Frequentist Modelling

Are there unconscious visual images in aphantasia? Development of an implicit priming paradigm

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# 1. Questionnaires analyses

## 1.1 Group differences

### 1.1.1 Table

| Questionnaire | yes | no | df | t | p |
| --- | --- | --- | --- | --- | --- |
| VVIQ | 19.083 ± 0.913 | 54.188 ± 1.095 | 148 | -21.24 | 8.65e-47 |
| OSIQ\_Object | 23.924 ± 0.994 | 46.561 ± 1.192 | 148 | -13.29 | 5.07e-27 |
| OSIQ\_Spatial | 41.011 ± 0.865 | 45.452 ± 1.036 | 148 | -3.40 | 8.58e-04 |
| SUIS | 17.335 ± 0.749 | 37.132 ± 0.898 | 148 | -15.51 | 7.75e-33 |

### 1.1.2 Plot

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| Figure S1.1 |

## 1.2 Congruence effects correlations

### 1.2.1 Matrices

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| Figure S1.2 |

### 1.2.2 Plots

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| Figure S1.3 |

# 2. Accuracy analyses

We quickly checked for accuracy differences between groups with a logistic regression model.

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| Table S2.1: Performance and estimates of the logistic GLMM fitted on accuracy in the implicit task.   | AIC | AICc | BIC | R2 (cond.) | R2 (marg.) | ICC | RMSE | Sigma | Log\_loss | Score\_log | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2614.99 | 2615.01 | 2679.02 | 0.17 | 9.48e-03 | 0.16 | 0.18 | 1.00 | 0.13 | -Inf |   # Fixed Effects   | Parameter | Log-Odds | SE | 95% CI | z | p | | --- | --- | --- | --- | --- | --- | | (Intercept) | 3.64 | 0.10 | (3.43, 3.84) | 34.70 | < .001 | | aphantasia1 | 0.19 | 0.19 | (-0.18, 0.56) | 1.01 | 0.312 | | congruence1 | 0.05 | 0.12 | (-0.18, 0.29) | 0.44 | 0.659 | | color1 | 0.32 | 0.12 | (0.08, 0.55) | 2.63 | 0.009 | | aphantasia1 × congruence1 | 0.15 | 0.24 | (-0.32, 0.63) | 0.64 | 0.519 | | aphantasia1 × color1 | -0.18 | 0.24 | (-0.65, 0.29) | -0.74 | 0.462 | | congruence1 × color1 | 8.71e-03 | 0.24 | (-0.46, 0.48) | 0.04 | 0.971 | | aphantasia1 × congruence1 × color1 | 0.34 | 0.48 | (-0.60, 1.29) | 0.72 | 0.473 |     # Random Effects   | Parameter | Coefficient | | --- | --- | | SD (Intercept: subjectid) | 0.79 | |

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| Table S2.2: Estimated probability of a correct answer and log-odds contrasts between groups for the accuracy in the implicit task.  Estimated Marginal Means   | aphantasia | Probability | SE | 95% CI | | --- | --- | --- | --- | | Control | 0.97 | 4.07e-03 | (0.96, 0.98) | | Aphantasia | 0.98 | 3.02e-03 | (0.97, 0.98) |   Marginal means estimated at aphantasia  Marginal Contrasts Analysis   | Level1 | Level2 | Odds ratio | 95% CI | SE | df | z | p | | --- | --- | --- | --- | --- | --- | --- | --- | | Control | Aphantasia | 0.83 | (0.57, 1.20) | 0.16 | Inf | -1.01 | 0.312 |   Marginal contrasts estimated at aphantasia p-values are uncorrected. |

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| Table S2.3: Performance and estimates of the logistic GLMM fitted on accuracy in the explicit task.   | AIC | AICc | BIC | R2 (cond.) | R2 (marg.) | ICC | RMSE | Sigma | Log\_loss | Score\_log | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2020.26 | 2020.28 | 2084.03 | 0.18 | 0.03 | 0.16 | 0.15 | 1.00 | 0.11 | -Inf |   # Fixed Effects   | Parameter | Log-Odds | SE | 95% CI | z | p | | --- | --- | --- | --- | --- | --- | | (Intercept) | 3.98 | 0.12 | (3.74, 4.21) | 33.19 | < .001 | | aphantasia1 | 0.21 | 0.21 | (-0.19, 0.62) | 1.03 | 0.304 | | congruence1 | 0.12 | 0.15 | (-0.16, 0.41) | 0.84 | 0.401 | | color1 | 0.65 | 0.15 | (0.37, 0.94) | 4.49 | < .001 | | aphantasia1 × congruence1 | -8.30e-03 | 0.29 | (-0.58, 0.56) | -0.03 | 0.977 | | aphantasia1 × color1 | -0.24 | 0.29 | (-0.81, 0.33) | -0.83 | 0.407 | | congruence1 × color1 | 0.32 | 0.29 | (-0.25, 0.89) | 1.11 | 0.265 | | aphantasia1 × congruence1 × color1 | -0.31 | 0.58 | (-1.45, 0.83) | -0.53 | 0.595 |     # Random Effects   | Parameter | Coefficient | | --- | --- | | SD (Intercept: subjectid) | 0.78 | |

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| Table S2.4: Estimated probability of a correct answer and log-odds contrasts between groups for the accuracy in the explicit task.  Estimated Marginal Means   | aphantasia | Probability | SE | 95% CI | | --- | --- | --- | --- | | Control | 0.98 | 3.37e-03 | (0.97, 0.99) | | Aphantasia | 0.98 | 2.40e-03 | (0.98, 0.99) |   Marginal means estimated at aphantasia  Marginal Contrasts Analysis   | Level1 | Level2 | Odds ratio | 95% CI | SE | df | z | p | | --- | --- | --- | --- | --- | --- | --- | --- | | Control | Aphantasia | 0.81 | (0.54, 1.21) | 0.17 | Inf | -1.03 | 0.304 |   Marginal contrasts estimated at aphantasia p-values are uncorrected. |

# 3. Response Times analyses

## 3.1 Rationale

To account for the non-normal, positively skewed distributions of the RTs, we fitted Generalized Linear Mixed Models (GLMMs) with inverse Gaussian distributions. The models were implemented in the lme4 R package and integrated in tidymodels workflows using the package multilevelmod. Models with Gamma and Gaussian distributions were also fitted and compared with the AIC and BIC to ensure that we chose the best distribution available.

The models included the ***Group*** (aphantasic, control), ***Congruence*** condition (congruent or incongruent) and ***Color*** condition (color or uncolored) along with all their two and three way interactions as fixed categorical predictors, while ***participants*** have been included as grouping factors (i.e. “random effects”). The random effect structure was chosen by fitting and comparing models with every possible combination of distribution and structure (intercept by participant, congruence or color, slope by participant on congruence and/or color) aiming for the best balance between goodness of fit and parsimony. Complex random-effects structures including various slopes on the factors failed to converge to stable and reliable estimates, hence the optimal models chosen included a single by-participant random intercept.

## 3.2 Model fitting

The formula of the model fitted is . See the HTML version for the code and details.

## 3.3 Model diagnostics

The quality checks of the models are displayed in [Figure S3.1](#suppfig-implicit-checks-2) and [Figure S3.2](#suppfig-explicit-checks-2).

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| Figure S3.1: Model assumption checks for the Generalized Linear Mixed Model fit on the RTs in the implicit task. |

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| Figure S3.2: Model assumption checks for the Generalized Linear Mixed Model fit on the RTs in the explicit task. |

## 3.4 Model summaries

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S3.1: Performance and estimates of the GLMM fitted on the implicit task data.   | AIC | AICc | BIC | R2 (cond.) | R2 (marg.) | ICC | RMSE | Sigma | | --- | --- | --- | --- | --- | --- | --- | --- | | -4619.06 | -4619.03 | -4548.26 | 0.01 | 3.47e-04 | 0.01 | 0.26 | 0.48 |   # Fixed Effects   | Parameter | Coefficient | SE | 95% CI | t(8767) | p | | --- | --- | --- | --- | --- | --- | | (Intercept) | 0.67 | 0.01 | (0.64, 0.69) | 53.99 | < .001 | | aphantasia1 | 0.02 | 0.02 | (-0.03, 0.07) | 0.77 | 0.442 | | congruence1 | -0.01 | 4.03e-03 | (-0.02, -5.69e-03) | -3.37 | < .001 | | color1 | -2.57e-03 | 4.02e-03 | (-0.01, 5.32e-03) | -0.64 | 0.523 | | aphantasia1 × congruence1 | 0.02 | 8.05e-03 | (7.70e-03, 0.04) | 2.92 | 0.004 | | aphantasia1 × color1 | -7.96e-04 | 8.04e-03 | (-0.02, 0.01) | -0.10 | 0.921 | | congruence1 × color1 | 0.01 | 8.03e-03 | (-5.65e-03, 0.03) | 1.26 | 0.209 | | aphantasia1 × congruence1 × color1 | 0.02 | 0.02 | (-0.01, 0.05) | 1.20 | 0.229 |     # Random Effects   | Parameter | Coefficient | | --- | --- | | SD (Intercept: subjectid) | 0.08 | | SD (Residual) | 0.48 | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S3.2: Performance and estimates of the GLMM fitted on the explicit task data.   | AIC | AICc | BIC | R2 (cond.) | R2 (marg.) | ICC | RMSE | Sigma | | --- | --- | --- | --- | --- | --- | --- | --- | | -2673.61 | -2673.58 | -2603.01 | 0.03 | 7.96e-04 | 0.03 | 0.28 | 0.41 |   # Fixed Effects   | Parameter | Coefficient | SE | 95% CI | t(8593) | p | | --- | --- | --- | --- | --- | --- | | (Intercept) | 0.79 | 0.02 | (0.75, 0.83) | 37.14 | < .001 | | aphantasia1 | 0.01 | 0.04 | (-0.07, 0.09) | 0.25 | 0.799 | | congruence1 | -0.02 | 4.21e-03 | (-0.03, -9.82e-03) | -4.29 | < .001 | | color1 | -0.03 | 4.20e-03 | (-0.04, -0.02) | -6.93 | < .001 | | aphantasia1 × congruence1 | 0.03 | 8.42e-03 | (0.01, 0.04) | 3.19 | 0.001 | | aphantasia1 × color1 | 7.19e-03 | 8.39e-03 | (-9.26e-03, 0.02) | 0.86 | 0.392 | | congruence1 × color1 | 2.74e-03 | 8.39e-03 | (-0.01, 0.02) | 0.33 | 0.744 | | aphantasia1 × congruence1 × color1 | 0.01 | 0.02 | (-0.02, 0.05) | 0.84 | 0.402 |     # Random Effects   | Parameter | Coefficient | | --- | --- | | SD (Intercept: subjectid) | 0.12 | | SD (Residual) | 0.41 | |

## 3.5 Estimated means and contrasts

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Table S3.3: Estimated means for each group in each congruence condition and contrasts between groups and conditions in the implicit task.   | Group | Condition | Median (ms) | SE | df | asymp.LCL | asymp.UCL | | --- | --- | --- | --- | --- | --- | --- | | Control | Incongruent | 669.71 | 19.36 | Inf | 631.77 | 707.65 | | Aphantasia | Incongruent | 676.89 | 15.84 | Inf | 645.84 | 707.93 | | Control | Congruent | 644.38 | 19.31 | Inf | 606.53 | 682.22 | | Aphantasia | Congruent | 675.05 | 15.83 | Inf | 644.02 | 706.08 |   Marginal Contrasts Analysis   | Level1 | Level2 | Difference | 95% CI | SE | df | z | p | | --- | --- | --- | --- | --- | --- | --- | --- | | Aphantasia Incongruent | Aphantasia Congruent | 1.84e-03 | (-0.01, 0.01) | 5.23e-03 | Inf | 0.35 | 0.725 | | Aphantasia Incongruent | Control Congruent | 0.03 | (-0.02, 0.08) | 0.02 | Inf | 1.30 | 0.193 | | Control Congruent | Aphantasia Congruent | -0.03 | (-0.08, 0.02) | 0.02 | Inf | -1.23 | 0.219 | | Control Incongruent | Aphantasia Congruent | -5.34e-03 | (-0.05, 0.04) | 0.02 | Inf | -0.21 | 0.831 | | Control Incongruent | Aphantasia Incongruent | -7.18e-03 | (-0.06, 0.04) | 0.02 | Inf | -0.29 | 0.774 | | Control Incongruent | Control Congruent | 0.03 | ( 0.01, 0.04) | 6.13e-03 | Inf | 4.13 | < .001 |   Marginal contrasts estimated at aphantasia, congruence p-values are uncorrected. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S3.4: Estimated means for each group in each congruence condition and contrasts between groups and conditions in the explicit task.   | Group | Condition | Median (ms) | SE | df | asymp.LCL | asymp.UCL | | --- | --- | --- | --- | --- | --- | --- | | Control | Incongruent | 801.78 | 33.22 | Inf | 736.68 | 866.88 | | Aphantasia | Incongruent | 799.21 | 27.05 | Inf | 746.18 | 852.23 | | Control | Congruent | 770.29 | 33.17 | Inf | 705.28 | 835.30 | | Aphantasia | Congruent | 794.57 | 27.04 | Inf | 741.56 | 847.57 |   Marginal Contrasts Analysis   | Level1 | Level2 | Difference | 95% CI | SE | df | z | p | | --- | --- | --- | --- | --- | --- | --- | --- | | Aphantasia Incongruent | Aphantasia Congruent | 4.64e-03 | (-0.01, 0.02) | 5.45e-03 | Inf | 0.85 | 0.394 | | Aphantasia Incongruent | Control Congruent | 0.03 | (-0.05, 0.11) | 0.04 | Inf | 0.68 | 0.499 | | Control Congruent | Aphantasia Congruent | -0.02 | (-0.11, 0.06) | 0.04 | Inf | -0.57 | 0.570 | | Control Incongruent | Aphantasia Congruent | 7.21e-03 | (-0.08, 0.09) | 0.04 | Inf | 0.17 | 0.866 | | Control Incongruent | Aphantasia Incongruent | 2.57e-03 | (-0.08, 0.09) | 0.04 | Inf | 0.06 | 0.952 | | Control Incongruent | Control Congruent | 0.03 | ( 0.02, 0.04) | 6.42e-03 | Inf | 4.91 | < .001 |   Marginal contrasts estimated at aphantasia, congruence p-values are uncorrected. |

## 3.6 Visualisations

The figures below are also displayed in the main article. See the HTML version for the code and details.

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| Figure 3.1: Subject means and model-estimated means per group and condition in the implicit task. |

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| Figure 3.2: Subject means and model-estimated means per group and condition in the explicit task. |

# 4. Finer sub-groups

| Aphantasia | Sub-group | N |
| --- | --- | --- |
| Control | Hyperphantasia | 1 |
| Control | Control | 57 |
| Aphantasia | Hypophantasia | 37 |
| Aphantasia | Aphantasia | 48 |

Interestingly, we have 39 participants that did not score at floor VVIQ but between 17 and 32, a score range that Reeder & Pounder (n.d.) have proposed to call “hypophantasia”. However, our sample comprised only 2 hyperphantasics, i.e. participants scoring above 74 (Zeman, 2024). These two participants will therefore be removed from the sample before performing new analyses on the aphantasic, hypophantasic and control groups.

## 4.1 Questionnaires analyses

### 4.1.1 Table

| Questionnaire | Control | Hypophantasia | Aphantasia |
| --- | --- | --- | --- |
| VVIQ | 53.492 ± 1.016 | 22.923 ± 1.26 | 16.049 ± 1.117 |
| OSIQ\_Object | 46.09 ± 1.192 | 25.041 ± 1.478 | 23.04 ± 1.31 |
| OSIQ\_Spatial | 45.467 ± 1.045 | 42.98 ± 1.295 | 39.456 ± 1.149 |
| SUIS | 36.983 ± 0.893 | 18.895 ± 1.107 | 16.102 ± 0.981 |

| Level1 | Level2 | Difference | CI | SE | t(145) | p | Questionnaire |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Control | Aphantasia | 37.44 | (34.45, 40.44) | 1.51 | 24.73 | < .001 | VVIQ |
| Control | Hypophantasia | 30.57 | (27.37, 33.76) | 1.62 | 18.91 | < .001 | VVIQ |
| Hypophantasia | Aphantasia | 6.87 | ( 3.54, 10.21) | 1.69 | 4.07 | < .001 | VVIQ |
| Control | Aphantasia | 23.05 | (19.54, 26.56) | 1.78 | 12.98 | < .001 | OSIQ\_Object |
| Control | Hypophantasia | 21.05 | (17.30, 24.80) | 1.90 | 11.10 | < .001 | OSIQ\_Object |
| Hypophantasia | Aphantasia | 2.00 | (-1.91, 5.91) | 1.98 | 1.01 | 0.314 | OSIQ\_Object |
| Control | Aphantasia | 6.01 | ( 2.93, 9.09) | 1.56 | 3.86 | < .001 | OSIQ\_Spatial |
| Control | Hypophantasia | 2.49 | (-0.80, 5.77) | 1.66 | 1.50 | 0.137 | OSIQ\_Spatial |
| Hypophantasia | Aphantasia | 3.52 | ( 0.09, 6.95) | 1.74 | 2.03 | 0.044 | OSIQ\_Spatial |
| Control | Aphantasia | 20.88 | (18.25, 23.51) | 1.33 | 15.70 | < .001 | SUIS |
| Control | Hypophantasia | 18.09 | (15.28, 20.89) | 1.42 | 12.74 | < .001 | SUIS |
| Hypophantasia | Aphantasia | 2.79 | (-0.14, 5.72) | 1.48 | 1.88 | 0.062 | SUIS |

### 4.1.2 Plot

# A tibble: 12 × 6  
 Questionnaire sub\_group Mean SE CI\_low CI\_high  
 <fct> <fct> <dbl> <dbl> <dbl> <dbl>  
 1 VVIQ Control 5.86e- 1 0.0158 0.555 0.617   
 2 VVIQ Hypophantasia 1.09e- 1 0.0196 0.0698 0.147   
 3 VVIQ Aphantasia -4.44e-16 0.0173 -0.0342 0.0342  
 4 OSIQ\_Object Control 5.18e- 1 0.0198 0.479 0.557   
 5 OSIQ\_Object Hypophantasia 1.68e- 1 0.0245 0.119 0.216   
 6 OSIQ\_Object Aphantasia 1.34e- 1 0.0217 0.0909 0.176   
 7 OSIQ\_Spatial Control 5.09e- 1 0.0174 0.474 0.543   
 8 OSIQ\_Spatial Hypophantasia 4.68e- 1 0.0216 0.425 0.510   
 9 OSIQ\_Spatial Aphantasia 4.05e- 1 0.0191 0.368 0.443   
10 SUIS Control 5.22e- 1 0.0186 0.485 0.558   
11 SUIS Hypophantasia 1.45e- 1 0.0230 0.0992 0.190   
12 SUIS Aphantasia 8.33e- 2 0.0203 0.0431 0.124

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| Figure S4.1 |

## 4.2 Response Times analysis

## 4.3 Model fitting

## 4.4 Model diagnostics

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| Figure S4.2: Model assumption checks for the Generalized Linear Mixed Model fit on the RTs in the implicit task with finer sub-groups. |

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| Figure S4.3: Model assumption checks for the Generalized Linear Mixed Model fit on the RTs in the explicit task with finer sub-groups. |

## 4.5 Model summaries

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S4.1: # Random Effects   | AIC | AICc | BIC | R2 (cond.) | R2 (marg.) | ICC | RMSE | Sigma | | --- | --- | --- | --- | --- | --- | --- | --- | | -4629.18 | -4629.13 | -4530.16 | 0.02 | 6.43e-04 | 0.01 | 0.26 | 0.48 |  | Parameter | Coefficient | SE | 95% CI | t(8702) | p | | --- | --- | --- | --- | --- | --- | | (Intercept) | 0.65 | 0.02 | (0.62, 0.69) | 34.08 | < .001 | | sub group [Hypophantasia] | 6.49e-03 | 0.03 | (-0.05, 0.07) | 0.21 | 0.831 | | sub group [Aphantasia] | 0.03 | 0.03 | (-0.02, 0.09) | 1.14 | 0.253 | | congruence1 | -0.03 | 6.15e-03 | (-0.04, -0.01) | -4.17 | < .001 | | color1 | -2.82e-03 | 6.15e-03 | (-0.01, 9.23e-03) | -0.46 | 0.647 | | sub group [Hypophantasia] × congruence1 | 0.01 | 9.93e-03 | (-7.99e-03, 0.03) | 1.16 | 0.248 | | sub group [Aphantasia] × congruence1 | 0.03 | 9.34e-03 | (0.02, 0.05) | 3.62 | < .001 | | sub group [Hypophantasia] × color1 | -6.66e-03 | 9.92e-03 | (-0.03, 0.01) | -0.67 | 0.502 | | sub group [Aphantasia] × color1 | 5.18e-03 | 9.32e-03 | (-0.01, 0.02) | 0.56 | 0.578 | | congruence1 × color1 | -1.41e-03 | 0.01 | (-0.03, 0.02) | -0.12 | 0.908 | | sub group [Hypophantasia] × congruence1 × color1 | 0.02 | 0.02 | (-0.02, 0.06) | 1.08 | 0.280 | | sub group [Aphantasia] × congruence1 × color1 | 0.02 | 0.02 | (-0.02, 0.06) | 1.14 | 0.253 |      | Parameter | Coefficient | | --- | --- | | SD (Intercept: subjectid) | 0.08 | | SD (Residual) | 0.48 | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S4.2: # Random Effects   | AIC | AICc | BIC | R2 (cond.) | R2 (marg.) | ICC | RMSE | Sigma | | --- | --- | --- | --- | --- | --- | --- | --- | | -2549.41 | -2549.36 | -2450.78 | 0.03 | 6.89e-04 | 0.03 | 0.28 | 0.41 |  | Parameter | Coefficient | SE | 95% CI | t(8462) | p | | --- | --- | --- | --- | --- | --- | | (Intercept) | 0.79 | 0.03 | (0.73, 0.86) | 23.50 | < .001 | | sub group [Hypophantasia] | 6.79e-03 | 0.05 | (-0.10, 0.11) | 0.13 | 0.898 | | sub group [Aphantasia] | 4.92e-03 | 0.05 | (-0.09, 0.10) | 0.10 | 0.921 | | congruence1 | -0.03 | 6.58e-03 | (-0.04, -0.02) | -4.31 | < .001 | | color1 | -0.03 | 6.55e-03 | (-0.04, -0.02) | -4.74 | < .001 | | sub group [Hypophantasia] × congruence1 | 0.02 | 0.01 | (4.44e-03, 0.05) | 2.39 | 0.017 | | sub group [Aphantasia] × congruence1 | 0.02 | 9.93e-03 | (3.42e-03, 0.04) | 2.30 | 0.021 | | sub group [Hypophantasia] × color1 | 5.46e-03 | 0.01 | (-0.01, 0.03) | 0.53 | 0.598 | | sub group [Aphantasia] × color1 | 5.70e-03 | 9.91e-03 | (-0.01, 0.03) | 0.57 | 0.565 | | congruence1 × color1 | -4.05e-03 | 0.01 | (-0.03, 0.02) | -0.31 | 0.757 | | sub group [Hypophantasia] × congruence1 × color1 | 0.03 | 0.02 | (-0.01, 0.07) | 1.39 | 0.165 | | sub group [Aphantasia] × congruence1 × color1 | 1.01e-03 | 0.02 | (-0.04, 0.04) | 0.05 | 0.959 |      | Parameter | Coefficient | | --- | --- | | SD (Intercept: subjectid) | 0.12 | | SD (Residual) | 0.41 | |

## 4.6 Estimated means and contrasts

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S4.3: Marginal Contrasts Analysis   | Condition | Sub-group | Median (ms) | SE | df | asymp.LCL | asymp.UCL | | --- | --- | --- | --- | --- | --- | --- | | Incongruent | Control | 667.63 | 19.48 | Inf | 629.45 | 705.82 | | Congruent | Control | 642.01 | 19.43 | Inf | 603.92 | 680.10 | | Incongruent | Hypophantasia | 668.39 | 24.03 | Inf | 621.28 | 715.49 | | Congruent | Hypophantasia | 654.24 | 24.00 | Inf | 607.20 | 701.28 | | Incongruent | Aphantasia | 682.92 | 20.92 | Inf | 641.92 | 723.92 | | Congruent | Aphantasia | 691.12 | 20.93 | Inf | 650.10 | 732.13 |  | Level1 | Level2 | Difference | 95% CI | SE | df | z | p | | --- | --- | --- | --- | --- | --- | --- | --- | | Congruent Control | Congruent Aphantasia | -0.05 | (-0.11, 0.01) | 0.03 | Inf | -1.72 | 0.085 | | Congruent Control | Congruent Hypophantasia | -0.01 | (-0.07, 0.05) | 0.03 | Inf | -0.40 | 0.692 | | Congruent Control | Incongruent Aphantasia | -0.04 | (-0.10, 0.01) | 0.03 | Inf | -1.43 | 0.152 | | Congruent Control | Incongruent Hypophantasia | -0.03 | (-0.09, 0.03) | 0.03 | Inf | -0.85 | 0.393 | | Congruent Hypophantasia | Congruent Aphantasia | -0.04 | (-0.10, 0.03) | 0.03 | Inf | -1.16 | 0.247 | | Congruent Hypophantasia | Incongruent Aphantasia | -0.03 | (-0.09, 0.03) | 0.03 | Inf | -0.90 | 0.367 | | Incongruent Aphantasia | Congruent Aphantasia | -8.19e-03 | (-0.02, 0.01) | 7.04e-03 | Inf | -1.16 | 0.244 | | Incongruent Control | Congruent Aphantasia | -0.02 | (-0.08, 0.03) | 0.03 | Inf | -0.82 | 0.411 | | Incongruent Control | Congruent Control | 0.03 | ( 0.01, 0.04) | 6.15e-03 | Inf | 4.17 | < .001 | | Incongruent Control | Congruent Hypophantasia | 0.01 | (-0.05, 0.07) | 0.03 | Inf | 0.43 | 0.665 | | Incongruent Control | Incongruent Aphantasia | -0.02 | (-0.07, 0.04) | 0.03 | Inf | -0.54 | 0.592 | | Incongruent Control | Incongruent Hypophantasia | -7.55e-04 | (-0.06, 0.06) | 0.03 | Inf | -0.02 | 0.981 | | Incongruent Hypophantasia | Congruent Aphantasia | -0.02 | (-0.09, 0.04) | 0.03 | Inf | -0.71 | 0.475 | | Incongruent Hypophantasia | Congruent Hypophantasia | 0.01 | ( 0.00, 0.03) | 7.79e-03 | Inf | 1.82 | 0.069 | | Incongruent Hypophantasia | Incongruent Aphantasia | -0.01 | (-0.08, 0.05) | 0.03 | Inf | -0.46 | 0.648 |   Marginal contrasts estimated at congruence, sub\_group p-values are uncorrected. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S4.4: Marginal Contrasts Analysis   | Condition | Sub-group | Median (ms) | SE | df | asymp.LCL | asymp.UCL | | --- | --- | --- | --- | --- | --- | --- | | Incongruent | Control | 805.25 | 33.85 | Inf | 738.91 | 871.59 | | Congruent | Control | 776.89 | 33.81 | Inf | 710.64 | 843.15 | | Incongruent | Hypophantasia | 799.65 | 40.77 | Inf | 719.74 | 879.56 | | Congruent | Hypophantasia | 796.06 | 40.76 | Inf | 716.17 | 875.95 | | Incongruent | Aphantasia | 798.72 | 36.34 | Inf | 727.49 | 869.96 | | Congruent | Aphantasia | 793.26 | 36.33 | Inf | 722.05 | 864.47 |  | Level1 | Level2 | Difference | 95% CI | SE | df | z | p | | --- | --- | --- | --- | --- | --- | --- | --- | | Congruent Control | Congruent Aphantasia | -0.02 | (-0.11, 0.08) | 0.05 | Inf | -0.33 | 0.742 | | Congruent Control | Congruent Hypophantasia | -0.02 | (-0.12, 0.08) | 0.05 | Inf | -0.36 | 0.717 | | Congruent Control | Incongruent Aphantasia | -0.02 | (-0.12, 0.08) | 0.05 | Inf | -0.44 | 0.660 | | Congruent Control | Incongruent Hypophantasia | -0.02 | (-0.13, 0.08) | 0.05 | Inf | -0.43 | 0.667 | | Congruent Hypophantasia | Congruent Aphantasia | 2.81e-03 | (-0.10, 0.11) | 0.05 | Inf | 0.05 | 0.959 | | Congruent Hypophantasia | Incongruent Aphantasia | -2.66e-03 | (-0.11, 0.10) | 0.05 | Inf | -0.05 | 0.961 | | Incongruent Aphantasia | Congruent Aphantasia | 5.46e-03 | (-0.01, 0.02) | 7.44e-03 | Inf | 0.73 | 0.463 | | Incongruent Control | Congruent Aphantasia | 0.01 | (-0.09, 0.11) | 0.05 | Inf | 0.24 | 0.809 | | Incongruent Control | Congruent Control | 0.03 | ( 0.02, 0.04) | 6.58e-03 | Inf | 4.31 | < .001 | | Incongruent Control | Congruent Hypophantasia | 9.19e-03 | (-0.09, 0.11) | 0.05 | Inf | 0.17 | 0.862 | | Incongruent Control | Incongruent Aphantasia | 6.53e-03 | (-0.09, 0.10) | 0.05 | Inf | 0.13 | 0.895 | | Incongruent Control | Incongruent Hypophantasia | 5.60e-03 | (-0.10, 0.11) | 0.05 | Inf | 0.11 | 0.916 | | Incongruent Hypophantasia | Congruent Aphantasia | 6.39e-03 | (-0.10, 0.11) | 0.05 | Inf | 0.12 | 0.907 | | Incongruent Hypophantasia | Congruent Hypophantasia | 3.59e-03 | (-0.01, 0.02) | 8.01e-03 | Inf | 0.45 | 0.654 | | Incongruent Hypophantasia | Incongruent Aphantasia | 9.30e-04 | (-0.11, 0.11) | 0.05 | Inf | 0.02 | 0.986 |   Marginal contrasts estimated at congruence, sub\_group p-values are uncorrected. |

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| Figure 4.1 |

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| Figure 4.2 |

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