# Supplementary Material

**A non-linear relationship between selective attention and associated ERP markers across the lifespan**

Running Head: Selective attention and associated ERP markers across the lifespan

Eva-Maria Reuter\*1, Solveig Vieluf2, Flora Koutsandreou3, Lena Hübner4, Henning Budde3,5,6, Ben Godde7, Claudia Voelcker-Rehage4

1Centre for Sensorimotor Performance, School of Human Movement and Nutrition Sciences, The University of Queensland, Brisbane, QLD, Australia

2Institute of Sports Medicine, University of Paderborn, Paderborn, Germany

3Faculty of Human Sciences, Medical School Hamburg, Hamburg, Germany

4Institute of Human Movement Science and Health, Chemnitz University of Technology, Chemnitz, Germany

5Physical Activity, Physical Education, Health and Sport Research Centre (PAPESH), Sports Science Department, School of Science and Engineering, Reykjavik University, Reykjavik, Iceland

6Lithuanian Sports University, Kaunas, Lithuania

7Psychology and Methods, Jacobs University, Bremen, Germany

\*Correspondence to this article should be directed to:

Eva-Maria Reuter

School of Human Movement and Nutrition Sciences

The University of Queensland

Brisbane, QLD 4072

email: e.reuter@uq.edu.au

phone: (+61 7) 3365 6104

**Supplementary Table 1.** Statistic results of curvilinear regression analysis with age and age-squared (age2) as a predictor for behavioural performance in the incongruent condition

|  |  |  |
| --- | --- | --- |
|  | Regression Statistics |  |
|  | Model | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | Df1 | Df2 | Sig. F Change |
| RT |  |  |  |  |  |  |  |  |
|  | Age | .107 | .007 | 145.145 | .012 | 2.402 | 1 | 206 | .123 |
|  | Age2 | .643 | .408 | 112.054 | .402 | 140.638 | 1 | 205 | .000 |
| Accuracy |  |  |  |  |  |  |  |  |
|  | Age | .243 | .239 | 0.125 | .243 | 66.2178 | 1 | 206 | .000 |
|  | Age2 | .528 | .523 | 0.099 | .285. | 123.737 | 1 | 205 | .000 |
| Q-Score |  |  |  |  |  |  |  |  |
|  | Age | .093 | .089 | 2.590 | .093 | 21.135 | 1 | 206 | .000 |
|  | Age2 | .457 | .451 | 2.010 | .364 | 137.258 | 1 | 205 | .000 |

**Supplementary Table 2.** Statistic results of curvilinear regression analysis with age as a predictor for P1 and N1 latencies and amplitudes in the incongruent condition.

|  |  |  |
| --- | --- | --- |
|  | Regression Statistics |  |
|  | Model | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | Df1 | Df2 | Sig. F Change |
| P1 Latency |  |  |  |  |  |  |  |  |
|  | Age | .413 | .410 | 13.834 | .413 | 145.139 | 1 | 206 | .000 |
|  | Age2 | .650 | .646 | 10.713 | .237 | 138.523 | 1 | 205 | .000 |
| P1 Amplitude |  |  |  |  |  |  |  |  |
|  | Age | .374 | .371 | 5.897 | .374 | 12.979 | 1 | 206 | .000 |
|  | Age2 | .672 | .669 | 4.275 | .229 | 186.908 | 1 | 205 | .000 |
| N1 Latency |  |  |  |  |  |  |  |  |
|  | Age | .287 | .284 | 21.666 | .287 | 83.077 | 1 | 206 | .000 |
|  | Age2 | .618 | .614 | 15.907 | .330 | 117.136 | 1 | 205 | .000 |
| N1 Amplitude |  |  |  |  |  |  |  |  |
|  | Age | .005 | .000 | 5.804 | .005 | 0.941 | 1 | 206 | .000 |
|  | Age2 | .101 | .092 | 5.529 | .096 | 21.992 | 1 | 205 | .000 |

**Supplementary Table 3.** Coefficient statistics per age group for regression analysis with factors Visual encoding, Visual attention, Cognitive control, Cognitive Processing Speed and Cognitive Updating as predictors for RT, accuracy, and q-scores.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Age group | Predictors | Reaction time |  | Accuracy |  | Q-scores |
| β | t | p |  | β | t | p |  | β | t | p |
| Children | Constant |  | 7.535 | 0.000 |  |  | 8.340 | 0.000 |  |  | 4.935 | 0.000 |
| Cognitive Processing Speed | 0.461 | 3.163 | 0.003 |  | -0.104 | -0.717 | 0.477 |  | 0.533 | 3.717 | 0.001 |
| Cognitive Control | -0.119 | -0.869 | 0.390 |  | -0.382 | -2.815 | 0.008 |  | 0.174 | 1.299 | 0.202 |
| Visual Attention | -0.137 | -0.963 | 0.341 |  | 0.017 | 0.119 | 0.906 |  | -0.129 | -0.926 | 0.360 |
| Visual Encoding | 0.011 | 0.081 | 0.936 |  | -0.165 | -1.167 | 0.250 |  | 0.164 | 1.172 | 0.248 |
| Cognitive Updating | 0.147 | 1.063 | 0.294 |  | 0.334 | 2.429 | 0.020 |  | -0.076 | -0.560 | 0.579 |
| Young  | Constant |  | 24.621 | 0.000 |  |  | 58.686 | 0.000 |  |  | 25.225 | 0.000 |
| Cognitive Processing Speed | 0.060 | 0.314 | 0.756 |  | -0.088 | -0.501 | 0.620 |  | 0.094 | 0.498 | 0.622 |
| Cognitive Control | 0.150 | 0.700 | 0.489 |  | 0.182 | 0.927 | 0.360 |  | 0.071 | 0.334 | 0.740 |
| Visual Attention | -0.096 | -0.452 | 0.654 |  | -0.084 | -0.429 | 0.671 |  | -0.057 | -0.271 | 0.788 |
| Visual Encoding | 0.044 | 0.212 | 0.833 |  | -0.247 | -1.286 | 0.207 |  | 0.146 | 0.707 | 0.484 |
| Cognitive Updating | -0.105 | -0.590 | 0.559 |  | 0.193 | 1.176 | 0.248 |  | -0.181 | -1.028 | 0.312 |
| Early middle-aged  | Constant |  | 9.884 | 0.000 |  |  | 32.347 | 0.000 |  |  | 9.725 | 0.000 |
| Cognitive Processing Speed | 0.273 | 1.132 | 0.275 |  | 0.170 | 0.702 | 0.493 |  | 0.223 | 0.922 | 0.371 |
| Cognitive Control | -0.009 | -0.039 | 0.970 |  | -0.211 | -0.860 | 0.403 |  | 0.038 | 0.155 | 0.879 |
| Visual Attention | -0.113 | -0.389 | 0.703 |  | 0.313 | 1.074 | 0.300 |  | -0.179 | -0.615 | 0.548 |
| Visual Encoding | 0.355 | 1.403 | 0.181 |  | -0.081 | -0.318 | 0.755 |  | 0.365 | 1.434 | 0.172 |
| Cognitive Updating | -0.049 | -0.175 | 0.864 |  | 0.338 | 1.197 | 0.250 |  | -0.129 | -0.455 | 0.655 |
| Late middle-age | Constant |  | 14.696 | 0.000 |  |  | 26.159 | 0.000 |  |  | 13.132 | 0.000 |
| Cognitive Processing Speed | 0.420 | 1.903 | 0.072 |  | 0.142 | 0.549 | 0.589 |  | 0.339 | 1.389 | 0.181 |
| Cognitive Control | 0.144 | 0.708 | 0.487 |  | 0.235 | 0.987 | 0.336 |  | 0.019 | 0.084 | 0.934 |
| Visual Attention | 0.561 | 2.919 | 0.009 |  | 0.311 | 1.380 | 0.184 |  | 0.416 | 1.953 | 0.066 |
| Visual Encoding | -0.078 | -0.367 | 0.718 |  | -0.031 | -0.122 | 0.904 |  | -0.052 | -0.221 | 0.827 |
| Cognitive Updating | 0.119 | 0.569 | 0.576 |  | 0.342 | 1.393 | 0.180 |  | -0.062 | -0.269 | 0.791 |
| Older <75 | Constant |  | 22.418 | 0.000 |  |  | 68.865 | 0.000 |  |  | 20.009 | 0.000 |
| Cognitive Processing Speed | -0.188 | -1.155 | 0.256 |  | 0.042 | 0.235 | 0.815 |  | -0.198 | -1.226 | 0.229 |
| Cognitive Control | 0.058 | 0.355 | 0.725 |  | 0.012 | 0.065 | 0.949 |  | 0.044 | 0.272 | 0.787 |
| Visual Attention | 0.287 | 1.746 | 0.090 |  | -0.271 | -1.517 | 0.139 |  | 0.349 | 2.137 | 0.040 |
| Visual Encoding | -0.229 | -1.296 | 0.204 |  | 0.005 | 0.025 | 0.980 |  | -0.251 | -1.425 | 0.163 |
| Cognitive Updating | -0.282 | -1.736 | 0.092 |  | 0.068 | 0.386 | 0.702 |  | -0.245 | -1.519 | 0.138 |
| Older>75 | Constant |  | 19.200 | 0.000 |  |  | 34.427 | 0.000 |  |  | 8.020 | 0.000 |
| Cognitive Processing Speed | 0.107 | 0.724 | 0.474 |  | -0.140 | -0.927 | 0.360 |  | 0.150 | 0.964 | 0.342 |
| Cognitive Control | 0.174 | 1.287 | 0.207 |  | -0.127 | -0.919 | 0.365 |  | 0.120 | 0.844 | 0.404 |
| Visual Attention | 0.182 | 1.284 | 0.208 |  | -0.188 | -1.297 | 0.203 |  | 0.182 | 1.221 | 0.231 |
| Visual Encoding | -0.002 | -0.017 | 0.987 |  | -0.209 | -1.398 | 0.171 |  | 0.144 | 0.935 | 0.357 |
| Cognitive Updating | -0.602 | -4.197 | 0.000 |  | 0.500 | 3.416 | 0.002 |  | -0.500 | -3.311 | 0.002 |

**Supplementary Table 4.** Coefficient statistics per age group for regression analysis with factor difference scores (incongruent – congruent conditions) as predictors for behavioural interference.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age group | Predictors | Reaction time Interference |  | Accuracy Interference |  |
| β | t | p |  | β | t | p |  |
| Children | Constant |  | 4.721 | 0.000 |  |  | -5.472 | 0.000 |  |
| ΔCognitive Processing Speed  | 0.293 | 1.865 | 0.069 |  | 0.007 | 0.042 | 0.967 |  |
| ΔCognitive Control  | 0.061 | 0.400 | 0.691 |  | 0.043 | 0.264 | 0.793 |  |
| ΔVisual Encoding  | -0.215 | -1.333 | 0.190 |  | 0.141 | 0.814 | 0.421 |  |
| ΔCognitive Updating | 0.121 | 0.718 | 0.477 |  | 0.011 | 0.062 | 0.951 |  |
| ΔVisual Attention Interference | -0.001 | -0.006 | 0.995 |  | -0.179 | -1.053 | 0.298 |  |
| Young  | Constant |  | 12.018 | 0.000 |  |  | -4.286 | 0.000 |  |
| ΔCognitive Processing Speed  | 0.406 | 2.468 | 0.019 |  | 0.046 | 0.291 | 0.773 |  |
| ΔCognitive Control  | 0.112 | 0.687 | 0.497 |  | 0.131 | 0.831 | 0.412 |  |
| ΔVisual Encoding  | 0.011 | 0.060 | 0.953 |  | -0.583 | -3.286 | 0.002 |  |
| ΔCognitive Updating | -0.275 | -1.656 | 0.107 |  | 0.025 | 0.157 | 0.876 |  |
| ΔVisual Attention Interference | 0.168 | 0.893 | 0.378 |  | 0.291 | 1.605 | 0.118 |  |
| Early middle-aged  | Constant |  | 9.508 | 0.000 |  |  | -1.522 | 0.149 |  |
| ΔCognitive Processing Speed  | 0.163 | 0.608 | 0.552 |  | 0.328 | 1.245 | 0.232 |  |
| ΔCognitive Control  | -0.005 | -0.016 | 0.987 |  | 0.036 | 0.128 | 0.900 |  |
| ΔVisual Encoding  | 0.086 | 0.343 | 0.736 |  | -0.064 | -0.262 | 0.797 |  |
| ΔCognitive Updating | -0.297 | -0.910 | 0.377 |  | 0.133 | 0.413 | 0.685 |  |
| ΔVisual Attention Interference | -0.215 | -0.835 | 0.417 |  | -0.124 | -0.489 | 0.632 |  |
| Late middle-age | Constant |  | 8.782 | 0.000 |  |  | -1.875 | 0.076 |  |
| ΔCognitive Processing Speed  | 0.264 | 1.226 | 0.235 |  | 0.291 | 1.251 | 0.226 |  |
| ΔCognitive Control  | -0.135 | -0.674 | 0.509 |  | 0.206 | 0.953 | 0.353 |  |
| ΔVisual Encoding  | 0.062 | 0.275 | 0.786 |  | 0.177 | 0.731 | 0.474 |  |
| ΔCognitive Updating | -0.404 | -2.012 | 0.059 |  | -0.032 | -0.147 | 0.884 |  |
| ΔVisual Attention Interference | -0.097 | -0.427 | 0.674 |  | -0.227 | -0.922 | 0.368 |  |
| Older <75 | Constant |  | 8.757 | 0.000 |  |  | -3.306 | 0.002 |  |
| ΔCognitive Processing Speed  | -0.057 | -0.334 | 0.741 |  | -0.202 | -1.203 | 0.237 |  |
| ΔCognitive Control  | -0.083 | -0.438 | 0.664 |  | -0.035 | -0.187 | 0.853 |  |
| ΔVisual Encoding  | 0.026 | 0.149 | 0.883 |  | 0.089 | 0.512 | 0.612 |  |
| ΔCognitive Updating | -0.163 | -0.884 | 0.383 |  | -0.131 | -0.716 | 0.479 |  |
| ΔVisual Attention Interference | 0.098 | 0.544 | 0.590 |  | 0.042 | 0.237 | 0.814 |  |
| Older>75 | Constant |  | 9.623 | 0.000 |  |  | -5.049 | 0.000 |  |
| ΔCognitive Processing Speed  | -0.079 | -0.446 | 0.659 |  | -0.014 | -0.087 | 0.931 |  |
| ΔCognitive Control  | 0.102 | 0.491 | 0.626 |  | -0.260 | -1.400 | 0.171 |  |
| ΔVisual Encoding  | 0.091 | 0.554 | 0.583 |  | -0.441 | -2.994 | 0.005 |  |
| ΔCognitive Updating | -0.206 | -1.056 | 0.299 |  | 0.278 | 1.590 | 0.121 |  |
| ΔVisual Attention Interference | 0.179 | 1.063 | 0.295 |  | -0.071 | -0.473 | 0.639 |  |

**Supplementary Table 5:** Statistic results of stepwise regression analysis with age and age-squared (age2), as well as factors based on ERP markers as predictors for behavioural performance in the incongruent condition (RT, Accuracy and Q-scores) as well as for interference effects (ΔRT, ΔAccuracy).

|  |  |  |
| --- | --- | --- |
|  | Regression Statistics |  |
|  | Model | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | Df1 | Df2 | Sig. F Change |
| RT |  |  |  |  |  |  |  |  |
|  | Age Age2 | .414 | .408 | 112.05350 | .414 | 72.334 | 2 | 205 | .000 |
|  | Visual encoding Visual attentionCognitive controlCognitive Processing Speed | .464 | .446 | 108.42937 | .051 | 3.787 | 5 | 200 | .003 |
| Accuracy |  |  |  |  |  |  |  |  |
|  | Age Age2 | .528 | .523 | .09925 | .528 | 114.672 | 2 | 205 | .000 |
|  | Visual encoding Visual attentionCognitive controlCognitive Processing Speed | .625 | .612 | .08957 | .097 | 10.333 | 5 | 200 | .000 |
| Q-score |  |  |  |  |  |  |  |  |
|  | Age Age2 | .457 | .451 | 2.00950 | .457 | 86.186 | 2 | 205 | .000 |
|  | Visual encoding Visual attentionCognitive controlCognitive Processing Speed | .545 | .529 | 1.86244 | .088 | 7.730 | 5 | 200 | .000 |
| ΔRT |  |  |  |  |  |  |  |  |  |
|  | Age Age2 | .019 | .009 | 29.90554 | .019 | 1.951 | 2 | 205 | .145 |
|  | ΔVisual encoding ΔVisual attentionΔCognitive controlΔCognitive ΔProcessing Speed | .055 | .022 | 29.70747 | .037 | 1.549 | 5 | 200 | .176 |
| ΔAccuracy |  |  |  |  |  |  |  |  |  |
|  | Age Age2 | .113 | .104 | .05306 | .113 | 13.019 | 2 | 205 | .000 |
|  | ΔVisual encoding ΔVisual attentionΔCognitive controlΔCognitive ΔProcessing Speed | .136 | .106 | .05300 | .023 | 1.087 | 5 | 200 | .369 |