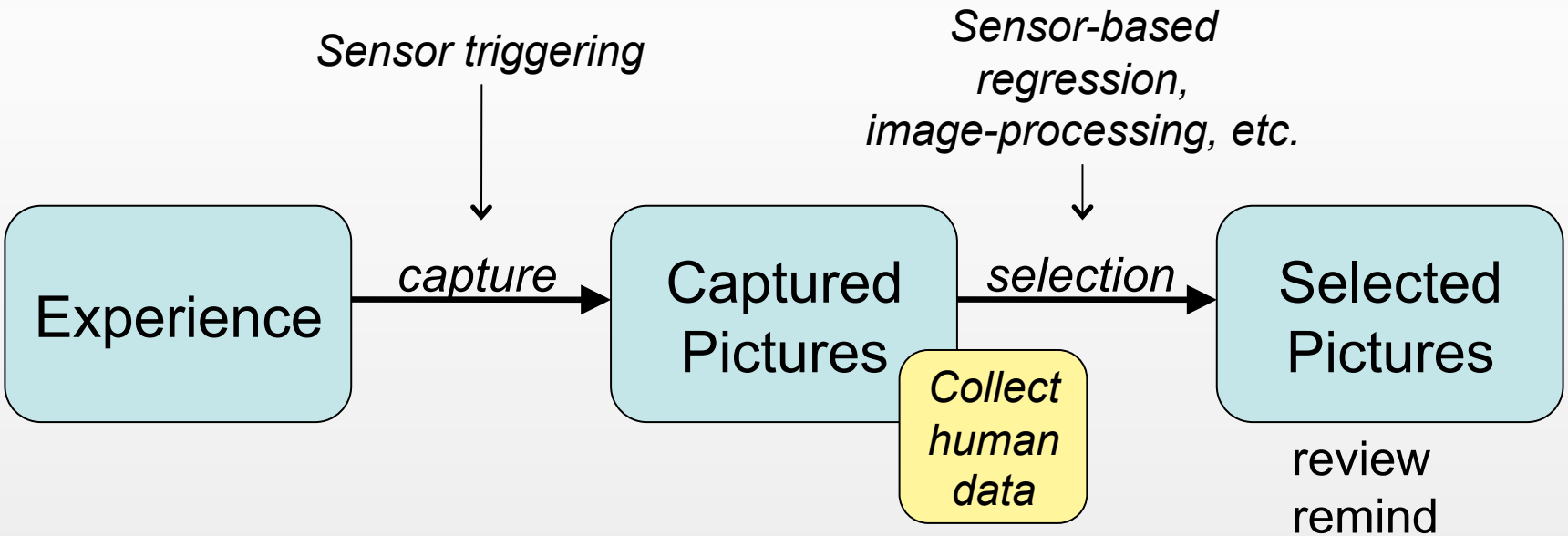

Mean Recognition Rating (1-7) for Selected Pictures
4.5
4.0
3.5
3.0
2.5
2.0
All Pictures (285)
Default Sensor Algorithm (154)
Default w/ Improved Thresholds (70)
Sensor Regression (75)
Individualized Sensor Regression (73)
Ind Reg + Image Features (72)
Ind Reg + Image Features & Schedule (70)
*
~
*
*
**
**
Picture Selection Method

Conclusions

- There ARE reflections of memory in the environment.
- Physical sensor data can be used to select more memorable images.
  - Especially when calibrated to an individual.
- And...

Lifelogging: A General Framework

- Goal: To **distill** a record of experience in the service of future use.
  Along some dimension (e.g., memorability).
- Cheap & easy: automated capture & storage.
- Bottleneck: human time and attention.
- Challenge: automate SELECTION.
- Question: at what point best?



Question: capture everything & sort it out later…?

Thank you

- Special thanks:
  - Microsoft Research
  - Steve Hodges, Emma Berry, Alex Butler, James Scott, Gavin Smyth