A moment of conscious experience is very informative

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Introduction

- Our visual experience of the world seems extremely rich.
- This subjective richness has proven difficult to verify in traditional psychophysics experiments.
- Our limited ability to recall objects in a briefly presented array has led to claims that the bandwidth of consciousness is very low (< 44 bits per second).

- We have extended these existing paradigms by asking participants to report on both what was present and what was *not* present in a given natural image.
- Importantly, the absent descriptors for a given image are always a present descriptor for one of >400 natural image sets used in the experiment.

Method

250ms
133ms
Time
60ms
x5 Masks
No Time Limit
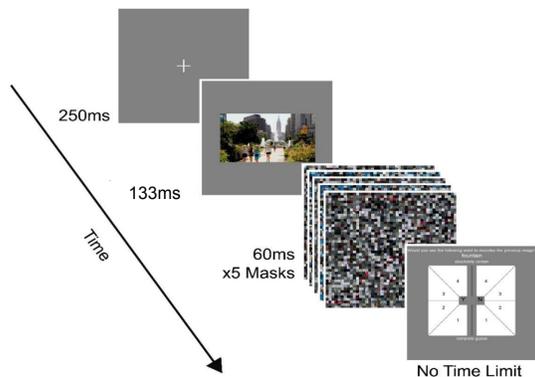
Experimental Design

- Participants judged whether a range of verbal descriptors (provided by a number of separate observers) were present or absent in a briefly viewed natural image.
- Participants were asked to rate either **10** (N=15), **20** (N=5), **80** (N=3), or **640** (N=5) descriptors per image and give a confidence rating.

Natural images (examples)

Calculating bits per second

- We adopted signal detection theory to estimate type 1 performance (based on confidence of answers) and type 2 performance (based on accuracy of metacognition) using a **receiver operating characteristic (ROC)** curve. We used the area under the ROC curve (AUC) as the measure of accuracy.
- In information theory, number of bits = $-\log_2 p$. We used objective accuracy as a measure instead of probability, so we adapted the equation accordingly, to give: $\log_2(2 \times AUC)$ (which was then multiplied by the number of questions asked per image).
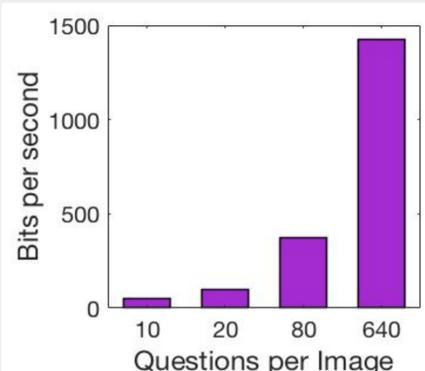
Descriptors (examples)

Walking	Casino	Plastic
Red	Light	Calm
Few	L'Oreal	Parent
Grass	Suit	Chainsaw

Results
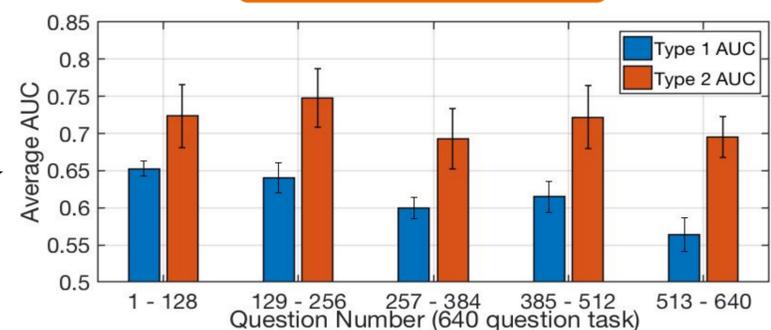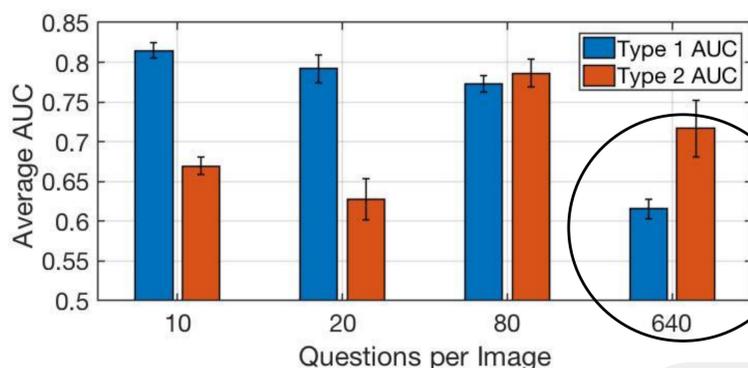
Objective accuracy

- High for both absent and present judgments for 10, 20, and 80 questions.
- Decays significantly overall for the 640 question condition.
- Also decreases as the task progresses for 640 questions (top right figure).

Bits per second

- Increases with the number of questions asked per image, despite the decay in average objective accuracy.
- **1428 bits per second** for 640 question condition (previous estimates were no higher than 44 bits per second).

Discussion

A higher bandwidth of consciousness?

- Lower bound on our estimate of the bandwidth of consciousness should be at least 1428 bits per second (this figure could probably be increased if more questions were asked per image).

Future planned experiments/analyses

- Condition with 3600 questions per image
- Run this and existing tasks using Amazon Mechanical Turk
- Calculate correlation between descriptors

Performance Decay

- Occurred over time where 640 questions were asked per image, possibly due to a lack of present descriptors eliciting an automatic *no* response (leading to an inflated false negative rate).
- Also possible that our ability to report on a briefly viewed image decays over time with memory, and that a lack of decay would suggest that people are sometimes relying on other high level cognitive functions to perform the task.