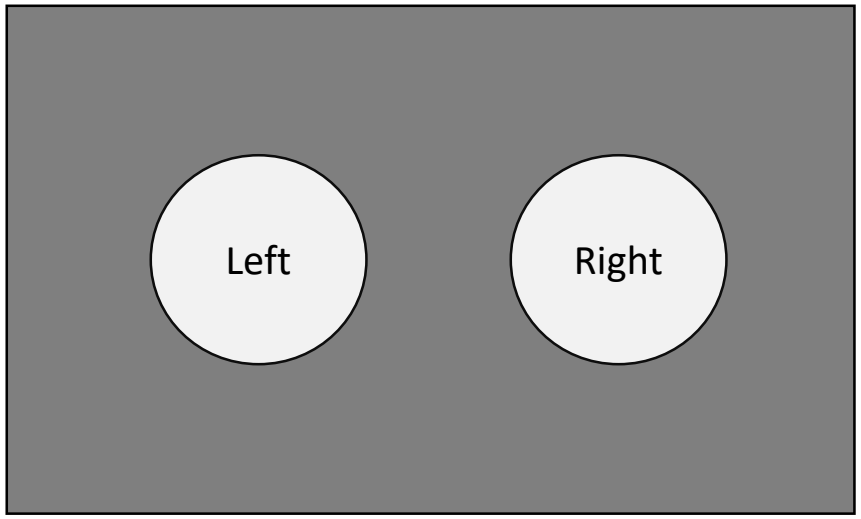
Optimizing data acquisition for scaling methods , particularly MLCM

Bachelor Thesis Exposé

Jan Zabel

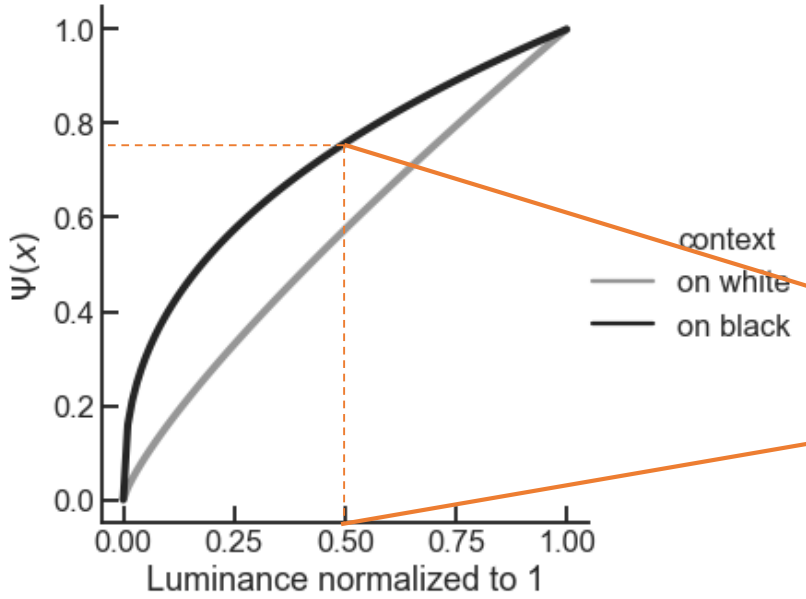
Trial: Which side does the participant perceive as brighter?

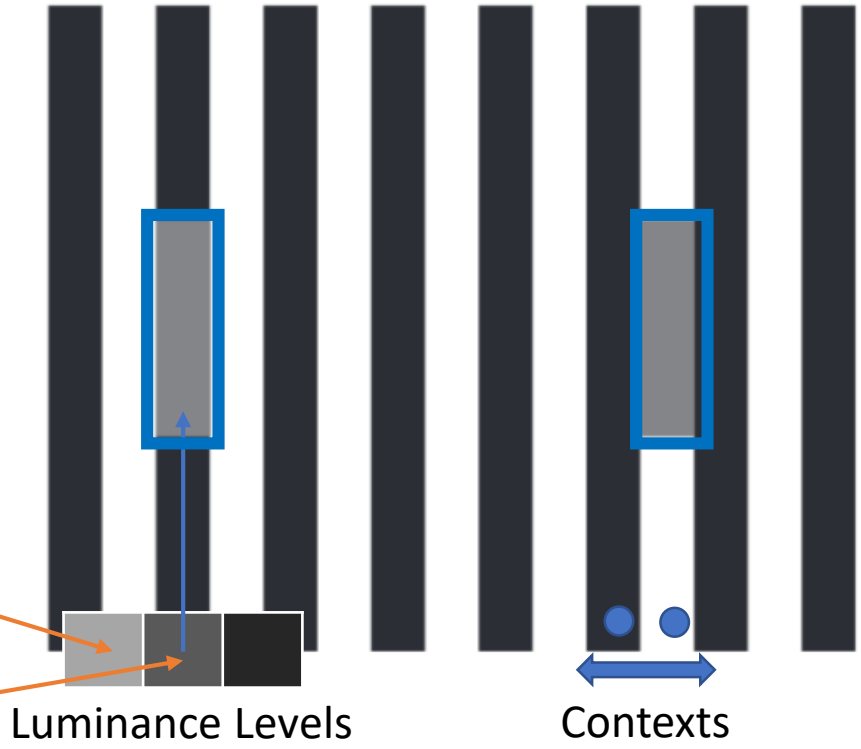


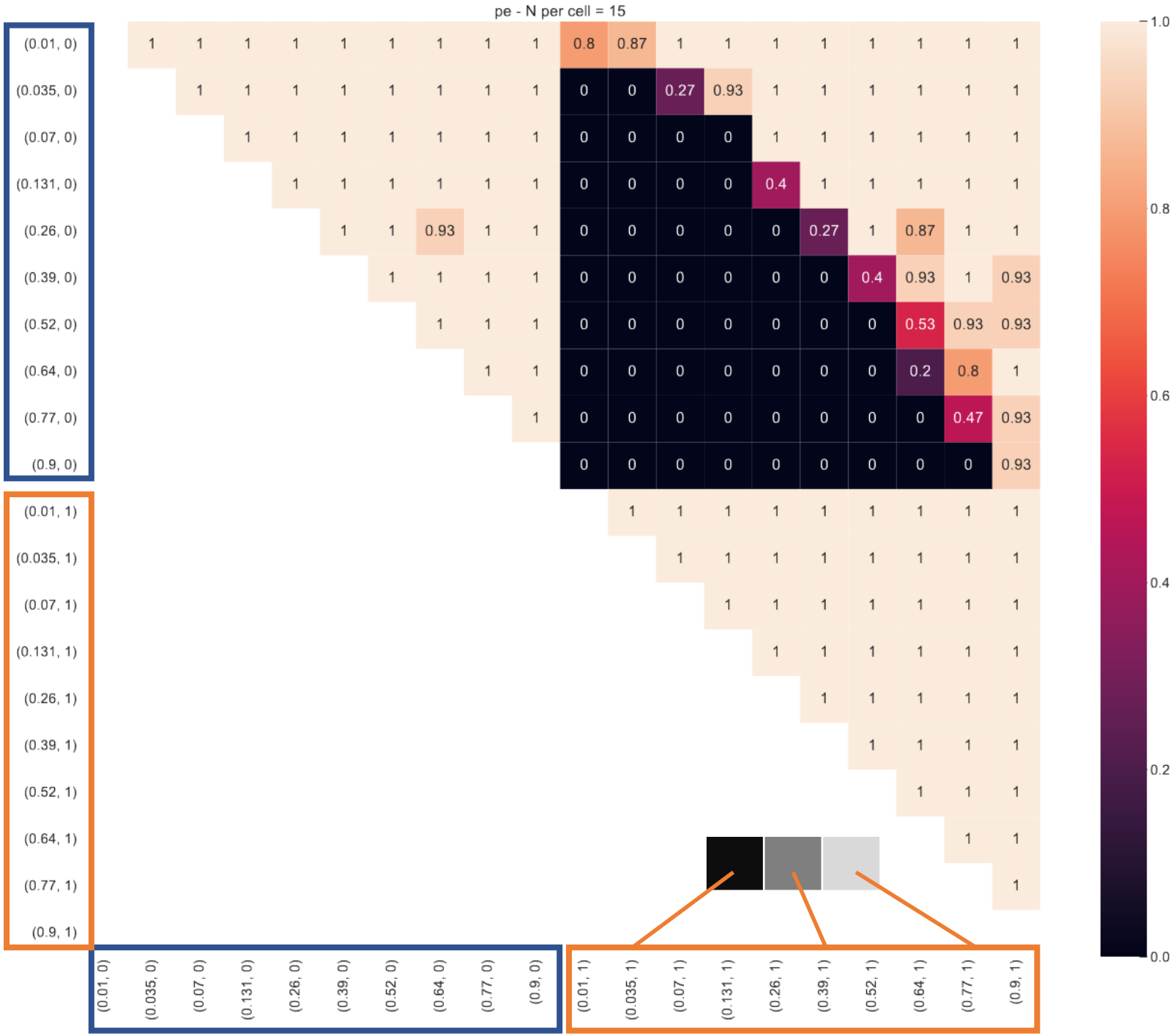
2AFC

Perceptual Encoding Function

- Empirical estimation of brightness perception in our visual system
- Transfer function f(x):
  - x: Luminance and Context
    - Luminance: 10 Levels between 0 and 1
    - Contexts: „On white“ and „On Black“
  - f: x to perceived brightness R





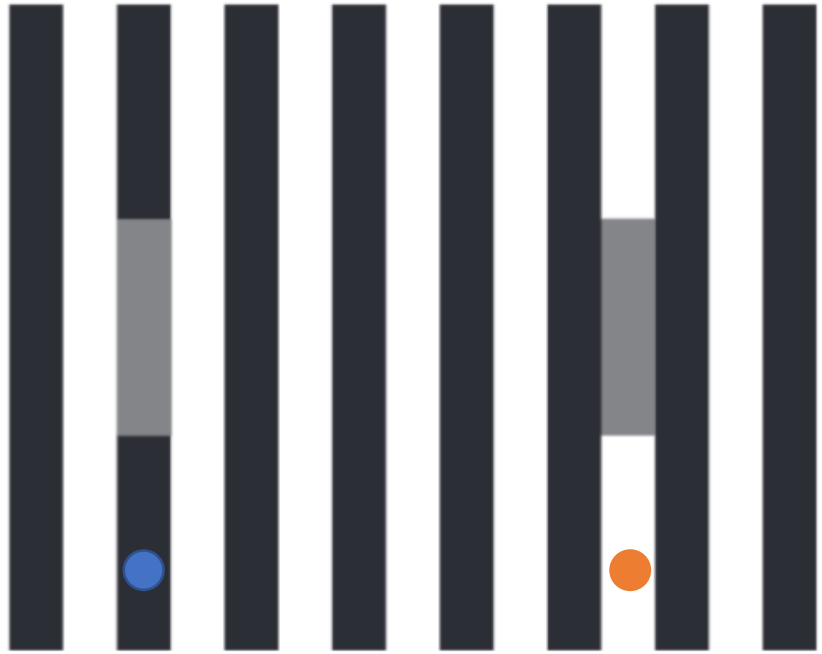


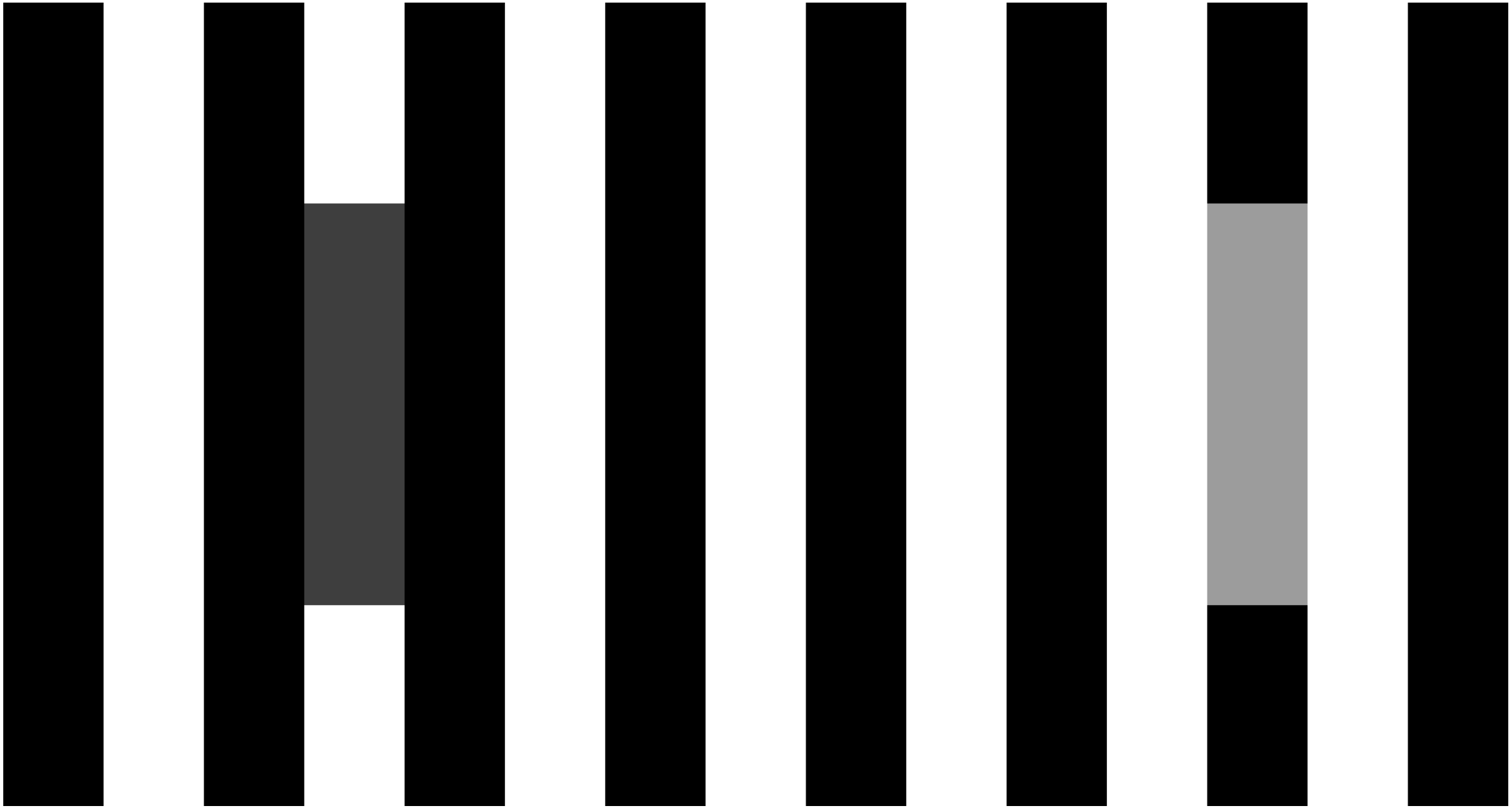
Percentage of a participant choosing either x-axis-stimuli or y-axis-stimuli.

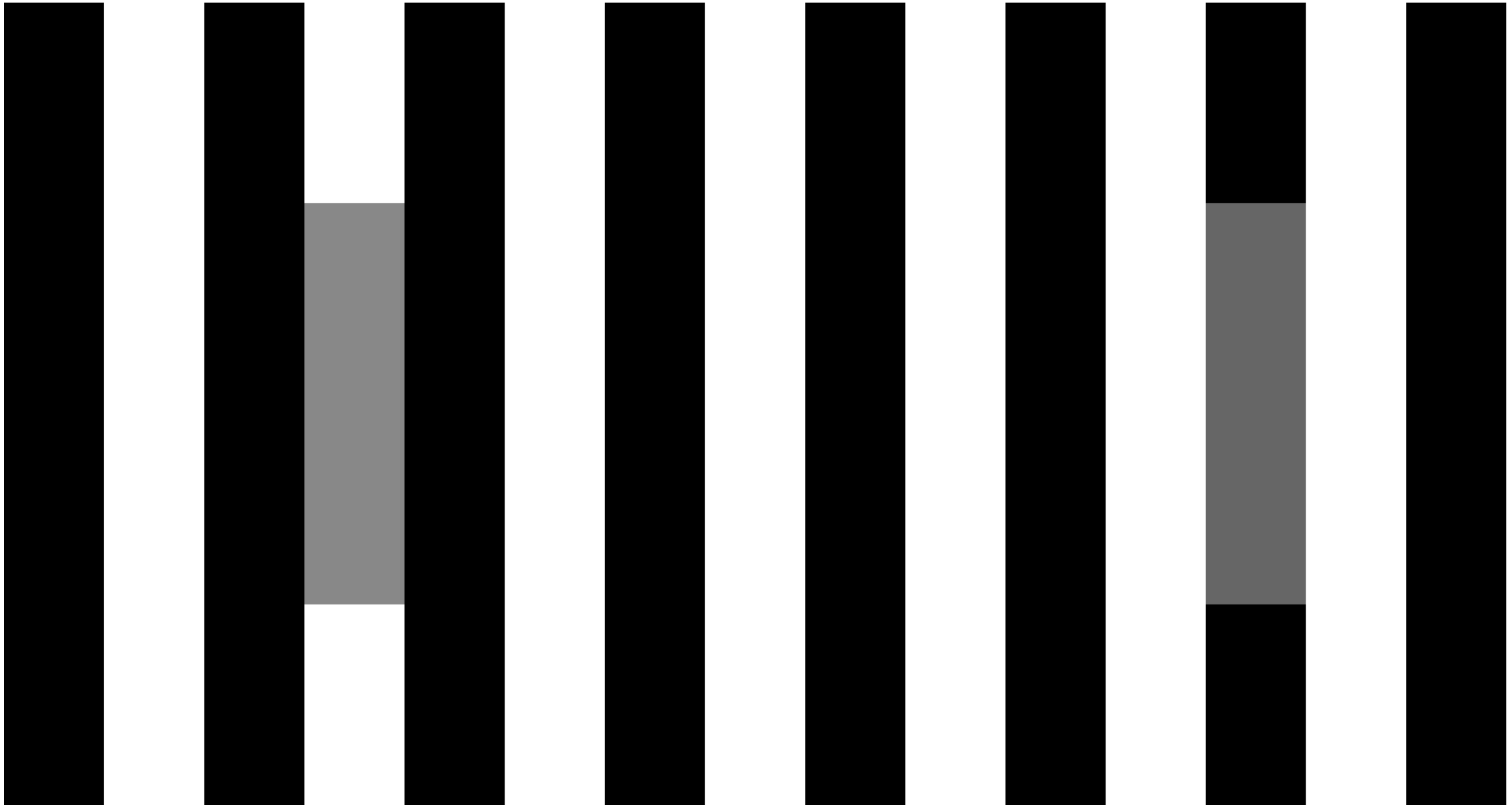
1: X-Axis

0: Y-Axis

15 Repeats

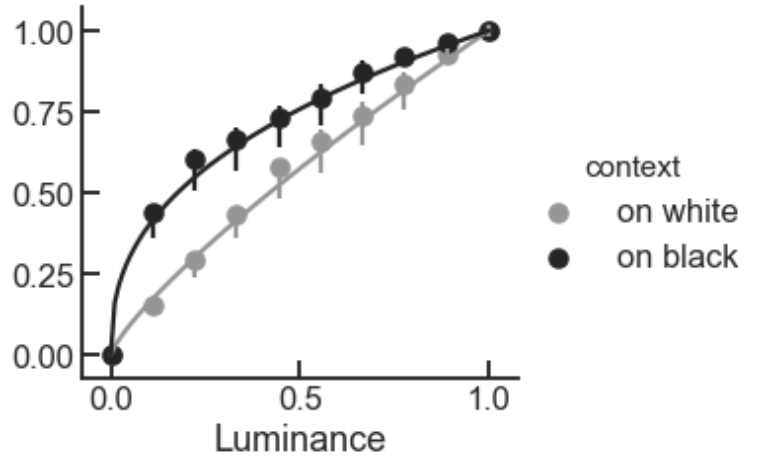


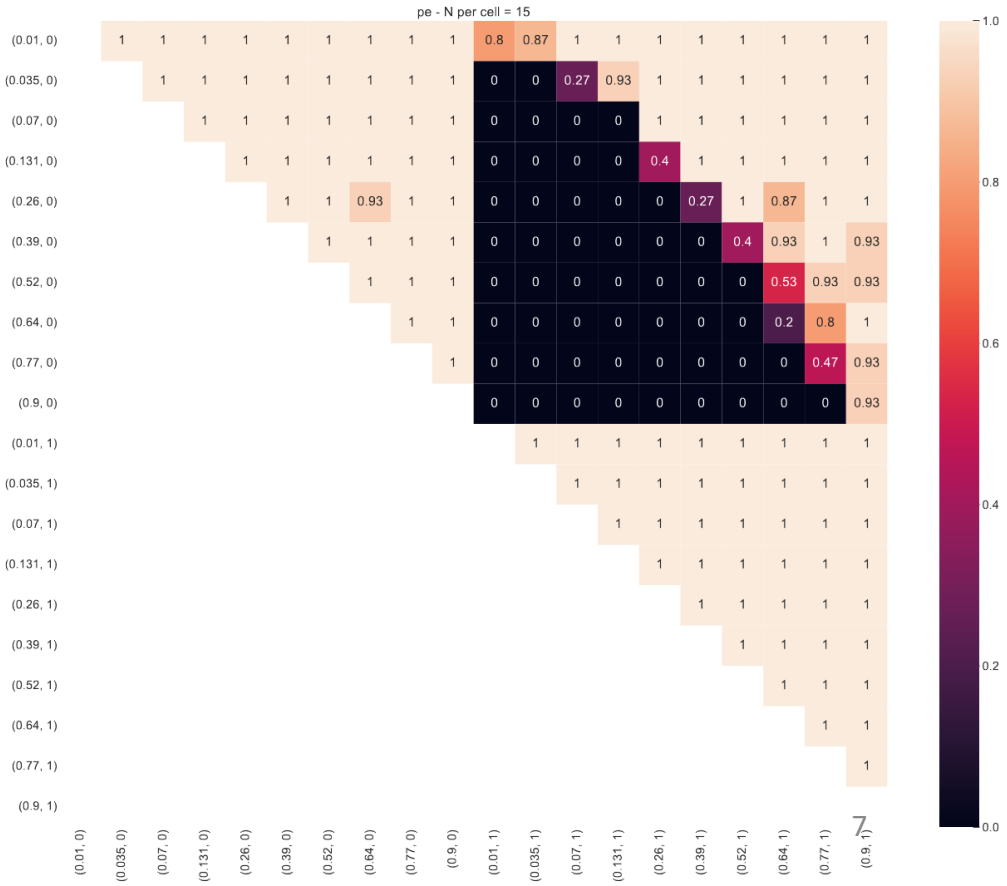




Maximum Likelihood Conjoined Measurement (MLCM)

- Used to estimate perceptual scales
  - Models relationship between stimulus and response
  - Luminance and perceived brightness
  - Maximum likelihood
- Perceptual scales represent Perceptual Encoding Function
  - How the illusion affects our perception
  - Response to a unique stimulus





The Problem

- Trials accumulate
- Some trials have consistent results
- Consistent results aren‘t precious
- Consistent results take up time and energy

Lumi-nance	Context	Trials	Total
10	2	190	2850
13	2	325	4875
10	3	435	6525
20	4	3160	47400

$$Unique\ Trials = \frac{20 \times (20 - 1)}{2}$$

$$10\ Luminance\ Levels\ \times 2\ Contexts\ - Itself$$

Research Question:

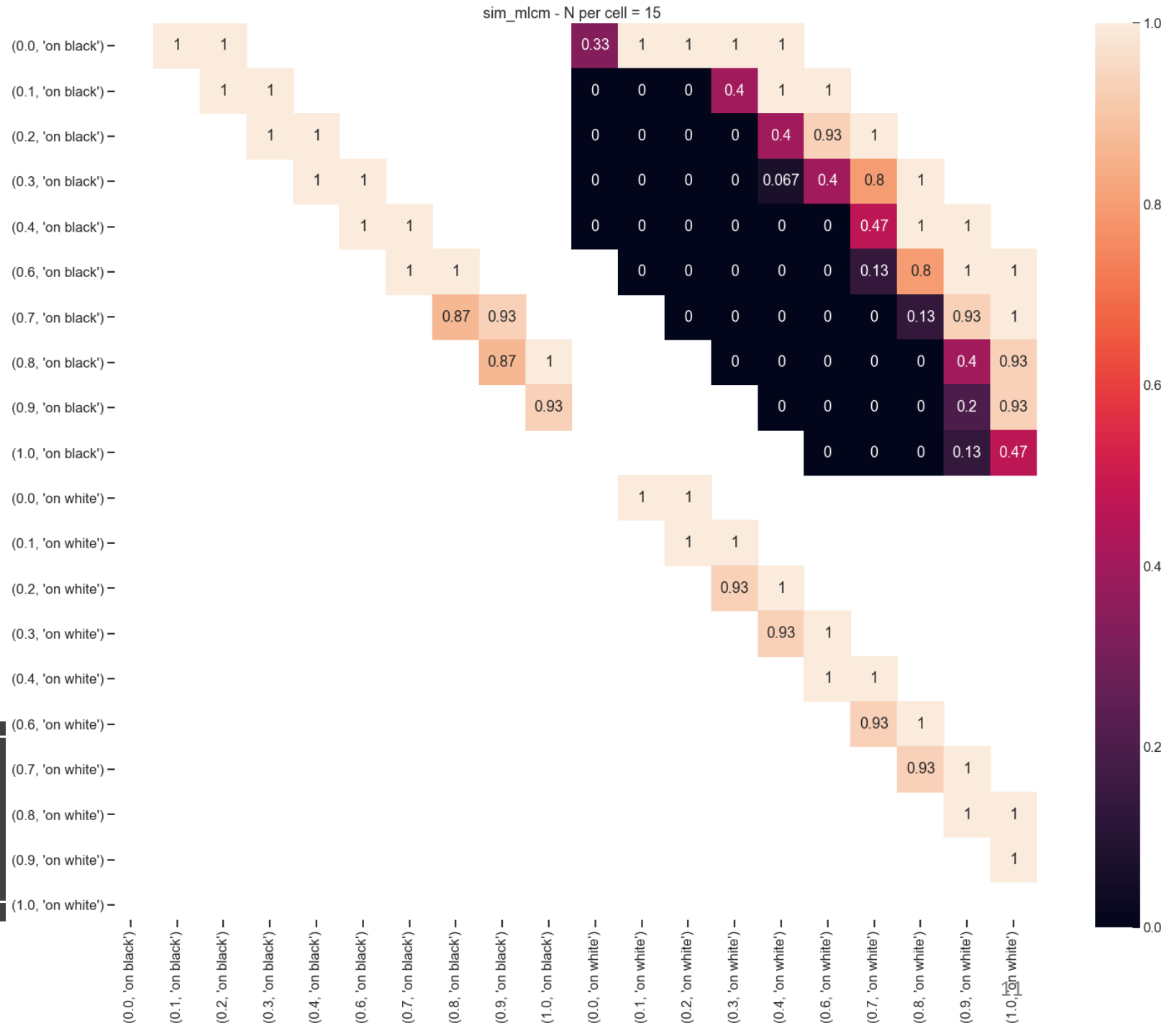
Can we reduce the amount
of trials and consequently the experiment's duration,
for a fixed set of unique
stimuli, without impacting the quality of the encoding
function recovered using
MLCM?

Proposed Method 1:

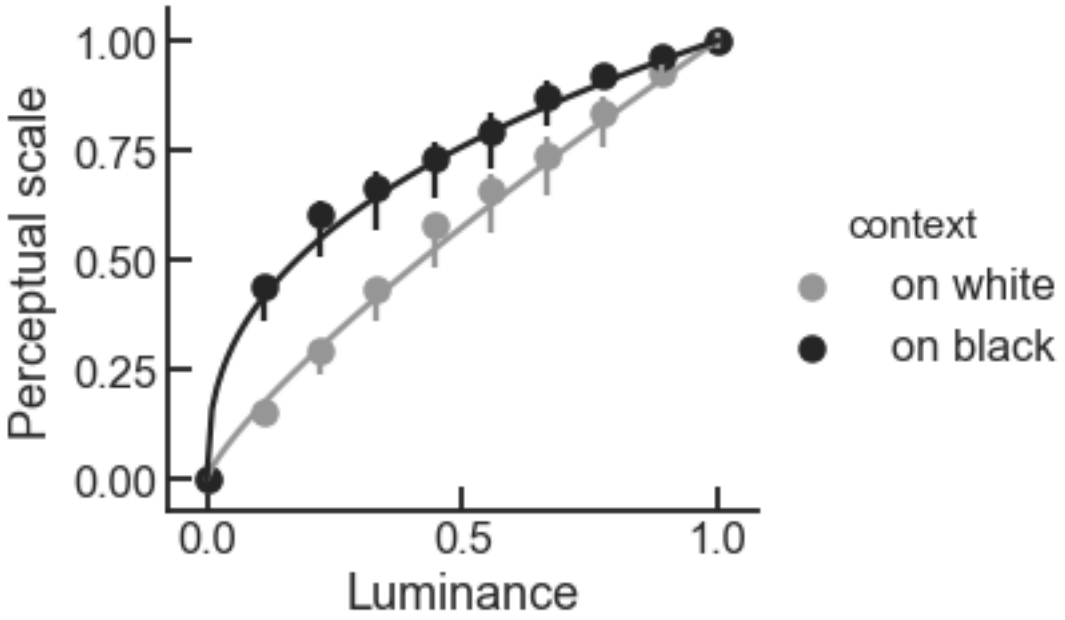
Remove trials with luminance difference of >0.2 for same context

Remove trials with luminance difference of >0.5 for different context

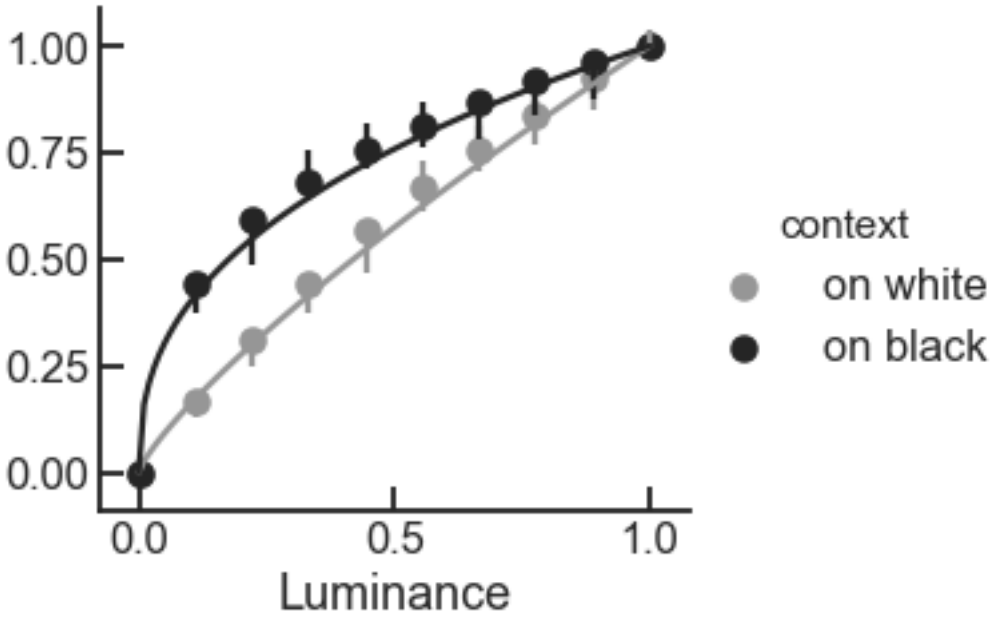
Cut down Matrix
1560/2850 Trials
45,3%



Preliminary results Static



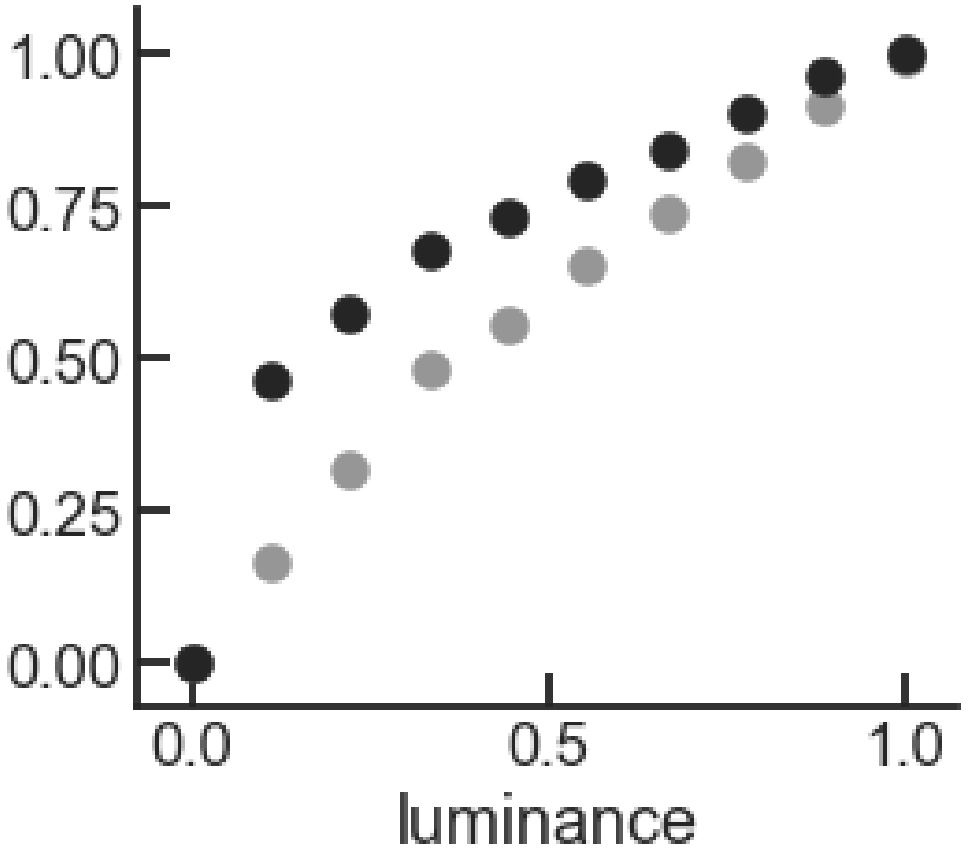
Original



Static cut down:

- 45,3% efficiency increase
- No decrease in accuracy (<0.4%)

How do actual results look like?



What else can be done?

- Fine tune static method
- Use other methods
- Vary the ground truth function
- Vary noise levels
- More Luminance Levels
- More Contexts (Size of Targets)