The synthesis of integral dimensions

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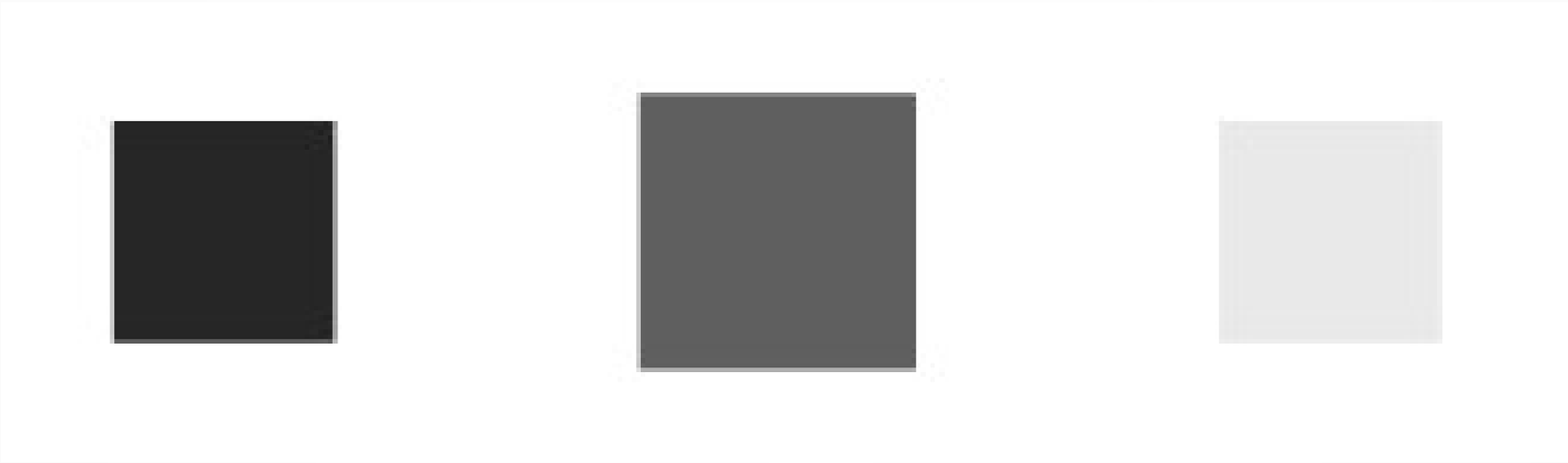
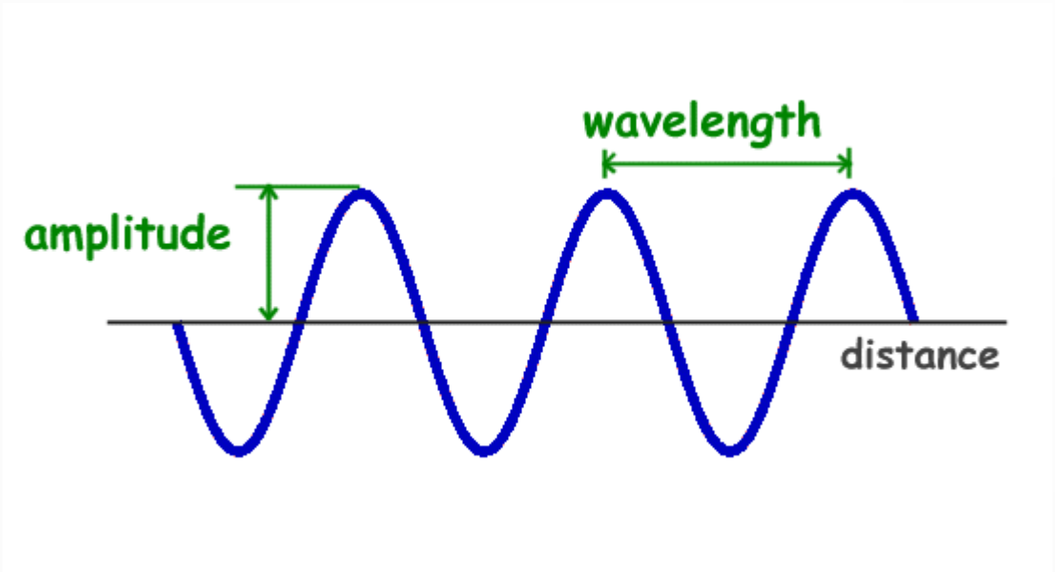
Stimuli have multiple attributes

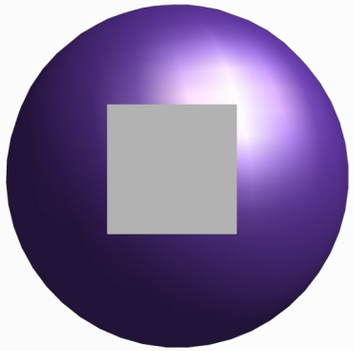




Classes of theories of classification

- **Differentiation Theory**
  - Lockhead (1972), et seq.
- **Combination Theory**
  - Neisser (1967), et seq.

Differentiation Theory



“Unanalyzed whole”

Size

Brightness

Widespread assumption of Differentiation Theory

- Use of terms “analytic” and “nonanalytic” (or “holistic”) to describe modes of thought.

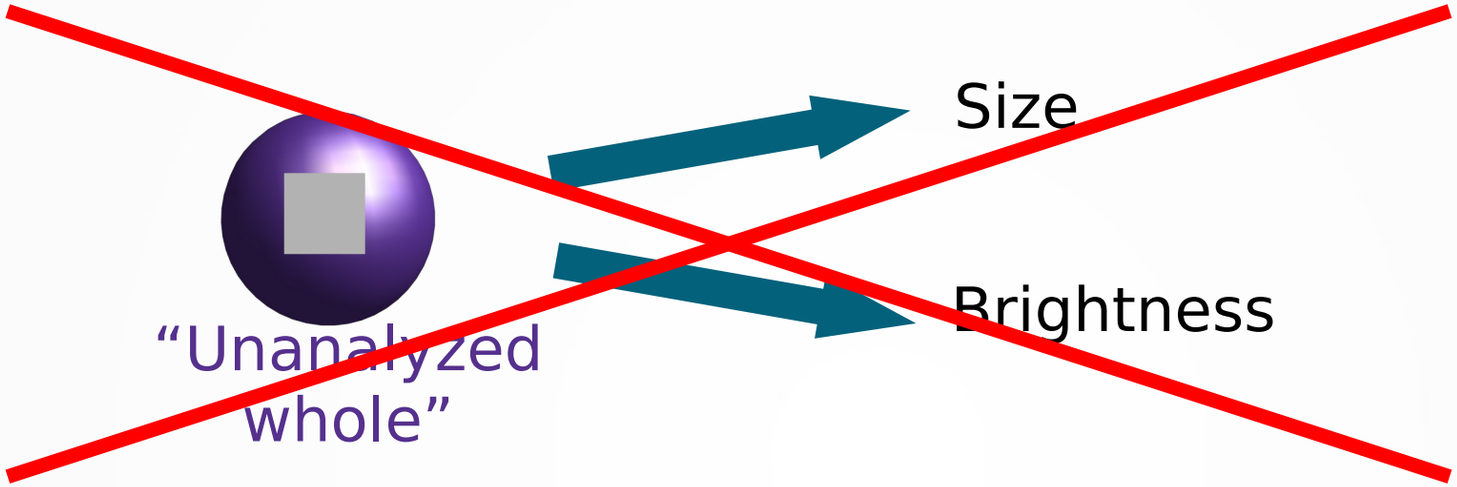
- Example: Hypothesis that **W**estern **E**ducated **I**ndustrialised **R**ich **D**emocratic (WEIRD) populations have an unusually analytic mode of thought
  - Heinrich et al. (2010)

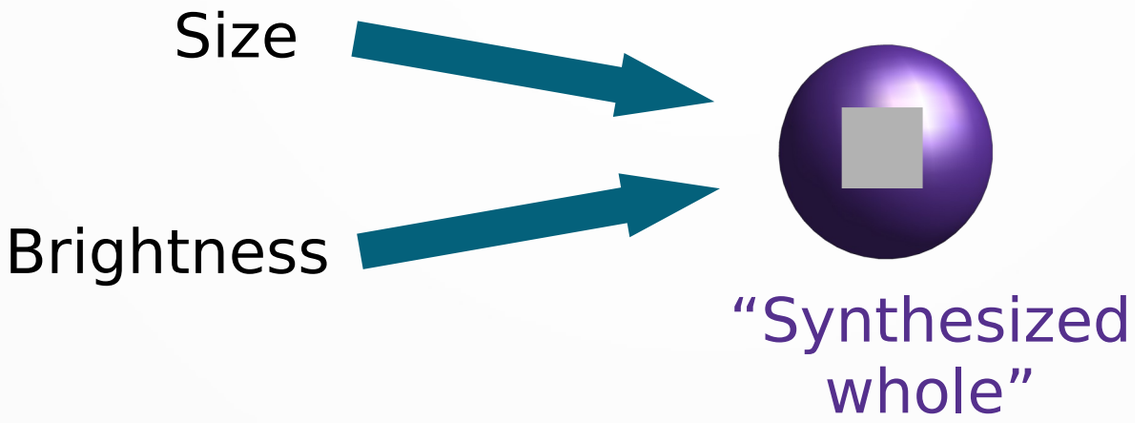
Differentiation Theory is wrong

For example:

- **Milton, Longmore & Wills (2008)**: time pressure, concurrent load
- **Milton, Wills & Hodgson (2009)**: fMRI
- **Wills et al. (2009)**: pigeon / squirrel / human comparisons
- **Wills et al. (2013):** concurrent load, instructions, working memory capacity
- **Wills, Inkster & Milton (2015):** time pressure, concurrent load, incidental training.
- **Wills, Ellett, Milton, Croft & Beesley (2020):** pretraining, concurrent load.

Combination Theory





Combination Theory

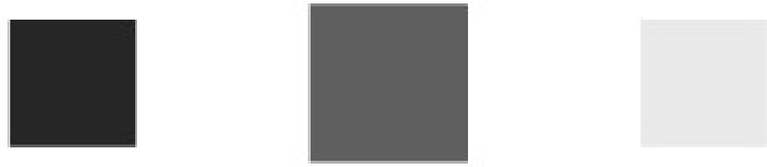
- Predicts the effects of time pressure, cognitive load, incidental training, instructions … on the classification of a variety of stimuli in a variety of procedures.

- **Basically:** The less time or mental resources we have to apply to a classification *the fewer stimulus attributes we use.*

Breaking Combination Theory?

Separable versus integral stimuli (Garner, 1976)

- Separable stimulus set:



- Integral stimulus set:

Predictions

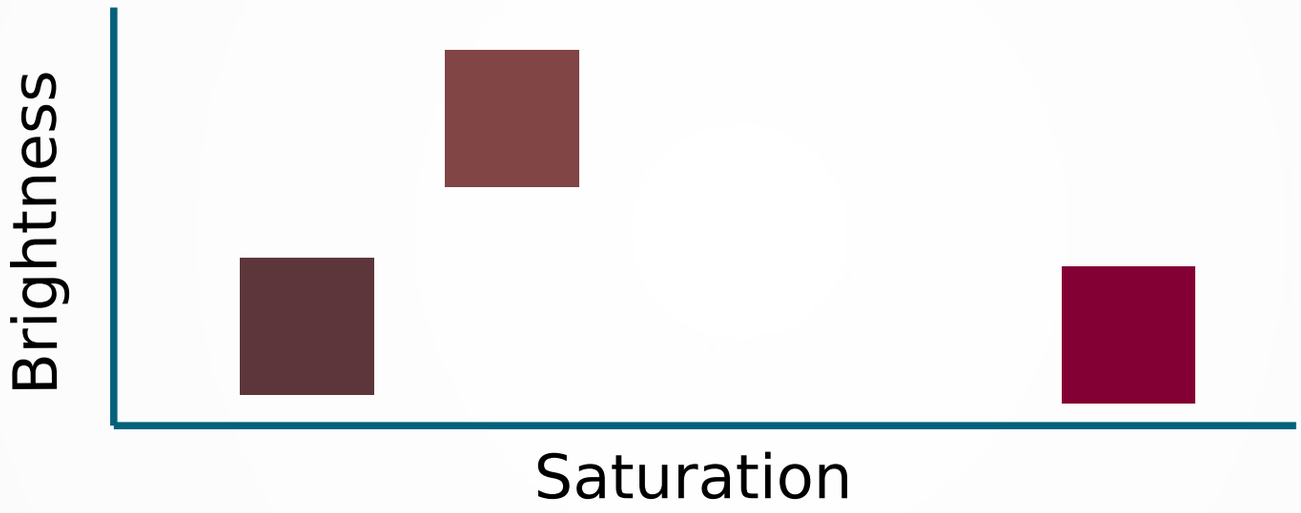
Combination Theory: With sufficiently high time pressure, people will classify integral stimuli on the basis of a single attribute, because the attributes have not yet been combined.

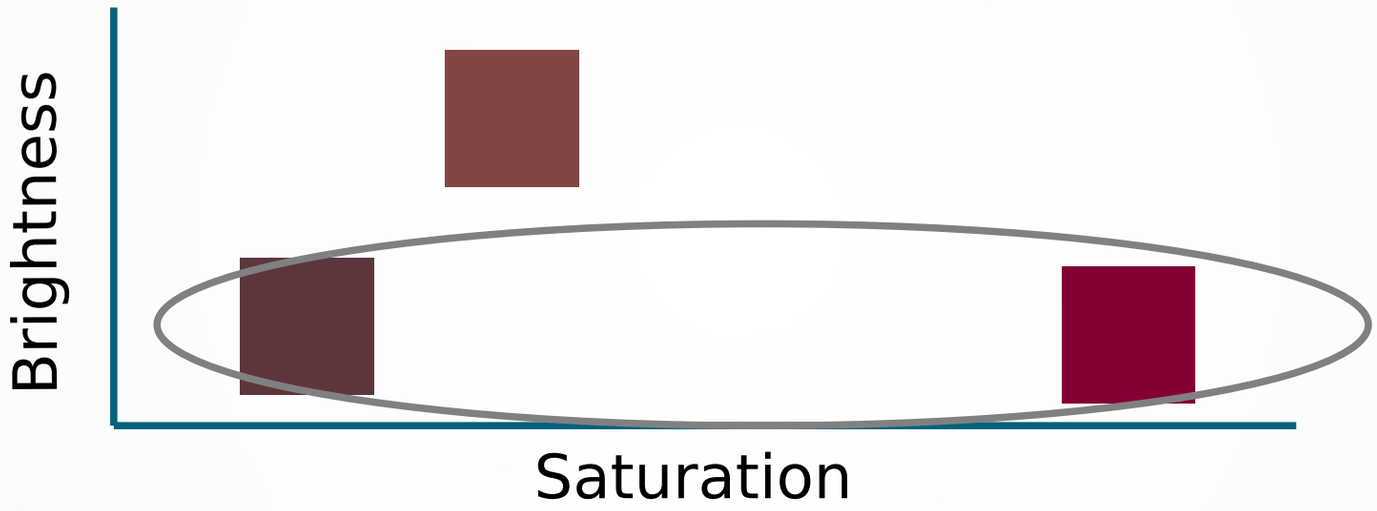
Differentiation Theory: Classification on the basis of a single attribute will be more likely as time pressure reduces.

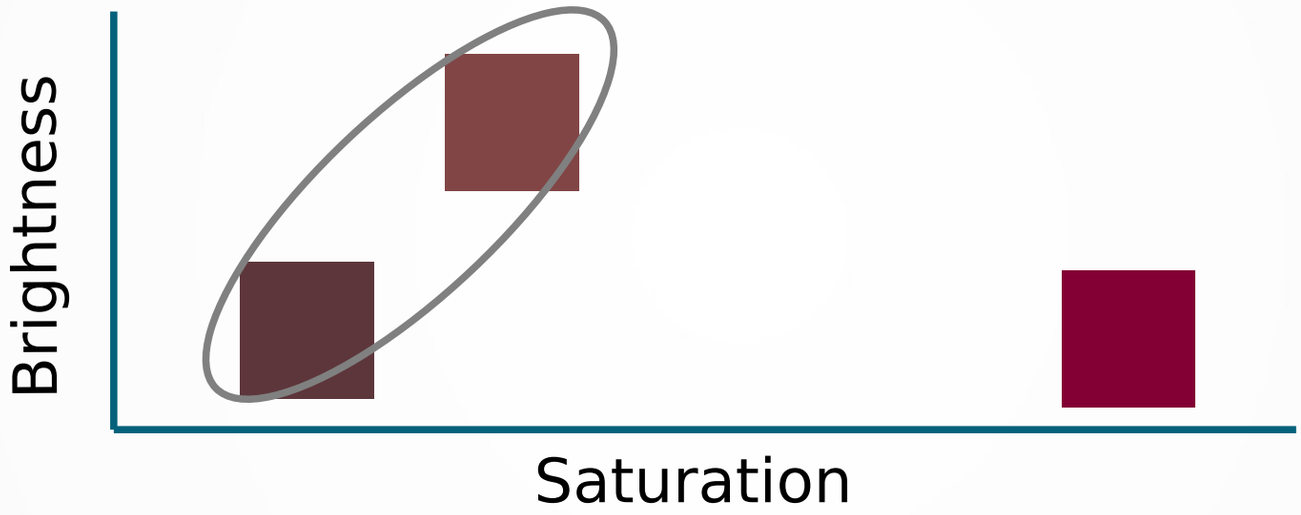
Experiment

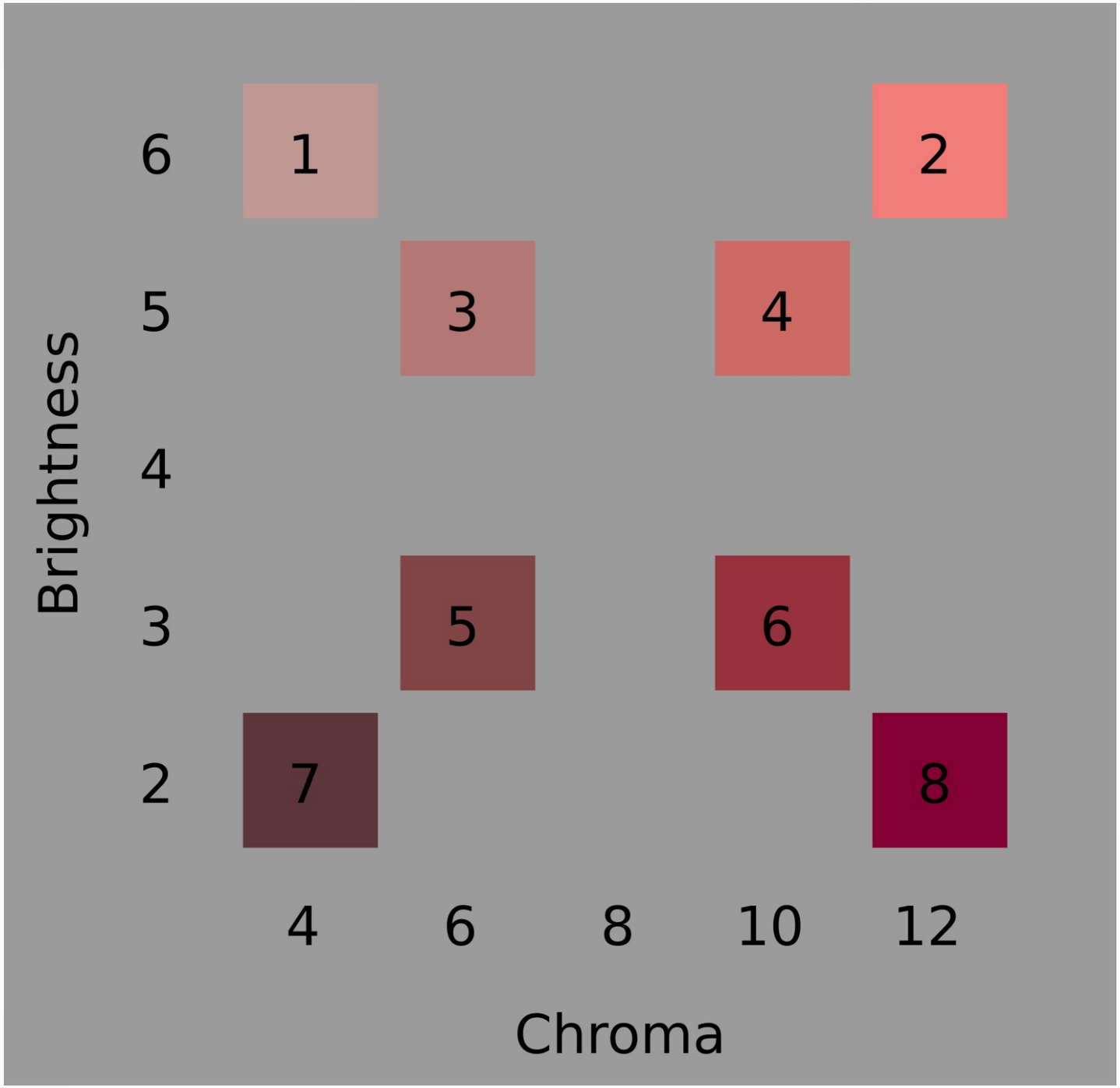
- **IV: stimulus presentation time**
  - 100 ms vs. 2000 ms (between-subjects)
- **Stimuli**
  - Red hue squares varying in saturation and brightness
- **Procedure**
  - “Triad” (restricted classification) task

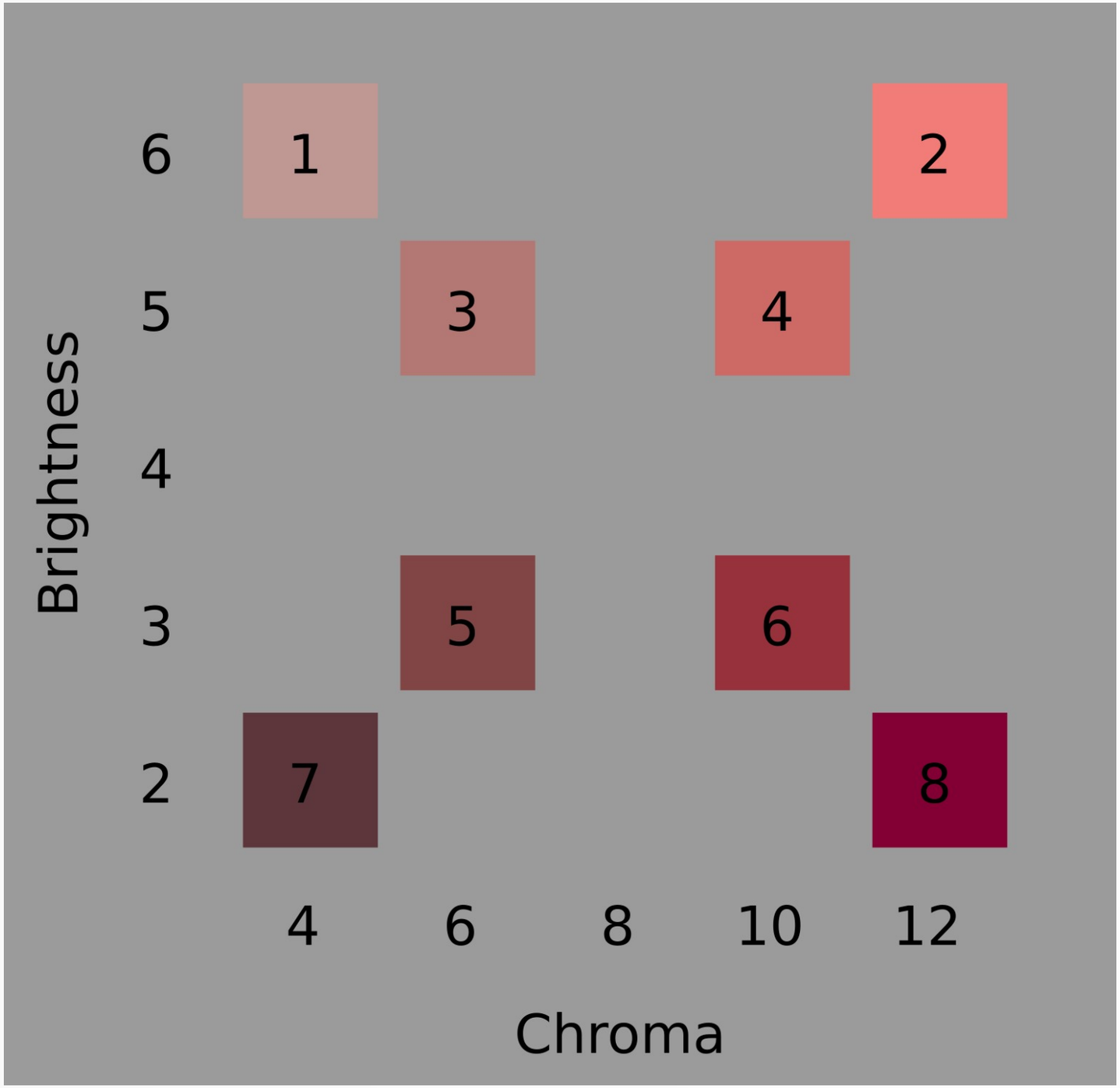
Odd one out?


Brightness
Saturation


Brightness
Saturation


Brightness
Saturation


Brightness
6
5
4
3
2
1
2
3
4
5
6
7
8
4
6
8
10
12
Chroma



Overall similarity

Identity

Single dimension

Results

Time	UD	OS	ID	Bias
100 ms	1	27	0	1
2000 ms	0	17	0	0

BF_{10} = 0.14

Exploratory analysis

Time	UD	OS	ID
100 ms	0.119	0.881	0.000
2000 ms	0.018	0.975	0.007

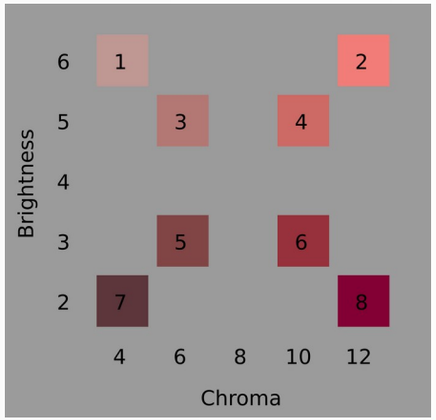
BF_{10} = 4.92

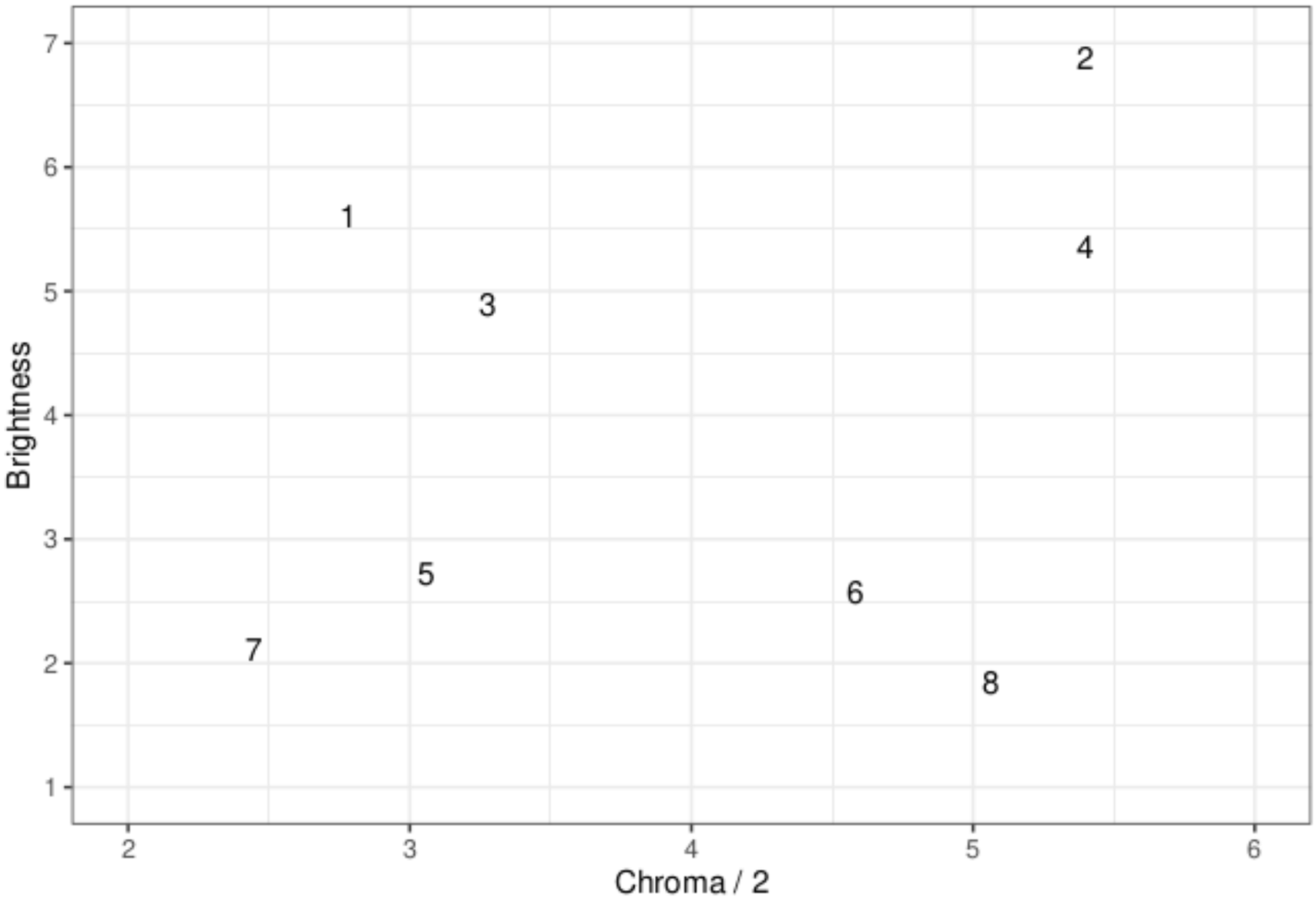
Direct replication

Time	UD	OS	ID
100 ms	0.142	0.850	0.008
2000 ms	0.012	0.988	0.000

BF_{10} = 1047

Multidimensional scaling



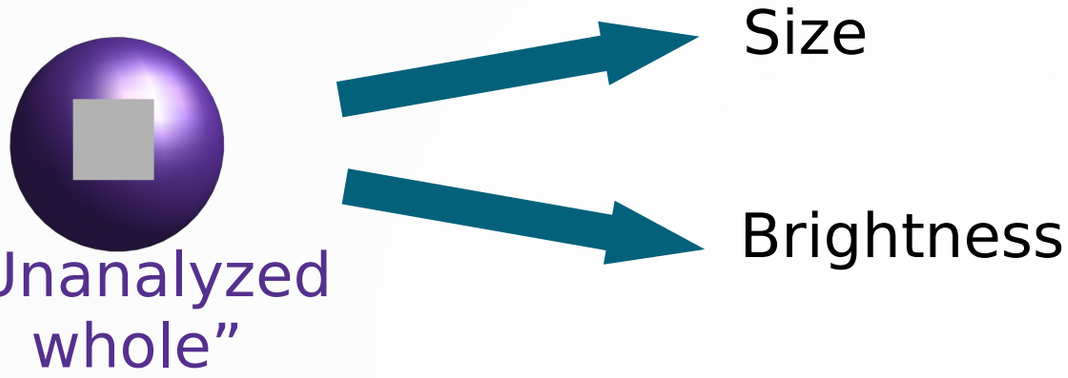


Final analysis

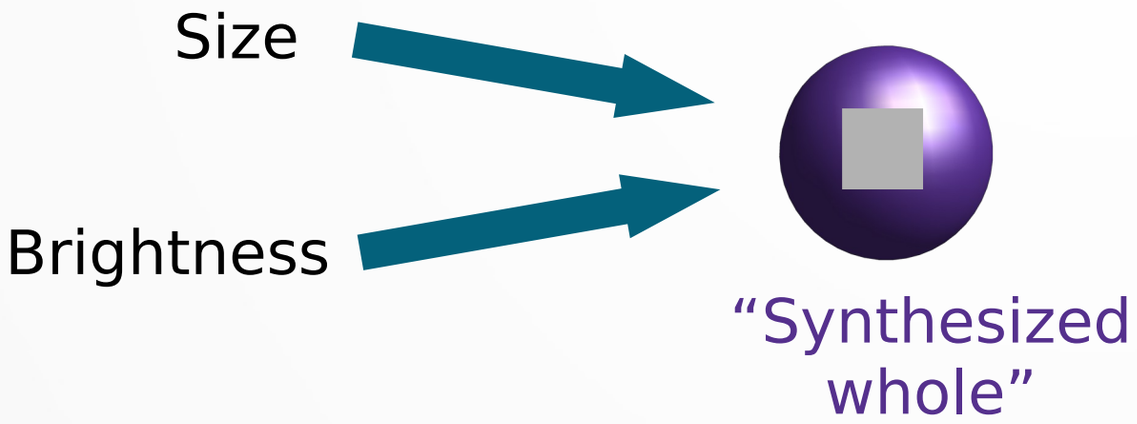
Time	UD	OS	ID
100 ms	0.319	0.681	0
2000 ms	0.086	0.914	0

BF_{10} = 892

Summary



Differentiation Theory



Combination Theory

Our cognitive chemists do not analyze mysterious compounds, they synthesize stimuli from their components.

Questions?