

Investigating Inter-Individual Differences in Human Brightness Perception

Bachelor Thesis

Anas al-Laham, 11.07.2022

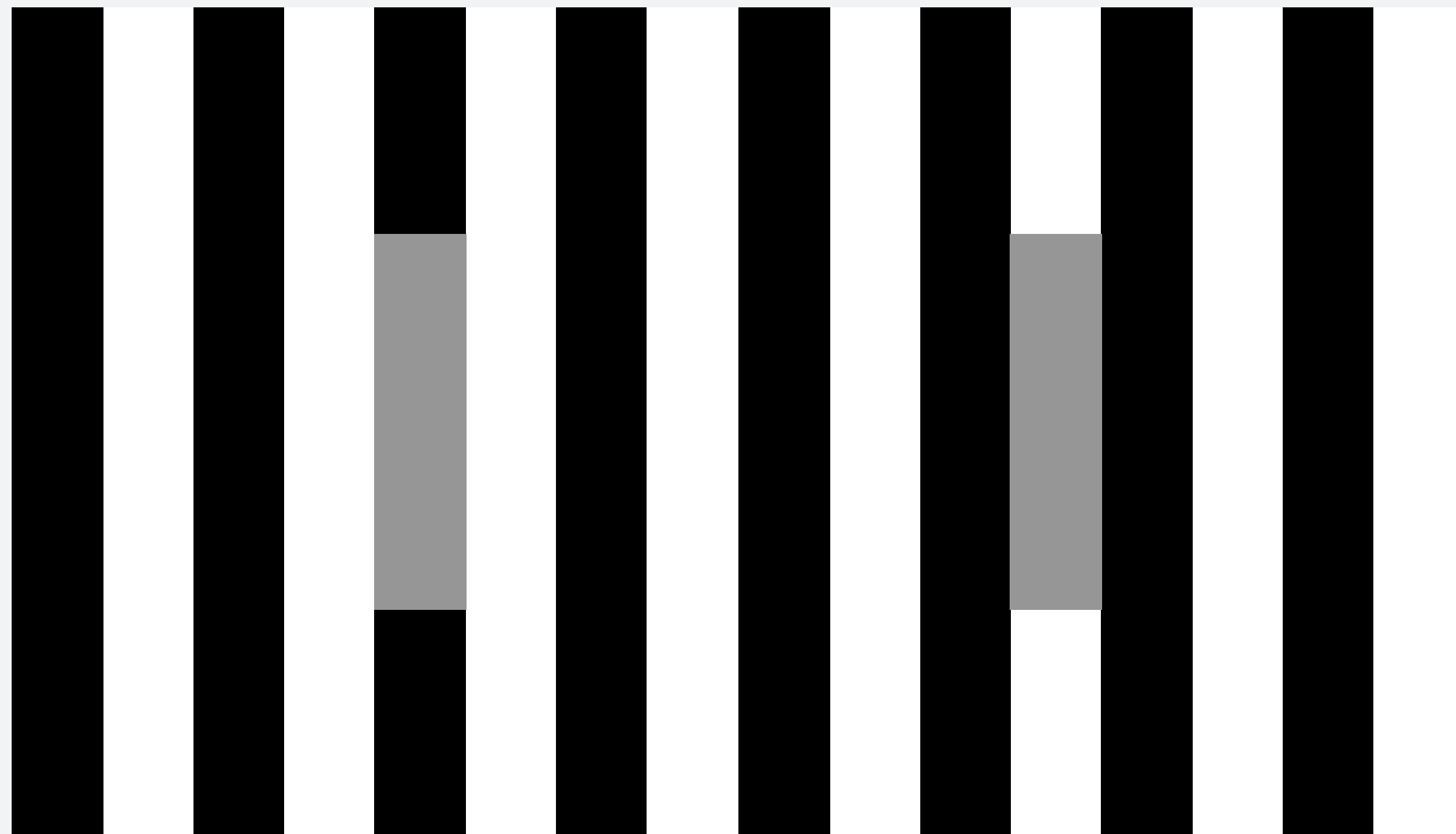
Recap: Brightness

- ❖ Defined as perceived luminance
- ❖ Highly dependant on visual context

Recap: Brightness



Recap: Brightness



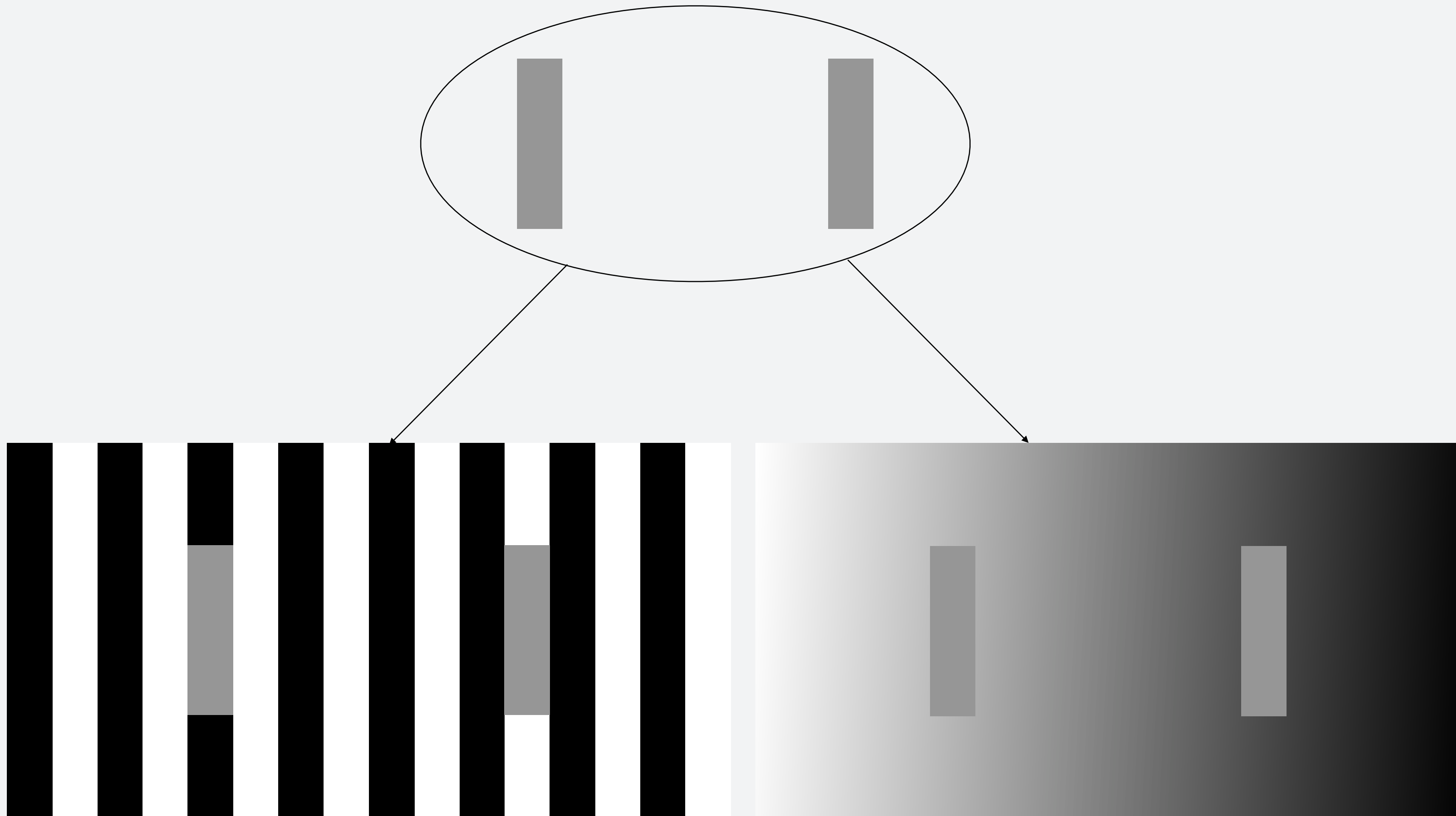
White's effect (1979)

Recap: Brightness



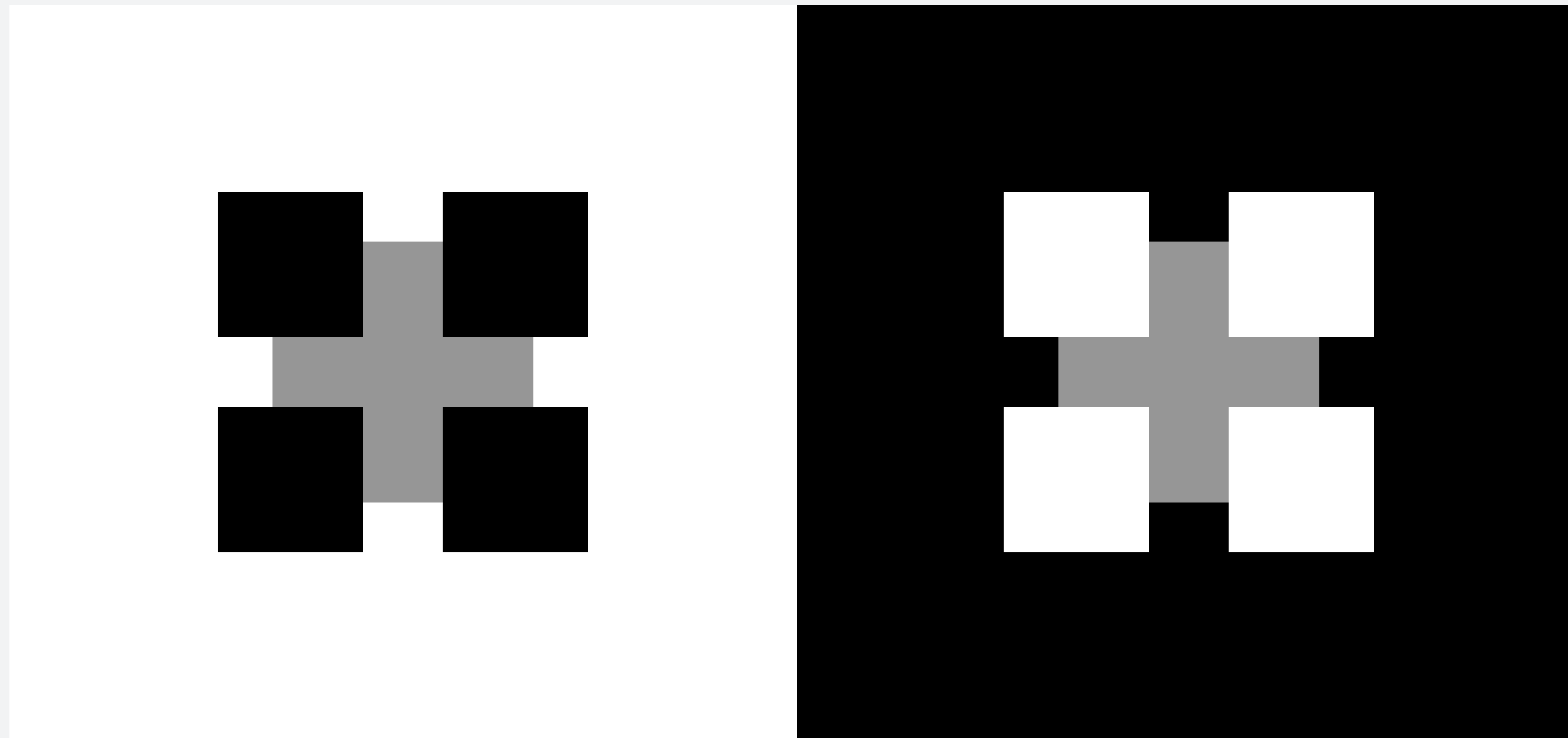
Simultaneous brightness induction

Recap: Brightness



Motivation

- ❖ Brightness varies between humans



Todorović illusion (1997)

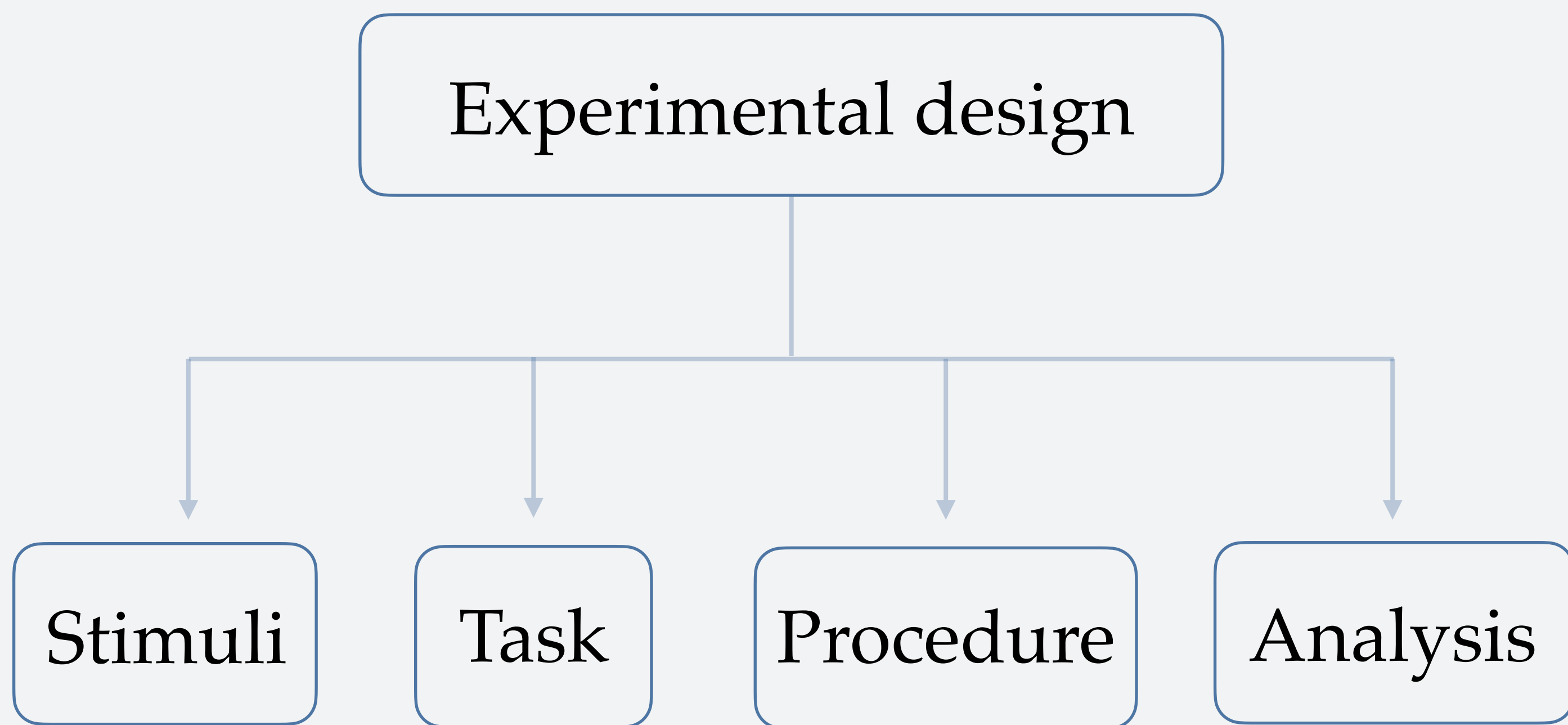
Motivation

- ❖ Brightness varies between humans
- ❖ Often assessed using a small number of stimuli and participants
- ❖ We need to:
 - produce data on a *large* number of stimuli depicting various context effects
 - identify stimuli that produce least and most consistent effects
 - attempt to generalize observed direction of effect to broader population
 - attain comprehensive dataset to test computational models

Research Question

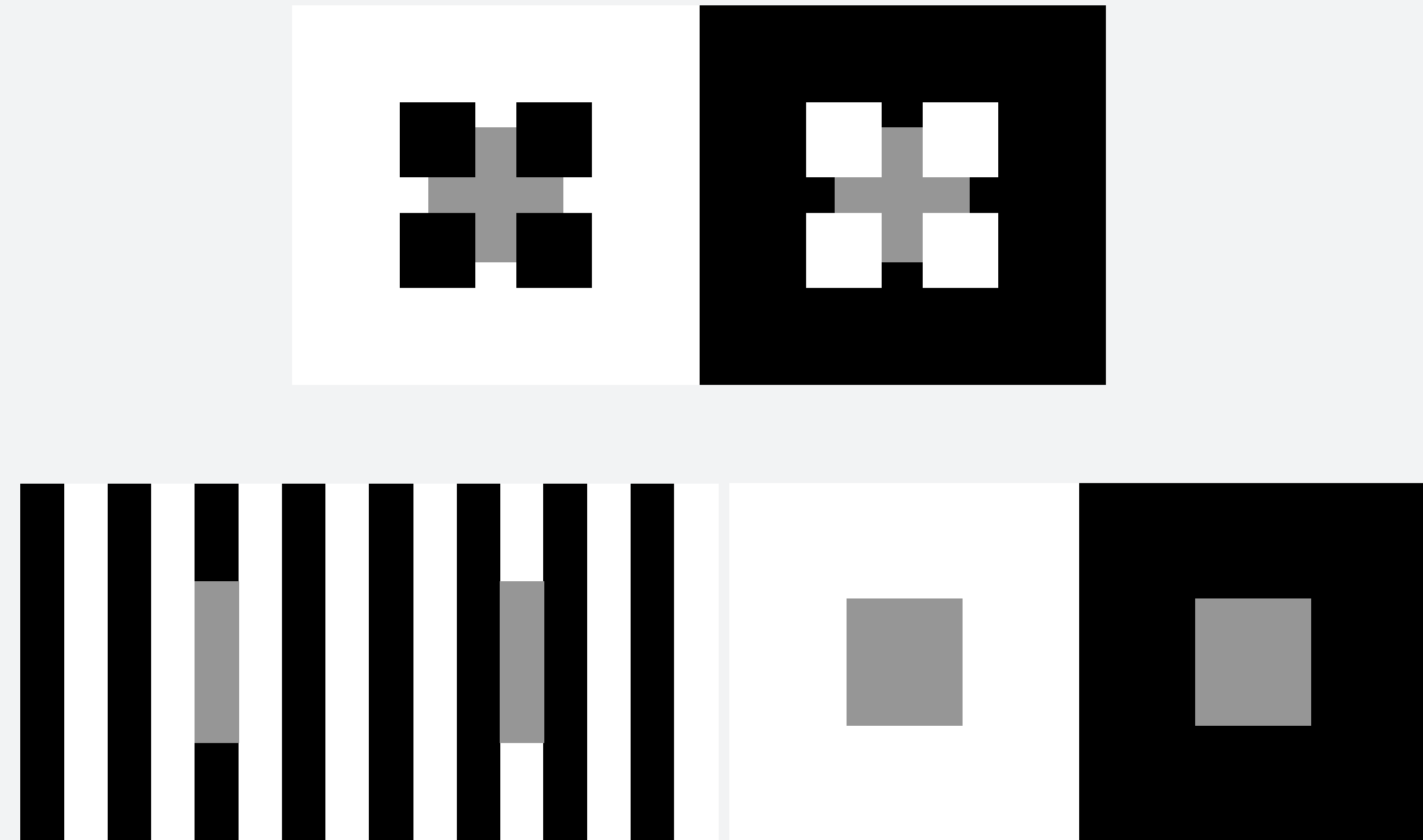
- ❖ **Research question:** To what extent do human observers differ or concur in their judgments of the perceived direction of selected brightness effects? Does their inter-individual variability correlate with the choice of stimuli?
- ❖ Explorative approach

Experimental Design



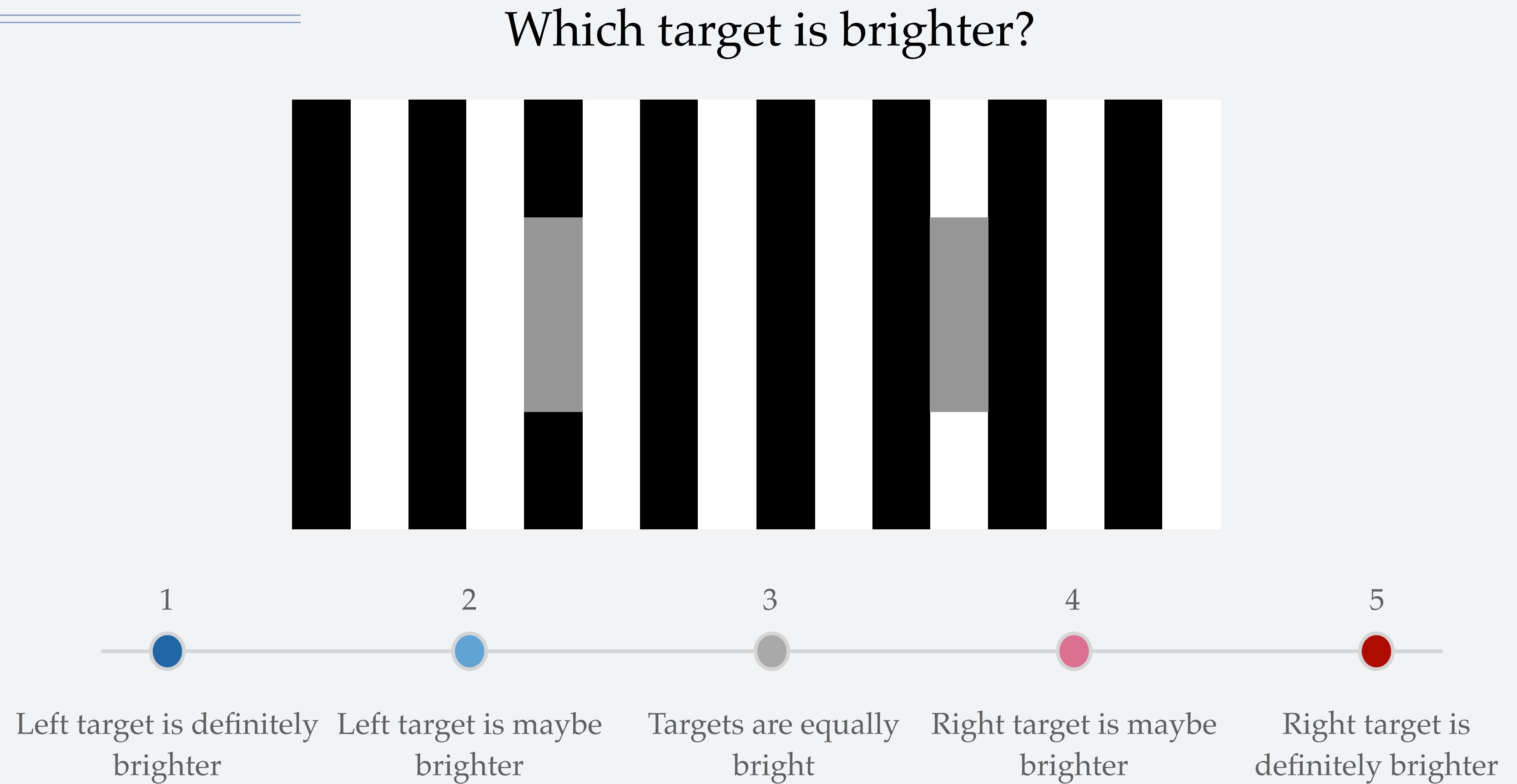
Stimuli

- ❖ Total of 45 stimuli from three papers:
 - Robinson 2007
 - Domijan 2015
 - Murray 2020
- ❖ Each stimulus repeated 5 times
- ❖ Order that minimizes carryover effects



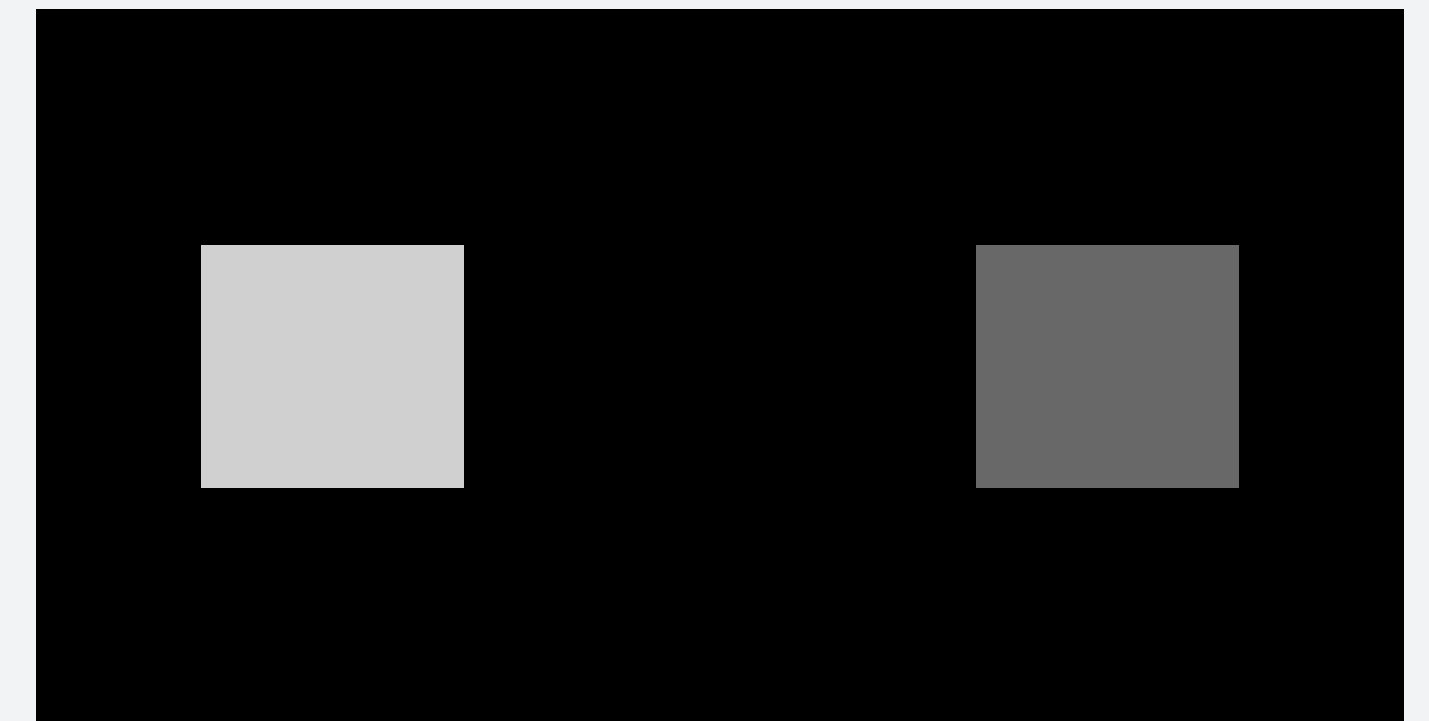
Task

- ✿ 5-item Likert scale:
 - ordinal data
 - no correct/incorrect answers



Procedure

- ❖ 15 observers are to:
 - complete practice: 5 trials with “dummy” stimuli
→ also used in actual experiment as catch trials
 - indicate choices on Likert scale
- ❖ Duration of about one hour per subject assuming 15-second trials
- ❖ 3375 trials in total



Practice stimulus

Analysis

- ❖ *Research question: To what extent do human observers differ or concur in their judgments of the perceived direction of selected brightness effects? Does their inter-individual variability correlate with the choice of stimuli?*
- ❖ Approach:
 - take median of 5 observations as “final answer”
 - visualize data for all stimuli
 - calculate Krippendorff's alpha to estimate inter-individual agreement
- ❖ Also interesting: Intra-individual consistency and its relationship with our stimuli
→ data will be qualitatively described

Analysis - Krippendorff's alpha

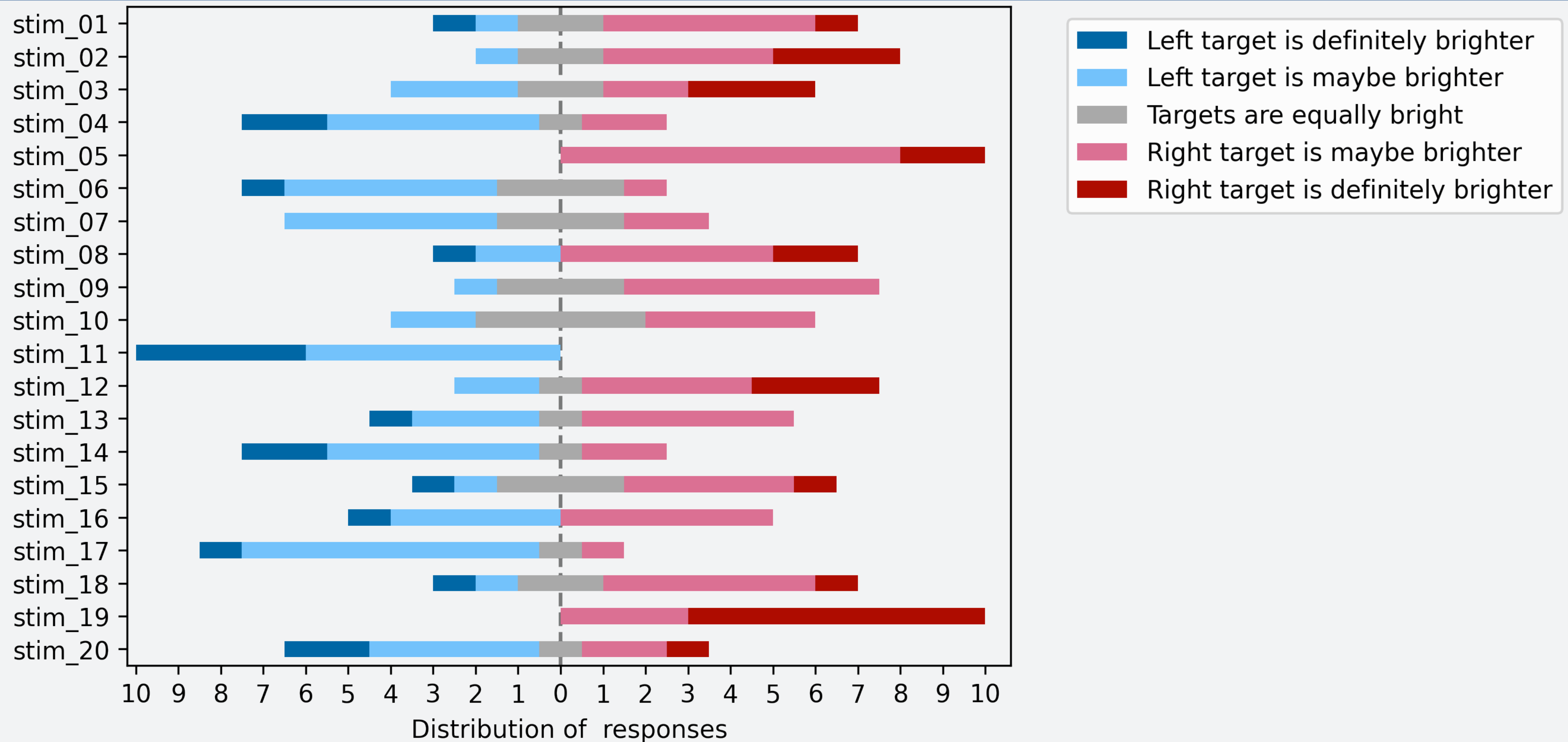
- ❖ Measure for inter-individual *reliability*: degree of agreement between observers
 - value ranges from 0 (perfect disagreement) to 1 (perfect agreement)
 - $\alpha \geq 0.800$ indicates high reliability
 - $0.800 > \alpha \geq 0.667$ indicates tentative reliability
 - $0.667 > \alpha$ indicates low reliability
- ❖ Why Krippendorff's α ?
 - applicable to ordinal data
 - not restricted in use to only two observers
 - takes disagreement magnitude into consideration
 - flexibility with missing data

Analysis - Example

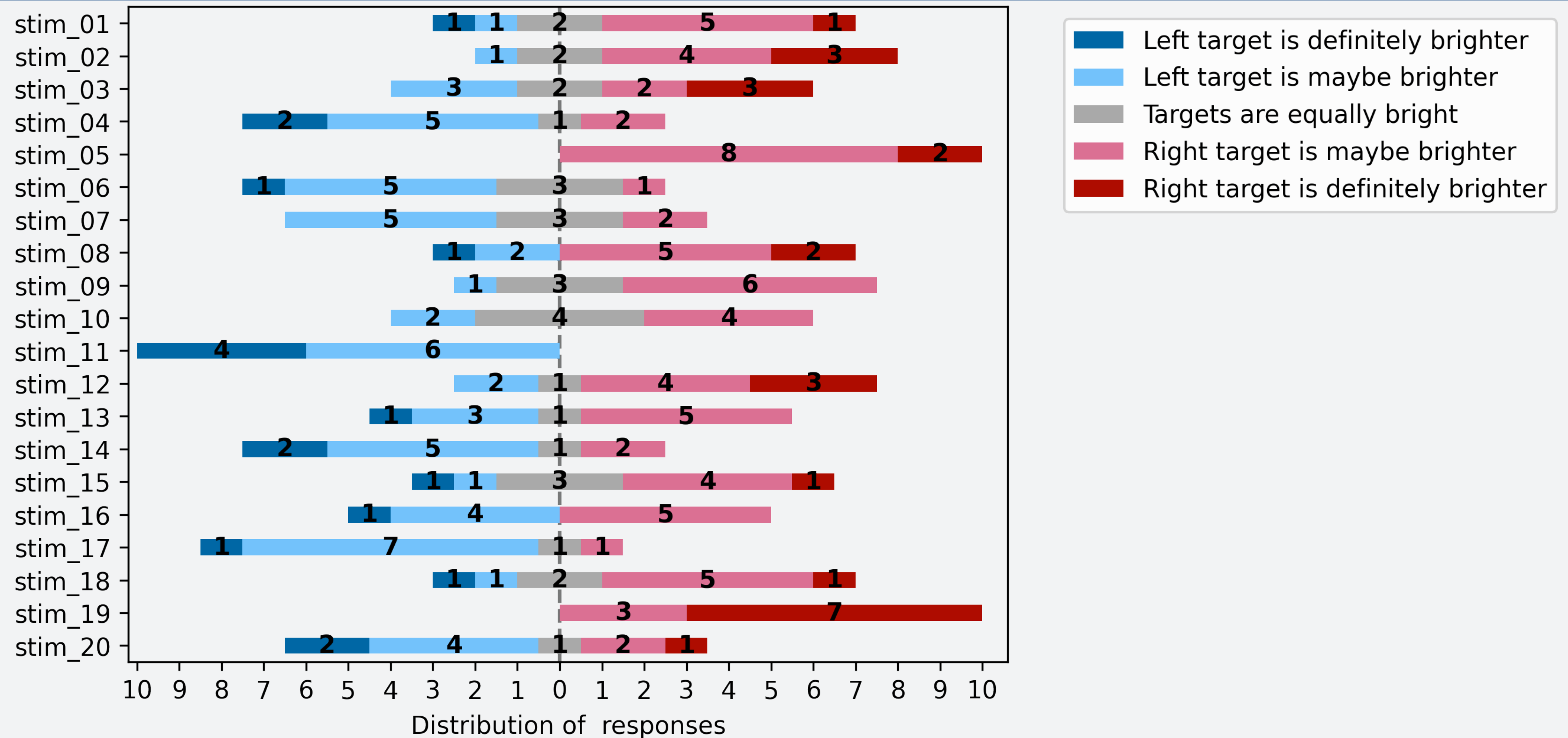
Fictitious, raw data of 10 participants and 20 stimuli.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
P1	4	4	2	2	4	2	3	5	3	4	2	5	2	1	4	4	2	1	5	2
P2	2	2	4	4	4	2	2	2	4	4	2	4	2	2	3	2	2	4	5	2
P3	4	5	4	1	4	2	2	4	4	3	2	2	2	1	2	4	4	2	5	4
P4	3	4	2	4	4	2	2	2	4	3	2	4	4	3	3	4	2	4	5	1
P5	4	4	3	2	4	3	4	5	4	3	1	5	3	2	4	2	2	3	4	2
P6	4	5	2	3	5	1	3	4	3	3	1	2	4	4	5	4	1	4	5	4
P7	5	5	5	2	4	3	2	4	4	2	2	4	4	2	4	2	2	4	4	5
P8	4	4	3	1	5	3	2	4	2	2	1	4	4	2	4	1	2	5	5	3
P9	1	3	5	2	4	4	3	1	4	4	2	3	1	4	3	4	3	3	4	1
P10	3	3	5	2	4	2	4	4	3	4	1	5	4	2	1	2	2	4	5	2

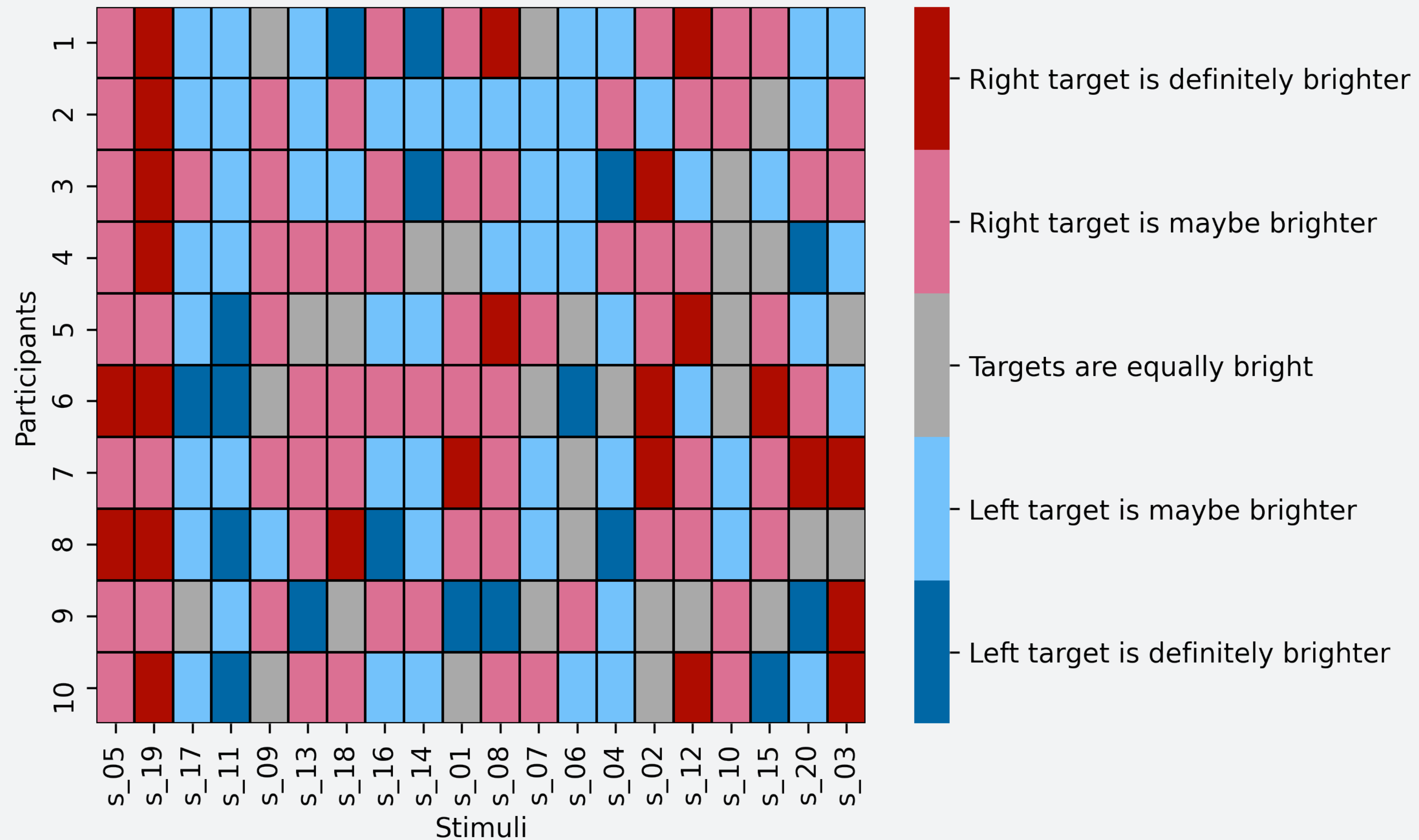
Analysis - Example



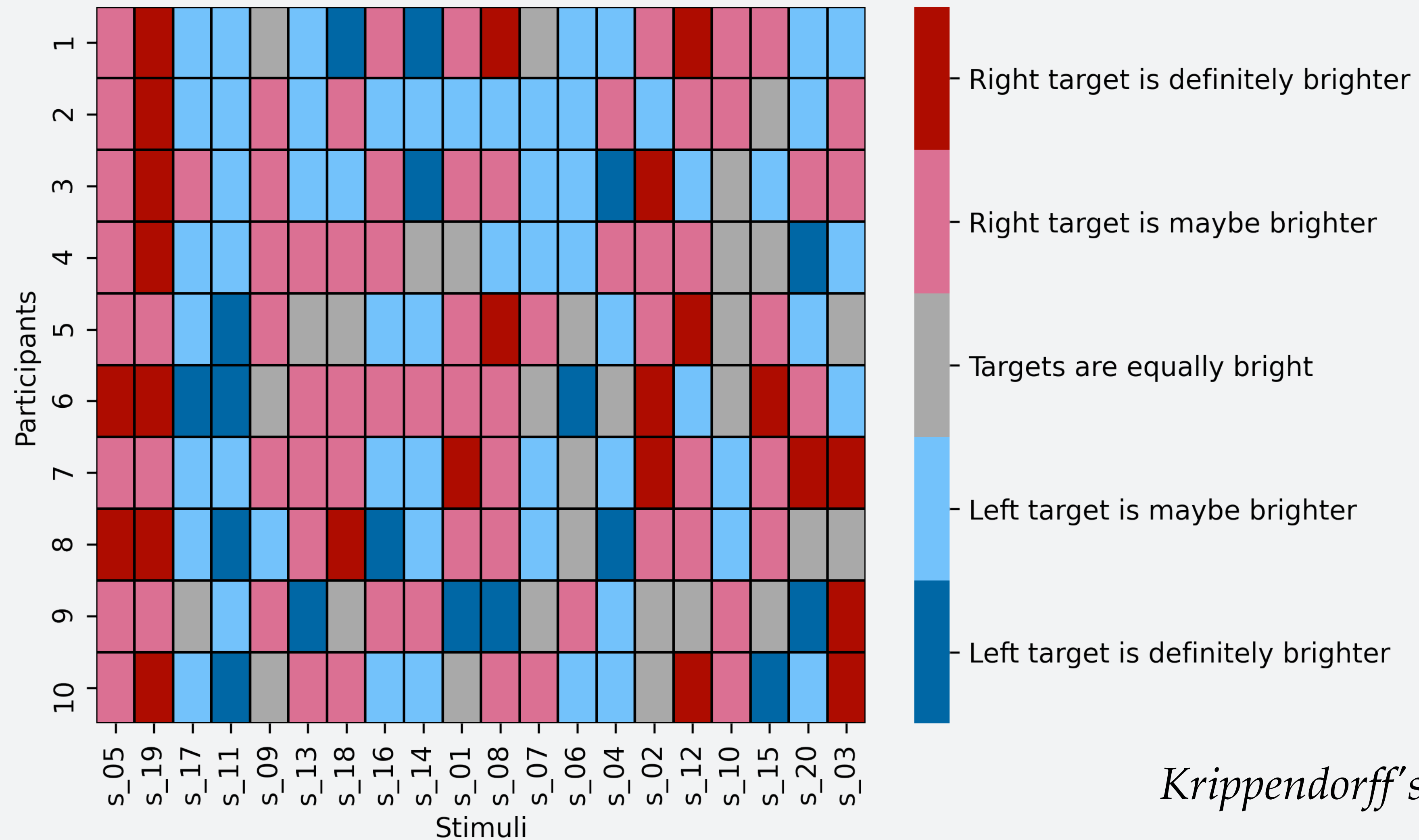
Analysis - Example



Analysis - Example



Analysis - Example



Krippendorff's $\alpha \approx 0.304$

Sources

- ❖ Krippendorff, K. (2004). Reliability in content analysis: Some common misconceptions and recommendations. *Human communication research*, 30(3), 411-433.

Questions?