# Are colour experiences equivalent across the visual field?

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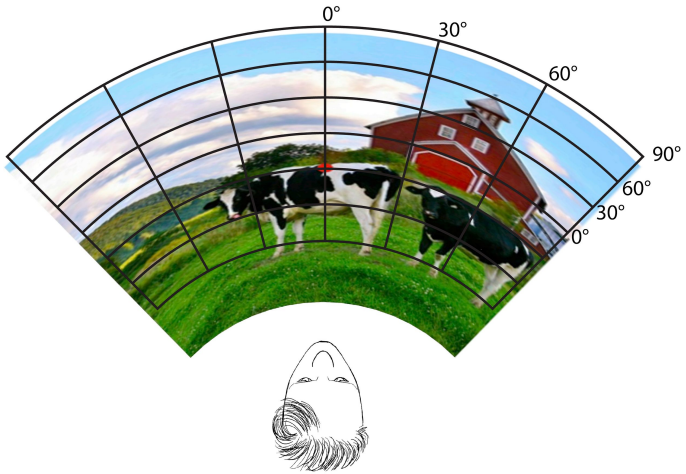
# Naive View: Colour & The Visual Field



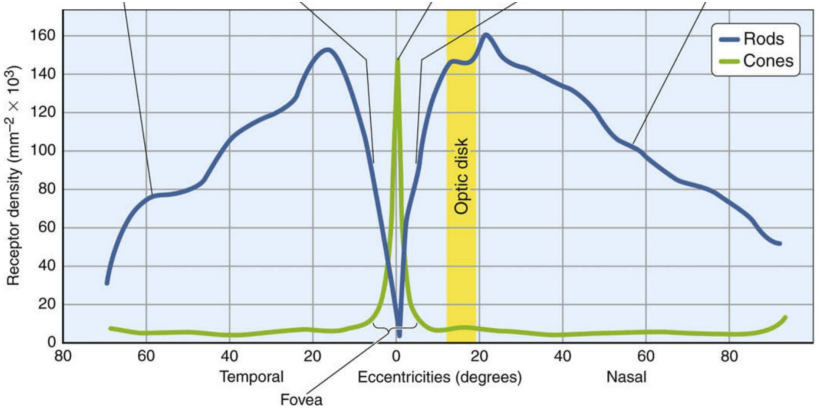

STIMULUS

EXPERIENCE

BEHAVIOUR

Cohen et al., 2020; Cohen & Rubenstein., 2020; Haun et al., 2017; Haun 2020

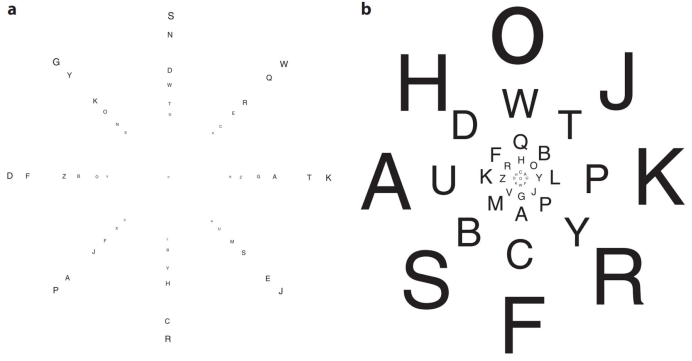
# Eccentricity Issues: Neurophysiology & Behaviour

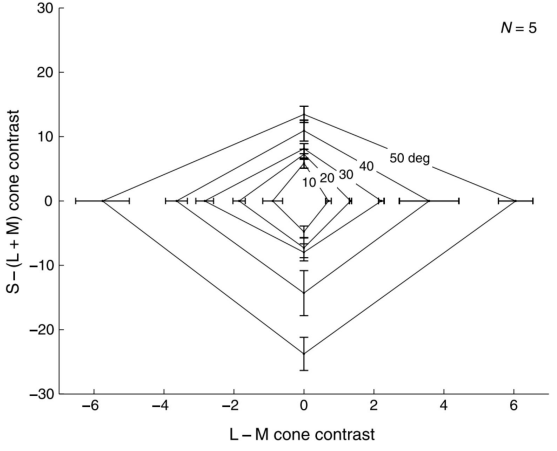



V +

XVK +

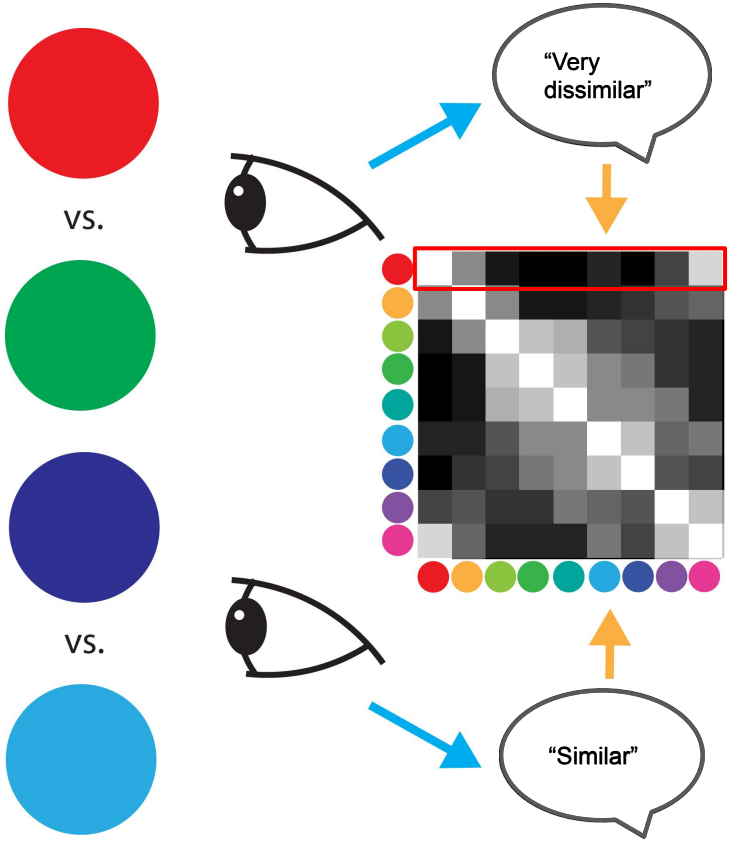
X V K +

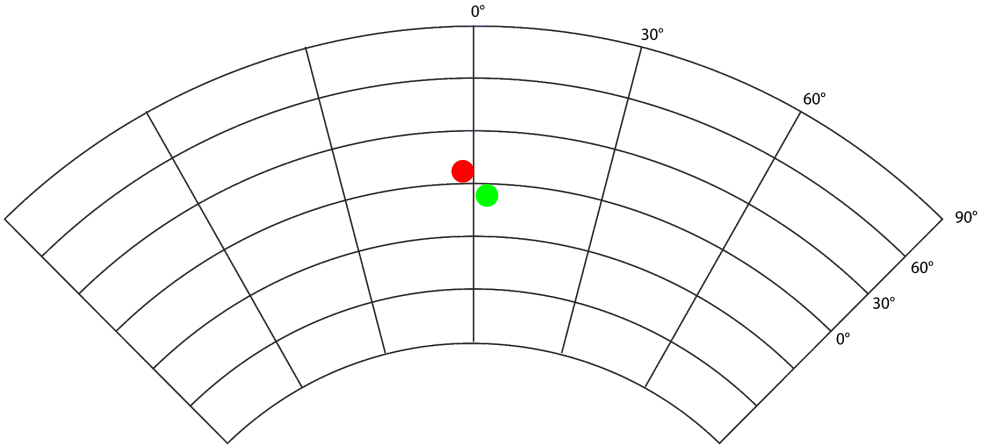



Rosenholtz, 2016;

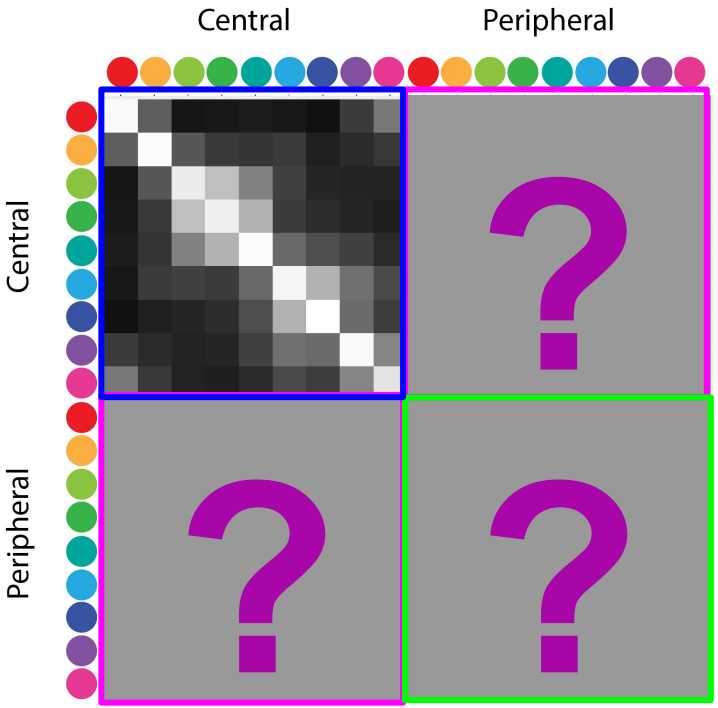
# Capturing Colour Experiences: Similarity Relationships

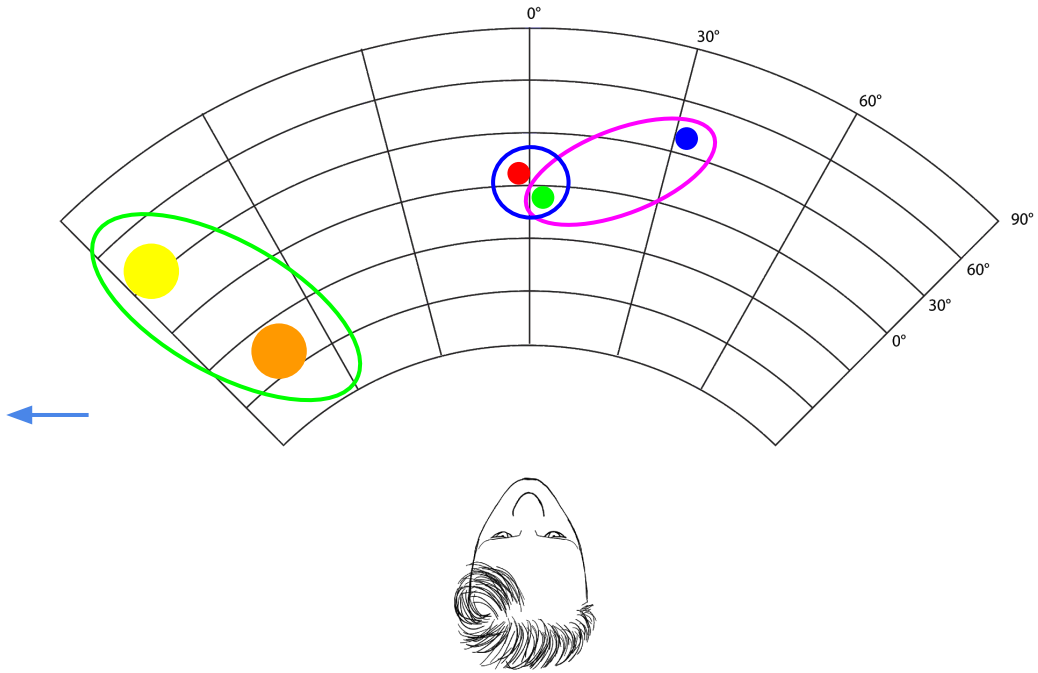



Helm 1964; Shepard 1970 ; Nili et al., 2014;

# Capturing Colour Experiences: Similarity Relationships

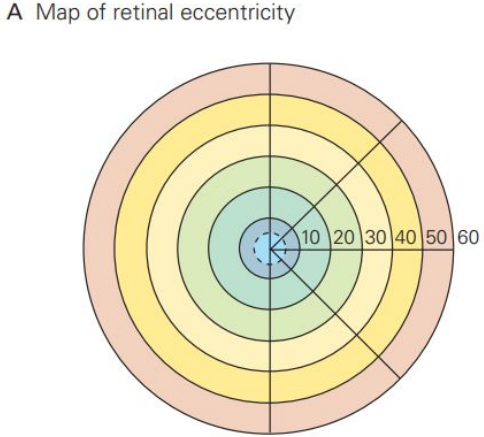


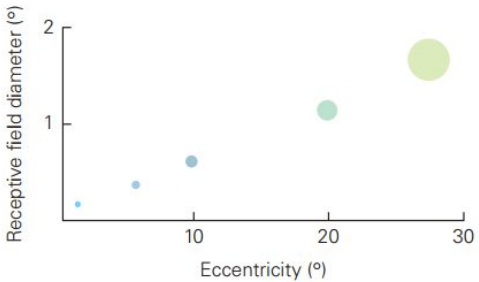



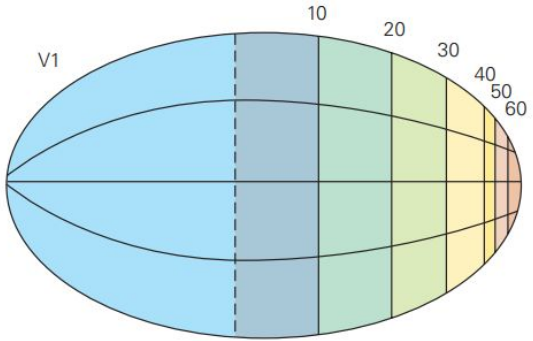

Gordon & Abramov, 1977; Ayama et al., 2004; Sakurai et al., 2003

# To Scale Or Not To Scale?

Cortical Magnification



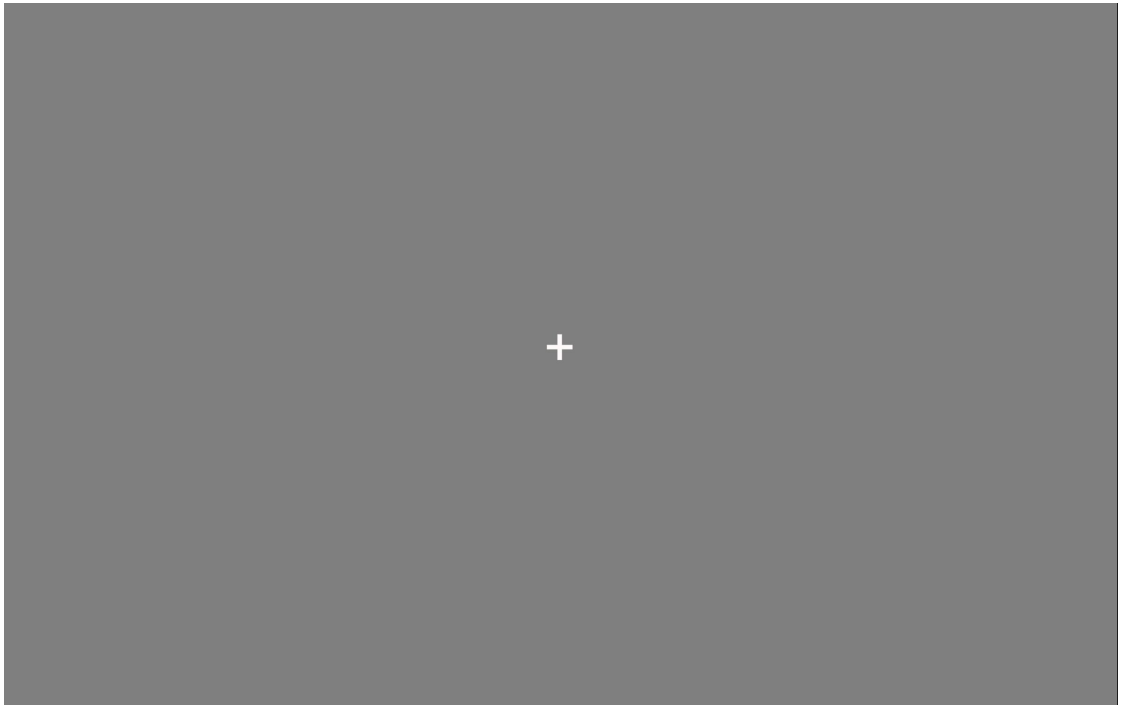




Tyler 2015; Gordon & Abramov, 1977; Freeman & Simoncelli, 2011; Giron et al., 2018

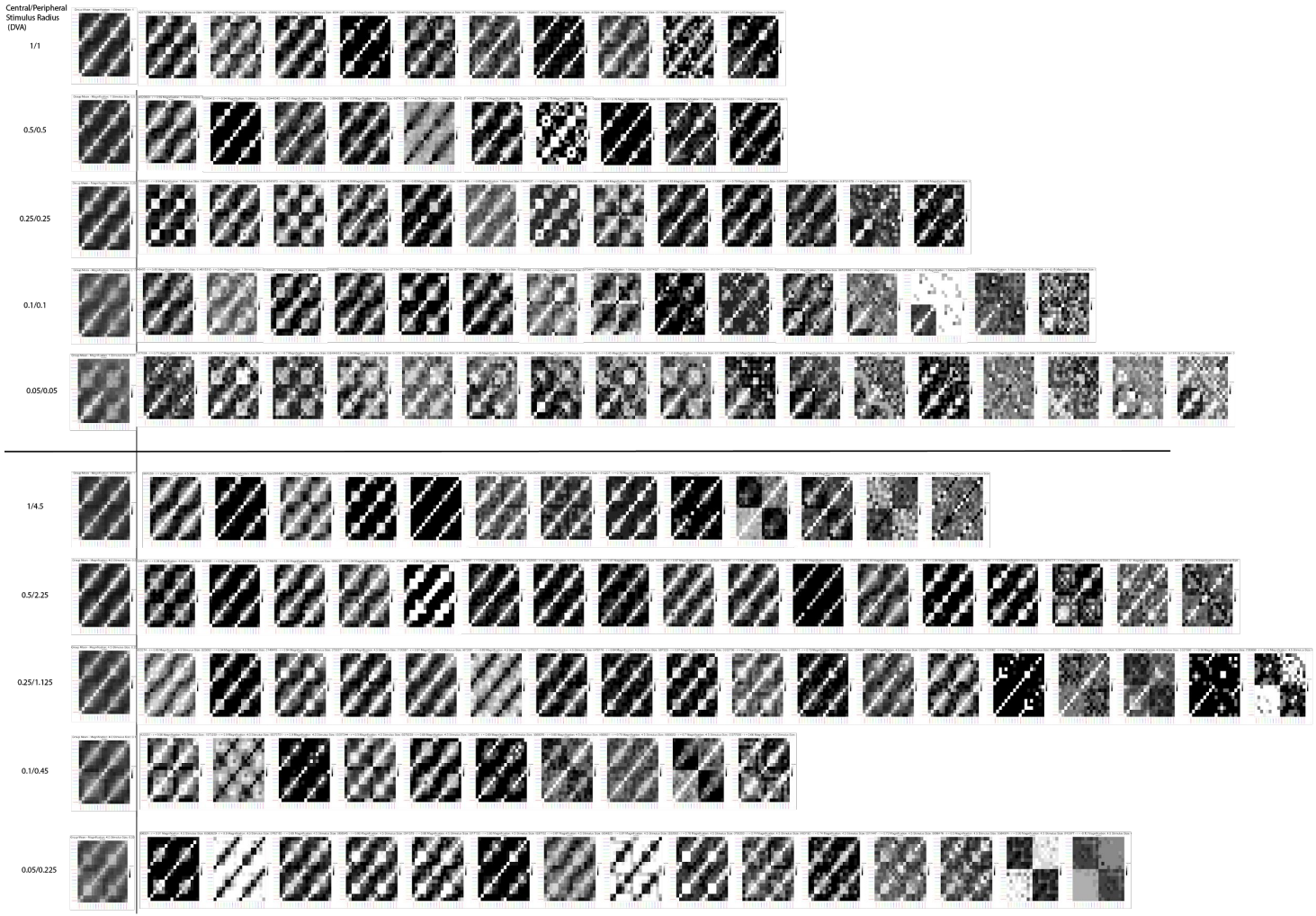
# The Experiment

- Online participants (MTurk)
- Screen size & viewing distance calibrations
- Eccentricity
  - Central: 1 DVA
  - Peripheral: 10 DVA
- Size
  - 0.1 - 2 DVA
  - Peripheral Scaled: 4.5x
  - Peripheral Fixed: 1x
- 9 Colours
- 250 ms presentation
- ~30 minutes for 243 trials

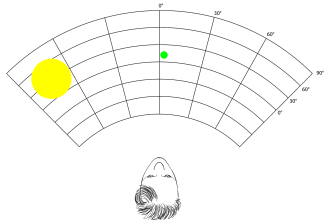


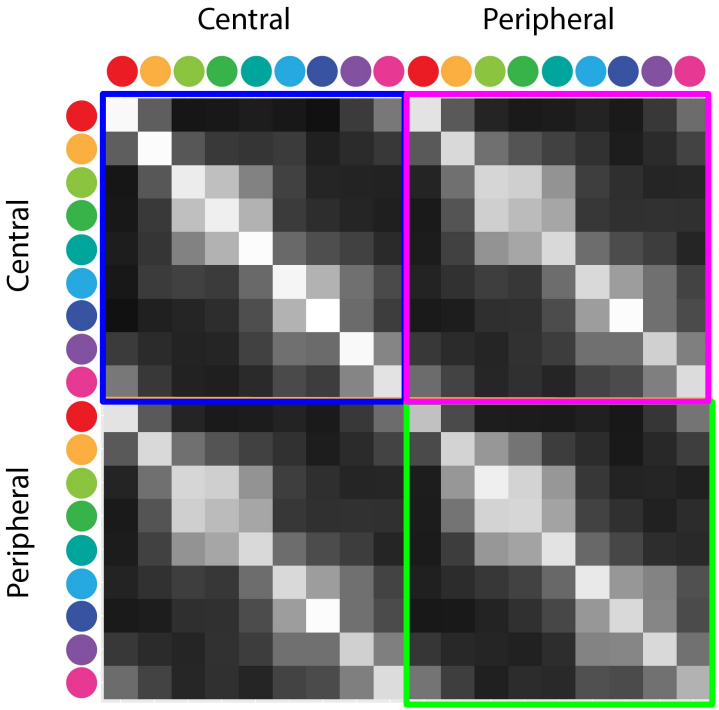

Slowed down

# Results


Central/Peripheral Stimulus Radius (DVA)
1/1
0.5/0.5
0.25/0.25
0.1/0.1
0.05/0.05
1/4.5
0.5/2.25
0.25/1.125
0.1/0.45
0.05/0.225

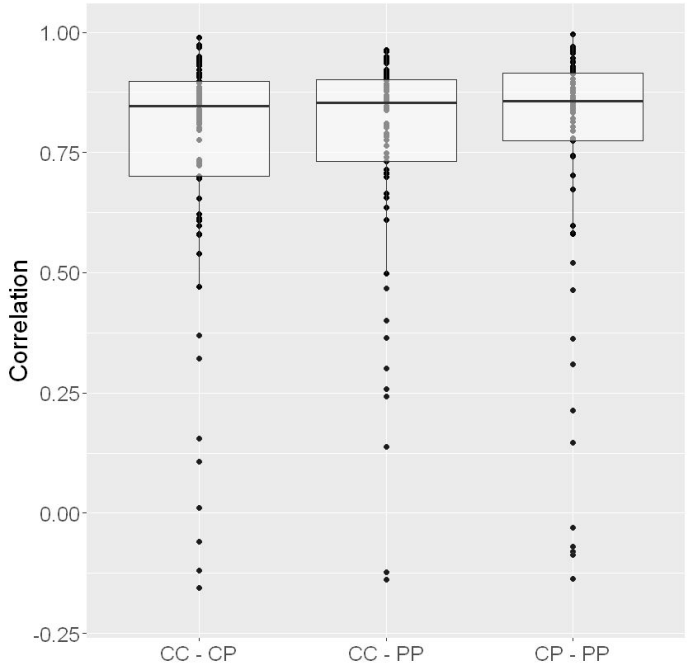
# Colour Similarity Across The Visual Field






r(CC,PP)
r(CC,CP)
r(CP,PP)

for each subject




N = 73, 1-way ANOVA on Fisher-transformed data, Correlation ~ Comparison, p = 0.81

# Effects of Scaling: Small Stimuli Look Different

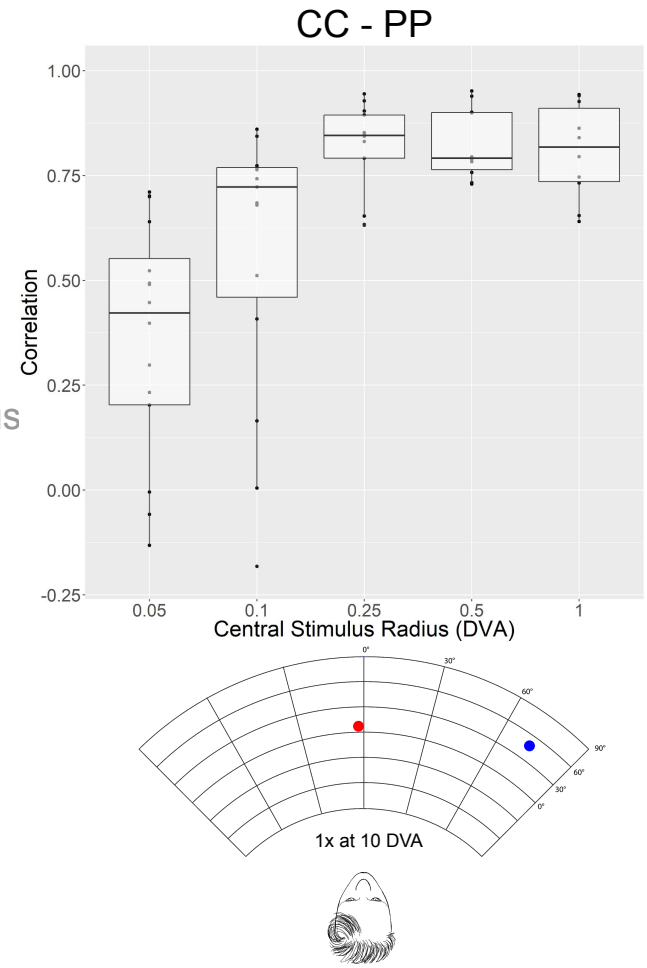
Central eccentricity: 1 DVA
Peripheral eccentricity: 10 DVA

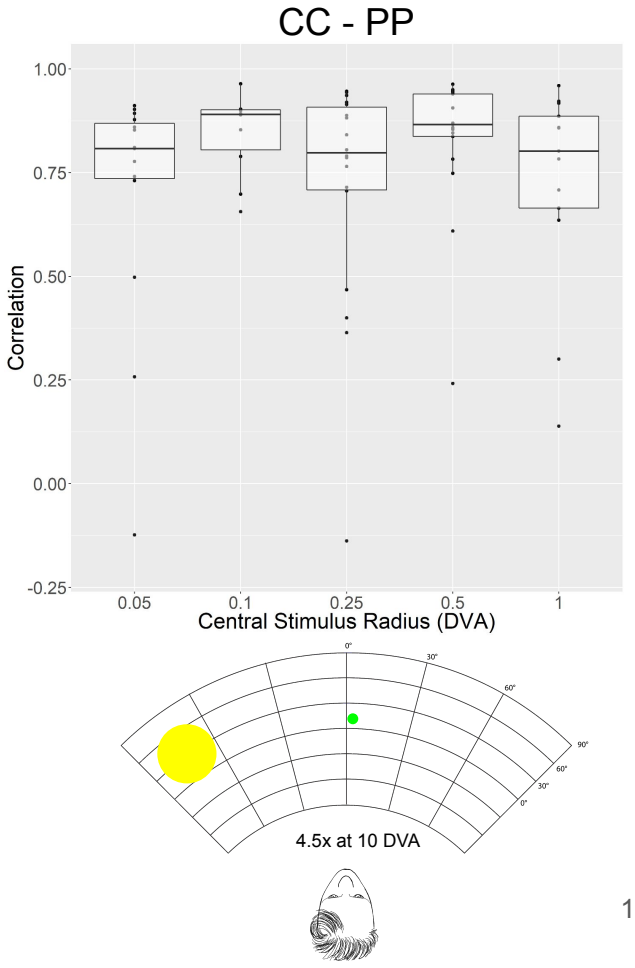
N = 10-18/group

2-way ANOVA on
Fisher-transformed data

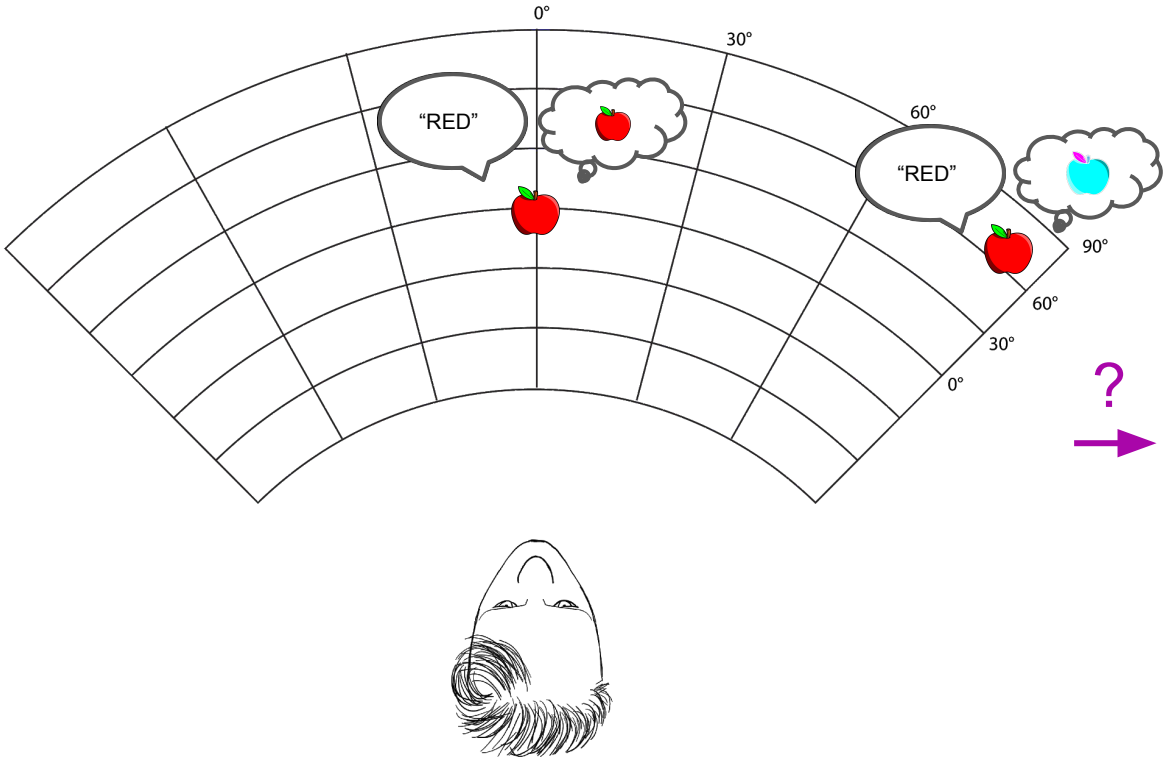
Correlation ~ scaling + radius
+ scaling*radius

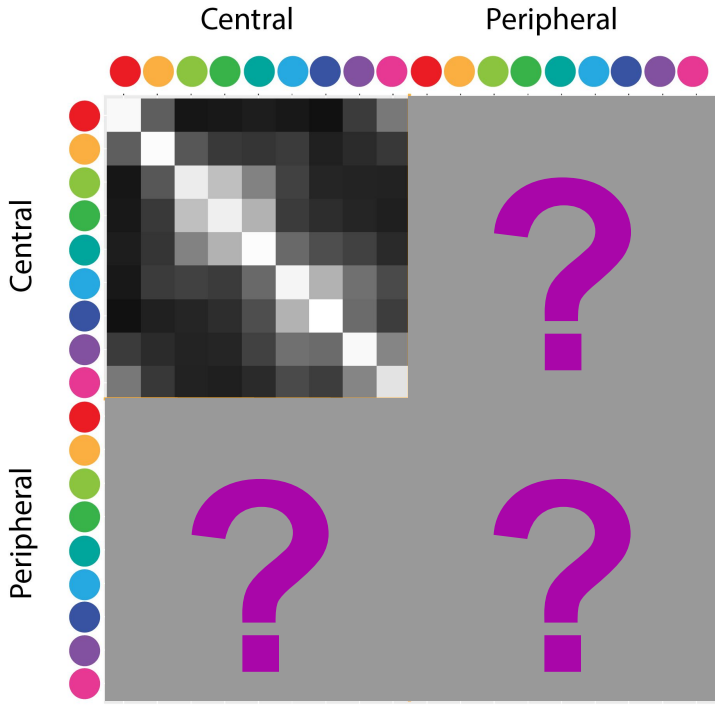
p<0.001 for all factors



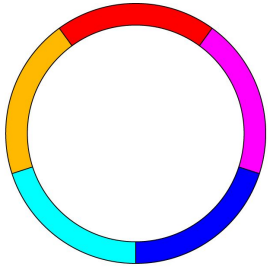



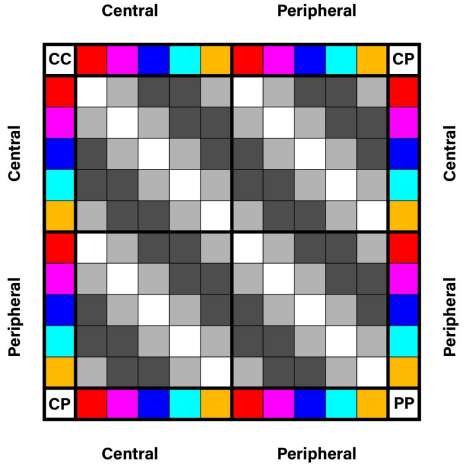
# Detecting Within-Subject Colour Inversion

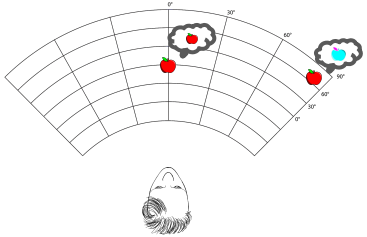


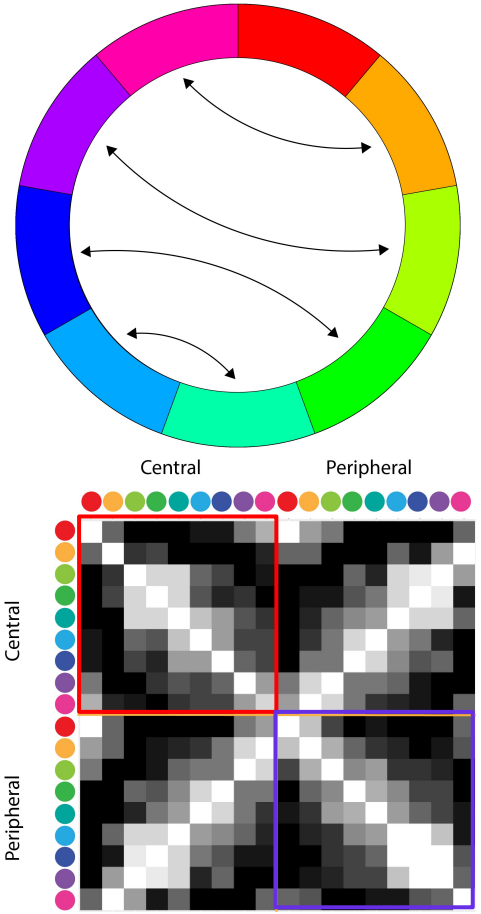
# Simulating & Detecting Inversion

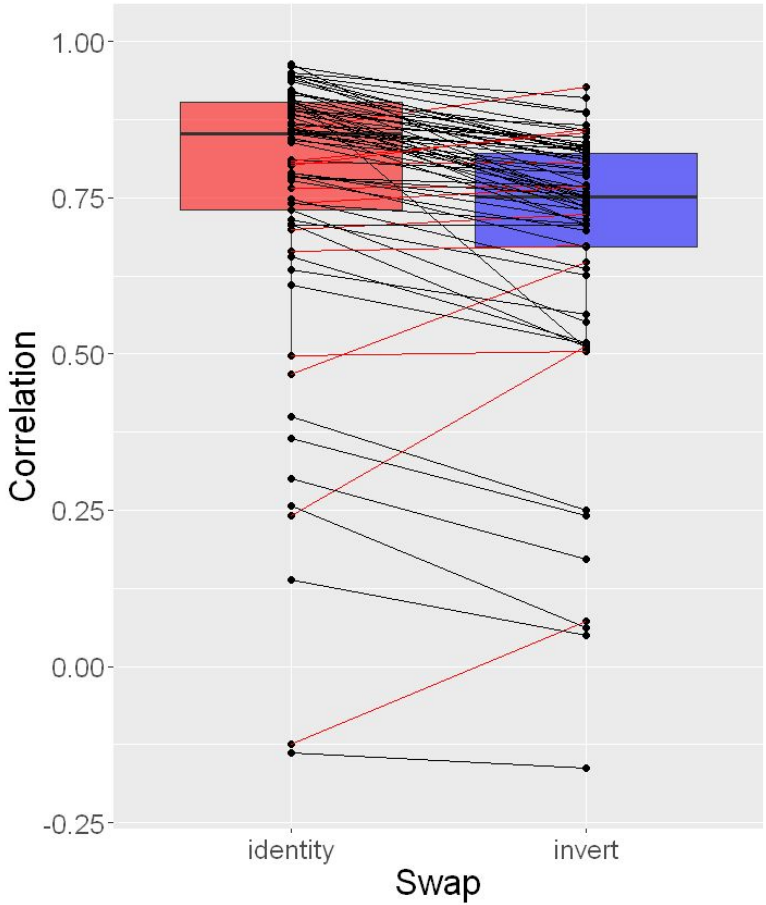




# Colour Inversions Are Detectable




N = 73

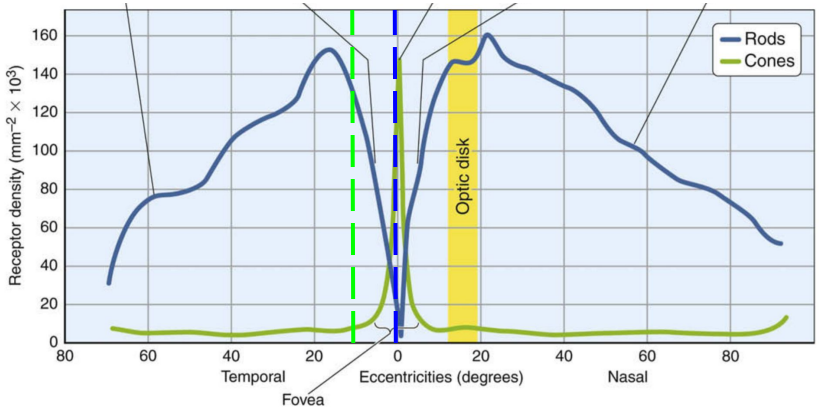
t-test (identity, invert) on Fisher-transformed data with Bonferroni correction

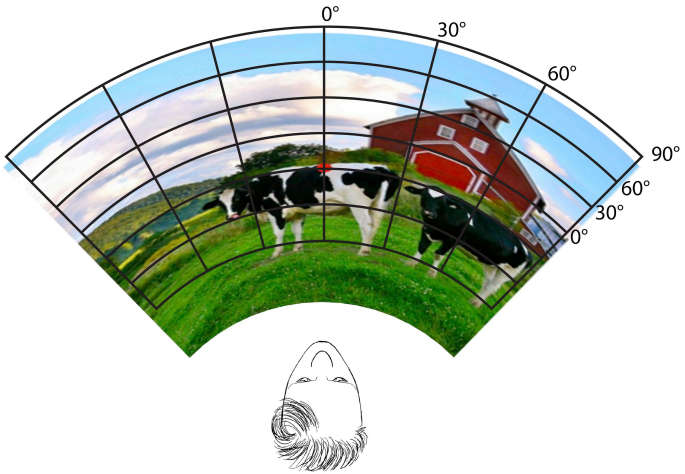
$p < 0.001$

# Conclusions & Takeaways

# Conclusions & Takeaways

- Colour experience structure probably equivalent across the visual field
- Sufficiently small stimuli elicit inequivalent colour experiences
  - But not so if accounting for cortical magnification
- Most (within-subject) colour inversions are detectable



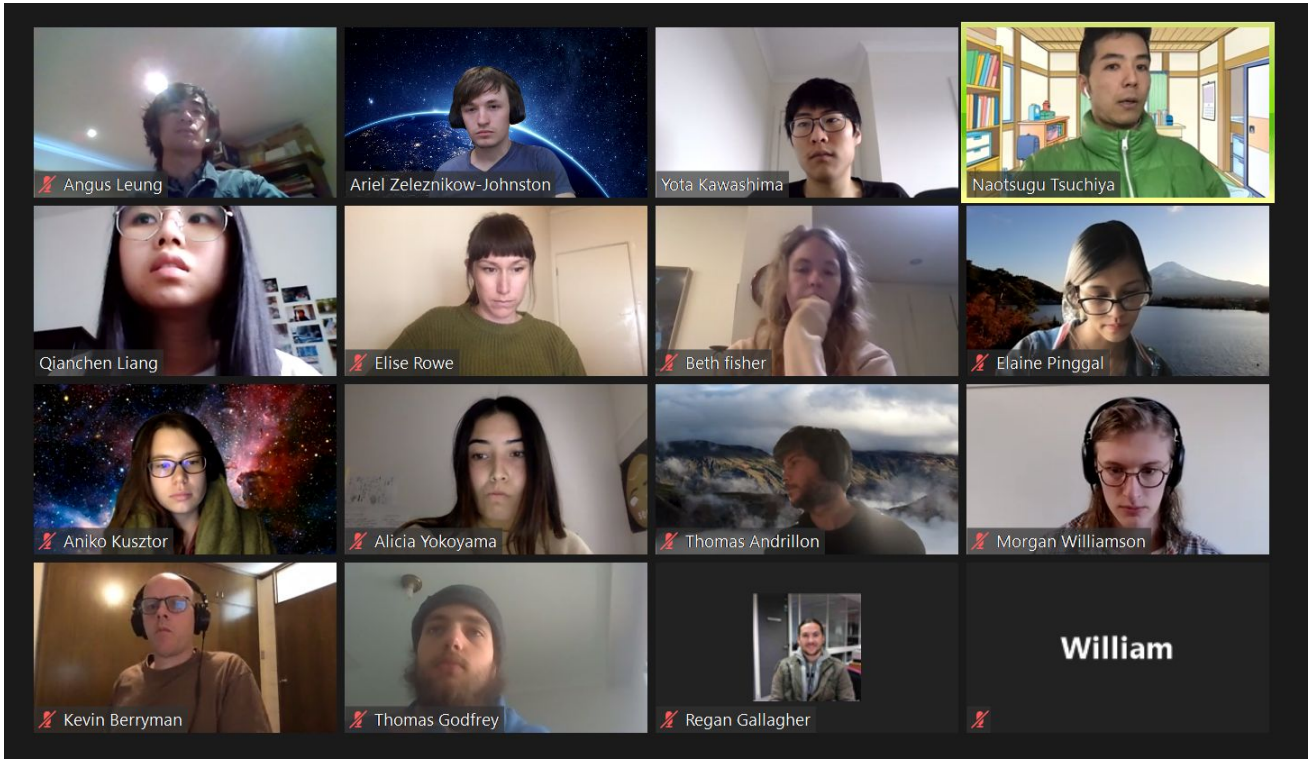



# Acknowledgements

Please tell me what you think about colour (survey link)!

MONASH University

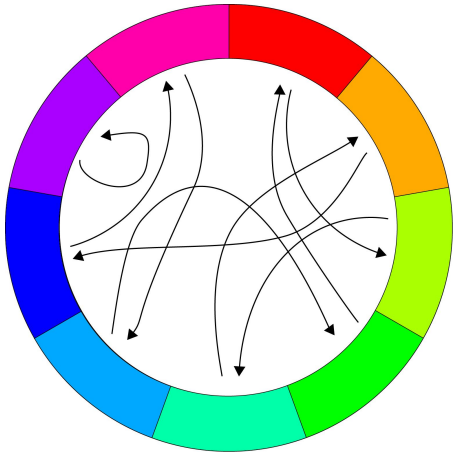
Australian Government
National Health and Medical Research Council

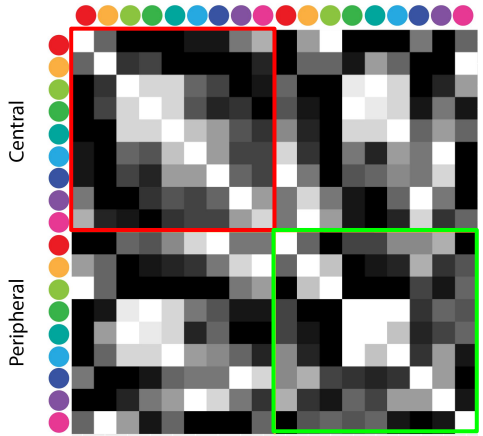


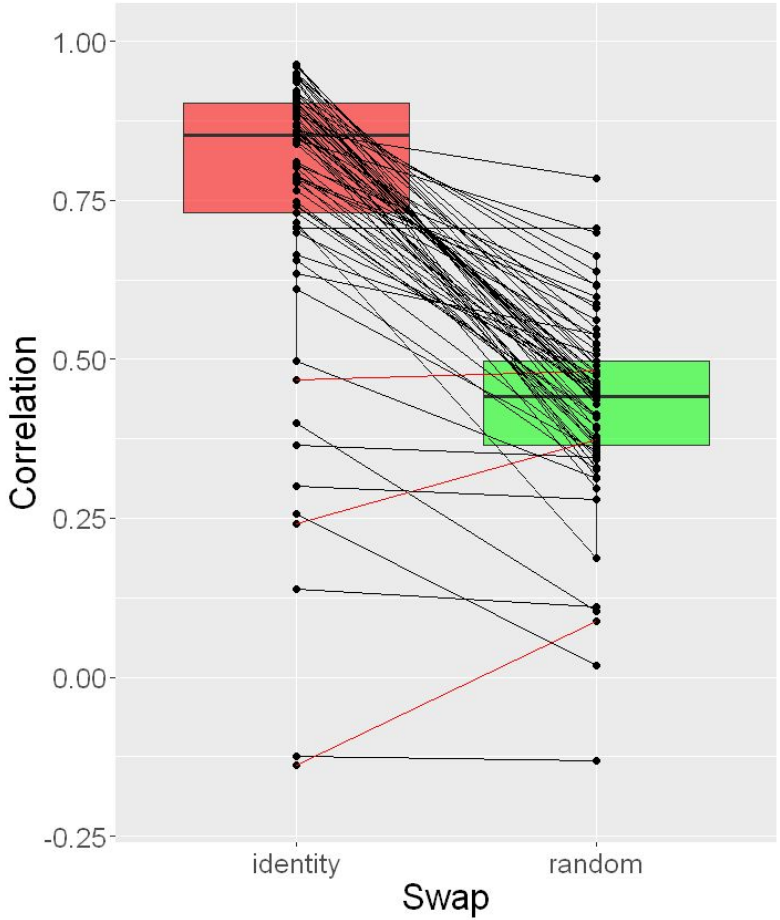

ariel.zeleznikow-johnston@monash.edu Link to talk recording

# Supplementary Slides

# (Some) Colour Swaps Are Detectable



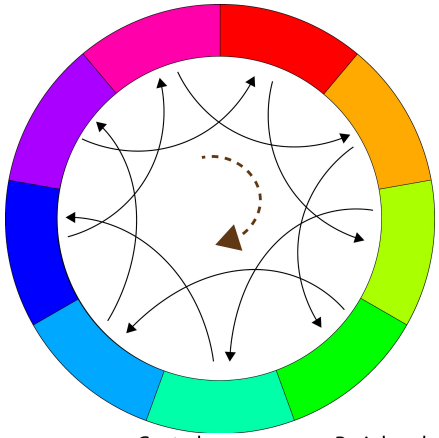



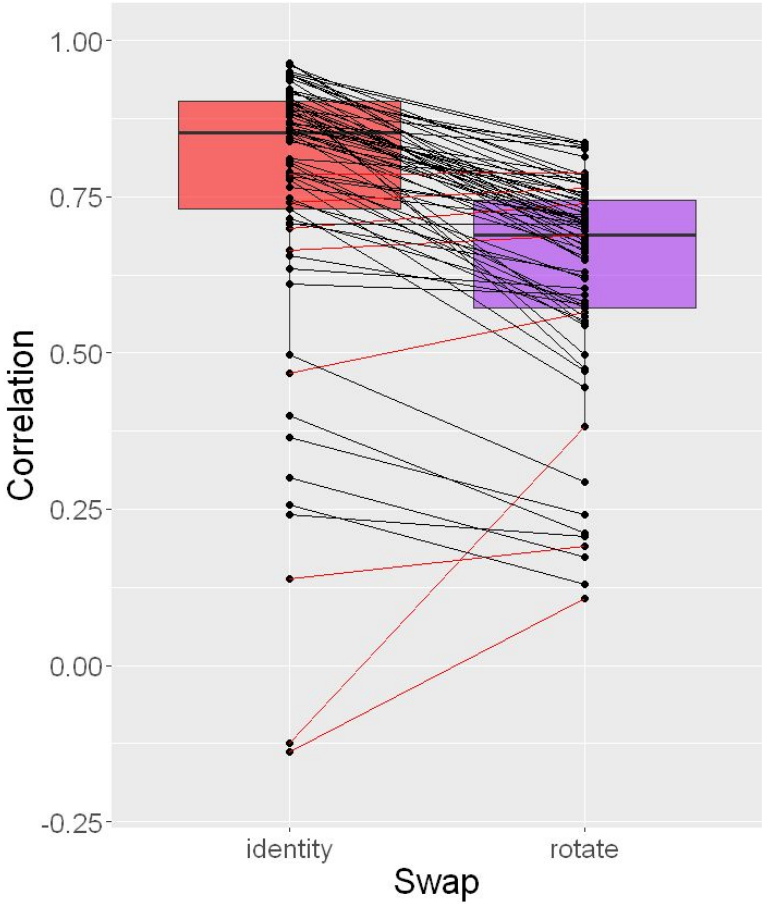

N = 73

t-test (identity, random) on Fisher transformed data with Bonferroni correction

$p < 0.001$ for all (identity, *swap*) comparisons

# (Some) Colour Swaps Are Detectable



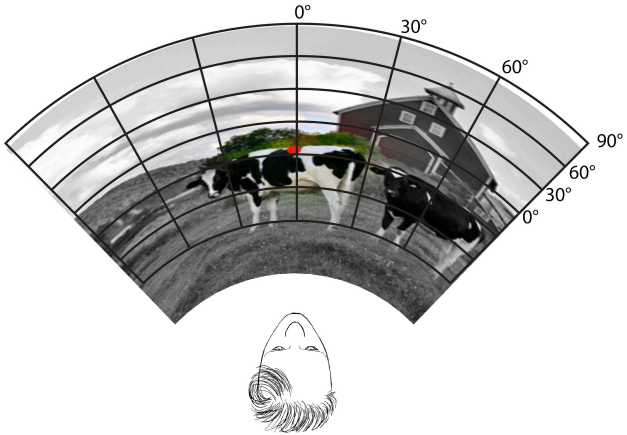




N = 73

t-test (identity, rotate) on Fisher-transformed data with Bonferroni correction

$p < 0.001$ for all (identity, *swap*) comparisons

# Refined View: Veridicality vs Experience




STIMULUS

BEHAVIOUR

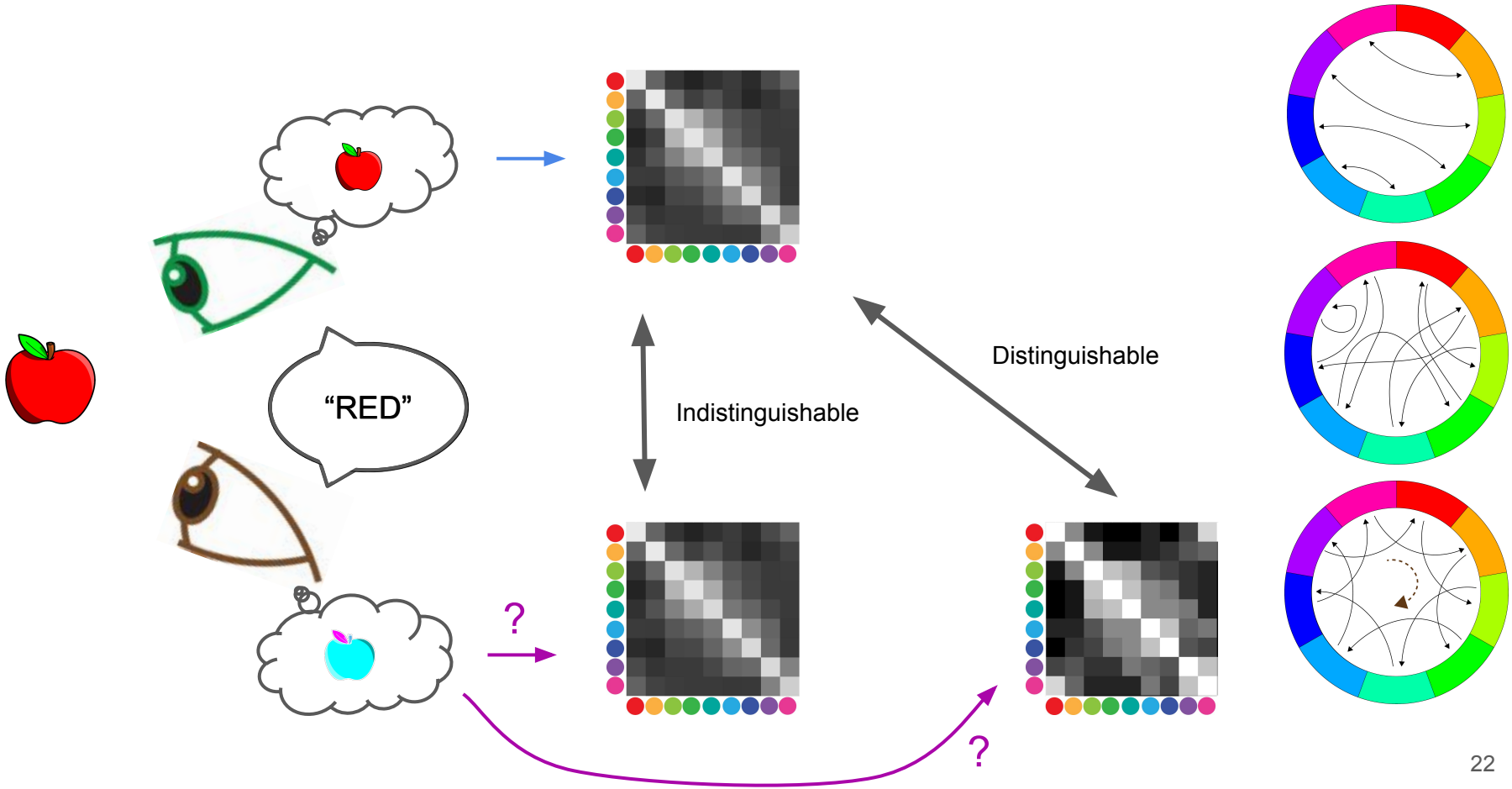
EXPERIENCE

"[We] have the immediate impression of a rich, colourful experience…
...here, we show that this impression is surprisingly inaccurate."

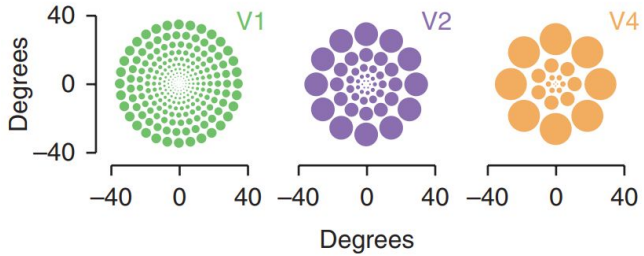
*The peripheral experience may well be inaccurate, but is it actually any different?*

Cohen et al., 2020; Cohen & Rubenstein., 2020

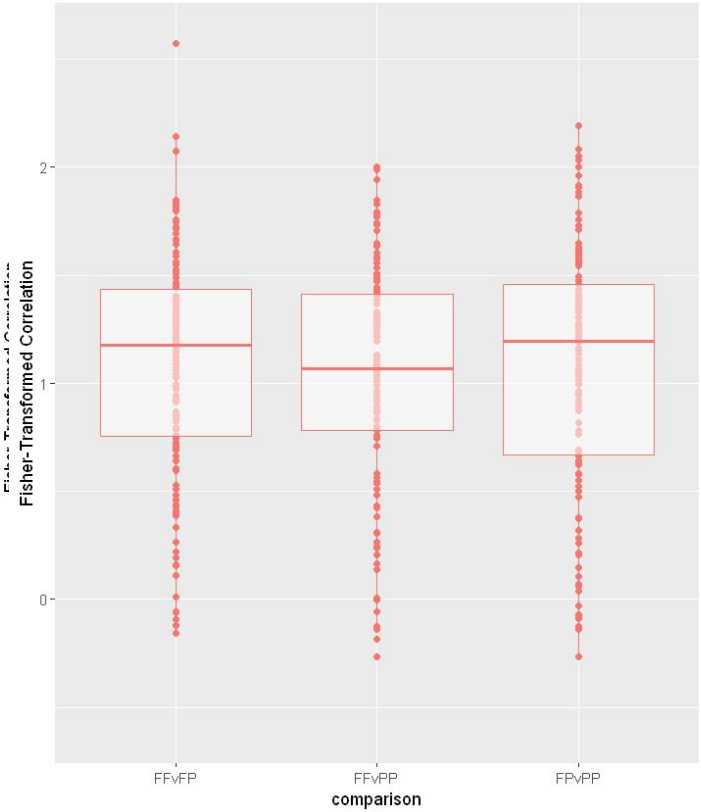
# Test Case: Color Inversion (And Other Swaps)

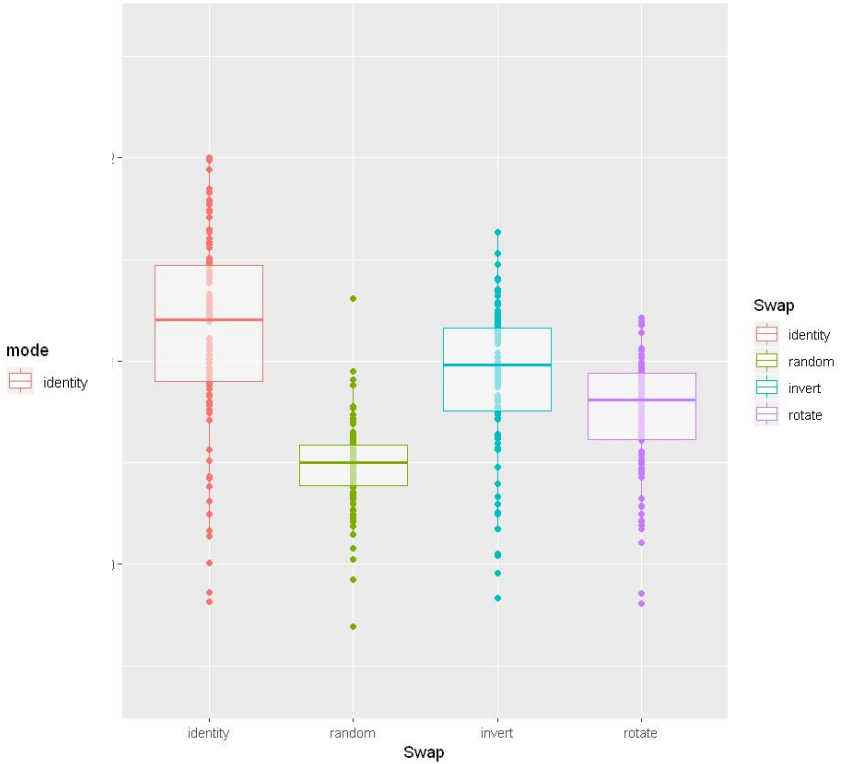


# Screen Size Calibrations



# Fisher-Transformed Plots

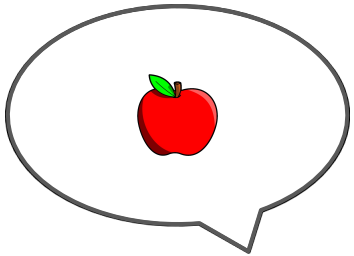


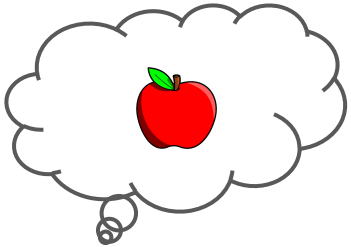
# Control Data

# Deleted Slides

BEHAVIOUR



EXPERIENCE

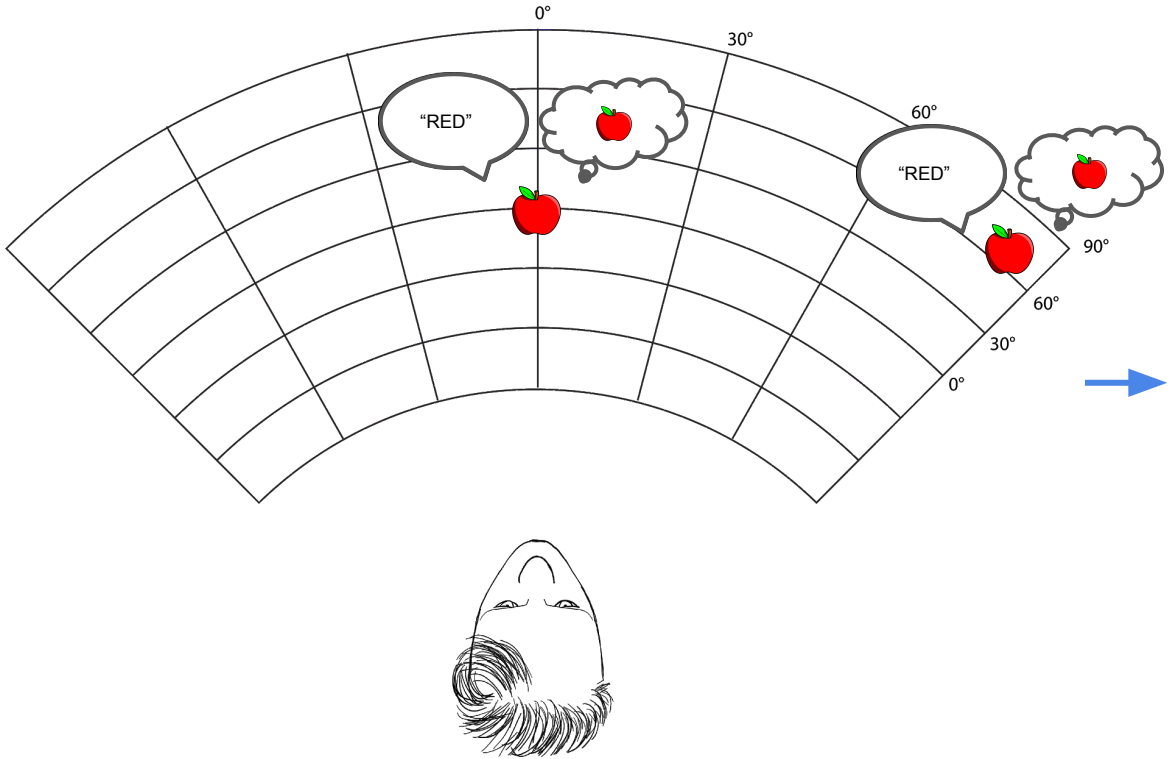


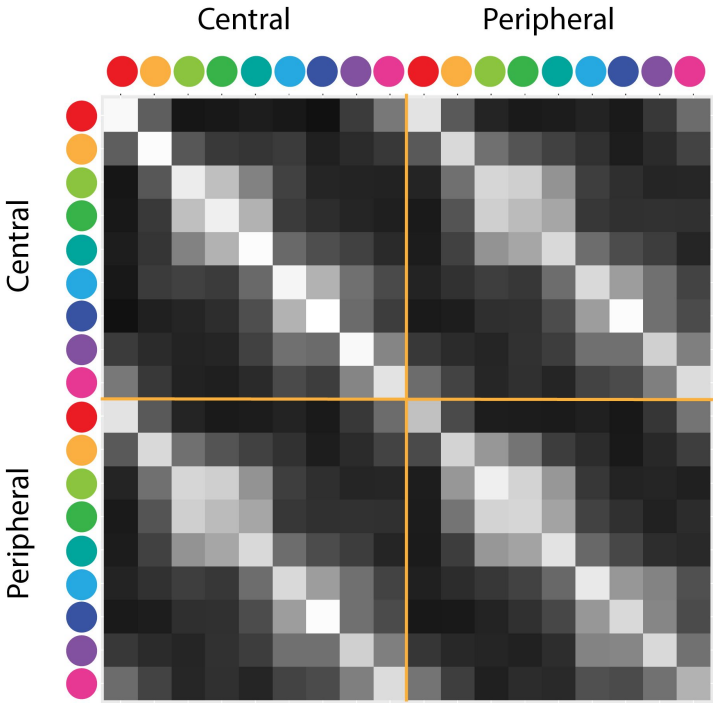
STIMULUS

# Analysis - Just merge this into the other slides...

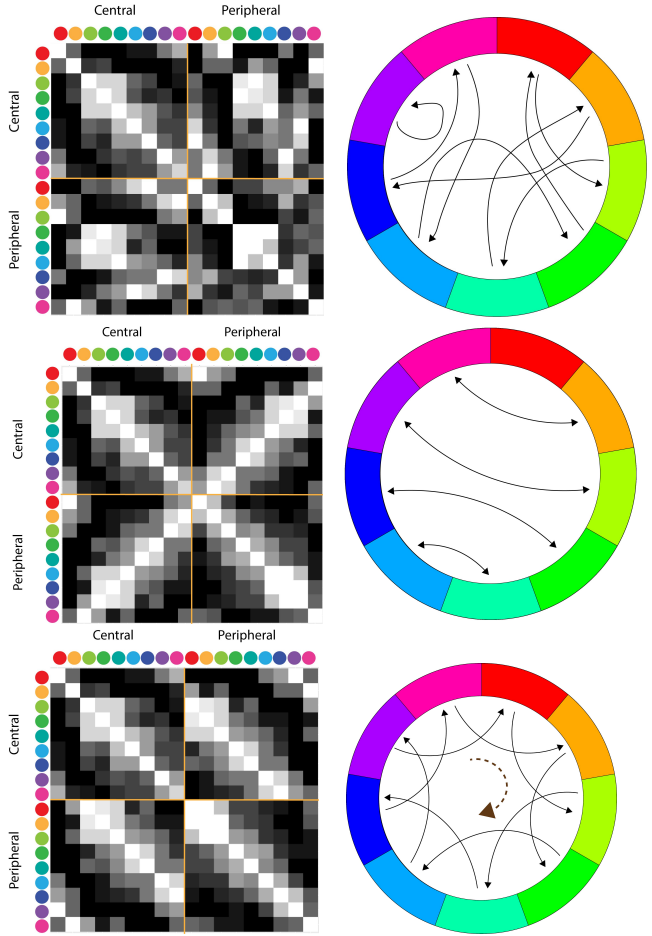
- Within-subject
  - *Main diagonal* (identification across the field?)
  - CC *(vs CP)* vs PP comparison (same similarity structure across the field?)
- Between-subjects
  - Stimulus size effect?
- Simulations (using real data as the basis)
  - Effects on correlation distributions of various swaps

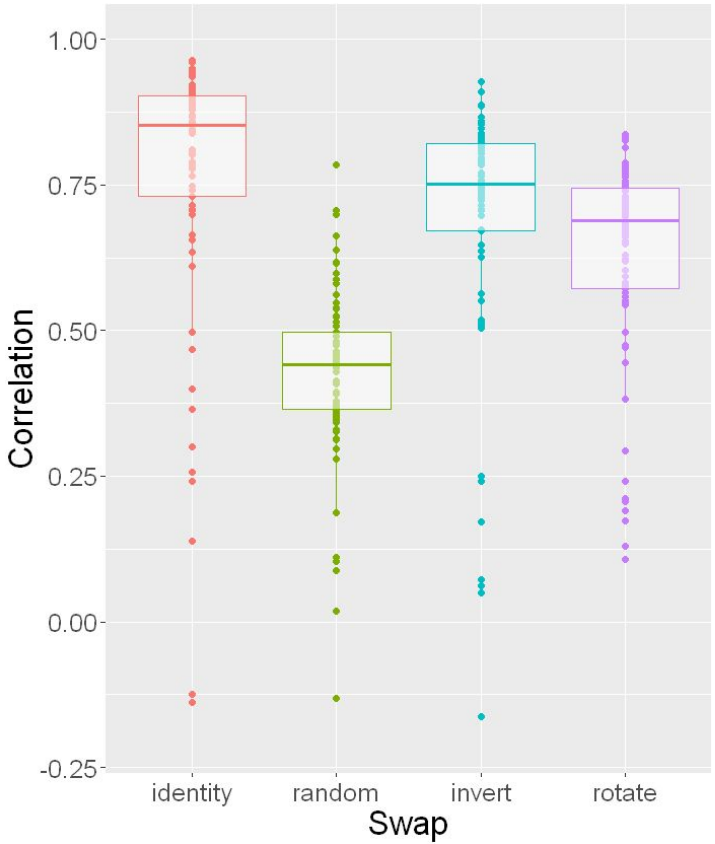
# Within-Subject Colour Inversion?



# (Some) Colour Swaps Are Detectable (+control)




N = 73

Data
Fisher-transformed

t-test (identity, *swap*) with Bonferroni correction

$p < 0.001$ for all comparisons