Estimating scene typicality from human ratings and image features

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brain+cognitive sciences

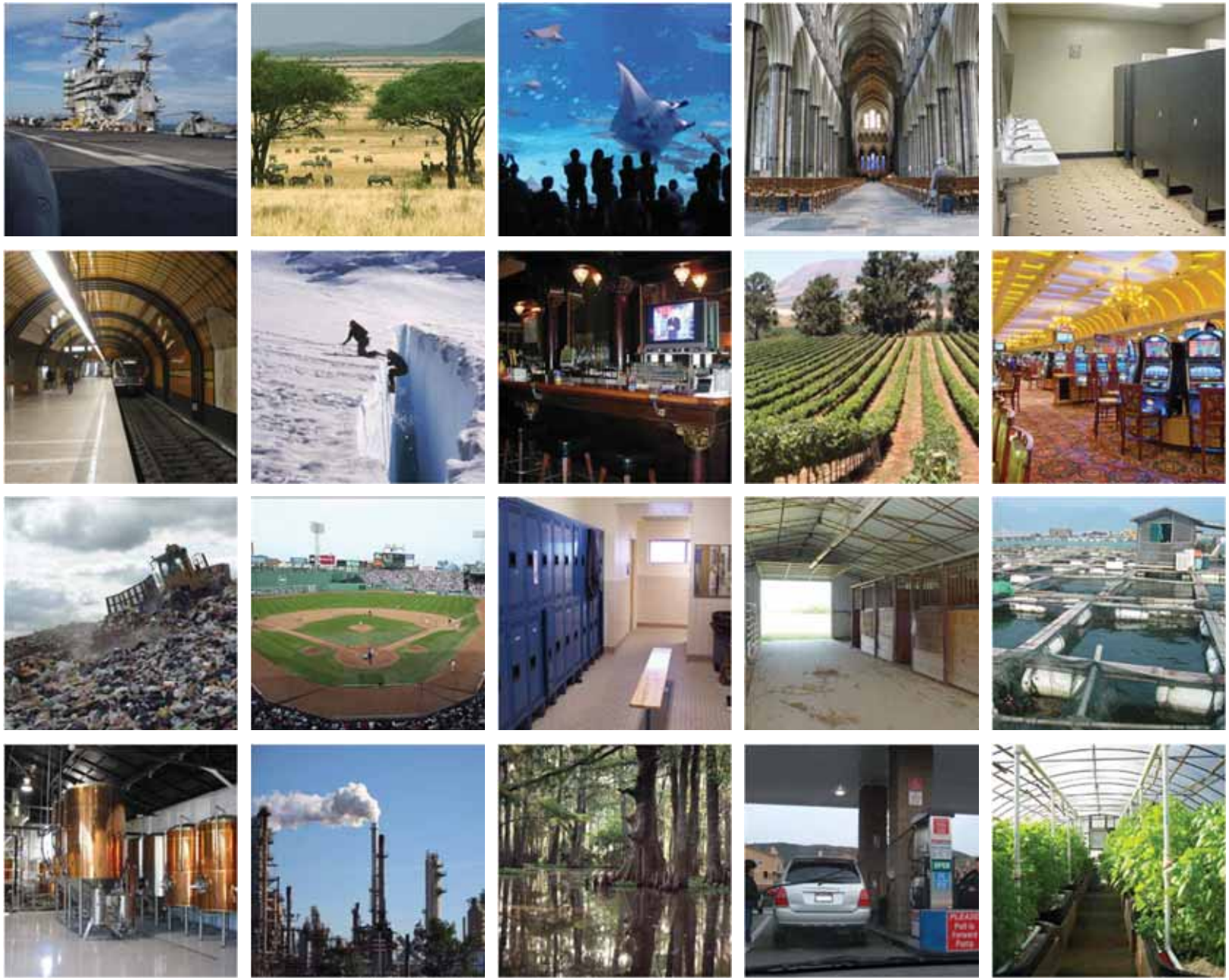
CSAIL

“chair”

“kitchen”

- Are there “typical” examples of scene categories?
- Do more typical examples contain more of the visual features relevant for scene categorization?

SUN Database: 899 scene categories, 130,519 images



Xiao, Hays, Ehinger, Oliva, & Torralba (2010)

Scene Understanding (SUN) database

Scenes:
- baseball_field
- warehouse
- theater
- opera_house
- forest

Not scenes:
- equator
- golden_gate_bridge
- outdoors

forest – evergreen

forest – deciduous

Rating scene typicality

- 706 categories
- 124,901 images (22 – 2360 images/category)
- 935 people contributed ratings through Amazon's Mechanical Turk service

living room: a room in a private residence intended for general social and leisure activities

1. Read the word and definition above, then select the image that matches the definition.

Click here to continue

living room: a room in a private residence intended for general social and leisure activities



















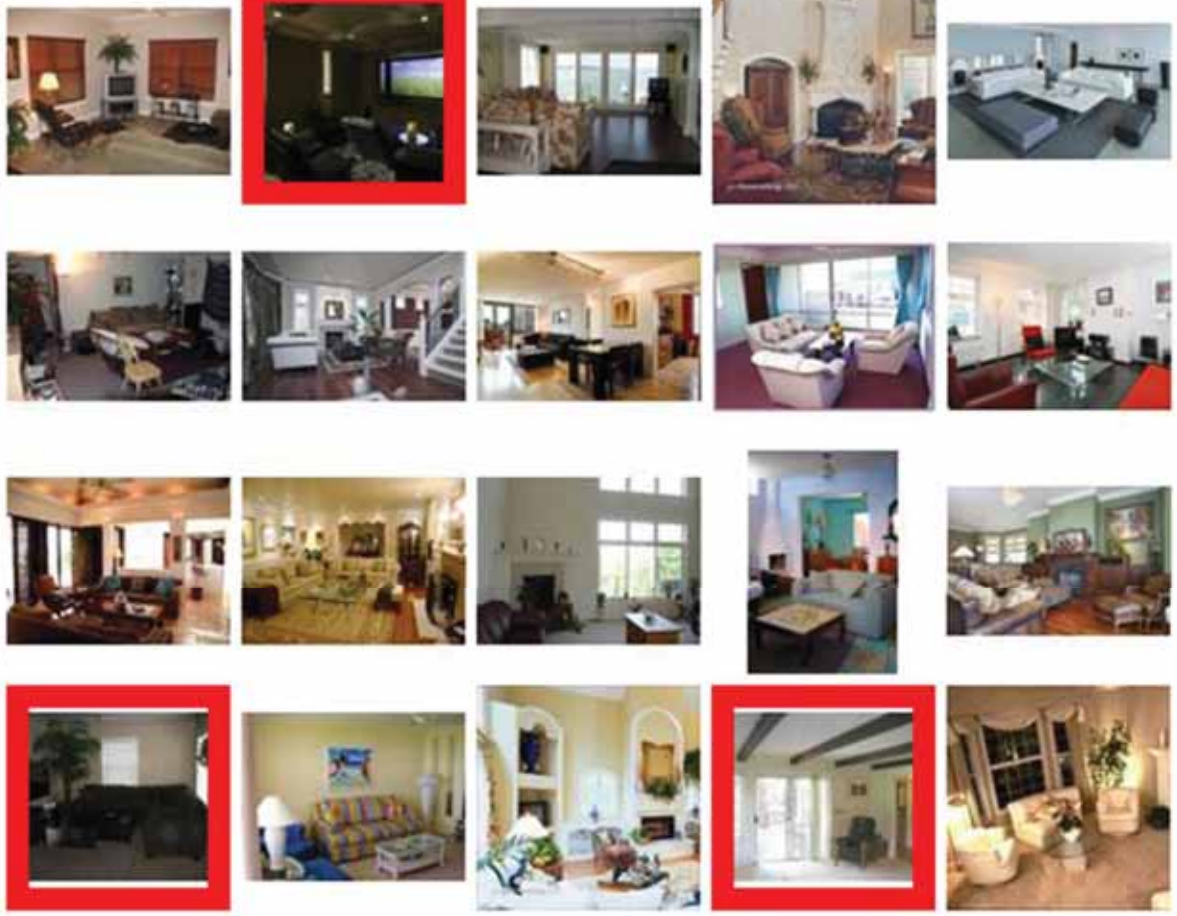

2. Select the **3 BEST** images to illustrate the definition above. These should be the most typical, average examples -- what you imagine when you read the definition.

Click here to continue

living room: a room in a private residence intended for general social and leisure activities

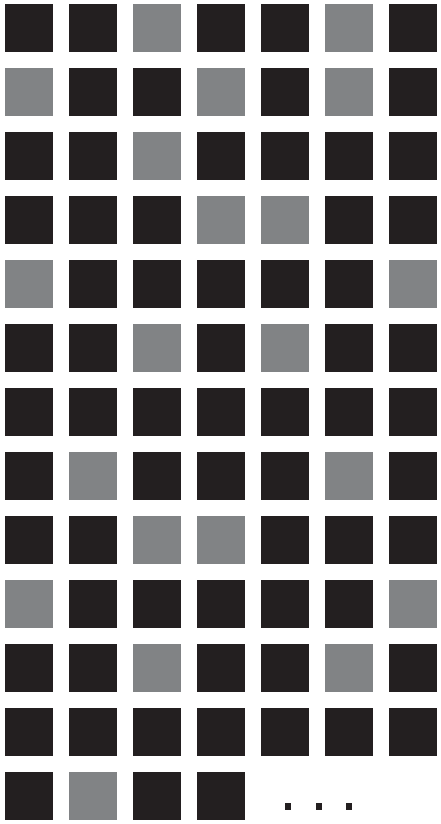
3. Select the **3 WORST** images to illustrate the definition above. (Note that these are the same images as before, just in a new order.)

Click here to continue

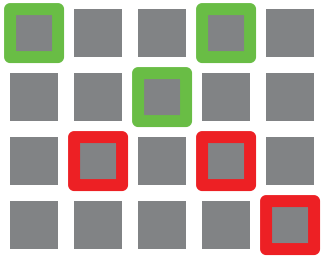


Rating scene typicality

Category images

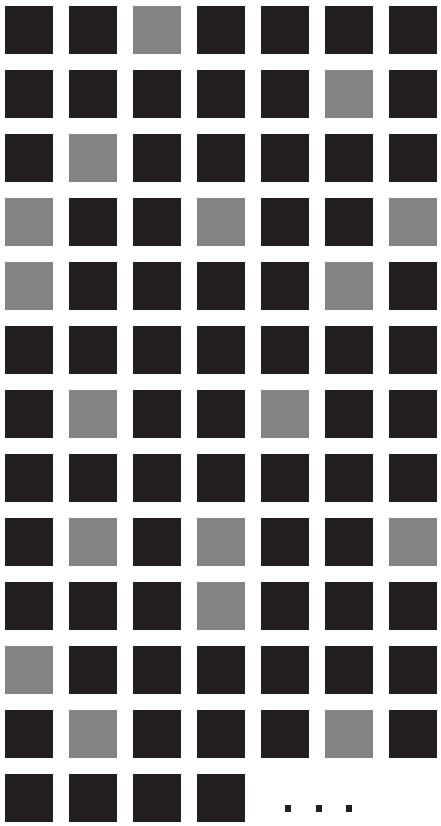


20 images per trial



Rating scene typicality

Category images



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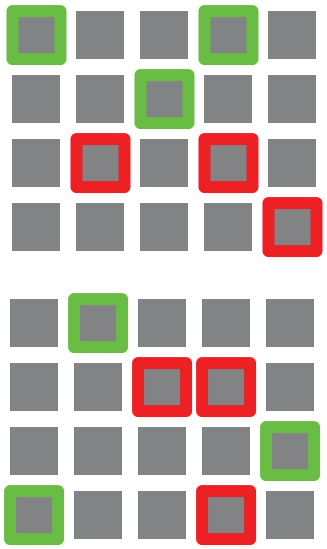

Rating scene typicality

Category images

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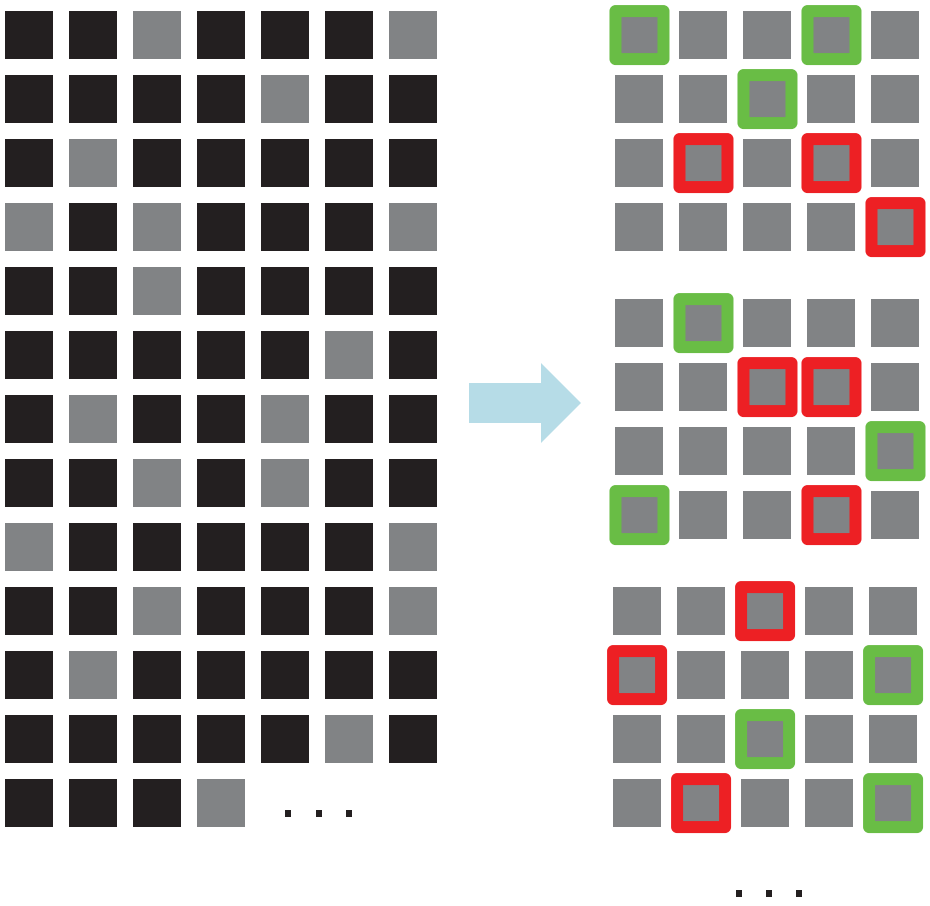
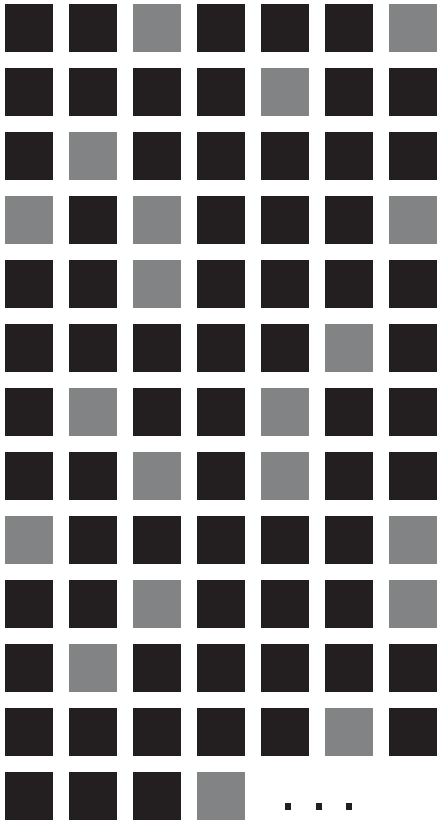


77,331 trials, each image appeared 12-15 times

Rating scene typicality

Category images



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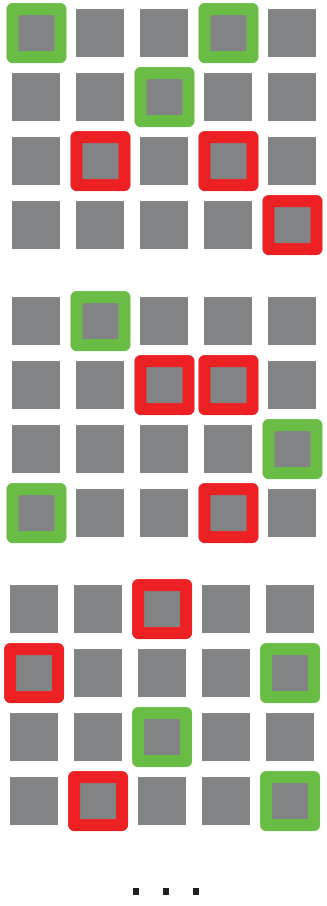


14 appearances
3 “best”
0 “worst”

12 appearances
1 “best”
1 “worst”

77,331 trials, each image appeared 12-15 times

Typicality score

$$\text{Typicality} = \frac{\text{“best” votes} - k(\text{“worst” votes})}{\text{Number of appearances}} \qquad k = 0.9$$

0.67

Voted a “best” exemplar on 8 out of 12 appearances

-0.52

Voted a “worst” exemplar on 7 out of 12 appearances

Examples

Most typical beaches




Most typical bedrooms




Examples

Least typical beaches

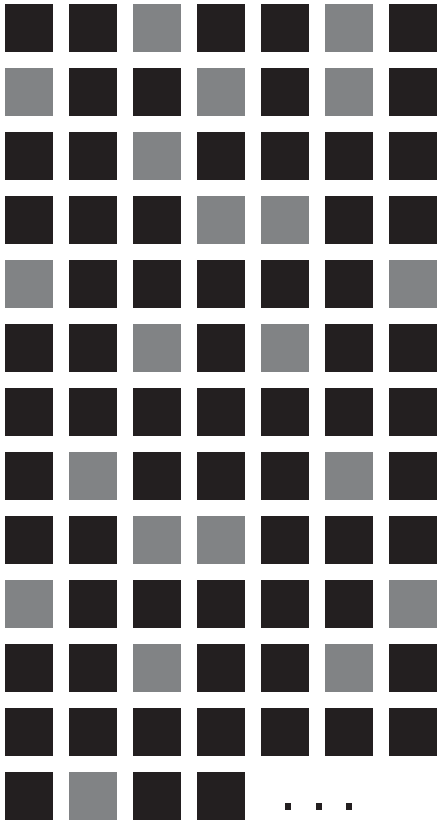



Least typical bedrooms




Rating scene typicality

Category images



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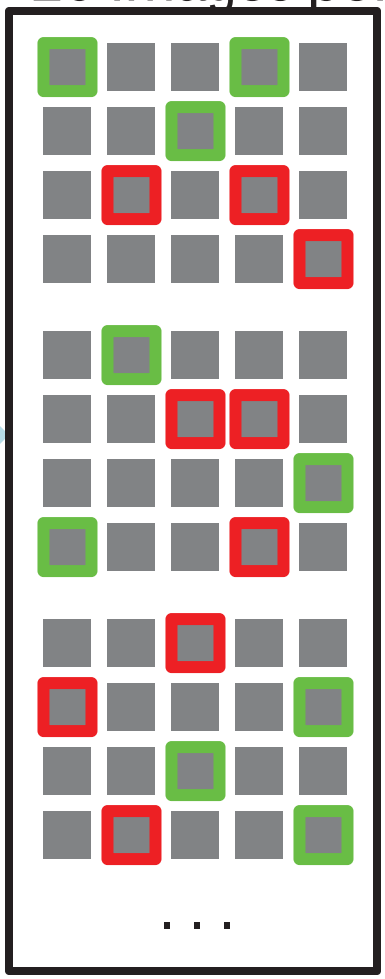

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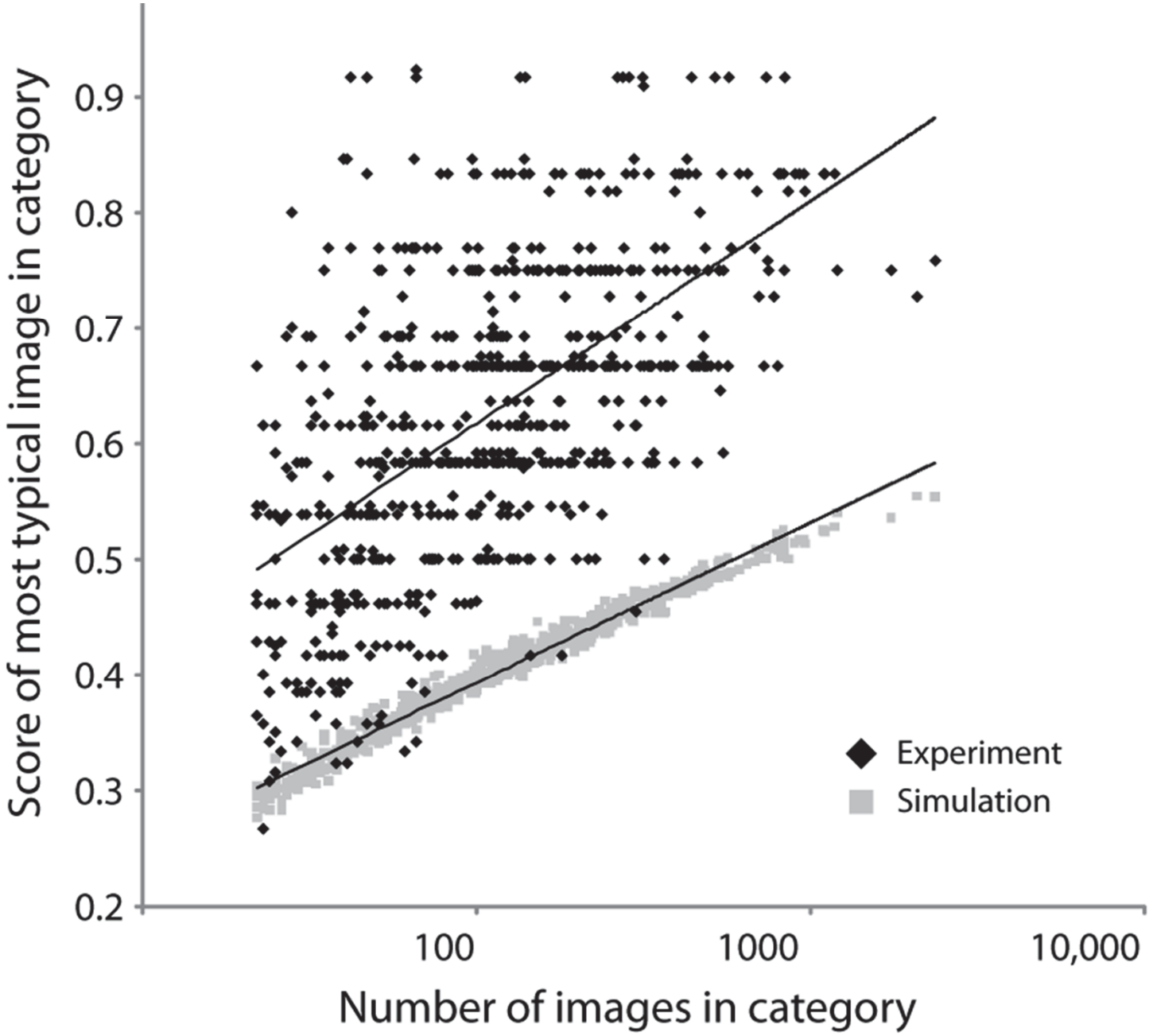
. . .

Simulation: Computer randomly selected images

Typicality scores: Experiment vs. simulation



boardwalk

Most typical

Average

closet

Most typical

Average

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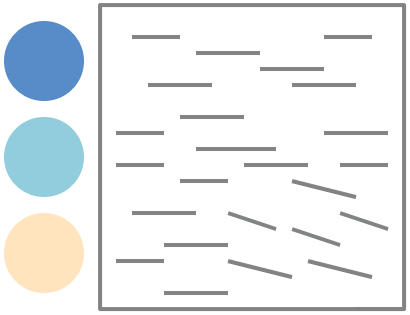
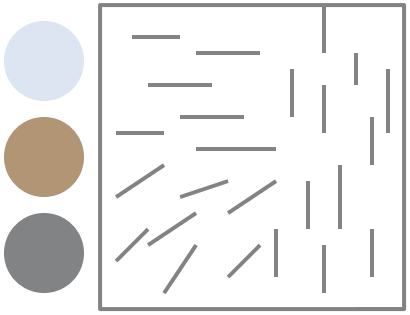
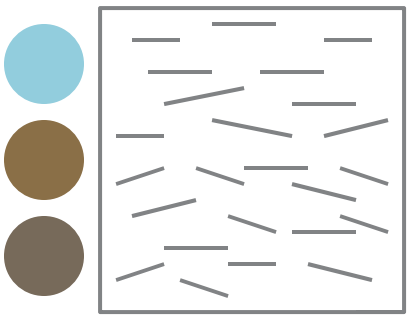
Training

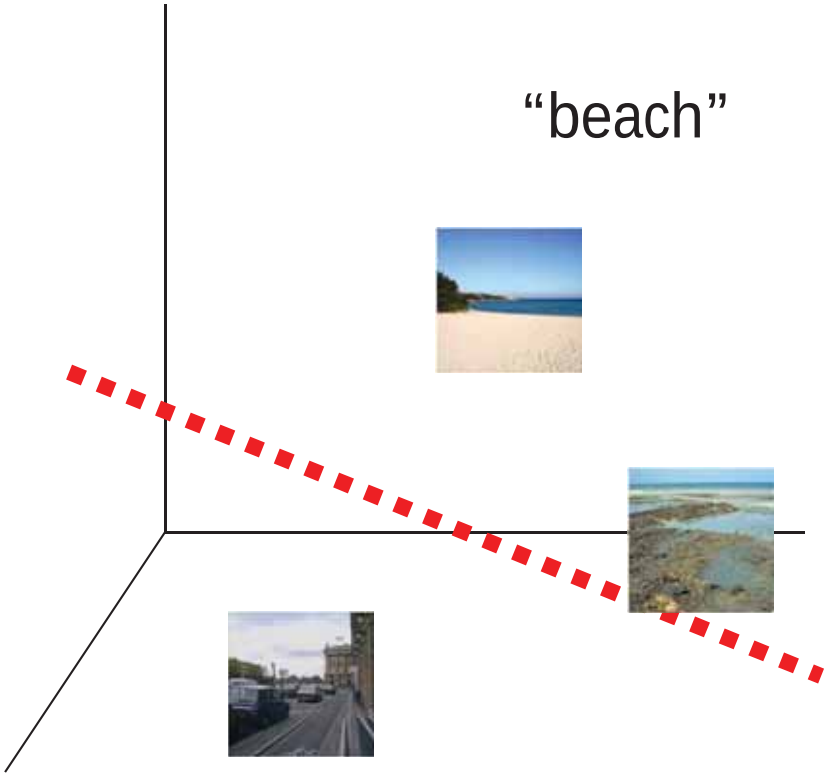
Image features





Test





Are more typical images classified more accurately?

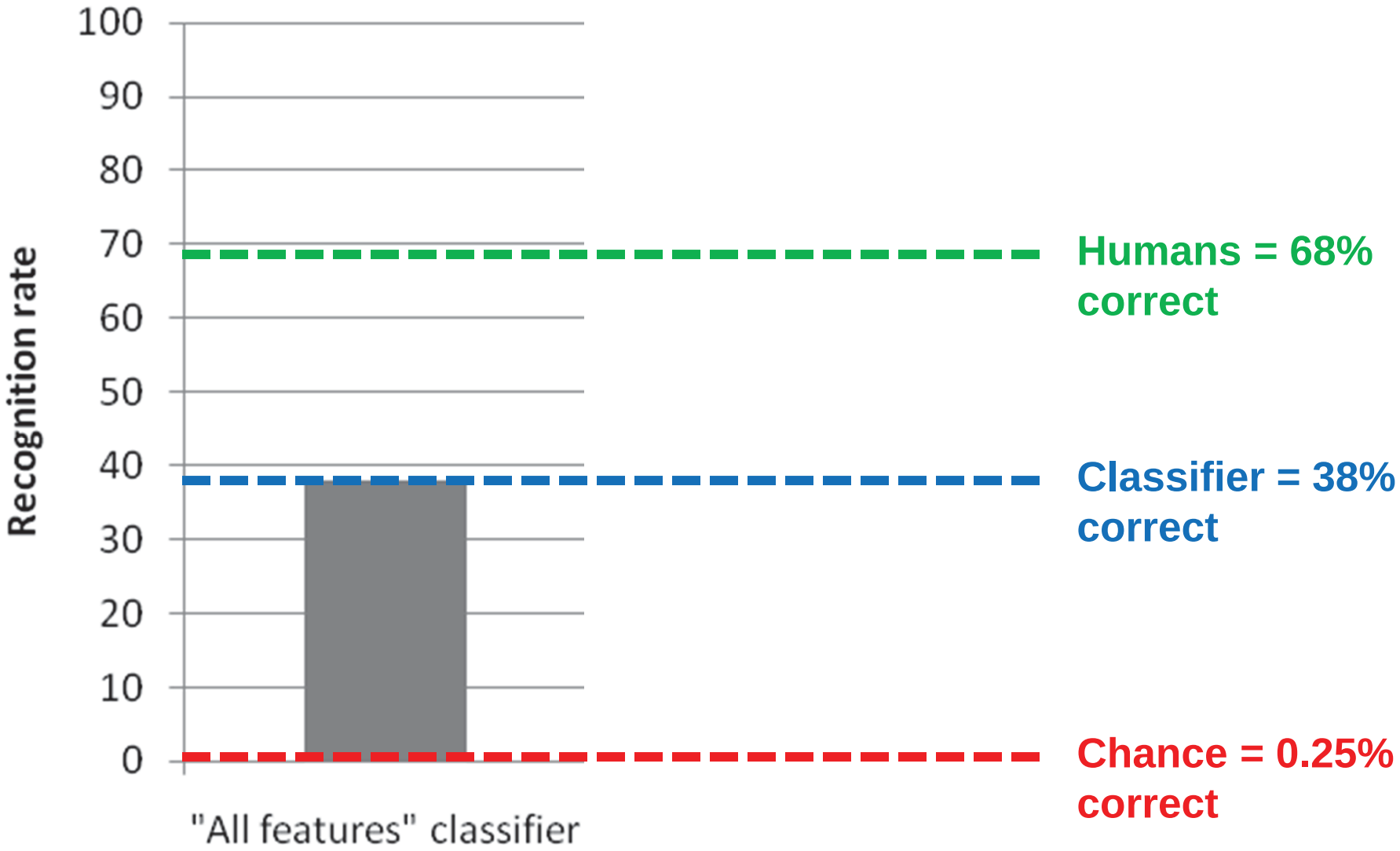
Machine-vision classifier

One vs. all SVM classifier trained on 50 random images in each category, tested on 50 images

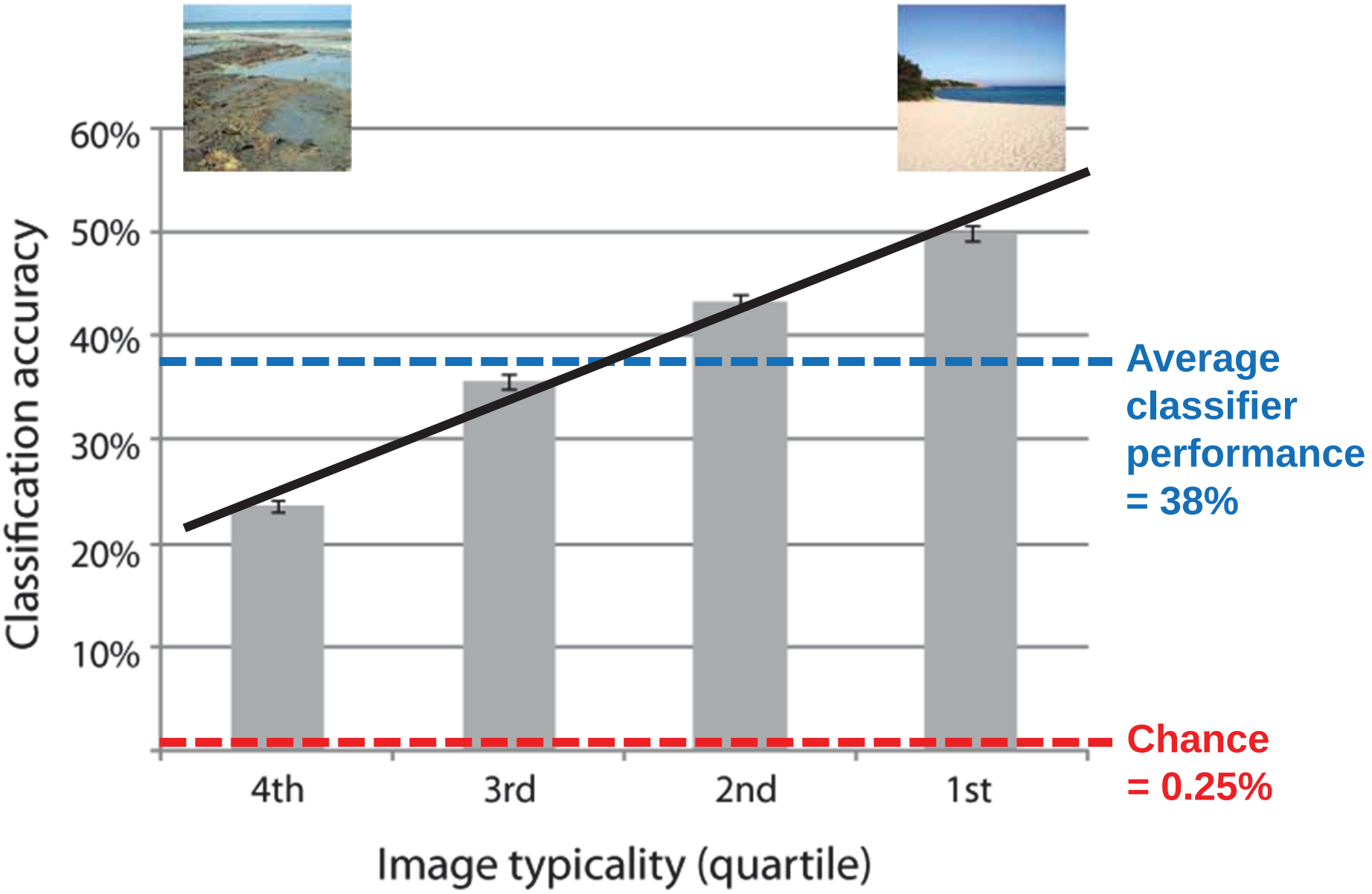
- Feature histograms (color, edges, texture features)
- GIST descriptor
- SIFT descriptor
- HOG (histograms of oriented gradients)
- SSIM (self-similarity)
- Geometric classes

Felzenszwalb, Girshick, McAllester, & Ramanan (2010); Hoiem, Efros, & Herbert (2007); Lazebnik, Schmid, & Ponce (2006); Oliva & Torralba (2001); Renninger & Malik (2004); Shechtman & Irani (2007)

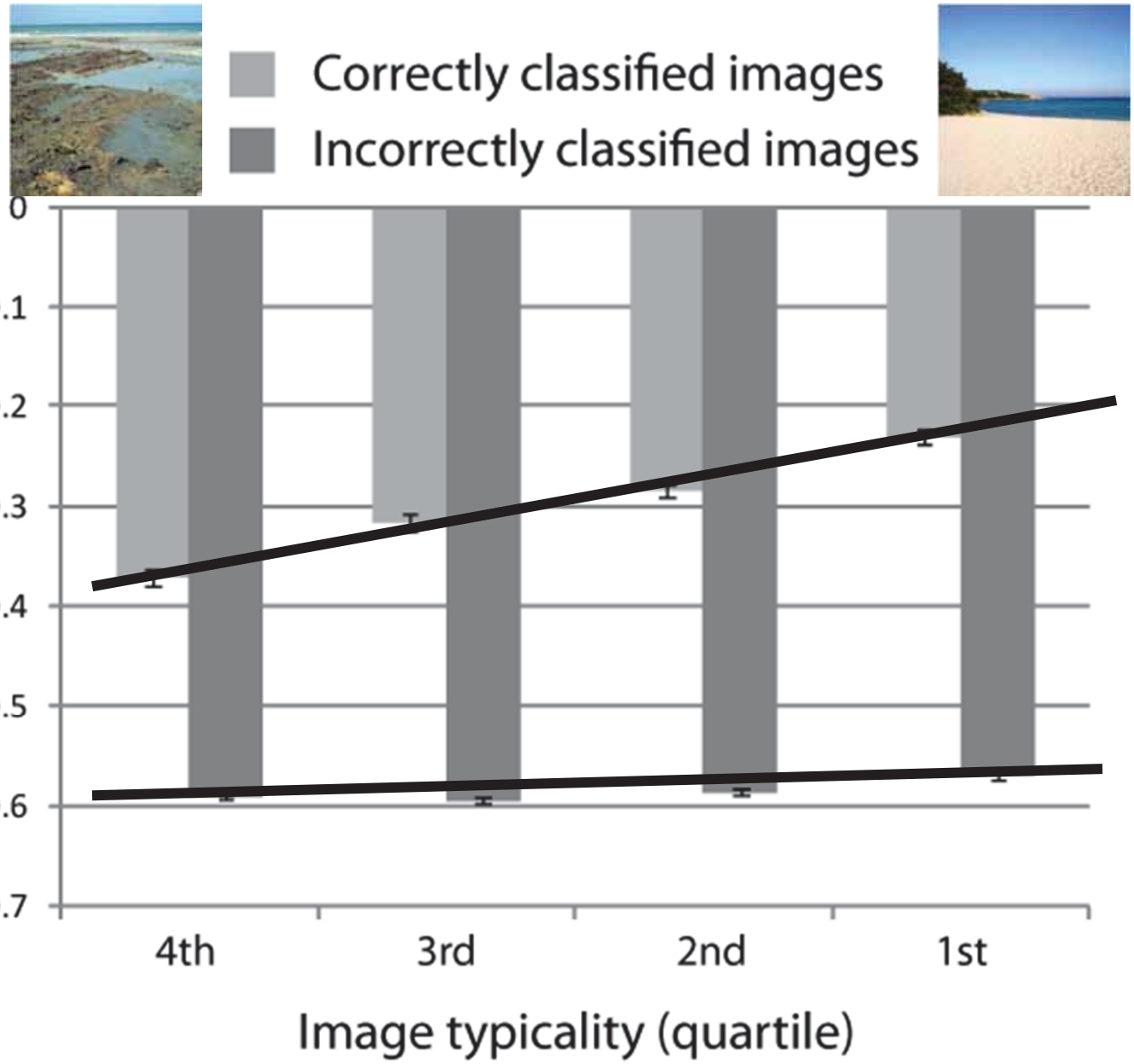
Classification performance



Scene classification vs. scene typicality



Classification confidence vs. scene typicality



- Are there “typical” examples of scene categories?
  - Yes, there is a range of typicality in scene categories
- Do more typical examples contain more of the visual features relevant for scene categorization?
  - Yes, more typical scenes are classified more accurately

Thank you!

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Antonio Torralba

Aude Oliva

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