Bringing the colour constancy illusion to the fMRI scanner

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Introduction

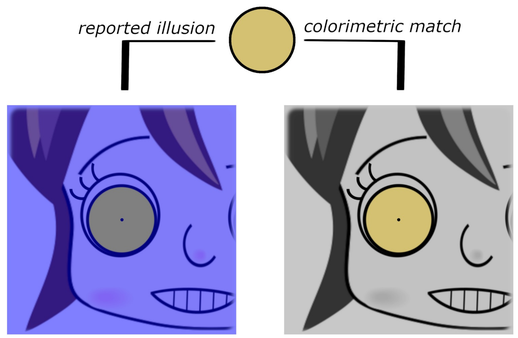
Colour constancy is a feature of human colour perception and refers to the fact that colours can appear largely constant across illumination conditions, despite pronounced colorimetric differences. On the flip side, colour constancy can lead to illusory percepts of colour for objectively desaturated surfaces.

In the present study we aim to use fMRI in conjunction with multivariate pattern analysis to localize neural representations of such illusory colours in the human brain.

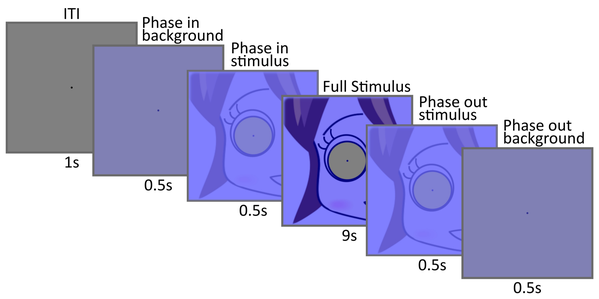
Here we present first results from this ongoing study: an analysis of behavioural effects and a proof of concept of colour decoding with our novel stimulus set.

Methods

Stimuli were adapted from Akioshi Kitaoka* and optimized for use with fMRI. The area of interest is the iris of the eye. In the beginning of the experiment participants report their individual illusion strength in a *colour matching* task.



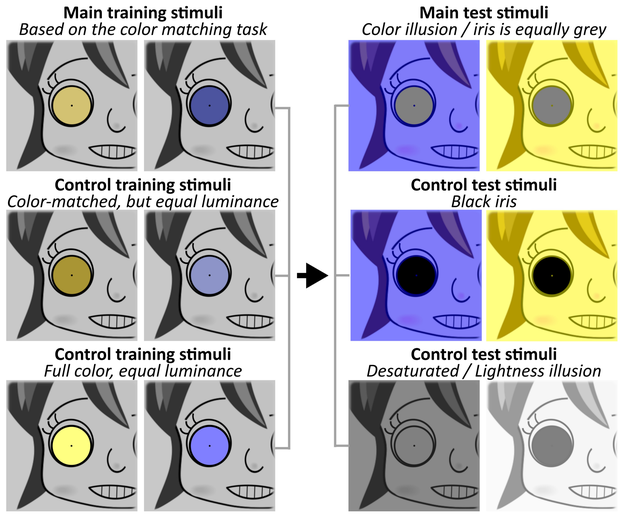
The experiment itself followed a block design in which participants were presented with illusory colour stimuli, colorimetrically matched colours, or with one of the control conditions (see next section)



* (http://www.psy.ritsumei.ac.jp/~akitaoka/)

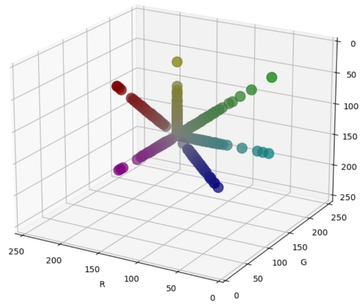
Design

- 8 blocks (4x training, 4x test)
- Training blocks: presentation of colorimetric "real" colours
- Test blocks: presentation of illusory colours or controls
- Three groups: blue/yellow, red/cyan, green/purple
- General logic: train classifier on patterns of colorimetric colours and test on illusory colours

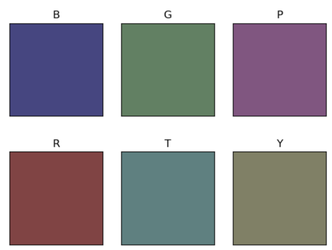


Behavioural Results

N=33

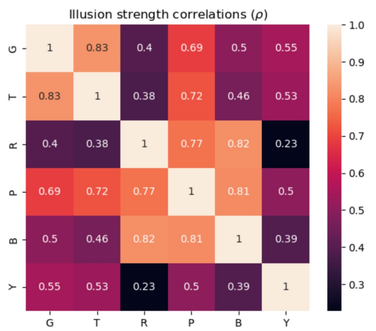


Reported illusions mapped in euclidean space



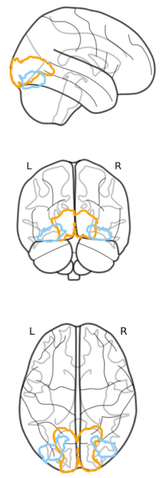
Average reported illusions

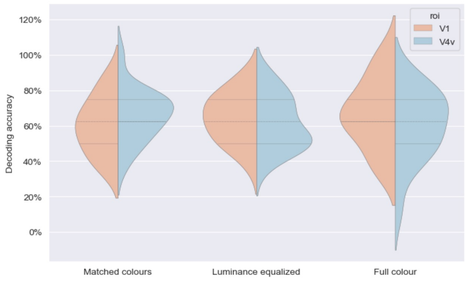
Correlation structure of illusion strengths for the six tested colours. All colours show positive cross-individual correlations.



fMRI: MVPA results

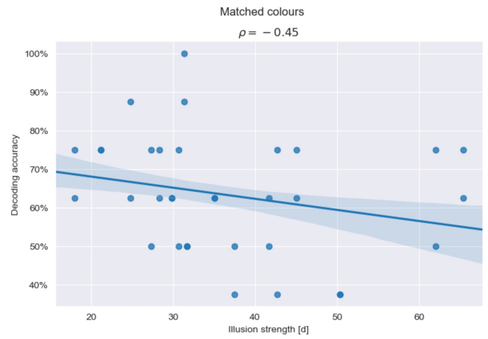
N=17





Good decoding accuracy for all colour pairs

Negative correlation between decoding accuracy and reported illusion strength



Summary

- Strong illusory colour effects provide solid basis for all downstream analyses
- Without any optimization and despite using group-level ROIs (at this point), colour decoding accuracies were superior to most previous studies → excellent basis for the planned cross-condition decoding analyses
- Positive cross-individual correlation between the illusion strength of all colours. Does this suggests general susceptibility towards the illusion, rather than subject-specific biases?
- Individual illusion strength negatively correlated with decoding accuracy - are individuals with less precisely encoded colors more prone to the illusion?

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